NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

GRADUATION PROJECT

ELECTRICAL INSTALLATION DESIGN

EE400

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The root of this success lies under the most affectionate wish of my loving Father & Mother. I am grateful to them to assist me to grow in knowledge.

Iwould also like to thank all my friends for their help and for their patience, and special thanks to defense committee.

ABSTRACT

This project in its role, is trying to put the engineer in a proper position to make a fine decision, and after reading it, it is supposed to enable the reader to go through the design taking into consideration the international prevailing quality and types to be then, well installed and achieved.

Electrical installations are divided into high voltage and low voltage appliances, and each is containing in its role more categories. The high voltage sources like sockets, disconnected switches and power outlets for emergent· loads should be connected to other stand by sources, which is seen clearly in this project.

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INTRODUCTION

It's known that electricity is a substantial part of our lives that we can't live without, even for a short period, that's why one of electrical engineers most important task is to provide a constant supply of electricity for consumers, with high reliability and the least possible cost, while conserving energy.

In my project, I present some theoretical and practical aspects of an electrical study for a commercial centre, considering the design for electrical network that belongs to this kind of institutions.

Where we present some important aspects related essentially to the study of the interior lighting and evaluating the power for the expected loads in the commercial centre, the electrical boards and the mechanical contactor.

The chapters of the project are combined with each others to serve the idea of the concern being in touch with the renewable knowledge of electrical installation design works, especially for the critical building projects that as huge as complicated is, like regulations in a commercial centre.

The chapters are illustrated in term of systems categories in five chapters as follows:

Chapter One mainly is written down to give an idea about the illumination design, in this chapter, a fully detailed explanation is included, thus, new lighting products were more energy efficient. Also, we'll discuss in this chapter the AC sockets and its types, uses and applications .It's the Outlet of electricity that feeds any electrical device.

Chapter Two; Cables and wiring systems are spotlighted in this chapter, illustrating the Cables form, an important part of any installation, but, because they are static, and in normal service are very reliable, they do not always receive the attention that they deserve.

Chapter Three; This chapter discusses the types of circuit breaker , its structure , operation and circuit breaker ratings, also a brief discusses about cables and short circuit analysis.

Chapter Four; is considering the total set of measures used to connect an electrically conductive part to earth. The earthing system is an essential part of power network at both high- and low-voltage levels; during this chapter we will discuss that.

Chapter Five; in this chapter, we are going to apply the theories explained earlier in this work on a commercial centre. This will include the calculations of lighting, electrical equipments, in addition to the choice of electrical wires.

CHAPTERl

THE ILLUMINATION DESIGN

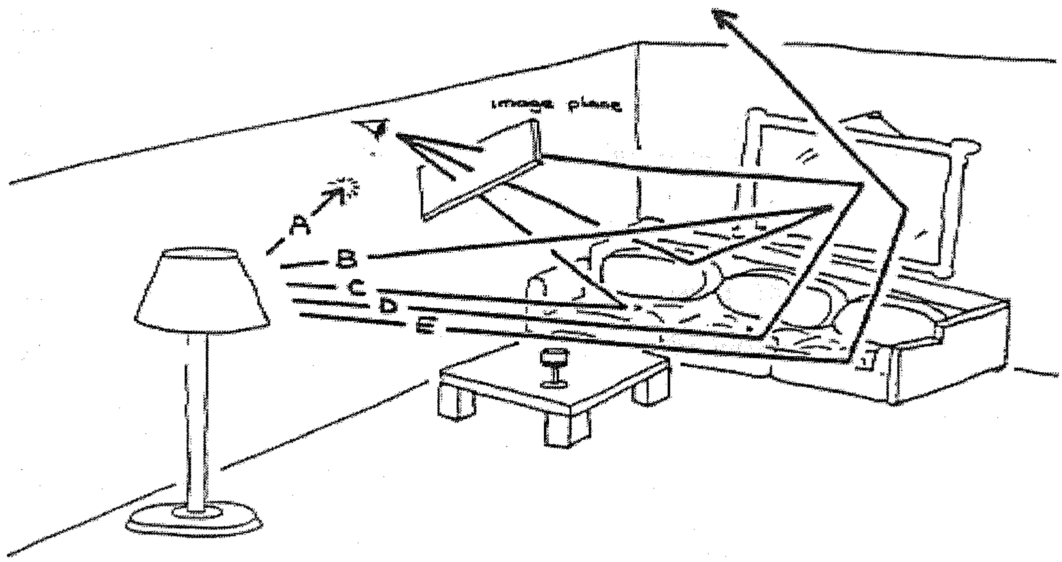
1.1 OVER VIEW:

Light is a prime factor in the human life as all activities of human beings ultimately depend upon the light where there is no natural light , use of artificial light is made. Artificial lighting produced electrically on account of its cleanliness, ease of control, reliability, steady output as well as its low cost is playing an increasingly important part in modem everyday life. Optimization of light is becoming more important whatever the Application Street or medical, in door or architectural lighting one of the main requirements is to optimize the uniformity of the lite area taking into account the environment and minimizing blooming effects. A basic understanding of lighting fundamentals is essential for specifies and decision-makers who are evaluating lighting upgrades. This document provides a brief overview of design parameters, technologies, and terminology used in the lighting industry. Good lighting has a lot of benefits where it decreases fatigue a protect health , eye , nervous system and reducing accidents , the science of illumination engineering is therefore becoming Of111.a.jor importance.

1.2 ILLUMINATION:

From Physics we can derive models, called "illumination", of how light reflects from surfaces and produces what we perceive as color. In general, light leaves some light source, illumination is the result of the light on surfaces in which it falls thus the illumination makes the surface look more or less bright with a certain color and this brightness and color which the eye sees and interprets as something useful or pleasant or otherwise.

(i.e. A lamp or the sun is reflected from many surfaces and then finally reflected to our eyes, or through an image plane of a camera).



1.3QUANTITY OF ILLUMINATION:

1.3.1 LIGHT OUTPUT:

The most common measure of light output (or luminous flux). is the lumen. Light sources are labeled with an output rating in lumens. For example, a T12 40-watt fluorescent lamp may have a rating of 3050 lumens. Similarly, a light fixture's output can be expressed in lumens. As lamps and fixtures age become dirty, their lumen output decreases (i.e., lumen depreciation occurs). Most lamp ratings are based on initial lumens (i.e., when the lamp is new). It can be explained in another way as maintenance factor which is know by the ratio of illumination under normal working conditions to the illumination when the lamps are perfectly clean.

1.3.2 LIGHT LEVEL:

Light intensity measured on a plane at a specific location is called *luminance.* Luminance is measured in *foot-candles,* which are workplace lumens per square foot. You can measure luminance using a light meter located on the work surface where tasks are performed. Using simple arithmetic and manufacturers' photometric data, you can predict luminance for a defined space. (Lox is the metric unit for luminance, measured in lumens per square meter. To convert foot-candles to lox, multiply foot-candles by 10.76.)

1.3.3. BRIGHTNESS:

Another measurement of light is *luminance,* sometimes called brightness. This measures light "leaving" a surface in a particular direction, and considers the luminance on the surface and the reflectance of the surface.

The human eye does not see luminance; it sees luminance. Therefore, the amount of light delivered into the space and the reflectance of the surfaces in the space affects your ability to see.

1.3.4 QUANTITY MEASURES:

- Luminous flux is defined as a total quantity of light energy emitted per second from a luminous body commonly called light output and is measured in lumens (lm) the conception of luminous flux helps us to specify the output and efficiency of a given light source.
- Luminance is called light level and is measured in foot-candles (fact).
- Luminance is defined as the luminance intensity per unit projected area of either a surface source of light or reflecting surface as is denoted by (L) where { L=I/A COS }.

1.3.5. DETERMINING TARGET LIGHT LEVELS:

When designing a new or upgraded lighting system, one must be careful to avoid over lighting a space. In the past, spaces were designed for as much as200 foot-candles in places where 50 foot-candles may not only be adequate, but superior. This was partly due to the misconception that the more light in a space, the higher the quality. Not only does over lighting waste energy, but it can also reduce lighting quality. Refer to Exhibit 2 for light levels recommended by the Illuminating Engineering Society of North America.

Within a listed range of luminance, three factors dictate the proper level: age of the occupant(s), speed and accuracy requirements, and background contrast. For example, to light a space that uses computers, the overhead light fixtures should provide up to 30 fact of ambient lighting. The task lights should provide the additional foot-candles needed to achieve a total luminance of up to 50 facts for reading and writing. For luminance recommendations for specific visual tasks, refer to the IES Lighting Handbook, 1993, or to the IES Recommended Practice No. 24 (for VDT lighting).

