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DEVELOPMENT OF EQUIPMENT DESIGN CAPABILITY AT THE
HAWAMDIA EQUIPMENT FACTORY OF THE EGYPTIAN SUGAR COMPANY

DP/EGY/87/022

EGYPT

Technical report: CAD Selection for Mechanical Equipment Design*

Prepared for the Government of Egypt
by the United Nations Industrial Development Organisation
acting as executing agency for the United Nations Development Programme

Based on the work of David S. Wadsworth,
expert in Computer Aided Design and Draughting

Backstopping Officer: C. Gürkök, Engineering Industries Branch

United Nations Industrial Development Organisation
Vienna

* This report has not been edited.

SUMMARY

This report is the culmination of the findings arising from the first mission of one months duration which was completed in March 1989.

The mission was augmented by the services of a specialist consultant on the design and manufacture of sugar processing machinery, and his report forms an essential preamble to the purpose of this report.

Much of the work undertaken by the design department lends itself to the application of computer based techniques, but clearly neither the allocated budget nor good management practice would advocate a sudden broad-based introduction of computer technology.

The recommendation is to introduce computer aided design in a phased manner, building progressively upon experience gained in the previous phase. The first two phases would be subject to assistance under the current project.

The study identified three areas where the use of computer techniques could make a significant contribution to the working methods within the department. These were the preparation of steelwork details, electrical schematics and pipework layouts.

The recommendation is therefore, to provide software and hardware for these activities in the first phase of an implementation programme which will be kept under constant review. At an appropriate time a decision will be taken to enhance the installation with either further equipment of the same type in order to address the workflow volume needs, or to augment the installation with more sophisticated tools to undertake some of the more complex design requirements.

It was noted that the environmental conditions were basically good but it is recommended that HEF management seek advice from potential vendors to ensure that no unforeseen difficulties arise subsequent to the commissioning of the equipment.

It was also noted that the enthusiasm and motivation of the staff was good and this augers well for a successful implementation programme.

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1 INTRODUCTION

Background information supplied to the consultant was provided in report Project number EGY/87/022/01/B/37 and in Job Description 022/11-1.

The mission was augmented by the services of a specialist consultant on the design and manufacture of sugar processing machinery, and his report 022/11-51/J13300 dated 18th March 1989 forms an essential preamble to the purpose of this report.

2 TERMS OF REFERENCE

The purpose of the mission was to:-

Carry out a short diagnostic study of the design and drafting departments of the Hawamdia Factory with regard to its customers' present and future need.

Based on the above mentioned diagnostic study, design a computer aided design and drafting system, complete with hardware, software and required human resources.

Arrange the training programme, and a study tour.

3. DESIGN OFFICE REQUIREMENTS

The purpose of this section of the report is to provide a background to the HEF Design Office structure and activities in relation to the manufacturing and installation needs of the existing development programme before discussing the applicability of computer aided design methods.

3.1 Structure of the Design Office

_____	Engineering Manager		
:			
:	_____ Project Office	(60)	[activity, number of staff]
:	:		
:	:- Process	6	
:	:- Mechanical	17	
:	:- Civil	4	
:	:- Electrical	7	
:	:- Architectural	1	
:	:- Drafting Office	25	(10 draftsmen, 15 tracers)
:			
:	_____ Spare Parts Office	(15)	
:			
:	:- Engineering	5	
:	:- Drafting Office	10	(5 draftsmen, 5 tracers)

3.2 Output

The output from the Project Office is concerned primarily with the development of new factories and major expansions of existing ones such as those initiated for Naga Hamadi and Abu Kourkas. The department is concerned with the preparation of documentation which defines the essential technical and manufacturing specifications.

The documentation consists of:

- Requirements specification
- Technical specification
- Civil engineering
- Mechanical engineering
- Electrical engineering and
- Architecture

Within each category of documentation there is a mix of analytical, descriptive and drawing information. Some of the analytical work is carried out using computer methods.

For the Naga Hamadi project, some 1040 drawings are currently being produced consisting of:

- 20 Process diagrams
- 500 Mechanical drawings, including equipment, piping & conveyors
- 300 Civil
- 200 Electrical, including 100 details
- 20 Architectural

The Naga Hamadi expansion is the first complete project to be designed by the recently formed Project Office. As such, the staff are setting new standards of working practice and expertise for the Company.

