# APPLICATION OF COMPUTER IN CABLE SIZE SELECTION FOR

# *SPECIFIC LOADS*

BY

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**GRADUATE DIPLOMA IN COMPUTER SCIENCE**

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# APPROVAL PAGE

This project has been read and approved by the undersigned on behalf of the department of MATHEMATICS AND COMPUTER SCIENCE, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, Niger State as meeting the partial requirements of the award of post graduate Diploma in Department of Mathematics and Computer Science, Federal University of Technology, Minna.


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EXTERNAL EXAMINER

# CIRCULATION

This project (application of computer in cable size selection for specific loads) is compiled in partial fulfillment of the requirement for the award of post graduate diploma in Computer Science of the Federal University of Technology, Minna.

It is therefore for the specific circulation to the following:

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*OJIOGO I. IHEAKA*

# *DEDICATION*

I dedicate this project to ALMIGHTY GOD, the fountain of Computer Learning, My Wife, MRS. OJIOGO, I. IHEAKA, My Children, PRECIOUS AMARACHI OJIOGO and IHEAKA OJIOGO.

# ACKNOWLEDGEMENT

# ABSTRACT

A good Engineering Services Design must specify appropriate cable type and standard cable sizes for the designed Electrical Loads. In Electrical Engineering profession the problem of use of appropriate cable-types, cable sizes, fuse ratings in Electrical Services in buildings involves a lot of mental resources due to intricate and tedious calculations associated with the exercise and efforts expended in scanning through volumes of Electrical Engineering books on standards and specifications.

The specification of wrong cable types, sizes and fuse ratings in buildings has contributed immensely to several Electrical circuit related hazardous fire incidence.

This has over the years constituted a great deal to insecurity of life and property. This project is a Computer aided solution (Computer Program) to the problem of f recommending the right Electrical Conductors for Electrical Services with specific focus on a range of flexible cables.

Chapter 1 justifies the need for the project (Application of Computer in cable size selection for specific Loads) and considers the history of information communication

Chapter 2 traces the evolution of Computer generations up till the end of the $20^{th}$ Century and forecasts the trend in the $21^{th}$ Century. Chapter 3 deals with system Design procedures and selects Basic language as the programme language for the project.

Chapter 4 conducts an in-depth analysis of the written program. Chapter 5 comments extensively on the limitations of the project and makes far-reaching recommendations.

Finally the programme and program outputs of the project are contain in the appendix.

This project is therefore another success in the application of computer in making the complex Electrical Engineering duty of Load calculation for specific flexible cable types ranging from $60^{0}$ C rubber- insulated BS 6141 to 185 C rubber- insulated BS 614 1 to $185^{0}$ C glass fiber types very easy.

The programme is however based on the $16^{th}$ Edition of institution of Electrical Engineers regulations.

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# CHAPTER I

INTRODUCTION:

The Application of computer in cable size selection is one of the various ways computer can be used for the aid of man in design activities. The need for this project is justified by the attendant problems occasioned by the use of either over-sized or undersized cables for satisfying specific load demands. The problems range from the conditions favourable to free hazards to Engineering structures that utilize electricity to inefficient and uneconomical use of cable. These problems have in them resulted to huge financial, time and efforts losses to individuals, group of persons, as industrial setting and even to governments at the various countries of the world. The se of inappropriate cable sizes in mechanical, civil, chemical and indeed engineering systems and others has always constituted problems, which take the financial and even intellectuals resources of and organization.

Specific examples are the use of improper cable sizes and types in automobiles, building structures, Electrically control chemical process, Electrical circuits devices and systems. etc. If the cable size used is inappropriate,(under sized) the cable may develop heat and subsequently the insulators may melt. The conductors are therefore exposed. If the exposed Conductors Bridge, sparks may result (if the circuit is not protected properly). The resultant effect may be that the entire Engineering construction may go in flames. The loss in efforts, time and money that can result therefrom can be better imagined.

This project -application computer in cable size selection- attempts to solve the problems by the use of computer programs.

1.1 History of information communication: Information communication has metamorphosed from cradle over the years to its present state of advanced computer aided form. It is however not certain exactly the day; months or specific year man commenced information communication. I posit that information communication commenced in man when he was imbued with curiosity about things surrounding him. The limitation of the sign language which included, complexity of signs (too many) and the difficulty in interpreting the meanings which the various signs project, made it imperative for speech to develop.

1.2 Speech involves communication through talking.

Speech has the problem of being forgotten and not easily recorded. This problem was overcome at the next stage of information communication by the introduction of writing. Writing had the problem of being tedious in replication or duplication of information to many people. This led to development of printing. Printing solved the problem of writing but presented another problem of information storage. This is because there is always the problem of storing voluminous and bulky printed jobs. Worse still the transportation of printed information was slow and exposed to hazards of pilfering, mutilation and misfiring. Telecommunication developed to solve the problems posed by printing as a mode of information communication. These brought about the use the of telephones and telex etc . In communication, information can be sent out fast but the information may not hit its target immediately. This leads to poor response tune by telecommunication. To improve this, the introduction of system of proper and accurate information recording, storage, processing, retrieval and communication became implicit. This led to the introduction of computers. Computer can be described as a robot with artificial intelligence (program) to accept, process and out put results that are usually information

related.

Information technology (IT) in its recent form includes, computing, communications, and controls systems whose hardwires incorporate micro-electronic components (chips). Information technology therefore provides man with the means of sending, receiving, manipulating, and sorting information at speeds and in quantities never before possible.

# CHAPTER 2

## LITERATURE REVIEW

2.1 Computer Generations: This project- application of computer in cable size selection for specific loads is computer dependent. Computers can be classified in terms of its size, the type of logic they use, and the purpose for which they are designed.

Computers can also be classified in terms of sizes such as Mainframe, microcomputers (personal computers) and mini-computers.

A mainframe is made up of large and expensive computers generally used in large business, governmental or academics settings because they can support multiple functions. In fact one subset of a mainframe may include super computers such as maxi which are the biggest and fastest computers. The hallmark of this type is that there are the most expensive and require special support staff and physical Environment.

The microcomputer or personal computers are small, one-user computers that are relatively inexpensive. Microcomputers can not store as much data as a mainframe.

The mini computers is in-between the mainframe and microcomputer. The ratio of costs of mainframe to maincomputer to minicomputer is 1000:500:1. A mainframe can be as costly as =N= 10, million.

In terms of type of logic computer can be classified as analogue or digital type. The analogue computer uses physical relationships to convert physical measurements into values. The digital computer uses Electronic circuit that obey Boolean algebra to represent on and off situations and therefore Numeric and alphanumeric constants in their equivalent digits representation.

In terms of purpose, computers are classified as special or general-purpose types.

A special purpose computer is designed for specific purpose and may not be applicable in other applications. These include dedicated computers used for guiding NASA'S space shuttles. The general-purpose computer can be used for many purposes such as computer games, to handle pay roll computerisation and the use of graphics to design buildings and even to solve complex mathematical problems.

Advances in computer are classified into five generations. This kind of classification is mainly based on the kind of logic circuit used by the computers.

The first generation computers came into use between 1951 to 1958. The kind of logic circuits used in these computers is the vacuum's tubes. The first generation computers commenced with ECKERT and Mauchly Eniac devices but were too bulky due to the use of vacuums tubes.

The second-generation computer was put to use between 1958 and 1963. This kind of computers replaced vacuums tubes with transistors and was therefore less bulky. The discovery of transistors which is a solid - state device marked the major technological break through that resulted in increased computer power at reduced size*

The third generation computer evolved with yet another technological advancement in integrated circuit. This occurred between 1964 to 1970. The computers that use integrated circuits are therefore referred to as the 3$^{rd}$ generation computers. There was an improvement of computers generations.

The forth generation of computers came to being in 1971 till 1990 with the introduction the chip or micro into the computer central processing unit. This led to the construction of the supper computers and monster computers that operate at very high speed and are widely applied in military and meteorological circuits.

The race for the fifth generation computer commenced in 1990 till date. The target by the

electronic world powers Japan and United States is to bequeath the world with the fifth generation computers for next millennium (year 2000). This generation of computers must be Y2k compliant. The focus is on the production of technological computers with major advances in artificial intelligence, voice recognition and image processing.

The fifth generation computer will utilise improved technology (ULS) ultra large-scale integrated in circuit chips. These can contain between 1 million to 100milliobn transistors in just an infinitesimal chip.

The fifth generation computers will be cheaper per unit memory storage space, and serves as intelligent assistance. It will give users access to a broad range of information and expertise. In office this computers can recognise and accept spoken requests, search through reservoirs of stored knowledge and decide which information is more relevant to the prescribed decision making system and then propose decisions. The fifth generation computers also promise to give advice to individuals on personal money management.

This project application of computer in cable size selection can run in the fourth generation computers. It can be seen as a support for the actualisation of the fifth computer generation dream. This is because computers use high percentage of flexible cords, which must of necessity be of the right sizes and types. This is the focus of this project-flexible cable size determination and consequent selection.

2.2    Electrical Engineering and computer: Electrical Engineering is one Engineering

field that has steadily contributed positively to the development of computers. The computer is an Electro-mechanical device and the various generations of computers are classified according to the electronic circuit components used in the development of the hardware. These range from vacuum tubes, transistors, integrated circuits and various chips.

Therefore electrical Engineering is vastly responsible for the development of the computer hardware and circuits.

However the computer is fastly becoming an inevitable tool for the development of science, technology and indeed all aspects of Engineering studies.

The situation is that Electrical Engineering has contributed in developing a device whose application aids not only the Electrical Engineer but also the various other professions. Infact the use to which the computer is put is far beyond the scope and grip of Electrical Engineering. However the Electrical Engineering development as a profession is daily becoming computer dependent.

The project topic- application of computer to flex cable selection for specific loads is an example of the use of computer to develop systems that aids the development of Electrical Engineering.

The study and application of Electricity as a phenomenuim are the hallmarks of Electrical Engineering. Electricity itself stems from the inherent properties of an atom. The atom consists of three basic particles. These are the hard central core (nucleus), the proton (carries positive charges) and the electron (carries negative charges). The Electrons revolve round the relatively massive nucleus in more or less elliptical orbits (or shells) and are infinitesimally small. According to Bohor-Rutherford model, the atoms is like a miniature solar system. A heavy positively-charged nucleus taking the place of the sun at

the centre, with orbital electrons acting like planets. The movement of electrons in an atom of which the element is made up of, constitutes the flow of Electricity. This normally occurs when there is a potential difference between a conductor.

Matter can generally be classified as good conductors, semi conductors and bad conductors of heat and Electricity. The general example of good conductors of Electricity are all class of metals, acids and salt solutions Examples of pure metals as good conductors are silver, copper and Aluminium. The bad conductors do not permit easy flow Electricity as their electrons are rigidly held to their atoms. Examples of such poor conductors are Bakelite, mica, glass, rubber, p.v.c and even dry wood. The semi conductor is the materials whose resistance at ordinary temperature are hybrids of typical metals and typical insulators. These include germanium silicon and silicon carbide. It is the thorough understanding and application of the phenomenuim of changes in circuit and circuits elements such as the diodes, transistors, and conductors that led to the successful assembly of the electronic computers.

The computer on the hand is an assemblage of hardware components [Electronic and others] which accepts inputs, stores, processes and produce outputs under the control of programs.

In this project a program is written which is fed [input] in the computer. The program contains the outline procedure for cable size selection, which the computer executes to obtain the desired result fastly and automatically.

2.3    IEE Regulation in cable type and cable size selection:

The accident or incident of Nigeria's colonial past history has bequeathed the

country the British way of doing things to some extent. This is equally true as it applies to Electricity standards in Nigeria.

The British standard institutes as well as the institution of Electrical Engineers have been the major influence on Nigerian Electricity standards. The institution of electrical engineers premier publication on Electricity standards can be traced as far back as in 1882 entitle Rules and Regulations for the prevention of fire risks arising from Electric lighting. The subsequent Edition of the Electricity standards publication of IEE were issued the following years in chronological order: 1888, 1894, 1903, 1907, 1911,1916,1924,1927,1934,1939,1950,1955,1966,1981 and 1991. These regulations in the use of electricity were published with various titles. For example the third Edition (1897) was titled General ruled recommended for writing for the supply of Electrical Energy. The 5th Edition (1907) was titled 'Wiring rules'. The Eight Editions (1924) was entitled the Regulation for the Electrical Equipment of buildings. The 14th Edition (1966) was reprinted in 31 unit in (1970). The fifteen and sixteenth Editions bear the same tittle [Regulations for Electrical installations].

These regulations always dedicate chapters of its publications to cables and cable size selection standards. This is because cables size is very fundamental to electric circuits and wrong cable type and size selection is almost sure to result in fire harzard to the environment.

This project on application of computer to flexible cable size selection is hindged on the 16th Edition publication of IEE.

The area of particular interest to this project is table 4H3A and 4H3B which deals with copper conductor flexible cords of BS 6141 and BS 650 operating within the

temperature range of $35^0$C to $175^0$C and of cross section area range 0.5 to 4mm$^2$. For the avoidance of doubt the temperature range for the $6^0$C rubber and PVC cords considered is $35^0$C to $55^0$C so as not to exceed the $60^0$C unit.

The terms flexible cable and flexible cords are generally interchangeable in usage. However, the technical difference between the two terms is that while the flexible cable consists of one or more cores each containing a group of wires, the diameters of the wires and the construction of the cable are such as to afford flexibility, the flexible cord is a flexible cable in which the cross-sectional area of each conductor does not exceed 4mm$^2$.

The flexible cable derives its name from the size of the conductors covered by the insulator that make up the smallest cable unit and the relationship between the flexible cable and others covered together in a sheat. The operating temperature of the insulation used is also an important aspect of flexible cable description.

