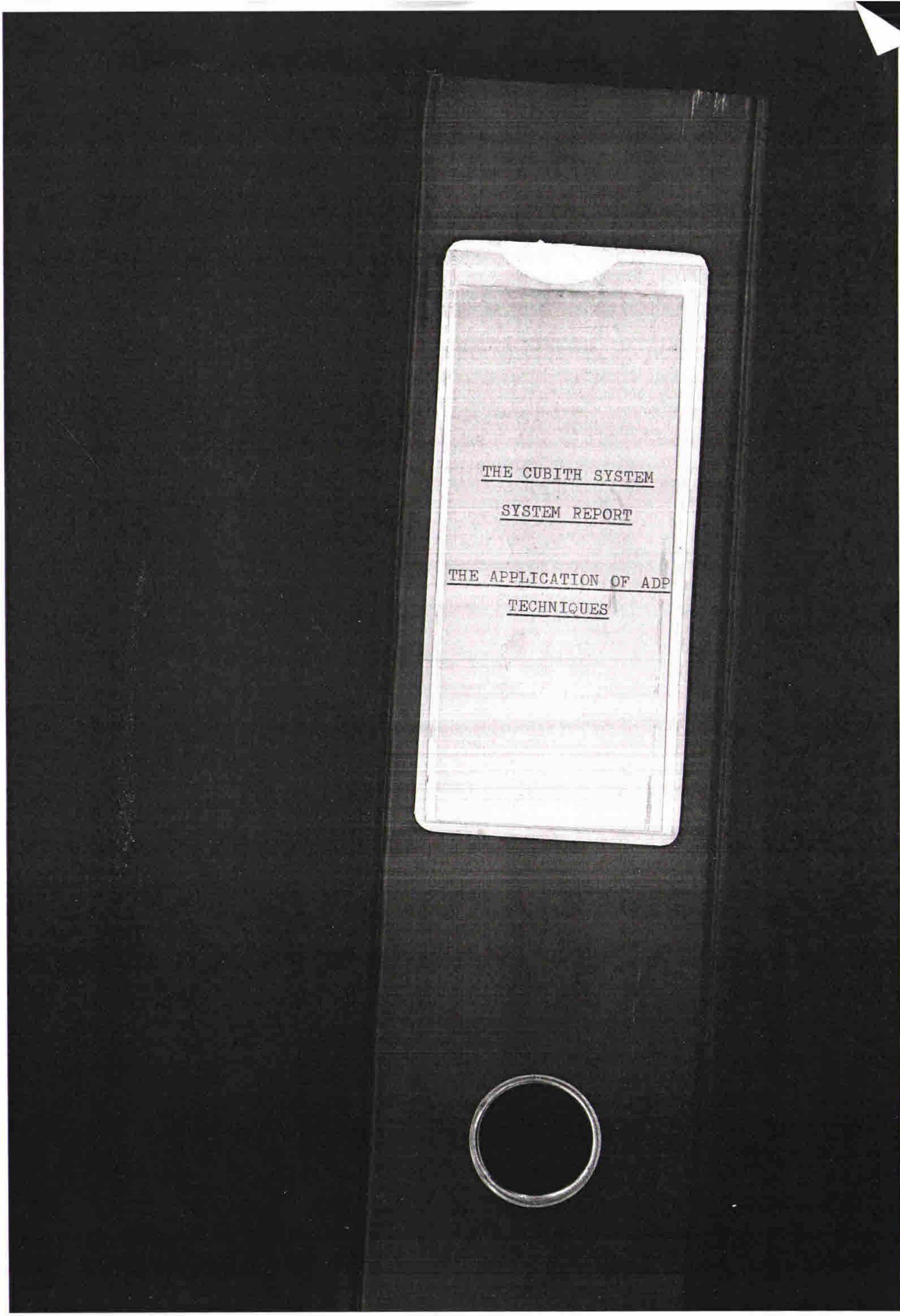
THE CUBITH SYSTEM
SYSTEM REPORT
THE APPLICATION OF ADP
TECHNIQUES

THE CUBITH SYSTEM

SYSTEM REPORT

THE APPLICATION OF ADP TECHNIQUES

Project Ref: fpl 727/September 1970

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SECTION 1 SUMMARY

SECTION 1. SUMMARY

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1.1 OBJECTIVES OF THE REPORT

1.1.1 This report describes the CUBITH System in relation to the application of ADP techniques. The main objective of the CUBITH System is to ensure the application of optimum design and construction techniques to Health and Welfare building within an environment of controlled cost and timescale.

1.1.2 The main objective of the report is to describe and define the System and the tasks required for the application of ADP techniques.

1.1.3 The report is intended to form a basis for further systems and software development.

1.2 CURRENT DEVELOPMENTS

1.2.1 Development of the System is at present proceeding at different rates in different areas, and this is usual for a large System.

Many of the non Software Systems - Design Development techniques, Cost Analysis Systems etc. are far advanced. In some areas the Systems are as yet undefined. In others pilot schemes for ADP applications are being carried out. In others still fairly advanced ADP techniques have been applied. The report attempts to define these areas and give guidance on future ADP development.

1.2.2 One of the most important aspects of CUBITH is the ready access to evaluated data which will assist with decision making within the Hospital Building Programme and the Construction Industry in general.

This data will include optimum design techniques, lists of evaluated and approved manufacturers' data together with performance factors and costs, evaluated functional requirements within the Hospital Building Programme etc. The data will be available to a variety of users ranging from other Government Departments, Regional Hospital Boards, Contractors, Manufacturers etc. - the access will only be limited by security status.

1.2.3 Without the application of ADP techniques to CUBITH it would be impossible to achieve the fairly fast access required to a large integrated System.

1.2.4 CUBITH will benefit greatly from the application of Computer Aided Design techniques. This is a new field and hardware and software developments are making tremendous strides. A technique which was once thought to be very costly is now becoming a basic requirement of any design system.

1.3 FUTURE DEVELOPMENTS

1.3.1 Into any large system must be built the ability to adapt to change and this ability is one of the criteria on which it should be judged. ADP techniques are developing continuously and some of those which may be used in the System, (e.g. Computer Aided Design) are in fields where rapid advances may be expected over the next few years. However, it is not only in the data handling part of the System where change can be envisaged but also in building techniques and the organisation of large projects. The following areas of change can be identified:-

(a) tasks - these may have to be modified to accommodate new requirements or new building techniques.

(b) techniques - the methods used to perform the tasks will develop and change as advanced techniques for data processing become widespread, as experience is gained in Computer Aided Design and related fields, as sub-contractors' own systems develop, etc.

(c) structure - the sequence in which tasks are performed may vary (the appointment of main contractor earlier in the project is already being considered; this will lead to a different order for those tasks connected with tendering and signing the contract).

1.3.2 These areas will interact with each other and changes will need to be continuously evaluated, both before and after being included in the System, in order to provide optimum further development.

1.4 CONCLUSION

The application of ADP techniques to CUBITH is progressing at an ever increasing rate. This report sets out to define the areas of development and suggest a strategem for further work. But it must be remembered that Automatic Data Processing is merely a tool which will assist the designer in his work and provide the improved methods of control throughout all areas of Hospital Building.

SECTION 2 INTRODUCTION

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SECTION 2 INTRODUCTION

2.1 THE AIMS OF THE REPORT

2.1.1 This report was commissioned by the Architect's Department of the Department of Health and Social Security. Its main function is to define the CUBITH System in relation to the Application of Automatic Data Processing techniques.

2.1.2 Each Section of the report is intended to 'stand alone' if required and the reader will find that there is, of necessity, duplication between sections.

2.1.3 The report includes references to, and quotations and diagrams from, current DHSS documents.

2.2 SUMMARY OF THE SECTIONS CONTAINED IN THE REPORT

2.2.1 Section 3 describes CUBITH in relation to other DHSS Systems associated with the Hospital Building Programme.

2.2.2 Section 4 describes the CUBITH System in general and attempts to define the various 'procedural sub-systems' within the total System.

2.2.3 Section 5 defines the 'procedural sub-systems' in more detail and attempts to show the inter-relation between them.

2.2.4 Section 6 describes the flow of data within the System and introduces the need for a Common Data Base.

2.2.5 Section 7 defines the Data Base concept in more detail and gives rules for the setting up and management of a Common Data Base.

2.2.6 Section 8 describes how ADP techniques can be applied to CUBITH.

2.2.7 Section 9 attempts to define the Computer Hardware requirements of the CUBITH ADP System.

2.2.8 Section 10 sets out to provide a timetable for the application of ADP techniques to CUBITH and define the inter-relation of ADP tasks.

2.2.9 Section 11 gives recommendations on how the work of the application of ADP techniques to CUBITH can be carried out and co-ordinated.

2.2.10 Section 12 refers to volumes of data for the CUBITH ADP System.

2.2.11 The Appendix gives details of other ADP applications which may be of interest to CUBITH.

SECTION 3 CUBITH RELATED TO THE HOSPITAL BUILDING PROGRAMME AND ASSOCIATED SYSTEMS

SECTION 3 CUBITH RELATED TO THE HOSPITAL BUILDING PROGRAMME AND ASSOCIATED SYSTEMS

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3.1 INTRODUCTION

3.1.1 In its broadest context, the Hospital Building Programme comprises two parts. Firstly, Research and Development related to Health and Welfare Building, under the direction of the Department of Health and Social Security. Secondly, the monitoring of established procedures for planning and construction of Health and Welfare buildings, under the direction of Regional Hospital Boards.

3.1.2 The Regional Hospital Boards submit their plans to the Department of Health for approval, and make quarterly returns of the rate of capital expenditure. The Boards can if required make use of facilities and expertise offered by the Department.

3.1.3 The total CUBITH System aims to interface with all aspects of the Hospital Building Programme, together with work developed specifically for CUBITH. This will enable Health and Welfare building from pre-brief to evaluation, to be carried out in the most efficient way, consistent with the function that the completed building is required to fulfil.

3.2 ESTABLISHED PROCEDURES

3.2.1 Regional Hospital Boards are responsible for deciding the general scope of their capital programmes, priority of projects, and the sequence of initiation of schemes, providing they do not exceed their allocated resources as given in the Hospital Building Programme.

3.2.2 Yearly allocations of expenditure over a ten year period are given in advance by the Department, and on the basis of these, the Boards draw up plans to balance resources against total activities.

3.2.3 Hence a ten year development plan is maintained for each region, and procedures exist for keeping the Department fully informed of these. The first three years of the plan are developed in considerable detail, while the remaining years are only outlined. Alterations to the detailed plans could have almost immediate consequences, and hence consultation with the Department is necessary.

3.2.4 This overall planning of expenditure by Regional Hospital Boards is commonly known as the Hospital Building Programme. However in this section it will be referred to as 'The Ten Year Plan'.

3.2.5 The method currently in use for the management of capital investment is known as 'Control by Starts'. It depends on the regulation of the annual input of capital resources into the Health and Welfare Service. Essentially two types of quarterly return are made. Those which give details of the progress of a project in terms of stages laid down in the Hospital Building Procedure Notes, and those containing details of expenditure. Returns for expenditure fall into two categories, namely those for projects before on-site work commences, and those for projects under construction.

3.2.6 In order to aid Boards in setting up their Ten Year Plans, the Department offers a 'Procedure for Forecasting the Out-turn of Expenditure on Capital Schemes'. Its effectiveness rests on the ability to gather and process information from schemes in progress, so as to provide optimum statistical data on Health and Welfare Building. The source of the data is the returns made under the Control by Starts procedure, and this information can be processed to provide the statistical data required by the Hospital Building Programme.

3.3 RESEARCH AND DEVELOPMENT

3.3.1 The Department is constantly reviewing all areas of the Hospital Building Programme, with a view to carrying out further research studies.

3.3.2 Aspects such as deployment of nurses, progressive patient care, cost of food, etc., affect the actual Hospital Building Programme in so far as they dictate the policy under which a hospital is to be built. Thus they comprise a Hospital Policy Development System.

3.3.3 Some of the other areas under review and available to Regional Hospital Boards are equipment, a compendium of components, management systems and standard departments. Finally, there is the CUBITH System, which will be discussed in some detail in Paragraph 3.4. The following paragraphs touch on the other areas mentioned above.

3.3.4 The Equipment System

A more rational approach to the supply of equipment is being achieved through the Equipment System. This has recently been established on ADP equipment by Supplies Department and is available for use by Regional Hospital Boards.

3.3.5 The Compendium

The range of building and engineering components, which use the national system of preferred dimensions in the sphere of hospital design, is known as the Compendium. Limited ranges of doors, storage units, window assemblies, partitions, etc., are provided, thus reducing design time and cost, the latter due to the favourable terms which have been negotiated with manufacturers.

3.3.6 Management Systems

Manufacturers in the Compendium, whose components are compatible, are linked together by what are known as Management Systems. Currently three such systems have been defined and are available to the designer as an aid to component selection.

3.3.7 Standard Departments

Development work is in progress on the design of Standard Departments. The aim is to use these as units to build up a whole hospital. One such unit, the main services ring, is of particular interest, because its name 'Harness' has been adopted as the name of the whole development project on Standard Departments.

3.4 THE CUBITH SYSTEM

3.4.1 The CUBITH System comes within the sphere of Research and Development and is under the direction of a group of architects at the Department of Health and Social Security. Taken in its total context, it embraces or impinges upon much of the work described in this section, and is the progenitor of the Compendium and the Management Systems. The following paragraphs will illustrate its impact on and relationship with the other systems.

3.4.2 The main objective of the CUBITH System is to ensure that optimum design and construction techniques are applied to future Health and Welfare building, within an environment of controlled cost and timescale. In many areas, once basic decisions on cost, function and policy have been made, there is much scope for automating procedures which are at the moment time consuming and costly. Also, many day to day decisions can be assisted by setting up a Management Information System, which will reduce the choice to one dependant on experience and evaluation of existing schemes.

3.4.3 To achieve its objective, the CUBITH System relies on a combination of existing skills and expertise, in the form of readily accessible data designed to aid decision making. In fact, the assembly of the Compendium and the organisation of the Management Systems, are basic to the fundamental conception of CUBITH and have already been implemented by the Cubith Group of Architects. Also, during the past year, they have assembled much detailed information, aimed at providing the basis of a Management Information System. In addition, there has been considerable progress towards providing pre-packaged designs, based essentially on the equipment and services required to perform one simple function within the Health and Welfare Service. These units are designed to allow flexible use within each project, yet provide the designer with information in such a form that much routine work using traditional methods is by-passed.

3.4.4 Because CUBITH is a comprehensive system for building, it is possible to apply it to the Harness schemes, and this is currently being done. Thus the material required to set up the pre-packaged design units is being supplied by actual projects. Also, since CUBITH requires the widest possible use of pre-packaged material, it embraces the Standard Departments designed for the Harness projects.

3.4.5 The Ten Year Plan provides the basic definition of a project requirement, which is the first point at which the CUBITH System can be applied to a project. Any modification to the Ten Year Plan must affect the functions and phasing of buildings in the pre-brief stage.

3.4.6 The administrative procedure for controlling the management of capital investment using the Control by Starts method is well established. The organisation of the stages of CUBITH is not traditional and does not coincide with that used in Control by Starts and set out in CAPRICODE. It is stressed that this situation must be rationalised, since there is clearly an interface between the two systems, returns on investment of capital in CUBITH schemes being required quarterly for the purpose of Control by Starts.

3.4.7 To fully implement the CUBITH System, much statistical information is required for a Common Data Base, to enable decisions to be taken based on the optimization of available expertise. The generation of this data will be in association with those systems already in use, such as systems devised by Regional Hospital Boards for forecasting the out-turn of expenditure on capital schemes.

3.4.8 It will be seen from the later sections of this report, that the CUBITH System is intimately concerned with the provision of equipment for hospitals, from the earliest planning stages to its positioning in the commissioned hospital. Thus, interfacing between the Equipment System implemented by Supplies Department and the Cubith Equipment System, is essential.

3.4.9 By its very nature, the Compendium forms a vital source of data for the CUBITH System. Since it is already a working document, it represents one of CUBITH's most valuable current assets.

3.4.10 The Management Systems represent a refinement of the conception of industrialised building, which is an inherent part of CUBITH.

3.4.11 There are other such sub-systems within the CUBITH System; for example, Cubith Activity Data, Cubith Cost Control, etc. These are discussed in more detail in Sections 4 and 5.

3.4.12 Figure 3A summarises the relationships between aspects of the Hospital Building Programme discussed in this section.

RELATIONSHIP BETWEEN CONSTITUENT SYSTEMS DISCUSSED IN SECTION 3

Note. Projects controlled by systems other than CUBITH and Harness are not represented.

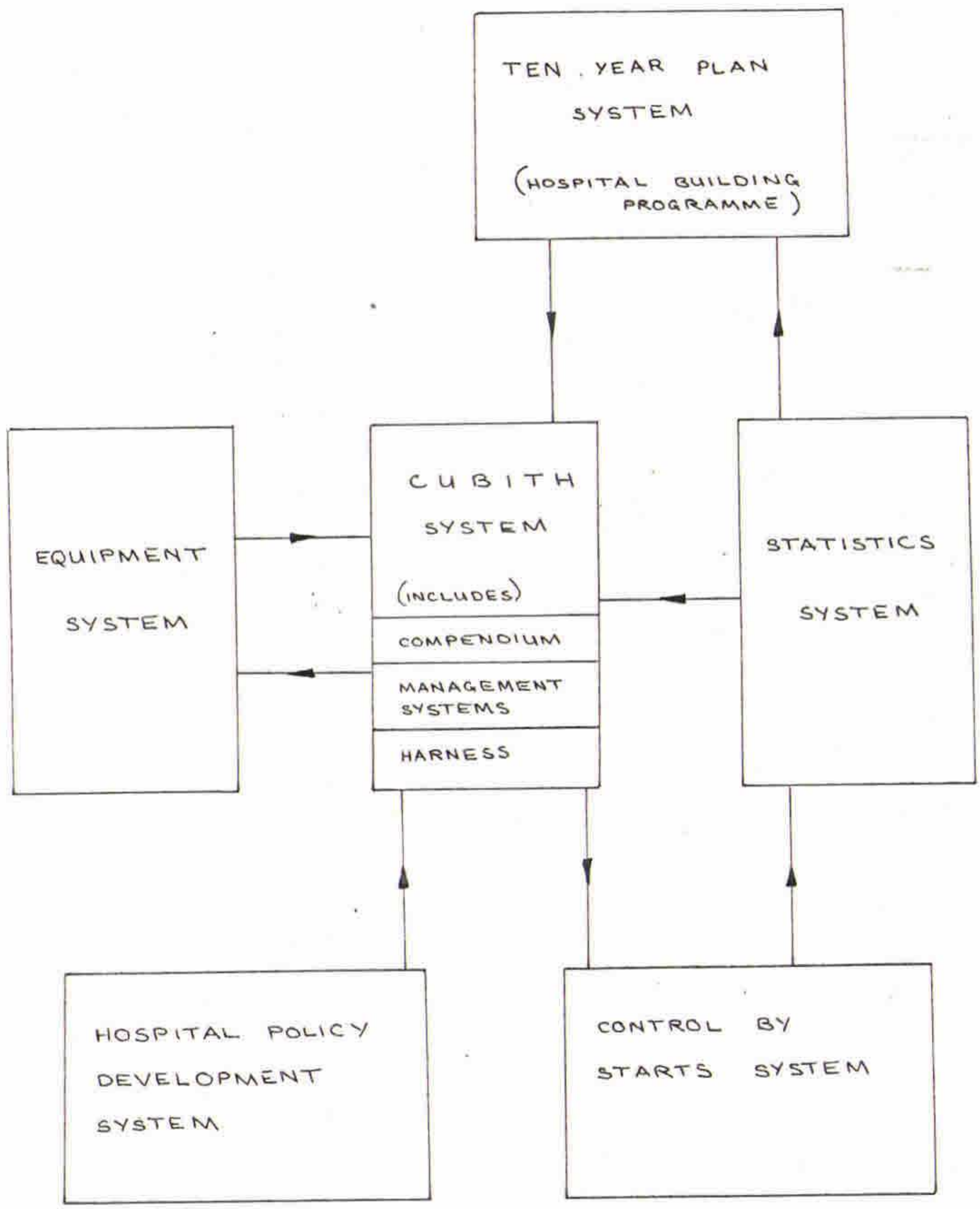

FIGURE 3A

SECTION 4 THE OVERALL CUBITH SYSTEM

SECTION 4 THE OVERALL CUBITH SYSTEM

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THE OVERALL CUBITH SYSTEM

FIGURE 4A

4.1 DEVELOPMENT OF THE SYSTEM

4.1.1 A considerable degree of analysis has already been carried out on the CUBITH System as a whole, and in certain areas ideas are fairly clear and procedures fairly well defined.

4.1.2 It is stressed that much more study in depth, on the user aspect of the system, is required.

4.1.3 The authors of this report are of the opinion that practical experience gained over the next few years, as pilot schemes are put into operation, will be invaluable in the development of the systems design. To be too firm, at this stage, about the final structure of the system, would discourage further development.

4.2 OBJECTIVES OF THE CUBITH SYSTEM

4.2.1 The main objective of the CUBITH System is to ensure the application of optimum design and construction techniques to Health and Welfare building within an environment of controlled cost and timescale.

4.2.2 This can only be achieved by the application of standardised techniques, through the gathering together of existing skills and expertise and the provision of easy access to this data to aid decision making.

4.2.3 Once basic decisions on cost, function and policy have been taken, there are many areas in which there is considerable scope for the automation of procedures which are at present time consuming and expensive. Many day to day decisions can be assisted by setting up a Management Information System which will evaluate the possible choices according to set rules laid down in the light of experience and previous schemes.

4.3 PRESENT STRUCTURE OF CUBITH SUB-SYSTEMS

4.3.1 It is customary to divide any Health and Welfare building scheme into six separate sub-systems. These have been defined in many other documents, but nevertheless it will be helpful to redefine them here.

4.3.2 The six sub-systems are as follows:

(i) Brief

(ii) Design

(iii) Production Documentation

(iv) Construction

(v) Commissioning

(vi) Evaluation and Maintenance.

The following paragraphs will describe each sub-system in turn.

4.4 BRIEF SUB-SYSTEM

4.4.1 The objectives of this sub-system is to draw up a specification for Health and Welfare buildings on a particular site in such a way that all the functional requirements are met and the capital and revenue cost consequences are within the Programme limitations.

4.4.2 This specification must be set out in terms suitable for direct conversion to a complete design.

4.5 DESIGN SUB-SYSTEM

4.5.1 The objective of this sub-system is to precisely define the physical shape, type of construction, and content of the actual project.

4.5.2 The advances in industrial building technology in recent years have led to preferred dimensions for Health buildings being laid down in British Standards. These will give, for example, a range of standardised floor-to-ceiling heights from which the most appropriate can be chosen. From a knowledge of the functional content of the building, the most suitable type of structure, room sizes, etc. can be selected.

4.5.3 A hospital designed under the CUBITH System uses the preferred dimensions most suitable to its own particular functional content. However, these techniques have been carried further in CUBITH by detailing a number of Management Systems, which greatly simplify the selection of building and engineering components.

4.5.4 Each Management System is a self-contained set of compatible components. Thus, if a Management System is chosen, the designer will know that all the doors, windows, junctions, etc. specified are co-ordinated to form a complete building, or section of a building. The designer thus chooses the Management System most appropriate to the particular project and is saved the tedious work of checking the interfacing of all the various engineering and building components required.

4.5.5 The designer also has, readily available, information on each component, including its performance, cost, availability, supply and fixing arrangements. This method also has the advantage that the user is selecting from known products and a predicted demand can be placed on industry. The aim is that, when a Management System is used, by the completion of the Design sub-system, a final selection of all the components will have been made.

4.5.6 As each component is evaluated and selected, the drawings are coded; thus, in the final stages of the Design sub-system, schedules can be prepared for cost-checking and further developed into a tender document. Producing a tender document at this stage has the advantage that industry can participate more fully in later operations. For example, suppliers can have early warning of future requirements. If a main contractor can be selected here, his skill and expertise are available to the design team, and work plans, etc. can be designed which are compatible with his own system.

4.6 PRODUCTION DOCUMENTATION SUB-SYSTEM

4.6.1 This sub-system is concerned solely with the processing of decisions which have been made in the Design sub-system, in order to form a basis for tender documentation and the provision of information necessary for building construction.

4.6.2 It is important to note that here there is a departure from traditional practice, where at this stage much time would still be spent on gathering information from the client.

4.6.3 The tasks in this sub-system commence when the detailed design and cost data have been prepared and established. The whole purpose of the Production Documentation is to take account of the way in which a general contractor and sub-contractor carry out their various operations.

4.6.4 Documentation is provided for each party involved in the industrial processing, describing his part of the work in clear and simple terms. The information is divided into packages of manageable size, in such a way that all relevant personnel can be provided at any particular time with the data they need in the correct form. Thus the need to extract particular information from the total data is removed, resulting in reduced management content and avoiding wasteful transcription by the various parties.

4.6.5 These packages of data observe certain conventions, such as in the setting out of graphic material (e.g. common plan levels for building and engineering data) and the use of pre-packaged constructional elements (components, assemblies and junctions).

4.6.6 These packages are complemented by written documentation which is suitable for tender purposes but can later be used as a basis for further project management.

4.6.7 The conventions outlined in this sub-system enable standard solutions to be applied to recurring building and engineering problems.

4.7 CONSTRUCTION SUB-SYSTEM

4.7.1 The tasks to be carried out in this sub-system are based on the need to economise on-site labour, a factor of prime importance throughout the CUBITH System.

4.7.2 This is achieved by using selected ranges of components (both supplied and supplied-and-fixed), assemblies of building and building/engineering components, and equipment. These would be accompanied by their associated and inter-related assembly and junction details, together with term contract agreements establishing, between those involved on the site, the conditions of supply, and requirements of on-site attendance. Each such range would form a complete Management System as described in paragraph 4.5.4.

4.7.3 The increased use of pre-packaged, composite components represents a departure from the traditional labour-intensive methods. This has resulted in the need for the main contractor to reinforce his role as co-ordinator and manager. This is particularly apparent in the CUBITH System, where the sub-contracted work can be as much as sixty to eighty per cent of the total contract, due to the high degree of plant usage and the sub-letting by the contractor of some site operations.

4.7.4 It is envisaged that in some projects a contractor may devote his entire resources to the management of sub-contractors. Whilst CUBITH sets out to rationalise site procedures and aid management, it cannot substitute for the contractor's responsibilities, since the work plan produced will not necessarily suit his own particular management system. Thus methods to be applied on the site could also be affected. Hence, if the main contractor can be brought in at an early stage, his ideas can be incorporated prior to the commencement of on-site working.

4.7.5 The value of standard systems can clearly be seen at this stage. The particular data needed for any series of site operations is readily available, together with any supplementary details which may be required. This data then becomes directly accessible to each sub-contractor, who can process it within his own system to give him information on plant utilisation, labour and material requirements, availability, ordering, cost control, etc.

4.7.6 It can be seen that the tasks in this sub-system fall into two main sections; those performed prior to the actual construction, and the construction itself which is the responsibility of the main contractor.

4.8 COMMISSIONING SUB-SYSTEM

4.8.1 This sub-system utilises the data prepared in the Brief and Design Sub-systems. The tasks to be performed relate to equipping and staffing, setting up building and engineering maintenance procedures, and public relations.

4.8.2 Standard information on these subjects is available as soon as the actual construction commences, and as the work progresses, the commissioning procedures, timed to the construction timetable, are put in hand. They involve the recruiting and training of staff, the ordering, delivering and positioning of equipment, the production of operational, maintenance and staff job manuals, the dissemination of publicity material, and general liaison.

4.9 EVALUATION AND MAINTENANCE SUB-SYSTEM

4.9.1 This sub-system has not been studied in detail by the authors of this report, and although it is an essential element, it requires further study in depth before a valid appraisal can be written.

4.9.2 By devising procedures related to the current operational systems, it is possible to simplify evaluation and subsequent feedback of information. This feedback results in an improved management information system, which is available to all projects, and aids the amendment of the common data base.

4.9.3 Evaluation within the CUBITH System is directly related to the original requirement, determined for the particular project. For example, activity policies on how the building is used can be compared with those proposed, and the fabric can be related to the actual performance.

4.10 PROCEDURAL SUB-SYSTEMS

4.10.1 The six currently accepted CUBITH sub-systems described above are mainly time oriented. They may be referred to by name, but in this report the System will be considered as a continuous whole from which groups of related tasks or procedures can be selected for discussion in turn. For example, the procedures dealing with the requirements, ordering, installation and evaluation of equipment cut across the six CUBITH sub-systems and can be said to form a sub-system on their own. These sub-systems, summarised in paragraph 4.14 and described in detail in Section 5, will be referred to in this report as Procedural Sub-systems.

4.10.2 It is most important to recognise that very few of the Procedural Sub-systems are self-contained and each should be developed within the framework of the total system. This report will attempt to give guidance on the relationship between the sub-systems, but further studies may show other relationships or other sub-systems.

4.11 COMMON DATA BASE

4.11.1 The CUBITH System is based on the ready access to data for control and decision making. It is therefore most important that sufficient thought is given to the task of setting up a common data base.

4.11.2 In Sections 6 and 7, guidance is given on this area of work, but at this stage, until further experience of practical applications has been gained, there is little point in defining a firm system. Thus only very generalised rules have been given, and it is most important to ensure that any data base should be capable of change and growth as the system develops.

4.11.3 Since the data base is intended to inter-relate all data, some of which would be highly confidential, considerable thought should be given to its security aspects. Access to the data should be via security keys, so that suitable control can be exercised.

4.12 PROJECT FILE

4.12.1 As well as a common data base, it is necessary to set up project files for each project. These will contain all relevant data on a project from pre-start. Eventually these files will form historical records for each Health and Welfare building, and will be of use when further schemes or extensions are planned, either to that project or inter-related projects.

4.12.2 The project file will contain reports on evaluation carried out once the building is in use. Thus it will feed back relevant information on usage to the common data base, and so assist, as appropriate, in the revision of standard techniques contained there.

4.12.3 The files will eventually contain details of all existing facilities, and can then be used during briefing as an aid to defining policy and function on new schemes in each area.

4.12.4 When project files are set up it is most important that all these aspects are investigated, since it would be wasteful to set up a file for the period from pre-start to commissioning only.

4.12.5 Normally the project file would be set up using references to the data base for standard data, rather than including full data on all subjects. However, if these files are to be used as historical records, they must take account of the fact that the common data base will change over a period of years, whilst a particular project may lie dormant without change during that time. Thus a system must be designed which avoids the necessity to update all the project files each time the standard data on the data base is changed.

4.13 SYSTEM REQUIREMENTS

4.13.1 The main requirement of the CUBITH System is that information on any aspect of the Hospital Building Programme should be readily and inexpensively available.

4.13.2 Some information will be provided on a routine basis, in the form of reports issued at regular intervals, or on request.

4.13.3 It is also envisaged that the CUBITH System will be able to assist in the decision making process on any project. Thus there must be easy access to all data affecting a decision. This data must be capable of presentation in a form suitable for the person or persons making the decision. Thus the presentation may vary, not only according to the decision to be made, but to the person making it.

4.13.4 Whenever possible, after decisions have been taken, automated procedures should take over to produce final requirements, such as schedules and drawings. In this way the purely manual tasks are minimised, resulting in reduced costs and timescales.

4.13.5 The facility for research and development must also be provided, so that new technologies can be introduced to the system and their application simulated, before they are accepted as principles for future projects.

4.14 SUMMARY OF PROCEDURAL SUB-SYSTEMS

4.14.1 Procedural Sub-systems have already been defined in paragraph 4.10.1. The following paragraphs will summarise the procedural sub-systems to be described in more detail in Section 5. The sub-systems have been named as follows:

(i) The Hospital Building Programme

(ii) Project Team Activities

(iii) Determination of Project Requirements

(iv) The Development Control Plan

(v) Activity Data

(vi) Equipment

(vii) Staffing

(viii) Cost Analysis

(ix) Design Development

(x) Production Drawings

(xi) Engineering

(xii) Scheduling and Component Selection

(xiii) Tender Action and Contracts

4.14.1 Cont'd (xiv) Construction

(xv) Services to the Construction Industry

(xvi) Maintenance Documentation

(xvii) Commissioning Team Activities

(xviii) Data Base Management

(xix) Project File

(xx) The On-Line Enquiry System

4.15 THE HOSPITAL BUILDING PROGRAMME

4.15.1 The Hospital Building Programme lays down the timescale and expenditure that is to govern the production of Health and Welfare buildings. The Programme covers a ten year period, and shows the expenditure for each project that is to start within this period.

4.15.2 The Programme also attempts to define the facilities required and policies to be followed, but only in the broadest terms, since requirements and policies may change over the ten year period. Naturally, expenditure becomes more precise and policies more clearly defined as the project start approaches.

4.15.3 Once a project has commenced, it must be phased so that expenditure during development and construction conforms to that laid down in the Hospital Building Programme for that project. The CUBITH System will be required to monitor this aspect.

4.16 PROJECT TEAM ACTIVITIES

4.16.1 The Project Team is responsible for ensuring the optimum use of funds and resources and that the finished project meets all requirements possible within the limits of existing technology, cost (both capital and revenue) and timescale.

4.16.2 The size of the project team will vary with the size of the project. A large team could include

Medical Officer

Architect

Engineer

Nursing Officer

Quantity Surveyor

Administration Officer

(Other Specialists could be co-opted as required).

It is possible for one project team to control several small projects simultaneously.

4.16.3 In addition to their overall responsibility, the project team must produce a management control plan for the project as a whole. This would include management networks for each phase on a multi-phase project. They must also write a project report, so that work can be reviewed in retrospect.

4.17 DETERMINATION OF PROJECT REQUIREMENTS

4.17.1 It is necessary for the project team to evaluate the needs of an area, so that the project can be correctly phased to take account of changes in local facilities and requirements. To enable them to do this, data on existing facilities, closures, etc. must be available to the system. In addition, details of changes in Government policy, the setting up of new towns, airports or motorways, must be made available to the project team, as these may cut across the present regional board areas. Details of facilities offered by surrounding boards may also be required.

4.17.2 The type of information just described may have to be obtained from other Government Departments, and it will be necessary to carry out further studies on the problem of interface with other systems which are outside the scope of this report.

4.17.3 Broad decisions on phasing form a basis for staff requirements and revenue estimates, and also give a guide to equipment expenditure phasing. For example, if a department requiring very expensive equipment is to be included in the first phase of a project, care must be taken to control expenditure, so that sufficient sums are available to adequately equip later phases. The information on staff requirements will form a basis for staff recruiting and re-training programmes.

4.18 THE DEVELOPMENT CONTROL PLAN

4.18.1 During the early stages of a project, a Development Control Plan is produced, and this, together with the production of its documentation, forms a system in its own right.

4.18.2 Production of the Development Control Plan is the first design activity to be carried out by the project team. The purpose of the plan is to determine the disposition of the required facilities on the selected site, to achieve a correct relationship between the two, both spatially and with regard to project phasing. It must also provide the means of assessing realistic overall capital costs for the project as a whole.

4.19 ACTIVITY DATA

4.19.1 The concept of activity data is now well defined, and the use, evaluation and updating of this data forms a system in its own right.

4.19.2 Fundamentally, activity data, comprising both alphanumeric and graphic information provides the project teams with pre-prepared planning data. This enables them to carry out systematic and rapid selection of standard sets of area layouts together with recommended environmental policies and equipment requirements, which when grouped together will fulfil particular demands for health services on a specific site.

4.19.3 Although the data is first used by the project team during briefing, it will be used throughout the system as a basis of design requirements, as a cross check on costs, to assist in the preparation of production drawings and master schedules at the pre-tender stage, and to revise and confirm equipment schedules during the commissioning phase.

4.19.4 It is envisaged that standard layouts could also be of assistance at the time of installing the pieces of equipment, although groups of standard activity data will have been drawn together by then, with possible modifications to form area layouts for each particular project.

4.19.5 Although activity data can be selected at a very low level, such as room data sheets, it must be remembered that the system is structured in such a way that, should a standard department or even a whole hospital be required, these too can be selected very simply using the same system.

4.20 EQUIPMENT

4.20.1 The broad phasing of a project will give a rough guide to equipment requirements and expenditure, but it is not until this is related to selected activity data that reasonably accurate costed schedules of equipment can be obtained.

4.20.2 Activity data will give equipment requirements in relation to broad performance specification, but these will have to be related to lists of approved costed equipment before it is possible to make a final selection of the exact equipment to be installed.

4.20.3 These preliminary decisions are made during briefing to ensure that the equipment meets the overall requirements of function and cost. However, during the design phase the exact selection could be modified to suit design requirements, more usually a compromise is made.

4.20.4 During the production drawings phase, the exact requirements are related to recommended manufacturer's equipment and a final selection made. Just before the building is put to tender, the lists of equipment are checked and updated with respect to developments during the course of the project.

4.20.5 During the construction of the building, a phased delivery plan is set up and orders for equipment are placed with suppliers. This is a function of the commissioning sub-system. As the building approaches completion, equipment is delivered, tested and installed. Costs are calculated and inventory lists are produced.

4.21 STAFFING

4.21.1 As each project is phased at the onset, broad staffing requirements are laid down during briefing. However, it is the responsibility of the commissioning team to establish the staff recruiting plan, including the retraining of existing staff, if appropriate.

4.21.2 It is also necessary to produce staff job specification manuals and ensure that the building is adequately staffed with the appropriate personnel before it becomes operational. The provision of a personnel record system could form part of this sub-system, and it may be necessary to relate this to the standard Department of Health and Social Security salary and staff grading procedures.

4.22 COST ANALYSIS

4.22.1 Full facilities must be provided for cost analysis at all stages in the system.

4.22.2 Some cost reports can be produced at specified stages and in pre-determined formats. For example, at the end of briefing, phased equipment costs should be fairly well established, as should capital and revenue costs for the project as a whole, and so reports can be produced.

4.22.3 One of the first requirements of the Design sub-system is to set up a project cost control plan and a system of cost checks for each project. Routine cost checks continue until tender action and must interface with the contractor's cost checking system.

4.22.4 Provision must be made for cost analysis on past projects, to assist in retrospective project evaluation related to cost.

4.22.5 Enquiries on cost may be made at any point in the project. These may take any form, and it is therefore important to ensure that cost data is easily accessible to the users of the management information system and is capable of presentation in a form suitable for each specific enquiry. Not only will information be required about actual costs to date, but it may be necessary to simulate alternative strategies on a cost basis to assist in management decisions.

4.23 DESIGN DEVELOPMENT

4.23.1 Towards the end of Briefing, selected sets of room data will provisionally have been collected within an overall site layout plan to form a viable scheme. At the start of the design phase, these will be developed further to form a 1/200 design layout plan for the project. This plan forms the basis for all design drawings and documentation, and from it the site layout, services layouts, and structural grid can be further developed.

4.23.2 Once the overall design has been established, 1/50 drawings can be produced, showing project room layouts. A design for the site services layout can be drawn up, and a structural system can be selected and further developed. A complete set up of 1/200 drawings can be produced, showing plans, sections and elevations. If applicable, a management system can be selected.

4.23.3 The term 'management system' is applied in this context to a particular grouping of component manufacturers whose products are thus grouped together to form a practical system. The advantage of selecting a management system at this stage is that the work of the project team is reduced by making it possible for certain design and constructional decisions to be short circuited and taken automatically. If a management system is used, it is possible to predict its resulting design, cost and constructional consequences.

4.23.4 Design documentation will contain many of the drawings referred to above, together with design stage schedules, and these form a basis for production drawings and master schedules.

4.23.5 It must be remembered that on a large scheme, several people or even different firms may be working in the same area. Care must therefore be taken to ensure that a comprehensive feedback system is designed, so that all decisions affecting other members of the design team are circulated as soon as possible.

4.24 PRODUCTION DRAWINGS

4.24.1 Although the CUBITH System regards the preparation of production drawings as a separate system, it does in fact continue automatically from the designers' work. The additional drawings produced at this stage are 1/100 project and design drawings, 1/50 and 1/20 engineering drawings, key base and location drawings, and junction details.

4.24.2 As with design documentation, several different disciplines may be working in the same area. Thus, a comprehensive feedback/information system must be set up to ensure that all modifications are appropriately fed back to those concerned.

4.24.3 Once production drawings are available, they form part of the tender documentation.

4.25 ENGINEERING

4.25.1 Engineering design and production drawings are really a sub-set of the constructional design and production drawing system, but show engineering services systems in more detail and how these relate to the layout of the project as a whole.

4.25.2 Details of services available near the site are included in the development control data. At the beginning of the design phase, the basic development control documentation is further developed to give 1/500 site layout plan showing services. When the structural system is established, a full engineering services layout is produced, and this is further developed on larger scales in the design phase. During the production phase, more detailed engineering drawings are produced on a 1/100, 1/50 and 1/20 scale, and engineering schedules are produced.

4.25.3 At the start of the construction sub-system, engineering work is submitted to tender in parallel with the main tender. However, engineering sub-contractors are appointed before the main tender documents are finished, and hence the sub-contracted engineering systems documents together with the names of the sub-contractors appointed, form part of the main tender documentation.

4.25.4 During construction, the engineers must work under the management of the main contractor.

4.25.5 During commissioning, engineering systems must be checked and retested as equipment is installed. Maintenance manuals must be prepared for future engineering maintenance, once the building is operational.

4.26 SCHEDULING AND COMPONENT SELECTION

4.26.1 Towards the end of the design sub-system, design stage schedules are produced, items included in selected (and possibly amended) room data sheets are checked against lists of recommended suppliers components, and a final choice is made according to requirements.

4.26.2 At this stage, lists of requirements can be sent to appropriate manufacturers, to give advance notification of quantities and delivery dates. If possible, these 'lists' should be presented in a form suitable for direct use by the selected manufacturers.

4.26.3 Once all production drawings are completed, master schedules can be produced. These form a basis for the various sortitions of bills of quantities and give prime costs for the tender documentation.

4.26.4 Material selection, ordering, purchase, delivery and site inventory systems, are all part of the scheduling system, together with stores issue. Information must be presented in a form suitable for each user requirement and should be compatible with contractors' and sub-contractors' own systems for stores purchase, cost control, etc.

4.26.5 There must also be provision for evaluation of manufacturers' components during use and this will be used in the assessment of manufacturers' components, together with recommendations for use and maintenance.

4.26.6 Much more study is required into the whole area of contractors' and sub-contractors' use of the information provided, before the system can be fully developed.

4.27 TENDER ACTION AND CONTRACTS

4.27.1 The whole area of tender action is not yet clearly defined, and more liaison is required with contractors and sub-contractors, before the system can be detailed. The contract system also needs further study.

4.28 CONSTRUCTION

4.28.1 It should be possible to lay down rules for the evaluation of contractors' work, especially in relation to the reports required during the building phase of a project. Time analysis, resource analysis and cost analysis will be required in various forms.

4.28.2 More detailed discussions with the contractors are required before rules can be laid down. This area will have to be carefully interfaced with the scheduling system and the tender action and contracts system.

4.29 SERVICES TO THE CONSTRUCTION INDUSTRY

4.29.1 It is envisaged that the output of the CUBITH System will be of great value to the construction industry in general, and especially to commissionees of the Hospital Building Programme.

4.29.2 The data available could be used in training and also in 'management games' type simulations. This would improve design technique and allow commissionees to gain experience of the system without actually erecting a building.

4.29.3 This facet of the system has tremendous potential if exploited fully.

4.30 MAINTENANCE DOCUMENTATION

4.30.1 During the construction phase, feedback on actual building techniques, materials and components, will be used to form the basis of a manual for use by maintenance teams.

4.30.2 Maintenance will probably start before the official opening. Broad revenue figures will have been agreed during the briefing phase, and the maintenance manual should contain details of cost maintenance, which could be cross checked with total revenue figures.

4.31 COMMISSIONING TEAM ACTIVITIES

4.31.1 The task of the commissioning team is to ensure that the project development phase is brought to a successful conclusion and that the building is opened on time and functions according to specification.

4.31.2 The commissioning team is also responsible for the staff recruitment plan and the provision of adequate staff, the installation of equipment, (including any checks which are to be made before equipment may be said to be operational), advance publicity, if required, and the official opening ceremony. They must also ensure that the change over period, from development to operational working, is as smooth as possible.

4.32 DATA BASE MANAGEMENT

4.32.1 The maintenance, updating and revision of the common data base, forms a system in its own right. More details are given in Sections 5, 6 and 7 of this report.

4.33 PROJECT FILE

4.33.1 The maintenance and updating of project files forms a system in its own right.

4.34 ON-LINE ENQUIRY SYSTEM

4.34.1 During the full operation of the CUBITH System, it is envisaged that an on-line enquiry system will be provided for project teams, regional hospital boards, designers, engineers, contractors, sub-contractors, main suppliers, etc.

4.34.2 This system will need further study in depth before it can be fully defined.

SECTION 5 PROCEDURAL SUB-SYSTEMS

SECTION 5 PROCEDURAL SUB-SYSTEMS

INDEX

5.1 INTRODUCTION

5.1.1 The purpose of this section is to discuss in detail the function and requirements of each of the Procedural Sub-systems which were described briefly in Section 4.

5.1.2 Each sub-system is illustrated by a set of diagrams.

The first of each set shows the overall CUBITH System with the tasks comprising the sub-system picked out.

The remaining diagrams illustrate these tasks in more detail.

5.2 THE HOSPITAL BUILDING PROGRAMME

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THE HOSPITAL BUILDING PROGRAMME

FIGURE 5.2A

THE HOSPITAL BUILDING PROGRAMME

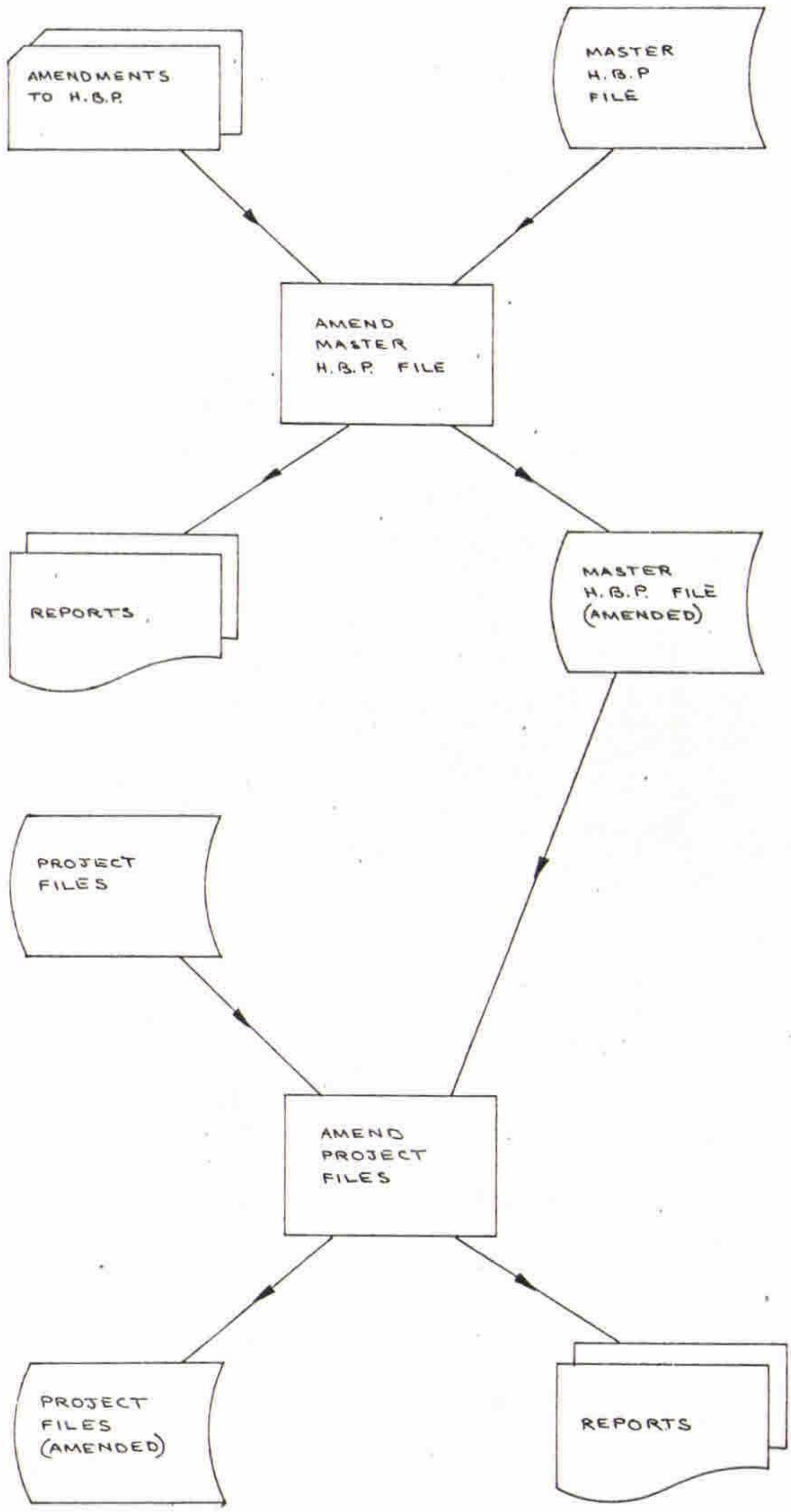


FIGURE 5.2B

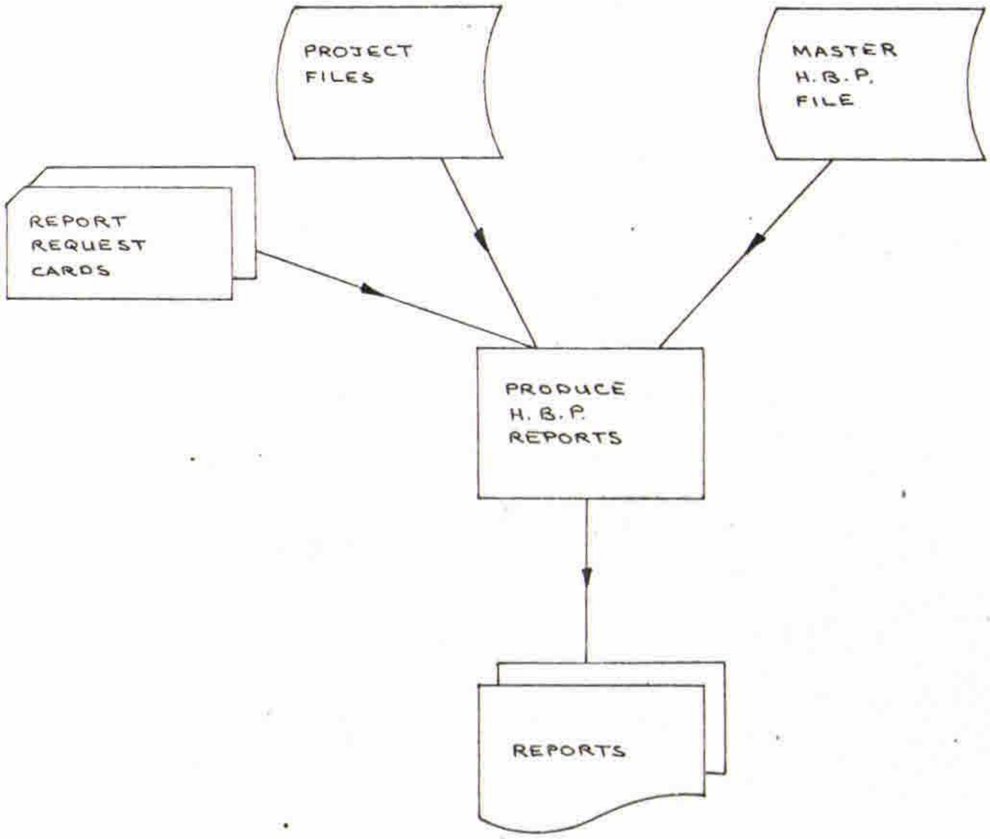

PROJECT
FILES
MASTER
H.B.P.
FILE
REPORT
REQUEST
CARDS
PRODUCE
H.B.P.
REPORTS
REPORTS

FIGURE 5.2C

5.2.1 The Hospital Building Programme constitutes information that is essential to the CUBITH System, since it gives details of time-scale and capital allocation for projects whose commencement is planned in the next ten year period. Thus it represents the point in the system at which each project starts.

