INTERACTIVE ESTIMATING FOR BUILDING CONTRACTORS

BY

WILLIAM DAVID SHER

A MASTER'S THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE OF THE LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

SEPTEMBER 1981

ABSTRACT

The objective of this work was to develop a computer-aided estimating system to meet the specific requirements of the British building industry. The sponsor was the National Research Development Corporation. The project comprised:

- a review of existing commercially available computer-aided estimating systems suitable for use by building contractors to establish the need for the project;
- a review of computer applications in the construction industry to establish the context in which computer-aided estimating systems could be applied;
- the development of a computer-aided estimating system specification for a system, INTEREST BUILD (INTERactive ESTimating for BUILDers), suitable for programming work by computer programmers;
- an appraisal and review of available classification systems for use with the estimating system;
- the development of a classification specifically for use with the INTEREST BUILD system against which performance data could be filed and retrieved;
- the collection of estimators' performance data suitable for use in demonstrating and testing the system; and
- the demonstrations, testing and assessments of the INTEREST BUILD system.

Five commercially available estimating systems were investigated and none were found to fully meet the needs of building estimators.

A review of computer applications for contractors revealed that existing applications in order of popularity were: accounting; network analysis; costing; cash flow forecasting; estimating; NEDO formulae; valuations; and discounted cash flow.

The difficulties of using computers as estimating aids included: the complexity of the estimating process; the use of estimators' judgement; errors; tender deadlines; security; and re-training of estimators.

The system specification for INTEREST BUILD was developed with the aid of four practising estimators. The main features of the system are: the storage of performance data; the utilization of these data to price bill items; the pricing of items where no data are stored; the updating of resource costs; the automatic completion of arithmetical calculations; the retrieval of item build-ups at will; and the addition of tender mark-ups. The system specification was used by the computer programmers to develop the INTEREST BUILD software.

The criteria for a classification system suitable for the storage and retrieval of estimators' data we established as: unique identification; length of notation; recognizability of notation; level of detail; description of materials; accommodation of dimensions; expandability of notation; and option for choice of method. Five existing classifications were examined against these criteria and found not to be entirely satisfactory. A classification for INTEREST BUILD was developed with the aid of the four assisting estimators. The INTEREST BUILD classification allows for up to six levels of description, with an additional seventh level being reserved for the method of construction. Classification tables have been developed for Excavation and Earthwork, Concrete work and Brickwork and Blockwork sections of SMM 6.

Performance data were collected for 1395 build-ups consisting of 171 single resources and 39 gang resources.

Forty-three demonstrations of the working system were given including two in-house demonstrations, 38 demonstrations at Loughborough University of Technology, two demonstrations to committees of the Chartered Institute of Building, and one public seminar. These resulted in certain minor revisions.

Seven estimators were interviewed following detailed demonstrations to establish if the INTEREST BUILD system had met their needs. The INTEREST BUILD software was generally deemed to be satisfactory. It was therefore concluded that the work had met the objectives of the sponsor and this was confirmed when commercial sales were achieved before the end of the project.

TABLE OF CONTENTS

C O N T E N T S

CONTENTS continued

CONTENTS continued

APPENDICES

LIST OF FIGURES

LIST OF FIGURES continued

LIST OF FIGURES continued

LIST OF FIGURES
CONTAINED IN APPENDICES

APPENDIX A

APPENDIX B

LIST OF FIGURES CONTAINED IN APPENDICES continued

LIST OF FIGURES CONTAINED IN APPENDICES continued

APPENDIX D

APPENDIX E

LIST OF TABLES

LIST OF TABLES
CONTAINED IN APPENDICES

APPENDIX D

ACKNOWLEDGEMENTS

I would like to thank all those who helped with the work undertaken in this thesis especially:

- the National Research Development Corporation for sponsoring the project;
- the assisting estimators for their time and patience in attending discussions and demonstrations;
- my supervisor, Dr. R. McCaffer, for his guidance and willingness to assist throughout the project;
- Mr. G. Cottrell of the Chartered Institute of Building for his constructive criticism and valuable comments;
- Moira Biggins and Christine Siddons, without whose programming skills the project would not have been possible; and
- Sue for the typing of the thesis, and for all her encouragement.

CHAPTER 1

INTRODUCTION

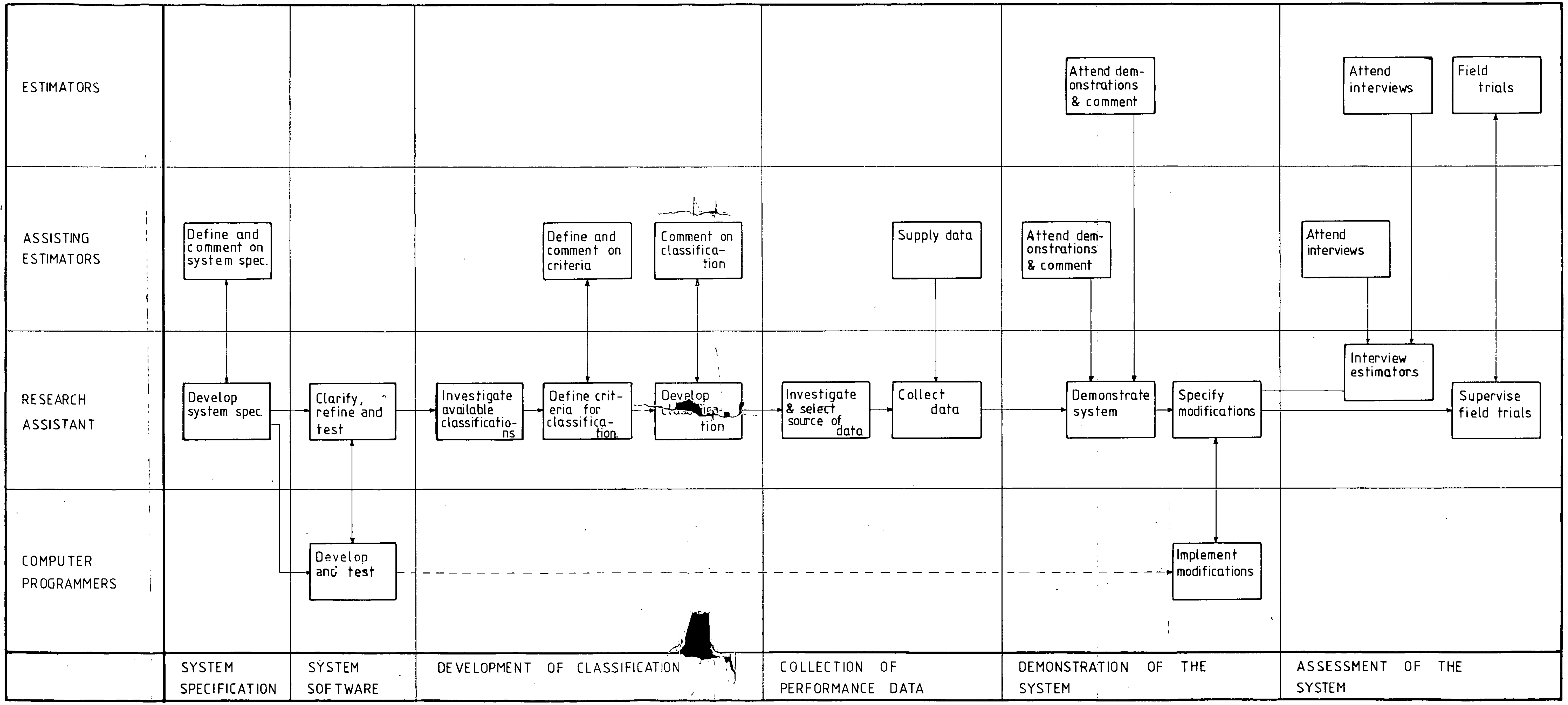


FIGURE 1.1: THE DEVELOPMENT OF THE ESTIMATING SYSTEM

CHAPTER 1

INTRODUCTION

1.1 SPONSOR

The work reported here is part of a project sponsored by the National Research Development Corporation (NRDC).

1.2 OBJECTIVE OF THE PROJECT

The objective of the project was defined by the NRDC to be the development of software for computer-aided estimating to meet the specific needs of the British building industry.

1.3 SPONSOR'S REQUIREMENTS

The sponsor stipulated that the requirements of industry should be determined in consultation with experienced estimators including members of the Estimating Practice Committee of the Chartered Institute of Building, and that reference should be made to the "Code of Estimating Practice" (1) (henceforth referred to as the CEP) published by that Institute. Furthermore it was required that at reasonable periods during the development phases demonstrations and trials of the system should be arranged for experienced estimators. Their comments and advice should be incorporated in revisions to the specification and programs as far as practicable.

1.4 NEED FOR THE RESEARCH

The use made of computer technology in the preparation of estimates has been limited. McCaffer (2) suggests that the number of serious practitioners is between one and two hundred in an industry that has over 50 000 companies. Further evidence is provided by considering the number of computer programs commercially available at the present time.

An investigation into such programs was undertaken by the Design Office Consortium (3) (now the Construction Industry Computing

Association) and is summarised in Chapter 3. This shows that the majority of programs available to industry are suitable for accounting applications with considerably fewer programs available in the fields of planning, cost control and estimating. In particular the field of estimating was extremely poorly served with only five programs available. Interactive programs developed at Loughborough University of Technology to aid civil engineering estimators illustrated the use that estimators could make of computers. This, combined with the building industry's need for estimating software,encouraged the sponsor to commission this project.

1.5 DESCRIPTION OF WORK UNDERTAKEN

The work was undertaken by members of the Computer-Aided Estimating Research and Development Group at Loughborough University of Technology (hereafter referred to as the "Research Group"). The group consisted of construction personnel and computer programmers employed specifically to develop estimating programs for the civil engineering and building industries, and the quantity surveying profession. The research staff specifically employed on this project were one computer programmer and one research assistant (the author).

The work undertaken may be divided into six stages. These are illustrated in Figure 1.1 and described below. It should be noted that whilst the stages may appear sequential, this was not the case in practice, as overlapping of various activities took place.

1.5.1 Development of the System Specification

To establish the detailed requirements of estimators, it was necessary to consult practising estimators and introductions to various organisations were provided by the Chartered Institute of Building and by members of the Research Group.

A series of discussions with these assisting estimators followed. During the early discussions demonstrations of a sister computer-aided estimating system for the civil engineering industry (INTEREST C.E.) were given. These proved useful in introducing the estimators to computers and stimulated the development of the initial specification of the system. Further discussions then took place and as a result the specification was modified. This revised specification then provided the basis for further discussions and modifications. The result was a comprehensive and detailed specification for the proposed system.

1.5.2 Development of System Software

Once the specification had been completed, it supplied the basis for programming work by the computer programmers. Continual discussion between the author and the programmers took place in order to clarify and develop methods of meeting the specified requirements. Development of the software extended over approximately nine months. During that period various demonstrations were given, which resulted in certain minor modifications. These demonstrations are further described in 1.5.5.

1.5.3 Development of the Classification of Building Works

One of the facilities specified was that it should be possible for the estimating system to store and retrieve data relating to the performance and usage of resources used in construction. To enable this data to be identified it was necessary to make use of a classification of building works. In order to evaluate the requirements of such classifications from an estimator's viewpoint a set of criteria were established. These enabled the author to investigate those classifications of building works which were commercially available. None proved to be suitable for the purpose of storing estimators' data and it was therefore necessary to develop a new "estimators'" classification of building works.

The manner in which this was done was that the author prepared classification tables relating to the work contained in various sections of the "Standard Method of Building Works: Sixth Edition" (4) (henceforth referred to as SMM 6). It was found that most building contractors made extensive use of sub-contractors for the pricing of specialist trades. Therefore, in accordance with the aims of the project, only those trades commonly priced using labour directly employed by the main contractor were included in these classification tables. These were then shown to the assisting estimators who suggested various alterations. The author included these modifications in the classification and re-visited the estimators for further comments. This procedure was repeated several times until all concerned were satisfied with the result. This then formed the classification of building works used with the computer-aided estimating system.

1.5.4 Collection of Performance Data

To facilitate the development and testing of the estimating system it was necessary to make use of a library of test data. Experience with a sister estimating system for use by the civil engineering industry indicated that demonstrations of the system had to make use of realistic data in order to avoid the estimators becoming distracted. It was therefore necessary to compile a library of realistic test data. Various sources of data were explored including pricing books, estimating text books and information from the assisting estimators' organisations. The initial decision taken was to collect data from these estimators' organisations. However, this did not prove to be an entirely successful approach and it was necessary to obtain supplementary data from the other sources noted above. The data so collected was sufficient for the demonstration and preliminary testing of the system.

1.5.5 Demonstrations and Testing of the System

During the course of development detailed demonstrations of the system were given to the assisting estimators, and to estimators of other contractors' organisations. In all demonstrations were given to the representatives of forty-seven different building contracting organisations and as a result certain minor modifications were made to the system.

Testing of the system was undertaken by the computer programmers and the author throughout the development of the system software.

1.5.6 Assessment of the System

Assessment of the developed system took place in two stages. The first involved interviews with seven estimators to whom the system had been demonstrated. These indicated that in the vast majority of cases the estimating system would be favourably received by industry.

The second stage involved long term field trials which are continuing under the author's supervision at the present time.

1.6 GUIDE TO THE REPORT

Chapter 2 described current estimating procedure as undertaken in building contractors' organisations.

Chapter 3 gives a brief outline of the potential uses that computers may be put to in the construction industry. The evolution of estimating software up to the start of this research project is then described.

Chapter 4 describes the estimating system and illustrates how it will fit into the estimating procedure described in Chapter 2.

Chapter 5 describes the criteria established for judging classifications from the estimator's viewpoint. It then measures various classifications against the criteria, including the INTEREST BUILD classification which was developed specifically for this project.

Chapter 6 reviews the various sources of data available for inclusion into the library of test data. It then describes the procedure adopted in assembling and entering these data into the computer system.

Chapter 7 describes demonstrations of the system given to estimators and other representatives from building contractors' organisations. Testing of the system is also described and assessments in the form of interviews with practising estimators are recorded. Field trials at present being undertaken are then briefly described.

Chapter 8 provides a summary of the report, conclusions as to the viability of the system and recommendations for further work in the field of computer-aided estimating.

CHAPTER 2

CURRENT ESTIMATING PRACTICE

CHAPTER 2

CURRENT ESTIMATING PRACTICE

2.1 GENERAL

The aim of this chapter is to describe briefly the manner in which the building industry in the United Kingdom prepares estimates and tenders for the construction of building projects. In accordance with the overall aims of the project (as stated in Chapter 1) the basis of the observations that follow originate largely from information provided by estimators and members of the construction industry. These are supplemented where necessary with information from the CEP and authoritative literature.

Two distinct aspects are involved:

a. the preparation of the estimate (the technical process of predicting the costs of production); and

b. the conversion of the estimate into a tender (a separate and subsequent commercial function based upon the estimate).

2.1.1 Parties involved in construction projects

To clarify the contents of this chapter the functions of the various parties involved in building projects are first of all defined. These assume contracts based on bills of quantities and let by a system of competitive tendering.

The CLIENT is the person or organisation for whom the building is to be constructed.

The PROFESSIONAL TEAM may comprise project managers, architects, quantity surveyors and engineers who are responsible to the client for the design and administration of the construction of the building works.

FIGURE 2.1: FLOW CHART OF CURRENT ESTIMATING PRACTICE

The MAIN CONTRACTOR represents the organisation responsible for the construction of the project in question.

2.1.2 Parties involved in the preparation of estimates and tenders

Further clarification is given here to define the various parties responsible for the preparation of estimates and tenders within the main contractor's organisation.

The ESTIMATOR is the person responsible for establishing the cost of construction of building projects and for managing this process (as defined in 2.2.3 and 2.2.4).

The PLANNER is the person responsible for arranging the materials, men and plant needed for construction in the form of a programme which reflects the timeous and economical completion of that project.

The BUYER is responsible for obtaining up-to-date prices for the materials, plant and sub-contract items involved in the project.

The SITE MANAGER, as far as the estimating process is concerned, is a construction representative who advises the estimator and planner on methods of construction and site organisation.

MANAGEMENT are those persons carrying out the function of general management and on whom the responsibility rests for making the decision to tender and for adjudicating.

The persons responsible for the above-mentioned tasks vary from organisation to organisation. In smaller firms, estimators may perform the functions of estimating, planning and buying, whereas larger contractors may employ specialists for each task. The term "estimating team" is used in this thesis to refer to those persons responsible for the functions of estimating, planning, buying and site management.

2.2 THE ESTIMATE

Work in this area may be divided into the following sections:

- the pre-selection of contractors;
- the decision to tender;
- the collection of information; and
- the preparation of the estimate.

This work is represented graphically in Figure 2.1 and described below.

2.2.1 Pre-selection of Contractors

In order to reduce the cost to industry of abortive tendering, the "Code of Procedure for Single Stage Selective Tendering" (5) (hereafter referred to as the CPSSST) recommends that the professional team pre-select contractors suitable to perform the works in question. This is done by furnishing these contractors with details of the project four to six weeks before the issue of the tender documents. The CPSSST recommends that contractors decide on the basis of this information whether or not to submit a tender and notify the professional team accordingly. Those aspects required to be provided by the professional team are:

- the name of the job;
- the names of the client, architect and quantity surveyor;
- the names of any consultants with supervisory duties;

- the location of the site;
- a general description of the work involved;
- the approximate cost range of the project;
- details of any nominated sub-contractors for major items;
- the form of contract to be used;
- the procedure to be adopted in examining and correcting priced bill(s);
- whether the contract is to be under seal or under hand;
- the anticipated date for possession of the site;
- the period for completion of the works;
- the approximate date for the despatch of tender documents;
- the duration of the tender period;
- the period which the tender is to remain open for;
- the anticipated value of liquidated damages (if any);
- details of bond requirements (if any); and
- any particular conditions relating to the contract.

The CPSSST further recommends that when initial agreement to tender has been signified such acceptance should be honoured. Where a contractor finds that he has to withdraw this acceptance (and the CPSSST suggests that this should only occur in "exceptional circumstances") notice of this intention should be given before the issue of the tender documents. If for any reason this is not possible, notice should be given not later than two days after the receipt of the tender documents.

2.2.2 The Decision to Tender

Notwithstanding the recommendations given above, compliance with the CPSSST is much less normal in the private sector than in the public sector (6). Consequently contractors frequently delay the decision to tender until full tender documentation is received. This decision involves a consideration of many factors, the principal ones being:

- current workload;
- financial resources;
- recovery of overheads;
- availability of resources;
- type of work;
- locality of work;
- identity of potential client and professional team; and
- a detailed examination of tender documents.

a. Current workload

The current commitment of the building organisation is examined. Initially this involves a consideration of whether or not the tender will fit into the current work pattern of the organisation. If the project is unsuitable, the professional team are notified directly and the tender documents returned. Where the project is of interest, the work load of the estimating and construction departments are examined in detail. The decision whether or not to tender then depends upon the ability of these departments to complete the work in question in the specified time.

b. Financial resources

Undertaking a new project requires the contractor to commit financial resources to enable its construction. The magnitude of these resources are established and, where necessary, the implications of obtaining additional finance are assessed. For a new or rapidly expanding business, or one that has been showing poor trading results, acquiring extra financial resources may not be easy. If these prove impossible to obtain, the contractor has no alternative but to decline the invitation to tender.

c. Recovery of overhead expenses

It is normal for contractors to compare their level of turnover with the overhead or fixed costs at frequent intervals. This enables them to determine the level of turnover required to support their fixed costs.

Fluctuating turnover complicates the recovery of overheads, and it is generally one of management's objectives to maintain turnover at a predictable level. Where turnover is low, the contractor will be under-utilizing certain resources (e.g. items of plant may be idle, construction sites may be over-staffed).

Conversely where the level of turnover is high, it is likely that such resources will be kept fully utilised.

The implications of these two situations on the decision whether or not to tender are obvious. Where the recovery of overhead costs is low, contractors are keen to obtain new work. Alternatively, where the level of recovery is high, contractors are not as eager to obtain new contracts because these are likely to result in an over-commitment of existing resources.

d. Availability of resources

Although additional financial resources necessary to support extra turnover may be available, it does not necessarily follow that the contractor can procure the required manpower, machines and materials with which to execute the extra work. Where additional resources are required, the recruitment of well-qualified and experienced staff and the obtaining of materials and plant will be necessary. This is not a simple and straightforward matter, and is one which is further exacerbated if the obtaining of a contract represents a new field of operations, or requires highly specialised staff or equipment (7).

e. Type of work

The type of work involved in the construction of the project is considered. Contractors usually prefer to undertake work which is in their normal field of operations. It is natural for them to build up expertise in a certain type of construction and, if their operations are profitable, to wish to remain in it. A project requiring a contractor to undertake a method of construction with which he is unfamiliar is thus likely to be met with a certain amount of reservation.

f. Locality of the project

The locality of the project is examined. Where this falls outside the normal field of operations, contractors are generally reluctant to submit tenders as this involves them in a consideration of numerous unknown factors (e.g. the availability of labour, climatic conditions).

g. Identity of potential client and professional team

The identity of the potential client and the names of the professional team employed by him in many cases provide the contractor with an indication as to whether or not a tender should be submitted. With private clients, if there is any doubt as to their ability to meet the cost of the work, contractors generally obtain a report of the client's financial standing through a bank or credit investigation agency. Public sector clients provide more security, as their ability to meet the costs of construction is secure.

Regarding the professional team, the contractor may have dealt with some or all of the practices concerned. Where working relationships have been unsatisfactory these may influence the contractor in his decision as to whether or not to submit a tender.

h. Detailed examination of tender documents

A detailed examination of all the tender documents is made. The most salient questions to be answered include the following (1):

(i) Is sufficient time allowed for the proper presentation of an estimate?

(ii) Have any alterations been made to the form of contract used? If so have any reasons for these been given? Does the form of tender correlate with the relevant conditions referred to in the bill of quantities?

(iii) Are the general arrangement drawings included?

(iv) Are the operating conditions defined clearly?

(v) What is the value and extent of the project and what is the main contractor's own contribution likely to be?

(vi) Is the design well developed or have the documents been prepared hastily?

(vii) Have the bills of quantities been prepared in accordance with SMM 6? If not, what method of measurement has been used?

(viii) Are there any unusual specification requirements? What is the standard of workmanship required?

After taking all the above-mentioned factors into account, the contractor decides whether or not to submit a tender. Where this decision is in the affirmative, the work described in the sections below is started.

2.2.3 <u>The collection of information</u>

This section deals with the collection of information necessary for the formulation of the estimate. Figure 2.1 shows that it may be considered as having two parts:

- the Enquiry Stage, where the necessary quotations are obtained; and

- the Project Appreciation, where an in-depth study of the project takes place.

(a) The Enquiry Stage

(i) Programming the Estimate

Time allowed for tendering is limited. It is therefore necessary to ensure that the preparation of the estimate is completed in time to allow for its subsequent adjudication and submission to the professional team. Key dates are therefore established and used to monitor progress.

(ii) Examination of Documents

A detailed examination of the contract documents is made by all members of the estimating team. Any onerous or unusual conditions are noted for discussion at the adjudication meeting. This inspection serves to highlight problem areas, and also to familiarise the team with the project.

(iii) Enquiries to Suppliers and Sub-Contractors

Materials and sub-contract items form a large portion of the value of a project. It is therefore essential that quotations obtained for these items are competitive. Due to the volatility of price and one-off nature of these items, it is normal practice to obtain a unique set of quotations for each estimate. Thus one of the first jobs undertaken by the estimator is to list the items requiring quotations and subsequently to ensure that enquiries are sent out. These should embody all relevant information including quantities, specification details and an indication of the timing and sequence of work or deliveries, so as to enable technically accurate quotations

FIGURE 2.1 (cont.): FLOW CHART OF CURRENT ESTIMATING PRACTICE

to be submitted. Enquiries should also state clearly the terms and conditions upon which the quotations are being invited.

b. Project Appreciation

(i) View Drawings

The CEP recommends that a visit is made to the offices of the architect and/or consultants. This provides the estimating team with an opportunity to clarify any queries they may have either by communication with the consultant, or by reference to the complete set of drawings. The visit also provides the team with a chance to appraise the state of design of the project (a factor which may influence decisions taken at the adjudication meeting) and to meet and assess members of the professional team.

(ii) Visit Site and locality

It is normal for the estimating team to visit the site in question. Most contractors produce "Site Visit" documents for use on such occasions. An example of one such document is illustrated in the CEP. These provide a check list which prompts the estimator to note various items. Some of the items to be recorded include:

- a description of the site;
- the positions of existing services;
- a description of ground conditions;
- an assessment of the availability of labour;

- any problems related to the security of the site;
- a description of the access to the site;
- topographical details of the site;
- a description of the facilities available for the disposal of spoil; and
- a description of any demolition works or temporary works to adjoining buildings.

(iii) Determining construction methods

When the estimator has become thoroughly acquainted with the project, and before calculation of estimated costs is commenced, the project is discussed with all other members of the estimating team. Alternative methods of construction, sequence of work and site layouts are evaluated, and one method selected as a basis for the estimate.

2.2.4 The Preparation of the Estimate

The preparation of the estimate, as illustrated in Figure 2.1 can be divided into the following stages:

- the preparation of the pre-tender construction programme;
- the establishment of all-in rates for key resources;
- the use of all-in rates and production standards to calculate item rates;

- the insertion of the item rates in the bill of quantities and the ensuing arithmetical computation; and
- the finalisation of the estimate.

a. Pre-Tender Construction Programme

When the construction methods, approximate strength of the labour force and the type of plant have been determined, a pre-tender construction programme is prepared. This is usually done by a member of the estimating team other than the estimator; normally a planner. There is generally frequent communication between the estimating, planning and production members of the team, resulting in a continual refinement of the programme. A detailed discussion of the contents and scope of the programme is a complete subject on its own and is therefore deemed to be outside the scope of this chapter. However, the information produced is often in the form of a bar chart or, in the case of the larger and more complicated projects, a network, incorporating varying degrees of ancillary information relating to resources and key dates.

b. Establishment of all-in rates

This involves the estimator collecting together all factors likely to incur cost relating to a particular resource.

(i) Labour

The labour element of cost is made up of wages and emoluments paid to operatives and statuatory costs which are incurred automatically as a result of the employment of labour. These items are resolved into all-in hourly rates for craftsmen, labourers and plant operatives. However, in certain circumstances it may not be possible to realise all the factors involved at the time of calculating the rate. In these cases such costs are excluded from the all-in hourly rate and added later in the project overheads. For example, it may be desirable to provide transport for personnel to site. The cost involved can only be calculated when the total labour strength has been computed, and this figure is usually available at a later stage in the preparation of the estimate. In such cases it would be normal to include the cost of this transport in the project overheads.

(ii) Plant

Depending upon the contractor in question, the operating cost of a particular machine is obtained from various sources including the company's own internal plant hire subsidiary or an external plant hire firm. In all cases the costs allowed should reflect the total expenses incurred by the utilization of the item of plant. This is done either by including all the relevant costs in the all-in rate, or by a combination of rates and ancillary costs. These costs, which usually represent establishment charges, are then included in the project overheads.

(iii) Materials

Quotations for the supply of materials are obtained as previously described, and the most attractive cost selected. This selection requires an evaluation of many factors including discounts, reliability of the supplier, compliance with specifications, and ability to meet delivery dates. The quotations so chosen are then used in the calculation of the item rates.

(iv) Sub-contractors

The procedure for the selection of sub-contract quotations is similar to that of materials in that the same aspects described above need to be considered. In addition it is necessary to undertake a detailed analysis of the sub-contractor's ability to perform the work in question. This involves an assessment of the financial standing of the sub-contractor as well as the resources he has at his disposal.

c. Calculation of Item Rates

The calculation of rates for the measured items in bills of quantities may be done either on a unit rate, operational rate or spot rate basis.

(i) Unit Rates

In calculating item rates by this method, careful consideration is given to every factor which may influence the cost of the work. The constituent elements of cost (i.e. labour, plant, materials and sub-contractors) are usually recorded separately so that summaries of these costs may be obtained. The unit rate method of estimating is best illustrated by an example. Consider Figure 2.2 which shows an item from a bill of quantities.

ITEM DESCRIPTION	UNITS	QUANT	RATE	EXTENSION
A. One brick wall in common bricks in 1:3 cement mortar	m^2	100		

FIGURE 2.2: Example of an item from a bill of quantities

An example of the calculations likely to be performed by the estimator are shown in Figure 2.3.

LABOUR	COST/HR	OUTPUT/USAGE		TOTAL COST
Bricklayer-Commons	£4.25	1.8 hrs/m^2		£ 7.65
Labour to unload (at 10 minutes/ 1000 bricks)	£2.50	1.2 min/m^2		£ 0.05
	TOTAL LABOUR COST			£ 7.70
MATERIALS	QUANT/M^2	NET MAT. COST	WASTE	TOTAL COST
Common Bricks	120 NR	£100.00/ 1000	10%	£13.20
Mortar (3.1)	0.045 m^3	£25.10/ m^3	5%	£ 1.19
	TOTAL MATERIAL COST			£14.39
	TOTAL COST/M^2			£22.09

FIGURE 2.3: Example of Unit Rate Build-Up

The following points are worth noting in relation to Figure 2.3.

Gang Costs

The CEP recommends that gang costs be used in preference to individual labour costs. An example of a brick-laying gang is given in Figure 2.4. This gang corresponds to that used in Figure 2.3.

2 Bricklayers @ £3.00/hr	=	£6.00
1 Labourer @ £2.50/hr	=	£2.50
TOTAL COST OF GANG		£8.50
	÷ 2	
COST OF ONE BRICKLAYER PER HOUR		£4.25

FIGURE 2.4: Example of a labour gang used for brickwork

Consultation with practising estimators illustrated that this principle was extended to other resource categories. An example of a materials gang is given in Figure 2.5. It was noted that estimators made extensive use of gangs wherever unique groups of resources recurred with some frequency.

Cement	0.52 tne	@ £35.00/tne	=	£18.20
Sand	1.38 m^3	@ £5.00/m^3	=	£ 6.90
TOTAL COST PER M^3				£25.10

FIGURE 2.5: Example of a gang rate for mortar

Output/Usage Rates

Recorded costs of similar work encountered on previous projects should provide estimators with a major source of performance data (see 6.2.1.d.). In most cases it was found that estimators had access to libraries of performance data. However, it was noted that the content and detail of these libraries varied enormously from organisation to organisation.

Allowances in Project Overheads

Various items incur costs which are dependant upon the total time during which operations take place. It is thus difficult to arrive at an output per unit for such items. In these cases it was found that estimators often preferred to exclude monies from the unit rates and include them in the project overheads.

Consider the example of mortar illustrated in Figure 2.5. Other costs associated with this resource are the labour cost of mixing the mortar, and the plant cost of providing a mortar mixer. Both these are likely to be incurred as long as bricklaying operations continue. At the stage when the estimator is preparing the estimate it is unlikely that information relating to the duration of bricklaying operations will be finalised. These costs may therefore be included in the project overheads. Figure 2.6 gives an example of the calculations likely to be performed in order to reflect the outstanding cost of the mortar. In the example, it is assumed that the bricklaying operations continue for twenty weeks.

LABOUR TO MIX MORTAR

2 labourers @ £100/wk for 20 weeks	£4000.00

PLANT TO MIX MORTAR

1 200/150 mortar mixer @ £12.00/wk for 20 weeks	£ 240.00

FIGURE 2.6: Example of supplementary calculations for mixing of mortar

(ii) Operational Rates

Unit rate estimating is satisfactory for work where resource costs vary in direct proportion to the quantity of work carried out. Where work is not heavily mechanised, operations tend to merge with each other. Each one starts slowly, builds to a peak, and then diminishes with the corresponding transfer of resources to another operation. Output rates for each operation can be adjusted by the movement of resources to different operations or locations around the site.

This is not the case with more mechanised operations particularly those requiring specialist plant. Such items of plant are likely to be brought on to site at the commencement of their specialist operation, and stay on site until it is completed. The average output achieved is thus dependant upon the period the plant remains on site.

The unit rate approach makes use of output rates for items of plant in a similar manner to that shown in Figure 2.3. It does not take into account the total time spent on site by that item of plant and a situation may thus arise where unproductive time is not allowed for. To cater for such situations, estimators make use of operational calculations which ensure that the total cost of utilizing resources is reflected in the rates. Figure 2.7 illustrates the calculations of an operational rate for the placing of concrete.

ASSUMPTIONS

Total cubic metres of concrete to be placed:	2550
Duration of concreting operations:	38 weeks
Plant required:	1 No. Mobile Crane 2 No. Concrete Skips 3 No. Dumpers 3 No. Vibrators

CALCULATIONS

Item	No.	Weekly Rate		No. Weeks		Cost
Mobile Crane	1	£220.00	X	38	=	£ 8360.00
Concrete Skip	2	£ 10.00	X	38	=	760.00
Dumper	3	£ 25.00	X	38	=	2850.00
Vibrator	3	£ 10.00	X	38	=	1140.00
		TOTAL COST				£13110.00
				÷ 2550		
		COST PER M^3				£5.14

FIGURE 2.7: Example of Operational Rate Build-Up

It was found that the majority of estimators consulted made limited use of operational calculations. This approach is more frequently adopted by the civil engineering industry where plant intensive operations are encountered more regularly. Building estimators do generally appreciate the need to allow for idle time. However, this is usually done by reconciling the hours allowed in the tender with the hours allowed in the pre-tender construction programme, and including a balancing sum of money in the project overheads.

(iii) Spot Rates

Spot rate estimating should not be confused with estimating costs for bill items described on a spot basis.

(a) Spot description of items

Spot items are used predominantly to describe the work involved in building refurbishment. These items describe the numerous operations involved in such work. The CEP suggests two ways of dealing with these items. They are:

- the taking-off of approximate quantities of the work involved and the subsequent use of unit rates to calculate a lump sum estimate for these items; or
- analysing the description into its constituent operations and estimating the cost of each.

In both cases it is normal to separate the spot item into its constituent elements of labour, plant and materials. For example, consider the spot item illustrated in Figure 2.8.

ITEM	DESCRIPTION	UNITS	QUANT	RATE	EXTENSION
G	Break out opening in one brick wall in common brickwork for door size 2.08 x 0.82 and make good opening to receive door lining	NR	2		

FIGURE 2.8: Example of item described on a spot basis

The calculations that may be performed by the estimator are shown in Figure 2.9.

Break out opening in wall including breaking out for bonding for new reveals		
1 labourer for 4 hours @ £2.50/hr	=	£10.00
Clear away rubble		
1 labourer for 2 hours @ £2.50/hr	=	£ 5.00
Build up reveals to required size		
1 bricklayer + 1 labourer for 4 hrs @ £5.50/hr	=	£22.00
Bricks 100 NR @ £100.00/1000	=	£10.00
Mortar 0.04 m³ @ £25.10/m³	=	£ 1.00
TOTAL COST		£48.00/NR

FIGURE 2.9: Example of a build-up for a spot item (calculated by considering constituent operations)

(b) Spot rate estimating

Spot rate estimating may be used by estimators where the value of the item to be priced is so small that it does not warrant their detailed consideration. In such cases it is normal to build up the rate by considering a monetary value relevant to the required cost elements (i.e. labour, plant, materials or sub-contractors). An example of a spot rate build-up for the fixing of a steel dowel into a section of formwork is given in Figure 2.10.

LABOUR	£0.50
MATERIAL	0.20
TOTAL COST	£0.70/NR

FIGURE 2.10: Example of a spot rate build-up

d. Insertion of Item Rates in the Bill of Quantities

The rates calculated above are transcribed into the bill of quantities by the estimator. These are normally split into their labour, plant, materials and sub-contract components. As sections of the bill are completed they are handed to comptometer operators who perform and check the arithmetic involved in extending the item rates.

These rates are totalled for each page, section and bill of the bill of quantities. Totals of the elements of cost of each item are also usually produced so that the estimator may review the cost of labour, plant, material and/or sub-contractors relevant to any page, section or bill of the contract. Overall totals are also produced. An example of an extract from a page of an extended and totalled bill of quantities is shown in Figure 2.11. This bill then forms the cost price bill of quantities which remains in the contractor's organisation as a record of the estimate.

ITEM	DESCRIPTION			UNITS	QUANT	RATE	EXTENSION
	LABOUR	MATERIAL	PLANT	S/C.			
A.	One brick wall in common bricks in 1:3 cement mortar			m²	100	£18.06	£1806.00
	£ 7.70	£ 10.36	–	–			
B.	Expansion joint 25 mm thick-Expandite or equivalent filler in common brickwork 113 mm wide - horizontal			m	10	£0.77	£ 7.70
	£0.25	£0.52	–	–			
	£ 772.50	£ 1041.20	–	–			£ 1813.70

FIGURE 2.11: Example of extended bill of quantities

e. Finalisation of the Estimate

This involves the estimator in a review of the estimate, the pricing of the project overheads, the calculation of allowances necessary to enable the submission of a fixed price (where necessary) and the preparation of a report for management.

(i) Review Estimate

Mudd (6) provides a good description of the work involved in this aspect. He states that "Prior to pricing project overheads and preliminaries and subsequent completion of the final summary form ready for presentation to management, the estimator should carefully check through his work-pricing supported by analysis, abstracts and resources related to time elements. He will need to establish if there is any further unloading and distributing required to be adjusted in preliminaries, check the abstract of PC - provisional sums - reconcile attendances on PCs, review domestic sub-contractors' attendances; and adjust the nett figure to incorporate late or amended quotations. Finally, when satisfied he should proceed with the process of completing the final summary form".

(ii) Project overheads

An assessment is made of the overheads likely to be incurred by the project. This involves a consideration of numerous items, the main ones being:-

- site staff;
- cleaning site and clearing rubbish;
- site transport facilities;
- mechanical plant not previously included in the item rates;
- scaffolding and gantries;
- site accommodation;
- small plant;

- temporary services;
- welfare, first aid and safety provisions;
- final clearance and handover;
- defects liability;
- transport of men to site;
- abnormal overtime; and
- risk.

Contractors frequently produce their own check list of such items for use on all tenders. An example of one such list may be found in the CEP. Notwithstanding the list, care must be taken to ensure that the specific requirements of the preliminaries section of the bill of quantities are met.

The project overheads calculated as described above form part of the estimate and are included in the final summary presented to management.

(iii) Fixed Price Calculations

Where the bill requires a fixed price to be submitted, the estimator needs to forecast the effect of inflation on the project. An anticipated rate of inflation is applied to the aggregated cost elements of the tender taking into account the time span over which the use of the elements extend.

(iv) Preparation of report to management

The estimator then prepares a report for management's use at the adjudication meeting. The CEP recommends that the following information should be contained therein:

- a brief description of the project;
- a description of the method of construction;
- notes of any unusual risks which are inherent in the project and which are not adequately covered by the conditions of contract or bills of quantities;
- any unresolved or contractual problems;
- an assessment of the state of the design process and the possible financial consequences thereof;
- notes of any major assumptions made in the preparation of the estimate;
- assessment of the profitability of the project; and
- any pertinent information concerning market and industrial conditions.

In addition it is normal practice to prepare a summary of the project costs. These usually consist of the values of the following sections of work extracted from the bill of quantities:

- main contractor's labour;
- main contractor's plant allocated to rates;
- main contractor's materials;

- domestic sub-contractors;
- P.C. sums for nominated sub-contractors;
- P.C. sums for nominated suppliers;
- provisional sums and dayworks;
- contingencies;
- amounts included for attendance on domestic and nominated sub-contractors; and
- amounts included for materials and sub-contract cash discounts.

2.3 THE TENDER

The conversion of the estimate into a tender usually takes place at the adjudication meeting which is attended by management and representatives of the estimating team. Tassie (8) recommends that estimators, planners, buyers and site managers should all be encouraged to communicate the knowledge they have acquired in the preparation of the estimate. He further suggests that it may be advisable to set up two-tiered adjudication meetings in larger organisations. The first involves a meeting between the estimating team and management during which the estimate is reviewed. The second is attended only by management and at this meeting commercial decisions relating to the conversion of the estimate into a tender are made.

These two meetings illustrate that the decisions taken at this stage fall into two distinct categories:

- the vetting of the estimate by management; and
- the addition of monies to the estimate to cater for risk, general company overheads and profit.

This is shown in Figure 2.1.

2.3.1 Vetting of estimate

Before taking any decisions it is necessary for the adjudication panel to familiarize themselves with the project. This involves a consideration of all the reports described in 2.2.4.e.(iv) as well as the conditions of contract and pre-tender construction programme. It is then usual for the panel to scrutinize the estimate in detail and in particular to check the following items:

- the method of construction to ensure that the most appropriate course has been adopted;
- the programme;
- the resource outputs;
- the relationship between the resource aggregations produced by the planner and those produced by the estimator;
- any assumptions made by the estimating team;
- the anticipated cash flow of the project; and
- any unusual features associated with the project.

It frequently occurs that after this investigation, numerous adjustments need to be made. These normally take the form of lump sum additions or subtractions to the estimate figure.

2.3.2 Tender Adjustments

The objective of these adjustments is to convert the estimate into a commercially viable price. Tassie (8) identified four separate aspects for management's consideration:

- risk margin
- general overhead] the "mark-up"
- profit]
- discounts

a. Risk Margin

Risk assessment is concerned with evaluating whether the chance of making a loss on a project is greater than the chance of breaking even, or the chance of making a profit. Tassie (8) suggests that it may be necessary to express uncertainty through applying a risk mark-up percentage to the relevant section(s) of the estimate.

b. The General Overhead

This involves the addition of a sum of money to cover the general overhead expenses incurred by the contractor's organisation in administering the contract.

c. The Profit

The desired level of profit is considered and monies are added to cover this aspect.

d. Discounts

Discounts taken on materials and sub-contract quotations are sometimes considered as an extra source of profit. However Tassie (8) suggests that they may be usefully considered as a buffer against "...the invisible economics of site organisation".

It was found that the manner in which contractors made allowances for these factors varies enormously from organisation to organisation. This aspect was also observed by Mudd (6) who states that "Those concerned with tender adjudication generally have their own formula for producing the right figures". It is therefore impossible to give a detailed description of the calculations involved. In general it was found that these adjustments were incorporated as lump sum additions or subtractions to the revised estimate figure.

2.3.3 Submission of the Tender

The tender figure arrived at as described above is then submitted to the professional team. Depending on the conditions of contract, it may or may not be necessary to supply priced bills of quantities at this stage. Both these situations are examined below.

a. Priced bills of quantities required

In these cases the lump sum adjustments noted in 2.3.1 and 2.3.2 need to be allocated to the bill of quantities. The manner in which these adjustments are apportioned was found to vary between organisations. Two distinct cases arise:

- the apportioning of estimate adjustments

  These logically require the adjustment of item rates.

- the apportioning of tender mark-ups

  In some organisations it is standard practice to mark-up all items by a percentage to cover general company overheads and profit, whereas other organisations prefer to reflect such additions as a total amount in the preliminaries section of the bill. Attempts are also sometimes made to maximise profits by moving money around the bill. This is done to try and take advantage of various factors, including changes in tender price adjustment formulae, site conditions and/or poor documentation.

The preliminaries section of the bill is frequently used to balance the above-mentioned adjustments to the tender figure.

b. No bills of quantities required

Some tenders require only the submission of the form of tender. In these cases it is not necessary to allocate the adjustments described in 2.3.3.a to the bill of quantities unless the bill is requested by the professional quantity surveyor.

CHAPTER 3

THE USE OF COMPUTER SYSTEMS AND THE DEVELOPMENT OF ESTIMATING SOFTWARE FOR THE CONSTRUCTION INDUSTRY

CHAPTER 3

THE USE OF COMPUTER SYSTEMS AND THE DEVELOPMENT OF ESTIMATING SOFTWARE FOR THE CONSTRUCTION INDUSTRY

3.1 GENERAL

The aim of this chapter is primarily to provide information relating to the evolution of estimating software in the construction industry. To put this in context, a brief description is first given of the uses that computers may be put to in building contractors' organisations, and the extent to which such systems are actually used in practice. The development of software to assist construction estimators is then described from the early systems up to the start of this project. The problems of using computer systems as estimating aids are reviewed and the methods by which the proposed system attempts to solve these problems are highlighted.

3.2 THE USE OF COMPUTER SYSTEMS IN BUILDING CONTRACTORS' ORGANISATIONS

Several areas of potential computer application in building contractors' organisations are described below.

3.2.1 Estimating

This area is generally viewed by industry (and by Barnes(9)) as not being fully developed yet. A more detailed discussion of this aspect may be found in 3.3 and 3.4.

3.2.2 Cost Control

The form of cost control used most frequently in industry is that of monitoring the actual costs of construction, and comparing them to the budgeted costs. According to Barnes (9) "Computer systems can make things more streamlined and enable the production of cost reports and forecasts of 'cost to completion' to be produced so that cost control ceases to be totally retrospective".

3.2.3 Planning

Critical path planning was one of the first computer applications to be adopted by the construction industry. This was due to the fact that the calculations and logic of the technique were well defined, and could be readily translated into computer programs. However, these programs were also the first to attract the cynicism of construction personnel who were sceptical of computers.

Recent reductions in the cost of computer hardware have influenced contractors to reconsider the use of critical path planning techniques. Barnes (9) states that "After a long period out of favour, network analysis has now found a place in construction management. Computer-aided systems have become sufficiently convenient that it will soon become usual for them to be used on building sites. The best systems now produce bar charts for the use of site staff and are able to link into cost control and cash-flow forecasting systems".

3.2.4 Cash Flow Forecasting

Cash flow forecasting is an area of computer application that has received limited attention as a single entity. Recent developments in this area at Loughborough University of Technology have illustrated the benefits that accrue by using the new technology in conjunction with estimating and planning software. An experimental computer program developed by Alsop (10) makes use of estimator's data produced by computer, a timescale (in this case a bar chart) to which this data is allocated, and certain variable payment parameters. The effect of this program is to produce a detailed cash flow forecast with a minimal amount of effort by estimating and planning personnel. It is likely that such programs will become increasingly more attractive to construction organisations as the use of computer systems in the fields of estimating and planning increases.

3.2.5 Materials Ordering

The buying department of a building firm handles a large volume of information. Tender enquiries in the form of specifications and extracts from bills of quantities are sent out to suppliers. Quotations are received, and orders are placed with suppliers for successful tenders. The volume of information generated thus makes materials ordering a good candidate for the adoption of direct access computer systems (9).

3.2.6 Valuations and Sub-contract Accounts

This is an area where computers have not yet made much impact. Barnes (9) suggests that this is because "...the amount of calculation is small and is often not sufficiently repetitive for computing to produce real economies". This aspect was further highlighted by McCaffer (2) who states that "...the data required to be entered virtually makes it uneconomical to use computers for price adjustment unless the data has already been entered for other reasons".

3.2.7 Payroll and Accounts

These two functions of the building business have been computerised for what, within the time span of computer history, is a very long time. They offer the right combination of repetition and the necessity for strict adherence to routine which makes them well suited to computerisation (9).

3.2.8 Integrated Management Systems

Such systems envisage drawing together in one set of information the previously separate tasks of estimating, cost control, planning, cash flow forecasting, materials ordering, valuations, sub-contract accounts, payroll and accounts. Barnes (9) observed that the "...use of a single set of information by specialists such as estimators, planners, buyers, quantity surveyors and line management has a powerful co-ordinating effect and has real benefits to the profitability of the business".

Very little information is available on the extent to which computers have been used in the above-mentioned fields. In the field of computer aided estimating McCaffer (2) suggests that "Although the number of companies turning to computers is growing almost daily the number of serious practitioners is, say, between one and two hundred in an industry that has over 50 000 companies and over 6 000 employing more than 25 personnel".

In the absence of further information it is suggested that an indication of computer usage may be obtained from a consideration of the computer programs commercially available to the industry at the present time. A survey of such programs was undertaken in 1979 by the Design Office Consortium (now the Construction Industry Computing Association)(3). This revealed numerous programs which are summarised in Table 3.1. A study of Table 3.1 will reveal that the major area of influence by computers has been in the field of accountancy. This observation was borne out by Barnes (9) and by discussions with representatives of organisations to whom the estimating system was demonstrated. Accountancy is a discipline which is normally delegated to specialists and it is therefore postulated that the impact of computer systems has not been felt to any appreciable extent by construction personnel.

3.3 THE DEVELOPMENT OF ESTIMATING SOFTWARE

The evolution of software to aid construction estimators has been determined to a large extent by the computer technology available at that time. The main stages that may be considered are:

- batch systems;
- interactive systems mounted on mainframe computers;

APPLICATION		NUMBER OF PACKAGES AVAILABLE
ACCOUNTING	PAYROLL	32
	PURCHASE - SALES - NOMINAL LEDGERS	40
	SUB-CONTRACT LEDGER	2
	INTEGRATED ACCOUNTING PACKAGES	36
MANAGEMENT REPORTING AND PLANNING		28
PLANT RECORDING AND CONTROL		2
STOCK RECORDING AND CONTROL		9
FIXED ASSET ACCOUNTING		10
DISCOUNTED CASH FLOW		3
CASH FLOW FORECASTING		7
ESTIMATING	CONTRACTORS	6
	PRICE PREDICTION	1
COSTING		12
NETWORK ANALYSIS		20
NEDO FORMULAE		4
VALUATIONS		4

TABLE 3.1: Commercially Available Computer Programs for the Construction Industry (3).

- interactive systems mounted on microcomputers.

3.3.1 Batch Systems

Very little published information is available on the early batch estimating systems. These were developed mainly by the large construction companies who could afford the expense of the large machines required and the cost of developing in-house software (2). By and large these systems were not made commercially available (2). A graphical representation of the procedure adopted in the preparation of an estimate using a batch estimating system is shown in Figure 3.1.

The preliminary work required to produce an estimate by this method is considerable, and necessitates the estimator divorcing himself from the estimate during the punching of the estimate data on to cards and the subsequent running of the computer program. Editing of data involves repeating the whole procedure, an aspect which proved unsatisfactory to most estimators. Barnes (3) sums up the disadvantages of these systems when he states that "Tuning the build-up to a particular job, the core of the estimator's judgement, was difficult because it required a degree of interaction with the machine which was too expensive and cumbersome to achieve and did not justify the cost and delay caused by punching up the bill".

3.3.2 Interactive systems mounted on mainframe computers

The emergence of interactive programming techniques has awakened construction firms to the possibilities of computer-aided estimating. Programs developed using these methods allow users to perform tasks by entering commands at a terminal for each step of a required operation. These facilities thus alleviate the problems caused by the use of batch systems as described above.

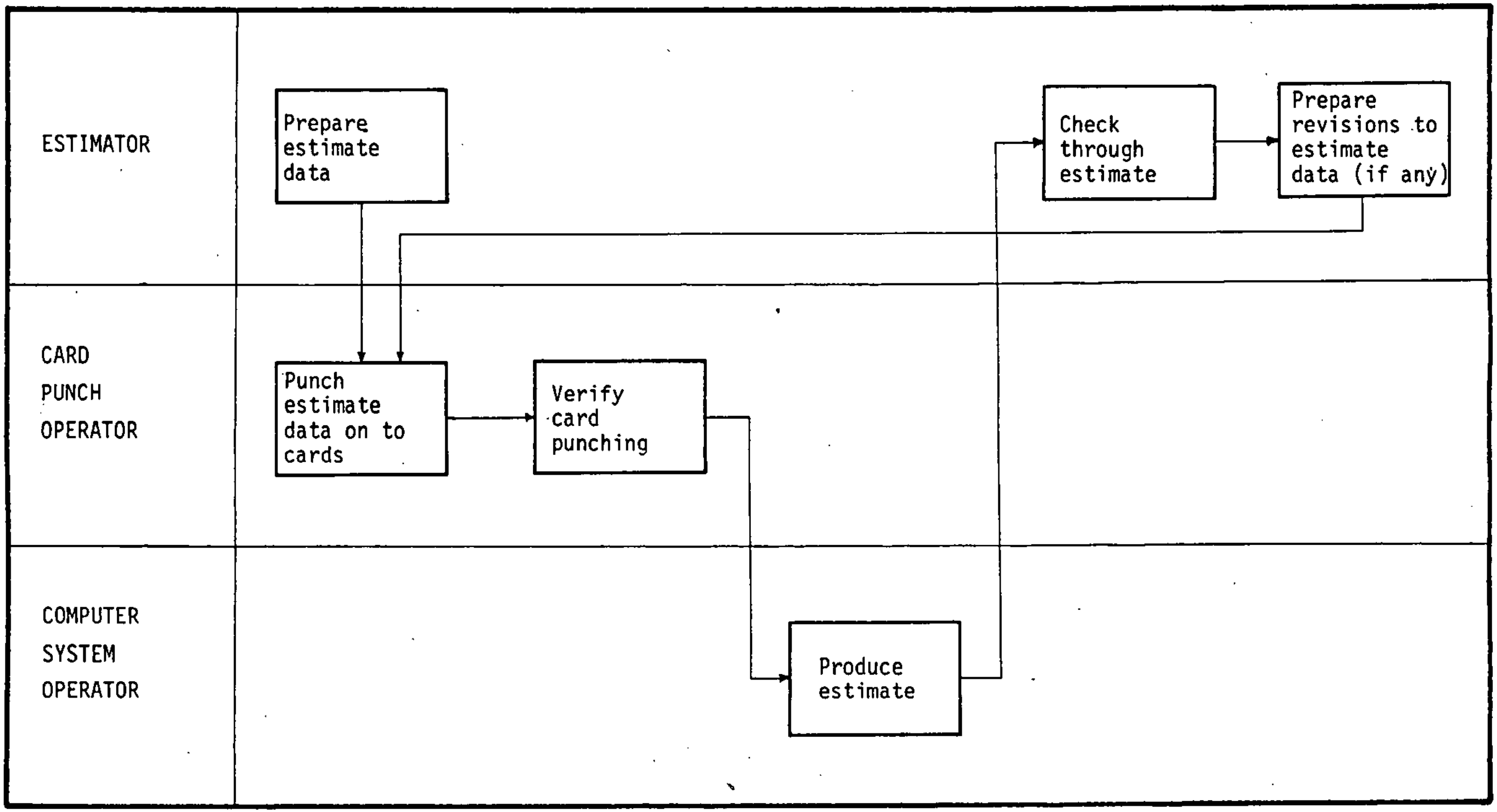


FIGURE 3.1: Flow Chart of a Batch Estimating System

At the present time there are only two such systems capable of dealing with complete bills of quantities which are commercially available in the United Kingdom (11). Table 3.2 gives brief details of these programs as well as other batch systems also commercially available at the present time. It should be noted that of the two interactive systems only one,(CAESAR) provides facilities which reflect traditional estimating procedures.

3.3.3 Interactive systems mounted on microcomputers

The arrival of microcomputers has further stimulated the interest of building firms in the use of computer systems as estimating aids. The greatly reduced cost of such systems together with their ability to support interactive programs has meant that viable software and hardware may be obtained for under £20 000 (2).

This reduction in cost has also resulted in the development of computer programs by building estimators themselves. This has occurred over the last two to three years. Such programs have been largely geared towards the production of systems which aid the estimator in certain isolated aspects of his task. The different types of systems which have been developed are described below.

a. Estimating programs for complete bills of quantities

   This type of system encompasses the complete estimator's task. The facilities provided enable:

   - the storage of performance data on the computer system's files;
   - the utilization of this performance data to price similar items found in bills of quantities;
   - the pricing of items where no relevant performance data is held on file;

	MODE OF OPERATION	DATA ENTRY	DATA BASE	LANGUAGE	COMPUTER HARDWARE	
					MAINFRAME	MICRO
CAESAR	I	T	YES	FORTRAN	PRIME 300	-
COST MONITOR	Bu	?	YES	COBOL	ANY DATA GENERAL MAINFRAME	-
ESTIMATING (CCS)	B	PT, C	YES	COBOL	ICL 1900	-
ESTIMATING SYSTEM (ICL)	LI or Bu	T	YES	PLAN	ICL 1901A	-
PCM	I or B	T, PT, C	NO	COBOL AND FORTRAN	PDP 11/03	-

ABBREVIATIONS:

I	Interactive	T	Terminal
B	Batch	C	Punched Cards
Bu	Bureau	PT	Paper Tape
LI	Limited Interactive	?	Unknown

TABLE 3.2: Estimating Systems for Complete Bills of Quantities Available October 1979 (11).

- the updating of volatile resource costs;
- all necessary arithmetical calculations to be performed automatically;
- the retrieval of item build-ups in their entirety; and
- the addition of tender mark-ups.

The only commercially available system which meets with the above-mentioned requirements at the present time is the system which forms the subject of this thesis.

b. Pricing programs for complete bills of quantities

Systems available in this category provide the estimator with information which may be likened to that contained in Price Books (see 6.2.1). This information is then used to price items found in bills of quantities. It is also generally possible to perform simple editing operations.

Although the facilities provided with such systems are limited, they have stimulated the interest of industry due to their extremely low price. The hardware requirements of these systems may be met by the smaller microcomputers, such as the PET Commodore, which sell for approximately £3 000.

An example of one such system is the CACE system (12) developed at Preston Polytechnic.

c. Programs for solving specific estimating problems

These systems have generally been developed to cater for well-defined estimating problems where various parameters fluctuate depending upon the conditions in question. Some of these tasks include drainage, concrete and formwork calculations. A good example of one such system is that developed by Miller (13) for the placing of concrete in walls.

d. Programs for performing arithmetical computations

These programs have been developed with the aim of transferring clerical computational tasks to the computer. Such systems require the data relating to bills of quantities and the build-ups of item rates to be entered into the computer. All incidental arithmetic in preparing priced bills is then automatically completed by the system. In the best systems, the entry of data is rationalised by the use of work-sheets prepared by the computer system. These sheets are used by the estimator to record item build-ups and then form the source documents for the data entry operation (3).

It was not possible to locate a commercially available example of this type of estimating system in the U.K. However the system specification included in Appendix A illustrates the salient features of one such system seen by the author in South Africa.

3.4 INTEREST C.E.

This section describes an interactive estimating system INTEREST C.E. (System O) which was designed for use by the civil engineering industry. It was developed at Loughborough University of Technology and provided the starting point for the present project. In describing the system, frequent reference will be made to the flow chart illustrated in Figure 3.2.

a. Company Data Files

Cost Files

The cost files contain the all-in costs of different

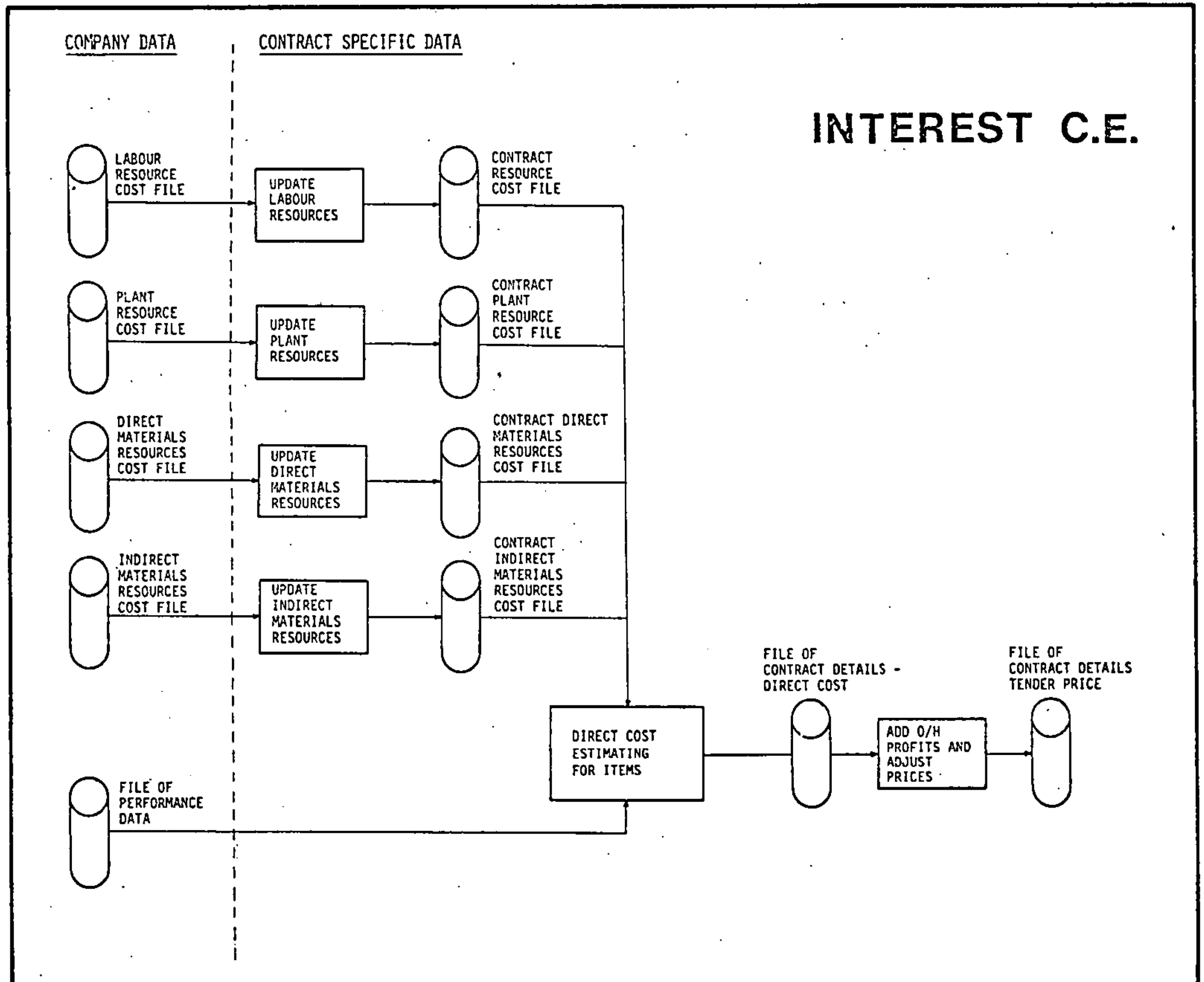


FIGURE 3.2: Flow Chart of the INTEREST C.E. (System 0) estimating system

categories of labour, different items of plant and various materials. Materials are divided into Direct Materials (being those materials used in permanent works) and Indirect Materials (those materials not used in permanent works). Only single resources may be stored in these files.

Performance Data Files

This file contains item build-ups with resources and usage rates for commonly recurring items of work.

b. Contract Specific Cost Files

The contract specific cost files are the company files transferred by the contract estimator who can either accept the cost recorded in the company data files or amend it to suit the individual contract.

c. Estimating Procedure

The estimator is required to input details of each bill item which he wishes to price. The system then provides him with three methods of pricing that item.

Known

This facility enables the estimator to use data stored in the File of Performance Data to price the item. An example of an item priced in this manner is shown in Figure 3.3. It is possible for the estimator to edit any of the data contained in this build-up until it meets with his satisfaction.

Unknown

Where no relevant performance data exists, this facility enables the estimator to build-up a unit

```
G511.0

CESMM code G511.0 MILD STEEL REINF TO BS 4449     6 MM DIA                U.O.M. T
-----------------------------------------------------------------------------------
Res.  Cat.  Description                           Usage rate           Cost
----  ----  -----------                           ----------           ----
 524  LAB.  STEELFIXER                          1.600 HR   /T        2.980 $/HR
 525  LAB.  STEELFIXER'S LABOURER               1.600 HR   /T        1.960 $/HR
 526  DIR.   6 MM DIA MILD STEEL -CUT,BENT &    1.000 TNNE/T       230.350 $/TNNE
-----------------------------------------------------------------------------------
Item rate     238.25 $/T
Options are:-
      CD - to Change the Description
      CU - to Change the Units of measurment
      AR - to Add a Resource
      DR - to Delete a Resource
      CR - to Change a usage Rate
      FW - to File the Work group
      DW - to Delete the Work group
```

FIGURE 3.3: Example of Known Work Group as presented by INTEREST C.E. (System 0).

rate from first principles. He may do this by selecting resources from the Contract Resource Cost Files and combining them with usage rates of his own choosing.

Gash Rates

This facility enables the estimator to allocate a sum of money to a particular item. This sum is required to be split up into its Labour, Plant, Direct Materials, Indirect Materials and Sub-contract elements.

d. Tender Adjustments

The costs of items as calculated in c. above are stored in the File of Contract Details - Direct Cost. To this may be added percentages to cover overheads, profits and surcharges. The results of these adjustments are then stored in the File of Contract Details - Tender Price.

e. Reports

At any stage during the estimating and adjudication procedure reports may be obtained. These include bill listings and resource reconcilliations.

f. Classification of Performance Data

The estimators link with the data held in the File of Performance Data is by means of a notation derived from a classification. The classification used with the system is the "Civil Engineering Standard Method of Measurement"(14). This classification was chosen "...because of the universally recognised basis of coding and the increasing number of bills of quantities that are being produced by this method of measurement" (15). An example of the "Civil Engineering Standard Method of Measurement" classification is given in Figure 3.4.

3.5 THE PROBLEMS OF USING COMPUTERS AS ESTIMATING AIDS

The early use of computer systems as aids to the estimating process aroused certain reservations on the part of prospective users. These were identified by McCaffer (16) and are discussed below.

3.5.1 Complexity of the estimating process and data availability

Preparing a tender is a process beginning with the invitation to tender and ending with the tender submission. During the preparation of the cost estimate and then the tender, estimators have exchanges of information with planners, buyers, site managers and management (as defined in Chapter 2) internally, and with potential clients, sub-contractors and materials suppliers externally. The estimators refer to their historical records, company manuals and other supporting data. When a computer-aided estimating system is interwoven into this fairly complex set of procedures estimators foresaw difficulties,

CLASS G: CONCRETE ANCILLARIES

Includes: Formwork for in situ concrete
Reinforcement for in situ concrete
Joints in in situ concrete
Post-tensioned prestressing
Accessories for in situ concrete

Excludes: Reinforcement in diaphragm walls (included in class C)
Pre-tensioned prestressing (included in class H)
Formwork and reinforcement in precast concrete (included in class H)
Formwork and reinforcement ancillary to drainage and pipework (included in classes K and L)
Formwork and reinforcement in piles (included in classes P and Q)
Formwork and reinforcement for concrete roads and pavings (included in class R)
Formwork for concrete rail track foundations (included in class S)
Formwork for tunnel and shaft linings (included in class T)
Formwork for foundations for fences and gates (included in class X)

FIRST DIVISION	SECOND DIVISION		THIRD DIVISION	
1 Formwork: rough finish	1 Plane horizontal		1 Width: not exceeding 0·1 m	m
2 fair finish	2 Plane sloping		2 0·1–0·2 m	m
3 other stated finish	3 Plane battered		3 0·2–0·4 m	m²
4 stated surface features	4 Plane vertical		4 0·4–1·22 m	m²
	5 Curved to one radius in one plane		5 exceeding 1·22 m	m²
	6 Other curved to stated radii	m²		
	7 For voids	nr	1 Small void, depth: not exceeding 0·5 m	
			2 0·5–1 m	
			3 1–2 m	
			4 stated exceeding 2 m	
			5 Large void, depth: not exceeding 0·5 m	
			6 0·5–1 m	
			7 1–2 m	
			8 stated exceeding 2 m	
	8 For concrete components of constant cross-section	m	1 Beams	
			2 Columns	
			3 Walls	
			4 Other members	
5 Reinforcement	1 Mild steel bars to BS 4449	t	1 Diameter: 6 mm	
	2 High yield steel bars to BS 4449	t	2 8 mm	
	3 Stainless steel bars of stated quality	t	3 10 mm	
	4 Reinforcing bars of other stated material	t	4 12 mm	
			5 16 mm	
			6 20 mm	
			7 25 mm or greater	
	5 High yield steel fabric to BS 4483	m²	1 Nominal mass: not exceeding 2 kg/m²	
	6 Fabric of other stated material	m²	2 2–3 kg/m²	
			3 3–4 kg/m²	
			4 4–5 kg/m²	
			5 5–6 kg/m²	
			6 6–7 kg/m²	
			7 7–8 kg/m²	
			8 stated exceeding 8 kg/m²	
6 Joints	*Surfaces*		1 Width or depth: not exceeding 0·5 m	
	1 Open surface plain	m²	2 0·5–1 m	
	2 Open surface with filler	m²	3 stated exceeding 1 m	
	3 Formed surface plain	m²		
	4 Formed surface with filler	m²		
	Internal or external details		1 Width: not exceeding 150 mm	
	5 Plastics or rubber waterstop	m	2 150–200 mm	
	6 Metal waterstop	m	3 200–300 mm	
			4 stated exceeding 300 mm	
	Internal or external details			
	7 Sealed rebate or groove	m		
	Internal or external details		1 Plain or greased	
	8 Dowel assembly	nr	2 Sleeved and capped	

FIGURE 3.4: Example of the "Civil Engineering Standard Method of Measurement" (14)

such as external information not being available on time, or information arriving in a different sequence or the proposed method of executing the work being changed.