The Illuminating Engineering Society of North America has developed a procedure for determining the appropriate average light level for a particular space. This procedure (used extensively by designers and engineers (recommends a target light level by considering the following:

- The task(s) being performed (contrast, size, etc.)
- the ages of the occupants
- the importance of speed and accuracy
- Then, the appropriate type and quantity of lamps and light fixtures may be selected based on the following:
- fixture efficiency
- lamp lumen output
- the reflectance of surrounding surfaces the effects of light losses from lamp lumen depreciation and dirt accumulation
- room size and shape
- availability of natural light (daylight)

1.4 QUALITY OF ILLUMINATION:

Improvements in lighting quality can yield high dividends for US businesses. Gains in worker productivity may result by providing corrected light levels with reduced glare. Although the cost of energy for lighting is substantial, it is small compared with the cost of labor. Therefore, these gains in productivity may be even more valuable than the energy savings associated with new lighting technologies. In retail spaces, attractive and comfortable lighting designs can attract clientele and enhance sales.

Three quality issues are addressed in this section.

- glare
- uniformity of luminance

- color rendition

1.4.1 GLARE:

It is the brightness within the field of vision of such a character as to cause annoyance, discomfort, Interference with vision or eye fatigue.

- Lumen:

It is the unit of luminous flux and is defined as the amount of luminous flux given out in a space represented

- Luminous Intensity:

It is the luminous flux emitted by the source per unit solid angle, measured in the direction in which the intensity is required. It is denoted by I and is measured in candela (cd) or lumens / steradian.

- Luminous Flux:

It is defined as the total quantity of light energy emitted per second from a luminous body. It is denoted by symbol cl> and measured in lumens.

- Lux or Meter Candle:

It is defined as the luminous flux falling per meter square on the surface which is everywhere perpendicular to the rays of light from a source of one candle power and one meter away from it.

1.4.2 UNIFORMITY OF ILLUMINANCE ON TASKS:

The uniformity of illuminance is a quality issue that addresses how evenly light spreads over a task area. Although a room's average illuminance may be appropriate, two factors may compromise uniformity.

- improper fixture placement based on the luminaire's spacing criteria (ratio of maxim recommended fixture spacing distance to mounting height above task height)
- Fixtures that are retrofit with reflectors that narrow the light distribution.

1.4.3 NON-UNIFORM ILLUMINANCE CAUSES SEVERAL PROBLEMS:

- inadequate light levels in some areas
- visual discomfort when tasks require :frequent shifting of view from under lit to over lit areas
- bright spots and patches of light on floors and walls that cause distraction and generate a low quality appearance

1.5.HOW TO CALCULATE LUMEN?

1.5.1 LUMINAIRES IN REGULAR ARRAYS:

$$E = \frac{N.n. @.UF.MF}{A,}$$

Where

E = average Illuminance (Ix)
N = no. ofluminarie
n = no. of lamps in each luminarie
F = flux :from one bare lamp
UF = utilization factor
MF = maintenance factor, allowing for effects of dirt and depreciation
At= area of working plane or floor

- Utilization Factor:

The Utilization Factor (UF) is the proportion of light flux emitted by the lamps which reaches the working plane. Luminaire manufacturers issues tables of utilization factors for various combinations of Room Index and surface reflectance.

The Room Index for a rectangular room l x w where hm is the height of luminaries above the working plane, is given by;

$$RI = \frac{lw}{h_m(l+w)}$$

- **Maintenance Factor:**

The maintenance Factor (MF) is the ratio of illumination under normal working conditions to the illumination when the things are perfectly clean

M.F= (Illumination under normal working condition/illumination when everything is perfectly clean).

Some factors affects maintenance factor such as:

- Dust and dirt inside luminaries surfaces.
- Aging of light bulbs emitting less light.
- Cleaning of room surfaces, e.g. ceiling.

Without detailed knowledge of maintenance plan,

One sets MF = 0.8 - 0.9

- **Depreciation Factor:**

This is merely the reverse of the maintenance factor and defined as the ratio of initial meter-candles to the ultimate maintained meter-candles on the working plane. Its value is more than unity.

- **Spacing to Mounting Height ratio (SHR):**

It is the ratio of horizontal distance between adjacent lamps and height of their mountings.

$$SHR = \frac{\text{distance between adjacent fittings (centre -to - centre)}}{\text{height of fittings above working plane}}$$

The best ratio is between 0.8 and 1.2 ($0.8<SHR<1.2$).

- **Ceiling ratio:**

The recommendation for general lighting with a predominantly downward distribution is for the ratio of average illuminance on the ceiling to the average illuminance on the horizontal working plane to be within the range 0.3 to 0.9.

In general the ceiling cavity reflectance should be as high as possible, at least 0.6.

For indirect lighting, the average luminance of all surfaces forming the ceiling cavity should be not more than 500 cd/m2 however small areas ofluminance up to 1500 cd/m2 will generally be acceptable, provided sharp changes from low to high luminance are avoided.

- **Walls:**

Higher reflectance of wall and partition surfaces will increase the perception of lightness in the interior. Walls with windows are a particular case. The walls surrounding a window should have a reflectance not less than 0.6 in order to reduce contrast.

The ratio of the average illuminance on the walls to the average illuminance on the horizontal working plane is related to the average verticalplane illuminance throughout the space. This has been shown to give good correlation with visual satisfaction for office lighting. The recommendation is for the ratio of the average illuminance on any wall or major partition surfaces to the average illuminance on the horizontal working plane to be within the range 0.5 to 0.8.

In general the effective reflectance of the principal walls should be between 0.3 and 0.7.

- **Floor and working plane:**

The reflectance of the floor cavity plays an important part in visual appearance of a room. With most lighting installations a proportion of the light on the ceiling will have been reflected off the floor. Low reflectance bench and desk tops should be avioded since these surfaces have a major effect on effective floor cavity reflectance.

In general it is undesirable for the average floor cavity reflectance to exceed 0.40 fall below 0.20. The reflectance of the area surrounding the task should not be less one third of the task itself. In the case of office tasks involving white paper this require desk tops to have a reflectance of at least 0.3

1.5.2 LAWS OF ILLUMINATION:

1.5.2.1 INVERSE SQUARE LAW:

If a source of light which emits light equally in all directions be placed at the center of a hollow sphere the light will fall uniformly on the inner surface of the sphere each square mm of the surface will receive the same amount of light if the sphere be replaced by one of the larger radius, the same total amount of light is spread over a larger area proportional to the square of the radius.

El =I* w / Al LUMEN / UNIT AREA

Where Al = w (Rl A2)

El = I/ (RIA2)

Similarly illumination on the surface area (A2)

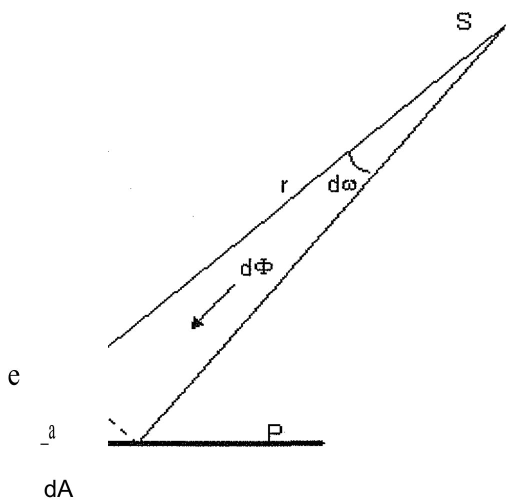
E2 = I / (R2A2)

1.5.2.2.LAMBERT COSINE LOW

At any point on a surface is proportional to the cosine of the angle between the normal at that point and the direction of luminous flux. We consider a point source, S, illuminating a plane surface, P. We know the luminance on a small area *ad,* illuminated by a luminous flux *d<fJ*

Where *di»* is the angle subtended by the element *ad* at the source.

The luminance produced at a point source at a distance *r* from a plane is obtained by first eliminating *d<P* from the above two equations



E = I*(dw/da)

AND dw = da COS *el*
r/\2

Substituting for dw gives

$$E (I \cos e) / (R^2)$$

This expresses both the inverse square and cosine laws of illumination from a point source.

1.6 TYPES OF LAMPS

1.6.1. INCADESCENT LAMPS:

Incandescent lamps or bulbs are the least energy efficient type of lighting. They are inexpensive to buy, but their running costs are high. Incandescent lamps are most suitable for areas where lighting is used infrequently and for short periods, such as laundries and toilets. Standard incandescent bulbs last about a thousand hours and must be regularly replaced

- Theory of Operation:

When electric current passes through resistance of the filament wire, power (PR) is used to heats the filament and produce a glowing.