5.2.2 For years subsequent to the first three of the ten year period, the Programme only gives the expenditure and starting date for each project. For projects planned to commence within the first three years, information regarding function and time-scale is given in increasing detail as the start date approaches.

5.2.3 The Programme is re-issued each year, to allow for an overall re-assessment and to include the plan for a further year. Revisions of the Programme can be issued at any time, and these include all alterations affecting the last seven years of the period, and any re-arrangements for the first three years. These revisions are necessitated by changes in Government policy, resulting in an increase or decrease of the money available to the Hospital Building Programme. Thus some existing schemes may have to be brought forward or re-scheduled, whilst others could be drastically cut or even removed from the Programme altogether. Each change to the Hospital Building Programme will affect some of the Project Files.

5.2.4 The Hospital Building Programme will provide information to assist in the selection of the Project Teams, since the choice of members will depend upon the type and size of the project. Once the Project Team is set up, the details given in the Hospital Building Programme for a specific project will form the basis of their discussions on functions, cost, phasing, staffing, and revenue. These details will also provide them with a basis for producing management control plans and the development control plan.

5.2.5 As work on each project progresses, actual cost and time-scale must be compared with the Hospital Building Programme, so that an assessment of general progress can be made, and repercussions on other projects monitored. The CUBITH System must allow for the provision of such progress reports, and reporting techniques must be fully defined both at Project and Programme level. The exact content of each report must be fully specified and special attention must be paid to layout. Such details as, when it is to be produced, for whom, number of copies, etc., must be given. Considerable work on this subject has been carried out by fpl. The report on 'Control by Starts', which was issued some eighteen months ago and includes the Hospital Building Programme, gives many of the details required.

5.2.6 The Hospital Building Programme forms part of the Common Data Base of the CUBITH System. The reporting techniques required must be also taken into account when designing the Project Files.

5.3 PROJECT TEAM ACTIVITIES

INDEX

PROJECT TEAM ACTIVITIES

FIGURE 5.3A

5.3.1 It is the responsibility of the Project Team to ensure optimum use of funds and resources on each project, and that the final design meets all requirements possible within the limits of existing technology, cost, (both capital and revenue), and time-scale.

5.3.2 Rules for setting up Project Teams are laid down in the CAPRICODE Manual, Book 1, and some details are quoted here for information.

'Each team should normally consist of Medical Officer, Architect, Engineer, Nursing Officer, Quantity Surveyor and Administrative Officer. Others (who should be nominated by the Planning Group) should be co-opted or consulted as required on particular aspects of the work, particularly finance, equipment, and supplies, catering domestic management and work study.
One member of the team should be regarded as the co-ordinator and be responsible to the Planning Group for securing the progress of the project through each successive stage of the procedure. When private architects, engineers or quantity surveyors are engaged for the design of the buildings, they should be associated with the working of the team from the onset; thus the project team will consist of a core of about seven officers with access to advice from other specialist officers as and when required. The choice of project co-ordinator is important to the smooth running of the project.
The co-ordinator should have no previous commitment to the project and need not be drawn from any particular discipline.
The qualities required are managerial ability experience in all aspects of achievment of capital expenditure programmes and particularly in service requirements and financial resources and an ability to command the confidence of other members of the team, of the Planning Group, and the Board.

5.3.2 cont. It is important that he should be provided with adequate supporting staff and that he should have free access to sources of specialist expertise (e.g. on finance, supplies, management, control planning, contracting procedures) in the Board. Members of project teams have a collective responsibility for ensuring that all relative authorities are consulted and their views taken into account; individual members are responsible for representing the views of all branches of their own professions, they should be selected on the basis of the knowledge, experience and qualifications they bring to the Hospital Planning and Design which is essentially a complex detailed and highly technical operation. It follows that teams should be composed of professional officers in the hospital service. Except perhaps in the case of very large projects, single project team could usually handle more than one project. There is much advantage, for example, in constituting teams to cover all projects in a given area of the region. Each team will have a great deal of detailed planning and design work to do and it will normally be necessary for it to set up sub-groups to assist in the solution of technical issues. These sub-groups invariably include the appropriate professional members of the project team or its nominated advisors and members of the staff of the hospital management committee in his group the project is located'.

5.3.3 Apart from their overall responsibility, the Project Team must produce the management control plan for the project as a whole, which for a multi-phase project will include a management network for each phase. Also a project report must be produced, so that work can be evaluated in retrospect.

5.3.4 It is apparent, from the preceding paragraphs, that the Project Team require full access at all times to all information relating to the project, and their questions may take many various forms. However, some reports may be required after specific tasks in the course of the project, and full details of these could be laid down after further study. The Project Team will also require access to the Common Data Base at all levels, to assist in decision making. When the CUBITH System is fully operational, it is envisaged that, once a Project Team has taken decisions, many of the subsequent tasks could be automated.

5.3.5 A detailed sub-system diagram has not been provided for Project Team Activities. The overall system diagram simply shows the areas where project teams will be expected to make key decisions or checks, although as already indicated, most of the tasks shown on this diagram involve members of the Project Team.

5.4 DETERMINATION OF PROJECT REQUIREMENTS

INDEX

DETERMINATION OF PROJECT REQUIREMENTS

FIGURE 5.4A

DETERMINATION OF PROJECT REQUIREMENTS

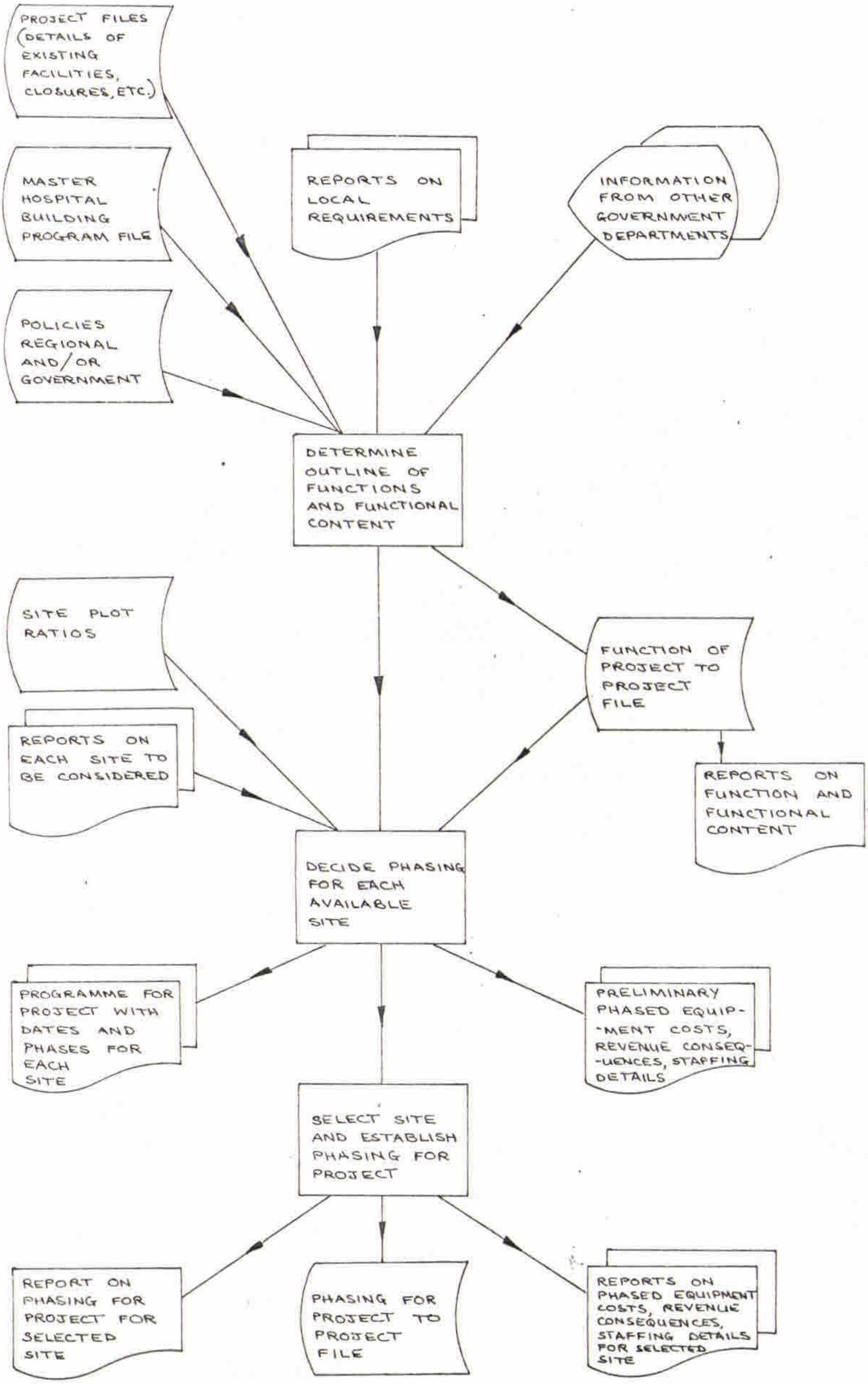


FIGURE 5.4B

5.4.1 One of the first activities of the Project Team is to determine the exact requirements of a project in relation to policy, both governmental and regional, existing facilities, closures, etc. and project phasing.

5.4.2 A general outline of the function of each project will be laid down in the Hospital Building Programme, together with details of total funds allocated and the way these are to be apportioned over the development period.

5.4.3 The definitions and objectives of planning policies are described in detail in Hospital Building Procedure Note 2. In the CUBITH System, these will be incorporated, often implicitly, into the Common Data Base at appropriate levels. To quote from Hospital Building Procedure Note 2, 'Policies are defined as the application of general principles to specific situations, the situation may range from regional decisions on location of hospital, to details of planning of departments at a particular hospital. Policies will thus reflect general planning principles laid down at regional board level and describe their applications in the light of local requirements and limitations bearing upon a specific project. Policies may refer to various aspects of planning, the main division being between operational policies and design policies. The former relates to staffing, organisation and function, while the latter applies to layout, environment and construction. The preliminary objective in formulating a statement of policy is to determine for that project the pattern of organisation and design which will provide optimum service with the available resources of staff and finance.

5.4.3 cont. The secondary objective is to communicate that pattern in terms which will

a) enable the architect and engineer to design an efficient and economical building in which this organisation can function

b) enable staffing requirements and revenue consequences to be assessed

c) permit co-ordination of the functions of individual departments within the hospital and with medical services outside the hospital before the building and engineering content has been finalised.

There are four types of policy statement

a) regional planning principles

b) regional (standard) policies

c) outline project policy

d) detailed project policy'.

All these are detailed more fully in HBPN 2.

5.4.4 Reports on local requirements may also contribute to the determination of planning policies.

5.4.5 Details of existing facilities and closures should be available on historical project files, which will be built up as the CUBITH System progresses, and these will assist in deciding the functions of the project in hand.

5.4.6 The method of determining the functional content is laid down in Hospital Building Procedure Note 3.

In general, the object is to decide

a) what shall be provided

b) when it shall be provided

c) where it shall be provided

5.4.6 cont. The main task of the project team at this stage is to present a statement of the project content, which will enable the architect and the engineer to carry out a feasibility study based on site considerations and general design concept. The medical and nursing members of the project team necessarily play a main part in this, although the team is, of course, collectively responsible for the statement.

5.4.7 Information from other Government departments will be required before a true assessment of function can be made, and for this it will be necessary for the CUBITH System to interface with other Government systems.

5.4.8 One area which will be appreciated immediately is the determination of planning population, and this is detailed in HBPN 3. This includes such topics as catchment area, age and composition of population in the catchment area, and vital statistics such as mortality and birth figures, which may vary considerably between different areas.

5.4.9 Another consideration is population projection. This will take into account population trends, including the assessed effect of both natural and planned migration, such as that from an existing area to a new or expanded town.

5.4.10 Local population drift must also be taken into account. This will include such factors as local variations of demand, due to housing development, transport facilities, seasonal influx at holiday centres, and other hospital development. Details of new towns, airports or motorways to be set up will also have to be obtained from the appropriate government departments.

5.4.11 When all these considerations have been taken into account, a report of functional content can be prepared, along the lines of that given in HBPN 3. Details of functional content for the project can then be noted on the Project File.

5.4.12 Once the functional content has been established, it can be applied to each of the sites under consideration, so that phasing can be determined in relation to site and functional requirements. At this stage, some of the sites may prove unacceptable because the phasing is not in line with functional requirements. For example, if a local maternity hospital is due to close in the very near future but the site selected does not allow the maternity department to be included in the first phase, then the site would not be suitable. The outcome of this task of phasing will be the provision of a programme for the project, with dates and phases for each site. This will be accompanied by provisional phased equipment costs, revenue consequences and staffing details, for possibly more than one site, if the site dictates phasing.

5.4.13 It is the task of the Project Team to select the exact site for the project, with reference to all the preceding considerations, and to firmly establish the phasing for the project. Reports are prepared giving details of the phasing and the project file must be updated with these details. The provisional phased equipment costs, revenue consequences and staffing details are revised and confirmed with respect to details of the site selected.

5.5 THE DEVELOPMENT CONTROL PLAN

INDEX

THE DEVELOPMENT CONTROL PLAN

FIGURE 5.5A

THE DEVELOPMENT CONTROL PLAN

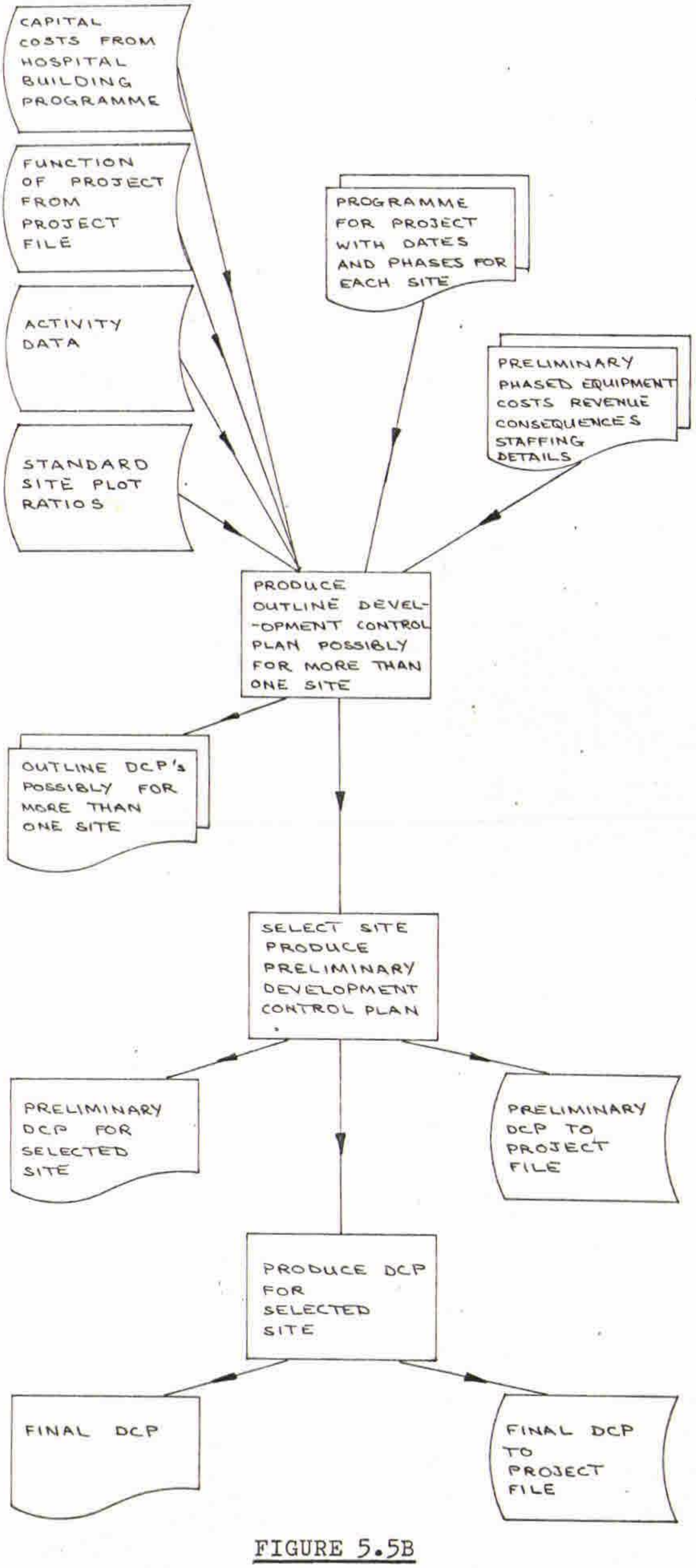


FIGURE 5.5B

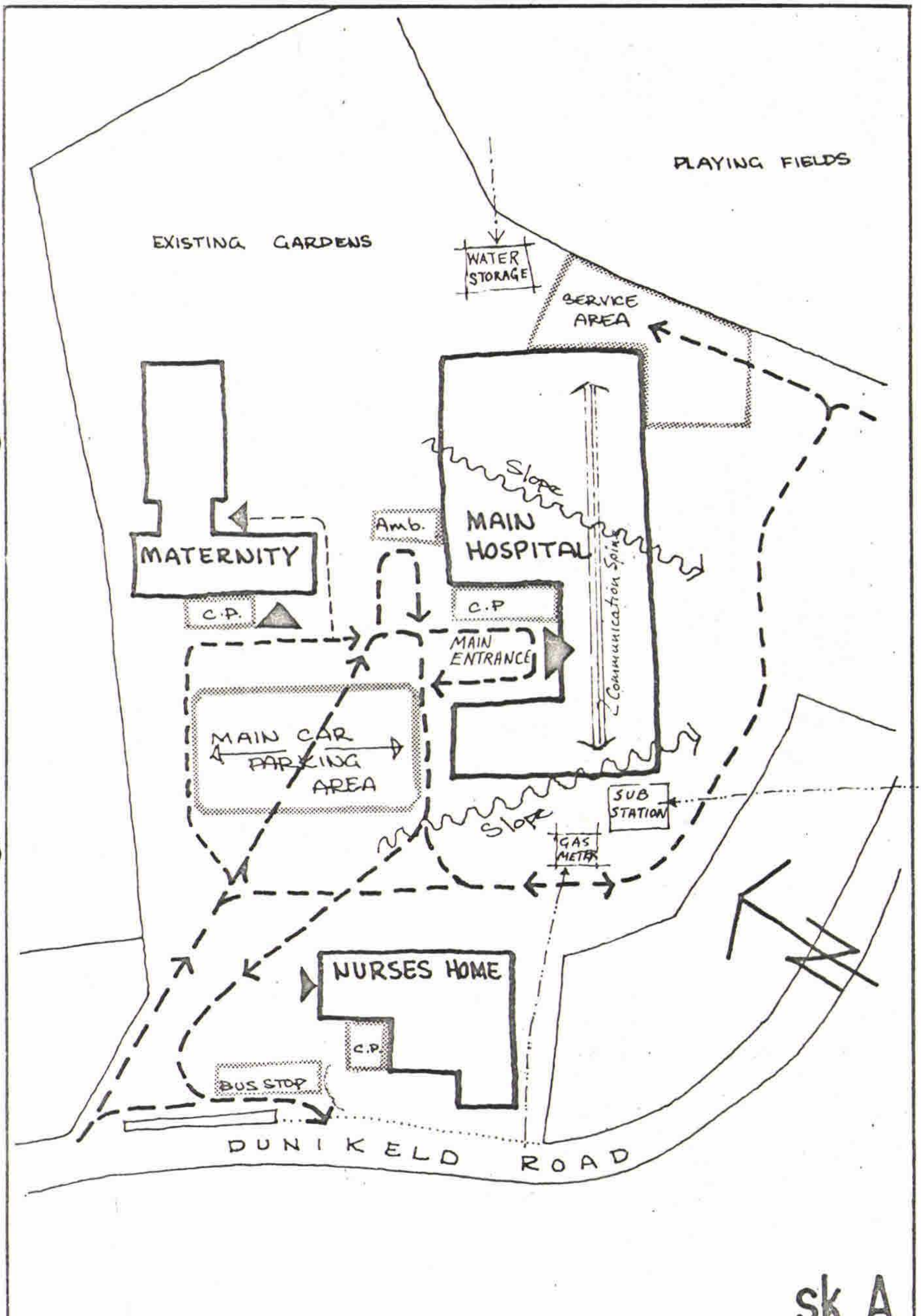

PLAYING FIELDS
EXISTING GARDENS
WATER STORAGE
SERVICE AREA
MATERNITY
Amb.
MAIN HOSPITAL
Slope
Communication Spine
C.P.
C.P
MAIN ENTRANCE
MAIN CAR PARKING AREA
SUB STATION
Slope
GAS METER
NURSES HOME
C.P.
BUS STOP
DUNIKELD ROAD
N
sk.A

FIGURE 5.5C

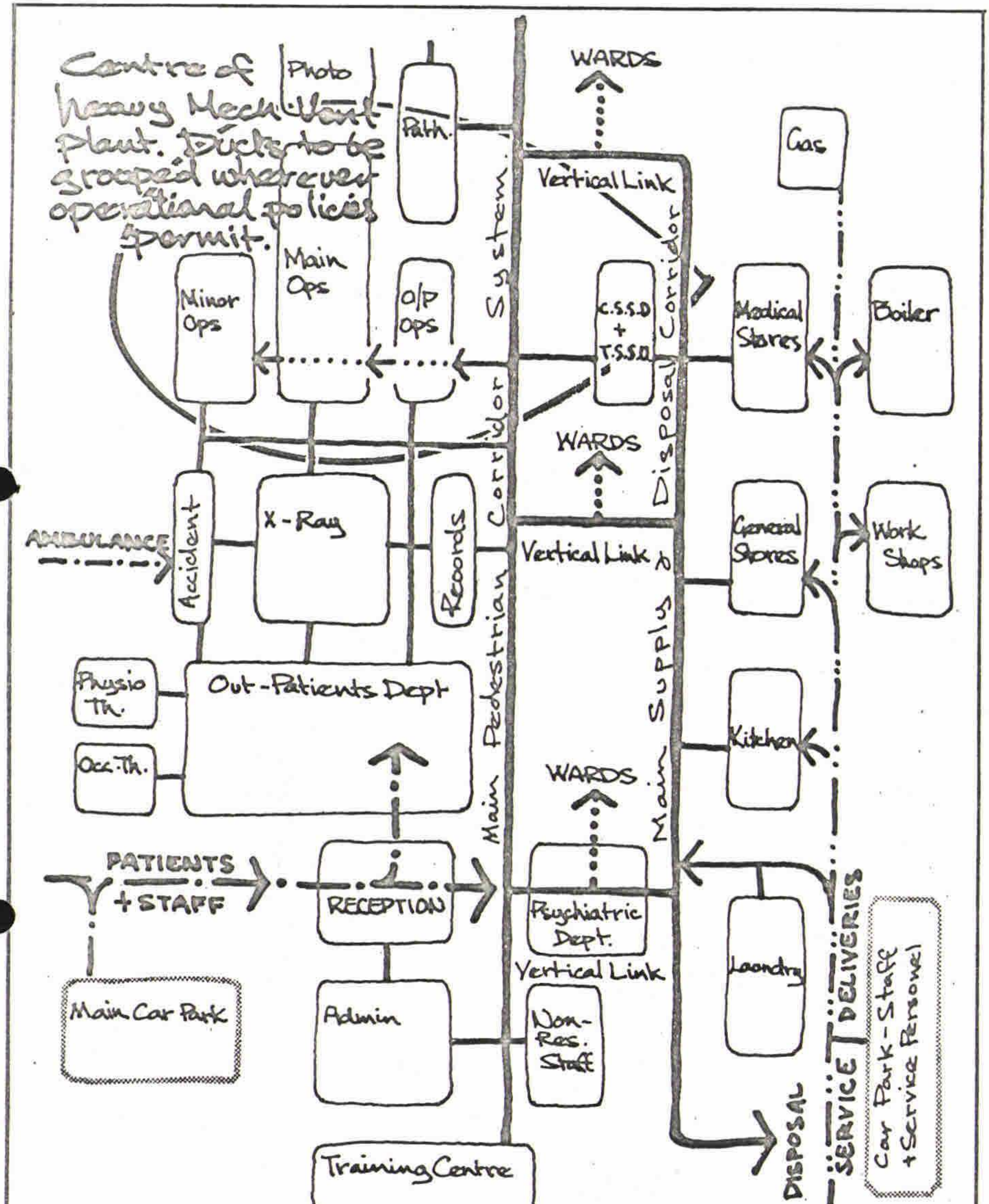
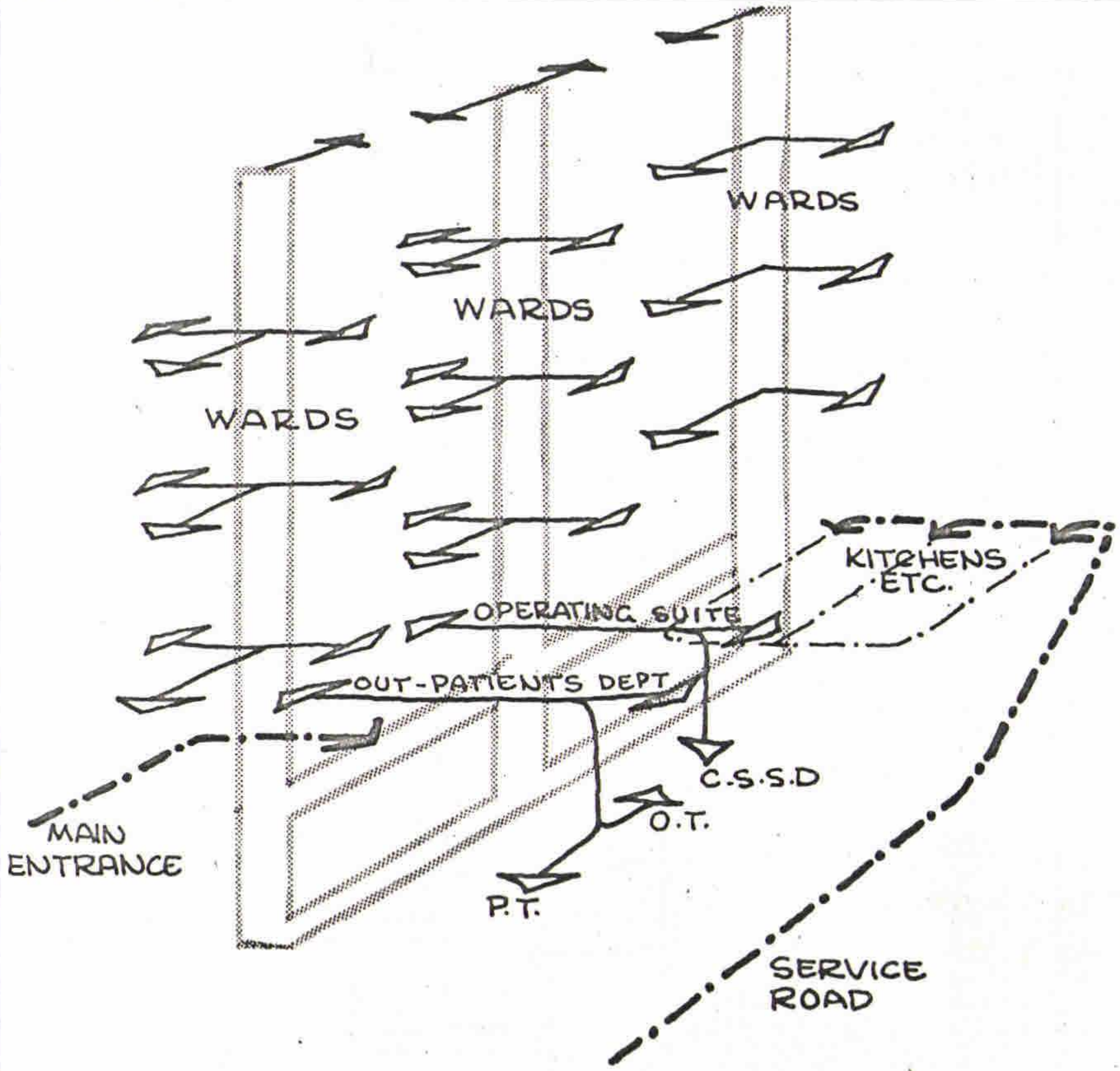

Centre of heavy Mech. Vent. plant. Ducts to be grouped wherever operational policies permit.
Photo
Path.
Main Ops
Minor Ops
O/P Ops
WARDS
Vertical Link
Gas
C.S.S.D + T.S.S.D
Medical Stores
Boiler
Main Pedestrian Corridor System
Main Supply & Disposal Corridor
WARDS
General Stores
Work Shops
AMBULANCE
Accident
X-Ray
Records
Vertical Link
Physio Th.
Out-Patients Dept
Occ. Th.
Kitchen
WARDS
PATIENTS + STAFF
RECEPTION
Psychiatric Dept.
Vertical Link
Laundry
DELIVERIES
Main Car Park
Admin
Non-Res. Staff
Car Park - Staff + Service Personnel
SERVICE
DISPOSAL
Training Centre
sk. B

FIGURE 5.5D



sk.C
isometric of communications

FIGURE 5.5E

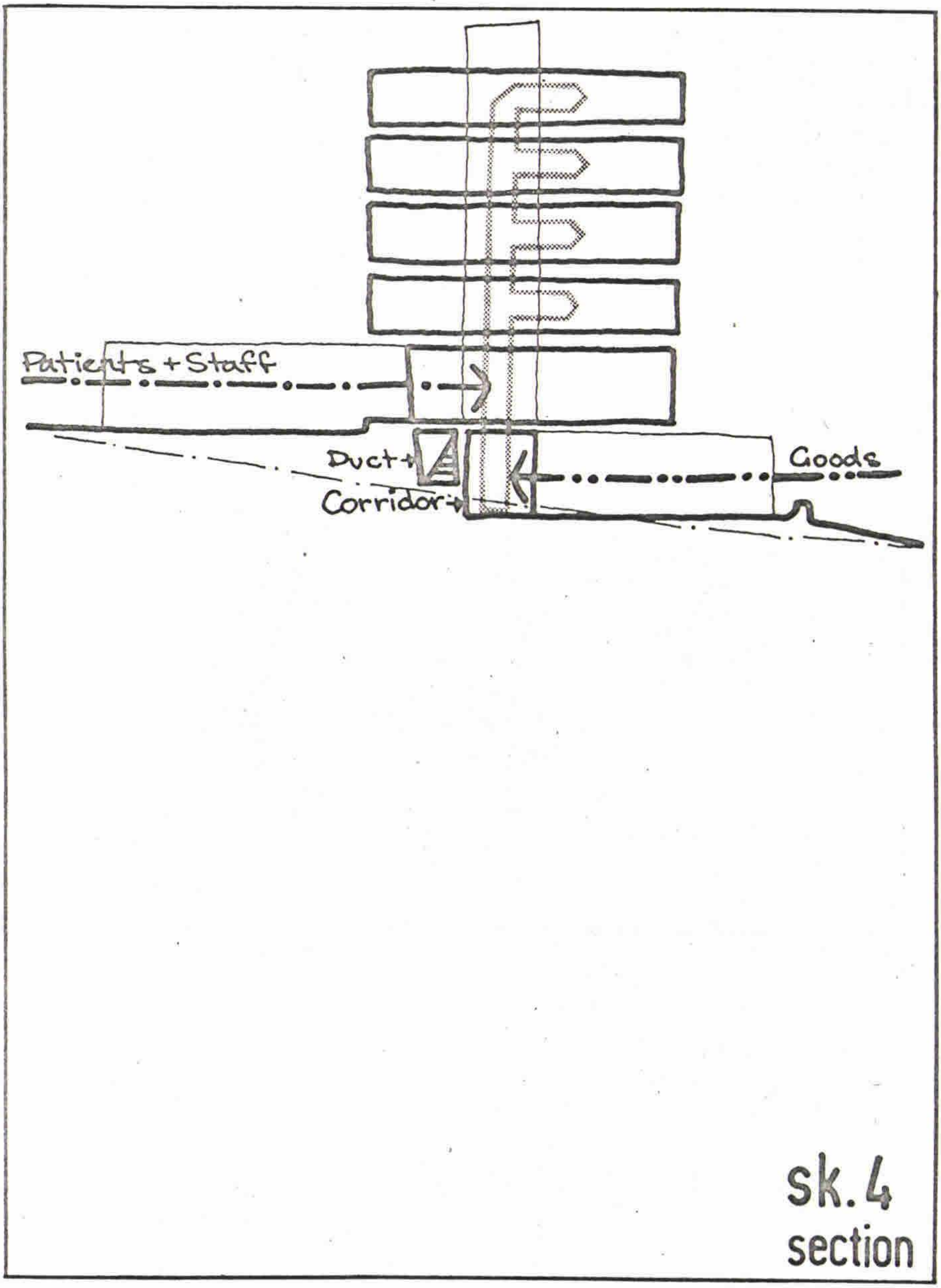


FIGURE 5.5F

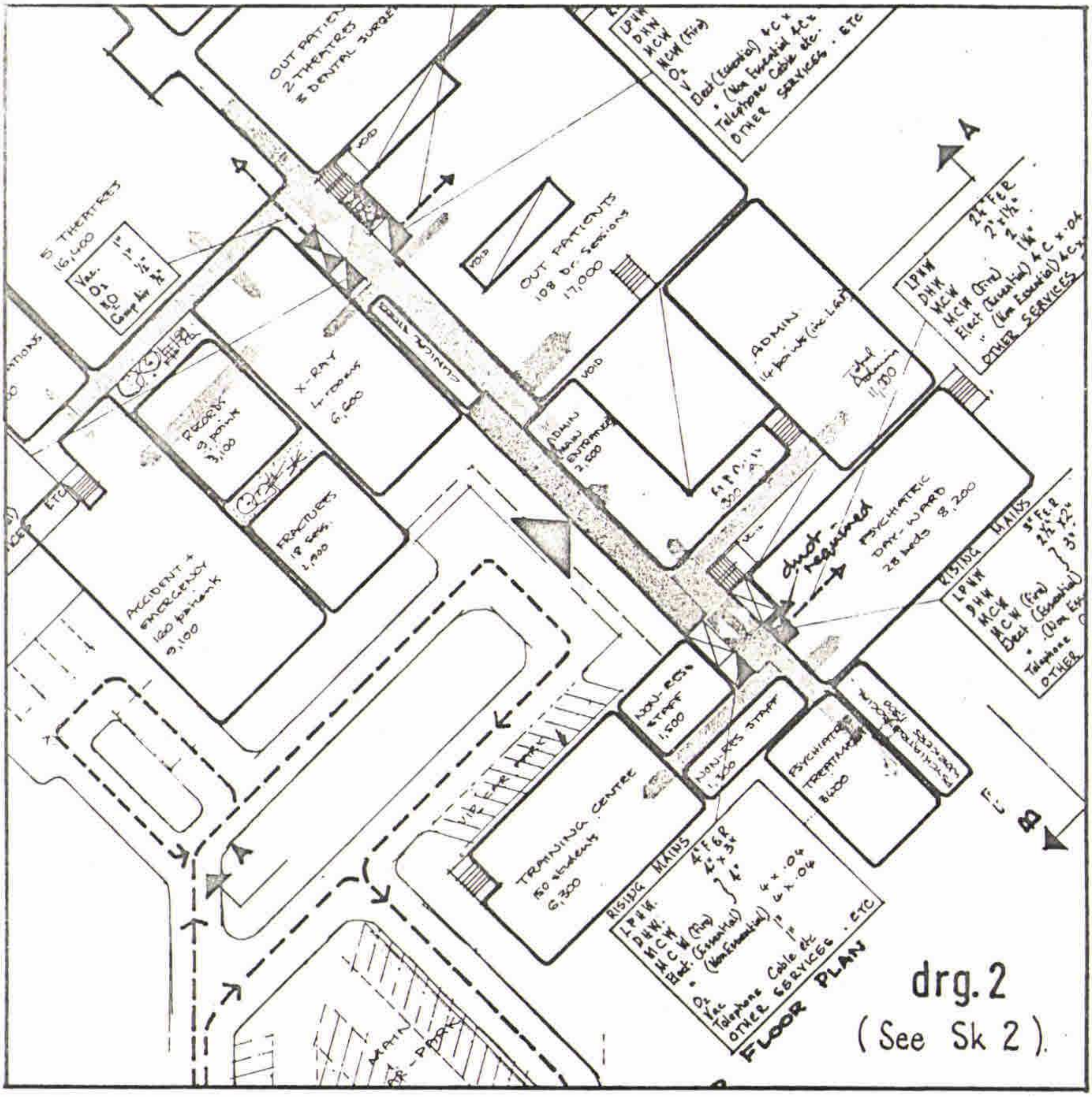

OUT PATIENTS
2 THEATRES
& DENTAL SURGERY
5 THEATRES
16,400
OUT PATIENTS
108 Dr. Sessions
17,000
X-RAY
4 rooms
6,600
RECORDS
9 point
3,100
ADMIN.
14 point (inc. Lab)
FRACTURES
18 Sess.
2,400
ACCIDENT + EMERGENCY
100 patient
9,100
PSYCHIATRIC
DAY-WARD
28 beds 8,200
TRAINING CENTRE
150 students
6,300
NON-RES STAFF
PSYCHIATRIC TREATMENT
RISING MAINS
OTHER SERVICES . ETC
FLOOR PLAN
MAIN CAR PARK
duct required
drg. 2
(See Sk 2).

FIGURE 5.5G

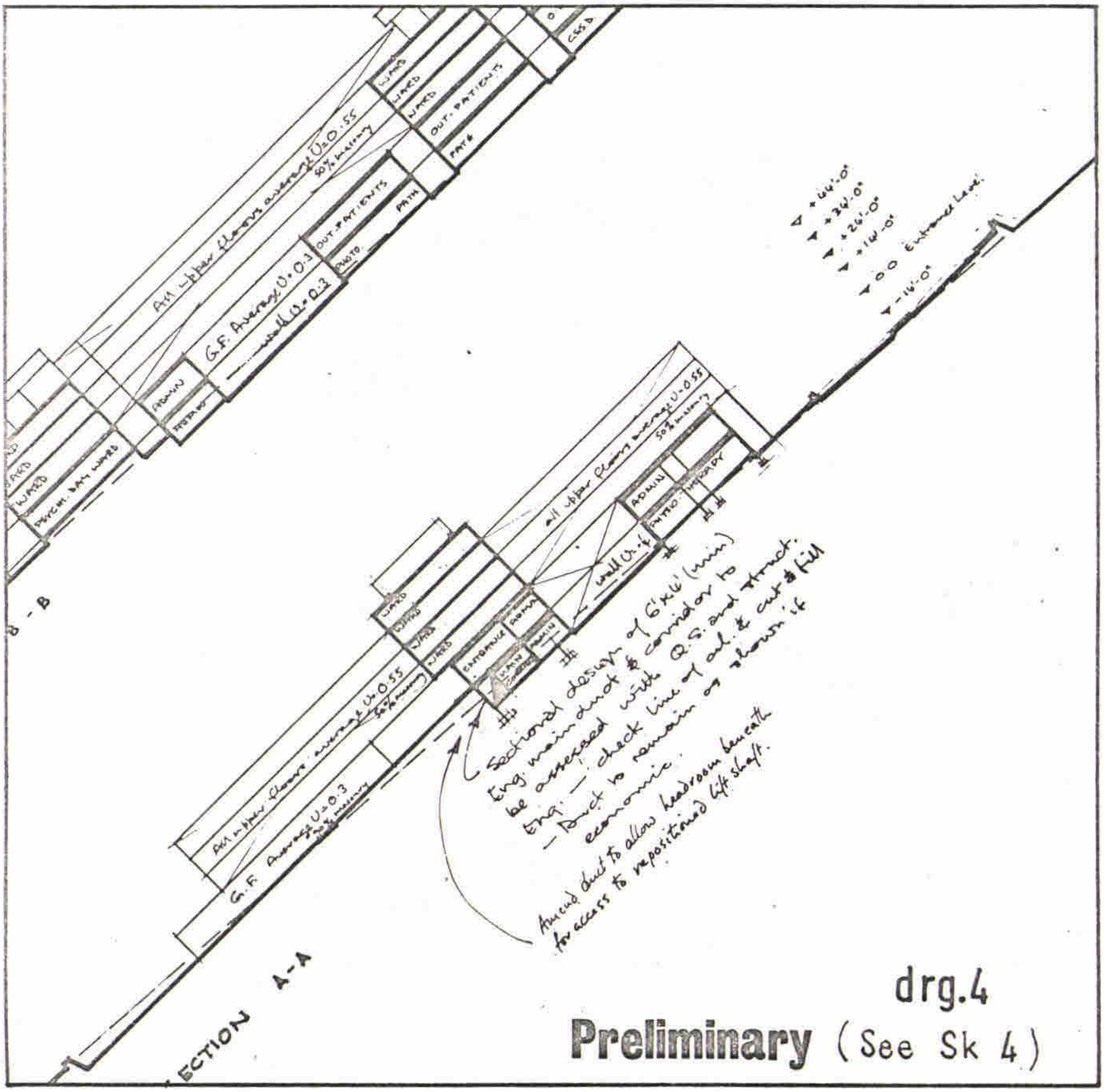

WARD
OUT-PATIENTS
PATH
PHOTO
ADMIN
All upper floors average U=0.55
G.F. Average U=0.3
+44'-0"
+34'-0"
+26'-0"
+14'-0"
0.0 Entrance Level
-14'-0"
Sectional design of 6'x6' (min) Eng. main duct & corridor to be assessed with Q.S. and Struct. Eng. — check line of cut & fill — Duct to remain as shown if economic.
Amend duct to allow headroom beneath for access to repositioned lift shaft.
SECTION A-A
drg.4
Preliminary (See Sk 4)

FIGURE 5.5H

5.5.1 The production of the Development Control Plan, together with development control documentation, is the first design activity to be carried out by the Project Team. Hospital Building Procedure Note 5 gives full details of the objectives and requirements of the Development Control Plan, and an extract is quoted here

'the aim of the development control plan is to provide,

1) an overall appreciation of the project in terms of the disposition of the required accommodation, the shapes of the buildings and their inter-relationship and phasing

2) a basis for the measurement of capital costs for use in the production of the budget costs for the scheme.

The Development Control Plan consists of a series of drawings in plan and section covering in detail the phases of a project which are intended to proceed to construction within the following few years of the current program and, in outline, subsequent phases. The drawings dealing with the immediate phases show how the floor areas and volumes for the required departments can be accommodated in the desired operational relationships to each other within the selected building shape disposed according to the character of the site. They should indicate the communication system and the routes of movement of patients, personnel, supplies, disposal and engineering services both within and outside the building, as appropriate. The drawings should also show the location of plant and switch rooms, lift shafts and main engineering service routes. The drawings dealing with subsequent phases will normally be limited to showing how these phases will fit in with the overall concept of the project, from the viewpoint of the inter-relationships with existing and proposed buildings and communications.

5.5.1 cont. In certain cases e.g. tightly knit developments, it may be necessary to describe in detail in the Development Control Plan all phases of the project. Where the proposed works consist of the improvement of, or addition to, existing accomodation, which is to remain in use the production of a fully detailed development plan will be unnecessary since the layout of the bulk of the building and services is fixed. The extent of the detail to be provided will depend on the scope and the nature of the works'.

5.5.2 The drawings needed to deal with these requirements may be summarised as follows:

a) Site plans indicating existing conditions

b) Site plans indicating proposals - i.e. phase drawings comprising a series of drawings showing:

   (i) existing buildings - identifying those due for demolition and those to be retained

   (ii) new works proposed in the phase under consideration

c) Layout drawings - floor plans of the new building and of the existing buildings that are to be retained, indicating the perimeter of each department, waiting spaces not included in the departmental areas, the main communication areas, and the housing of engineering services.

d) Elevations and sections - these are required to demonstrate the site utilisation, and the modelling and co-ordinating dimensions. Also the Project Team will use them to explain the proposals and for costing purposes.

5.5.3 HBPN 5 goes on to describe the various stages of the Development Control Plan in great detail, giving examples of design layouts. Some of these are reproduced in this section for interest and can be seen in Figures 5.5C - 5.5.H.

5.5.4 The CUBITH System will still require the Development Control Plan to be produced. In fact, if a new site is to be provided, it may be necessary to produce outline Development Control Plans for several sites, to assist in the final selection of the site for the building. It is usual for a preliminary Development Control Plan to be produced before the plan is finalised.

5.5.5 Before outline Development Control Plans can be produced the function and phasing of the project will have been decided and set out, as described in Paragraph 5.4 on 'Determination of Project Requirements'. This, together with standard site/plot ratios, will form a basis of assessment for each site. Activity Data will be selected according to functional requirements and an attempt will be made to relate this to each site, taking into account the phasing required. Details of how Activity Data is selected and grouped together on a site plan are given in Paragraph 5.6.

5.5.6 On some sites it will be impossible to combine required function and phasing and so the site will be rejected. On others, although the plan may be viable, the costs may prove excessive when related to funds made available in the Hospital Building Programme.

5.5.7 After discussions between the Project Team and the Department of Health and Social Security, a final selection of site is made and a preliminary Development Control Plan is produced for that site. Further discussions follow before a final Development Control Plan is produced.

5.5.8 The preparation of the Development Control Plan calls for close collaboration between the architect, engineer, and other members of the Project Team. There should also be frequent consultation with other professional advisers at Board or Department level as necessary.

5.5.9 The final Development Control Plan will comprise:

a) Details of the way in which departments are located in relation to each other within the broad building shape, taking into account the detailed characteristics of the site and the need to allow for growth and adaptability during the life of the buildings.

b) Gross floor area for the departments to be accommodated, giving provisional schedules of accommodation.

c) Simple diagrams based on the appraisal of requirements on function and phasing, from which 1/500 scale layout drawings can be produced.

d) Details of internal and external communications systems.

e) More detailed plans of individual departments and their inter-relation one with another, to assist in overall design concepts.

f) Adequate provision for future extensions.

g) Full details of both capital and revenue costs and on-costs.

5.5.10 Presentation of the Development Control Plan is most important. There is a need for uniformity of presentation, as this enables easy comparison between like schemes. The conventions chosen should allow for quick and easy reproduction of the Development Control Plan, as it is proposed that the plan will form the basis of all discussion on a project and should therefore be made readily available as necessary. About 30 copies would be required, and possibly more.