For this and all other projects the Company intend to standardise on specific ratings, ie throughput capacities, for sugar processing. In order to achieve this, certain preferred sizes of equipment are to be adopted and designed primarily as a 'one-off' requirement.

Currently the Company's design development programme for the major equipment items is estimated to be as follows:

Equipment type	Process					
	Crushing	Juice Heater	Evaportr	Vacuum Pan	Strike Receiver	Drier
No of designs	4	1	10	4	4	3
Already designed		1	3	4	2	1
Man months reqd						
Design commitment completed	None	2	25	12	8	9
still to do	-	2	7.5	12	4	3
	-	-	17.5	-	4	6
Number drawn	-	1	3	3	2	-
Man months reqd						
Drafting comm completed	-	1	15	4	4	18
still to do	-	1	4.5	3	2	18
	-	-	10.5	1	2	18
Number dgs/unit	-	6	12	7	12	65
Total No. of drgs:	-	6	120	28	48	195

This table is illustrative of the design commitment that is a prerequisite to the Company establishing its own design authority and working practices for future installations. By extension, it is possible to deduce a supportive commitment at the next level of detail design for components such as pumps and pipework details.

As a manufacturing unit the Company has accumulated some 12,000 drawings, most of which will be progressively superseded as new designs are created.

3.3 Existing Computerisation

The Project Office has recently been equipped with two IBM PC's and two IBM AT computers. The configurations are as follows:

- 1 PC with 30MB HDisc, 6087 maths co-processor, 2-5 1/4 floppies
- 1 PC with 30MB HDisc, 2-5 1/4 floppies
- 1 AT with 2-5 1/4 floppies
- 1 AT with 80287 maths co-processor, 2-5 1/4 floppies
and an un-installed 30MB HDisc

Analytical programs written in BASIC have mostly been developed at Cairo University or under the supervision of University staff. Several software packages are also available but, of the list of fourteen programs, only four had instruction manuals. None of the software was of the latest release and none of it was supported by a local vendor. To be effective, any initiative to introduce computer aided design must ensure the continuous maintenance and support of the latest software releases.

The workshops are equipped with three CNC lathes which are programmed by staff in the Tool Room. Approximately 20 - 25 programs are written each year for a variety of parts including wheels, shafts, flanges, pins and bushes.

3.4 Links with Cairo University and the Training Programme

Following a successful one year liaison programme with staff at Cairo University, HEF have agreed to a further three year programme of co-operation. Within this programme, professors from the University are available to assist specific departments at HEF, such as Civil, Mechanical, Planning and Production Technology, Chemical and Process Engineering. The professors are able to provide the design staff at HEF with a considerable amount of computer related training and other technical expertise.

The following training has already been arranged for the Project Office staff.

	----- Subject -----			
No of Engineers	BASIC language	Database	AutoCAD	Finite Element Methods
12 completed	x	x	x	
4 completed				x
12 in hand	x			
12 within two months	x			

3.5 The Applicability of Computer Aided Design (CAD)

HEF have commenced a vigorous schedule in order to train their engineers in the BASIC programming language. This language will enable engineers to assess the potential of using computers to solve analytical requirements. There are many applications which can be solved using either standard packages written in BASIC or customised programs written according to instructions established by the engineers themselves.

However, a further technique is available to enable engineers to solve problems of engineering design more quickly. The technique is to use Spreadsheets. Spreadsheet programs are easier to develop and can be used to solve a multiplicity of generalised iterative design problems and specification requirements. LOTUS 1-2-3 is a good example of the spreadsheet technique and it is recommended that training in this software should commence as soon as powerful enough computers are available.

In general, the use of computer programs provide a consistency of result, a speed, and an accuracy which is not achievable using manual methods. Additionally, there are some analytical techniques, such as Finite Element Analysis, which can be used to solve problems that would be impossible to resolve using manual methods.