For example 1.5mm$^2$ twisted twin PVC flexible cable means the following:

1.  There are two flexible cables enclosed in an insulator;

2.  The size of each flexible cable is 1.5mm$^2$;

3.  The overall insulation of the cable is polyvinyl chloride;

4.  The cables are twisted on each other.

There are other descriptions of the flexible cable such as circular flexible rubber sheathed, workshop flexible. However, the flexible cable types considered in this program are the $60^0$C rubber and PVC cords; the $85^0$C rubber cords having hofr [heat, oil and flame resistant] sheat, $150^0$C rubber cords and glass fibre cords.

The IEE regulation 16$^{th}$ Edition on which this computer program on flexible cable selection is made of seven parts, five appendixes and the index. The seven parts deal with

the following topics respectively.

part 1 scope, object and fundamentals requirements for safety.

Part 2: Definitions

Part 3: Assessment of General supplies characteristics

Part 4: protection against over current of circuits

Part 5: selection and Erection of wiring systems

Part 6: Hot air saunas

Part 7: Inspection and testing standards of installations

It worthy to note that appendix 4 deals exhaustively with procedure for cable size selection and recommends cable types, methods of installation, voltage drops appropriate correction factors and current carrying capacity of cables. The two types of conductors considered in this regulation are copper conductors and Aluminium types. This project selects copper conductor because at cross-sectional areas below 4mm copper is the better option since it is a better Electrical and thermal conductor. It has lower cross-sectional area for same voltage drop. In addition it is corrosion resistant and possesses high scrap value. Finally it is easier to joint and has lower resistively.

The tabulated current carrying capacity is intended to provide for a satisfactory life of conductor and insulation subject to the thermal effects of currents for sustained periods in normal service.

The IEE Regulation 525-01-02 16th Edition which is similar to Electricity supply regulation 1988 (as amended) recommends that if the voltage drop between the origin of the installation (usually the supply terminals) and the fixed current using Equipment does not exceed 4% of the normal voltage of the supply.

The programme on application of computer complies with the recommendation

and recommends the permissible cable length for each flexible cable size-contained in Table 4H3A and B.

The programme took into consideration all the factors considered for cable size selection such as the voltage drop per meter per ampere, the current carrying capacity of the conductor, the ambient temperature of use of the conductor and the limiting temperature due to the kind of insulation used in the flexible cord.

It is therefore a sure bait to all professional and cable size designers for specific loads.

2.4.   Computer system as an aid in Engineering designs [cable size selection application.]

A computer can be defined as an automatic Electro-mechanical machine which accepts data from an input device, stores and performs automatic and logical operations in accordance with a pre-defined program and finally transfers the processed data to an output device either for further processing or in final printed form.

The program on cable size selection is a set of instructions informing the computer of the sequence of steps to take to produce the designed results.

# CENTRAL PROCESSING UNIT (CPU)

CPU
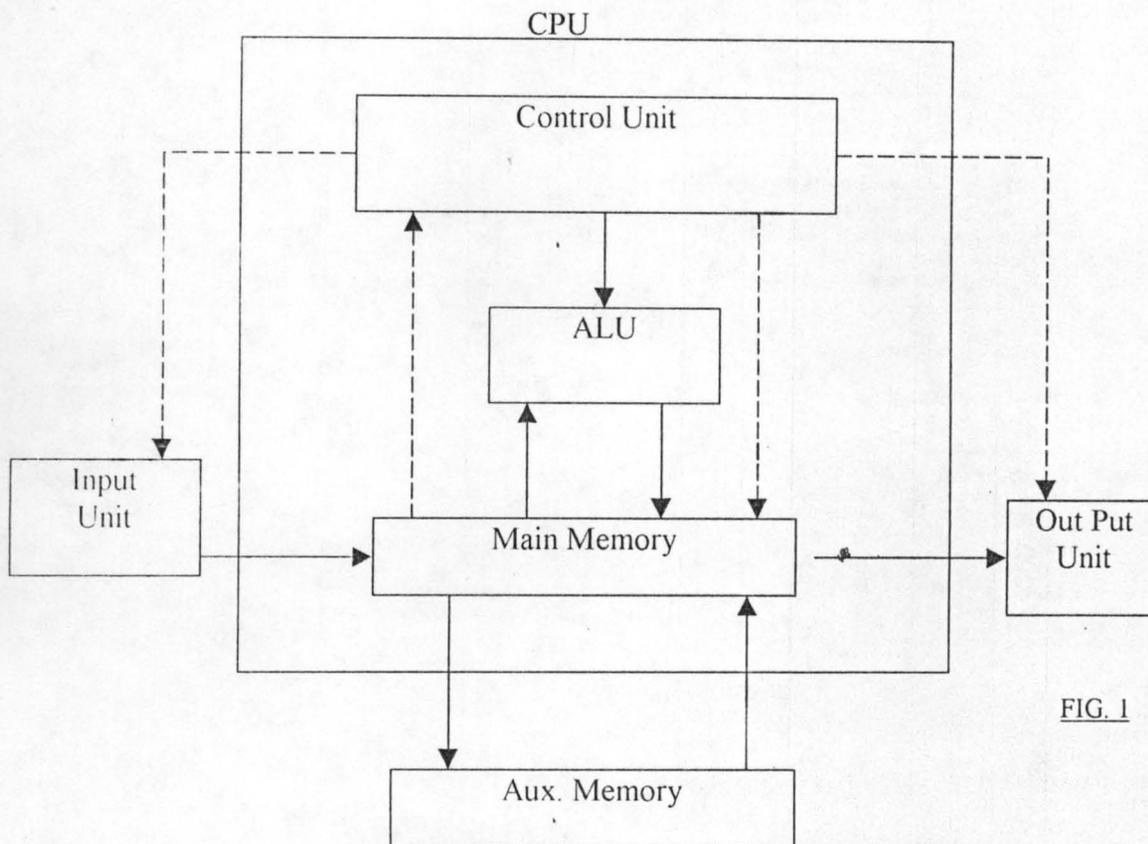


FIG. 1

## BASIC COMPUTER HARDWARE

The computer system consists of three major components. These are the Hardware, software and human ware (Life ware.)

The central processing unit is basically made up of the control unit (which co-ordinates the entire computer process), the Arithmetic logic unit {ALU}which performs the arithmetic and logical computations, the main memory (which stores programs), while the Auxiliary memory holds data and programmes temporarily while processing action is active (see fig I). Information held in the auxiliary memory are lost shortly after debuting the computer hardware.

The whole bulk of the physical system which consists of all the essential parts of the hardware, work to achieve the designed goal.

The input unit accepts data or information into the computer, the central

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processing unit (CPU) processes the information under the control of programmes and the result of the process is made visible through the output unit either as a vision display or head copy.

A functional computer is called a computer system only if there is hardware and software to run on the hardware to make the hardware work, the hardware being essentially all the physical aspects of the computer and the circuitry making up the machine.

The computer hardware is the physical components of the computer. This consists of the mechanical, magnetic, electrical and electronic devices of the computer.

The computer hardware can be classified into the following functional devices. The input device (used to send information to the computer) the central processing unit {CPU} and storage devices and output equipment that communicates computers results to humans. It is the hardware that does the physical work on the program to produce results. This project application of computer on cable size selection is programme based but it requires the computer hardware for it actualisation.

The input device is the medium through which information [data, program] is given to the computer. Examples of input devices are the keyboards, magnetic tapes, paper tapes, etc.

The software is the term used to represent all forms of programs that control the activities of a computer. It denotes the set of computer programs, procedures and associated documentation related to the effective operation of a data processing system. Software enables the exploitation of the capabilities of the computer.

The development of a software that aids the appropriate flex cable sizes to be selected for specific electrical loads is the subject matter of this project.

The following types of software are used in a computer system.

System software: These are programs usually written and supplied by computer manufacturers. They contribute to effective control and performance of the computer system. There are written to assist human or users in tapping the resources of the computer system by performing tasks such as controlling all of the operations required to move data into and out of a computer. They enhance the performance of the computer system especially in the implementation of application programs. Examples of system software are Operation system, language translators and Editors

This project does not develop system software but recognises the fact that the program on cable size selection must be run on computer with efficient, good, and reliable system software.

Application software: These are general programs written with a view to solving a problem. This may appear as user programs for specific application. An application program is usually referred to as a Job. Sometimes a job may be divided into smaller units referred to as tasks. A job usually comprises of programs and data. Most application programs require appropriate system programs to work. This project can rightly be referred to as an application software.

Application (utility) packages: These are made of pre-developed or pre-written and tested programs designed by experts to perform one or more specific purposes. They are a collection of fully documented programs designed to perform a particular data processing task in more than one organisation or installation. Examples of standard application packages are spreadsheet packages, word-processing packages, Database management packages, statistical analysis packages, Windows 95 packages, etc.

The program that is the focus of this project is not a utility package but an

application software.

Home made packages: These are programs written to solve a local problem within a particular organisation. Such programs may apply to only the organisation it is targeted to serve.

This program on cable size selection cannot be regarded home made package as its international and in compliance with the recommendation of the 16$^{th}$ Edition of Institution of Electrical Engineers.

Human ware: This aspect of computer system is often forgotten as it Incorporates the computer user as a part of the computer system. However the human beings who engage in computer use such as programmers, system analysts, system Engineers, computer operators and every computer user is referred to as human ware.

In this project the human ware consists of all the persons that use the computer for cable size selection jobs. The process of use of the computer for cable size selection involves the following procedure:

(1)     Physical installation of an appropriate computer.

(2)     Loading the computer with a compiler through input device.

(3)     Loading the programs on cable size selection input device

(4)     Running the program on cable size selection with the compiler at central processing unit.

1)     Inputting the specific values of electrical parameters relevant to your design.

2)     Processing of the entire data in CPU by the computer.

3)     Production of result in computer screen or printer (output device).

4)     Collection of the result by human beings (hardware) as print out [hardware] or screen display.

Here the process ends and maybe used for further application.

# CHAPTER 3

## SYSTEM DESIGN

### 3.1 TYPES OF ALGORITHM:

In a simplistic sense a computer is an electronic device which works under the control of a stored program. However a program is a sequence (list) of Instruction written in a specified computer language. An algorithm is one of the foremost program designed steps. It involves the application of a technique used in breaking down a problem into its meaningful stages so as to admit easy programming. Algorithm is not in fact limited in application to programming alone. It can represent the sequence of stages or steps required to be taken in order to solve a specific problem.

An algorithm is indeed a step-by-step set of instructions for solving a specific problem. It can also be described as a set of unambiguous rules that define how a particular problem or class of problems can admit a solution in a finite sequence of steps.

In general an algorithm can be defined as a list (i.e. a finite sequence ) of instructions (each of which has a clear meaning), which can be carried out in a fixed order (with a finite amount of effort and time) to find the answer to a problem.

In the process of writing a computer program that satisfies the duty of computing cable sizes, the use of algorithm becomes very glaring. In this case the individual components of the blocks whose sum totality represents the solution of the problem is designed. Then a sub program is written for each block. There must interaction between the respective blocks as required so as to actualise he designed result of cable size computation.

The process of producing necessary instructions that make up a program involves

the following stages:

1) Understanding the problem

2) Planning g solution method

3) Use of suitable algorithm to develop method of solution

4) Writing the instruction prescribed in the algorithm in a selected program language

5) Transcribing the instruction into the "machine sensible" form as input via computer visual display unit (VDU) and keyboard.

6) Program Testing

7) Program Documentation

8) Program Installation.

The first 3 steps of the programming stages enumerates above belongs to algorithms. A good algorithm must satisfy the following conditions.

1) Definiteness: Each instructions contained therein must be clear, unambiguous and precise.

2) Finiteness: An algorithm must have finite number of instructions arranged in an order in which there are to be executed and must terminate after a finite number of steps

3) Effectiveness : Each instruction in a good algorithm mat be sufficiently basic, feasible and executable

The types of Algorithm popularly used in programming are as follows:

1) Flow chart

2) Pseudocode

3) Decision table

The flowchart which is selected for use in this program of computer aid in cable

size determination and selection is a pictorial (graphical) representation of steps taken to solve a specific problem after the execution of the loop.

In this form of algorithm each processing step is placed in a box, and arrows used to indicate the next step. Different shaped boxes stand for different kinds of operations. Each box is arranged in a logical sequence so when programmes are written for each block and properly linked, the end product is the actualisation of the desired result - flexible cable size determination and selection.

## Some of the flow chart symbols used in the algorithm are as follows:
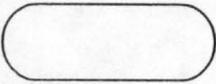
| Symbols | Names | Usage |
|---------|-------|-------|
| | The terminal Start stop | Used as the first or last symbol in a program or separately drawn program module |
| | The Process | Used to represent any kind of processing activity detail |

| Symbols | Names | Usage |
|---------|-------|-------|
| | A predefined process symbol | Used to represent a process, which has been set out in detail elsewhere |
| | The decision symbol | Used where a decision has to be made in selecting the subsequent path to be followed |
| | The input/output symbol | Used where data input output is to be performed |
| | Connector | Used to show the connecting points between two connecting blocks. |

| | | |
|---|---|---|
| → | Link | Used to establish connection between a flowchart block and the other |
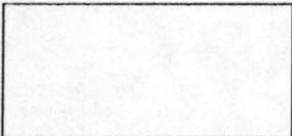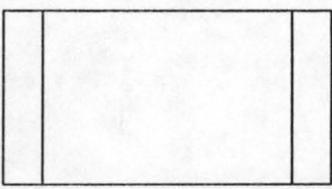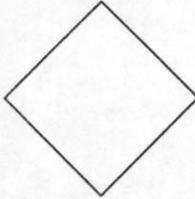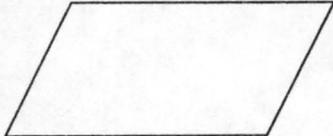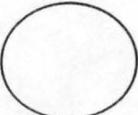
These are however three basic control structures that any flowchart algorithm can be built from its combinations. In fact two Italians computer scientists, C Bohm and G Jocopini in 1996 showed that the flowchart for any algorithm can be built from a combination of just the following three basic kinds of flowchart.

