"Computer Application to the lifespan of a limestone mine using Geophisical data(a case study of south of Ewekoro, South Western Nigeria)".

Presented by

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In

Partial fulfilment of the requirements for the award of the postgraduate Diploma(PGD) in Computer Science.

March , 2000

CERTIFICATION

This is the project work of Akpovwovwo Iniovosa Timothy in Partial fulfilment of the requirements for the award of a postgraduate Diploma in Computer Science of the federal University of Technology, Minna Niger State.

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DEDICATION

This project is dedicated to God, my heavenly Father who gave me life.

I also dedicate this work to my beloved sister Ruth .A Aweto.

ACKNOWLEDGMENT

Firstly, i want to give God all the Glory and Honor for giving me the strength and enablement to stay back for my PGD programme after my service year in Niger State, i say thank you Daddy for endowing my heart with wisdom and my mind with understanding. I love you.

A big thank you, goes to my supervisor, Mr. Isa Audu for his understanding, support and guidance throughout the course of this work. Thank you sir, may God continue to increase you in your chosen carrier. Same goes to the HOD of Maths/Computer Science Dr. Reju and all the lecturers in Maths/Computer Science Dept. Prince Badmus, God loves you.

I appreciate my loving sister, Mrs. R.A Aweto, her husband Prof. A .O. Aweto and my brother Rev Joseph Akpovbovbo for their financial support. Florence Akpovbovbo, you are loved. Some people are too wonderful to me to be forgotten, Bukola Akintokun and Opeyemi Ojo, you both touched my heart, may God reward you, you haven't seen anything yet. Dele Omotosho and Daniel Ogunwonyi; you were wonderful roommates. Victor Olubode, Omotosho Rotimi and Titi the class wouldn't have been completed without you guys. Pastor mike o. Paul, my daddy in living faith church, you were God sent to re-direct my steps. God bless your dear heart. Rev and Mrs. Idowu Akintola i appreciate you very much especially in times of emergencies. Its too late for you to refuse God's blessings. You are blessed forever. N.C.C.F Niger state Daddy, Bayo. Thank you so much, you were there when i needed help, you did not only take me into your

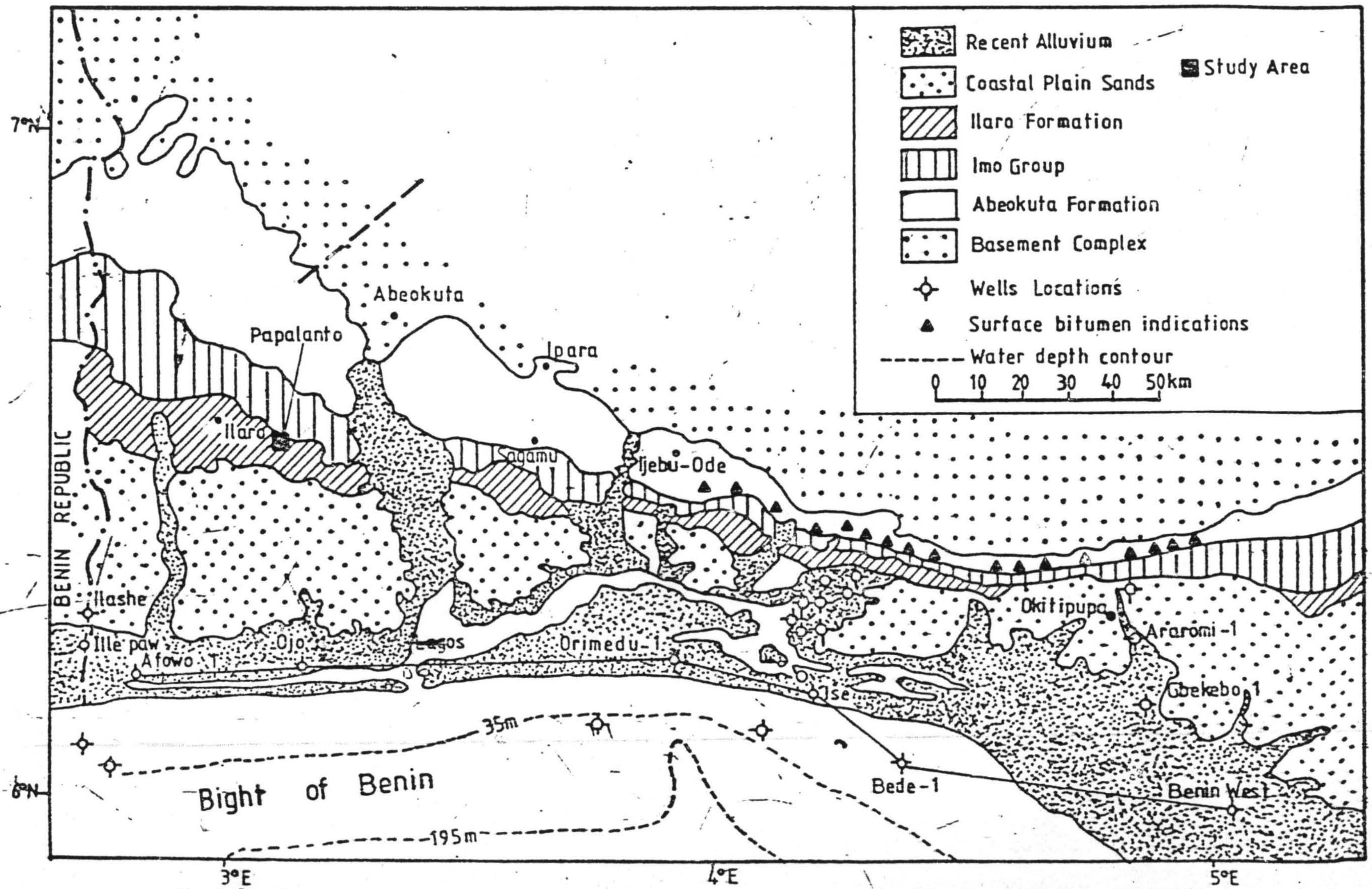


Fig. 1.G Geological map of the Eastern Dahomey Basin (After Agagu 1985)

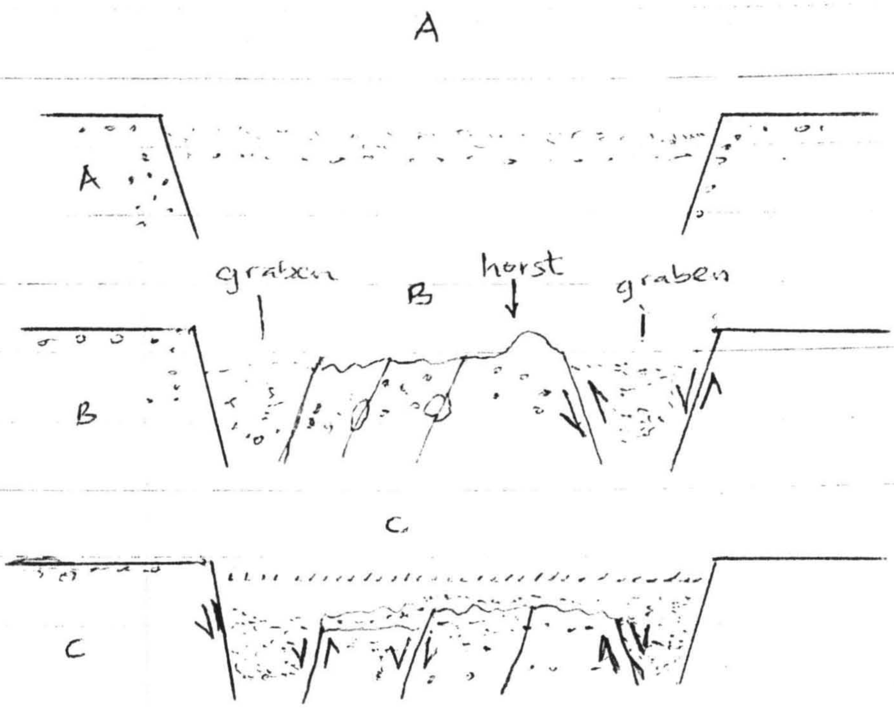


Fig. 1.1 tectonic model for the evolution of dahomey basin

(After Omotsola and Adegoke)

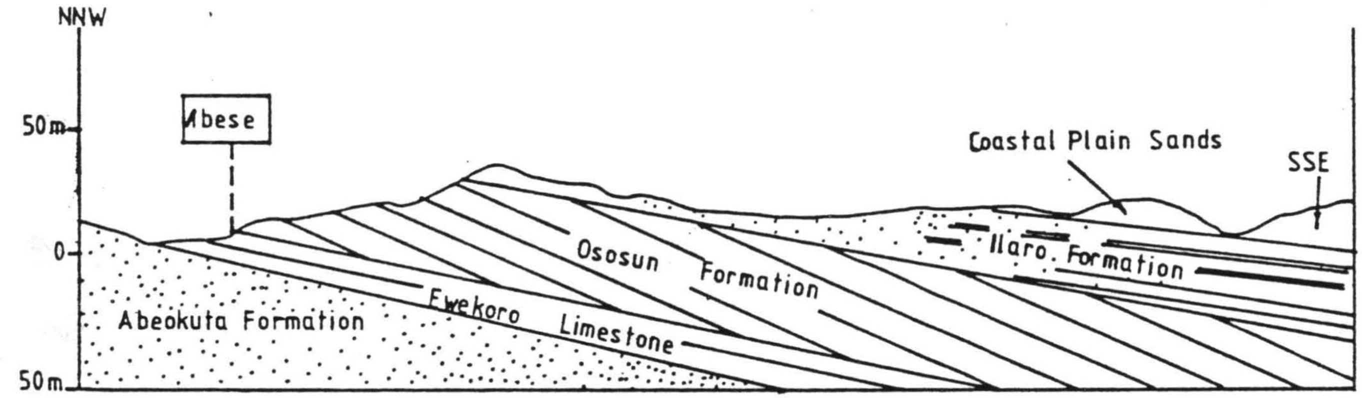
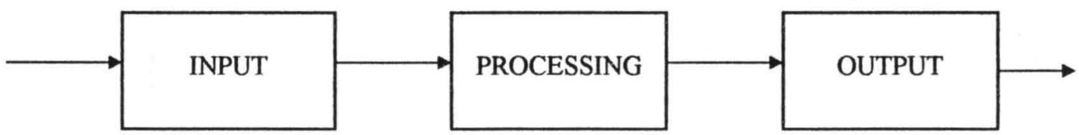


Fig. 12 Diagrammatic cross-section illustrating different formations in South-Western Nigeria. After Dessawvagie (1972)

1.3 Basic Concept Of Computer

A Computer is an Electronic device that is capable of accepting data, storing data, processing data and producing results fast with minimum human intervention.