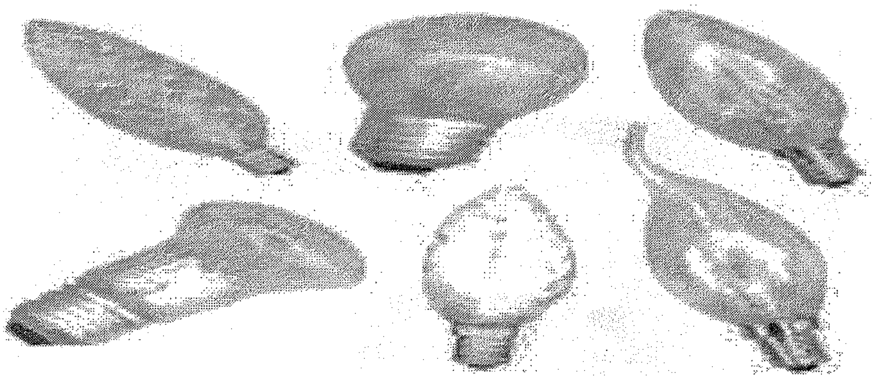


Fig **(1-1) Incandescent Lamps**

1.6.2. FLUORESCENT LAMPS:

Fluorescent lamps are the most energy efficient form of lighting for households and use only about a quarter of the energy used by incandescent bulbs to provide the same light level. They are more expensive to buy but are much cheaper to run and can last up to ten thousand hours. Most fluorescent lamps do not switch on immediately. This is a design feature to lengthen the life of the tube.

Fluorescent lamps are ideal for areas where lighting is requiredfor long periods of time, such as the living room, kitchen, and for security lighting.

There are two main types of fluorescent lamps:

- Tubular.

- Compact type.

Tubular lamps, also known as fluorescent tubes, are available in a straight or circular style. They are cheaper to buy than compact fluorescent lamps (CFLs), but unlike CFLs require special fittings. Tubes are ideal for kitchens, garages and workshops.

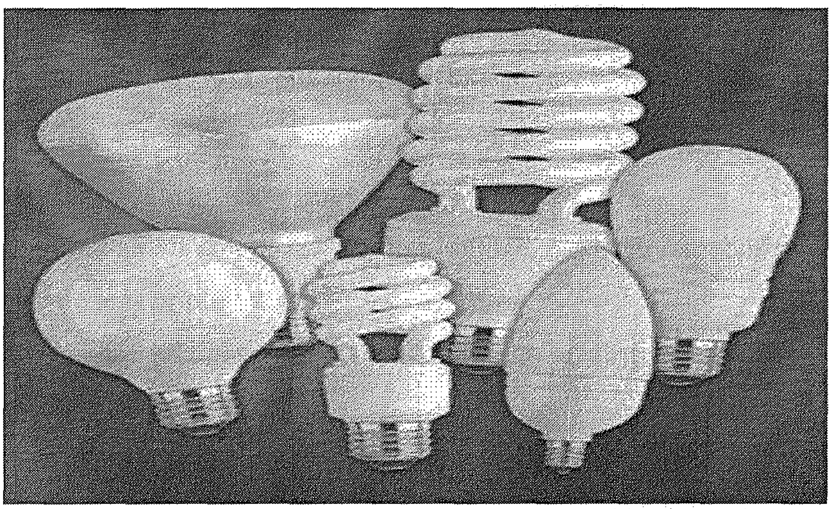


Fig (:t_l) Different Types of Fhıorescent lıtunps;

1.6.3 HIGH PRESSURE SODIUM LAMP:

A high intensity discharge (HID) lamp whose light is produced by radiation from sodium vapor (and mercury)

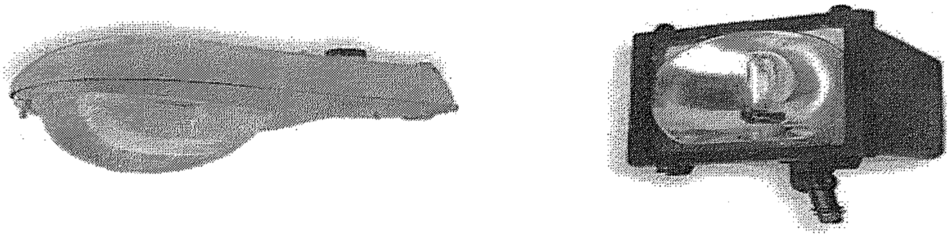


Fig (l_3) HIGH PRESSURE SODIUM LAMP

1.7.0UTDOOR LIGHTING:

1.7.1 CALCULATION OF LUMINARIES

1 - Determining the level of luminance by using table number (4)

2 - Light uniformity along the roadway is the second element of illuminance design. It is measured in terms of ratio of the average to minimum illuminance along the roadway Uniformity.

3 - Determining the lamp type sodium, mercury, halogen,

4 -We select the height of pole acc. Table no (5) .

5 - If $w \le h$ then select single side design

Where: - h = pole height, w = street width

6- If $h < w < 1.5h$ then select zigzag design

7- If $w > 1.5 h$ then select double side design

8 - A luminaire is composed of a light source, a reflector, and usually a glass or plastic lens or refractor.

9 -In designing a lighting system, maximizing spacing of luminaries consistent with good illumination design.

10-We determine the lumen of lamp according to the lamp catalogue

11- Use the next Formula for calculation of the spacing between two poles

$$S = \frac{0 \times U \times M}{W \times E}$$

S = Luminaire Spacing

W = Road width

E = Nominal illuminance level.

M = maintenance factor.

U= Utilization factor

0 =Initial lamp lumens

Table(1.7.1)

item	Type of rood - way	Lux level
1	**Highway, main road and main streets**	2Q.. 30Lux
2	Secondary rood /secondary streets:	15-20 Lux
3	Residential area streets,, industrial area streets	10-15 Lux

Table (1.7.2)

item	Luminous flux of lumlnalre (lumen}	Mounting height of luminaire
1	3000 - 10000	6-7meter
2	10000 - 20000	7i-9mete.r
1	20	> 9·meter

1.8 SOCKET

1.8.1.INTRODUCTION:

There are many types of sockets which used in distribution system but in our project we show the sockets which be used in commercial building and the floor boxes used in the administrative building.

1.8.2 TYPES OF SOCKETS

1.8.2.1. NORMAL SOCKETS

Is used for light load only (each socket is 180VA). Its ratings are 2A, 3A, 5A and lOA. Rating (3A) and (5A) can be used for bedrooms, entrance and balcony which needs low electrical power appliances such as T.V, Radio and small electrical fans.

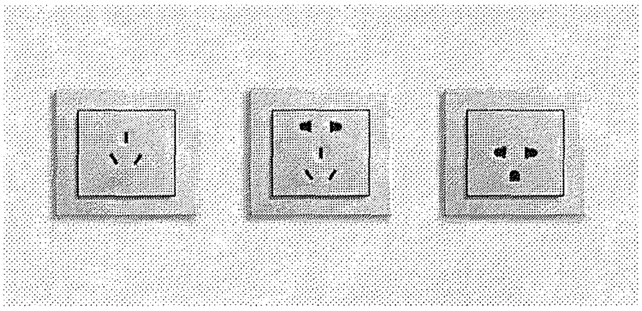


Fig (1_4) NORMAL SOCKETS

1.8.2.2POWER SOCKETS

Is called electrical socket, mains socket, plug-in, outlet, respectable and female power connector; Used for automatic washing cloth machines, air conditions, dish washers and electrical ovens. Its ratinğis at least equal to 16A.