These are as follows:

1)      Sequence

2)      Repetition/ looping

3)      Decision/selection

These are represented as follows:

Representation

1.      Sequence



Action 1
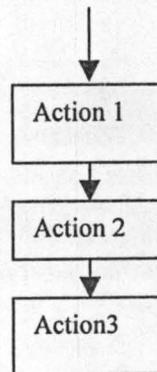
Action 2

Action3

## 2. Decision/Selection
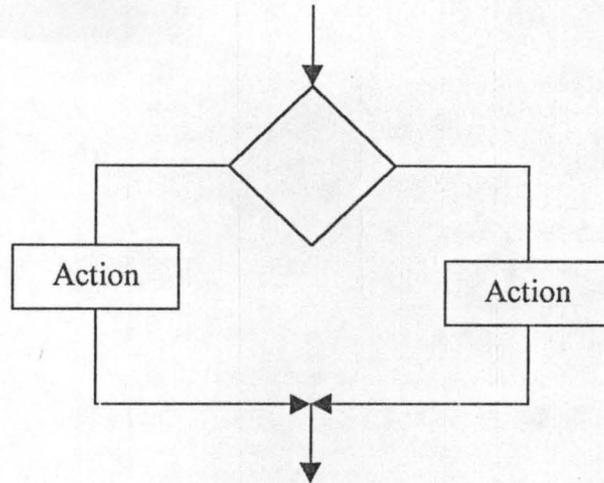


## 3. Repetation and Looping

While Loop
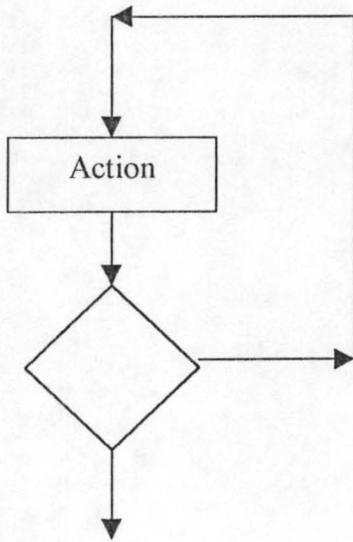


ii.   Repeat....Until
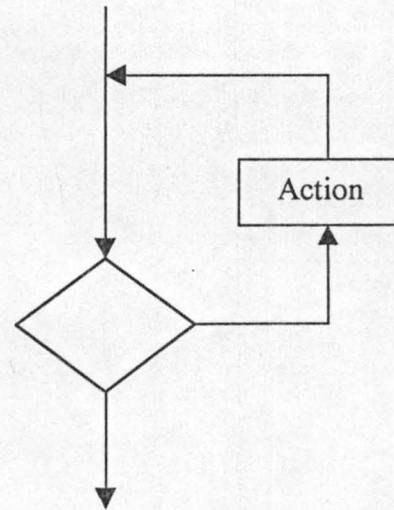


Equivalent of the three control structures in pseudocodes are as follows:

| uence | Selection | Repetition |
|---|---|---|
| on - 1 | if condition then | while condition |
| on - 2 | Actions | Actions |
| on - 3 | Else | |
| | Actions | endwhile |
| | Endif | |

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The distinguishing qualities of the three basic structures are as follows:

1)      There are easy to recognise when looking for solutions to programming programs

2)      They are  simple to deal with because they have just one entry point and just one
        exit point

3)      They are free of complications of any particular programming language.

4)      In the while loop the condition is tested before the loop is entered, whereas in the

repeat  until the expression is tested after the execution of the loop. Therefore a repeat

loop will always be executed at least once even if the condition is false at the start.

The flowchart algorithm for the selection of cable sizes was designed bearing in mind the

various symbols and their relevant areas of application. The flowchart as a form of

algorithm was selected for application in this program because of its ease in being

understood as it is in pictorial (graphical) form

        Some of the other forms of algorithm are  1)     Pseudocode                        2)

Decision tree  3)   Decision table.

1)   Pseudocode:   This type is similar to programming  language. It uses a combination

of the programming language and the relevant language such as English language.

Statements like start, End --- while loop, Do --endo. Go to, - (line No) etc are commonly

found in pseudocodes.

It is however not selected for use in this program because it is not pictorial and may not

be well interpreted by a non-program Expert. However an illustrative example of

Pseudocode equivalent for this project is as shown in pages 26- 28.

        Decision Tree: This  find wide application in a program dealing with problems

that are almost entirely logical.  The problems may be such that a number of possible

alternative actions are to be worked out so to admit programming. Indeed a decision tree

gives a quick view of the possible alternatives. Example of Decision tree to be used in determining the voltage drops in two cables types involving two different phase types (single and 3 phase) is as shown below:

```
                                      single phase ————————voltage drop
                Cable type 1
Start                          3 phase ——————————— voltage drop

                               Single phase ——————————— voltage drop
        Cable type 2
                               3 phase ——————————— voltage drop
```
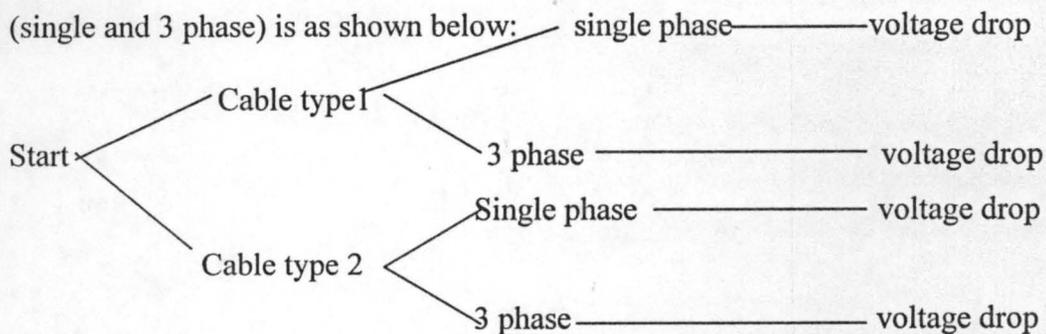
FIG. 2

This type (fig 2) was not selected for use in this program on the cable determination because it is decision intensive

Decision Table algorithm:

This is similar to decision tree but consider purely of a table indicting different selection options.

A decision table for the program  shown  in the

 decision tree (fig 2) is as shown below.

| Condition | N For cable type 1 means type 2, N For cable type 2 means type 1. Y Stands for yes and Good for Calculate | |
|---|---|---|
| Input cable type 1 | Y | N |
| Input cable type 2 | N | Y |
| Calculate current for type 1 | GOOD | |
| Calculate current for type  2 | | GOOD |
| Calculate voltage drop $VD_1$ for 1. | GOOD | |
| Calculate voltage drop $VD_2$ for 2. | | GOOD |
| Display Result | | GOOD |
| Display Result | GOOD | |

FIG.3

This type (fig 3) was not considered in this project for the same reason forwarded for

Decision tree.

N – S  CHART: This is an algorithm in a chart form. This N – S chart was not selected for this project because of its complication in interpretation.

3.2 Computer flowchart development on flexible cable size selection

Step 1

```
      ┌─────────────┐
      │    Start    │
      └──────┬──────┘
             │
             ▼
     ╱─────────────────╲
    ╱ Input electrical  ╲
    ╲ circuit            ╱
     ╲ Parameters       ╱
      ╲───────┬────────╱
              │
              ▼
      ┌─────────────────────┐
      │ Process parameter to│
      │ obtain cable        │
      │ quantity & quality  │
      └──────────┬──────────┘
                 │
                 ▼
        ╱─────────────────╲
       ╱ Output cable      ╲
       ╲ parameters to      ╱
        ╲ carry the load   ╱
         ╲──────┬─────────╱
                │
                ▼
         ┌─────────────┐
         │    Stop     │
         └─────────────┘
```

Step 2

```
       ┌─────────────┐
       │    Start    │
       └──────┬──────┘
              │
              ▼
      ╱─────────────────╲
     ╱ Display valid     ╲
     ╲ range of cable     ╱
      ╲ parameter        ╱
       ╲──────┬─────────╱
              │
              ▼◄───────────────────────┐
      ╱─────────────────╲              │
     ╱ Input cable       ╲             │
     ╲ design             ╱            │
      ╲ parameters       ╱             │
       ╲──────┬─────────╱              │
              │                        │
              ▼                        │
          ╱───────╲            ╱──────────────╲
         ╱  Are    ╲          ╱ Display invalid╲
        ╱  input    ╲────────►╲ values          ╱
        ╲ parameters╱          ╲───────────────╱
         ╲  valid? ╱
          ╲───┬───╱
              │
              ▼
      ┌─────────────────┐
      │ Compute desired │
      │ design values   │
      └────────┬────────┘
               │
               ▼
      ╱─────────────────╲
     ╱ Print results of  ╲
     ╲ cal. as recom.     ╱
      ╲ values           ╱
       ╲──────┬─────────╱
              │
              ▼
       ┌─────────────┐
       │    Stop     │
       └─────────────┘
```

FIG. 4

FIG. 5

2
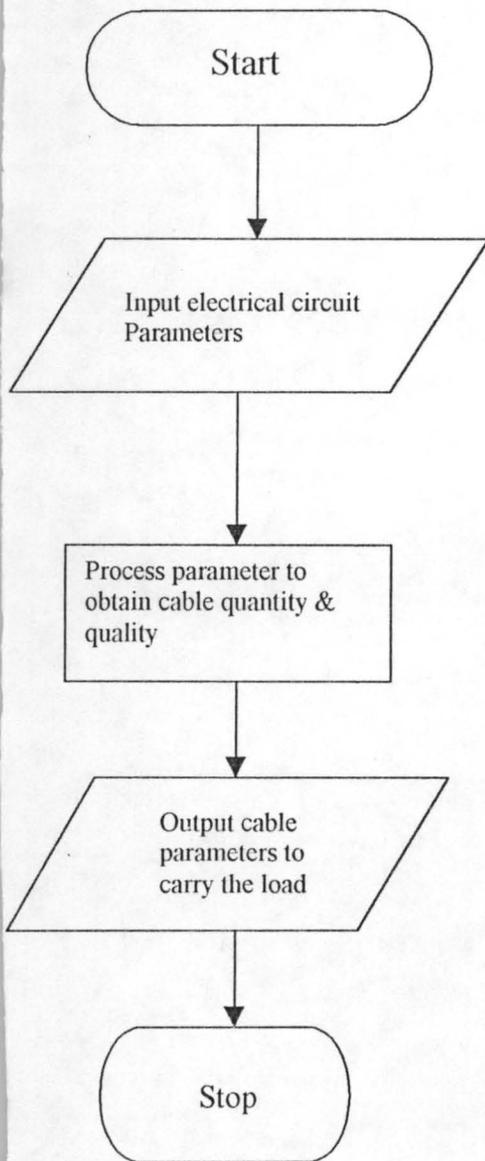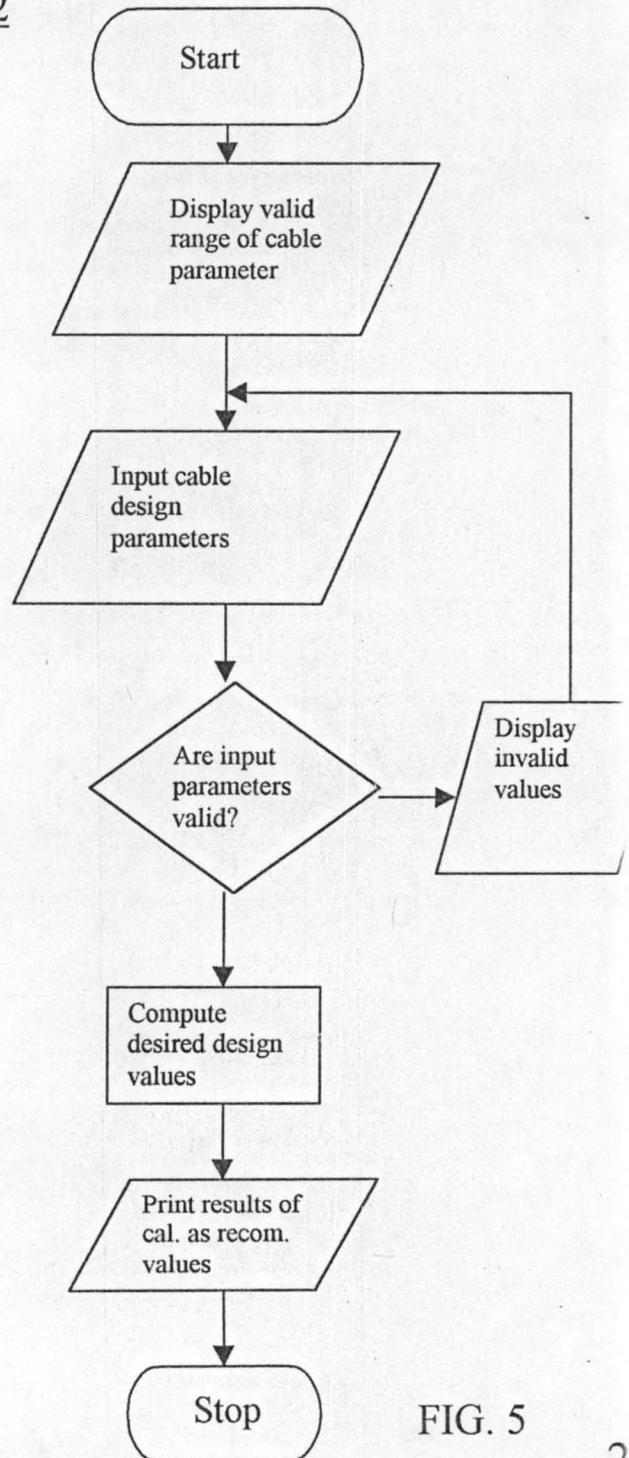
## 3.3 FLOW CHART ON FLEXIBLE CABLE SELECTION

See        Appendix    (3)

## 3.4    PSEUDOCODE FOR FLEXIBLE CABLE SIZESELECTION:

Start

Print program topic

Print cable types and temp ranges

Input working Temperature (T), voltage (v), power (Wt1)

Number of phase (Ch) or current (IE)

If o<I<32 then

Print I

Else

       If cable type < I and cable type >5 then

Display invalid cable type

Restart

else

if cable temp< > range

Display invalid temp

Restart

Else

calculate current

compute voltage drop value VDU

End if

If Temp is valid then

Compute correction factor

End if

Compute maximum length

Compute minimum recommended cable size for cable numbers

Print maximum cable size

Maximum weight supportable

Standard specification applied

stop

Refinement of Algorithm on flexible cable size selection

The technique applied in the structured design of the algorithm for the flexible cable size selection is the Top-down design stepwise refinement style.