Computers are commonly regarded as "thinking machine" it is a programmed unit that performs only the Operations it is instructed to do. A computer is faster, more economical more reliable. It converts input data to output data by operating on it. Processing of data in a computer is performed by programs which are written by programmers . The programs are in form of instructions necessary to operate on input so as to produce a meaningful output.



1.4 Classes Of Computers.

Computer come in a wide variety of sizes ranging from tiny hand held devices to some that are several feet in height and diameters .Classification of computer can be done based on their sizes, types of logic and by purpose. In terms of sizes, computers can be divided into four categories.

1.4.1 Classification based on size

(i) **Super Computers :** These are the most powerful machines available in the mid 1960s. They have capacity of performing 10 million arithmetic operations per second. Super computers can be used to process seismic data gathered during crude oil exploration, to study results of explosions of nuclear weapons etc. They are very expansive.

(ii) **Main frames :** These are large computers commonly used in business and industry. It is also very expensive. They have large Computers commonly used in business and Industry. It is also very expensive. They have large memory Capacity. They Operate at high speed and create a fair amount of heat requiring cooling systems. They serve more than one User at time because they are able to support large network of Individual terminals. This makes it possible for banks, large commercial and industrial companies to utilize mainframes.

(iii) **Micro Computers :** These are lowest forms of Computers. They are found in small businesses and in homes. It has a small primary storage unit. They are generally less complex, executing programs at lower speed.

(iv) **Mini Computers:** They have many capabilities of a mainframes, but generally low priced and with a smaller primary storage unit. They can store and retrieve data from the same type of input and output devices as mainframes. They are often used in business which do not require the capabilities of mainframes.

1.4.1 Classification Based On Logic

These are analogue, digital and hybrid. Analogue computers measure changes in continuos physical or electrical states e.g. Pressure, Voltage, Temperature etc. They accept data directly from measuring instruments without need for intermediate conversion from or to some symbol or code and to its high speed of data collection.

Digital Computer works with numbers, words and symbols exposed as digits which it manipulates and counts discretly.

Hybrid computer combine the features of the two others and utilizes both. They are powerful computing device and hence utilized to solve rather sophisticated problems.

1.4.2 Classification Based on Purpose

Under purpose classification, we have the general purpose and the special purpose computers. A special purpose computer is designed for only one purpose. It is also designed to carryout specific tests. Example of a special purpose computer is computer used for guiding NASA's space shuttles.

A general purpose computer can be used for many purposes. They are not designed for specific purpose . e.g . Computers for games, handling computation and for solving complex mathematical problems

1.5 Aims and Objective

The objective of this project focuses on using computer systems to determine the multiplication factors for distance and depth of the mineral deposit, computation of the volume of the mineral deposit, density determination and hence the computation of the weight of the deposit in tons. Finally, it would also help to determine the lifespan of the mineral deposit which is the main aim of this work. A series of lifespan is expected depending on the mining rate per annum.

1.6 Significance of Study

One of the major factors used in determining the economic quality of a mineral deposit is the lifespan of such deposit. This study would enable inventors to decide whether to invest on the mining of the mineral would be worth while. All other conditions being favorable, the profit from a mining activity is directly proportional to the longetivity or the lifespan of a mine. In other words the longer a mine last the more the profit made on investments and vice-versa. Hence before mining activity commences it is essential that the lifespan of the deposit concerned be determined.

This study would also encourage more exploratory activities in a country. This is because in the event of where the lifespan is very short and the deposit would not meet the need of the people, more effort would have to be made in search for more mineral deposits.

1.7 Scope Of study

The study area cover about forty square kilometres in area, being roughly ten kilometers by four kilometres. This work is restricted only to the computation of certain parameters earlier mentioned which would help to determine the lifespan of the deposit. It should also be noted that similar work could be carried on similar deposits in other locations or other places where such mineral exist e.g. other limestone deposit in other states like Gboko in Benue, Sokoto cement etc.

1.8 Advantages of the proposed system

The computerized system of lifespan determination would help to reduce the laborious work involved in the manual system of computation of areas, volumes and densities of the mineral deposits. The computation of these parameters using the computer systems saves time and energy which would have otherwise been impossible. The reduction of time in processing of data as a result of the use of computers gives room for more availability of time and effort be to invested on both planning of both mining processes, capital investment work, production work and projection of profit ranges. The computerized system also reduce or totally eliminate possible errors when computing the lifespan of a mineral deposit. The system also has the opportunity of being modified and expanded. Finally, although at the initial stage, it would cost a lot to acquire more than the manual process but on the long run it would be more cost effective.

1.9 Research Methodology

The undertaking of this project could be done in stages. The various stages are outlined below.

(i) Feasibility Study

This is the preliminary investigation . This is essential so as to be able to ascertain whether or not the proposed project is desirable and possible.

(ii) System Analysis

The examination of the Existing system by breaking it into discrete phase in order to determine its problem. This helped to derive a requirement specification for the proposed system.

(iii) Software Development

This is the stage of coding the design using a programming language. Test data are usually used to determine the problems of the developed software before real or live data is used.

1.91 Data Collection Method.

When calculating the life-span of a mine, data can be collected by two different means. It can be gotten from drilling programs. In other words the use of drilling equipment to determine depths of mineral deposit at different locations.

A more recent method of determining parameters such as depth, water level, rock type, salinity etc. is the use of geophysical methods of survey. It is on this method this project is based.

1.92 Geophysical method.

The word geophysical is from the word geophysics. Geophysical method of survey is the study of the nature and physical properties of the earth using specialized equipment which send down signals into the earth. Observed variations of these properties can be interpreted in terms relevant to the particular investigations.

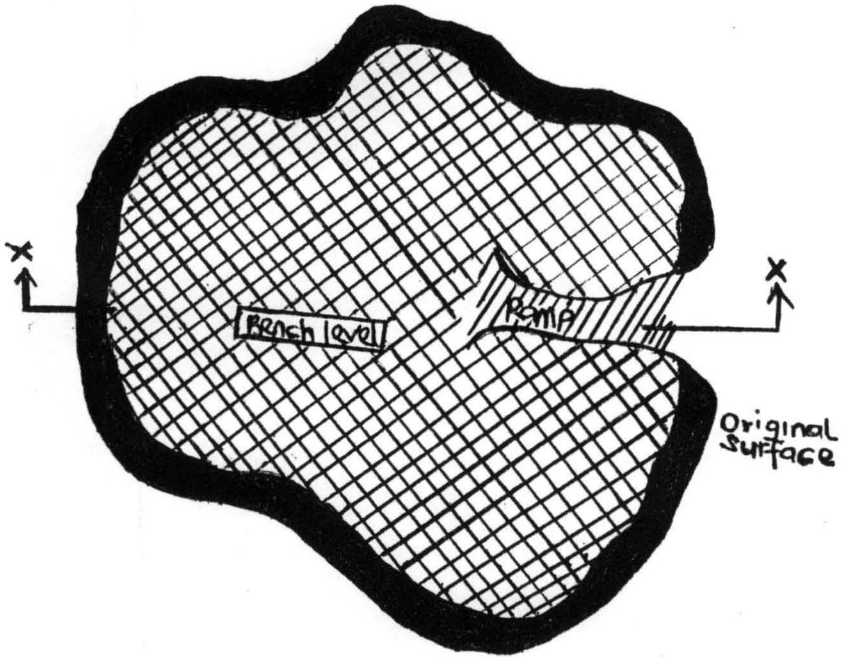
Some of the methods are Electrical resistivity method, siesmic method, magnetic method e.t.c for this work however, electrical resisvity method of dimension of the deposit. A parallel strip is then excavated in the opposite direction and the overburden is placed into the strip previously mined. The cycle is repeated as often as the deposit allow (Fig 2.3)

(d) <u>Quarry Mining</u>

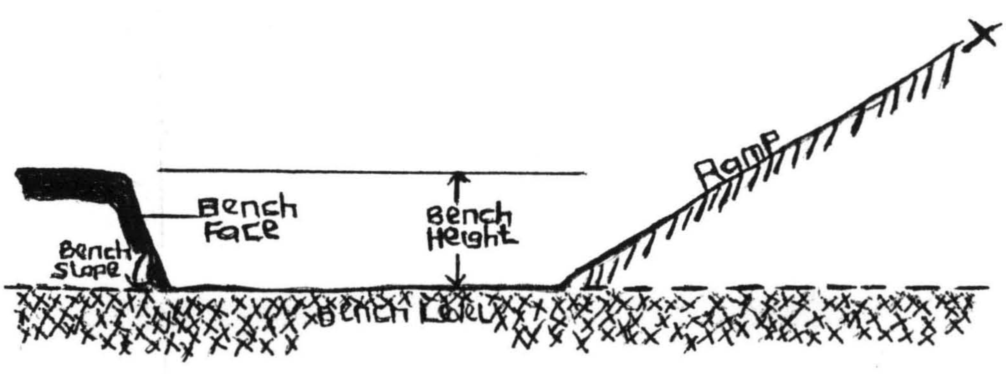
Quarrying is the term used to describe the surface mining of rock, such as marble, granite, limestone, slate etc. In quarry mining the deposit is usually either massive, bedded and is suitable for bench mining.