3.5.2 Estimators' judgement

Estimators were concerned about the opportunity available in programs to exercise their judgement. In early systems, computer-held cost data could only be married to the quantities for the current tender after someone had punched the bill of quantities on to computer cards. Editing operations could not be easily carried out and at best the resulting estimate was too standardised. It is not surprising therefore, that interactive systems have gained more acceptance by estimators. Such systems allow the estimator to operate a terminal (normally a Visual Display Unit) and to select resources, amend resources suggested to him by the systems data files, and similarly to edit output rates and resource costs. These facilities enable the estimator to be in direct control of the estimating process.

3.5.3 Errors

Estimators feared the following:

- errors in data which get used over and over again;
- not being able to understand how a particular result was achieved due to insufficient data being supplied by the computer system.

3.5.4 Tender Deadlines

As the deadline for submitting tenders is very precise, the estimating process must take place within the time available. Estimators were apprehensive about the ability of computer-aided estimating systems to meet such deadlines, and also concerned about possible system failure.

3.5.5 Security

Early systems experienced a security problem in that they necessitated data leaving the estimator's office for processing. As this data related to tenders not yet submitted, estimators were concerned about the possibility of the data getting into competitors' hands.

3.5.6 Re-training of Estimators

Estimators were anxious about the amount of training required to enable them to use computer-aided estimating systems.

3.6 SOLUTIONS TO THE PROBLEMS OF USING COMPUTER SYSTEMS AS ESTIMATING AIDS

In considering solutions to the problems noted in 3.5 a description is first given of the methods in which computer systems may be used to aid estimators in their work. Consideration is then given of the manner in which the system developed and reported in this thesis attempts to solve these problems.

3.6.1 Solutions that computer systems can offer

Computer systems can offer the estimator assistance in three ways: as a calculator, as a filing system, and as a report generator (16). In order to provide estimating systems that exploit computer technology fully, it is maintained that such systems should perform these three functions.

a. A Calculator

The ability of the computer to perform calculations eases several areas in the estimating process.

In the first instance the arithmetic involved in the calculation of rates may be done by the computer.

The only requirement is that the estimator should be familiar with the arithmetical options available. This implies that the estimator will no longer need his calculator. Whilst this is unlikely to be the case it seems probable that the use of the calculator will diminish to that of a support role.

Secondly extension of rates, totalling of pages, sections and bills may be done automatically and accurately by the computer. This will greatly reduce, if not eliminate altogether, the need for comptometer staff.

Thirdly estimating software may be designed to allow revision to resource costs and outputs to occur at a very late stage in the preparation of an estimate. This, combined with the speed with which the calculations are performed, allows the estimator to simulate several different methods of construction.

b. A Filing System

This function provides a powerful tool in many respects. Firstly it enables the user to store data relating to the performance and cost of a company's resources. This data may then be retrieved at will and used to price similar items of work.

Secondly, it provides a means of storing all information relating to a specific tender. An ancillary implication is that all decisions relating to that tender may be stored and retrieved at a later stage.

Thirdly, the storing of information provides a formalisation of presentation not achieved with manual estimating methods. This aspect is attractive to management, as it enables the interpretation of different estimators' work to be simplified.

c. A Report Generator

The main advantage of this facility lies in the distribution of information. Reports can be tailored to meet specific users' requirements. For example, detailed item build-ups for the estimator, cost summaries for the adjudication panel, resource analyses for the planning department and lists of materials and sub-contract items requiring quotes for the buying department may all be produced without any extra effort on the part of the estimator.

3.6.2 Solutions provided by the INTEREST BUILD estimating system

This section briefly describes solutions to the problems noted in 3.5 provided by the INTEREST BUILD estimating system (INTERactive ESTimating for BUILDers). A more detailed description of the system is given in Chapter 4 and Appendix B.

a. Complexity of the estimating process and data availability

The facilities provided by the system have been designed to reflect traditional estimating practice. In addition the interactive features of the system enable the user to work on any section of the bill of quantities. As such there is no start or end to the system and no problems should be experienced in obtaining information in the sequence desired. In addition the filing and calculating facilities provided by the system enable the estimator to make changes to the estimate by the insertion of revised costs and/or usage rates. This facility greatly reduces the work necessitated by such changes when compared to manual methods of estimating as all calculations are automatically completed by the computer system.

b. Estimators' judgement

The interactive features of the system allow the estimator to exercise his judgement at all stages in the estimating procedure. At no stage is he forced to accept an item build-up, resource cost or any other information supplied by the system. Responsibility for all decisions remains with the estimator, and is effected by keying in commands and data at the Visual Display Unit (VDU).

c. Errors

Errors contained in data entered into the data library (see Chapter 6) are subject to re-use if this data is selected by the estimator. However, the facilities provided by the system are comprehensive and allow both the keyboard operator and the estimator to peruse and edit the data before storing it in the system.

In all other cases detailed displays and print-outs are provided to allow the estimator to vet the decisions made. Where required, modifications to data may be effected with a minimum of effort.

d. Tender deadlines

The meeting of tender deadlines necessitates planning the workload of the estimating department. In this respect the system provides facilities which serve to smooth the estimating procedure. These facilities enable calculations to commence before having obtained materials and sub-contract quotations. As and when they become available, they may be entered into the system, and all occurrences of such items are automatically updated. In this way the system provides a means of ensuring a more even workload as the sometimes unproductive period spent awaiting quotations is obviated.

The management of the estimating procedure should also ensure that any failure of the technology, particularly at a late stage in the estimate preparation, leaves estimators with sufficient information to complete the estimate. This may be done by taking "back-up" copies of estimate data either in the form of printed reports, or on computer storage devices such as removable hard discs or tapes.

e. Security

The use of microcomputer systems alleviates estimator's fears of data getting into competitors' hands as such systems are under his direct physical control.

A further security aid in the form of a system of passwords is also provided. This restricts the use of the system to those authorised persons to whom the password is known.

f. Re-training of Estimators

The main skills required in the use of the estimating system are the ability to use a VDU and an understanding of the filing structure employed by the system. A certain period of training is thus inevitable. However, the prompts provided by the system are, to a large extent, self-explanatory and the level of keyboard competence required is not great. The training period is therefore seen as being of relatively short duration.

CHAPTER 4

THE COMPUTER-AIDED ESTIMATING SYSTEM

CHAPTER 4

THE COMPUTER-AIDED ESTIMATING SYSTEM

4.1 GENERAL

The aim of this chapter is to describe the development of a computer-aided estimating system for the U.K. building industry by the Research Group. An outline is first given of the procedure adopted in the development of the specification for the system. A description of the system itself is then given. This is followed by an outline of how the system relates to the overall estimating process.

4.2 DEVELOPMENT OF THE SYSTEM SPECIFICATION

A prime requisite for the success of any computer-aided estimating system is that it should reflect traditional estimating procedure. This requirement was also noted by Harrison (17) who states that new systems "...should follow closely the logic of the traditional process (evolution is better than revolution) to gain acceptance by estimators". Further support for this requirement is evidenced by estimators' rejection of revolutionary estimating techniques such as those using regression techniques as developed by Moyles (18).

In order to establish detailed requirements for the estimating system it was therefore necessary to investigate traditional estimating practice, and a description of this work is given in Chapter 2. Whilst basic procedures were found to follow the CEP to a large extent, it was noted that slightly different methods of calculating various items were adopted by different estimators. This aspect was also observed by Barnes (9)

It was therefore necessary to consult with practising estimators during the preparation of the specification for the system. Initially six organisations were represented, four of which supported the project throughout its duration. Without exception, these estimators had limited knowledge of computers, and in order to provide them with an appreciation of the new technology, the civil engineering estimating system described in 3.4 was demonstrated to them. This then provided the basis for discussions which enabled the author to prepare a specification describing the requirements of the system. This was then studied by the assisting estimators, and their comments incorporated in revisions to the specification. Numerous discussion/revision cycles followed, resulting in a comprehensive specification. This described in detail the requirements of a computer-aided estimating system for the building industry and incorporated criteria judged by the estimators as essential to the operation of such systems. The specification was subsequently used by the programming staff in preparing the computer programs.

4.3 THE COMPUTER-AIDED ESTIMATING SYSTEM

This section describes briefly the computer-aided estimating system called INTEREST BUILD. A detailed description of the system and the facilities it provides may be found in the User Manual, included in Appendix B. A flow chart of the system is illustrated in Figure 4.1. Reference to this chart will show that files may be categorised into those supporting the estimators' calculations (the RESOURCE COST FILES, the FILE OF PERFORMANCE DATA and the OPERATIONAL RESOURCE GROUPS FILE), and those retaining these calculations (the FILES OF CONTRACT DETAILS and the FILE AWAITING QUOTES). Figure 4.1 also shows that the supporting files are classed either as "Company Data" or "Contract Specific Data". The COMPANY files are available to all estimators and are managed by senior staff, whereas the CONTRACT SPECIFIC files are the responsibility of the contract estimator.

4.3.1 Company Data Files

a. Resource Cost Files

The RESOURCE COST FILES contain the all-in cost of

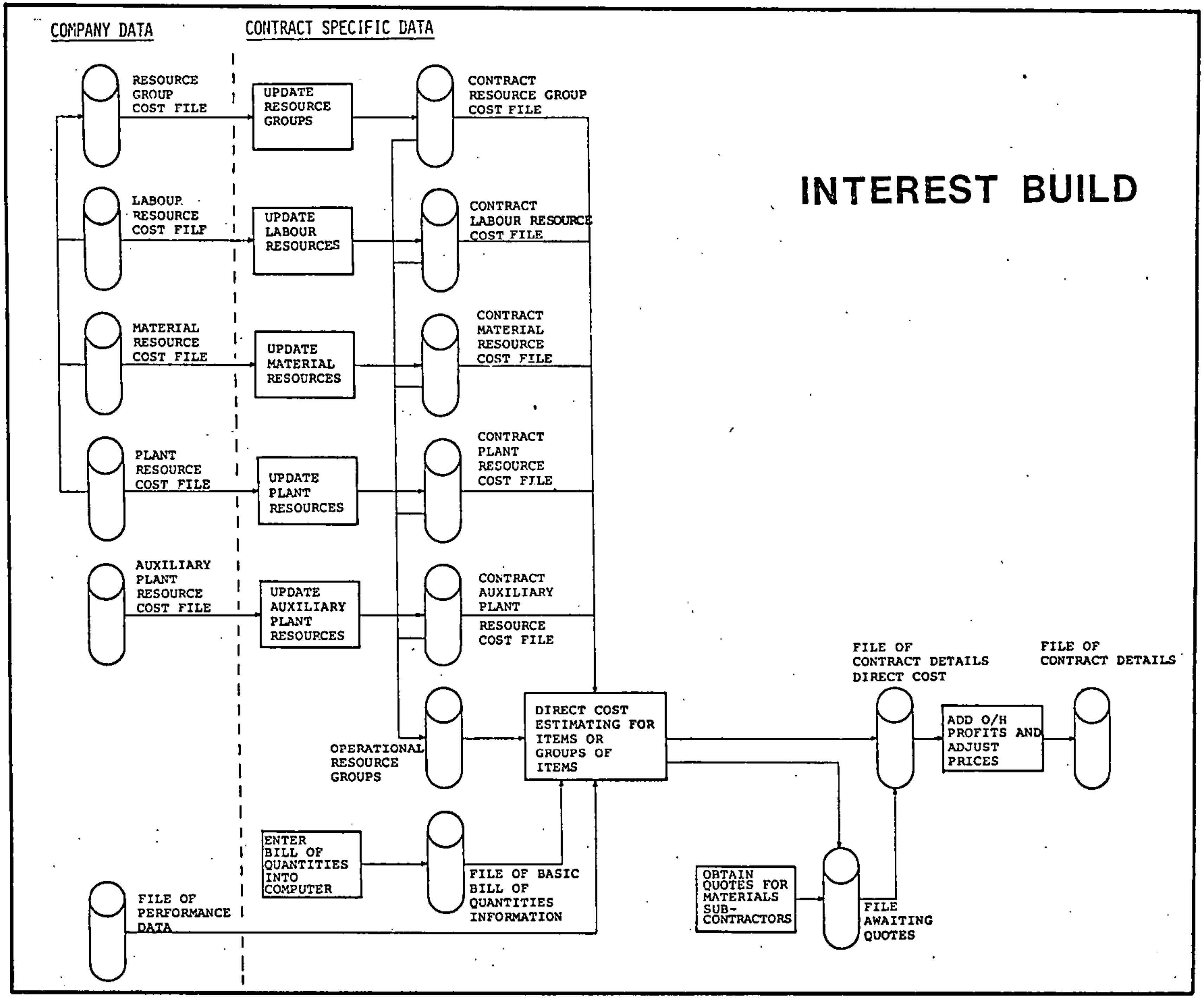


FIGURE 4.1: Flow chart of the INTEREST BUILD estimating system

different categories of labour, differing items of plant and materials prices. Within these cost files, data may be stored relevant to individual resources or gangs of resources as illustrated in Figure 4.2.

L1	LABOURER	2.25 £/HR
L2	LABOURER (CONC)	2.85 £/HR
L3	LABOURER (BRICKWORK)	2.25 £/HR
L4	LABOURER (CARP)	2.25 £/HR
L5	LABOURER (STEELFIX)	2.25 £/HR
L6	LABOURER (UNLOAD)	2.25 £/HR
L7	LABOURER (CLEAN)	2.25 £/HR
L11	GANGER	2.85 £/HR
L12	GANGER (CONC)	2.85 £/HR
LG20	CONC GANG (5)	14.25 £/HR
LG21	CONC GANG (6)	17.10 £/HR
LG26	BRICKWORK GANG (2+1)	4.28 £/HR
LG27	BRICKWORK GANG (3+2)	4.65 £/HR

FIGURE 4.2: Examples of data held on COMPANY RESOURCE COST FILES

The Resource Group (or Gang) cost file allows the combination of individual resources from other cost files as shown in Figure 4.3. It will be noted that these gang facilities are in accord with current estimating practice as described in 2.2.4.c.(i).

b. File of Performance Data

This file contains item build-ups (or WORK GROUPS) consisting of resources and associated usage rates for commonly recurring items of work. In order to facilitate the retrieval of a required WORK GROUP, it is necessary for the estimator to locate the WORK GROUP by a code (henceforth referred to as the WORK

```
*****************************************************************************
XG1        SFTWD/UNLD/NAILS                                           (used)

M67        SOFTWOOD
                                        $125.00 * 1.00 M3            $125.00
L6         LABOURER (UNLOAD)
                                          $2.25 * 1.00 HR              $2.25
M68        NAILS
                                          $0.90 * 7.00 KG              $6.30
                                                                 -----------
                                                                     $133.55
                                           Divided by    1.0
                                                                 -----------
                                           Gang Cost /M3             $133.55
*****************************************************************************
```

FIGURE 4.3: Example of data held in Resource Group Cost File

GROUP CODE). This entails the use of a classification relating to the different items of work measured in accordance with SMM 6. Investigations into suitable classifications are described in Chapter 5.

4.3.2 Contract Specific Data Files

a. Resource Cost Files

The CONTRACT SPECIFIC cost files are the COMPANY cost files transferred by the contract estimator for a particular contract. He can either accept the cost recorded in the COMPANY files, amend it to suit the individual contract, or mark as "Awaiting Quotes". New resources may also be entered.

b. Operational Resource Groups Files

This file retains operational resources data built up for a particular project by the estimator. These data are subsequently used for pricing items on an operational basis as described in 2.2.4.c.(ii).

4.3.3 Estimating Procedure

a. Entering the bill of quantities

This facility allows all basic bill of quantities information to be entered into the computer. As this aspect requires no estimating expertise, it may be performed by a typist or junior member of the estimating team. Nevertheless, it is necessary for the estimator to check through the bill and identify several aspects, including the WORK GROUP CODE for each item, and any sub-contract operations. The information required to be entered for each item is as follows:

- bill number;
- section number;
- page number;
- item reference;
- quantity;
- units of measurement;
- WORK GROUP CODE;
- percentage allocation of WORK GROUP CODE;
- sub-contract item (if applicable).

It should be noted that at this stage the entry of the WORK GROUP CODE and the percentage allocation of the WORK GROUP CODE are optional.

Additional facilities are also provided for the entry of P.C. and provisional sums and related attendance and profit allowances as well as for "Items".

At this stage it is possible to obtain bill listings and reconciliations of the estimate (see d. Reports below). These reports may be regarded as "rough estimates" and provide the estimating team with a useful basis for reviewing the overall feasibility of the construction methods chosen. It should be noted that these estimates include only the cost of those items the performance data of which are held on file.

b. Estimating

The estimating methods available allow the estimator to price items as unit rates, operational rates, combinations of both or as spot rates.

(i) Unit Rates

Items priced in this manner may be either KNOWN (i.e. where relevant performance data is held on file), or UNKNOWN (i.e. where no data is available).

Known Unit Rates

This facility involves the retrieval of information from the FILE OR PERFORMANCE DATA using the WORK GROUP CODE as a means of identification. The estimator may then examine the item, and if he chooses, use the performance data presented to him. If he is not satisfied, he may amend the WORK GROUP by adding or deleting resources and/or by altering usage rates. These facilities are such that the estimator retains actual command of all the calculations. An example of an item accessed from the FILE OF PERFORMANCE DATA is given in Figure 4.4.

Work Group G1A.0
6MM M.S.REBAR IN FOUNDS

Code	Description		Cost/HR	Usage	Weight Factor	Cost/TNE
L6	LABOURER (UNLOAD)	-	$2.25	.500	100.0%	$1.13
L31	STEELFIXER	-	$3.00	54.000	100.0%	$162.00
L46	BANKSMAN	-	$2.25	.250	100.0%	$0.56
P5	MOBILE CRANE	-	$14.50	.250	100.0%	$3.63
Code	**Description**		**Net. Cost/Unit**	**Usage**	**Wastages Per Unit**	**Cost/TNE**
M1	6MM M.S.REBAR	-	$295.00/TN	1.000	2.5%	$302.38
M34	BINDING WIRE	-	$1.50/KG	18.000	0.0%	$27.00

TOTAL LABOUR	COST/TNE	$163.69
TOTAL PLANT	COST/TNE	$3.63
TOTAL MATERIAL	COST/TNE	$329.38
TOTAL NET COST/TNE		$496.69

FIGURE 4.4: Example of WORK GROUP accessed from the FILE OF PERFORMANCE DATA

Unknown Unit Rates

Should a build-up not be held on the FILE OF PERFORMANCE DATA, facilities exist to enable the estimator to develop an estimate for an item by entering individual resources and usage rates at the terminal. As with the KNOWN unit rate build-up, he remains in command of all calculations, and the resulting build-up is displayed in a similar manner to that shown in Figure 4.4.

(ii) Operational Rates

Bill items may be priced on an operational basis as previously described. Operational rates may be used in conjunction with unit rates or independently.

(iii) Spot Rates

This facility enables the estimator to price items without reference to specific resources or usage rates. It is designed to allow the insertion of lump sums against the cost categories of Labour, Plant, Auxiliary Plant, Materials and Sub-contractors. An example of a spot rate is given in Figure 4.5.

```
Section 1  Page 2/ D
Quantity     54     M3
Work Group Classification : F

      Category                      Rate in $/M3
      --------                      --------------
        LAB.                                  5.50
        MAT.                                 33.00
        DOM.                                   .85
                                        ----------
                      Item Rate              39.35 $/M3
                      Item Cost          $2,124.90
```

FIGURE 4.5: Example of a spot rate

Once the estimator has arrived at a satisfactory item rate he may apply this rate to other similar items in the bill of quantities.

When the direct cost for an item is complete it is stored in the FILE OF CONTRACT DETAILS - NET COST. This file retains all the estimator's calculations and enables him or the tender adjudication panel to recall any item at any stage so that it may be reworked.

If the direct cost for an item contains resources, usually either Materials or Sub-contractors, which are awaiting quotes, that item will be stored in the AWAITING QUOTES FILE. This file serves the quotations subsystem.

c. Quotations Subsystem

Resources marked as "Awaiting Quotes" carry either zero or dummy prices. This allows the estimator to proceed with his calculations by selecting resources and usage rates with or without the support of the data files. All build-ups using resources awaiting quotes are flagged. As and when quotations are finalised they are entered into the system and all occurrences of this resource throughout the bill of quantities are automatically updated. In this way the item build-ups "Awaiting Quotes" are completed.

The quotations subsystem enables reports of resources "Awaiting Quotes" to be obtained at any time. This provides the basis for chasing late quotations.

d. Reports

At the completion of the direct cost estimate several reports are available to the tender adjudication panel. These are described below.

Bill Listings

This report gives a breakdown of each bill item into its labour, plant, auxiliary plant, materials and sub-contract elements.

Direct Cost Summaries

These collate the direct cost totals under headings of labour, plant, auxiliary plant, materials and sub-contractors. The summaries are available for the whole bill, a section, a page or for a work section.

Resource Reconciliations

This report lists all the resources used in the estimator's build-ups and the associated resource quantities (i.e. plant and labour hours and material quantities). The costs of these resources are also included in the report.

Examples of these reports are given in Figures 4.6, 4.7 and 4.8. It will be noted that the reports display the direct cost as well as the tender amounts. The tender amounts take into account the tender adjudication adjustments described below.

4.3.4 Tender Adjudication Adjustments

The following adjustments are available to management for the conversion of the estimate into a tender.

a. Surcharges

This adjustment allows the cost of individual resources or groups of resources to be altered. For example, it may be desired to add 5% to the cost of all bricklayers, or to deduct 2% from all plant. Such operations are carried out by entering the appropriate resource code or category, and the desired adjustment. All further calculations are done automatically.

b. General Overheads

Additions in the form of a percentage or lump sum to the different cost categories are allowed.

Contract TOM : USER MANUAL DEMONSTRATION　　　　　　　　　　　　　　　　　　Page 2
Reference Code : REF-99　　　　　　　Tender Submission Date 25-12-81　Today's Date 4-8-81

Bill of Quantities Listing - Single Section

Direct Cost and Tender Price Item Listing

		LAB. rate	PLT. rate	AUX. rate	MAT. rate	DOM. rate	Quantity		TOTAL rate	Sum	
1/1/1/A	Direct	7.29	0.00	0.00	29.02	0.00			£36.31	£617.27	
	Tender	8.03	0.00	0.00	32.61	0.00	17	M3	£40.64	£690.88	*AQ*
1/1/1/B	Direct	0.00	0.00	0.00	0.00	6.41			£6.41	£1,378.15	
	Tender	0.00	0.00	0.00	0.00	6.57	215	M3	£6.57	£1,412.55	*S/C*
1/1/1/C	Direct	2.00	3.00	4.00	5.00	6.00			£20.00	£200.00	
	Tender	2.20	3.31	4.28	5.62	6.15	10	M3	£21.56	£215.60	
1/1/1/D	Direct	4.59	.65	0.00	28.35	0.00			£33.59	£1,813.86	
	Tender	5.06	.72	0.00	31.85	0.00	54	M3	£37.63	£2,032.02	*S/CK
1/1/1/E	Direct	73.44	4.71	0.00	316.23	0.00			£394.38	£9,070.74	
	Tender	80.94	5.19	0.00	355.28	0.00	23	TNE	£441.41	£10,152.43	
1/1/1/F	Direct	4.22	0.00	0.00	2.34	0.00			£6.56	£1,154.56	
	Tender	4.65	0.00	0.00	2.63	0.00	176	M3	£7.28	£1,281.28	
1/1/1/G	Direct	4.20	0.00	0.00	3.77	0.00			£7.97	£334.74	
	Tender	4.63	0.00	0.00	4.23	0.00	42	M	£8.86	£372.12	

Direct cost of bill page	1	£14,569.32
Tender price of bill page	1	£16,156.88

FIGURE 4.6: Example of Bill Listing as produced by the INTEREST BUILD estimating system

Contract TOM : USER MANUAL DEMONSTRATION   Page 4
Reference Code : REF-99   Tender Submission Date 25-12-81 Today's Date 4-8-81

Bill of Quantities Listing - Single Section

Direct Cost and Tender Price Page Summaries

SECTION/PAGE		LAB. value	PLT. value	AUX. value	MAT. value	DOM. value	Others	TOTAL value
1/1/1	Direct	£3,000.03	£173.43	£40.00	£9,917.71	£1,438.15	£0.00	£14,569.32
	Tender	£3,306.23	£191.35	£42.80	£11,142.45	£1,474.05	£0.00	£16,156.88
1/1/2	Direct	£801.90	£0.00	£0.00	£3,192.20	£0.00	£0.00	£3,994.10
	Tender	£883.30	£0.00	£0.00	£3,587.10	£0.00	£0.00	£4,470.40
1/1	TOTAL Direct	£3,801.93	£173.43	£40.00	£13,109.91	£1,438.15	£0.00	£18,563.42
	TOTAL Tender	£4,189.53	£191.35	£42.80	£14,729.55	£1,474.05	£0.00	£20,627.28

FIGURE 4.7: Example of a Direct Cost Summary as produced by the INTEREST BUILD estimating system.

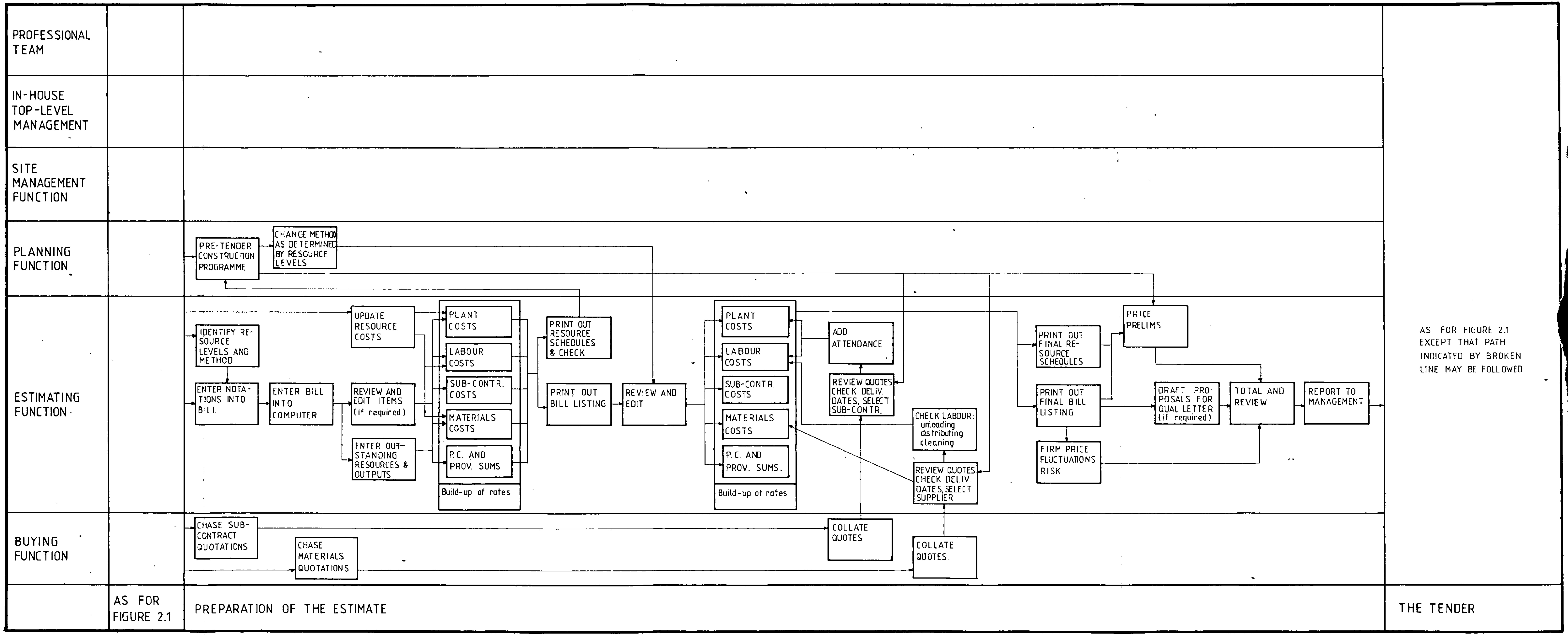


FIGURE 4.9: FLOW CHART OF ESTIMATING PROCEDURE USING THE INTEREST BUILD ESTIMATING SYSTEM

Contract TOM : USER MANUAL DEMONSTRATION
Reference Code : REF-99

Page 5

Tender Submission Date 25-12-81 Today's Date 4-8-81

Resource Reconciliation

Material Resources

RESOURCE	DESCRIPTION	BASIC AMOUNT	DIRECT COST	TENDER PRICE	WASTAGE	DIRECT COST	TENDER PRICE
M11	25MM.M.S.REBAR	29.90 TNE	£6,877.00	£7,726.31	.75 TNE	£171.93	£193.16
M34	BINDING WIRE	149.50 KG	£224.25	£251.94	0.00 KG	£0.00	£0.00
M66	PLYWOOD (EXT) 18MM	49.06 M2	£244.32	£274.49	5.97 M2	£29.75	£33.42
M67	SOFTWOOD	2.01 M3	£251.60	£282.67	.17 M3	£21.38	£24.02
M68	NAILS	23.90 KG	£21.51	£24.17	2.39 KG	£2.15	£2.42
M105	CONCRETE MIX A	181.00 CU M	£4,887.00	£5,490.54	12.23 CU M	£330.08	£370.84 *

FIGURE 4.8: Example of a Resource Reconciliation as produced by the INTEREST BUILD estimating system.

c. Profits

Additions in the form of percentages are allowed for main contractor's own work, that of domestic sub-contractors, and that of nominated sub-contractors and suppliers.

d. Rate Loading

A facility for the movement of money within the bill whilst keeping the total contract sum constant is provided.

4.3.5 Submission of the tender

As described in Chapter 2, it is sometimes necessary for priced bills of quantities to be submitted with the form of tender. The facilities provided by the INTEREST BUILD system aid the estimator in the preparation of such bills as the adjustments required may be easily carried out (and may even be effected as part of the adjudication procedure). This is possible as the system performs these alterations on the source data. The work involved in preparing bills is therefore greatly reduced, as the effort required to effect such adjustments without the aid of a computer is considerable.

4.4 RELATIONSHIP OF THE SYSTEM TO THE ESTIMATING PROCESS

Conversion of traditional estimating procedures into a computer-aided estimating system resulted in the rationalisation of two of the procedures described in Chapter 2. These are the "Preparation of the Estimate" (2.2.4) and the "Tender" (2.3).

4.4.1 The Preparation of the Estimate

The flow chart illustrated in Figure 4.9 shows the activities involved in the preparation of an estimate using the estimating system. It will be noted that the basic approach resembles that illustrated in Figure 2.1.

a. Identifying resource levels and method of construction

This activity follows discussions between the members of the estimating team during which proposed construction methods and resources are agreed.

b. Coding-up the bill of quantities

An essential feature of the estimating system is one which enables the estimator to make use of standard build-ups stored in the system and to use these to price similar items found in bills of quantities. In order to do this, it is necessary to identify each bill item by a WORK GROUP CODE which then allows the computer system to access the required WORK GROUP from a library of WORK GROUPS. This operation may be carried out before entry of the bill into the system (see c. below) or at a later stage in the procedure.

c. Entering the bill of quantities

This involves entering the information described in 4.3.3.a. into the computer system.

d. Updating the resource costs

This activity allows the estimator to revise the all-in resource costs according to the specific requirements of the project in question.

e. Building up the item rates

Coded Items

Where WORK GROUP CODES have been entered at the bill entry stage, items priced from the library of WORK GROUPS are reviewed by the estimator. These may be accepted or modified to meet his requirements. It is not necessary for resource costs to be available at this stage, as the system allows these costs to be updated at any time during the preparation of the estimate.

"One-off" Items

It is not practicable to store WORK GROUPS for the many different items found in buildings. In order to cater for the "one-off" items, the system provides the estimator with facilities to build up item rates which meet with his satisfaction. These include the ability to build up a rate from first principles and also to retrieve and edit WORK GROUPS from the FILE OF PERFORMANCE DATA.

Operational Rates

It is possible to calculate item rates on an operational basis as described in 2.2.4.c.(ii).

Spot Rates

This facility enables the user to estimate item cost on a lump sum basis.

f. Obtaining Reports

The facility provided by the system for allowing estimating to progress independently of obtaining resource costs enables this work to commence at an earlier stage than with most manual estimating systems. This has the added advantage of promoting liaison between the estimating and planning functions in that resource schedules resulting from the estimator's workings may form part of the pre-tender planning procedure. It is thus possible to review the overall construction strategy at an early stage, and take appropriate action if required.

g. Insertion of Materials' costs

One of the reports produced by the system is an "Awaiting Quotes" list for materials. This includes all materials marked by the estimator as "Awaiting Quotes" thus providing a check list of such resources for the estimator and/or buyer. As and when costs become available, they are entered into the system, and such resources are then deleted from the "Awaiting Quotes" report. Allowances for unloading, distribution and cleaning are made in the normal way in the rate build-ups.

h. Inserting the Sub-contract quotations

The treatment of sub-contract quotations is similar to that of materials costs described above. Attendance allowances are also made in the rate build-ups.

i. Calculation of Project Overheads

It was found that the method in which estimators calculated project overheads varied enormously from contractor to contractor. It was therefore decided to allow the estimator to continue his manual approach and to insert the sum so arrived at into the system for inclusion with the estimate.

j. Finalisation of the Estimate

Once the estimate has been completed it is possible to obtain reports of the extended and totalled bill. All incidental arithmetic involved in arriving at these figures is automatically performed by the computer system. Subsequent finalisation procedures follow normal practice.

4.4.2 The Tender

Figure 4.9 illustrates the activities undertaken at tender adjudication. As with the estimating procedure, it will be noted that traditional practice has been followed as far as possible.

a. Adjudication Procedure

The facilities provided by the computer greatly enhance the adjudication panel's ability to adjust the cost of a project. It is, for example, possible to ask numerous "what if?" questions and have all the necessary arithmetic performed in a very short space of time.

b. Printing out of reports

The system enables print-outs of nett and gross reports of bills of quantities to be obtained at any stage in the estimating procedure.

c. "Writing-up" the bills of quantities

Where a contractor is required to submit a priced bill with the form of tender it is necessary to transfer the rates, extensions and totals included in the gross reports described above into a fresh copy of the bill of quantities. This is then submitted to the professional quantity surveyor in accordance with current practice.

CHAPTER 5

CLASSIFICATION OF THE PERFORMANCE DATA

CHAPTER 5

CLASSIFICATION OF THE PERFORMANCE DATA

5.1 DEFINITIONS

In order to clarify the terminology used in this chapter and Chapter 6, the following definitions are given.

a. Classification

Classification of any series of objects means "the actual or ideal arrangement together of those which are like and the separation of those which are unlike; the purpose of the arrangement being, primarily, to facilitate the operations of the mind in clearly conceiving and retaining in the memory the characters of the objects in question, and the recording of them that they may be conveniently and quickly referred to; and, secondarily, to disclose the correlations or laws of union of properties and circumstances "(19).

b. Notation

Notation means "the set of symbols which represents the subjects in the classification schedule" (19).

c. Code

A code is "a set of symbols allocated to an entity for the purpose of manipulation and not necessarily exhibiting any relationships" (19).

5.2 GENERAL

The classification of the performance data is an aspect which is fundamental to the success of a computer-aided estimating system. In order to fully utilise the computer's facilities, its ability to store data must be comprehensively exploited. This aspect is critical to the success of such systems. As described previously, the classification forms the link between bills of quantities and the estimator's library of WORK GROUPS stored in the computer. Should this link in any way hinder the estimator in his interpretation of bill items, he is likely to become disillusioned and revert to more traditional methods of estimating.

The problem of organising data for subsequent use is not one which is peculiar to this computer application. It is experienced by all computer users. Difficulties are not solved by the existence of data. Data must be organised in such a way as to be usable (20).

It was thus necessary to identify the requirements of a suitable classification.

A set of criteria were developed which arose out of the following:

a. a consideration of the objectives of the estimating system;

b. a consideration of the nature of information desired to be stored for use with the system;

c. discussion with practising estimators and construction personnel;

d. a review of relevant literature; and

e. a consideration of the specific requirements of the estimating software.

These criteria are described in section 5.3.

A review of the classifications currently in use in industry revealed none that could meet the criteria in their entirety. SMM 6 was unsatisfactory and the degree to which other classifications proved acceptable was insufficient to warrant their use with the estimating system. These classifications are described in 5.5 to 5.9. A new classification (the INTEREST BUILD classification) was consequently developed. Details of this classification are given in section 5.4. Future developments in the form of proposals for the Seventh Edition of the "Standard Method of Measurement of Building Works" are described in 5.10. It should be noted that for the purposes of this project, it has been assumed that all bills of quantities are prepared in accordance with SMM 6.

5.3 CRITERIA FOR THE CLASSIFICATION

The criteria are summarised below and subsequently examined in more detail. It should be noted that the aspects considered apply only to work within the confines of this research project. It would thus be incorrect to employ these criteria verbatim to systems likely to be used on different aspects of building work.

The criteria are:

- unique identification;
- length of notation;
- recognizability of notation;
- level of detail;
- description of materials;
- accommodation of dimensions;
- expandability of notation; and
- option for choice of method.

5.3.1 Unique Identification

This is the single most important requirement of a classification system and is one that has been recognised by Crisp (21), Gilchrist and Gaster (19) and Gilb (22). Each item in a bill of quantities needs to be identifiable by a unique and unambiguous reference. This may be achieved by devising a system of unique notation for differing items. Such a notation would enable the desired information to be stored and retrieved at will.

5.3.2 Length of Notation

There are several factors supporting the use of concise notation. These are described below.

a. Resistance to lengthy notation

Moyles (18) in his investigation into estimating procedure found that estimators were dissatisfied with a lengthy notation. Similar observations were also made by Bradburn (23) and the author in discussions with estimators. In the allied field of Quantity Surveying, Scoins (24) noted that many practising quantity surveyors had experienced the "nightmare" of lengthy notations when using computers to assist in bill of quantities preparation. Gilb (22) states that "Techniques for psychologically shortening long (notations)....should be capitalised upon wherever possible" (Word in brackets inserted by the author to conform with the terminology used in this chapter). In the opinion of the author, Crisp (21) sums up the situation well when he suggests a "basically rigid as well as a simple structure" as being a prerequisite of a classification system. The case for a short notation is therefore well supported.

b. Errors in identifying correct notation

Excessive length provides more opportunity for errors to occur when identifying or interpreting a notation.

c. Errors in entering notation into the computer

A lengthy notation is likely to augment the opportunities for errors to occur during the entry of a notation into the computer.

d. Time taken in entering the notation

The longer the notation, the more time-consuming it will be to enter into the computer.

The resistance to lengthy codes may be due in part to the factors discussed in b. to d. above. It may be argued that the estimator's responses reflect a natural resistance to change. The sphere of computer technology is comparatively new to the construction industry, and as illustrated in 3.3 has not been used in estimating departments to any appreciable extent. In addition, the estimators consulted by the author were commenting upon classifications based on a new method of measurement, the "Standard Method of Measurement of Building Works: Sixth Edition" (4). This document has theoretically been in operation since March 1979, but discussions with estimators indicated that the majority of bills of quantities were still prepared in accordance with the "Standard Method of Measurement of Building Works: Fifth Edition" (25).

All agreed that the desired classification should be based on the latest edition, but it is felt that unfamiliarity with this new document must have influenced opinions.

The inescapable fact is that the length of notation depends upon the amount of information it is to carry (26). This aspect was also recognised by Dent (27) who states that "....the simpler the system of (notation) the more items would be required" (Word in brackets inserted by the author to conform with the terminology used in this chapter). It is thus necessary to consider the time taken to locate a particular notation in a classification.

e. Time taken to find the desired notation

The result of keeping the notation as short as possible may be a slight lengthening of the time needed to find an item (28). This is an inevitable result of a short notation. In order to contain a given amount of information, the classification must grow vertically i.e. the successive levels that make up a long notation need to be restructured to form fewer levels. This results in longer lists to search through. Consequently, the initial inconvenience of using a longer notation could eventually be outweighed.

Taking into account all the factors discussed above, it was felt that the advantages to be gained from using a short notation outweighed those supporting the use of a more lengthy notation. It was thus decided to consider a short notation as a prime objective of the desired classification.

5.3.3 Recognizability of the Notation

The user of the classification should easily be able to translate an item in a bill of quantities into its notation and vice versa. Crisp (21) recognised this requirement when he suggested that it should be possible to "more or less guarantee to get (the notation) right first time....the feasibility of which one can check at the merest glance" (Words in brackets inserted by the author to conform with the terminology used in this chapter.). This aspect is a function of the presentation of the classification. Stewart (20) identified several factors which contribute to good design when investigating the manner in which information is displayed on Visual Display Units. It is argued that these factors are equally relevant to the case in question.

They are: logical sequencing, spaciousness, relevance, consistency, grouping and simplicity.

a. Logical Sequencing

The sequence in which information is presented should be logical in terms of the user's task.

b. Spaciousness

Spacing and blanks are important, both to emphasize and maintain the logical sequencing or structure and also to aid the identification and recognition of items of information. Clutter greatly increases search time and increases the likelihood of missing or overlooking items, misreading items, and other errors.

c. Relevance

There is a natural desire to ensure that the user has available all information of real and potential relevance. In many cases, information of only potential relevance should be excluded. (This aspect is dealt with in more detail in 5.3.4.)

d. Consistency

The value of consistency is that unfamiliar sections can be more readily and accurately interpreted if they conform to existing practices in the use of language and structure. This aspect was also recognised by Gilb (22) who states that "Rules for the design of (notations) for any given system should be....consistently followed". (Word in brackets inserted by the author to conform with the terminology used in this chapter).

e. Grouping

Where there are relationships between items it can improve the presentation if relevant items are grouped together.

f. Simplicity

All the above factors should be taken into account, but the overriding consideration should be to present the appropriate quantity and level of information in the simplest way.

As there are numerous items which will require the allocation of a notation, the degree to which these factors have been considered will determine the overall efficiency of the system.

5.3.4 Level of Detail

It is not envisaged that the required classification will cater for the multitude of different items that may occur in a bill of quantities. The sheer volume of items would make this impracticable. What is required is that the classification should cover the items of work normally undertaken by the organisation in question. In other words a contractor specializing in factories would develop a classification relating to that building type, whereas another contractor with a more varied workload would require a more general range of items. The degree to which the classification is refined to cater for more unusual items would therefore depend upon the organisation in question.

5.3.5 Description of Materials

Detailed materials' description is not a prerequisite of the desired classification. The inclusion of the numerous different materials which may be used in a building was deemed to be an impossible task and one which would require inordinate computer storage. The system should distinguish between materials that make differing demands upon other resources. (E.g. The cost of pouring concrete mix "A" or concrete mix "B" will not vary greatly in any given location. However, any difference in reinforcement content may have significant consequences on the cost of the placed concrete.).

Materials should be able to be allocated on an ad hoc basis into broad categories incorporated in the classification.

5.3.6 Accommodation of Dimensions

In order to store performance data relevant to various items, the classification must allow for the definition of dimensions as and when required.

5.3.7 Expandability of notation

This requirement was recognised by Gilb (22) and Crisp (21). Crisp highlights the problems associated with adding to classifications when he states that "Flexibility of extension within the (notation) structure is essential. The dangers of overspill and its inevitable concomitant, the amendment of established (notations) should be guarded against at all costs". (Words in brackets inserted by the author to conform with the terminology used in this chapter.)

5.3.8 Option for Choice of Method

When pricing an item, the estimator's choice of resources depends upon many factors. These include the quantity of work involved, restrictions (if any) on working conditions, and the height of the work above ground level. If the estimator is to use the estimating system described in Chapter 4, it is necessary that he be able to store and retrieve performance data peculiar to differing conditions. To enable him to do this, the classification should in some way represent the required method of operation.

An added bonus would be the ability of the classification to adapt to the demands of different methods of measurement. This would allow for the introduction of new editions of the "Standard Method of Measurement of Building Works" and any in-house measuring procedure followed by design/contract organisations.

5.4 INTEREST BUILD CLASSIFICATION

5.4.1 Aims

This classification has as its aim the provision of a system for use with computer-aided estimating systems.

5.4.2 Description

It is divided into sections broadly in accordance with SMM 6. However, the SMM 6 work sections do not determine the parameters of an INTEREST BUILD section.

The INTEREST BUILD classification allows for up to six levels of description.

a. Level 1 defines the INTEREST BUILD section

b. Level 2 is used predominantly for materials description

c. Level 3 is used for the location of the item

d. Levels 4 to 6 are used to describe thicknesses, cross-sectional areas and similar dimensional restrictions.

In accordance with the objectives of this project (i.e. to develop computer-aided estimating software to meet the specific requirements of the British building industry), only trades generally undertaken by labour directly employed by the main contractor have been considered.

A detailed description of the classification is given in Appendix C.

Figure 5.1 shows a page from the classification.

5.4.3 Assessment against Criteria

a. Unique Identification

This is obligatory with the system.

b. Length of Notation

A concise notation results from the use of this

G. REINFORCE-MENT	BARS	(TONNE)	STRAIGHT AND BENT BARS		
	1. MILD STEEL DIAMETER 6 MM	A. IN FOUNDATIONS	A. HORIZONTAL 12.00 TO 15.00 M		
	2. DITTO 8 MM	B. IN GROUND SLABS	B. DITTO 15.00 TO 18.00 M		
	3. DITTO 10 MM	C. IN SUSPENDED SLABS	C.		
	4. DITTO 12 MM	D. IN WALLS	D.		
	5. DITTO 14 MM	E. IN CASING TO STEEL COLUMNS	E. VERTICAL 5.00 TO 8.00 M		
	6. DITTO 16 MM	F. IN CASING TO STEEL BEAMS	F. DITTO 8.00 TO 11.00 M		
	7. DITTO 18 MM	G. IN CASING TO STEEL COLUMNS	G.		
	8. DITTO 20 MM	AND BEAMS	H.		
	9. DITTO 22 MM	H. IN STEPS	CURVED BARS		
	10. DITTO 24 MM	I. IN STAIRCASES AND STRINGS	I. HORIZONTAL 12.00 TO 15.00 M		
	11. DITTO 25 MM	J. IN STAIRCASES AND STRINGS AND	J.		
	12. DITTO 26 MM	ASSOCIATED LANDINGS			
	13. DITTO 28 MM	K. IN STEPS, STAIRCASES, STRINGS	K. VERTICAL 5.00 TO 8.00 M		
	14. DITTO 32 MM	AND ASSOCIATED LANDINGS	L.		
	15. DITTO 40 MM	L. IN TOPS OF DORMERS			
	16. DITTO 50 MM	M. IN TOPS AND CHEEKS OF DORMERS	M. LINKS, STIRRUPS, BINDERS		
	17.	N. IN MACHINE AND SUNDRY BASES	AND SPECIAL SPACERS		
	18. HIGH YIELD DIAMETER 6MM	O. IN ISOLATED COLUMNS			
	19. DITTO 8 MM	P. IN ISOLATED BEAMS AND LINTELS			
	20. DITTO 10 MM	Q. IN ISOLATED COLUMNS, BEAMS			
	21. DITTO 12 MM	AND LINTELS .			
	22. DITTO 14 MM				
	23. DITTO 16 MM				
	24. DITTO 18 MM				
	25. DITTO 20 MM				
	26. DITTO 22 MM				
	27. DITTO 24 MM				
	28. DITTO 25 MM				
	29. DITTO 26 MM				
	30. DITTO 28 MM				
	31. DITTO 32 MM				
	32. DITTO 40 MM				
	33. DITTO 50 MM				
	34.				

FIGURE 5.1: Example of the "INTEREST BUILD classification".

classification. Consider the following item of reinforcement:

"6 mm mild steel reinforcement in foundations"

Reference to Figure 5.1 illustrates the required notation to be G1A.

c. Recognizability of Notation

In drawing up thé classification cognizance was taken of the criteria described in 5.3.3.

- Logical Sequencing

  The levels in the classification have been arranged in accordance with current practice in preparing bills of quantities. The sequence followed by the estimator in relating the bill to the classification and vice versa is thus one with which he is familiar.

- Spaciousness

  Throughout the classification, use of spaces has been made to emphasize structure, and to avoid clutter.

- Relevance

  See d. below.

- Consistency

  A similar format of presentation has been adopted throughout the classification.

- Grouping

  Where possible, like items have been grouped together within a level, and separated from other items by small spaces.

- Simplicity

  It is felt that reasonable success has been achieved in this aspect as comparison with the ensuing classifications will show.

d. Level of Detail

As set out in 5.3.4, the level of detail incorporated in the classification must be in line with the user's requirements. The aim of the INTEREST BUILD Classification is to satisfy industry that such a system can be used without being cumbersome and confusing. Additions and/or omissions will have to be made in accordance with specific users' requirements.

e. Description of Materials

Detailed description of all materials has not been undertaken in the classification. The determining factor in deciding whether to amplify a description has been the consideration of whether like materials of a different specification affect the outputs of resources contained within a given WORK GROUP. Reference to Appendix C will illustrate this point.

f. Accommodation of Dimensions

Two approaches have been formulated to deal with this aspect:

- Inclusion of dimensions in the body of the classification

  Where possible, a level has been allocated to accommodate dimensions relating to a particular item. This method is generally more suited to items whose size is well established in the industry (e.g. the size of a cavity in a brick wall), or where the graduation of dimensions within a level can satisfactorily cater for all the possibilities encountered in practice.

- Interactive sub-routines

  Not all items can be dealt with as above. For example, some items describe components which would require several levels for adequate definition (e.g. formwork to a concrete beam).

  In other cases, a particular dimension may fall between the sizes defined. This may, or may not, have significant cost consequences depending upon the quantity and the item involved. In these cases, interactive sub-routines have been devoloped which allow the estimator to enter dimensions peculiar to the item in question. These dimensions then serve to select performance data from a file of such data already held in the computer. This data is, in turn, used to arrive at a rate for the particular item. An example of one such sub-routine is given in Appendix D.

g. Expandability of notation

The classification provides ample opportunity for addition and/or deletion of descriptions. This will be more fully appreciated by reference to the classification, which is included in Appendix C.

h. Option for choice of method

An additional level following the main body of the notation allows the estimator to store up to ten different ways of pricing each item. As the construction methods chosen by estimators vary according to the construction strategies adopted by their respective organisations, the descriptions included in this level will vary from company to company. Thus these methods have not been included in the classification but will need to be identified in individual organisations.

5.4.4 Conclusions

This classification satisfactorily meets the criteria described in 5.3. It was thus decided to use it as the basis for storing and retrieving data for use with the computer-aided estimating system.

In addition the structure of the classification is felt to be flexible enough to cater for future developments in the "Standard Method of Measurement of Building Works".

5.5 THE STANDARD METHOD OF MEASUREMENT OF BUILDING WORKS: SIXTH EDITION (4)

5.5.1 Aims

This document describes the rules for the measurement of buildings dealt with in this project.

5.5.2 Description

This classification is divided first of all into twenty four work sections. These are divided into sub-sections identified by main headings. These sub-sections are further divided into sub-sub-sections. The relevant rules are then listed in these sub-sub-sections under the appropriate sub-heading.

Figure 5.2 gives an example of the system.

5.5.3 Assessment against Criteria

a. Unique identification

This is not possible with the system of notation used.

b. Length of notation

Not applicable due to a. above.

SECTION F.

Concrete work

Reinforcement

F.11 Bar reinforcement

1. Particulars of the following shall be given:
   a. Kind and quality of steel.
   b. Section of bars if other than plain circular.
   c. Tests of the bars.
   d. Restrictions on bending.
2. Bar reinforcement shall be given in tonnes stating the diameters. Each diameter shall be given separately.
3. Bends, hooks, tying wire, distance blocks and ordinary spacers shall be deemed to be included. No allowance in calculating the weight of reinforcement shall be made for tying wire, ordinary spacers or rolling margin.
4. Classification of bar reinforcement shall be as follows:
   a. In foundations, which shall be deemed to include column and pier bases, ground beams, pile caps and the like.
   b. In ground slabs, which shall be deemed to include beds, roads, footpaths and pavings.
   c. In suspended slabs which shall be deemed to include attached beams, upstands, kerbs and lintels.
   d. In walls, which shall be deemed to include attached columns.
   e. In casings to steel columns and beams (grouped together).
   f. In steps, staircases and strings and associated landings (grouped together).
   g. In tops and cheeks of dormers.
   h. In machine bases.
   j. In isolated columns, beams and lintels (grouped together).
5. Within each of the above categories the following shall be shown separately:
   a. Straight and bent bars, which shall be deemed to include hooked bars (grouped together).
   b. Curved bars irrespective of radius.
   c. Links, stirrups, binders and special spacers defined as designed spacers not at the Contractor's choice, and the like (grouped together).
6. Horizontal bars and bars sloping not more than 30° from the horizontal (grouped together) over 12.00 m long shall be so described stating the length in further stages of 3.00 m.
7. Vertical bars and bars sloping more than 30° from the horizontal (grouped together) over 5.00 m long shall be so described stating the length in further stages of 3.00 m.

FIGURE 5.2: Example of the "Standard Method of Measurement for Building Works: Sixth Edition" (4).

c. Recognizability of notation

Not applicable due to a. above.

d. Level of Detail

As SMM 6 is the set of rules by which buildings are measured, all eventualities must be catered for. The rules are therefore often necessarily broad in scope. There are, for example, instances where diagrams are required for amplification. Other rules call for "methods" and "treatments" to be stated. Clearly it is impossible to store performance data unless these aspects are clearly defined.

e. Description of materials

SMM 6 requires that bills of quantities describe materials as and when they are used. No actual materials descriptions are included in the document. It is thus impossible to store performance data for such items.

f. Accommodation of dimensions

In some cases SMM 6 defines the range of sizes allowable for a particular item, and in others requires the dimensions peculiar to that item to be stated. This latter aspect prevents storage of performance data relevant to that item.

g. Expandability of notation

Due to the method of classification used, difficulties in expanding the system will be experienced.

h. Option for choice of method

No facility exists within SMM 6 for this requirement.

5.5.4 Conclusions

The "Standard Method of Measurement of Building Works: Sixth Edition" (4) is unsuitable as a classification for use with the computer-aided estimating system developed due to the following reasons:-

- it is impossible to identify items individually;
- the level of detail provided is inadequate to facilitate storing performance data;

- insufficient materials descriptions and insufficient information regarding dimensions hamper the storage of performance data;
- difficulties are likely to be experienced in expanding the classification; and
- there is no facility to record different methods of construction.

5.6 STANDARD PHRASEOLOGY FOR BILLS OF QUANTITIES

by L. Fletcher and T.Moore (29).

5.6.1 Aims

The primary objective of this classification is to provide a basis for consistent descriptions of building works. The authors believe that "....considerable savings in time and expense would be made throughout the building industry, and not least by quantity surveyors and estimators, if all concerned with the description of building work expressed themselves in precisely the same terms, and pieced the various factors of building work descriptions together in a consistent and logical order". The notation employed aims to "assist those users who wish to automate their billing systems". Following on from this, the authors further hope that "...the data generated by the quantity surveyor's measurements can rapidly be reprocessed by computer, for a variety of purposes, at successive stages of the construction process, from design to completion of contract".

5.6.2 Description

The classification is divided into sections which accord with the SMM 6 work sections. The descriptions in each section are divided into a sequence of levels related to the significance of the component phrases, and at each level alternative phrases are grouped in vertical columns which are arranged horizontally in logical sequence. An item is composed by selecting phrases successively from these levels.

Up to seven levels are used, the seventh only infrequently. The first two levels provide headings under which collections of items are grouped, and the remainder provide descriptions which combine to form items.

Figure 5.3 shows sections of the system corresponding to bar reinforcement.

5.6.3 Assessment against Criteria

a. Unique identification

This aspect is a feature of the system.

b. Length of notation

A fairly long notation results from the use of this classification. Consider the same item of reinforcement as before i.e.

"6 mm mild steel reinforcement in foundations"

Reference to Figure 5.3 will show that the desired notation is as follows:

F2M2(6) cg.

where	F	represents	Standard Section Group;
	2	represents	Third Level Group;
	M	represents	Selected Material Specification;
	2	represents	White page;
	(6)	represents	Diameter of reinforcement; and
	cg	represents	Selected phrases from fourth and subsequent levels.

c. Recognizability of notation

The degree to which this classification meets the essentials of "recognizability" described in 5.3.3 is

REINFORCEMENT

01 Reinforcement bars	02 ;Staifix	0000	000000	00000000	00000	000000000
	000000	06 ;BS 4449	07 hot rolled	09 plain	14 round	18 mild steel
				10 deformed	15 square	19 high yield steel
			08 cold worked	11 ribbed		
						21 stainless steel designation 316S16

F2

25 mm

c ;straight or bent ,in

d ;curved

e ;links or the like

T

g foundations

h ground slabs

i suspended slabs

j walls

k casings to steel columns or beams

m steps, staircases, strings or associated landings

n tops or cheeks of dormers

p machine bases

q isolated columns, beams or lintels

0000000000000000000

s ;12–15 m long horizontal or sloping not more than 30 degrees from horizontal

t ;5–8 m long, vertical or sloping more than 30 degrees from horizontal

F2/1

FIGURE 5.3: Example of the "Standard Phraseology for Bills of Quantities" (29)

(These pages reproduced with permission from Standard Phraseology for Bills of Quantities) not entirely satisfactory. In particular the requirements of logical sequencing and simplicity are not adequately met.

- Logical sequencing

  Reference frequently needs to be made to different sections of a page or to different pages in the classification. This can be confusing.

- Simplicity

  In order to use the classification effectively, the system of notation must be thoroughly understood. This requires disproportionate effort when compared to the other classifications investigated.

It is felt that the combination of these aspects makes the system cumbersome to use and difficult to interpret.

d. Level of Detail

As stated above, the main objective of this classification is to enable building works to be described in a consistent manner. It would thus not achieve its goal unless an attempt was made to cater for the majority of items encountered in buildings. Descriptions of items in bills of quantities are furthermore legal statements of work to be completed. Considerable emphasis has been placed on producing descriptions which comply with both these aspects of bill preparation. The volume and quality of items incorporated in this classification is thus in excess of that desired for the purposes of the project.

e. Description of materials

Facilities are available for supplementing materials descriptions in the classification. These new and/or additional descriptions would need to be formulated and incorporated into the classification in order to define the performance data to be stored. Generally it appears that the "Standard Phraseology for Bills of Quantities" (29) will comply with the requirements of this criterion.

f. Accommodation of dimensions

The method provided for accommodating dimensions enables the professional quantity surveyor to enter them on an ad hoc basis. This is done during the "coding up" of the dimensions as taken off for the project (30). It is possible to extend this approach into the estimating application. Performance data relevant to selected dimensions may be stored and retrieved by the inclusion of that dimension in the notation. However, problems are likely to be experienced as the user would have no record of the data held on file.

g. Expandability of notation

No problems in adding to or altering the system can be foreseen.

h. Option for Choice of Method

No facility exists for catering for this requirement.

5.6.4 Conclusions

The criteria which the "Standard Phraseology for Bills of Quantities" (29) meets satisfactorily are summarised below:

- unique identification of items;
- ad hoc description of materials; and
- expandability of the classification.

Those which it does not meet are:

- length of notation;
- recognizability of notation;
- level of detail;
- accommodation of dimensions; and
- option for choice of method.

In view of the above it was decided not to make use of this classification with the computer aided estimating system.

5.7 STANDARD LIBRARY OF DESCRIPTIONS OF BUILDING WORKS

by Monk and Dunstone, Mahon and Scears (31)

5.7.1 Aims

The main aim of this classification is to assist the professional quantity surveyor in the following fields:

a. consistent descriptions in bills of quantities; and the

b. preparation of bills of quantities especially when assisted by the use of computers.

5.7.2 Description

The work sections of the "Standard Library of Descriptions of Building Works" (31) correspond to the SMM 6 work sections and are further divided into sub-sections called "Library Groups" (or "Libgros"). These "Libgros" represent the natural sub-divisions of each work section. Each contains up to three levels of descriptive text. These are as follows:

a. Main Headings

b. Sub-Headings

c. Work Heads.

Figure 5.4 gives an example of the system for bar reinforcement.

```
TITLES
------
    SECTION TITLE   :   SECTION : CONCRETE WORK                DC
    LIBGRC TITLE    :   REINFORCEMENT

MAIN HEADINGS
-------------

     01-04 ...
     05 BAR REINFORCEMENT
     06 ...
     07 SUNDRIES
     08-17 ...
     18 FABRIC REINFORCEMENT
  SUB HEADINGS
  ------------

        01-10 ...
        11 PLAIN HOT ROLLED MILD STEEL BARS
        12-16 ...
        17 DEFORMED HOT ROLLED MILD STEEL BARS
        18-22 ...
        23 DEFORMED HOT ROLLED HIGH YIELD STEEL BARS
        24-28 ...
        29 DEFORMED COLD WORKED STEEL BARS
            T 050 6 MM
            T 051 8 MM
            T 052 10 MM
            T 053 12 MM
            T 054 14 MM
            T 055 16 MM
            T 056 18 MM
            T 057 20 MM
            T 058 22 MM
            T 059 24 MM
            T 060 25 MM
            T 061 26 MM
            T 062 28 MM
            T 063 32 MM
            T 064 40 MM
            T 065 50 MM
             01 HORIZONTAL AND SLOPING NOT MORE THAN 30 DEGREES FROM
                HORIZONTAL AND OVER 12.00 M BUT NOT EXCEEDING 15.00 M LONG
             02 HORIZONTAL AND SLOPING NOT MORE THAN 30 DEGREES FROM
                HORIZONTAL AND OVER 15.00 M BUT NOT EXCEEDING 18.00 M LONG
             03 HORIZONTAL AND SLOPING NOT MORE THAN 30 DEGREES FROM
                HORIZONTAL AND OVER 18.00 M BUT NOT EXCEEDING 21.00 M LONG
             04 HORIZONTAL AND SLOPING NOT MORE THAN 30 DEGREES FROM
                HORIZONTAL AND OVER 21.00 M BUT NOT EXCEEDING 24.00 M LONG
             05 HORIZONTAL AND SLOPING NOT MORE THAN 30 DEGREES FROM
                HORIZONTAL AND OVER ... BUT NOT EXCEEDING ... LONG
             06-20 ...
             21 VERTICAL AND SLOPING MORE THAN 30 DEGREES FROM HORIZONTAL
                AND OVER 5.00 M BUT NOT EXCEEDING 8.00 M LONG
             22 VERTICAL AND SLOPING MORE THAN 30 DEGREES FROM HORIZONTAL
                AND OVER 8.00 M BUT NOT EXCEEDING 11.00 M LONG
             23 VERTICAL AND SLOPING MORE THAN 30 DEGREES FROM HORIZONTAL
                AND OVER 11.00 M BUT NOT EXCEEDING 14.00 M LONG
             24 VERTICAL AND SLOPING MORE THAN 30 DEGREES FROM HORIZONTAL
                AND OVER 14.00 M BUT NOT EXCEEDING 17.00 M LONG
             25 VERTICAL AND SLOPING MORE THAN 30 DEGREES FROM HORIZONTAL
                AND OVER ... BUT NOT EXCEEDING ... LONG
                  01 IN FOUNDATIONS
                  02 IN GROUND SLABS
                  03 IN SUSPENDED SLABS
                  04 IN WALLS
                  05 IN CASINGS TO STEEL COLUMNS
                  06 IN CASINGS TO STEEL BEAMS
                  07 IN CASINGS TO STEEL COLUMNS AND BEAMS
                  08 IN STEPS
                  09 IN STAIRCASES AND STRINGS
                  10 IN STAIRCASES AND STRINGS AND ASSOCIATED LANDINGS
                  11 IN STEPS STAIRCASES AND STRINGS AND ASSOCIATED
                     LANDINGS
                  12 IN TOPS OF DORMERS
                  13 IN TOPS AND CHEEKS OF DORMERS
                  14 IN MACHINE AND SUNDRY BASES
                  15 IN ISOLATED COLUMNS
                  16 IN ISOLATED BEAMS AND LINTELS
                  17 IN ISOLATED COLUMNS BEAMS AND LINTELS
                       01 : STRAIGHT AND BENT
                       02 : CURVED
                       03 : LINKS STIRRUPS BINDERS AND SPECIAL SPACERS
```

FIGURE 5.4: Example of the "Standard Library of Descriptions of Building Works"(31)

5.7.3 Assessment against Criteria

a. Unique identification

Unique identification of items is obligatory with this classification.

b. Length of notation

A long notation results from the use of this classification. Consider the same item of reinforcement as before, i.e.

"6 mm mild steel reinforcement in foundations"

The required notation is as follows:

DC 05 050/0101

where DC represents Library Group;
05 represents Main Heading; and
05/01 01 represents Work Heads.

c. Recognizability of notation

This classification performs comparatively well when assessed against the detailed requirements of "recognizability" as defined in 5.3.3. However, the user does need to refer to more than one page in order to ascertain a desired notation, and this can become confusing.

d. Level of detail

As with the previous classification, considerable effort has been devoted to developing a system which enables items to be described in a consistent, unambiguous manner. The result is one which provides more detail than that required for use with the computer aided estimating system.

e. Description of materials

It is possible to edit the materials described in this classification. Thus categories of materials may be tailored to meet the requirements of specific users. In this respect the use of the classification is suitable.

f. Accommodation of dimensions

By and large the method used for defining dimensions is to insert them on an ad hoc basis during the "coding" of dimensions. As described in 5.6.3.f, this approach may be extended into the estimating field. Similar problems of identifying data stored in the system are likely to be experienced.

g. Expandability of notation

No problems with this aspect are foreseen.

h. Option for choice of method

No facility exists for this requirement.

5.7.4 Conclusions

The criteria which the "Standard Library of Descriptions of Building Works" (31) meets satisfactorily are:

- unique identification;
- recognizability of notation;
- description of materials; and
- expandable.

Those which it does not meet are:

- length of notation;
- level of detail;
- accommodation of dimensions; and

- option for choice of method.

As a result it was decided not to use this classification.

5.8 PRICE'S STANDARD METHOD OF BILLING FOR SMM 6
by S.G. Price (32)

5.8.1 Aims

The aim of this classification is to enable quantity surveyors to produce bills of quantities containing consistent descriptions.

5.8.2 Description

"Price's Standard Method of Billing for SMM 6" (32) comprises sample descriptions for all work sections included in SMM 6.

These are divided into:

a. a central heading in bold upper case type representing a major work section in SMM 6;

b. a side heading in bold upper case type;

c. a sub-heading in bold lower case type; and

d. an item description in light lower case type.

An example of this classification is given in Figure 5.5.

5.8.3 Assessment against Criteria

a. Unique identification

No comprehensive method of notation is used in the system. It is thus impossible to identify items by a unique reference.

Item	SMM6 Clause	Description
		CONCRETE WORK
		REINFORCEMENT *FG*
A	F11.1	**Plain round steel bars, BS 4449** **Deformed high yield steel bars, BS 4449** **Cold worked deformed high yield steel bars, BS 4461**
B	F11.2	*8 mm*
	F11.5a b	Straight and bent Curved
		bars
	F11.6	horizontal bars and bars sloping not more than 30° from horizontal
		12.00-15.00 m long 15.00-18.00 m long *etc. in 3.00 m stages*
	F11.7	vertical bars and bars sloping more than 30° from horizontal
		5.00-8.00 m long 8.00-11.00 m long *etc. in 3.00 m stages*
	F11.5c	Links, stirrups, binders and special spacers
	F11.4	in foundations in ground slabs in suspended slabs in walls in casings to steel columns and beams in steps, staircases and strings and associated landings in tops and cheeks of dormers in machine bases in isolated columns, beams and lintels

FIGURE 5.5: Example of "Price's Standard Method of Billing for SMM 6" (32)

b. Length of notation

Not applicable due to a. above.

c. Recognizability of notation

Not applicable due to a. above.

d. Level of detail

"Price's Standard Method of Billing for SMM 6" (32) is not as voluminous as the classifications discussed in 5.6 and 5.7. The spread of items incorporated is thus more in keeping with the requirements of a classification for use with a computer-aided estimating system.

e. Description of materials

This system requires specific materials to be inserted in item descriptions according to the demands of each contract. The classification would thus not meet with the requirements of this criterion in its present form.

f. Accommodation of dimensions

Dimensions similarly need to be entered to cater for each item. This criterion can therefore also not be adequately met by the classification.

g. Expandability of notation

As no form of notation is used, it is possible to add to or delete from the system without affecting the existing structure of the classification.

h. Option for choice of method

No facility exists for this requirement.