5.6 ACTIVITY DATA

INDEX

ACTIVITY DATA

FIGURE 5.6A

ACTIVITY DATA

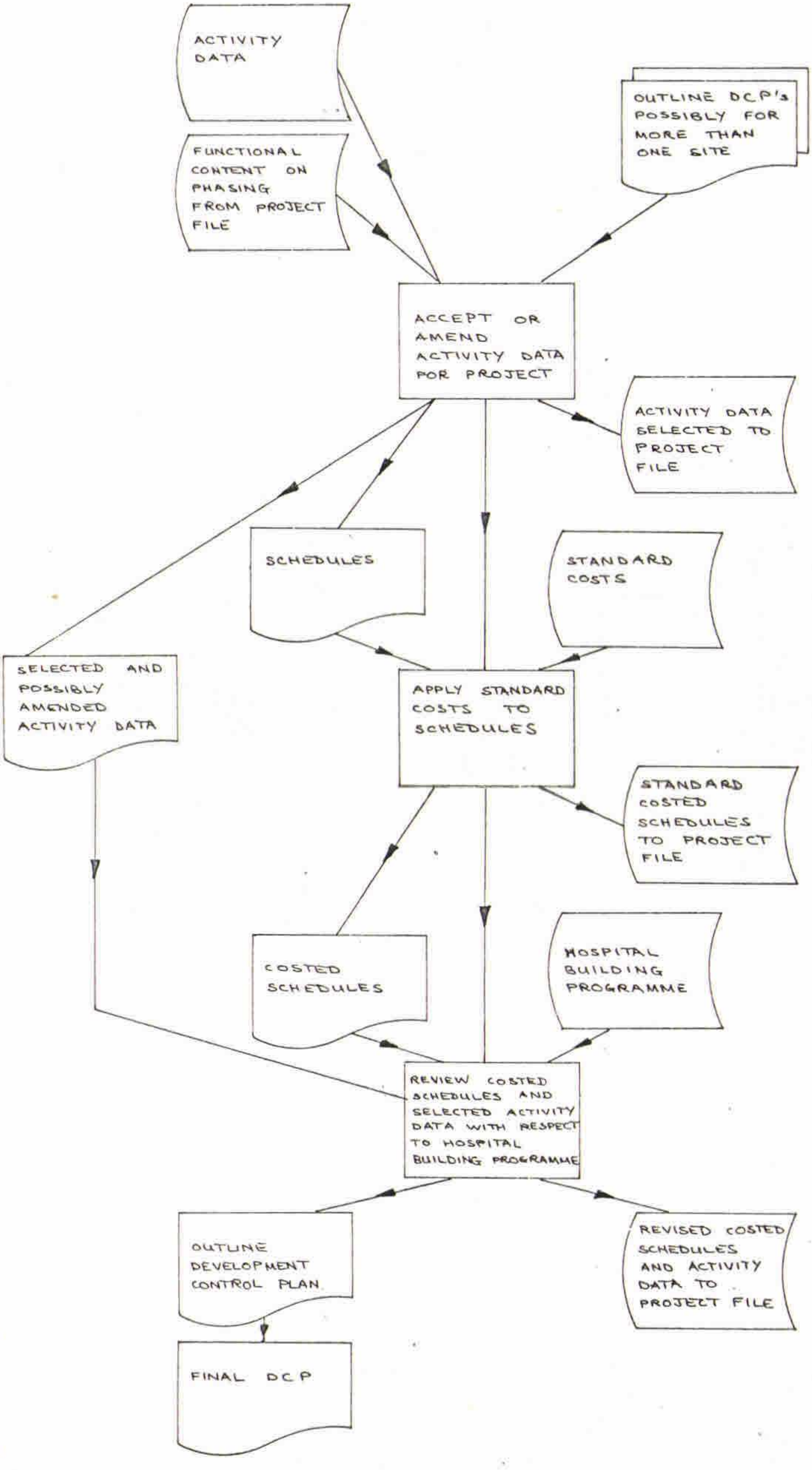


FIGURE 5.6B

ACTIVITY DATA

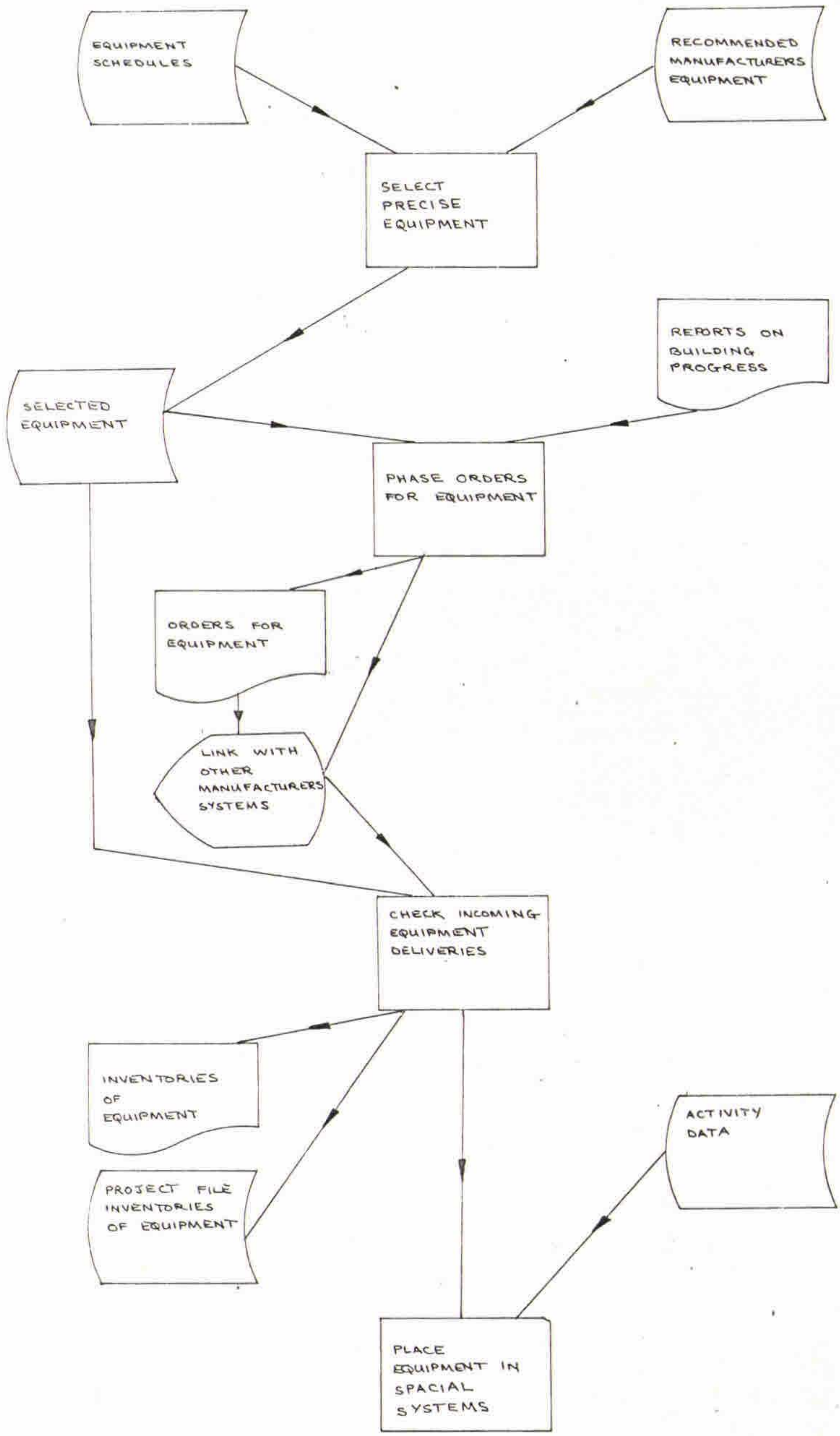


FIGURE 5.6D

ACTIVITY DATA

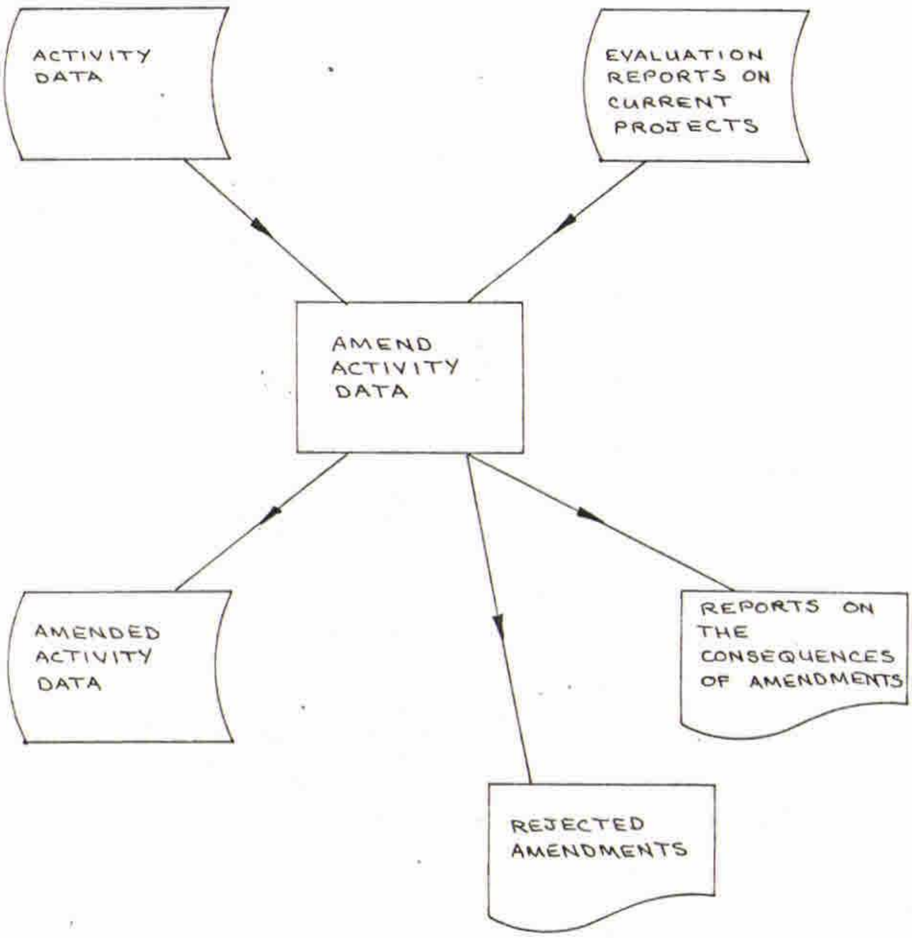


FIGURE 5.6E

ACTIVITY DATA

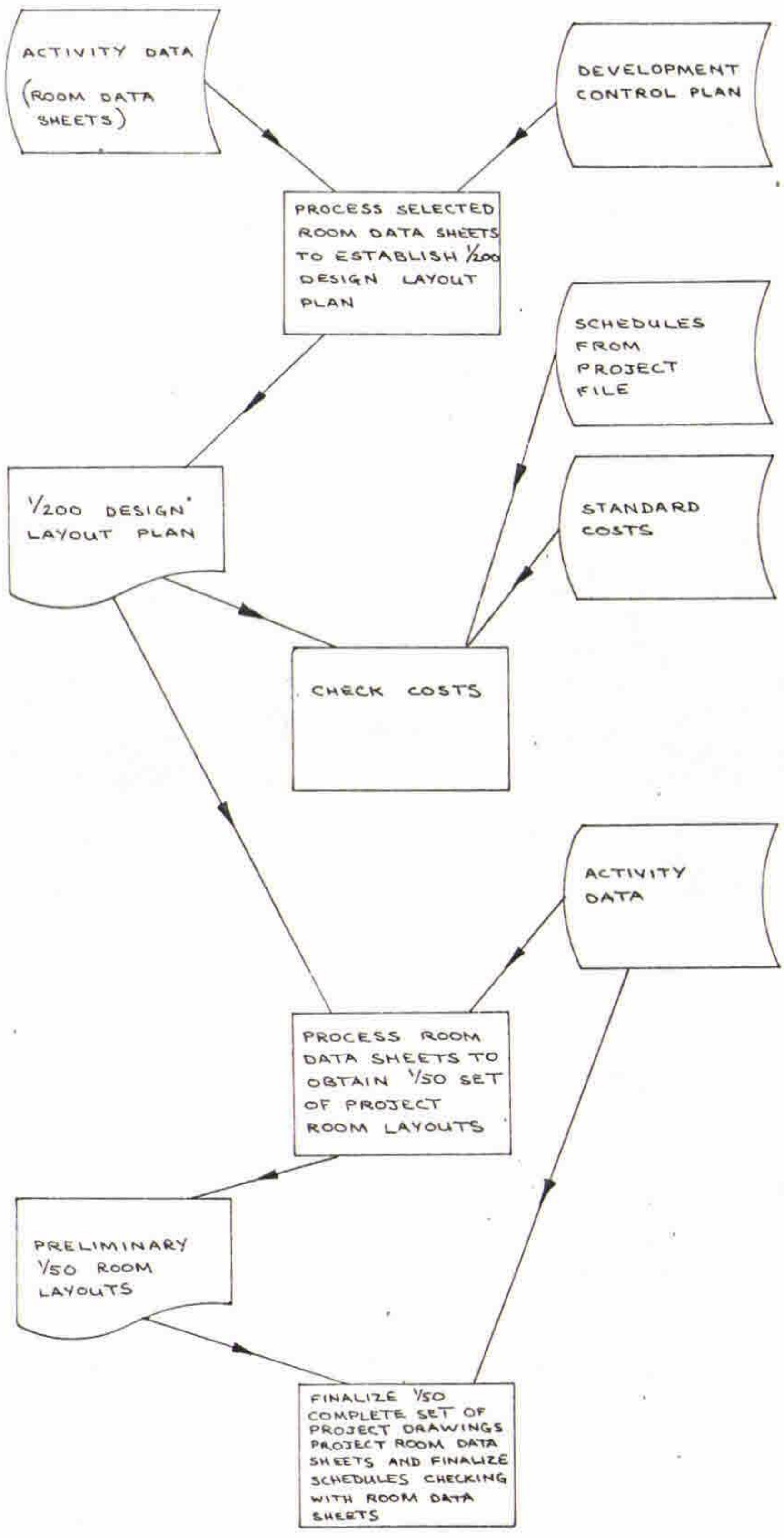


FIGURE 5.6C

ACTIVITY DATA

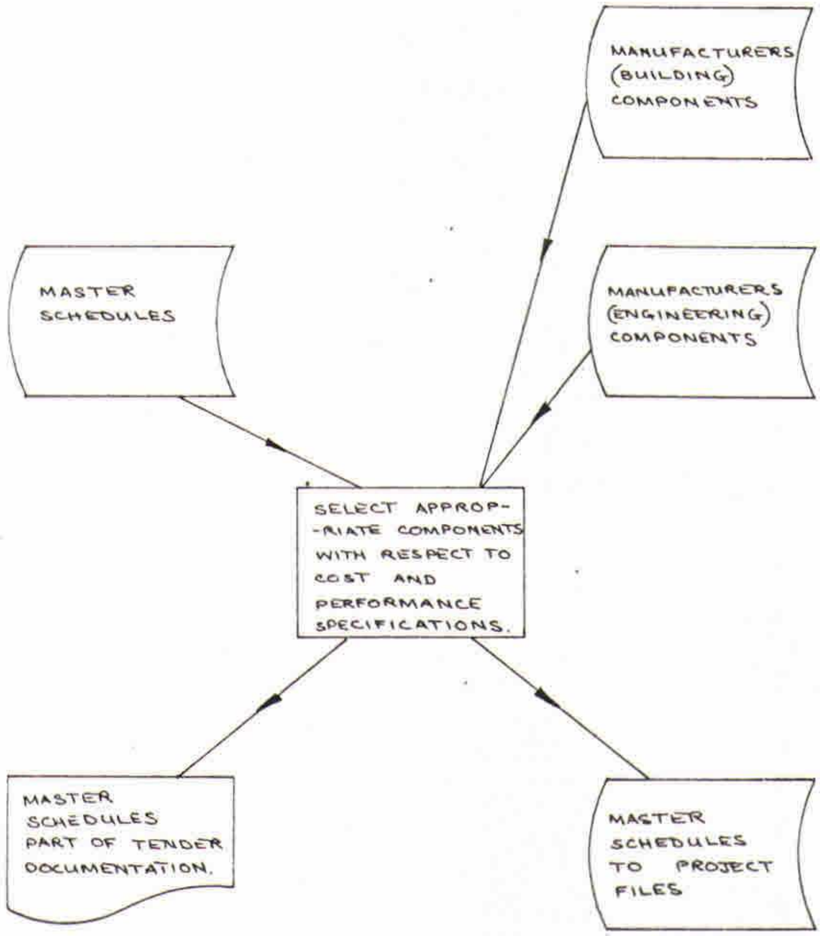


FIGURE 5.6F

AN EXAMPLE OF ACTIVITY DATA

CUBITH SYSTEM ACTIVITY DATA BASE		ROOM DATA SHEET	F A R O O M / S P E - - 1
ACTIVITY SPACE		CONSULTING/EXAMINATION ROOM	E A J A O 9
ACTIVITY GROUP	1 x	Consulation	A . 21 . AA . 00
	1 x	Examination	A . 22 . AA . 00
	1 x	Changing (Patients)	A . 01 . AA . 01
	1 x	Cleansing (Handwashing)	A . 02 . AA . 25
	1 x	Chinagraph board	C . 20 . - -

Room function and location: This room provides facilities for:-

(a) History taking (may include blood pressure reading).

(b) Patient undressing in privacy.

(c) Weighing of patient.

(d) Examination from patient's right side or foot of couch using adjustable examination lamp.

(e) Recording results.

(f) Staff handwashing.

Up to 4 persons may be in the room at any one time.

The room should be located (essentially) near to the storage of records, adjacent to the waiting area, and near to clean and dirty utility rooms.

General design considerations:

Room temperature:		Winter 18°C.
Air changes:		3/hour. Natural supplemented by mechanical
Lighting:	General:	300 lux
	Local:	Examination lamp 500 lus.
Sound attenuation:		High.
Internal finishes:		Walls: Grade B; Floor: Grade B; Ceiling: Grade B.
Door:		900 mm. wide leaf, single swing, locking lever latch furniture. Room in use indicator. Curtaining between room and staff working corridor.
Windows:		None.

FIGURE 5.6G

CUBITH SYSTEM ACTIVITY DATA BASE		ROOM DATA SHEET	F A R O O M / S P E - - 1
ACTIVITY SPACE		CONSULTING/EXAMINATION ROOM	E A J A O 9
ACTIVITY GROUP	1 x	Consultation	A . 21 . AA . 00
	1 x	Examination	A . 22 . AA . 00
	1 x	Changing (Patients)	A . 01 . AA . 01
	1 x	Cleansing (Handwashing)	A . 02 . AA . 25
	1 x	Chinagraph board	C . 20 . - . -
PROJECT			Room No.

Fitting out summary of Group 1, 2A and 2B items

Group	Item	Quantity	Size or Cost	M. D. B. Code
1	Large basin with integral shelf, no plug	1		
	Deck mounted elbow/wrist action taps with			
	swivel nozzle	1		
	W.P.B.	1		
	13amp. twin switched socket outlet	1		
	Hat and coat hooks	2		
	Chinagraph board	1	900x900mm	
	Ceiling mounted fluorescent light fitting			
	13amp twin switched socket outlet			
	Radiator			
2A	Soap dispenser	1		
	Towel dispenser	1		
	Nailbrush dispenser	1		
	Small wall mounted disposal sack frame	1		
	Writing desk	1		
	Desk chair	2		
	Instrument hooks	2		
	Hinged writing flap	1		
	Wall mounted disposal sack	1		
	Couch cover dispenser	1		
	Mirror and shelf	1	1.2m x 300mm	
	Curtain and track	1		
2B	X-ray viewer	1		
	Examination couch	1		
	Steps	1		
	Upright chair	1		
	Weighing machine	1		

FIGURE 5.6H

ACTIVITY DATA

F·2

CUBITH SYSTEM ACTIVITY DATA BASE		ROOM DATA SHEET	F A R O O M S P E - - 1
ACTIVITY SPACE		CONSULTING/EXAMINATION ROOM	E A J A O 9
ACTIVITY GROUP	1 x	Consultation	A . 21 . AA . 00
	1 x	Examination	A . 22 . AA . 00
	1 x	Changing (patients)	A . 01 . AA . 01
	1 x	Cleansing (Handwashing)	A . 02 . AA . 25
	1 x	Chinagraph Board	C . 20 . - . -
PROJECT			Room No.

Engineering Services

	Service	Room terminals	Q'nty Size	Project Notes
Activity Unit requirements	Local lighting	Examination lamp, ceiling mounted,		
		integral switch	1	
	Power	X-ray viewer, wall mounted	1	
		Socket outlet, 13amp. with switch, double	1	
	Waste & Vent	Basin, large	1	
	Hot Water	Basin, large	1	
	Cold Water	Basin, large	1	

	Service	Room terminals	Q'nty Size	Project Notes
Room requirements	Heating	Radiator		
	General Lighting	Light fitting, ceiling mounted, fluorescent		
	Ventilation			
	Staff/staff call			

FIGURE 5.61

CUBITH SYSTEM ACTIVITY DATA BASE		ROOM DATA SHEET	F A R O O M / S P E - - 1
ACTIVITY SPACE		CONSULTING/EXAMINATION ROOM	E A J A O 9
ACTIVITY GROUP	1 x	Consultation	A . 21 . AA . 00
	1 x	Examination	A . 22 . AA . 00
	1 x	Changing (Patients)	A . 01 . AA . 01
	1 x	Cleansing (Handwashing)	A . 02 . AA . 25
	1 x	Chinagraph Board	C . 20 . - . -
PROJECT			Room No.

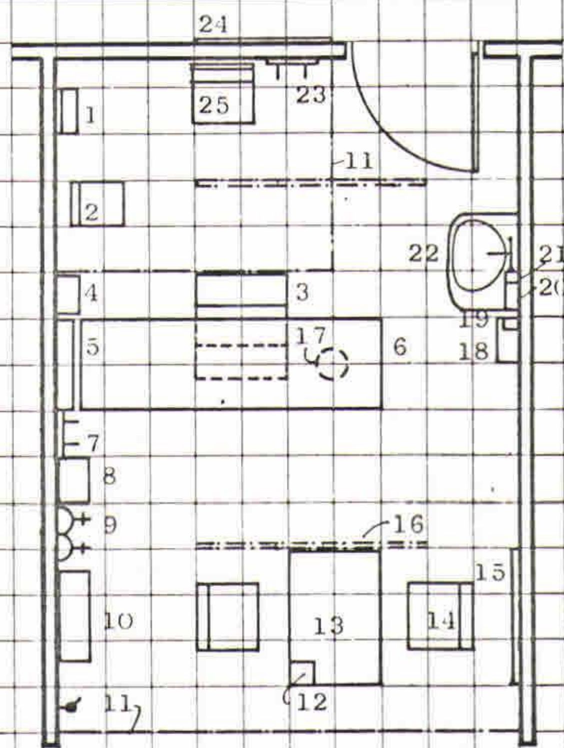
Group 3 equipment

Item	Quantity	Cost	A. D. P. Code
Bin, waste paper	1		
Curtain, screening	as requ'd		
Stethoscope	1		
Stethoscope, foetal	1		

FIGURE 5.6J

CUBITH SYSTEM ACTIVITY DATA BASE		ROOM DATA SHEET	F A R O O M S P E - - 1
ACTIVITY SPACE		CONSULTING/EXAMINATION ROOM	E A J A O 9
ACTIVITY GROUP ▷	1 x	Consultation	A . 21 . AA . 00
	1 x	Examination	A . 22 . AA . 00
	1 x	Changing (Patients)	A . 01 . AA . 01
	1 x	Cleansing (Handwashing)	A . 02 . AA . 25
	1 x	Chinagraph Board	C . 20 . -- . --

Example of room layout (to 1/50 scale) taken from: ______



1. Mirror Shelf
2. Weighing Machine
3. Steps
4. Wall mount Disposal Sack
5. Cover Dispenser
6. Examination Couch
7. Instrument Hooks
8. Writing Flap
9. 13 amp. Twin S.S.O
10. X-ray Viewer
11. Curtain
12. W.P.B.
13. Writing Table
14. Desk Chair
15. Chinagraph Board
16. Ceiling Light
17. Examination Light
18. Disposal Sack Frame
19. Nail Brush Dispenser
20. Towel Dispenser
21. Soap Dispenser
22. Hand Basin
23. Coat Hooks
24. Pin-up Board
25. Chair

FIGURE 5.6K

Internal finishes:		
Walls	Ceiling	Floor

Evaluation of this room layout example:

FIGURE 5.6L

5.6.1 The fundamental objective of Activity Data is to make pre-prepared planning data available to project teams for the systematic and rapid selection of standard sets of area layouts, together with recommended environmental policies and equipment requirements, which when grouped together will fulfil particular demands for health and welfare services on a specific site.

5.6.2 Once CUBITH is fully operational, Activity Data will express recommended solutions of the inter-relation of spatial systems, which is the placing of activity spaces in relation to each other and the placing of equipment within each activity space. It will include recommended environmental conditions and equipment options.

5.6.3 It is envisaged that the standard sets of Activity Data will allow optimum technological solutions with regard to space, environment, and equipment, to be applied to standard medical problems.

5.6.4 Considerable thought has gone into the design of Activity Data, although further development may still take place. The data has been structured on seven levels, and examples of each level are shown below:

5.6.4 cont.

Level A	Activity System	Data relevant to advanced combination of discreet services e.g. a district general hospital
Level B	Activity Sub-system	Data relevant to a discreet service, e.g. in-patient care
Level C	Activity Organisation	Data relevant to a division of an activity sub-system e.g. 144 bed nursing unit
Level D	Activity Sub-organisation	Data relevant to a working sub-unit, e.g. a 72 bed nursing unit
Level E	Activity Section	Data relevant to a group of rooms, e.g. a 12 bed high dependency area
Level F	Activity Spaces, Schedules of spaces (rooms) required for user activities	
	Activity Group	The number and type of activity units appropriate to a specific activity space
	Room Data, Sets of Data (A-F)	Appropriate to each activity space
Level G	Activity Units	Data presented by graphics and schedules, defining the equipment and engineering services required for the accomplishment of a specific activity or number of related activities

5.6.5 It is envisaged, that although standard sets of Activity Data will be available, a particular project may require, say with regard to site, a modification of the standard data. Since it will be possible to select data at any level, any amendments to the standard data must be carried down through the system to the lower levels.

5.6.6 Activity Data comprises both text and spatial system data, the latter being expressed as graphics. It is envisaged that a text will probably be modified for each particular project, indeed standard equipment lists will have to be transformed into actual schedules of manufacturers equipment. However, spatial systems will not, in general, be modified. Selected Activity Data will have to be made available to the various members of the Project Team. At least twelve copies of each selected set seems to be required, although further study is needed on this. Activity Data must therefore be in a form which is readily, easily and cheaply reproduced.

5.6.7 Once the functional content of a project is laid down, reference to standard sets of Activity Data will assist in turning policies into spatial systems, together with their related environmental options and equipment specifications.

5.6.8 In producing the Development Control Plan, one of the considerations is the interrelation of discreet services within a project as a whole, and their relation to spatial systems. It is also necessary to ensure that the projected design will be within the limits of both capital and revenue cost as laid down in the Hospital Building Programme. To carry out these functions, it is necessary to select and review Activity Data at all levels. It should be remembered here that if standard data is fully acceptable at one level, lower levels will probably require little or no change. However, if a change is required at any level, this must be carried down to lower levels of data, as has been mentioned earlier. Once Activity Data has been selected and amended it will form the basis of gross floor areas and provide schedules of accommodation.

5.6.9 When Activity Data is applied to phasing policies, which would have been determined at the start of briefing, checks for overlaps in provision of equipment can be made. Also, allowances for phased equipment costs can be compared with standard costs applied to selected and amended sets of Activity Data. At this stage, it may be necessary to re-phase equipment purchase or review amendments to standard schedules of equipment. However, it must be remembered that phased equipment costs are only on a very broad basis in the Development Control Plan, and design considerations may also amend equipment phasing.

5.6.10 By the time the final Development Control Plan is produced, any basic amendment to Activity Data will have been made, and all levels of data will serve to provide an outline of the final scheme, together with the inter-relation of spatial systems and their related communication systems, costed schedules of equipment, and requirements on services. This whole will form the basis of a viable phased scheme, which meets both the functional and the cost requirements laid down in the Hospital Building Programme.

5.6.11 When the Development Control Plan passes to the design phase, selected and amended room data sheets are processed to establish a 1/200 design layout plan, which forms the basis of all design drawings. This system, Design Development, is detailed further in paragraph 5.10. Room data sheets are further used to obtain 1/50 project room layouts and 1/50 plans of the whole project, sub-divided into divisions.

5.6.12 Towards the end of the design phase, a complete set of 1/50 project drawings is produced, together with a complete set of project room data sheets, and a complete set of project design stage schedules.

5.6.13 Activity Data is used in nearly every task of the design phase, to assist in establishing the site and services layout, and structural grid, and to prepare project design drawings on all levels. In the production phase, it is used as the basis of 1/100 project and engineering drawings, to prepare key, base, and location drawings, and to select junction details. Master schedules are also developed by the application of selected manufacturers' components to amended schedules.

5.6.14 Just before the project is put to tender, one of the responsibilities of the Commissioning Team is to ensure that equipment schedules are updated and related to recommended manufacturers equipment. Equipment is then selected, with respect to performance specifications and actual costs. Towards the end of construction, the schedules are phased with respect to delivery requirements, in line with actual progress of the building, and orders are placed.

5.6.15 When equipment is delivered, it is checked against the appropriate schedules, examined, and distributed. The correct placing of equipment, in relation to spatial systems, again requires reference to Activity Data, as does the checking of environmental conditions prior to the building being made operational.

5.6.16 It will be seen that Activity Data interrelates closely with nearly every sub-system, and should therefore be structured within the Common Data Base with respect to all requirements.

5.6.17 Activity Data can also be of great value in the simulation of various schemes, and in the theoretical relationship of sets of activities one with another.

5.6.18 The amendment and updating of Activity Data forms a sub-system in its own right. Only the best principles of design should be included. The standard theoretical data will be amended with respect to practical application and there will be a constant feed-back of amendments to Activity Data via the Evaluation Sub-system.

5.6.19 Care should be taken to ensure that amendments to Activity Data are fully assessed before new data is included. However, there must be provision within the system for research and development, so that the use of new data can be simulated before modified principles are adopted as standard. The Project File should allow for new Activity Data to be included within a project if desirable, after it has been included in the Common Data Base.

5.7 EQUIPMENT

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EQUIPMENT

FIGURE 5.7A

EQUIPMENT

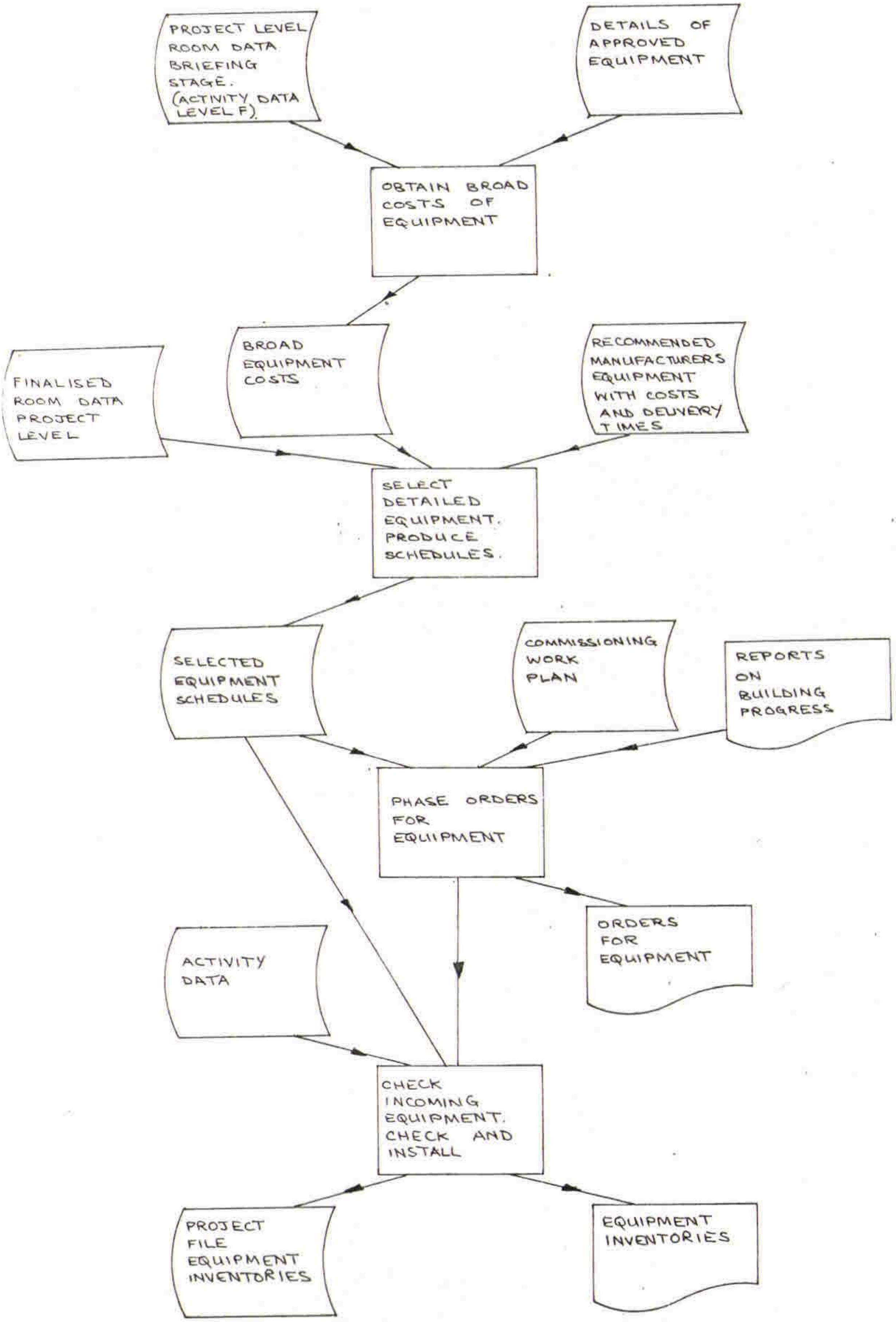


FIGURE 5.7B

EQUIPMENT

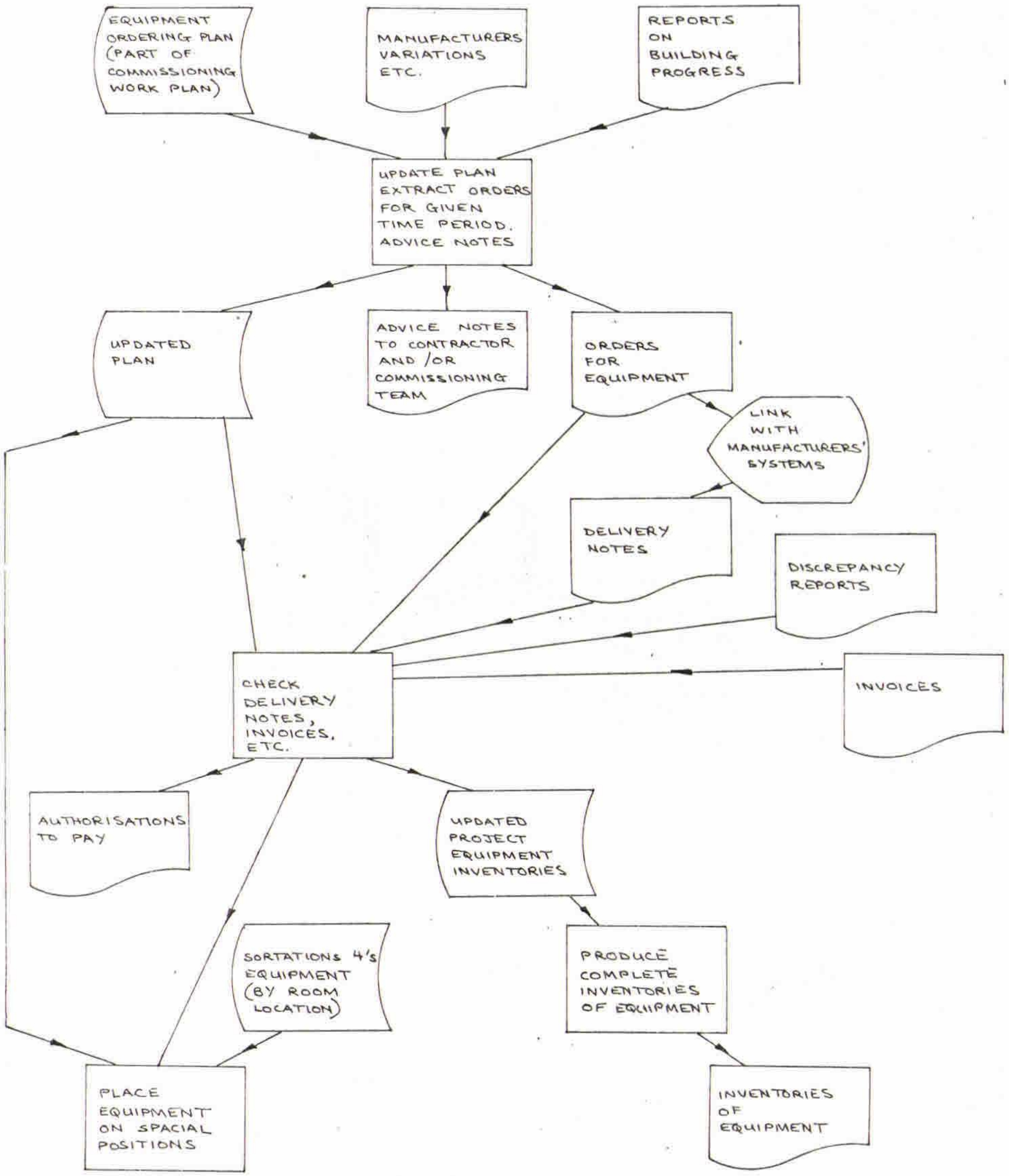


FIGURE 5.7C

5.7.1 Although broad estimates of equipment requirements and cost are made during the briefing stage, reasonably accurate costed schedules of equipment can only be produced after the room data sheets for the project have been finalised.

5.7.2 Ordering, checking deliveries and positioning the equipment are all tasks within the commissioning work plan. Thus, updated schedules, giving the delivery times for each type of equipment, will be required during preparation of the commissioning work plan.

5.7.3 Orders will be phased, and each will be placed according to progress of the construction, delivery lead time, and required delivery date. Some orders will be fairly constant over a given period, such as, for example, ten beds to be delivered each week for six weeks. Other orders will be 'one-off'.

5.7.4 The ordering and delivery work plans will require constant monitoring, due to:

a) Variation in progress of constructional work from original constructional work plan

b) Fluctuation in delivery times for equipment

Methods of storing current delivery times and of obtaining their amended values must be considered.

If the delivery time increases, then if possible, the equipment must be ordered earlier. Alternatively, it may be necessary to consider other sources of supply. If the delivery time is reduced, care must be taken to ensure that the equipment does not arrive until the building (or storage) is ready.

5.7.5 Equipment will be supplied by a number of different manufacturers, and the ordering system should interface with the manufacturers' systems so that intermediate paperwork and data processing are kept to a minimum.

5.7.6 As each piece of equipment is delivered it will be checked against the delivery note, and the delivery note will be checked against the order. The invoice must be checked before payment is authorised, and the equipment is then added to the inventory. Arrangements must be made for the equipment to be stored, if necessary, and then placed in position as required. Thus, it will be necessary to organise labour for unloading and positioning. It may also be necessary to allocate storage space.

5.7.7 As the project approaches completion, inventories are produced and the project equipment inventory, on the project file, is finalised. If an equipment inventory is kept for any length of time on the project file, it must be remembered that it will require updating when equipment becomes obsolete, is replaced, renewed, or augmented. If it is possible for this updating to be done at stock-taking intervals, this could be of assistance when updated inventories are required. In this case, the inventory would form a useful basis for an operational equipment system.

5.7.8 Figure 5.7B shows an outline of the overall scheme, while Figure 5.7C shows the ordering, delivering, etc. in more detail (see also Figure 5.7D).

5.7.9 The Supplies Department have recently established an ADP Equipment System which is available to Regional Hospital Boards. Further investigation is required on the possibility of interfacing this with the CUBITH System.

5.8 STAFFING

INDEX

STAFFING

FIGURE 5.8A

STAFFING

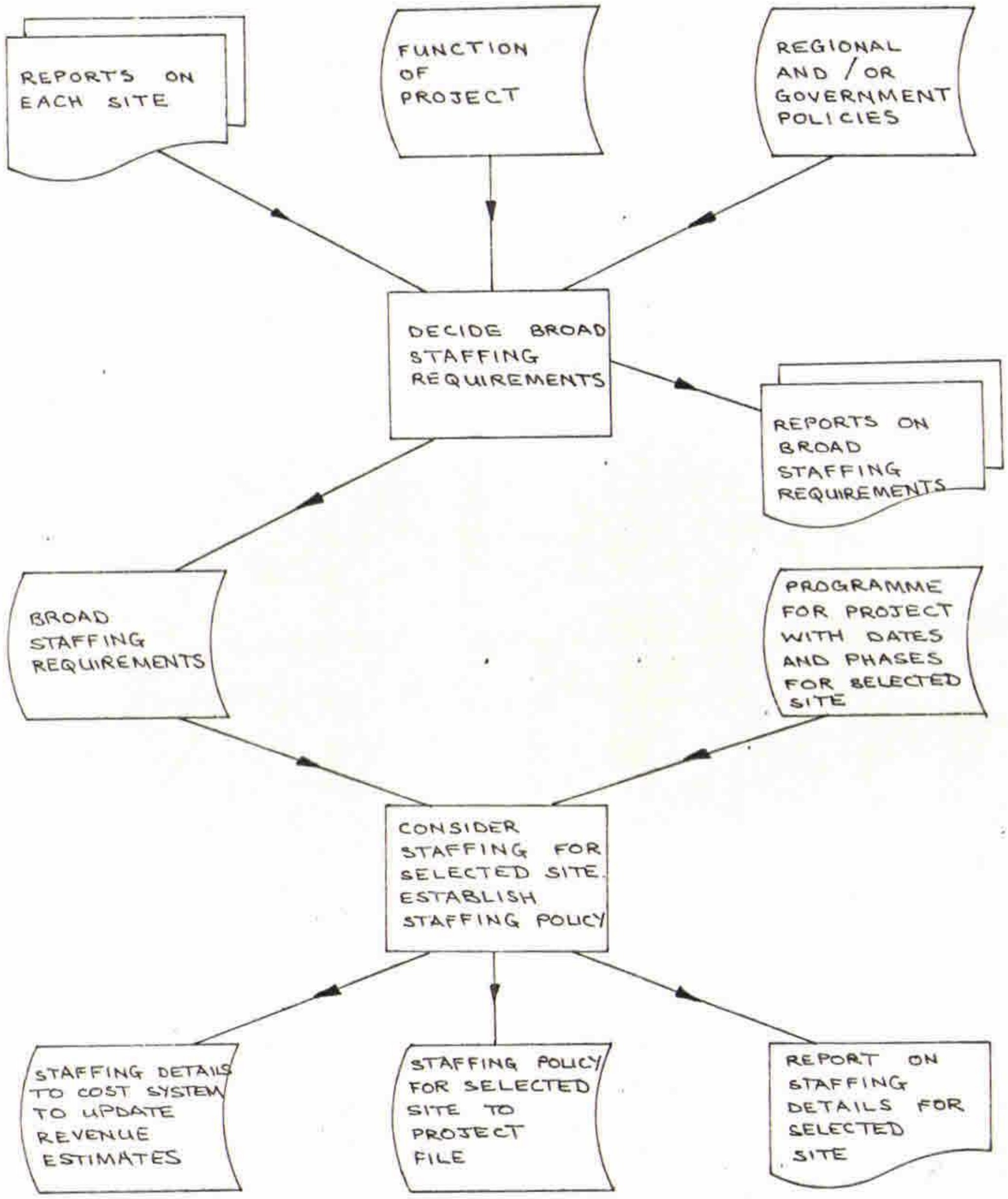


FIGURE 5.8B

STAFFING

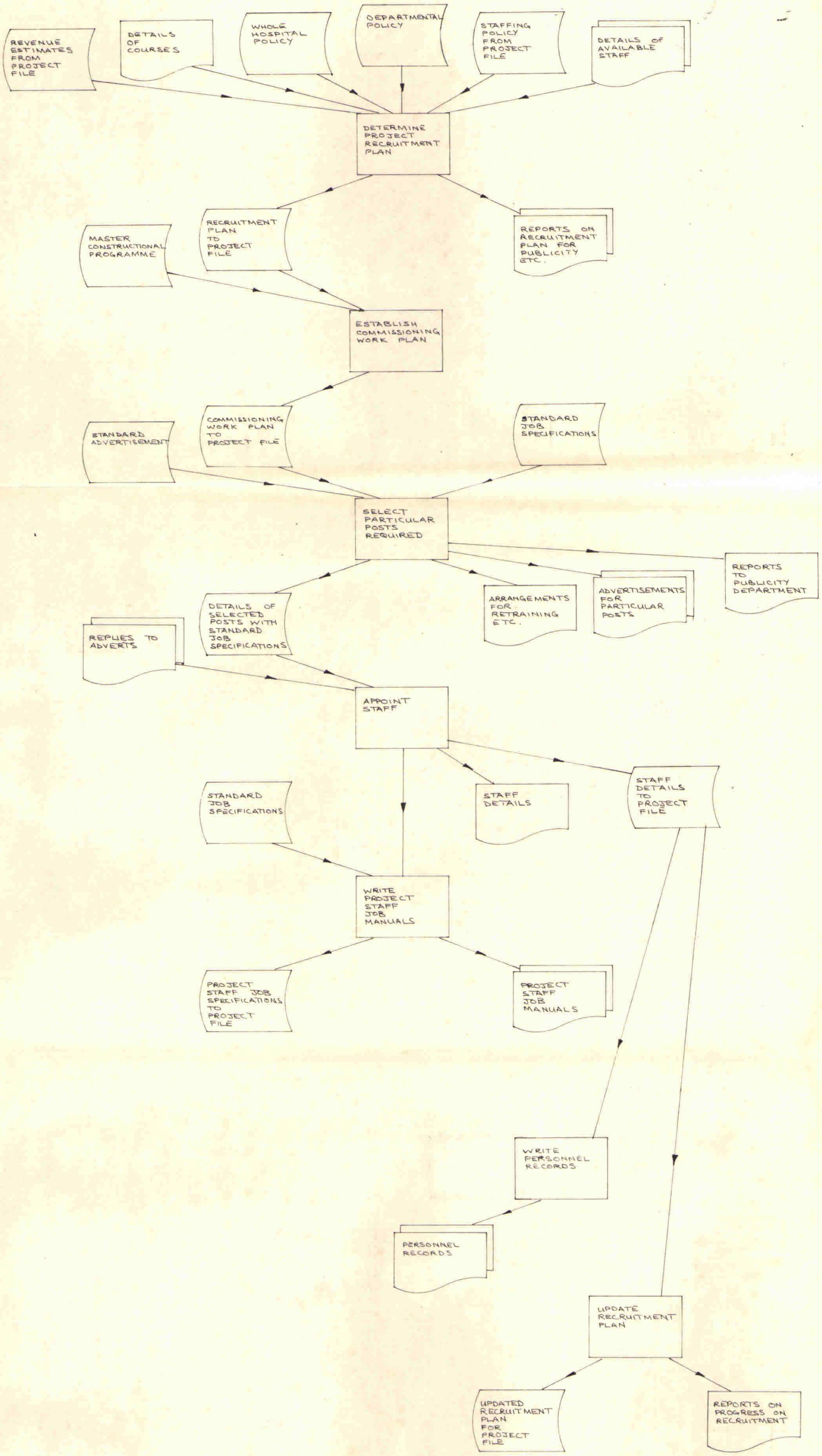


FIGURE 5.8C

5.8.1 During briefing, phased staff requirements are considered on a broad basis. Towards the end of briefing, these are revised with respect to the particular site selected. Staffing estimates are included in Revenue estimates, as policies may involve re-training existing staff or recruiting new staff. Figure 5.8B illustrates the functions just described. Also, the sub-system 'Determination of Project Requirements', described in paragraph 5.4, relates to these aspects of staffing.

5.8.2 During Commissioning the staff recruiting plan is established. This includes the re-training of existing staff as appropriate. The staff estimates laid down during briefing are updated and developed to give a staff recruitment plan, with the sequence of key appointments detailed. This plan is incorporated into the overall commissioning work plan and supplied to the publicity department where it is used to produce suitable publicity to amplify the recruitment advertisements. Figure 5.8C illustrates these recruiting activities. The work on the recruitment plan is phased, and each phase will itself be an iterative process as some posts are filled more easily than others. Thus it will be necessary to periodically update the recruitment plan and issue progress reports.

5.8.3 Job specifications and hence advertisements for particular posts will generally vary only slightly from project to project. It should be possible to set up standard specifications and advertisements which could be modified to suit the particular project in hand. Job specification manuals must also be produced and here too it should be possible to modify standard text to suit each particular case.

5.8.4 The creation of a personnel records system follows naturally from the appointment of staff and could probably form part of this sub-system. However, before this area can be discussed in detail, the inter-action with standard staff policies of the Department of Health and Social Security needs investigating. The system will also link with salary administration and pay-roll systems.

5.9 COST ANALYSIS

INDEX

COST ANALYSIS

FIGURE 5.9A

COST ANALYSIS

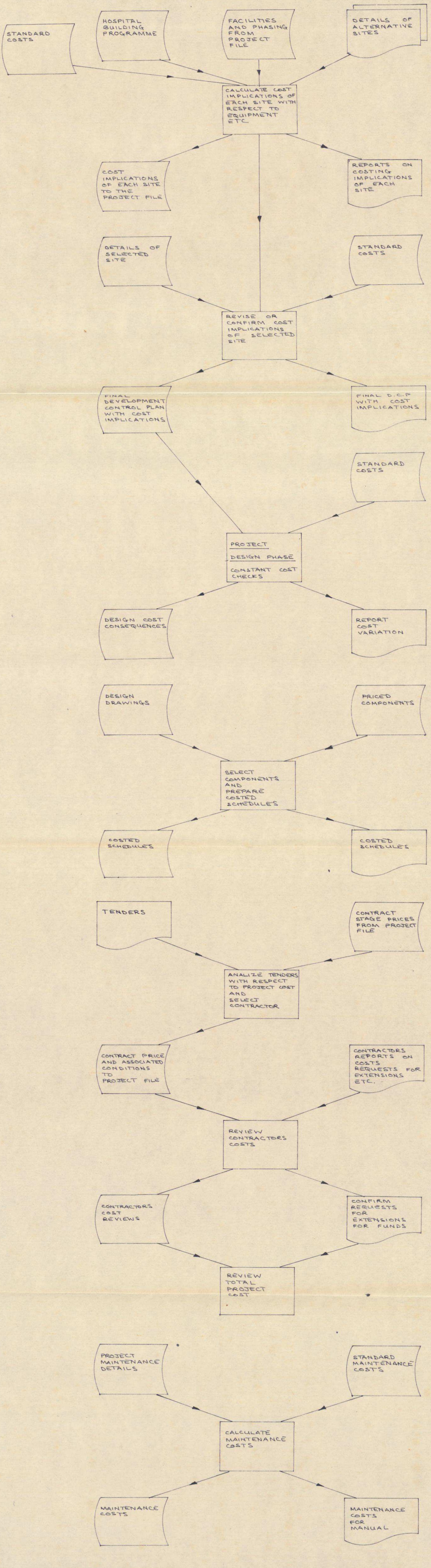


FIGURE 5.9B

5.9.1 Full facilities for cost analysis must be provided at all stages of the development of a project. Under the CUBITH System this costing will be relatively simple, because standard planning techniques, systems, components, etc. will be largely used and their cost consequences are known. Each stage of development will be carefully monitored, thus reducing the possibility of costs escalating on a project without there being full knowledge of the circumstances surrounding the rise in cost. It will be possible for changes in costs to be detected earlier, thus allowing action to be taken sooner so that further cost rises can be prevented if possible.