There are two basic types of quarries: dimension stone and broken stone (i.e. aggregate and chemical stone). Dimension stone quarries normally have benches with vertical faces and the overall pit slope is steep (fig2.4) The rock therefore must have bending across any fracture, or joint planes producing a relatively high cohesive strength. The stone generally is broken loose by some manner of cutting instead of blasting. This is done to preserve its shape and strength. Bench height can range as high as 200ft.

Quarry mining of aggregate or chemical stone usually is done by blasting to fragment the rock. The degree of fragmenting depends on the product desired. The rock therefore can have a low cohesive strength. Most stone quarries require some overburden removal e.g. limestone.



(a) Horizontal section



(b) Vertical section

Fig 2-1 Single Bench Open-Pit Mine

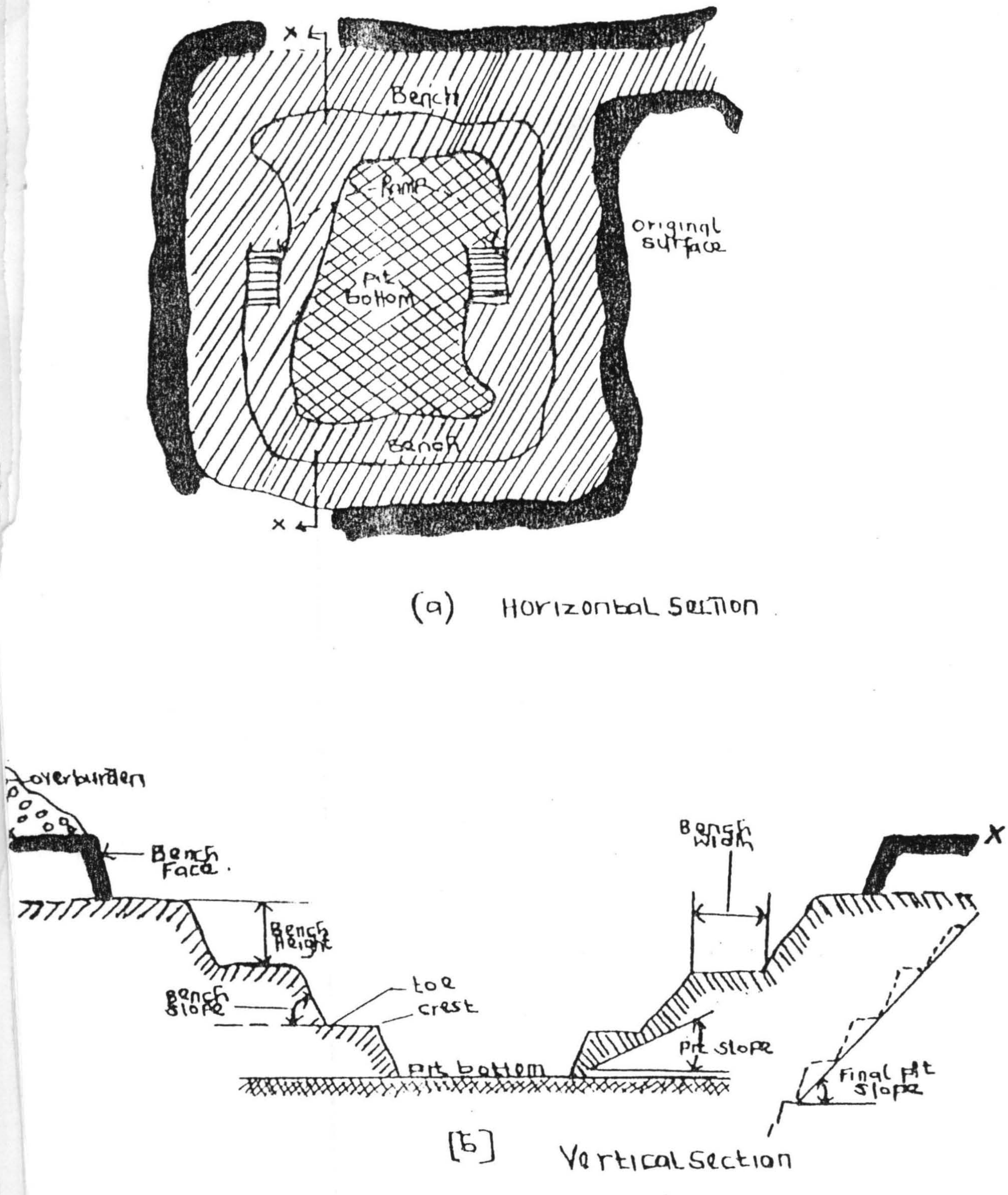
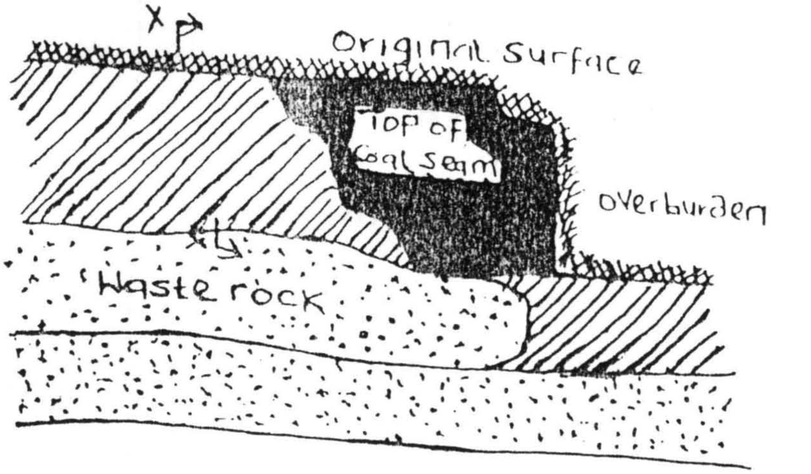


Fig 2.2 Multiple-bench open-pit mine



(a) Reclaimed and Contoured

(b)

Fig 2.3 Strip mine

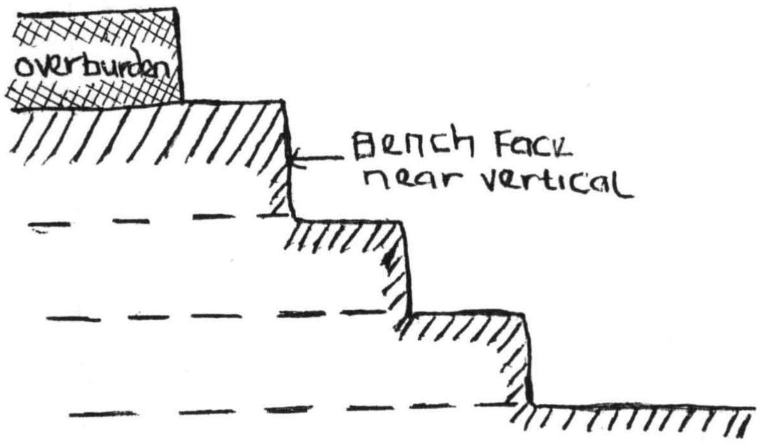


Fig 2·4 Dimension-stone quarry

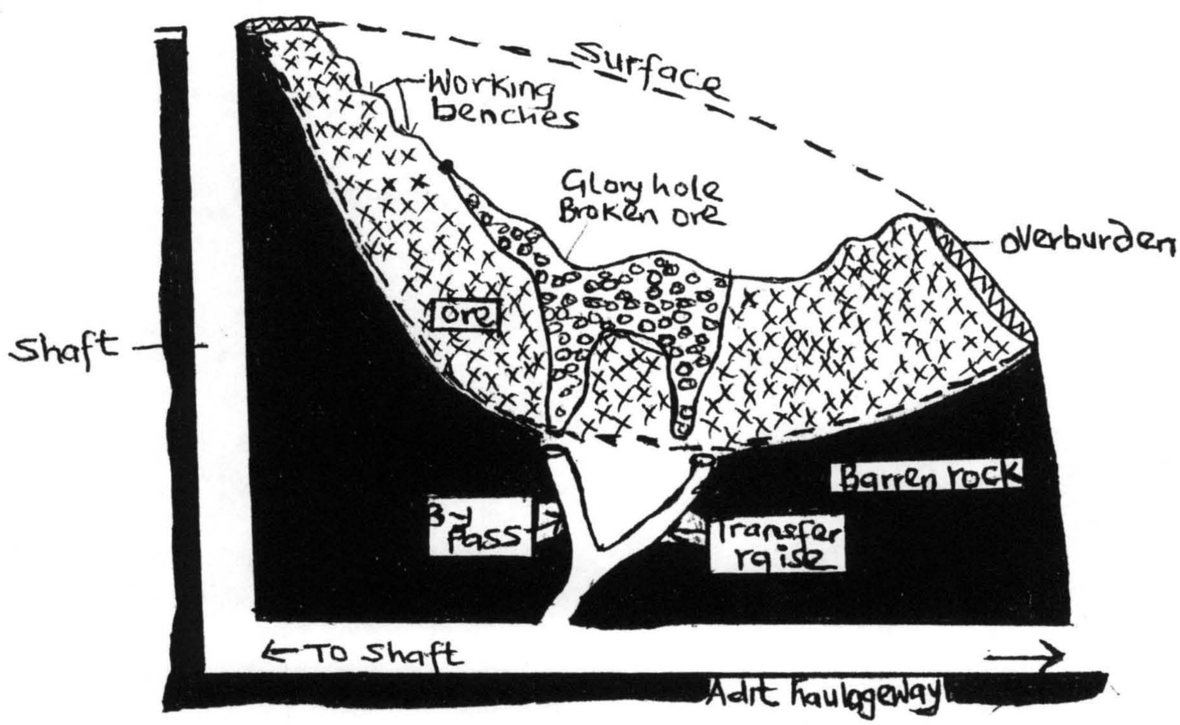


Fig 2·5 Glory hole mining (Jackson and Hedges)