Although some training has been provided in the use of AutoCAD drafting procedures for the preparation of drawings, the current computer hardware ie, processors and plotting facilities, are insufficient for the use of AutoCAD as a productive tool. Drafting skills using computers should be introduced in a phased manner, and experience built up progressively when suitable hardware becomes available.

In the first phase, it would be advisable to concentrate on Civil and Electrical activities as these two disciplines lend themselves to the use of libraries of pre-prepared standardised symbols which, if stored in the computer memory, can be recalled to build-up manufacturing and assembly drawings for, for example, site and process layouts, process and instrument diagrams, circuit layouts, steel fabrications and piping and equipment layouts.

Subsequent phases of the implementation programme would involve using the computer to prepare detailed mechanical engineering manufacturing drawings and to program the NC lathe machining requirements.

It should be noted that the recommendation is to introduce three graphic workstations during the first phase. Clearly there will be a limit to the amount of work that can be processed effectively, hence the need to target certain activity areas. As experience builds up it will be possible to disseminate this knowledge to a wider audience and progressively expand the throughput and variety of work tackled.

Other powerful CAD techniques could also be introduced progressively, for example parametric methods. This technique is used to define a generalised shape within a family of units. When a specific requirement is identified, the engineer feeds into the computer only those variable dimensional details necessary to make the shape specific, and the computer outputs a complete drawing to scale. A variation of this technique can be used to instruct the computer to select information from a table of pre-established preferred sizes which has the effect of minimizing variations in the manufacturing process and thus reduce manufacturing costs.

Database programs can be used to catalogue or index engineering records under a variety of keyword headings. It is particularly useful in enabling the effective retrieval of archived and other indexed information in sequences most useful to the engineer.

4. REQUIREMENT FEATURES OF THE PROPOSED SYSTEM

Following the short diagnostic study of the HEF design and drafting requirements, the following feature list was compiled.

4.1 Application Software

2D drafting package with good library and macro manipulation specifically to provide assistance in the following areas:

civil engineering - site layouts and steel structures
process and instrument diagrams
electrical schematics, logic diagrams and panel layouts
mechanical handling and process machinery
platework and welding
pumps and pipework design

2 1/2 D NC machining capability for lathe applications using Siemens controllers Sinumerik 3T and 5T

database

spreadsheet

desktop publishing

word processing

4.2 Hardware

3 Engineering workstations
3 PC's
1 Local Area Network, LAN
2 A0 plotters
1 A3 plotter
3 Dot matrix printers
1 Laser printer
1 Uninterrupted Power Supply, UPS

4.3 Study Tour

A study tour should be arranged for three high-level officers of the Egyptian Sugar Company.

4.4 Training Programme

A training programme should be arranged in parallel with the procurement of the computer-based equipment. The programme should consist of the following elements:

Educational cassettes of suitable CAD material
Training for appropriate project managers
Subscription to suitable CAD related technical journals

5. POTENTIAL SOLUTION

5.1 Management Objectives for the System

The following objectives should be read in conjunction with the schematic layout diagram shown in Appendix 1.

There are to be three Engineering graphic workstations for use with specialised graphics packages including AutoCAD, CADPIPE, CADELEC and SSDS - Structural Steel Detailing and Scheduling.

There are to be two workstations supplied for a variety of Engineering Calculation work to augment the two PC and two AT computers mentioned in Para 3.3.

In addition, the six computers mentioned above will be capable of running software packages including dBASE IIII, Wordperfect, Lotus 1-2-3 and Desktop Publishing eg. Ventura or PageMaker.

The computers will be networked together using CADmaster combined network and drawing office manager software with Q-LINK cards to a File Server.

The function of the file server will be to host as many of the systems peripherals as possible, including three plotters, Laser and console printers, internal and external file backup.

The file server will provide file network administration and security roles, and will provide multi-user access to common files such as plot spool files, data and library files.

The CADmaster software will provide comprehensive management reporting, including drawing status and time reports.