5.9.2 The overall allocation of capital cost to each project is given in the Hospital Building Programme. This forms the basis of the decisions on provision of facilities, phasing, and site selection, which are all considered before the final proposals for the building can be formalised into the Development Control Plan. At all stages costs are a prime factor, and there must be provision for costing out various groupings of facilities and evaluating gain in functional efficiency against both capital and revenue cost. For example, it may be necessary to evaluate the cost of a high building, with say 140 beds per floor, and regard the additional cost of lifts etc. as a necessary expense when set against the saving of time and cost resulting from shorter corridors and better land use. The early decisions are embodied in the Development Control Plan and their importance is indicated by this quotation from the Capricode Manual. 'The Department has reviewed some of the larger projects that have been planned and designed in recent years and found that many major decisions taken at an early stage in a project took inadequate account of the full cost implications. The content of the project and the utilisation of the site largely dictate the ultimate cost and any economics achieved during the later detailed design construction stages are generally marginal in effect'.

5.9.3 cont.

c) costs due to height factor. Additional costs due to the need to build high blocks.

d) costs of auxiliary buildings - separate minor buildings such as bicycle stores, sub-stations, etc.

e) any abnormal costs not included above but not directly chargeable to the provision of nursing facilities. Examples include air conditioning due to density on a restricted site, and the provision of a water pressurization plant. Demolition and alterations to existing buildings are also included.

5.9.4 Each of the two cost categories discussed above, namely departmental costs and on-costs, can be applied to the site under consideration. However, cost considerations alone do not determine the function, phasing and site selection. Thus the final Development Control Plan will reflect other factors and will not be based on cost factors alone. As large volumes of data are assessed, it will be possible to simulate various designs and determine the resulting cost consequences very simply.

5.9.5 Some interesting studies have been carried out by the Department of Health and Social Security, and these will contribute to the determination of cost on some types of building. Papers have been produced on the cost of high rise buildings, and the cost factors associated with building shape. Extracts from the Capricode Manual are included here for interest. Appendices 1, 2 and 3 of Section 5.9.

5.9.6 It is apparent that throughout the briefing stage constant access to standard cost data will be required. This will involve cross reference to Activity Data, since this should include the cost consequences for various groupings of accommodation and standard items of equipment. Revenue costs should also be well established during briefing, and before the final Development Control Plan can be produced, a full check must be made to ensure that the whole conforms to the Capital cost allocations laid down for the project in the Hospital Building Programme.

5.9.7 It is important that the Revenue costs likely to follow from a project are identified at an early date, so that the financial arrangements can be made in good time. Estimates of Revenue costs of the development are required at various stages. These should show gross Revenue costs in the first full year of operation, the savings which will accrue (e.g. from sales or closures of existing accommodation), and the net Revenue costs. Expenditure on the senior medical staff should be included and identified. Where work consists of additions to existing accommodation which is to be retained, the revenue estimate should take account of the direct effect of the new development on the expenditure of the existing departments. No allowance should be included forup-grading of services in the hospital generally.

5.9.8 One of the first requirements of the Design Sub-system is the creation of a project cost control plan and a system of cost checks for each project.

5.9.9 Cost planning is that part of cost control which deals with the design of buildings and other works in the scheme. The main object of Design Cost Control is to obtain a tender figure within the budget cost, and subsequently the design cost, which provides a method of allocation of the available monies in order to promote a balances design solution. To achieve this there are two main tasks. Firstly, the preparation of a cost plan, and secondly, the process of cost checking.

5.9.10 It is important to recognise that the cost plan in itself does not exercise control. It only provides a reference against which later control, by way of cost checks, can be exercised. Under CUBITH, the division into elements of constituent parts of a building, allows for comparisons to be made between the cost of achieving various functions in one project and that of achieving equivalent functions in other projects. An accurate list of cost elements under CUBITH has not been fully defined, but in general, elements will be more detailed than those laid down in Appendix 5 of Hospital Building Procedure Note 6 of the Capricode Manual. A cost control plan should be prepared by the Project Team in consultation with the architect and engineers, who will decide on the distribution of the money for a building and the associated external work. This general costing will be prepared with reference to standard costs built up within the CUBITH System.

5.9.11 During the Design Sub-System, cost checks will be constantly made. Where a cost check reveals a significant discrepancy in the cost plan, the architect is responsible for taking action as far as the building sphere is concerned. The engineer will carry out similar cost checks as the engineering design proceeds. It is essential that there should be the closest collaboration between the professional groups at this important stage of cost control.

5.9.12 The long design periods traditionally associated with large hospital building schemes create particular problems for cost planners in assessing and providing for increases in construction costs during the design period. However, CUBITH aims to solve these problems by the application of standard design techniques which should shorten the design period considerably. Should costs increase during the design period, the basic data within the CUBITH System will be modified and the increase in prices applied to all projects in progress. This will enable cost consequences to be rapidly evaluated and prompt action to be taken. If a Management System has been selected during the design phase, costing is simplified, since cost consequences are included in the Management System.

5.9.13 At the end of the Design Sub-System, once all design costs have been established, the exact components to be used in the building are selected during the Production Sub-System. The selection is made from coded costed items of approved manufacturers' components and equipment, and costed master schedules are produced.

5.9.14 When the construction phase is reached, the building is put to tender and full provision should be made for the cost analysis of submitted tenders. At this stage, although the burden of cost analysis is largely transferred to the contractor or sub-contractor, it is important that control is not lost and also that the cost details included in the tender documentation should interface efficiently with the contractors' systems of costing. Contractors should report on cost aspects of their project, together with other aspects, and it is recommended that a system of cost evaluation be designed for use by contractors, to provide facilities similar to those provided by developments of PERT techniques.

5.9.15 Towards the end of the construction phase, Maintenance Manuals must be produced, and these should include the cost of maintenance. This is particularly important if contract maintenance, for example window cleaning, is to be employed or evaluated against non-contract maintenance.

5.9.16 Enquiries on cost may be made throughout a project, and as these may take any form it is important that cost cata should be easily accessible to users of the management information system and be capable of presentation in a form suitable for each specific enquiry. Not only will information about actual costs to date be required, but alternative strategies may need to be simulated on a cost basis to assist in management decisions. For example, it may be necessary to evaluate the effect of a cheaper floor covering. It may result in lower capital costs, but operational costs may be higher, since the floor may be difficult and expensive to clean and require replacement earlier than would a more expensive floor.

5.9.17 Provision must be made for cost analysis on past projects to assist in cost related evaluation of current projects. Studies have been made within the Department of Health and Social Security on the sort of cost data that will need to be provided so that the analysis described above can be produced.

The following categories of information summarise the results of these studies:

a) Facilities Costs - this relates to functional units or appropriate data derived from departmental cost material

b) Activity Costs - this data would also be derived from departmental cost material but referenced directly in the form of cost per square metre of gross area for certain levels of activity data

c) Cost Factors such as on-cost norms, height factors and effect of building shape

d) Revenue Costs - this includes all data required to assess Revenue Costs

e) Equipment Costs which are related to appropriate levels of activity data

f) Elemental Costs related to the cost of building elements and the cost associated with the use of a Management System

g) Engineering Costs - costs related to engineering distribution systems

h) Component Costs - these are costs related to approved manufacturers building and engineering components

i) Basic prices relating to the cost of labour, materials, work pieces

j) Professional Fees - this would comprise of scales of fees for consultant services e.g. architects, quantity surveyors, structural engineers, engineering services consultants

5.9.17 cont.

k) Cost Guidance - this would take the form of general guidance material on estimating on-costs on non-standard areas of costing and would include typical cost plans for reference

It is most important to remember that the Cost System relates to all areas of a CUBITH project, and so full provision must be made for integration at all levels.

Appendix 1

Cost of High Rise Building

Introduction

1 The Department has recently carried out a study of high rise building (i.e., over four storeys) with the object of examing the effect of cost generally taking into account the technological advances in recent years in contractors' "know-how" and plant capabilities. This appendix describes the study and its results. The application of the results to the costing of individual projects and schemes is described in Appendix 9, paragraphs 5 and 6.

2 In order to reduce variables as far as possible the problem was tackled by examining separately the two distinct factors (a) extra design costs, and (b) additional overhead costs, which together contribute to the additional "notional" cost of high rise buildings per se. Those on-cost factors such as communications, cost of lifts, possible need to air-condition and/or double-glaze which also have to be taken into account in assessing the true cost of high rise development were not assessed and must be separately considered in addition to the factors dealt with in this study, when costing individual projects or schemes.

Extra Design Costs

3 A study was carried out using a constant floor plan form of 240′×96′ and progressively inserting additional floors above the four storey norm. (This method of retaining a constant floor plan obviates the additional variation of shape). The in-situ reinforced concrete frame was designed to cover three basic grids (a) 24′×16′, (b) 32′×16′ and 24′×24′, each of 13′ 0″ storey height.

4 The variable portions of the following elements were costed (at standard rates using prices analogous to those for current departmental cost allowances) for each storey height, converted to a rate per square foot and compared with the basic square foot rate for the four storey norm:

(i) Foundations

(ii) Frame (including upper floor and roof construction)

(iii) Roof coverings

(iv) Windows (improved design and heavier glazing commencing at six storeys)

(v) Engineering (including dry riser mains, water boosting, increased exposure factor and air change)

5 The square foot rates obtained for the above compared with the four storey norm are:

Extra Design Costs

	Rates expressed in shillings per square foot gross floor area above or below four storey norm				
Number of Storeys	Foundations (average of grids)	Frame (average of grids)	Roof Coverings	Windows	Engineering
5	−0·12	+0·20	−0·21	—	+0·04
6	−0·05	+0·39	−0·38	+0·08	+0·14
7	−0·03	+0·59	−0·46	+0·14	+0·23
8	−0·19	+0·73	−0·55	+0·18	+0·30
9	−0·17	+0·91	−0·63	+0·21	+0·36
10	−0·06	+1·09	−0·67	+0·24	+0·45
11	−0·12	+1·24	−0·71	+0·26	+0·50
12	−0·17	+1·40	−0·75	+0·28	+0·54
13	−0·41	+1·56	−0·80	+0·29	+0·58
14	−0·46	+1·72	−0·82	+0·30	+0·60
15	−0·15	+1·88	−0·84	+0·32	+0·63

Additional Overhead Costs

6 Information was obtained from leading contractors experienced in both low and high rise building concerning the range of additional overheads considered necessary to cover hoisting, additional protection, loss of output, height money and other general items related to the problem of high rise building.

7 This data was expressed as a percentage addition for different storey heights to cover those overhead items relating to high rise building generally (and not to any specific development shape).

8 The various percentages were converted into rates per square foot using a standard rate appropriate to a Ward Unit (the department most likely to be involved in this type of development) and the results are:

Additional Overhead Costs

Number of Storeys	Rates expressed in shillings per square foot gross floor area
5	0·58
6	0·91
7	1·28
8	1·81
9	2·12
10	4·05*
11	4·19
12	4·51
13	4·56
14	4·60
15	4·65

* This represents the point at which passenger hoists would normally be used during construction.

Overall Notional Cost

9 The overall additional cost of high rise building so obtained is shown in the analysis overleaf.

High Rise Building Costs

Rates expressed in shillings per square foot gross floor area

	5	6	7	8	9	10	11	12	13	14	15
Work below ground	−0·12	−0·05	−0·03	−0·19	−0·17	−0·06	−0·12	−0·17	−0·41	−0·46	−0·15
Frame	+0·20	+0·39	+0·59	+0·73	+0·91	+1·09	+1·24	+1·40	+1·56	+1·72	+1·88
Roof coverings	−0·21	−0·38	−0·46	−0·55	−0·63	−0·67	−0·71	−0·75	−0·80	−0·82	−0·84
Extra for windows	—	+0·08	+0·14	+0·18	+0·21	+0·24	+0·26	+0·28	+0·29	+0·30	+0·32
TOTAL Structure	−0·13	+0·04	+0·24	+0·17	+0·32	+0·60	+0·67	+0·86	+0·64	+0·74	+1·21
Additional on-costs	0·58	0·91	1·28	1·81	2·12	4·05	4·19	4·51	4·56	4·60	4·65
Engineering (including profit, attendance, prelims and builders' work)	0·04	0·14	0·23	0·30	0·36	0·45	0·50	0·54	0·58	0·60	0·63
	0·49	1·09	1·75	2·28	2·80	5·10	5·36	5·91	5·78	5·94	6·49
Say	6d	1s 0d	1s 9d	2s 3d	2s 9d	5s 0d	5s 6d	←——	6s 0d	——→	6s 6d

N.B. These rates relate to "notional" additional costs only. Certain other additional cost consequences, usually of a significant order, are inescapably associated with high rise building—see paragraph 2 above.

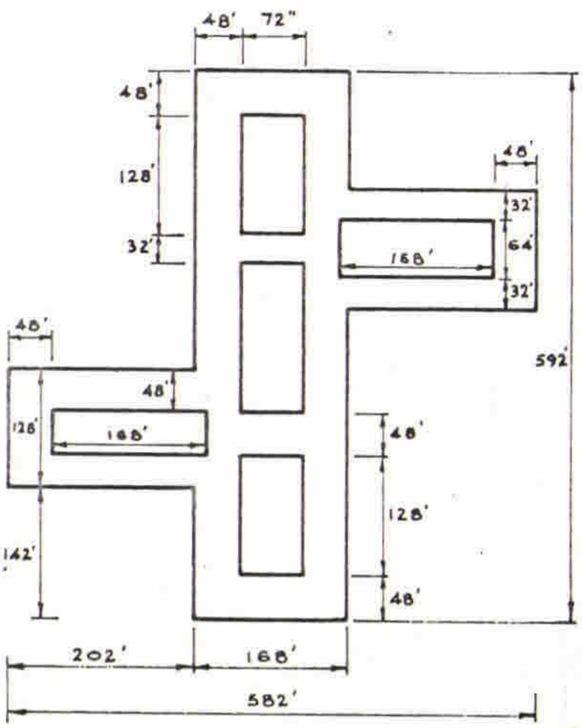
Appendix 2

Comparative Costs of Different Shaped Blocks (Study 1)

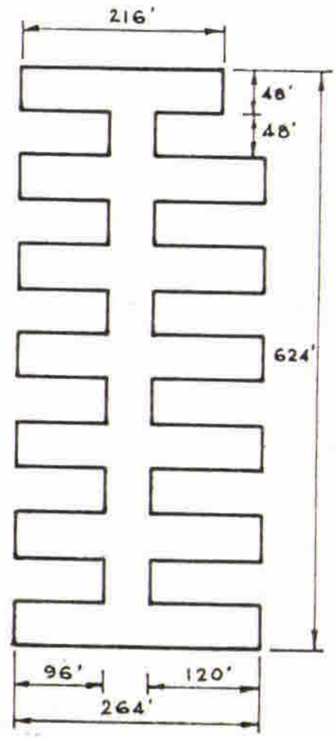
Introduction

1 Theoretical cost studies have been carried out on four different block shapes in four-storey construction, each having a gross floor area of approximately 400,000 sq.ft. The shapes chosen were as indicated below:

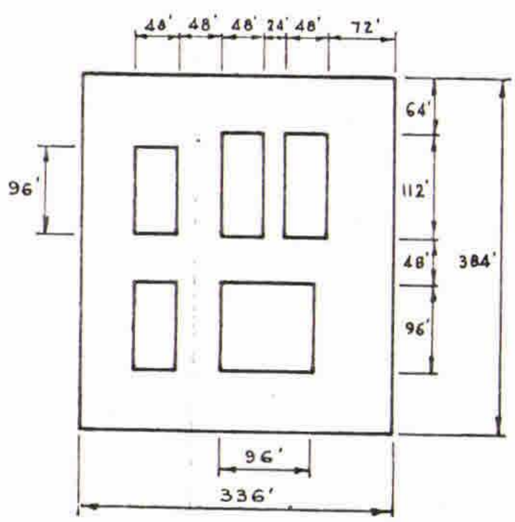
SHAPE 'A' Wall/floor ratio = 0·535



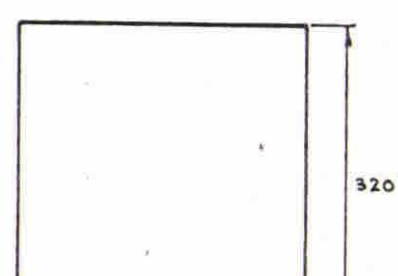
SHAPE 'B' Wall/floor ratio = 0·511



SHAPE 'C' Wall/floor ratio = 0·365



SHAPE 'D' Wall/floor ratio = 0·152



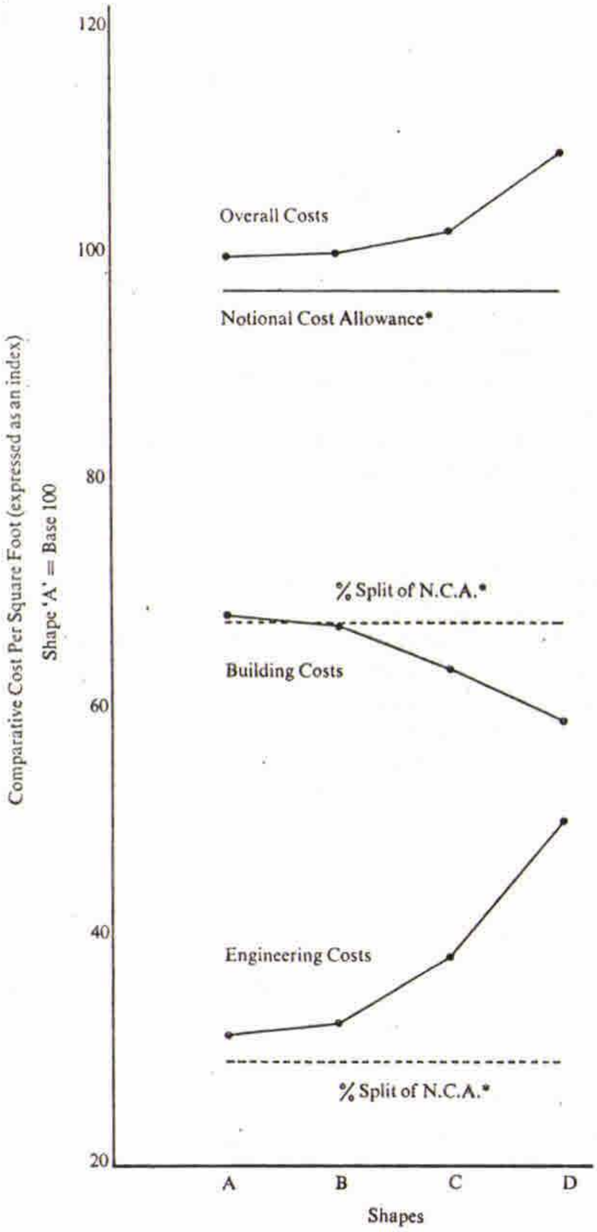
Method

2 A constant area content of "fitting-out" elements was assumed and a similar construction form of in-situ reinforced concrete frame applied in each case.

3 The variable items of perimeter (cladding, resultant structural and foundation effects and engineering heat losses), vertical communications (staircases and lifts) and abnormal engineering (mechanical ventilation, air-conditioning and permanent artificial lighting) were measured.

Results

4 The costs per sq. ft. are shown below in graphical form indicating the trend of overall costs and the varying proportions of building and engineering work making up the totals. In addition the level of the Notional Cost Allowance (together with the theoretical percentage split between Building and Engineering) is shown. [The Notional Cost Allowance (exclusive of on-costs) has been set at an index of 97 compared with Base 100 for Shape 'A'—Base 100 includes an on-cost increment in respect of vertical communications.]



*Exclusive of On-Costs

Comment

5 The foregoing graph indicates the interplay of building and engineering costs as the plan shape varies from an extended to a compact form of development and demonstrates:

(i) how building costs decrease as the wall/floor ratio is reduced,

(ii) how engineering costs increase due to abnormal on-cost requirements for ventilation, air-conditioning and permanent artificial lighting to the core of the building as the shape becomes more compact,

(iii) how the increase in engineering costs outweighs the reduction in building costs to give a resultant increase in overall costs as the shape becomes more compact.

6 These effects are largely common knowledge (having been demonstrated time and time again in practice) and the main object of this exercise is to focus attention on the economics of building in the absolute sense as distinct from the design target figures set by the Cost Control Procedures.

7 It is by no means uncommon practice to apportion the functional (or Departmental) Cost Allowances between Building and Engineering strictly in accordance with the engineering percentages quoted in the Building Notes. This practice not only discourages integration of design of the building as a complete entity but, in certain cases, actively prevents the distribution of financial resources within the overall design field to achieve the most economical solution without detriment to standards of specification.

8 The data related to Shapes C and D serve to illustrate the points raised in the previous paragraph. Both of these blocks exemplify the compact form inevitable when site restrictions prohibit a more extended (and economical) type of development and each will attract on-costs for abnormal engineering in addition to the normal (though in this case hypothetical) functional Cost Allowance. The graphical data show the comparative costs reflecting full integration of building and engineering services (i.e. the most economical solution) as tabulated below:

	Shape C Index	Shape D Index
Building costs	63·9	59·0
Engineering costs	38·4	50·3
Overall costs	102·3	109·3

Compare the difference on overall costs had the Architect and Engineer each "designed-up" to their individual percentage Cost Allowances plus their particular share of on-costs without "pooling" the total financial resources:

	Shape C Index	Shape D Index
Building Cost Allowance	67·9	67·9
Building On-costs	1·3	3·1
	69·2	71·0
Engineering Cost Allowance	29·1	29·1
Engineering On-costs	9·3	21·2
	38·4	50·3
Overall Costs	107·6	121·3

Thus in the case of Shape D the difference between "full design integration" and complete "design in isolation" is of the order of 11% (and in financial terms, amounts perhaps to £325,000!).

Whilst, no doubt, the practicable solution will usually lie somewhere between these extremes the figures are indicative of the order of saving which could be set aside to finance other schemes in the programme if full integration of design can be achieved in the first instance.

Appendix 3

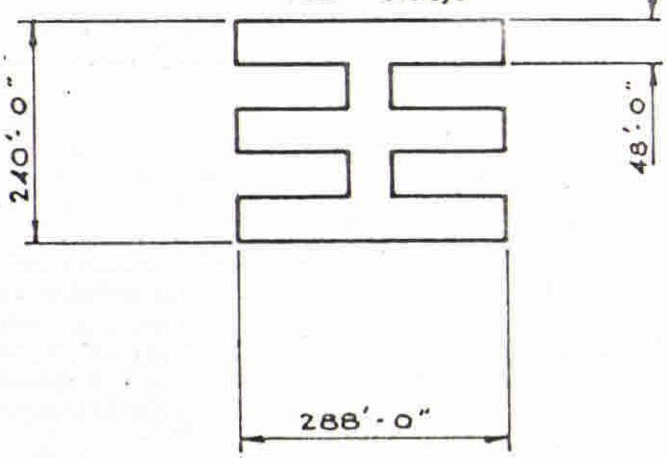
Comparative Costs of Different Shaped Blocks [Study 2]

Introduction

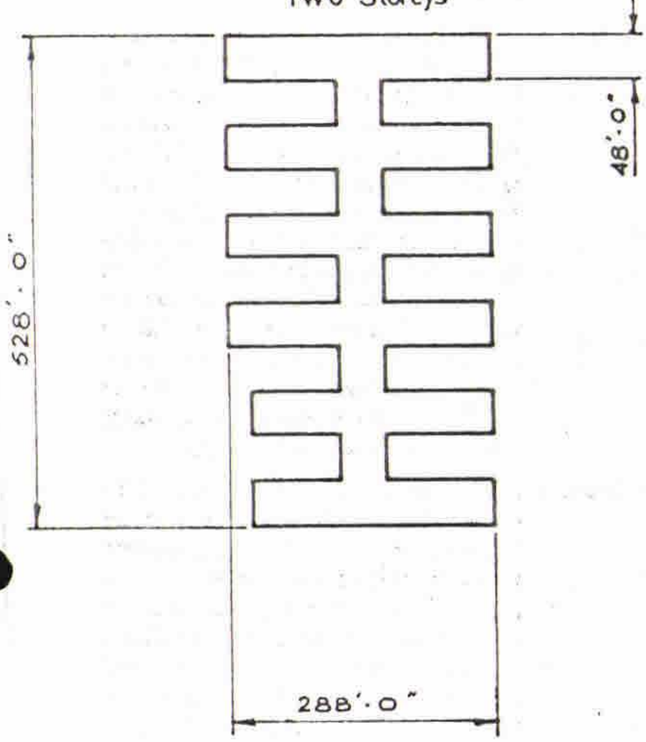
1 As an extension of the methodology of the cost studies in Appendix 2 (involving different shapes in four-storey construction) a further series of studies has been carried out taking a constant area of 184,320 sq. ft. and translating this into two, three and four storey development using the generic shape B (as Appendix 2). The plans indicated below thus represent the following floor areas proportional to the total floor area:

Two storey—92,160 sq. ft.
Three ,, —61,440 ,, ,,
Four ,, —46,080 ,, ,,

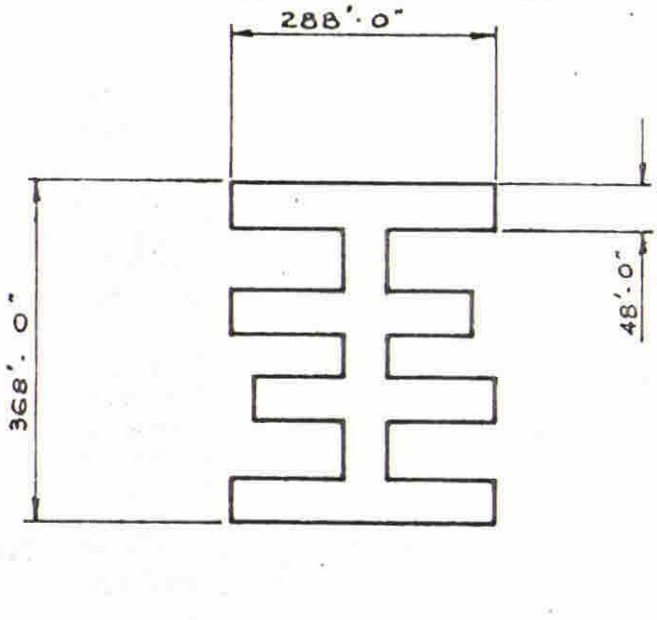
Four Storeys



Two Storeys



Three Storeys



Results

2 The comparative costs per square foot are shown in the following table in index form. (*Base 100 = total cost of two storey block*)

Element	2 storey	3 storey	4 storey
Foundations	3·1	2·3	1·9
Structures (including stairs)	25·1	24·9	25·2
Fitting-out	26·0	26·0	26·0
Engineering (excluding lifts)	30·0	30·1	30·1
Lifts	4·9	5·2	5·6
Builders' work in connection with Engineering and Lifts	1·7	1·7	1·7
Non-constructional items (Preliminaries etc.)	9·2	9·2	9·2
Totals	100·0	99·4	99·7

Interpretation

3 No general conclusions should be drawn from this particular cost/area study since it does *not* take into account the important effects of planning and policy decisions inherent in a specific scheme. The object of the exercise is to demonstrate methodology—that a multi-stage approach is necessary in order to isolate and separately adjust the particular parameters under consideration, for it is only by stabilising certain factors, ringing the changes on others and observing their effects on overall costs that the optimum solution in economic terms is capable of achievement.

Comment

4 This study represents the first stage only in such a multi-stage exercise as for instance in a series of pre-development control plan exercises on general shape aspects once the approximate area and site characteristics (e.g. soil conditions) have been broadly established. Certain basic parameters have been selected as a starting point, of which the more important are:

(i) A particular generic shape

(ii) Constant area

(iii) A particular comparative form of construction (in this case reinforced concrete frame to a 24′ × 16′ grid)

(iv) Constant content of "fitting-out" elements (both with regard to area and specification)

(v) A subjective, but otherwise consistent, assumption as to the requirements for vertical communications (stairs and lifts)

5 The next stage in any specific economic appraisal which Boards would have to undertake (before arriving at the actual development control plan layout) would be to critically examine certain factors and to explore alternatives. To stimulate ideas some of these further factors are now considered:

(i) *Shape* Is the generic shape selected valid throughout the storey range in the light of operational policy decisions (e.g. disposition of departments, distribution of supplies and general communications network etc.)?

(ii) ***Area*** A constant area has been assumed but in fact variations will occur throughout the storey range. Disposition of departments and operational policies will dictate the extent to which room sharing and similar space economies are possible. Plant rooms and other engineering spaces (e.g. ducts and shafts) may vary. Communications space tends to increase with height (e.g. fire escape stairs). The greater the number of storeys the more difficult becomes the problem of full space utilisation within a fixed perimeter unless layouts are repetitive (e.g. wards and residential accommodation).

(iii) ***Structure*** Alternative forms of frame should be examined particularly in the low-rise range where some form of lightweight structure may prove an economical proposition. Choice of grids may be dictated by the need for flexibility. Specification standards for the external envelope and degree of fenestration must be considered conjointly with maintenance and engineering implications in mind (e.g. heat loss). [It should be noted that even where the plan shape follows a generic form, as in this study, there will be a significant variation in "wall to floor ratio" over the storey range]. Foundation costs may largely influence the choice between low and medium/high rise when soil conditions are particularly unsuitable leading to abnormal structural requirements.

(iv) ***Fitting-out*** The various elements (e.g. internal partitions, doors, wall, floor and ceiling

finishes, fittings and the like), which form the internal components of the building, will obviously be effected by variations in area [see 5(ii) above]. They will also be influenced by planning decisions and repetitive variations of layout (e.g. stacking and concentration of sanitary facilities to minimise engineering service runs, internal drainage etc.).

(v) *Vertical communications* Although (as in this study) a reasonable assessment of vertical communications can be made in general terms, the specific requirements stemming from the disposition of departments and the operational policy decisions pertaining to general traffic movement may sometimes produce solutions having economic consequences (e.g. separate supply centre linked by sloping ramps to a two-storey development).

(vi) *General development* The ultimate selection of building shape and number of storeys must have regard to the particular site and should be considered against the total implications of *all* on-costs. [See SECTION A—paragraphs 16 and 17].

5.10 DESIGN DEVELOPMENT

INDEX


DESIGN DEVELOPMENT
BRIEF
EVALUATE ALTERNATIVE SITES
PRODUCE OUTLINE DCP (POSSIBLY FOR MORE THAN ONE SITE
DETERMINE OUTLINE OF FUNCTIONS AND FUNCTIONAL CONTENT
DECIDE PHASING
ACCEPT OR AMEND PLANNING DATA (ACTIVITY DATA)
OBTAIN BROAD COSTS OF EQUIPMENT
FINALISE BUILDING AND ENGINEERING COSTS
DECIDE PHASED STAFFING REVENUE AND EQUIPMENT COSTS
FINALISE DEVELOPMENT CONTROL PLAN
SET UP PROJECT TEAM
PRODUCE MANAGEMENT CONTROL PLAN
DESIGN
ESTABLISH PROJECT COST CONTROL PLAN AND SYSTEM OF COST CHECKS
CHECK COSTS
ESTABLISH SITE LAYOUT SERVICES LAYOUT STRUCTURAL GRID
DEVELOP SITE SERVICES LAYOUT
PROCESS SELECTED ROOM DATA SHEETS ESTABLISH 1/200 DESIGN LAYOUT PLAN
SELECT STRUCTURAL SYSTEM
COMPLETE SET 1/200 OUTLINE PLANS, SECTIONS AND ELEVATIONS
SELECT MANAGEMENT SYSTEM
PROCESS ROOM DATA TO OBTAIN 1/50 PROJECT ROOM LAYOUTS 1/50 WHOLE PROJECT
PREPARE PROJECT DESIGN DRAWINGS
SELECT COMPONENTS FINALISE 1/50 PROJECT DRAWING PROJECT ROOM DATA SHEETS DESIGN STAGE SCHEDULES
START DRAFTING PROJECT REPORT
ESTABLISH DESIGN COSTS
PRODUCTION
DEFINE OUTPUT OF PRODUCTION SUB-SYSTEM IN DETAIL INCLUDING PLAN OF WORK
PREPARE 1/100 PROJECT AND ENGINEERING DRAWINGS
PREPARE 1/50 AND 1/20 ENGINEERING DRAWINGS
PREPARE ENGINEERING SCHEDULES
PREPARE KEY BASE AND LOCATION DRAWINGS
SELECT JUNCTION DETAILS
UPDATE MASTER SCHEDULES
CONSTRUCTION
UPDATE PROJECT COST DOCUMENTATION
COLLATE AND SELECT TENDER DOCUMENTS
SUBMIT PROJECT TO TENDER APPOINT CONTRACTOR
TENDER INVITATION ACTION
PREPARE BILLS OF QUANTITIES SORTATIONS ETC.
OBTAIN NOMINATED SUB-CONTRACTORS PRELIM CONFIRMATION PRODUCE NOTIONAL PROJECT CONSTRUCTIONAL WORK PLAN
PREPARE ENGINEERING BILLS OF QUANTITIES SELECT SUBCONTRACTOR
CONTRACTOR / SUBCONTRACTOR
CHECK AND DISCUSS DRAWINGS BILLS OF QUANTITIES ETC.
PROCESS BILLS OF QUANTITIES SORTATIONS ETC.
PRODUCE MASTER CONSTRUCTIONAL PROGRAMME WITH REFERENCE TO SUBCONTRACTORS
CHECK AND DISCUSS ENGINEERING BILLS OF QUANTITIES ETC.
APPOINT NOMINATED SUBONTRACTORS
ORGANISE PROJECT SITE MANAGEMENT SITE USAGE
CHECK SUBCONTRACTORS PERFORMANCE
REVIEW VARIATIONS
REVIEW SUBCONTRACT ORGANISATION
REPORT AND FEEDBACK INFORMATION
PRODUCE MAINTENANCE MANUAL UPDATE PRODUCTION DATA
OBTAIN COMPLETION CERTIFICATES
SET UP COMMISSIONING TEAM
ESTABLISH STAFF RECRUITMENT PLAN
ALLOCATE RESOURCES ETC.
UPDATE EQUIPMENT SCHEDULES FROM ROOM DATA SHEETS
ESTABLISH COMMISSIONING WORK PLAN
RETRAIN AVAILABLE STAFF APPOINT STAFF REQUIRED PRIOR TO BUILDING OPERATIONAL
PREPARE FOR OFFICIAL OPENING
RECEIVE AND TEST GROUP IIa EQUIPMENT
EXAMINE EQUIPMENT SCHEDULES PHASE PURCHASING AND DELIVERY
PLACE ORDERS FOR EQUIPMENT
COMPLETE PROJECT REPORT
WRITE PROJECT STAFF JOB MANUALS
OFFICIAL OPENING CEREMONY
TAKE OVER OF ENGINEERING MAINTENANCE PREPARE BUILDING MAINTENANCE GUIDE
COMMENCE BUILDING MAINTENANCE
RECEIVE CHECK DISTRIBUTE EQUIPMENT PRODUCE INVENTORY AND COSTS
COMMISSIONING

FIGURE 5.10A

DESIGN DEVELOPMENT

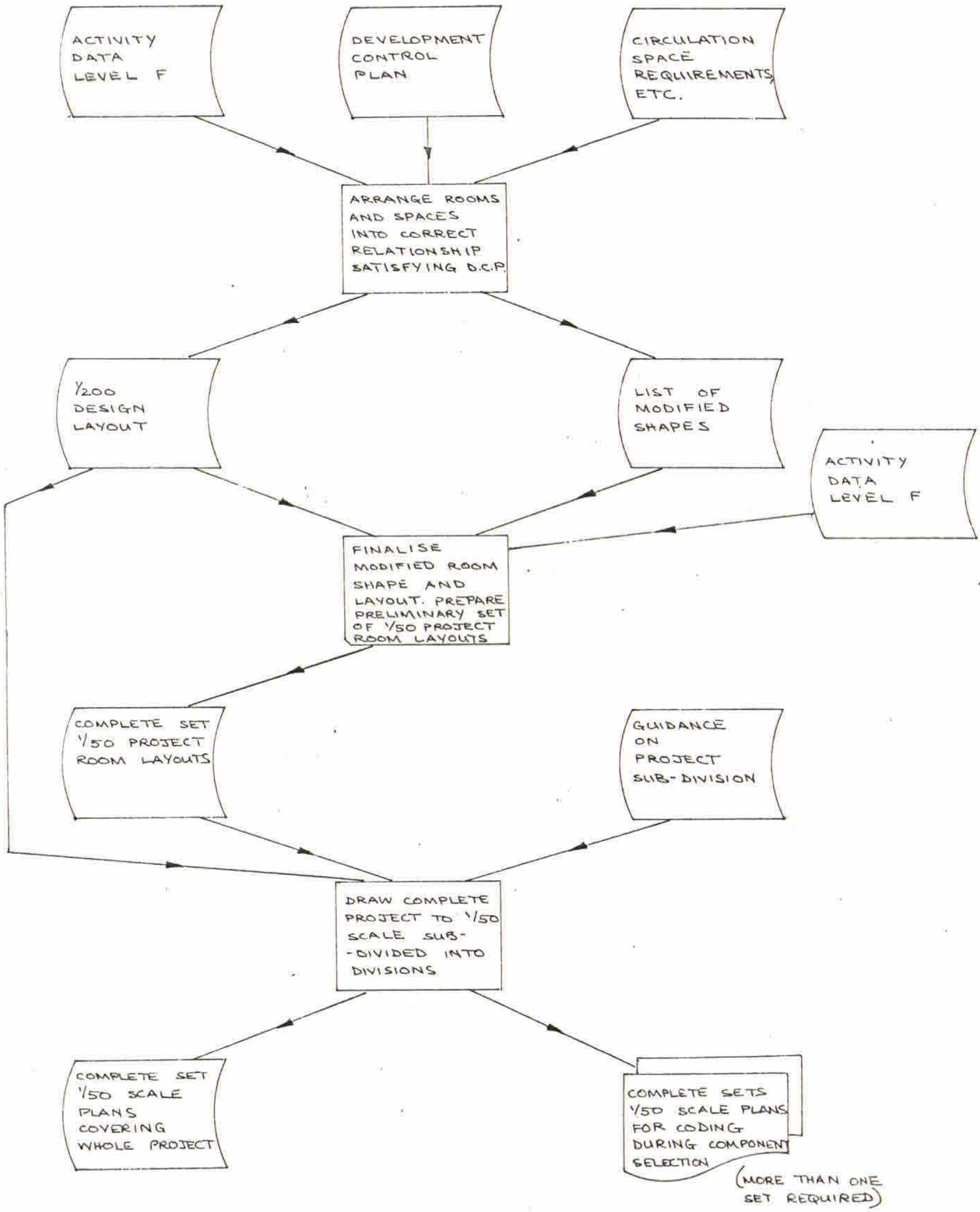


FIGURE 5.10B

DESIGN DEVELOPMENT

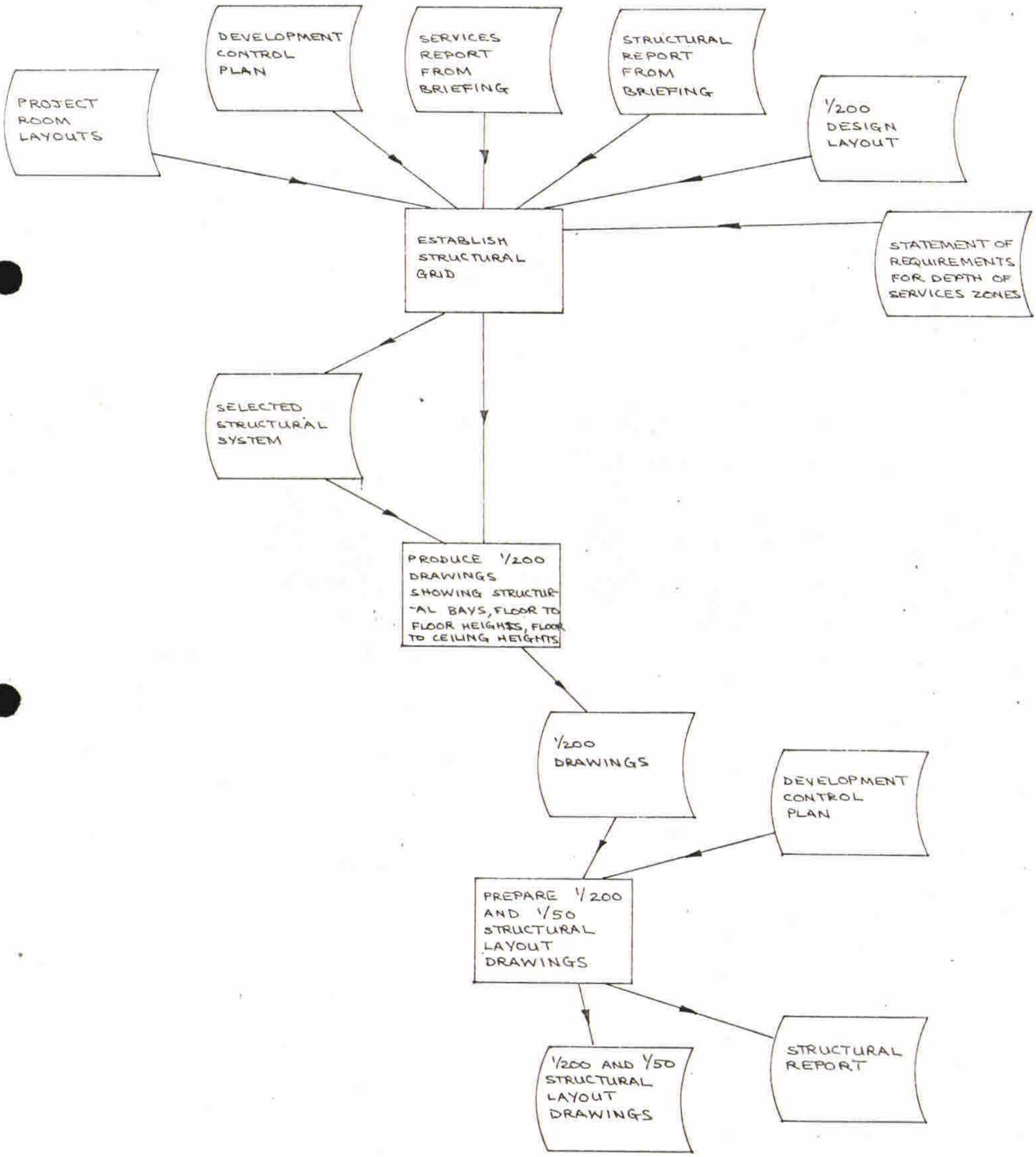


FIGURE 5.10C

DESIGN DEVELOPMENT

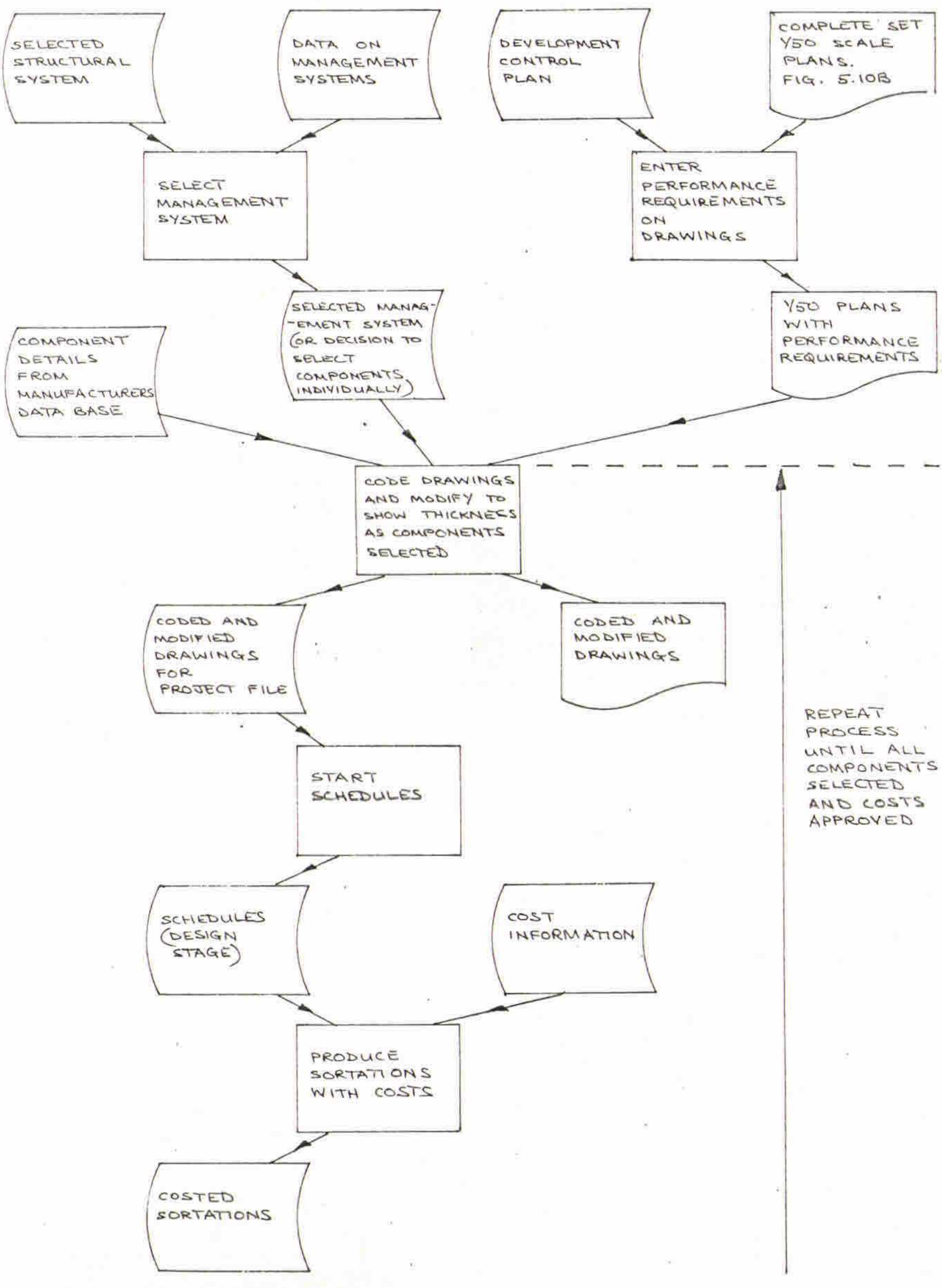


FIGURE 5.10D

DESIGN DEVELOPMENT

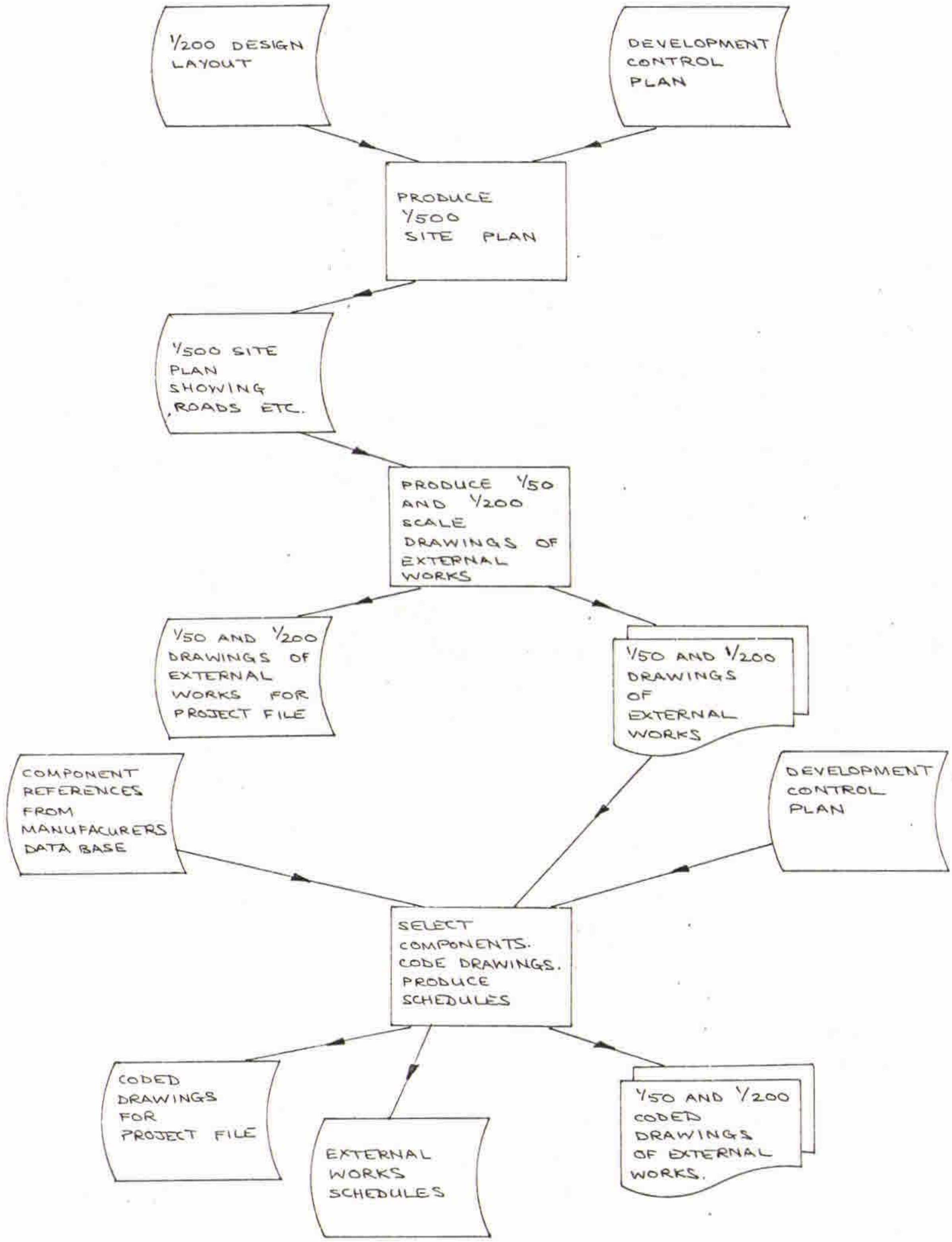


FIGURE 5.10E

DESIGN DEVELOPMENT

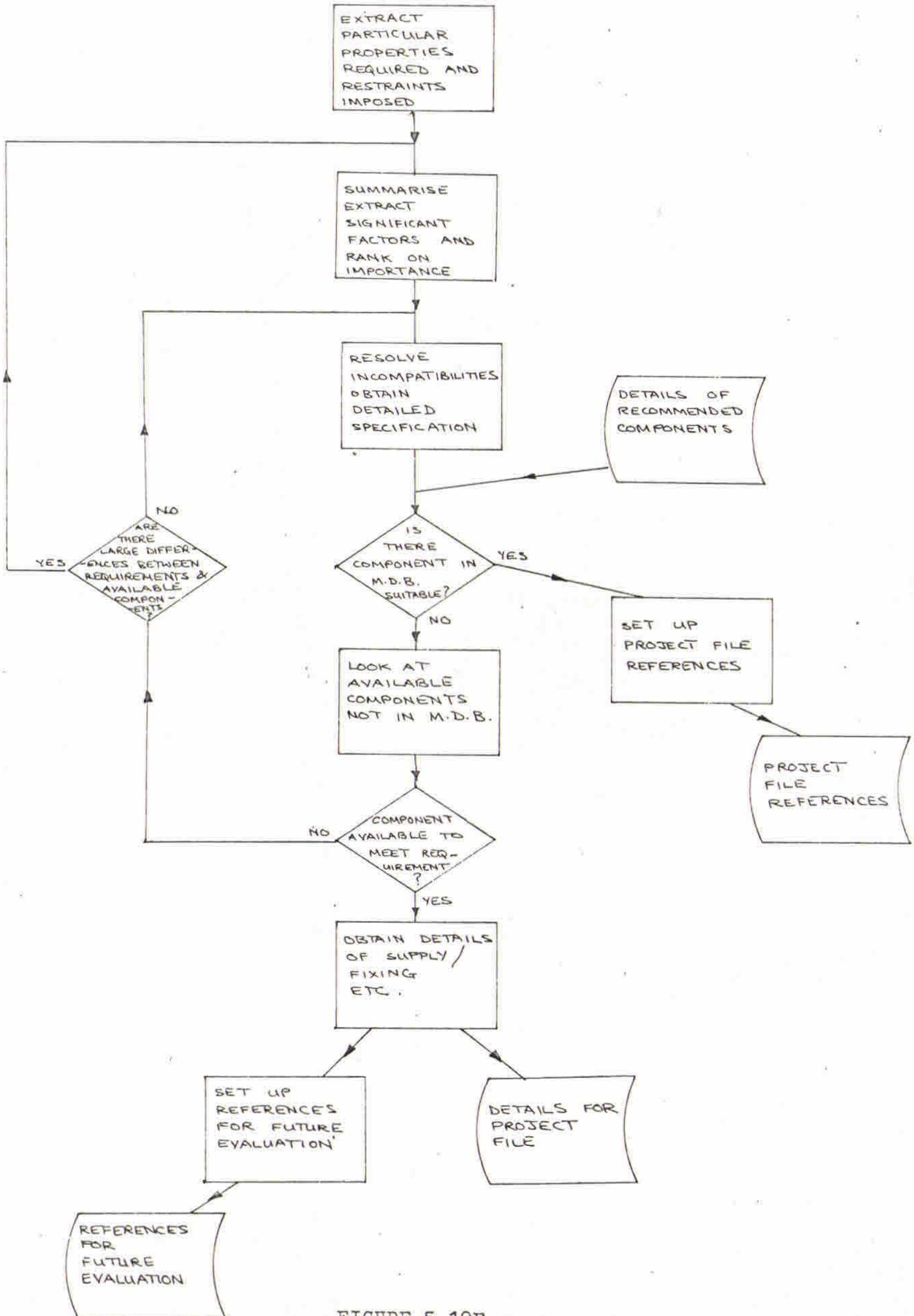


FIGURE 5.10F

5.10.1 In CUBITH, the term 'design' refers to the processing of the briefing material, particularly the Development Control Plan, to produce the physical shape, content and constructional consequences required for the building. The aim is, that by the end of the design stage, all decisions will have been made in sufficient detail for production documentation to proceed smoothly.