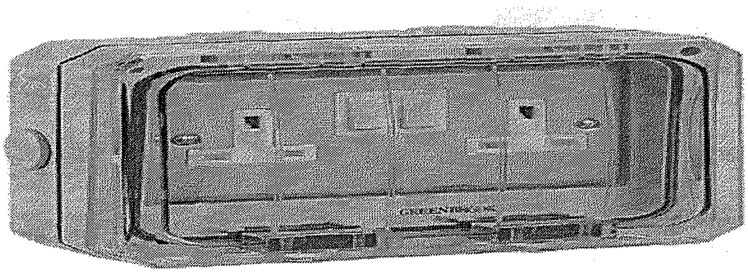


Fig (J.-5) POWER SOCKETS

1.8.3.EMERGENCY POWER SOCKETS

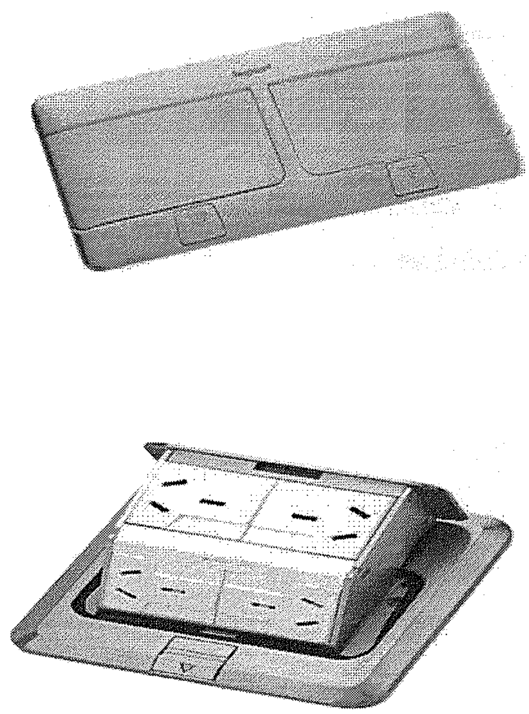
- Mainly used in ventilation systems (each socket is 200VA).

- Has a main sign which is EXIT sign.
- Each socket is a single circuit directly connected to the panel board.

1.8.4. FLOOR BOXES

A wide range of accessory plates is available for power data and telecommunication services .

We use floor box for any equipment with many plugs like computers and its attached .



Fig(1_6).FLOOR BOXES

CHAPTER2

CABLES AND WIRING SYSTEMS

2.1 OVER VIEW

This chapter explaining the design of feeders for lighting circuits and socket branch circuits by determine the current that can carry the diameters of cables "feeder" and connections between it and also between distribution boards.

2.2 DEFINITION OF CABLES

Cables are the material used in connections in electrical circuits; consists of many layers; conductor covered with semi conductor then insulation may be PVC type and the insulation is covered with another layer of a semiconductor then may be armour layer or another insulation in most XLPE type; the last two layers (armour; XLPE) can be changed in arrangement there sequence is not constant and this depend in the usage of the cable.

2.3. CONSTRUCTION AND MATERIAL

2.3.1. CONDUCTOR:

In plain soft annealed copper, cables are supplied either with class 2 of compacted circular or circular stranded conductors or aluminum conductors Copper is about 1.7 times more conductive than aluminum, so smaller diameters will result with copper although the conductor will be heaver. Conductors are sized to adequately carry the required current at the rated temperature of operation (temperature is influenced by the heat transfer properties of the materials and conditions in which they are installed.). The cable manufacturer can assist in sizing.

2.3.2 CONDUCTOR SHIELD:

A conductor shield is required over stranded conductors above 2kV. The conductor shield provides for a smooth, radial electric field within the insulation4. The conductivity must be greater than the dielectric constant times the frequency, for power frequency operation. The dielectric constant of a semicon is in the order of 1000, so even if the phase angle of the shield approached 90°, the field in the shield would be negligible compared to that in the insulation. Therefore the conductor shield can perform its function at low fairly low conductivity levels5. Industry specifications require a receptivity of below 1000 ohm-meters. The conductor shield is produced with a copolymer of ethylene or EPR filled with carbon black to make the material semi-conducting. Some manufacturers use a nonconductive material with a dielectric constant of about 10. All are compatible with, and firmly bond to, the, insulation. Modem ethylene copolymers allow for compounding of exceptionally smooth materials continuous compounding machines and transport in completely enclosed handling systems in pellet form.

2.3.3. CONDUCTOR SCREENING:

Conductor screening, that is non-metallic and made up of semi-conducting tape or a layer of extruded semi-conducting compound, or a combination of both, is supplied to cables

2.4. INSULATION

A layer of extruded cross-linked polyethylene (XLPE) makes up the insulation. Cables rated voltages that are above 1.8/3(3.6) KV has insulation screening consisting of a non-metallic semi-conducting part with a metallic part. Unamoured cables of 1.8/ 3(3.6) KV rated voltage have insulation screening thatcôrisists of metallic screen. The non-metallic part is applied onto .tlie insulation and makes.up.of either semi-conducting tape or a layer of extruded· semi-conducting/coınpourid -. For cables .with rated voltage above 1.8/3(3.6) KV, the metallic part is applied on the individual cores whereas for cables with rated voltage 1.8/3(3.6) KV, it is applied on the core assembly and consists of a plain annealed copper tape. A choice of copper tape screen, a lead alloy, corrugated aluminum sheath or a layer of copper wires is provided for your selection.

Ethylene propylene rubber (EPR) became available in the mid 1960s with the invention of Ziegler Natta polymerization catalysts. Insulation compounds based on these synthetic EPRs became available in the 1970sl. These insulation types are approaching 40 years of reliable service. Rubber insulation is chosen for its proven service life, flexibility and performance in high temperature operation2. Most rubber insulations produced today are based on ethylene propylene (EP) or ethylene propylene diene (EPDM) polymers. EPDM insulations are used on cables rated up to 138 kV. Some have attempted to classify EPDM polymers by the percentage of ethylene present in an EPDM base resin. One theory is that the higher the ethylene content, the higher the crystallinity (semi-crystalline) and therefore, the greater the susceptibility to treeing and early failure. All EPDM cable insulations, however, are inherently resistant to treeing. It is believed that EPDM's high resistance to degradation and reduced hydrophobic prevents water from condensing and causing the Oxiclatiôı:i associated with water trees. It is also theorized that the ionic species introduced by' the clay filler makes the water too conductive to form trees3.

2.5. ADVANTAGES OF UNDERGROUND CABLE

1-No Interruption of Supply Even Under Several Weather Condition

2- No Liability of accident to the public

3-No Effect of Environment

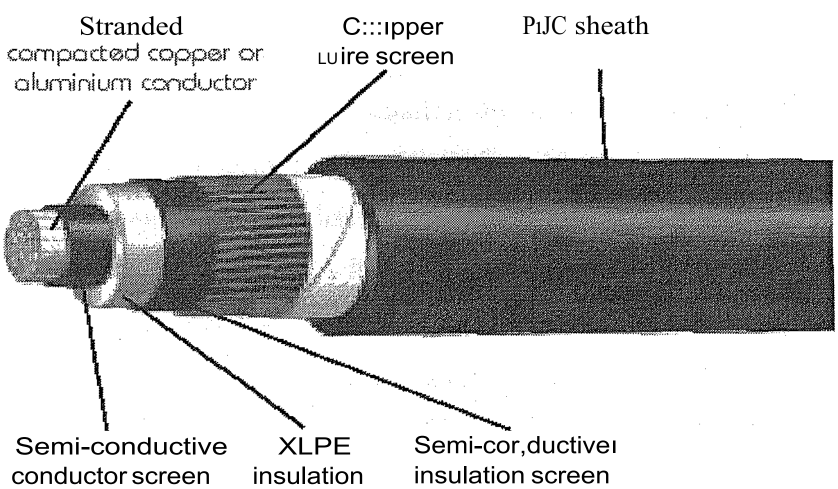
2.6. THE DESIGNING OF CABLES AFFECTED BY FOUR MAIN FACTORS

1-Conductors

2-Insulation

3-screening

4-armoring



Fig(:?,.)) THE DESIGNING OF CABLES

2.7. TYPES OF CABLES

2.7.1. PILC CABLES:

One of the most successful designs were paper insulated lead covered (PILC) cables.
Use of paper insulated power cables can be traced back to 1891 in London. During the years the paper impregnation was improved by changing vegetable substances by mineral oil, later by wax-_lied compounds. The sheath protecting the cable from moisture ingress progressed from lead to aluminum .

2.7.2. XLPE CABLES:

Development of synthetic polymer materials boosted the birth of extruded power cables. The growth of solid dielectric insulated· rnediu111 voltage cables began in the early 1950s, with the introduction of butyl rubber and thermoplastic high molecular weight polyethylene. Introduction of cross linked polyethylene (XLPE) as an insulation material in the mid-1960s seemed to be very promising due to good electrical, thermal and mechanical properties. XLPE has low permittivity, high dielectric Insulation Shield The insulation shield, like the conductor shield, is required in medium- and high-voltage cables rated 2kV and above. The insulation shield provides for a smooth, radial electric field within the insulation. Industry specifications require a receptivity of below 500 ohmmeters to adequately carry current to the metallic shield. Most commercial materials are below 100 ohm-meters. One very important aspect of the insulationshield is its degree of "strip-ability". The insulation shield must be easily removable in order to be terminated and spliced. In most cables, the insulation shield is co-extruded with the insulation and cross linked to its surface. Most insulation shields are based on ethylene vinyl acetate (EVA) copolymers that have a high enough polarity that even though cross-linked to the insulation, do not mix with and bond permanently to it. Note: EVA can generate acetic acid, noticeable by a strong vinegar odor, if overheated during cure. Acid scavengers are added to neutralize small amounts of acid if generated. Çomputer programs are used to predict and control the surface temperature of the cable during manufacture.