It consist of first specifying the solution to a problem in general terms and then breaking the solution down into final and finer default. It involves a diagram that shows the components of a program and the connection between them. The approach is to determine what needs to be done, isolate the processing steps, and break the program into a set of interrelated modules. The resulting diagram therefore becomes a useful visual method for checking the design logic.

In this project the flowchart for the program was developed in three Basic steps. The first (step 1) derives from the fact that the computer is an input, process, intput system (IPOS). The computer demands inputs relevant to the design (Electrical circuit parameters), stores and processes them and output the result through the VDU or printer (hard copy (see fig 4). The result is therefore the size and cable type appropriate to the design in line with the institute of Electrical Engineer recommendation (16<sup>th</sup> Edition).

The next step [step 2] deals with a broader algorithm stage of the design (see fig 3). This contains the VDU output of valid range of cable Parameter to input,and then the

values within acceptable range to be keyed in. If this is not the case, it flags off error signal and recommences the process by demanding valid input values from the human ware.

However if the input values are within the valid range, it is time for the next stage of the sequence of steps to be carried out. In this case the computer will compute the desired cable designs values. Then it outputs the result of its computation which of course must be in tune with the recommendation for of institute of Electrical Engineers approved values, size and type of flexible cable to conduct the load safely.

The last stage [3$^{rd}$ step] of the flowchart design (SEE appendix 3-3.2) involves the further refinement of the second step. It refines the flowchart in its reasonable stages to accept easy programming. In this the input decision blocks, process blocks and output blocks are generously used to represent the individual component or modules that can accept easy programming.

The step 3 represents the final algorithmic stage with the application of flowchart representation. It is therefore on is flowchart that the project program is finally developed.

## 3.5 Computer Programming Language Selection For Flexible Cable Design Programme.

The act of giving instructions to computer is made possible through the computer programming languages. A programming language is basically the mode of communicating to computers. It is in the form of an artificially defined set of characters, symbols and words into meaningful communications, so designed to be conveniently used by human beings in developing programmes.

The computer programming languages are simply classified as code or machine

language, assembly language, and high level language.

The code or machine language is one in which instructions and data are represented in binary numbers. The binary numbers are number sequences consisting of 1's and 0's which can be executed by a computer without translation. In this type of machine language, the numbers in the series consist of an operation code or OP Code that the computer interprets to cause some actions to take place. The Op codes tells the computer what action it is to perform, and gives names or addresses of the memory location(s) that will be affected by this operation. This type of computer language was not selected for use in this project because it is machine dependent and cannot be run in another brand of computer.

The assembly language program is one that consists of mnemonics and symbols such that each instruction corresponds to or resembles a machine instruction. In this type mnemonics are used in the place of Op codes while symbolic addresses are used instead of actual machine addresses. The program written in assembly language must be translated into machine language through a special programme called the assembler. This type of program language was not selected in this project because of its lavish use of mnemonics and symbols which are not natural.

The high level computer language is one written in English-like manner. With models of computer rapidly changing, programs written in either the code or assembly language may require being re-written or at least major modifications to be operable on any newly acquired computer system. However, high level languages are machine independent. This means that a program in one of these languages need little or no changes before it can run on a different computer system. Though this type of language has the inherent disadvantage of speed of execution as it requires the use of either an

interpreter or compiler, for translation, it is selected for use in this project due to its versatility in computer systems. In high level language the processing begins by translating the original program using a language processor to machine codes before its execution.

The high level language are of various types: The Pascal, the FORTRAN, the C language, the D base versions, the Basic (Beginners all-purpose symbolic instruction code), the cobalt e.t.c.

However, in this project the specific program language selected for use is the Basic (Beginners all-purpose symbolic instruction code).

This is because it is easy to write. It finds wide application in programming scientific, mathematical and many business problems. It has the advantages of being easy for the user to find out whether the program is working properly or there is a bug. It also encourages running the computer in an interactive mode. In fact as soon as the user submits a program and some data to the computer, the computer executes the program produces the result back to the user immediately.

The basic is available on all Disc operating systems (DOS). The basic translators have the following versions:

1. GWBASIC available on DOS 33;

2. Basic and basica available on DOS 4.01

3. Q Basic available on DOS 5 and above

The GWBasic, Basic and Basica are interpreters while Q Basic is a compiler. The higher versions of basic show superiority and enhancement over the lesser versions. The Q Basic supports blocked operations particularly structured programming than those before it and also support instant syntax checking as instructions are entered and gives

instant help on errors.

The programme on the selection of cable sizes for specific loads is Basic compiler dependent and can be tested and run in Q Basic environment.

## 3.6 The Program On Flexible Cable Size Selection

The program is written in Basic language and in line with the developed algorithm (see appendix4- -- 4.7).

The formal procedure or technique for this program de involves the following: velopment

Program planning; program design; coding; debugging, testing, implementation, documentation.

**Program Planning:** This is the preliminary stage in program development. It is virtually impossible to write a computer program without first identifying and clearly understanding the problem. In this case the problem is as follows:

1. The use of table 4H3A and 4H3B of $16^{th}$ edition to determine flexible cable sizes ranging from "5m$^2$ to 4mm$^2$ with current range from 1 to 32 Amps. For five cable types and the determination of the mass support table by the twin flexible cords.

2. **The governing temperature range for each cable type is as follows:**

   Cable Type 1      $35^0$C to $55^0$C

   Cable Type 2      $35^0$C to $55^0$C

   Cable Type 3      $35^0$C to $70^0$C

   Cable Type 4      $35^0$C to $145^0$C

   Cable Type 5      $35^0$C to $175^0$C

   Cable type 1 represents $60^0$C flexible rubber cord.

   Cable Type 2 represents PVC cords

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Cable Type 3 represents $85^0C$ rubber cords, having a h.o.f.r sheath or a heat-resisting PVC sheath.

Cable Type 4 represents 1500C rubber cords

Cable type 5 represents glass fibre cords

3. The cable conductor specifically considered is copper conductor as aluminium types not applicable in this range.

4. The voltage consideration is for phase or one phase with their respective voltage drop per ampere per meter according to 4H3B

5. correction factors for the appropriate flexible cable is applied as recommended by table 4H3B.

6. The result of the computation is the specification of flexible cable size appropriate for a specific load, the maximum tolerable length of the flexible cable, the maximum weight supportable and the regulation applied.

7. However, if the cable and temperature parameters are not within range, the error signal is flagged off and the program recommence or terminates as may be desired by the user.

8. The program assumes surface wiring.

**CALCULATION: Step 1**

The formula for the determination of the load (current) the cable is to conducts is given as:     $P = IV \, pF$ for single phase

Where     $P$ = power in watts

$I$ = Current in Ampers

$pF$ = Power factor (values 0 - 1)

$\therefore \quad I = \dfrac{P}{V.P.F}$

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for 3 phase $\quad I = \dfrac{P}{3.V.P.F}$

If (load) current of value is specified, there is no further need to calculate it. When the contrary is the case the computer computes the value base on the above formula and the phase input (one or 3 phase).

**Step 2**

Once the cable type is selected and the appropriate load (current) supplied or calculated as the case may be, it is time to select the correction factor based on the input temperature according to table 4H3A of 16th edition of IEE (see appendix 1)

For example, correction factor for $40^0C$ of $60^0C$ PVC cord is 0.82, that for $150^0C$ rubber cord of $35^0C$ to $120^0C$ is 1.

**Step 3.**

Now having known the load (current) to be conducted by a specific cable type and the correction factor relevant to the prescribed ambient temperature, it is time to calculate the actual current (load) that will be incident on the cable as follows:

$$I \text{ actual } = \dfrac{I \text{ input}}{\text{Correction factor}}$$

For I actual of 3 Amps single phase and correction factor of 0.41 as in $60^0C$ flexible PVC cords, of $55^0C$.

$$I \text{ actual } = \dfrac{3}{41} \text{ Amps } = 7.31A$$

**Step 4**

Under the current carrying capacity of table 4H3A the specification is $0.75mm^2$ for 6 Amps and $1mm^2$ for 10 Amps. 7.31 Amps can therefore, be conducted by cable type one of minimal cross sectional area of $1mm^2$.

### Step 5  Determination of Maximum Cable Run

This is given by $\dfrac{Vd/A/M}{1000}$ = 9.6 for single phase

OR  $\dfrac{Vd/A/M}{1000}$ = 4%  for 1 or 3 phase voltages

Where  Vd  =  Voltage drop (In millivolts)

A  =  Current in ampere

M  =  Length of run in meters.

Hence for say single phase situation the result of the maximum length computation for the cable being considered (1) and temperature ($55^0$C), is as follows:

M = 9.6 x 1000/(Vd/A/M)

$\quad = \dfrac{9.6 \text{ x } 1000}{46 \text{ x } 7.31}$

$\quad =$  28.55  meters

This calculation is for excess current protection coarse.  For excess current protection close, M is multiplied by 1.33 factor.  In this case 1.33 x 28.55 = 37.97m

### Step 6

The maximum mass supportable was read of according to table 4H3A for 10 Amps equal 5kg.

### Step 7

The relevant computations can be carried out for 3 phase situation, respective correction factors and specific cable types as required by reading off the voltage drop per meter per amp as for 3 phase as contained in table 4H3B that is 40mV (see appendix 2)

### Step 8

When and where any of the specified parameters are exceeded either by input or calculation, the "error invalid signal" must be displayed and the program restarts or

terminates as may be desired by the user.

These are the problems the program sets to achieve.

**Program design:** The design is perhaps the most important stage as it outlines and defines the set of rules required for the solution of the problem (cable size selection). It involves the listing of successive steps the tools used to achieve this is the algorithm. (see appendix 3)

**Coding:** Once the steps of the solution of the flexible size selection problem is ordered and outlined, the next stage is the transformation of the steps to the form understandable by the computer. Therefore for coding stage covers the transformation of the design made earlier into a chosen computer language as well as entering the programs into the computer. In this case the chosen computer language is the Basic language. (see appendix 4)

The next stages of program development are treated in the next chapter (Chapter four).

# CHAPTER 4

## 4.0 SYSTEM ANALYSIS

### 4.1 Program Analysis

The program analysis can be said to commence after coding the program. Some of the premier stages of program analysis are the Debugging and testing stages.

In this program of flexible cable size selection through the use of computer, there were ample examples of debugging exercise carried out even after the program had be coded in Basic language.

The basic bugs that occurred in the program were syntax and logic errors. Here and there in the premier program, there were syntax errors which involved incorrect punctuation. These include the use of Go sub statement without return, the use of Goto statement without line number, the use of alpha (string) constants without dollar signs and undefined variables etc.

These errors were easy to find and were corrected because the language processor pointed them out by printing error messages on the source listing. These errors actually occurred at compilation time.

**Logic Errors:**

Though the syntax errors were corrected, the program still failed to produce the expected results. This is because the formula used were incorrectly keyed in and the conditional statement, logic were defective. defective etc.

This problem was solved by checking the planning of the program as well as the design logic. The program was run using simple data with known answers and the program output compared with known results (see appendix 5).

determine whether any error still remains in the program. Testing is therefore the process of running the computer program and evaluating the program result so as to determine if any errors exit. This is achieved by running the program with various sets of input values so as to be sure that the expected result is obtained.

In this program flexible cable size selection for specific loads various test values for used and the cables sizes obtained compared with expected values. The values used for the tests were both extreme and intermediate values. The test values, computer output values and expected results are as shown in appendix 5.

## INPUTS/OUTPUTS TEST TABLE
## SEE APPENDIX(5 - 5.95)

| CT | T | I | P | V | PF | PT | ECS | OP | REMARKS |
|----|----|----|----|----|----|----|----|----|----|
| 3 | 40 | - | 1000 | 240 | 0.8 | Y | .5 | SEE A5-5.1 | OK |
| 2 | 35 | 20 | - | 24 | - | N | 2.5 | ,, A5.2 | OK |
| 3 | 45 | - | 3460 | 110 | 0.9 | N | 4 | ,, A5.3 | OK |
| 4 | 120 | 30 | - | 240 | - | Y | 1 | ,, A5.4 | OK |
| 5 | 150 | - | 5000 | 415 | 0.8 | Y | 0.75 | ,, A5.5 | OK |
| 1 | 30 | 30 | - | 415 | 0.5 | Y | 4 | ,, A5.6 | OK |
| 2 | 40 | - | 8000 | 24 | 0.4 | N | - | ,, A5.7 | EM |
| 3 | 20 | 15 | - | 240 | - | N | 2.5 | ,, A5.8 | OK |
| 4 | 60 | - | 9000 | 415 | 0.6 | Y | 1.25 | ,, A5.9 | OK |
| 5 | 115 | 25 | - | 240 | .9 | N | 2.5 | A5.91 | OK |
| 1 | 60 | - | - | - | - | - | - | A5.92 | EM |
| 2 | 40 | 45 | - | - | - | - | - | A5.93 | ,, |
| 3 | 50 | - | 30 | 240 | 2 | - | - | A5.94 | ,, |
| 4 | 200 | - | - | - | - | - | - | A5.95 | ,, |

LEGEND

| | |
|----|----|
| CT | CABLE TYPES ( SEE PAGE 32 ) |
| T | ,, TEMPERATURE |
| I | SPECIFIED (LOAD) CURRENT TO BE CONDUCTED |
| P | LOAD IN (WATTS) |
| V | SUPPLY VOLTAGE |
| PF | POWER FACTOR |
| PT | PHASE TYPE-Y FOR 3PHASE:N FOR 1 PHASE |
| ECS | EXPECTED CABLE SIZE IN mmSQ |
| OP | COMPUTER OUTPUT(PRINT-OUT) |
| EM | ERROR MESSAGE |

The outputs (results) of the program(flexible cable size determination for specific loads)have shown clearly in practica

that the aim of the project has been achieved.