5.10.2 During the Design Development phase, the overall site layout and the structural framework must be established. The rooms and spaces must be arranged in correct relation to each other and the engineering services, and all must be chosen so that the functional requirements for all the departments are met within the limitations detailed in the Hospital Building Programme.

5.10.3 The design work is central to each project, and CUBITH has been devised to ensure that an optimum design is obtained whilst design time and repetitive work are minimised. The system requires that:

a) the processes involved in each task, and their inter-dependence and interaction, are identified

b) the input and output required for each task, and the resulting data flow, are clearly stated

c) the data on which design decisions depend is assembled in an easily accessible form

d) components which form compatible systems are grouped together

5.10.4 This structuring of the design work means that tasks requiring different approaches and facilities can be more easily identified. For example, repetitive tasks can be isolated; those for which analytical solutions exist noted; and those where the designer must make fundamental creative decisions described.

5.10.4 cont. A number of studies have recently been published, describing and structuring design processes, and these are summarised in MPBW Design Note (1969) Appendix 8. Markus (1967) discusses the two distinct structures which can be recognised:

a) a series of sequential phases which attempt to regulate the development of a design e.g. the tasks in the CUBITH System

b) iterative and cyclic processes which sppear within most stages of (a).

5.10.5 The MPBW Design Note quotes Levin as describing 'how, in producing solutions, the designer performs an iterative sequence of operations, usually starting from those identified parameters or variables which offer the least room for manoeuvre. He suggests that the difficulty of reaching optimum solutions directly necessitates the generation of a wide variety of solutions (to be sure of including a good one), and requires the ability to recognise and select that good one'.

5.10.6 Iterative processes will be necessary within many of the tasks described below, although the pre-sorting and evaluation of components before they are added to the Data Base, and their assembly into Management Systems, will greatly reduce the undefined areas and work required. Figure 5.10F shows a simple iterative process - the selection of a non-standard component

5.10.7 When the 1/200 layout plan is complete, a cost check is made. Indeed, throughout the design stages, accurate checks must be made to ensure that the design is developed within the costs laid down. When these checks are completed satisfactorily the room data is processed to give a preliminary 1/50 set of project room layouts, sub-divided into divisions which will be valid throughout the project. More than one set of these drawings are required at this stage so that they can be coded as the components are selected. (See Figure 5.10B)

5.10.8 While the 1/50 room layouts are being finalised, the structure grid and engineering services layout can be established. The ease of distributing services within the building; the provision of lifts, stairs, service ducts, air conditioning, etc; noise, thermal insulation, maintenance procedures, and the availability of the materials chosen, are all factors which, together with the net cost, must be taken into account when the structural system is selected. Thus the latter is closely inter-related to the engineering services, and is chosen from the range of assemblies provided by CUBITH, to give the optimum solution to this design problem. As the CUBITH System develops and projects are completed, these assemblies will be evaluated and updated. Thus the designer of a particular building will have at his disposal experience accumulated from previous solutions to problems similar to his own.

5.10.9 When the structural system has been selected, 1/200 drawings can be prepared, showing structural bays, floor to floor heights, and floor to ceiling heights. From these drawings and the development control documentation, including the site survey, 1/200 drawings for the whole project, 1/50 drawings showing structural details, and the structural report, can be produced. (See Figure 5.10C).

5.10.10 The selection of a structural system leads to the choice between using a Management System or selecting components individually. When this choice has been made and the 1/50 set of plans for the complete project is ready, then detailed component selection can start. If a Management System is being used, the process is simplified, because the designer does not have to check the compatibility of individual components.

5.10.10 cont. Performance requirements are first entered on the 1/50 drawings, and components to meet these are selected from those of recommended manufacturers. As each component or assembly is selected, its code is entered on the drawings, which are modified to show the thickness of walls and partitions. During this selection process, factors may emerge which necessitate the investigation of alternative design solutions and the consideration of modifications. It is thus vital that areas which impinge on each other, and modifications with wide-ranging effects, be easily identifiable. As soon as selection commences, schedules can be drawn up. The partially completed and preliminary schedules must be sorted, since cost checks are made throughout the selection process. Because components are selected at this stage, manufacturers for the supply and erection of all parts of the construction can be nominated and given early advice of future requirements. (See Figure 5.10D).

5.10.11 The production of the drawings of the external works is another responsibility of the Design Team. (See Figure 5.10E). From the 1/200 design layout and the Development Control Plan, a 1/500 scale site plan is prepared, showing roads, car parks, etc. Using this as a basis, 1/50 and 1/200 scale drawings of the external works are produced. The components are then selected from those recommended, the drawings coded accordingly, and the schedules for the external works obtained.

5.10.12 When all the processes described in the preceding paragraphs are complete the full set of design drawings can be finalised.

These comprise:

1/200 basic project drawings
1/500 site layout plan
1/50 and 1/200 external works design drawings
1/100 services site plan) see Engineering
1/100 services distribution drawings) Sub-system
1/200 structural layout drawings
1/50 structural detail drawings
1/50 complete set project drawings

5.10.13 The following references relate to the work of the Design Development Sub-system.

a) Ministry of Public Building and Works - 1969 - Computer Aided Architectural Design - Part 1: Reports of three working groups

b) Levin, P.H. - 1966 - The design process in planning Town Planning Review, 37, (i), 5-20

c) Markus, T.A. - 1967 - The role of building performance measurement and appraisal in design method Architect's Journal, 20 December

d) Turin, D.A. - 1968 - Building as a process Trans. Bart. Soc. 6, 1967-8 (University College, London).

5.11 PRODUCTION DRAWINGS

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PRODUCTION DRAWINGS

FIGURE 5.11A

PRODUCTION DRAWINGS

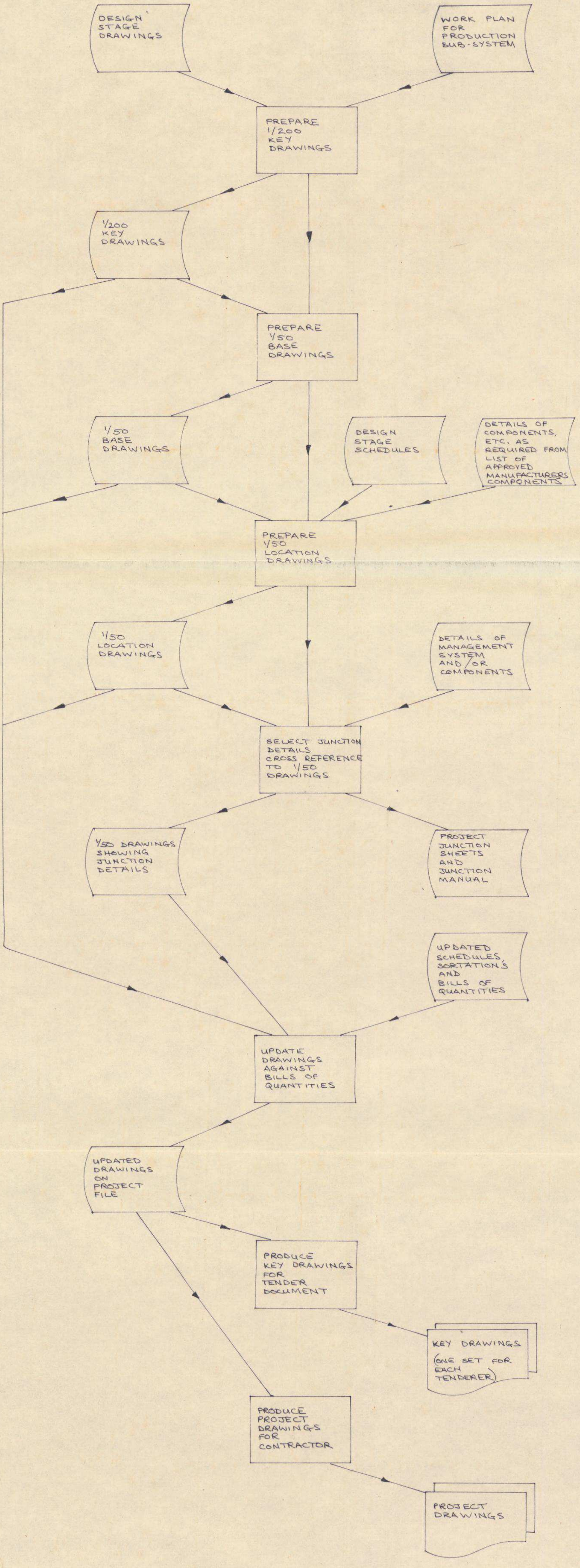

FIGURE 5.118

PART OF KEY LOCATION DRAWING

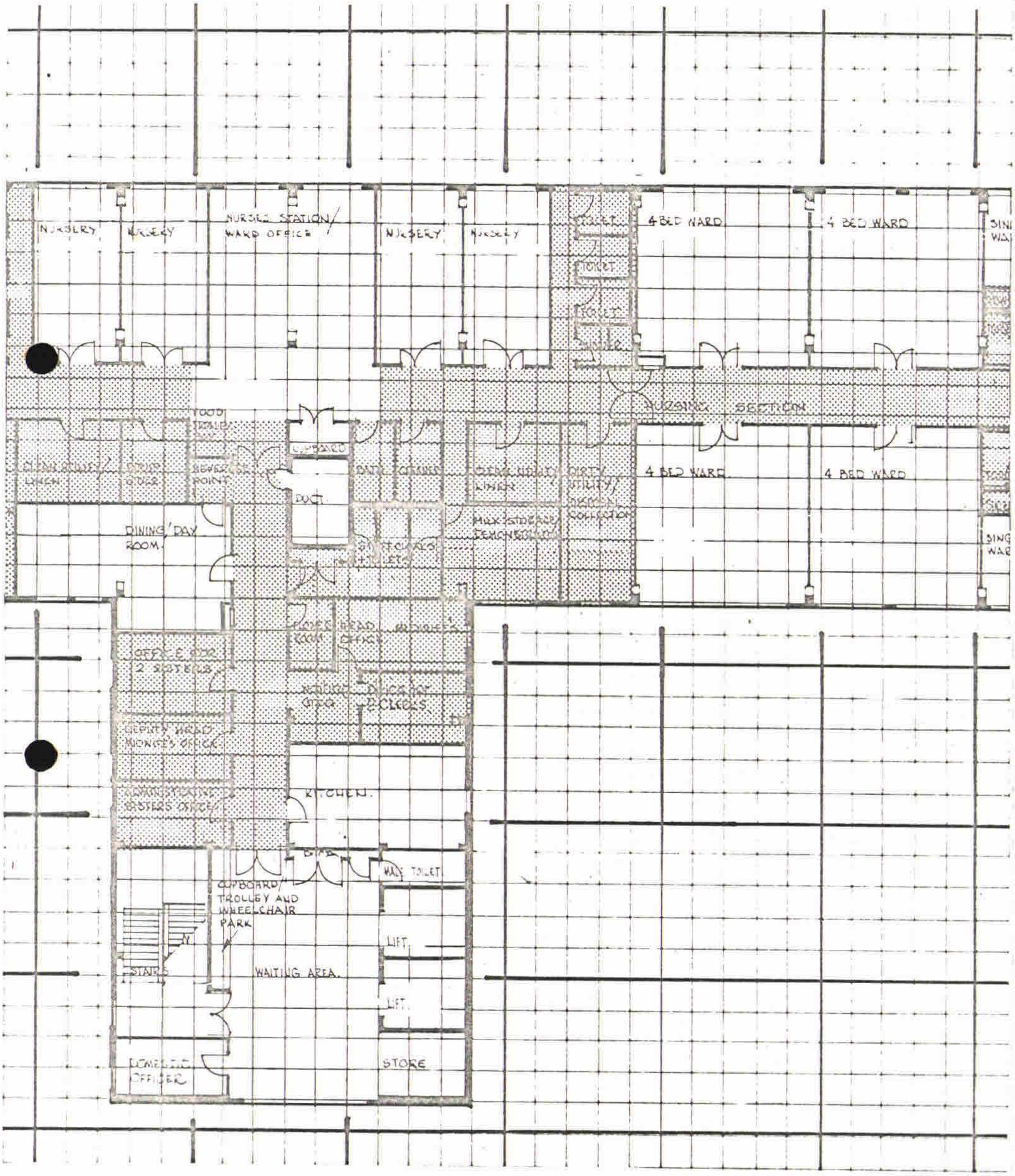

FIGURE 5.11C

PART OF 1/50 CODED DRAWING

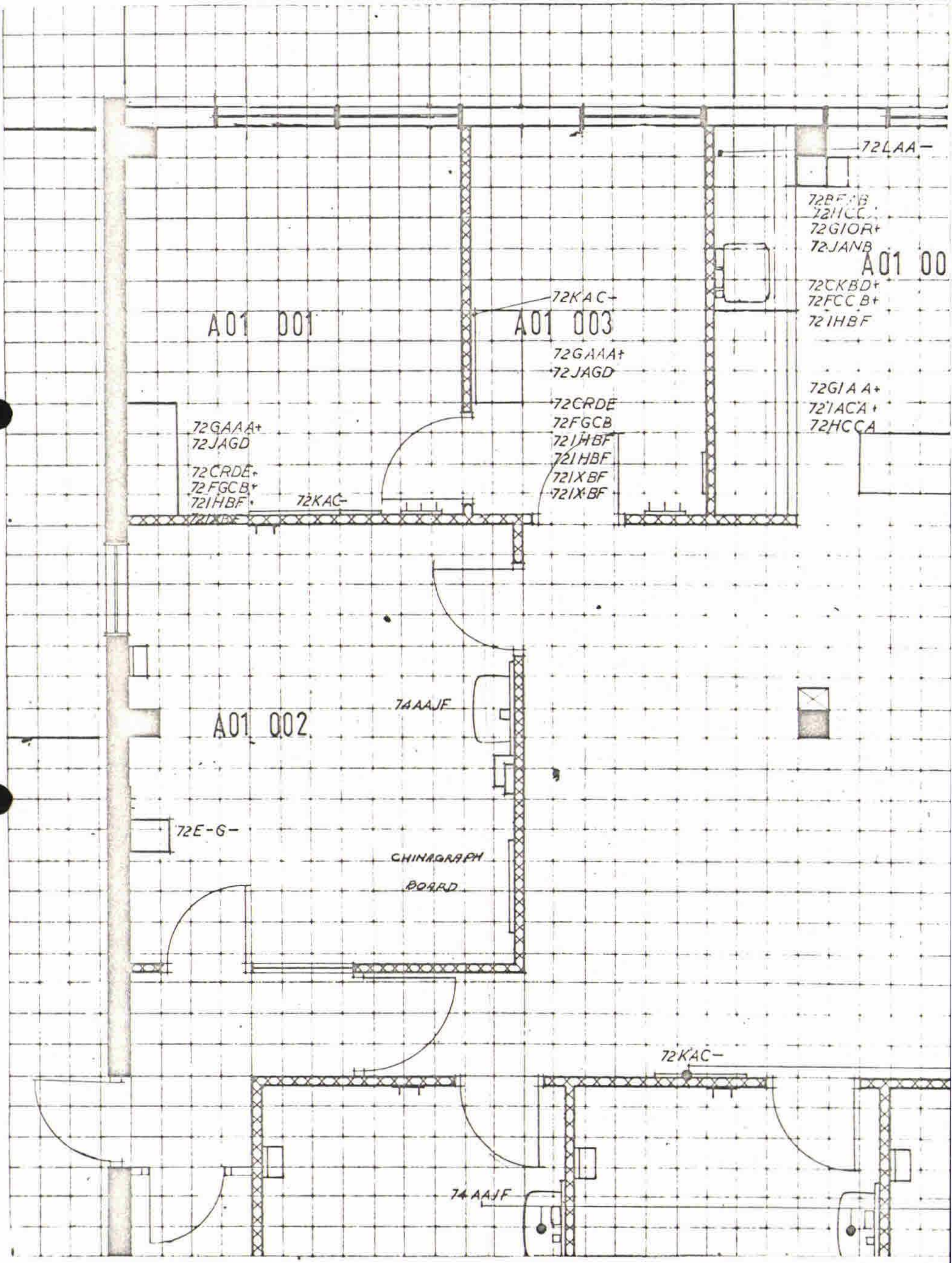

FIGURE 5.11D

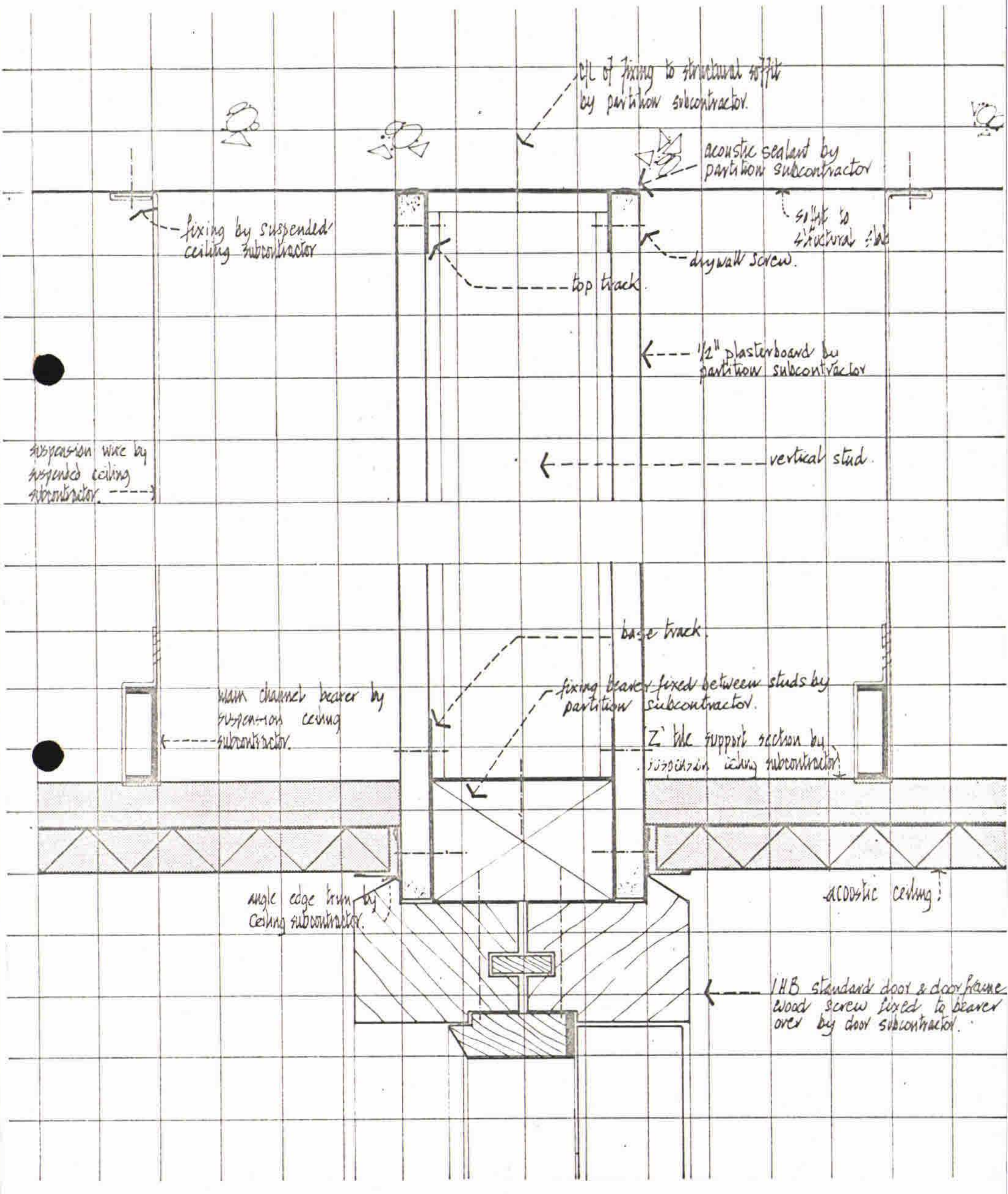
C/L of fixing to structural soffit by partition subcontractor.
acoustic sealant by partition subcontractor
fixing by suspended ceiling subcontractor
soffit to structural slab
drywall screw.
top track.
1/2" plasterboard by partition subcontractor
suspension wire by suspended ceiling subcontractor.
vertical stud.
base track.
main channel bearer by suspension ceiling subcontractor.
fixing bearer fixed between studs by partition subcontractor.
'Z' tile support section by suspension ceiling subcontractor.
angle edge trim by ceiling subcontractor.
acoustic ceiling.
IHB standard door & door frame wood screw fixed to bearer over by door subcontractor.

FIGURE 5.11E

5.11.1 This sub-system follows on directly from the Design Development Sub-system. It is concerned solely with processing the drawings, all the detailed design decisions having been taken.

5.11.2 The drawings produced by the Design Development Sub-system, and listed in paragraph 5.10.12, are processed by this sub-system to give:

1/200 key drawings
1/50 base drawings
1/50 location drawings
1/50 drawings showing junction details
1/100 engineering distribution drawings) see Engineering
1/50 engineering drawings) Sub-system
1/20 engineering drawings)

5.11.3 These drawings, and the associated documentation, are prepared bearing in mind the methods used by the contractor and sub-contractors during construction. They describe fully and clearly the part played by each, with a minimum of extraneous information. The data is divided in such a way that, at all stages, each person has information relevant to the job in hand in an easily appreciated form. This assists both those undertaking the constructional work, and those concerned with management control of the project.

5.11.4 As in the systems described earlier, pre-packaged constructional elements (component assemblies and junctions), and conventions for setting out graphic material (e.g. common plan levels for building and engineering data), are fully developed.

5.11.5 Although most of the production drawing will be much more straightforward than that in the Design Development System, there must be ample facilities for interative processes, updating of earlier drawings, and assessment of the modifications required to encompass a particular alteration so that necessary changes can be fully evaluated and easily implemented.

5.11.6 Figure 5.11C is an example of a key location drawing. Figure 5.11D is an example of a 1/50 drawing coded for sanitary fittings. (This would be coded for other types of fitting as well, so that a number of coded drawings are produced from one 1/50 drawing). Figure 5.11E is an example of a building assembly detail.

5.12 ENGINEERING

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ENGINEERING

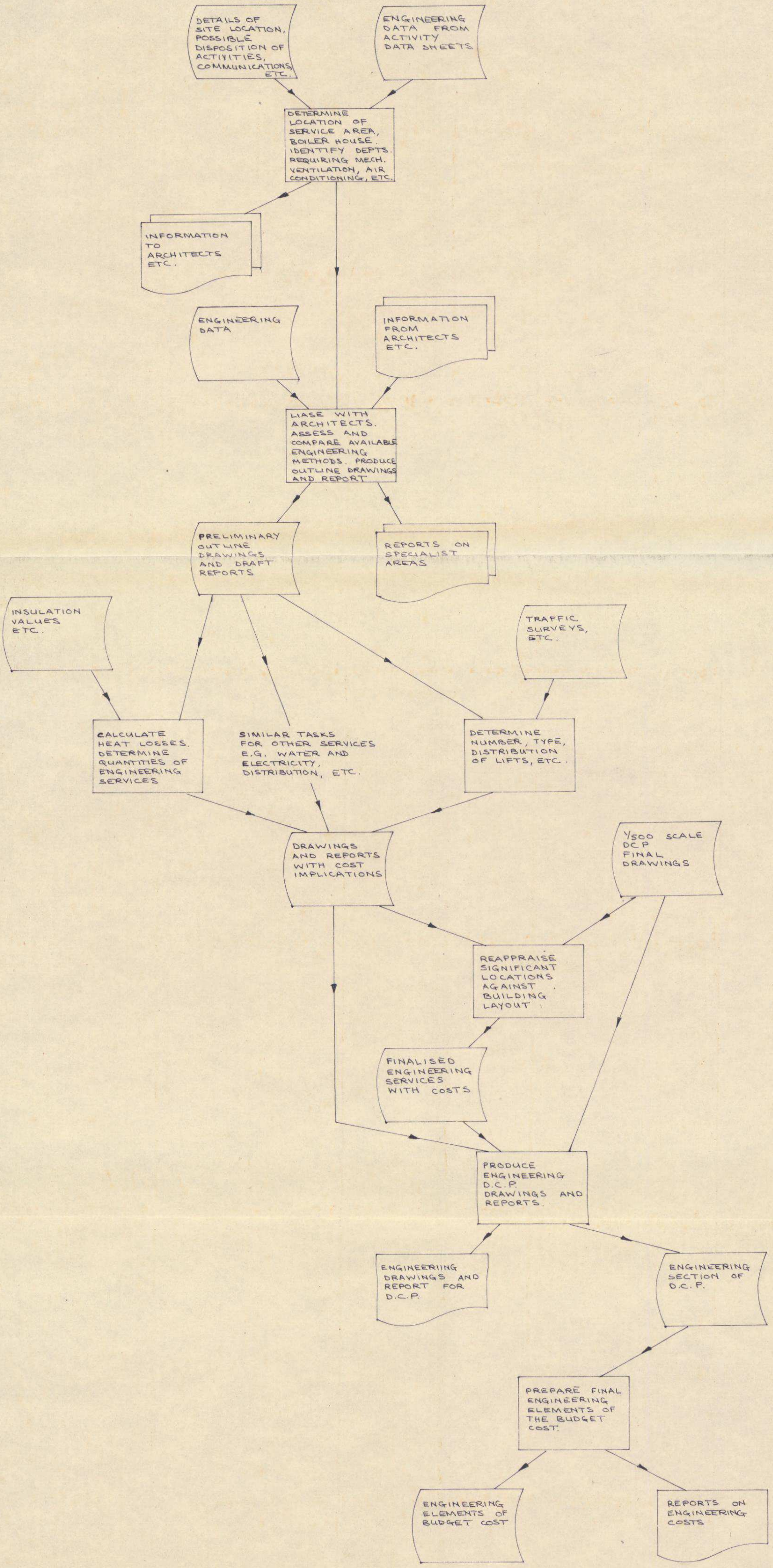
FIGURE 5.12A

THE ENGINEERING SYSTEM

FIGURE 5.12B

ENGINEERING TASKS ASSOCIATED WITH THE DEVELOPMENT CONTROL PLAN

FIGURE 5.12C



PART OF 1/50 ENGINEERING DRAWING CODED

FOR LIGHTING INSTALLATION

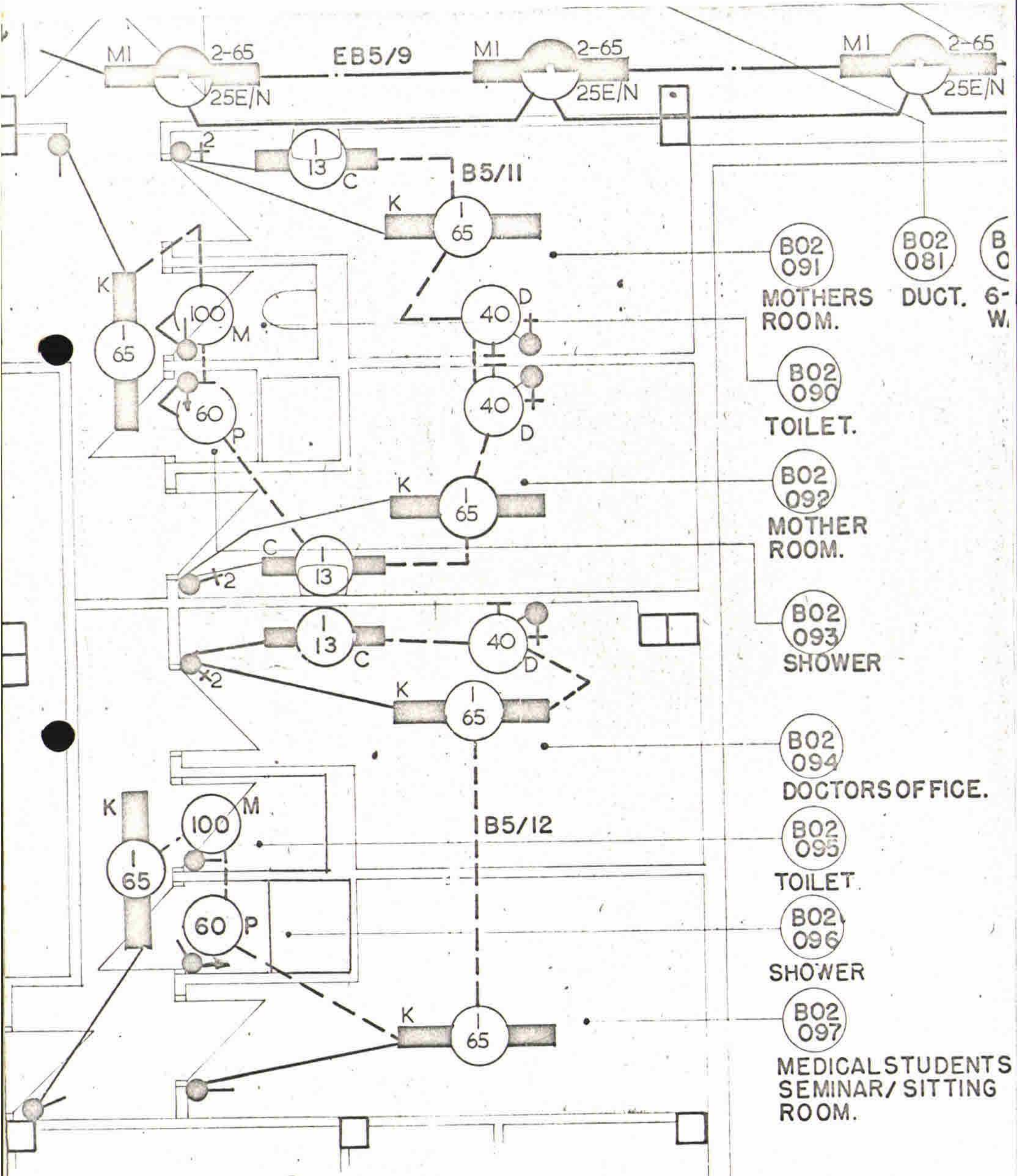


FIGURE 5.12D

APPENDIX 2

Outline of engineering requirements check list of contents of report

1 Key Service Departments

(a) Boiler House:

(i) Boilers: Number, type, operating pressure, maximum continuous rating.

(ii) Fuel: medium, proposals for storage and handling.

(iii) Mechanical stokers/oil burning equipment: brief details.

(iv) Instrumentation: brief details.

(b) Laundry: Output. Hospitals to be served indicating type and number of beds. List of fixed equipment and mechanical handling arrangements not covered by B.N. recommendations.

(c) Workshops: Number of beds at location. Total area proposed. Number, category and area for trade. List of fixed equipment.

(d) Kitchen: Number of meals. List of fixed equipment not covered by B.N. recommendations.

(e) C.S.S.D.: Number of beds served. List of fixed equipment not covered by B.N. recommendations.

2 Other Departments

(a) Building Note Departments:

(i) Description of the environmental design conditions, if differing from B.N. recommendations.

(ii) Details of additional engineering proposals.

(iii) Details of on-cost items [see paragraph 3(a) below].

(b) Non-Building Note Departments: A general report indicating the environmental design conditions required and brief details of each service proposed e.g. heating, lighting, ventilation etc.

3 On-costs

(a) Abnormal Engineering: Details of increased content or of special requirements brought about by site factors, building shape and height. These details should be provided under each service giving the location of the increased content or special requirement.

(b) Lifts: Number, type, contract load, contract speed.

(c) External Works:

(i) Steam Supply: locations to be served.

(ii) Calorifier Plant: location, type, rating/capacity.

(iii) Heating and Hot Water Supplies: details of any special distribution or control arrangements for departments not in use at night time or week-ends.

(iv) Town Gas Supply: brief description indicating accommodation to be served and metering proposals.

(v) Medical Gases, Suction, Compressed Air: Details of central arrangements.

(vi) Cold water: main storage (location and content). Water pressurisation and water treatment (extended and need).

(vii) Fire Fighting: description of proposals.

(viii) Sewerage/Pumping Plant: proposals associated with drainage.

(ix) Incinerators: type, description.

(x) Boiler House Chimney: height, number of flues proposed.

(xi) Electricity:

(a) Incoming Supply: pressure, number and cross section area of feeders, termination points, metering.

(b) Distribution: number and location of sub-stations and inter-connecting arrangements. Type and capacity of transformers. Method of distribution e.g. ring, radial. Type and cover section areas of extra high voltage and medium voltage cables. Metering arrangements.

(c) External Lighting: number and type of fittings.

(d) Stand-by Supply: type of provision, capacity, method of operation.

Notes:

(a) A brief description is required of proposals for accommodating distribution mains external to buildings and between departments within buildings.

(b) The report need not contain details of boiler plant and associated requirements if it is to be accompanied by an economic appraisal on the choice of fuel.

(c) Details of additional engineering proposals are required in the Report. It will be necessary for the cost of additional engineering (e.g. extra ventilation), whether referred to as such in Building Notes or brought about by clinical or other user needs, to be met within the allowance provided in the Department Cost and Area Guide (see HBPN 6).

FIGURE 5.12E

5.12.1 The Engineering Sub-system is closely linked to the Development Control Plan, Design Development and Production Drawings Sub-systems and uses the same conventions (e.g. common plan levels for building and engineering data) and techniques (e.g. engineering assemblies to economise on site labour). When the full CUBITH system operates, much of the data required for engineering will be collected in a standard form. This will:

a) reduce the work of the project team by offering a variety of solutions to the requirements for service integration

b) provide effective and suitable integration of services with each other and with the building fabric

c) ensure significant increase in certainty of engineering consequences during the briefing and design stages

d) provide for the rationalisation and classification of a range of engineering services, from a system suitable for a whole project to the details of components and junctions

e) enable systematic engineering techniques to be adopted throughout the whole CUBITH system

f) provide for the prediction of the cost and constructional consequences arising from alternative requirements and design decisions

g) provide, during the construction of the project, data which defines these solutions in physical terms relating to the components of the building in which the services are being installed.

5.12.2 During the briefing stage, the Development Control Plan is prepared, and this calls for close co-operation between the engineer, architect and quantity surveyor. Hospital Building Procedure Note 5 - The Development Control Plan - states 'During the production of diagrams and layouts, the engineer will advise on the impact of proposals on engineering design and the related capital and revenue costs. Factors affecting engineering include the location of energy conversion centres, average thermal insulation values, and orientation and shapes of buildings, especially when mechanical ventilation or air conditioning will be in continuous use because of deep planning or the provision of a sealed environment. The disposition and design of lifts and other mechanical conveyors required to satisfy operational requirements will need to be determined and separate graphic or cost studies may be needed. The engineer will be studying the requirements for utility services and their distribution routes and making a technical and cost appraisal of the choice of fuel for steam raising, etc.'

5.12.3 Appendix 2 of this Hospital Building Procedure Note, reproduced as Figure 5.12E, gives a check list of the major items which should be covered in the report, prepared by the engineer, to supplement the Development Control Plan.

5.12.4 Development Control Plans will be drawn to a scale of 1/500 (see Para. 5.5 - Development Control Plan) and, to avoid excessive complication, the engineering services will be shown on separate drawings. From these the engineering elements of the budget cost will be prepared on the basis of linear measurement and unit rates for specific items of plant (see Figure 5.12B).

5.12.5 The engineering services will be determined from the selected activity data in a similar way to the building fabric and layout. Engineering data (i.e. that which has implications for demands for engineering services and realisation) is held at the same seven levels as that having spatial implications (see para. 5.6 on Activity Data) e.g.

Level G	Activity Units (Engineering)	data presented by graphics and schedules defining the engineering services required for the accomplishment of a specific activity or number of related activities

Each level of data is sub-divided, grouped in order of the space requirements within the building fabric.

These sub-divisions are:

a) air conditioning
b) heating
c) water supplies
d) waste, soil and rainwater (disposal)
e) supplies (vehicles)
f) refuse (disposal)
g) piped gases and special services
h) lighting
i) power
j) communications
k) protection
l) special apparatus, e.g. cooking appliances

5.12.6 The data on integrated engineering services will be held in the eight levels given below. That required for a particular project is selected by reference to the demands generated by reference to the Activity Data.

Level A	System	data details and procedures relevant to the integration of a complete system, i.e. concerned with the integration of services as a whole with the building fabric

5.12.6 cont.

Level B	Assembly	data relevant to a group of elements or components, i.e. concerned with the integration of composite groupings of components or elements with a management system (if applicable). An example of this is: a panel mounted sanitary fitting e.g. a lavatory basin
Level C	Element	data relevant to an integrated service having its own function and identity. Examples are: a) waste pipes within partitioning b) medical gas services within glazed screens
Level D	Component	data relevant to a compound integrated unit. An example is: the integration of a light fitting with ceiling tiles
Level E	Sub-component	data relevant to the parts of a component. In most cases these are subject to restraints on their performance and characteristics which do not lie within the sphere of Integrated Service data and thus this level of data will rarely be used
Level F	Junction	data relevant to an individual integrated situation between a service installation and building fabric. Examples of this type of data are: the integration of a light switch with a partition the method of installing conduit at the junction of two partitions
Level G	Work-piece	data relevant to a constructional situation; information which enables the physical execution of the integrated work. Examples are: a) details of fixing methods to be employed in installing a suspended light fitting b) the method of joining the outlet of a WC pan to the soil pipe

5.12.6 cont.

Level H	Material	data relevant to a material, dealing with the materials of integrated components An example is: the materials used in the construction of panel mounted sanitary fittings

5.12.7 During the design stage, systems similar to those described in para. 5.10 on Design Development will be required, standard information being used as follows:

a) to determine restraints imposed by the integration of the services with the fabric of the building, e.g. the effect of using panel recounted sanitary fittings on the size and shape of particular rooms, and the effect on overall planning of running waste pipes in partitions

b) to identify detailed design constraints and to select all necessary junction details, etc.

5.12.8 Again, the engineering part of the production phase will be similar to that described in para. 5.11 on Production Drawings, the output from this part of the system being

1/100 engineering distribution drawings
1/50 engineering drawings
1/20 engineering detailed drawings

Figure 5.12D is an example of a 1/50 engineering drawing coded for lighting installation.

5.12.9 Throughout all these stages there must be close collaboration between all the disciplines working on the project, so that modifications to one part of the system are immediately available to the whole project team.

5.12.10 Engineering schedules are produced at the end of the production stage in a similar way to the building schedules.

The basic standard engineering information and that for a particular project will be organised so that the following sortations can be provided:

Central plant, local plant and service cores distribution networks (engineering assemblies) terminals (elements, components, sub-components) installation and maintenance requirements

5.12.11 A list of engineering sub-contractors prepared to tender is obtained in the same way as for the main contractor (see para. 5.14 on Tender Action and Contracts and figure 5.14B). The two appointments follow similar procedures, the engineering sub-contractor being appointed first.

5.13 SCHEDULING

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SCHEDULING

FIGURE 5.13A

SCHEDULING AND COMPONENT SELECTION

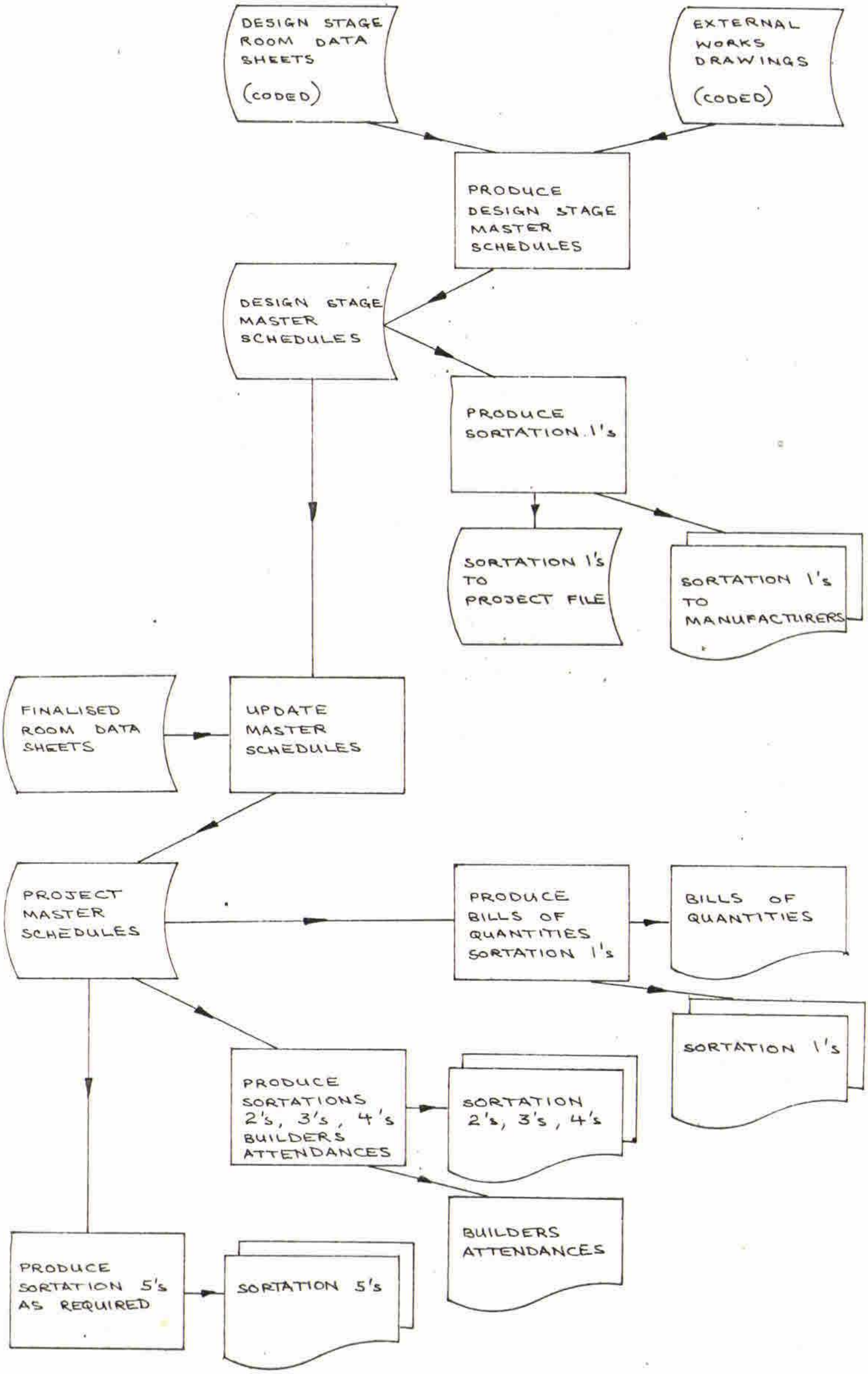

FIGURE 5.13B

5.13.1 In the CUBITH System, the master schedules are obtained by taking-off components, etc. from the coded project room data sheets (Activity Data, Level F) and the external works drawings. At the end of the design stage this part of the project design will have been finalised into references to standard room data sheets supplemented, where necessary, by non-standard details. These, and the external works drawings will have been coded after the decision has been made where, and whether, to use a management system. From this data the master schedules can be obtained. Sortation 1's, i.e. bulk sortations, are obtained from these design stage master schedules and sent to the manufacturers (nominated sub-contractors) to give them advance notice and approximate dates for delivery.

5.13.2 The master schedules are updated when the production drawings are completed but the facility to update them must be available throughout the construction stage so that manufacturers' and/or contractors' variations can be accommodated.

5.13.3 Bills of quantities, various sortations, builders attendances, etc. are all obtained from the master schedules.

The main sortations are:

Sortation 1's - similar items bulked together
2's - by delivery date
3's - by location
4's - by room
5's - special sortations required by the contractor

Bills of quantities and the prime costs from sortation 1's form part of the tender documentation (see para. 5.14 on Tender Action and Contracts); sortation 2's and 3's are sent to the nominated sub-contractors so that preliminary confirmation of location and delivery dates can be obtained.

5.13.4 After the contract has been signed, the project team check the sortations with the contractor and the master schedules are used to give any sortation 5's which he may require. The sortations form a basis for the ordering, receiving, checking and placing of the components, materials, etc., but, although this part of the system is also described in para 5.15 on Construction, more investigation must be carried out into the methods and processes used by the contractor before it can be detailed further.

5.13.5 The Compendium (a range of building and engineering components using the national system of preferred dimensions in the special environment of hospital design) and some of the Selected Manufacturers' Components required for CUBITH have already been set up. However, as the system develops further, the following attributes of an ideal coding system should be remembered:

a) flexibility so that extra components attributes and facets can easily be added
b) compatibility with manufacturers' and contractors' own systems
c) ease of use, both in the field and by the central CUBITH organisation
d) it must be designed so that the systems using it are as simple as possible
e) optimum length of code suitable for all the varied users.