5.2 Application Software

All software should be provided in their metric or European version

	Price US\$
AutoCAD - release 10 European version, 3 licences	10500
Pagemaker or Ventura Publisher, Desk Top Publishing	895
WordPerfect - version 5.0	495
Lotus 1-2-3	625
dBASE IIII	1166
CADPIPE - Forms, ISO, P&ID, Jrtho	5390
Caesar II	10000
SSDS - Structural Steel Detailing & Scheduling	2550
CADELEC	850
AutoLisp	
C Compiler	593

5.3 Hardware

Item	Description	Quantity	Price US\$-CIF
File Server and peripherals - one required			56827
1	IBM PS/2 Model 80-311 2MB, 315MB HDisc	1	14560
2	Mono Screen 8503 (12")	1	336
3	Keyboard	1	318
4	Printer XL III	1	920
5	150 MB Backup Streamer Tape	1	2797
6	Hewlett-Packard 33477A LaserJet IID	1	4250
7	A0 HP Draftmaster II 7596A (dual mode)	2	23646
8	A3 HP Plotter with auto-sheetfeed 7550	1	6700
9	300 MB External HDisc	1	3300
Engineering Workstation - three required			71916
1	IBM PS/2 Model 70-21A 2MB, 120MB HDisc	1	11510
2	80387-25 Maths co-processor	1	1345
3	Keyboard	1	318
4	19" Colour Screen	1	4482
5	19" Adaptor Card	1	3096
6	234x441mm SummaSketch Pro Digitiser	1	1275
7	A3 HP 7550A Plotter with autosheet feed	1	1946
Engineering Calculation Station - two required			18812
1	IBM PS/2 Model 50Z 1MB, 60MB HDisc	1	5312
2	Keyboard	1	318
3	14" Colour Screen	1	814
4	1MB Memory expansion	2	650
5	2MB Memory expansion	1	1062
6	A4 Scanner with controller HPone unit	1	2500
Network			9280
1	Q-LINK3 Starter kit + additional wkstn kit incl. Aprotect CADmaster netware & DO mnger	1	5430
2	Q-LINK3 PS/2 cards	2	1340
3	Q-LINK3 interface cards for IBM XT's & PC's	4	2000
4	Cable	100 m	510
Operating System			196
1	MSDOS version 4	1	196
Uninterruptable Power Supply (UPS)			15000
1	15 KVA BEST (single phase)	1	15000
			<hr/> 172063

Warranty

One year from date of purchase

Hardware Maintenance

5% without spare parts

8% inclusive of spare parts

5.4 Conditions of Supply

- 5.4.1 Whilst the above specification is believed to be complete, it will be the supplier's responsibility to satisfy the client as to the viability of the specification against the management objectives for the system as defined in Para 5.1.
- 5.4.2 It will be the vendors responsibility to quote prices delivered to, and installed on, the client's site.
- 5.4.3 It will be the supplier's responsibility to state what performance criteria can be achieved with the equipment quoted and to provide methods whereby the client may be assured that the performance has been achieved in practice.
- 5.4.4 Suppliers may quote alternative equipment to that stated above provided that they can demonstrate that its performance is equal to, or better than, the required specification and will not involve additional costs.
- 5.4.5 Suppliers should indicate which agent will be responsible for the installation and commissioning of the equipment and what will be the terms and conditions for its continued support and maintenance.
- 5.4.6 Suppliers should indicate what training will be provided free as part of the installation commitment and what will be the per diem rates per person or per group for subsequent training.
- 5.4.7 Suppliers must specify/provide all plugs, sockets, cables, connectors, interface cards and other accessories necessary to make the installation complete in accordance with the plans shown in Appendix 1 & 2.
- 5.4.8 Suppliers should provide quotations based on unit and bulk purchase price for all consumables associated with the smooth running of the design installation.
- 5.4.9 Suppliers must specify in writing to HEF, any special requirements regarding the site preparation, eg air conditioning, earthing, etc.
- 5.4.10 All software must be supplied to the most recent version and update notices issued as and when appropriate.

5.5 Potential Longer-term Solution, Second Phase

After the initial phase of equipment has been installed, and utilised for a reasonable length of time, its effectiveness will be reviewed. Recommendations will then be made to either augment the first phase equipment to deal with volume throughput requirements or, to enhance the installation with more sophisticated equipment of the type shown in the table below.