The colour codes which form a part of the programs attention to visual comfort on the screen are contained in appendix 6.

Based on the above test values the program on cable size selection is a highly reliable and successful..

## 4.3    PROGRAM    IMPLIMENTATION:

Since the program on flexible cables size selection has been tested and found working as required, the next stage attention was focused on   the implementation stage which  is concerned with making the program fully operational. That is, it involves applying the program to solve actual problem of flexible cable size determination for various loads as may be required by the user.

In this implementation stage it must be noted that the computer for which this program is run must have Q Basic environment. At the C  prompt command , the program diskette is inserted. The A:  is typed and entered at the prompt to change to A drive.   Then Alt + f is entered to obtain the file menu. The file is opened by entering 'Open' at the file menu. In the VDU display  that results NO 1 * Bas or the tab and cursor combinations used to access the file name that in No.1 * Bas is typed in. This takes you to the program on flexible cable size selection environment. The program is therefore run by typing in F5.

The display from the VDU that results is highly interactive as it displays the purpose of the program, the acceptable temperature voltage, power factor and current values and ranges. Immediately the necessary  inputs are made the result is the display of relevant flexible cable size, maximum weight it can carry and the relevant regulation used to obtain the result.

The program can be exited by typing in alt + f to get the file menu. The cursor  is

then moved to 'Exit' and entered. Immediately the C prompt is displayed again. The diskette is then retrieved from the CPU and if necessary you can debut the system.

This way the program on flexible cable size selection at specific loads is implemented.

It is very important to know how to access the program See program implementation. Immediately the program is accessed and run, the program title is display sleeps for 3 seconds and the screen is cleared with another display which specifies the different cable types covered by the program [type 1 to 5] the permissible current and temperature ranges. The current value should not exceed 32 A for the flexible cables under consideration whereas the temperature ranges are according to the cable types 0 to 175 degree centigrade in general.

The Display is again cleared and program now begins to demand cable input, voltage value power factor and phase type design values intended by the program user.

The supplied values are used to compute the design current. However if any of the inputs are out of range the program stops further processing, displays errors message, recommences the program hoping that the new values input will be within its specific range. If this is the case, it computes and displays the current value obtained as a result of the computation so that the user will be well aware of the current value being used to arrive at the appropriate cable size to carry such current safely.

The next display is the voltage drop per meter per ampere computed based on table 4H3A and B of IEE regulation 16th Edition (see appendix 1 and 2).

## 4.4 PROGRAM DOCUMENTATION:

This is the description of the program in the proper form for the users and to enhance maintainability.

This project (software) maintenance is divided into two parts as follows:

1)      Software integrity maintenance

2)      Program maintenance

Software integrity maintenance:   In this software is made to continue to function normally. This is achieved as follows:

i)      Offering protection to the program (cable size selection) from being infected by virus. This can be achieved by using the current version of a very powerful anti-virus program.

ii)     Storing the diskette including its backups in a safe air cool temperature.

iii)    Ensuring unauthorised duplication of the software.

iv)     Using original version of the software except when it is freely downloaded on the Internet.

v)      Quitting the software in the normal way and not through switching off of the system.

vi)     **Program maintenance:** The maintenance of this program is highly ensured by the style of writing the program and the use of sub-programs which can easily submit themselves to changes. The documentation of this program is important as it aids its maintenance.

The cables can be maintained if more cable types are to be covered   by introducing another subprogram using additional Go sub statement, introducing the required temperature ranges for the new cable type, specifying correction factors in the appropriate segment of the program as may be required.

i)      Documentation :      The documentation is both internal (use of remarks) and external by the use of flowchart and Elaborate description of the program.

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The display of various cable types, current ranges and temperature limits is to guide the users against inputting values that are out of range. However whenever this is the case, error message is immediately generated and displayed.

The technique of this program is such that if current value is supplied, there will be no need for its calculation but if this is not the case, current carrying value of the cable is calculated using the power voltage and power factor values keyed in. The formula used for this is

$I = P/VxPf$ for single phase situation

and $I = P/3 \times V \times Pf$

Where Pf = Power factor

P = Power in watts

I = Current in amps

The value of current intended to be conducted by the flexible cable is displayed so that the user will keep track of the current value being used for a specific cable type chosen.

The next is the calculation of permissible voltage drop on the cable. This is achieved by two sub-programs one for single phase situation and the other for 3 phase situation as prescribed in Appendix 1 and 2. However the permissible voltage drop is determined with the use of correction factors which are functions of anticipated working temperature of the design.

The formula for this is

$IT = IZ/X$

Where IZ is the input current

X = the correction factor

IT = the upgraded current value as a result of working temperature.

A great chunk of the program specifies the various correction factors for different temperature ranges for a specific cable type in accordance with table 4H3A  see appendix (see appendix 1).

Having established the correction factor the formula

K = 0.04 x V x 1000

Where  V = applied voltage in volts

K = the overall permissible voltage drop in volts

Then    M =K/VDI

Where M is the maximum permissible length in meters.

The cable size specified is a function of the upgraded value of the input current as specified in Table 4H3A (see appendix  1 and 2). The determined maximum length of cable is for coarse  excess current protection. However where close current protection is to be used, the value of M is multiplied by 1.33.

The program however displays the two values of M so that the designer can select which one best suits his design. Here it ends

This program on selection  of flexible cable sizes for specific loads is written in basic language and applies a lot of techniques ,styles and manipulations to achieve its purpose and produce results. The user can then make final decisions on what he needs.

1)      In fact this program presents almost all the facts required for all cable size selection

There is ample use of remarks in the program to ensure good internal documentation of the program. (see appendix 4).

The program uses the following basic commands effectively and efficiently to achieve results:

Locate cls, print, colour input, if ---- Then --- Else if---endif, if--- then---End If, Go sub---'Return, tab, Goto, etc.

The rules for numeric and alphanumeric constraints were obeyed. The colour codes used are as contained in appendix 6.

# CHAPTER 5

## 5.1 LIMITATION:

Like any other program written in basic language, this program is prone to certain limitations. This stems from repetitive use of if ---Endif, if --- then, Goto, if -- then -- else End If etc commands. The program is a bit voluminous so as to account for all necessary conditions.

The limitations in this program can be classified into 3 main categories as follows

1) Time Constraint (2) Space Constraint (3) Cost Constraint.

Time Constraint: This program is not run immediately it was written and keyed in. This led the author to do extensive research by visiting libraries, practising programmers, etc and seeking advice from the supervisor. The program therefore seemed too involved and consumed a lot of time but thank God it is an actuality.

Space Constraint: This program can at best be reported within the space (number of pages) prescribed by the authority of the federal university of technology for project of this kind. So one has to compress or cram the entire project work within the specific page range. A better report work may be achieved if more project paper space is allowed.

Cost Constraint: The entire project work is to say the least expensive. It involves a lot of running about, and production costs. In the present economic dispensation of the country, one has to have a lion's heart to actualise project like this in terms of cost.

Technically some of the limitations of this project are as follows:

1) Limited number of program books in the library

2) Limited number of computers at the disposal of project executioners

3)   Not modularising program projects and assigning modules to more than one student.

4)   This program can only run in a Q basic compiler

5)   Maintenance of the program will require the attention of the author or program expert.

## 5.2   CONCLUSION:

This idea to allocate projects of this type to students is indeed a laudable thought. It indeed offers an opportunity and challenge to the students to apply their knowledge of computer and computer programming to the solution of the problems of our time and even beyond. It is an effort which requires the application of classroom lectures and practical experience gathered during the post graduate course to solve problems relevant to ones field.

This program on flexible cable size selection is one such application of computer programming learning. Now, flexible cable sizes can be determined without scanning through volumes of institution of Electrical Engineers editions but just by keying in the design cable parameters and the computer does all the computations.

## 5.3   RECOMMENDATION:

Based on the experiences gathered while compiling this program 'flexible cable size selection' I recommend as follows:

1)   Assigning of projects involving program writing project to post graduates students is a welcome development as it enables practice to be marched with theories. what they learnt.

2)   Projects should be made less expensive by the management of federal university allocating funds to the department of maths and computer science, the project co-ordinator and project supervisors for project matters

3)	An alumni of PGD (post graduate diploma) federal university of Technology Minna should be immediately instituted with the aim of increasing funding to the Department of Maths and computer science especially in the area of purchase up-to-date, state of the art computers for Example windows This can be done such that before any graduate receives his certificate he must register with the alumni with a specific amount of money which will be used to up-date the library and others

4)	More than one student can compile a project work

5)	This program on cable size selection should be stored properly and maintained as necessary so as to obtain desired result any time it is used

6)	The institution of Electrical engineers should be informed of this program as it may  lead to more international recognition of the university efforts at programming.

7)	The idea of introducing post graduates diploma in maths and computer science is

a	very laudable thought as it bring computer literacy to the door step of professionals.

# REFERENCES

1) B.L and A.K Theraja (1999) Electrical Technology, S. Chand & Company Ltd. New Delhi, Edition

2) Microsoft Co-operation, 1985, Microsoft GW Basic Users guide, Technology Research Co limited Hong Kong

3) IEE Wiring regulation, 1992, Regulation for Electrical installation BS 7671, A. MC Lay and Co Ltd, Cardiff, 16th Edition,

4) RCIM (1996) Computer Maintenance Course Manual, Regional Centre for Micro information Maintenance, Lagos

5) Adediran and Kukoyi, 1995 Fundamentals of Electrical Circuits, FUT, Minna.

6) Prince Badmus (1997), Introduction to Computer System Lecture notes, FUT Minna.

7) Israel O, (1997) Algorithms, Lecture notes, FUT Minna

8) Kola Raimi (1998) Computer Programming made easy, Lecture note, FUT Minna.

APPENDIX 1
TABLE 4H3A
FLEXIBLE cords
BS 6141
BS 6500
COPPER CONDUCTORS
CURRENT CARRYING CAPACITY(AMPERES): and MASS SUPPORTABLE:

| Conductor Cross-sectional area | CURRENT CARRYING CAPACITY | | Max. mass supportable by twin flexible cord (see reg 522-08-06) |
|---|---|---|---|
| | 1-Phase a.c | 3-Phase a.c | |
| 1 | 2 | 3 | |
| mm sq | A | A | kg |
| 0.5 | 3 | 3 | 2 |
| 0.75 | 6 | 6 | 3 |
| 1 | 10 | 10 | 5 |
| 1.25 | 13 | -- | 5 |
| 1.5 | 16 | 16 | 5 |
| 2.5 | 25 | 20 | 5 |
| 4 | 32 | 25 | 5 |

Non Reel
CORRECTION FACTORS FOR AMBIENT TEMPERATURES

60 deg. c rubber and pvc cords:

| Ambient temp. (degree C) | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|
| Correction factor | 0.91 | 0.82 | 0.71 | 0.58 | 0.41 |

85 deg.rubber cords having a h.o.f.r sheath or a heat-resisting pvc sheath and for 85 deg.C heat resisting cords:

| Ambient temp. (deg.C) | 35-50 | 55 | 60 | 65 | 70 |
|---|---|---|---|---|---|
| Correction factor | 1.0 | 0.96 | 0.83 | 0.67 | 0.47 |

150 deg. C rubber cords:

| Ambient temp. (deg.C) | 35-120 | 125 | 130 | 135 | 140 | 145 |
|---|---|---|---|---|---|---|
| Correction factor | 1.0 | 0.96 | 0.85 | 0.74 | 0.60 | 0.42 |

Glass fibre cords:

| Ambient temp. (deg.C) | 35-150 | 155 | 160 | 165 | 170 | 175 |
|---|---|---|---|---|---|---|
| Correction factor | 1.0 | 0.92 | 0.82 | 0.71 | 0.57 | 0.40 |

## TABLE 4H3B

VOLTAGE DROP (per ampere per meter):    Conductor operating
temperature: 60 deg C

| Conductor cross sectional area | d.c or single phase a.c | Three-phase a.c |
|---|---|---|
| 1 | 2 | 3 |
| mm² | mV | mV |
| 0.5 | 93 | 80 |
| 0.75 | 62 | 54 |
| 1 | 46 | 40 |
| 1.25 | 37 | — |
| 1.5 | 32 | 27 |
| 2.5 | 19 | 16 |
| 4 | 12 | 10 |

NOTE: The tabulated values above are for 60 deg. C rubber-insulated
and p.v.c insulated flexible cords and for other types of flexible
cords they are to be multiplied by the following factors:

For 85 deg. C rubber or p.v.c-insulated        1.09

    150 deg.C rubber-insulated                 1.31

    185 deg.C glass fibre                       1.43

# FLOW CHART ON FLEX-CABLE
# SIZE SELECTION

START

DISPLAY PROGRAM
FOR IG CABLE TYPES
AND VALID TEMPS.

INPUT WIRING
DENSITY, VOLTAGE
DROP, MOTOR KW,
CURRENT, CABLE
TYPE, PHASES etc.

COMPUTE CURRENT
VALUE ID

C

DISPLAY
INVALID IT

DISPLAY
INVALID
CABLE TYPE

B

D

IS
C·IZ<=ID

PRINT
INVALID
IZ

DISPLAY
INVALID
TEMP.