2.8. INSULATION SIDELD

The insulation shield, like the conductor shield, is required in medium- and high-voltage cables rated 2kV and above. The insulation shield provides for a smooth, radial electric field within the insulation. Industry specifications require a resistively of below 500 ohmmeters to adequately carry current to the metallic shield. Most commercial materials are below 100 ohm-meters. One very important aspect of the insulation shield is its degree of "strip-ability". The insulation shield must be easily removable in order to be terminated and spliced. In most cables, the insulation shield is co-extruded with the insulation and crosslinked to its surface. Most insulation shields are based on ethylene vinyl acetate (EVA) copolymers that have a high enough polarity that even though cross-linked to the insulation, do not mix with and bond permanently to it. Note: EVA can generate acetic acid, noticeable bya strôri.ğyineğar odor, if overheated during cure.

Acid scavengers are added to neutralize small arnôµı1tspf apid.ifğerterated. Computer programs are used to predict and control the suffаce}ternpetafüte ofthe cable during manufacture.

2.9. METALLIC ARMOUR

If required, the amour can be made to specifications, consisting of a layer of round wires or double tapes of galvanized steel or aluminum. Non-magnetic amour is essential for single core cable on A.C. circuit, thus single core cables are armored with aluminum.

2.10. OUTER SHEATH

An extruded black PVC (class ST2) outer sheath is provided to all cables.

Jackets are available in a number of different compounds for specific requirements. Jacket types include polyvinyl chloride (PVC), polyethylene (LLDPE, MDPE, and HDPE), Polypropylene (PP), Neoprene, Hyperion®, and thermoplastic chlorinated polyethylene (CPE). For certain applications, a lead sheath and interlocking or corrugated armors are available for multiconductor cables. Jackets may offer properties, such as sunlight, flame, and chemical and abuseresistance:.Jacketselection depends on where and how a .cable will be used and the ex.posure/cortditions, both during installation and while in service.

2.11. CABLE MARKING

The following information is indicated on the surface of the outer sheath;

- Voltage rating (eg. 30kV)
- Manufacturer's name
- Year of manufacture (eg. 1999)

2.12. TYPICAL CONSTRUCTION OF CABLE 6/10 (12) KV

2.12.1. XLPE INSULATED UNARMORED CABLE (XLPE/PVC}

2.12.1.1 Single Core

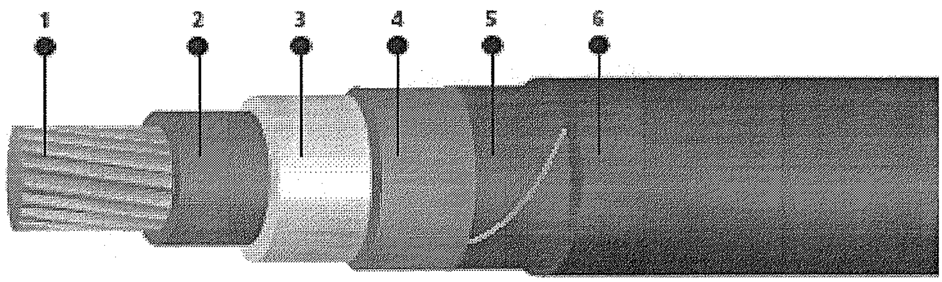


Fig (2:_2) Single Core

1. Conductor
2. Conductors
3. Insulation
4. Insulation Screen (Nonmetallic)
5. Insulation Screen (Metallic)
6. Outer Sheaths

2.12.1.2 THREE CORES

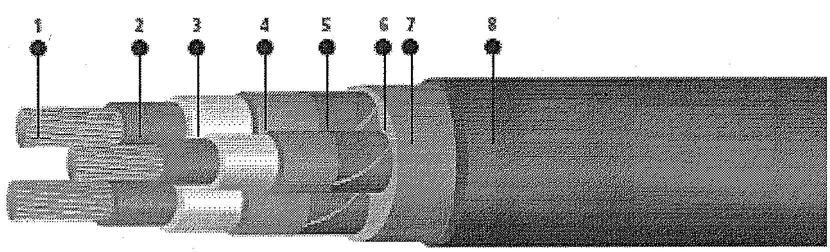


Fig (2t}) THREE CORES

1. Conductor
2. Conductor Screen
3. Insulation
4. Insulation Screen (Non-Metallic)
5. Insulation Screen (Metallic)
6. Filler
7. Binder Tape
8. Outer Sheaths

2.13. PROTECTION OF CABLES

By covering the route of the laid cables with durable and resistant materials, the cables will be protected from tools if there should be excavations. Due to the increasingly extensive networks and excavations, it is important to keep complete and accurate marking of the cable route. If this method cannot be used, then all dimension figures of the markers should be indicated on the site drawing.

2.14. CABLE JOINTING

Cable jointing must be carried out by a skilled sta.ffwithmaximum care, using the appropriate material.

2.15. ALLOW ABLE MAXIMUM PULLING TENSION

The allowable maximum pulling tension of the aluminuincoriductor cables is 4kg per mm2 and the copper conductor cable is 7kg per mm2 öfcön.düctor total section.al area.

2.16. ELECTRICAL TESTS AFTER INSTALLATION

At the completion of the cable installation, the following test is recommended
To carry out on site for the relevant cable voltage

Rated voltage (KV)	D.C test voltage (KV) / 15min.
0 J5J1	15
1.813(3.6)	, 1
3 JfiJ'\15(1.2~	1 [illegible]
6110(12)	25
8.71'150 7,5)	37
12120(24)	5 Cl
l ~H0(315)	75.5

2.17. CABLE RATING

The size of the conductor used must be large enough for it to carry the expected load current without exceeding the temperature limit appropriate to the insulating material involved. Factors affecting the current that a the discussed below.

GROUPS OF CABLES

Where more than one circuit or cable run together in conduit, trucking, or on the surface the mutual heating between them reduces their current carrying capacities. For most arrangements of cables in general use factors are issued with the rating tables whereby the maximum current carrying capacity of cables in groups can be calculated. Because they have to deal With the subject in a general way, these factors must be derived on the assumption that all the cables in a group are of the same size and are equally loaded. This situation does not often arise in practice, but it is usually assumed that the application of such factors to a practical group of mixed sized of cables would be on the safe side. In fact, this is not true. The application of usual group factors across the board to a group of cables of different sizes can result in the smaller cables being overheated and the larger cables being under utilized. Extensive work on this matter has resulted in the issue of several new ERA reports which provide ratings for cables in groups of mixed sizes carrying different loads. It is obvious that, because the ratings for cables in such groups are specific to the cable and load content of each group, rating under these circumstances and, dependent on the size of group and the loading of the other cables, its permissible load may be even greater than that for the cable in isolation. The method of conductor size selection given in the ERA reports provides for the adjustment of individual sizes (subject to other constraints such as voltage drop) so that the most economical mix of sizes can be selected. A point worth making here is that, a wiring cable which is continuously loaded to even 10% more than its maximum permissible value has its expectation of life reduced by about 50%.

Where a large number of simultaneously loaded cables must be accommodated it can be preferable to split them into several small groups so as to avoid the economic penalties of the low ratings required for large groups.

2.19. USE OF CABLES IN DESIGN

As mentioned electric cables used in connections in any electrical design, as it is used in small town project to connect between installed lamps and circuit breakers all over the building also this cables used in connection between sockets and circuit breakers for all kinds of sockets Four kinds of lamps (florescent, incandescent, spot compact and high pressure sodium) and varies kinds of sockets were used in the design of the small town lighting and power system

2.20. STANDARD CABLES CALCULATION

For Lighting:-

Basement

From*** Electro cable Syria company*** catalogue

Each line carries 5A current

Apparent power =5*220=1100=1.100 KVA

I C.B. =5*1.25=6.25 A

C.B. Rating=10 A

- According to Syrian code the method of calculating the percentage voltage **drop:**
- **The** max percentage voltage drop for:-

1- Single phase (5.5v) which is 2.5% of the nominal value (220v).
2- Three phase (9.5v) which is 2.5% of the nominal value (380).