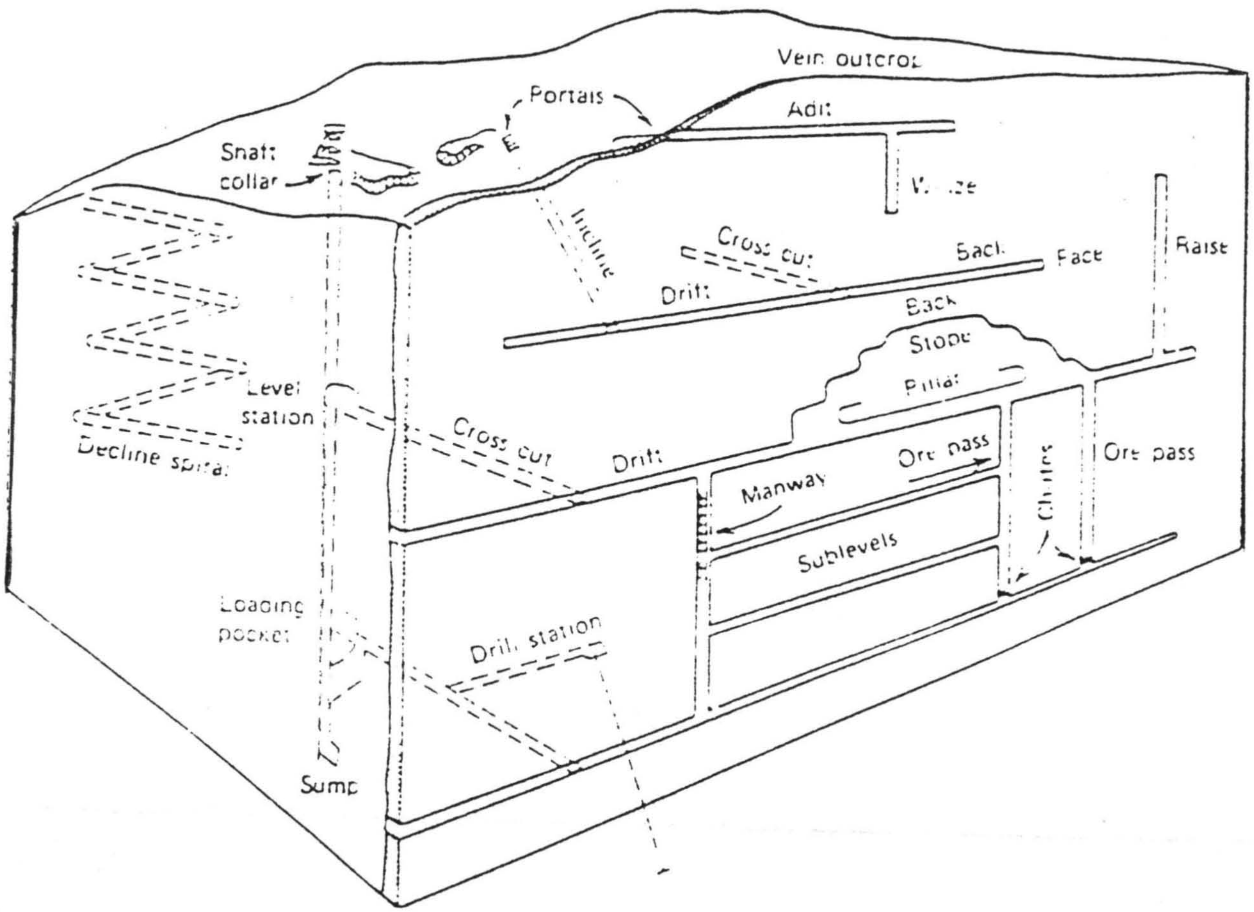


Fig 2.6 - Schematic diagram of an underground mine

(iii) <u>Glory Hole</u>

Glory hole mining implies an open pit excavation from which mineral is removed by gravity through a raise or raises connecting to underground haulage ways (fig 2.5) A Glory hole method may be used to mine almost any type of deposit that can be mined by open pit methods. The rock material in the deposit can be of any type but should not have a tendency to pack in he draw points. In this type of deposits the pit may become deep, narrow and long (Fig 2.5). The sidewalls may or may not be benched and therefore should be massive or infractured, of high cohesive strength.

B UNDERGROUND MINING

The words "mining" and "Underground" are a natural couple. In a dipping tabular body whether in a bed or a vain only the narrowest dimension is ordinarily exposed at the surface, therefore, a small pit that furnishes early production will soon reach a practical limit in depth because of excessive waste removal.Mining then goes underground with favorable topography a horizontal entry or <u>adit</u> can be driven in to the deeper zones (Fig 2.6)

In cases of still deeper mining a shaft is sunk in the ore body (mineral), or more preferably, near the ore- body generally on the <u>footwall</u> side so that fractures caused by mining will not damage the shaft. At great depth however, a vertical shaft is generally more economical because it is more direct, In underground mineral mining, level drifts follow the ore, level Cross cuts connect drift and vertical or inclined raises connect the workings from level to level. Raises designed to serve as ore passes, as manways, or for ventilation, are driven upward, Winzes or larger blind shaft are sunk. The left behind after ore as been removed are called stopes, while Pillars are left to support the walls.

Whether working in a drift or in a stope the miners working place is bounded by the back, ribs and bottom and by the advancing or limiting face. The hanging wall of a vein or of a steeply dipping bed may be part of the back, the rib or both. The footwall is part of the bottom and possible part of a rib.

2.3 Life - Span of a Mine

The life - span of a mine refers to the length of time it takes any mineral deposit to be exhausted or totally depleted or utilized. It could also be defined as the ratio of the quantity of the mineral deposit to the mining or exploiting rate per annum. Viz.

$$Life\ Span\ of\ \ Mine = \frac{Quantity\ \ in\ Volume\ \ or\ tons}{Mining\ \ rate}$$

2.4 Computers In Mine planing and Development

Despite the abundance of mineral resources in the Nigeria soil, the rate of development of the soil mineral sector in the past and present have been very slow and disappointing. This is obviously due to the occurrences of crude oil in the

Niger Delta area which presently serves as the country's major source of income. The "world" of computer being a highly dynamic one requires a dynamic system to enhance its application, unfortunately due to the poor rate of developmen in the solid mineral sector, the Government and investors in general have not been able to fully utilize the computer system to enhance performance in mining process such as mine planing development and design.

In advance countries such as Britain, France and United State, the capabilities of the computer system have been fully exploited in mining process. In these countries, computer use in mine planning has evolved from theory to application in the mining industry. Traditional mine planning methods have been combined with computer technology to produce information related to compiling ore reserves and mining plans. Other application includes production of both vertical and horizontal sections of mines, derivation of a mineralization inventory, production of a lithostratigraphic sequence (The nature of layering of different minerals from top to bottom within a particular deposit) etc.

Computer controlled robots are now being used for underground mining reaching over a hundred meters beneath the earth while the mining process is being monitored and controlled at the surface. This to a large extent has helped to reduce death rate of miners due to structural failures in the mines.

CHAPTER THREE

SYSTEM ANALYSIS

From the feasibility study, it has been found that the inefficiency of the manual computation of the life span of a mine can been solved by automation, that is using the computer system. This chapter is concerned with a detailed analysis of investigation and understanding of the old system to the extent that the analyst is able to assemble facts and recommendation for the design. Note that the various methods of data collection techniques had already been explored under 1.8

3.1 General Over- view

In calculating the life-span of a mine , the first step is the calculation of the quantity of the deposit . In calculating the quantity, the area of the deposit must be divided into sections (see fig 3.1). The volume is then calculated from the area of the sections multiplied by its thickness and is then converted to weight unit (tons) by multiplying it by the weight of ore cubic meter of mineral (density) determined experimentally. In this work, the method of triangles is used. Another method in use is called the close vertical and horizontal section technique.

In the method of triangles, the deposit or its blocked out portion or part is split into triangles whose apexes are at the point of "sounding" (sending down electrical charges in to the ground using specialized geophysical equipment) or drilling points. The whole section of the deposit is thus broken into triangular prisms *(smaller sections) bounded by triangles at the top.

The apexes of triangles (e.g. A,B,C) are the point of sounding corresponding to point of entry of exploratory boreholes. With vertical exploratory sections or boreholes through horizontal deposits, the edges of the prism are equal to the thickness of the deposit. Using this method, it is assumed that the thickness and density of the mineral changes from one intersection to the next.