E

A

# APPENDIX 3.1

```
        (E)
         │
         ▼
      ╱ IS ╲
     ╱ CABLE ╲      NO      ┌─────────────┐
    ╱ TYPE B/W ╲ ────────►  │   PRINT     │ ──────► (E)
    ╲ '1'AND'5' ╱           │  INVALID C  │
     ╲       ╱              └─────────────┘
      ╲     ╱
       │ YES
       ▼
```

```
   ╱ IS ╲         ╱ IS ╲          ╱ IS ╲          ╱ IS ╲
  ╱ CABLE ╲  NO  ╱ CABLE ╲  NO   ╱ CABLE ╲  NO   ╱ CABLE ╲   NO
 ╱  TYPE   ╲───►╱  TYPE   ╲───► ╱  TYPE   ╲───► ╱  TYPE   ╲ ───► (B)
 ╲ C1 ORC2 ╱    ╲   C3    ╱     ╲   C4    ╱     ╲   C5    ╱
  ╲       ╱      ╲       ╱       ╲       ╱       ╲       ╱
   │ YES            │ YES           │ YES            │ YES
   ▼                ▼               ▼                ▼
```

```
  ╱ IS ╲  NO       ╱ IS ╲  NO        ╱ IS ╲                ╱ IS ╲   YES
 ╱ <55 ╲ ──► (A)  ╱0<T<50╲ ──► (A)  ╱0<T<=145╲ ──► (A)    ╱0<T<=175╲ ──► (A)
 ╲     ╱          ╲      ╱          ╲        ╱            ╲        ╱
  ╲   ╱            ╲    ╱            ╲      ╱              ╲      ╱
   │ YES            │ YES            │                     │ YES
   ▼            (F)─┘ YES       (F)─ YES                (F)─┘
```

# APPENDIX 3.2

```
                            ( F )
                              |
                              v
                      +---------------+
                      |   DISPLAY     |
                      |     I Z       |
                      +---------------+
                              |
                             YES
                              |
                              v
                             / \
                            /   \
                           / IS  \
  +------------+    YES    / PHASE \    NO    +------------+
  | GOSUB 2500 |<---------| TYPE 1  |-------->| GOSUB 3500 |
  | COMPUTE VDROP|         \       /          | COMPUTE VDROP|
  | VD2 FOR 1PH |          \     /            | VD1 FOR3PHASE|
  +------------+            \   /             +------------+
        |                    \ /                     |
        |                                            |
        |              +----------------+            |
        +------------->| COMPUTE VOLTAGE |<-----------+
                       | DROP FOR SPECIFIC|
                       |   CABLE TYPE    |
                       +----------------+
                              |
                              v
                     +--------------------+
                     | COMPUTE CORRECTION |
                     | FACTOR (X),NEW CABLE|
                     | CURRENT RATING (IT),|        ( G )
                     | MAX.CABLE LENGTH   |-------->
                     | ALLOWABLE (N),MIN. |
                     | MASS SUPPORTABLE M,|
                     | TOLERABLE FUSE RATING|
                     +--------------------+
```

# APPENDIX 3.3

```
                    ( G )
                      |
                      v
                     / \
                    / IS \
              <   0<IT<=32   >  --YES-->  ( D )
                    \   /
                     \ /
                      |
                      v
                     |NO

   +--------------------------------------+
   | PRINT MAX. ACCEPTABLE CABLE          |
   | LENGTH(M),MIN. CABLE SIZE(P)         |
   | MAX. WEIGHT SUPPORTABLE BY THE       |
   |                                      |
   |                                      |
   |                                      |
   +--------------------------------------+
                      |
                      v
                  (        )
                  (  STOP  )
                  (        )
```

```
REM
10
CLS
REM PROGRAM ON CABLE SIZE SELECTION
LOCATE 9, 20: COLOR 4, 8, 9
PRINT "  Program on flexible cable (cords) size selection  by ojiogo
I.I"
SLEEP 3
CLS
REM           DISPLAY   CABLE TYPES UNDER CONSIDERATION
COLOR 15, 2, 5: PRINT : PRINT : PRINT : PRINT
PRINT "Cable  Types"; TAB(62); "Number"
PRINT "60 deg c rubber-insulated Bs6141"; TAB(65); "1"
PRINT "PVC insulated flexible-cords bs6500"; TAB(65); "2"
PRINT "85 deg c rubber or PVC insulated"; TAB(65); "3"
PRINT "150 deg c rubber or PVC insulated"; TAB(65); "4"
PRINT "185 deg c glass fibre"; TAB(65); "5": PRINT : PRINT
COLOR 14, 4
PRINT " ALL THE ABOVE ARE FLEXIBLE CORD TYPES"
INPUT "select any of the above numbers appropriate to your cable type";
C$
IF C$ < "1" OR C$ > "5" THEN BEEP: CLS : GOTO 10 ELSE
IF C$ <> "1" AND C$ <> "2" AND C$ <> "3" AND C$ <> "4" AND C$ <> "5"
THEN BEEP: GOTO 10 ELSE
15    CLS
GOTO 16
16    COLOR 5, 7, 8
PRINT "ACCEPTABLE TEMPERATURE RANGES  FOR  THIS PROGRAM ARE IN
ACCORDANCE WITH "
COLOR 5, 7, 8
PRINT "              TABLE 4H3A 16TH EDITION OF IEE REGULATION AS FOLLOWS"
COLOR 6, 7, 8: CLS : PRINT : PRINT : PRINT
PRINT TAB(0); "CABLE TYPE"; TAB(25); "CURRENT RATING(AMPS)"; TAB(60); "
TEMP RANGE"
PRINT TAB(60); "(IN DEG CENT)"
COLOR 5, 7, 8
PRINT TAB(0); "(1)60 deg c insulated"
PRINT TAB(0); "flexible cable BS6141 "; TAB(30); "0<I<=32 "; TAB(60); "0
< T <= 55 ":
PRINT TAB(0); "(2)PVC insulated flexible"
PRINT TAB(0); "cord BS6500"; TAB(30); "0<I<=32 "; TAB(60); "0 < T < =
55": PRINT
PRINT TAB(0); "(3)85 deg. cent. insulated"
PRINT TAB(0); "flexible cord"; TAB(30); "0<I<=32 "; TAB(60); "0 < T < =
70": PRINT
PRINT TAB(0); "(4)150 deg. cent. PVC "
PRINT TAB(0); "or rubber cords insulation"; TAB(30); "0<I<=32 ";
TAB(60); "0 < T < = 145": PRINT
PRINT TAB(0); "(5)185 deg. cent. glass"
PRINT TAB(0); "fibre insulated"; TAB(30); "0<I<=32 "; TAB(60); "0 < T <
= 175": PRINT
LOCATE 23, 10: COLOR 15, 2, 5
```

```
INPUT "working (ambient) temperature of cable"; t
IF C$ = "1" OR C$ = "2" THEN
'Test for temperature
IF t < 0 OR t > 55 THEN
BEEP: CLS : GOTO 210
ELSE
CLS : GOTO 24
END IF
END IF

IF C$ = "3" THEN
'Test for temperature
IF t < 0 OR t > 70 THEN
BEEP: CLS : GOTO 335

ELSE
CLS : GOTO 24
END IF

END IF
IF C$ = "4" THEN
'Test for temperature
IF t < 0 OR t > 145 THEN
BEEP: CLS : GOTO 410

ELSE
CLS : GOTO 24
END IF
END IF

IF C$ = "5" THEN
'Test for temperature
IF t < 0 OR t > 175 THEN
BEEP: CLS : GOTO 710

ELSE
CLS : GOTO 24
END IF
END IF

CLS
LOCATE 10, 20: COLOR 4, 15, 2
24 LOCATE 10, 20: COLOR 1, 2: PRINT "A....ANTICIPATED LOAD IN WATTS
INCIDENT ON THE FLEXIBLE CORD"
LOCATE 12, 30: COLOR 2, 8: PRINT "B.....EXPECTED CONDUCTOR DESIGN
CURRENT IN AMPS "
LOCATE 15, 20: COLOR 8, 2: INPUT "KEY IN EITHER (A) OR (B) AS
APPLICABLE"; z$
```

```
CLS
IF z$ = " " THEN 15 ELSE 20
20   IF z$ = "A" OR z$ = "a" THEN 30
IF z$ = "B" OR z$ = "b" THEN 35
30    LOCATE 15, 18: COLOR 13, 6, 5
INPUT " A....  enter the load in watts incident on the cable "; wt
 LOCATE 17, 20: COLOR 13, 6, 4
INPUT "Enter the cable input voltage "; V
LOCATE 19, 20: COLOR 12, 6, 4
31    INPUT "enter power factor(pf)      { o< pf<=1 } "; q
IF q <= 0 OR q > 1 THEN
CLS : BEEP: LPRINT "POWER FACTOR OUT OF RANGE":
SLEEP 2: CLS :    GOTO 31
ELSE
CLS
GOTO 45
END IF
CLS
35   LOCATE 13, 20: COLOR 15, 2, 5
INPUT " Enter conductor design current in ampere"; iz
IF iz <= 0 OR iz > 32 THEN 40
LOCATE 14, 20: COLOR 14, 3, 4
36   INPUT "enter conductor design voltage  in volts"; V: CLS : GOTO 50
40 BEEP: CLS : PRINT "CURRENT INPUT OUT OF RANGE ( 0 < I <= 32) "; iz:
BEEP: SLEEP 2: GOTO 35
45 CLS
LOCATE 14, 18: COLOR 12, 6
INPUT "enter (y) for 3 phase or (n) for single phase "; CH$
CLS
IF V < 0 THEN PRINT "UNREASONABLE VOLTAGE VALUE"; V: CLS : GOTO 36

IF CH$ = "y" OR CH$ = "Y" THEN iz = wt / (3 * V * q): GOTO 47
iz = wt / V
IF iz <= 0 OR iz > 32 THEN
BEEP: CLS
PRINT "Current Out Of Range ( 0 < I <= 32) "; iz: SLEEP 2: CLS : GOTO 35
ELSEIF iz > 0 OR iz <= 32 THEN
CLS
47     LOCATE 5, 30: COLOR 14, 6
50   PRINT "NOTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED
ACCORDING TO YOUR INPUT  VALUES ="; iz; "AMPS"
END IF
INPUT "Did you make any mistake in your input values (PARAMETERS)( Y/N)
"; J$
' L$ = J$
IF J$ = "Y" OR "L$" = "y" THEN
GOTO 10
CLS
END IF
```

```
CLS
IF iz > 32 THEN

LOCATE 10, 40: COLOR 4, 8, 1: PRINT "this current"; iz; " AMPS  is too
high ":
PRINT " for  flexible cords "
INPUT "DO YOU WANT TO CONTINUE ( Y/N) "; P$
IF P$ = "Y" OR P$ = "y" THEN GOTO 10
IF P$ = "n" OR P$ = "N" THEN GOTO 1000
END IF
IF C$ = "1" OR C$ = "2" THEN GOTO 200 ELSE IF C$ = "3" THEN GOTO 330
ELSE IF C$ = "4" THEN GOTO 400 ELSE IF C$ = "5" THEN GOTO 700

200 IF t < 0 OR t > 55 THEN
210 LOCATE 8, 40: COLOR 4, 8, 15
PRINT "This temperature"; t; "DEG CENTIGRADE is too inapropriate for":
PRINT "  flexible cords"
310  INPUT "Do you want to continue(Y/N) "; Y$
CLS
IF Y$ = "y" OR Y$ = "Y" THEN GOTO 10
IF Y$ = "n" OR Y$ = "N" THEN GOTO 1000
END IF
IF C$ <> "1" OR C$ <> "2" THEN
IF C$ = "1" OR C$ = "2" AND t >= 0 AND t <= 55 THEN GOTO 320
320 IF t <= 35 AND t >= 0 THEN x = 1 ELSE
IF t > 35 AND t <= 40 THEN x = .9 - (((40 - t) * .09) / 5) ELSE
IF t > 40 AND t <= 45 THEN x = .82 - (((45 - t) * .11) / 5) ELSE
IF t > 45 AND t <= 50 THEN x = .071 - (((50 - t) * .13) / 5) ELSE
IF t > 50 AND t <= 55 THEN x = .58 - (((55 - t) * .17) / 5) ELSE
GOTO 1500
END IF
330
REM correction factor for 85 deg centigrade rubber cords
IF C$ <> "3" GOTO 500
IF t < 0 OR t > 70 AND C$ = "3" THEN
335   LOCATE 8, 5: COLOR 5, 9
PRINT "This temperature"; t; "DEG CENT is inappropriate"; :
PRINT " for flexible cord number"; "3"

INPUT "DO YOU WANT TO CONTINUE(Y/N)"; q$
GOTO 419
END IF
IF C$ = "3" AND t >= 0 AND t <= 70 THEN GOTO 340
340 IF t >= 0 AND t <= 50 THEN x = 1 ELSE
IF t > 50 AND t <= 55 THEN x = .96 ELSE
IF t > 55 AND t <= 60 THEN x = .83 ELSE
IF t > 60 AND t <= 65 THEN x = .67 ELSE
IF t > 65 AND t <= 70 THEN x = .47 ELSE

IF t > 70 AND C$ = "3" THEN
LOCATE 8, 40: COLOR 5, 9, 10
PRINT "This temperature"; t; "DEG CENT  is too high for 85 deg
centigrade":
```

```
PRINT "rubber cords having H.O.F.R sheath or a heat resisting Pvc
sheath"
PRINT " and for 85 deg centegrade heat-resisting Pvc cords"

INPUT "Do you want to continue (y/n)"; q$
END IF
CLS
419    IF q$ = "y" OR q$ = "Y" THEN GOTO 15
IF q$ = "n" OR q$ = "N" THEN GOTO 1000
' END IF
REM correction factor for 150 deg centigrade rubber cord
500 IF C$ = "4" THEN
GOTO 400
END IF
400 IF t < 0 AND t > 145 AND C$ = "4" THEN
410    LOCATE 8, 40: COLOR 5, 9, 10
PRINT "This temperature is inappropriate for 150 centigrade rubber
cords"; t; " cent"
INPUT "DO YOU WANT TO CONTINUE (y\n)  "; q$
GOTO 419

END IF
IF C$ <> "4" THEN 700
IF t >= 0 AND t <= 120 THEN
x = 1
END IF
IF t > 120 AND t <= 125 THEN
x = .96
END IF
IF t > 125 AND t < 130 THEN
x = .85
END IF
IF t > 130 AND t <= 135 THEN
x = .74
END IF
IF t > 135 AND t < 140 THEN
x = .6
END IF
IF t > 140 AND t <= 145 THEN
x = .42
END IF
IF t > 145 AND C$ = "4" THEN
LOCATE 12, 44: COLOR 4, 8, 15
PRINT "This temperature is too high for 150 deg centigrade rubber
cords"; t; " deg Cent "
INPUT "DO YOU WANT TO CONTINUE "; q$
GOTO 419
END IF
IF C$ = "5" THEN
700    IF C$ = "5" AND t < 0 OR t > 175 THEN
710      LOCATE 12, 40: COLOR 4, 8, 14
PRINT "THIS TEMPERATURE IS INAPROPRIATE FOR GLASS FIBRE CORDS"; t
INPUT "DO YOU WANT TO CONTINUE"; q$
```

```
GOTO 419
END IF
END IF
CLS
'IF c$ <> "5" THEN 1005
IF C$ = "5" AND t >= 0 AND t <= 150 THEN
x = 1
END IF
IF t >= 150 AND t <= 155 THEN
x = .95
END IF
IF t > 155 AND t <= 160 THEN
x = .82
END IF
IF t > 165 AND t <= 170 THEN
x = .57
END IF
IF t > 170 AND t <= 175 THEN
  x = .4
END IF
IF t > 175 AND C$ = "5" THEN
LOCATE 8, 40: COLOR 4, 8, 15
PRINT "THIS TEMPERATURE IS TOO HIGH FOR GLASS FIBRE CORDS "
INPUT "do you want to continue (y/n)"; q$
GOTO 419
END IF
IF x = 0 THEN
PRINT "THIS VALUE OF CORRECTION FACTOR IS  UNACCEPTABLE"
INPUT "DO YOU WANT TO CONTINUE    ( Y/N)  "; q$
GOTO 419
END IF
1500
it = iz / x
1005 IF it <= 0 OR it > 32 THEN
PRINT " THIS VALUE OF CURRENT OBTAINED AFTER CORRECTION FACTOR
APPLICATION"; it; "AMPS"; "IS UNACCEPTABLE"
GOTO 660
END IF
IF it > 32 AND VD1 = 0 THEN
660 LOCATE 10, 5: COLOR 4, 8, 1: PRINT "This current"; it; "AMPS"; "is
too high for flexible cords "
INPUT "DO YOU WANT TO CONTINUE ( Y/N) "; P$
IF P$ = "Y" OR P$ = "y" THEN GOTO 10
IF P$ = "n" OR P$ = "N" THEN GOTO 1000
END IF
CLS
IF CH$ = "y" OR CH$ = "Y" THEN
GOSUB 3500
END IF
IF CH$ <> "y" OR CH$ <> "Y" THEN
GOSUB 2500
END IF
```

```
IF VD = 0 THEN 926
IF C$ = "1" OR C$ = "2" THEN VD1 = VD ELSE
IF C$ = "3" THEN VD1 = 1.09 * VD ELSE
IF C$ = " 4" THEN VD1 = 1.31 * VD ELSE
VD1 = 1.43 * VD:
LOCATE 7, 3:     COLOR 7, 2
PRINT "Permissible Voltage Drop On This(flex cord) Cable Of Current";
it; "AMPS"; "="; VD1; " Millivolts"
PRINT "VD="; VD1
IF V <= 0 THEN
LOCATE 2, 21
PRINT "THIS VALUE OF VOLTAGE"; V; "VOLTS IS UNACCEPTABLE"

GOTO 310
END IF
911    K = .04 * V * 1000 / it
IF VD1 <> 0 THEN 921
IF VD1 = 0 THEN
926      PRINT " THIS VALUE OF CURRENT OBTAINED AFTER CORRECTION FACTOR
APPLICATION IS OUT OF RANGE"; it
INPUT "do you want to continue (Y/N)"; q$
GOTO 419
END IF
921    M = K / VD1

LOCATE 10, 13: COLOR 15, 2, 1
PRINT "THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER "; C$; "="; M *
1.33; "Meters"
LOCATE 10, 21: COLOR 15, 2, 1
PRINT "IF CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN"
LOCATE 12, 17: COLOR 14, 2, 4
PRINT "OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER "; C$; "="; M;
"Meters"; "IF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE
DESIGN"
IF CH$ = "Y" OR CH$ = "y" THEN 925
925    IF it <= 3 THEN
P = .5
ELSEIF it <= 6 AND it > 3 THEN
P = .75
ELSEIF it > 6 AND it <= 10 THEN

P = 1
ELSEIF it > 10 AND it <= 16 THEN
P = 1.5

ELSEIF it > 16 AND it <= 20 THEN
P = 2.5
ELSEIF it > 20 AND it <= 25 THEN
P = 4
END IF

IF CH$ = "N" OR CH$ = "n" THEN 950
```

```
950 IF it <= 3 THEN
P = .5
ELSEIF it > 3 AND it <= 6 THEN
P = .75
ELSEIF it > 6 AND it <= 10 THEN
P = 1
ELSEIF it > 10 AND it <= 13 THEN
P = 1.25

ELSEIF it > 13 AND it <= 16 THEN
P = 1.5

ELSEIF it > 16 AND it <= 25 THEN
P = 2.5
ELSEIF it > 25 AND it <= 32 THEN
P = 4
END IF
IF P < .5 OR P > 4 THEN
PRINT "THIS RANGE OF CABLE SIZE IS NOT COVERED BY THIS  PROGRAM"
INPUT "do you want to contue"; q$
 GOTO 419
END IF
LOCATE 16, 11: COLOR 2, 9
PRINT "THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  "; C$; "
IS"; P; "MM^2"
LOCATE 19, 5: COLOR 4, 8
PRINT "The fuse rating must not be less than"; it; "AMPS"; " within next
availble value"
IF it > 32 THEN
' AND
IF CH$ = "N" OR CH$ = "n" THEN
PRINT "THIS CURRENT IS TOO MUCH FOR SINGLE PHASE  FLEXIBLE CORDS"; it
INPUT "DO YOU WANT TO CONTINUE"; q$
GOTO 419
END IF
END IF
IF CH$ <> "y" OR CH$ <> "Y" THEN 901
IF it > 25 THEN
LOCATE 10, 30: COLOR 15, 2, 1
PRINT "THIS CURRENT IS TOO HIGH IN THREE-PHASE    FLEXIBLE CORDS "
GOTO 419
INPUT "do you want to continue"; q$
END IF
901   M$ = "MAXIMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO
IEE· REG(522-08-06) 16TH EDITION"
IF P = .5 THEN K$ = M$ + "= 2KG"
IF P = .75 THEN K$ = M$ + "=3KG"
IF P >= 1 AND P <= 4 THEN K$ = M$ + "=5KG"
LOCATE 20, 5: COLOR 15, 2
PRINT K$
PRINT : PRINT
COLOR 15, 2
PRINT "THIS CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING":
```

```
PRINT "TO TABLE 4H3A AND B        IEE 16TH EDITION"
1000      END
2500 IF it > 0 AND it <= 3 THEN VD = 93 ELSE
IF it > 3 AND it <= 6 THEN VD = 62 ELSE
IF it > 6 AND it <= 10 THEN VD = 46 ELSE
IF it > 10 AND it <= 13 THEN VD = 37 ELSE
IF it > 13 AND it <= 16 THEN VD = 32 ELSE
IF it > 16 AND it <= 25 THEN VD = 19 ELSE
IF it > 25 AND it <= 32 THEN VD = 1 ELSE
IF it > 32 THEN VD = 0
RETURN
3500
IF it > 0 AND it <= 3 THEN VD = 80
IF it > 3 AND it <= 6 THEN VD = 54
IF it > 6 AND it <= 10 THEN VD = 40
IF it > 10 AND it <= 16 THEN VD = 27
IF it > 16 AND it <= 20 THEN VD = 16
IF it > 20 AND it <= 25 THEN VD = 10
IF it <= 0 OR it > 25 THEN VD = 0
RETURN
```