• For the lighting circuits we will use cables of cross section area is 3 mm2.

• We can now calculate the max length of the circuit as follow

Max length= (5.5*10"3)/(6*mv/a/m)

From the table mv/a/m=H.697

Then max length =78.367 meter.

- • All lighting circuit are chosen to achieve this condition.

For socket:-

Basement

From*** Electro cable Syria company*** catalogue

Each line carries SA current

Apparent power =8*220=1760=1. 760 KVA

I C.B. =8*1.25=10A

C.B. Rating=16 A

• According to Syrian code the method of calculating the percentage voltage **drop:**

• The max percentage voltage drop for:-

3- Single phase (5.5v) which is 2.5% of the nominal value (220v).

4- Three phase (9.5v) which is 2.5% of the nominal value (380).

• For the lighting circuits we will use cables of cross section area is 3 mm2.

▪ We can now calculate the max length of the circuit as follow

Max length= (5.5*10"3)/(6*mv/a/m)

From the table mv/a/m=H.697

Then max length =78.367 meter.

- • All lighting circuit are chosen to achieve this condition.

CHAPTER3

PROTECTION SYSTEM

3.1 OVER VIEW

This chapter discusses the types of circuit breaker , its structure , operation and circuit breaker ratings also a brief discusses about cables and short circuit analysis.

3.2. CIRCUIT BREAKER

Circuit breaker is a piece of equipment which is designed to protect an electrical apparatus from damage caused by overload or short circuit. Unlike a fuse which operates once and then has to be replaced. A circuit breaker can be reset (either manually or automatically) to resume normal operation.

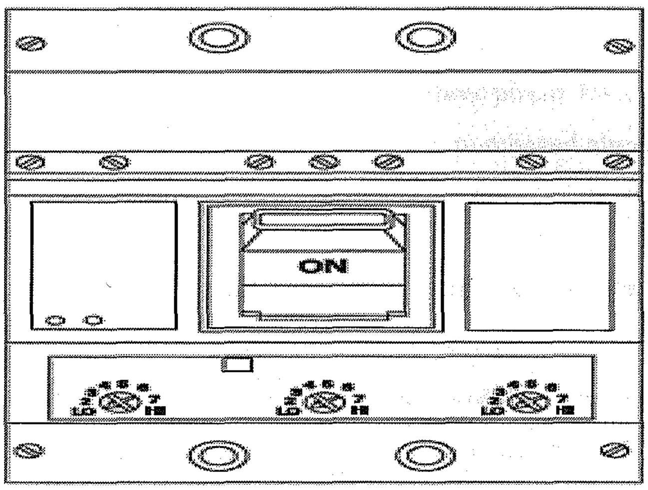


Fig (3_1) CIRCUIT BRE.ı\KER

3.3. CIRCUIT BREAKER PARTS

1. Actuator lever - used to manually trip andresetthe circuit breaker. Also indicates the status of the circuit breaker (On or Off/tripped). Most breakers are designed so

they can still trip even if the lever is held or locked in the on position. This is sometimes referred to as "free trip" or "positive trip" operation.

2.Actuator mechanism - forces the contacts together or apart.

3.Contacts - Allow current to flow when touching

and break the flow of current when moved apart.

4.Terminals.

5.Bimetallic strip.

6.Calibration screw - allows the manufacturer to precisely adjust the trip current of the device after assembly.

?.Solenoid.

8.Arc divider / extinguisher.

3.4. COMMON TRIP BREAKERS:

Three pole common trip breaker for supplying athreepha.se device. This breaker has a 2 ampere rating. Common trip breakers are usuallfptırchased already assembled into groups of two or three or the like.

When supplying a branch circuit with more than one live conductor, each live conductor must be protected by a breaker pole. To ensure that all live conductors are interrupted when any pole trips, a "common trip" breaker must be used. These may either contain two or three tripping mechanisms within one case, or for small breakers, may externally tie the poles together via their operating handles.

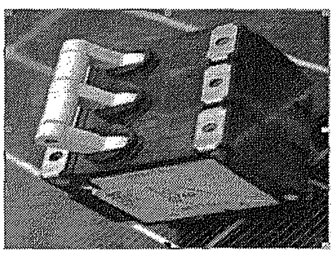


Fig (3_2) COMMON TRIP BREAKER

3.5. CIRCUIT BREAKER STRUCTURE

Its structure can be divided into three major parts:

3.5.1. POWER CIRCUIT:

It is where the main current flows or is interrupted; and it includes:

3.5.1.1 ARCING CHAMBER:

The arcing chamber is a closed volume containing a fixed contact, a moving contact and the interrupting medium. The current is established when the moving contact touches the fixed contact and interrupted when they part.

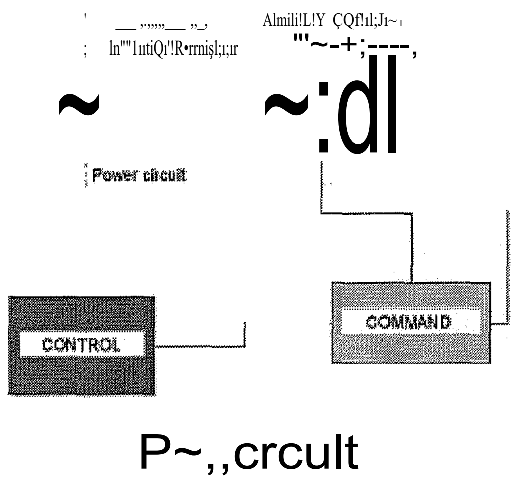


Fig (3'-3) ARCING CHAMBER

An arc is created when the contacts part. The interrupting medium is responsible for quenching the arc and establishing the nominal level of isolation between the open contacts.

Several chambers may be connected in series to serve higher voltage levels; in this case a grading capacitor is installed in parallel with each chamber to balance the voltage across the contacts when parting.

3.5.1.2. INSERTION RESISTOR:

The sudden modification of circuit characteristics, when circuit breakers operate, produces peak voltage impulses where the level is determined by the circuit characteristics. These impulses may reach very high levels and must be reduced.

3.5.2 OPERATING MECHANISM

It is where the needed energy to part the contacts and to extinguish the arc is developed.

It includes devices, called energy accumulators, to store the needed energy.

Examples of accumulators are:

- Springs.
- Nitrogen-charged cylinders.

The most common operating mechanisms in circuit breakers are:

- Spring operated.
- Hydraulically operated.
- Pneumatically operated.

3.5.3. CONTROL

The order to operate the breaker is launched in the control part of the circuit breaker, as an electric impulse of a fraction of a second duration. The order is then amplified in the operating mechanism to a complete circuit breaker operation capable of interrupting short circuit currents.

3.7. CHARACTERISTICS

The circuit breaker has special functioning characteristics. It is normally either close or open for long periods of time, is asked to change state on occasion and rarely sees short circuit current.

3.7.1. RELIABILITY:

It needs to change state efficiently after long periods of inactivity.

3.7.2. CORRECT FUNCTION:

The circuit breaker control must ensure correct closing action, whatever the closing current value, and ensure breaking (opening) at the required moment by releasing, by mechanical action or via a relay, the energy stored in the accumulators.
This energy has to face opposing forces when closing or breaking circuits under load or not, and even stronger forces with short circuit currents.
This means an excess of energy, when operated without load, has to be damped with a proper damping system.

3.7.3. OPERATION CYCLES:

The circuit breaker has to be capable of executing different operation cycles and achieve fast breaking of short circuit currents, the faster the better for the network. Recent progress has reduced the response time from 5 to 3 cycles, and down to 2 cycles. It is already planned to have response times of 1 cycle.
Operation has to be reliable, robust and easy to maintain.

3.8 . TYPES ACCORDING TO ISOLATING MATERIAL

1. oil circuit breaker
2. gass circuit breaker
3. vacoum circuit breaker
4. pressure circuit breaker
5. sf6 circuit breaker

3.9. CONCLUSION

An accurate analysis makes it possible to make decisions that are profitable to the breaker, the network and to the maintenance personnel. In order to achieve this, knowing the timing machine and the significance of the operating times is important but not enough .Knowing well the breaker itself, the reference values (timing chart) and the network characteristics is necessary.

CHAPTER4

EARTHING SYSTEM

4.1 OVER VIEW

Many electrical operated devices (e.g. washing machines, heaters and some lighting fittings) have exposed metal parts that could become live if a fault occurred. Anyone touching it could then receive a shock or even be killed depending on the current flowing through them to earth. To prevent this, an earthing conductor should be provided to all socket outlets, lighting circuits and any fixed appliances to which exposed metal parts are then connected .In the small town project we take earthing to power sockets .