5.8.4 Conclusions

"Price's Standard Method of Billing for SMM 6"(32) was not used with the estimating system for the following reasons:

- unique identification of items is impossible;
- there are inadequate facilities to cope with the description of materials;
- similarly, the facilities to accommodate the varying sizes of components are inadequate; and

- the system does not provide a way of representing different methods of construction.

5.9 ENVIRO B.Q. SYSTEM (33)

5.9.1 Aims

The objective of this classification is to aid quantity surveyors in the production of bills of quantities using computers. An ancillary aim is the rationalization of this process by the utilization of descriptions used for "taking-off" as a form of notation.

5.9.2 Description

The "Enviro B.Q. System" (33) provides descriptions for items measured in accordance with SMM 6. These are formed from a maximum of four phrase levels. The characteristics of each level are as follows:

a. Level 1 - Heading level;

b. Level 2 - Sub-Heading level;

c. Level 3 - The measurable item; and

d. Level 4 - Statements qualifying Level 3.

Only one phrase can occur at levels 1 to 3, but several may occur at level 4, separated by hyphens. Supplemental information regarding materials specification is normally inserted at level 2. An example of this classification is given in Figure 5.6.

5.9.3 Assessment against Criteria

a. Unique identification

This is obligatory with the system.

b. Length of notation

An extremely long notation results from the use of

F: CO/1

DESCRIPTION	LVL	CODE	UNIT	IN NR / SPEC	NB
CONCRETE WORK IN CONCRETE FRAMED STRUCTURES		F CO			
CONCRETE WORK TO STEEL FRAMED STRUCTURES	1	SF CO			
CONCRETE WORK GENERALLY		GEN CO			
NOTE: For approximate total volume of insitu concrete see Job Monitor.					
PLAIN INSITU CONCRETE	2	PL C			
REINFORCED INSITU CONCRETE		RC			
FOUNDATIONS IN TRENCHES	3	FDS			
... thick	4	( )	M3		100/150/300
ISOLATED FOUNDATION BASES TO COLUMNS OR PIERS	3	ISO BASE	M3	[N]	
CASINGS TO STEEL GRILLAGES		S GRIL			
GROUND BEAMS	3	G BM			
CASINGS TO STEEL GROUND BEAMS		S G BM			
... M2 sectional area	4	S A ( )	M3		.03/.1/.25
PILE CAPS		P CAP		[N]	
MACHINE BASES	3	M BASE	M3		
FILLING AROUND FOUNDATIONS		FIL FDS			
FILLING AROUND TANKS OR THE LIKE		FIL TANKS ETC			
FILLING TO POCKETS	3	PKT		[N]	
over 0.10 M3	4	(no code)	M3		
FILLING TO POCKETS	3	S PKT			} Less than 0.10 M3
... x ... x ...	4	(x x)	N		
poured against faces of excavation	4	AG EXC			
reinforcement content in excess of 5%		H REINF			
BEDS		BED			
BEDS FORMING ROADS		ROAD			
BEDS FORMING FOOTPATHS	3	PATH			
BEDS FORMING PAVINGS		PAVG			
SUSPENDED SLABS		SLAB			
... thick	4	( )	M3		100/150/300

F: CO/3

DESCRIPTION	LVL	CODE	UNIT	IN NR / SPEC	NB
BEDS TO PIPES		P BED			
BENCHING TO PIPES	3	P BENCH			
COVERINGS TO PIPES		P COVR			
VERTICAL SURROUND TO PIPES		P SURD			
... diameter: ... x ...	4	(D: x)	M		
REINFORCEMENT BARS		REINF			
REINFORCEMENT FABRIC	2	FAB	M2		[P]
SELFCENTERING REINFORCEMENT FABRIC		SC FAB			
THE TENDERER IS TO STATE HERE THE TYPE OF STEEL BAR SELECTED	3	SEL REINF	ITEM		Use only when particular type of high yield steel bar (eg. hot rolled) is unknown
....					
IN FOUNDATIONS		IN FDS			
IN GROUND SLABS		IN G SLAB			
IN SUSPENDED SLABS		IN SLAB			
IN WALLS		IN WL			
IN CASINGS TO STEEL COLUMNS OR BEAMS	3	IN CASG			
IN STEPS STAIRCASES STRINGS OR ASSOCIATED LANDINGS		IN STEP			
IN TOPS OR CHEEKS OF DORMERS		IN DORMR			
IN MACHINE BASES		IN M BASE			
IN ISOLATED COLUMNS BEAMS OR LINTELS		IN COL			
... diameter	4	(D)			Bars
strips ... wide with main bars along the length	4	STRIP L ( )	M		} Fabric
strips ... wide with main bars across the width		STRIP W ( )			
straight lengths		STRT			
curved		CVD			
In links or the like		LINKS			
temporary strutting ... high	4	T STRUT ( )			
horizontal bars ... to ... M long		H BAR LEN (→ M)			Over 12M in 3M stages
vertical bars ... to ... M long		V BAR LEN (→ M)			Over 5M in 3M stages
EXTRAS LABOURS ETC	3	X			
raking cutting		R CUT			
curved cutting	4	C CUT	M		
bending across ... bars		BEND FAB (			

FIGURE 5.6: Example of "Enviro B.Q. System" (33)

this classification. If the same item of reinforcement as that used in previous examples is considered, the resultant notation will be:

CO/3 MLD REINF IN FDS (6D)

where CO/3 represents Classification page;
MLD represents Materials specification;
REINF represents Level 2 phrase;
IN FDS represents Level 3 phrase; and
(6D) represents Level 4 phrase.

This assumes that it is unnecessary to include the first level phrase in order to achieve unique identification of items.

c. Recognizability of notation

The method of notation adopted resulted from the rationalization of the "taking-off" process used in the production of bills of quantities by computers. This process necessitates an extra manual activity which is the identifying of notations for each item "taken-off" (30). The "Enviro B.Q. System" (33) overrides this step by requiring the person "taking-off" to describe work using the abbreviations included in the classification. These abbreviations are then used as the notation.

This approach results in an easily recognizable notation. The detailed requirements of this criterion are met comparatively well. It may, however, be necessary to refer to more than one page in order to identify the required phrases.

d. Level of detail

The volume and detail of the descriptions included in this classification are felt to be appropriate to the use of a computer-aided estimating system.

e. Description of materials

The ad hoc description of materials is a feature of this classification. However, the method of presentation causes problems in that there is no reference to enable the user to record (and therefore select) required descriptions.

f. Accommodation of dimensions

Dimensions need to be entered in accordance with the requirements of each item. Performance data relevant to certain sizes may thus be stored, but the classification does not provide the user with a record of the sizes catered for.

g. Expandability of notation

No problems are foreseen relating to this aspect.

h. Option for choice of method

No facility exists for catering for this requirement.

5.9.4 Conclusions

The "Enviro B.Q. System" (33) was found to be unsuitable for use with the estimating system due to the following reasons:

- the excessive length of the notation;
- unsatisfactory manner of describing materials;
- inadequate facilities for catering with item dimensions; and
- no facility to identify different methods of construction.

5.10 THE STANDARD METHOD OF MEASUREMENT OF BUILDING WORKS: SEVENTH EDITION

5.10.1 General

Probably the most important development to affect the estimator in the near future will be the introduction of the Seventh Edition of the "Standard Method of Measurement of Building Works" (henceforth referred to as SMM 7). SMM 7 is currently being compiled by the Standard Method of Measurement Development Unit which was set up by the National Federation of Building Trades Employers and the Royal Institution of Chartered Surveyors. A consultative document (34) has recently been published which outlines proposals for SMM 7.

It was considered prudent to assess SMM 7 against the criteria described in 5.3. This approasal was carried out on the basis of the consultative document noted above.

5.10.2 Aims

The main terms of reference which were adhered to in the preparation of the proposals for SMM 7 are outlined below.

a. Simpler Bills

The use of SMM 7 should eventually result in the preparation of simpler and less detailed bills of quantities.

b. Time-related or fixed cost items

Rules of measurement should be developed which identify within the Preliminaries and the Work sections those items which are time-related or with fixed cost.

c. Compatibility with civil engineering

Particular regard should be paid to achieving the maximum compatibility between the measurement practices and conventions of the building and civil engineering sectors of the construction industry.

d. Wider use of measurement

Wider use of the measurement information should be considered.

5.10.3 Description

The rules for measurement are presented in the form of classification tables. These occupy a two page format.

a. The Classification Tables

These are printed on the left hand page. The tables contain all the rules relating to the sub-division of work into items,about item descriptions and about the units in which quantities are to be given.

On the right-hand page, set out to align with the relevant part of the classification table, are supplementary rules of four distinct types.

b. Measurement Rules

These govern the calculation of quantities and dimensions and, in some cases, prescribe when an item is to be measured.

c. Definition Rules

These are used to widen the commonly understood meanings of words used in item descriptions so that the latter can be kept brief and precise.

d. Coverage Rules

These draw attention to incidental work the cost of which is deemed to be covered by the rates entered although the incidental work is not mentioned in item descriptions.

e. Specification Information

This is information about the work which must be given in detail in the specification preambles.

An example of an SMM 7 classification table for steel reinforcement is given in Figure 5.7.

5.10.4 Assessment against Criteria

a. Unique identification

This should be possible with the system of notation employed.

b. Length of Notation

As stated above, the SMM 7 classification shown in Figure 5.7 does not represent the final document, and it is necessary to recognise this fact when attempting to identify a notation. A consideration of the same item of reinforcement as previously discussed will result in a comparatively short notation. This is:

D1211

where D12	represents the work section
1	represents item description
1	represents detailed item description.

The form of notation used is likely to necessitate a longer notation than the prima facie examination above suggests. For example, where the number of

D12 Reinforcement for in situ concrete

CLASSIFICATION TABLE				
1 Bar	1 Nominal size stated	t	1 Links	
			2 Straight 3 Curved	1 Horizontal, length 12 – 15 m 2 Horizontal, length 15 – 18 m and thereafter in 3 m stages 8 Vertical, length 6 – 9 m 9 Vertical, length 9 – 12 m and thereafter in 3 m stages
2 Spacers	1 Description	nr		
3 Fabric		m²		1 Bent 2 Wrapped
4 Self-centering				

D12

MEASUREMENT RULES	DEFINITION RULES	COVERAGE RULES	SPECIFICATION INFORMATION
The weight of bar reinforcement excludes tying wire, rolling margin, spacers and chairs less than 0.25 m high	Vertical bars include bars sloping $>30°$ Horizontal bars include bars sloping $\leq 30°$	Bar reinforcement is deemed to include hooks, tying wire, chairs and spacers which are at the Contractor's discretion	Material Details of tests Bending restrictions
Spacers are measured only where they are not at the Contractor's discretion			
The area measured for fabric excludes laps. Voids ≤ 1 m² in area are not deducted		Fabric reinforcement is deemed to include tying wire, notching around obstructions and spacers which are at the Contractor's discretion	Fabric type (BS 4483) Minimum laps
Voids ≤ 1 m² in area are not deducted		Self-centering reinforcement is deemed to include securing and notching around obstructions	Details of reinforcement Propping requirements

FIGURE 5.7: Example of the "Standard Method of Measurement of Building Works: Seventh Edition" (34)

bar sizes contained in the sample classification shown in Figure 5.7 exceeds nine, confusion will arise as to which level is being referred to. In order to distinguish between the different description levels, it will be necessary to make use of a fixed-field format for the presentation of the notation. An example of this is shown in Figure 5.8 and it will be seen that the length of the notation is considerably increased.

D	1	2	0	1	0	1				
1st	2nd		3rd		4th		5th		6th	

FIGURE 5.8: Example of fixed fields required for definition of a SMM 7 notation.

The problems associated with such notations were recognised by Gilchrist and Gaster (19). They stated that "One possible disadvantage of having fixed order and number of fields is that there may be excessive redundancy with some of the fields rarely carrying any information. In addition, errors of missing or inserted characters may have repercussions through whole sections of the (notation) unless other checks are incorporated" (Word in brackets inserted by the author to conform with the terminology used in this chapter).

One possible way of overcoming this problem would be to use alternative alphabetical and numerical levels as adopted in the INTEREST BUILD classification.

c. Level of detail

It is impossible to assess the overall effect of

SMM 7 at this stage of its development. However, the reduction in the number of bill items resulting from the use of SMM 7 as indicated in the consultative document (34) suggests that it will provide a classification in keeping with the requirements of a computer-aided estimating system.

d. Recognizability of notation

The detailed requirements of this criterion as described in 5.3.3 are satisfactorily complied with.

e. Description of Materials

SMM 7 does not meet with the requirements of this criterion in its present form. This could be overcome by tailoring the classification to accommodate broad categories of materials. No major problems should be experienced in doing this.

f. Accommodation of dimensions

The means of dealing with dimensions envisaged with SMM 7 is either to provide the user with allowable sizes pertaining to each item, or to allow the user to insert item dimensions on an ad hoc basis. This latter approach is likely to cause difficulties in identifying dimensions when SMM 7 is used as a means of classifying performance data and has already been described in 5.6.3.f. One method of overcoming this problem is to adopt the use of interactive subroutines, as described in 5.4.3.f.

g. Expandability of notation

No problems should be experienced in expanding the classification. However, this is likely to result in confusing the identification of different levels, as described in b. above.

h. Option for choice of method

No facility exists for catering for this requirement. However, use could be made of an extra level of description for this purpose. This may be done in a similar manner to that described for the INTEREST BUILD classification in 5.4.3.h.

5.10.5 Conclusions

SMM 7 potentially satisfies all the requirements of a classification for storing estimators' performance data. However, it must be noted that SMM 7 is in the early stages of development. The consultative document (34) includes rules of measurement for Concrete, Formwork, Reinforcement and Roof Covering work sections and the complete document is only programmed for completion at the end of 1983. It is then likely to be some time before SMM 7 becomes widely accepted as a basis for preparing bills of quantities. Until that time there is still a need for a classification facilitating the storage of estimators' performance data relevant to SMM 6. The INTEREST BUILD classification is thus likely to serve this purpose in the interim period.

CHAPTER 6

THE COMPILATION OF THE DATA LIBRARY

CHAPTER 6

THE COMPILATION OF THE DATA LIBRARY

6.1 GENERAL

This chapter deals with the compilation of the data library for use with the estimating system. The term "data library" is here used to encompass the FILE OF PERFORMANCE DATA and the COMPANY RESOURCE COST FILES described in Chapter 4.

The objectives of preparing the data library were:

- to provide realistic data for demonstration purposes

  Development of the estimating system required continual consultation with practising estimators. Experience gained during the development of INTEREST C.E. indicated that those consulted frequently focused their attention on minor items (such as over-optimistic output rate), and neglected conceptual problems. There was thus a need for a realistic data library for demonstration purposes.

and - to provide industry with an indication of the work load and development problems in setting up a data library.

  Consultation with assisting estimators indicated that none of them would be satisfied with a data library provided by a third party. This view was confirmed by Mason (35) in his investigation into "data bases" for the civil engineering field. It was therefore felt that information relating to the preparation of a data library would be useful to contractors.

A short description of the work undertaken is given below.

a. Performance data were assembled from various sources. These related to the various items of work described in the INTEREST BUILD classification (see Chapter 5).

b. Costs relating to the resources used in a. above were collected.

c. The resource data described above were then arranged in a comprehensible fashion in order to allow for their insertion into the computer system.

d. The above-mentioned data were then entered into the computer files.

6.2 THE RESOURCES AND ASSOCIATED PERFORMANCE DATA

6.2.1 Sources of Information

The following sources of information were considered. It was not possible to satisfy the requirements of the data library from one particular source. Reasons for this are given in 6.2.2.

a. Price Books

(i) Spon's Architects and Builders Price Book (36)

This publication is in its 104th edition. It includes information dealing with rates of wages, daywork, professional fees, building costs, market prices of materials, labour and material constants, rates for measured works, approximate estimating, comparative prices and a European section.

(ii) Laxtons Building Price Book (37)

This was the first reference book of its kind and is now in its 151st edition. It includes information dealing with market prices for materials, measured rates for both major and small works, rates of wages, daywork, professional fees, some price analysis and a section on trade names.

(iii) Griffiths Building Price Book (38)

This has now reached edition 26 and includes wage rates, market prices of materials and measured rates separately analysed under three headings. There is also an extensive section dealing with prices for spot items.

(iv) Hutchins' Priced Schedules (39)

These were first published in 1946 and include much of the information contained in other price books. Each item in the schedule includes the necessary man-hours which can be adjusted for changes in wage-rates and bonuses.

b. Monthly Cost Information Sheets

(i) Estimating Supplement (40)

This is published in its complete format once each month. It provides an extensive list of materials prices. Recent issues include a separate section dealing with rehabilitation work.

(ii) Cost File (41)

This document is prepared by the Building Cost Information Service and is published in its complete format on the first Friday of the month. Information regarding materials and measured rates are supplied. The "Cost File" includes a simplified market report giving an overall guide to the movement of prices. It also includes a visual index of the major building materials and several analyses for typical measured items.

(iii) QS Datafile (42)

This is published in weekly parts and a complete set is compiled every four weeks. Datafile is probably the easiest source to use and, as far as measured rates are concerned, the most comprehensive.

(iv) Cost Index (43)

It is published in two parts, prices of materials and measured rates alternating in every monthly issue.

c. Estimating Text Books

(i) "Estimating for Building and Civil Engineering Works" by S. Geddes (44)

This book is designed to provide an understanding of the considerations involved in the production of an estimate. Introductory chapters describe the different forms of contract, the individual elements of cost, the monitoring of site costs, estimating the total cost of construction, the site administrative staff, tendering, organising the work, bonus schemes, and the working cost of plant. Subsequent chapters deal with the detailed aspects of estimating costs for the major work sections of SMM 6.

Performance data contained in this text book are comprehensive.

(ii) "Estimating for Builders and Surveyors" by H. Enterkin and G. Reynolds (45)

This book has been written to cater primarily for the requirements of students. The authors further trust that "...it will also be of interest to small and medium-sized builders, to estimators and to practising surveyors generally". The aim of the book is to provide data by means of the detailed analysis of prices for those items commonly used in current building practice and to illustrate this by providing practical examples. It also shows methods of dealing with preliminaries, and illustrates the effect of cash flow in respect of building contracts. The volume of data assembled is not as comprehensive as that contained in the previous text.

d. Information from Contractors' Organisations

The CEP states that the "recorded cost of similar work encountered on previous projects will be a major source of the information used in estimating". The extent to which this actually happens in industry as a whole is not known (46). It was generally found that the assisting estimators referred to libraries of production rates in the compilation of their estimates. Whether or not these were based on actual site performances could not be established. It was noted that the content and detail of the libraries varied enormously.

6.2.2 The Choice of the Information Source

It was decided to formulate the data library from information supplied from contractors' organisations. This arose primarily out of a need to satisfy estimators and management during demonstrations of the system (see 6.1). Further reasons for this choice are given below:

a. Price Books

(i) Generally the information presented in the price books follows the old "Standard Method of

Measurement of Building Works: Fifth Edition" (25). In some cases it is possible to relate these outputs to the requirements of SMM 6, but there are areas in which direct comparisons are not possible, and in some cases no pertinent information is available at all.

(ii) It was found that the labour outputs and material constants varied between the different books. These factors naturally differ from company to company and from site to site. However, all the published information is based on the compiler's view of what constitutes "average" prices for "average" projects carried out under "average" conditions. (The word average in this context means typical, and should not be confused with the arithmetic mean) (47). The differences noted between the price books thus illustrates the difficulty in selecting any one source of data.

(iii) Not all books display output constants. This information is frequently disguised in the cost elements. In order to extract the required information, various calculations have to be performed. Allied to this is the ambiguity engendered by inadequate definition of how the cost element is built up. For example, an amount for Plant may not indicate the type and/or combination of plant items selected. Similarly an amount for Materials may not reflect the constituent materials and their respective wastage rates.

(iv) The estimators consulted regarded the use of price books as unsatisfactory (probably as a result of the reasons given above). They indicated that their only use for them was in checking unusual items. This proved to be the deciding factor in rejecting price books as a source of performance data. As stated above, it was feared that lack of credibility of the data library would hamper development of the system.

b. Monthly Cost Information Sheets

(i) Each of the sets of cost information are prepared by quantity surveyors for use by both the design and construction groups of industry. Ashworth (47) observed that "There is, however, an inherent bias towards private practice, probably on the assumption that contractors will calculate their own rates from first principles". This bias was instrumental in influencing estimators to reject the use of these sheets as the basis of a data library.

(ii) As with the price books, resource outputs were found to vary between different sources.

(iii) Output constants are difficult to identify, as information is generally presented in monetary terms.

(iv) Similar to the previous source of performance data discussed above, the decision not to use the monthly cost information sheets was largely influenced by estimators' disregard for them.

c. Estimating Text Books

The contents of these books is generally more comprehensive than that included in the references previously explored. However, the assisting estimators expressed several reservations, the principal ones being:

(i) that resources and methods used were, in many cases, different to those employed in their organisations; and

(ii) that the outputs suggested generally did not compare with those achieved in their organisations.

d. Information from Contractors' Organisations

It was decided to formulate the data base on information supplied directly by the assisting estimators. It was considered that this would best satisfy the objectives stated in 6.1. The estimators were therefore asked to provide item build-ups based on the classification described in the previous chapter. A manual was circulated to assist the estimators in this task, and is included in Appendix E.

6.2.3 The Collection of Information

Several problems were encountered with the method of data collection suggested above.

a. Estimators proved reluctant to divulge the required information. This appeared to be due to the fear that their performance data might get into competitors' hands.

b. Day to day work delayed the preparation of build-ups. As the job was undertaken on a voluntary basis, estimators were only able to work during slack periods, or in their spare time.

c. The information that was produced generally took the form of extracts from the company's library of estimating data. These, without exception, followed the Fifth Edition of the "Standard Method of Measurement of Building Works" (25) with the associated problems already noted in 6.2.2.a.(i).

d. Allied to c. above is the use made by estimators of weighting factors to cater for slightly different items or site conditions. Whilst this might produce suitable results in practice, the approach does not provide sufficient detail for the preparation of data for inclusion in the data library.

In order to overcome these problems a rigid approach could not be maintained. Estimators' data were manipulated to suit the INTEREST BUILD classification, and supplemented with data from the other sources listed in 6.2.1. This procedure proved to be satisfactory. However, it became apparent that the detail and volume of data required makes demands on contractors' organisations that few appear to be able to meet from their existing resources at the present time.

6.3 COLLECTION OF COST DATA

As described in 4.3.2, the estimating system provides a number of ways for dealing with resource costs. These are summarized below:

a. Resource cost "Firm"

This facility is designed to cater for resource costs which remain relatively stable. In such cases, current prices may be stored and updated periodically.

b. Resource cost "Awaiting Quotes"

The aim of this facility is to cater for fluctuating resource costs. Such resources are marked as "Awaiting Quotes", and have approximate, average or zero costs associated with them.

These costs are then revised according to the requirements of each tender.

In collecting cost data, these facilities were used in the following manner:

- all Labour and Plant resources were considered as "Firm";

- Materials and Sub-contract resources were generally considered as "Awaiting Quotes".

This method of dealing with resource costs was observed to reflect that used by the estimators assisting with the project. Consultation with other members of industry indicated that this practice was commonplace and it was therefore considered reasonable to adopt this approach in the collection of resource cost data.

Where appropriate, current costs were obtained from the latest editions of the monthly cost information sheets described in 6.2.1.b.

6.4 THE PRESENTATION OF THE DATA FOR ENTRY INTO THE COMPUTER FILES

The performance data collected were generally in the form of tables. An example of one such table for the fixing of steel reinforcement is given in Table 6.1. This illustrates the resource output rates (i.e. the output of the steelfixer) and weighting factors (i.e. the multipliers to be applied to the output rates depending upon the location of the work) as used by estimators when calculating the cost of a particular bill item.

An example of the manner in which these tables may be used is illustrated in Figure 6.1. This shows a unit rate build-up for an item of 6 mm mild steel reinforcement in foundations. Table 6.1 provides the output rate used for the steel fixing operation (i.e. 60 hrs/tonne x 90% = 54 hrs/tonne). Other tables (not illustrated) would be used to provide the output rates for the

STEEL FIXER OPERATIONS

Hours per Tonne (1000kg.)

Operation	6mm	8mm	10mm	12mm	16mm	20mm	25mm	32mm	40mm
Hand cut steel	9	8	7	6	5	4	-	-	-
Hand bend steel	33	26	21	17	14	11	-	-	-
Machine cut steel	7	6	5	4	4	3	3	2	2
Machine bend steel	26	20	16	14	10	8	6	5	4
Fix steel	60	42	32	25	18	14	13	11	9
Extra over for hoisting by hand n.e.									
15m	4	4	4	4	4	4	4	4	4
Over 15m	7	7	7	7	7	7	7	7	7

LOCATION	WEIGHTING FACTOR(%)
Foundations	90
Ground Slabs	75
Suspended Slabs	90
Walls	100
Steps	200
Staircases and Strings	150
Isolated Columns	150
Isolated Beams	150

TABLE 6.1: Example of estimators performance data tables for steel-fixing operations

off-loading of the reinforcement, and the amount of binding wire required. These output and usage rates are then used in conjunction with their associated costs to arrive at total costs for each resource. Totals for each cost code category (i.e. Labour, Plant and Materials) are also illustrated.

LABOUR						
Off-load Steel	0.5 hrs	@	£2.25/hr	=	£ 1.12	
Fix Steel	54 hrs	@	£3.00/hr	=	£162.00	
Banksman	0.25 hrs	@	£2.25/hr	=	£ 0.56	£163.69
PLANT						
Mobile Crane	0.25 hrs	@	£14.50/hr	=	£ 3.62	£ 3.62
MATERIAL						
6 mm m.s. reinforcement	1 tonne Wastage	@	£295.00/tne 2.5%	= =	£295.00 £ 7.38	
Binding Wire	18 kg	@	£1.50/kg	=	£ 27.00	£329.38
TOTAL UNIT RATE/TONNE				=		£496.69

FIGURE 6.1: Example of unit rate build-up for 6mm Mild Steel Reinforcement in Foundations

As can be seen from Figure 6.1, the estimator is not restricted in any way when building-up an item. He may use any resource or combination of resources that he chooses. It is in this respect that the estimating system imposes a certain discipline as build-ups can only be generated using resources contained in the RESOURCE COST FILES. Thus a certain amount of preliminary work was necessary before the performance data could be entered into the computer. This work involved scheduling and coding the resources to be used.

6.4.1 Scheduling and Coding of Resources

a. Scheduling

This was done by inspecting the tables of performance data described above. Resources were then scheduled in their appropriate cost code category.

b. Coding

Identification of resources is by means of a code (henceforth referred to as a "resource code"). It was thus necessary to allocate codes to the resources listed above. The system adopted for the coding of resources is described briefly below. Detailed consideration of this aspect is given in Appendix B.

It was decided to use as simple a system as possible. This was in order to satisfy the following considerations:-

- Codes to be concise in length

  The preference of prospective users for short codes has already been established in 5.3.2.

- Ad hoc creation of codes

  Due to the variety of materials encountered in different building contracts, a large proportion of these resources need to be created on an ad hoc basis. A simple coding system is thus essential to ease entry of these resources.

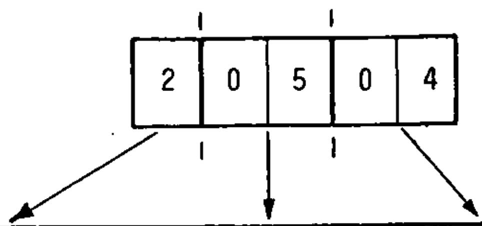
Table 6.2 illustrates the coding system. It will be seen that the codes are alphanumeric in construction, with the alphabetical prefix denoting the cost code category. The numeric part is an arbitrary number in the specified range corresponding to the required resource. (This range may be tailored to meet specific users' requirements - see Appendix B).

An ancillary consideration supporting the use of this system is the recognizability of the code (as defined in 5.3.3) engendered by the use of the alphabetical prefix. Furthermore there is evidence to suggest that human beings can remember sets of characters containing a mixture of letters and figures better than sets with the same amount of information expressed purely as letters or numbers (26).

CATEGORY	SINGLE RESOURCE	GANG RESOURCE
Labour	L1 to L1999	LG1 to LG1999
Plant	P1 to P1999	PG1 to PG1999
Auxiliary Plant	A1 to A1999	AG1 to AG1999
Materials	M1 to M6999	MG1 to MG4999
Resource Groups	-	XG1 to XG4999

TABLE 6.2: Resource Codes used with the INTEREST BUILD system.

Many different methods of resource coding exist. One such system is that proposed by Mason (35) in his investigation into "data bases" for the civil engineering industry. His codes make use of fixed fields, and are illustrated in Figure 6.2. This method was not adopted as it was felt that it did not meet with the "short" and "ad hoc" requirements of resource coding described above.



FIELD	FIRST	SECOND	THIRD
FIELD SIZE	1 to 5	00 to 99	00 to 99
RESOURCE IDENTIFI-CATION	1 = LABOUR 2 = PLANT 3 = MATERIALS 4 = AUXILIARY MATERIALS 5 = SUB-CONTRACTOR	Broad Grouping of resource type	Specific resource type
ABOVE-MENTIONED EXAMPLE	PLANT	CONCRETE MIXERS	600/400 ELECTRIC

FIGURE 6.2: Example of Fixed Field Resource Coding

6.4.2 The Presentation of Performance Data for Entry into the Computer System

This section deals with transforming the performance data, assembled as described above, into a form suitable to allow its entry into the computer system. The input mechanism used for this purpose dictates the manner in which the data should be presented. The mechanisms in commercial use are discussed in 6.5. It was decided to enter all data via a VDU due to the advantages of this method of input as described in 6.5.1. A detailed description of the facilities enabling this to be done are given in Appendix B.

The main aspects involved in the presentation of data for entry into the computer system are the identification of the appropriate notation, and the subsequent presentation of the data.

a. Identification of the required notation

In order to facilitate the storage and retrieval of WORK GROUPS it is necessary to identify each WORK GROUP by means of a notation. The notations used were obtained from the INTEREST BUILD classification tables. As described in 5.4.3.h this classification facilitates the addition of an extra level of description to cater for the method of construction employed. This level is not provided with the classification (see Figure 5.1) and it was therefore necessary to include descriptions relating to different construction methods where applicable. The manner in which this was done is illustrated in Figure 6.3. This shows the additional level in the extreme right hand column.

It should be noted that the notation obtained from this last "method related" level is separated from the main notation by means of a full stop. (Full details relating to the use of the INTEREST BUILD classification are given in Appendix C). For example, consider the item of reinforcement shown in Figure 6.1. Reference to Figure 6.3 will show that, if the project under investigation is a medium sized refurbishment contract, the correct notation would be GA1.4.

b. The performance data

Having identified the required notation it was then necessary to present the build-ups in a manner suitable to allow their entry into the computer system.

In order to appreciate the requirements of a document supplying the performance data, it is necessary to consider the prompts provided by the estimating system which allow such entry to occur. For each WORK GROUP the following information is requested:

G. REINFORCE-MENT	BARS	(TONNE)	STRAIGHT AND BENT BARS		*NEW PROJECTS.*
	1. MILD STEEL DIAMETER 6 MM	A. IN FOUNDATIONS	A. HORIZONTAL 12.00 TO 15.00 M		0. LARGE
	2. DITTO 8 MM	B. IN GROUND SLABS	B. DITTO 15.00 TO 18.00 M		1. MEDIUM
	3. DITTO 10 MM	C. IN SUSPENDED SLABS	C.		2. SMALL.
	4. DITTO 12 MM	D. IN WALLS	D.		
	5. DITTO 14 MM	E. IN CASING TO STEEL COLUMNS	E. VERTICAL 5.00 TO 8.00 M		*REFURBISHMENT PROJECTS.*
	6. DITTO 16 MM	F. IN CASING TO STEEL BEAMS	F. DITTO 8.00 TO 11.00 M		
	7. DITTO 18 MM	G. IN CASING TO STEEL COLUMNS AND BEAMS	G.		
	8. DITTO 20 MM		H.		
	9. DITTO 22 MM	H. IN STEPS	CURVED BARS		3. LARGE
	10. DITTO 24 MM	I. IN STAIRCASES AND STRINGS	I. HORIZONTAL 12.00 TO 15.00 M		4. MEDIUM
	11. DITTO 25 MM	J. IN STAIRCASES AND STRINGS AND ASSOCIATED LANDINGS	J.		5. SMALL
	12. DITTO 26 MM				
	13. DITTO 28 MM	K. IN STEPS, STAIRCASES, STRINGS AND ASSOCIATED LANDINGS	K. VERTICAL 5.00 TO 8.00 M		
	14. DITTO 32 MM		L.		
	15. DITTO 40 MM	L. IN TOPS OF DORMERS			
	16. DITTO 50 MM	M. IN TOPS AND CHEEKS OF DORMERS	M. LINKS, STIRRUPS, BINDERS AND SPECIAL SPACERS		
	17.	N.IN MACHINE AND SUNDRY BASES			
	18. HIGH YIELD DIAMETER 6MM	O. IN ISOLATED COLUMNS			
	19. DITTO 8 MM	P. IN ISOLATED BEAMS AND LINTELS			
	20. DITTO 10 MM	Q. IN ISOLATED COLUMNS, BEAMS AND LINTELS			
	21. DITTO 12 MM				
	22. DITTO 14 MM				
	23. DITTO 16 MM				
	24. DITTO 18 MM				
	25. DITTO 20 MM				
	26. DITTO 22 MM				
	27. DITTO 24 MM				
	28. DITTO 25 MM				
	29. DITTO 26 MM				
	30. DITTO 28 MM				
	31. DITTO 32 MM				
	32. DITTO 40 MM				
	33. DITTO 50 MM				
	34.				

FIGURE 6.3: Example of "INTEREST BUILD Classification" showing method-related description level.

- the WORK GROUP CODE;
- the WORK GROUP description;
- the units of measurement;
- the RESOURCE CODE and associated usage and wastage rates.

An example of these prompts is shown in Figure 6.4. It should be noted that all information entered by the VDU operator is underlined. All other print out represents the prompts supplied by the estimating system.

```
Work Group Code (ABORT to return to Main Menu) ? G1A.1

Description ? 6MM MILD STEEL REINFORCEMENT IN FOUNDATIONS

Units of Measurement ? TNE

Resource Code (END to finish) ? L6

                        Description - LABOURER (UNLOAD)
                        Cost        -        2.250 $/HR     (used)
OK ? Y

Description Extension ?

Usage Rate ? .5

Resource Code (END to finish) ? L31

                        Description - STEELFIXER
                        Cost        -        3.000 $/HR     (used)
OK ? Y

Description Extension ?

Usage Rate ? 54

Resource Code (END to finish) ? L46

                        Description - BANKSMAN
                        Cost        -        2.250 $/HR     (used)
OK ? Y

Description Extension ?

Usage Rate ? .25

Resource Code (END to finish) ?
```

FIGURE 6.4: Example of prompts for the entry of WORK GROUPS

The most important consideration with these documents is that the data should be presented in a clear and unambiguous way so as to ensure accurate entry into the system (48). The manner in which the data were presented is shown in Figure 6.5. This example relates to the items of reinforcement shown in Figure 6.1, and presupposes that the constituent resources have already been entered in the relevant RESOURCE COST FILES.

6.5 CURRENT METHODS OF ENTERING DATA INTO COMPUTER SYSTEMS

There are several methods of entering data into a computer system. These include punched cards, paper tape and on-line data capture. Due to the advantages of on-line data capture, it was decided to use this method for creating the data library. The various methods of data input are described below.

6.5.1 On-Line Data Capture

a. Description

The on-line capture of data entails data being transmitted directly to the computer with no interposed medium involved. This means that a more rapid output response is achieved following the data's input. On-line input contrasts with batch processing (i.e. those methods described below) in that the latter entails accumulating a considerable amount of data before input to the computer, whereas the former tends towards inputting one transaction at a time. Typically with on-line input, the user operates a keyboard constituting part of a terminal linked to a computer, the computer's response being transmitted back to the terminal (48).

WORK GROUP Code

G	1	A	.	0									

WORK GROUP Description

6MM MILD STEEL REINFORCEMENT IN FOUNDATI
ONS

Units of measurement

T	N	E	

Resource Code	Resource Description Extension	Usage	Wastage %
L6		0.5	
L31		54.0	
L46		0.25	
P5	HOIST	0.25	
M1		1.0	2.5
M34		18.0	

FIGURE 6.5: Example of the presentation of a WORK GROUP corresponding to the build-up shown in Figure 6.1.

b. Verification of Data

This may be done whilst entering the data or by checking a print out of the relevant data.

c. Advantages (48)

- No intervening media is involved, so minimizing the time taken and the labour cost of input.

- Data captured from several sources is immediately available for processing with consequent earlier output of results.

- Certain types of input error have a good chance of being detected immediately, and are therefore corrected sooner. Verification of input data is consequently less necessary.

- The input operator can be guided by the computer as regards the format of the data, its completeness, and the choice of optional data items to be input.

d. Disadvantages (48)

- There is less opportunity for verifying all the input data keyed in from source documents.

- Continuous and prolonged use of the VDU may cause fatigue.

6.5.2 Punched Cards

Input by this method involves the punching of cards to enable the computer to recognise the required information. Verification of the information is normally done by re-punching the cards on a punch/verifier machine. Since both the above operations are labour intensive, and thus expensive, it is essential that they are performed as efficiently as possible (48).

6.5.3 Paper Tape

This method of input is similar to that of punched cards in that it enables the computer to accept information punched on paper tape. Verification is also effected by the repunching of information.

No recommendations are given as to the most satisfactory method of entering the data. The choice will depend mainly upon the hardware on which the estimating system is mounted.

6.6 THE ENTRY OF DATA INTO THE COMPUTER SYSTEM

This section presents data relating to the time taken in keying in data necessary for the creation of the data library. These times are pertinent to those considering the use of the system.

6.6.1 Entry of resources

This aspect was undertaken by the author. 171 SINGLE and 39 GANG resources were keyed into the system to facilitate the subsequent entry of the WORK GROUPS by a keyboard operator (see 6.6.2 below). The total elapsed time taken to achieve this task was approximately eight hours. In analysing this time, the following points should be taken into account:

a. The author had limited expertise in the operation of a VDU keyboard.

b. The entry of data was made to the University's main frame PRIME computer. As this machine is available to all University staff and students, response times were, on occasions, longer than would be experienced with a microcomputer installation.

c. Entry of data took place during the development of the estimating programs. Response times have been considerably accelerated with later versions of the software.

6.6.2 Entry of WORK GROUPS

Entry of this data was carried out by a keyboard operator. In total 1395 WORK GROUPS were entered into the system over a period of approximately four months. This input took place intermittently with a total of 92 hours physically being spent in operating the VDU. The average time taken to enter a WORK GROUP is thus 3.96 minutes. In examining this elapsed time, cognizance should be taken of points b. and c. discussed in 6.6.1, as these are also relevant to this operation. In addition it should be noted that the operator entering the data also had limited experience in the operation of a VDU keyboard. She also had no prior knowledge of the estimating system, and it was thus necessary to first train her in the use of the system.

CHAPTER 7

DEMONSTRATIONS, TESTING AND ASSESSMENT OF THE SYSTEM

CHAPTER 7

DEMONSTRATIONS, TESTING AND ASSESSMENT OF THE SYSTEM

7.1 GENERAL

The work in this chapter describes demonstrations of the system given to members of the building industry, testing of the system during program development and assessments of the system made by practising estimators.

7.1.1 Demonstrations of the system

The performance data collected as described in Chapter 6 enabled demonstrations of the system to be given to representatives of industry including directors, chief estimators, estimators, buyers, quantity surveyors, planners and site managers. These demonstrations took several forms, the principal ones being:

- in-house demonstrations to several estimators followed by discussions;

- demonstrations to between one and eight estimators from individual building organisations at Loughborough University of Technology followed by discussions;

- demonstrations to estimators, chief estimators and directors followed by assessment interviews;

- demonstrations to committees of the Chartered Institute of Building followed by discussion; and

- a demonstration at a seminar followed by questions.

These are all described in 7.2.

7.1.2 Testing of the system

The performance data also facilitated testing of the system during development of the software. This and subsequent testing by repricing a completed bill of quantities are described in 7.3.

7.1.3 Assessment of the system

In order to establish whether the objectives stated in Chapter 1 had been met, it was necessary to carry out an assessment of the system. This took place in two stages. The first involved interviews with estimators from six building contractors and a direct labour organisation to whom the system had been demonstrated. These interviews are described in 7.4. The second stage took the form of long term field trials. These are continuing at the time of writing (August 1981) under the supervision of the author and are described in 7.5.

7.2 DEMONSTRATIONS OF THE SYSTEM

In order to stimulate comments from industry, numerous demonstrations of the system were given. In all, representatives of forty-seven different organisations attended demonstrations. These were drawn from all sectors of the building industry including small, medium and large contractors, as well as specialist sub-contractors and direct labour organisations. Details of the demonstrations are given in Table 7.1.

Of these forty seven organisations, representatives of eight returned on at least one other occasion and six, including those assisting with the project, attended several demonstrations during the development of the software.

The demonstrations served to provoke numerous comments and suggestions. Some of these resulted in minor modifications to the system. However, not all suggestions were accommodated. This was due to the fact that:

TYPE OF DEMONSTRATION	NUMBER OF DEMONSTRATIONS GIVEN	NUMBER OF ORGANISATIONS REPRESENTED	APPROXIMATE NUMBER OF ESTIMATORS PRESENT	APPROXIMATE NUMBER OF PERSONS PRESENT
In-house demonstrations	2	2	17	30
Individual demonstrations at L.U.T.	31	18	29	37
Individual demonstrations at L.U.T. followed by interviews	7	7	7	12
CIOB Committees	2	-	-	32
Seminars	1	20	55	110

TABLE 7.1: Demonstration of INTEREST BUILD given between 27th February 1981 and 30th August 1981

a. certain proposals were observed to be limited to the organisation in question

The estimating methods followed by different construction organisations were found to follow the same basic procedures. This was observed by the author and by Geary (49). However, certain suggestions reflected the peculiarities in approach of that organisation (or estimator). This aspect is not confined to this project and was observed by both Barnes (9) and Mudd (6). It was therefore considered inappropriate to incorporate features that would not be of use to the majority of building estimators.

b. certain proposals involved work outside the scope of this project

Various suggestions involved the development of features which were outside the scope of the project. These were generally proposed by construction personnel other than estimators (e.g. building quantity surveyors, buyers, planners, site managers) who saw the potential benefits that could accrue by further developments of the system.

7.3 TESTING OF THE SYSTEM

Extensive testing of the system took place. This work may be considered as having two aspects. The first involved testing of the system during its development, and the second, a simulation of the preparation of an estimate.

7.3.1 Development testing

This involved the testing of the system by the computer programmers to ensure the robust operation of the software. The author subsequently undertook detailed testing of sections of the software as and when they were completed by the programmers. As such, work in this area continued throughout the development of the system.

7.3.2 Simulation of the preparation of an estimate

This was the most extensive test carried out. It involved the repricing of an estimate already completed by one of the assisting estimators. The objectives of undertaking this test were:

- to test the software with a large number of bill items;

- to determine the time required for the entry of the basic bill of quantities information;

- to provide some indication of the time taken to produce an estimate; and

- to supply the assisting estimator with reports to enable him to gauge the full extent of the information provided.

The bill of quantities provided was for the construction of a prison which had been estimated to have a direct cost of £215 248.12. The number of items included in the bill was 1297.

a. Description of work undertaken

It was not possible to make use of the performance data described in Chapter 6 in the preparation of the estimate. This was due to the fact that the data and the estimating system were installed on different computers at the time of testing. Use therefore had to be made of other estimating facilities for the preparation of the item costs. An analysis of the methods used is shown in Table 7.2.

ESTIMATING METHOD	NUMBER OF ITEMS	PERCENTAGE OF TOTAL
Unknown	13	1.0
Spot	453	34.9
Sub-contractors	620	47.8
Included	176	13.6
Items	16	1.2
P.C. Sub-contractors	3	0.2
P.C. Suppliers	1	0.1
Provisional Sums	5	0.4
Attendances	6	0.5
Profit on P.C. Sums	4	0.3

TABLE 7.2: Analysis of estimating methods used in preparation of test estimate.

b. Results of the test

The test highlighted certain programming difficulties relating to the manner in which the computer system handled large volumes of data. These were rectified by the programmers.

The entry of the basic bill of quantities information into the system took nine hours. In examining this elapsed time it should be taken into account that those entering the data had limited experience both in the use of the system and in the operation of VDU keyboards.

Entry of cost data relating to each bill item took 14 hours. This operation was carried out by persons familiar with the system and with some typing skills.

Regarding the reports produced by the system, the assisting estimator found these to be generally satisfactory. However minor alterations to the format of the bill listing and resource reconciliation were noted as being desirable. These are to be included in future revisions of the software.

7.4 INTERVIEWS WITH ESTIMATORS

Seven estimators to whom the system had been demonstrated in detail were interviewed between mid-June 1981 and early August 1981. Particulars of the organisations represented are given in Table 7.3. Two of those interviewed were from organisations who had assisted with the project from its inception, whilst the others were from other building firms.

7.4.1 The interviews

In each interview, the estimators were asked about certain aspects of the estimating system. These aspects as well as the estimators' viewpoints are described below.

a. THE SYSTEM FACILITATES THE STORAGE OF COMPANY PERFORMANCE DATA AND COMPANY RESOURCE COSTS. THESE MAY BE VARIED ACCORDING TO THE REQUIREMENTS OF EACH TENDER, BUT THE COMPANY DATA REMAINS UNCHANGED. IS THIS A DESIRABLE FEATURE?

CONTRACTOR	DESCRIPTION OF CONTRACTOR	APPROX. ANNUAL TURNOVER
A	Medium sized contractor located in Newcastle area	£12m
B	Small local contractor	£ 7m
C	Medium sized national contractor	£18m
D	Direct labour organisation based in Central Midlands	£26m
E	Medium sized contractor located in Newcastle area	£16m
F	Small London based contractor	£ 3.5m
G	Small London based contractor	£ 5m

TABLE 7.3: Organisations whose representatives attended assessment interviews of INTEREST BUILD.

All estimators agreed that this was the correct approach to be adopted. Estimators A, B and F said that this was the only way in which an estimating system could be effectively structured.

b. THE SYSTEM ENABLES BUILD-UPS OF PERFORMANCE DATA TO BE STORED IN THE SYSTEM AND SUBSEQUENTLY USED TO ESTIMATE THE COST OF SIMILAR ITEMS ENCOUNTERED IN BILLS OF QUANTITIES. IS THIS A REQUIREMENT OF AN ESTIMATING SYSTEM?

All seven estimators agreed that this was a desirable facility and one that would be used in practice. This approach was generally observed to reflect traditional methods.

c. THE SYSTEM MAKES USE OF NOTATIONS OBTAINED FROM A CLASSIFICATION IN ORDER TO EFFECT A LINK BETWEEN THE COMPANY PERFORMANCE DATA AND THE ITEMS FOUND IN BILLS OF QUANTITIES. IS THIS AN EFFICIENT AND USABLE APPROACH?

Six of the estimators consulted approved of this method. The solution proposed was viewed as the only way of enabling performance data to be stored in the system's files. However Estimator C was not altogether satisfied and preferred to view the use of such notations as "...an interesting solution". Whilst he appreciated the benefits of using performance data as described in b. above, he could not suggest an alternative approach to enable this data to be used effectively.

d. IS IT POSSIBLE FOR ESTIMATORS TO ADAPT TO THE USE OF NOTATIONS AS A MEANS OF IDENTIFYING AND RETRIEVING

DATA FROM AN ESTIMATING SYSTEM?

All consulted agreed that it would be possible to adapt to the use of the proposed notations. It was generally felt that it would only be a matter of time before estimators familiarized themselves with the notations in more common use, and would thus not have to consult the classification with as much regularity.

Estimators E and G expressed the view that the presentation of the classification was very important. Estimator E suggested that different work sections be printed on different coloured paper and that various sizes of type-face be used as a further aid to the identification of notations.

e. FACILITIES ARE PROVIDED WHICH ENABLE THE BASIC INFORMATION CONTAINED IN THE BILL OF QUANTITIES TO BE ENTERED INTO THE SYSTEM BY A PERSON OTHER THAN THE ESTIMATOR. IS THIS A DESIRABLE FEATURE?

All estimators indicated that this was the correct approach to the entry of this large volume of data.

f. ARE THE FACILITIES PROVIDED FOR COPING WITH FLUCTUATING MATERIALS PRICES SATISFACTORY?

All estimators approved of these facilities. Estimators A, B and G commented specifically that the "Awaiting Quotes" facility would be extremely useful in the updating of materials costs.

g. WILL THE USE OF THE SYSTEM RESULT IN ANY CHANGE IN THE WAY MATERIALS QUOTATIONS ARE OBTAINED?

Estimators B, C, D and F indicated that the use of the system would not result in any significant change in the way they obtained materials quotations. Estimator D noted further that the reports showing the materials for which quotations were being awaited would enable the chief estimator to monitor progress in the preparation of the estimate.

Estimators A, E and G foresaw changes to the manner in which their organisations would obtain materials quotations. These were unanimously viewed as being improvements on traditional practice. The main suggestion was that the system would enable standard materials costs to be stored and updated periodically. Control of this aspect could be delegated to a buyer resulting in a reduction of the work and cost of sending out of enquiries.

h. THE SYSTEM ENABLES RESOURCES TO BE STORED AS GANGS. IS THIS USEFUL?

All estimators agreed that this was a necessary feature. The facility was generally seen as reflecting traditional practice.

i. ARE THE FACILITIES PROVIDED FOR UNIT, OPERATIONAL AND SPOT RATE CALCULATIONS SATISFACTORY?

All estimators indicated that these facilities met with their requirements. It was noted that unit rate estimating was the approach most frequently adopted by the estimators. Operational and spot rates were observed to be used far less often.

j. HAVING COMPLETED A BUILD-UP FOR AN ITEM, IT CAN BE RETRIEVED AT ANY STAGE AND REWORKED. WHERE THE TENDER HAS BEEN SUCCESSFUL IT IS ALSO POSSIBLE TO VIEW THE DETAILED BUILD-UP AT ANY STAGE DURING CONSTRUCTION. IS THIS USEFUL?

This aspect was seen by all to be extremely useful both during the preparation of the estimate and tender, and also in post-tender applications. Furthermore Estimators B and G noted that the facility would be of great assistance in providing detailed information to enable the pricing of variations. It was also seen by Estimators E and F as an aid to chief estimators in assessing the work of their staff.

k. ARE THE FACILITIES PROVIDED FOR ADJUSTMENTS AND THE ADDITION OF MARK-UPS AT THE ADJUDICATION STAGE SATISFACTORY?

Estimators A, B, C, E and F stated that the mark-up facilities would meet their requirements. However, it appeared that the facilities provided are in excess of those currently being used by these estimators. They generally felt that the options available would enable them to adopt a more sophisticated approach to tender adjudication.

Estimator D indicated that the facilities would simplify his organisation's present requirements whilst Estimator G stated that the mark-up facilities would not be used at all. The calculation of mark-ups in this latter organisation was described as taking the form of lump sum additions to the estimate figures.

l. ARE THE FACILITIES PROVIDED FOR THE IDENTIFICATION OF SUB-CONTRACT ITEMS AND THE INSERTION OF THEIR COSTS SATISFACTORY?

These facilities were unanimously seen as being suitable.

m. WHAT ARE THE STRENGTHS OF THE SYSTEM?

The following points were noted in this connection:

- Estimators A and G saw the ability to start pricing a contract without having to wait for materials and sub-contract quotes as a "major advantage" of the system. They foresaw that this would allow the preparation of estimates to be planned, thus resulting in a more evenly distributed estimating work-load;

- the ability to easily update resources marked as "Awaiting Quotes" combined with the detailed information produced in the reports was viewed by Estimator G as enabling various methods of construction to be simulated. This was seen as being extremely advantageous, as the tendering time generally allowed does not permit such analyses to be completed by manual estimating methods;

- Estimator F noted that the system was in the total control of the estimator and that he was not forced to accept any aspect with which he did not agree. This was viewed as being advantageous as the estimator's judgement and expertise were thus used throughout the preparation of the estimate;

- the system was seen by Estimator D as resulting in a standardization in the manner in which estimates were prepared;

- Estimator D also noted that the clerical aspects of the estimator's work load should be reduced thus enabling the estimator to devote a greater proportion of his time to analysing the estimate; and

- the incidence of arithmetical errors (both in the calculation of the item rates and in the extension and totalling of these rates) was seen as being reduced. This aspect was noted by Estimator D.

n. WHAT ARE THE UNSATISFACTORY ASPECTS OF THE SYSTEM?

In this connection the following points were noted:

- Estimator D expressed concern about the possibility of health hazards likely to be experienced due to using VDUs;

- Estimators D and G felt that the system would not result in estimates being produced faster than by manual methods. However, both stated that they felt the advantages to be gained by operating the system were sufficient to warrant its use;

- the task of identifying notations for the items contained in the bill of quantities caused some concern on the part of Estimator G. He felt that this aspect was "...the chore of the system"; and

- Estimators A and D expressed the need for additional SMM 6 work sections to be included in the INTEREST BUILD classification.

7.4.2 Analysis of Interviews

From the above it will be seen that the estimating system was favourably received by those interviewed. The system was generally viewed as reflecting traditional estimating practice (an objective which was regarded as essential to its success) and no criticism was made of the approach or methodology adopted. Where changes to normal practice were envisaged (e.g. in the obtaining of quotations for materials as described in h. above), these were seen as enhancing traditional procedures. However, certain aspects were described as unsatisfactory. These are examined below.

a. Health hazards of VDUs

The interactive features of the estimating system necessitate the use of VDUs. However there is currently some concern about the possible health hazards resulting from the use of such computer terminals. Research in this field so far has "been highly subjective and....so unrealistic and distorted as to be unworthy of consideration" (50). It is noteworthy that in the serious studies which have been undertaken into the health aspects of the use of VDUs, no evidence has been found to suggest that they are in anyway harmful (50). Authorities emphasise the ergonomic aspects relating to the use of computers and Pearce (51) states that research into this area "...has hardly begun". In view of the lack of conclusive information available in this field, it has been considered as being outside the scope of this thesis.

b. Speed of use

Effective use of the system requires that extensive use is made of stored performance data in producing estimates for the items found in bills of quantities. In cases where no data is available, use will have to be made of the UNKNOWN, SPOT and OPERATIONAL facilities described in 4.3.3.b. These slow down the production of the estimate and it was the demonstration of these facilities which caused concern to Estimators C and G.

The compilation of a comprehensive data library is fundamental to the efficient use of the system and is an aspect which must be recognised by prospective users of the system.

c. Identification of notations for the bill items

The estimator who expressed fears relating to this aspect did so because he saw it as an extra task to be performed. However, the benefits resulting from identifying notations for bill items must be assessed against the effort involved in this task. It is suggested that frequent use of the classification will result in users familiarizing themselves with the more commonly recurring notations.

This assumption is supported by Gilchrist and Gaster (19) who state in their investigation into coding and data co-ordination for the construction industry that "...many organisations will find it useful to make one member of staff their main coding link (just as they find it useful to have an information officer or librarian)".

d. Expansion of INTEREST BUILD classification

In accordance with the stated objectives of the research project, only those work sections commonly undertaken by labour directly employed by the contractor were included in the INTEREST BUILD classification. However, certain of the estimators interviewed were employed by organisations who undertook work normally regarded as the province of specialist sub-contractors such as plumbing, plastering and painting and decorating. They expressed the requirement for classification tables to be prepared which reflect work in these areas. To this end additional tables are being prepared, and will be added to the classification at a later date.

7.5 FIELD TRIALS

At the time of writing long term field trials were being undertaken. However, due to their anticipated duration this aspect was deemed to be outside the scope of this thesis. A brief report of the state of the trials as at mid-August 1981 is given below.

7.5.1 Organisation undertaking field trial

The field trial is being undertaken in the estimating department of a direct labour organisation (henceforth referred to as the DLO) situated in the Central Midlands. This organisation employs some 210 tradesmen and has an annual turnover of approximately £26m.

The DLO were supplied with a GENESYS DESIGN CENTRE mini-computer on 5th August 1981. In terms of an agreement reached between the DLO and Genesys Ltd. (which is the organisation appointed by the NRDC for the marketing and selling of the INTEREST BUILD estimating system) the period of the field trial is for six months. During this period it is intended that a comprehensive data library be developed and used to produce estimates and tenders with the estimating system.

7.5.2 Development of data library

As described in 6.4 the two main aspects involved in this task are the scheduling and coding of resources and the collection of performance data. In addition the work undertaken by the DLO involves trades not catered for by the INTEREST BUILD classification. Additional sections of the classification are thus also required. These aspects are discussed below.

a. The scheduling and coding of resources

In order to make the most effective use of the system during the loan period, extensive preparatory work was undertaken prior to the delivery of the computer. One aspect that received such consideration was the scheduling and coding of the resources to be used in the compilation of the data library. At the time of writing this task has already been substantially completed and work is at present progressing in the entry of this data into the computer system.

b. Collection of performance data

The DLO have extensive performance data at their disposal. A work study department has been in operation for several years, and the data so collected included in the organisation's library of performance constants. Whilst the problems of such data noted in 6.2.3.c. still apply, the volume and detail of the data available is in excess of that contained in the sources examined in 6.2.1. It was for this reason that an agreement between the DLO, Genesys and Loughborough University of Technology was drawn up as it was seen as advantageous to all parties to demonstrate the use of the system in a working environment.

The presentation of this data in a form suitable to facilitate its entry into the computer system (as described in 6.4.2) is currently in progress. Entry of this data into the system is scheduled to start by the end of August 1981.

c. Extensions to the INTEREST BUILD classification

Development of further classification tables relating to work done by the DLO is currently being undertaken by the author in conjunction with a DLO estimator. It is envisaged that all work sections included in SMM 6 will eventually be catered for with the exception of Piling and Diaphragm Walling, Masonry, Asphalt Work, Structural Steelwork and Electrical Installations.

7.5.3 The production of estimates

The DLO intend to produce estimates using the INTEREST BUILD estimating system. It is envisaged that initially only those work sections for which performance data are stored in the data library will be priced using the system. As the field trial progresses, performance data relevant to more work sections will become available and when this happens, ensuing estimates will be able to make use of these data. Eventually it is hoped that a complete estimate and tender will be produced using the system.

CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 SUMMARY

8.1.1 Objective of the Project

The objective of the research reported in this thesis was to develop a computer-aided estimating system to meet the specific requirements of the British building industry. The principal aspects of work undertaken involved the development of a specification for the system, the development of a classification to facilitate the storage of estimators' performance data, the testing and demonstration of the system, and an assessment of the system. The contributions of the author, the computer programmers and practising estimators to the project are illustrated in Figure 1.1.

8.1.2 Current Estimating Practice

A study of current estimating procedure was undertaken. This involved discussions with practising estimators and reference to the CEP and other authoritative sources. A flow chart showing the estimating procedure is presented in Figure 2.1.

8.1.3 Computer Applications

Computer applications for building contractors were examined to provide background to the use of computers as estimating aids. This revealed that such systems could be used in the fields of cost control, planning, cash flow forecasting, materials ordering, valuations and sub-contract accounts, payroll and accounts, and integrated management systems as well as in the field of estimating. Table 3.1 shows those computer programs currently available to perform these tasks.

The existing computer aids for estimating were investigated. Progress in this application was found to be dependant upon the evolution of computer technology. Early batch systems had proved unsuccessful, whereas interactive systems mounted on mainframe computers had gained more acceptance. Table 3.2 lists the programs commercially available in these categories. The use of microcomputers was observed to have already made an impact as evidenced by the development of systems to cater for certain estimating tasks as described in section 3.3.3. Further developments in the use of microcomputers and interactive programming techniques for computer-aided estimating form the subject of this thesis. This is reflected in the name "INTEREST BUILD" (INTERactive ESTimating for BUILDers).

8.1.4 Development of the System Specification

A specification of the detailed requirements of the estimating system was prepared. This was discussed on numerous occasions with several practising estimators and particularly with four who assisted with the development of the project in all its stages. These discussions produced modifications and revisions to the specification, after which further discussions took place. The resulting specification contained all the required features of the estimating system, and provided the basis for subsequent work by the computer programmers. The main features of the system are:

- the storage of performance data on the computer system's files;

- the utilization of this data to estimate the cost of similar items found in bills of quantities;

- the pricing of items where no relevant performance data are held on file;
- the updating of volatile resource costs;
- the automatic performance of all necessary arithmetical calculations;
- the retrieval of item build-ups in their entirety; and
- the addition of tender mark-ups.

A detailed description of all the facilities provided by the system may be found in the User Manual (see Appendix B).

8.1.5 The Classification of Performance Data

A fundamental feature of the system was the use made of performance data stored in the computer's files to estimate the cost of similar items found in bills of quantities, as described in 3.6.1.b., 4.3.1.b. and 5.2. This required a classification to enable the orderly storage and retrieval of this data. Before developing a classification specifically for the INTEREST BUILD system, existing classifications were examined. To evaluate these classifications, a set of criteria were established as described in 5.3. These criteria were:

- unique identification;
- length of notation;
- recognizability of notation;
- level of detail;

- descriptions of materials;
- accommodation of dimensions;
- expandability of notation; and
- option for choice of method.

The five commercially available classifications assessed against the requirements of these criteria were:

- "The Standard Method of Measurement of Building Works: Sixth Edition" (4);
- "Standard Phraseology for Bills of Quantities" (29);
- "Standard Library of Descriptions of Building Works" (31);
- "Price's Standard Method of Billing for SMM 6" (32);
- "Enviro B.Q. System" (33).

Sections 5.5 to 5.9 compare these classifications against the established criteria and explain why none of these proved suitable.

It was therefore necessary to develop a new classification, the "INTEREST BUILD Classification". This classification enables estimators to identify notations for items of work and to use these notations to store and retrieve performance data in the computer system's files for such items. The INTEREST BUILD classification evolved by a process of development and discussion, whereby the author prepared classification tables for comment by the assisting estimators. Their suggestions were then incorporated in revisions and a further round of discussions were undertaken. The classification currently covers the following work sections of SMM 6:

- Excavation and Earthwork;
- Concrete Work; and
- Brickwork and Blockwork.

The development of the classification is described in 1.5.3 and 5.2. The classification itself is presented in Appendix C.

8.1.6 Collection of Performance Data

A realistic data library was created to enable testing and demonstrations of the system to take place. Four price books, four monthly cost information publications, two estimating text books and information from four assisting estimators were investigated as sources of data for the data library. This aspect is described in 6.2.1. No one source proved to be entirely satisfactory, and the library eventually developed made use of data collected from several of the above-mentioned sources. In all 1395 WORK GROUPS were collected. These made use of 171 SINGLE resources and 39 GANG resources in their compilation.

8.1.7 Demonstrations and Testing of the System

Forty-three demonstrations of the system were given. All in all representatives of forty-seven different building organisations attended these demonstrations as listed in Table 7.1.

Testing of the system was undertaken both by the computer programmers and the author throughout the development of the system software. An example is the repricing of an estimate supplied by an assisting estimator. The estimating methods used in this exercise are listed in Table 7.2.

8.1.8 Assessments of the System

Assessments of the system were then undertaken. These involved interviews with seven building estimators to whom the system had been demonstrated. Details of those estimators interviewed are given in Table 7.3. The responses given during the interviews indicated that the system had been favourably received. These are recorded in 7.4.

Long term field trials were also arranged as part of the assessments. These are continuing at the time of writing (August 1981) and are described briefly in 7.5.

8.2 CONCLUSIONS

In providing conclusions to this thesis, the following aspects are reviewed:

- the effort required to use the system;
- the benefits resulting from the use of the system; and
- the cost of installing and using the system.

Concluding comments are made at the end of this section.

8.2.1 The Effort Required

Those aspects requiring the acquisition of new skills or the expending of additional effort on the part of estimating staff are:

- an understanding of the operation of the system (as in 3.6.2.f.);
- the acquisition of typing skills by estimators (as in 3.6.2.f.);

- the identification of notations for bill items by the estimator (as in 4.3.1.b, 4.4.1.b, 5.2 and 7.4.2.c.);

- the entry of the basic bill of quantities information into the system by a keyboard operator (as in 4.3.3.a.);

- the compilation and entry into the system of a comprehensive data library (as in Chapter 6, 7.4.2.b.).

8.2.2 <u>The Benefits Accruing from the Use of the System</u>

These are:

- the ability to commence with the preparation of the estimate without having to wait for materials and sub-contract quotations (as in 3.6.2.d, 4.3.3.c and 4.4.1.g.);

- the concomitant ability to plan the estimating work load thus providing more time for the simulation of different construction methods (as in 3.6.1.a, 3.6.2.a, 4.3.3.a, 4.4.1.f and 7.4.1.m.);

- the ability to update any resource cost with a minimum of effort (as in 3.6.1.a, 3.6.2.a, 4.3.3.c, 4.4.1.g and 7.4.1.m.);

- the obtaining of reports giving details (e.g. of materials and sub-contract resources awaiting quotations, and reconciliations of the resource requirements for the estimate) that may only be obtained by extensive clerical effort using manual procedures (as in 3.6.2.a, 4.3.3.d, 4.3.5 and 4.4.1.f.);

- the reduction (if not elimination altogether) of the need for comptometer staff (as in 3.6.1.a);

- the accuracy and speed with which all arithmetical computations are completed (as in 3.6.1.a,4.3.5 and 4.4.2.a);

- the possibility for the enhancement of adjudication procedure through the provision of tender adjustment facilities for use by the adjudication panel (as in 7.4.1.k.);

- the standardization in the manner in which estimates are produced by different estimators within the same organisation (as in 3.6.1.b and 7.4.1.m.); and

- the fact that the system is under the direct control of the estimator (as in 3.6.2.b, 4.3.3.b, 4.4.1.e and 7.4.1.m).

8.2.3 <u>The Cost of Using the System</u>

The aim of this section is to provide guidelines as to the approximate cost of installing and operating the system. At the time of writing the selling price of the system had not been finalised, and an attempt has therefore been made to identify the major areas for detailed consideration.

a. Cost of Software

Indications are that this will be between £10 000 and £15 000 depending upon the type of computer that the software is to be installed on.

b. Cost of Hardware

The requirements of individual users need to receive detailed consideration before the choice of hardware is made. This aspect is, however, outside the scope of this thesis. As an indication, development of the software took place on a CROMEMCO Z-2H microcomputer capable of supporting two users. This system complete with two VDUs and a printer had a purchase price of £9 350.00 in 1980.

c. Maintenance and Consumables

Maintenance costs of both hardware and software should be considered by prospective purchasers, as well as the cost of paper, printer ribbons, and similar consumables.

d. Cost of Preparation of Data Library

This cost will vary considerably from organisation to organisation and will depend upon the extent to which performance data is already recorded in the libraries of production rates compiled by that organisation.

e. Staffing Costs

As stated in 4.4.1.f, the use of the system should result in estimators being able to devote more of their time to considerations of alternative methods of construction. No reduction in the number of estimators is foreseen. However, some reduction in the requirement for comptometer staff is likely. Comptometer operators are suited to the task of bill entry, and it is therefore probable that some staff will be transferred to this area.

8.2.4 Concluding Comments

The viability of the system depends to a large extent on the organisation contemplating its use. The INTEREST BUILD system is viewed as a viable system for those contractors undertaking work with labour directly employed by themselves. However, the system is unlikely to be suitable to very small contractors (usually sub-contractors who perform specialised operations), or organisations whose work load is effected predominantly by sub-contract labour. In the former case, the cost of the system is likely to prove prohibitive, and such organisations would be advised to make use of alternative computer aids to estimating such as those described in 3.3.3. In the latter case, the extensive use of sub-contractors is unlikely to warrant the use of the facilities provided by the system.

At the time of writing, two systems have already been sold and three contractors are considering similar purchases although the system has not yet been commercially released. This was taken as positive evidence that the objective of developing software to meet the specific needs of the British building industry had been met.

8.3 RECOMMENDATIONS FOR FUTURE WORK

Several areas of future work are recommended by the author. These involve enhancements to the estimating system, and the development of computer programs which make use of the estimate data for control purposes.