Program on flexible cable (cords) size selection  by ojiogo I.I

| Cable   Types | Number |
|---|---|
| 60 deg c rubber-insulated Bs6141 | 1 |
| PVC insulated flexible-cords bs6500 | 2 |
| 85 deg c rubber or PVC insulated | 3 |
| 150 deg c rubber or PVC insulated | 4 |
| 185 deg c glass fibre | 5 |

ALL THE ABOVE ARE FLEXIBLE CORD TYPES
elect any of the above numbers appropriate to your cable type? 1

| LE TYPE | CURRENT RATING(AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| 0 deg c insulated ible cable BS6141 | 0<I<=32 | 0 < T <= 55 |
| PVC insulated flexible BS6500 | 0<I<=32 | 0 < T < = 55 |
| 5 deg. cent. insulated ible cord | 0<I<=32 | 0 < T < = 70 |
| 50 deg. cent. PVC ubber cords insulation | 0<I<=32 | 0 < T < = 145 |
| 85 deg. cent. glass e insulated | 0<I<=32 | 0 < T < = 175 |

working (ambient) temperature of cable? 40

A....ANTICIPATED LOAD IN WATTS INCIDENT ON THE FLEXIBLE

B.....EXPECTED CONDUCTOR DESIGN CURRENT IN AN

APPENDIX 5.1
COMPUTER PRINT OUT



A....   enter the load in watts incident on the cable ? 1(

   Enter the cable input voltage ? 240

   enter power factor(pf)    ( o( pf(=1 ) ? .8




      enter (y) for 3 phase or (n) for single phase ? Y




E THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
LUES = 1.736111 AMPS
 you make any mistake in your input values (PARAMETERS)( Y/N) ? N



ermissible Voltage Drop On This(flex cord) Cable Of Current 1.929012 AI
2.99   Millivolts
 132.99
         THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 1= 49.77015 Met(
LOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
         OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 1= 37.4;
rsIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN


      THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  1   IS .5 M


 he fuse rating must not be less than 1.929012 AMPS
 hin next availble value
 MUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-
  EDITION= 2KG

APPENDIX 5.2
COMPUTER PRINT OUT


| Cable Types | Number |
|---|---|
| 60 deg c rubber-insulated Bs6141 | 1 |
| PVC insulated flexible-cords bs6500 | 2 |
| 85 deg c rubber or PVC insulated | 3 |
| 150 deg c rubber or PVC insulated | 4 |
| 185 deg c glass fibre | 5 |


ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 2


| CABLE TYPE | CURRENT RATING (AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| 1)60 deg c insulated flexible cable BS6141 | 0<I<=32 | 0 < T <= 55 |
| 2)PVC insulated flexible cord BS6500 | 0<I<=32 | 0 < T < = 55 |
| )85 deg. cent. insulated flexible cord | 0<I<=32 | 0 < T < = 70 |
| )150 deg. cent. PVC rubber cords insulation | 0<I<=32 | 0 < T < = 145 |
| )185 deg. cent. glass bre insulated | 0<I<=32 | 0 < T < = 175 |


working (ambient) temperature of cable? 35


A....ANTICIPATED LOAD IN WATTS INCIDENT ON THE FLEXIBLE

B.....EXPECTED CONDUCTOR DESIGN CURRENT IN AMP


KEY IN EITHER (A) OR (B) AS APPLICABLE? B


Enter conductor design current in ampere? 20
THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR I
UES = 20 AMPS
you make any mistake in your input values (PARAMETERS)( Y/N) ?

NOTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR ]
  VALUES = 20 AMPS
Did you make any mistake in your input values (PARAMETERS)( Y/N) ? N

  Permissible Voltage Drop On This(flex cord) Cable Of Current 20 AMPS= 27.
  Millivolts
VD= 27.17
               THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 2= 2.349651 Meter
F CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
               OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 2= 1.7666
etersIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN

          THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  2   IS 2.5 MM

   The fuse rating must not be less than 20 AMPS within next availble valu

XIMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-08
H EDITION=5KG

S CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
 TABLE 4H3A AND B        IEE 16TH EDITION

ss any key to continue

| Cable  Types | Number |
|---|---|
| 60 deg c rubber-insulated Bs6141 | 1 |
| PVC insulated flexible-cords bs6500 | 2 |
| 85 deg c rubber or PVC insulated | 3 |
| 150 deg c rubber or PVC insulated | 4 |
| 185 deg c glass fibre | 5 |

ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 3

WORKING (AMBIENT) TEMPERATURE OF CABLE 45

A.... enter the load in watts incident on the cable ? 3460

Enter the cable input voltage ? 110

enter power factor(pf)    ( o( pf(=1 ) ? .9

enter (y) for 3 phase or (n) for single phase ? n

THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR INF
UES = 31.45455 AMPS
you make any mistake in your input values (PARAMETERS)( Y/N) ? n

rmissible Voltage Drop On This(flex cord) Cable Of Current 31.45455 AMPS=
Millivolts
.43

THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 3= 130.1023 Meters
OSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 3= 97.8212E
sIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN

THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  3  IS 4 MM^2

he fuse rating must not be less than 31.45455 AMPS
in next availble value
UM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-08-0
EDITION=5KG

CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
LE 4H3A AND B        IEE 16TH EDITION

any key to continue

| Cable  Types | Number |
|---|---|
| 60 deg c rubber-insulated Bs6141 | 1 |
| PVC insulated flexible-cords bs6500 | 2 |
| 85 deg c rubber or PVC insulated | 3 |
| 150 deg c rubber or PVC insulated | 4 |
| 185 deg c glass fibre | 5 |

ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 4

| CABLE TYPE | CURRENT RATING(AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| (1)60 deg c insulated flexible cable BS6141 | $0 < I <= 32$ | $0 < T <= 55$ |
| (2)PVC insulated flexible cord BS6500 | $0 < I <= 32$ | $0 < T < = 55$ |
| (3)85 deg. cent. insulated flexible cord | $0 < I <= 32$ | $0 < T < = 70$ |
| (4)150 deg. cent. PVC or rubber cords insulation | $0 < I <= 32$ | $0 < T < = 145$ |
| (5)185 deg. cent. glass fibre insulated | $0 < I <= 32$ | $0 < T < = 175$ |

working (ambient) temperature of cable? 120

A.....ANTICIPATED LOAD IN WATTS INCIDENT ON THE FLEXIBLE

B.....EXPECTED CONDUCTOR DESIGN CURRENT IN AM

KEY IN EITHER (A) OR (B) AS APPLICABLE? a

Permissible Voltage Drop On This(flex cord) Cable Of Current 10 AMPS= 65
illivolts
= 65.70

THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 4= 8.087565E-02
CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 4=
000876E-02 Meters
COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN

THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  4  IS 1 MM

The fuse rating must not be less than 10 AMPS within next availble val

IMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-
H EDITION=5KG

S CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
IEE 16TH EDITION

APPENDIX 5.5
COMPUTER PRINT OUT


Cable  Types                                                       Number
60 deg c rubber-insulated Bs6141                                     1
PVC insulated flexible-cords bs6500                                  2
85 deg c rubber or PVC insulated                                    3
150 deg c rubber or PVC insulated                                   4
185 deg c glass fibre                                               5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 5

            A....   enter the load in watts incident on the cable ? 