4.2. EARTIDNG SYSTEM

For AC protective earthing, the 1N-S system in accordance with IEC 364-3 shall be used for all electrical installations within the scope of these specifications.

4.2.1 TN-S SYSTEM:

The 1N-S system has only one point which is directly connected to earth. This point shall be at the service entrance which is the main distribution board. From that point, the neutral and the protective earth conductors must be separated and not be mixed together at any point ofthe secondary distribution system.

4.2.2 EARTHING RODS

Earthing rods shall be made of copper welded steel rods approx. 18mm diameter. Rods shall be equipped with a connection flange for the connection. Conductors of copper conductor up to 70mm2. Minimum length of rods shall be 105. If more than one rod is provided for one earthing system, the distance between two rods shall be at least twice the length of one rod .

4.2.3 EARTHING COPPER PLATES

Earthing copper plates shall be approximately 5mm high and 500mm wide or equal area. Plates shall be placed vertical, upper comer of the plast shall be at least 1m below ground level. If more than one copper plate is being installed for one system, the distance between two plates shall be at least 3m.

4.2.4 EARTHLING SERVICE MANHOLES

If an earthing system includes only one earthing road or plate, this rod or plate shall be provided with a service manhole. If an earthing system includes more than one earthing rod or plate, these rods or plates shall be connected to one main central earthing rod or plated which shall be provided with a service manhole .Soil conditioning agents: Marconite concrete shall be used as a backfill for earth electrode in rocky area.

4.3.LIGHTNING PROTECTION

The building shall be fitted with a complete lightning protection system in accordance with these specifications and relevant drawings. The system shall meet BS665 l, NFP A 780, and VDEO185. The system shall consist of a grid of copper tape in the high part of roof, air terminal spikes, down running earth conductors and earth pits and rods as in the drawings. The metallic bodies and objects on the roof, e.g. water tank, chillers, etc... Shall have suitable and solid electrical connection to the roof grid via the same kind of copper tape. Joints between two or more copper tapes shall be done by means of suitable chrome plated steel connecting blocks to form, to all intents and purposes, a solid electrical joint. The grid shall be fixed to the roof by means of steel cramps at 1 m intervals. Sharp curvatures in the tape shall be avoided and should have a radius of no less than 25 cm.

The air terminal spikes shall be blunt air rods with all accessories as air terminal. The terminals shall have a suitable base fixing them solidly to the inside wall of roof parapets and other suitable places on the roof. The terminals shall have suitable solid electrical joints to the roof grid. The down running conductors shall have suitable and solid electrical joints to the roof grid and to the earthing rods inside earth pits. They will run down a non-metallic non-flameable conduit embedded in the concrete walls of the building. No other cable, wire or tape shall be allowed to run down this conduit. Earth rods shall be copper clad steel rods and shall have suitable means of electrical connection at the top. No electrical cables, water, fuel and gas pipes shall be within 3 m of the rods.

4.4. SHAPE OF EARTHING

Any terminal which is intended for connection to an external protective conductor for protection against electric shock in case of a fault.

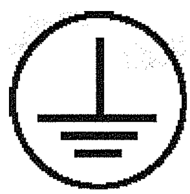


Fig (ıtJ)Protective Earth Symbol

Terminal which connect to external protective conductor through metal enclosure or through second ground wire from input. (Terminal and/or conductor are not qualified for protective earth requirement).

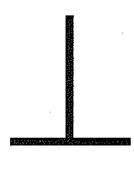


Fig (4_2) Ground Symbol

Example of connecting protective ground to chassis:

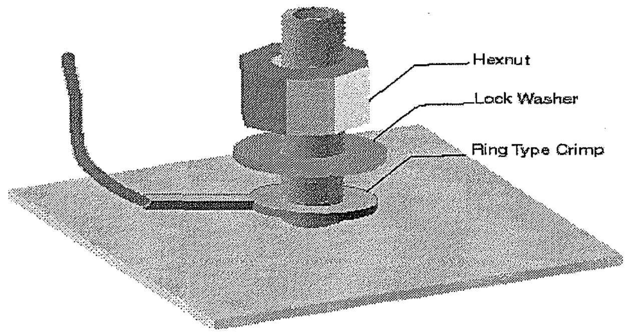


Fig (4:...,3) connecting protective ground to chassis

4.5. EARTH BARS

Earth bars are an efficient and convenient way of providing a common earth point. Integral disconnecting links mean the earth bars can be isolated For testing purposes

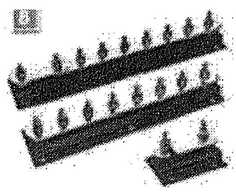


Fig (4_4) EARTH BARS

4.6. EARTH RESISTANCE

Earth resistance is the resistance between the metal of an electrode and an imaginary electrode placed at infinity.

4.6.1. CALCULATING EARTH RESISTANCE:

The equation for earth resistance for various systems of electrodes is quite complicated, and in some cases may be expressed only as an approximation.

$$R=p*L/A$$

Where:

R= Uniform earth resistance (O).

A= X-section area of the electrode (m^2).

p = Resistivity of soil (ü.m).

L= Length of the electrode (m).

For Single driven rod:

$$R = (p/2*pi*L)*[ln(3*L/d)]$$

Where:

L=length of the electrode (m).

d= diameter of the electrode (m).

For Multiple driven rods:

R [of N rods in parallel]/R [of one rod]= [l+K * X] *IN*

Where;

N= number of parallel rods

K= Screen Coefficient

X = L * *Dl* In (3*L/d)

Where: D= Distance between parallel rods (m).

4.6.2. FACTOR AFFECTING EARTH RESISTANCE:

* Effect of rod size: It's an important factor that affects 7.18.2.2. the resistance of the soil which usually decreases as the depth increases.
* Effect of rod diameter: increasing the diameter of the rod decreases the resistance.

Effect of soil resistivity: as the resistivity of the soil increases the earth resistance is increased.

4.6.3. FACTOR AFFECTING SOIL RESISTIVITY:

* Soil type.
* Degree of moisture in the soil.
* Temperature of the soil.
* Compactness of the soil.
* Soil grain size.

* Concentration of salts.

* Electrode length.

This table shows the variation of screen coefficient due to number of rods

Z	N	K
2	4	2.707
3	8	4.25
4	12	5.4
5	16	6
6	20	6.46
7	24	6.83
8	28	7.15
9	32	7.41
10	36	7.61

Where;

Z= Number of rods inside of a hollow square.

WE defined the sutible earth resistance to be(5 Ohm) ,Which is the total resistance of the small town

$$RE=Rrod=\frac{p}{2*\pi*L}Ln\frac{3*L}{d}$$

- P :Conduction of soil
- L :Length of rod
- d:Diameter of rod
- Assume that
- $P=100$ Ohm..m
- L=3m
- D=3Cm
- $RE = Rrod = \frac{100}{2*\pi*3}Ln\frac{3*3}{0.025}=31.23$ Ohm
- #Assume no of rod in side square=2 N=4 rods

  X=LD/In(3L/d)
- Where X=Distance between paraller rods(m)
- R(for N parallel rods) /R rod= (1+Kx/N)

=(1+2.707*0.1 7/4)

=0.365

- K=2.707 FROM TABLE
- R(for N parallel rods)= 0.365*31.23=11 .4 Ohm> 5 Ohm [NO]

- #Assume no of rod in side square=3 N=8 rods
- R(for N parallel rods) /R rod= (1+Kx/N)

=(1+4.25*0.17/8) =0.2153

- K=4.25 FROM TABLE
- R(for N parallel rods)= 0.2153*31.23=6.72Ohm> 5 Ohm [NO]
- #Assume no of rod in side square=4 N=12rods
- R(for N parallel rods) /R rod= (1+Kx/N=(1+5.4*0.17/12)=0.1598
- K=5.4 FROM TABLE
- R(forN parallel rods)= 0.1598*31.23=4.9Ohm< 5 Ohm [YES]

CHAPTERS

PRACTICAL STUDY

5.1 OVER VIEW:

In this chapter we are going to apply the theories explained earlier in this work on a commercial centre. this will include the calculations of lighting, electrical equipments, in addition to the choice of electrical wires. The basis of wires selection will be the voltage drop, thermal effect in addition to the short circuit current.

Following, the main distribution panels will be designed for all the parts of the centre

5.2.GENERAL DESCRIPTION OF THE PROJECT:

The study will include a commercial centre of one floor and a garage the floor includes many shops, wc's, basement and garage.