8.3.1 Enhancements to INTEREST BUILD

The following are the principal areas in which future work should be undertaken:

a. Extension of the INTEREST BUILD classification

Further sections of SMM 6 should be included in the INTEREST BUILD classification so as to widen the appeal of the estimating system to more contractors.

b. Development of Interactive Sub-Routines

This area requires extensive development, and should be the subject of a detailed investigation.

8.3.2 Development of Computer Programs for Control Purposes

The estimating department is the first department in a contractor's organisation to have contact with a project. Estimators not only produce an estimate of the cost for use in a tender, but in so doing also assemble and organise a considerable amount of pertinent data relating to the project. These data are used primarily for the production of the estimate but are also of value to subsequent job control activities. However, the use of these assembled data in subsequent job control activities is limited. The reasons for this are that in most manually produced estimates the assembled data are difficult to access or interpret. These difficulties have led in many cases to a clear and unnecessary division between estimating and subsequent job control activities such as planning, cost control and measurement and valuation (52).

The existence of a computer-aided estimating system offers the facility of retention of detailed and accessible records of the estimator's calculations and assembled data. In the INTEREST BUILD system these data are contained in the FILE OF CONTRACT DETAILS - TENDER PRICE illustrated in Figure 4.1. All that is required to link these data with the control activities is the ability of these activities to access the data contained in the FILE OF CONTRACT DETAILS - TENDER PRICE. This is represented in Figure 8.1 where the FILE OF CONTRACT DETAILS is the same as that shown in Figure 4.1.

At the present time no commercially available systems which make use of estimators' data exist to service these control activities. These are seen as being logical enhancements to a computer-aided estimating system. The need for such

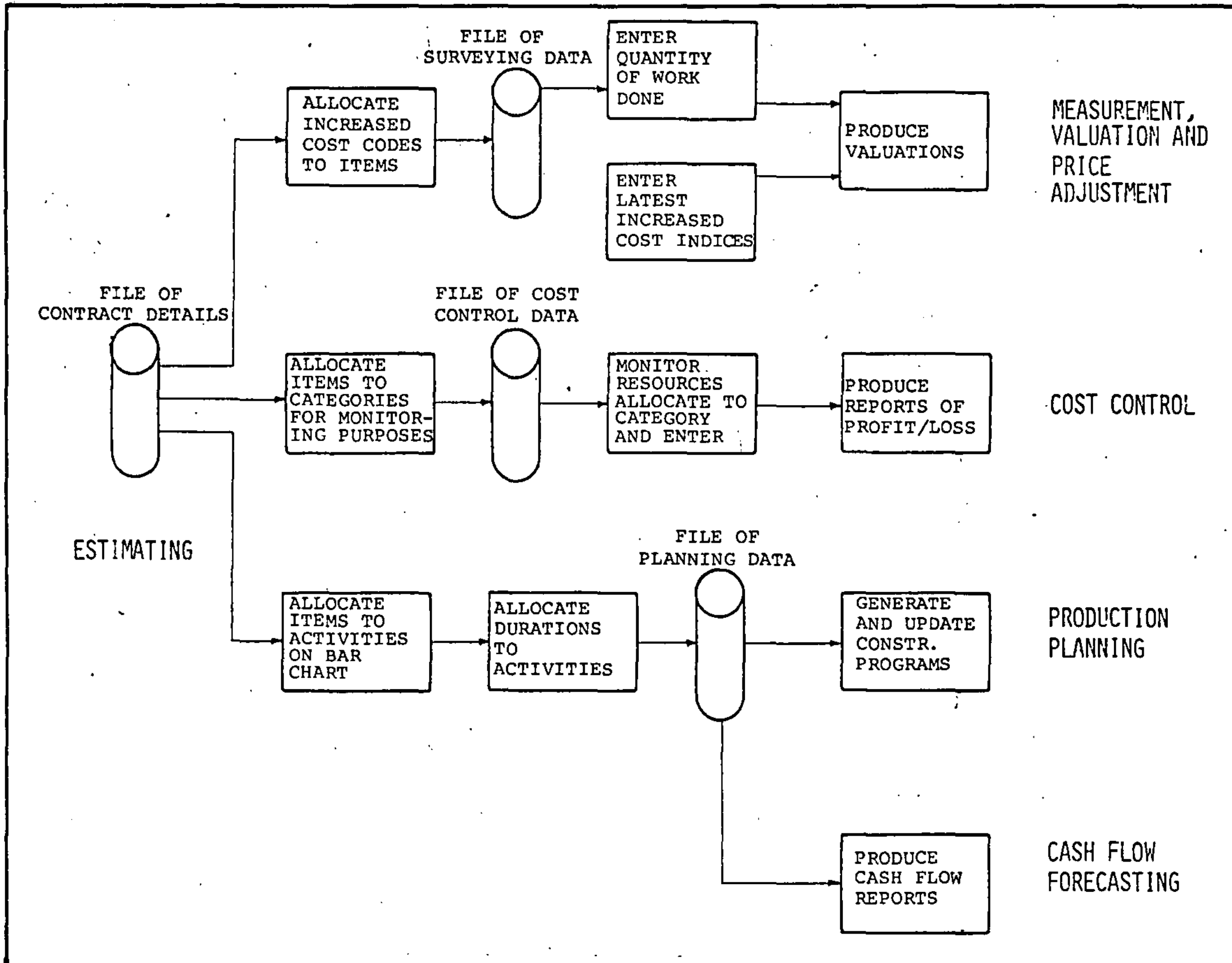


FIGURE 8.1: Relationship between INTEREST BUILD and Job Control Activities.

systems was expressed by many estimators to whom the INTEREST BUILD system was demonstrated. In several cases the ability to use estimators' data for such control activities was seen as the main reason for adopting computer-aided estimating techniques.

The author therefore recommends that further work be undertaken in providing job control software that makes use of estimators' data.

REFERENCES

REFERENCES

1. ESTIMATING PRACTICE COMMITTEE OF THE INSTITUTE OF BUILDING

Code of Estimating Practice

The Institute of Building, 1979.

2. McCAFFER, R.

Computer aided estimating - its evolution, difficulties and future

In "The Practice of Estimating", The Chartered Institute of Building, 1981.

3. BENSASSON, S. and SCOINS, D. (with contributions by Bennett, J., McCaffer, R. and Barnes, N.M.L.)

Computer Programs for Construction Management

Design Office Consortium, 1979.

4. THE ROYAL INSTITUTION OF CHARTERED SURVEYORS

Standard Method of Measurement of Building Works: Sixth Edition

The National Federation of Building Trades Employers, 1979.

5. NATIONAL JOINT CONSULTATIVE COMMITTEE FOR BUILDING

Code of Procedure for Single Stage Selective Tendering 1977

RIBA Publications Ltd., 1977.

6. MUDD, D.R.

Administration of a tender

Estimating Information Service No. 33, Institute of Building, Summer 1979.

7. FARROW, J.J.

Tendering - an Applied Science

The Institute of Building, 1976.

8. TASSIE, C.R.

Aspects of tendering: converting a net estimate into a tender

In "The Practice of Estimating", The Chartered Institute of Building, 1981.

9. BARNES, M.

What can computing do to improve the profitability of a building business?

Paper presented at Building Advisory Service seminar, 22nd February 1980.

10. ALLSOP, P.

Cash Flow and Resource Aggregation from Estimators' Data

M.Sc. Project report. Loughborough University of Technology (Supervisor R.McCaffer), 1980.

11. HAMLYN-HARRIS, H.

A Review and Critical Appraisal of Commercially Available Computer Aided Estimating Systems for Builders and Civil Engineers

M.Sc. Project report. Loughborough University of Technology (Supervisor R. McCaffer), 1979.

12. RYAN, T.M.

Computers for Estimating

Building Technology and Management, January 1981.

13. MILLER, J.L.

Computer-aided Estimating

Estimating Information Service No. 35, The Institute of Building, Winter 1979/80.

14. INSTITUTION OF CIVIL ENGINEERS

Civil Engineering Standard Method of Measurement

1976

15. BALDWIN, A. and McCAFFER, R.

Computer Aided Estimating and Tendering for Civil Engineering Works

Unpublished paper, Loughborough University of Technology, 1981.

16. McCAFFER, R.

Increasing Efficiency - Will the Computer Help?

Paper delivered at the Institute of Building Estimating Seminar, Sheffield, 1980.

17. HARRISON, R.S.

Computer Assisted Estimating for the Contractor

Paper delivered to Computer Applications and Methods Group, The Institution of Civil Engineers, 21 January 1980.

18. MOYLES, B.F.

An Analysis of the Contractor's Estimating Process

M.Sc. Thesis, Loughborough University of Technology (Supervisor G. Trimble) 1973.

19. GILCHRIST, A. and GASTER, K.

A Study of coding and data co-ordination for the building industry - Information systems relating to the construction industry

British Research Station Current Paper 11/69.

20. SHACKEL, B. (Ed.)

Man-Computer Communication: Infotech State of the Art Report. Volume 1: Analysis and Bibliography

Infotech, 1979.

21. CRISP, P.B.J.

Thoughts on a standard code for the building industry

The Chartered Surveyor, March 1966.

22. GILB, T.

Humanised Computers: the necessity and payoff

Computers and People (U.S.A.), May 1980.

23. BRADBURN, S.M.

The means by which computers can assist estimators

In "Estimating in Building and Civil Engineering", Northwood Publications Ltd., 1974.

24. SCOINS, D.

Surveying the computer way

Building, 25th July 1980.

25. THE ROYAL INSTITUTION OF CHARTERED SURVEYORS

Standard Method of Measurement of Building Works: Fifth Edition

The National Federation of Building Trades Employers, July 1968.

26. BISHOP, D. and ALSOP, K.

A Study of Coding and Data Co-ordination for the Construction Industry

Her Majesty's Stationery Office 1969.

27. DENT, C.

Quantity Surveying by Computer

Oxford University Press, 1964.

28. RAY-JONES, A. and McCANN, W.

CI/SfB Project Manual

RIBA Services, 1971.

29. FLETCHER, L. and MOORE, T.

Standard Phraseology for Bills of Quantities

George Godwin Ltd. 1979.

30. ALVEY, R.J.

Computers in Quantity Surveying

The MacMillan Press Ltd., 1976.

31. MONK AND DUNSTONE, MAHON AND SCEARS

Standard Library of Descriptions of Building Works

The Estates Gazette Ltd., 1980.

32. PRICE, S.G.

Price's Standard Method of Billing for SMM 6

Q.S. Weekly

33. DEPARTMENT OF THE ENVIRONMENT (Property Services Agency)

Enviro BQ System. Part 1: Bill Item Descriptions

1980.

34. STANDARD METHOD OF MEASUREMENT DEVELOPMENT UNIT

SMM 7: Proposals for discussion

The Royal Institution of Chartered Surveyors and the National Federation of Building Trades Employers May 1981.

35. MASON, D.R.

The Limitations of Estimators' Data Bases

M.Sc. Project Report, Loughborough University of Technology (Supervisor R. McCaffer), Sept. 1980.

36. DAVIS, BELFIELD and EVEREST (CHARTERED QUANTITY SURVEYORS) (Eds.)

Spons Architects and Builders Price Book

E. & F.N. Spon Ltd., 1979.

37. WHEATLEY, N.R. (Ed.)

Laxtons Building Price Book

Kelly's Directories Ltd., 1980.

38. GRIFFITHS, G.H. (Ed.)

Griffith's Building Price Book

Barton Publishers, 1980.

39. CRYSTAL-SMITH, G. (Ed.)

Hutchins Priced Schedules

G.H. Lake & Co. Ltd.

40. WATERFIELD, B.A. and KING,E.H.

Estimating Supplement

Published monthly in "Building Trades Journal", Northwood Publications

41. BUILDING COST INFORMATION SERVICE

Cost File

Published monthly in "Building", The Builder Ltd.

42. PATRICK AMOS CHARTERED SURVEYORS

Q.S. Datafile

Published weekly in "Q.S. Weekly", B.W.S. Publishing Ltd.

43. Cost Index

Published monthly in "Building Specification", Manning Rapley Publishing Ltd.

44. GEDDES, S.

Estimating for Building and Civil Engineering Works

Crystal-Smith, G. (Ed.), Newnes-Butterworths, 1977.

45. ENTERKIN, H. and REYNOLDS, G.

Estimating for Builders and Surveyors

Heinemann, 1978.

46. Personal Communication with Mr. W.S. FORBES, British Research Establishment.

47. ASHWORTH, A.

The source, nature and comparison of published cost information

Building Technology and Management, March 1980.

48. CLIFTON, H.D.

Business Data Systems: A practical guide to systems analysis and data processing

Prentice-Hall, 1978.

49. GEARY, R.

How can a builder obtain computing services and how much will it cost?

Paper presented at Building Advisory Service Seminar, 22 February 1980.

50. A Guide to users of business equipment incorporating Visual Display Units

The Business Equipment Trade Association.

51. PEARCE, B.G.

Health Hazards in Perspective

Paper presented at a one day conference entitled "Health Hazards of VDUs? 1", Loughborough University of Technology, 11 December 1980.

52. McCAFFER, R. and SHER, W.

Management Control from Computer-Aided Estimating

Paper delivered at CIOB Estimating Seminar, 26th March 1981.

Publications not specifically referred to

BENSASSON, S.

Micros in Construction

The Design and Construction Computing Association 1980

HUNTER, K.N.

Experience and practice in setting up and use of a computer-aided estimating system

Paper presented at Building Advisory Service Seminar, 22nd February, 1980.

McCAFFER, R. and SHER, W.

Computer Aided Estimating - an Interactive Approach

Building Technology and Management, February 1981.

PONSFORD, G.W.

Further Developments in Computer Assisted Estimating

M.Sc. Project report, Loughborough University of Technology (Supervisor R. McCaffer), Sept. 1979.

APPENDIX A

SPECIFICATION OF A COMPUTER SYSTEM FOR PERFORMING ESTIMATORS' ARITHMETICAL COMPUTATIONS

GENERAL

This specification illustrates the features of a computer system designed to aid estimators in the completion of the arithmetical computations involved in producing priced bills of quantities. A flowchart of the system is illustrated in Figure A.1. The following operations are involved:

- the entry of basic bill of quantities information into the computer;
- the printing out of work-sheets by the system;
- the insertion of item rates on to the work-sheets by the estimator;
- the entry of the data contained in the work-sheets into.the computer system by a keyboard operator;
- the addition of tender adjustments; and/or
- the production of reports.

Each of these operations is described below.

ENTRY OF BASIC BILL OF QUANTITIES INFORMATION

This operation is similar to that described for the INTEREST BUILD system (see Appendix B, Chapter 4). The information that needs to be entered into the system for each bill item is as follows:

- the bill number (if applicable);
- the section number;
- the page number;
- the item reference;

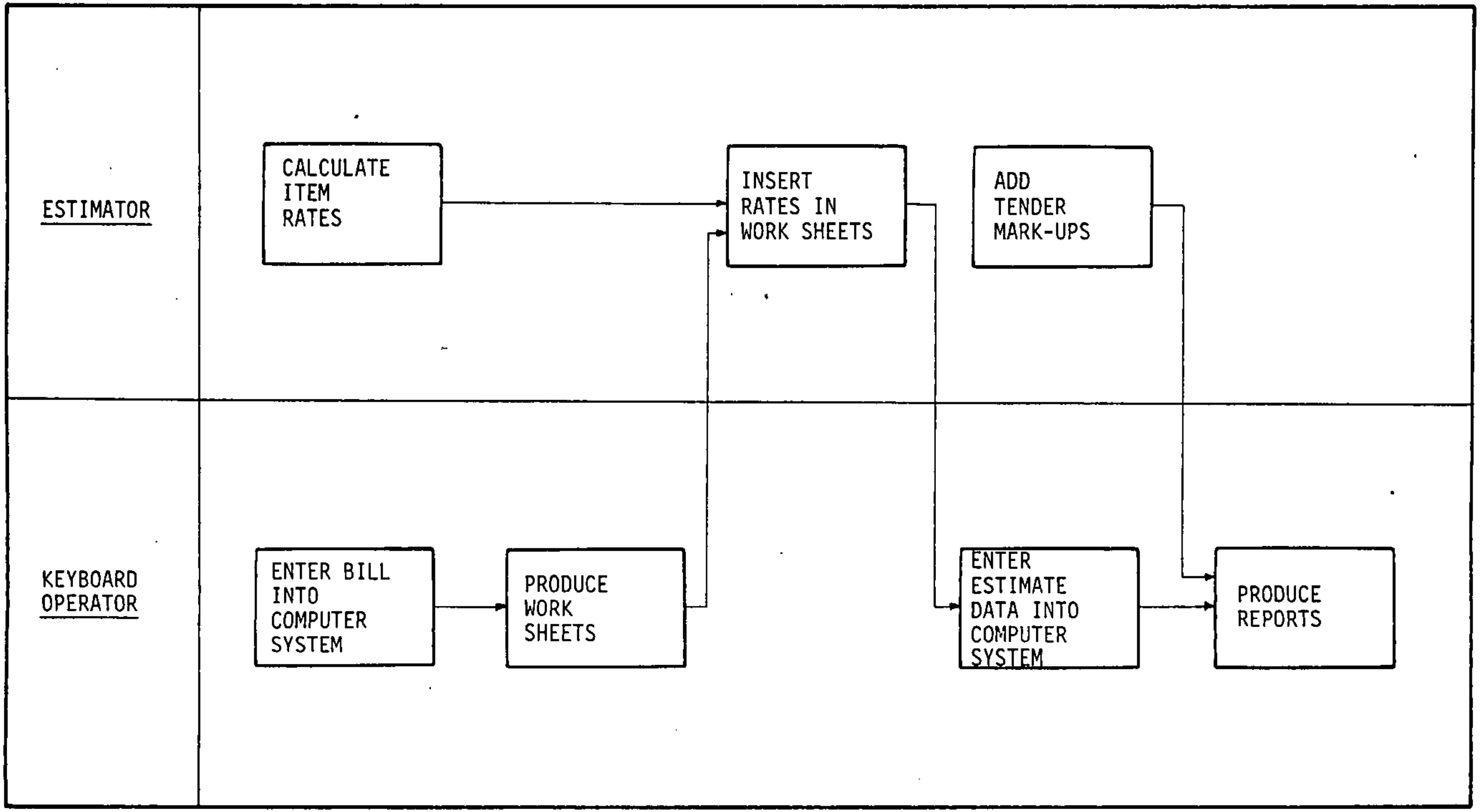


FIGURE A.1: Flow Chart of a Computer System for Performing Estimators' Arithmetical Computations

- the units of measurement; and
- the quantity.

THE PRINTING OUT OF WORK SHEETS

Work-sheets similar to those shown in Figure A.2 should then be printed out. These provide the basis for recording the estimated value of Labour, Plant, Auxiliary Plant, Materials, Domestic Sub-contractors, Nominated Sub-contractors, Nominated Suppliers and/or Provisional Sums for each bill item entered into the system.

THE INSERTION OF ITEM RATES ON TO THE WORK-SHEETS

The estimator should then enter the item rates on to the work-sheets. These rates need to be presented in their allowable cost code categories of Labour, Plant, Auxiliary Plant, Materials, Domestic Sub-contractors, Nominated Sub-contractors, Nominated Suppliers and Provisional Sums. Note that the total rate need not be entered; this should be automatically calculated by the system. An example of the data entered on to a work-sheet is given in Figure A.3.

THE ENTRY OF COST DATA INTO THE COMPUTER SYSTEM

This operation involves the entry of the cost data contained in the work-sheets into the computer system. The prompts provided by the system should facilitate the entry of these data relevant to each cost code category for all items contained in the bill of quantities. Due to the volume of data involved, it is envisaged that this task will be carried out by a keyboard operator, or similarly trained person.

THE ADDITION OF TENDER ADJUSTMENTS

Facilities similar to those provided with the INTEREST BUILD system for the addition of mark-up percentages should be provided. These are described in Appendix B, Section 6.2.

PAGE No 1

ITEM	QUANTITY	UNITS	LAB.	PLANT	AUX. PLANT	MAT.	DOM. SUB-CON.	NOM. SUB-CON.	NOM. SUPP-LIER	PROV. SUMS	TOTAL UNIT RATE	TOTAL PER ITEM
A	10	m^3										
B	5	m^3										
C	100	m										
D	1	NR										
											TOTAL COST FOR PAGE 1	

FIGURE A.2: Example of a Work Sheet for a Computer System for Performing Estimators' Arithmetical Computations

ITEM	QUANTITY	UNITS	LAB.	PLANT	AUX. PLANT	MAT.	DOM. SUB-CON.	NOM. SUB-CON.	NOM. SUPP-LIER	PROV. SUMS	TOTAL UNIT RATE	TOTAL PER ITEM
A	10	m^3	1.00	–	–	4.00	–	–	–	–		
B	5	m^3	–	–	–	–	4.85	–	–	–		
C	100	m	2.10	1.92	–	0.50	–	–	–	–		
D	1	NR	–	–	–	–	–	–		600.00		
											TOTAL COST FOR PAGE 1	

FIGURE A.3: Example of a Filled-In Work Sheet for a Computer System for Performing Estimators' Arithmetical Computations.

THE PRODUCTION OF REPORTS

Reports should be able to be obtained at any stage after the entry of the basic bill of quantities information. These should take the form of bill of quantities listings as described in Appendix B, Section 6.1.1.

APPENDIX B

USER MANUAL FOR THE INTEREST BUILD ESTIMATING SYSTEM

CONTENTS

Both the "INTEREST BUILD" system and this manual have been designed and written assuming that the user has no previous knowledge of computers or computing. The use of jargon and specialist phraseology has been eliminated wherever possible. A section on terminology is included at the rear of this manual.

The system and contents of this document do assume that the user has knowledge of analytical estimating based upon bills of quantities, and the tender procedure for the award of building contracts.

This manual contains examples of computer printout. In this connection it is important to note that all input by the user has been underlined. Everything else is information presented by the system.

1. INTRODUCTION

1.0 GENERAL

The software described here has been produced by a research team in the Department of Civil Engineering at Loughborough University of Technology.

The system design has been based on the manual estimating practices commonly used by building estimators. The objective in designing this system has been to bring to estimators the facilities offered by computers without major and unacceptable changes in estimators' current practice.

The name given to this system is INTEREST-BUILD representing INTERACTIVE ESTIMATING FOR BUILDERS. The system is designed to aid the estimator prepare cost estimates for building contracts based on bills of quantities prepared in a variety of formats. Facilities are also provided for the adjudication panel to convert this estimate into a tender.

1.1 KEY FEATURES OF THE SYSTEM

The key features of the system are:

(a) It is a computer system which <u>aids</u> the estimator - it does not replace or automate his task.

(b) It is an interactive system whereby the estimator communicates directly with the computer via a Visual Display Unit (VDU). The calculations are thus performed at the pace and sequence determined by the estimator.

(c) It provides a series of detailed prompts or instructions to the estimator at his VDU. These explain to him the various options which may be selected at each stage. This also means that the user has little chance of making errors. If he does enter incorrect information (e.g. a number where a letter is expected), or does not respond correctly to a prompt, the system will not allow further progress to be made until the error has been rectified.

(d) It is a very flexible system. The computer programs supporting this system are broken down into a number of small discrete packages. Each one of these is accessed by use of a word known as a command. The flexibility of the system lies in the fact that these commands can be used in any order, recalled, or the system switched off and started again.

(e) It uses stored performance data supported by files containing data on Labour, Plant, Auxiliary Plant and Materials resources. The estimator may use this data to price items found in bills of quantities. If the data is not suitable, he can modify it, or enter new data for resources not on file. The system covers the range of requirements needed by the estimator to prepare cost estimates.

(f) It will allow the estimator to retrieve and rework any item at any stage in the estimating process. It is also possible to retrieve this information after the tender adjudication.

(g) It will allow the adjudication panel to surcharge any cost code category (i.e. Labour, Plant, Auxiliary Plant, Materials and Domestic Sub-contractors), and will also allow the addition of monies to cover overheads and profit.

(h) It will produce reports of the bill of quantities at any stage during the estimating and tendering process. These reports reflect both the direct cost and the tender price of the bill items in question. It is also possible to obtain reports of the quantities of resources used in the preparation of the estimate.

(i) It keeps accurate records of the estimator's build-ups and the decisions taken at the adjudication meeting. These can be retrieved for reference at any stage.

(j) It allows the estimator to price items on a 'unit rate' or 'spot rate' basis.

(k) It enables the estimator to proceed with his calculations before having obtained Materials and Sub-contract quotations. These resources may be marked as 'Awaiting Quotes'. As and when prices become available they are entered into the system and all occurrences of these resources are automatically updated.

(l) It is possible to price similar items scattered through the bill of quantities by pricing one typical item. This facility is extremely useful where bills are presented in an 'elemental' format.

1.2 IMPORTANT COMMANDS

The estimating system is command driven. In other words the user has to select a command from a list (or 'menu') of commands in order to instruct the system. In this connection it is important to note the following points:

(a) The first two letters of any command are those that should be keyed into the VDU. (i.e. it is not necessary to enter more than the first two letters).

(b) In certain cases the system will request a YES or NO command. In such cases all that is necessary to enter is Y or N as the case may be.

(c) In all cases the RETURN key should be pressed following the entry of the required command. (Pressing the RETURN key instructs the VDU to send the command entered on the VDU screen to the computer. Unless the RETURN key is pressed, nothing will happen).

(d) If, at any stage during the operation of the system, the user wishes to exit from the section of the program he is working in, AB should be keyed into the VDU. This command instructs the system to ABORT the work it is doing, and will return the user to the relevant Main Menu of commands.

2. AN OUTLINE OF THE SYSTEM

2.0 GENERAL

The system is divided into three stages as shown in Figure 2.1:

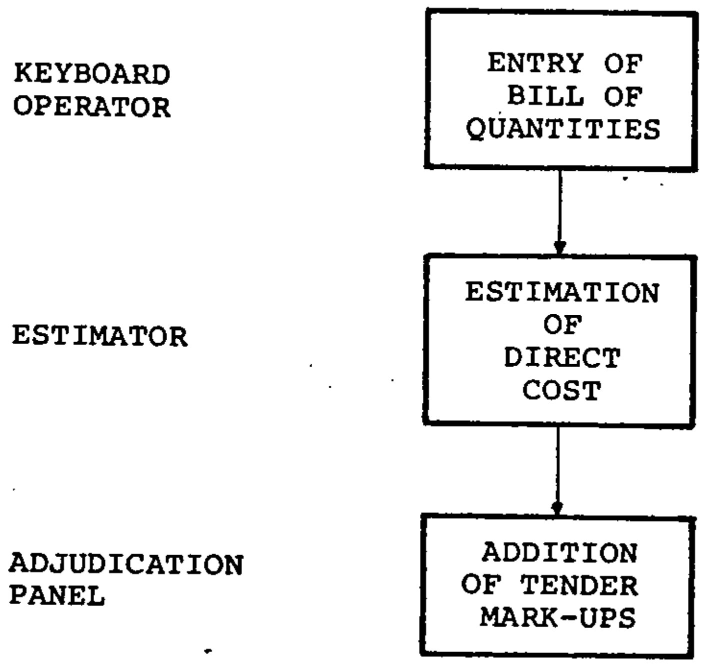


Figure 2.1 The Stages of the Estimating System

Whilst Figure 2.1 suggests a sequential relationship between the various stages, this is not necessarily so. The system is command driven (i.e. the user may call upon a command from a 'menu' or list of commands displayed before him), and as such there is no set order for the program to run. The only proviso is that the estimator can only work upon items that have been entered into the system. Nevertheless, the bill of quantities does not have to be completely entered into the system before estimation of direct cost can start.

In addition to the above, the estimator in charge of system has extra facilities available. These are described in Chapter 8.

Each stage of the system is described briefly below.

2.1 THE ENTRY OF THE BILL OF QUANTITIES INTO THE COMPUTER

This aspect is described in detail in Chapter 4. It involves the entry of basic information contained in the bill of quantities into the computer system. The main skill required is that of competence in entering data at a keyboard, and the task is thus ideally suited to a typist, comptometer operator or similarly trained person. However, the estimator is required to pencil into the bill certain extra items of information. This extra information, when entered into the computer system, serves to prime the system for the preparation of various reports (e.g. an approximate cost of the project, a list of all items awaiting sub-contract quotations - see Chapter 6).

The menu of commands available to the user when entering the bill into the computer is shown below:

```
        Commands are :-
                  FU - Full Page
                  SI - Single Item
                  GE - Generate Bill
                  ST - Stop
    Command ?
```

A brief outline of each command is given below:

FULL PAGE	:	This command enables the user to enter all the items contained on one page of a bill of quantities into the computer system.
SINGLE ITEM	:	This allows the user to edit or enter a single item into the computer.
GENERATE BILL	:	This command instructs the computer system to allocate space for the estimator's calculations.
STOP	:	This command calls a halt to the program.

2.2 ESTIMATION OF DIRECT COST

The stage of the computer system is described in detail in Chapter 5.

The menu of commands available to the estimator is shown below:

```
                    MAIN MENU
                    ---------
        Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop
    Command ?
```

These commands are described briefly below:

INSPECT ITEM : Only items which have been entered into the computer system may be inspected.

This command enables the estimator to view the build-up (or WORK GROUP) for any item by entering the required item reference (i.e. Bill Number/Section Number/Page Number/Item Letter).

Where the data previously entered into the system contained codes linking the bill items to the system's FILE OF PERFORMANCE DATA, the estimator is presented with the appropriate WORK GROUP.

He may then accept the WORK GROUP, reject it outright and use another, or modify the original WORK GROUP. When satisfied, the estimator then instructs the computer to file (i.e. store) the WORK GROUP, and he may then proceed to inspect another item.

In some cases it may not be possible to price an item from the computer's files because of the unusual nature of that item (i.e. no suitable data on file). In these cases the estimator will have to build up a rate from first principles.

It should be noted that at any point during the 'Estimation of the Direct Cost' and the 'Addition of Tender Mark-ups', the estimator may return to a particular item and re-work it. In such cases the most recent build-up is retrieved in its entirety and may be edited as described above.

SUB CONTRACT QUOTES : This command enables the user to enter quotations for sub-contract items. Such prices automatically update these items.

UPDATE PRICES : This command is used to update the resources contained in the COMPANY RESOURCE COST FILES (i.e. Labour, Plant, Materials and Auxiliary Materials). Such revised information is then stored in the CONTRACT RESOURCE COST FILES. It should be noted that these revisions apply only to the tender in question, and that the original resources remain unchanged for use on subsequent contracts.

APPLY MARK-UPS : See 2.3.

PRINT REPORTS : This command may be used at any point during this stage of the preparation of the estimate. It enables the estimator to obtain reports detailing the cost of the work priced, the resources used, and will also identify those resources for which quotes are required.

HELP : With frequent use of the system, the user will become familiar with the prompts provided. This command enables the user to suppress prompts if he so chooses.

STOP : This command calls a halt to the program.

2.3 ADDITION OF THE TENDER MARK-UPS

This aspect is described in detail in Chapter 6.

The facilities allowing the addition of tender mark-ups are an extension of the previous stage. They enable the adjudication panel to adjust the direct cost of the estimate and so to turn the estimate into a commercial venture by adding sums of money to cover overheads and profit.

The menu of commands is the same as the one illustrated in 2.2. The relevant commands are described briefly below:

ADD MARK-UPS : This command enables the user to adjust the cost price of items by using the SURCHARGE facility. Similarly money to cover overheads and profit may be added by using the OVERHEADS and PROFIT facilities respectively.

PRINT REPORTS : This facility is similar to that described in 2.2. The main difference is that the reports produced after the manipulations and additions detailed above will relfect both the direct cost and the tender figure for the work.

3. HOW THE SYSTEM WORKS

3.0 GENERAL

This chapter briefly describes the operation of the estimating system. For the purposes of explanation, frequent reference will need to be made to the flow chart of the system which is illustrated in Figure 3.1. This diagram shows the flow of information between the various files (or locations) within the computer system.

It will be seen that the files may be divided into those which support the estimator's calculations (e.g. the PLANT RESOURCE COST FILE) and those which store the results of his calculations (e.g. the FILE AWAITING QUOTES). A further distinction between the supporting files may be made; they may be divided into those holding data for the whole company, and those holding data for a specific contract.

3.1 COMPANY FILES SUPPORTING THE ESTIMATOR

These files consist of COMPANY RESOURCE COST FILES and FILE OF PERFORMANCE DATA.

3.1.1 The COMPANY RESOURCE COST FILES

These files store resource data under the following cost code categories:

Labour
Plant
Auxiliary Plant
Materials

These resources may be either SINGLE or GANG resources (see below).

In addition to the above, combinations of SINGLE resources from different cost code categories may be stored in Resource Groups.

The number of resources stored in any of these categories is defined in Chapter 9, but may be altered for specific users requirements.

(a) Labour Resource Cost File:

This file contains the all-in labour cost per hour of the different labour resources normally employed by the company. These may be held either as SINGLE units or as GANGS (e.g. 2

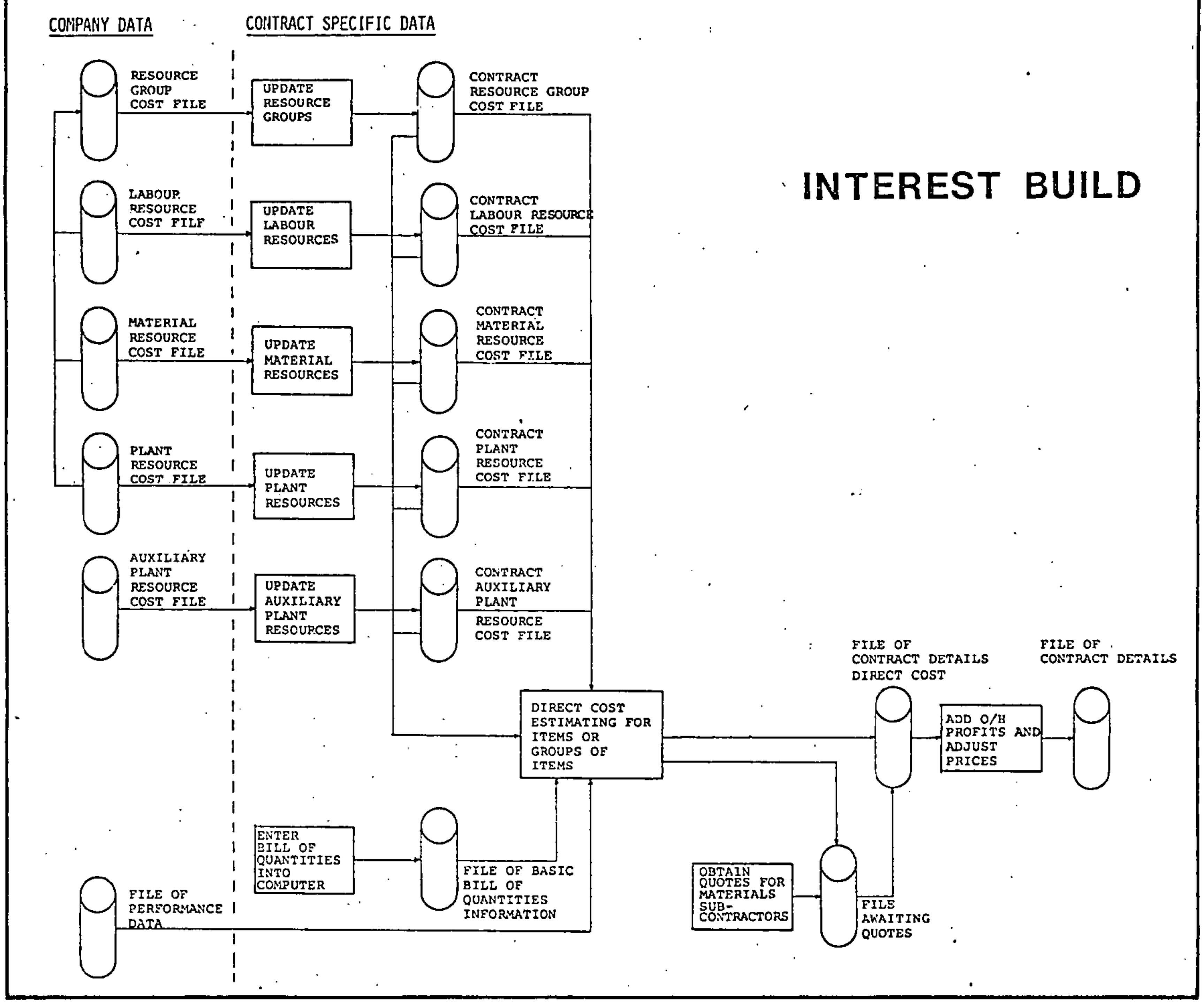


Figure 3.1 Flow chart of INTEREST BUILD

bricklayers + 1 labourer). In order to distinguish between different resources it is necessary to provide some form of identification. This is done by means of a code (henceforth referred to as the RESOURCE CODE). The system of resource coding used with INTEREST-BUILD requires all SINGLE labour resources to begin with the letter L and be followed by a number within the defined range. Labour GANGS begin with the letters LG and are followed by a number, also within the defined range. An example of the information contained in this file is given in Figure 3.2.

L1	LABOURER	£2.25 / hr
L2	CARPENTER	£3.50 / hr
LG1	CONCRETE GANG	£6.75 / hr

Figure 3.2 Example of Information Held on Labour Resource Cost File.

(b) Plant Resource Cost File:

Similarly this file contains the all-in cost per hour of using different items of Plant. Costs may be stored either singly or in gangs. SINGLE resources begin with the letter P and GANGS with PG, followed by a number within the specified range.

Examples of various Plant resources are given in Figure 3.3.

P1	EXCAVATOR	£12.00 / hr
P2	TIPPER TRUCK	£10.00 / hr
PG3	EXCAVATOR/TRUCK	£22.00 / hr

Figure 3.3 Example of Plant Resources

(c) Auxiliary Plant Resource Cost File:

This file is designed to hold items of Plant which are normally hired out on a week by week basis, (e.g. scaffolding). The costs are therefore stored per unit per week. SINGLE resources are identified by codes beginning with the letter A and followed by a number within the specified range. GANG (or group) resource codes begin with the letters AG followed by a number within the specified range. Various auxiliary plant resources are shown in Figure 3.4.

A1	RMD PANEL 300 x 600	£0.10 / wk
A2	RMD PANEL 300 x 900	£0.14 / wk
A3	RMD CLAMP A	£0.02 / wk
AG1	RMD WALL FMWK	£1.85 / wk

Figure 3.4 Example of Auxiliary Plant Resources

(d) Material Resource Cost File:

This file contains prices for Materials. GROUPS (or GANGS) of Materials may also be formed. SINGLE resources begin with M and GROUPS with MG followed by a number within the defined range. Examples of Materials resources are given in Figure 3.5.

M1	SAND	£5.00 / m^3
M2	CEMENT	£40.00 / TNE
MG1	CMT. MORTAR	£18.00 / m^3

Figure 3.5 Example of Material Resources

It is also possible to mark materials resources as 'Awaiting Quotes'. This aspect is described in Chapter 7.

(e) Resource Group Cost File:

This file allows GROUPS of resources to be stored which are formed from SINGLE Labour, Plant and Materials resources. It is thus possible, for example, to form one resource for an excavation team consisting of an excavator, an operator and fuel. All Resource Groups are identified by the letters XG and followed by a number within the specified range. Various Resource Groups are illustrated in Figure 3.6.

XG1	EXCAV / TIPPER / OP	£24.19 / hr
XG2	CONC / PUMP / LAB	£37.40 / hr
XG3	12mm M.S / LAB / WIRE	£340.00 / TNE

Figure 3.6 Example of Resource Groups

3.1.2 The FILE OF PERFORMANCE DATA

This file contains item build-ups for the commonly recurring items of work. These build-ups are comprised of resources, their usage rates, and various other factors. In order to facilitate the storage and retrieval of this information, each build-up is given a unique WORK GROUP CODE.

A more detailed description of the FILE OF PERFORMANCE DATA and the WORK GROUP CODE is given in Chapter 9.

3.2 CONTRACT SPECIFIC FILES SUPPORTING THE ESTIMATOR

The files consist of the CONTRACT RESOURCE COST FILES, and the FILE OF BASIC BILL OF QUANTITIES INFORMATION.

3.2.1 The CONTRACT RESOURCE COST FILES

The files contain the resources stored in the COMPANY RESOURCE COST FILES, but updated for the contract in question.

(a) Contract Labour Resource Cost File:

This file contains the all-in labour rates described above updated for a particular tender. It is possible to update both SINGLE and GANG resources. However, updating the cost of GANG resources can only be done by updating the costs of the constituent SINGLE resources. (The procedure for doing this is described in 5.3).

If the original COMPANY rates are satisfactory, they are then used throughout the tender.

It is also possible to create new Labour resources specifically for use on the tender in question.

(b) Contract Plant Resource Cost File:

The updated Plant costs stored in this file are edited as described in (a).

(c) Contract Auxiliary Plant Resource Cost File:

Updated Auxiliary Plant costs are stored in this file. They are also edited in a manner similar to that described in (a).

(d) Contract Material Resource Cost File:

Materials resources may also be updated in a similar manner to that described in (a). However, due to the volatility of materials prices, frequent use of the 'Awaiting Quotes' facilities will be made.

This facility allows the estimator to mark a material resources as 'Awaiting Quotes' and to proceed with his calculations before having obtained any quotations. These quotations are obtained in the normal manner, and, as and when they become available, they are entered into the system. All occurrences of that material resource are then automatically updated. This aspect is more fully described in Chapter 7.

(e) Contract Resource Group Cost File:

Resources contained in this file are automatically updated by the revision of constituent resources. It is also possible to create new Resource Groups for a specific tender.

3.2.2 FILE OF BASIC BILL OF QUANTITIES INFORMATION

This file contains the information entered into it relevant to the bill of quantities. This information includes the following aspects for each item:

Bill number (if applicable).
Section number.
Page number.
Item letter/number.
WORK GROUP CODE.
Percentage of WORK GROUP CODE.
Domestic Sub-contract item (if applicable).

Further details of this aspect may be found in Chapter 4.

3.3 CONTRACT FILES STORING THE ESTIMATORS DATA

These files consist of the FILE OF CONTRACT DETAILS-DIRECT COST, the FILE AWAITING QUOTES, and the FILE OF CONTRACT DETAILS-TENDER PRICE. Their function is to retain the estimator's calculations, and the adjudication panel's decisions so as to enable data to be retrieved in its entirety at any stage.

3.3.1 FILE OF CONTRACT DETAILS-DIRECT COST

This file contains the results of the estimator's calculations. These arise from the pricing of items using one of the methods described below.

(a) Items priced by WORK GROUP CODE:

The cost of these items is calculated by using the WORK GROUP CODE to locate the required build-up (or WORK GROUP) in the FILE OF PERFORMANCE DATA. The system then links the performance data contained in the WORK GROUP with the latest costs stored in the CONTRACT RESOURCE COST FILES, and arrives at an item cost. This is then displayed on the VDU and the estimator has the choice either to accept the WORK GROUP or to modify it.

When this has been done, the item WORK GROUP is stored in one of two files. If all cost information is complete, the FILE OF CONTRACT DETAILS-DIRECT COST is used, but if resources contained within the WORK GROUP are marked as 'Awaiting Quotes', the WORK GROUP is then stored in the FILE AWAITING QUOTES. Once quotes have been obtained, they are fed into the system, the resource cost is updated, and the WORK GROUP is then transferred to the FILE OF CONTRACT DETAILS-DIRECT COST.

(b). Items Priced From First Principles:

When no suitable data is held on the FILE OF PERFORMANCE DATA, the estimator may choose to build-up a rate from first principles. He can do this by choosing resources from the CONTRACT RESOURCE COST FILES, and by selecting usage rates, wastage factors etc. to suit the item in question. When satisfied with the build-up, the item is then stored in the FILE OF CONTRACT DETAILS-DIRECT COST or the FILE AWAITING QUOTES, as the case may be.

(c) Items Priced Using SPOT RATES:

This is another way the estimator may price an item when no data exists in the FILE OF PERFORMANCE DATA. He accumulates allowances against cost code categories (i.e. Labour, Plant, Auxiliary Plant, Materials and Sub-Contractors) and uses these to price the relevant item. The SPOT RATE is then stored in the FILE OF CONTRACT DETAILS-DIRECT COST.

3.3.2 FILE AWAITING QUOTES

This file stores all build-ups containing resources 'Awaiting Quotes' (either MATERIALS or SUB-CONTRACTORS). As and when suitable quotations are obtained, they are entered into the system and all occurrences of the relevant resource are automatically updated. Such build-ups are then automatically transferred to the FILE OF CONTRACT DETAILS-DIRECT COST.

The 'Awaiting Quotes' facilities are described in detail in Chapter 7.

3.3.3 FILE OF CONTRACT DETAILS-TENDER PRICE

On completion of the preparation of the direct cost, the system provides facilities to enable the adjudication panel to add mark-ups and to manipulate rates (this is described in Chapter 6). The results of all such calculations are stored in the FILE OF CONTRACT DETAILS-TENDER PRICE.

4. ENTRY OF THE BILL OF QUANTITIES INTO THE COMPUTER

4.0 GENERAL

This chapter describes the section of the system which enables the user to enter information contained in the bill of quantities into the computer. The main expertise required with this operation is competence in entering data at a keyboard and it is therefore envisaged that this task will be performed by someone other than the estimator (e.g. a comptometer operator or typist).

The information that is entered for each bill item is:

- Bill number (if applicable);
- Section number;
- Page number;
- Item letter/number;
- WORK GROUP CODE;
- Percentage of WORK GROUP CODE (if applicable);
- Domestic Sub-contract item (if applicable).

Certain items of this information are not available from the bill of quantities itself. This information needs to be supplied by the estimator in charge of the tender. This is described below.

4.1 EXTRA INFORMATION TO BE SUPPLIED BY THE ESTIMATOR

The additional information that needs to be supplied is:

- the WORK CROUP CODE;
- the Percentage of the WORK GROUP CODE;
- the identification of Domestic Sub-contract items.

It should be noted that certain of these aspects are optional (i.e. need not be supplied by the estimator at this stage). This is described below.

4.1.1 <u>THE WORK GROUP CODE</u>

The INTEREST BUILD estimating system allows performance data to be stored in the computer and used to price similar items found in bills of quantities. In order to locate the required data from the computer's files, some form of identification is required. This is provided by a code (the WORK GROUP CODE) which needs to be supplied by the estimator for items in the bill of quantities. This code should be pencilled into the bill adjacent to the item to which it refers.

NOTE:

- In some cases it will not be possible to provide a WORK GROUP CODE for certain items. This could occur where no suitable code exists, or the estimator knows that no relevant data is held in the computer.

- It is possible to allocate two WORK GROUP CODES to a particular item if so desired.

- If the estimator so wishes he need not code up the bill at this stage. He will then have to enter the WORK GROUP CODE himself when pricing the various bill items. (See 5.2.2 (a)).

4.1.2 THE WORK GROUP CODE PERCENTAGE

This information determines the contribution that the stored data, identified by the WORK GROUP CODE will make to the cost of an item. It is, in effect, a multiplier which is applied to all the performance data included in the WORK GROUP. Thus if a WORK GROUP PERCENTAGE of 110 is entered, this will increase the usage rates of all constituent resources by 10%.

The percentage needs to be pencilled into the bill of quantities for all WORK GROUP CODES, though the program will automatically assume an allocation of 100 if no other information is entered.

NOTE:

- The percentage can be any figure, and need not add up to 100 in the case where 2 WORK GROUP CODES are used.

- Where no WORK GROUP CODE has been entered, it is not possible to enter a percentage.

4.1.3 IDENTIFICATION OF DOMESTIC SUB-CONTRACT ITEMS

The estimator should also note on the bill of quantities which items are to be completed by Domestic Sub-contractors. This enables the system to recognise such items, and to produce the necessary prompts and reports for the insertion of quotes at a later stage. The system will allow up to 2 Domestic Sub-contract quotes to be expected for any one item.

NOTE:

- Unless otherwise stated, Sub-contract items refer only to Domestic Sub-contractors. Nominated Sub-contractors are dealt with in 4.2.3 A. (iii) and (iv) and Chapter 10.

4.2 THE ENTRY OF THE BILL OF QUANTITIES

The system is command driven. In other words the user may call upon a command from a 'menu' of commands (see 4.2.3 for an example) displayed before him to help enter the bill. There is no set order for the program to run. The user may start at any page of the bill, stop, continue on another page etc. However, it is recommended that work commences at the start of the first bill section, and continues through the bill. In this way it is unlikely that isolated pages of the bill will be omitted.

The examples that follow make use of two sample bill of quantities pages shown in Figures 4.1 and 4.2. These have been marked up, where appropriate, in the manner described in 4.1.

4.2.1 STARTING THE PROGRAM

The procedure for switching on the computer depends upon the computer on which the system has been installed. Details of this procedure for your computer are given elsewhere.

Once this has been done it is necessary to select the program which allows the entry of the bill of quantities to take place. This is done by keying in WS5DPREP into the VDU and is illustrated below.

4.2.2 THE CONTRACT IDENTIFIER AND PASSWORD

After selecting the bill entry program, the computer will prompt the user for the following information:

CONTRACT IDENTIFIER	:	This is a combination of letters and numbers which enables the program to distinguish between one contract and another.
PASSWORD	:	This is a word which enables only the persons to whom it is known to gain access to the system.

	BILL NUMBER 1				
	SECTION NUMBER 1				
	Mass Concrete				
A	Blinding Mix A to bottom of trenches 50mm thick	m^3	17	FA25A.	7
B	Mass Concrete Mix B in beds 200mm thick	m^3	215	S/C	
	Reinforced Concrete				
C	Concrete Mix C in casing to steel ground beams, cross sectional area $0.3m^2$	m^3	10	—	
D	Ditto in casing to steel beams, cross sectional area $0.3m^2$	m^3	54	FB18D	.3 S/C
	Reinforcement				
E	25mm mild steel reinforcement in steps and tops of dormers	TONNE	23	G11K.0 G11L.0	- 80% - 50%
	Formwork				
F	Rough formwork to walls	m^2	176	—	
G	Rough formwork to battering ends of walls 275mm wide	m	42	HA100H	.0 - 120%
	PAGE 1				

Figure 4.1 Sample page of a bill of quantities

	SECTION NUMBER 7			
A	Allow for protecting the whole of the work in this section			
	P.C. Sums			
	PROVIDE THE FOLLOWING P.C. SUM FOR WORK TO BE EXECUTED BY A NOMINATED SUB-CONTRACTOR			
B	Work to electrical services in Boiler Room	-	-	£1500 00
C	Add for Profit	-	-	
D	Add for Attendance	-	-	
	PROVIDE THE FOLLOWING P.C. SUM FOR MATERIAL TO BE SUPPLIED BY A NOMINATED SUPPLIER			
E	Ironmongery	-	-	£900 00
F	Add for Profit	-	-	
	PROVIDE THE FOLLOWING PROVISIONAL SUM			
G	Builder's work in connection with the adaption and removal of existing shoring	-	-	£250 00
	PAGE 209			

Figure 4.2 Sample page of bill of quantities

Both the CONTRACT IDENTIFIER and the PASSWORD are more fully described in Chapter 8. Each should be unique for a particular tender, and should be obtained from the estimator in charge of the estimating system.

The relevant prompts by the system are shown below. The correct CONTRACT IDENTIFIER and PASSWORD in this example are WIL and PETER respectively. It should be noted that <u>all entry by the user is underlined.</u>

4.2.3 ENTERING THE BILL

Upon entering the CONTRACT IDENTIFIER and PASSWORD, the menu of commands shown below is displayed:

```
        Commands are :-
                      FU - Full Page
                      SI - Single Item
                      GE - Generate Bill
                      ST - Stop
     Command ?
```

It is only necessary to enter the two 'command letters' to instigate a command (i.e. FU for Full Page etc.).

Each of these commands is described in detail below.

A. FULL PAGE:

This command enables the user to enter a complete page of a bill of quantities. The user is first of all instructed to enter the page reference (see explanatory notes below) and the last item reference on the page in question. This enables the system to automatically 'know' how many items are included in that particular page, and to prompt the user for information on each item. This is shown below.

(i) Bill number 1, Section number 1, Page number 1:

Note that the information entered by the user is underlined, and relates to the sample bill of quantities page given in Figures 4.1.

```
9C>WS5DPREP

INTEREST-BUILD System 5.
Data Preparation Program


Contract Identifier ? TRIAL
```

INCORRECT CONTRACT IDENTIFIER ENTERED.

```
Contract does not exist

End of Run
 STOP.

9C>WS5DPREP

INTEREST-BUILD System 5.
Data Preparation Program


Contract Identifier ? WIL

Password ? REX


Password ? TEST
```

INCORRECT PASSWORD ENTERED.

```
Access Denied

End of Run
 STOP
 9C>WS5DPREP

 INTEREST-BUILD System 5.
 Data Preparation Program


 Contract Identifier ? WIL

 Password ? PETER


 Contract Title:-
 USER MANUAL DEMONSTRATION
 Reference Code:- REF-99
 Tender Submission Date:- 25-12-81
```

```
        Commands are :-
                  FU - Full Page
                  SI - Single Item
                  GE - Generate Bill
                  ST - Stop
Command ? FU

FULL PAGE option
Page Reference ? 1/1/1
```

Explanatory Notes on Page Reference:

As shown above, the PAGE REFERENCE, i.e. the information enabling the system to recognise the bill page being worked on, must be entered in the following manner:

```
             1/1/1 <------ PAGE NUMBER
BILL                  
NUMBER        SECTION
              NUMBER
```

Where the complete bill of quantities is contained within one document, the BILL NUMBER need not be entered.
The information that would need to be entered in this case is shown below:

```
            1/1

SECTION            PAGE NUMBER
NUMBER
```

The response from the computer system shown below follows on from the entry of the PAGE REFERENCE given above.

```
Last Item on Page ? G

Bill 1  Section 1  Page 1/ A
Quantity ? 17

Units of Measurement ? M3

Work Group Code [RETURN for no Code] ? FA25A.7

Percentage [RETURN for 100%]  ? <—— RETURN KEY PRESSED

Sub-Contract Item ? N

Bill 1  Section 1  Page 1/ A
Quantity      17      M3
Work Group FA25A.7        100.00%
OK ? Y
```

The user now has the opportunity to check the data entered into the computer system. If it is satisfactory the user should type in YES (or Y). The system will then proceed by prompting the user for data relevant to the next item in the bill of quantities, as follows. If the user has made a mistake NO (or N) should be entered. The facilities enabling changes to be made are described in (ii) below.

<u>NOTE</u>:

- On completion of the entry of data contained on a specified bill page, the menu of commands is displayed again. The user may then proceed by selecting FU (FULL PAGE) for the next page, or any of the other commands.

- When entering the next full page the system will again request a PAGE REFERENCE relevant to that page. The same Bill number and Section number as the previous page will be assumed if // is entered instead of the Bill number and Section number requested, i.e. if you want to enter Bill number 1 Section number 1 Page number 2 following the FULL PAGE shown above, either of the

```
Item Filed
Bill 1  Section 1  Page 1/ B
Quantity ? 215

Units of Measurement ? M3

Work Group Code [RETURN for no Code] ? <—— RETURN KEY
                                            PRESSED
Sub-Contract Item ? Y

Bill 1  Section 1  Page 1/ B
Quantity    215     M3
Sub-contractor Required
OK ? Y

Item Filed
Bill 1  Section 1  Page 1/ C
Quantity ? 10

Units of Measurement ? M3

Work Group Code [RETURN for no Code] ? <—— RETURN KEY
                                            PRESSED
Sub-Contract Item ? N

Bill 1  Section 1  Page 1/ C
Quantity     10     M3
OK ? Y

Item Filed
Bill 1  Section 1  Page 1/ D
Quantity ? 54

Units of Measurement ? M3

Work Group Code [RETURN for no Code] ? FB18D.3

Percentage [RETURN for 100%]  ? <—— RETURN KEY  PRESSED

Sub-Contract Item ? Y

Bill 1  Section 1  Page 1/ D
Quantity     54     M3
Work Group FB18D.3       100.00%
Sub-contractor Required
OK ? Y

Item Filed
Bill 1  Section 1  Page 1/ E
Quantity ? 23

Units of Measurement ? TNE

Work Group Code [RETURN for no Code] ? G11K.0

Percentage [RETURN for 100%]  ? 80

Sub-Contract Item ? N

Bill 1  Section 1  Page 1/ E
Quantity     23     TNE
Work Group G11K.0          80.00%
OK ? N
```

```
        Commands :-
                      QU - Change Quantity
                      UN - Change Units of Measurement
                      AD - Add Work Group
                      CH - Change Percentage
                      DE - Delete Work Group
                      FI - File Item
                      SU - Change to Sub-contract Item
Command ? AD

Work Group Code ? G11L.0

Percentage [RETURN for 100%] ? 50

Bill 1  Section 1  Page 1/ E
Quantity     23     TNE
Work Group 1 G11K.0          80.00%
Work Group 2 G11L.0          50.00%
OK ? Y

Item Filed
Bill 1  Section 1  Page 1/ F
Quantity ? 176

Units of Measurement ? M2

Work Group Code [RETURN for no Code] ?<——— RETURN KEY PRESSED

Sub-Contract Item ? N

Bill 1  Section 1  Page 1/ F
Quantity    176     M2
OK ? Y

Item Filed
Bill 1  Section 1  Page 1/ G
Quantity ? 42

Units of Measurement ? M

Work Group Code [RETURN for no Code] ? HA100H.0

Percentage [RETURN for 100%]  ? 120

Sub-Contract Item ? N

Bill 1  Section 1  Page 1/ G
Quantity     42     M
Work Group HA100H.0      120.00%
OK ? Y

Item Filed
        Commands are :-
                      FU - Full Page
                      SI - Single Item
                      GE - Generate Bill
                      ST - Stop
Command ?
```

following two inputs are correct:

1/1/2
//2

Similarly, where only Section number and Page number are used, the system will assume the previous section number if / is entered instead of the section number.

- The use of the / may be extended to cover any reference that was used in the previous PAGE REFERENCE. Thus /3/49 would represent:

  Bill number 1
  Section number 3
  Page number 49

- Where items are numbered (instead of lettered as described above), the use of the FULL PAGE command, will result in the user being prompted for the first and last item numbers on each page. (In this way the system caters for bills where items are numbered consecutively from the start to the end of the bill, and bills where items are numbered for each page).

```
        Commands are :-
                      FU - Full Page
                      SI - Single Item
                      GE - Generate Bill
                      ST - Stop
Command ? FU

FULL PAGE option
Page Reference ? 3/44

First Item on Page ? 45

Last Item on Page ? 51
```

(ii) Changing the FULL PAGE data:

In the event of the user entering any of the data incorrectly, the program provides full editing facilities. These are shown below. It should be noted that the examples given relate to the data entered for the sample bill page illustrated in (i) above.

Changing the Quantity:

This option allows the user to change the quantity entered into the computer system.

```
Bill 1  Section 1  Page 1/ A
Quantity      17      M3
Work Group FA25A.7         100.00%
OK ? N

      Commands :-
                    QU - Change Quantity
                    UN - Change Units of Measurement
                    AD - Add Work Group
                    CH - Change Percentage
                    DE - Delete Work Group
                    FI - File Item
                    SU - Change to Sub-contract Item
Command ? QU

Quantity ? 27.5

Bill 1  Section 1  Page 1/ A
Quantity      27.5    M3
Work Group FA25A.7         100.00%
OK ?
```

Changing the Units of Measurement:

The units of measurement may also be changed, illustrated as follows.

```
Bill 1  Section 1  Page 1/ A
Quantity      27.5   M3
Work Group FA25A.7         100.00%
OK ? N

      Commands :-
                     QU - Change Quantity
                     UN - Change Units of Measurement
                     AD - Add Work Group
                     CH - Change Percentage
                     DE - Delete Work Group
                     FI - File Item
                     SU - Change to Sub-contract Item
Command ? UN

Units of Measurement ? CU M

Bill 1  Section 1  Page 1/ A
Quantity      27.5   CU M
Work Group FA25A.7         100.00%
OK ?
```

Adding a WORK GROUP:

It is possible to add two work groups together. This has already been shown in the entry of page 1 above (see item E).

Changing the Percentage:

The WORK GROUP percentage may be changed as shown below.

```
Bill 1  Section 1  Page 1/ A
Quantity      27.5   CU M
Work Group FA25A.7         100.00%
OK ? N

      Commands :-
                     QU - Change Quantity
                     UN - Change Units of Measurement
                     AD - Add Work Group
                     CH - Change Percentage
                     DE - Delete Work Group
                     FI - File Item
                     SU - Change to Sub-contract Item
Command ? CH

Percentage [RETURN for 100%] ? 90

Bill 1  Section 1  Page 1/ A
Quantity      27.5   CU M
Work Group FA25A.7          90.00%
OK ?
```

Where two WORK GROUPS have been entered into the system, it is possible to select the percentage to be changed. This is done by choosing the relevant WORK GROUP and entering the new percentage as shown below.

```
Bill 1  Section 1  Page 1/ E
Quantity     23     TNE
Work Group 1 G11K.0          80.00%
Work Group 2 G11L.0          50.00%
OK ? N

      Commands :-
                     QU - Change Quantity
                     UN - Change Units of Measurement
                     CH - Change Percentage
                     DE - Delete Work Group
                     FI - File Item
                     SU - Change to Sub-contract Item
Command ? CH

Work Group 1 or 2 ? 1

Percentage [RETURN for 100%] ? 75

Bill 1  Section 1  Page 1/ E
Quantity     23     TNE
Work Group 1 G11K.0          75.00%
Work Group 2 G11L.0          50.00%
OK ?
```

Deleting a WORK GROUP:

It is possible to delete the WORK GROUP CODE if so wished.

```
Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
Work Group FA25A.7         90.00%
OK ? N

      Commands :-
                     QU - Change Quantity
                     UN - Change Units of Measurement
                     AD - Add Work Group
                     CH - Change Percentage
                     DE - Delete Work Group
                     FI - File Item
                     SU - Change to Sub-contract Item
Command ? DE

Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
OK ?
```

Where two WORK GROUP CODES have been entered for an item, it is possible to select which one is to be deleted. This is done by choosing either the first code (WORK GROUP 1) or the second code (WORK GROUP 2) as shown below.

```
Bill 1  Section 1  Page 1/ E
Quantity      23     TNE
Work Group 1 G11K.0          75.00%
Work Group 2 G11L.0          50.00%
OK ? N

        Commands :-
                  QU - Change Quantity
                  UN - Change Units of Measurement
                  CH - Change Percentage
                  DE - Delete Work Group
                  FI - File Item
                  SU - Change to Sub-contract Item
Command ? DE

Work Group 1 or 2 ? 2

Bill 1  Section 1  Page 1/ E
Quantity      23     TNE
Work Group G11K.0          75.00%
OK ?
```

Filing the Item:

This command instructs the system to store the information previously displayed.

```
Bill 1  Section 1  Page 1/ A
Quantity      27.5   CU M
OK ? N

        Commands :-
                  QU - Change Quantity
                  UN - Change Units of Measurement
                  AD - Add Work Group
                  FI - File Item
                  SU - Change to Sub-contract Item
Command ? FI
```

Changing an item to a sub-contract item:

It may be required to change an item to mark it as being done by a sub-contractor.

```
Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
Work Group FA25A.7        90.00%
OK ? N

        Commands :-
                      QU - Change Quantity
                      UN - Change Units of Measurement
                      AD - Add Work Group
                      CH - Change Percentage
                      DE - Delete Work Group
                      FI - File Item
                      SU - Change to Sub-contract Item
Command ? SU

Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
Work Group FA25A.7        90.00%
Sub-contractor Required
OK ?
```

Changing a Sub-contract item to non-Sub-contract:

It may be required to change an item previously entered as a sub-contract item to one not being undertaken by a Sub-contractor. This is shown below.

```
Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
Work Group FA25A.7        90.00%
Sub-contractor Required
OK ? N

        Commands :-
                      QU - Change Quantity
                      UN - Change Units of Measurement
                      AD - Add Work Group
                      CH - Change Percentage
                      DE - Delete Work Group
                      FI - File Item
                      NS - Change to Non-Sub-contract Item
                      SN - Change Number of Sub-contractors
Command ? NS

Bill 1  Section 1  Page 1/ A
Quantity     27.5   CU M
Work Group FA25A.7        90.00%
OK ?
```

Changing the number of Sub-contractors:

It is also possible to change the number of Sub-contract quotes required for a particular item. The system will allow up to 2 Sub-contract quotes to be awaited for any one item. The manner in which this may be done is shown below.

```
Bill 1  Section 1  Page 1/ B
Quantity    215     M3
Sub-contractor Required
OK ? N

      Commands :-
                 QU - Change Quantity
                 UN - Change Units of Measurement
                 AD - Add Work Group
                 FI - File Item
                 NS - Change to Non-Sub-contract Item
                 SN - Change Number of Sub-contractors
Command ? SN

Number of Sub-contractors ? 2

Bill 1  Section 1  Page 1/ B
Quantity    215     M3
2 Sub-contractors Required
OK ? Y
```

(iii) **Section number 7, Page number 209:**

The printout shown below illustrates the entry of Section 7 Page 209 of the bill of quantities shown in Figure 4.2.

```
      Commands are :-
                 FU - Full Page
                 SI - Single Item
                 GE - Generate Bill
                 ST - Stop
Command ? FU

FULL PAGE option
Page Reference ? 7/209

Last Item on Page ? G

Section 7  Page 209/ A
Quantity ? <---------- RETURN KEY PRESSED OR 0 ENTERED
```

Where zero is entered as a quantity the system assumes that the item in question falls into one of the categories shown. The user should then select the appropriate command.

```
Confirm that this is a no-quantity Item ? Y

      Commands :-
                  IT - Item
                  SP - Prime Cost - Nominated Supplier
                  SC - Prime Cost - Nominated Sub-Contractor
                  PS - Provisional Sum
                  AT - Attendance Allowance
                  PR - Profit Allowance
Command ? IT

Section 7  Page 209/ A
Item
OK ? Y

Item Filed
Section 7  Page 209/ B
Quantity ? <---- RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y

      Commands :-
                  IT - Item
                  SP - Prime Cost - Nominated Supplier
                  SC - Prime Cost - Nominated Sub-Contractor
                  PS - Provisional Sum
                  AT - Attendance Allowance
                  PR - Profit Allowance
Command ? SC

Prime Cost ? 1500

Section 7  Page 209/ B
Prime Cost
(Nominated Sub-Contractor)
   $1,500.00

OK ? Y

Item Filed
Section 7  Page 209/ C
Quantity ? <---- RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y
```

```
        Commands :-
                    IT - Item
                    SP - Prime Cost - Nominated Supplier
                    SC - Prime Cost - Nominated Sub-Contractor
                    PS - Provisional Sum
                    AT - Attendance Allowance
                    PR - Profit Allowance
Command ? PR

Profit Allowance on:- ///B

Not a valid Reference
Please re-enter : //B

Section 7  Page 209/ C
P.C. Profit  on Section 7  Page 209/ B

OK ? Y

Item Filed
Section 7  Page 209/ D
Quantity ? <-------- RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y

        Commands :-
                    IT - Item
                    SP - Prime Cost - Nominated Supplier
                    SC - Prime Cost - Nominated Sub-Contractor
                    PS - Provisional Sum
                    AT - Attendance Allowance
                    PR - Profit Allowance
Command ? AT

Attendance Allowance on:- //B

Section 7  Page 209/ D
Attendance   on Section 7  Page 209/ B

OK ? Y

Item Filed
Section 7  Page 209/ E
Quantity ? <-------- RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y

        Commands :-
                    IT - Item
                    SP - Prime Cost - Nominated Supplier
                    SC - Prime Cost - Nominated Sub-Contractor
                    PS - Provisional Sum
                    AT - Attendance Allowance
                    PR - Profit Allowance
Command ? SP

Prime Cost ? 900
```

```
Section 7  Page 209/ E
Prime Cost
(Nominated Supplier)
     $900.00

OK ? Y

Item Filed
Section 7  Page 209/ F
Quantity ? <———————— RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y

      Commands :-
                   IT - Item
                   SP - Prime Cost - Nominated Supplier
                   SC - Prime Cost - Nominated Sub-Contractor
                   PS - Provisional Sum
                   AT - Attendance Allowance
                   PR - Profit Allowance
Command ? PR

Profit Allowance on:- //E

Section 7  Page 209/ F
P.C. Profit  on Section 7  Page 209/ E

OK ? Y

Item Filed
Section 7  Page 209/ G
Quantity ? <———————— RETURN KEY PRESSED

Confirm that this is a no-quantity Item ? Y

      Commands :-
                   IT - Item
                   SP - Prime Cost - Nominated Supplier
                   SC - Prime Cost - Nominated Sub-Contractor
                   PS - Provisional Sum
                   AT - Attendance Allowance
                   PR - Profit Allowance
Command ? PS

Provisional Sum ? 250

Section 7  Page 209/ G
Prov. Sum
     $250.00

OK ? Y

Item Filed
      Commands are :-
                   FU - Full Page
                   SI - Single Item
                   GE - Generate Bill
                   ST - Stop
Command ? _
```

(iv) Changing the FULL PAGE data (continued):

The examples below all refer to Section number 7, Page number 209 (i.e. Figure 4.2).