Prime CV Item	quantity	cost US \$
1 File server, Sun 3/280	1	67,000
2 Eng. wkstns, Sun	2	32,000
3 Exchangeable disk,	1
4 1st CADDs 4X	1	12,000
5 2nd CADDs 4X	1	9,600
6 Non graphic properties	1	3,000
7 Data extract/data merger	1	4,000
8 Electrical	1	6,500
9 Piping	1	9,500
10 Structures	1	3,500

147100

5.6 Study Tour

A study tour is to be arranged to start at the end of May 1989 for three high-level officers of the Egyptian Sugar Company.

The participants will be:

Mohamad Shawky Abdel Wahab, National Project Manager
A H M Abdel Halim, Gen.Man. Engineering Sectors, Project Sector's
Samir Abdel Kader Jamir, Deputy National Project Manager

The following visit programme has been tentatively decided upon:

United Kingdom : Tate & Lyle, Fletcher & Smith, British Sugar, UMIST
FR Germany : BMA
Turkey : Mechanical Factory of Sugar Company

5.7 Training Programme

The initial training programme will consist of the following three elements:

* The immediate purchase of an EITB set of CAD/CAM educational video cassettes "A Complete Engineering Designer Programme", 1800 Sterling Pounds plus a suitable Video cassette recorder.

* An initial training programme to start around the end of May 1989 for the following senior Project Office managers:

Shawky Hussein Ibrahim, Manager of the Engineering Office
Mohamed Hussein Mahamoud, Civil Engineer
Aly Mohamed El-Batal, Mechanical Engineer
Hamdy Abdel-Razek Osman, Electrical Engineer

Possible courses and venues for this two month programme are:

United Kingdom : Design management courses, CADD courses
Software Vendor : Short specialised courses
AutoCAD Training : Basic and advanced courses

* Subscription to the following technical journals is recommended:

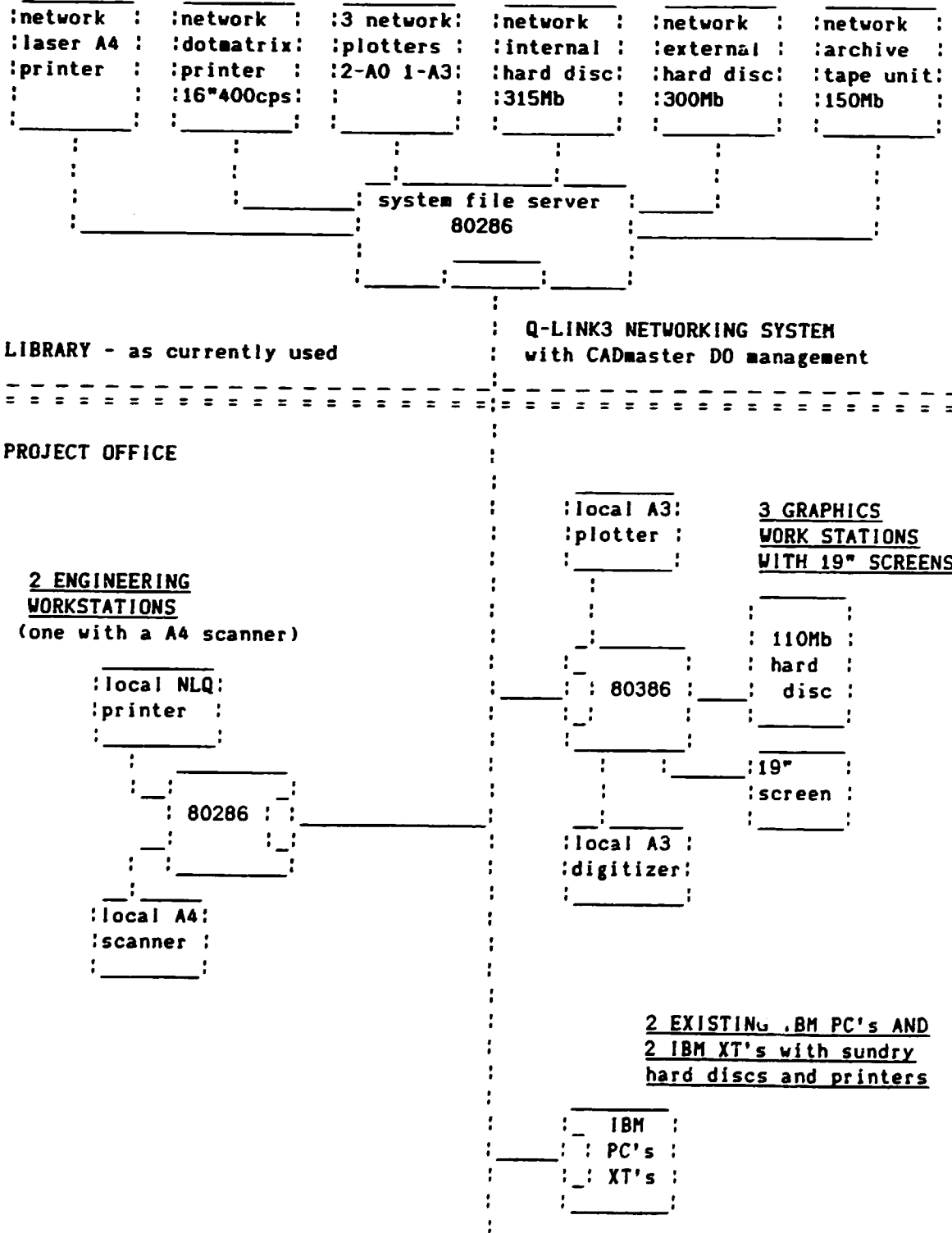
PC Magazine, USA
CAD/CAM International, UK
CAD User, UK