The used devices for the internal lighting

The lighting devices were calculated according to the requirements of the international codes and the place.

The lumen method has been applied for the calculation of the internal lighting, this method uses the average lighting on the surface as a basis of calculation.

The flux of light need in order to have enough amount of lighting E can be found using:

$$E*S$$
$$\eta*\mu f$$

Where

η is the using factor, for a given device it is related to the dimensions of place in addition to the reflection of the light from walls and floor. It can be obtained from special tables and based on the factor k, where k can be found by:

$$K = \frac{a x b}{(a+b)h}$$

The number of lights can be determined by:

$$N = \frac{\varphi_t}{n.\varphi_L}$$

Where

n: the number of bulbs in the lighting device

φ_L : the light flux for each lamp

5.3 APPLICATION:

We have a room with the next dimensions:

L=7.8 [m]

W=4.7 [m]

H= 2.5 [m]

The height of the working surface is: H=3 [m], we have economical lamps with light intensity of 500lux.

The using factor found by

$$k = \frac{a * b}{h * (a+b)} = \frac{7.8 * 4.7}{2.5 * (7.8 + 4.7)} = 1.17$$

From tables and using k=1.17, we can find the use factor with reflection factors 80% for ceiling, 50% for walls, we find η =0.38.

The total lumen is then found by

$$\phi_T = \frac{E.A}{\mu.\eta} = \frac{500 * (7.8 * 4.7)}{0.7 * 0....} = 68984.96[Lumen]$$

Will be divided using maintenance factor of $\mu = 0.7$

The number of devices

The number of devices can be found using the next relation:

$$N = \frac{\phi_T}{n.\phi_l} = \frac{68984.96}{\ldots} = 17.2[Device]$$

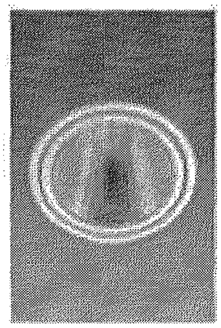
17 devices will be considered

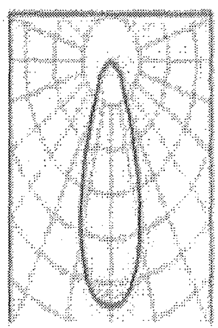
Same way, the lighting of the floor will be calculated for all Stores, results will be arranged in a table and given in this chapter.

5.4 THE TYPE OF LAMP :

We used this lamp in the projec

Disano Milano T - FM Fosnova Milano T - FM CDM-T 35 CELL white
Article No.: Milano T - FM
Luminous flux (Luminaire): 2092 lm
Luminous flux (Lamps): 4000 lm
Luminaire Wattage: 39.0 W
Luminaire classification according to CIE: 100
CIE flux code: 85 100 100 99 73
Fitting: 1 x CDM-T35 Elite (Correction Factor 1.000)





Fig(5-l)Compact Fluorescent Lamp

Room	Store1	Store2	Store3	Store4	Store5	Store6	Store7	Store8	Store9	Store 10	Storell	Store 12
A [m]	60	46	71	138.5	41.3	26.5	36.7	40	51	47.6	45.5	94.7
H [m]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Perimeter [m]	36	37.7	34.5	47.5	28	24	25	27.8	30	28.7	29.6	41
Half Perimeter m	18	18.85	17.25	23.75	14	12	12.5	13.9	15	14.35	14.8	20.5
E [lux]	500	500	500	500	500	500	500	500	500	500	500	500
K	t.33	0.97	1.64	2.33	1.18	0.8	1.17	1.15	t.36	1.32	1.23	t.84
η	0.42	0.35	0.46	0.52	0.48	0.31	0.38	0.37	0.42	o.42	0.4	0.49
μ	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
φ_T [lm]	102040.81	93877.55	108695.65	190247.25	61458.33	61059.9	68984.96	7722o	86734.69	80952.38	8125o	138046.64
Device [lm]	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Device [W]	39	39	39	39	39	39	39	39	39	39	39	39
N [Device]	26	24	27	48	15	15	17	19	22	20	20	35

Fig(5-1) Hand Calculation For Project

Room	M 2	M 3	M 4+5	M 6+7	M 8+9 +11	M 10+1 2	M 13	WC 1	WC 2	WC 3	WC 4
A [m]	42	17.7	56.7	22.7	51.1	65.1	22.6	17.6	17.6	23.5	16
H [m]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Perimeter [m]	38.6	17	45.7	20.2	46.7	45	20	23.6	23.6	21.9	16.6
Half Perime ter rml	19.3	8.5	22.8	10.1	23.3 5	22.5	10	11.8	11.8	10.9 5	8.3
E [lux]	250	250	250	250	250	250	250	200	200	200	200
K-	0.87	0.83	0.99	0.89	0.87	1.16	0.9	0.59	0.59	0.85	0.77
ɳ	0.32	0.31	0.36	0.35	0.35	0.37	0.35	0.24	0.24	0.32	0.29
μ	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
<fJT [Im]	468 75	203 91.7	562 50	231 63	521 42.8	628 37.8	230 61.2	261 90.4	261 90.4	262 27.6	197 04.4
Device [Im]	400 0	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Device [W]	39	39	39	39	39	39	39	39	39	39	39
N [Device]	12	5	14	6	13	16	6	7	7	7	5

Fig(5-Hand Calculation For Project (2

5.4 CALCULATION OF WIRES OF THE SECONDARY DISTRIBUTION PANELS:

5.4.1. INSIDE THE CENTRE

The power of the panel p=78.3[kW]

5.4.1.1. THERMAL IMP ACITY :

The current IL can be found by:

$$IL = \frac{p}{\sqrt{3} \times u \times Cos\phi}$$

Where the power factor is considered 0.9

$$\frac{386.6 \times 1000}{\sqrt{3} \times 380 \times 0.9} = 652.S[A]$$

The MCB current is then:

Ice= ILX1.25 =815. 7 [A]

We can take a MCB 40[A], under the condition of air wires and 30 degrees Celsius. Taking in consideration the thermal effect under 45°C, the correction factor will be kl=0.95. considering also the alignment of many wires aside, k2 will be taken as k2=0.85.

As a result, the real current based on which our wires are to be calculated:

$$I\,cable = \frac{I}{} = \frac{815.7}{} = 1010.2\ [A]$$

From tables we can find that the large current for chose cross sectional area of the wire is I= 290[A] so must chose Four cable the cross sectional area of each one is That is

$$S = 185\ [mm^2]$$

5.4.1.2. VOLTAGE DROP CALCULATION:

The voltage drop can be found using the relation:

$$SI: = J3 * 40..76 * R * 0.85$$

The resistance can be calculated from

$$R = px- \frac{L}{S}$$

By considering L=lOO[m], The resistance can be then calculated by:

$$R = 0.009\ [O]$$

The voltage drop is then

$$LlU = ..fi \times 253 \times 0.009 \times 0.9 = 3.5\ [v]$$

And the relative voltage drop

$$LlUo/o = \frac{LlU}{380} \times 100 = \frac{3.5}{380} \times 100 = 0.93\% < 3\%$$

Which means it is less than the standard and is accepted.

5.5. DESIGN OF THE DISTRIBUTION BOARDS:

5.5.1. MAIN BOARDS:

The secondary distribution boards are fed from a main panel constructed of many parts. It is fed by two three phase counters.

The board contains two automatic changeovers (one for each supply) to switch between the mains supply and the spare generators in case of mains fault.

5.5.2.SECONDARY DISTRIBUTION BOARDS OF THE PROJECT:

After applying all the required calculations of the project, the circuits of the outlets and lights are calculated and found, the devices are distributed and drawn on the design. Each one of these circuits will be protected using a miniature circuit breaker (MCB).

The main MCB of the feeding boards must be provided with a differential circuit breaker to protect persons of any expected faults in electrical devices.

CONCLUSION

At the first when we start the project, we hadn't predicted that we have difficulties in this level. However, it is not easy that is seen from outside, because in real life, calculationsare placed specificformulationand there is no searchingin detail. We tried to get calculations in detail because my purpose is that the project should include collectingand permanentinformation.

In project electric interior installation was drawn, after necessary information's were given for illuminating calculations for that, electrical requirement, wire cross section were calculated with falling down of necessary voltage and calculating of current control..

Auto-Cad software has recently an important place in the engineering field in terms of facilities by developing computer·technolögy. Therefore, I got interior installed, loading schedule, column diagram with preferring Auto-Cad 2010 software in drawingthis project and also I used Microsoftoffice program

This project helps me to see conditions of jobs in business life and process of electricalproject drawn into the market.

This project helps us in futurework.

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