5.14 TENDER ACTION AND CONTRACTS

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TENDER ACTION AND CONTRACTS

FIGURE 5.14A

TENDER ACTION & CONTRACTS

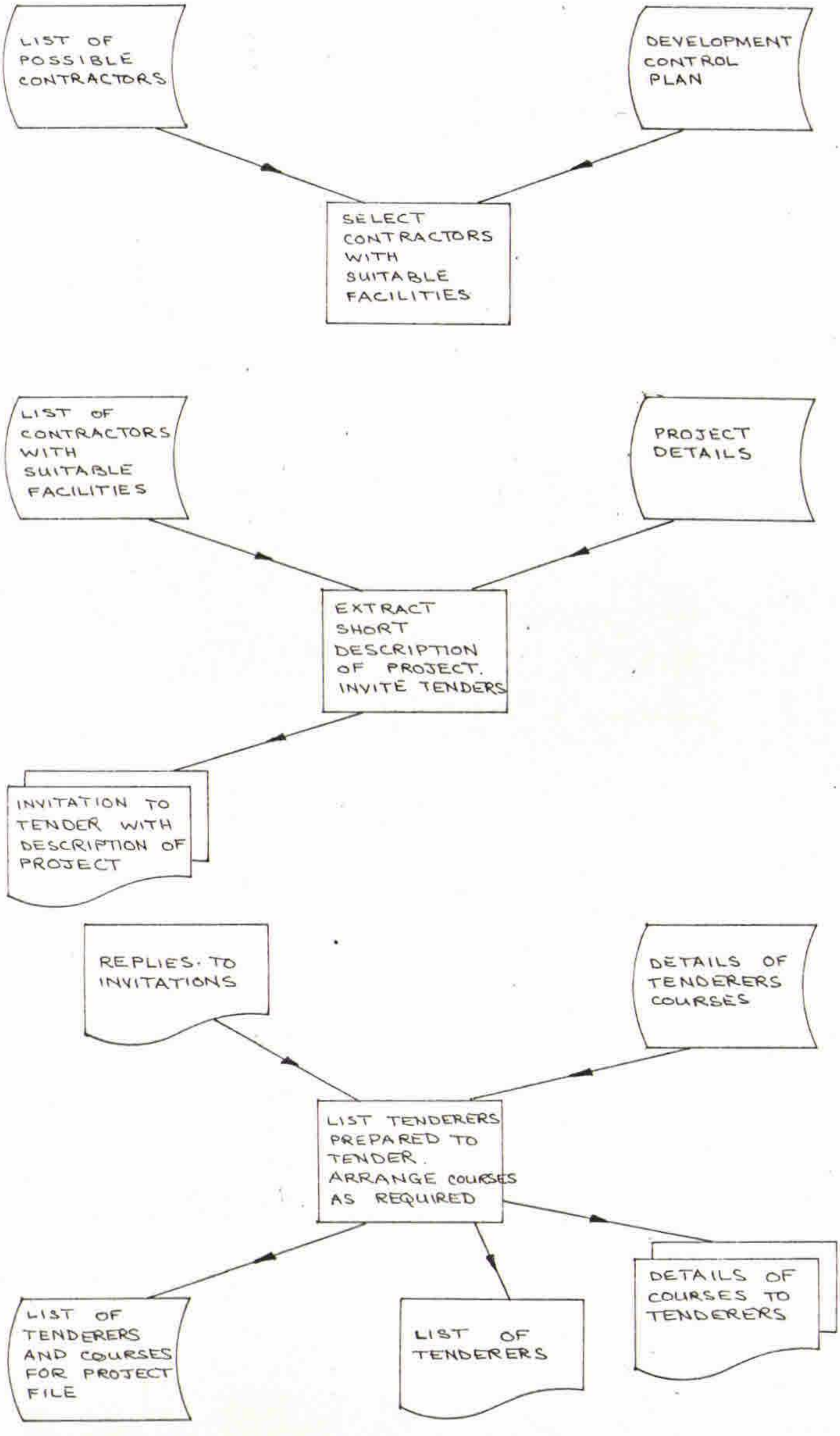

FIGURE 5.14B

TENDER ACTION & CONTRACTS

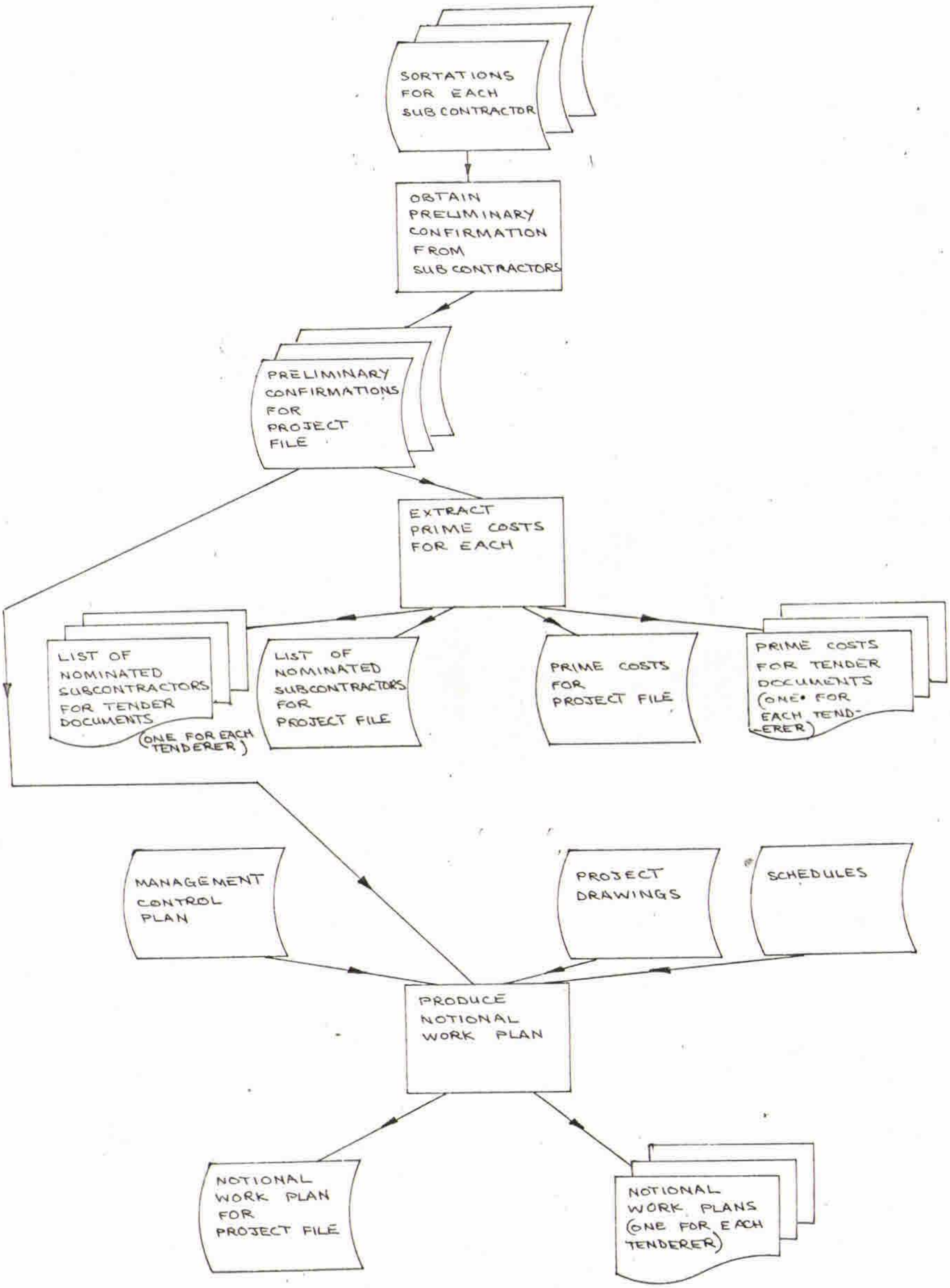

FIGURE 5.14C

TENDER ACTION & CONTRACTS

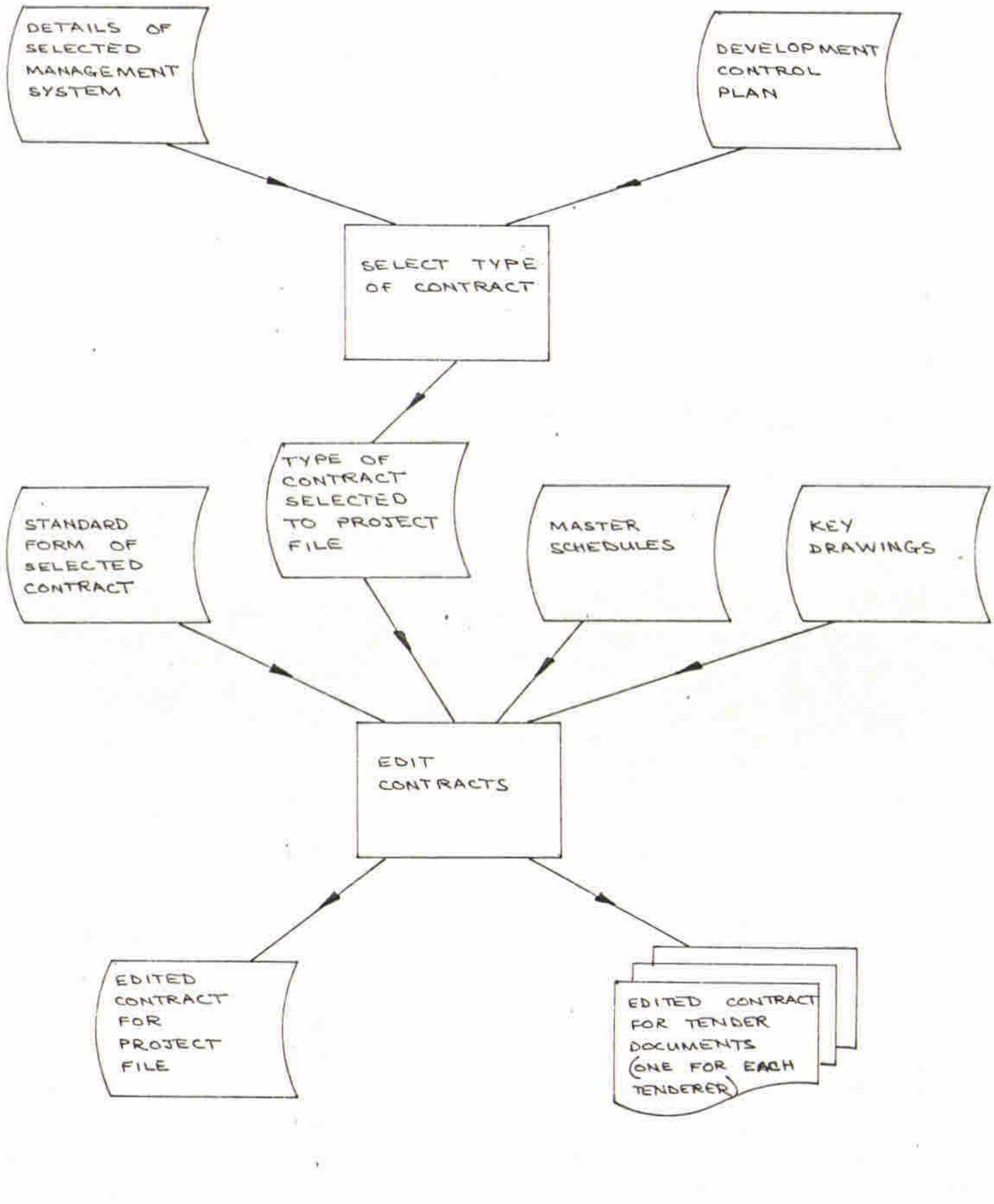

FIGURE 5.14D

TENDER ACTION & CONTRACTS

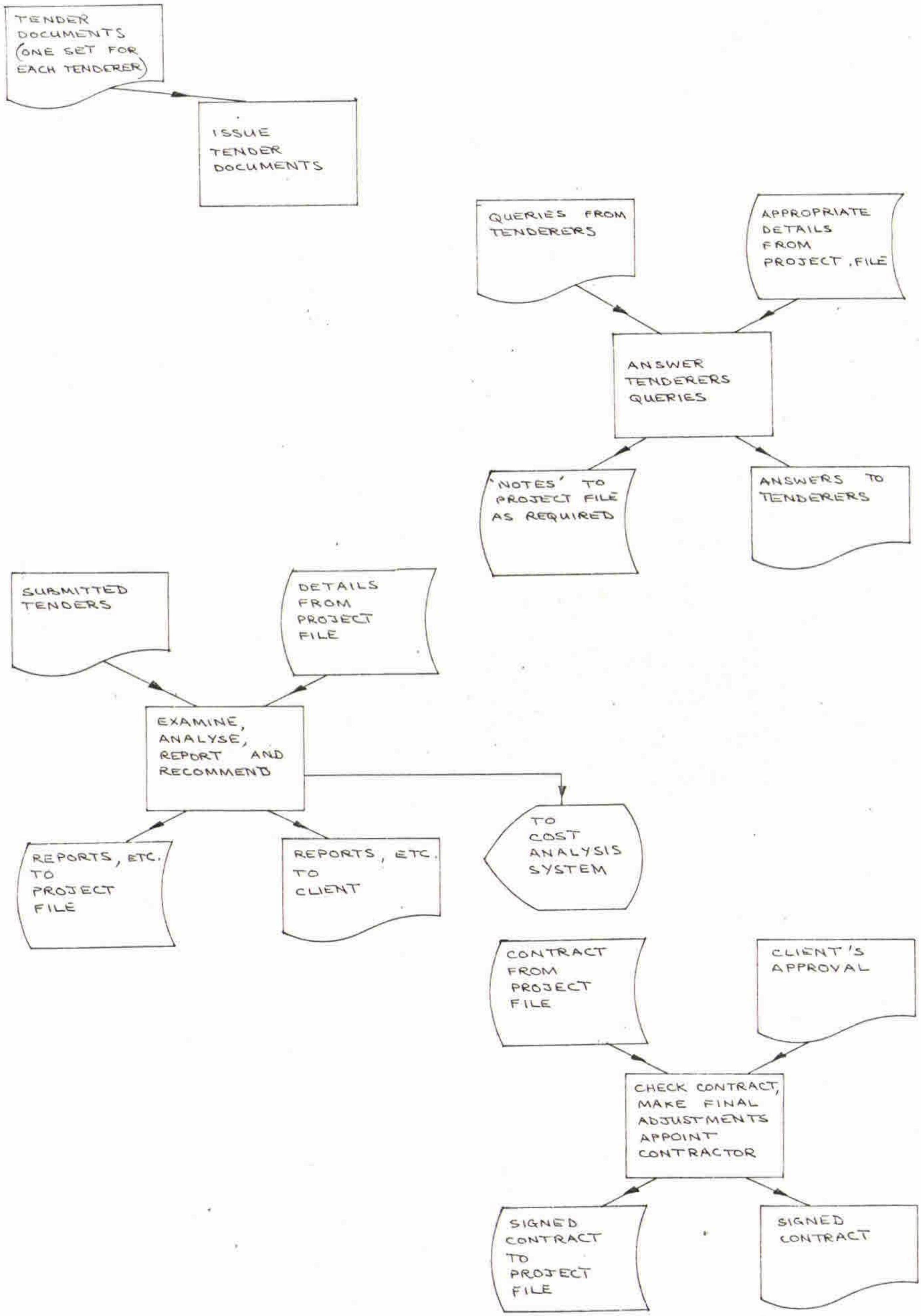

FIGURE 5.14E

5.14.1 Once the production drawings and master schedules have been finalised, there are various preliminary tasks which must be carried out before the project can be put out to tender. Each Regional Hospital Board has a list of potential contractors and engineering sub-contractors. Prior to tendering, these lists are consulted to give the details of those who have facilities suitable for the project in hand. Selected contractors are given brief details of the project those wishing to be invited to tender may attend a tenderers' course giving details of the CUBITH System - see figure 5.14B.

5.14.2 The engineering sub-contractor is appointed before the main contractor since the engineering prime cost is part of the main tender documentation. The two appointments follow similar procedures, figures 5.14B, 5.14C and 5.14D being directly applicable to both.

5.14.3 Sortation 2's and 3's (i.e. by delivery dates and location) are sent to the respective nominated sub-contractors for their preliminary confirmation so that prime costs can be obtained and a notional work plan produced to accompany the tender documents - see figure 5.14C.

5.14.4 It should be possible to set up a number of standard contracts from which the one to be used can be selected and then edited for the particular project. The selection may be made at the same time as the management system is chosen but the editing can be completed only just before the tenders are sent out - see figure 5.14D.

5.14.5 The tender documents can now be assembled.

The main ones are:

key drawings
bills of quantities
lists of nominated sub-contractors with prime costs
details of engineering sub-contract with prime costs
notional work plan (for tender use)
conditions of contract

This data must be organised in a manner most suitable for

a) the tenderers
b) the project team analysing the resulting tenders.

5.14.6 After the tender documents have been sent out to possible contractors, the system must be capable of answering queries, about the contract, from the tenderers.

5.14.7 It is a function of the project team to examine, analyse and report on the submitted tenders, making recommendations to the client on the contractor most suitable for the project. When the client's approval has been obtained, final adjustments are made to the form of contract and the main contractor is appointed - see figure 5.14E.

5.14.8 The main contractor appoints the nominated sub-contractors but, since it is proposed that standard forms of contracts, with suitable editing are again used, a system similar to that shown in figure 5.14D will probably be appropriate.

5.14.9 This sub-system links closely with those described in para. 5.10, 5.11, 5.12 and 5.13 (Design Development, Production Drawings, Engineering and Scheduling) and also with the contractor's own system. It is again stressed that a fuller study should be undertaken of the contractors' and sub-contractors' actual requirements.

5.15 CONSTRUCTION/CONTRACTORS

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CONSTRUCTION

FIGURE 5.15A

CONSTRUCTION

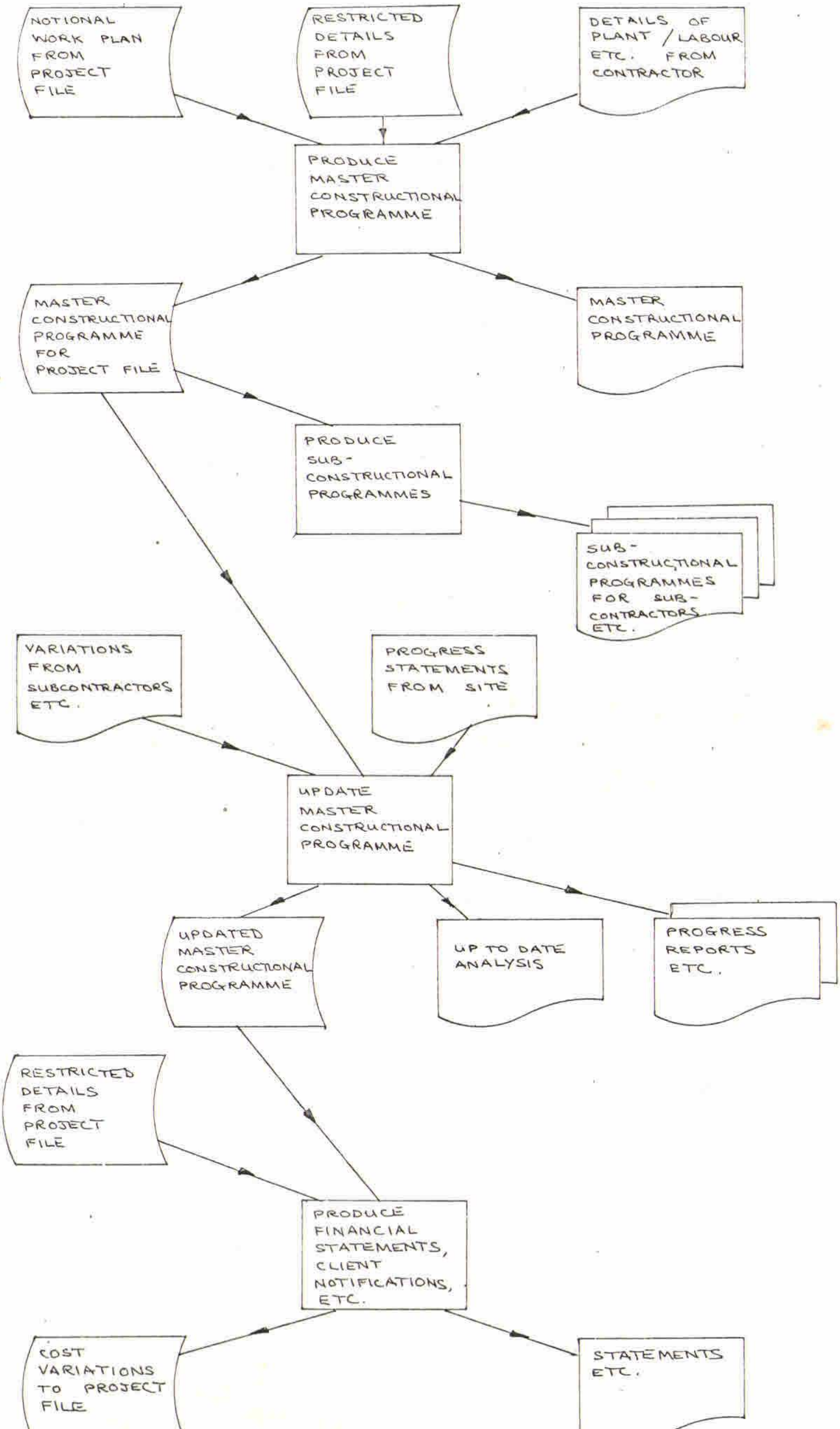


FIGURE 5.15B

5.15.1 Following a successful tender, the main contractor is appointed and then the nominated sub-contractors are appointed by his organisation. During the construction phase, the contractor uses part of the data assembled on the project file during the ealier stages, in particular, the schedules and project drawings. It should be possible to arrange for the contractor and sub-contractors to have access to selected parts of the project file thus greatly reducing the paperwork which must, of necessity, flow between the project team and the contractor.

5.15.2 After the nominated sub-contractors have been appointed, the contractor will produce a master constructional programme which, as work proceeds, will require periodic checking and up-dating. Similar work plans will be produced to monitor the progress of the sub-contractors. Time, resource and cost analyses will all be required in various forms although it may be possible to standardise to some extent. Such analyses will range in complexity from simple statements, of say, the number of men required on site on a particular date, to complete and detailed analyses.

5.15.3 The commissioning team is set up just prior to the start of the construction stage and, throughout this part of the project, both the commissioning and the project teams will receive reports from the contractors to enable them to evaluate and check the progress of the building.

5.15.4 The project team may also receive notifications of modifications required from the client and there may be amendments due to unforeseen constructional/sub-contractor variations. The simulation facilities offered by CUBITH should make it possible to obtain comprehensive assessments of the effect of the changes before they are put into practice. For example, it will be possible to simulate the results of a number of solutions to a particular problem so that the optimum, rather than the most obvious, can be chosen. In these simulations, the effect on Revenue, as well as Capital Costs, can be provided.

5.16 SERVICES TO THE CONSTRUCTION INDUSTRY

5.16.1 It is already clear that there are various ways in which it will be possible to use CUBITH for the benefit of the construction industry, training architects and supplying information for contractors and clients. Three of these are described below. More will appear as the system develops and more data on evaluation and design techniques is available.

5.16.2 Systems and expertise developed as part of CUBITH could be used, either directly or after modification, by the construction industry in general as part of their own systems. Those suitable will vary from procedures (such as those used to produce schedules and sortations) which will require little adaptation to special techniques evolved during the development of computer-aided design.

5.16.3 Because, in CUBITH, the development of each project follows a predetermined order, it should be possible to bring the contractor in at an earlier stage than at present. Evaluation and experience of previous projects built, using CUBITH, will accumulate as the system develops. These two features mean that the contractor's experience will be available during the design phases and the contractor will be able to draw on expertise gained on similar projects. This should be a benefit to both the contractor and the project itself since the project will be 'tailored' to the contractor's own system from an early stage.

5.16.4 Design of a building involves specifying values for a large number of interrelated variables so as to obtain the optimum solution. Algorithms can be used only when the interaction between all the variable can be explicitly specified and so tend to have limited application at present.

5.16.4 cont. Heuristic methods can be developed using models to simulate the results of various proposed solutions. Both these methods of obtaining optimum solutions to complex problems will be used in the fully developed CUBITH system and both are powerful tools applicable to a wide range of activities. During the development stage, simpler procedures showing the interaction between variables and the areas which impinge on each other will be available in the CUBITH system. The construction industry, clients and architects will all be able to make use of these systems for training, 'management games' type simulation, the evaluation of new components, etc.

5.16.5 No systems diagrams are provided for this sub-system since the are not applicable.

5.17 MAINTENANCE DOCUMENTATION

INDEX

MAINTENANCE DOCUMENTATION

FIGURE 5.17A

MAINTENANCE DOCUMENTATION

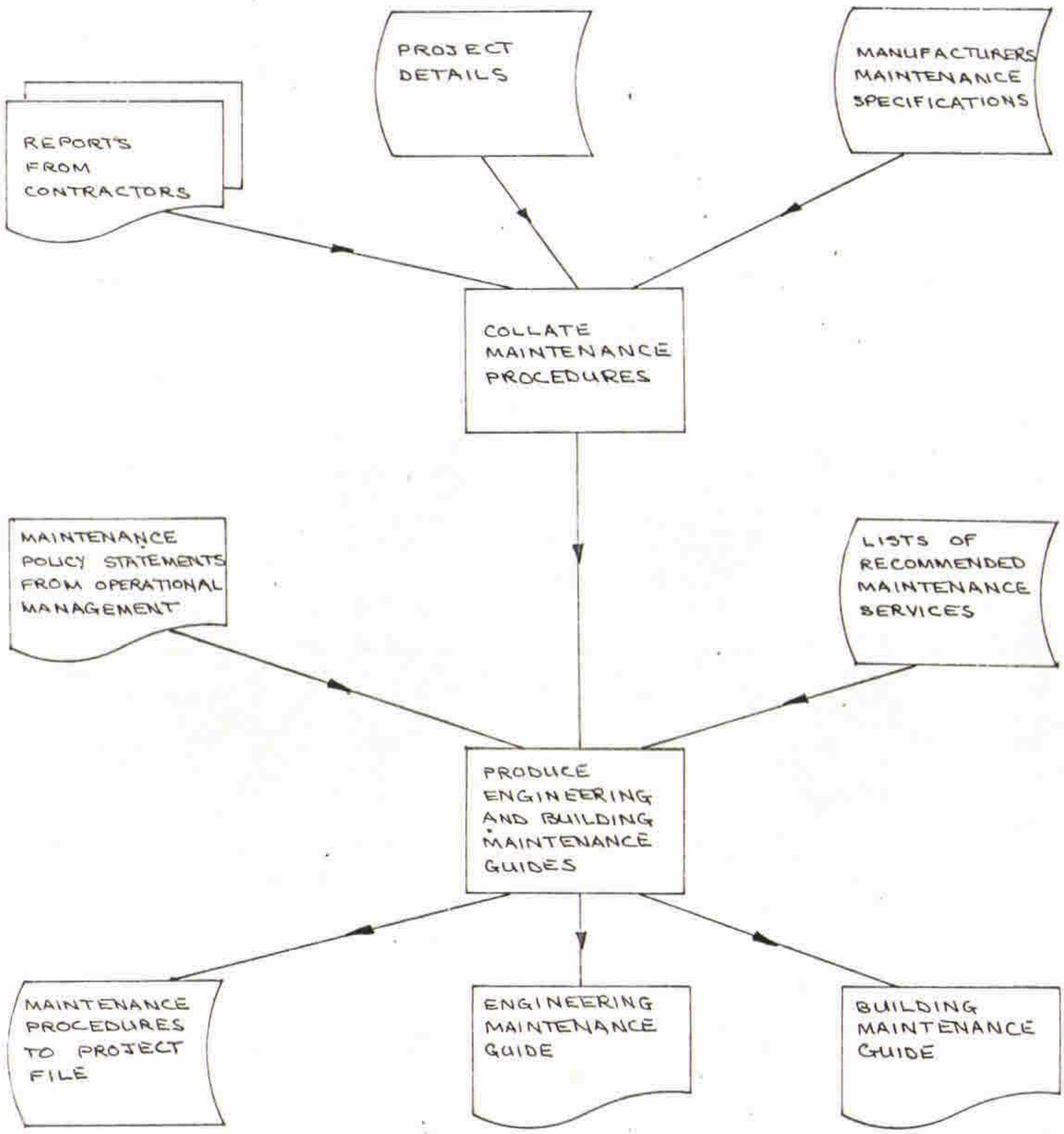


FIGURE 5.17B

5.17.1 Even as early as the briefing stage when estimates of revenue are made, broad maintenance policies will have to be devised. Maintenance procedures are usually labour intensive and these costs will undoubtedly rise steeply in the next few decades. Already, the maintenance costs during the lifetime of a building can amount to a large proportion of the original capital cost.

5.17.2 Different maintenance requirements must play a part in design decisions, for example, if a life-long corrosion-free finish is chosen for metal window frames, these maintenance costs can be minimised and perhaps justify a higher capital cost. Thus all the data on materials, components, services, etc. in CUBITH must include details of maintenance procedures and their relative costs so that these are readily available to the designer. It will also be possible to simulate the effects on maintenance costs, and thus revenue, of specifying different types of materials, engineering services, etc.

5.17.3 As the construction phase is reached, the detailed requirements can be collated from the manufacturers' recommendations, contractors' experience, design details, etc. Many of these will already be in the project file in the form of references. These will be organised in combination with operational maintenance policies to produce engineering and building maintenance guides.

5.17.4 Maintenance of certain parts, for example, the heating system, may start before the building is fully operational but, in any case, maintenance requirements carry directly into the operational stage when the references built up in the project file could be used as a basis for developing preventive maintenance schemes, etc.

5.17.5 This system also interacts with staffing requirements as, before staff requirements can be finalised, the size of the maintenance staff must be determined and decisions made where, and if, outside labour is to be used, for example, is an outside firm to be commissioned for window-cleaning.

5.17.6 Maintenance procedures and costs on the historical project files will require updating as a result of evaluation and change - see para. 5.20 The Project File.

5.18 COMMISSIONING

INDEX


COMMISSIONING
BRIEF
DESIGN
PRODUCTION
CONSTRUCTION
CONTRACTOR / SUBCONTRACTOR
EVALUATE ALTERNATIVE SITES
PRODUCE OUTLINE DCP (POSSIBLY FOR MORE THAN ONE SITE
DETERMINE OUTLINE OF FUNCTIONS AND FUNCTIONAL CONTENT
ACCEPT OR AMEND PLANNING DATA (ACTIVITY DATA)
DECIDE PHASING
OBTAIN BROAD COSTS OF EQUIPMENT
FINALISE BUILDING AND ENGINEERING COSTS
DECIDE PHASED STAFFING REVENUE AND EQUIPMENT COSTS
FINALISE DEVELOPMENT CONTROL PLAN
ESTABLISH PROJECT COST CONTROL PLAN AND SYSTEM OF COST CHECKS
CHECK COSTS
ESTABLISH SITE LAYOUT SERVICES LAYOUT STRUCTURAL GRID
DEVELOP SITE SERVICES LAYOUT
PROCESS SELECTED ROOM DATA SHEETS ESTABLISH 1/200 DESIGN LAYOUT PLAN
SELECT STRUCTURAL SYSTEM
COMPLETE SET 1/200 OUTLINE PLANS, SECTIONS AND ELEVATIONS
SELECT MANAGEMENT SYSTEM
PROCESS ROOM DATA TO OBTAIN 1/50 PROJECT ROOM LAYOUTS 1/50 WHOLE PROJECT
PREPARE PROJECT DESIGN DRAWINGS
SELECT COMPONENTS FINALISE 1/50 PROJECT DRAWING PROJECT ROOM DATA SHEETS DESIGN STAGE SCHEDULES
ESTABLISH DESIGN COSTS
DEFINE OUTPUT OF PRODUCTION SUB-SYSTEM IN DETAIL INCLUDING PLAN OF WORK
PREPARE 1/100 PROJECT AND ENGINEERING DRAWINGS
PREPARE 1/50 AND 1/20 ENGINEERING DRAWINGS
PREPARE ENGINEERING SCHEDULES
PREPARE KEY BASE AND LOCATION DRAWINGS
SELECT JUNCTION DETAILS
UPDATE MASTER SCHEDULES
UPDATE PROJECT COST DOCUMENTATION
COLLATE AND SELECT TENDER DOCUMENTS
TENDER INVITATION ACTION
PREPARE BILLS OF QUANTITIES SORTATIONS ETC.
OBTAIN NOMINATED SUB-CONTRACTORS PRELIM CONFIRMATION PRODUCE NOTIONAL PROJECT CONSTRUCTIONAL WORK PLAN
PREPARE ENGINEERING BILLS OF QUANTITIES SELECT SUBCONTRACTOR
SUBMIT PROJECT TO TENDER APPOINT CONTRACTOR
CHECK AND DISCUSS DRAWINGS BILLS OF QUANTITIES ETC.
PROCESS BILLS OF QUANTITIES SORTATIONS ETC.
PRODUCE MASTER CONSTRUCTIONAL PROGRAMME WITH REFERENCE TO SUBCONTRACTORS
CHECK AND DISCUSS ENGINEERING BILLS OF QUANTITIES ETC.
APPOINT NOMINATED SUBONTRACTORS
ORGANISE PROJECT SITE MANAGEMENT SITE USAGE
CHECK SUBCONTRACTORS PERFORMANCE
REVIEW VARIATIONS
REVIEW SUBCONTRACT ORGANISATION
REPORT AND FEEDBACK INFORMATION
PRODUCE MAINTENANCE MANUAL UPDATE PRODUCTION DATA
OBTAIN COMPLETION CERTIFICATES
SET UP COMMISSIONING TEAM
ALLOCATE RESOURCES ETC.
ESTABLISH STAFF RECRUITMENT PLAN
UPDATE EQUIPMENT SCHEDULES FROM ROOM DATA SHEETS
ESTABLISH COMMISSIONING WORK PLAN
RETRAIN AVAILABLE STAFF APPOINT STAFF REQUIRED PRIOR TO BUILDING OPERATIONAL
PREPARE FOR OFFICIAL OPENING
RECEIVE AND TEST GROUP IIa EQUIPMENT
EXAMINE EQUIPMENT SCHEDULES PHASE PURCHASING AND DELIVERY
PLACE ORDERS FOR EQUIPMENT
WRITE PROJECT STAFF JOB MANUALS
TAKE OVER OF ENGINEERING MAINTENANCE PREPARE BUILDING MAINTENANCE GUIDE
RECEIVE CHECK DISTRIBUTE EQUIPMENT PRODUCE INVENTORY AND COSTS
OFFICIAL OPENING CEREMONY
COMMENCE BUILDING MAINTENANCE
SET UP PROJECT TEAM
PRODUCE MANAGEMENT CONTROL PLAN
START DRAFTING PROJECT REPORT
COMPLETE PROJECT REPORT
COMMISSIONING

FIGURE 5.18A

COMMISSIONING

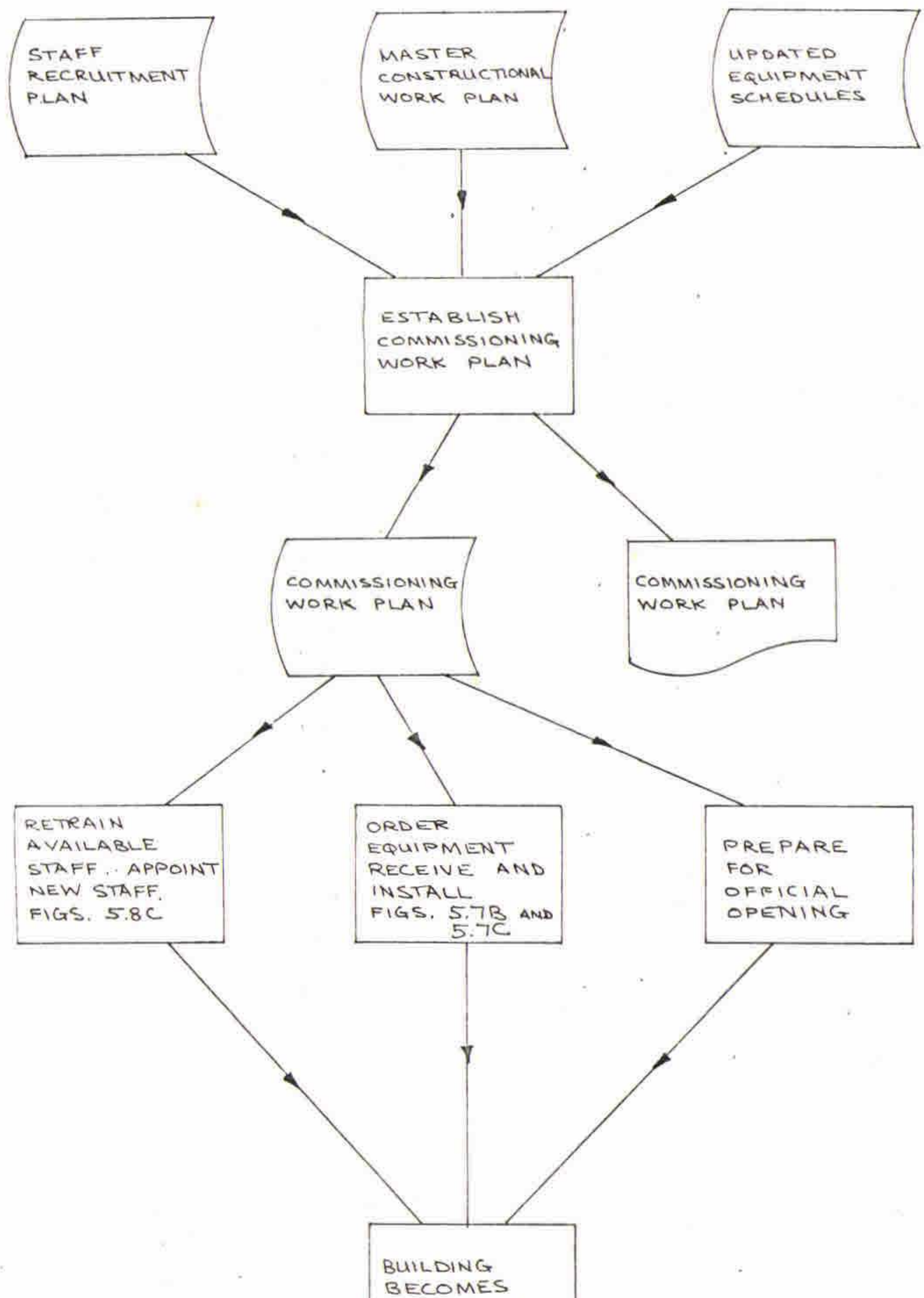


FIGURE 5.18B

5.18.1 At the Commissioning stage, resources and areas of responsibility are allocated and lines of communication with the contractor, sub-contractors, etc. are established. The staff recruitment plan is drawn up and the equipment schedules updated. The first of these tasks links with the staffing sub-system and the latter is part of the equipment sub-system. Both, however, must be related to the other commissioning tasks and the master constructional work plan from the contractor so that the overall commissioning work plan can be established.

5.18.2 The official opening ceremony is planned and, here, dates must be fixed and important guests invited well ahead of actual completion so that plans must be devised at an early stage.

5.18.3 Publicity forms a major part in staff recruitment. The public and all the local organisations which may be interested must be kept fully informed of the progress being made and the aims it is hoped to achieve. This means that press reports, talks, models and plans for public showing, visits, etc. must be arranged for the most suitable times.

5.18.4 A large amount of documentation is required when the building is operational - departmental procedures and staffing manuals (para 5.8), maintenance documentation (para 5.17) and equipment inventories (para 5.7). This is based on project references from the design and production drawing stages and on information on the particular project which only becomes available during the construction and commissioning stages. Project files set up earlier could, perhaps, be further developed and used as input to various operational systems such as stocktaking, maintenance schedules, etc.

5.19 DATA BASE MANAGEMENT SYSTEM

5.19.1 The maintenance, up-dating and revision of the Common Data Base forms a system in its own right and more details about the management of the Data Base are given in Section 7.

5.19.2 It is stressed that the requirements of the Data Base to be provided for CUBITH must be fully studied before any further work in setting it up is carried out.

This study must include considerations of:

a) Structure
b) storage media
c) the inter-relation of various aspects of the Data Base
d) the provisions to be made for communications between files of different media.

5.19.3 No system diagrams are provided for this sub-system since it forms a basis for the whole of CUBITH.

5.20 THE PROJECT FILE

5.20.1 Each project commissioned within CUBITH will require its own project file containing all the relevant details. It is hoped that the Project file, as well as containing constructional details, will form a basis for a historical file giving the facilities available throughout the hospital service. In this way, each Project file would become an element in the Common Data Base.

5.20.2 Once the facilities are in existence, the file must allow for their evaluation as this will form a basis for the up-dating of recommended manufacturers components, building methods, etc.

5.20.3 The Project File will also provide all the necessary details should extensions to the existing buildings be required.

5.20.4 It would be wasteful to include details on the Project File which may be kept in the Common Data Base. However, it must be remembered that, only references to the Data Base elements are included, problems will arise when the content of the Data Base changes and the referenes are no longer accurate. This will be particularly important if the Project files are used for historical purposes.

5.20.5 The storage media for Project files is most important. 'Hard copy' i.e. written text, drawings, etc. must be provided for various interested parties, possibly at different locations, and in different degrees of detail. Whilst work is being carried out on the project, the data will probably be different from that on historical files. Consideration must also be given to the interface with associated manual systems.

This is another area of the system which requires a full study; it is closely related to the setting up of the Common Data Base.

5.20.6 No systems diagrams are provided for this sub-system since it forms a basis for the whole of CUBITH.

5.21 ON-LINE ENQUIRY

5.21.1 When CUBITH is fully operating, it is envisaged that an On-line enquiry system will be provided for project teams, regional hospital boards, designers, engineers, contractors, sub-contractors, main suppliers, etc.

5.21.2 It will be necessary to provide copies of drawings and text, on projects under development, on request. Access to standard design techniques and recommended components must be provided for the appropriate personnel.

5.21.3 The provision of these facilities poses two major problems:

a) Who is to have access

b) In a changing environment, how are users of the system to be notified of changes?

5.21.4 The first is solved fairly simply by setting up a security system. By this method, each user can gain access to only pre-specified areas of the system determined by his security status embodied in a special code allocated to him for this purpose. This is a most important aspect of CUBITH. For instance, were all data to be stored centrally with free access, one contractor could possibly obtain information about his competitors tenders. This is just one example; there will be other more vital parts of such a system involving higher security risks.

5.21.5 The second problem, that of changing data in a real time environment, is an old problem - a service engineer and a structural engineer may both be working on the same area of a plan and chages made by one may affect the other. In the past, this problem has been overcome by allowing time for joint consultations at regular intervals. However, with more design being based on standard systems and the probability that hard copies will not always be provided, this problem becomes more acute.

5.21.6 There will need to be further study on these two problems after discussion with all the users concerned.

5.21.7 The kind of On-line enquiry system to be provided must be decided before the design of the system is started.

Some points to be considered are:

a) will all standard files be held centrally

b) what provisions will be made for distributing information.

5.21.8 No systems diagrams are provided for this sub-system since it forms a basis for the whole of CUBITH.

SECTION 6 THE FLOW OF DATA AND DATA BASE REQUIREMENTS

SECTION 6 THE FLOW OF DATA AND DATA BASE REQUIREMENTS

INDEX

6.1 DATA FOR THE CUBITH SYSTEM

6.1.1 The CUBITH System requires that appropriate data should be readily available to facilitate the decision-making process and control upon which the system depends.

6.1.2 Data for the CUBITH System falls broadly into two categories:

(a) Project Data - that is data relating to a specific project either currently under construction or in the form of historical data about an existing building.

(b) Common Data - that is data not related to a specific project but available to users of the CUBITH System to enable them to find solutions for specific projects.

6.1.3 Evaluation of projects leads in turn to the provision of better Common data.

6.2 PROJECT DATA

6.2.1 Starting from the time a project appears on the ten year plan, through Briefing to Commissioning and on to the Operational Stage when project evaluation can take place, historical records of all transactions on that project must be maintained.

6.2.2 Project Data is certain to take many different forms, (letters, reports, drawings, standard forms, etc.), be stored on many different media, (possibly in different locations), be required for many different functions and be assessed by different people according to their different requirements.

6.2.3 The composition of Project Data will vary from Project to Project. On a large project costing many millions of pounds, the approval of design and requests for expenditure etc. will probably have to be taken to higher levels of authority. However, the level of detail in any one area, e.g. the design of a room, will be the same on a large as on a small project.

6.2.4 Volumes of Project Data will vary according to the size of a project, but not necessarily directly in proportion to project cost.

6.2.5 Both volume and composition of Project Data will vary with time. New techniques will be developed both in data handling and in the representation of facts and it is important that any 'historical' data can be incorporated into new systems with the minimum of effort and cost.

6.2.6 Project Data will form a part of Common Data as once buildings are operational they will become part of the facilities offered by the Hospital Service.

6.2.7 Project Data must be available in a form which allows easy evaluation of existing schemes to provide a basis for the amendment and re-assessment of techniques embodied in the Common Data.

6.3 THE COMPOSITION OF PROJECT DATA

6.3.1 The exact composition of Project Data is not yet fully appreciated by the authors of this report, but certainly for each project, most of the following will be required:

Pre-briefing:

(a) Capital funds allocated to the project apportioned over the development period.

(b) Basic functions of the Project as given in the Ten Year Plan.

At the end of briefing:

(a) The Development Control Plan.

(b) Whole Hospital and Departmental Policies.

(c) Selected Activity Data.

(d) Budget Costs.

(e) Equipment Costs.

(f) Revenue and Staffing Estimates.

(g) The Management Control Plan.

At the end of the Design Stage:

(a) Project Design Drawings.

(b) A complete set of room data.

(c) Design Stage Schedules.

(d) Project Cost Documentation.

(e) An updated Management Control Plan.

(f) Project Report.

(g) Selected Management Systems.

(h) Details of type of Contract.

6.3.1 Cont'd At the end of the Production Stage:

(a) Key Drawings.

(b) Location Drawings.

(c) Detailed Drawings.

(d) Index of Production Material.

(e) Master Schedules.

(f) Further Project Cost Documentation.

(g) An updated Project Report.

(h) An updated Management Control Plan.

Construction Stage - Pre-Tender

(a) Full Tender Documentation.

(b) Sortition 1's, 2's, 3's and 4's.

(c) Lists of Nominated Sub-contractors.

(d) Notional Project Constructional Work Plan.

(e) Tenders.

(f) Selected Contracts.

(g) Signed Contract.

Construction Stage - Post-Contract

(a) Master Constructional Work Plan.

(b) Reports and Returns as specified by Client.

(c) Maintenance Manuals.

(d) Completion Certificates.

(e) Feedback from Construction Stage.

Required During Commissioning:

(a) Project Recruitment Plan.

(b) Details of Areas of Responsibility and Lines of Communication.

(c) Commissioning network and work plan.

6.3.1 Cont'd At the end of the Commissioning Stage:

(a) Operating Manuals, Inventories.

(b) Documentation to assist with Monitoring and Evaluation and for General Operational Use.

(c) Departmental Procedures.

(d) Project Staff Job Manuals.

(e) Staff in Post/Establishment.

(f) Test Sheets (Engineering).

(g) Test Reports (Engineering).

(h) Inventory (Equipment).

(i) Full Project Cost Analysis.

(j) Project Building Maintenance Guide.

(k) Full Project Report.

6.3.2 This list is not fully comprehensive as intermediate documents are often produced and worked upon before being finalised. The categories above require sub-dividing and defining in greater detail. For example: what are the exact contents of the Project Report? What form do Design Schedules take? - how do they differ from the Master Schedules? Although many of these questions have been answered and a more detailed review of data flow is given in the fpl Task diagrams, this information must be expanded much further before the detailed requirements of Project Data are fully understood.

6.4 THE USE OF PROJECT DATA

6.4.1 Project Data will need to be available to the Project Team throughout the project, the Tenderers at the Tender Stage and the Contractor after he has been appointed. In all cases data must be presented in the form suitable for the needs of the user and these requirements will most certainly differ. The security aspect is also most important as the information provided to Tenderers will not of course be the full set of Project Data and the Contractor should not be allowed to see rival tenders, many more security aspects will be readily appreciated.

6.5 DATA STORAGE

6.5.1 Most of the Project Data will need to be stored in a form from which it is simple to obtain typed documents, 'hard copy' of drawings, etc. Much of the Project Data will be issued in report form for general discussion and a method of cheap and easy report reproduction must be considered as part of the System.

6.5.2 If all the data is to be stored centrally, it must be possible for users not situated near the central data store to gain remote access to the exact data they require simply and within a reasonable time. If the data is not stored centrally consideration must be given to those reports etc. which are required by a central organisation - say a Regional Hospital Board or DHSS - and how they are to be achieved.

6.6 FURTHER STUDIES ON PROJECT DATA

6.6.1 A full study is required of exactly what data is required for each project - who uses it - how it should be presented for different users - how it is to be stored - where it is to be stored.

6.7 COMMON DATA

6.7.1 One of the main aims of the CUBITH System is the provision of standard data on optimum design and planning techniques for Health and Welfare buildings. It is the intention that this data should be available to all CUBITH users as appropriate to their needs and for the purpose of the report this data is referred to as 'Common Data'.

6.7.2 The CUBITH System is based on the access of its users to a very large data base containing all that is best in design techniques. Access to the Data Base will be limited according to users' needs and security status, and more details of this aspect of the System are given in Section 7 of this report.

6.7.3 The medium on which this Data Base is stored is most important and it is not necessary that the whole Data Base is stored on the same media - more important is the structure of the Data Base and the relationships between various parts.

6.7.4 The data on the Data Base will need to be constantly evaluated, reviewed and updated; it is important that normally only fully accepted data be available to the users of the System, where experimental or temporary data is provided a warning should be issued.