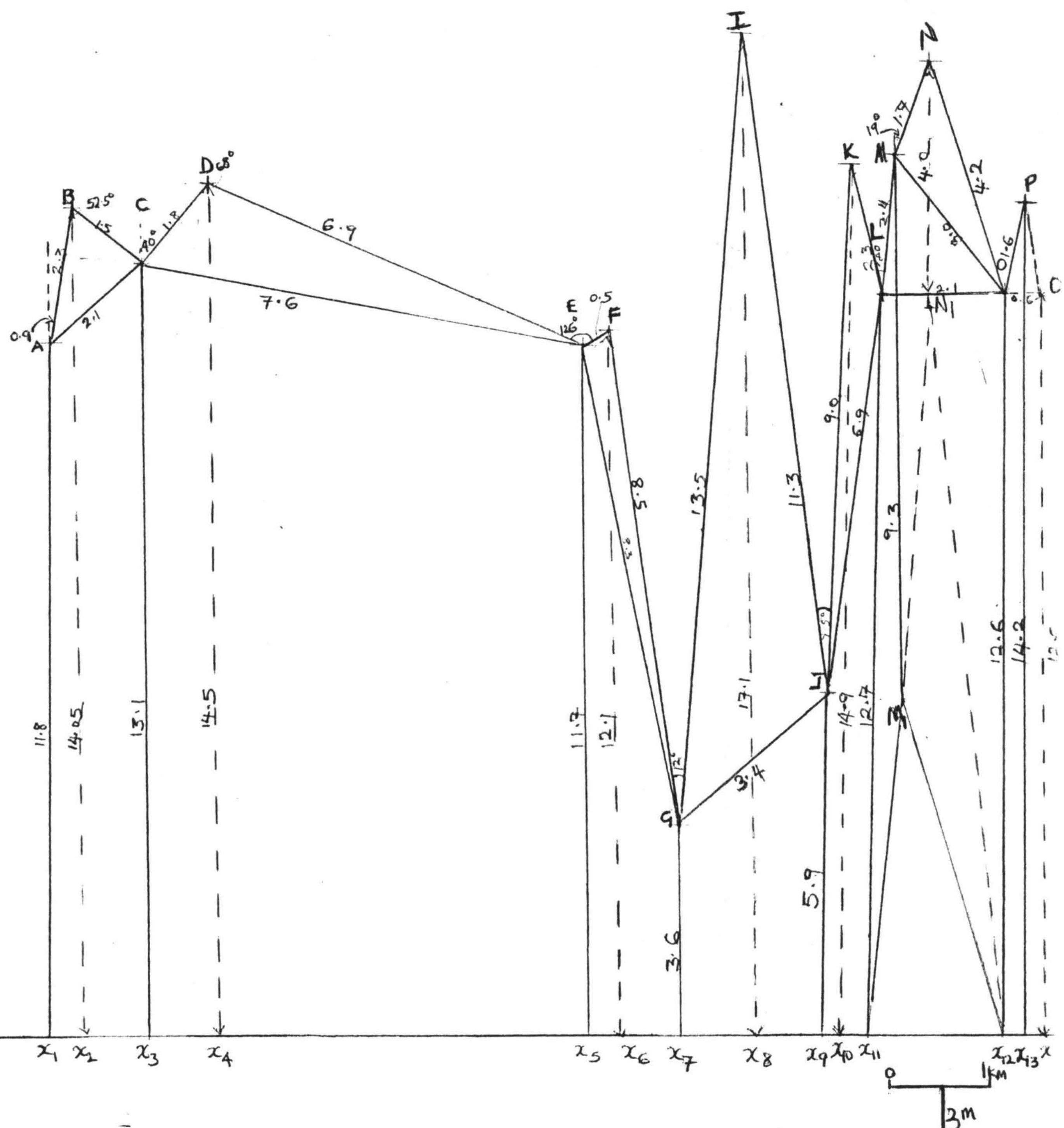
The quantity is calculated separately for each prism, its base is the triangle ABC, CDE, EFG (See Fig3.1) etc. Perpendicular to the edges which are lengths L_1, L_2 and L_3. Then, if the area of the triangular bases is S1, the volume of the prism will be

$$V = \frac{S_1}{3}(L_1 + L_2 + L_3);\ m^3$$

Where $S_1 = {}^1/_2\, bXh$, knowing the density of the mineral e.g. limestone we can find the quantity in one prism.

$$Q = VY = \frac{S_1}{3}(L_1 + L_2 + L_3)\ Y \text{ tons}$$

Summing the quantity in the different prisms, we obtain the quantity in the whole section or deposit. This quantity is what is known as the RESERVE of the deposit. The ratio of this reserve to that of a stipulated mining rate per annum automatically gives the life span of the mineral deposit.



... OF THE LIMESTONE BODY

3.2 Analysis of the Existing System

In the computation of the volume using the formula $V = S^1/_3 (L_1 + L_2 + L_3)$, the various actual depth and distances from one point to the other at the study area must be considered, This is important because the scales used on ground in the field is quiet different from those used on cartographical sheets. This results into the manual computation of he multiplication factor depth and distance Hence, in order to obtain the actual values for both depth and distances as it were in the field, this factors must be used to multiply the scale values used on cartographical sheets. All these are done manually.

Note that S_1 represents the area of the triangular base of prism in M^2. $S_1 = {}^1/_2 bXh$. Where b is the base and h represents the height. Also, $(L_1 + L_2 + L_3)/_3$ represents the average of the length of sides of the prism. Both S_1 and $(L_1 + L_2 + L_3)/_3$ must be calculated manually before the volume V can be obtained. The volumes which is in M^3 must be converted to tons by multiplying it with density of mineral samples collected from the fields using the formula $D = {}^m/_v$, where m is the mass of samples in grams, V is volume of samples in cm^3 and D is density in g/cm3. More than one sample were collected from different locations and the average found. A stipulation of mining rate is then male and this is used in the manual computation of the life span of the mine

[3.3] Problem and weakness of the system

One of the major problem and weakness of the existing system is in the consumption of time and effort. A lot of time and effort is being spat on the computation of the various parameter using the manual method. This cause a major delay in arriving at a meanfully conclusion as to decisions needed to commence mining activities at the area.

The manual system is also pare to errors. The likely errors are human errors resulting fro wrong use of data and arithmetic operation. When this occurs it gives a wrong a wrong lifespan computation.

[3.4] Analysis of the Proposed system

Basically, computation of the lifespan of a mine deposit using the computer system much the same as that that done manually. The main difference is that a computer handles all the work at once, in one continous operation at high speed.

In the computerized system of computing lifespan, the computer system will receive input data, carry out a computation or process on it, and output results. The input may be typed in directly on a keyboard or by appropriate device from printed character, magnetic disc or tape, punched card and other media. The output will usually either be displayed on a screen or take the form of a printed output or hard copy.

In the proposed system, all the parameters needed for the computation of the lifespan of a mine deposit is done by automation. This is made possible by the use of a series of instruction codes known as computer program. Computer program is written to cater for the computation of each parameter for instance computation of the multiplication factor for the depths and distances throughout the area of the deposit is done by automation. All it requires is the supply of the scale values used on the field and that used on the catographical sheets. This makes possible the computation of the actual depth and distance in the field.

Similarly in the computation of the area of the deposit S_1, density and the lifespan, the computer system requires the supply of the required and appropriate data on request. This however is a deviation from the manual system which has to do with the manual computation of these parameters, hence resulting into spending much time and effort. Data are processed on - line in the computer system.This paves way for easy accessibility of large or small quantities of data, program or information from the computer's main memory. The system which is also interactive allow users run the program or interacts with the computer directly via a keyboard mouse and terminal display to request the execution of a job or carry out a transaction The user also receives instantaneous response from the computer.

[3.5] COST - BENEFIT ANALYSIS

A cost - benefit analysis is necessary to determine economic feasibility of the proposed system. The primary objectives of cost - benefit analysis is to find out whether it is economically worthwhile to invest in the project.

To ensure a thorough installation of the proposed system, some element of "cost" must be considered by the management. A total cost of the materials needed in the new system is then made and an inference is made to determine its benefits over the old system. The cost analysis is as done below.

[A]	**Equipment cost**	**Cost**
	1 personal computer	₦ 60, 000
	A laser jet printer	₦ 40.000
[B]	**Installation Cost**	
	Computer room ₦ 500/month	6, 000
[C]	**Development Cost**	
	Programmer/System Analysis for 2 weeks	50, 000
[D]	**Personnel cost**	
	Staff training/Computer operator 10, 000/month 120, 000	

[E] **Operating cost**

Disk/Tapes	2,000
Maintenance cost	5, 000
Uninterrupted Power Supply (UPS)	15, 000
Stabilizer (200V.A)	5, 000
Miscellaneous	5, 000
Total cost	---- ₦ 308, 000-------

The total cost represents the investment within a year to develop the new proposed system. Although it should be noted that some material do not need annual replacement e.g. personal computers, laser jet printer and stabilizer e.t.c Hence in the following year and possibly beyond, the total cost expended in the new system would be less the initial total development cost of ₦ 308, 000.

The financial benefit derived from the installation of this new computerized system would be exceedingly noticed overtime, especially as the same system is used for several jobs. A major benefit is in the speed of processing the date and obtaining the desired outputs with less effort inputed. Finally, the time benefits can be converted to financial since more charges can be made based on speed of results.

CHAPTER FOUR

[4.0] SYSTEM DESIGN AND IMPLEMENTATION.