Changing a P.C. or Provisional Sum:

The prompts for changing the sums entered for P.C. sub-contractors, P.C. suppliers and Provisional sums are all similar to those shown below.

```
Section 7  Page 209/ B
Prime Cost
(Nominated Sub-Contractor)
   $1,500.00

OK ? N

Commands :-
                    CS - Change Sum
                    DF - Delete Item from File
                    CT - Change Type
                    FI - File Item
Command ? CS

Sum ? 2500

Section 7  Page 209/ B
Prime Cost
(Nominated Sub-Contractor)
   $2,500.00

OK ?
```

Changing the type of 'no-quantity' item:

This may be done as shown below.

```
Section 7  Page 209/ C
P.C. Profit  on Section 7  Page 209/ B

OK ? N

Commands :-
                    CI - Change Item this is Profit on
                    DF - Delete Item from File
                    CT - Change Type
                    FI - File Item
Command ? CT
```

```
Commands :-
                    IT - Item
                    SP - Prime Cost - Nominated Supplier
                    SC - Prime Cost - Nominated Sub-Contractor
                    PS - Provisional Sum
                    AT - Attendance Allowance
                    PR - Profit Allowance
Command ? AT

Section 7  Page 209/ C
Attendance   on Section 7  Page 209/ B

OK ?
```

Changing the item referred to for Profit and Attendance:

The item referred to in Profit and Attendance items may be changed as shown below.

```
Section 7  Page 209/ C
Attendance   on Section 7  Page 209/ B

OK ? N

Commands :-
                    CI - Change Item this is Attendance on
                    DF - Delete Item from File
                    CT - Change Type
                    FI - File Item
Command ? CI

Bill Item this is Attendance on ? ///A

Not a valid Reference
Please re-enter :  //A

Section 7  Page 209/ C
Attendance   on Section 7  Page 209/ A

OK ? Y
```

B. SINGLE PAGE:

The main use of this command is to enable the user to make changes to the bill of quantities once it has been entered into the computer system. These changes may result from instructions obtained from the professional quantity surveyor, or from incorrect entry of data. The manner in which this may be done is illustrated as follows.

```
        Commands are :-
                      FU - Full Page
                      SI - Single Item
                      GE - Generate Bill
                      ST - Stop
Command ? SI

SINGLE ITEM option
Item Reference ? 1/1/1/D

Item is already on File.  Do you wish to Inspect it? Y

Bill 1  Section 1  Page 1/ D
Quantity      54     M3
Work Group FB18D.3        100.00%
Sub-contractor Required
OK ? N

        Commands :-
                      QU - Change Quantity
                      UN - Change Units of Measurement
                      AD - Add Work Group
                      CH - Change Percentage
                      DE - Delete Work Group
                      FI - File Item
                      NS - Change to Non-Sub-contract Item
                      SN - Change Number of Sub-contractors
Command ?
```

The editing facilities provided are similar to those described in A. (FULL PAGE) above.

<u>NOTE</u>:

- Changes may only be made to items in the manner described above <u>before</u> they are INSPECTED by the estimator. (See Chapter 5).

- Where items have already been INSPECTED, the user will not be able to make any changes, and will receive a display similar to that shown as follows.

```
Command ? SI

SINGLE ITEM option
Item Reference ? 1/1/1/E

Item is already on File.  Do you wish to Inspect it? Y

Bill 1  Section 1  Page 1/ E
Quantity      23      TNE
Work Group G11K.0          75.00%
Item already Priced by Estimator
      Commands are :-
                  FU - Full Page
                  SI - Single Item
                  GE - Generate Bill
                  ST - Stop
Command ?
```

C. GENERATE BILL:

This command serves two purposes:

(i) it instructs the computer system to check through the bill items entered and to ensure that they are in the correct sequence;

(ii) it instructs the system to allocate storage space for the estimators calculations that will follow in the next stage of the estimating process.

```
      Commands are :-
                  FU - Full Page
                  SI - Single Item
                  GE - Generate Bill
                  ST - Stop
Command ? GE

GENERATE BILL option
   7 bill items now on file

End of Run
 STOP
```

NOTE:

- It is only necessary to use this command when the whole bill has been entered into the computer system.

D. STOP:

As the command suggests, this instruction allows the user to stop work. He may do so at any stage during the entry of the bill items. Those items which have already been entered are retained by the computer. Upon re-starting work, the remaining items may be entered by using the commands described above.

```
      Commands are :-
                    FU - Full Page
                    SI - Single Item
                    GE - Generate Bill
                    ST - Stop
Command ? ST

End of Run
 STOP
```

5. CALCULATION OF ITEM RATES

5.0 GENERAL

The estimating system enables the user to price bill items using data from a library of WORK GROUPS already stored in the computer. This allows item rates to be calculated using traditional unit rate methods. The link between the data library and the item which is to be priced is made by use of a WORK GROUP CODE as previously described.

In certain cases it will be found that no suitable WORK GROUP CODE or performance data exists. In these instances the system provides alternative facilities which enable the estimator to build up a rate from first principles. This may be done either on a unit rate or a 'spot' rate basis and is described below.

5.1 STARTING THE PROGRAM

The computer system should be started using the standard procedure. Once this has been done it is necessary to select the program which allows the estimating calculations to be performed. This is done by typing WS5RUN into the VDU. The system will then request the CONTRACT IDENTIFIER and PASSWORD for the contract in question. This information should be obtained from the person in charge of the estimating system (see Chapter 8). The system will then respond by displaying a menu of commands. This is the Main Menu of commands from which all estimating facilities originate.

```
9C>WS5RUN

INTEREST-BUILD System 5.
Estimator's Program

Contract Identifier ? WIL

Password ? BLUE

Contract is:
USER MANUAL DEMONSTRATION
                         MAIN MENU
                         ---------
        Commands :-
                         IN - Inspect Item
                         SU - Sub-Contract Quotes
                         UP - Update Prices
                         AP - Apply Mark-Ups
                         PR - Print Reports
                         HE - Set HELP Level
                         ST - Stop

Command ?
```

The commands included in this menu provide the estimator with the necessary facilities to enable him to price items found in bills of quantities. In order to instigate the required option, all that is necessary is for the user to enter the first two letters of that command. Each command relevant to the estimating procedure is described below.

5.2 INSPECTING ITEMS

This command enables the estimator to inspect the items entered into the system by the keyboard operator (as described in Chapter 4).

It is important to note that all items need to be INSPECTED by the estimator for them to be included in the final estimate figure (i.e. to be transferred to the FILE OF CONTRACT DETAILS - see Chapter 3).

The only exceptions to this rule are:

- items <u>only</u> requiring the entry of a Domestic Sub-contract quote do not have to be INSPECTED (see 7.2).

- P.C. sums and Provisional sums do not have to be INSPECTED (see 10.2).

- items for profit on Nominated Suppliers and Nominated Sub-contractors do not have to be INSPECTED (see 6.2.2 and 10.3.1(a)).

After entering the IN command, the estimator is then requested to enter an ITEM REFERENCE. This should be done by using one of the two methods shown below:

BILL NUMBER → 1/1/1/A ← ITEM LETTER/NUMBER

SECTION NUMBER

PAGE NUMBER

1/1/A ← ITEM LETTER/NUMBER

SECTION NUMBER

PAGE NUMBER

The method which is appropriate to the tender in question will already have been defined to enable the entry of the bill to take place (see Chapter 4). It will therefore be necessary to check to ensure that the same method is chosen. (For further explanatory notes on this aspect see 4.2.3.A.(i)).

```
                    MAIN MENU
                    ---------
         Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

      Command ? IN

      INSPECT ITEM option
      Item Reference ? 1/1/1/A

      Pricing Item from Data Library
```

There will then be a short pause while the system locates the data relevant to this item.

At this stage the system provides 3 different facilities:

- Where a WORK GROUP CODE has been entered into the system (as described in Chapter 4), the relevant WORK GROUP will be displayed.

- Where no WORK GROUP CODE has been entered, alternative facilities are provided to enable the estimator to build up a rate from first principles.

- Facilities are also proved to enable the estimator to build up a rate on a 'spot' basis.

These facilities are illustrated below. Wherever possible the examples given relate to the sample bill of quantities page shown in Figure 4.1.

5.2.1 PRICING AN ITEM USING A WORK GROUP CODE

In the example following, a WORK GROUP CODE has been entered into the system at the bill entry stage (see Chapter 4).

```
                    MAIN MENU
                    ---------
         Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

Command ? IN

INSPECT ITEM option
Item Reference ? 1/1/1/A

Pricing Item from Data Library
Bill 1  Section 1  Page 1/ A
Quantity    17    M3
Work Group FA25A.7
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
------------------------------------------------------------------------------
                                                        Weight
Code         Description              Cost/HR     Usage   Factor     Cost/M3
----         -----------              ---------   -----   ------     ---------
L2    LABOURER (CONC)      -            $2.85     2.650   100.0%       $7.55
                                      Net.                Wastages
Code         Description              Cost/Unit   Usage   Per Unit   Cost/M3
----         -----------              ---------   -----   --------   ---------
M105  CONCRETE             -          $19.00/M3   1.000     7.5%      $20.43*
------------------------------------------------------------------------------
                       TOTAL LABOUR     COST/M3              $7.55
                       TOTAL MATERIAL   COST/M3             $20.43
                                                        ------------
                       TOTAL NET COST/M3                    $27.98
------------------------------------------------------------------------------
```

This display represents the WORK GROUP stored in the system under the code FA25A.7.

If the estimator wishes to make any change to this WORK GROUP or if he wishes to file it away, the RETURN key should be pressed. The note below will then be displayed by the computer.

```
      BILL ITEM EDIT option
```

There will then be a short delay, after which the sub-menu below will be displayed.

```
Commands :-
                      QU - Change Bill Item Quantity
                      UN - Change Units of Measurement
                      FI - FILE Bill Item
                      VI - VIEW Work Groups
                      RR - Display Resource Reconciliation
                      LU - Lump Other Bill Items with this One
                      RP - Reprice Item
                      CH - Change Percentage of work group
                      ED - Edit work group
                      DE - Delete work group
                      AD - Add work group
Command ?
```

Each of these commands is described below. It is only necessary to enter the first two letters of a command in order to call up the facilities provided.

(a) Changing the Bill Item Quantity:

This command may be used to change the bill item quantity presented in the item build-up above.

```
Command ? QU

Input New Quantity for Bill Item ? 25
```

(b) Changing the Units of Measurement:

If the units of measurement have been incorrectly entered, they may be changed by using this facility.

```
Command ? UN

Units of Measurement ? CU M
```

(c) Filing the Bill Item:

When the estimator is satisfied with the build-up, he may instruct the system to store it by using this command.

```
Command. ? FI

Item Filed
```

NOTE:

- FILING the item does not stop the estimator changing it again at a later stage. If he does wish to make an alteration, he may INSPECT it as described above.

After having FILED an item, the following prompt will be displayed by the system.

```
INSPECT ITEM option.
Item Reference ?
```

This enables the estimator to INSPECT a new item by entering that item's Bill/Section/Page/Item reference.

(d) Viewing the WORK GROUP:

It is possible for the estimator to view the WORK GROUP by using this command. He may wish to do this to see the effect of the changes he has made.

```
Command ? VI

Bill 1  Section 1  Page 1/ A
Quantity    25    CU M
Work Group FA25A.7
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
---------------------------------------------------------------------------------
                                                             Weight
Code        Description              Cost/HR       Usage     Factor      Cost/CU M
----        -----------              ---------     -----     ------      ---------
L2    LABOURER (CONC)     -            $2.85       2.650     100.0%        $7.55
                                     Net.                    Wastages
Code        Description              Cost/Unit     Usage     Per Unit    Cost/CU M
----        -----------              ---------     -----     --------    ---------
M105  CONCRETE            -          $19.00/M3     1.000       7.5%       $20.43
---------------------------------------------------------------------------------
                    TOTAL LABOUR      COST/CU M                $7.55
                    TOTAL MATERIAL    COST/CU M               $20.43
                                                        -------------
                    TOTAL NET COST/CU M                       $27.98
---------------------------------------------------------------------------------
```

(e) Displaying the Resource Reconciliation:

This facility enables the estimator to view the total quantity of resources used in the build-up.

```
Command ? RR

RESOURCE RECONCILIATION option
Code   Description                                        Amount
----   -----------                                        ------
L2     LABOURER (CONC)                                    66.25  HR
M105   CONCRETE MIX A                                     26.875 CU M
                                              Press RETURN to continue
```

NOTE:

- This facility aggregates all occurrences of similar resources contained within a build-up. For example, if a build-up contains a particular resource which is used to perform several operations (e.g. a carpenter making, fixing and striking an item of formwork), all hours expended by the carpenter are collected into a total number of hours.

- Where resource GANGS are used, the RECONCILIATION splits them up into their constituent resources. For example a brickwork gang consisting of 2 bricklayers and 1 labourer will be presented in the RECONCILIATION in terms of bricklayer hours and labourer hours (and not in GANG hours).

(f) Lumping other Bill Items with this one:

This command instructs the computer system to search for all bill items which have been entered into the system with the same WORK GROUP CODE as the item being worked on.

It is then possible to price all these items in an identical manner to the item being worked on.

In the example below there are 4 other items contained in page 3 of the bill which have been entered with the same WORK GROUP CODE as Bill 1, Section 1, Page 1, Item A.

```
Command ? LU

Item Filed
LUMP ITEMS option
    List of Bill References
    ----------------------

  Bill 1  Section 1  Page 3/ A
  Bill 1  Section 1  Page 3/ B
  Bill 1  Section 1  Page 3/ C
  Bill 1  Section 1  Page 3/ D
```

The system then provides the estimator with the facility to add to or delete from this list of bill items. In the example below an additional item B on page 2 of the bill of quantities is considered similar to the items being worked on, and is added to the list.

```
     Commands :-
                AD - Add Bill Reference
                DE - Delete Bill Reference
                FI - File all References
Command ? AD

Item Reference ? 1/1/2/B

     List of Bill References
     -----------------------

  Bill 1  Section 1  Page 2/ B
  Bill 1  Section 1  Page 3/ A
  Bill 1  Section 1  Page 3/ B
  Bill 1  Section 1  Page 3/ C
  Bill 1  Section 1  Page 3/ D
```

It is also possible for the estimator to delete an item from this list. In the example below Bill 1 Section 1 Page 3 Item D is removed from the list.

```
        Commands :-
                   AD - Add Bill Reference
                   DE - Delete Bill Reference
                   FI - File all References
Command ? DE

Item Reference ? 1/1/3/D

     List of Bill References
     -----------------------

   Bill 1  Section 1  Page 2/ B
   Bill 1  Section 1  Page 3/ A
   Bill 1  Section 1  Page 3/ B
   Bill 1  Section 1  Page 3/ C
```

When the estimator is satisfied with the list of bill items to be priced in the same way as the item he is working on, he should FILE the list. This command automatically prices all items in the same manner as the original item.

```
        Commands :-
                   AD - Add Bill Reference
                   DE - Delete Bill Reference
                   FI - File all References
Command ? FI

   Reference Filed - Bill 1  Section 1  Page 2/ B
   Reference Filed - Bill 1  Section 1  Page 3/ A
   Reference Filed - Bill 1  Section 1  Page 3/ B
   Reference Filed - Bill 1  Section 1  Page 3/ C

All References been Filed
```

<u>NOTE</u>:

- It is <u>not</u> possible to make any changes to the LUMPED items.
- It is only possible to change the original item, and in that case all the LUMPED items will reflect the alterations.

(g) Removing the Pricing Information:

This command removes <u>all</u> pricing information for the item in question.

```
Command ? RP

Removing Price Information
```

The system then provides the estimator with alternative ways of pricing the item. These options are described in detail in 5.2.2.

```
PRICE ITEM option
      Commands :-
                 KN - Known Group
                 UN - Unknown Group
                 SP - Spot Rate
                 IN - Included In
      Press RETURN to return to Main Menu
Command ?
```

(h) Changing the Percentage of the WORK GROUP:

This facility allows the estimator to change the percentage which is applied to the whole WORK GROUP. In the example below, all usage rates contained in WORK GROUP FA25A.7 will be multiplied by 150%.

```
Command ? CH

Input New Work Group Percentage ? 150
```

If the estimator wishes to see the effect of this change he should use the VI command shown below.

```
Command ? VI

Bill 1   Section 1   Page 1/ A
Quantity    25    CU M
Work Group FA25A.7          150.0%
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
-----------------------------------------------------------------------
                                                      Weight
Code       Description          Cost/HR    Usage     Factor    Cost/CU M
----       -----------          -------    -----     ------    ---------
L2    LABOURER (CONC)            $2.75     3.975     100.0%     $10.93*
                                Net.                 Wastages
Code       Description          Cost/Unit  Usage     Per Unit  Cost/CU M
----       -----------          ---------  -----     --------  ---------
M105  CONCRETE MIX A            $27.00/CU  1.500      7.5%      $43.54
-----------------------------------------------------------------------
                  TOTAL LABOUR      COST/CU M          $10.93
                  TOTAL MATERIAL    COST/CU M          $43.54
                                                 -------------
                  TOTAL NET COST/CU M                  $54.47
-----------------------------------------------------------------------
                                         Press RETURN to Continue
```

(i) **Editing the WORK GROUP:**

If the estimator wishes to make any change to the resources used in the WORK GROUP, he should use this command. A sub-menu will then be displayed, the contents of which are described below.

```
Command ? ED

EDIT WORK GROUP option
     Commands :-
                   AD - Add resource
                   DE - Delete resource
                   CH - Change resource
                   VI - View bill item

Command ?
```

· **Adding a Resource:**

This command allows the estimator to add a new resource into the WORK GROUP. Each resource is identified by a RESOURCE CODE, and the estimator will have to locate the required resource from a print-out of resources held on the COMPANY RESOURSE COST FILES (see 8.9).

In the example below, the estimator decides to add in a dumper. He finds that the RESOURCE CODE for the dumper is

P3 and enters this code into the system. The commands that follow (i.e. Description Extension? and Usage Rate? are described in 5.2.2.(b)).

```
        Commands :-
                    AD - Add resource
                    DE - Delete resource
                    CH - Change resource
                    VI - View bill item

Command ? AD

Resource Code (END to finish) ? P3

                      Description - DUMPER 1M3
                      Cost        -       3.500 $/HR     (used)
OK ? Y

Description Extension ? <---- RETURN KEY PRESSED

Usage Rate ? .5

Resource Code (END to finish) ? END
```

NOTE:

- It is also possible to create a new SINGLE and GANG resource at this stage, i.e. if no suitable resource is held on the CONTRACT RESOURCE COST FILES (see Figure 3.1) a new one may be entered. This is done by calling up a RESOURCE CODE that has not been used before. In the example below a new SINGLE resource is entered.

```
Command ? AD

Resource Code (END to finish) ? M203

Resource not on File
Do you wish to enter a new Resource ? Y

Description ? PLASTISIZER

Cost ? 15

Units of Measurement ? L

Discount (%) ? 7.5

Supplier's Name ? FRED SMITH LTD

Quotes Required ? Y
```

The facilities enabling a new resource to be entered are described in 8.8.1.

The commands enabling this resource to be used in the build-up in question are as before, and are shown below.

```
Description Extension ? <------ RETURN KEY PRESSED

Usage Rate ? .5

Wastage (%) ? 0

Resource Code (END to finish) ? END
```

NOTE:

- The maximum number of resources that can be contained in any build-up on the CONTRACT files is 12. These may be either SINGLE or GANG resources.

Deleting a Resource:

Similarly it is possible to delete a resource from those included in the WORK GROUP.

```
     Commands :-
                 AD - Add resource
                 DE - Delete resource
                 CH - Change resource
                 VI - View bill item

Command ? DE

Resource Code ? L2

                                                            Weight
Code        Description            Cost      Usage      Factor
----        -----------         -------      -----      ------
L2    LABOURER (CONC)     -       $2.75*     3.975      100.0%
Delete this Resource [RETURN to continue]
                                   <------ RETURN KEY PRESSED.
Item Deleted
```

Changing a Resource:

It is also possible to make various changes to the resources contained in a WORK GROUP. In the examples below changes to resource M105 are illustrated.

```
        Commands :-
                     AD - Add resource
                     DE - Delete resource
                     CH - Change resource
                     VI - View bill item

Command ? CH

Resource Code ? M105

                                           Net.                          Wastages
Code           Description              Cost/Unit     Usage             Per Unit
----           -----------              ---------     -----            ---------
M105   CONCRETE MIX A       -            $27.00       1.500               7.5%
       Commands :-
                     EX - Change Extension
                     US - Change Usage Rate
                     WA - Change Wastage per Unit
       Press RETURN to exit

Command ? EX

Description Extension ? R.MIX

        Commands :-
                     EX - Change Extension
                     US - Change Usage Rate
                     WA - Change Wastage per Unit
        Press RETURN to exit

Command ? US

Usage Rate ? 1.15

        Commands :-
                     EX - Change Extension
                     US - Change Usage Rate
                     WA - Change Wastage per Unit
        Press RETURN to exit

Command ? WA

Wastage (%) ? 16

        Commands :-
                     EX - Change Extension
                     US - Change Usage Rate
                     WA - Change Wastage per Unit
        Press RETURN to exit

Command ?
```

Viewing the Bill Item:

In order to see the affect of the alterations above it is necessary to select the VI command. This is illustrated below. Note that the contents of the WORK GROUP shown reflect the changes described above.

```
  Commands :-
               AD - Add resource
               DE - Delete resource
               CH - Change resource
               VI - View bill item

Command ? VI

Bill 1  Section 1  Page 1/ A
Quantity    25    CU M
Work Group FA25A.7          150.0%
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
--------------------------------------------------------------------------
                                                        Weight
Code        Description            Cost/HR    Usage     Factor    Cost/CU M
----        -----------            ---------  -----     ------    ---------
P3    DUMPER 1M3         -          $3.50     .500      100.0%      $1.75
                                   Net.                 Wastages
Code        Description            Cost/Unit  Usage     Per Unit  Cost/CU M
----        -----------            ---------  -----     --------  ---------
M105  CONCRETE MIX A     -R.MIX    $27.00/CU  1.150       16.0%     $36.02
M203  PLASTISIZER        -         $13.88/L    .500        0.0%      $6.94*
--------------------------------------------------------------------------
                      TOTAL PLANT     COST/CU M          $1.75
                      TOTAL MATERIAL  COST/CU M         $42.96
                                                  -------------
                      TOTAL NET COST/CU M               $44.71
--------------------------------------------------------------------------
                                            Press RETURN to Continue
```

(j) Deleting a WORK GROUP:

This command enables the estimator to delete a WORK GROUP from the build-up for a particular item. In the example below, the WORK GROUP already contained for 1/1/1/A is deleted.

```
Command ? DE

Delete Work Group [RETURN to Continue]
```

If the RETURN key is pressed, the estimator is provided with further facilities. These are described below.

Changing the Bill Item Quantity:

This facility has already been described in 5.2.1.

Changing the Units of Measurement:

This facility is similar to that already described in 5.2.1.

Adding a New WORK GROUP:

This command allows the estimator to add a new WORK GROUP for the item in question.

```
Commands :-
                  QU - Change Bill Item Quantity
                  UN - Change Units of Measurement
                  AD - Add work group
Command ? AD

Work Group Code ? FA25A.7

FA25A.7      :- CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)

Input New Work Group Percentage ? 125
Commands :-
                  QU - Change Bill Item Quantity
                  UN - Change Units of Measurement
                  FI - FILE Bill Item
                  VI - VIEW Work Groups
                  RR - Display Resource Reconciliation
                  LU - Lump Other Bill Items with this One
                  RP - Reprice item
                  CH - Change Percentage of work group
                  ED - Edit work group
                  DE - Delete work group
                  AD - Add work group
Command ?
```

NOTE:

- Where a build-up for a bill item contains two WORK GROUPS (as shown in (k) below), the DELETE facility enables the estimator to select which WORK GROUP he wants to delete. This is shown as follows.

```
Command ? DE

Delete Work Group [RETURN to Continue]<------ RETURN KEY PRESSED.

Work Group 1 or Work Group 2 ? 2

Commands :-
                  QU - Change Bill Item Quantity
                  UN - Change Units of Measurement
                  FI - FILE Bill Item
                  VI - VIEW Work Groups
                  RR - Display Resource Reconciliation
                  LU - Lump Other Bill Items with this One
                  RP - Reprice Item
                  CH - Change Percentage of work group
                  ED - Edit work group
                  DE - Delete work group
                  AD - Add work group
Command ?
```

WORK GROUP 1 refers to the first **WORK GROUP** contained in the build-up and **WORK GROUP 2** refers to the second (see (k) below).

(k) Adding a WORK GROUP:

It is possible to add a second WORK GROUP to the contents of the bill item. This may be done as shown below.

```
Command ? AD

Work Group Code ? FA25A.7

FA25A.7      :- CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)

Input New Work Group Percentage ? 125

Commands :-
                  QU - Change Bill Item Quantity
                  UN - Change Units of Measurement
                  FI - FILE Bill Item
                  VI - VIEW Work Groups
                  RR - Display Resource Reconciliation
                  LU - Lump Other Bill Items with this One
                  RP - Reprice Item
                  CH - Change Percentage of work group
                  ED - Edit work group
                  DE - Delete work group
Command ?
```

It is then possible to view the contents of this build-up by using the VI command.

```
Command ? VI

Bill 1  Section 1  Page 1/ A
Quantity    25    CU M
Work Group FA25A.7          125.0%
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
--------------------------------------------------------------------------------
                                                           Weight
Code         Description               Cost/HR    Usage    Factor    Cost/CU M
----         -----------               ---------  -----    ------    ---------
L2    LABOURER (CONC)       -            $2.75    3.313    100.0%      $9.11*
                                       Net.                Wastages
Code         Description               Cost/Unit  Usage    Per Unit  Cost/CU M
----         -----------               ---------  -----    --------  ---------
M105  CONCRETE MIX A        -          $27.00/CU  1.250      7.5%     $36.28
--------------------------------------------------------------------------------
                      TOTAL LABOUR     COST/CU M              $9.11
                      TOTAL MATERIAL   COST/CU M             $36.28
                                                          ------------
                      TOTAL NET COST/CU M                    $45.39
--------------------------------------------------------------------------------
                                                 Press RETURN to Continue
```

The WORK GROUP above is the original one entered for this item. The system refers to this WORK GROUP as 'WORK GROUP 1'.

If the RETURN key is pressed, the second WORK GROUP is displayed. This is the WORK GROUP added as described above, and referred to as 'WORK GROUP 2'.

```
Work Group FA25A.7          125.0%
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
--------------------------------------------------------------------------
                                                          Weight
Code        Description             Cost/HR     Usage     Factor    Cost/CU M
----        -----------             -------     -----     ------    ---------
L2    LABOURER (CONC)     -           $2.75     3.313     100.0%       $9.11*
                                    Net.                  Wastages
Code        Description             Cost/Unit   Usage     Per Unit  Cost/CU M
----        -----------             ---------   -----     --------  ---------
M105  CONCRETE MIX A      -         $27.00/CU   1.250       7.5%      $36.28
--------------------------------------------------------------------------
                      TOTAL LABOUR     COST/CU M              $9.11
                      TOTAL MATERIAL   COST/CU M             $36.28
                                                          -----------
                      TOTAL NET COST/CU M                    $45.39
--------------------------------------------------------------------------
                TOTAL COST/CU M (For Both Work Groups)       $90.78
                                                          ===========
                                            Press RETURN to Continue

BILL ITEM EDIT option
Commands :-
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    FI - FILE Bill Item
                    VI - VIEW Work Groups
                    RR - Display Resource Reconciliation
                    LU - Lump Other Bill Items with this One
                    RP - Reprice Item
                    CH - Change Percentage of work group
                    ED - Edit work group
                    DE - Delete work group
Command ?
```

← RETURN KEY PRESSED.

5.2.2 PRICING AN ITEM FROM FIRST PRINCIPLES

Where no WORK GROUP CODE has been entered into the system at the bill entry stage (see Chapter 4), the system provides the estimator with alternative ways of pricing the item in question.

```
                         MAIN MENU
                         ---------
            Commands :-
                         IN - Inspect Item
                         SU - Sub-Contract Quotes
                         UP - Update Prices
                         AP - Apply Mark-Ups
                         PR - Print Reports
                         HE - Set HELP Level
                         ST - Stop

     Command ? IN
```

```
INSPECT ITEM option
Item Reference ? 1/1/1/F

PRICE ITEM option
      Commands :-
                   KN - Known Group
                   UN - Unknown Group
                   SP - Spot Rate
                   IN - Included In
      Press RETURN to return to Main Menu
Command ?
```

NOTE:

- The estimator may skip from one item to another by entering the desired ITEM REFERENCE into the system.

- He does not have to start at the beginning of the bill and progress to the end.

(a) Pricing using the KNOWN GROUP command:

This command gives the estimator the opportunity of pricing the item using data stored in the FILE OF PERFORMANCE DATA. To do this he needs to select a WORK GROUP CODE appropriate to the item in question and enter it into the system as shown below.

```
PRICE ITEM option
      Commands :-
                   KN - Known Group
                   UN - Unknown Group
                   SP - Spot Rate
                   IN - Included In
      Press RETURN to return to Main Menu
Command ? KN

KNOWN WORK GROUP option
Bill 1  Section 1  Page 1/ F
Quantity     176     M2
Work Group Code ? FA25A.7
```

```
Bill 1  Section 1  Page 1/ F
Quantity   176    M2
Work Group FA25A.7
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
------------------------------------------------------------------------------
                                                          Weight
Code         Description              Cost/HR     Usage      Factor     Cost/M2
----         -----------              ---------   -----      ------     ---------
L2    LABOURER (CONC)       -             $2.75   2.650      100.0%      $7.29*
                                      Net.                   Wastages
Code         Description              Cost/Unit   Usage      Per Unit   Cost/M2
----         -----------              ---------   -----      --------   ---------
M105  CONCRETE MIX A        -         $27.00/CU   1.000        7.5%      $29.03
------------------------------------------------------------------------------
                  TOTAL LABOUR     COST/M2                 $7.29
                  TOTAL MATERIAL   COST/M2                $29.03
                                                     -------------
                  TOTAL NET COST/M2                       $36.31
------------------------------------------------------------------------------
                                              Press RETURN to Continue
                                       <------RETURN KEY PRESSED
BILL ITEM EDIT option
Commands :-
                 QU - Change Bill Item Quantity
                 UN - Change Units of Measurement
                 FI - FILE Bill Item
                 VI - VIEW Work Groups
                 RR - Display Resource Reconciliation
                 LU - Lump Other Bill Items with this One
                 RP - Reprice Item
                 CH - Change Percentage of work group
                 ED - Edit work group
                 DE - Delete work group
                 AD - Add work group
Command ?
```

The facilities provided at this stage are similar to those described in 5.2.1.

(b) Pricing using the UNKNOWN GROUP command:

This facility enables the estimator to build up an item rate from first principles by entering resources and performance data into the system. This is shown as follows.

```
INSPECT ITEM option
Item Reference ? 1/1/1/F

PRICE ITEM option
     Commands :-
               KN - Known Group
               UN - Unknown Group
               SP - Spot Rate
               IN - Included In
     Press RETURN to return to Main Menu
Command ? UN

UNKNOWN WORK GROUP option
Bill 1  Section 1  Page 1/ F
Quantity   176    M2
Classification ?
```

At this stage the estimator is asked for a classification. This is the first level of the INTEREST-BUILD Classification relevant to the item of work in question. In this case 1/1/1/F (as shown in Figure 4.1) is an item of formwork. Reference to the INTEREST-BUILD classification will show that the first level for formwork is H. This should then be entered into the system. The estimator is then presented with the menu of commands shown below.

```
Classification ?  H

EDIT WORK GROUP option
     Commands :-
               AD - Add resource
               DE - Delete resource
               CH - Change resource
               VI - View bill item
Command ?
```

In order to enter a resource for this item, the AD command should be selected. The estimator is then able to enter a resource of his choosing into the system by entering the appropriate RESOURCE CODE. This is shown below.

```
Command ? AD

Resource Code (END to finish) ? L34

                    Description - CARPENTER (FORMWORK)
                    Cost        -       3.100 $/HR     (used)
OK ? Y
```

The estimator is then asked for a DESCRIPTION EXTENSION. This facility allows the resource description to be amplified in order to identify the task being performed by that resource. In the example shown below the estimator has selected a carpenter (resource L34) to make the formwork for item in question (see Figure 4.1). He may thus wish to enter 'make' as a RESOURCE ENTENSION. This is shown below.

NOTE:

- Only 8 characters are allowed for the RESOURCE EXTENSION (including blank spaces).

- If no RESOURCE EXTENSION is required, the RETURN key should be pressed.

```
Description Extension ? MAKE
```

The system then requests a USAGE RATE. This is the usage (or output) constant selected by the estimator as suitable for the work to be performed by the resource.

```
Usage Rate ? 1.75
```

In the case of formwork items (i.e. build-ups with a first level INTEREST BUILD classification of H), the system will then request the NUMBER OF USES. This enables the estimator to make the necessary allowances for the anticipated number of uses for the item of formwork in question.

```
Number of Uses ? 5
```

At this stage the system will again request a RESOURCE CODE, so allowing the estimator to continue entering resources for this particular item.

```
Resource Code (END to finish) ? L34

                          Description - CARPENTER (FORMWORK)
                          Cost        -        3.100 $/HR      (used)
OK ? Y

Description Extension ? ERECT

Usage Rate ? .8

Number of Uses ? 1
```

Resource GANGS/GROUPS may be entered in a similar manner to that described above.

```
Resource Code (END to finish) ? XG1

*****************************************************************************
XG1      SFTWD/UNLD/NAILS                                           (used)

M67    SOFTWOOD
                                        $125.00 * 1.00 M3          $125.00
L6     LABOURER (UNLOAD)
                                          $2.25 * 1.00 HR            $2.25
M68    NAILS
                                          $0.90 * 7.00 KG            $6.30
                                                                -----------
                                                                   $133.55
                                           Divided by   1.0
                                                                -----------
                                          Gang Cost /M3            $133.55
*****************************************************************************
OK ? Y

Description Extension ? <---- RETURN KEY PRESSED.

Usage Rate ? .035

Number of Uses ? 5
```

Where a Material or a Resource Group is entered, the system will also request an allowance for WASTAGE to be entered.

```
Wastage (%) ? 10

Resource Code (END to finish) ? XG2

******************************************************************************
XG2      18MM PLY/UNLD/NAILS                                          (used)

M66     PLYWOOD (EXT) 18MM
                                          $4.98 * 1.00 M2              $4.98
L6      LABOURER (UNLOAD)
                                          $2.25 *  .05 HR              $0.11
M68     NAILS
                                          $0.90 *  .20 KG              $0.18
                                                                   ---------
                                                                       $5.27
                                            Divided by   1.0
                                                                   ---------
                                           Gang Cost /M2               $5.27
******************************************************************************
OK ? Y

Description Extension ? <------ RETURN KEY PRESSED

Usage Rate ? 1

Number of Uses ? 5

Wastage (%) ? 15

Resource Code (END to finish) ?
```

When the estimator has finished entering resources for the item, he should key in END. The system will then respond with the menu of commands shown below.

```
Resource Code (END to finish) ? END

     Commands :-
                 AD - Add resource
                 DE - Delete resource
                 CH - Change resource
                 VI - View bill item

Command ?
```

If the estimator then wishes to see the build-up he should select the VI command.

```
Command ? VI

Bill 1  Section 1  Page 1/ F
Quantity   176     M2
Classification H
-----------------------------------------------------------------------------
                                                     No of  Weight
Code         Description           Cost/HR    Usage  Uses   Factor     Cost/M2
----         -----------           --------   -----  -----  ------    ---------
L34   CARPENTER (FORMWORK)-MAKE      $3.10    1.750  5.0   100.0%        $1.08
L34   CARPENTER (FORMWORK)-ERECT     $3.10     .800  1.0   100.0%        $2.48
                                   Net.              No of  Wastages
Code         Description           Cost/Unit  Usage  Uses   Per Unit   Cost/M2
----         -----------           ---------  -----  -----  --------  ---------
XG1   SFTWD/UNLD/NAILS      -      $133.55/M3  .035  5.0    10.0%        $1.03
XG2   18MM PLY/UNLD/NAILS   -        $5.27/M2 1.000  5.0    15.0%        $1.21
-----------------------------------------------------------------------------
                   TOTAL LABOUR     COST/M2              $3.57
                   TOTAL RES. GANG  COST/M2              $2.24
                                                   -------------
                   TOTAL NET COST/M2                     $5.81
-----------------------------------------------------------------------------
                                              Press RETURN to Continue
```

(c). Pricing using the SPOT RATE command:

This option allows the estimator to insert sums of money against the different cost code categories available (i.e. LABOUR, PLANT, AUXILIARY PLANT, MATERIALS and DOMESTIC SUB-CONTRACTORS). These sums of money then form the rate for the item in question.

As with the UNKNOWN GROUP facility it is necessary to insert a WORK GROUP classification for the item.

```
Item Reference ? 1/1/1/C

PRICE ITEM option
      Commands :-
                  KN - Known Group
                  UN - Unknown Group
                  SP - Spot Rate
                  IN - Included In
      Press RETURN to return to Main Menu
Command ? SP

SPOT RATE option
Bill 1  Section 1  Page 1/ C
Quantity    10    M3
Work Group Classification ? F

     Commands :-
                 AD - Add Rate
                 CH - Change Rate
                 DE - Delete Rate
                 QU - Change Bill Item Quantity
                 UN - Change Units of Measurement
                 VI - View Item
                 FI - File Item
                 RP - Reprice Item
Command ?
```

Adding a Rate:

This facility allows the estimator to enter a sum of money into the system under a chosen cost code category. These are:

- LABOUR
- PLANT
- AUXILIARY PLANT
- MATERIALS
- DOMESTIC SUB-CONTRACTORS

NOTE:

- It is only necessary to enter the first two letters of a category when entering it into the system.

```
Command ? AD

Cost Code ? LAB

Rate (in $/M3  )? 7.5

     Commands :-
                    AD - Add Rate
                    CH - Change Rate
                    DE - Delete Rate
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    VI - View Item
                    FI - File Item
                    RP - Reprice Item
Command ?
```

The estimator may then continue to add another sum as shown below.

```
Command ? AD

Cost Code ? MAT

Rate (in $/M3  )? 30

     Commands :-
                    AD - Add Rate
                    CH - Change Rate
                    DE - Delete Rate
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    VI - View Item
                    FI - File Item
                    RP - Reprice Item
Command ?
```

- **Changing a Rate:**

  This facility enables the estimator to change a rate already entered into the system.

```
Command ? CH

Cost Code ? LA

Rate is       7.50 $/M3
New Rate ? 12

     Commands :-
                AD - Add Rate
                CH - Change Rate
                DE - Delete Rate
                QU - Change Bill Item Quantity
                UN - Change Units of Measurement
                VI - View Item
                FI - File Item
                RP - Reprice Item
Command ?
```

Deleting a Rate:

If the estimator wants to delete a rate already entered into the system, he should use this command.

```
Command ? DE

Cost Code ? MA

     Commands :-
                AD - Add Rate
                CH - Change Rate
                DE - Delete Rate
                QU - Change Bill Item Quantity
                UN - Change Units of Measurement
                VI - View Item
                FI - File Item
                RP - Reprice Item
Command ?
```

Changing the Bill Item Quantity:

This facility is similar to that already described in 5.2.1.

Changing the Units of Measurement:

This has also been described in 5.2.1.

Viewing the Item:

This facility allows the estimator to see the manner in which the spot rate has been calculated. The example below reflects the results of all the examples shown above.

```
Command ? VI

Bill 1  Section 1  Page 1/ C
Quantity    10    M3
Work Group Classification : F

        Category                          Rate in $/M3
        --------                          --------------
          LAB.                                  12.00
                                             ----------
                            Item Rate           12.00 $/M3
                            Item Cost         $120.00
      Commands :-
                    AD - Add Rate
                    CH - Change Rate
                    DE - Delete Rate
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    VI - View Item
                    FI - File Item
                    RP - Reprice Item
Command ?
```

Filing the Item:

This facility has already been described in 5.2.1.

Repricing the Item:

This facility removes all the pricing information stored for this item, and provides the estimator with facilities for repricing it.   This is shown below.

```
Command ? RP

PRICE ITEM option
      Commands :-
                    KN - Known Group
                    UN - Unknown Group
                    SP - Spot Rate
                    IN - Included In
      Press RETURN to return to Main Menu
Command ?
```

(d) Pricing using the INCLUDED IN command:

This command enables the estimator to INCLUDE the cost of a certain item in another specified item.   In the example below, the estimator INCLUDES the cost of 1/1/4/A in 1/1/1/A.

```
                    MAIN MENU
                    ---------
     Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

Command ? IN

INSPECT ITEM option
Item Reference ? 1/1/4/A

PRICE ITEM option
     Commands :-
                    KN - Known Group
                    UN - Unknown Group
                    SP - Spot Rate
                    IN - Included In
     Press RETURN to return to Main Menu
Command ? IN

INCLUDED IN option
Included in ? 1/1/1/A

Bill 1  Section 1  Page 4/ A
Quantity     45    M3
Included in  Bill 1  Section 1  Page 1/ A
     Commands :-
                    CI - Change Item Included in
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    RP - Reprice Item
                    FI - File Item
Command ?
```

The facilities available in the sub-menu above allow the estimator to edit the INCLUDED item.

Changing the item INCLUDED IN:

The CI command enables the estimator to re-select the item to contain the INCLUDED item. This is shown as follows.

```
Command ? CI

Included in ? 1/1/1/B

Bill 1  Section 1  Page 4/ A
Quantity      45    M3
Included in  Bill 1  Section 1  Page 1/ B
      Commands :-
                    CI - Change Item Included in
                    QU - Change Bill Item Quantity
                    UN - Change Units of Measurement
                    RP - Reprice Item
                    FI - File Item
Command ?
```

Changing the Bill Item Quantity:

This facility allows the estimator to change the quantity of the item he is working on (in this case 1/1/4/A). (See 5.2.1).

Changing the Units of Measurement:

The facility allows the units of measurement to be changed (see 5.2.1).

Repricing the item:

This command may be used to reprice the item. It removes all previous pricing information, and enables the estimator to choose a new method of pricing the item.

```
Command ? RP

PRICE ITEM option
      Commands :-
                    KN - Known Group
                    UN - UnKnown Group
                    SP - Spot Rate
                    IN - Included In
      Press RETURN to return to Main Menu
Command ?
```

Filing the item:

This command instructs the computer system to store the data entered.

5.3 UPDATING PRICES

This section of the system enables the estimator to create and edit resources for use in the item build-ups as described in 5.1 and 5.2.

All resources created and altered using this facility are retained only for the tender in question (i.e. they are held in the CONTRACT RESOURCE COST FILES - see Chapter 3).

Access to this facility is obtained through the estimator's Main Menu of commands.

```
                    MAIN MENU
                    ---------
         Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

      Command ? UP
```

5.3.1 ENTRY OF NEW RESOURCES

(a) SINGLE resources:

Where the estimator wants to enter a new SINGLE resource, a RESOURCE CODE that has not already been used should be entered into the system. Prompts will then be displayed which will enable the estimator to enter a new resource. This is shown as follows.

```
UPDATE PRICES option
Resource Code ? M241

Resource not on File
Do you wish to enter a new Resource ? Y

Description ? CONCRETE BLOCKS

Cost ? 125

Units of Measurement ? TH

Discount (%) ? 5

Supplier's Name ? A.N.OTHER STORES

Quotes Required ? Y

                           Description - CONCRETE BLOCKS
                           Cost        -     125.000 $/TH
                           Price with  5.000 % Discount =   118.750 $/TH
                           *********** Awaiting Quotes **********
                           Supplier's Name - A.N.OTHER STORES
OK ?
```

Detailed explanations of these prompts are given in 8.8.1 (a).

(b) GANG resources:

New GANG resources may also be entered into the CONTRACT RESOURCE COST FILES. The manner in which this may be done is similar to that described in 8.8.1 (b).

5.3.2 EDITING OF EXISTING RESOURCES

(a) SINGLE resources:

Where it is required to edit an existing SINGLE resource, the system requests the relevant RESOURCE CODE to be entered. A sub-menu of commands is then displayed as shown below, which allows the estimator to make the necessary alterations.

```
UPDATE PRICES option
Resource Code ? M105

                   Description - CONCRETE MIX A
                   Cost        -      30.000 $/CU M   (used)
                   Price with 10.000 % Discount =    27.000 $/CU M
                   Supplier's Name - READYMIX CONCRETE SUPPLIES
OK ? N

      Commands :-
                  DS - Change Description
                  CO - Change Cost
                  MA - Mark as requiring Quotes
                  UN - Change Units of Measurement
                  DC - Change Discount
                  SU - Change Supplier's Name
                  VI - View Resource
                  FI - File Resource
Command ?
```

The options enabling these changes to be made are similar to those already described in 8.8.2 (a).

NOTE:

- It is not possible to DELETE a resource from the CONTRACT RESOURCE COST FILES.

(b) GANG resources:

It is possible to edit GANG resources by calling up the editing sub-menu as described above. The facilities available in this menu are similar to those described in 8.8.2 (b).

5.4 HELP

Frequent use of the system will result in the estimator becoming familiar with the menus of commands provided. It is possible to suppress the menus by the use of the HELP command. The manner in which this may be done is shown below.

```
                    MAIN MENU
                    ---------
        Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

   Command ? HE

                 Help levels
          0 - Suppress Menus
          1 - Display Menus
   Help Level [RETURN for 1] ? 0
```

The example below illustrates the prompts presented to the estimator if he wants to select the Print Reports option from the Main Menu.

```
                    MAIN MENU
                    ---------
   Command ? PR

   PRINT REPORTS option
   Command [Or RETURN] ?
```

The estimator should then enter the command for the report which he requires. If he wants to check on the options available, HE should be entered into the system. The appropriate sub-menu is then displayed.

```
Command [Or RETURN] ? HE

        Commands :-
                   BI - Bill of Quantities List
                   QU - Quotes List
                   MA - Materials Usage List
                   OU - Outstanding Sub-Con. Items List
                   RE - Resource Reconciliation
                   CO - Contract Resource List
        (or press RETURN to return to Main Menu)

Command [Or RETURN] ?
```

If the estimator wants to have the menus displayed in full, the HELP LEVEL should be re-set to 1.

```
                    MAIN MENU
                    ---------
Command ? HE

               Help levels
          0 - Suppress Menus
          1 - Display Menus
Help Level [RETURN for 0] ? 1
```

6. REPORTS AND MARK-UPS

6.0 GENERAL

This chapter describes the reports that may be obtained from the system, and also the facilities available for the conversion of the estimate into a tender by the addition of various mark-up percentages. Access to these facilities is through the Main Menu of commands supplied with the estimator's program (i.e. WS5RUN).

6.1 REPORT PRINTING

This section describes the various reports that may be obtained. It should be noted that any of the reports illustrated below may be printed out at any stage during the estimating process.

In order to select the report printing facility, it is necessary to use the PR command from the Main Menu of commands as shown below.

```
                         MAIN MENU
                         ---------
          Commands :-
                         IN - Inspect Item
                         SU - Sub-Contract Quotes
                         UP - Update Prices
                         AP - Apply Mark-Ups
                         PR - Print Reports
                         HE - Set HELP Level
                         ST - Stop

     Command ? PR

     PRINT REPORTS option
          Commands :-
                         BI - Bill of Quantities List
                         QU - Quotes List
                         MA - Materials Usage List
                         OU - Outstanding Sub-Con. Items List
                         RE - Resource Reconciliation
                         CO - Contract Resource List
          (or press RETURN to return to Main Menu)

     Command ?
```

6.1.1 THE BILL OF QUANTITIES LISTING

This report is illustrated in Figures 6.1, 6.2 and 6.3. The report enables the estimator to obtain listings of the unit rates (split into their relevant cost code categories) for the complete bill of quantities, or for selected pages, sections and/or bills.

It is first of all necessary to enter the date. This enables the estimator to identify the most recent print out.

```
Command ? BI

BILL OF QUANTITIES LIST option
Enter date (DD/MM/YY) 4-8-81
```

The system then requires the estimator to select the section or page of the bill of quantities that is required to be printed out. This information should be entered in accordance with the Bill Numbering Method previously defined (see 8.1 (h)).

For example:

Where Bill Numbering Method 1 has been chosen, if a print of page 59 in Section 3 was required, the following command should be keyed into the system:

3/59

If the estimator wants a complete bill section to be printed out (e.g. Section 5) this would be done by entering 5 into the system.

Where a print out of the complete bill of quantities is required the RETURN key should be pressed.

(A similar principle should be applied where Bill Numbering Method 2 has been selected, see 8.1 (h)).

```
Portion of Contract to be Listed [RETURN for Whole Contract] ? 1/1
```

The system then prints out the total number of items included in the contract at that stage.

```
There are   11 Bill Items in the Whole Contract
```

Following this the estimator is asked whether he wants to include WORK GROUPS in the Bill Listing which have not yet been INSPECTED by him. (This facility has been designed primarily to facilitate the obtaining of an approximate price of the tender directly after the bill has been entered into the system as described in Chapter 4).

If NO is entered following this prompt, the listings produced will reflect only those items INSPECTED by the estimator (but those items which do not have to be INSPECTED as defined in 5.2 will be included).

```
Do you wish to Include Known work groups not yet inspected ? Y
```

There is a pause during which the computer system performs some calculations. A display is then produced which shows the total cost of each bill page. This is shown below.

```
Bill Calculation in Progress


  Direct cost of bill page  1/1/1                  $14,569.32
  Tender price of bill page 1/1/1                  $16,156.88

  Direct cost of bill page  1/1/2                   $3,994.10
  Tender price of bill page 1/1/2                   $4,470.40

                                              --------------
                                              --------------
     Direct cost of bill section  1/1              $18,563.42
     Tender price of bill section 1/1              $20,627.28
```

It is then necessary to make sure that the printer is switched on, and in the case of multi-user systems, that no-body else is using the printer at the time. The amount of paper available should also be checked to ensure that sufficient is available for the report. When this has been done, the RETURN key should be pressed following the command shown below.

```
Make sure Printer is available [RETURN to Continue]  <---- RETURN KEY
                                                          PRESSED
```

The system will then print out reports similar to those shown in Figures 6.1, 6.2 and 6.3.

Notes on Figure 6.1:

- This report shows the mark-up precentages which will be added to the DIRECT COST of the estimate. The manner in which these percentages may be entered into the system as described in 6.2. Where no percentages have been entered, all percentages shown in this report will be zero.

Notes on Figure 6.2:

- This report illustrates a page from a bill of quantities.

- Each item contained in the page is identified by its ITEM REFERENCE (see 5.2).

- The rate shown for each item is split into its cost code categories so that the estimator may see the Labour, Plant, Auxiliary Plant, Materials and Domestic Sub-contract costs for that item.

- Both the DIRECT COST and the TENDER PRICE of each item are shown. The DIRECT COST shows the cost price of each item including any SURCHARGE adjustments entered (see 6.2.3). The TENDER PRICE shows the gross price for each item including any OVERHEADS and PROFIT percentages added (see 6.2.1 and 6.2.2).

- Where items have been priced direct from the FILE of PERFORMANCE DATA without having been INSPECTED by the estimator, they are identified by a line of text which notes that they have been 'Priced Direct from Data Library'. As and when these items are INSPECTED by the estimator, the 'Priced Direct from the Data Library' note will automatically disappear from subsequent printouts of the Bill Listing.

- The following are special markers that may appear in the Bill Listing:

  *S/C*K — This marker identifies WORK GROUPS containing Sub-contractors that have not been INSPECTED.

  S/C — This signifies items containing only Sub-contractors.

  A/Q — This marker identifies items containing resources that are marked as 'Awaiting Quotes'.

  NE — This relates to a profit or attendance item (see Chapter 10). The marker signifies that the item this is profit/attendance on is not on file.

  NP — This relates to a profit or attendance item (see Chapter 10). It signifies that the item this is profit/attendance on exists, but has not been priced.

Contract TOM : USER MANUAL DEMONSTRATION | Page 1
Reference Code : REF-99 | Tender Submission Date 25-12-81 Today's Date 4-8-81

Bill of Quantities Listing - Single Section

Mark-up Percentages

Surcharges for:-

Labour	:	0	%
Plant	:	0	%
Auxiliary Plant	:	0	%
Materials	:	0	%
Domestic Sub-contractors	:	0	%

Overheads for:-

Labour	:	3	%
Plant	:	3	%
Auxiliary Plant	:	0	%
Materials	:	5	%
Domestic Sub-contractors	:	0	%

Profits for:-

Own Work	:	7	%
Domestic Sub-contractors	:	2.5	%
Nominated Suppliers	:	0	%
Nominated Sub-Contractors	:	0	%

Figure 6.1 Example of Bill Listing

Contract TOM : USER MANUAL DEMONSTRATION Page 2
Reference Code : REF-99 Tender Submission Date 25-12-81 Today's Date 4-8-81

Bill of Quantities Listing - Single Section

Direct Cost and Tender Price Item Listing

		LAB. rate	PLT. rate	AUX. rate	MAT. rate	DOM. rate	Quantity		TOTAL rate	Sum	
1/1/1/A	Direct	7.29	0.00	0.00	29.02	0.00			£36.31	£617.27	
	Tender	8.03	0.00	0.00	32.61	0.00	17	M3	£40.64	£690.88	*AQ*
1/1/1/B	Direct	0.00	0.00	0.00	0.00	6.41			£6.41	£1,378.15	
	Tender	0.00	0.00	0.00	0.00	6.57	215	M3	£6.57	£1,412.55	*S/C*
1/1/1/C	Direct	2.00	3.00	4.00	5.00	6.00			£20.00	£200.00	
	Tender	2.20	3.31	4.28	5.62	6.15	10	M3	£21.56	£215.60	
1/1/1/D	Direct	4.59	.65	0.00	28.35	0.00			£33.59	£1,813.86	
	Tender	5.06	.72	0.00	31.85	0.00	54	M3	£37.63	£2,032.02	*S/CK
1/1/1/E	Direct	73.44	4.71	0.00	316.23	0.00			£394.38	£9,070.74	
	Tender	80.94	5.19	0.00	355.28	0.00	23	TNE	£441.41	£10,152.43	
1/1/1/F	Direct	4.22	0.00	0.00	2.34	0.00			£6.56	£1,154.56	
	Tender	4.65	0.00	0.00	2.63	0.00	176	M3	£7.28	£1,281.28	
1/1/1/G	Direct	4.20	0.00	0.00	3.77	0.00			£7.97	£334.74	
	Tender	4.63	0.00	0.00	4.23	0.00	42	M	£8.86	£372.12	

Direct cost of bill page 1 £14,569.32
Tender price of bill page 1 £16,156.88

Figure 6.2 Example of Bill Listing (continued)

Contract TOM : USER MANUAL DEMONSTRATION — Page 4

Reference Code : REF-99 — Tender Submission Date 25-12-81 — Today's Date 4-8-81

Bill of Quantities Listing - Single Section

Direct Cost and Tender Price Page Summaries

SECTION/PAGE		LAB. value	PLT. value	AUX. value	MAT. value	DOM. value	Others	TOTAL value
1/1/1	Direct	£3,000.03	£173.43	£40.00	£9,917.71	£1,438.15	£0.00	£14,569.32
	Tender	£3,306.23	£191.35	£42.80	£11,142.45	£1,474.05	£0.00	£16,156.88
1/1/2	Direct	£801.90	£0.00	£0.00	£3,192.20	£0.00	£0.00	£3,994.10
	Tender	£883.30	£0.00	£0.00	£3,587.10	£0.00	£0.00	£4,470.40
1/1	TOTAL Direct	£3,801.93	£173.43	£40.00	£13,109.91	£1,438.15	£0.00	£18,563.42
	TOTAL Tender	£4,189.53	£191.35	£42.80	£14,729.55	£1,474.05	£0.00	£20,627.28

Figure 6.3 Example of Bill Listing (continued)

NPC This relates to a profit item (see Chapter 10). It signifies that the item this is profit on is not a PRIME COST item.

(The last three markers *NE*, *NP* and *NPC* are all error situations and should be remedied by the insertion of the appropriate data).

Notes on Figure 6.3:

- This report summarises the costs of each cost code category for the various pages in each section of the bill of quantities.

- The column marked OTHERS is reserved for all PRIME COST and PROVISIONAL SUMS.

6.1.2 THE QUOTES LISTING

This listing is shown in Figures 6.4 and 6.5. It illustrates all Materials and Labour, Plant and Auxiliary Plant resources 'Awaiting Quotes'. (For a listing of Domestic Sub-contract items 'Awaiting Quotes' see 6.1.4).

In order to select this report it is necessary to select the QU command and enter the data as shown below.

```
        Commands :-
                    BI - Bill of Quantities List
                    QU - Quotes List
                    MA - Materials Usage List
                    OU - Outstanding Sub-Con. Items List
                    RE - Resource Reconciliation
                    CO - Contract Resource List
        (or press RETURN to return to Main Menu)

Command ? QU

QUOTES LIST option
Date (DD/MM/YY) ? 4-8-81
```

There is then a short pause, and it is necessary to ensure that the printer is switched on. Note the other points in this respect described in 6.1.1.

```
Sorting in Progress
Make sure Printer is On Line (Press RETURN ) <—— RETURN KEY
                                                 PRESSED
```

```
Contract TOM     : USER MANUAL DEMONSTRATION                                                    Page      1
Reference Code : REF-99                                  Tender Submission Date 25-12-81   Today's Date 4-8-81

                                              Resources Awaiting Quotes

                                                   Priced Resources


Resource    Description                                                           Supplier
--------    -----------                                                           --------

 L2         LABOURER (CONC)                          2.75 £/HR
 M67        SOFTWOOD                               125.00 £/M3
 M68        NAILS                                     .90 £/KG
 M105       CONCRETE MIX A                          27.00 £/CU M          READYMIX CONCRETE SUPPLIES
```

Figure 6.4 Example of Quotes Listing (Priced Resources)

```
Contract TOM     : USER MANUAL DEMONSTRATION                                                    Page      1
Reference Code : REF-99                                  Tender Submission Date 25-12-81   Today's Date 4-8-81

                                              Resources Awaiting Quotes

                                                  Unpriced Resources


Resource    Description                                                           Supplier
--------    -----------                                                           --------

 M66        PLYWOOD (EXT) 18MM                    M2
```

Figure 6.5 Example of Quotes Listing (Unpriced Resources)

The system then prints out reports as shown in Figures 6.4 and 6.5.

Notes on Figure 6.4:

- This report lists all Materials, Labour, Plant and Auxiliary Plant resources marked as 'Awaiting Quotes' and containing approximate or average prices.

Notes on Figure 6.5:

- The contents of this report is similar to that described for Figure 6.4. However, the resources collected in this file are those which have no price associated with them.

6.1.3 THE MATERIALS USAGE LISTING

These reports are shown in Figures 6.6 and 6.7. The main aim of the reports is to illustrate for each Material which bill items contain that Material. This is especially relevant for the numerous 'one-off' Materials that will be inserted for each tender. Such Materials should be given ad-hoc Materials RESOURCE CODES as described in 9.1.2 (c). The Materials Usage Lists enable the estimator to relate quotes obtained from suppliers to the ad-hoc Materials RESOURCE CODES used for that particular project. Such prices are then updated as described in 5.3.

The manner in which the estimator may obtain these reports is shown below.

```
PRINT REPORTS option
      Commands :-
                    BI - Bill of Quantities List
                    QU - Quotes List
                    MA - Materials Usage List
                    OU - Outstanding Sub-Con. Items List
                    RE - Resource Reconciliation
                    CO - Contract Resource List
      (or press RETURN to return to Main Menu)

Command ? MA
```

The estimator is then asked whether WORK GROUPS not yet INSPECTED are to be included in the reports (see 6.1.1).

```
MATERIALS USAGE LIST option
Do you wish to Include Known work groups not yet Inspected ? Y

Data Collection in Progress
```

```
         Contract TOM   : USER MANUAL DEMONSTRATION                                                          Page    1
         Reference Code : REF-99                                   Tender Submission Date 25-12-81   Today's Date 4-8-81

                                    Quote Materials Usage Listing

M66    PLYWOOD (EXT) 18MM                      Gross Cost         £0.00/M2    Discount  0.00%  Net Cost        £0.00/M2
                   Bill 1  Section 1  Page 1/ F                          40.48 M2
                   Bill 1  Section 1  Page 1/ G                          14.55 M2
                                          Total Quantity               55.03 M2    Gross Price         £0.00
                                                                                     Discount          £0.00
                                                                                    Net Price          £0.00

M67    SOFTWOOD                                Gross Cost       £125.00/M3    Discount  0.00%  Net Cost      £125.00/M3
                   Bill 1  Section 1  Page 1/ F                           1.55 M3
                   Bill 1  Section 1  Page 1/ G                            .64 M3
                                          Total Quantity                2.18 M3    Gross Price       £272.98
                                                                                     Discount          £0.00
                                                                                    Net Price        £272.98

M68    NAILS                                   Gross Cost         £0.90/KG    Discount  0.00%  Net Cost        £0.90/KG
                   Bill 1  Section 1  Page 1/ F                          18.94 KG
                   Bill 1  Section 1  Page 1/ G                           7.36 KG
                                          Total Quantity               26.29 KG    Gross Price        £23.66
                                                                                     Discount          £0.00
                                                                                    Net Price         £23.66

***************************************************************************************************************
Total Discounts on all Materials Awaiting Quotes          £0.00
***************************************************************************************************************
```

Figure 6.6 Example of Materials Usage Listing

```
        Contract TOM      : USER MANUAL DEMONSTRATION                                                        Page      1
        Reference Code : REF-99                                    Tender Submission Date 25-12-81   Today's Date 4-8-81

                              Non-Quote Materials Usage Listing

M11     25MM.M.S.REBAR                          Gross Cost      £230.00/TNE   Discount  0.00%  Net Cost       £230.00/TNE
                       Bill 1  Section 1  Page 1/ E                        30.65 TNE
                                                    Total Quantity         30.65 TNE   Gross Price     £7,048.93
                                                                                          Discount       £0.00
                                                                                         Net Price     £7,048.93

M34     BINDING WIRE                            Gross Cost        £1.50/KG    Discount  0.00%  Net Cost         £1.50/KG
                       Bill 1  Section 1  Page 1/ E                      149.50 KG
                                                    Total Quantity       149.50 KG     Gross Price       £224.25
                                                                                          Discount       £0.00
                                                                                         Net Price       £224.25

M105    CONCRETE MIX A                          Gross Cost       £30.00/CU M  Discount 10.00%  Net Cost        £27.00/CU M
Supplier READYMIX CONCRETE SUPPLIES
                       Bill 1  Section 1  Page 1/ A                        18.28 CU M
                       Bill 1  Section 1  Page 2/ A                        11.83 CU M
                       Bill 1  Section 1  Page 2/ B                        23.65 CU M
                       Bill 1  Section 1  Page 2/ C                        35.48 CU M
                       Bill 1  Section 1  Page 2/ D                        47.30 CU M
                                                    Total Quantity        136.53 CU M  Gross Price     £4,095.75
                                                                                          Discount       £409.58
                                                                                         Net Price     £3,686.18

*****************************************************************************************************************
Total Discounts on all Materials with Firm Prices            £409.58
*****************************************************************************************************************
```

Figure 6.7 Example of Materials Usage Listing (continued)

There is a short delay whilst the system performs the necessary calculations.

The estimator is then asked whether he requires a listing of QUOTE or NON-QUOTE Materials.

- QUOTE Materials are those Materials which are marked as 'Awaiting Quotes'. (See Figure 6.6).

- NON-QUOTE Materials are not marked as 'Awaiting Quotes'. (See Figure 6.7).

```
QUOTE or NON-QUOTE materials ? QU
Date (DD/MM/YY) ? 4-8-81
```

It is also necessary to enter the data as shown above. The relevant reports are then printed out as shown in Figures 6.6 and 6.7.

Notes on Figure 6.6:

- The quantities of each resource shown include Wastage Allowances.

- The amount at the bottom of the report shows the total value of all the discounts taken on all the Materials included in the report.

Notes on Figure 6.7:

- As for Figure 6.6.

6.1.4 THE OUTSTANDING SUB-CONTRACT ITEMS LISTING

This report is ullustrated in Figure 6.8. It shows all the items for which Sub-contract quotes are being awaited.

In order to obtain this listing, it is necessary for the estimator to respond to the prompts as shown below.

Contract TOM : USER MANUAL DEMONSTRATION Page 1
Reference Code : REF-99 Tender Submission Date 25-12-81 Today's Date 4-8-81

Outstanding Sub-Con. Quotes Listing

Item Reference	Quantity	
1/1/3/A	11	M
1/1/3/B	55	M2
1/1/3/C	7	NR
1/1/3/D	77	M
1/1/7/D	77	NR

Figure 6.8 Example of Outstanding Sub-Contract Items Listing

```
PRINT REPORTS option
      Commands :-
                 BI - Bill of Quantities List
                 QU - Quotes List
                 MA - Materials Usage List
                 OU - Outstanding Sub-Con. Items List
                 RE - Resource Reconciliation
                 CO - Contract Resource List
      (or press RETURN to return to Main Menu)

Command ? OU

OUTSTANDING SUB-CON. ITEMS LIST option
Enter date (DD/MM/YY) 4-8-81

Make sure Printer is available [RETURN to Continue] <---- RETURN KEY
                                                         PRESSED

     Outstanding Sub-Con. Quotes Listing in Progress
```

Cognisance should be taken of 6.1.1 regarding the use of the printer.

There is then a short delay after which the report shown in Figure 6.8 will be printed out.

Notes on Figure 6.8:

- As and when Sub-contract quotes are obtained, they may be entered into the system as described in 7.2. Subsequent printouts of the Outstanding Sub-contract Quotes listing will not reflect items for which quotes have been inserted.

6.1.5 THE RESOURCE RECONCILIATION

This report is shown in Figures 6.1 and 6.9. The complete reports comprise the mark-up percentages (as shown in Figure 6.1) and reconciliations of resources for each of the cost code categories. Figure 6.9 illustrates the Materials Reconciliation.

In order to obtain the report the estimator should respond to the prompts shown below in a similar manner to those described in 6.1.1.

```
Commands :-
                BI - Bill of Quantities List
                QU - Quotes List
                MA - Materials Usage List
                OU - Outstanding Sub-Con. Items List
                RE - Resource Reconciliation
                CO - Contract Resource List
        (or press RETURN to return to Main Menu)

Command ? RE

RESOURCE RECONCILIATION option
Do you wish to Include Known work groups not yet Inspected ? Y
```

There will then be a pause, after which the estimator should respond as below.

```
                    Reconciliation in progress



Make sure Printer is On Line (Press RETURN )<------- RETURN KEY
                                                      PRESSED
Date (DD/MM/YY) 4-8-81
```

The complete report described above will then be printed out. An example of the reconciliation of Materials resources is shown in Figure 6.9.

Notes on Figure 6.9:

- All GANG resources are split into their constituent SINGLE resources.

- The Basic Amount represents the nett total number of units of each resource used. Associated DIRECT COSTS and TENDER PRICES for each resource are shown next to each Basic Amount.

- The Wastage amount reflects the quantity of each resource considered as waste. Associated DIRECT COSTS and TENDER PRICES are also shown adjacent to each wastage amount.