6.7.5 Data available to CUBITH users should be expressed in the form most suitable for their requirements. It should enable them to make decisions with the knowledge that, because of the composition of the Data Base, all available data has been considered, that which is inappropriate for policy, or other, reasons having been rejected leaving the user with only feasible solutions.

6.8 THE USERS OF THE COMMON DATA BASE

6.8.1 Users of the Common Data Base may include DHSS staff and others from different firms, covering the project teams, the Regional Hospital Boards, designers, engineers, contractors, sub-contractors and suppliers; most of whom will require access at various stages of the work.

6.8.2 In view of the need for further study, the outline of Data Base requirements and its possible organisation which are given here, is no more than a suggestion made in the light of the information at present available.

6.8.3 The term 'file group' indicates a group of data to be included in a file or set of files. It does not mean a discrete file, or record, or any organisational grouping.
From the information at present available it can be ascertained that certain types of data are required at various stages of the System. These can be described as the following file groups but are further expanded in the DHSS publication on the CUBITH System dated 17/7/70.

Hospital Building Programme:

(a) Expenditure for each project to start within 10 year period.

(b) Facilities required.

(c) Policies to be followed.

(d) Details of standard rates of spend in relation to project size, type and time.

Historical Data:

(a) Existing facilities.

(b) Closures, etc.

6.8.3 Cont'd **Policy:**

(a) Regional.

(b) Government.

(c) Planning regulations.

Sites:

(a) Plot ratios.

(b) Building constraints.

(c) Communications.

(d) Noise factors.

(e) Ground conditions.

(f) Contours.

(g) Availability of services.

Staffing:

(a) Standard requirements for activities.

(b) Standard staff/patient ratios.

Revenue:

(a) Standard for functions.

Cost Data:

(a) Activities.

(b) Equipment.

(c) Elements.

(d) Components.

Engineering:

(a) Basic prices - labour
materials

(b) Professional fees - Architects
Quantity Surveyors
Structural Engineers

6.8.3 Cont'd <u>Activity Data</u>:

For each type of activity e.g. Maternity
Coronery care
Geriatrics
Children
Infectious diseases,
etc.

Level A-System i.e. whole hospital
B-Sub-system i.e. discrete service
C-Organisation (division of sub-system) e.g. 144 bed unit

D-Sub-organisation (working sub-unit) e.g. 72 bed sub-unit

E-Section (group of rooms) e.g. 12 bed high dependence area

F-Spaces (schedules of spaces required for activities) - rooms

Group (units within a space)

Room data (appropriate to each space)

Units - equipment and engineering services to accomplish the activity.

<u>Equipment Data</u>:

For each type of equipment by Activity System classification (as above) and by Realisation System classification

Level S-System

T-Assembly

U-Element

V-Component

W-Sub-component

X-Junction (a construction situation)

Y-Workpiece (sub-division of construction convenient to manufacturer)

Z-Material

6.8.3 Cont'd <u>Components</u> (for building):

Classified in functional groups for compatibility

Level A-Structural assemblies	Structure
B-External envelope	(Roofing systems (Cladding (Windows (Composite infill units
C-Internal divisions	(Partitions (Door sets (Ceilings (Floorings (Cubicles
D-Services	(Sanitary assemblies (Sanitary assemblies panels
E-Fitting out	(Storage and workshop units (Signposting (Curtain tracks (Laboratory units
F-External works	

<u>Components</u> (for engineering):

For all types of service:

air conditioning
heating
water supplies
waste disposal
lighting
power
communications
special services, etc.

Level A-Systems

B-Assemblies

C-Elements

D-Components

E-Sub-components

F-Junctions and workpieces
Material.

<u>Contracts</u>:

(a) Standard contracts.

6.8.3 Cont'd Management Systems Data:

(a) Grouping of component manufacturers.

(b) Constructional limitations.

(c) Services distribution.

(d) Operational sequences and timescale for various situations.

Commissioning:

(a) Standard Commissioning Data

6.9 FILE STRUCTURE WITH THE COMMON DATA BASE

6.9.1 The structure of the Common Data Base must be such that the user can store and retrieve any records held on it. It is necessary, therefore, to define data description elements which declare the existence of relationships between records. These relationships are expanded more fully in Section 7.

6.9.2 The principal data organisation mechanism is the chain which relates records. This relationship is accomplished by giving within each record of the chain a reference to the next record. The master record links with the first detail record. The first detail links to the second detail, and so on. Finally, the last detail in the chain links back to the master record: thus a chain becomes a circular association of records. A simple chain is illustrated in Figure 6A.

6.9.3 The data contained in the File Groups described above are inter-related to such an extent that together they create a complex network. Thus there is clearly a complex hierarchical relationship between the data items. A record in the Hospital Building Programme on the expenditure allocated for a particular project will relate naturally to the Project Record for that project. This in turn relates to the Activities required by the project. The Activity data, which has its own hierarchical structure relates also, at various levels, to Equipment, Building Components, Engineering Components, Staffing requirements and Costs, each of these having their own hierarchy and being further inter-related at various levels. The Project Record, as well as relating to all the above file groups, will also refer to the Historical data, Policy and Site information needed to establish the project.

6.10 PROJECT DATA AND THE COMMON DATA BASE

6.10.1 The link between Project Data and the Common Data Base is important. To the user of the System it might appear that whilst Project Data is constantly changing, Common Data is fairly static, but this is not necessarily so. Common Data will change and it is important that the changes are fed through to the project files where appropriate. Similarly, once a project becomes operational, Project Data will become fairly static.

6.11 STRUCTURE OF THE PROJECT FILES AND COMMON DATA BASE

6.11.1 It is again stressed by the authors of this report that the organisation of the Project File and the Common Data Base forms a basis for the whole CUBITH System. Discussion on the various aspects of Data Base management are given in Section 7 of this report, but the most common errors in any large system are failure to fully appreciate the relationships between data and failure to fully comprehend the users' requirements.

A SIMPLE CHAIN STRUCTURE

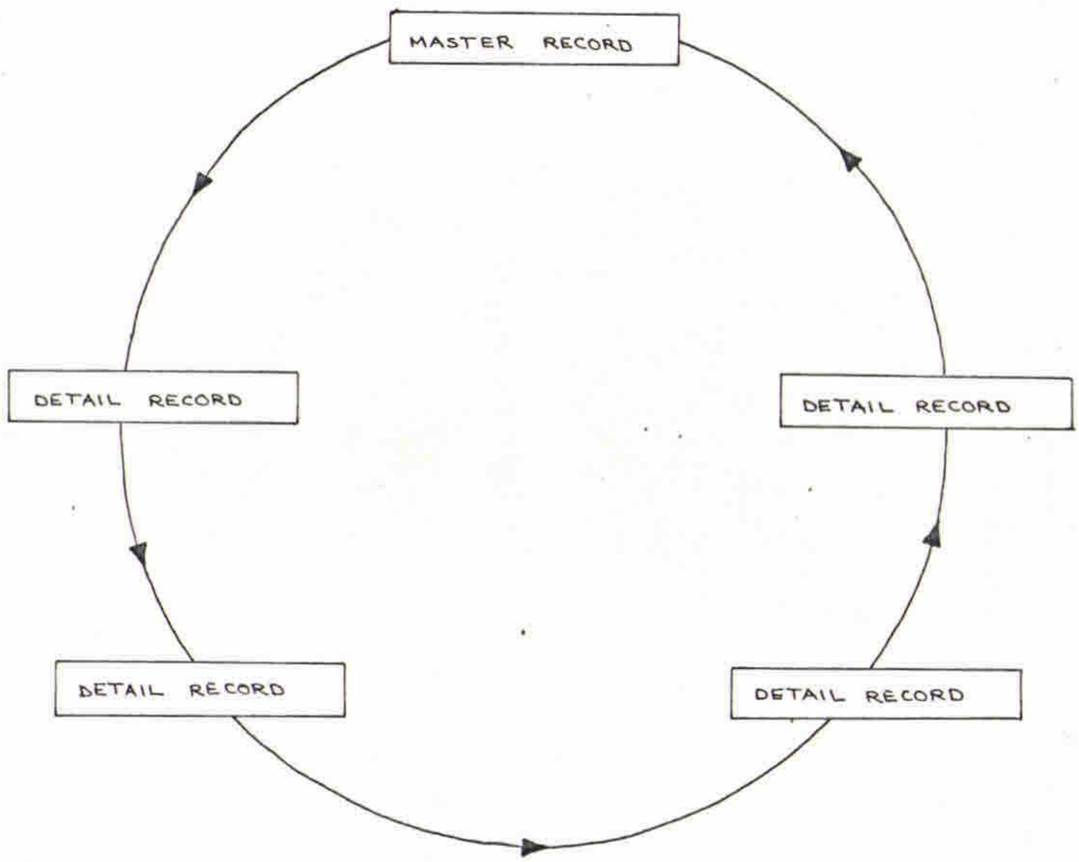


FIGURE 6A

SECTION 7 THE ORGANISATION AND MANAGEMENT OF THE COMMON DATA BASE

SECTION 7 THE ORGANISATION AND MANAGEMENT OF THE COMMON DATA BASE

INDEX

7.1 INTRODUCTION

7.1.1 The central entity of a Management Information System is the large volume of data which is common to the whole system. This is known as the Common Data Base, and can be either the group of files, in various media, which forms the basis of data for the system, or an integral file of all information, held on one medium, such as a large disc file.

7.1.2 The Common Data Base may be used in various ways. It may be a data exchange, where users can have their own files, but where limited cross-access is provided. It may be a data co-operative, where a pool of information is both updated and interrogated by a group of users. Finally, it may be a data supply house, a data bank, which is updated by the supplier and interrogated by the users.

7.1.3 Consideration of the Common Data Base reveals two important characteristics. Firstly, it involves the development and use of standard data definitions. Secondly, it may involve a means of common access to data by a number of systems.

7.1.4 It is important to remember that although relationships between data carried within a data base structure must be clearly defined, all data need not be stored on one medium, indeed none of the data need be stored on a computer, but for a large and complex data base such as that which will be required for CUBITH much of the data will need to be assessed by computer based systems and thus much of the data base will be set up on computer type media.

7.1.5 Two other characteristics, carried over from modern data files in general, should be noted. Firstly, there is a trend towards storing more data about system entities. For example, personnel files have expanded from a few hundred characters of information on each employee to include education, training, job history, health, etc. With repeated occurrences of each of these, a file might contain several thousand characters of data for each employee. Secondly, there is a trend towards more explicit relationships between data items. For example, in a manufacturing organisation holding production control files, customer orders pertain to products, so the customer file is related to the product file. The product file is in turn related to the manufacturing instructions file, and so on.

7.2 DESIGN CRITERIA

7.2.1 Clearly the requirement is for an optimum design for the complete system, and it is suggested that once the current requirements of the CUBITH System have been established, this design solution should begin in the files area.

7.2.2 In a changing environment, a special-purpose file organisation would rapidly become obsolete. The prudent approach for the designer would be to make no prior assumptions as to how the data base will be used, because new uses will arise and new data will be added.

7.2.3 A Management Information System is characterised by large direct access files. There is a variety of real-time activity to the files, with background work during the business day, and intensive and periodic batch processing of the files in non-prime time.

7.2.4 The file system to support these real-time and batch processes must consider:-

(i) Security of Information.

(ii) Recovery of system operation after failure, and restoration of data lost.

(iii) Key and addressing methods that will result in densely populated storage.

(iv) The need for additions and changes to the data base to meet changing requirements.

(v) Performance requirements of all types of activity.

(vi) Reduction of wasted mass storage, consistent with performance requirements.

(vii) Co-ordination of the file system with the programming system.

Some of these factors depend on the needs of the particular system. The speed requirements for recovery of operation and data restoration is not the same for all systems. Some can tolerate delays of several days; others need action within seconds. Duplexed files are not always required. Each application has its own unique security problems and scheme for identifying records.

7.2.5 However, every system requires an optimum file record. The record designer must be able to describe this optimum record before going further. It will:-

(i) Utilise the maximum space allocated at the home address of the storage device.

(ii) Permit selection of data from within the record.

(iii) Be structured so that data fields can be added, eliminated and rearranged.

(iv) Identify records by using a logical description, in addition to absolute identification.

(v) Be as short as possible and yet, in the selected length, supply the maximum amount of file data to the programs in one seek.

7.2.6 The Common Data Base may also have to provide the facility for private files, which are accessible only by the originator, or are partially protected with access only to authorised personnel.

7.3 <u>LIKELY FEATURES</u>

7.3.1 A most important feature of the Common Data Base is consistency of data definitions. People within an organisation become accustomed to their own definition of data, and thus the name of a data field might be interpreted differently by different organisational groups. For example, 'sales' might mean gross sales or net sales.

7.3.2 Another feature of the Common Data Base is the use of data catalogues or directories. These define each data field in the system, give location of the data and past generations of data, a description format, and security or protection code.

7.3.3 The data is made independant of programs. Data definitions are interpreted at execution time, thus avoiding the need to recompile all programs when changes are made to data. There is, of course, flexibility for data fields to be added to or deleted from files, and to be lengthened or shortened.

7.3.4 There must be centralised control of data definitions, particularly for data available to many users. Whether data is stored centrally or at remote processing sites, the standard data definitions and control must still apply.

7.3.5 The Common Data Base must be organised so as to meet the requirements of routine production and retrieval-by-content. There is also the likelihood of data from outside organisations being used. This will require the development of some standard data formats to facilitate the exchange of data between organisations.

7.4 TYPES OF CONTENTS

7.4.1 Some of the types of contents included in the Common Data Base are often simply carried over from existing 'historical' files, such as current status master files, summary files, current transaction files, etc.

7.4.2 A newer type of data is planning information. This includes the current version of future plans and also standard lists of activities and resources to aid in developing new plans. Thus, when a new project is to be undertaken, lists of activities and resources for that general type of project would be retrieved to aid in formulating the plans.

7.4.3 Another type of data is managements report files. These would be held in mass storage instead of being printed out. A manager can then retrieve part or all of a report on demand, either as a visual display or as a hard copy.

7.4.4 Files of detailed historical transactions, while not frequently used, may prove invaluable when needed for analysis of trends, unsatisfactory conditions and performances.

7.4.5 Also included, might be business intelligence data, such as competitive products, prices, fees, marketing and other practices, all by region.

7.4.6 Another type of data which might be recorded and stored is 'instrumentation' data. This records the performance of the information and physical systems within an organisation. As well as recording all transactions, it could include procedures to obtain feedback from users of the system.

7.4.7 Data provided by outside organisations could also be held. This might be market analyses, financial data such as credit status of individuals and organisations, government data such as labour statistics, census data or business economics.

7.5 FILE ORGANISATION

7.5.1 The subject of file organisation breaks down into three topics. Firstly, there are data structures. The user must be aware of these in order to process the file. Secondly, there are storage structures. These are the form of the internal system representation of the data. Thirdly, there are access methods, the means by which the data is accessed.

7.5.2 These three topics will be discussed in more detail in the following paragraphs.

7.6 DATA STRUCTURES

7.6.1 A data structure usually comprises file elements and record elements. A file may be regarded as a matrix whose rows are the data fields, whose columns are the actual occurrences, and whose elements are the data field values. A record is usually regarded as a set of related data fields pertaining to some entity.

7.6.2 With this familiar record concept, the data in the file is organised by column, data fields pertaining to entity A being stored together. This method of data organisation is effective when it is desired to reference several attributes or descriptions of one entity at the same time.

7.6.3 However, it is sometimes desirable to organise the file by rows, instead of columns of the matrix. Here a 'non-record', as opposed to record, concept applies. This organisation collects references to a set of entities which have the same value of an attribute, and is usually called the 'inverted' file. It facilitates finding all entities having a common value of an attribute, but pulling together all the attributes of one entity is difficult. Thus the choice between the two types of organisation will depend on the way in which the data is to be used.

7.6.4 The relationships between data introduces one of the first complications in attempting to structure data. This is the concept of level. A multi-level structure occurs where there is a dominant-dependant relationship, or an owner-owned relationship, between data elements. As a first approximation, many such data structures are regarded in terms of a tree structure or a hierarchy. The structures are, in fact, networks where a data element has two or more owners. Diagrams of a tree structure and a network are shown in Figures 7A and 7B.

7.7 STORAGE STRUCTURES

7.7.1 In discussing storage structures, the concepts of mapping methods and relationship techniques will be used. Mapping is concerned with placing logical records in the storage space, taking into account the features of the physical media and also the question of access.

7.7.2 In sequential mapping, the logical records follow one another in the storage space. Thus, sequential access consists of retrieving the next line. This common form of mapping, used with magnetic tapes, has been carried over to mass storage media.

7.7.3 In distributed mapping, the records are placed at known locations in the storage space, and paths exist for going directly to those locations. The concept is one of priority. To retrieve record N, there is no need to first retrieve records 1, 2, etc. up to N-1.

7.7.4 It is possible to have a combination of sequential and distributed mapping. Some systems use 'clusters' of distributed records, and access is achieved by going directly to the selected cluster and then searching sequentially along a chain for the desired record.

7.7.5 If there is a relationship between data fields, the most common method of indicating this is by adjoining them to form a segment. This is done by various methods. Fixed field lengths may be used, where the location of a field is known from its position within the segment or record. Alternatively, explicit labels may be used to identify each field. A third method builds an index of labels and locations at the head of the record or segment. A fourth method uses field separators.

7.7.6 If there is a relationship between data segments, this is usually shown in mass storage systems, where distributed mapping occurs, by the use of pointers. It is possible to have tables of pointers to define the relationships between fields and between segments. This is what is done in inverted file systems, which were described under data structures.

7.7.7 Another method of file organisation is chaining. This uses information embedded in a data record to locate the next record, which need not be contiguously stored. Chaining is useful for linking inter-related records and provides an effective means of building hierarchical relationships into the file.

7.7.8 An extension of the chaining concept is a branching file structure. This provides a positioning mode which has the advantages of using fixed field records and contiguous placement of records, but can handle repeating fields, and can save space when the value of a field recurs often throughout the file and when record structure changes are frequent. With this structure, a file can be organised by removing the set of repeating fields from all records, and placing them in a separate location, omitting repetitions and duplications. This set is replaced in the original record by a single address, referring to a record in a file of addresses. Each record in the address file will contain the record numbers of repeating field values that pertain to the specific record. An illustration of a branching file structure is given in Figure 7C.

7.7.9 Another way of organising and allocating storage is by the use of list processing. A list is a group of items arranged in some organised sequence. Each item consists of two parts, namely the data and a pointer to the next item on the list. Thus, the items in a list can be located anywhere in store. A new item is inserted by placing it in any available storage space, and making its pointer aim at the next successive item. The pointer of the previous item must be altered to aim at the new item. The concept of list processing is very similar to that of chaining. In fact, chaining is the basic mode of operation in list processing.

7.7.10 One of the major uses of list processing methods is the allocation and handling of internal computer memory under conditions of dynamic change, by maintaining a list of available storage space.

7.7.11 In handling mass storage files, list processing is based on the concept of master records and detail records. A master record is connected to all of its detail records by means of a chain. Thus, the master points to the first detail, the first detail points to the second detail, and so on to the list termination, which may be the master. An example of this chain structure is given in Figure 7D.

7.7.12 Each record type can be of fixed length, the length varying with the record type, yet variable length records are achieved through the variable number of details which can be in a chain.

7.7.13 Records are stored in pages, a page being a large block of mass storage of 2000 to 3000 characters. Records of many types can be intermixed, but each is assigned a unique sequence number, part of which is a symbolic address by a simple calculation.

7.7.14 There are many advantages of list processing. In particular, it does not require the general partitioning of mass storage to accomodate subject-oriented files. Master records are stored in random order, but usually details are stored in close proximity to the master, on the same page if possible. When a record is a member of more than one chain, it is stored closest to the master having the most activity. No directory is required for either master or detail records.

7.7.15 A second advantage of list processing is in connection with multi-level files. Here records relate to those at the level above as well as to those at the level below. With list processing, each record is a member of a chain to the level above and to the level below. Thus records can be retrieved either in assembly sequence or in 'where-used' sequence.

7.8 ACCESS METHODS

7.8.1 Access methods are closely linked to data and storage structures and cannot be considered in isolation from them. A data structure is in fact an access method. For example, data is structured so as to access it selectively. Alternatively, an access method may determine a data structure or a storage structure. This is the case with indexed sequential access methods, which force the storage to use fixed length records. On the other hand, the storage structure may determine the access method, as with magnetic tape which forces sequential access.

7.8.2 Access methods fall into two types. Firstly, there is direct addressing, where the program may use actual storage locations, and pointers used in chains may point directly at storage locations. Secondly, there is content addressing, where access is controlled by the content of one or more fields in the record. There are two main variations of content addressing, namely tree-structured index, and calculated address.

7.8.3 A tree-structured index is usually known as an indexed sequential file. This is organised and processed in the order of logical keys contained

7.8.3 Cont'd in each record. This means that records need not be processed in physical sequence, though they often are, and it provides a facility for processing in their correct sequential position those records which are held separately from the main file. In an indexed file, the disadvantages of serial organisation are overcome by the maintenance of indexes at various levels, to enable new records to be inserted in their logical sequence, and to permit the selection of individual records when required. Thus, the file can be processed both sequentially and directly, and can be amended without the need to re-write the complete file.

7.8.4 The calculated address is a relative addressing system, which derives the address from the key by means of a calculation. This is done by an algorithm or randomising formula, possibly quite a simple one such as extracting a combination of digits from the key, say the four least significant, or alternate ones. Another possibility is truncation, the key being divided by a power of 10, leaving the remainder as a relative address. Another transformation formula is folding, the digits in the key being divided into two portions and added. There are several other techniques which may be used, alone or in combination, such as radix transformation, squaring methods, or prime number division. In the latter, when the run increase and divisor are relatively prime, a string of unique remainders is produced, which can be used as relative addresses.

7.9 MANAGEMENT OF THE COMMON DATA BASE

7.9.1 Most files are dynamic structures of information, frequently changing in content, and occasionally in structure, sequence or storage medium. Thus, in designing the data base, much consideration must be given to the maintenance of the file. Management of the Common Data Base covers three main areas. Firstly, changes to the file and the consequent restructuring. Secondly, handling the growth of records and the file. Thirdly, the security of the data. These will be discussed in the following paragraphs.

7.9.2 Adapting to changing needs will necessitate restructuring of the data base. The kind of changes which take place are to the length of fields, the number of fields, or the sequence of fields within a record in order to meet operational requirements more satisfactorily. It may increase

7.9.2 Cont'd efficiency of operation to combine partial records to form composite records, or to split composite records to form partial records. It may also be necessary to set up new chains between data fields to identify new inter-relationships in the data, or to establish different block lengths for records with a consequent effect on chains.

7.9.3 The size of the data base will increase with the growth of the record sizes and the addition of new types of data, such as planning data, business intelligence data, detailed historical transactions, and system instrumentation data. The very magnitude of the data base will therefore demand efficient management techniques and the minimising of redundancy. Causes of redundancy are duplication of records or file groups, retention of past generations of data, or the use of specialised files updated in parallel with the regular data base. This redundant data not only increases the file size, but also causes problems in the updating and maintenance of redundant file groups and the reconciliation between file groups.

7.9.4 One of the problems of managing the data base is that of privacy and security of data, when it is possible for the data to be accessed by many people. Two types of protection are required. Firstly, content validity, where the user must know what is being read and perhaps updated. Secondly, content security, where the question of who is reading and perhaps updating the data becomes paramount. Two system considerations are relevant here. Read-only retrieval, where no updating is to be done; and retrieval for updating.

7.9.5 The case of content validity with read-only retrieval is quite straightforward. The data currently in the file is the data retrieved, and its validity should have been established when it was recorded.

7.9.6 Content validity with retrieval for updating is more complex, the problem being one of possible concurrent updating. For example, if a transaction from User 1 is to update record X in the file, the record is retrieved and brought into internal storage. However, before it can be updated and replaced, a transaction arrives from User 2 which also affects record X. The record is again retrieved, but User 2 is not getting the record he expects, since the version in the file does not yet reflect the change made by User 1. This is particularly applicable to the CUBITH System, where for instance several members of a design team may be working on a specific part of a project.

7.9.7 The case of content security, with read-only retrieval, concerns the privacy of information. One solution involves lockwords or passwords, the user having to supply the correct password before the data can be retrieved. To protect against users trying all combinations of characters, the software system usually counts the number of requests, and after a certain number, say five, of unsuccessful requests, issues a report to someone in authority that tampering may be taking place.

7.9.8 The problems of the last two cases are combined in the case of content security with retrieval for updating. A possible solution is the breakdown of the data base into public, private and personal files. Public files containing data which is retrievable by anyone who has access to the system, private files having various levels of security imposed and possibly constituting the major number of the file groups in the system, and personal files being used by one person or a group of persons for special purposes.

7.10 CONCLUSION

7.10.1 It is clear that the organisation and management of the Common Data Base is complex, and poses a system design problem in itself. The starting point in data base design is the users' needs, and in particular the way in which the users regard that data, namely the data structure. When these needs have been determined, a choice of access method and storage structure can be made.

EXAMPLE OF A TREE STRUCTURE

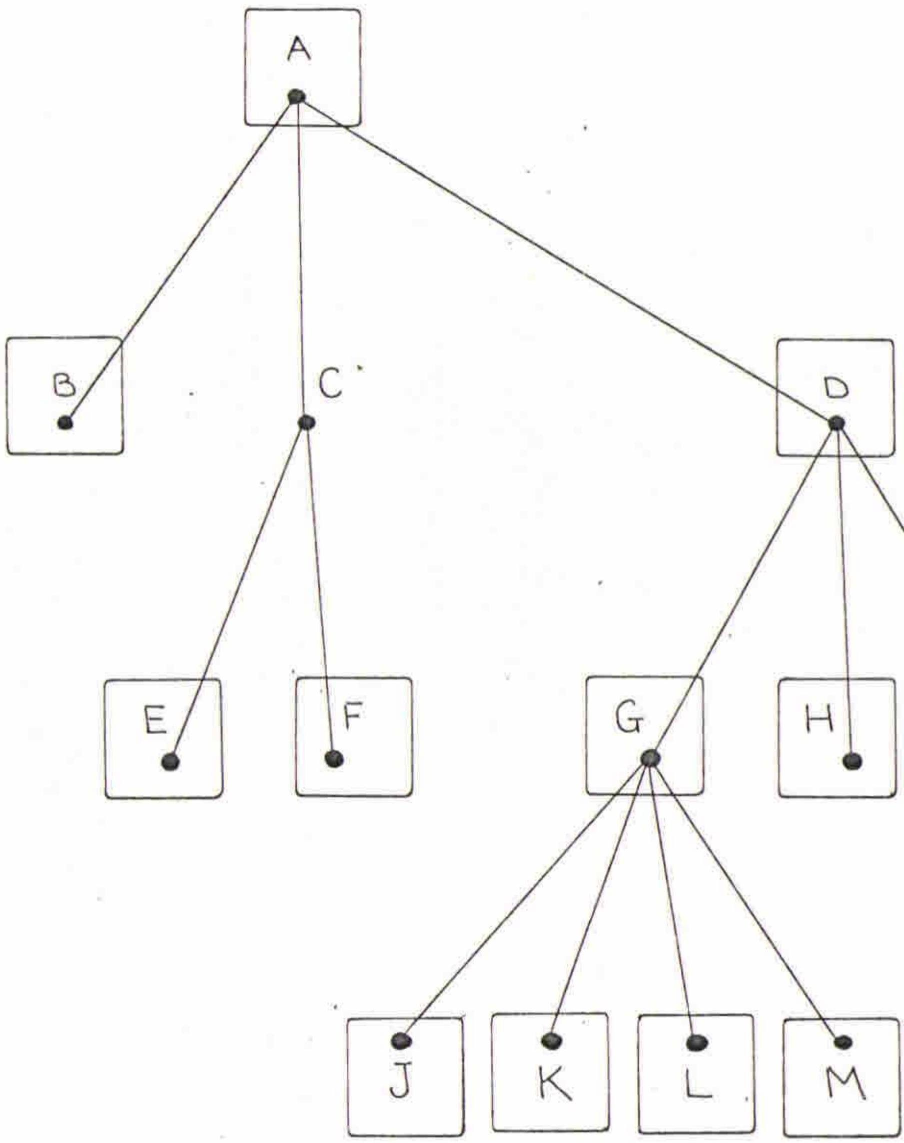


FIGURE 7A

EXAMPLE OF A NETWORK

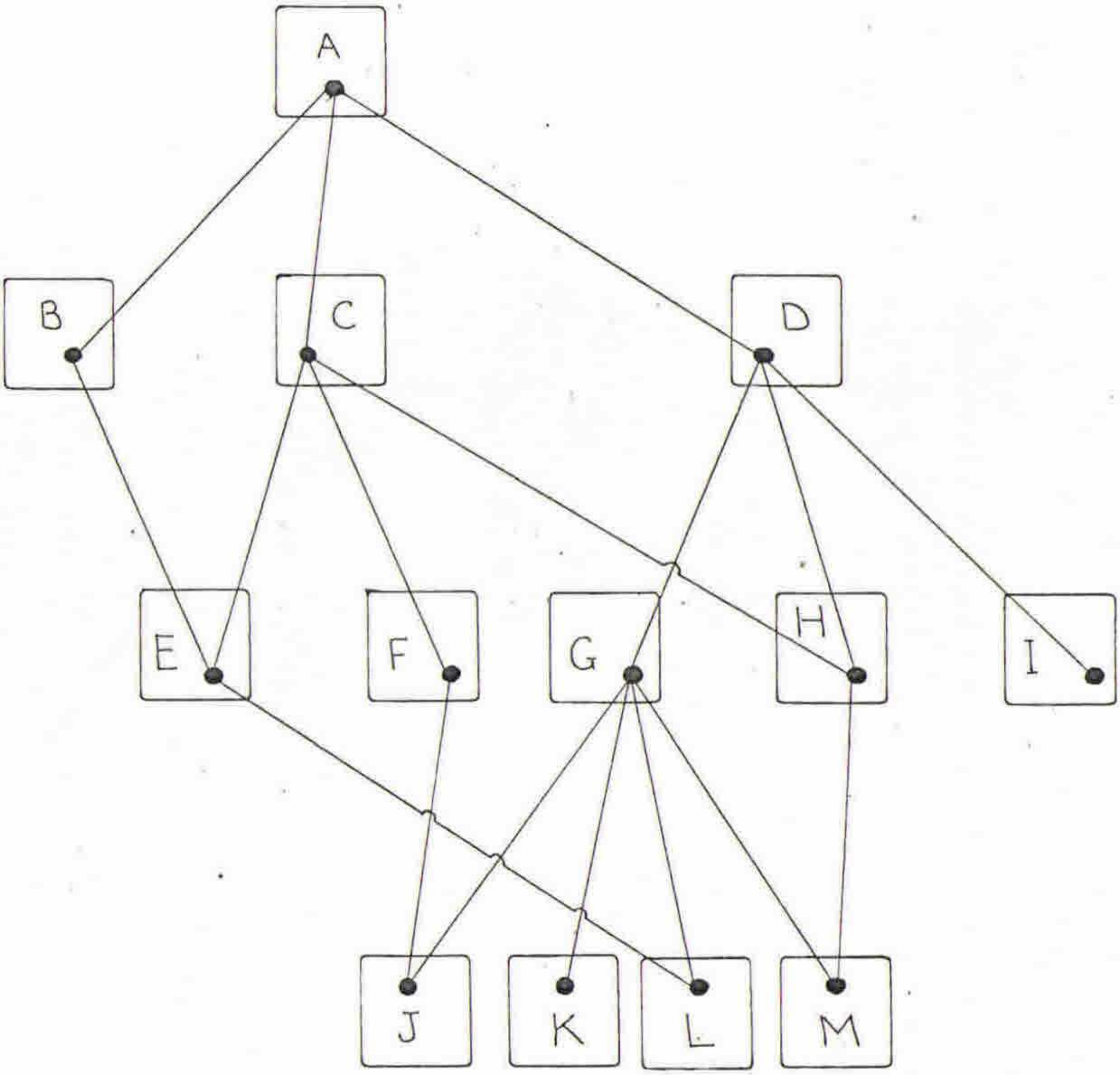


FIGURE 7B

EXAMPLE OF A BRANCHING FILE STRUCTURE

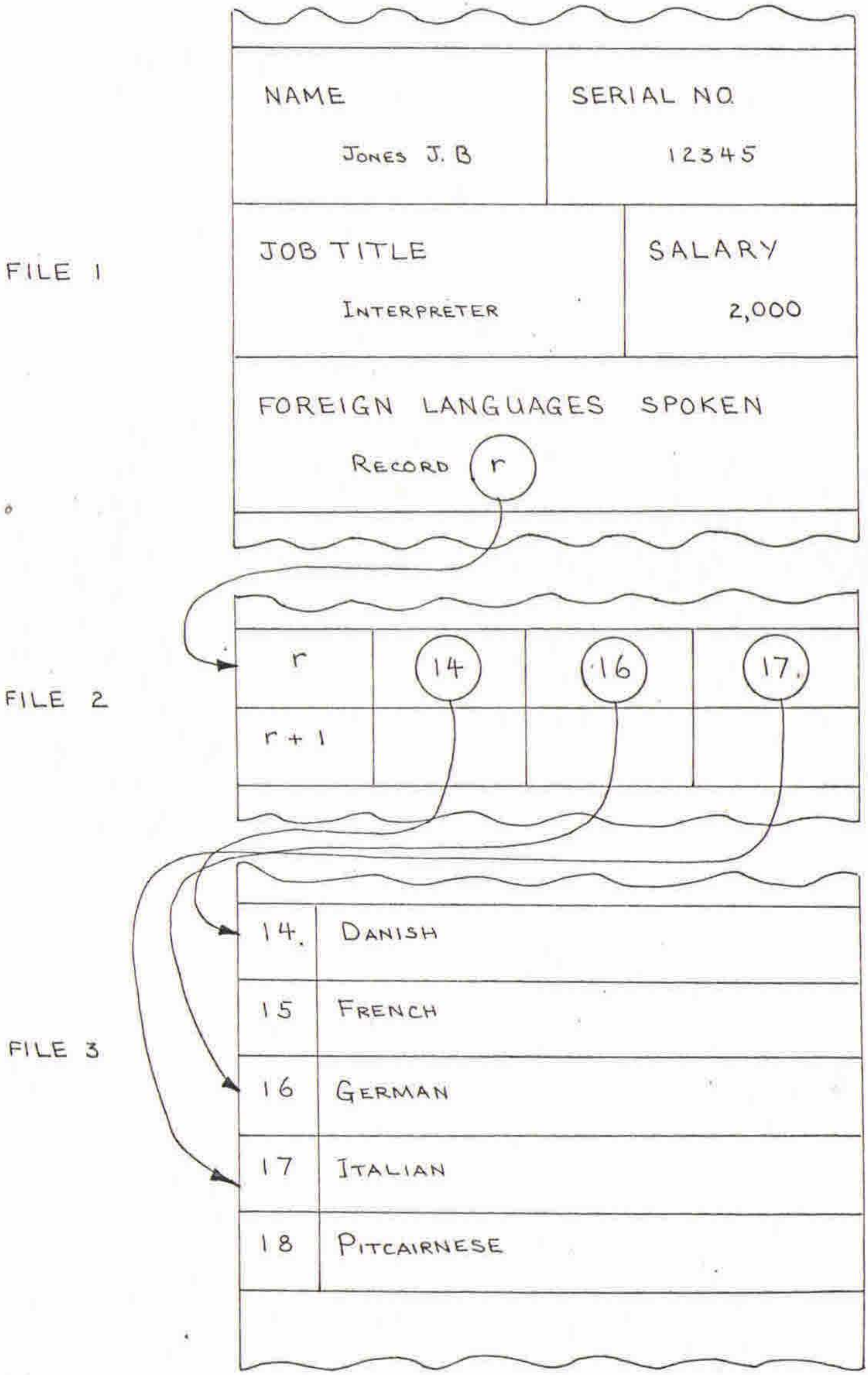


FIGURE 7C

A LIST STRUCTURE

Memory location	Contents: Data	Contents: Address
14	A	18
18	78	11
11	C	143
143	D	56
56	END	
78	E	79
79	F	2
2	G	194
194	H	22
22	END	(18)

DIAGRAMMATIC REPRESENTATION OF A LIST STRUCTURE

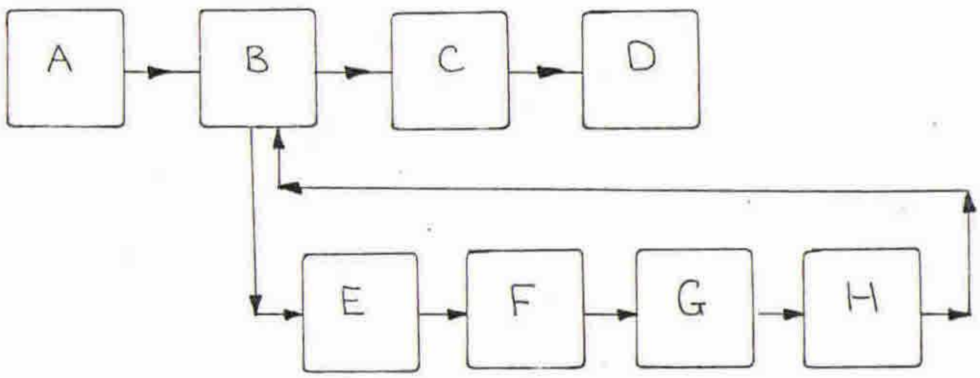


FIGURE 7D

SECTION 8 THE APPLICATION OF ADP METHODS TO CUBITH

SECTION 8 THE APPLICATION OF ADP METHODS TO CUBITH

INDEX

8.1 THE CUBITH SYSTEM

8.1.1 In Sections 2 - 7 of this report the Authors have attempted to define the CUBITH System.

8.1.2 In Section 3 CUBITH is related to other systems, either already in existence or under development, which are associated with the Hospital Building Programme.

8.1.3 In Section 4 the CUBITH System is defined in more detail and an attempt is made to outline various procedural sub-systems within the whole.

8.1.4 In Section 5 the procedural sub-systems are defined in more detail and related to the whole System.

8.1.5 In Section 6 the data associated with the System is described briefly and the idea of the need for Project files and a Common Data Base is introduced.

8.1.6 Section 7 defines Data Bases in general and gives suggestions for Data Base Design and Management.

8.1.7 Although Sections of CUBITH could be implemented using manual methods, it is quite obvious that with the need for a fully integrated system and the provision of vast quantities of data in the form of a User Data Bank, ADP methods must be used.

8.2 THE ADVANTAGE OF THE APPLICATION OF ADP TECHNIQUES TO CUBITH

8.2.1 The main advantage of the application of ADP methods to CUBITH is the infinitely faster response, provided by such a System, to requests for facts on which to base decisions. This reduces overall design and construction time and leaves more time for true decision making, which can be followed by the automation of many routine procedures.
Other advantages are the provision of improved methods of control on all aspects of a project and the ready access to large volumes of standard data which will allow the use of optimum design and construction techniques.

8.2.2 It is envisaged that the users of the CUBITH System will assist with the evaluation and revision of standard techniques in the light of experience of their use and this pooling of expertise will be one of the more attractive features of the System.

8.2.3 The link between CUBITH and associated systems will be most valuable and will allow for better communications between systems within the Hospital Building Programme as a whole. With a better communication system it should be possible for more accurate data to be passed between systems more quickly allowing key decisions to be taken sooner and with the knowledge that all the data is available. Similarly, CUBITH will interface with manufacturers' systems providing data on component and equipment requirements at an earlier stage than possible before and in a form most suitable to each manufacturer. Many manufacturers now have their own computer systems and it should be possible to supply data directly to these in the medium and format required without the need for manual intervention. Many contractors are now also using computers for the Evaluation and Control of Construction techniques, stores scheduling, costing, forecasts of labour requirements, etc. The CUBITH System could receive data on all these thus keeping a better control on contractors throughout the construction phase.

8.2.4 With the provision of an integrated system it should be possible to examine all consequences of a particular line of approach before it is implemented. Thus it should be possible to simulate the results of various actions so that a choice can be made with full knowledge of the consequences. For instance, to reduce capital costs on a project it may be decided to use a cheaper wall cladding. But what are the consequences of this? With the full ADP System in operation it should be possible to receive a reply to such a question in about half-an-hour and at a fairly low cost when compared with current methods where a Quantity Surveyor, Service Engineer and Designer may need to consult to provide a full answer.

The System could also be requested to provide detail of the action to be taken to reduce capital costs by a percentage and give all the consequences, thus reducing the need for manual intervention even further except to evaluate the consequences and make a final decision. The decision could then be fed back to the system with the instruction to carry out the necessary action to ensure that the decision is implemented and all concerned with the change notified. It is a simple step to progress from that stage to the stage where only decisions of a certain magnitude are made outside the System; all minor decisions being taken and implemented by the System.

8.3 THE COMMON DATA BASE

8.3.1 As the provision of standard data based on optimum design techniques, approved components, standards costs, etc., forms the basis of the CUBITH System, this data must be in a form readily available to its users.

8.3.2 Only a computer based system will give the fairly fast response required, and allow for the full appreciation of all the relationships between such data.

8.3.3 It is stressed that care must be taken to explore all possible relationships between data so that the Data Base can be structured to give ready access to all possible combinations of data and that there must be full provision for further developments. The requirements of CUBITH will change throughout the development period and when the full system is in operation. To design a Data Base based only on the requirements appreciated today would restrict the full development of the System.

8.3.4 It is important that the response required should be examined as described in Section 7 of this report. As in some cases a fast response time is not required, but in others - for instance Computer Aided Design Techniques - a long response time would be intolerable. A designer working at an interactive display needs to see the results of his activities in seconds - not in half-an-hour!

8.4 PROJECT FILES

8.4.1 As described in Section 6 the Project files will contain information in many different forms. Some of the information will be set up on computer files, but there will still be a need to carry much of it in a directly readable form. This may be achieved by the use of Computer Activated Microfilm techniques - descriptions of these are developed more fully in Section 9 of this report.

8.5 PROCEDURAL SYSTEMS

8.5.1 Many of the procedural systems described in Sections 4 and 5 of this report will benefit from the application of ADP techniques, but some will remain largely non-computer applications being backed by the knowledge that people taking decisions made round a table, say, have ready access to evaluated data on which to base these decisions.

8.5.2 Full analysis and control of The Hospital Building Programme can be greatly improved by the application of ADP techniques. The provision of data on existing facilities and the evaluation of project spend will lead to a better assessment of facilities required and the allocation and control of the outflow of capital on current projects.

8.5.3 Project team activities will be greatly improved by the ready access to fully evaluated data on which decisions can be based.

8.5.4 The determination of project requirements will be greatly assisted by the availability of data on existing facilities and the ease of access to data on related systems giving details of need, population drift, etc.

8.5.5 The procedures required to produce the Development Control Plan will be greatly assisted by the easy access to data on Design and Cost consequences, Site Plot Ratio analysis, and Computer Aided Design techniques. It is thought that the application of ADP techniques in this area alone will considerably reduce the time taken to produce and finalise the Development Control Plan.

8.5.6 Activity Data will be one of the major constituents of the Common Data Base. Its use is widespread throughout the CUBITH System and it forms an important 'base' on which the designer can 'build'.

8.5.7 Systems associated with the selection, purchasing, supply and installation of Equipment will benefit from the ready access to data on cost and performance standards, etc. for the equipment available to CUBITH. It is important to remember that there is a pre-selection process before equipment is considered suitable for CUBITH thus reducing the total range available.

8.5.8 Staff requirements are broadly considered as part of the work involved in producing the Development Control Plan, but a fully integrated Staffing system could be designed for CUBITH, growing from standard staff requirements, depending upon facilities to be provided. (This data would be part of the Common Data Base) - to the full integration with Hospital Personnel systems and National Staff grading and salary procedures.

8.5.9 Full Cost Analysis is a major part of the CUBITH System and is one of the points at which it is expected further control can be exercised giving gains in the control of the outflow of Capital and Revenue consequences.

8.5.10 The Design Development System will be greatly improved by the application of Computer Aided Design techniques based on the ready access to optimum design solutions in the Common Data Base.

8.5.11 In CUBITH the Production Drawing System will be largely automated following directly from decisions taken at the Design Development Stage. An important area of further development is to fully appreciate techniques required for the production of Architectural Drawings by computer.

8.5.12 Engineering Systems will benefit from Computer Aided Design techniques in the same way as the Design and Production Systems.

8.5.13 Vast areas of Scheduling and Component Selection can be automated under CUBITH with reference to data provided in the Common Data Base.

8.5.14 Tender Action and Contracts Selection can be greatly assisted by the provision of data selected and collated by computer according to the requirements of the user. Standard contracts can be held as part of the Common Data Base and modified for specific projects by the use of Text Editing techniques.

8.5.15 During Construction it is hoped that the use of ADP methods can provide better control in terms of Time Analysis, Resource Analysis and Cost Analysis, so that the resultant buildings show a better relationship to estimates in the 3 areas, i.e. Time, Resources used and Cost.

8.5.16 When the full CUBITH System is in operation it is hoped to provide Services to the Construction Industry. Such considerations as restricted access to the Common Data Base and the provision of data in a form readily acceptable to the Industry, etc. should be investigated.

8.5.17 Maintenance Documentation can be assisted by ADP techniques. This will be based on a gathering together of standard forms of maintenance data and the formation of Maintenance Manuals. Although probably required mainly in 'hard copy', it can be envisaged that Business Intelligence data on the local facilities for maintenance to a given area, can be provided, and costs of window cleaning etc. can be held on the Common Data Base.

8.5.18 As with the Project Team Commissioning Team Activities can be greatly assisted by the ready access to standard data.

8.5.19 Although it is possible to set up an On-line Enquiry System using manual methods, the long response time is usually intolerable on a System the size of CUBITH. The application of ADP techniques and the provision of a fully automated Management Information System, makes an On-line Enquiry System feasible.

8.6 SOFTWARE DEVELOPMENT

8.6.1 A System such as CUBITH requires considerable software development and in Section 10 of this report the authors attempt to define the requirements in more detail, but it must be stressed that Software Development must be co-ordinated or the result will be an unco-ordinated system.

8.7 COMPUTER AIDED DESIGN

8.7.1 Computer Aided Design techniques can be applied to many areas of the CUBITH System, and as these techniques are fairly new, full consideration must be given to current developments in this area.

8.7.2 The Ministry of Technology's Computer Aided Design Centre at Cambridge is a leader in this field in England and full advantage should be taken of their expertise, but it may well be that new CAD techniques developed for CUBITH will extend the range of CAD applications currently available.

8.7.3 It must be stressed that to date Computer Aided Design has been a fairly costly exercise, but with cheaper hardware and the development of existing techniques, this need not be so. The advantages of Computer Aided Design are difficult to assess, but the main advantage is in the shortening of the design time and if this can be costed the gains can be measured.

8.7.4 Response times for Computer Aided Design are critical, a designer wants to see the result of his design in seconds not hours, so the structuring of the Data Base backing the Computer Aided Design System is most important.

8.7.5 One technique which is sometimes associated with Computer Aided Design, is the development of Text Editors. These enable the user to bring standard text onto a screen and amend it either by light pen or the use of a standard set of command keys. This is a powerful technique which will be required in the amendment of the Environmental part of Activity Data and the preparation of Project Contracts from a list of Standard Contracts.

8.8 THE ON-LINE ENQUIRY SYSTEM

8.8.1 An important feature of CUBITH is the provision of a Management Information System which can be accessed by an On-line Enquiry System.

8.8.2 It is envisaged that the users of the Management Information System will range from other Government Departments, the Department of Health and Social Security in general, the Regional Hospital Boards, Planning Teams, Contractors and the Construction Industry in general, their access only being restricted by security keys.

8.8.3 If a varied range of enquirers is to have access the security system must be designed with great care. Considerations are outlined in Section 7 but this aspect of CUBITH requires a full study.

8.8.4 The On-line Enquiry System will be via remote terminals set up in the various user organisations. An Enquiry language will be required and must be designed. Full advantage should be taken of the work already carried out on other ADP applications in this field.

8.9 CONCLUSION

8.9.1 The application of ADP techniques to CUBITH has already started in various select areas and has so far proved that ADP techniques can be successfully applied to the System, but if the full gain is to be obtained from this exercise, a strategy for System Design and Software Development must be formulated.

SECTION 9 EQUIPMENT CONSIDERATIONS

SECTION 9 EQUIPMENT CONSIDERATIONS

INDEX

9.1 INTRODUCTION

9.1.1 At the present time, the implementation of the CUBITH ADP System divides into two distinct phases. These will be referred to as The Total System and The Development Phase.

9.1.2 With increased understanding of the system and experience of applying it to more projects in greater depth, other phases may be introduced.

9.1.3 The discussion of The Total System in paragraphs 9.2 - 9.4, is an attempt to set out the type of installation which will finally be required when CUBITH is a fully integrated system offered on a bureau basis to project teams, Regional Hospital Boards, manufacturers, contractors, etc.

9.1.4 Although CUBITH is conceived in terms of the Hospital Building Programme, its extension to all forms of building activity would appear possible, since many of its constituent systems are of general application to the Construction Industry.

9.1.5 Development of The Total System must inevitably be spread over several years. However, it is the ultimate goal, although it is imperfectly understood at the present time. This section attempts to indicate the implications of implementing the ADP System in its full context.

9.1.6 There will be several distinct phases of development. These will include various pilot building schemes, enabling an increasing number of tasks within the CUBITH System to be processed on ADP equipment. The design of these pilot schemes must be far-sighted enough for their application to be general and not limited to the one project.

9.1.7 This Section defines a phase as that work planned to be carried out on a given central processor. For this reason, only one phase is considered for development. However, as has already been suggested, more than one phase of development may result before the decision is taken to proceed to The Total System. It may well prove advisable to have an intermediate phase, when part of The Total System is made available to clients before the organisation for running and maintaining The Total System is fully established, and the central processor has attained final size. Having mentioned this possibility, this Section will proceed to consider only the two phases named in paragraph 9.1.1.