Introduction

This process involve the planning of a new system, to replaces or complement an existing one. This is undertaken after a through understanding of the old system and a determination on how best the computers can be used if at all necessary to make its operation more effective. In system design, the analyst formulate exactly the procedures and sub - system that will operate in the new or modified system. The final product of the design activity is the design report. This is a detailed description of the ultimate output of the system development cycle. In this project work however, it is the lifespan of the mine. This system design is followed by the system implementation. Hence, a detailed procedure on how the new system is put into a working condition is well spelt out.

[4.2] INPUT DESIGN

For any task to be achieved or a problem to be solved in a system, there is need for the supply of data or a set of input data for a program to work on.

The data that will be given to the program in order to accomplish the defined task or problem constitute the input design. The type of input used depends on the task or problem. In this work, however, the major task involves computation of volume both in M3 and in tons and lastly determination of lifespan. When calculating

[a] Volume of minerals in m3, then the parameters of all the prisms must be supplied viz.

L_1, L_2, L_3	= Length of the prisms
A or S_1	= Area of prism.
B	= breath of prism
h	=height of prism.

[B] Conversion of volume in M^3 to tons. This is achieved by first calculating the density of the minerals involved. The data supplied here are Iv - initial volume in Cm^3, fv - final volume in Cm3 and lastly the mass of the minerals in gms. The volume is multiplied by the density

[C] The lifespan of the mine. The input required here is the volume expected to be mined per annum

Firstly, to compute the multiplication factor for depths and distance the input required are the scale values on ground and on cartographic sheets. Different programs are written to cater for all these computation.

[4.3] OUT PUT DESIGN

The output generated in the new system depends on the input data. From above, we can generate output of actual depth, distances, volumes in both M^3 and in tons and finally the lifespan of a particular deposit of minerals. A list of lifespan can also be generated depending on the choice of mining rate made per annum.

The type of output media used depends largely on the operator and the purpose for which it is meant. The results of the various computations can be displayed on the screen of the V.D.U or the visual display unit. A hard copy could also be produced using a good printer.

[4.4] Operation Manual

To execute the program when the computer is off, you can take the following steps

- Put on the system and allow all the hardware configuration to be properly set
- From the DOS - prompt go to the Pascal directory by typing CD Pascal
- From the Pascal directory, execute the Pascal file - turbo. Turbo will start the Pascal compiler
- Load your program by pressing F3.
- Run your program by pressing ctrl + F9.
- At this stage, the user is introduced to the main - menu.

MAIN MENU

(1) Enter parameter

(2) Computation of volume (m3)

(3) Computation of weight (tons)

(4) Life span

(5) Exist

The entire program consists of a main - menu with five options. It also has up to six sub - menus. Detailed description of the main - menu and sub - menu is done in the next chapter under program documentation.

[4.5] System Implementation.

System implementation is directed to all the activities involved in converting an old system to a new system, which has been certified efficient in terms of performance. It is good to note that the development of a new system does not solve the problem of an organization until it is properly utilized. The steps taken to fully utilized the new system is part of what constitute the implementation activities. The steps are as follows

(A) Training [B] Conversion

[C] Installation [D] Data collection

[E] Program testing [F] Debugging of programs.

[A] Training; This covers the training of personnel for the new system operations. These personnel include data preparation personnel, computer operators and file and Tape personnel - the library personnel. The training helps to define the roles of these personnel for instance in this project, there is need for a cartographer to act as the data preparation personnel. He helps to prepare a detailed map of the study area, location of sounding points, identification of depths and distances etc.

[B] Conversion; This refers to the actual change from the old system to the new system. There are several methods to achieve this, examples are

(i) Direct approach: This involves converting everything at once from the old to the new system. In other words, the old system seizes to exist after the change over date.

(ii) The Pilot approach: In this method a working version of the system is implemented in a section of the organization. Based on the output obtained necessary changes are made, then the installation of the system in the whole organization would be effected either all at once or gradually.

[iii] To based approach: This eases the new system into place in parts, for example, department by department, or better still, computation of density values only at first and then others later.

(iv) **Parallel approach:** This runs the new system concurrently with the old system for a time to set it by comparison before final conversion.

For this project work, however, the parallel approach is most suitable because it helps to compare the two results from the old and the new system. It determines the level of accuracy of the new system.

[C] **Installation:** Generally, this describes the steps taken to put the computer system and the system software in place for use.

[D] **Collection of data:** As applicable to this system, relevant data is collected from the maps drawn to scale by the cartographers. A data control personnel is responsible for sorting out the most relevant information for the system.

[E] **Program Testing:** The validation of software system is a continous process through each stage of the software life cycle. This involves making use of data similar to the real data to observe the outputs and inferring the existence of program errors or inadequacies.

[F] **Program Debugging:** The difference between program testing and debugging is that the former is the process of establishing the existence of program errors and the latter is the process of locating where these errors occur in the program and correcting them.

[4.6] Software and Hardware requirement.

The software used in implementing this system consist of

10)Olade,A. M. 1988: Raw materia for cement production after the year 2000..Availability, suitability, and accessibility. Unpub. Pp 1-13.

11)Reyment , R. A. 1965: Aspects of the Geology of Nigeria . Ibadan university press. Pp. 145.

12)Roy, A.. and Apparro; A. 1971: Depth Of Investigation in D. C. methods of Geophisics Vol.35. No.5 pp. 943- 950.

13)Walker, P. M. B. 1991: Chambers Earth Science dictionary W and R chambers Ltd. Edinburgh. England pp. 51.

14) William C. P. 1978: Approaches to mining Eng. Factor, Exploration and mining Geology.3pp. 177-200.

```
{  This program is a project work.It belongs to Mr. Timothy Apovwovwo}
Program Life(Input, Output, Parafile, Tonsfile);
{$N+}
Uses Crt, Printer, Graph,Dos;
Const
  {User define fill pattern}
  User1 : FillPatternType = ($AA, $59, $AA, $55, $AA, $55, $AA, $55);
  User2 : FillPatternType = ($FF, $AA, $FF, $AA, $FF, $AA, $FF, $AA);
  User5 : FillPatternType = ($AE, $A4, $AE, $A4, $AE, $A4, $AE, $A4);
  Empty : FillPatternType = ($00,$00,$00,$00,$00,$00,$00,$00);
  space = ' ';
  {Constants Used}

Var
  GraphDriver : integer;  { The Graphics device driver }
  GraphMode   : integer;  { The Graphics mode value }
  MaxX, MaxY  : word;     { The maximum resolution of the screen }
  ErrorCode   : integer;  { Reports any graphics errors }
  MaxColor    : word;     { The maximum color value available }
  OldExitProc : Pointer;  { Saves exit procedure address }
  choice,choice3,choice1,choice2:integer;
  Years,Sam,Prisms,i,j,k,ecode,flag:integer;
  Keyp,Ans:char;
  Parafile, Tonsfile, Outt:Text;
  L1,L2,L3,B,H,Ave,Area,Vol: Array[1..50] of double;
  FV,IV,WV,MA,DE:Array[1..50] of double;
  TVol,YVol,Cdist1,CDist2,Cdist,Cdept1,Cdept2,Cdept,Cumm:double;

function Int2Str(L : LongInt) : string;
{ Converts an integer to a string for use with OutText, OutTextXY }
var
  S : string;
begin
  Str(L, S);
  Int2Str := S;
end; { Int2Str }

Procedure box(x1,y1,x2,y2,r1,r2,c1,c2,c3:integer);
begin
  setcolor(c1);
  setlinestyle(Solidln,0,Normwidth);
  arc(x1+r1,y1+r1,90,180,r1);
  arc(x2-r2,y1+r2,0,90,r2);
  arc(x1+r2,y2-r2,180,270,r2);
  arc(x2-r1,y2-r1,270,0,r1);
  line(x1+r1,y1,x2-r2,y1);
  line(x2,y1+r2,x2,y2-r1);
  line(x2-r1,y2,x1+r2,y2);
  line(x1,y2-r2,x1,y1+r1);
  floodfill(x1+10,y1+10,c1);
  setlinestyle(Solidln,0,Thickwidth);
  setcolor(c2);
  arc(x1+r1,y1+r1,90,180,r1);
  arc(x2-r2,y1+r2,0,90,r2);
  setcolor(c3);
  arc(x1+r2,y2-r2,180,270,r2);
  arc(x2-r1,y2-r1,270,0,r1);
  setcolor(c2);
  line(x1+r1,y1,x2-r2,y1);
  line(x2,y1+r2,x2,y2-r1);
  setcolor(c3);
  line(x2-r1,y2,x1+r2,y2);
  line(x1,y2-r2,x1,y1+r1);
```

```
end;

Procedure Press;
Begin
  Setcolor(Yellow);
  Settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(100, 450,'- Press any key to continue');
  Keyp := Readkey;
End;


Procedure LOADER;
Begin
     Reset(Parafile);
     Readln(Parafile,Prisms);
     Readln(Parafile,Cdist);
     Readln(Parafile,Cdept);
     for i := 1 to Prisms do
        Begin
          Readln(Parafile,L1[i]);
          Readln(Parafile,L2[i]);
          Readln(Parafile,L3[i]);
          Readln(Parafile,B[i]);
          Readln(Parafile,H[i]);
        end;
     close(Parafile);
end;


Procedure NEWER;
Begin
    setfillpattern(User1,7);
    Settextstyle(Defaultfont, Horizdir,2);
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Outtextxy(50,50, 'How many Prisms                :'); Gotoxy(70,4);Readln(Prisms);
    Outtextxy(50,80, 'Ground Measurement Rate (Distance): ');
Gotoxy(70,6);Readln(Cdist1);
    Outtextxy(50,110,'Paper Measurement Rate (Distance) : ');
Gotoxy(70,8);Readln(Cdist2);
    Outtextxy(50,140,'Ground Measurement Rate (Depth)    : ');
Gotoxy(70,10);Readln(Cdept1);
    Outtextxy(50,170,'Paper Measurement Rate (Depth)     : ');
Gotoxy(70,12);Readln(Cdept2);
    Cdist := Cdist1/Cdist2;
    Cdept := Cdept1/Cdept2;
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Settextstyle(Defaultfont, Horizdir,1);
    for i := 1 to Prisms do
     Begin
        box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
        Outtextxy(20,500, Concat('Prism',Int2Str(i)));
        Outtextxy(50,50, 'Enter Length 1  :'); Gotoxy(34,4);Readln(L1[i]);
        Outtextxy(50,80, 'Enter Length 2  :'); Gotoxy(34,6);Readln(L2[i]);
        Outtextxy(50,110,'Enter Length 3  :'); Gotoxy(34,8);Readln(L3[i]);
        Outtextxy(50,140,'Enter Base (b)  :'); Gotoxy(34,10);Readln(B[i]);
        Outtextxy(50,170,'Enter Height (h):'); Gotoxy(34,12);Readln(H[i]);
       { L1[i] := L1[i] * Cdept;
        L2[i] := L2[i] * Cdept;
        L3[i] := L3[i] * Cdept;
        B[i] := B[i] * Cdist;
        H[i] := H[i] * Cdist;}
     end;
     Settextstyle(Defaultfont, Horizdir,2);
```

```
     Outtextxy(80,400,'Do you want to write data to FILE ? ');
     repeat
       Ans := Readkey;
     until (upcase(Ans) = 'Y') or (upcase(Ans) = 'N');
  if upcase(Ans) = 'Y' then
   Begin
     Rewrite(Parafile);
     Writeln(Parafile,Prisms);
     Writeln(Parafile,Cdist);
     Writeln(Parafile,Cdept);
     for i := 1 to Prisms do
        Begin
          Writeln(Parafile,L1[i]);
          Writeln(Parafile,L2[i]);
          Writeln(Parafile,L3[i]);
          Writeln(Parafile,B[i]);
          Writeln(Parafile,H[i]);
        end;
     close(Parafile);
   end;
end;

Procedure VOLUME2;
Begin
  Rewrite(outt);
  setfillpattern(Empty,0);
  bar(0,0,Maxx,Maxy);
  Cumm := 0.0;
  Writeln(outt,space:16,'EXPERIMENTAL DENSITY DETERMINATION OF LIMESTONE');
  Writeln(outt,space:16,'***********************************************');
  Writeln(Outt);
  for i := 1 to 79 do write(outt,'í'); Writeln;
  Writeln(outt,' Final      Initial      Volume of                    Density   ');
  Writeln(outt,' Volume     Volume     Water Displaced     Mass     (mass/vol.) ');
  Writeln(outt,' (cm3)      (cm3)           (cm3)          (g)        (g/cm3)');
  for i := 1 to 79 do write(outt,'í'); Writeln;
    for i := 1 to Sam do
     Begin
       WV[i] := FV[i] - IV[i];
       DE[i] := MA[i] / WV[i];
       Writeln(outt,FV[i]:6:2,space:6,IV[i]:6:2,space:9,WV[i]:6:2,space:8,
       MA[i]:6:2,space:8,DE[i]:7:4);
       Cumm := Cumm + DE[i];
     end;
     Cumm := Cumm/Sam;
  for i := 1 to 79 do write(outt,'í'); Writeln;
  Writeln(outt,'Mean Density of Limestone',space:22,Cumm:14:3,'ton/m3');
  for i := 1 to 79 do write(outt,'í'); Writeln;
  press;
 close(outt);
End;


Procedure NEWDEN;
Begin
    setfillpattern(User1,7);
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Outtextxy(50,50, 'How many Samples           :'); Gotoxy(64,4);Readln(Sam);
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Settextstyle(Defaultfont, Horizdir,2);
    for i := 1 to Sam do
     Begin
        box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
```