Contract TOM : USER MANUAL DEMONSTRATION
Reference Code : REF-99

Page 5
Tender Submission Date 25-12-81 Today's Date 4-8-81

Resource Reconciliation

Material Resources

RESOURCE	DESCRIPTION	BASIC AMOUNT	DIRECT COST	TENDER PRICE	WASTAGE	DIRECT COST	TENDER PRICE
M11	25MM.M.S.REBAR	29.90 TNE	£6,877.00	£7,726.31	.75 TNE	£171.93	£193.16
M34	BINDING WIRE	149.50 KG	£224.25	£251.94	0.00 KG	£0.00	£0.00
M66	PLYWOOD (EXT) 18MM	49.06 M2	£244.32	£274.49	5.97 M2	£29.75	£33.42
M67	SOFTWOOD	2.01 M3	£251.60	£282.67	.17 M3	£21.38	£24.02
M68	NAILS	23.90 KG	£21.51	£24.17	2.39 KG	£2.15	£2.42
M105	CONCRETE MIX A	181.00 CU M	£4,887.00	£5,490.54	12.23 CU M	£330.08	£370.84 *

Figure 6.9 Example of Resource Reconciliation

6.1.6 THE CONTRACT RESOURCE LISTING

Examples of these reports are shown in Figures 6.10 and 6.11.

These reports show the SINGLE and GANG resources used for the tender in question (i.e. the contents of the CONTRACT SPECIFIC RESOURCE COST FILES - see Chapter 3). The prompts enabling these reports to be obtained are shown below.

```
PRINT REPORTS option
      Commands :-
                 BI - Bill of Quantities List
                 QU - Quotes List
                 MA - Materials Usage List
                 OU - Outstanding Sub-Con. Items List
                 RE - Resource Reconciliation
                 CO - Contract Resource List
      (or press RETURN to return to Main Menu)

Command ? CO

CONTRACT RESOURCE LIST option
Date ? 4-8-81

      Commands:-
                 CS   - List Contract Single Resources
                 CG   - List Contract Gang Resources
       (or press RETURN to return to PRINT REPORTS menu)
Command ?
```

The estimator has to select whether SINGLE or GANG resources are required. It is also possible to obtain FULL or BRIEF listings. In the printout below a FULL listing of SINGLE resources is requested.

```
 Command ? CS

 Sort in Progress
     4 Resources to be printed

FULL or BRIEF listing ? FU

Make sure printer is available (press RETURN) <---- RETURN KEY
                                                    PRESSED
```

The resulting report is shown in Figure 6.10. A BRIEF listing for the same set of SINGLE resources is shown in Figure 6.11.

It is also possible to get FULL and BRIEF listings of GANG resources by entering the appropriate commands.

```
Contract TOM    : USER MANUAL DEMONSTRATION                                                  Page    2
Reference Code : REF-99                                Tender Submission Date 25-12-81  Today's Date 4-8-81
                                            Material

                     M105       Description - CONCRETE MIX A
                                Cost        -      30.000 £/CU M
                                Price with 10.000 % Discount =    27.000 £/CU M
                                *********** Awaiting Quotes **********
                                Supplier's Name - READYMIX CONCRETE SUPPLIES
```

Figure 6.10 Example of Full Contract Resource Listing

```
Contract TOM    : USER MANUAL DEMONSTRATION                                                  Page    2
Reference Code : REF-99                                Tender Submission Date 25-12-81  Today's Date 4-8-81
                                            Material

            M105   CONCRETE MIX A                                 27.00 £/CU M *
```

Figure 6.11 Example of Brief Contract Resource Listing

6.2 MARK-UPS

This section describes the facilities available for applying MARK-UPS to the direct cost of items contained in FILE OF CONTRACT DETAILS-DIRECT COST. The effect of these MARK-UPS is shown in the reports described in 6.1.

It should be noted that the estimator may enter and change the percentages at any stage during the preparation of the estimate.

6.2.1 OVERHEADS

It is possible to add monies for OVERHEADS to any of the allowable cost code categories. These are:

LAB - Labour

PLT - Plant

AUX - Auxiliary Plant

MAT - Materials

DOM - Domestic Sub-contractors

The facilities which the system provides for this is to allow the user to enter a percentage relevant to a cost code category. This percentage is then applied to all occurrences of resources contained in that category throughout the bill of quantities. The effect of applying these OVERHEAD percentages is reflected in the TENDER PRICE figures shown in the reports (see 6.1). The DIRECT COSTS thus remain unchanged by the operation of this facility. The relevant prompts provided by the system are shown below.

```
Command ? AP

APPLY MARK-UPS option
      Commands :-
                 OV - Overheads
                 PR - Profits
                 SU - Surcharges
      or press RETURN to return to Main Menu
Command ? OV
```

```
Overheads :-
-------------
                LAB.   0   %
                PLT.   0   %
                AUX.   0   %
                MAT.   0   %
                DOM.   0   %
Commands :-
            AD - Add Percentage
            CH - Change Percentage
            DE - Delete Percentage
            VI - View Percentages
            FI - File Information

Command ?
```

Adding a Percentage:

In the examples below, percentages are entered for Labour and Domestic Sub-contractors. When the user has finished entering the percentages, it is necessary to key in END. This instructs the system to proceed as shown below.

```
Command ? AD

Cost Code (END to finish) ? LA

Percentage Mark-up ? 5

Cost Code (END to finish) ? DOM

Percentage Mark-up ? 7.5

Cost Code (END to finish) ? END

     Commands :-
                 AD - Add Percentage
                 CH - Change Percentage
                 DE - Delete Percentage
                 VI - View Percentages
                 FI - File Information

Command ?
```

Changing a Percentage:

It is possible to change any percentage by selecting the CH command. In the example below, the percentage previously entered for Labour is changed to 10 per cent.

```
Command ? CH

Cost Code ? LA

Percentage is    5    %
New Percentage ? 10

     Commands :-
                  AD - Add Percentage
                  CH - Change Percentage
                  DE - Delete Percentage
                  VI - View Percentages
                  FI - File Information

Command ?
```

Deleting a Percentage:

It is possible to delete a percentage previously entered into the system.

```
Command ? DE

Cost Code ? DOM

     Commands :-
                  AD - Add Percentage
                  CH - Change Percentage
                  DE - Delete Percentage
                  VI - View Percentages
                  FI - File Information

Command ?
```

Viewing the Percentages:

The VI command enables the user to see the percentages entered into the system. The example below illustrates the results of all the examples shown above.

```
Command ? VI

        Overheads :-
        --------------
                    LAB.  10   %
                    PLT.   0   %
                    AUX.   0   %
                    MAT.   0   %
                    DOM.   0   %
      Commands :-
                AD - Add Percentage
                CH - Change Percentage
                DE - Delete Percentage
                VI - View Percentages
                FI - File Information

Command ?
```

Filing the Percentages:

This command instructs the system to store the percentages.

6.2.2 PROFITS

The system allows percentages to be added to the following categories to allow for PROFITS.

- OWN - All work completed by the Main Contractor's own resources.
- DOM - All work completed by Domestic Sub-contractors.
- SP - Nominated Suppliers.
- SC - Nominated Sub-contractors.

Percentages entered for any of these categories will be applied to all work undertaken in that category.
As with OVERHEADS, adjustments made by the addition of PROFIT percentages are reflected in the TENDER PRICE figures shown in the reports (see 6.1). No adjustments due to the addition of PROFITS are shown in the DIRECT COSTS.

NOTE:

- That it is possible to enter PROFITS for Nominated Suppliers and Nominated Sub-contractors as described in 10.3.1.
  Where percentages have been entered in that manner, the PROFIT percentages entered here will not over-ride the other values.

The examples given below show the entering of PROFITS.

```
Command ? AP

APPLY MARK-UPS option
      Commands :-
                    OV - Overheads
                    PR - Profits
                    SU - Surcharges
      or press RETURN to return to Main Menu
Command ? PR

        Profits :-
        -------------
                          OWN    0    %
                          DOM.   0    %
                          SP.    0    %
                          SC.    0    %
      Commands :-
                    AD - Add Percentage
                    CH - Change Percentage
                    DE - Delete Percentage
                    VI - View Percentages
                    FI - File Information

Command ? AD

Cost Code (END to finish) ? OWN

Percentage Mark-up ? 2

Cost Code (END to finish) ? DOM

Percentage Mark-up ? 3

Cost Code (END to finish) ? SP

Percentage Mark-up ? 4

Cost Code (END to finish) ? SC

Percentage Mark-up ? 5

Cost Code (END to finish) ? END
```

The facilities provided for editing the PROFIT values are similar to those illustrated for OVERHEADS. (See 6.2.1).

6.2.3 SURCHARGES

This facility enables the user to make an adjustment to the DIRECT COST of resources contained within the allowable cost code categories. The result of using this facility is thus shown in the DIRECT COST figures illustrated in the reports (see 6.1).

NOTE:

- This adjustment is only reflected in the reports described in 6.1.
- No adjustment is made to the individual item build-ups. Thus using the INSPECT command will result in the original cost of the item as priced by the estimator being displayed.
- It is possible to enter a negative percentage for SURCHARGES. This will reduce the cost of all resources within the chosen cost code category and will display the reduced figures in the relevant reports (see 6.1).

The cost code categories that may be SURCHARGED are shown below.

LAB - Labour

PLT - Plant

AUX - Auxiliary Plant

MAT - Materials

DOM - Domestic Sub-contractors.

The example below illustrates the menu of commands allowing the entry of SURCHARGE percentages. The operation of these commands is similar to that described for OVERHEADS in 6.2.1.

```
Command ? AP

APPLY MARK-UPS option
          Commands :-
                         OV - Overheads
                         PR - Profits
                         SU - Surcharges
          or press RETURN to return to Main Menu
Command ? SU

            Surcharges :-
            -------------
                              LAB.   0   %
                              PLT.   0   %
                              AUX.   0   %
                              MAT.   0   %
                              DOM.   0   %
        Commands :-
                        AD - Add Percentage
                        CH - Change Percentage
                        DE - Delete Percentage
                        VI - View Percentages
                        FI - File Information

Command ?
```

7. THE AWAITING QUOTES SUBSYSTEM

7.0 GENERAL

The 'Awaiting Quotes' subsystem has been designed to deal with obtaining costs for MATERIALS and SUB-CONTRACTOR resources. The system enables the estimator to proceed with the preparation of item rates (as described in Chapter 5) before having received MATERIAL or SUB-CONTRACT quotations. As and when these become available, they may be entered into the system, and the price of all such resources is automatically updated wherever they are used.

Reports identifying all MATERIALS and SUB-CONTRACT items 'Awaiting Quotes' are produced as illustrated in Chapter 6. These reports serve as a reminder for the chasing of quotations.

NOTE:

- The facilities described below for marking MATERIALS resources as 'Awaiting Quotes' are also provided for Labour, Plant and Auxiliary Plant resources. However, it is envisaged that the main use of the 'Awaiting Quotes' facility will be for the updating of MATERIALS costs.

7.1 MATERIAL RESOURCES 'AWAITING QUOTES'

MATERIALS resources may be stored in the COMPANY RESOURCE COST FILES and the CONTRACT RESOURCE COST FILES as described in Chapter 3.

All resources, regardless of their origin, are identified in all item build-up displays by an *. In the example shown below, resource L2 is 'Awaiting Quotes".

```
Bill 1  Section 1  Page 1/ A
Quantity     27.5  CU M
Work Group FA25A.7           90.0%
CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)
-----------------------------------------------------------------------------
                                                          Weight
Code          Description               Cost/HR    Usage   Factor    Cost/CU M
----          -----------               ---------  -----   ------    ---------
L2    LABOURER (CONC)        -            $2.75    2.385   100.0%      $6.56*
                                        Net.                Wastages
Code          Description               Cost/Unit  Usage   Per Unit  Cost/CU M
----          -----------               ---------  -----   --------  ---------
M105  CONCRETE MIX A         -          $27.00/CU   .900     7.5%      $26.12
-----------------------------------------------------------------------------
Sub-Contractor Required
-----------------------------------------------------------------------------
                  TOTAL LABOUR     COST/CU M              $6.56
                  TOTAL MATERIAL   COST/CU M             $26.12
                                                    -------------
                  TOTAL NET COST/CU M                    $32.68
-----------------------------------------------------------------------------
```

7.1.1 COMPANY MATERIALS RESOURCES

The entry of MATERIALS resources into the COMPANY RESOURCE COST FILES is described in 8.8.1. It will be noted that it is possible to enter resources with or without marking them as 'Awaiting Quotes'.

It is recommended that, due to the changeability of MATERIALS costs all MATERIALS contained in these files be marked as 'Awaiting Quotes'. Resources marked in this way will be readily identifiable when used in a particular contract, and will be able to be updated for that contract as described in 7.1.2(b) below.

7.1.2 CONTRACT MATERIALS RESOURCES

Entry of new resources into the CONTRACT RESOURCES COST FILE, and editing of resources already contained in that file should be done by selecting the UP command from the Main Menu of commands provided by the estimators program (i.e. WS5RUN).

```
                  MAIN MENU
                  ---------
     Commands :-
                  IN - Inspect Item
                  SU - Sub-Contract Quotes
                  UP - Update Prices
                  AP - Apply Mark-Ups
                  PR - Print Reports
                  HE - Set HELP Level
                  ST - Stop

Command ?
```

(a) Entry of new resources:

In the example below, a new SINGLE resource is entered. A detailed explanation of the facilities provided for entering new resources is given in 8.8.1(a).

```
Command ? UP

UPDATE PRICES option
Resource Code ? M987

Resource not on File
Do you wish to enter a new Resource ? Y

Description ? SPECIAL MATERIAL

Cost ? 6.75

Units of Measurement ? M2

Discount (%) ? 12.5

Supplier's Name ? BLUE BOTTLE STORES

Quotes Required ? Y

                    Description - SPECIAL MATERIAL
                    Cost        -        6.750 $/M2
                    Price with 12.500 % Discount =     5.906 $/M2
                    *********** Awaiting Quotes **********
                    Supplier's Name - BLUE BOTTLE STORES
OK ?
```

NOTE:

- It is also possible to enter new GANG resources. The options provided are similar to those described in 8.8.1(b).

- New SINGLE and GANG resources may also be entered whilst building up an item rate. This is illustrated in 5.2.1(i).

(b) Editing existing resources:

This facility should be used for entering up-to-date costs for MATERIALS resources. Note that it is necessary to switch off the 'Awaiting Quotes' mark, as shown below, otherwise the resource will continue to be marked as awaiting quotes. Failure to switch off this mark will result in the

MATERIAL still appearing as 'Awaiting Quotes' in the relevant reports shown in Chapter 6.

The result of revising a resource, as shown below, is to up-date all occurrences of that resource wherever they occur throughout the bill.

In the example below the cost and discount of resource M987 are altered. The resource is also changed to not requiring quotes. (A detailed description of all the editing facilities provided is given in 8.8.2(a)).

```
Resource Code ? M987

                      Description - SPECIAL MATERIAL
                      Cost        -        6.750 $/M2
                      Price with 12.500 % Discount =     5.906 $/M2
                      *********** Awaiting Quotes **********
                      Supplier's Name - BLUE BOTTLE STORES
OK ? N

       Commands :-
                    DS - Change Description
                    CO - Change Cost
                    MA - Mark as Not requiring Quotes
                    UN - Change Units of Measurement
                    DC - Change Discount
                    SU - Change Supplier's Name
                    VI - View Resource
                    FI - File Resource
Command ? CO

Cost ? 10

       Commands :-
                    DS - Change Description
                    CO - Change Cost
                    MA - Mark as Not requiring Quotes
                    UN - Change Units of Measurement
                    DC - Change Discount
                    SU - Change Supplier's Name
                    VI - View Resource
                    FI - File Resource
Command ? DC

Discount (%) ? 7.5

       Commands :-
                    DS - Change Description
                    CO - Change Cost
                    MA - Mark as Not requiring Quotes
                    UN - Change Units of Measurement
                    DC - Change Discount
                    SU - Change Supplier's Name
                    VI - View Resource
                    FI - File Resource
Command ? MA
```

```
        Commands :-
                    DS - Change Description
                    CO - Change Cost
                    MA - Mark as requiring Quotes
                    UN - Change Units of Measurement
                    DC - Change Discount
                    SU - Change Supplier's Name
                    VI - View Resource
                    FI - File Resource
    Command ? VI

                      Description - SPECIAL MATERIAL
                      Cost          -      10.000 $/M2
                      Price with  7.500 % Discount =      9.250 $/M2
                      Supplier's Name - BLUE BOTTLE STORES
```

NOTE:

- It is also possible to edit GANG resources already entered into the file. This may be done in a similar manner to that described in 8.8.2(b).

7.2 DOMESTIC SUB-CONTRACT RESOURCES 'AWAITING QUOTES'

DOMESTIC SUB-CONTRACT items should not be confused with NOMINATED SUB-CONTRACT items (all NOMINATED items are described in Chapter 10). Note that wherever SUB-CONTRACT is used in this manual, it refers to DOMESTIC SUB-CONTRACT items unless otherwise stated.

The identification of SUB-CONTRACT items by the system results from the data keyed in during the entry of the bill of quantities (see Chapter 4). The system is thus able to provide reports of all the items awaiting SUB-CONTRACT reports (see 6.1.4). As and when SUB-CONTRACT quotes are entered into the system, as described in 7.2.2, they are automatically deleted from these reports.

NOTE:

- It is not possible to enter a SUB-CONTRACT quote for an item not marked as requiring a SUB-CONTRACT quote as described in 4.1.3.

- The system does not provide facilities for storing SUB-CONTRACT resource costs in the COMPANY RESOURCE COST FILES. These are considered as unique for each tender.

7.2.1 INSPECTION OF UNPRICED ITEMS

If the estimator INSPECTS an item before the entry of the SUB-CONTRACT cost, he will receive displays similar to those shown below.

(a) SUB-CONTRACT and WORK GROUP item:

As described in Chapter 4, the system enables the estimator to combine a WORK GROUP with a SUB-CONTRACT item. As shown below the system illustrates that a SUB-CONTRACT quote is awaited for this item.

```
Bill 1   Section 1   Page 1/ D
Quantity      54     M3
Work Group FB18D.3
RNFCD.CONC.CASING TO ISOL.STL.BMS EXCDG 0.25M2   (CONVEYER)
----------------------------------------------------------------------------
                                                              Weight
Code          Description            Cost/HR      Usage       Factor     Cost/M3
----          -----------            ---------    -----       ------     ---------
L2    LABOURER (CONC)     -            $2.75      1.670       100.0%      $4.59*
P7    CONVEYOR            -            $5.00       .130       100.0%      $0.65
                                     Net.                     Wastages
Code          Description            Cost/Unit    Usage       Per Unit   Cost/M3
----          -----------            ---------    -----       --------   ---------
M105  CONCRETE MIX A      -          $27.00/CU    1.000         5.0%      $28.35
----------------------------------------------------------------------------
Sub-Contractor Required
----------------------------------------------------------------------------
                         TOTAL LABOUR     COST/M3                $4.59
                         TOTAL PLANT      COST/M3                $0.65
                         TOTAL MATERIAL   COST/M3               $28.35
                                                          -------------
                         TOTAL NET COST/M3                      $33.59
----------------------------------------------------------------------------
```

(b) SUB-CONTRACT only items:

Where an item has been entered into the system as requiring <u>only</u> a SUB-CONTRACT quote, the UNKNOWN option has to be used to INSPECT it (see 5.2.2(b)). This is necessary because the system requires a classification (see 5.2.2(b)) to be entered for all items.

<u>NOTE</u>:

- It is not necessary to INSPECT such items to ensure that they are transferred to the FILE OF CONTRACT DETAILS.

- It is thus not necessary for the estimator to enter a classification for items requiring only SUB-CONTRACT quotes.

  (The classification is used to enable the system to produce listings of the bill of quantities in Work Section sequence. If this is required, a classification will have to be entered).

```
                    MAIN MENU
                    ---------
        Commands :-
                    IN - Inspect Item
                    SU - Sub-Contract Quotes
                    UP - Update Prices
                    AP - Apply Mark-Ups
                    PR - Print Reports
                    HE - Set HELP Level
                    ST - Stop

Command ? IN

INSPECT ITEM option
Item Reference ? 1/1/1/B

PRICE ITEM option
        Commands :-
                    KN - Known Group
                    UN - Unknown Group
                    IN - Included In
        Press RETURN to return to Main Menu
Command ? UN

UNKNOWN WORK GROUP option
Bill 1  Section 1  Page 1/ B
Quantity   215    M3
Classification ? S

EDIT WORK GROUP option
        Commands :-
                    AD - Add resource
                    DE - Delete resource
                    CH - Change resource
                    VI - View bill item

Command ? VI

Bill 1  Section 1  Page 1/ B
Quantity   215    M3
Classification S
------------------------------------------------------------------------------
There are no Resources in this Work Group
------------------------------------------------------------------------------
Sub-Contractor Required
------------------------------------------------------------------------------
```

7.2.2 ENTERING SUB-CONTRACT QUOTATIONS

This section describes the entry of SUB-CONTRACT quotes into the system, and their subsequent effect on the display of item build-ups. Access to this facility is obtained through the Main Menu of commands provided with the estimator's program (i.e. WS5RUN).

```
                MAIN MENU
                ---------
      Commands :-
                IN - Inspect Item
                SU - Sub-Contract Quotes
                UP - Update Prices
                AP - Apply Mark-Ups
                PR - Print Reports
                HE - Set HELP Level
                ST - Stop

   Command ? SU
```

The system continues by requesting the estimator to enter a SUB-CONTRACT CODE. This code enables the system to identify all items priced by a particular Sub-contractor. It is therefore necessary to allocate a unique SUB-CONTRACT CODE for each Sub-contractor.

A SUB-CONTRACT CODE consists of the letter S followed by a number between 1 and 1999 (i.e. the limit on the number of Sub-contractors that may be entered for any one contract is 1999 - see 9.1.1).

```
   SUB-CONTRACT QUOTES option
   Sub-Contract Code (ABORT to return to Main Menu) ? S1

   Resource not on File
   Do you wish to enter a new Resource ? Y
```

The estimator is then asked to enter the name of the sub-contractor in question, and the percentage discount applicable to his quotation.

<u>NOTE</u>:

- The PERCENTAGE DISCOUNT entered is automatically applied to quotations entered.

```
Name ? JOE SUB-CONTRACTOR

Discount (%) ? 2.5

      Commands :-
               IN - Enter Item S/C Included in
               ED - Edit Resource
      Press RETURN to Exit
Command ?
```

The system then provides facilities for entering the SUB-CONTRACT quotations, and for editing the details relating to a particular Sub-contractor.

(a) Entry of quotations:

In order to enter quotations, the IN command should be selected from the sub-menu shown above. The estimator is then asked to enter the following information for each item which is to be priced using the SUB-CONTRACTOR previously defined:

- ITEM REFERENCE

- CLASSIFICATION (if applicable - this is only requested where no WORK GROUP CODE or CLASSIFICATION has previously been entered - see 7.2.1).

- SUB-CONTRACT RATE

This is shown below.

```
Command ? IN

Item Reference ? 1/1/5/A

Classification ? S

Rate ? 5
```

The system then displays the quote entered for the users approval. If it is incorrect, editing facilities are provided. (These are described at the end of this section).

```
Adding S1      to Bill 1  Section 1  Page 5/ A
(Classification S)
With Rate      $5.00
Is This OK ? Y

Item Filed
```

It is then possible to continue entering SUB-CONTRACT quotations for the particular Sub-contractor in question.

```
Do you wish to enter this Resource with another Bill Item ? Y

Item Reference ? 1/1/4/C

Classification ? S

Rate ? 44

Adding S1      to Bill 1  Section 1  Page 4/ C
(Classification S)
With Rate     $44.00
Is This OK ? Y

Item Filed
```

When the estimator has finished entering quotes for a particular SUB-CONTRACTOR, he may exit from this facility as shown below.

```
Do you wish to enter this Resource with another Bill Item ? N

Sub-Contract Code (ABORT to return to Main Menu) ? END
```

<u>**NOTE:**</u>

- It is only possible to enter SUB-CONTRACT quotes for items entered into the system as requiring SUB-CONTRACT quotes (see Chapter 4).

- If an attempt is made to enter a quote for an item not marked as awaiting a SUB-CONTRACT quote, the user will obtain a display similar to that shown as follows.

```
Command ? IN

Item Reference ? 1/1/1/C

This Bill Item already contains its Sub-Contract Quote(s)
      Commands :-
                  IN - Enter Item S/C Included in
                  ED - Edit Resource
      Press RETURN to Exit
```

- It is possible to enter 2 SUB-CONTRACT quotations for any one item. These may be both from the same Sub-contractor, or from two different Sub-contractors.

- Where incorrect information has been entered for a particular quote, it may be changed as shown below.

```
Item Reference ? 1/1/7/C

Classification ? S

Rate ? 3

Adding S1      to Bill 1   Section 1   Page 7/ C
(Classification S)
With Rate      $3.00
Is This OK ? N

      Commands :-
                  CH - Change Rate
                  BI - Change Bill Reference
                  VI - View
                  CL - Change Classification
Command ?
```

Changing the SUB-CONTRACT rate:

A new SUB-CONTRACT rate may be entered as shown below.

```
Command ? CH

Rate ? 4

Adding S1      to Bill 1   Section 1   Page 7/ C
(Classification S)
With Rate      $4.00
Is This OK ?
```

Changing the Bill Reference:

It is possible to change the item for which the quote has been entered.

```
Command ? BI

Item Reference ? 1/1/7/D

Adding S1       to Bill 1  Section 1   Page 7/ D
With Rate       $4.00
Is This OK ?
```

Changing the Classification:

This CL command enables the estimator to alter the classification.

```
Command ? CL

Classification ? T

Adding S1       to Bill 1  Section 1   Page 7/ C
(Classification T)
With Rate       $4.00
Is This OK ?
```

Viewing the Rate:

It is possible to view the rate by using this command.

```
Command ? VI

Adding S1       to Bill 1  Section 1   Page 7/ C
(Classification T)
With Rate       $4.00
Is This OK ?
```

(b) Editing a SUB-CONTRACT resource:

The facilities shown below illustrate the editing of information stored for a particular Sub-contractor.

```
SUB-CONTRACT QUOTES option
Sub-Contract Code (ABORT to return to Main Menu) ? S1

                    Description - JOE SUB-CONTRACTOR
                     2.500 % Discount
OK ? Y

      Commands :-
                 IN - Enter Item S/C Included in
                 ED - Edit Resource
      Press RETURN to Exit
Command ? ED

      Commands :-
                 DS - Change Description
                 DC - Change Discount
                 VI - View Resource
                 FI - File Resource
Command ?
```

Changing the SUB-CONTRACT description:

This facility enables the estimator to alter the description entered for a particular Sub-contractor.

```
Command ? DS

Name ? H.L.& H STORES
```

Changing a SUB-CONTRACT discount:

It is possible to alter the discount entered for a particular Sub-contractor.

```
Command ? DC

Discount (%) ? 12
```

Displaying the SUB-CONTRACT resource:

The revised resource may be displayed by using this command.

```
Command ? Vi

            Description - H.L.& H STORES
            12.000 % Discount
```

Filing the SUB-CONTRACT resource:

This command instructs the computer system to store the SUB-CONTRACT resource in its most recent form.

7.2.3 PRESENTATION OF SUB-CONTRACT RESOURCES IN ITEM BUILD-UPS

SUB-CONTRACT quotes entered for a particular item are displayed in that item build-up.

Where an item build-up already contains resource data, (i.e. by previous entry of KNOWN or UNKNOWN resources), it will be displayed in a manner similar to that shown below.

```
Bill 1  Section 1  Page 1/ D
Quantity    54    M3
Work Group FB18D.3
RNFCD.CONC.CASING TO ISOL.STL.BMS EXCDG 0.25M2  (CONVEYER)
---------------------------------------------------------------------------
                                                      Weight
Code        Description           Cost/HR    Usage    Factor     Cost/M3
----        -----------           --------   -----    ------     -------
L2    LABOURER (CONC)      -       $2.75     1.670    100.0%      $4.59*
P7    CONVEYOR             -       $5.00      .130    100.0%      $0.65
                                  Net.                Wastages
Code        Description           Cost/Unit  Usage    Per Unit   Cost/M3
----        -----------           ---------  -----    --------   -------
M105  CONCRETE MIX A       -      $27.00/CU  1.000      5.0%      $28.35

Code        Description                                          Cost/M3
----        -----------                                          -------
S1    H.L.& H STORES       -                                       $3.52
---------------------------------------------------------------------------
                  TOTAL LABOUR     COST/M3             $4.59
                  TOTAL PLANT      COST/M3             $0.65
                  TOTAL MATERIAL   COST/M3            $28.35
                  TOTAL SUB. CON.  COST/M3             $3.52
                                                  -------------
                  TOTAL NET COST/M3                   $37.11
---------------------------------------------------------------------------
```

Where two SUB-CONTRACT quotations have been entered and resource data is already held for the item in question, the build-up will be displayed as shown below.

```
Bill 1  Section 1  Page 10/ A
Quantity     22    M3
Classification FA25A.7
------------------------------------------------------------------------------
                                                          Weight
Code         Description             Cost/HR    Usage     Factor    Cost/M3
----         -----------             ---------  -----     ------    ---------
L2    LABOURER (CONC)        -         $2.75    2.650     100.0%      $7.29*
                                     Net.                 Wastages
Code         Description             Cost/Unit  Usage     Per Unit  Cost/M3
----         -----------             ---------  -----     --------  ---------
M105  CONCRETE MIX A         -       $27.00/CU  1.000       7.5%      $29.03

Code         Description                                            Cost/M3
----         -----------                                            ---------
S1    H.L.& H STORES         -                                        $4.18
S2    FRED SMITH INC         -                                        $5.46
------------------------------------------------------------------------------
                   TOTAL LABOUR     COST/M3              $7.29
                   TOTAL MATERIAL   COST/M3             $29.03
                   TOTAL SUB. CON.  COST/M3              $9.64
                                                   -------------
                   TOTAL NET COST/M3                    $45.96
------------------------------------------------------------------------------
```

If the estimator wishes to INSPECT an item containing only a SUB-CONTRACT resource (e.g. 1/1/1/B on Figure 4.1) this may be done as shown below.

```
                   MAIN MENU
                   ---------
        Commands :-
                   IN - Inspect Item
                   SU - Sub-Contract Quotes
                   UP - Update Prices
                   AP - Apply Mark-Ups
                   PR - Print Reports
                   HE - Set HELP Level
                   ST - Stop

    Command ? IN
```

```
INSPECT ITEM option
Item Reference ? 1/1/1/B

Bill 1  Section 1  Page 1/ B
Quantity   215    M3
Classification S
--------------------------------------------------------------------------

Code          Description                                         Cost/M3
----          -----------                                         ---------
S1    H.L.& H STORES     -                                           $5.72
--------------------------------------------------------------------------
                    TOTAL SUB. CON.  COST/M3              $5.72
                                                    ------------
                    TOTAL NET COST/M3                     $5.72
--------------------------------------------------------------------------
```

NOTE:

- It is not necessary to INSPECT an item containing only a SUB-CONTRACT quote in order to ensure its transferral to the FILE OF CONTRACT DETAILS (see 5.2).

7.2.4 SUB-CONTRACT ITEMS INCLUDED IN OTHER SUB-CONTRACT ITEMS

Where SUB-CONTRACT quotations are provided by the Sub-contractor on an item by item basis, quotes may be entered as described in 7.2.2 above. However, where quotations are obtained with several item rates marked as 'Included' in another rate, use will then have to be made of the INCLUDED IN option (described in 5.2.2(d)).

Thus:

- All SUB-CONTRACT items containing SUB-CONTRACT quotes should be entered as 7.2.2.

- All SUB-CONTRACT items marked as 'Included' in other items should be priced as 5.2.2(d).

8. THE SYSTEM CONTROL PROGRAM

8.0 GENERAL

This program controls the entire computer-aided estimating system. As such it is envisaged that the person in charge of the estimating system and/or others authorised by that person, should be the only persons allowed to use this program. It enables the user to:

- add a new contract to the files;
- delete a contract from the files;
- change the details of a new contract;
- change the master password;
- list the current contracts;
- edit the FILE OF PERFORMANCE DATA;
- list the WORK GROUPS contained on the FILE OF PERFORMANCE DATA;
- edit the contents of the COMPANY RESOURCE COST FILES;
- list the contents of the COMPANY RESOURCE COST FILES;
- set the level of help required;
- stop the program.

Access to the system is obtained by selecting the WS5CHIEF program. This is done by keying in WS5CHIEF after switching on the computer. The system will then require a password to be entered. (This password is known as the MASTER PASSWORD).

```
9C>WS5CHIEF

INTEREST-BUILD System 5.
Chief Estimator's Program
Password ? TOPMAN
```

The system responds by printing out the Main Menu of commands relevant to this program.

```
                    MAIN MENU
                    ---------
       Commands :-
                    AD - Add a new Contract
                    DE - Delete a Contract
                    CH - Change a Contract Details
                    MP - Change the Master Password
                    LC - List current Contracts
                    EW - Edit the Work Groups File
                    LW - List the Work Groups File
                    ER - Edit the master Resource and Resource Gangs file
                    LR - List the master Resource and Resource Gangs file
                    HE - Set HELP Level
                    ST - Stop program
   Command ?
```

Each of these options is described below.

8.1 ADDING A NEW CONTRACT

This facility enables the user to enter details relating to a new estimate. Additional information will be needed to supplement that contained in the bill of quantities. Details of this information are given in Figure 8.1 and described below.

(a) Contract Identifier:

This enables the system to store and retrieve the records relating to a particular tender.

(b) Contract Title:

This is the name of the particular tender in question.

(c) Reference Code:

This is the organisations own internal reference relating to the tender in question.

(d) Tender Submission Date:

This is the date on which the tender is to be submitted.

(e) Estimator's Password:

This facility restricts the use of the estimator's program (WS5RUN - see Chapter 5) to those persons familiar with the ESTIMATOR'S PASSWORD.

(f) Data Prep. Password:

Similarly, this facility restricts the use of the bill entry program (WS5DPREP - see Chapter 4) to those persons who know this password.

(g) Approximate Number of Items:

This information enables the computer system to reserve space within its files for the particular project in question.

OPTION	MAX. LENGTH ALLOWED (CHARACTERS)	CHARACTERS ALLOWED		
		ALPHA-BETICAL	NUMER-ICAL	SPACES
Contract Identifier	4	Yes	Yes	No
Contract Title	80	Yes	Yes	Yes
Reference Code	40	Yes	Yes	Yes
Tender Submission Date	8	Yes	Yes	Yes
Estimator's Password	6	Yes	Yes	Yes
Data Prep Password	6	Yes	Yes	Yes

Figure 8.1 Requirements of options for ADD A NEW CONTRACT command

(h) Bill Numbering Method:

This determines the manner in which the PAGE REFERENCE (see Chapter 4) and ITEM REFERENCE (see Chapter 5) need to be entered. Where the bill of quantities is supplied as one document, the BILL NUMBERING METHOD would allow the PAGE and ITEM reference to be entered in the following manner.

3/49/C

SECTION NUMBER — PAGE NUMBER — ITEM LETTER (OR NUMBER)

Similarly, where the bill of quantities is supplied as several documents, the BILL NUMBERING METHOD would allow the PAGE and ITEM references to be entered in the following manner.

2/3/104/F

BILL NUMBER — SECTION NUMBER — PAGE NUMBER — ITEM LETTER (OR NUMBER)

The user will also be asked to select the method of referencing items. This may be either LETTERS or NUMBERS depending upon the bill in question. If the items are referenced by LETTERS, the user will also be asked whether the letters i and o are to be included.

The printout below illustrates the adding of a contract for a new tender. Note that all input by the user is underlined.

```
Command ? AD

ADD CONTRACT option
Contract Identifier ? WIL

Contract Title ?
USER MANUAL DEMONSTRATION

Reference Code ? REF-99

Tender Submission Date (DD/MM/YY) ? 25 DEC 81

Estimator's Password ? BLUE

Data Prep. Password ? PETER

Approximate Number of Bill Items ? 100
```

```
BILL NUMBERING METHOD
For    Section / Page / Item              enter   1
For    Bill / Section / Page / Item       enter   2
Option ? 1

LETTERS or NUMBERS ? LE

Excluding I and O ? Y

File Initialisation in Progress
```

A short pause will follow to enable the computer system to allocate space in its files for the new contract. The menu of commands will then be displayed.

```
Commands :-
              AD - Add a new Contract
              DE - Delete a Contract
              CH - Change a Contract Details
              MP - Change the Master Password
              LC - List current Contracts
              EW - Edit the Work Groups File
              LW - List the Work Groups File
              ER - Edit the master Resource and Resource Gangs file
              LR - List the master Resource and Resource Gangs file
              HE - Set HELP Level
              ST - Stop program
Command ?
```

8.2 DELETING A CONTRACT

This command enables the user to delete a contract that is no longer needed. If it is required to preserve the contract information for later use, the files displayed by the computer system will need to be preserved. The procedure for doing this may be found elsewhere.

```
     Commands :-
                    AD - Add a new Contract
                    DE - Delete a Contract
                    CH - Change a Contract Details
                    MP - Change the Master Password
                    LC - List current Contracts
                    EW - Edit the Work Groups File
                    LW - List the Work Groups File
                    ER - Edit the master Resource and Resource Gangs file
                    LR - List the master Resource and Resource Gangs file
                    HE - Set HELP Level
                    ST - Stop program
Command ? DE

DELETE CONTRACT option
Contract Identifier ? WIL

Contract Title:-
USER MANUAL DEMONSTRATION
Reference Code:- REF-99
Tender Submission Date:- 25 DEC 8
OK ? Y

To Preserve the Data for this Contract, you should
have Saved the following Files:-
      WCONTROL.WIL
      WCONMAIN.WIL
      WCONSUBS.WIL
      WRESUPDT.WIL
      WSRTKEYS.WIL
OK to proceed ? Y

Contract Deleted
```

8.3 CHANGING THE CONTRACT DETAILS

This facility allows the estimator to change details relating to the particulars of a contract already entered into the computer. The sub-menu of commands which enables these changes to be made is shown as follows.

```
        Commands :-
                   AD - Add a new Contract
                   DE - Delete a Contract
                   CH - Change a Contract Details
                   MP - Change the Master Password
                   LC - List current Contracts
                   EW - Edit the Work Groups File
                   LW - List the Work Groups File
                   ER - Edit the master Resource and Resource Gangs file
                   LR - List the master Resource and Resource Gangs file
                   HE - Set HELP Level
                   ST - Stop program
Command ? CH

CHANGE CONTRACT DETAILS option
Contract Identifier ? WIL

        Commands :-
                   ES - Change Estimator's Password
                   DA - Change Data Prep Password
                   CO - Change Contract Title
                   RE - Change Reference Code
                   TE - Change Tender Submission Date
                   ME - Change Numbering Method
        Press RETURN to return to Main Menu
Command ?
```

It should be noted that the options provided (as illustrated below) may be exercised at any time during the operation of the estimating system with the exception of changing the NUMBERING METHOD. This can only be done before entry of the bill of quantities into the computer has started.

(a) Changing the Estimator's Password:

The example below shows how the ESTIMATOR'S PASSWORD may be changed.

```
Command ? ES

Estimator's Password is:- BLUE
New Password ? RED
```

(b) Changing the Data Prep Password:

It is also possible to change the password allowing access to the bill entry program.

```
Command ? DA

Data Prep. Password is:- PETER
New Password ? GREEN
```

(c) Changing the Contract title:

This facility allows the user to change the title of a particular contract.

```
Command ? CO

Title is:-
USER MANUAL DEMONSTRATION
New Title ?
MANUAL FOR USERS - DEMONSTRATION
```

(d) Changing the Reference Code:

This command allows the reference code to be altered.

```
Command ? RE

Reference Code is:- REF-99
New Code ? JET/54F
```

(e) Changing the Tender Submission Date:

The date entered for the submission of the tender may be altered by using this option.

```
Command ? TE

Tender Submission Date is:- 25 DEC 8
New Date (DD/MM/YY) ? 12-12-81
```

(f) Changing the Numbering Method:

This option enables the method of numbering to be altered. As stated above, it is only possible to make this alteration before entry of the bill into the computer system has commenced.

```
Command ? ME

Numbering method is:-
Bill / Section / Page / Item
Items lettered (I and O excluded)

For     Section / Page / Item               enter 1
For     Bill / Section / Page / Item        enter 2
Option ? 2

LETTERS or NUMBERS ? NU
```

8.4 CHANGING THE MASTER PASSWORD

The MASTER PASSWORD is the password allowing access to the System Control Program (i.e. WS5CHIEF). The method by which this change may be effected is shown below.

```
                    MAIN MENU
                    ---------
          Commands :-
                    AD - Add a new Contract
                    DE - Delete a Contract
                    CH - Change a Contract Details
                    MP - Change the Master Password
                    LC - List current Contracts
                    EW - Edit the Work Groups File
                    LW - List the Work Groups File
                    ER - Edit the master Resource and Resource Gangs file
                    LR - List the master Resource and Resource Gangs file
                    HE - Set HELP Level
                    ST - Stop program
     Command ? MP

     CHANGE MASTER PASSWORD option
     New Password ? TOPMAN
```

8.5 LISTING THE CURRENT CONTRACTS

This command enables the user to view the contracts currently stored in the computer system. In the example below, there are two contracts held in the system's files.

```
                    MAIN MENU
                    ---------
          Commands :-
                    AD - Add a new Contract
                    DE - Delete a Contract
                    CH - Change a Contract Details
                    MP - Change the Master Password
                    LC - List current Contracts
                    EW - Edit the Work Groups File
                    LW - List the Work Groups File
                    ER - Edit the master Resource and Resource Gangs file
                    LR - List the master Resource and Resource Gangs file
                    HE - Set HELP Level
                    ST - Stop program
     Command ? LC

     LIST CURRENT CONTRACTS option
     There are 2 current contracts
```

```
---------------------------------------------------------------------------

Contract Identifier:- MJB

Contract Title:-
Standard Contract - Try-out of Materials Usage Listing

Reference Code:- VC404

Tender Submission Date:- 31/07/81

---------------------------------------------------------------------------


Press RETURN to continue <------ RETURN KEY PRESSED



---------------------------------------------------------------------------

Contract Identifier:- WIL

Contract Title:-
MANUAL FOR USERS - DEMONSTRATION

Reference Code:- JET/54F

Tender Submission Date:- 12-12-81

---------------------------------------------------------------------------


Press RETURN to continue <------ RETURN KEY PRESSED

                  MAIN MENU
                  ---------
      Commands :-
                  AD - Add a new Contract
                  DE - Delete a Contract
                  CH - Change a Contract Details
                  MP - Change the Master Password
                  LC - List current Contracts
                  EW - Edit the Work Groups File
                  LW - List the Work Groups File
                  ER - Edit the master Resource and Resource Gangs file
                  LR - List the master Resource and Resource Gangs file
                  HE - Set HELP Level
                  ST - Stop program
Command ?
```

8.6 EDITING THE WORK GROUPS FILE

This section of the system enables the person in charge of the estimating system to edit the FILE OF PERFORMANCE DATA. Two different operations may be carried out. These are:

- the entry of new WORK GROUPS into the FILE OF PERFORMANCE DATA;

- the editing of WORK GROUPS already held in the FILE OF PERFORMANCE DATA.

8.6.1 ENTERING A NEW WORK GROUP

The example below illustrates the entering into the system of a new WORK GROUP. This WORK GROUP relates to the placing of mass concrete in sundry bases, and involves the use of two resources (i.e. ready mixed concrete, and labour to place the concrete).

The user is first of all asked to enter the WORK GROUP CODE. This is the code obtained from the INTEREST-BUILD classification which corresponds to the WORK GROUP in question. It is then necessary to enter the description and units of measurement as shown below.

```
Command ? EW

WORK GROUPS EDIT option


Work Group Code (ABORT to return to Main Menu) ? FA?.0

Description ? MASS CONCRETE IN SUNDRY BASES

Units of Measurement ? M3
```

The user is then prompted for information relating to the resources used in the WORK GROUP. The entry of resources is shown below, and is similar to that already described in 5.2.2(b).

<u>NOTE</u>:

- These resources relate to those held in the <u>COMPANY</u> RESOURCE COST FILES. (See Chapter 3).

- It is possible to create a new resource at this stage by entering a RESOURCE CODE which has not been used before. (This may be done in a similar manner to that described in 5.2.1(h)).

- Up to 10 resources (either SINGLE or GANG) may be entered for any WORK GROUP.

```
Resource Code (END to finish) ? M105

                    Description - CONCRETE
                    Cost        -      20.000 $/M3     (used)
                    Price with  5.000 % Discount =    19.000 $/M3
                    *********** Awaiting Quotes **********
                    Supplier's Name - REDLAND READYMIX CONC
OK ? Y

Description Extension ? <------ RETURN KEY PRESSED

Usage Rate ? 1

Wastage (%) ? 5

Resource Code (END to finish) ? LG18

**************************************************************************
LG18   CONC GANG (3)

L2          LABOURER (CONC)
                                    $2.75 * 3.00 HR    *AQ*      $8.25
                                                              -----------
                                                                 $8.25
                                      Divided by   1.0
                                                              -----------
                                      Gang Cost /HR              $8.25
**************************************************************************
OK ? Y

Description Extension ? <------ RETURN KEY PRESSED

Usage Rate ? .35

Resource Code (END to finish) ? END

      Commands :-
                  AD - Add Resource
                  DE - Delete Resource
                  CH - Change Resource
                  VI - View Work Group
Command ?
```

The user may then view the WORK GROUP by selecting the VI command. (The other commands in this sub-menu are similar to those already described in 5.2.1(h)).

```
Command ? VI

Work Group FA9.0
MASS CONCRETE IN SUNDRY BASES
---------------------------------------------------------------------------------
                                                               Weight
Code         Description              Cost/HR      Usage       Factor     Cost/M3
----         -----------              ---------    -----       ------     ---------
LG18  CONC GANG (3)          -           $6.75      .350       100.0%       $2.36
                                      Net.                     Wastages
Code         Description              Cost/Unit    Usage       Per Unit   Cost/M3
----         -----------              ---------    -----       --------   ---------
M105  CONCRETE               -        $19.00/M3    1.000          5.0%     $19.95*
---------------------------------------------------------------------------------
                    TOTAL LABOUR     COST/M3                  $2.36
                    TOTAL MATERIAL   COST/M3                 $19.95
                                                         -------------
                    TOTAL NET COST/M3                        $22.31
---------------------------------------------------------------------------------
Do you wish to Edit ?
```

If the user is satisfied with the WORK GROUP he should enter N and the system will proceed by requesting another WORK GROUP CODE.

8.6.2 EDITING A WORK GROUP

It is possible to change any data entered for a particular WORK GROUP. The manner in which this may be done is shown as follows.

```
Command ? EW

WORK GROUPS EDIT option
Work Group Code (ABORT to return to Main Menu) ? G1A.0

Work Group G1A.0
6 MM MILD STEEL REINFORCEMENT IN FOUNDATIONS
---------------------------------------------------------------------------------
                                                               Weight
Code         Description              Cost/HR      Usage       Factor     Cost/T
----         -----------              ---------    -----       ------     ---------
L6    LABOURER (UNLOAD)      -           $2.25      .500       100.0%       $1.13
L31   STEELFIXER             -FIX        $3.00    54.000       100.0%     $162.00
L46   BANKSMAN               -           $2.25      .250       100.0%       $0.56
P5    MOBILE CRANE           -          $14.50      .250       100.0%       $3.63
                                      Net.                     Wastages
Code         Description              Cost/Unit    Usage       Per Unit   Cost/T
----         -----------              ---------    -----       --------   ---------
M1    6MM M.S.REBAR          -        $295.00/TN   1.000          2.5%    $302.38
M34   BINDING WIRE           -          $1.50/KG  18.000          0.0%     $27.00
---------------------------------------------------------------------------------
                    TOTAL LABOUR     COST/T                  $163.69
                    TOTAL PLANT      COST/T                    $3.63
                    TOTAL MATERIAL   COST/T                  $329.38
                                                         -------------
                    TOTAL NET COST/T                         $496.69
---------------------------------------------------------------------------------
Do you wish to Edit ? Y
```

```
        Commands :-
                      DS - Change Description
                      UN - Change Units of Measurement
                      ED - Edit Work Group
                      VI - View Work Group
                      DF - Delete Work Group from File
                      FI - File Work Group
Command ?
```

The commands enabling changes to be made are described below.

Changing the Description:

It is possible to change the WORK GROUP description as shown below.

```
Command ? DS

Description ? 6 MM M.S. REBAR IN FOUNDS

        Commands :-
                      DS - Change Description
                      UN - Change Units of Measurement
                      ED - Edit Work Group
                      VI - View Work Group
                      DF - Delete Work Group from File
                      FI - File Work Group
Command ?
```

Changing the Units of Measurement:

This may be done as illustrated below:

```
Command ? UN

Units of Measurement ? T

        Commands :-
                      DS - Change Description
                      UN - Change Units of Measurement
                      ED - Edit Work Group
                      VI - View Work Group
                      DF - Delete Work Group from File
                      FI - File Work Group
Command ?
```

Editing the contents of the WORK GROUP:

This command allows the user to make changes to the resources contained in the WORK GROUP.

```
Command ? ED

      Commands :-
                  AD - Add Resource
                  DE - Delete Resource
                  CH - Change Resource
                  VI - View Work Group
Command ? CH

Resource Code (END to finish) ? L46

                                                           Weight
Code         Description            Cost/HR      Usage     Factor      Cost/T
----         -----------            ---------    -----     ------    ---------
L46    BANKSMAN            -HOIST      $2.25      .250     100.0%        $0.56
      Commands :-
                  EX - Change Extension
                  US - Change Usage Rate
      Press RETURN to exit

Command ? EX

Description Extension ? HOIST

      Commands :-
                  EX - Change Extension
                  US - Change Usage Rate
      Press RETURN to exit

Command ? <---------- RETURN KEY PRESSED

      Commands :-
                  AD - Add Resource
                  DE - Delete Resource
                  CH - Change Resource
                  VI - View Work Group
Command ?
```

These editing commands are described in more detail in 5.2.1(h).

<u>NOTE</u>:

- The WEIGHTING FACTOR is assumed as 100 for all performance data contained in the COMPANY files.

Viewing the WORK GROUP:

The user may wish to see the results of the changes he has made. This may be done by using the VI command. The example below illustrates the changes made to the original WORK GROUP described above.

```
Command ? VI

Work Group G1A.0
6 MM M.S. REBAR IN POUNDS
--------------------------------------------------------------------------------
                                                               Weight
Code        Description                   Cost/HR      Usage   Factor    Cost/T
----        -----------                   ---------    -----   ------    --------
L6    LABOURER (UNLOAD)    -                $2.25       .500   100.0%      $1.13
L31   STEELFIXER           -FIX             $3.00     54.000   100.0%    $162.00
L46   BANKSMAN             -HOIST           $2.25       .250   100.0%      $0.56
P5    MOBILE CRANE         -               $14.50       .250   100.0%      $3.63
                                          Net.                 Wastages
Code        Description                   Cost/Unit    Usage   Per Unit  Cost/T
----        -----------                   ---------    -----   --------  --------
M1    6MM M.S.REBAR        -              $295.00/TN   1.000      2.5%   $302.38
M34   BINDING WIRE         -                $1.50/KG  18.000      0.0%    $27.00
--------------------------------------------------------------------------------
                     TOTAL LABOUR     COST/T               $163.69
                     TOTAL PLANT      COST/T                 $3.63
                     TOTAL MATERIAL   COST/T               $329.38
                                                         -----------
                     TOTAL NET COST/T                      $496.69
--------------------------------------------------------------------------------
Do you wish to Edit ?
```

Deleting the WORK GROUP:

If the WORK GROUP is not required for subsequent use, it may be removed from the system's files by using this command.

```
Command ? DF

Work Group Deleted
```

Filing the WORK GROUP:

This command instructs the system to store the revised WORK GROUP in the FILE OF PERFORMANCE DATA for further use.

8.7 LISTING THE WORK GROUPS FILE

The use of this command will provide a report giving all the WORK GROUPS on the computer system's files at that stage. The commands allowing this report to be obtained are shown below.

```
                         MAIN MENU
                         ---------
        Commands :-
                         AD - Add a new Contract
                         DE - Delete a Contract
                         CH - Change a Contract Details
                         MP - Change the Master Password
                         LC - List current Contracts
                         EW - Edit the Work Groups File
                         LW - List the Work Groups File
                         ER - Edit the master Resource and Resource Gangs file
                         LR - List the master Resource and Resource Gangs file
                         HE - Set HELP Level
                         ST - Stop program
   Command ? LW

   WORK GROUPS LIST option
   Sorting in Progress
```

A short delay will be experienced to enable the system to sort all the WORK GROUPS into order (the system assumes that they will be entered in a random fashion). It will then be necessary to enter the date (to allow identification of the report). Ensure that the printer is switched on and that, in the case of multi-user systems, nobody else is using the printer at the same time. It will also be necessary to check that sufficient paper is available for the printing of the complete report.

```
        51 work groups sorted

      Date ? 4-8-81

      This list will need about    3 pages.
      Make sure printer is available (press RETURN)<---- RETURN KEY
                                                          PRESSED
```

The report will now be printed out. A section of it is illustrated in Figure 8.2.

Interest-Build 5 Work Groups Listing

Date : 4-8-81 Page 1

FA25A.7	CONCRETE IN BLINDING N.E. 100MM THICK (50 TO 100MM) (BARROW 25M)	Units M3
FA25A.9	BLINDING NE 100MM (HAND)	Units M3
FA26E.3	CONCRETE TO BEDS 150-300MM THICK (CRANE)	Units M3
FA26G.2	CONCRETE TO BEDS EXCDG 300MM THICK (BARROW 25M)	Units M3
FB14D.5	REINFCD.CONC.CASING STL.BMS. EXCDG 0.25M2 (CONVEYER)	Units M3
FB18D.3	RNFCD.CONC.CASING TO ISOL.STL.BMS EXCDG 0.25M2 (CONVEYER)	Units M3
FB26G.3	REINFCD CONC.IN BEDS EXCDG 300MM THICK (CRANE)	Units M3
FB27G.2	REINFCD.CONC.IN ROADS EXCDG.300MM THICK (BARROW 25M)	Units M3
FB36G.2	REINFCD.CONC.TO WALLS EXCDG.300MM THICK (PUMP)	Units M3
G11J.0	25MM M.S.REBAR IN SCASES,STRNGS,LANDINGS	Units TNE
G11K.0	25MM M.S.REBAR IN STEPS,SCASES,STRNGS,LNDGS	Units TNE
G11L.0	25MM M.S.REBAR IN TOPS OF DORMERS	Units TNE
G11M.0	25MM M.S.REBAR IN TOPS +CHEEKS DORMERS	Units TNE
G14H.0	32MM M.S.REBAR IN STEPS	Units TNE
G14I.0	32MM M.S.REBAR IN STAIRCASES+STRINGS	Units TNE
G14J.0	32MM M.S.REBAR IN SCASES,STRNGS,LANDINGS	Units TNE
G14K.0	32MM M.S.REBAR IN STEPS,SCASES,STRNGS,LNDGS	Units TNE
G15G.0	40MM M.S.REBAR IN CASING STEEL COLS+BMS	Units TNE

Figure 8.2 Example of COMPANY WORK GROUPS listing

8.8 EDITING THE MASTER RESOURCE AND RESOURCE GANGS FILE

The purpose of this command is to enable the person in charge of the estimating system to edit the contents of the COMPANY RESOURCE COST FILES (i.e. the Master Resource and Resource Gangs File). Two different operations may be carried out. They are:

- the entry of new resources or gangs of resources into the system.

- the editing of resources or resource gangs already stored in the COMPANY RESOURCE COST FILES.

8.8.1 ENTRY OF NEW RESOURCES

(a) SINGLE resources:

In order to enter a new SINGLE resource, the user needs to enter a RESOURCE CODE which has not already been used. (See Chapter 3). The prompts which the computer system provides are illustrated below.

```
Command ? ER

MASTER RESOURCES EDIT option
Resource Code (ABORT to return to Main Menu) ? M155

Resource not on File
Do you wish to enter a new Resource ? Y
```

The system then requires the following information to be entered for the resource:

- Description

- Cost per unit

- Units of measurement

- Percentage discount (if applicable - see NOTE below)

- Suppliers name (if known)

- Are quotes required? (This prompt allows the 'Awaiting Quotes' SUB-SYSTEM to come into operation. See Chapter 7).

```
Description ? SPECIAL EPOXY GLUE

Cost ? 6.95

Units of Measurement ? L

Discount (%) ? 5 ←—— PERCENTAGE SIGN NOT REQUIRED!

Supplier's Name ? JOE BLOGGS & SON

Quotes Required ? Y

                    Description - SPECIAL EPOXY GLUE
                    Cost        -     6.950 $/L
                    Price with  5.000 % Discount =    6.602 $/L
                    *********** Awaiting Quotes **********
                    Supplier's Name - JOE BLOGGS & SON
Do you wish to Edit ? N
```

NOTE:

- That the percentage discount is automatically applied to the cost entered.
- The NET cost (i.e. the Gross cost less discount) is that used in all subsequent calculations.

(b) GANG resources:

The prompts below illustrate the manner in which GANG resources may be entered into the system. They may only be formed from SINGLE resources. As shown, the user is asked to enter the quantity of the SINGLE resource used in the GANG.

```
Resource Code (ABORT to return to Main Menu) ? XG220

Resource not on File
Do you wish to enter a new Resource ? Y

Description ? SPECIAL GANG RESOURCE

Units of Measurement ? TNE
```

```
Single Resource Code (END to finish) ? L1

                    Description - LABOURER
                    Cost        -      2.250 $/HR     (used)
OK ? Y

Quantity of Resource ? .5

Single Resource Code (END to finish) ? P5

                    Description - MOBILE CRANE
                    Cost        -     14.500 $/HR     (used)
OK ? Y

Quantity of Resource ? .25

Single Resource Code (END to finish) ? M6

                    Description - 16MM M.S.REBAR
                    Cost        -    240.000 $/TNE    (used)
OK ? Y

Quantity of Resource ? 1

Single Resource Code (END to finish) ? END
```

It is then necessary to enter a GANG DIVISION RATE. This divides the GANG in accordance with the requirements of the resource in question. (e.g. Where a GANG consists of 2 bricklayers and 1 labourer, it would be necessary to divide by 2 to get a GANG rate).

If no division is required, 1 should be entered. This is shown below.

```
Gang Division Rate ? 1

*****************************************************************************
XG220    SPECIAL GANG RESOURCE

L1       LABOURER
                                     $2.25 *  .50 HR            $1.13
P5       MOBILE CRANE
                                    $14.50 *  .25 HR            $3.63
M6       16MM M.S.REBAR
                                   $240.00 * 1.00 TNE         $240.00
                                                           -----------
                                                              $244.75
                                       Divided by   1.0
                                                           -----------
                                       Gang Cost /TNE         $244.75
*****************************************************************************
Do you wish to Edit ?
```

NOTE:

- As shown above, it is only possible to create GANG resources from SINGLE resources. However, it is possible to create a SINGLE resource at this stage be entering a SINGLE RESOURCE CODE that has not been used. The manner in which this may be done is similar to that already described in 5.2.1(i).

8.8.2 EDITING OF EXISTING RESOURCES

(a) SINGLE resources:

The commands below illustrate the manner in which the contents of a SINGLE resource may be changed. It is first necessary to call up the resource by its RESOURCE CODE, and then to instruct the system that the editing facilities are required.

```
Resource Code (ABORT to return to Main Menu) ? M105

                    Description - CONCRETE
                    Cost        -       20.000 $/M3     (used)
                    Price with  5.000 % Discount =    19.000 $/M3
                    *********** Awaiting Quotes **********
                    Supplier's Name - REDLAND READYMIX CONC
Do you wish to Edit ? Y

      Commands :-
                   DS - Change Description
                   CO - Change Cost
                   MA - Mark as Not requiring Quotes
                   UN - Change Units of Measurement
                   DC - Change Discount
                   SU - Change Supplier's Name
                   VI - View Resource
                   FI - File Resource
Command ?
```

The editing commands are described below.

Changing the Description:

A new description may be entered as shown below.

```
Command ? DS

Description ? CONCRETE MIX A
```

Changing the Cost:

A new cost may be entered by using the CO command.

```
Command ? CO
Cost ? 30
```

Marking as NOT requiring quotes:

This facility removes the mark which identifies this resource as 'Awaiting Quotes'. (This aspect is further described in Chapter 7).

```
Command ? MA
```

Changing the Units of Measurement:

The units of measurement may be changed.

```
Command ? UN
Units of Measurement ? CU M
```

Changing the Discount:

The discount may be changed as shown below. It is also possible to enter 0 if this facility is not required.

```
Command ? DC
Discount (%) ? 10
```

Changing the Supplier's Name:

The facility allows changes to be made to the name of the supplier.

```
Command ? SU
Supplier's Name ? READYMIX CONCRETE SUPPLIES
```

Viewing the Resource:

This command enables the user to view the resource.

```
Command ? VI

                Description - CONCRETE MIX A
                Cost        -      30.000 $/CU M    (used)
                Price with 10.000 % Discount =    27.000 $/CU M
                Supplier's Name - READYMIX CONCRETE SUPPLIES
```

Filing the Resource:

This command instructs the system to store the resource in its present form.

```
Command ? FI

Resource Filed
```

Deleting the Resource:

If the resource is no longer required, it may be removed by exercising this command.

```
Command ? DE

Resource Deleted
```

<u>NOTE</u>:

- Where a resource has been marked as (used) - this signifies that it is used in a GANG resource or a WORK GROUP.
- It is not possible to delete SINGLE resources marked as (used).

(b) GANG resources:

As with SINGLE resources, it is necessary for the user to call up the GANG resource in question.

```
Resource Code (ABORT to return to Main Menu) ? XG231

*****************************************************************************
XG231     SPECIAL GANG RESOURCE

L1        LABOURER
                                        $2.25 *  .90 HR              $2.02
M5        16MM M.S.REBAR
                                      $240.00 * 1.00 TNE           $240.00
M34       BINDING WIRE
                                        $1.50 *20.00 KG             $30.00
                                                                -----------
                                                                   $272.03
                                          Divided by   1.0
                                                                -----------
                                          Gang Cost /TNE           $272.03
*****************************************************************************
Do you wish to Edit ? Y

      Commands :-

                 DS - Change Description
                 UN - Change Units of Measurement
                 AD - Add Resource
                 DE - Delete Resource
                 QU - Change Quantity
                 VI - View Gang Build Up
                 DV - Change Division Rate
                 FI - File Gang
                 DF - Delete Gang from File

Command ?
```

Some of the editing commands have already been described in the section for SINGLE resources above. Only the outstanding facilities are described below.

Adding a Resource:

It is possible to add a new SINGLE resource into the GANG resource by using this command.

```
Command ? AD

Single Resource Code ? P5

                    Description - MOBILE CRANE
                    Cost        -     14.500 $/HR     (used)
OK ? Y

Quantity of Resource ? .38
```

Deleting a Resource:

It is also possible to delete a resource from those already contained within the GANG.

```
Command ? DE

Single Resource Code ? M34
```

Changing the Quantity:

This command enables the user to change the quantity of a resource used in the GANG. To do this he needs to enter the RESOURCE CODE to be changed as shown below.

```
Command ? QU

Single Resource Code ? L1

Quantity of Resource ? .75
```

Changing the Division Rate:

It is possible to change the division for the GANG as shown below.

```
Command ? DV

Gang Division Rate ? 1.25
```

Viewing the GANG Build-up:

This command enables the user to view the GANG build-up. The display below illustrates the changes made to resource XG231.

```
Command ? VI

*****************************************************************************
XG231     SPECIAL GANG RESOURCE

L1        LABOURER
                                     $2.25 *  .75 HR            $1.69
M6        16MM M.S.REBAR
                                   $240.00 * 1.00 TNE         $240.00
P5        MOBILE CRANE
                                    $14.50 *  .38 HR            $5.51
                                                          -----------
                                                              $247.20
                                        Divided by   1.2
                                                          -----------
                                        Gang Cost /TNE        $197.76
*****************************************************************************
Press RETURN to continue
```

8.9 LISTING OF THE MASTER RESOURCE AND RESOURCE GANGS FILE

This command enables the user to obtain a listing of all the SINGLE and GANG resources stored in the COMPANY RESOURCE COST FILES. The prompts enabling these listings to be obtained are shown below.

```
Command ? LR

MASTER RESOURCES LIST option
Date ? 4-8-81

      Commands:-
                MS   - List Master Single Resources
                MG   - List Master Gang Resources
     (or press RETURN to return to Main Menu)
Command ? MS

Sort in Progress
```

A short delay will be experienced at this stage. The computer system will then continue as below.

```
  152 Resources to be printed

FULL or BRIEF listing ? FU
```

The listing may be obtained in either a FULL or BRIEF form. Examples of these listings are given in Figures 8.3 to 8.4. In order to obtain the listings the RETURN key should be pressed. (Note the additional requirements described in 8.7).

```
Make sure printer is available (press RETURN) <—— RETURN KEY PRESSED
```

8.10 SETTING THE HELP LEVEL

Frequent use of the system will result in the user becoming familiar with the options provided by the system. In such cases it is likely that he will not wish to see the Main Menu of commands for every operation undertaken. The use of the HELP command enables the user to select whether he wants this menu suppressed or displayed. This is illustrated as follows.

```
                    Interest-Build 5 Master Resource Listing
Date : 4-8-81                                                        Page 18
                                 Material

           M101     Description - RAWLTIE
                    Cost        -      .400 £/NR


           M105     Description - CONCRETE MIX A
                    Cost        -     30.000 £/CU M    (used)
                    Price with 10.000 % Discount =    27.000 £/CU M
                    Supplier's Name - READYMIX CONCRETE SUPPLIES


           M110     Description - PUMP MIX CONCRETE
                    Cost        -     25.000 £/M3      (used)
                    Price with  5.000 % Discount =    23.750 £/M3
                    *********** Awaiting Quotes **********
                    Supplier's Name - BLUE CIRCLE


           M120     Description - CONC MIX A
                    Cost        -     20.000 £/M3
                    Price with  5.000 % Discount =    19.000 £/M3
                    *********** Awaiting Quotes **********
                    Supplier's Name - REDLAND READYMIX CONC


           M121     Description - CONCRETE MIX B
                    Cost        -     21.000 £/M3
                    Price with  5.000 % Discount =    19.950 £/M3
                    *********** Awaiting Quotes **********
                    Supplier's Name - REDLAND READYMIX CONC
```

Example 8.3 Example of COMPANY RESOURCE listing

Interest-Build 5 Master Resource Listing

Date : 16-8-81

Material

M91	SOFTWOOD 75 X 100MM	87.10	£/100M	
M92	SOFTWOOD 75 X 150MM	126.10	£/100M	
M93	SOFTWOOD 75 X 175MM	148.20	£/100M	
M94	SOFTWOOD 75 X 200MM	172.25	£/100M	
M95	SOFTWOOD 75 X 225MM	197.60	£/100M	
M96	SOFTWOOD 100 X 100MM	126.10	£/100M	
M100	RAWLLOOP	.45	£/NR	
M101	RAWLTIE	.40	£/NR	
M105	CONCRETE	19.00	£/M3	*
M110	PUMP MIX CONCRETE	23.75	£/M3	*
M120	CONC MIX A	19.00	£/M3	*
M121	CONCRETE MIX B	19.95	£/M3	*

Figure 8.4 Example of COMPANY RESOURCE listing (continued)

```
Commands :-
                 AD - Add a new Contract
                 DE - Delete a Contract
                 CH - Change a Contract Details
                 MP - Change the Master Password
                 LC - List current Contracts
                 EW - Edit the Work Groups File
                 LW - List the Work Groups File
                 ER - Edit the master Resource and Resource Gangs file
                 LR - List the master Resource and Resource Gangs file
                 HE - Set HELP Level
                 ST - Stop program
Command ? HE

          Help levels
    0 - Suppress Menus
    1 - Display Menus
Help Level [RETURN for 1] ? 0
```

If, at any stage, the user enters a command that is not recognised by the system, the MAIN MENU will be displayed. This is shown below.

```
Command ? <------ RETURN KEY PRESSED

Not a valid Command
     Commands :-
                 AD - Add a new Contract
                 DE - Delete a Contract
                 CH - Change a Contract Details
                 MP - Change the Master Password
                 LC - List current Contracts
                 EW - Edit the Work Groups File
                 LW - List the Work Groups File
                 ER - Edit the master Resource and Resource Gangs file
                 1R - List the master Resource and Resource Gangs file
                 HE - Set HELP Level
                 ST - Stop program
Command ?
```

If the user wishes to have the MAIN MENU displayed again, the HELP level will have to be set to 1.

```
Command ? HE

          Help levels
    0 - Suppress Menus
    1 - Display Menus
Help Level [RETURN for 0] ? 1
```

8.11 STOPPING THE PROGRAM

This command enables the user to stop work. This is shown below.

```
        Commands :-
                    AD - Add a new Contract
                    DE - Delete a Contract
                    CH - Change a Contract Details
                    MP - Change the Master Password
                    LC - List current Contracts
                    EW - Edit the Work Groups File
                    LW - List the Work Groups File
                    ER - Edit the master Resource and Resource Gangs file
                    LR - List the master Resource and Resource Gangs file
                    HE - Set HELP Level
                    ST - Stop program
Command ? ST
 STOP
```

The computer may then be switched off.