5.8 Responsibilities for HEF

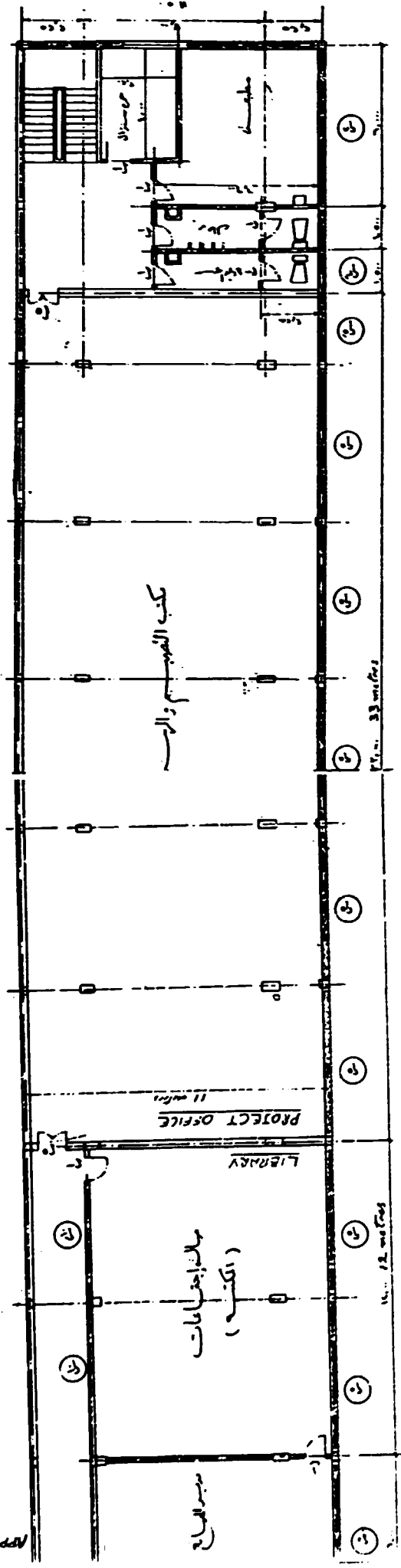
The management at HEF must ensure that adequate site preparation plans are made in conjunction with recommendations that may be made by the supplier of the equipment discussed in this report.

It is recommended that all the equipment should be installed on the second floor of the building currently housing the project office. In addition it is recommended that the section of the library adjacent to the project office is used to house the file server together with the plotters and archiving devices, whilst the engineering workstations and other computers - including those currently sited downstairs, be sited at suitable engineering desks within the present project office, see Appendix 2.

SCHEMATIC NETWORK LAYOUT



APPENDIX 2



APPENDIX 2

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