9.1.8 For the initial development phase, the central processor to be used is the MinTech Atlas at the CAD Centre at Cambridge. The paragraphs dealing with this are limited to a discussion of the terminal equipment required at the CUBITH Project Base in this phase.

9.1.9 In the context of the total CUBITH ADP System, the word terminal refers to a grouping of equipment designed to perform certain functions which will vary during the course of the project. Suggested groupings and their functions are discussed in detail in this Section of the report.

9.2 THE TOTAL SYSTEM

9.2.1 The Total System is considered in two parts. Firstly, the Central Installation, and secondly, some of the groupings of equipment which form terminals remote from it. Discussion of the Central Installation includes an outline of the organisational requirements, since these require planning on a long term basis for such a large and complex ADP System. Also included are considerations of hard copy requirements.

9.3 THE CENTRAL SERVICE

9.3.1 It has been suggested that only one installation should be set up to provide a National centre for the CUBITH ADP System, but at this early stage it is too soon to decide on the number and situation of central installations. This and the associated services will necessarily evolve from the preliminary development stage, prototype techniques etc. The laying down of a firm strategy will follow from the experience gained in this work in both terms of hardware and users' requirements. Therefore, although the preliminary work with MinTech is not given great prominence in this report, in fact it will be crucial in terms of evolving a really practical means for evaluation of the system, thus identifying the eventual pattern of central services and development, project operation and the service to be provided. The objectives of the central service are:-

(a) To provide a central processing service for ADP operations, including data preparation and maintenance of the CUBITH System in general, at the central installation.

(b) To liaise with clients, etc.

9.3.1 Cont'd linked to the central processor it will be necessary to provide

(a) A service to maintain and augment technical data and the Common Data Base.

(b) A service to develop the CUBITH ADP System, including all software and hardware modification and development.

9.3.2 In the sphere of data processing, information is available in many forms. To make it suitable for the computer, it is generally the practice to prepare data in a pre-set form on media suitable as computer input such as punched cards, tape, etc. Within the computer, information is essentially held in computer coded form which will be different from the coded format of the input. The output may be required in graphic or alphanumeric format, and it must be converted to a form suitable for the various output media, magnetic tape, paper tape, printer, etc. The printed versions of computer output are often referred to as hard copy.

9.3.3 Because of the high internal working speeds of computers, obtaining output in printed form has always presented difficulties. Line printers, which output alphanumeric data a line at a time, have now been developed to print up to about 2,000 lines per minute with reliability. However, such high speed line printers are very expensive, require much maintenance, and are not suitable for the output of graphic information. In the CUBITH ADP System, graphic output is an inherent feature. It falls into three categories:

(a) A4 size diagrams of room layouts, activity units, junctions, components, etc.

(b) Drawings, up to standard drawing size, required for off-line working where quality may be adequate rather than good.

(c) Drawings, up to standard drawing size, where quality must be as good as that currently produced manually.

9.3.4 In the case of the A4 size diagrams, the system requires these, together with alphanumeric data, to be formed into project books, of which 10 to 30 copies may be required. A solution to this would be provided by a Copy Unit - Computer Output on Microfilm. This would ideally be at

9.3.4 Cont'd the central installation and could also perform the function of an off-line printer-cum-microfilm unit, taking magnetic tape output by the central processor and storing directly on to microfilm rather than on printed paper which is bulky to store.

9.3.5 It is also proposed that a master flat-bed plotter, for producing high quality standard drawings, be situated at the central installation as it is a costly piece of equipment. The flat-bed plotter should also operate off-line.

9.3.6 These two hard copy drawings would produce the high quality output for specific areas of the system.

9.3.7 It is recognised that each remote terminal will have to be provided with a quick method of obtaining hard copy, for the purposes of off-line working. At the moment, the solution to this problem in reasonably economic terms is not clear, and therefore the required equipment will be referred to simply as Hard Copy Device.

9.3.8 To determine the magnitude of the central processor required to support the CUBITH ADP System, when working in its fully developed state, a list of functions is given with an estimate of the core required, in bytes, to perform each function.

		Bytes
(a)	Routine operations including program testing and development	50K
(b)	On-line enquiry systems via terminals, allowing for 6 concurrently	132K
(c)	Programs for manipulating the data base as required by systems on-line	256K
(d)	Communications software, including the operating system	72K
	say	512K

9.3.9 Outside office hours, all or part of the area allocated to the on-line enquiry system, together with that for routine operations, may be used to provide a very large area for routine batch processing.

9.3.10 However, by allowing for the functions itemised above, a minimum requirement for an initial installation could be established and a programme for phased enhancement laid down.

9.3.11 The system requirement for disc drives will relate directly to the ultimate size of the Common Data Base and the number of project files required to be kept on-line at any one time. No assessment can be made at the present time, since only limited information is available on the size of the Common Data Base and no work has yet been done on the structure and organisation of a project file in ADP terms.

9.3.12 The system will extensively use magnetic tape as a data carrier. Examples are:

(a) Output to master plotter.

(b) Output to COM Unit.

(c) Output for later processing by the small processor.

(d) Communication with other systems, both within DHSS and also with contractors etc. whose systems interface with the CUBITH ADP System.

The same equipment will also serve the file retrieval system.

9.3.13 To optimise the use of the central processor, a small processor should be interfaced between it and the terminal lines. This arrangement gives the central processor the impression of having only one terminal and protects it from many routine functions. The capability of the small processor to take on additional tasks, as a slave of the central processor, will be determined by its size.

9.3.14 With an installation such as the one proposed for the CUBITH ADP System, it is usual to provide a virtually duplicate system which is immediately available to take over in the case of machine failure. However, comparing and contrasting the CUBITH System with the type of application having full back-up, such as an air-line reservation system, one fact stands out above all, this is that the CUBITH ADP System is only real time in the area of project development. It is anticipated that development work would be incorporated within the project file system within a few working hours

9.3.14 Cont'd of inception.. Hence the work lost in the event of a machine failure would be at the most a few man hours at a terminal, and this work may well be supported by hard copy taken during its progress. In view of the capital outlay involved in duplicating a system of this magnitude, compared with the potential loss in man hours, it is not considered necessary to duplicate the central installation in any way. However, very comprehensive file dump and retrieval routines will be required for recovering from machine failure.

9.3.15 Provision for the input of data to the system is essential. This can be achieved by punched cards, paper tape or magnetic tape, the method adopted being governed by other overriding considerations.

9.3.16 If the organisation and housing of the central installation allows for all staff concerned to be within the same building, direct lines to terminals used by them will be possible. This is assumed in the diagrams shown in Figures 9A and 9B. The alternative is a line through a modem to an out-station, as with other terminals. Truly remote terminals, as used by a contractor on site, require transmission on lines after conversion by a modem. The diagram assumes the use of Post Office Telecommunications lines, but a study in depth of all possible methods of data transfer is required before any decision is made.

9.4 TERMINALS

9.4.1 In the discussion which follows, the various operations whose function would require the use of a terminal, are listed:-

	Operation	Function
(a)	Data Base Development	To maintain and update the Common Data Base.
(b)	Software Development	To further systems work on the CUBITH ADP System and software development. N.B. It is important to appreciate that this work must be carried out in conjunction with the Operations of the Construction Industry as a whole.

9.4.1 Cont'd (c) <u>Project Team Operations including Commissioning</u> — To prepare a project for tender from its inception and to make the hospital operational.

(d) <u>Industrial Use</u> — To provide interfaces with the CUBITH ADP System, or to assist firms whose management is aided by the System.

9.4.2 When discussing the system requirements for <u>visual display</u>, owing to the very general confusion currently existing in that comparatively new industry, it is necessary to refer to the types of unit arbitrarily as <u>'scope' and 'display'</u>.

9.4.3 In the fullest application of the CUBITH ADP System, many screens will be required, and are referred to in this section as '<u>scopes</u>'. The following list itemises the facilities that they should ideally possess, although some terminals or users would be given access to only a selected number of these:

(a) A keyboard giving access, by a non-skilled operator, to Common Data Base files, Project Files, and, implicitly, to the associated systems. Ideally the software should be designed to require minimum rules of operation. To this end, it will probably be necessary to base the development of the Data Base Files and Project Files on the design of the keyboard, which may incorporate such aids as dedicated press buttons, etc.

(b) Alphanumeric display capable of very comprehensive editing under software control. From the overall operational considerations of the system, it is desirable to develop general software that will edit and then store the data, for all cases.

(c) The ability to project, but not edit, graphic data. These scopes would be required to display the following types of graphic data:

(i) Diagrams of Activity Data, Junction Details, etc., contained in the Data Base Files, a picture being required for information at various points in the system.

9.4.3 Cont'd

(ii) The results of digitising, to ensure that no co-ordinates have been omitted. It is envisaged that digitising will be done off-line, with periodic on-line checks for which the image digitised to date must be projected.

(iii) Drawings developed in the display area which are required by the display operator for reference.

(d) An operator identifier device to switch on the scope and serve as an overall security check on the demands made by the operator.

9.4.4 At the present time, it is only in the design area that interactive graphic display units are seen to have an application. In this section they are referred to as '<u>displays</u>'. They differ from scopes in that, by their very nature, they require the support of a small processor. Displays of great complexity can be projected, providing the small processor is large enough to manipulate them, and the central processor can run the sophisticated software necessary to handle their projection calculations. In particular, display units offer the light pen, or similar device, by which the operator can directly address and amend the display, and, by using function buttons, call from store virtually any graphic macros requiring manipulation. A display incorporates all the features of a scope, as defined in paragraph 9.4.3. This section assumes that displays incorporated within terminals offer the fullest facilities currently available, so that they may be fully exploited as an aid to architectural design.

9.4.5 A device recently introduced on the market, which allows microfilm frames to be projected under the control of the current computer program, is the <u>Computer Activated Microfilm Unit</u>. In this mode the device must be on-line. For a system such as CUBITH, with its wealth of associated graphics, there may well be a place for these devices. They could be particularly useful in the early stages, when it may not be desirable to put the graphic material in the Common Data Base, because it is required to perform other functions within the system, such as providing macros for the display.

9.4.6 With this facility for projecting graphic data, two other off-line applications immediately offer themselves. Firstly, the ability to project the graphics off-line as well. Secondly, the facility for holding Common Data Base material, which is not of ADP type, in a form readily accessible to all interested personnel. Both these demand a viewer capable of off-line operation. In the later stages of the system, the use of these devices could be as aide-memoires, since when one element of a hospital policy is modified, component selection, etc. must be brought to the operator's notice. The devices can be supplied as reader/printers.

9.4.7 Owing to the complexity of all terminals, other than those using a scope only, it will be necessary to have some form of electronics device, in addition to a modem, as an interface between the line and the items of terminal equipment. This can be in the form of a hard wired electronics unit or a small processor operating through software. No attempt is made to specify which solution is desirable in any of the terminals to be described below. However, a small processor would offer much greater flexibility in all cases, and may well prove to be the only solution in the more complex arrangements. It could, if considered desirable, be of such magnitude as to allow some local processing.

9.4.8 There is no inherent problem in the provision of scopes for any personnel requiring them, other than cost considerations. It should be relatively simple to install them as required. Consideration should be given to the operating capability of managers and administrators, and their willingness to learn a conversational language. For these personnel, it may be desirable to set up a terminal with a skilled operator, whose function is to deal with management queries. A simple monitor screen could be provided to transmit the answer to the interrogator.

9.4.9 For many projects, the actual siting of terminals for use by the Project Team may present no problem. However, it is probable that when construction of the hospital is sufficiently advanced, it may be desirable to transfer the terminal to it. It may also become policy to leave all or part of the terminal for use by the Hospital.

9.4.10 Because the functions of a terminal cover only part of the time span of a project, it is suggested that the terminal groupings might be mobile, possibly loaned by the Central Installation. This mobility

9.4.10 Cont'd and the flexibility it demands, may best be met by allowing for each terminal to be plugged in near the team, as and when required.

9.4.11 The following paragraphs set out the constitution and function of the terminals to be used by the project teams.

9.4.12 Development Team Terminal

Constitution:
- (i) Small processor
- (ii) 2 scopes
- (iii) 1 Interactive Display (and keyboard)
- (iv) Computer Activated Microfilm Unit
- (v) Digitiser
- (vi) Hard copy device.

Function: To have available a set of equipment so that the function of any one terminal can be simulated. This equipment will be used to develop the CUBITH ADP System and its associated software, amend the Common Data Base, etc.

N.B. This terminal must be seen as also assisting with technical development within the Building Industry and not solely as a ADP Unit.

9.4.13 Project Team Terminals

In order to carry out the functions of the Project Team, four groupings of the equipment are required, and the information is set out as four terminals. This does not imply that duplication of the function of units is not possible.
It should also be pointed out that for a very large project, actual terminals might require to be duplicated to enable, for example, selection of briefing material, to be carried on by several groups concurrently. Another point relating to this team's activities is that, from the nature of the functions, Terminal (A)'s work is virtually ended by the time Terminal (B)'s starts. This is possibly a case where mobile terminal groupings, as described in paragraph 9.4.10, could be used. Thus the total demand for equipment for use by the Project Team is less than is implied by the way the terminals are set out in this report.

9.4.14 **Project Team Terminal A**

Constitution:

(i) Small processor/electronic unit

(ii) 2 scopes

(iii) Computer Activated Micro-film Unit

(iv) Hard copy unit

Function:

To enable activity data amended for the project to be displayed at one level while standard data for the level below is examined and edited at the second scope. The computer activated microfilm unit is available for projection of associated standard graphic material and to act as an aide-memoire.
Hard copy of chosen portions of amended text can be obtained as required.
Also to provide control data, to assist project team operations.

9.4.15 **Project Team Terminal B**

Constitution:

(i) Small processor

(ii) 1 scope

(iii) 1 Interactive Display (and keyboard)

(iv) Computer Activated Microfilm Unit

(v) Hard copy device

Function:

1. To enable alternative sites to be evaluated together with the build-up of a Development Control Plan for each. The operator to use the display to build-up the Development Control Plan in association with Common Data Base and Project File material, projected on the scope and backed up by associated graphic data on the computer activated microfilm unit, which can also serve as an aide-memoire. Hard copy of chosen portions of amended text can be obtained as required.

2. To develop, on the display, groupings of accommodation to

9.4.15 Cont'd

form the design, as far as is practicable, using the scope for projecting Data Base and Project File material, and the microfilm unit for some graphic data and as an aide-memoire. From this work, a co-ordinate representation of the hospital is available to the Project File. Hard copy may be required to enable the operator to transfer to working off-line.

3. To use the representation of the hospital held in the Project File for developing a final design, including selection of components, engineering services, etc.

4. To provide cost checking data.

5. To provide data adequate for tenders at the end of the Design Sub-system (Prime Production Data).

9.4.16 Project Team Terminal C

Constitution:

(i) Small processor/electronic unit

(ii) 1 scope

(iii) Digitiser

(iv) Computer Activated Microfilm Unit

(v) Hard copy device.

Function:

1. To enable freehand drawings to be transferred to the Project File as co-ordinates. It is anticipated that this would be an off-line activity, with occasional on-line connection to the work to date as viewed in the scope and, possibly, a hard copy taken.

2. To develop drawings further by selection of components etc., which are displayed as lists, either in the scope or through the microfilm unit, depending on whether working is on or off-line.

9.4.16 Cont'd

3. To check costs.

4. To produce contracts/production documentation (Schedules, etc., Specifications, Bills of Quantities).

5. To monitor the project during construction.

9.4.17 Project Team Terminal D

Constitution:

(i) Electronic unit/small processor

(ii) 1 scope

(iii) Computer Activated Microfilm Unit

(iv) Hard copy device.

Function: To offer the access to all data relevant to the commissioning activity.

9.4.18 Industry Operations Terminal

Constitution:

(i) Electronics unit

(ii) 1 scope

(iii) Hard copy unit.

Function:

1. To supply information from the Data Base or Project File to contractors and manufacturers, and offer them the facility to take a hard copy.

   N.B. Access to files by this Terminal is restricted.

2. To interface project team operations with the needs of Industry during the construction phase.

9.5 THE DEVELOPMENT PHASE

9.5.1 It has been agreed in principle to carry out the initial development phase of the work at the Computer Aided Design Centre, Cambridge, using the MinTech Atlas. A report on the proposed use of this computer has been prepared jointly by the three groups of software consultants associated with the CUBITH project, CAP fpl SPL.

9.5.2 The acceptance by DHSS of this combined report, in whole or in part, will effect the arrangements for providing a terminal remote to the MinTech Atlas and accessible locally to DHSS architects.

9.5.3 Much software of a general nature is available at the CAD Centre. Thus the remote terminal could be used for familiarising the architects with techniques, and for their local development work. It is recognised that some initial software development work, at least, will have to be done at Cambridge.

9.5.4 The establishment of a remote terminal for the CUBITH Project Base is considered to be essential.

9.5.5 Discussions are at present progressing on how the remote terminal would be <u>interfaced with Atlas</u>. One approach would be to take advantage of development work already carried out at Cambridge, and to use the equipment that is available there as a terminal. CAD's advice on scopes, etc. will be of great value here. Also, their willingness to add to their equipment to meet the needs of the CUBITH ADP System will be very important.

9.5.6 It will be necessary to study the economics of providing <u>lines for the remote terminal</u>. This will prove a heavy overhead on the terminal, against which can be set the cost of sending software development personnel to Cambridge, and the disadvantages of development remote from the CUBITH Project Base.

9.5.7 In view of the experimental nature of the proposed remote terminal, it is suggested that all the equipment is clustered to provide the most desirable facilities for carrying out the development work. The constitution itemised in paragraph 9.5.8 is proposed with this overall objective in mind. The functions outlined are suggestions only. Until the initial strategy for using the MinTech Atlas is agreed, it is not possible to be specific as to which CUBITH ADP System might be developed or demonstrated on the remote terminal.

9.5.8 <u>Remote Terminal to MinTech Atlas</u>

Constitution:
- (i) Processor
- (ii) 2 scopes
- (iii) 1 Interactive Display (and keyboard)
- (iv) Computer Activated Microfilm Unit
- (v) Digitiser
- (vi) Hard copy device.

9.5.8 Cont'd Function:

1. To familiarise DHSS staff with the type of equipment it is proposed to introduce.

2. To develop CUBITH work as is practicable.

3. To carry out production work if possible.

9.5.9 Since the remote terminal will support at least one display unit, a processor will probably be required to drive it. This computer could be such that it is wholly occupied servicing the terminal. However, it is suggested that by servicing the terminal with a disc-backed computer, work of a batch processing nature might be done, using the terminal in its own right as an out-station. This suggestion is not dealt with further in this report since it is affected by decisions which are outside the brief of this report as to the use to be made of the MinTech Atlas, and the capital outlay proposed at this initial phase of the project.

9.5.10 The choice of the scope and display equipment can only be made in close consultation with the CAD Centre. Obviously, the use of equipment already installed at Cambridge would reduce development time. However, it is possible that a large capital outlay is not desirable at this stage, and a simple graphic interactive display, which can also function as a scope, may be the alternative. Two of these devices could fully cover the functions set out for the scopes and display in the initial use of the remote terminal.

9.5.11 Much of the CUBITH ADP System design is in a very elementary stage and only outline requirements are understood. One of the most important of these is the use of graphic data, such as activity data, junctions, and components as macros for design purposes. For this reason alone, it may be desirable to restrict data base material held in the computer initially to that in alphanumeric form, while suitable graphical representation is being developed. Since it is possible to control a microfilm viewer by software, the graphic information can be readily associated with the relevant alpha display until it is practicable to set it up in the computer itself.

9.5.12 Development work in depth is necessary on the possible incorporation of large scale digitisers into the system. There are currently three schools of thought regarding the introduction of co-ordinates into the ADP drawings systems. DHSS will require practical experience in order to draw their own

9.5.12 Cont'd conclusions. It is proposed to digitise off-line probably on to paper tape, and at intervals 'inspect' in the scopes the drawings to date, after on-line processing of the paper tape. There are the alternatives of using the display itself, or punched cards/tape, for co-ordinate input.

9.5.13 There is no doubt that there must be provision for the architects to obtain hard copy locally. Should it be decided to enhance the processor to allow for batch processing, a line printer would be a definite requirement, and this would ease the problem of obtaining alphanumeric output from the system. For combined graphic and alphanumeric output, from a scope or display, a polaroid camera offers a simple method with small capital outlay. Hard copy from the microfilm unit can be obtained by specifying a reader/printer type. These are available at about twice the price of the reader alone. Certain scope/displays with restricted facilities offer a scanner attachment which produces hard copy up to A4 size. For graphic information, and restricted alphanumeric, a drum plotter will suffice. Their quality varies with their price and none of them can, by their nature, offer immediate results. The conclusion is, that to provide adequate hard copy facilities at the architects remote terminal, will require further study in conjunction with the total function of the terminal.

CENTRAL INSTALLATION

INCLUDING POSSIBLE IN-HOUSE TERMINALS FOR DATA BASE TEAM AND DEVELOPMENT TEAM

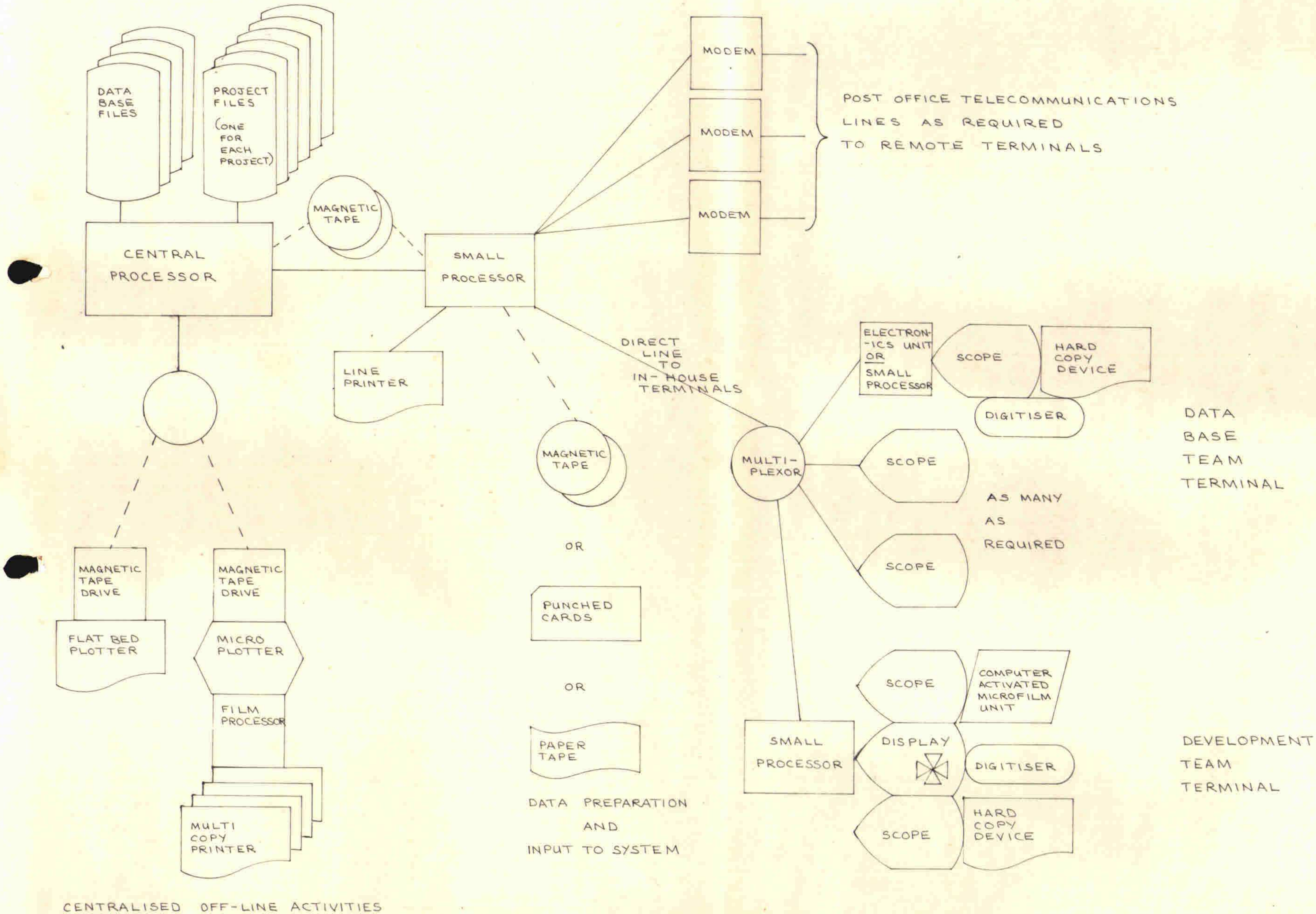


FIGURE 9A

REMOTE TERMINALS GROUPED BY USER

AT PROJECT TEAM H.Q.

ON-SITE

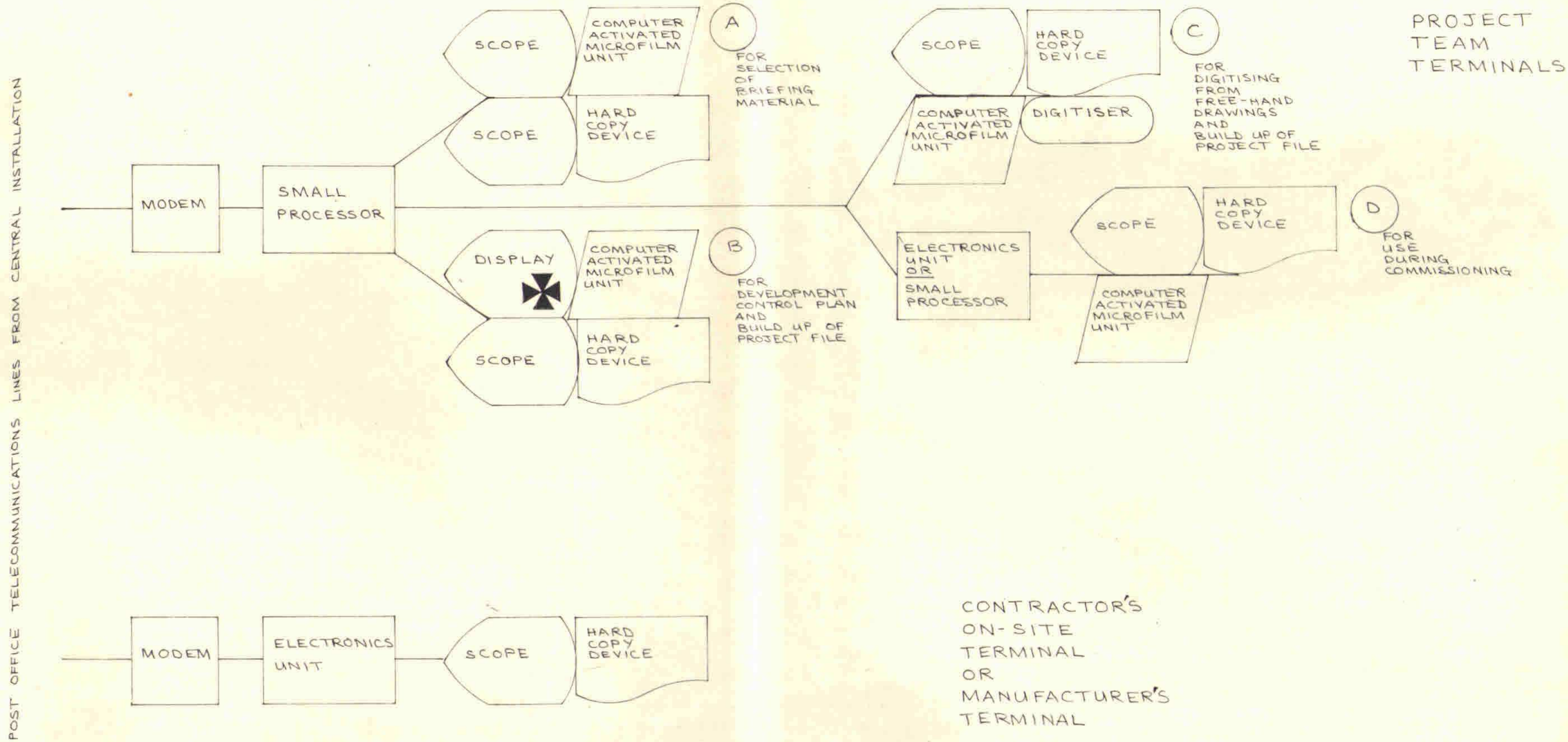


FIGURE 9B

SECTION 10 THE INTER-RELATION OF TASKS, COSTS, MANPOWER AND RESOURCES REQUIRED TO IMPLEMENT THE CUBITH ADP SYSTEM

SECTION 10 — THE INTER-RELATION OF TASKS, COSTS, MANPOWER AND RESOURCES REQUIRED TO IMPLEMENT THE CUBITH ADP SYSTEM

INDEX

10.1 THE AIMS OF THIS SECTION OF THE REPORT

10.1.1 When drawing up the list of contents for this report the Authors felt it essential to provide a Section outlining the Timescale for implementation of the ADP System. However, this has proved a most difficult task as much of the System still needs to be defined.

10.1.2 The development of the System will inevitably be spread over several years but given a well organized strategy and full co-ordination, together with the necessary resources, it should be possible to offer a service based on a version of the full System in about 1975.

10.1.3 The System will of course be modified with use and it is suggested that the first two years following the introduction of the service should be considered as an assessment time for the scheme. After this it can be said to be a fully operational System.

10.1.4 It is stressed that Systems Design and Software Development takes time and even if unlimited resources were to be available there must be full co-ordination if the result is not to be a fragmented system.

10.1.5 Alongside the development of ADP procedures other techniques associated with the System must be developed. Data must be collected and evaluated and the Common Data Base filled. Standard Designs must be approved and incorporated and a full educational and publicity program laid down.

10.1.6 The suggested timescale is that the co-ordinated development of Procedural Systems and their associated Management Systems, the Common Data Base, the On-line Enquiry System etc., should take place over the next 4 years with steadily increasing use of live schemes as areas of the System are developed in part.
Thus by the beginning of 1975 it should be possible to offer a prototype system for universal use. Over the following 2 years this will be developed and refined so that the fully operational System should be available by 1977.

10.2 THE INTER-RELATION OF ADP TASKS

10.2.1 Figure 10A lists the tasks at present thought necessary to implement the ADP System.

10.2.2 Many of these tasks can be broken down into smaller sub-divisions but the overall design and implementation of any one task should be the direct responsibility of one carefully co-ordinated group. Thus the design of the Common Data Base, although carried out by several individual designers, should be co-ordinated at all stages so that the various parts fit together to form a fully integrated whole. The inter-relation of tasks is most important and it is recommended that no System should be developed in isolation. This whole area requires discussion between the groups of people implementing the systems throughout the development period.

10.3 TIMESCALE

10.3.1 Figure 10A attempts to show feasible timespans for each task listed. Of course, this timespan will depend on resources allocated but those shown in the diagram are considered reasonable, taking into account their inter-relation.

10.3.2 Work on the overall CUBITH System will continue for several years and extend beyond the time when the scheme becomes available to users. Similarly the Study of the Application of ADP techniques to CUBITH will extend beyond the development period.

10.3.3 Evaluation of Hardware for the System should continue throughout the development phase so that when the time comes to choose a central processor, sometime during 1972, the best possible choice can be made. The Computer can then be installed at the beginning of 1974 so that the System can benefit from a full years development under operational conditions. It is envisaged that phased enhancement will continue throughout the first 4 years and this must be borne in mind when a Computer System is selected.

10.3.4 It is most important that Standards should be laid down at the start of the development period thus forming a good basis for an integrated System.

10.3.5 Areas common to most of the Procedural Systems such as the Design and Development of the Common Data Base, The Project File, Computer Aided Design Techniques, etc. must be developed alongside the Procedural Systems themselves thus ensuring full compatibility.

10.3.6 The Procedural Systems can each be developed over short timespans but the correct sequence must be observed to take into account the overall development.

10.4 THE RESOURCES REQUIRED TO IMPLEMENT THE CUBITH ADP SYSTEM

10.4.1 There has been no attempt in Figure 10A to show the resources required to implement the tasks listed.

10.4.2 Some of the tasks will require high resources spread over a short timespan so that they can progress rapidly. Others will require resources spread over a longer timespan. Still others may progress in short bursts of activity, with longer periods of virtually no development, while other parts of the System are being developed in parallel.

10.4.3 It is recommended that the strategy for ADP development should include the evaluation of resources required to implement the CUBITH ADP System. It must be remembered that one leading Industrialist recently quoted a figure of 20 man years for the design of the Data Base for his company.

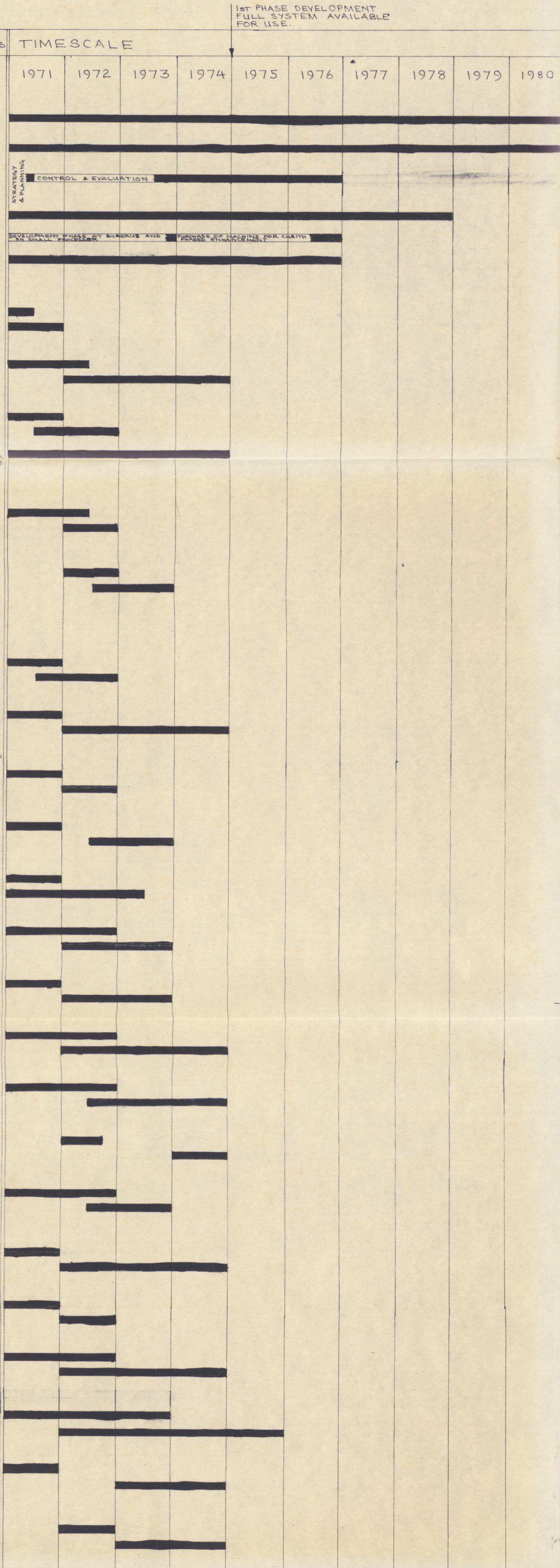
10.5 COSTS

10.5.1 The evaluation of costs for each task will follow directly from the evaluation of resources required and should form a separate study.

DIAGRAM SHOWING THE INTER-RELATION OF TASKS WITH RESPECT TO TIMESCALE

FIGURE 10A

TASKS	INTERACTS WITH TASKS
1. DESIGN OF THE OVERALL CUBITH SYSTEM	ALL
2. STUDY OF THE APPLICATION OF ADP TECHNIQUES	ALL
3. ADP SYSTEM DEVELOPMENT INCLUDING THE FORMATION OF A STRATEGY & EVALUATION	2-29
4. SOFTWARE DEVELOPMENT	2-29
5. HARDWARE DEVELOPMENT	2-29
6. EDUCATION FOR USE OF THE ADP SYSTEM	2-29
7. STANDARDS FOR ADP DEVELOPMENT	2-29
SYSTEMS	
SOFTWARE	
8. THE COMMON DATA BASE	2-29
DESIGN	
SOFTWARE DEVELOPMENT	
9. THE PROJECT FILE	4,5,7,8, 10-29
DESIGN	
SOFTWARE DEVELOPMENT	
10. COMPUTER AIDED DESIGN EXPERIMENTAL TECHNIQUES	3-9, 11, 12, 14, 16, 17, 18, 20-27, 29
11. DEVELOPMENT OF A CUBITH LANGUAGE FOR THE ON LINE ENQUIRY SYSTEM	3-10, 12, 13-29
DESIGN	
SOFTWARE DEVELOPMENT	
12. DEVELOPMENT OF A CUBITH SECURITY SYSTEM	8, 9, 11, 13-29
DESIGN	
SOFTWARE DEVELOPMENT	
PROCEDURAL SYSTEM DEVELOPMENT	
13. THE HOSPITAL BUILDING PROGRAMME	8, 9, 14, 15, 20
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
14. PROJECT TEAM ACTIVITIES	8-13, 15, 16, 17, 20, 21, 23, 25, 26, 28, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
15. DETERMINATION OF PROJECT REQUIREMENTS	8, 9, 11, 13, 14, 16, 20
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
16. THE DEVELOPMENT CONTROL PLAN	8-15, 17-20, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
17. ACTIVITY DATA	8-12, 14, 16, 20-24, 27, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
18. EQUIPMENT	8, 9, 11, 20-24, 26-29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
19. STAFFING	8, 9, 11, 12, 15-18, 20, 28, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
20. COST ANALYSIS	8-29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
21. DESIGN DEVELOPMENT	8-18, 20, 21, 22, 26, 27
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
22. PRODUCTION DRAWINGS	8-12, 14, 17, 18, 20, 21, 23-26, 28, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
23. ENGINEERING	8-12, 14, 17, 18, 20, 21, 22, 24-29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
24. SCHEDULING AND COMPONENT SELECTION	8-12, 14, 17, 18, 20-23, 25-29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
25. TENDER ACTION AND CONTRACTS	8-12, 14, 16, 18, 20, 21, 23, 24, 26, 27, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
26. CONSTRUCTION	8-12, 14, 18, 20, 23-26
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
27. SERVICES TO THE CONSTRUCTION INDUSTRY	2-29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
28. MAINTENANCE DOCUMENTATION	8, 9, 11, 14, 19, 29
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	
29. COMMISSIONING TEAM ACTIVITIES	8-12, 14, 16-20, 23-26, 28
SYSTEMS DESIGN	
SOFTWARE DEVELOPMENT	



SECTION 11 — RECOMMENDATIONS ON HOW THE APPLICATION OF ADP TECHNIQUES TO CUBITH SHOULD BE CARRIED OUT AND CO-ORDINATED

SECTION 11 RECOMMENDATIONS ON HOW THE APPLICATION OF ADP TECHNIQUES TO CUBITH SHOULD BE CARRIED OUT AND CO-ORDINATED

INDEX

11.1 GENERAL RECOMMENDATIONS

11.1.1 Throughout this report it has been stressed that the whole application of ADP techniques to CUBITH should be carefully co-ordinated both in itself and with relation to the development of the total CUBITH System.

11.1.2 To date three groups of Software Consultants are involved in CUBITH development, CAP, fpl and SPL. Each group of Consultants has been working in predefined areas as commissioned by the DHSS. During the past 6 months more regular contact has been established between the three groups, at first on an informal one but latterly on a more formal basis and an ADP steering group has been set up to meet regularly and discuss further ADP Development and try, together with DHSS staff, to define future ADP policies.

11.1.3 This is a good start but this group should form a real steering committee and should be well co-ordinated and empowered to define overall ADP strategy and evaluate progress together with DHSS staff.

11.1.4 The laying down of a Timetable for the CUBITH ADP System along the lines of that given in Section 10 of this report should be the first function of the steering group followed by the setting up of a System to evaluate and report progress.

11.2 CURRENT DEVELOPMENT OF ADP TECHNIQUES WITHIN THE CUBITH SYSTEM

11.2.1 The present state of development of the ADP System varies greatly between areas. Activity data has been well developed by the Architect's Department firstly with the help of fpl and then much further with the assistance of SPL so that many of the implications of the System are now well understood. Here the Application of ADP Techniques should require very little further System development and software development could start fairly soon. Techniques associated with the Development Control Plan have also been fairly well formalized by the DHSS but will need to be developed with respect to ADP techniques. Considerable work has already been carried out on the Hospital Building Programme and 'Control by Starts' on an earlier assignment by fpl. Schedules have been developed on a prototype project by SPL. Other development areas could be discussed and evaluated.

11.2.2 Many other parts of CUBITH require further definition before System Design can start but most of the System Design effort will be concentrated during 1971.

11.3 USERS INVOLVEMENT

11.3.1 The involvement of the user at an early stage is a most important development within any ADP System and will both considerably fore-shorten the Educational and Publicity Programmes and avoid difficulties and resistance when the System is implemented.

11.3.2 Thus users should be involved in the design of the System as it progresses and their requirements evaluated.

11.4 EDUCATION AND PUBLICITY

11.4.1 As stated in paragraph 11.3.1 Education and Publicity on a System such as CUBITH, where ADP techniques are being introduced into a labour based industry, are most important and it is essential that such schemes be formulated early in the System.

11.5 STANDARDS

11.5.1 In any ADP System Standards must be set up to ensure co-ordinated development. This is most important where several groups of Software Consultants are working together on a System as each may have their own Standards.

11.6 DEVELOPMENT PHASES

11.6.1 It is most important that on a System the size of CUBITH practical experience of operating the System should be gained during ADP development. Practical applications at an early stage of ADP Systems Design usually leads to a more viable final System.

SECTION 12 VOLUMES OF DATA

SECTION 12 VOLUMES OF DATA

INDEX

12.1 DEFINITION OF CUBITH DATA

12.1.1 As discussed in Section 6 of this report Data for the CUBITH System falls into two main categories:

(a) Project Data relating to specific projects under development or historical data about previous projects.

(b) Common Data that is all the data needed by users of the CUBITH System to enable them to find solutions to specific projects.

12.2 PROJECT DATA

12.2.1 The number of projects under development at any time is obviously dependent on the size of the Hospital Building Programme. The volume of data for each of these projects is related, but not directly proportionally, to project expenditure. The volume will also depend on the type of activities included and the amount of standard data which can be used.

12.2.2 Project Data consists of both data developed specifically for a project, and thus unique, and standard data from the Common Data Base which may or may not be kept in detail on the Project File. More details of the constituents of the Project File may be found in Section 6.3 and it can be seen from this that the data may be graphic or quantitative.

To enable the extent of Project Data to be defined a full analysis needs to be undertaken. This should ascertain such factors as the number of Key drawings, Detailed drawings, Building and Engineering elements involved, related to project size and the number of different facilities offered.

12.3 DATA VOLUMES WITH REFERENCE TO THE WHIPPS CROSS PROJECT

12.3.1 From an analysis by Mr. J. Hudson of the DHSS of the CUBITH development of the Whipps Cross project, figures show that for a Development Project of about three quarters of a million pounds in one block, approximately 500 unique drawings and 2,200 standard data base drawings, were required made up as follows:

12.3.1 Cont'd Schedule of Drawings Involved (originals not amendments)

(a) Architects

Key drawings	15
Production drawings	237
Construction details (standard) approximately	900

(b) Structural Engineers

Production drawings	16
Bending schedules	54

(c) Services Engineers

Distribution and Co-ordination drawings (1/20, 1/50)	176
Standard Engineering details approximately	700

(d) Building/Engineering Assembly drawings

approximately	600
approximate total	2,700

12.4 DATA VOLUMES RELATED TO THE COMMON DATA BASE

12.4.1 It is already appreciated that the Common Data Base consists of many File Groups. It is essential that the volume of the Data contained in these Groups be investigated with reference to the present Developments using CUBITH principles. The File Groups are defined in Section 6.8.3 and are for example Cost Data, Activity Data, Equipment Data etc.

12.4.2 There is already some assessment of the volumes of Activity Data, for example

Level F Spaces: It is estimated that there could be 2,500 different room types.

Level G: It is estimated that there will be 1,000 Room Data sheets.

12.4.3 Likewise, there is some information available about Manufacturers Data, but the full detail of this is being assessed by SPL and will not be contained in this report.

12.5 FURTHER STUDIES

12.5.1 It can be seen from the small amount of detail available that there is considerable study required to establish the size of a Project File and the volume of data held in each File Group of the Common Data Base.

12.5.2 A full study of volumes of data should be carried out as part of the design of the Project File and Common Data Base.

APPENDIX SOURCES OF FURTHER INFORMATION

APPENDIX SOURCES OF FURTHER INFORMATION

INTRODUCTION

There is much work being done, on the application of computers to the building industry, which impinges upon or complements current and projected work for CUBITH. This Appendix gives information on some of the sources of this work. The object of this list is to provide a basis for a mutual exchange of ideas and experience, with the aim of reducing learning time on applied software techniques.

The references are sub-divided into two groups. Firstly, papers on topics related to CUBITH, and secondly, projects of a similar nature.

PAPERS

1. COMPUTER AIDED ARÇHITECTURAL DESIGN - a recent R and D paper from the Ministry of Public Building and Works, which comprehensively sets out the work being done up to 1969. It lists many bodies working in the field, as well as offering some case histories (see part 2). Of particular interest is Appendix 2 (Page 81 of Part 1), which sets out past and present projects in 'Computer Aids to Architectural Design and Related Areas', and gives a summary of their aims and a list of publications, where applicable.

2. INDEX OF INFORMATION SOURCES - the first edition was published in July 1968 by the Ministry of Technology Computer Aided Design Committee (Information Retrieval Sub-Committee). Edition 2 is due this year. It provides a broader list of references in index form.

3. THE COMPUTER GRAPHICS '70 SYMPOSIUM - held at Brunel University and provided a forum for many projects currently in hand. The following papers were presented by British teams whose work has much in common with CUBITH.

   SCOTTISH SPECIAL HOUSING ASSOCIATION (SSHA) PROJECT

   A. Bijl
   University of Edinburgh
   55 George Square
   Edinburgh, 8.

   THE COMDAC PROJECT FOR SCHOOLS DESIGN

   P.A. Purcell
   Industrial Design (Engineering) Research Unit
   Royal College of Art
   Kensington Gardens
   London, S.W.7.

   ASSOCIATIVE DATA STRUCTURE

   A. Britch
   Department of Building Service
   University of Liverpool
   Liverpool.

3. (Cont'd.)

COMPUTER AS AID TO ARCHITECT

P.E. Walter
County Architects's Department
W.S.C.C
Chichester
Sussex.

VDU's IN M.I.S.'s

R.B. Williams
Operational Research Section
Organisation Division
Unilever
London, E.C.4.

A DIRECT APPROACH USING A SMALL COMPUTER

G.D. Parkington
Computer Science Department
Ford Motor Company
Dagenham
Essex.

GRAPHICAL PLOTTERS IN CIVIL ENGINEERING

D.M.A. Hook
G. Maxwell & Partners
Glen House
Stag Place
London, S.W.1.

STRUCTURAL DESIGN USING GRAPHICS

Dr. A.G. Young
Department of Engineering
University of Leicester
Leicester.

DEFINITION OF A GEOMETRICAL DATA FILE

Dr. R.F.D. Porter Goff
Department of Engineering
University of Leicester
Leicester

FORTRAN PACKAGE FOR INTERACTIVE GRAPHICS

G.A. Butlin
Department of Engineering
University of Leicester
Leicester.

SOFTWARE FOR SATELLITE GRAPHICS

A.R. Rundle
Marconi Elliott
Elstree Way
Borehamwood
Herts.

APPENDIX

3. (Cont'd.)

GRAPHIC CONSOLES IN A PRODUCTION ENVIRONMENT

P. Smith & B.T. Torson
Rolls Royce Ltd.
Derby.

DISPLAY SYSTEM FOR PROCESSING 'ENGINEERING' DRAWINGS

D.K. Ewing & Mrs. D.W. Tedd
N.E.L.
East Kilbride

PROJECTS

1. BYGGEDATA A.S., HOFF TERRASSE 6, OSLO 2 - a bureau who for several years have been producing software for the KINGMATIC range of equipment. Their work includes hospital design (Gentofte Hospital, Copenhagen). They also work with architects William W. Bond and Associates of Memphis, Tennessee on motel design. There is limited literature and some samples available. The source is Mr. King of d-MAC who market KINGMATIC equipment.

2. MANSELL & PARTNERS (ARCHITECTS) - in conjunction with the Architects Association and National Builders Association have done work using a d-MAC pencil follower. The source is Mr. King of d-MAC.

3. THE ADVANCED COMPUTER TECHNIQUES PROJECT - is concerned with Data Structure. Marconi-Elliott are working on Satellite Graphical Software for the Storage Allocation portion. The work is due for mid '71 and some is currently available. The source is Peter Strudwicke of Marconi-Elliott.

4. W.S. ATKINS & PARTNERS - three projects in hand. Scheduling of Reinforced Concrete Columns in Building, Bridge Design, and Perspective Views of Structure. The source is Computer Instrumentation Ltd. - application report plotters.

5. NATIONAL BUILDING AGENCY, ARUNDEL ST., LONDON W.C.2. - a system using COBOL has been developed by them, called COMPACT. It is an aid to overall co-ordination of capital works programmes, etc. The source is brochures on COMPACT.

6. MINISTRY OF PUBLIC BUILDING & WORKS - two projects. A computer system for Bills of Quantity is being finally tested using the data supplied by a Newcastle RHB project. The source is MPBW R&D paper.
A sub-committee of the Committee on the Application of Computers in the Construction Industry is currently examining the structure of a Project File.

APPENDIX

7. COMPUTER AIDED DESIGN CENTRE, MADINGLEY RD., CAMBRIDGE CB3 OHB - considerable work in remote access to interactive graphics for design purposes and graphic software. GINO system of graphic software particularly valuable. The contact is Mr. B. Gott.

8. FERRANTI LTD. - a project for DHSS Engineers on the automated production of layered engineering drawings. CUBITH is currently in touch.