9. THE DATA LIBRARY

9.0 GENERAL

This chapter gives detailed consideration to the requirements of the COMPANY RESOURCE COST FILES and the FILE OF PERFORMANCE DATA. These files together form the DATA LIBRARY of the estimating system. Resources entered into the COMPANY RESOURCE COST FILES are used in conjunction with performance data stored in the FILE OF PERFORMANCE DATA to form WORK GROUPS. These WORK GROUPS are then used to price items found in bills of quantities as described in Chapter 5.

9.1 THE COMPANY RESOURCE COST FILES

The contents and method of coding to be adopted in these files has already been described in Chapter 3. Consideration is given below to the allowable number of resources in each cost code category, the arrangement of resources within a category, and the presentation of resources for entry into the computer system.

9.1.1 THE ALLOWABLE NUMBER OF RESOURCES

Resources are divided into cost code categories (i.e. Labour, Plant, Auxiliary Plant, Materials, Resource Groups and Sub-contractors), according to the alphabetical prefix associated with each RESOURCE CODE. For example SINGLE Labour resources start with L, GANGS of Labour resources start with LG etc. (see Chapter 3). The number of resources that may be contained in each of these categories is shown in Figure 9.1. These may be altered according to the user's specific requirements, with the proviso that the overall maximum number of resources does not exceed 30 990.

9.1.2 ARRANGEMENT OF RESOURCES

It is recommended that the entry of resources into the system is undertaken in a disciplined manner. Entry of resources on a 'first come, first served basis' is likely to be unsatisfactory, as the time taken to find a specific resource may become excessive.

The example given below illustrates the manner in which a COMPANY RESOURCE COST FILE may be sub-divided in order to ease the effort in locating a particular resource.

CATEGORY	ALLOWABLE RESOURCE CODING	
	SINGLE RESOURCE	GANG RESOURCES
LABOUR	L1 to L1999	LG1 to LG1999
PLANT	P1 to P1999	PG1 to PG1999
AUXILIARY PLANT	A1 to A1999	AG1 to AG1999
MATERIALS	M1 to M6999	MG1 to MG4999
SUB-CONTRACTORS	S1 to S1999	-
RESOURCE GROUPS	-	XG1 to XG4999

Figure 9.1 Limits of Resource Coding

(a) List resources:

The first step is to list all resources likely to be used in the compilation of WORK GROUPS. These should be arranged in their appropriate cost code category.

(b) Sorting of resources:

The resources in each category should then be sorted into 'like' or 'logical' areas. The example shown in Figure 9.2 illustrates an extract from a sorted list of Plant resources.

JCB 3C) JCB 807B) CAT 992) CAT 955L)	EXCAVATORS
17/10 WINGET) 21/14 WINGET)	CONCRETE MIXERS
$0.5m^3$ SAMBRON) $1m^3$ SAMBRON)	DUMPERS

Figure 9.2 Example of Plant Resources arranged in 'like' areas

(c) Allocating RESOURCE CODES:

It is then necessary to allocate RESOURCE CODES to the different resources listed above. The total number of allowable RESOURCE CODES as defined in Figure 9.1 should then be divided into sections. These sections should allow the storage of 'like' areas of resources, and provide a suitable number of blank RESOURCE CODES (i.e. unused RESOURCE CODES). The purpose of these blank codes is twofold:

(i) to allow for the future addition of new resources to the files,

(ii) to allow for the numerous 'one-off' resources that will need to be entered for each tender. This requirement is especially relevant for Materials resources.

Figure 9.3 illustrates an example of the manner in which a PLANT RESOURCE COST FILE may be divided. The 1999 resources available have been divided into sections.

PLANT RESOURCE CODES	PLANT ITEMS
P1 to P49	Compressors
P50 to P99	Compressor tools
P100 to P149	Conc. Mixers
P150 to P199	Conc. Batching Plant
P200 to P249	Conc. Pumps
P250 to P299	Mobile Cranes
P300 to P349	Dumpers
P350 to P399	Excavators
P400 to P449	Forklifts
P450 to P499	Generators
P500 to P549	Hoists
P550 to P599	Hoist Ancillaries
P600 to P649	Lorries - tippers
P650 to P699	Lorries - ordinary
P700 to P749	Water pumps
P750 to P799	Rollers
P800 to P1999	

Figure 9.3 Example of sections within PLANT RESOURCE COST FILE

Each section is then used to store 'like' areas of Plant resources. Blank RESOURCE CODES have been included in each section (i.e. in the case of Excavators, 4 different types of excavator are listed in Figure 9.2 and 49 RESOURCE CODES are allocated to Excavators in Figure 9.3), and after the 'like' areas of resources (i.e. P800 to P1999).

9.1.3 PRESENTATION OF RESOURCES FOR ENTRY INTO THE COMPUTER SYSTEM

The main skill required with entering resources into the computer system is competence in the operation of a keyboard. It is therefore likely that this task will be performed by someone other than the estimator, i.e. a keyboard operator.

In order to aid the keyboard operator in his/her task, it is recommended that the estimator make use of forms similar to those shown in Figure 9.4 for the arrangement of resources (as described in 9.1.2 above). These forms could then be used by the keyboard operator to enter the resource data into the system.

The different aspects of the form are described below. Note that a character may be a letter, number, decimal point, space etc.

RESOURCE CODE : Up to 6 characters are allowed. These should be in accordance with the requirements of 3.1.1 and 9.1.1.

RESOURCE DESCRIPTION : Up to 40 characters are allowed.

<u>NOTE</u>: that the computer system presents this description in two lines 20 characters long. Care should thus be taken to ensure that each set of 20 characters is meaningful.

UNITS OF MEASUREMENT : Up to 4 characters allowed.

COST : Must be a number in the range 0.01 to 99 999.99.

<u>NOTE</u>:

- if the user so wishes he should add extra

RESOURCE CODE	RESOURCE DESCRIPTION	UNIT	RATE

Figure 9.4 Example of form to be used for the arrangement of SINGLE resources

columns to cater for discount and marking resources as 'Awaiting Quotes'.

9.2 THE FILE OF PERFORMANCE DATA

The purpose of this section is to describe the use of the FILE OF PERFORMANCE DATA. This requires an explanation of the use of the INTEREST BUILD classification.

The entry of WORK GROUPS into the FILE OF PERFORMANCE DATA is then briefly described. Examples of forms to be used to aid the collection and entry of WORK GROUP data are also given.

The effect of using GANG resources in the compilation of WORK GROUPS stored in the FILE OF PERFORMANCE DATA is then illustrated.

9.2.1 THE FUNCTION OF THE FILE OF PERFORMANCE DATA

The purpose of this file is to provide the estimator with the facility to store unit rate build-ups for the commonly recurring items of work encountered in building projects. Consider the example of one such build-up shown in Figure 9.5. This illustrates the resources, outputs and wastage factors involved in fixing 6mm mild steel reinforcement in foundations.

Labour			
Off-load Steel	0.5 hrs @ £2.25/hr	= £ 1.12	
Fix Steel	0.25 hrs @ £2.25/hr	= £ 0.56	
Banksman	54 hrs @ £3.00/hr	= £162.00	£163.69
Plant			
Mobile Crane	0.25hrs @ £14.50/hr	= £ 3.62	£ 3.62
Material			
6mm m.s. reinforcement	1 tonne @ £295.00/tne	=£295.00	
	Wastage 2.5%	=£ 7.38	
Binding Wire	18 kg @ £1.50/kg	=£ 27.00	£329.38
TOTAL UNIT RATE/TONNE =			£496.69

Figure 9.5 Example of unit rate 'Build-up' for 6mm Mild Steel Reinforcement in Foundations.

In order to be able to re-use this data, the estimator needs to be able to:

- store the data in the computer system,

- retrieve the data at will for use in the estimate being priced.

It is therefore necessary for the system to facilitate the orderly storage and retrieval of this data (or WORK GROUP). This is done by allocating a code (WORK GROUP CODE) to the WORK GROUP in question, and using this code to identify its location in the computer's files. These WORK GROUP CODES are arranged in the form of a classification, an example of which is given in Figure 9.6.

NOTE:

- The user does not have to make use of the classification suggested. If it is required to use an alternative classification, contact Genesys Limited, who will advise you on the criteria which the new classification should meet.

9.2.2 GUIDELINES FOR USING THE INTEREST BUILD CLASSIFICATION

Detailed instructions on the use of the INTEREST BUILD classification are given with the classification, which should accompany this User Manual.

The following are brief guidelines on the use of the classification:

- The complete WORK GROUP CODE for an item of work should be identified by noting the required codes from the classification;

- The codes should be accumulated from the left side and progress to the right hand side of the page;

- Only the codes relevant to the item of work in question need be accumulated;

- Once all the codes have been collected, a decimal point should be inserted to signify the end of the WORK GROUP CODE as obtained from the classification;

- The decimal point should be followed by a number between 0 and 9. This additional level of coding is used to identify the different methods of construction that may be used for the item of work in question.

G. REINFORCEMENT	BARS	(TONNE)	STRAIGHT AND BENT BARS		
	1. MILD STEEL DIAMETER 6 MM	A. IN FOUNDATIONS	A. HORIZONTAL 12.00 TO 15.00 M		
	2. DITTO 8 MM	B. IN GROUND SLABS	B. DITTO 15.00 TO 18.00 M		
	3. DITTO 10 MM	C. IN SUSPENDED SLABS	C.		
	4. DITTO 12 MM	D. IN WALLS	D.		
	5. DITTO 14 MM	E. IN CASING TO STEEL COLUMNS	E. VERTICAL 5.00 TO 8.00 M		
	6. DITTO 16 MM	F. IN CASING TO STEEL BEAMS	F. DITTO 8.00 TO 11.00 M		
	7. DITTO 18 MM	G. IN CASING TO STEEL COLUMNS AND BEAMS	G.		
	8. DITTO 20 MM		H.		
	9. DITTO 22 MM	H. IN STEPS	CURVED BARS		
	10. DITTO 24 MM	I. IN STAIRCASES AND STRINGS	I. HORIZONTAL 12.00 TO 15.00 M		
	11. DITTO 25 MM	J. IN STAIRCASES AND STRINGS AND ASSOCIATED LANDINGS	J.		
	12. DITTO 26 MM				
	13. DITTO 28 MM	K. IN STEPS, STAIRCASES, STRINGS AND ASSOCIATED LANDINGS	K. VERTICAL 5.00 TO 8.00 M		
	14. DITTO 32 MM		L.		
	15. DITTO 40 MM	L. IN TOPS OF DORMERS			
	16. DITTO 50 MM	M. IN TOPS AND CHEEKS OF DORMERS	M. LINKS, STIRRUPS, BINDERS AND SPECIAL SPACERS		
	17.	N. IN MACHINE AND SUNDRY BASES			
	18. HIGH YIELD DIAMETER 6MM	O. IN ISOLATED COLUMNS			
	19. DITTO 8 MM	P. IN ISOLATED BEAMS AND LINTELS			
	20. DITTO 10 MM	Q. IN ISOLATED COLUMNS, BEAMS AND LINTELS			
	21. DITTO 12 MM				
	22. DITTO 14 MM				
	23. DITTO 16 MM				
	24. DITTO 18 MM				
	25. DITTO 20 MM				
	26. DITTO 22 MM				
	27. DITTO 24 MM				
	28. DITTO 25 MM				
	29. DITTO 26 MM				
	30. DITTO 28 MM				
	31. DITTO 32 MM				
	32. DITTO 40 MM				
	33. DITTO 50 MM				
	34.				

Figure 9.6 Example of INTEREST BUILD classification

Considering the classification shown in Figure 9.6, and taking into account the guidelines described above, it will be seen that the WORK GROUP CODE relevant to the build-up shown in Figure 9.5 is G1A.0 (where 0 refers to the method of construction).

9.2.3 PRESENTATION OF WORK GROUP DATA FOR ENTRY INTO THE COMPUTER SYSTEM

The entry of WORK GROUPS into the computer system is described in 8.6.1. It will be noted that the user needs to make use of resources stored in the COMPANY RESOURCE COST FILES and associated performance and wastage factors selected by the estimator. The resources are identified by RESOURCE CODES which are described in 3.1.1 and 9.1.

The example shown in Figure 9.7 illustrates the manner in which the build-up shown in Figure 9.5 would need to be presented by the estimator in order to provide the necessary data to answer the prompts supplied by the system (as described in 8.6.1). This assumes that all resources used have already been entered into the COMPANY RESOURCE COST FILES as described in 8.8.1.

WORK GROUP CODE: GA1.0

DESCRIPTION: 6mm Mild Steel reinforcement in foundations

UNITS OF MEASUREMENT: TNE

RESOURCE NUMBER	DESCRIPTION EXTENSION	USAGE RATE	WASTAGE RATE
L6	-	0.5	-
L31	-	54	-
L46	-	0.25	-
P5	-	0.25	-
M1	-	1	2.5
M34	-	18	-

Figure 9.7 Example of data required for the entry of a WORK GROUP relating to the build-up shown in Figure 9.5

The collection of performance data for the setting up of the FILE OF PERFORMANCE DATA requires the entry of a large number of WORK GROUPS into the system. This data will need to be accumulated by the estimator and then entered into the computer system. It is likely that some one other than the estimator will perform this entry of data and it is therefore essential that the estimator presents the data in a clear and legible fashion.

It is recommended that the estimator makes use of forms similar to those shown in Figures 9.8 and 9.9 for the presentation of this data. The completed forms should then be handed to the keyboard operator who will use them to enter the data into the system as described in 8.6.1.

There are two different types of forms. Type A (Figure 9.8) should be used on non-formwork items. Type B (Figure 9.9) is for use <u>only</u> with formwork items. The number of characters allowed for each entry is given below. Note that letters, numbers, spaces, decimal points etc. are recognised by the system as a character.

WORK GROUP CODE	:	Variable up to 14 characters long. <u>Must</u> include a decimal point and a numeric level after the decimal point in the range 0 to 9.
DESCRIPTION	:	Up to 80 characters allowed. These are presented on <u>one</u> line by the system.
UNITS OF MEASUREMENT	:	Up to 4 characters.
RESOURCE CODE	:	Variable between 2 to 6 characters.
DESCRIPTION EXTENSION	:	Up to 8 characters.
USAGE RATE	:	Must be a number between 0.001 and 999.999. Up to 7 characters allowed.
NUMBER OF USES	:	Must be a number between 0.1 and 99.9. Up to 4 characters allowed.
WASTAGE	:	Must be a number between 0.1 and 999.9. Up to 5 characters allowed.

WORK GROUP Code

WORK GROUP Description

Units of measurement

Resource Code

Resource Description Extension

Usage

Wastage %

Figure 9.8 Type A pro-forma for entry of WORK GROUP data

WORK GROUP Code

WORK GROUP Description

Units of measurement

Resource Code

Description Extension

Usage

Number of uses (FWK)

Wastage

Figure 9.9 Type B pro-forma for entry of WORK GROUP data

Work Group G1A.0
6 MM MILD STEEL REINFORCEMENT IN FOUNDATIONS

Code	Description		Cost/HR	Usage	Weight Factor	Cost/TNE
L6	LABOURER (UNLOAD)	-	$2.25	.500	100.0%	$1.13
L31	STEELFIXER	-	$3.00	54.000	100.0%	$162.00
L46	BANKSMAN	-	$2.25	.250	100.0%	$0.56
P5	MOBILE CRANE	-	$14.50	.250	100.0%	$3.63

Code	Description		Net. Cost/Unit	Usage	Wastages Per Unit	Cost/TNE
M1	6MM M.S.REBAR	-	$295.00/TN	1.000	2.5%	$302.38
M34	BINDING WIRE	-	$1.50/KG	18.000	0.0%	$27.00

TOTAL LABOUR	COST/TNE	$163.69
TOTAL PLANT	COST/TNE	$3.63
TOTAL MATERIAL	COST/TNE	$329.38
TOTAL NET COST/TNE		$496.69

Figure 9.10 WORK GROUP relating to the build-up shown in Figure 9.5

Work Group G1A.1
6 MM MILD STEEL REBAR IN FOUNDS

Code	Description		Cost/HR	Usage	Weight Factor	Cost/TNE
L31	STEELFIXER	-	$3.00	54.000	100.0%	$162.00

Code	Description	Net. Cost/Unit	Usage	Wastages Per Unit	Cost/TNE
XG20	6MM M.S./B.WIRE/UNLD-	$327.31/TN	1.000	2.5%	$335.49

TOTAL LABOUR	COST/TNE	$162.00
TOTAL RES. GANG	COST/TNE	$335.49
TOTAL NET COST/TNE		$497.49

Figure 9.11 WORK GROUP relating to the build-up shown in Figure 9.5 (using GANG resources)

NOTE : Up to 10 resources may be entered in any WORK GROUP.

9.2.4 USE OF GANG RESOURCES IN THE COMPILATION OF WORK GROUPS

In order to minimise the number of resources that have to be entered for each WORK GROUP, GANG resources should be used wherever possible.

The results of using GANG resources are illustrated by considering the two WORK GROUPS shown in Figures 9.10 and 9.11. The WORK GROUP comprised of SINGLE resources (i.e. Figure 9.10) requires the entry of 6 resources, whereas the use of GANGS reduces this input to 2 resources.

Figure 9.12 illustrates Resource Group XG20 as used in the WORK GROUP illustrated in Figure 9.11.

```
****************************************************************************
XG20      6MM M.S./B.WIRE/UNLD                                     (used)

L6        LABOURER (UNLOAD)
                                        $2.25 *   .50 HR            $1.13
L46       BANKSMAN
                                        $2.25 *   .25 HR            $0.56
P5        MOBILE CRANE
                                       $14.50 *   .25 HR            $3.63
M1        6MM M.S.REBAR
                                      $295.00 *  1.00 TNE         $295.00
M34       BINDING WIRE
                                        $1.50 * 18.00 KG           $27.00
                                                               -----------
                                                                  $327.31
                                        Divided by    1.0
                                                               -----------
                                        Gang Cost /TNE            $327.31
****************************************************************************
```

Figure 9.12 Resource Group XG20 as used in WORK GROUP shown in Figure 9.11

It should be noted that the difference of £0.80 between the WORK GROUP costs shown in Figures 9.10 and 9.11 results in the application of the Wastage factor to resource XG20. Allowance for this aspect should be made when preparing data for entry in the FILE OF PERFORMANCE DATA.

10. PRIME COSTS, PROVISIONAL SUMS AND ITEMS

10.0 GENERAL

This chapter describes how the system deals with PRIME COSTS, PROVISIONAL SUMS and ITEMS. It also illustrates how profits and attendances may be added to P.C. and/or PROVISIONAL SUMS.

In describing the facilities provided, it is necessary to consider the different stages of the system, i.e.:

- the entry of the bill of quantities into the computer system;
- the estimation of direct cost, and
- the addition of mark-ups.

10.1 THE ENTRY OF P.C./PROV. SUMS INTO THE COMPUTER SYSTEM

This aspect has already been described in detail in Chapter 4. Section 4.2.3(a)(iii) illustrates the entry of the sample bill of quantities page shown in Figure 4.2. It should be noted that the system distinguishes between NOMINATED SUPPLIERS (SP) and NOMINATED SUB-CONTRACTORS (SC).

10.2 THE ESTIMATION OF DIRECT COST

As described in 5.2 it is not necessary to INSPECT P.C. and PROVISIONAL SUMS where these sums have been entered into the system at the bill entry stage. However it is possible to edit the sums entered at the INSPECT stage. The examples below illustrate the facilities provided for INSPECTING PRIME COSTS, PROVISIONAL SUMS, ITEMS, Attendances and Profits. These may be accessed by using the IN command from the estimator's Main Menu of commands.

```
        Commands :-
                        IN - Inspect Item
                        SU - Sub-Contract Quotes
                        UP - Update Prices
                        AP - Apply Mark-Ups
                        PR - Print Reports
                        HE - Set HELP Level
                        ST - Stop

    Command ?
```

NOTE:

- The examples shown below all relate to the sample bill of quantities page illustrated in Figure 4.2.

- It is only possible to INSPECT items that have been entered into the system at the bill entry stage as described in Chapter 4.

10.2.1 PRIME COSTS

The examples below relate to sums entered for both Nominated Sub-contractors and Nominated Suppliers.

```
Command ? IN

INSPECT ITEM option
Item Reference ? 7/209/B

Item already priced. Retrieving Data
Section 7  Page 209/ B
Prime Cost
   $1,500.00

(Nominated Sub-Contractor)
Commands :-
                    CS - Change Sum
                    CT - Change Type
                    FI - File Item
Command ?
```

Changing the Sum:

It is possible to change the PRIME COST entered into the system by using the CS command.

```
Command ? CS

Sum ? 2000

Section 7  Page 209/ B
Prime Cost
   $2,000.00

(Nominated Sub-Contractor)
Commands :-
                    CS - Change Sum
                    CT - Change Type
                    FI - File Item
Command ?
```

Changing the type:

This command allows the user to change the type of sum entered into the computer.

```
Command ? CT

        Commands :-
                        IT - Item
                        SP - Prime Cost - Nominated Supplier
                        SC - Prime Cost - Nominated Sub-Contractor
                        PS - Provisional Sum
                        AT - Attendance Allowance
                        PR - Profit Allowance
                        RP - Reprice Item

Command ?
```

The required type of sum should then be selected from the sub-menu and entered into the system.

Filing the Item:

This command instructs the system to store the item.

10.2.2 PROVISIONAL SUMS

```
Item Reference ? 7/209/G

Item already priced. Retrieving Data
Section 7  Page 209/ G
Prov. Sum
     $250.00

Commands :-
                    CS - Change Sum
                    CT - Change Type
                    FI - File Item
Command ?
```

The facilities provided for editing PROVISIONAL SUMS are similar to that described in 10.2.1.

10.2.3 ITEMS

Two methods of pricing ITEMS are provided. They are:

- by the INCLUSION of the ITEM in another bill item; and

- by the insertion of lump sums of money.

(a) INCLUDED in another bill item:

This facility is similar to that described in 5.2.2(d) and is shown below.

```
Command ? IN

INSPECT ITEM option
Item Reference ? 7/209/A

This is a no-quantity item
Do you wish to include it with another item ? Y

Included in ? //B

Section 7  Page 209/ A
Included in  Section 7  Page 209/ B
     Commands :-
               CI - Change Item Included in
               RP - Reprice Item
               FI - File Item
Command ?
```

Changing the item INCLUDED IN:

It is possible to change the bill item in which the ITEM is to be included.

```
Command ? CI

Included in ? //E

Section 7  Page 209/ A
Included in  Section 7  Page 209/ E
     Commands :-
               CI - Change Item Included in
               RP - Reprice Item
               FI - File Item
Command ?
```

Repricing the Item:

The RP command removes all pricing information from the bill item, and provides the estimator with commands to enable him to reprice it. This is shown as follows.

```
Command ? RP

PRICE ITEM option
      Commands :-
                 KN - Known Group
                 UN - Unknown Group
                 SP - Spot Rate
                 IN - Included In
      Press RETURN to return to Main Menu
Command ?
```

(b) Lump Sums of money:

This facility enables the estimator to enter sums of money allocated to cost code categories. The cost code categories allowed are shown below.

LAB - Labour

PLT - Plant

AUX - Auxiliary Plant

MAT - Materials

DOM - Domestic Sub-contractors.

```
Command ? IN

INSPECT ITEM option
Item Reference ? 7/210/A

This is a no-quantity item
Do you wish to include it with another item ? N

Section 7  Page 210/ A
Item

      Commands :-
                 AD - Add Sum
                 CH - Change Sum
                 DE - Delete Sum
                 VI - View Item
                 FI - File Item
                 CT - Change Type
Command ?
```

The facilities provided are described as follows.

Adding a Sum:

In the example below, sums for Labour, Materials and Domestic Sub-contractors are entered into the system.

```
        Commands :-
                     AD - Add Sum
                     CH - Change Sum
                     DE - Delete Sum
                     VI - View Item
                     FI - File Item
                     CT - Change Type
Command ? AD

Cost Code ? LAB

Sum ? 500

        Commands :-
                     AD - Add Sum
                     CH - Change Sum
                     DE - Delete Sum
                     VI - View Item
                     FI - File Item
                     CT - Change Type
Command ? AD

Cost Code ? MAT

Sum ? 100

        Commands :-
                     AD - Add Sum
                     CH - Change Sum
                     DE - Delete Sum
                     VI - View Item
                     FI - File Item
                     CT - Change Type
Command ? AD

Cost Code ? DOM

Sum ? 69

        Commands :-
                     AD - Add Sum
                     CH - Change Sum
                     DE - Delete Sum
                     VI - View Item
                     FI - File Item
                     CT - Change Type
Command ?
```

Change a Sum:

It is also possible to change a sum previously entered into the system. This is done by selecting the cost code category to be altered and entering the new sum.

```
Command ? CH

Cost Code ? DOM

Sum is      $69.00
New Sum ? 100

     Commands :-
                 AD - Add Sum
                 CH - Change Sum
                 DE - Delete Sum
                 VI - View Item
                 FI - File Item
                 CT - Change Type
Command ?
```

Deleting a Sum:

Facilities are provided for deleting a sum entered into the system. In the example below, the sum previously entered for Material is deleted.

```
Command ? DE

Cost Code ? MAT

     Commands :-
                 AD - Add Sum
                 CH - Change Sum
                 DE - Delete Sum
                 VI - View Item
                 FI - File Item
                 CT - Change Type
Command ?
```

Viewing the ITEM:

The VI command displays the build-up of the ITEM. The printout following illustrates the result of the examples shown above.

```
Command ?:VI

Section 7  Page 210/ A
Item

       Category                 Sum
       --------                 ---
         LAB.               $500.00
         DOM.               $100.00
                         ----------
              Item Cost     $600.00
     Commands :-
                  AD - Add Sum
                  CH - Change Sum
                  DE - Delete Sum
                  VI - View Item
                  FI - File Item
                  CT - Change Type
Command ?
```

Changing the Type:

This command allows the estimator to redefine the type of item in question. The facilities provided are shown below.

```
Command ?,CT

     Commands :-
                  IT - Item
                  SP - Prime Cost - Nominated Supplier
                  SC - Prime Cost - Nominated Sub-Contractor
                  PS - Provisional Sum
                  AT - Attendance Allowance
                  PR - Profit Allowance
                  RP - Reprice Item

Command ?
```

10.2.4 ATTENDANCE ON NOMINATED SUB-CONTRACTORS

The facilities provided for pricing ATTENDANCE on NOMINATED SUB-CONTRACTORS are similar to those described for ITEMS (see 10.2.3). i.e. Sums of money may be entered appropriate to the cost code categories allowed. The commands allowing this to be done are shown as follows.

```
Item Reference ? 7/209/D

This is a no-quantity item
Do you wish to include it with another item ? N

Section 7  Page 209/ D
Attendance   on Section 7  Page 209/ B

     Commands :-
                AD - Add Sum
                CH - Change Sum
                DE - Delete Sum
                VI - View Item
                FI - File Item
                CT - Change Type
                CI - Change Item Attendance on
Command ?
```

The editing facilities provided are also similar to those described in 10.2.3. The additional facility provided with ATTENDANCE is described below.

Changing the item that ATTENDANCE is priced on:

It is possible to redefine the item that ATTENDANCE is to be priced on. This is done by entering the new ITEM REFERENCE as shown below.

```
Command ? CI

Bill Item Attendance is on ? //E

Section 7  Page 209/ D
Attendance   on Section 7  Page 209/ E

      Category                     Sum
      --------                     ---
        LAB.                   $500.00
        DOM.                   $100.00
                              ----------
             Item Cost         $600.00
     Commands :-
                AD - Add Sum
                CH - Change Sum
                DE - Delete Sum
                VI - View Item
                FI - File Item
                CT - Change Type
                CI - Change Item Attendance on
```

10.3 THE ADDITION OF MARK-UPS

The addition of mark-ups is described in 6.2. Facilities are provided to add monies for PROFITS, OVERHEADS and SURCHARGES.

10.3.1 PROFITS

(a) Prime Cost Sums:

Facilities are provided for entering PROFIT percentages for NOMINATED SUPPLIERS and NOMINATED SUB-CONTRACTORS at the INSPECT stage. This is illustrated below.

NOTE:

- It is not necessary to INSPECT items describing profit on NOMINATED SUPPLIERS and NOMINATED SUB-CONTRACTORS.
- Where such items have not been INSPECTED, the PROFIT percentages entered as described in 6.2.2 will apply.
- Where PROFIT percentages have been entered at the INSPECT stage as described below, these percentages will over-ride those entered at 6.2.2.

```
        Commands :-
                        IN - Inspect Item
                        SU - Sub-Contract Quotes
                        UP - Update Prices
                        AP - Apply Mark-Ups
                        PR - Print Reports
                        HE - Set HELP Level
                        ST - Stop

    Command ? IN

    INSPECT ITEM option
    Item Reference ? 7/209/C

    This is a no-quantity item
    Do you wish to include it with another item ? N
    ---------------------------------
    Section 7   Page 209/ C
    P.C. Profit   on Section 7   Page 209/ B

    Profit (%) ? 5
```

```
Section 7  Page 209/ C
P.C. Profit  on Section 7  Page 209/ B

  5.0% =        $75.00
Commands :-
                    CP - Change Percentage
                    CI - Change Item this is Profit on
                    CT - Change Type
                    FI - File Item

Command ?
```

The editing facilities provided after the INSPECT option are described below.

Changing the Percentage:

It is possible to change the percentage profit entered.

```
Command ? CP

Profit (%) ? 10

Section 7  Page 209/ C
P.C. Profit  on Section 7  Page 209/ B

 10.0% =        $150.00
Commands :-
                    CP - Change Percentage
                    CI - Change Item this is Profit on
                    CT - Change Type
                    FI - File Item

Command ?
```

Changing the Item that the PROFIT is on:

This command allows the estimator to redefine the item that PROFIT is to be calculated on.

```
Command ? CI

Bill Item this is Profit Allowance on ? //G

Section 7  Page 209/ C
P.C. Profit  on Section 7  Page 209/ G

 10.0% =        $25.00
Commands :-
                    CP - Change Percentage
                    CI - Change Item this is Profit on
                    CT - Change Type
                    FI - File Item

Command ? .
```

Changing the type of item:

This option is similar to that described in 10.2.3.

Filing the Item:

This command instructs the system to store the INSPECTED data.

(b) Provisional Sums:

No facilities are available for allowing PROFITS on PROVISIONAL SUMS.

(c) Items:

PROFITS added as described in 6.2.2 will be applied to the relevant cost category sums priced for ITEMS.

(d) Attendance on Nominated Sub-Contractors:

Profits as described in 6.2.2 will be applied to the Main Contractors cost code category sums used to price ATTENDANCE items.

10.3.2 OVERHEADS

(a) Prime Cost Sums:

It is not possible to add OVERHEADS on PRIME COST items.

(b) Provisional Sums:

It is not possible to add OVERHEADS to PROVISIONAL SUMS.

(c) Items:

OVERHEAD percentages entered into the system as described in 6.2.1 will affect the relevant cost code categories of money entered for ITEMS.

(d) Attendance:

As for ITEMS above.

10.3.3 SURCHARGES

The effect of SURCHARGE percentages entered into the system as described in 6.2.3 is similar to that described for OVERHEADS above.

FILE	-	an organised collection of inter-related units of data.
INTERACTIVE DISPLAY	-	any display which allows the user to input data in response to the information displayed.
FLOW CHART	-	the diagrammatic representation of a sequence of events.
COMMAND DRIVEN	-	the running of a program by the instruction of commands selected by the user from a list of 'menu'.
V.D.U.	-	visual display unit. A display unit consisting of a cathode ray tube used to display characters or graphs representing data read from the main memory of the computer.
DATA LIBRARY	-	a collection of resources and work groups stored on the system's files.
WORK GROUP	-	a build-up stored in the data library.
WORK GROUP CODE	-	a code used for identifying each work group.
RESOURCE CODE	-	a code used for identifying each resource.

APPENDIX C

THE INTEREST BUILD CLASSIFICATION

EXPLANATORY NOTES

1. The INTEREST BUILD classification contains six levels plus an additional level to cater for different methods of construction.

2. The system of notation adopted is a combination of letters and numbers. Numerical levels may contain up to 999 different descriptions.

3. Alphabetical levels may occur adjacent to one another.

4. Numerical levels must be bounded by alphabetical levels i.e. no two numerical levels may occur next to each other.

5. The complete notation is identified by reading from left to right and accumulating the constituent codes.

6. It is not necessary to use all the levels of description if no relevant information is contained therein. However it is not possible to skip levels in the middle of a notation. Only right-hand levels may be disregarded.

7. The end of the notation as identified from the classification must be signified by a full stop.

8. An additional seventh level of description must be used following the full stop to identify the method of construction selected. This is a numeric level containing codes in the range 0 to 9.

9. Horizontal lines are used to restrict the choice of descriptions from different levels. These lines may commence at any level, and isolate the descriptions contained above the line from those below it.

B. EXCAVATION AND EARTHWORK	REMOVING TREES (NR)				
	1. CUT DOWN SMALL TREES AND GRUB UP ROOTS	A. FILL AND COMPACT VOIDS WITH MATERIAL ARISING FROM EXCAVATIONS			
	2. CUT DOWN TREES OVER 600 MM BUT N.E. 900 MM GIRTH AND GRUB UP ROOTS	B. DITTO WITH SELECTED MATERIAL ARISING FROM EXCAVATIONS C. DITTO WITH HARDCORE			
	3. CUT DOWN TREES OVER 900 MM BUT N.E. 1.20 M GIRTH AND GRUB UP ROOTS	D.			
	4.				
	5.				
	6.				
	REMOVING HEDGES (M)				
	7. 1.00 M HIGH AND GRUB UP ROOTS				
	8. 1.25 M HIGH AND DITTO				
	9. 1.50 M HIGH AND DITTO				
	10.				
	11.				
	12.				
	CLEARING UNDERGROWTH (M^2)				
	13. CLEAR SITS OF BUSHES, SCRUB AND UNDERGROWTH AND GRUP UP ROOTS				
	14. CLEAR SITE OF BUSHES, SCRUB, AND UNDERGROWTH AND CUT DOWN SMALL TREES AND GRUP UP ROOTS				
	15.				
	16.				

B. EXCAVATION AND EARTHWORK	<u>LIFTING TURF (M^2)</u>				
	17. LIFT TURF TO BE PRESERVED TRANSPORT AVERAGE DISTANCE OF 20 M	A. STACK ON SITE, WATER AND MAINTAIN UNTIL RE-USE			
	18. DITTO AVERAGE DISTANCE OF 25 M	B. FLAT STACK ON SITE : WATER MAINTAIN UNTIL RE-USE			
	19. DITTO AVERAGE DISTANCE OF 30 M				
	20.				
	21.				
	22. LIFT AND ROLL TURF TO BE PRESERVED AND TRANSPORT AVERAGE DISTANCE OF 20 M				
	23. DITTO AVERAGE DISTANCE OF 25 M				
	24. DITTO AVERAGE DISTANCE OF 30 M				
	25.				
	26.				

B. EXCAVATION AND EARTHWORK	<u>EXCAVATION (M^3)</u> 27. REDUCE LEVELS 28. CUTTINGS 29. BASEMENTS 30. PITS TO RECEIVE BASES 31. PITS HAVING BOTH PLAN DIMENSIONS LESS THAN 1.25 M TO RECEIVE BASES 32. TRENCHES EXCEEDING 0.30 M WIDE TO RECEIVE FOUNDATIONS 33. DITTO CURVED 34. PILE CAPS 35. TRENCHES FOR GROUND BEAMS BETWEEN PILES	A. MAX.DEPTH N.E. 0.25 M B. DITTO 1.00 M C. DITTO 2.00 M D. DITTO 4.00 M E.			
	<u>EXCAVATION (M)</u> 36. TRENCHES N.E. 0.30 M WIDE TO RECEIVE FOUNDATIONS 37. DITTO CURVED	A. AVERAGE DEPTH 0.25 M B. DITTO 0.50 M C. DITTO 0.75 M D. DITTO 1. 00 M E. DITTO 1.25 M F. DITTO 1.50 M G.			

B. EXCAVATION AND EARTHWORK	<u>EXCAVATION (M)</u> 38. TRENCHES FOR SERVICE PIPES AND CABLES N.E. 100 MM DIAM. INC. SUPPORT 39. DITTO N.E. 200 MM DIAM. DITTO 40. DITTO N.E. 300 MM DIAM. 41. 42. CURVED TRENCHES FOR SERVICE PIPES AND CABLES N.E. 100MM DIAM INC. SUPPORT 43. DITTO N.E. 200 MM DIAM DITTO 44. DITTO N.E. 300 MM DIAM DITTO 45.	A. AVERAGE DEPTH 0.25 M B. DITTO 0.50 M C. DITTO 0.75 M D. DITTO 1.00 M E. DITTO.1.25 M F. DITTO 1.50 M G.	<u>FILLING IN WITH:</u> A. MATERIAL ARISING FROM EXCAVATIONS B. SAND TO A DEPTH OF 200 MM MATERIAL ARISING FROM EXCAVATIONS TO REMAINDER C. DITTO 300 MM DITTO D. DITTO 400 MM DITTO E. DITTO 500 MM DITTO F. G. HARDCORE TO A DEPTH OF 200 MM. MATERIAL ARISING FROM EXCAVATIONS TO REMAINDER H. DITTO 300 MM DITTO J. DITTO 400 MM DITTO K. DITTO 500 MM DITTO L. M. CONCRETE TO A DEPTH OF 200 MM. MATERIAL ARISING FROM EXCAVATIONS TO REMAINDER N. DITTO 300 MM DITTO P. DITTO 400 MM DITTO Q. DITTO 500 MM DITTO	<u>DISPOSAL OF SURPLUS EXCAVATED MATERIAL BY :</u> A. DEPOSITING ON SITE IN SPOIL HEAPS AVERAGE 50 M DISTANT. B. DITTO 100 M DITTO C. DITTO 200 M DITTO D. E. F. SPREAD ON SITE AVERAGE 50 M DISTANT G. DITTO 100 MM DITTO H. DITTO 200 MM DITTO J. K. L. REMOVE FROM SITE	

B. EXCAVATION AND EARTHWORK	<u>EXCAVATION OF WORKING SPACE AROUND: (M^3)</u> 46. REDUCE LEVELS 47. CUTTINGS 48. BASEMENTS 49. PITS TO RECEIVE BASES 50. PITS HAVING BOTH PLAN DIMENSIONS LESS THAN 1.25 M TO RECEIVE BASES 51. TRENCHES EXCEEDING 0.30 M WIDE TO RECEIVE FOUNDATIONS 52. DITTO CURVED 53. PILE CAPS 54. TRENCHES FOR GROUND BEAMS BETWEEN PILES 55. 56. 57. 58.	A. MAX. DEPTH N.E. 0.25 M B. DITTO 1.00 M C. DITTO 2.00 M D. DITTO 4.00 M E.	<u>FILLING IN WITH:</u> A. MATERIAL ARISING FROM EXCAVATIONS B. SELECTED MATERIAL ARISING FROM EXCAVATIONS C. PRESERVED TOPSOIL ARISING FROM EXCAVATIONS D. HARDCORE E. SHALE F. SAND G.	<u>DISPOSAL OF SURPLUS EXCAVATED MATERIAL BY:</u> A. DEPOSIT ON SITE IN SPOIL HEAPS AVERAGE 50 M DISTANT B. DITTO 100 M DISTANT C. D. SPREAD ON SITE AVERAGE 50 M DISTANT E. DITTO 100 M DISTANT F. G. REMOVE FROM SITE H. REMOVE FROM SITE AND DEPOSIT IN SPOIL HEAPS 5 KM DISTANT J. DITTO 7.5 KM DISTANT K. DITTO 10 KM DISTANT	

B. EXCAVATION AND EARTHWORK	BREAKING UP (M^3) 59. BRICKWORK 60. REINFORCED BRICKWORK 61. MASS CONCRETE 62. REINFORCED CONCRETE 63. ROCK 64.				
	BREAKING UP (M^2) 65. SURFACE MACADAM 66. BRICK PAVINGS 67. PRECAST CONCRETE PAVINGS 68. STONE PAVINGS 69. SURFACE CONCRETE 70. SURFACE REINFORCED CONCRETE	A. THICKNESS 50 MM B. DITTO 60 MM C. DITTO 70 MM D. DITTO 80 MM E. DITTO 90 MM F. DITTO 100 MM G. DITTO 110 MM H. DITTO 120 MM J. DITTO 130 MM K. DITTO 140 MM L. DITTO 150 MM M. DITTO 160 MM N. DITTO 170 MM P. DITTO 180 MM Q. DITTO 190 MM R. DITTO 200 MM	A. SET ASIDE FOR RE-USE B. DITTO AND RE-INSTATE TO MATCH EXISTING		

C. EARTHWORK SUPPORT REMOVAL AND FILLING	<u>EARTHWORK SUPPORT (M^2)</u> 1. TO FACES 2. TO SLOPING FACES EXCEEDING 45 DEG. FROM HORIZONTAL 3. 4.	A. MAXIMUM DEPTH N.E. 1.00 M B. DITTO 2.00 M C. DITTO 4.00 M D. DITTO 5.00 M E.	<u>DISTANCE BETWEEN OPPOSING FACES:</u> A. NOT EXCEEDING 2.00 M B. EXCEEDING 2.00 M BUT N.E. 4.00 M C. EXCEEDING 4.00 M		
	<u>REMOVAL ON SITE (M^3)</u> 5. EXCAVATED MATERIAL 6. EXCAVATED MATERIAL LEFT BY OTHERS INCLUDING EXCAVATION 7. PRESERVED TOP SOIL 8. BROKEN OUT BRICKWORK 9. BROKEN OUT MASS CONCRETE 10. BROKEN OUT REINFORCED CONCRETE 11. BROKEN OUT ROCK 12. 13. 14. 15. 16. 17. 18. 19.	A. AVERAGE DISTANCE OF 20 M B. DITTO 30 M C. DITTO 40 M D. DITTO 50 M E. DITTO 75 M F. DITTO 100M G. DITTO 200 M H. DITTO 300 M J. DITTO 400 M K. DITTO 500 M L. DITTO 1 KM	A. DEPOSIT IN SPOIL HEAPS ON SITE B. DEPOSIT AND SPREAD ON SITE C. DEPOSIT AND SPREAD ON SITE IN 150 MM LAYERS D. DITTO IN 225 MM LAYERS E. DITTO IN 300 MM LAYERS F.		

C. EARTHWORK SUPPORT REMOVAL AND FILLING	REMOVAL FROM SITE (M^3)				
	20. EXCAVATED MATERIAL	A. AVERAGE DISTANCE FROM SITE ½ KM			
	21. EXCAVATED MATERIAL LEFT BY OTHERS	B. DITTO 1 KM			
	22. TOP SOIL	C. DITTO 1½ KM			
	23. BROKEN OUT BRICKWORK	D. DITTO 2 KM			
	24. BROKEN OUT MASS CONCRETE	E. DITTO 2½ KM			
	25. BROKEN OUT REINFORCED CONCRETE	F. DITTO 3 KM			
		G. DITTO 3½ KM			
	26. BROKEN OUT ROCK	H. DITTO 4 KM			
	27.	J. DITTO 4½ KM			
	28.	K. DITTO 5 KM			
	29.	L. DITTO 6 KM			
	30.	M. DITTO 7 KM			
	31.	N. DITTO 8 KM			
	32.	P. DITTO 9 KM			
		Q. DITTO 10 KM.			

C. EARTHWORK SUPPORT REMOVAL AND FILLING	FILLING(M^3) 33. MATERIAL ARISING FROM EXCAVATIONS 34. SELECTED MATERIAL ARISING FROM EXCAVATIONS 35. IMPORTED MATERIAL 36. 37. 38. 39.	A. TO EXCAVATIONS B. TO MAKE UP LEVELS	DEPOSIT AND SPREAD: A. IN LAYERS B. DITTO 150 MM THICK C. DITTO 225 MM THICK D. DITTO 300 MM THICK E. F. DEPOSIT, SPREAD AND COMPACT G. IN LAYERS H. DITTO 150 MM THICK J. DITTO 225 MM THICK K. DITTO 300 MM THICK L. DEPOSIT ON SLOPES AND SPREAD M. IN LAYERS N. DITTO 150 MM THICK P. DITTO 225 MM THICK Q. DITTO 300 MM THICK R. DEPOSIT ON SLOPES, SPREAD AND COMPACT S. IN LAYERS T. DITTO 150 MM THICK U. DITTO 225 MM THICK V. DITTO 300 MM THICK W. X.		

C. EARTHWORK SUPPORT REMOVAL AND FILLING	FILLING TO MAKE UP LEVELS (M^2) 40. AVERAGE THICKNESS 100 MM 41. DITTO 150 MM 42. DITTO 200 MM 43. DITTO 250 MM 44.	A. DEPOSIT AND SPREAD B. DITTO IN 100 MM LAYERS C. DITTO IN 150 MM LAYERS D. DITTO IN 200 MM LAYERS E. DITTO IN 250 MM LAYERS F. G. DEPOSIT ON SLOPES AND SPREAD H. DITTO IN 100 MM LAYERS J. DITTO IN 150 MM LAYERS K. DITTO IN 200 MM LAYERS L. DITTO IN 250 MM LAYERS M.	A. LEVEL D. LEVEL AND COMPACT C. GRADE TO FALLS D. GRADE AND COMPACT TO FALLS E. F. G. H.		
	HAND PACK HARDCORE (M^2) 45. TO FORM VERTICAL AND BATTERING FACES 46. DITTO CURVED 47. 48. 49.	A. BLIND WITH SAND 25 MM THICK B. DITTO 50 MM THICK C. DITTO 75 MM THICK D. DITTO 100 MM THICK			
	HAND PACK HARDCORE (M) 50. TO FORM VERTICAL AND BATTERING FACES 51. DITTO CURVED 52. 53. 54.	A. WIDTH 100 MM B. WIDTH 150 MM C. WIDTH 200 MM D. WIDTH 250 MM	A. BLIND WITH SAND 25 MM THICK B. DITTO 50 MM THICK C. DITTO 75 MM THICK D. DITTO 100 MM THICK		

C. EARTHWORK SUPPORT REMOVAL AND FILLING	SURFACE TREATMENTS (M^2) 55. LEVEL 56. LEVEL AND COMPACT 57. GRADE 58. GRADE TO FALLS 59. GRADE AND COMPACT 60. GRADE AND COMPACT TO FALLS 61. 62. 63. 64.	A. BOTTOMS OF EXCAVATIONS B. BOTTOMS OF EXCAVATIONS IN ROCK C. SURFACES OF GROUND D. SURFACES OF FILLINGS E. SURFACES OF ROCK	A. BLIND WITH SAND 25 MM THICK B. DITTO 50 MM THICK C. DITTO 75 MM THICK D. DITTO 100 MM THICK E.		
	TRIMMING (M^2) 65. SIDES OF CUTTINGS TO SLOPES 66. DITTO CURVED 67. SIDES OF EMBANKMENTS TO SLOPES 68. DITTO CURVED 69. VERTICAL SIDES UP EXCAVATIONS IN ROCK TO PRODUCE FAIR EXPOSED FACES 70. DITTO CURVED 71. SLOPING SIDES OF EXCAVATIONS IN ROCK TO PRODUCE FAIR EXPOSED FACES 72. DITTO CURVED 73. 74. 75.	A. BLIND WITH SAND 25 MM THICK B. DITTO 50 MM THICK C. DITTO 75 MM THICK D. DITTO 100 MM THICK E.			

F. IN-SITU CONCRETE	A. CONCRETE	1. MASS FILLING (M^3)			
		2. FOUNDATION TRENCHES (M^3)			
		3. ISOLATED FNDN. BASES (M^3)			
	B. REINFORCED CONCRETE	4.			
		5. CASING TO STEEL GRILLAGES (M^3)			
	C. HEAVILY REINFORCED CONCRETE	6. PILE CAPS (M^3)			
		7. STEPS (M^3)			
		8. STAIRCASES (M^3)			
		9. STEPS AND STAIRCASES (M^3)			
		10.			
		11. MACHINE BASES (M^3)			
		12. SUNDRY BASES (M^3)			
		13. GROUND BEAMS (M^3)	A. CROSS SECTIONAL AREA N.E. 0.03 M^2		
		14. CASING STEEL GROUND BEAMS (M^3)			
		15. UPSTANDS AND KERBS (M^3)	B. DITTO EXCEEDING 0.03 M^2 BUT N.E. 0.10 M^2		
		16.			
		17. ISOLATED BEAMS (M^3)	C. DITTO EXCEEDING 0.10 M^2 BUT N.E. 0.25 M^2		
		18. CASING TO ISOLATED STEEL BEAMS (M^3)	D. DITTO EXCEEDING 0.25 M^2		
		19. DEEP BEAMS (M^3)			
		20. DEEP CASING TO STEEL BEAMS (M^3)			
		21.			
		22. ISOLATED COLS. (M^3)			
		23. ISOLATED CASING TO STEEL COLUMNS (M^3)			
		24.	A. NOT EXCEEDING 100 MM THICK		
			B. 100 MM TO 150 MM THICK		
		25. BLINDING (M^3)	C. 150 MM TO 300 MM THICK		
		26. BEDS (M^3)	D. EXCEEDING 300 MM THICK		
		27. BEDS - ROADS (M^3)			
		28. BEDS - FOOTPATHS (M^3)			
		29. BEDS - PAVINGS (M^3)			
		30.			
		31. SUSPENDED SLABS (M^3)			
		32. COFFERED SUSPENDED SLABS (M^3)			

F. IN-SITU CONCRETE	A. CONCRETE B. REINFORCED CONCRETE C. HEAVILY REINFORCED CONCRETE	33. TROUGHED SUSPENDED SLABS (M^3) 34. SUSPENDED SLABS IN MARGINS (M^3) 35. 36. WALLS (M^3) 37. WALLS N.E. 1.50 HIGH (M^3) 38. WALLS TO HORIZONTAL OR SLOPING DUCTS IN BEDS OR SLABS (M^3) 40. TOPS OF DORMERS (M^3) 41. CHEEKS OF DORMERS (M^3) 42. 43. TOPS AND CHEEKS OF DORMERS (M^3) 44. 45. FILLING HOLLOW WALLS (M^3)	A. NOT EXCEEDING 100 MM THICK B. 100 MM TO 150 MM THICK C. 150 MM TO 300 MM THICK D. EXCEEDING 300 MM THICK		
		46. FILLING TO POCKETS	A. VOLUME EXCEEDING 0.10 M^3 (M^3) B. VOLUME N.E. 0.10 M^3 (NR)		

F. IN-SITU CONCRETE	V. JOINTS IN WALLS (M)	*1. TYPE A *2. TYPE B *3. TYPE C *4. TYPE D 5. 6. 7. 8.	A. REINFORCEMENT STOPPED AT JOINT B. REINFORCEMENT CROSSING JOINT C. PERFORATED FOR REINFORCEMENT CROSSING JOINT D. CUT AND FITTED AROUND REINFORCEMENT CROSSING JOINT E. PERFORATED FOR AND CUT AND FITTED AROUND REINFORCEMENT CROSSING JOINT		
	W. JOINTS IN SLABS (M)	*1. TYPE A *2. TYPE B *3. TYPE C *4. TYPE D 5. 6. 7. 8.	A. REINFORCEMENT STOPPED AT JOINT B. REINFORCEMENT CROSSING JOINT C. PERFORATED FOR REINFORCEMENT CROSSING JOINT D. CUT AND FITTED AROUND REINFORCEMENT CROSSING JOINT E. PERFORATED FOR AND CUT AND FITTED AROUND REINFORCEMENT CROSSING JOINT		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED

F. IN-SITU CONCRETE	X. LABOURS	TREATMENT OF UNSET SURFACES (M^2) 1. GRADE 2. TAMP 3. FLOAT 4. POWER FLOAT 5. TROWEL 6. PATTERN SURFACES WITH STUD MARKING 7. 8.	A. HORIZONTAL B. TO FALLS C. D. E. F.		
		TREATMENT OF SET SURFACES (M^2) 9. RUB 10. TOOL 11. BRUSH TO EXPOSE AGGREGATE 12. REMOVE SKIN TO EXPOSE AGGREGATE 13. SAND BLAST 14. BUSH HAMMER 15. GRIND 16. 17. 18.	A. SURFACES OF WALLS B. SURFACES OF FLOORS C. SOFFITS D. SOFFITS OVER 3.50 BUT NOT EXCEEDING 5.00 M HIGH E. DITTO 5.00 TO 6.50 M HIGH		
		TREATMENT OF SET SURFACES (M^2) 19. HACK SURFACES 20. SPECIALLY MECHANICALLY HACK SURFACES 21. HACK OFF ENTIRE SURFACES 22. 23. 24.	A. AS KEY FOR ASPHALT B. AS KEY FOR FINISHING C.		

F. IN-SITU CONCRETE	X. LABOURS	WORK CONCRETE AROUND (M^2) 25. PIPE CABLES AND MATS OF PANEL HEATING SYSTEMS 26. 27.			
		CUTTING OF CONCRETE *28. CUT CHANNELS (M) *29. CUT CHASES (M) 30. 31. *32. CUT MORTICES (NR) *33. CUT POCKETS (NR) *34. CUT HOLES (NR) 35. 36.	A. MAKE GOOD B. MAKE GOOD WITH FAIR FINISH C. D.		
		GROUTING 37. UNDER STEEL STANCHION BASES (M^2) 38. UNDER STEEL GRILLAGES (M^2) 39. 40. *41. INTO MORTICES (NR) *42. INTO POCKETS (NR) *43. INTO HOLES (NR) 44. 45.	A. GROUT WITH "GROUT MIX A" B. GROUT WITH "GROUT MIX B" C. D. GROUT WITH "EXPANDING GROUT" E. RUN WITH LEAD F.		
		CASTING IN OR ANCHOR BOLTS ETC. (NR) 46. ANCHORS 47. ANCHOR BOLTS 48. RAG BOLTS 49. LUGS 50. BRACKETS 51. TIES 52. WALL TIES			

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

G. REINFORCEMENT	BARS	(TONNE)	STRAIGHT AND BENT BARS		
	1. MILD STEEL DIAMETER 6 MM	A. IN FOUNDATIONS	A. HORIZONTAL 12.00 TO 15.00 M		
	2. DITTO 8 MM	B. IN GROUND SLABS	B. DITTO 15.00 TO 18.00 M		
	3. DITTO 10 MM	C. IN SUSPENDED SLABS	C.		
	4. DITTO 12 MM	D. IN WALLS	D.		
	5. DITTO 14 MM	E. IN CASING TO STEEL COLUMNS	E. VERTICAL 5.00 TO 8.00 M		
	6. DITTO 16 MM	F. IN CASING TO STEEL BEAMS	F. DITTO 8.00 TO 11.00 M		
	7. DITTO 18 MM	G. IN CASING TO STEEL COLUMNS	G.		
	8. DITTO 20 MM	AND BEAMS	H.		
	9. DITTO 22 MM	H. IN STEPS	CURVED BARS		
	10. DITTO 24 MM	I. IN STAIRCASES AND STRINGS	I. HORIZONTAL 12.00 TO 15.00 M		
	11. DITTO 25 MM	J. IN STAIRCASES AND STRINGS AND	J.		
	12. DITTO 26 MM	ASSOCIATED LANDINGS			
	13. DITTO 28 MM	K. IN STEPS, STAIRCASES, STRINGS	K. VERTICAL 5.00 TO 8.00 M		
	14. DITTO 32 MM	AND ASSOCIATED LANDINGS	L.		
	15. DITTO 40 MM	L. IN TOPS OF DORMERS			
	16. DITTO 50 MM	M. IN TOPS AND CHEEKS OF DORMERS	M. LINKS, STIRRUPS, BINDERS		
	17.	N. IN MACHINE AND SUNDRY BASES	AND SPECIAL SPACERS		
	18. HIGH YIELD DIAMETER 6MM	O. IN ISOLATED COLUMNS			
	19. DITTO 8 MM	P. IN ISOLATED BEAMS AND LINTELS			
	20. DITTO 10 MM	Q. IN ISOLATED COLUMNS, BEAMS			
	21. DITTO 12 MM	AND LINTELS			
	22. DITTO 14 MM				
	23. DITTO 16 MM				
	24. DITTO 18 MM				
	25. DITTO 20 MM				
	26. DITTO 22 MM				
	27. DITTO 24 MM				
	28. DITTO 25 MM				
	29. DITTO 26 MM				
	30. DITTO 28 MM				
	31. DITTO 32 MM				
	32. DITTO 40 MM				
	33. DITTO 50 MM				
	34.				

G. REINFORCE- MENT	<u>FABRIC REINFORCEMENT</u> 35. 0 TO 2.5 KG/M^2 36. 2.5 TO 5.0 KG/M^2 37. 5.0 TO 7.5 KG/M^2 38. 7.5 TO 10.0 KG/M^2	(M^2) A. IN FOUNDATIONS B. IN GROUND SLABS C. IN SUSPENDED SLABS D. IN WALLS E. IN CASING TO STEEL COLUMNS F. IN CASING TO STEEL BEAMS G. IN CASING TO STEEL COLUMNS AND BEAMS H. IN STEPS J. IN STAIRCASES AND STRINGS K. IN STAIRCASES AND STRINGS AND ASSOCIATED LANDINGS L. IN STEPS, STAIRCASES, STRINGS AND ASSOCIATED LANDINGS M. IN TOPS OF DORMERS N. IN TOPS AND CHEEKS OF DORMERS P. IN MACHINE AND SUNDRY BASES Q. IN ISOLATED COLUMNS R. IN ISOLATED BEAMS AND LINTELS S. IN ISOLATED COLUMNS, BEAMS AND LINTELS	A. SIDE AND END LAPS 150 MM B. DITTO 200 MM C. DITTO 225 MM D. DITTO 250 MM E. DITTO 300 MM F. SIDE LAPS 150 MM END LAPS 200 MM G. DITTO END LAPS 225 MM H. DITTO END LAPS 250 MM J. DITTO END LAPS 300 MM K. SIDE LAPS 200 MM END LAPS 225 MM L. DITTO END LAPS 250 MM M. DITTO END LAPS 300 MM N. SIDE LAPS 225 MM END LAPS 250 MM P. DITTO END LAPS 300 MM Q. DITTO END LAPS 350 MM R. SIDE LAPS 250 MM END LAPS 300 MM S. DITTO END LAPS 350 MM T. DITTO END LAPS 400 MM U. SIDE LAPS 300 MM END LAPS 350 MM V. DITTO END LAPS 400 MM W. DITTO END LAPS 450 MM		
		T. RAKING CUTTING (M) U. CURVED CUTTING (M)			
		V. BENDING OF FABRIC REINFORCE-MENT (M)	A. EAR SIZE 6 MM B. DITTO 8 MM C.		

G. REINFORCE- MENT	<u>SELF CENTERING FABRIC REINFORCEMENT</u> 65. 66. 67. 68.	(M^2) A. IN GROUND SLABS B. IN SUSPENDED SLABS C. IN WALLS D. IN CASING TO STEEL COLUMNS E. IN CASING TO STEEL BEAMS F. IN CASING TO STEEL COLUMNS AND BEAMS G. IN TOPS OF DORMERS H. IN TOPS AND CHEEKS OF DORMERS J. IN ISOLATED COLUMNS K. IN ISOLATED BEAMS AND LINTELS L. IN ISOLATED COLUMNS, BEAMS AND LINTELS	A. TEMPORARY STRUTTING N.E. 3.50 M HIGH B. DITTO 3.50 TO 5.00 M HIGH C. DITTO 5.00 TO 6.50 M HIGH		
		M. RAKINJ CUTTING (M) N. CURVED CUTTING (M)			

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	<u>FOUNDATIONS AND BEDS</u> 1. EDGES AND FACES OF FOUNDATIONS *2. GROUND BEAMS *3. DITTO PROFILE A 4.	A. HEIGHT NOT EXCEEDING 250 MM (M) B. DITTO 250-500 MM (M) C. DITTO 500-1.00 M (M) D. DITTO EXCEEDING 1.00 M (M^2)		
		<u>SLABS, STAIRCASES AND ASSOCIATED FEATURES</u> 5. SLOPING UPPER SURFACES OF SLABS MORE THAN 15 DEG. FROM HORIZONTAL (M^2) 6.			
		7. SOFFITS OF SLABS (M^2) 8. SOFFITS OF STAIRCASES (M^2) 9. SOFFITS OF LANDINGS (M^2) 10. SOFFIT OF COFFERED OR TROUGHED SLABS (M^2) 11. DITTO (M^2) 12. DITTO (M^2) 13. SOFFIT OF RIBS AND MARGINS OF COFFERED OR TROUGHED SLABS EXCEEDING 500 MM WIDE (M^2)	A. SLAB THICKNESS N.E.200 MM B. DITTO 200 - 300 MM C. DITTO 300 - 400 MM D. DITTO 400 - 500 MM E. DITTO 500 -	A. SOFFIT HEIGHT LESS THAN 1.00 M B. DITTO 3.50 TO 5.00 M C. DITTO 5.00 TO 6.50 M D. DITTO 6.50 TO 8.00 M	
		*14. ATTACHED BEAMS (M) *15. DITTO PROFILE A (M) *16. DITTO PROFILE B (M) 17. *18. ATTACHED BEAM CASINGS (M) *19. DITTO PROFILE A (M) *20. DITTO PROFILE B (M) 21.	A. SOFFIT HEIGHT LESS THAN 1.00 M B. DITTO 3.50 TO 5.00 M C. DITTO 5.00 TO 6.50 M D. DITTO 6.50 TO 8.00 M		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	*22. DOWNSTAND BEAMS (M) *23. DITTO PROFILE A (M) *24. DITTO PROFILE B (M) 25. *26. DOWNSTAND BEAM CASINGS (M) *27. DITTO PROFILE A (M) *28. DITTO PROFILE B (M) 29. *30. PROJECTING EAVES (M) *31. DITTO PROFILE A (M) *32. DITTO PROFILE B (M) 33.	A. SOFFIT HEIGHT LESS THAN 1.00 M B. DITTO 3.50 TO 5.00 M C. DITTO 5.00 TO 6.50 M D. DITTO 6.50 TO 8.00 M		
		*34. UPSTAND BEAMS (M) *35. DITTO PROFILE A (M) *36. DITTO PROFILE B (M) 37. *38. RECESSES (M) *39. DITTO PROFILE A (M) *40. DITTO PROFILE B(M) 41.			
		42. STRINGS (M) 43. DITTO PROFILE A (M) 44. DITTO PROFILE B (M) 45.	A. WIDTH 150 MM B. " 175 MM C. " 200 MM D. " 225 MM E. " 250 MM F. " 275 MM G. " 300 MM		
		46. KICKERS (M)	A. DEPTH N.E. 25 MM B. DEPTH 50 - 75 MM C. DEPTH 75 - 100 MM	A. FIXED DIRECT B. ONE SIDE SUSPENDED C. BOTH SIDES SUSPENDED	
		*47. MORTICES (M) 48. *49. POCKETS (NR)	A. GROUT WITH MIX A B. GROUT WITH MIX B C. D. GROUT WITH EXPANDING GROUT		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	50. *51. SINKINGS (NR), 52.	E. RUN WITH LEAD F.		
		53. HOLES - RECTANGULAR IN SLABS, LANDINGS (NR) 54. DITTO IN BEAMS (NR) 55. HOLES - CIRCULAR IN SLABS, LANDINGS (NR) 56. DITTO IN BEAMS (NR)	A. GIRTH N.E. 1.00 M B. GIRTH 1.00 TO 2.00 M C. GIRTH 2.00 TO 4.00 M	A. DEPTH/WIDTH 100 MM B. " 125 MM C. " 150 MM D. " 175 MM E. " 200 MM F. " 225 MM G. " 250 MM H. " 275 MM I. " 300 MM J. " 325 MM K. " 350 MM L. " 375 MM M. " 400 MM N. " 425 MM	
		57. EDGES OF SLABS (M) 58. STEPS IN TOPS OF SLABS (M) 59. STEPS IN SOFFITS OF SLABS (M) 60. 61. RISERS (M) 62. RISERS OF STAIRCASES (M) 63. 64. EDGES OF STAIRCASE FLIGHTS (M)	A. NOT EXCEEDING 250 MM DEEP B. EXCEEDING 250 MM BUT NOT EXCEEDING 500 MM DEEP		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	WALLS 65. VERTICAL (M^2) 66. VERTICAL TO ONE SIDE ONLY (M^2) 67. VERTICAL INTERRUPTED BY PROJECTIONS (M^2) 68. VERTICAL INTERRUPTED BY PROJECTIONS TO ONE SIDE ONLY (M^2) 69. BATTERED (M^2) 70. BATTERED TO ONE SIDE ONLY (M^2) 71. BATTERED INTERRUPTED BY PROJECTIONS (M^2) 72. BATTERED INTERRUPTED BY PROJECTIONS TO ONE SIDE ONLY (M^2) 73. VERTICAL ONE SIDE, BATTERED ONE SIDE (M^2) 74. VERTICAL ONE SIDE, BATTERED ONE SIDE INTERRUPTED BY PROJECTIONS (M^2) 75. VERTICAL STAIR WELL WALLS (M^2) 76. VERTICAL LIFT SHAFT WALLS (M^2) *77. PROJECTIONS (M) *78. DITTO PROFILE A (M) *79. DITTO PROFILE B (M) 80. *81. RECESSES (M) *82. DITTO PROFILE A (M) *83. DITTO PROFILE B (M) 84. *85. PILASTERS (M) *86. DITTO PROFILE A (M) *87. DITTO PROFILE B (M) 88.	A. FACES OF WALL FORMWORK OVER 3.50 M HIGH		
		*89. MORTICES	A. GROUT WITH GROUT MIX A		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	90. *91. POCKETS (NR) 92. *93. SINKINGS (NR) 94.	B. GROUT WITH GROUT MIX B C. D. GROUT WITH EXPANDING GROUT E. RUN WITH LEAD F.		
		95. HOLES RECTANGULAR (NR) 96. HOLES CIRCULAR (NR)	A. GIRTH N.E. 1.00 M B. GIRTH 1.00 TO 2.00 M C. GIRTH 2.00 TO 4.00 M	A. WIDTH 100 MM B. " 125 MM C. " 150 MM D. " 175 MM E. " 200 MM F. " 225 MM G. " 250 MM H. " 275 MM I. " 300 MM J. " 325 MM K. " 350 MM	
		97. VERTICAL ENDS OF WALLS (M) 98. DITTO PROFILE A (M) 99. 100. BATTERING ENDS OF WALLS (M) 101. DITTO PROFILE A (M) 102. 103. SLOPING TOPS OF WALLS (M) 104. DITTO PROFILE A (M) 105.	A. WIDTH 100 MM B. " 125 MM C. " 150 MM D. " 175 MM E. " 200 MM F. " 225 MM G. " 250 MM H. " 275 MM I. " 300 MM J. " 325 MM K. " 350 MM		
		106. SOFFITS OF WALLS (M) 107. DITTO PROFILE A (M) 108. 109. SLOPING SOFFITS OF WALLS (M) 110. DITTO PROFILE A (M) 111.	A. SOFFIT HEIGHT LESS THAN 1.00 M. B. DITTO 3.50 TO 5.00 M C. DITTO 5.00 TO 6.50 M D. DITTO 6.50 M TO 8.00 M	A. WIDTH 100 MM B. " 125 MM C. " 150 MM D. " 175 MM E. " 200 MM F. " 225 MM G " 250 MM	

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

H. FORMWORK	A. LEFT AS STRUCK B. DITTO WITH RETARDING AGENT C. LEFT IN D. FAIR FACED E. DITTO WITH RETARDING AGENT F. DITTO LEFT IN G. H.	112. PERIMETERS OF OPENINGS (M) 113. DITTO PROFILE A (M) 114.	A. WIDTH 100 MM B. " 125 MM C. " 150 MM D. " 175 MM E. " 200 MM F. " 225 MM G. " 250 MM H. " 275 MM I. " 300 MM J. " 325 MM		
		<u>ISOLATED BEAMS AND COLUMNS</u> *115. ISOLATED BEAMS (M) *116. DITTO PROFILE A (M) *117. DITTO PROFILE B (M) 118 *119. ISOLATED BEAM CASINGS (M) *120. DITTO PROFILE A (M) *121. DITTO PROFILE B (M) 122.	A. SOFFIT HEIGHT LESS THAN 1.00 M B. DITTO 3.50 TO 5.00 M C. DITTO 5.00 TO 6.50 M D. DITTO 6.50 TO 8.00 M		
		*123. ISOLATED COLUMNS (M) *124. DITTO PROFILE A (M) *125. DITTO PROFILE B (M) 126. *127. ISOLATED COLUMN CASINGS (M) *128. DITTO PROFILE A (M) *129. DITTO PROFILE B (M) 130.			