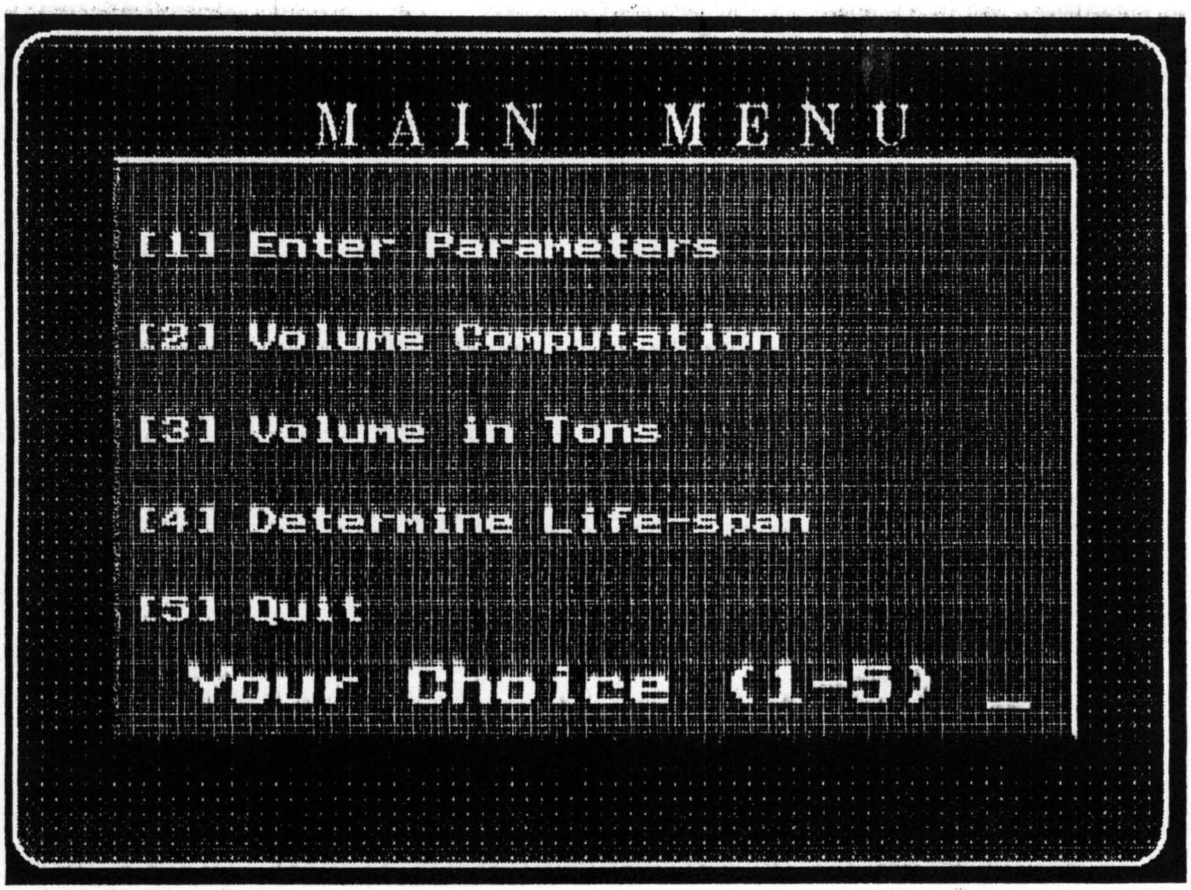
```pascal
        Outtextxy(20,500, Concat('Sample',Int2Str(i)));
        Outtextxy(50,50, 'Enter Final Volume              :');
Gotoxy(64,4);Readln(FV[i]);
        Outtextxy(50,80, 'Enter Initial Volume            :');
Gotoxy(64,6);Readln(IV[i]);
        Outtextxy(50,110,'Enter Mass                      :');
Gotoxy(64,10);Readln(MA[i]);
     end;
     Outtextxy(50,400,'Do you want to write data to FILE ? ');
     repeat
       Ans := Readkey;
     until (upcase(Ans) = 'Y') or (upcase(Ans) = 'N');
  if upcase(Ans) = 'Y' then
   Begin
     Rewrite(Tonsfile);
     Writeln(Tonsfile,Sam);
     for i := 1 to Sam do
        Begin
          Writeln(Tonsfile,FV[i]);
          Writeln(Tonsfile,IV[i]);
          Writeln(Tonsfile,MA[i]);
        end;
     close(Tonsfile);
     VOLUME2;
   end;
end;


Procedure FORDEN;
Begin
     Reset(Tonsfile);
     Readln(Tonsfile,Sam);
     for i := 1 to Sam do
        Begin
          Readln(Tonsfile,FV[i]);
          Readln(Tonsfile,IV[i]);
          Readln(Tonsfile,MA[i]);
        end;
     close(Tonsfile);
     VOLUME2;
end;

Procedure Initialize;
{ Initialize graphics and report any errors that may occur }
var
  InGraphicsMode : boolean; { Flags initialization of graphics mode }
  PathToDriver   : string;  { Stores the DOS path to *.BGI & *.CHR }
begin
  { when using Crt and graphics, turn off Crt's memory-mapped writes }
  DirectVideo := False;
  OldExitProc := ExitProc;                { save previous exit proc }
  PathToDriver := 'a:\bgi';
  repeat

{$IFDEF Use8514}                          { check for Use8514 $DEFINE }
    GraphDriver := IBM8514;
    GraphMode := IBM8514Hi;
{$ELSE}
    GraphDriver := Detect;                { use autodetection }
{$ENDIF}

    InitGraph(GraphDriver, GraphMode, PathToDriver);
    ErrorCode := GraphResult;             { preserve error return }
```

```
    if ErrorCode <> grOK then              { error? }
    begin
      Writeln('Graphics error: ', GraphErrorMsg(ErrorCode));
      if ErrorCode = grFileNotFound then  { Can't find driver file }
      begin
        Writeln('Enter full path to BGI driver or type <Ctrl-Break> to quit:');

        Readln(PathToDriver);
        Writeln;
      end
      else
        Halt(1);                           { Some other error: terminate }
    end;
  until ErrorCode = grOK;
  Randomize;                { init random number generator }
  MaxColor := GetMaxColor;  { Get the maximum allowable drawing color }
  MaxX := GetMaxX;          { Get screen resolution values }
  MaxY := GetMaxY;
end; { Initialize }


Procedure Background;
Begin;
  initialize;
  setfillpattern(user1,3);
  box(5,10,Maxx-10,Maxy-10,20,20,7,15,15);
End;


Procedure VOLUME1;
Begin
  Rewrite(outt);
  setfillpattern(Empty,0);
  bar(0,0,Maxx,Maxy);
  Cumm := 0.0;
  Writeln(outt,space:25,'TOTAL VOLUME OF LIMESTONE BODY');
  Writeln(outt,space:25,'******************************');
  Writeln(Outt);
  for i := 1 to 79 do write(outt,'Í'); Writeln;
  Writeln(outt,'Prism    Lengths of sides  Average  Breadth  Height          Area
Volume');
  Writeln(outt,'Label   L1(m) L2(m) L3(m)  length     b(m)    h(m)            (m2)
(m3) ');
  for i := 1 to 79 do write(outt,'Í'); Writeln;
    for i := 1 to Prisms do
     Begin
       Ave[i] := (L1[i]+L2[i]+L3[i])/3;
       Area[i] := 0.5*B[i]*H[i];
       Vol[i] := Ave[i] * Area[i];
       Writeln(outt,Concat('Prism',Int2Str(i)),space:2,L1[i]:5:2,space:1,
       L2[i]:5:1,space:1,L3[i]:5:2,space:3,Ave[i]:5:2,space:2,B[i]:7:2,
       space:2,H[i]:7:2,space:2,Area[i]:12:3,space:2,Vol[i]:12:3);
       Cumm := Cumm + Vol[i];
     end;
  for i := 1 to 79 do write(outt,'Í'); Writeln;
  Writeln(outt,'Total Volume',space:50,Cumm:14:3,'m3');
  for i := 1 to 79 do write(outt,'Í'); Writeln;
  press;
 close(outt);
End;


Procedure LISTER;
```

```
Begin
    setfillpattern(User1,7);
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Settextstyle(Defaultfont, Horizdir,2);
    Outtextxy(50,70,  'Enter Total Volume (tons) :'); Gotoxy(44,8);Readln(TVol);
  Rewrite(outt);
  setfillpattern(Empty,0);
  bar(0,0,Maxx,Maxy);
  Cumm := 0.0;
  Writeln(outt,space:31,'LIST OF LIFE SPAN');
  Writeln(outt,space:31,'*****************');
  Writeln(Outt);
  for i := 1 to 79 do write(outt,'í'); Writeln;
  Writeln(outt,'      Percentage (%)           Value of         LIFE SPAN');
  Writeln(outt,'      of total Volume           Volume                   ');
  for i := 1 to 79 do write(outt,'í'); Writeln;
    for i := 1 to 10 do
     Begin
       YVol := TVol/(i*10);
       Years := Round(TVol/YVol);