          Enter the cable input voltage ? 415

          enter power factor(pf)     ( o( pf(=1 ) ? .8




          enter (y) for 3 phase or (n) for single phase ? Y




OTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
VALUES = 5.052000 AMPS
id you make any mistake in your input values (PARAMETERS)( Y/N) ? N




Permissible Voltage Drop On This(flex cord) Cable Of Current 5.284295 AM
3.66  Millivolts
= 88.66
            THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 5= 47.12431 Met
 CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
            OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 5= 35.4
ersIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN


          THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  5   IS .75 M


  The fuse rating must not be less than 5.284295 AMPS
thin next availble value
IMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-0
H EDITION=3KG


 S CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
TABLE 4H3A AND B       IEE 16TH EDITION

Cable   Types                                                          Number
60 deg c rubber-insulated Bs6141                                          1
PVC insulated flexible-cords bs6500                                       2
85 deg c rubber or PVC insulated                                         3
150 deg c rubber or PVC insulated                                        4
185 deg c glass fibre                                                    5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 1




ABLE TYPE                     CURRENT RATING(AMPS)                TEMP RANGE
                                                                 (IN DEG CENT)
1)60 deg c insulated
lexible cable BS6141          0(I(=32                             0 ( T (= 55
2)PVC insulated flexible
ord BS6500                    0(I(=32                             0 ( T ( = 55

3)85 deg. cent. insulated
lexible cord                  0(I(=32                             0 ( T ( = 70

)150 deg. cent. PVC
 rubber cords insulation      0(I(=32                             0 ( T ( = 145

)185 deg. cent. glass
bre insulated                 0(I(=32                             0 ( T ( = 175



        working (ambient) temperature of cable? 30




                Enter conductor design current in ampere? 30
                enter conductor design voltage   in volts? 415




TE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
LUES = 30 AMPS
 you make any mistake in your input values (PARAMETERS)( Y/N) ? n

Permissible Voltage Drop On This(flex cord) Cable Of Current 30 AMPS= 1.
Millivolts
VD= 1.43
              THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 1= 514.6387 Mete
IF CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
              OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 1= 386.9
MetersIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN


         THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  1  IS 4 MM^


    The fuse rating must not be less than 30 AMPS within next availble val

MAXIMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-0
6TH EDITION=5KG


THIS CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
TO TABLE 4H3A AND B        IEE 16TH EDITION

ress any key to continue

Cable  Types                                                  Number
60 deg c rubber-insulated Bs6141                                1
PVC insulated flexible-cords bs6500                             2
85 deg c rubber or PVC insulated                               3
150 deg c rubber or PVC insulated                              4
185 deg c glass fibre                                          5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 2




        A....   enter the load in watts incident on the cable ? 80

          Enter the cable input voltage ? 24

          enter power factor(pf)      ( o( pf(=1 ) ? .4


        enter (y) for 3 phase or (n) for single phase ? n




        A....   enter the load in watts incident on the cable ? 80

          Enter the cable input voltage ? 24

          enter power factor(pf)      ( o( pf(=1 ) ? .4


ent Out Of Range ( 0 ( I (= 32)   333.3333


          enter (y) for 3 phase or (n) for single phase ? n




        Enter conductor design current in ampere?

Press any key to continue

Cable  Types                                                      Number
60 deg c rubber-insulated Bs6141                                     1
PVC insulated flexible-cords bs6500                                  2
85 deg c rubber or PVC insulated                                    3
150 deg c rubber or PVC insulated                                   4
185 deg c glass fibre                                               5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 3




               Enter conductor design current in ampere? 20
               enter conductor design voltage  in volts? 240




OTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
VALUES = 20 AMPS
id you make any mistake in your input values (PARAMETERS)( Y/N) ? n




Permissible Voltage Drop On This(flex cord) Cable Of Current 20 AMPS= 27
illivolts
= 27.17
               THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 3= 23.49651 Mete
 CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
               OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 3= 17.66
tersIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN


               THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  3  IS 2.5 M


 The fuse rating must not be less than 20 AMPS within next availble val

IMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-0
H EDITION=5KG


S CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
TABLE 4H3A AND B      IEE 16TH EDITION

APPENDIX 5.9
COMPUTER PRINT OUT


Cable   Types                                              Number
60 deg c rubber-insulated Bs6141                              1
PVC insulated flexible-cords bs6500                           2
85 deg c rubber or PVC insulated                             3
150 deg c rubber or PVC insulated                            4
185 deg c glass fibre                                        5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 4




                A....   enter the load in watts incident on the cable ?

              Enter the cable input voltage ? 415

              enter power factor(pf)      ( o< pf<=1 ) ? .6



              enter (y) for 3 phase or (n) for single phase ?

              enter (y) for 3 phase or (n) for single phase ? y



NOTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
VALUES = 12.04819 AMPS
id you make any mistake in your input values (PARAMETERS)( Y/N) ? n



Permissible Voltage Drop On This(flex cord) Cable Of Current 12.04819 AM
2.91  Millivolts
= 52.91
            THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 4= 34.6338 Meter
 CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
                OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 4= 26.04
erslF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN



            THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  4   IS 1.25



   The fuse rating must not be less than 12.04819 AMPS
thin next availble value
IMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-0
 EDITION=5KG

| Cable  Types | Number |
|---|---|
| 60 deg c rubber-insulated Bs6141 | 1 |
| PVC insulated flexible-cords bs6500 | 2 |
| 85 deg c rubber or PVC insulated | 3 |
| 150 deg c rubber or PVC insulated | 4 |
| 185 deg c glass fibre | 5 |

 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 5

                 Enter conductor design current in ampere? 25
             enter conductor design voltage  in volts? 240

NOTE THE CURRENT VALUE FOR WHICH THE DESIGN IS INTENDED ACCORDING TO YOUR
  VALUES = 25 AMPS
Did you make any mistake in your input values (PARAMETERS)( Y/N) ? n

 Permissible Voltage Drop On This(flex cord) Cable Of Current 25 AMPS= 2
Millivolts
D= 27.17
          THE MAXIMUM ACCEPTABLE LENGTH OF CABLE NUMBER 5= 18.7972 Mete
F CLOSE EXCESS CURRENT PROTECTION IS TO BE USED IN THE DESIGN
            OR THE MAXIMUM ACCEPTABLE LENGTH OF  CABLE NUMBER 5= 14.1
etersIF COARSE EXCESS CURRENT PROTECTION IS REQUIRED IN THE DESIGN

          THE MINIMUM RECOMMENDED CABLE SIZE FOR CABLE NUMBER  5  IS 2.5

    The fuse rating must not be less than 25 AMPS within next availble va

AXIMUM MASS SUPPORTABLE BY TWIN FLEXIBLE CORDS ACCORDING TO IEE REG(522-
TH EDITION=5KG

IS CABLE SIZE AND CABLE LENGTH CALCULATION IS ACCORDING
 TABLE 4H3A AND B       IEE 16TH EDITION

ress any key to continue

Cable  Types                                                    Number
60 deg c rubber-insulated Bs6141                                   1
PVC insulated flexible-cords bs6500                                2
85 deg c rubber or PVC insulated                                  3
150 deg c rubber or PVC insulated                                4
105 deg c glass fibre                                            5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 1


| CABLE TYPE | CURRENT RATING(AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| (1)60 deg c insulated flexible cable BS6141 | 0 < I <=32 | 0 < T <= 55 |
| (2)PVC insulated flexible ord BS6500 | 0 < I <=32 | 0 < T < = 55 |
| (3)85 deg. cent. insulated flexible cord | 0 < I <=32 | 0 < T < = 70 |
| (4)150 deg. cent. PVC or rubber cords insulation | 0 < I <=32 | 0 < T < = 145 |
| (5)105 deg. cent. glass ibre insulated | 0 < I <=32 | 0 < T < = 175 |


          working (ambient) temperature of cable? 60


                                  This temperature 60
  0 CENTIGRADE is too inappropriate for
  flexible cords
  you want to continue(Y/N) ? y



program on flexible cable (cords) size selection  by ojiogo I.I

Cable Types                                                      Number
60 deg c rubber—insulated Bs6141                                    1
PVC insulated flexible-cords bs6500                                 2
85 deg c rubber or PVC insulated                                   3
150 deg c rubber or PVC insulated                                  4
185 deg c glass fibre                                              5


ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 2


CABLE TYPE              CURRENT RATING(AMPS)              TEMP RANGE
                                                         (IN DEG CENT)

(1)60 deg c insulated
flexible cable BS6141      0<I<=32                        0 < T <= 55
(2)PVC insulated flexible
ord BS6500                  0<I<=32                       0 < T < = 55

(3)85 deg. cent. insulated
flexible cord               0<I<=32                       0 < T < = 70

(4)150 deg. cent. PVC
or rubber cords insulation  0<I<=32                       0 < T < = 145

(5)185 deg. cent. glass
fibre insulated             0<I<=32                       0 < T < = 175


            working (ambient) temperature of cable? 40

                  A....ANTICIPATED LOAD IN WATTS INCIDENT ON THE FLEXIBLE

                        B.....EXPECTED CONDUCTOR DESIGN CURRENT IN AM


                  KEY IN EITHER (A) OR (B) AS APPLICABLE? B


            Enter conductor design current in ampere? 45


RRENT INPUT OUT OF RANGE ( 0 < I (= 32)   45

Cable   Types                                                      Number
60 deg c rubber-insulated Bs6141                                      1
PVC insulated flexible-cords bs6500                                   2
85 deg c rubber or PVC insulated                                     3
150 deg c rubber or PVC insulated                                    4
185 deg c glass fibre                                                5


 ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 3


| CABLE TYPE | CURRENT RATING(AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| (1)60 deg c insulated flexible cable BS6141 | 0<I<=32 | 0 < T <= 55 |
| (2)PVC insulated flexible ord BS6500 | 0<I<=32 | 0 < T < = 55 |
| (3)85 deg. cent. insulated flexible cord | 0<I<=32 | 0 < T < = 70 |
| (4)150 deg. cent. PVC or rubber cords insulation | 0<I<=32 | 0 < T < = 145 |
| (5)185 deg. cent. glass fibre insulated | 0<I<=32 | 0 < T < = 175 |

                A....   enter the load in watts incident on the cable ? 3

                Enter the cable input voltage ? 240
        working (ambient) temperature of cable? 50
                enter power factor(pf)     ( o< pf<=1 ) ? 2



POWER FACTOR OUT OF RANGE



ter power factor(pf)      ( o< pf<=1 ) ?

Cable   Types                                                              Number
60 deg c rubber-insulated Bs6141                                              1
PVC insulated flexible-cords bs6500                                           2
85 deg c rubber or PVC insulated                                             3
150 deg c rubber or PVC insulated                                           4
185 deg c glass fibre                                                        5


ALL THE ABOVE ARE FLEXIBLE CORD TYPES
select any of the above numbers appropriate to your cable type? 4


| CABLE TYPE | CURRENT RATING(AMPS) | TEMP RANGE (IN DEG CENT) |
|---|---|---|
| (1)60 deg c insulated flexible cable BS6141 | 0<I<=32 | 0 < T <= 55 |
| (2)PVC insulated flexible cord BS6500 | 0<I<=32 | 0 < T < = 55 |
| (3)85 deg. cent. insulated flexible cord | 0<I<=32 | 0 < T < = 70 |
| (4)150 deg. cent. PVC or rubber cords insulation | 0<I<=32 | 0 < T < = 145 |
| (5)185 deg. cent. glass fibre insulated | 0<I<=32 | 0 < T < = 175 |


working (ambient) temperature of cable? 200


is temperature is inappropriate for 150 centigrade rubber cords 200
   YOU WANT TO CONTINUE (y\n)   ? Y

# APPENDIX 6
## COLOUR CODES

| COLOURS | CODES |
|---|---|
| BLACK | 0 |
| BLUE | 1 |
| GREEN | 2 |
| CYAN | 3 |
| RED | 4 |
| MAGENTA | 5 |
| BROWN | 6 |
| GRAY | 7 |
| DARK GRAY | 8 |
| LIGHT BLUE | 9 |
| LIGHT GREEN | 10 |
| LIGHT CYAN | 11 |
| LIGHT RED | 12 |
| LIGHT MAGENTA | 13 |
| YELLOW | 14 |
| WHITE | 15 |

NOTE: BLINKING COLOURS ARE 16 TO 31 STARTING SEQUENTIALLY FROM BLACK TO WHITE