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

K. BRICKWORK	STRETCHER BOND	LIME: SAND MORTARS	(M^2)		
	1. BRICK-ON-EDGE	A. MIX 1:2	1. WALLS	A. IN TRENCHES	
	2. ½ BRICK WALL	B. MIX 1:3	2. SKINS OF HOLLOW WALLS		
	3. 1 BRICK WALL	CEMENT:LIME:SAND MORTARS	3. SKINS OF COMPOSITE		
	4. 1½ BRICK WALL	C. MIX 1:¼:3	WALLS		
	5. 2 BRICK WALL	D. MIX 1:½:4½	4.		
	6.	E. MIX 1:1:5-6			
	7.	F. MIX 1:2:8-9	5. DWARF SUPPORT WALLS		
	ENGLISH BOND	G. MIX 1:3:10-12	6. BATTERING WALLS		
	8. 1 BRICK WALL	CEMENT:SAND MORTARS	7. PROJECTIONS OF FOOTINGS		
	9. 1½ BRICK WALL	H. MIX 1:3	8. FILLING EXISTING		
	10. 2 BRICK WALL	J. MIX 1:4	OPENINGS		
	11.	CEMENT:SAND AND PLASTICIZER MORTARS	9. ISOLATED PIERS		
	12.		10.		
	FLEMISH BOND	K. MIX 1:4			
	13. 1 BRICK WALL	L. MIX 1:5-6	11. PROJECTIONS OF		
	14. 1½ BRICK WALL	M. MIX 1:7-8	CHIMNEY BREASTS		
	15. 2 BRICK WALL	N. MIX 1:8	12. PROJECTIONS OF FOOTINGS		
	16.		AND CHIMNEY BREASTS		
	17.				
			13. CHIMNEY STACKS		
			14. ISOLATED PIERS AND		
			CHIMNEY STACKS		
			15.		
			16. BACKING TO MASONRY		
			17. BACKING TO MASONRY CUT		
			AND BONDED		
			18.		
			19. LINING TO FLUES		
			20. LINING TO FLUES IN-		
			CLUDING BONDING TO		
			SURROUNDING BRICKWORK		
			21. BOTTOMS OF FLUES		
			22.		

K. BRICKWORK	STRETCHER BOND 1. BRICK-ON-EDGE 2. $\frac{1}{2}$ BRICK WALL 3. 1 BRICK WALL 4. 1$\frac{1}{2}$ BRICK WALL 5. 2 BRICK WALL 6. 7. ENGLISH BOND 8. 1 BRICK WALL 9. 1$\frac{1}{2}$ BRICK WALL 10. 2 BRICK WALL 11. 12. FLEMISH BOND 13. 1 BRICK WALL 14. 1$\frac{1}{2}$ BRICK WALL 15. 2 BRICK WALL 16. 17.	LIME: SAND MORTARS A. MIX 1:2 B. MIX 1:3 CEMENT:LIME:SAND MORTARS C. MIX 1:$\frac{1}{4}$:3 D. MIX 1:$\frac{1}{2}$:4$\frac{1}{2}$ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 CEMENT:SAND MORTARS H. MIX 1:3 J. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	(M^2) 23. DAMP-PROOF COURSES 24. RAISING EXISTING STRUCTURES 25. 26. THICKENING EXISTING WALLS -BOND - CUT POCKETS FOR ALTERNATIVE COURSES 27. THICKENING EXISTING WALLS - BLOCK BOND - CUT POCKETS FOR ALTERNATIVE GROUPS OF COURSES 28. 29.	A. IN TRENCHES	
			CLOSE CAVITIES (M) 30. VERTICALLY BONDED ONE SIDE 31. DITTO BONDED BOTH SIDES 32. HORIZONTALLY ONE COURSE HIGH INC. BONDING 33. DITTO TWO COURSES HIGH DITTO 34. DITTO THREE COURSES HIGH DITTO 35. 36.	A. WIDTH OF CAVITY 25 MM B. DITTO 50 MM C. DITTO 65 MM D. DITTO 75 MM E. DITTO 100 MM	
			ROUGH ARCHES (M) 37. IN ONE RING 38. IN TWO RINGS 39. IN THREE RINGS 40. IN FOUR RINGS 41. 42.		

K. BRICKWORK	<u>BONDING OF:</u> <u>STRETCHER BOND</u> 1. BRICK-ON-EDGE 2. ½ BRICK WALL 3. 1 BRICK WALL 4. 1½ BRICK WALL 5. 2 BRICK WALL 6. 7. <u>ENGLISH BOND</u> 8. 1 BRICK WALL 9. 1½ BRICK WALL 10. 2 BRICK WALL 11. 12. <u>FLEMISH BOND</u> 13. 1 BRICK WALL 14. 1½ BRICK WALL 15. 2 BRICK WALL 16. 17.	<u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	(M) 43. TO EXISTING BRICKWORK 44. TO EXISTING ENGINEERING BRICKWORK 45. TO EXISTING CONCRETE BLOCKWORK 46. TO EXISTING CLAY BLOCK-WORK 47. 48.	A. CUT POCKETS FOR ALTERNATIVE COURSES B. CUT POCKETS FOR ALTERNATIVE GROUPS OF COURSES C. CUT FAIR POCKETS FOR ALTERNATIVE COURSES D. CUT FAIR POCKETS FOR ALTERNATIVE GROUPS OF COURSES	

K. BRICKWORK	18. STRETCHER BOND 19. ENGLISH BOND 20. FLEMISH BOND 21. 22.	<u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX $1:\frac{1}{4}:3$ D. MIX $1:\frac{1}{2}:4\frac{1}{2}$ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	<u>TAPERING WALLS (M^2)</u> 1. TAPERING WALLS ONE SIDE TAPERED AT 30 DEG. 2. DITTO AT 45 DEG. 3. DITTO AT 60 DEG. 4. DITTO AT 75 DEG. 5. 6. TAPERING WALLS BOTH SIDES TAPERED AT 30 DEG. 7. DITTO AT 45 DEG. 8. DITTO AT 60 DEG. 9. DITTO AT 75 DEG. 10. 11. 12.	A. AVERAGE THICKNESS 200 MM B. DITTO 250 MM C. DITTO 300 MM D. DITTO 350 MM E. DITTO 400 MM F. DITTO 450 MM G. DITTO 500 MM H.	A. IN TRENCHES

K. BRICKWORK

PROJECTIONS IN:

18. STRETCHER BOND
19. ENGLISH BOND
20. FLEMISH BOND
21.
22.

LIME: SAND MORTARS

A. MIX 1:2
B. MIX 1:3

CEMENT:LIME:SAND MORTARS

C. MIX 1:$\frac{1}{4}$:3
D. MIX 1:$\frac{1}{2}$:4$\frac{1}{2}$
E. MIX 1:1:5-6
F. MIX 1:2:8-9
G. MIX 1:3:10-12

CEMENT:SAND MORTARS

H. MIX 1:3
J. MIX 1:4

CEMENT:SAND AND PLASTICIZER MORTARS

K. MIX 1:4
L. MIX 1:5-6
M. MIX 1:7-8
N. MIX 1:8

OF: (M)

*13. ATTACHED PIERS
*14. PLINTHS
*15. BANDS
*16. OVERSAILING COURSES
*17. ATTACHED PIERS, PLINTHS, BANDS AND OVERSAILING COURSES
18.
19.

TO EXISTING WALLS (M)

*20. ATTACHED PIERS INC. CUTTING POCKETS FOR ALTERNATIVE COURSES AND EXTRA MATERIAL
*21. ATTACHED PIERS - BLOCK BONDING INC. CUTTING POCKETS FOR ALTERNATIVE GROUPS OF COURSES AND EXTRA MATERIAL
*22. CHIMNEY BREASTS INC. CUTTING POCKETS FOR ALTERNATIVE COURSES AND EXTRA MATERIAL
*23. CHIMNEY BREASTS BLOCK BONDING INC. CUTTING POCKETS FOR ALTERNATIVE GROUPS OF COURSES AND EXTRA MATERIAL
24.
25.

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

K. BRICKWORK	23. FORM CAVITIES (M)	A. WIDTH 50 MM. B. DITTO 65 MM. C. DITTO 75 MM. D. DITTO 100 MM. E. F. G.	1. GALVANISED BUTTERFLY WALL TIES 2. GALVANISED TWISTED WALL TIES 3. 4. 5. 6.	A. 3 NO. PER M^2 B. 4 NO. PER M^2 C. 5 NO. PER M^2 D. 6 NO. PER M^2 E.	
	24. ROUGH CUTTING (M)	*A. CHAMFERED ANGLES *B. ROUNDED ANGLES *C. MOULDED ANGLES D.			
	25. ROUGH CHASES (M)	*A. HORIZONTAL *B. RAKING *C. VERTICAL D.			

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

L. FACE BRICKWORK	STRETCHER BOND 1. BRICK-ON-EDGE 2. $\frac{1}{2}$ BRICK WALL 3. 1 BRICK WALL 4. $1\frac{1}{2}$ BRICK WALL 5. 2 BRICK WALL 6. 7. ENGLISH BOND 8. 1 BRICK WALL 9. $1\frac{1}{2}$ BRICK WALL 10. 2 BRICK WALL 11. 12. FLEMISH BOND 13. 1 BRICK WALL 14. $1\frac{1}{2}$ BRICK WALL 15. 2 BRICK WALL 16. 17.	LIME: SAND MORTARS A. MIX 1:2 B. MIX 1:3 CEMENT:LIME:SAND MORTARS C. MIX 1:$\frac{1}{4}$:3 D. MIX 1:$\frac{1}{2}$:$4\frac{1}{2}$ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 CEMENT:SAND MORTARS H. MIX 1:3 J. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	(M^2) 1. WALLS 2. SKINS OF HOLLOW WALLS 3. SKINS OF COMPOSITE WALLS 4. 5. DWARF SUPPORT WALLS 6. BATTERING WALLS 7. PROJECTIONS OF FOOTINGS 8. FILLING EXISTING OPENINGS 9. ISOLATED PIERS 10. 11. PROJECTIONS OF CHIMNEY BREASTS 12. PROJECTIONS OF FOOTINGS AND CHIMNEY BREASTS 13. CHIMNEY STACKS 14. ISOLATED PIERS AND CHIMNEY STACKS 15. 16. BACKING TO MASONRY 17. BACKING TO MASONRY CUT AND BONDED 18. 19. LINING TO FLUES 20. LINING TO FLUES INCLUDING BONDING TO SURROUNDING BRICKWORK 21. BOTTOMS OF FLUES 22.	POINTING AS WORK PROCEEDS: FLUSH POINTING A. TO ONE SIDE B. TO BOTH SIDES FLUSH RUBBED OR BAGGED JOINTS C. TO ONE SIDE D. TO BOTH SIDES KEYED (IRONED D) POINTING E. TO ONE SIDE F. TO BOTH SIDES STRUCK-WEATHERED POINTING G. TO ONE SIDE H. TO BOTH SIDES FLAT RECESSED POINTING J. TO ONE SIDE K. TO BOTH SIDES KEYED (IRONED D) HORIZONTAL AND FLUSHED VERTICAL POINTING L. TO ONE SIDE M. TO BOTH SIDES RAKE OUT AND POINT WITH POINTING MORTAR : KEYED (IRONED D) POINTING N. TO ONE SIDE P. TO BOTH SIDES STRUCK-WEATHERED POINTING Q. TO ONE SIDE R. TO BOTH SIDES FLAT RECESSED POINTING S. TO ONE SIDE T. TO BOTH SIDES KEYED (IRONED D) HORIZONTAL AND FLUSH VERTICAL POINTING U. TO ONE SIDE V. TO BOTH SIDES	A. IN TRENCHES

L. FACE BRICKWORK	STRETCHER BOND 1. BRICK-ON-EDGE 2. ½ BRICK WALL 3. 1 BRICK WALL 4. 1½ BRICK WALL 5. 2 BRICK WALL 6. 7. ENGLISH BOND 8. 1 BRICK WALL 9. 1½ BRICK WALL 10. 2 BRICK WALL 11. 12. FLEMISH BOND 13. 1 BRICK WALL 14. 1½ BRICK WALL 15. 2 BRICK WALL 16. 17.	LIME: SAND MORTARS A. MIX 1:2 B. MIX 1:3 CEMENT:LIME:SAND MORTARS C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 CEMENT:SAND MORTARS H. MIX 1:3 J. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	(M^2) 23. DAMP-PROOF COURSES 24. RAISING EXISTING STRUCTURES 25. 26. THICKENING EXISTING WALLS -BOND - CUT POCKETS FOR ALTERNATIVE COURSES 27. THICKENING EXISTING WALLS - BLOCK BOND - CUT POCKETS FOR ALTERNATIVE GROUPS OF COURSES 28. 29.	POINTING AS WORK PROCEEDS: FLUSH POINTING A. TO ONE SIDE B. TO BOTH SIDES FLUSH RUBBED OR BAGGED JOINTS C. TO ONE SIDE D. TO BOTH SIDES KEYED (IRONED D) POINTING E. TO ONE SIDE F. TO BOTH SIDES STRUCK-WEATHERED POINTING G. TO ONE SIDE H. TO BOTH SIDES FLAT RECESSED POINTING J. TO ONE SIDE K. TO BOTH SIDES KEYED (IRONED D) HORIZONTAL AND FLUSHED VERTICAL POINTING L. TO ONE SIDE M. TO BOTH SIDES RAKE OUT AND POINT WITH POINTING MORTAR : KEYED (IRONED D) POINTING N. TO ONE SIDE P. TO BOTH SIDES STRUCK-WEATHERED POINTING Q. TO ONE SIDE R. TO BOTH SIDES FLAT RECESSED POINTING S. TO ONE SIDE T. TO BOTH SIDES KEYED (IRONED D) HORIZONTAL AND FLUSH VERTICAL POINTING U. TO ONE SIDE V. TO BOTH SIDES	A. IN TRENCHES

L. FACE BRICKWORK	18. STRETCHER BOND 19. ENGLISH BOND 20. FLEMISH BOND 21. 22.	<u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	<u>TAPERING WALLS (M^2)</u> 1. TAPERING WALLS ONE SIDE TAPERED AT 30 DEG. 2. DITTO AT 45 DEG. 3. DITTO AT 60 DEG. 4. DITTO AT 75 DEG. 5. 6. TAPERING WALLS BOTH SIDES TAPERED AT 30 DEG. 7. DITTO AT 45 DEG. 8. DITTO AT 60 DEG. 9. DITTO AT 75 DEG. 10.	<u>POINTING AS WORK PROCEEDS:</u> <u>FLUSH POINTING</u> A. TO ONE SIDE B. TO BOTH SIDES <u>FLUSH RUBBED OR BAGGED JOINTS</u> C. TO ONE SIDE D. TO BOTH SIDES <u>KEYED (IRONED D) POINTING</u> E. TO ONE SIDE F. TO BOTH SIDES <u>STRUCK-WEATHERED POINTING</u> G. TO ONE SIDE H. TO BOTH SIDES <u>FLAT RECESSED POINTING</u> J. TO ONE SIDE K. TO BOTH SIDES <u>KEYED (IRONED D) HORIZONTAL AND FLUSHED VERTICAL POINTING</u> L. TO ONE SIDE M. TO BOTH SIDES <u>RAKE OUT AND POINT WITH POINTING MORTAR :</u> <u>KEYED (IRONED D) POINTING</u> N. TO ONE SIDE P. TO BOTH SIDES <u>STRUCK-WEATHERED POINTING</u> Q. TO ONE SIDE R. TO BOTH SIDES <u>FLAT RECESSED POINTING</u> S. TO ONE SIDE T. TO BOTH SIDES <u>KEYED (IRONED D) HORIZONTAL AND FLUSH VERTICAL POINTING</u> U. TO ONE SIDE V. TO BOTH SIDES	A. AVERAGE THICKNESS 200 MM B. DITTO 250 MM C. DITTO 300 MM D. DITTO 350 MM E. DITTO 400 MM F. DITTO 450 MM G. DITTO 500 MM H. J. K.

L. FACE BRICKWORK

<u>STRETCHER BOND</u>

1. BRICK-ON-EDGE
2. ½ BRICK WALL
3. 1 BRICK WALL
4. 1½ BRICK WALL
5. 2 BRICK WALL
6.
7.

<u>ENGLISH BOND</u>

8. 1 BRICK WALL
9. 1½ BRICK WALL
10. 2 BRICK WALL
11.
12.

<u>FLEMISH BOND</u>

13. 1 BRICK WALL
14. 1½ BRICK WALL
15. 2 BRICK WALL
16.
17.

<u>LIME: SAND MORTARS</u>

A. MIX 1:2
B. MIX 1:3

<u>CEMENT:LIME:SAND MORTARS</u>

C. MIX 1:¼:3
D. MIX 1:½:4½
E. MIX 1:1:5-6
F. MIX 1:2:8-9
G. MIX 1:3:10-12

<u>CEMENT:SAND MORTARS</u>

H. MIX 1:3
J. MIX 1:4

<u>CEMENT:SAND AND PLASTICIZER MORTARS</u>

K. MIX 1:4
L. MIX 1:5-6
M. MIX 1:7-8
N. MIX 1:8

<u>CLOSE CAVITIES (M)</u>

30. VERTICALLY BONDED ONE SIDE
31. DITTO BONDED BOTH SIDES
32. HORIZONTALLY ONE COURSE HIGH INC. BONDING
33. DITTO TWO COURSES HIGH DITTO
34. DITTO THREE COURSES HIGH DITTO
35.
36.

<u>POINTING AS WORK PROCEEDS:</u>

<u>FLUSH POINTING</u>

A. TO ONE SIDE
B. TO BOTH SIDES

<u>FLUSH RUBBED OR BAGGED JOINTS</u>

C. TO ONE SIDE
D. TO BOTH SIDES

<u>KEYED (IRONED D) POINTING</u>

E. TO ONE SIDE
F. TO BOTH SIDES

<u>STRUCK-WEATHERED POINTING</u>

G. TO ONE SIDE
H. TO BOTH SIDES

<u>FLAT RECESSED POINTING</u>

J. TO ONE SIDE
K. TO BOTH SIDES

<u>KEYED (IRONED D) HORIZONTAL AND FLUSHED VERTICAL POINTING</u>

L. TO ONE SIDE
M. TO BOTH SIDES

<u>RAKE OUT AND POINT WITH POINTING MORTAR :</u>

<u>KEYED (IRONED D) POINTING</u>

N. TO ONE SIDE
P. TO BOTH SIDES

<u>STRUCK-WEATHERED POINTING</u>

Q. TO ONE SIDE
R. TO BOTH SIDES

<u>FLAT RECESSED POINTING</u>

S. TO ONE SIDE
T. TO BOTH SIDES

<u>KEYED (IRONED D) HORIZONTAL AND FLUSH VERTICAL POINTING</u>

U. TO ONE SIDE
V. TO BOTH SIDES

A. WIDTH OF CAVITY 25 MM
B. DITTO 50 MM
C. DITTO 65 MM
D. DITTO 75 MM
E. DITTO 100 MM

L. FACE BRICKWORK	<u>STRETCHER BOND</u> 1. BRICK-ON-EDGE 2. ½ BRICK WALL 3. 1 BRICK WALL 4. 1½ BRICK WALL 5. 2 BRICK WALL 6. 7. <u>ENGLISH BOND</u> 8. 1 BRICK WALL 9. 1½ BRICK WALL 10. 2 BRICK WALL 11. 12. <u>FLEMISH BOND</u> 13. 1 BRICK WALL 14. 1½ BRICK WALL 15. 2 BRICK WALL 16. 17.	<u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	37. MARGINS (M) 38. <u>FAIR RETURNS AND REVEALS (M)</u> 39. NOT EXCEEDING HALF BRICK WIDE 40. EXCEEDING HALF BRICK BUT NOT EXCEEDING ONE BRICK WIDE 41. EXCEEDING ONE BRICK BUT NOT EXCEEDING ONE AND HALF BRICK WIDE 42. EXCEEDING ONE AND HALF BRICK BUT NOT EXCEEDING TWO BRICK WIDE 43. 44. 45. FAIR CURVED CUTTING 46.	A. FLUSH POINTING B. FLUSH RUBBED OR BAGGED JOINTS C. KEYED (D) POINTING D. STRUCK-WEATHERED POINTING E. FLAT RECESSED POINTING F. KEYED (D) HORIZONTAL AND FLUSH VERTICAL POINTING G. RAKE OUT AND POINT WITH POINTING MORTAR KEYED (D) POINTING H. DITTO STRUCK-WEATHERED POINTING I. DITTO FLAT RECESSED POINTING J. DITTO KEYED (D) HORIZONTAL AND FLUSH VERTICAL POINTING	

L. FACE BRICKWORK	BONDING OF: STRETCHER BOND 1. BRICK-ON-EDGE 2. ½ BRICK WALL 3. 1 BRICK WALL 4. 1½ BRICK WALL 5. 2 BRICK WALL 6. 7. ENGLISH BOND 8. 1 BRICK WALL 9. 1½ BRICK WALL 10. 2 BRICK WALL 11. 12. FLEMISH BOND 13. 1 BRICK WALL 14. 1½ BRICK WALL 15. 2 BRICK WALL 16. 17.	LIME: SAND MORTARS A. MIX 1:2 B. MIX 1:3 CEMENT:LIME:SAND MORTARS C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 CEMENT:SAND MORTARS H. MIX 1:3 J. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	47. TO EXISTING BRICKWORK (M) 48. TO EXISTING ENGINEERING BRICKWORK (M) 49. TO EXISTING CONCRETE BRICKWORK (M) 50. TO EXISTING CLAY BLOCKWORK (M) 51. 52. 53. PANELS (NR) 54. APRONS (NR) 55. PANELS AND APRONS (NR) 56. 57.	A. CUT POCKETS FOR ALTERNATIVE COURSES B. CUT POCKETS FOR ALTERNATIVE GROUPS OF COURSES C. CUT FAIR POCKETS FOR ALTERNATIVE COURSES D. CUT FAIR POCKETS FOR ALTERNATIVE GROUPS OF COURSES	
			FAIR CHASES (M) *58. HORIZONTAL *59. RAKING *60. VERTICAL *61. CURVED		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

L. FACE BRICKWORK

<u>STRETCHER BOND</u>

1. BRICK-ON-EDGE
2. $\frac{1}{2}$ BRICK WALL
3. 1 BRICK WALL
4. $1\frac{1}{2}$ BRICK WALL
5. 2 BRICK WALL
6.
7.

<u>ENGLISH BOND</u>

8. 1 BRICK WALL
9. $1\frac{1}{2}$ BRICK WALL
10. 2 BRICK WALL
11.
12.

<u>FLEMISH BOND</u>

13. 1 BRICK WALL
14. $1\frac{1}{2}$ BRICK WALL
15. 2 BRICK WALL
16.
17.

<u>LIME: SAND MORTARS</u>

A. MIX 1:2
B. MIX 1:3

<u>CEMENT:LIME:SAND MORTARS</u>

C. MIX $1:\frac{1}{4}:3$
D. MIX $1:\frac{1}{2}:4\frac{1}{2}$
E. MIX 1:1:5-6
F. MIX 1:2:8-9
G. MIX 1:3:10-12

<u>CEMENT:SAND MORTARS</u>

H. MIX 1:3
J. MIX 1:4

<u>CEMENT:SAND AND PLASTICIZER MORTARS</u>

K. MIX 1:4
L. MIX 1:5-6
M. MIX 1:7-8
N. MIX 1:8

<u>FLUSH BANDS INCLUDING POINTING TO MARGINS (M)</u>

62. PLAIN CONTRASTING BANDS
63. BRICK-ON-EDGE BANDS
64. BRICK-ON-END BANDS
65.
66.

<u>SUNK BANDS INCLUDING POINTING TO MARGINS (M)</u>

*67. PLAIN CONTRASTING BANDS
*68. BRICK-ON-EDGE BANDS
*69. BRICK-ON-END BANDS
70.
71.

<u>PROJECTING BANDS INCLUDING POINTING TO MARGINS (M)</u>

*72. PLAIN CONTRASTING BANDS
*73. BRICK-ON-EDGE BANDS
*74. BRICK-ON-END BANDS
75.
76.

<u>QUOINS (M)</u>

*77. FLUSH PLAIN CONTRASTING QUOINS
*78. SUNK PLAIN CONTRASTING QUOINS INCLUDING POINTING TO MARGINS
*79. PROJECTING PLAIN CONTRASTING QUOINS INCLUDING POINTING TO MARGINS
80.
81.

A. FLUSH POINTING
B. RECESSED POINTING
C. RECESSED POINTING WITH MORTAR MIX A
D.
E. KEYED POINTING
F. DITTO WITH MORTAR MIX A
G.
H. STRUCK WEATHERED POINTING
I. DITTO WITH MORTAR MIX A
J.
K. BUCKET HANDLE POINTING
L. DITTO WITH MORTAR MIX A
M.

A. HEIGHT 75 MM
B. DITTO 112.5 MM
C. DITTO 225 MM
D. DITTO 225 MM
E. DITTO 300 MM

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

L. FACE BRICKWORK	23. HEADERS-ON-EDGE 23. HEADERS-ON-EDGE 24. STRETCHERS-ON-EDGE 25. STRETCHERS-ON-END 26. 27.	LIME: SAND MORTARS A. MIX 1:2 B. MIX 1:3 CEMENT:LIME:SAND MORTARS C. MIX 1:$\frac{1}{4}$:3 D. MIX 1:$\frac{1}{2}$:4$\frac{1}{2}$ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 CEMENT:SAND MORTARS H. MIX 1:3 J. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	SILLS, THRESHOLDS COPINGS AND STEPS (M) *1. SILLS *2. THRESHOLDS *3. COPINGS *4. STEPS *5. EDGINGS *6. KERBS 7. 8.	A. SET WEATHERING B. BUILT FAIR AND POINTED ON EXPOSED FACES C. SET WEATHERING-BUILT FAIR AND POINTED ON EXPOSED FACES	

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

M. BLOCKWORK

BLOCKS
A. THICKNESS 50 MM
B. DITTO 60 MM
C. DITTO 75 MM
D. DITTO 100 MM
E. DITTO 150 MM
F. DITTO 200 MM
G. DITTO 215 MM
H.

LIGNACITE BLOCKS
($3.5N/MM^2$ 450 X 225 MM)
J. 75 MM SOLID
K. 100 MM CELLULAR SOLID
L. 100 MM TWIN CORED
M. 100 MM SOLID
N. 150 MM TRIPLE CORED
P. 200 MM HOLLOW
Q. 220 MM HOLLOW PARTY WALL
($7N/MM^2$ 450 X 225 MM)
R. 100 MM SOLID
S. 210 MM SOLID

LIME: SAND MORTARS
A. MIX 1:2
B. MIX 1:3
CEMENT:LIME:SAND MORTARS
C. MIX $1:\frac{1}{4}:3$
D. MIX $1:\frac{1}{2}:4\frac{1}{2}$
E. MIX 1:1:5-6
F. MIX 1:2:8-9
G. MIX 1:3:10-12
CEMENT:SAND MORTARS
H. MIX 1:3
J. MIX 1:4
CEMENT:SAND AND PLASTICIZER MORTARS
K. MIX 1:4
L. MIX 1:5-6
M. MIX 1:7-8
N. MIX 1:8

(M^2)
1. WALLS
2. SKINS OF HOLLOW WALLS
3. SKINS OF COMPOSITE WALLS
4.
5.

6. DWARF SUPPORT WALLS
7. FILLING EXISTING OPENINGS
8.

9. PIERS
10. CHIMNEY STACKS
11. ISOLATED CASINGS
12. RAISING EXISTING STRUCTURES
13.
14.

POINTING AS WORK PROCEEDS:
FLUSH POINTING
A. TO ONE SIDE
B. TO BOTH SIDES
FLUSH RUBBED OR BAGGED JOINTS
C. TO ONE SIDE
D. TO BOTH SIDES
KEYED (IRONED D) POINTING
E. TO ONE SIDE
F. TO BOTH SIDES
STRUCK-WEATHERED POINTING
G. TO ONE SIDE
H. TO BOTH SIDES
FLAT RECESSED POINTING
J. TO ONE SIDE
K. TO BOTH SIDES
KEYED (IRONED D) HORIZONTAL AND FLUSHED VERTICAL POINTING
L. TO ONE SIDE
M. TO BOTH SIDES

RAKE OUT AND POINT WITH POINTING MORTAR :
KEYED (IRONED D) POINTING
N. TO ONE SIDE
P. TO BOTH SIDES
STRUCK-WEATHERED POINTING
Q. TO ONE SIDE
R. TO BOTH SIDES
FLAT RECESSED POINTING
S. TO ONE SIDE
T. TO BOTH SIDES
KEYED (IRONED D) HORIZONTAL AND FLUSH VERTICAL POINTING
U. TO ONE SIDE
V. TO BOTH SIDES

A. IN TRENCHES

M. BLOCKWORK	<u>BLOCKS</u> A. THICKNESS 50 MM B. DITTO 60 MM C. DITTO 75 MM D. DITTO 100 MM E. DITTO 150 MM F. DITTO 200 MM G. DITTO 215 MM H. <u>LIGNACITE BLOCKS</u> ($3.5N/MM^2$ 450 X 225 MM) J. 75 MM SOLID K. 100 MM CELLULAR SOLID L. 100 MM TWIN CORED M. 100 MM SOLID N. 150 MM TRIPLE CORED P. 200 MM HOLLOW Q. 220 MM HOLLOW PARTY WALL ($7N/MM^2$ 450 X 225 MM) R. 100 MM SOLID S. 210 MM SOLID	<u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8	<u>TAPERING WALLS (M^2)</u> 15. ONE SIDE TAPERED AT 30 DEG. 16. DITTO AT 45 DEG. 17. DITTO AT 60 DEG 18. DITTO AT 75 DEG. 19. 20. BOTH SIDES TAPERED AT 30 DEG. 21. DITTO AT 45 DEG. 22. DITTO AT 60 DEG. 23. DITTO AT 75 DEG. 24.	A. AVERAGE THICKNESS 200 MM B. DITTO 250 MM C. DITTO 300 MM D. DITTO 350 MM E. DITTO 400 MM F. DITTO 450 MM G. DITTO 500 MM H.	A. IN TRENCHES
			<u>CLOSE CAVITIES (M)</u> 25. VERTICALLY BONDED ONE SIDE 26. DITTO BONDED BOTH SIDES 27. HORIZONTALLY ONE COURSE HIGH INCLUDING BONDING 28. HORIZONTALLY TWO COURSES HIGH INCLUDING BONDING 29. 30.	A. WIDTH OF CAVITY 25 MM B. DITTO 50 MM C. DITTO 65 MM D. DITTO 75 MM E. DITTO 100 MM	

M. BLOCKWORK

BLOCKS

A. THICKNESS 50 MM
B. DITTO 60 MM
C. DITTO 75 MM
D. DITTO 100 MM
E. DITTO 150 MM
F. DITTO 200 MM
G. DITTO 215 MM
H.

LIGNACITE BLOCKS
($3.5N/MM^2$ 450 X 225 MM)

J. 75 MM SOLID
K. 100 MM CELLULAR SOLID
L. 100 MM TWIN CORED
M. 100 MM SOLID
N. 150 MM TRIPLE CORED
P. 200 MM HOLLOW
Q. 220 MM HOLLOW PARTY WALL

($7N/MM^2$ 450 X 225 MM)

R. 100 MM SOLID
S. 210 MM SOLID

LIME: SAND MORTARS

A. MIX 1:2
B. MIX 1:3

CEMENT:LIME:SAND MORTARS

C. MIX $1:\frac{1}{4}:3$
D. MIX $1:\frac{1}{2}:4\frac{1}{2}$
E. MIX 1:1:5-6
F. MIX 1:2:8-9
G. MIX 1:3:10-12

CEMENT:SAND MORTARS

H. MIX 1:3
J. MIX 1:4

CEMENT:SAND AND PLASTICIZER MORTARS

K. MIX 1:4
L. MIX 1:5-6
M. MIX 1:7-8
N. MIX 1:8

BONDING (M)

32. TO BRICKWORK
33. TO ENGINEERING BRICKWORK
34. TO CONCRETE BLOCKWORK
35. TO CLAY BLOCKWORK
36. TO EXISTING BRICKWORK
37. TO EXISTING ENGINEERING BRICKWORK
38. TO EXISTING CONCRETE BLOCKWORK
39. TO EXISTING CLAY BLOCKWORK
40.
41.
42.

A. CUT POCKETS FOR ALTERNATIVE COURSES
B. CUT POCKETS FOR ALTERNATIVE GROUPS OF COURSES
C. CUT FAIR POCKETS FOR ALTERNATIVE COURSES
D. CUT FAIR POCKETS FOR ALTERNATIVE GROUPS OF COURSES

ENDS OF BLOCKS (M)

43. FILL ENDS OF BLOCKS WITH MORTAR
44.

ROUGH CUTTING (M)

*45. CHAMFERED ANGLES
*46. ROUNDED ANGLES
*47. MOULDED ANGLES
48.

ROUGH CHASES (M)

*49. HORIZONTAL
*50. RAKING
*51. VERTICAL

FAIR CHASES

*52. HORIZONTAL
*53. RAKING
*54. VERTICAL
*55. CURVED

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

M. BLOCKWORK	T. FORM CAVITIES	1. WIDTH 50 MM	A. GALVANISED BUTTERFLY WALL TIES	A. 3 NO. PER M^2	
		2. WIDTH 65 MM	B. GALVANISED TWISTED WALL TIES	B. 4 NO. PER M^2	
		3. WIDTH 75 MM	C.	C. 5 NO. PER M^2	
		4. WIDTH 100 MM	D.	D. 6 NO. PER M^2	
		5.	E.	E.	
		6.	F.		

P. BRICKWORK/ BLOCKWORK SUNDRIES	A. REINFORCEMENT (M)	<u>MILD STEEL BARS</u> 1. DIAMETER 6 MM 2. DIAMETER 8 MM 3. <u>HIGH YIELD STEEL BARS</u> 4. DIAMETER 6 MM 5. DIAMETER 8 MM 6. <u>WOVEN MESH-MILD STEEL-ASPHALTUM DIPPED</u> 7. 8. 9. 10. <u>"BRICKTOR" WOVEN MESH-MILD STEEL BLACK JAPANNED</u> 11. 12. 13. 14. <u>"BRICKTOR" WOVEN MESH-MILD STEEL - GALVANISED</u> 15. 16. 17. 18. <u>EXPANDED STEEL ASPHALTUM DIPPED</u> 19. 20. 21. 22. <u>"EXMET" - MILD STEEL - ASPHALTUM DIPPED</u> 23.	A. IN HORIZONTAL JOINT OF BRICKWORK AND BLOCKWORK B. PART IN HORIZONTAL JOINTS OF BRICKWORK AND BLOCKWORK AND PART CAST INTO CONCRETE C. IN VERTICAL JOINTS OF BRICKWORK AND BLOCKWORK D. IN VERTICAL JOINTS OF BRICKWORK AND BLOCKWORK THREADED THROUGH JOINTS E. PART IN VERTICAL JOINTS OF BRICKWORK AND BLOCKWORK AND PART CAST INTO CONCRETE F.		

P. BRICKWORK/ BLOCKWORK SUNDRIES	A. REINFORCEMENT(M)	<u>"EXMET" MILD STEEL - ASPHALTUM DIPPED</u> 24. 25. 26. <u>"EXMET" - MILD STEEL - GALVANISED</u> 27. 28. 29. 30.	A. IN HORIZONTAL JOINT OF BRICK-WORK AND BLOCKWORK B. PART IN HORIZONTAL JOINTS OF BRICKWORK AND BLOCKWORK AND PART CAST INTO CONCRETE C. IN VERTICAL JOINTS OF BRICKWORK AND BLOCKWORK D. IN VERTICAL JOINTS OF BRICKWORK AND BLOCKWORK THREADED THROUGH JOINTS E. PART IN VERTICAL JOINTS OF BRICK WORK AND BLOCKWORK AND PART CAST INTO CONCRETE F.		
	B. KEYING (M^2)	1. RAKE OUT JOINTS 2. HACK SURFACES 3. RAKE OUT JOINTS AND HACK SURFACES	A. AS KEY FOR ASPHALT B. AS KEY FOR FINISHINGS		
	C. WEATHER - FILLETS AND ANGLE FILLETS (M)	1. FILLINGS 2. TROWELLED FILLINGS 3. ANGLE FILLETS 4. TROWELLED WEATHER FILLETS 5. WEATHER FILLETS, ANGLE FILLETS AND HAUNCHINGS 6. TROWELLED WEATHER FILLETS, ANGLE FILLETS AND HAUNCHINGS	<u>CEMENT:LIME:SAND MORTARS</u> A. MIX 1:¼:3 B. MIX 1:½:4½ C. MIX 1:1:5-6 D. MIX 1:2:8-9 E. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> F. MIX 1:3 G. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> H. MIX 1:4 J. MIX 1:5-6 L. MIX 1:7-8 M. MIX 1:8	A. WIDTH 25 MM B. WIDTH 50 MM C. WIDTH 65 MM D. WIDTH 75 MM E. WIDTH 100 MM F.	

P. BRICKWORK/ BLOCKWORK SUNDRIES	D. BEDDING (M)	1. PLATES 2. SHEETING 3. CORRUGATED SHEETING 4. WOOD FRAMES 5. WOOD SILLS 6. WOOD FRAMES AND SILLS 7.	BEDDED IN: CEMENT:LIME:SAND MORTARS A. MIX 1:¼:3 B. MIX 1:½:4½ C. MIX 1:1:5-6 D. MIX 1:2:8-9 E. MIX 1:3:10-12 CEMENT:SAND MORTARS F. MIX 1:3 G. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS H. MIX 1:4 J. MIX 1:5-6 K. MIX 1:7-8 L. MIX 1:8	A. WIDTH OF PLATE/SHEET 100 MM B. DITTO 125 MM C. DITTO 150 MM D. DITTO 175 MM E. DITTO 200 MM F. DITTO 225 MM	
	E. CLOSE CAVITIES (M)	HORIZONTALLY 1. WITH ONE COURSE OF SLATES 2. WITH MULTIPLE COURSES OF SLATES 3. VERTICALLY 4. WITH ONE COURSE OF SLATES 5. WITH MULTIPLE COURSES OF 6.	BEDDED IN: CEMENT:LIME:SAND MORTARS A. MIX 1:1¼:3 B. MIX 1:½:4½ C. MIX 1:1:5-6 D. MIX 1:2:8-9 E. MIX 1:3:10-12 CEMENT:SAND MORTARS F. MIX 1:3 G. MIX 1:4 CEMENT:SAND AND PLASTICIZER MORTARS H. MIX 1:4 J. MIX 1:5-6 K. MIX 1:7-8 L. MIX 1:8	A. WIDTH OF CAVITY 25 MM B. DITTO 50 MM C. DITTO 65 MM D. DITTO 75 MM E. DITTO 100 MM	
	F. CUTTING GROOVES (M)	1. FOR WATER BARS 2.	A. GROUT WITH GROUT MIX A B. GROUT WITH GROUT MIX B C. D. GROUT WITH EXPANDING GROUT E. BED IN LEAD F.		

P. BRICKWORK/ BLOCKWORK SUNDRIES	H. PREPARING FOR FLASHINGS AND ASPHALT SKIRTINGS (M)	<u>RAKE OUT JOINTS FOR:</u> 1. TURNED IN EDGES OF HORIZONTAL FLASHINGS 2. DITTO OF HORIZONTAL ASPHALT 3. DITTO OF RAKING FLASHINGS 4. DITTO OF RAKING ASPHALT 5. DITTO OF STEPPED FLASHINGS 6. DITTO OF STEPPED ASPHALT 7. DITTO OF VERTICAL FLASHINGS 8. DITTO OF VERTICAL ASPHALT <u>RAKE OUT AND ENLARGE JOINTS FOR:</u> 9. TURNED IN EDGES OF HORIZONTAL ASPHALT 10. DITTO OF RAKING ASPHALT 11. DITTO OF STEPPED ASPHALT 12. DITTO OF VERTICAL ASPHALT <u>CUT GROOVES FOR:</u> 13. TURNED IN EDGES OF HORIZONTAL FLASHINGS 14. DITTO OF HORIZONTAL ASPHALT 15. DITTO OF RAKING FLASHINGS 16. DITTO OF RAKING ASPHALT 17. DITTO OF STEPPED FLASHINGS 18. DITTO OF STEPPED ASPHALT 19. DITTO OF VERTICAL FLASHINGS 20. DITTO OF VERTICAL ASPHALT.	POINT IN: <u>LIME: SAND MORTARS</u> A. MIX 1:2 B. MIX 1:3 <u>CEMENT:LIME:SAND MORTARS</u> C. MIX 1:¼:3 D. MIX 1:½:4½ E. MIX 1:1:5-6 F. MIX 1:2:8-9 G. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> H. MIX 1:3 J. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> K. MIX 1:4 L. MIX 1:5-6 M. MIX 1:7-8 N. MIX 1:8		

P. BRICKWORK/ BLOCKWORK SUNDRIES	J. BUILDING IN OR CUTTING AND PINNING (NR)	<u>INCLUDING LUGS</u> *1. METAL WINDOWS *2. METAL FRAMES *3. METAL DOOR FRAMES *4. METAL DOORS AND FRAMES *5. STRONG ROOM DOORS AND FRAMES *6. SAFE DOORS AND FRAMES 7. <u>CUTTING AND PINNING LUGS</u> *8. METAL WINDOWS *9. METAL FRAMES *10. METAL DOOR FRAMES *11. METAL DOORS AND FRAMES *12. STRONG ROOM DOORS AND FRAMES *13. SAFE DOORS AND FRAMES *14.	BEDDING FRAMES IN: <u>CEMENT: LIME:SAND MORTARS</u> A. MIX $1:\frac{1}{4}:3$ B. MIX $1:1\frac{1}{2}:4\frac{1}{2}$ C. MIX 1:1:5-6 D. MIX 1:2:8-9 E. MIX 1:3:10-12 <u>CEMENT:SAND MORTARS</u> F. MIX 1:3 G. MIX 1:4 <u>CEMENT:SAND AND PLASTICIZER MORTARS</u> H. MIX 1:4 J. MIX 1:5-6 K. MIX 1:7-8 L. MIX 1:8 <u>MASTIC</u> M. N. P.	A. POINTING TO ONE SIDE B. POINTING TO BOTH SIDES C. POINTING TO ONE SIDE IN MASTIC D. POINTING TO BOTH SIDES IN MASTIC	
				A. MAKE GOOD WALLS B. DITTO AND FAIR FACE ONE SIDE C. DITTO AND FAIR FACE BOTH SIDES D. DITTO AND FACINGS ONE SIDE E. DITTO AND FACINGS BOTH SIDES F. DITTO AND FACINGS ONE SIDE AND FAIR FACE OTHER SIDE G. DITTO AND BLOCKWORK ONE SIDE AND BRICKWORK OTHER SIDE H. DITTO AND BLOCKWORK ONE SIDE AND FAIR FACE OTHER SIDE J. DITTO AND BLOCKWORK ONE SIDE AND FACINGS OTHER SIDE	

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

P. BRICKWORK/ BLOCKWORK SUNDRIES	J. BUILDING IN OR CUTTING AND PINNING (NR)	<u>CUT AND PIN</u> 15. ENDS OF LINTELS, STEPS, SILLS, TIMBER BRACKETS AND SUPPORTS 16. ENDS OF ANCHOR BOLTS AND RAG BOLTS 17. ENDS OF STANDARDS AND RAILS 18. 19. ENDS OF SMALL PIPES AND BARS (N.E. 250 MM DEPTH) 20. ENDS OF LARGE PIPES AND BARS (250-500 MM DEPTH) 21. ENDS OF EXTRA LARGE PIPES AND BARS (EXCEEDING 500 MM DEPTH) 22. 23. ENDS OF SMALL METAL SECTIONS (N.E. 250 MM DEPTH) 24. ENDS OF LARGE METAL SECTIONS (250-500 MM DEPTH) 25. ENDS OF EXTRA LARGE METAL SECTIONS (EXCEEDING 500 MM DEPTH) 26.	A. MAKE GOOD WALLS B. DITTO AND FAIR FACE C. DITTO AND FACINGS		

P. BRICKWORK/ BLOCKWORK SUNDRIES	K. HOLES (NR)	<u>FORM HOLES THROUGH:</u> 1. BRICK-ON-EDGE WALL 2. ½ BRICK WALL 3. 1 BRICK WALL 4. 1½ BRICK WALL 5. 2 BRICK WALL 6. 7. BRICK CAVITY WALL FORMED OF TWO ½ BRICK SKINS 8. 9. CAVITY WALL FILLED WITH CONCRETE 255 MM WIDE 10. DITTO 268 MM WIDE 11. DITTO 280 MM WIDE 12. DITTO 305 MM WIDE 13. 14. 75 MM BLOCK WALL 15. 100 MM BLOCK WALL 16. 150 MM BLOCK WALL 17. 200 MM BLOCK WALL 18. 215 MM BLOCK WALL 19. 20. CAVITY WALL FORMED OF 1 SKIN BRICKWORK AND OTHER SKIN 75 MM BLOCKWORK 21. DITTO 100 MM BLOCKWORK 22. DITTO 150 MM BLOCKWORK 23.	<u>FOR SMALL (I.E. N.E. 55 MM DIAM):</u> A. PIPES AND BARS B. LUGS, BRACKETS AND SUPPORTS C. METAL SECTIONS D. <u>FOR LARGE (I.E. 55 - 110 MM DIAM)</u> E. PIPES AND BARS F. LUGS, BRACKETS AND SUPPORTS G. METAL SECTIONS H. <u>FOR EXTRA LARGE (EXCEEDING 110 MM DIAM)</u> J. PIPES AND BARS K. LUGS, BRACKETS AND SUPPORTS L. METAL SECTIONS M. N. NOT EXCEEDING 0.10 M^2 P. 0.10 TO 0.20 M^2 Q. 0.20 TO 0.30 M^2 R. 0.30 TO 0.40 M^2 S.	A. FIX ONLY SLEEVES (SUPPLIED) B. DITTO AND PACK AROUND ONE END WITH FIRE RESISTANT MATERIAL C. DITTO AND PACK AROUND BOTH ENDS WITH FIRE RESISTANT D. FIX ONLY PUDDLE FLANGES (SUPPLIED) E. DITTO AND PACK AROUND ONE END WITH FIRE RESISTANT MATERIAL F. DITTO AND PACK AROUND BOTH ENDS WITH FIRE RESISTANT MATERIAL G. POINTING H. RENDERING AROUND J. SLATE SEALING CAVITY K. SLATE SEALING CAVITY - RENDERING AROUND	A. MAKE GOOD WALLS B. DITTO AND FAIR FACE ONE SIDE C. DITTO AND FAIR FACE BOTH SIDES D. DITTO AND FACINGS ONE SIDE E. DITTO AND FACINGS BOTH SIDES F. DITTO AND FACINGS ONE SIDE AND FAIR FACE OTHER SIDE G. DITTO AND BLOCKWORK ONE SIDE AND BRICKWORK OTHER SIDE H. DITTO AND BLOCKWORK ONE SIDE AND FAIR FACE OTHER SIDE J. DITTO AND BLOCKWORK ONE SIDE AND FACINGS OTHER SIDE

P. BRICKWORK/ BLOCKWORK SUNDRIES	K. HOLES (NR)	<u>CUT HOLES THROUGH</u> 27. BRICK-ON-EDGE WALLS 28. ½ BRICK WALL 29. 1 BRICK WALL 30. 1½ BRICK WALL 31. 2 BRICK WALL 32. 33. BRICK CAVITY WALL FORMED OF TWO ½ BRICK SKINS 34. 35. CAVITY WALL FILLED WITH CONCRETE 255 MM WIDE 36. DITTO 268 MM WIDE 37. DITTO 280 MM WIDE 38. DITTO 305 MM WIDE 39. 40. 75 MM BLOCK WALL 41. 100 MM BLOCK WALL 42. 150 MM BLOCK WALL 43. 200 MM BLOCK WALL 44. 215 MM BLOCK WALL 45. 46. CAVITY WALL FORMED OF 1 SKIN BRICKWORK AND OTHER SKIN 75 MM BLOCKWORK 47. DITTO 100 MM BLOCKWORK 48. DITTO 150 MM BLOCKWORK 49.	<u>FOR SMALL (I.E. N.E. 55 MM DIAM):</u> A. PIPES AND BARS B. LUGS, BRACKETS AND SUPPORTS C. METAL SECTIONS D. <u>FOR LARGE (I.E. 55 - 110 MM DIAM)</u> E. PIPES AND BARS F. LUGS, BRACKETS AND SUPPORTS G. METAL SECTIONS H. <u>FOR EXTRA LARGE (EXCEEDING 110 MM DIAM)</u> J. PIPES AND BARS K. LUGS, BRACKETS AND SUPPORTS L. METAL SECTIONS M. N. NOT EXCEEDING 0.10 M^2 P. 0.10 TO 0.20 M^2 Q. 0.20 TO 0.30 M^2 R. 0.30 TO 0.40 M^2 S.	A. FIX ONLY SLEEVES (SUPPLIED) B. DITTO AND PACK AROUND ONE END WITH FIRE RESISTANT MATERIAL C. DITTO AND PACK AROUND BOTH ENDS WITH FIRE RESISTANT D. FIX ONLY PUDDLE FLANGES (SUPPLIED) E. DITTO AND PACK AROUND ONE END WITH FIRE RESISTANT MATERIAL F. DITTO AND PACK AROUND BOTH ENDS WITH FIRE RESISTANT MATERIAL G. POINTING H. RENDERING AROUND J. SLATE SEALING CAVITY K. SLATE SEALING CAVITY - RENDERING AROUND	A. MAKE GOOD WALLS B. DITTO AND FAIR FACE ONE SIDE C. DITTO AND FAIR FACE BOTH SIDES D. DITTO AND FACINGS ONE SIDE E. DITTO AND FACINGS BOTH SIDES F. DITTO AND FACINGS ONE SIDE AND FAIR FACE OTHER SIDE G. DITTO AND BLOCKWORK ONE SIDE AND BRICKWORK OTHER SIDE H. DITTO AND BLOCKWORK ONE SIDE AND FAIR FACE OTHER SIDE J. DITTO AND BLOCKWORK ONE SIDE AND FACINGS OTHER SIDE

P. BRICKWORK/ BLOCKWORK SUNDRIES	L. MORTICES (NR)	<u>FORM:</u> *1. MORTICES *2. POCKETS *3. SINKINGS *4. FAIR MORTICES *5. FAIR POCKETS *6. FAIR SINKINGS <u>CUT:</u> *7. MORTICES *8. POCKETS *9. SINKINGS *10. FAIR MORTICES *11. FAIR POCKETS *12. FAIR SINKINGS	A. GROUT WITH MIX A B. DITTO WITH MIX B C. D. E. RUN WITH LEAD F.	A. MAKE GOOD WALLS B. DITTO AND FAIR FACE C. DITTO AND FACINGS D.	
	M. AIR BRICKS (NR)	<u>75 X 225 MM</u> 1. TERRA COTTA 2. CONCRETE 3. CAST IRON 4. PLASTIC 5. 6. <u>150 X 225 MM</u> 7. TERRA COTTA 8. CONCRETE 9. CAST IRON 10. PLASTIC 11. 12. <u>225 X 225 MM</u> 13. TERRA COTTA 14. CONCRETE 15. CAST IRON 16. PLASTIC	A. AIR BRICKS B. VENTILATORS C. CAVITY WALL HORIZONTAL BRIDGING DUCTS		

* DENOTES THAT SUPPLEMENTARY INFORMATION WILL NEED TO BE ENTERED.

P. BRICKWORK/ BLOCKWORK SUNDRIES	N. CENTERING	OVER 300 MM WIDE AND N.E. 2.00 M SPAN (M^2) 1. FLAT SOFFITS 2. NOT EXCEEDING 300 MM WIDE AND N.E. 2.00 M SPAN (M) 3. FLAT SOFFITS 4. SPAN EXCEEDING 2.00 M (NR) 5. FLAT SOFFITS 6.	A. STRUTTING 3.50 TO 5.00 M HIGH B. DITTO 5.00 TO 6.50 M HIGH C.		
		CUTTING (M) 13. RAKING 14. CURVED 15. PROFILE 16. AGAINST RIBS 17. TO INTERSECTIONS 18. TO GROIN POINTS			

APPENDIX D

ISOLATED BEAM FORMWORK SUB-ROUTINE

GENERAL

This appendix demonstrates the use of interactive sub-routines designed to cater for the storage of performance data. It is envisaged that such sub-routines will be used where the dimensions peculiar to the item in question cannot satisfactorily be accommodated in the INTEREST BUILD classification.

All programming work in this area was undertaken by the author.

AIM OF SUB-ROUTINE

The sub-routine below has been developed to facilitate the storage and retrieval of performance data relating to the making, erecting and striking of formwork to isolated beams. SMM 6 requires that such formwork should be described in lineal metres with the dimensions of the beam being stated in the bill item description. SMM 6 further stipulates that."Except in the case of members which can be adequately described each cross-section shall be accompanied by a bill diagram showing the required profile of the concrete member....". It was considered impractical to attempt to define such dimensions within the INTEREST BUILD classification and the sub-routine illustrates a solution to this problem.

DESCRIPTION OF SUB-ROUTINE

The sub-routine allows the storage of performance data, and subsequently enables such data to be retrieved in accordance with the user's requirements. This is illustrated below.

a. Storage of performance data

Tables D.1 and D.2 show the data stored in the computer system. The Labour outputs and Materials usage constants illustrated relate to allowables for 1 square metre of isolated beam formwork. The choice of these allowables depends upon the size of the beam section and the number of uses selected.

		SIDES OF ISOLATED BEAMS									
		LABOUR					MATERIALS				
		MAKE	ERECT	STRIP	REMAKE	OIL	SOFT WOOD	PLY	OIL	REMAKE SOFT WOOD	REMAKE PLY
RESOURCE NO.		1	1	1	1	2	3	4	5	3	4
NUMBER OF USES	SIZE (MM)										
UP TO 4	0-300	3.6	1.8	1.5	-	0.1	0.08	1.0	0.12	-	-
	300-500	3.3	0.9	1.2	-	0.1	0.07	1.0	0.12	-	-
	500-800	2.7	0.75	0.9	-	0.1	0.09	1.0	0.12	-	-
	800-1000	1.8	0.75	0.75	-	0.1	0.15	1.0	0.12	-	-
5 - 6	0-300	3.6	1.8	1.5	0.36	0.1	0.08	1.0	0.12	0.008	0.1
	300-500	3.3	0.9	1.2	0.33	0.1	0.07	1.0	0.12	0.007	0.1
	500-800	2.7	0.75	0.9	0.27	0.1	0.09	1.0	0.12	0.009	0.1
	800-1000	1.8	0.75	0.75	0.18	0.1	0.15	1.0	0.12	0.015	0.1
7 - 8	0-300	3.6	1.8	1.5	0.45	0.1	0.08	1.0	0.12	0.010	0.13
	300-500	3.3	0.9	1.2	0.41	0.1	0.07	1.0	0.12	0.009	0.13
	500-800	2.7	0.75	0.9	0.34	0.1	0.09	1.0	0.12	0.011	0.13
	800-1000	1.8	0.75	0.75	0.23	0.1	0.15	1.0	0.12	0.019	0.13
9 - 10	0-300	3.6	1.8	1.5	0.54	0.1	0.08	1.0	0.12	0.012	0.15
	300-500	3.3	0.9	1.2	0.50	0.1	0.07	1.0	0.12	0.011	0.15
	500-800	2.7	0.75	0.9	0.41	0.1	0.09	1.0	0.12	0.014	0.15
	800-1000	1.8	0.75	0.75	0.27	0.1	0.15	1.0	0.12	0.023	0.15
11 - 12	0-300	3.6	1.8	1.5	0.63	0.1	0.08	1.0	0.12	0.014	0.18
	300-500	3.3	0.9	1.2	0.58	0.1	0.07	1.0	0.12	0.012	0.18
	500-800	2.7	0.75	0.9	0.47	0.1	0.09	1.0	0.12	0.016	0.18
	800-1000	1.8	0.75	0.75	0.32	0.1	0.15	1.0	0.12	0.026	0.18

TABLE D.1: Performance data for the making, erecting and stripping of formwork to sides of Isolated Beams.

		SOFFITS OF ISOLATED BEAMS									
		LABOUR					MATERIALS				
		MAKE	ERECT	STRIP	REMAKE	OIL	SOFT WOOD	PLY	OIL	REMAKE SOFT WOOD	REMAKE PLY
RESOURCE NO.											
NUMBER OF USES	SIZE (MM)	1	1	1	1	2	3	4	5	3	4
UP TO 4	0-300	3.6	1.8	1.5	-	0.1	0.08	1.0	0.12	-	-
	300-500	3.3	0.9	1.2	-	0.1	0.07	1.0	0.12	-	-
	500-800	2.7	0.75	0.9	-	0.1	0.09	1.0	0.12	-	-
	800-1000	1.8	0.75	0.75	-	0.1	0.15	1.0	0.12	-	-
5 - 6	0-300	3.6	1.8	1.5	0.36	0.1	0.08	1.0	0.12	0.008	0.1
	300-500	3.3	0.9	1.2	0.33	0.1	0.07	1.0	0.12	0.007	0.1
	500-800	2.7	0.75	0.9	0.27	0.1	0.09	1.0	0.12	0.009	0.1
	800-1000	1.8	0.75	0.75	0.18	0.1	0.15	1.0	0.12	0.015	0.1
7 - 8	0-300	3.6	1.8	1.5	0.45	0.1	0.08	1.0	0.12	0.010	0.13
	300-500	3.3	0.9	1.2	0.41	0.1	0.07	1.0	0.12	0.009	0.13
	500-800	2.7	0.75	0.9	0.34	0.1	0.09	1.0	0.12	0.011	0.13
	800-1000	1.8	0.75	0.75	0.23	0.1	0.15	1.0	0.12	0.019	0.13
9 - 10	0-300	3.6	1.8	1.5	0.54	0.1	0.08	1.0	0.12	0.012	0.15
	300-500	3.3	0.9	1.2	0.50	0.1	0.07	1.0	0.12	0.011	0.15
	500-800	2.7	0.75	0.9	0.41	0.1	0.09	1.0	0.12	0.014	0.15
	800-1000	1.8	0.75	0.75	0.27	0.1	0.15	1.0	0.12	0.023	0.15
11 - 12	0-300	3.6	1.8	1.5	0.63	0.1	0.08	1.0	0.12	0.014	0.18
	300-500	3.3	0.9	1.2	0.58	0.1	0.07	1.0	0.12	0.012	0.18
	500-800	2.7	0.75	0.9	0.47	0.1	0.09	1.0	0.12	0.016	0.18
	800-1000	1.8	0.75	0.75	0.32	0.1	0.15	1.0	0.12	0.026	0.18

TABLE D.2: Performance data for the making, erecting and stripping of formwork to soffits of isolated beams.

b. Retrieval of performance data

In order to retrieve the data, the user is required to enter certain information relating to the beam in question. The information required is:

- the depth of the beam;
- the width of the beam;
- the anticipated number of uses of the soffit formwork;
- the anticipated number of uses of the side formwork; and
- the height of the soffit above the supporting surface.

The manner in which this information is entered into the system is shown in Figure D.1. Note that all input by the user is underlined. All other print-out is that supplied by the system.

This information serves to instruct the system to select the required output and usage rates from the stored data illustrated in Tables D.1 and D.2. These rates are then combined with current resource costs, and a unit rate build-up as shown in Figure D.2 is displayed.

RELATIONSHIP BETWEEN THE SUB-ROUTINE AND THE ESTIMATING SYSTEM

The sub-routine illustrates the manner in which interactive programs may be used to ease the identification of notations. At the present time no link exists between the INTEREST BUILD system and the sub-routine. It is envisaged that this link will be effected by the selection of the appropriate WORK GROUP CODE (in this case, reference to the INTEREST BUILD classification will show this notation to be HA115).

```
ISOLATED BEAM FORMWORK SUBROUTINE
*********************************
ENTER DEPTH OF BEAM
.85
ENTER WIDTH OF BEAM
.45
ENTER NUMBER OF USES OF SOFFIT FORMWORK
3
ENTER NUMBER OF USES OF SIDE FORMWORK
6
ENTER HEIGHT OF SOFFIT ABOVE SUPPORT
2.75
              *********
              *       *
              *       *
              *       *
              *       *
              *       *    D =  0.85
              *       *
              *       *
              *       *
              *       *
              *********

               B =  0.45

     NUMBER OF USES OF SOFFIT FORMWORK IS  3.00
     NUMBER OF USES OF SIDE FORMWORK IS    6.00
     HEIGHT OF SOFFIT ABOVE SUPPORT        2.75 M
```

FIGURE D.1: Example of the entry of information required to prime the Isolated Beam formwork sub-routine.

RES. NR	COST/UNIT	USAGE	NR. USES	WASTE	COST/M	
SOFFIT	0.450 WIDE					
1	\$3.48	3.3	3.0		\$ 1.72	
1	\$3.48	0.9	1.0		\$ 1.41	
1	\$3.48	1.2	1.0		\$ 1.88	
1	\$3.48	0.0	1.0		\$ 0.00	
2	\$2.25	0.1	1.0		\$ 0.10	
			TOTAL LABOUR COST			\$ 5.11
3	\$133.55	0.07	3.0	0.0	\$ 1.40	
4	\$ 5.27	1.00	3.0	0.0	\$ 0.79	
5	\$ 0.85	0.12	1.0	0.0	\$ 0.05	
3	\$133.55	0.00	1.0	0.0	\$ 0.00	
4	\$ 5.27	0.00	1.0	0.0	\$ 0.00	
			TOTAL MATERIAL COST			\$ 2.24
SIDES	0.850 WIDE X 2					
1	\$3.48	1.8	6.0		\$ 1.77	
1	\$3.48	.75	1.0		\$ 4.44	
1	\$3.48	.75	1.0		\$ 4.44	
1	\$3.48	.18	1.0		\$ 1.06	
2	\$2.25	.10	1.0		\$ 0.38	
			TOTAL LABOUR COST			\$12.10
3	\$133.55	0.15	6.0	0.0	\$ 5.68	
4	\$ 5.27	1.00	6.0	0.0	\$ 8.96	
5	\$ 0.85	0.12	1.0	0.0	\$ 0.17	
3	\$133.55	0.01	1.0	0.0	\$ 3.41	
4	\$ 5.27	0.10	1.0	0.0	\$ 0.90	
			TOTAL MATERIAL COST			\$19.11
			TOTAL COST PER METRE			\$38.56

FIGURE D.2: Example of a unit rate build-up resulting from the use of the Isolated Beam formwork sub-routine.

APPENDIX E

MANUAL FOR THE PREPARATION OF THE DEMONSTRATION DATA LIBRARY

INTRODUCTION

This document deals with the collection of performance data for use with the computer-aided estimating system for builders currently being developed at Loughborough University of Technology.

The data (henceforth referred to as the "data library") needs to be collected in order to facilitate testing and demonstration of the estimating system. As organisations using the system will eventually develop their own data library, it is hoped that this exercise will not only provide the required information, but will also assist contractors in assessing the work load involved.

This manual contains details of how to compile the data library.

1. OUTLINE - COMPILING A BUILD-UP TO BE STORED IN THE DATA LIBRARY

Generally the sequence of operations to be followed is shown in Figure E.1 below.

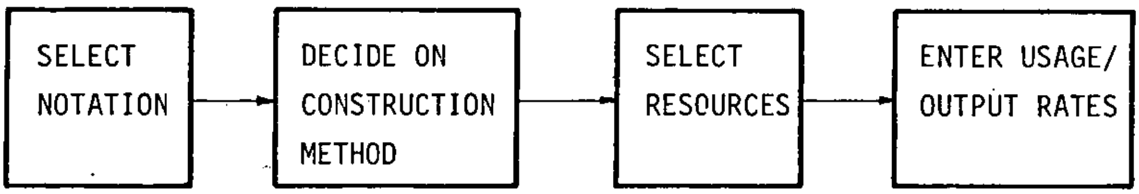


FIGURE E.1: The compilation of a build-up

Each of these aspects is examined below.

a. Select notation

This involves selecting a notation which corresponds to the build-up to be stored in the data library. The notations are included in the INTEREST BUILD classification which accompanies this document.

All notations relate to item descriptions found in bills of quantities drawn up in accordance with SMM 6. For example, reference to the classification will show that FA1.0 refers to "In-situ concrete in mass filling". (For further particulars on the use of the classification see the explanatory notes contained at the start of the classification).

b. Decide on method of construction

The method of construction for the build-up in question should be decided upon. The system is able to store up to ten different ways of constructing each item. Different methods are identified by the numeric level following the full stop in the notation.

c. Select resources

This involves noting the resources (i.e. Labour, Plant, Auxiliary Plant and Materials) to be used in the build-up.

d. Enter usage/output rates

The usage/output rates appropriate to each resource should be established and recorded next to each resource.

2. DETAILED DESCRIPTION OF DATA REQUIRED

Figure E.2 shows a typical layout of the options available to the estimator when pricing an item. The data entered into the system thus needs to make use of these options. The manner in which this data should be presented is described in 3. EXAMPLE OF A BUILD UP. A description of the options and the information that should be recorded is given below.

a. Notation

The notation to which the build-up refers should be written above the data.

NOTATION:

BUILD-UP DESCRIPTION:

UNITS OF MEASUREMENT:

LABOUR

Res. Code	Description	Cost/Hr	Usage	Number of Uses	Cost/ Unit

TOTAL LABOUR COST/UNIT

PLANT

Res. Code	Description	Cost/Hr	Usage	Cost/ Unit

TOTAL PLANT COST/UNIT

AUXILIARY PLANT

Res. Code	Description	Cost/Week	Usage	Number of Weeks	Cost/ Unit

TOTAL AUX. PLANT COST/UNIT

MATERIAL

Res. Code	Description	Net Cost/Unit	Usage	Number of Uses	Wastage Per Unit	Cost/ Unit

TOTAL MATERIAL COST/UNIT

TOTAL NET COST PER UNIT

TOTAL NET COST PER (N) UNITS

FIGURE E.2: Example of options available for compiling a build-up.

b. Build-up description

A description of the work to which the build-up refers should also be given.

c. Units of measurement

The units of measurement relevant to the build-up in question should be noted.

d. Resource code

No code need be entered.(On completion of the data library a comprehensive schedule of resources used in the library will be drawn up. Codes will then be allocated to these resources.)

e. Resource Description

The description of the resource used must be noted (e.g. bricklayer, labourer, etc.). Resources may also be considered as gangs.

Brickwork gang	-	2 Bricklayers 1 Labourer
Excavation team	-	JCB 3C JCB Operator Banksman.

f. Cost/hr

No information on costs need be entered. (This will be collected at a later stage).

g. Usage/Output

The Labour/Plant/Materials constants entered here should reflect the hours/weeks/quantity taken per unit of the build-up in question.

h. Number of Uses

This facility is only available for formwork build-ups. The anticipated number of uses should be entered where applicable. These may be varied according to the requirements of a particular contract.

i. Weighting Factor

No information need be entered for this option. (It is assumed as 100% for all build-ups stored in the data library).

j. Wastage

This facility is only available for Materials resources. The anticipated wastage percentage should be noted next to each material.

3. EXAMPLE OF A BUILD-UP

Figure E.3 illustrates the manner in which data should be presented. The layout is not obligatory; but please ensure that all data may be easily interpreted.

NOTATION: FA1.0

BUILD-UP DESCRIPTION: In-situ concrete in mass filling.

UNITS OF MEASUREMENT: m^3

LABOUR	USAGE/OUTPUT	
Concrete gang (4 labourers)	0.5 HR/m^3	
PLANT		
Dumper (1m^3)	0.5 HR/m^3	
MATERIAL		**WASTE**
Concrete Mix A	1m^3/m^3	10%

FIGURE E.3: Example of presentation of performance data for inclusion in data library.