       Writeln(outt,space:10,i*10,'%',space:10,YVol,space:10,Years);
     end;
  for i := 1 to 79 do write(outt,'í'); Writeln;
  press;
 close(outt);

End;

Procedure SPECIAL;
Begin
    setfillpattern(User1,7);
    box(10,10,Maxx-10,Maxy-10,10,10,4,15,15);
    Settextstyle(Defaultfont, Horizdir,2);
    Outtextxy(50,70,  'Enter Total Volume (tons) :'); Gotoxy(44,8);Readln(TVol);
    Outtextxy(50,110, 'Enter Yearly Volume  :'); Gotoxy(44,10);Readln(YVol);
    Years := Round(TVol/YVol);
    {calculate }
    Outtextxy(50,170, 'Life Span            :'); Gotoxy(44,14);Write(Years);
end;



Procedure Page1;
Begin
  Background;
  settextstyle(Triplexfont, Horizdir,6);
  Setcolor(Red);
   setfillpattern(user2,1);
   box(40,50,maxx-50,maxy-330,20,20,1,1,1);
   setcolor(White);
  for k:=1 to 8 do
  begin
    setcolor(14);
    settextstyle(1,0,k);
    setwritemode(1);
    outtextxy(120,60,'LIFE SPAN');
    delay(150);
    outtextxy(120,60,'LIFE SPAN');
  end;
    outtextxy(120,60,'LIFE SPAN');
  setwritemode(0);
  settextstyle(Defaultfont, Horizdir,5);
  Outtextxy(60, 170,' COMPUTATION');
```

```
  settextstyle(Sansseriffont, Horizdir,4);
  Outtextxy(200, 240,'CASE-STUDY:');
  Outtextxy(65, 280,' A Limestone Mine, south of');
  Outtextxy(55, 320,'EWEKORO, using geophysical data');

  Press;
End;


Procedure Page2;
Begin
  Background;
  settextstyle(Triplexfont, Horizdir,6);
  Setcolor(Red);
  Outtextxy(120, 30,'A Project Work');
  settextstyle(Defaultfont, Horizdir,6);
  Outtextxy(260, 120,'BY');
  settextstyle(Defaultfont, Horizdir,3);
  Outtextxy(50, 210, 'AKPOVWOVWO I. TIMOTHY');
  settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(180, 240, 'PGD/MCS/97/98/537');
  settextstyle(Triplexfont, Horizdir,4);
  Outtextxy(80,300, 'In partial Fulfilment of the');
  Outtextxy(70,330, 'Requirement for the Award of');
  Outtextxy(30,360, 'Post Graduate Diploma in Comp. Sc.');
{  Outtextxy(70,300, 'Computer Science');}
  Press;
End;


rocedure PARAM;
egin
  Background;
  setfillpattern(user2,2);
  box(80,80,Maxx-80,Maxy-80,0,0,2,15,8);
  Setcolor(White);
  Settextstyle(Triplexfont, Horizdir, 4);
  Outtextxy(210,40,'PARAMETER MENU');
  setcolor(Yellow);
  settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(100, 120,'[1] Load Data From File');
  Outtextxy(100, 200,'[2] Enter New Data');
  Outtextxy(100, 280,'[3] Exit ');
  settextstyle(Defaultfont, Horizdir,3);
  Setcolor(White);
  Outtextxy(100, 360,'Your Choice (1-3) _');
  repeat
   Begin
    keyp := Readkey;
    val(keyp,choice1,ecode);
   end;
  ntil choice1 in [1,2,3];
  ase Choice1 of
      1: LOADER;
      2: NEWER;
  nd;
  ;

  cedure TONS;
  in
  ackground;
  tfillpattern(user2,2);
  x(80,80,Maxx-80,Maxy-80,0,0,2,15,8);
```

```
  Setcolor(White);
  Settextstyle(Triplexfont, Horizdir, 4);
  Outtextxy(200,40,'VOLUME IN TONS');
  setcolor(Yellow);
  settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(100, 120,'[1] Use Former Density');
  Outtextxy(100, 190,'[2] New Determination');
  Outtextxy(100, 280,'[3] Exit');
  settextstyle(Defaultfont, Horizdir,3);
  Setcolor(White);
  Outtextxy(100, 360,'Your Choice (1-3) _');
  repeat
   Begin
    keyp := Readkey;
    val(keyp,choice2,ecode);
   end;
  until choice2 in [1,2,3];
  Case Choice2 of
      1: FORDEN;
      2: NEWDEN;
  End;
End;

Procedure DETER;
Begin
  Background;
  setfillpattern(user2,2);
  box(80,80,Maxx-80,Maxy-80,0,0,2,15,8);
  Setcolor(White);
  Settextstyle(Triplexfont, Horizdir, 4);
  Outtextxy(200,40,'OUTPUT DESIGN');
  setcolor(Yellow);
  settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(100, 120,'[1] List');
  Outtextxy(100, 190,'[2] Specific');
  Outtextxy(100, 280,'[3] Exit');
  settextstyle(Defaultfont, Horizdir,3);
  Setcolor(White);
  Outtextxy(100, 360,'Your Choice (1-3) _');
  repeat
   Begin
    keyp := Readkey;
    val(keyp,choice3,ecode);
   end;
  until choice3 in [1,2,3];
  Case Choice3 of
      1: LISTER;
      2: SPECIAL;
  End;
End;

Procedure MainMenu;
Begin
  Background;
  setfillpattern(user2,2);
  box(60,80,Maxx-60,Maxy-80,0,0,2,15,8);
  Setcolor(White);
  Settextstyle(Triplexfont, Horizdir, 4);
  Outtextxy(170,40,'M A I N    M E N U');
  setcolor(Yellow);
  settextstyle(Defaultfont, Horizdir,2);
  Outtextxy(70, 120,'[1] Enter Parameters');
  Outtextxy(70, 170,'[2] Volume Computation');
```


MAIN MENU
[1] Enter Parameters
[2] Volume Computation
[3] Volume in Tons
[4] Determine Life-span
[5] Quit
Your Choice (1-5) _

Enter Total Volume (tons) :

292480463.2

Enter Yearly Volume :

2000000

Life Span :

146yrs

- Press any key to continue