NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

ELECTRICAL OF INSTALLATION

Graduation Project
EE- 400

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ABSTRACT

This project is prepared as a thesis for graduating in 2006-2007 education year, Near East University Engineering Faculty, Electric and Electronic Engineering department.

This project is an acceptable TEDAŞ and is readiness for competitive and difficulties life with it is practical more than theatrical.

Verbal and written resources are utilized during preparing this project. These are listed end of project

ACKNOWLEDGMENT

I would like to acknowledge and thank to Özgür Özerdem for being such a great supervisor for helping me all along my project and designing every phase of this application

Special thanks to my family and friends, chiefly my Mother and Father who simply are the best

Thanks also goes out to classmate who are generous enough to allot their precious time day in very detail of application and sharing their suggestions with me in documentation to bring about this valuable work

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INTRODUCTION

Today we are living in an electrical era. Most of the energy that we consume is electrical energy.

When we mention electrical energy, three; important parameter come into mind. These are producing electricity, transmitting and its distribution. The distribution of electricity is the last phase between electrical energy source and consumer...

In this project we are going to discus the distribution of electricity coming from network, tools to be used during this distribution process, calculations done, devices and conductor type to be employed and in addition to this we will cover the material and techniques that will project the people and the business in terms of monetary and physical damage, plus the fuse earth processes will be explained.

This project is specific to the building of L-block resident hold located in Cyprus International University campus having three stories and Saray Hotel.

This building has rooms of 2 and 4 – persons and each having its own lobby, rest room, manager room and also in each story has a special room for dormitory manager.

To sum up, after doing necessary calculations and preliminary work, the building's internal electrical installation design is sketched.
The entire topic discussed above is described through out this project.

CHAPTER 1

INSTALLATION FUNDAMENTALS

1.1 BASIC FUNCTIONS

Wiring is an essential requirement for conveying. Safety and efficiently, electrical energy from the point of supply to the current using devices such as lamps, heaters and motors. As a result of the almost unlimited variations in buildings conditions of service and rating of electrical apparatus there are many different kinds of wiring system. But whatever the type, installations must conform to the safety rule: all apparatus and conductors can be sufficient in size and power for the work they are called upon to do, and so constructed, installed, protected, worked and maintained, as to prevent danger as far as is reasonably practicable

1.2 ELECTRICITY FACTOR ACTS

These also are compulsory and apply to all premises that come under the jurisdiction of the factory Acts. While many of the consumer requirements of the Electricity Supply Regulations are common to the Electricity Factory Acts, the latter place special emphasis on motor control and the design and location of switchboards. Regulation 12 may be taken as typical:

Every electrical motor shall be controlled by an efficient switch or switches for starting and stopping, so placed as to be easily worked by the person in charge of the motor.

In every place in which machines are being driven by any electric motor, there shall be means at hand for either switching off the motor or stopping the machines if necessary to prevent danger.

1.3 CABLE INSULATIONS

Tables of the I.E.E. Wiring Regulations classify 20 types of conductor core or sheathe insulation. Such cables are normally made to operate with 600 V between any conductor and 1000 V between conductors.

Vulcanized rubber is now used only on a limited scale, for example for welding cables, and has been replaced almost completely by PVC (polyvinyl chloride) plastic general purpose cables. This insulation is virtually non-ageing and does not show any detraction due to moisture or dampness. However, being a thermoplastic material, it is affected by the extremes of heat or cold. The material should not be installed where the ambient (surrounding) temperature is above 65°C or the operating temperature of the cable is above 70°C.

Below about 0°C PVC becomes brittle so that it is inadvisable to use it for the temporary wiring of buildings or in refrigerator cold rooms. In these situations the PVC covering will split and crack when sharply bent. in addition, it can easily be shattered by sharp blows

Oiled paper insulated cables are run in distribution networks, especially when laid underground, or for heavy industrial supplies. Although being increasingly displaced by PVC-armored cables, they are still widely employed. Lead covering is often used for the mechanical protection of these heavy duty cables, with additional protection being offered by steel tape or wire armoring applied helically.

High- temperature cables

Modern building construction and environmental conditions have brought an increasing demand for cable insulation that is able to withstand the effects of temperatures in excess of 70°C.

The term electrometer is often employed for this class of insurants. Here the chemical compounds have to be vulcanized or cured in order to convert them to a suitable tough or elastic condition. One of the butyl! Rubber is a synthetic rubber- like material and its normal operating temperature may be extended to 85°C. EPR (ethylene propylene rubber) has somewhat similar physical properties and may be installed in temperature as low as -70°C it should not be directly exposed to oil or greases and requires a hover (heat, oil and fire resistant) sheeting.

Silicone rubber resembles natural rubber and has an even wider range of utilization from 150°C to -75°C. It may be used at temperature up to 200°C for intermittent operations without detraction,

1.4 CABLE RATINGS

There is an increasing move away from 70°C P.V.C. insulation to materials which are more environmentally friendly, for example 90°C XLPE. The ratings of fuse gear, switches, accessories etc. are generally based upon the equipment being connected to conductors intended to be operated at a temperature not exceeding 70°C in normal service.

In view of the above it is recommended that the practice of designs based upon conductor temperatures of 70°C be regarded as the norm. In accordance with clause 512-02-01 of the Wiring Regulations the equipment manufacturer should be consulted to ascertain the reduction of nominal current rating of the equipment if conductor temperatures exceeding 70°C are used. In addition an overriding factor is often voltage drop consideration.

1.5 FUSES

The main job of the fuse is to protect the wiring Fuses should be sized and located to protect the wire they are connected to. So if there is a high current appeared suddenly draws enough current to blow the fuse.

The fuse will be there to protect the wire, which would be much easier to replace than the device.

And as we know that the heat build-up in the wire depends on the resistance and the amount of current flowing through the wire. Fuses are really just a special type of wire in a self-contained connector. Most fuses today have two blade connectors and a plastic housing that contains the conductor so when a high current or if the heat went high this connection will be destroyed so it will not again so the circuit will be opened in I twill protect the device

A consumer unit or fuse box is a particular type of distribution board comprising a co-ordinate assembly for the control and distribution of electrical energy, principally in domestic premises. A consumer unit incorporates a manual means of isolation on the incoming circuit(s) - a main switch, and an assembly of one or more fuses, circuit-breakers or residual current devices.

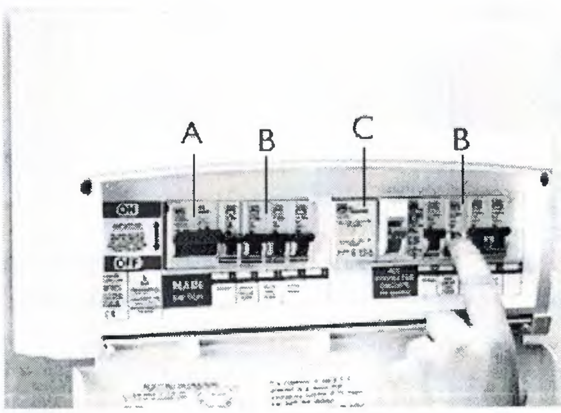


Figure 1.5 Fuse box

A = Main switch B = Circuit breakers C = Residual current device

1.6 CONDUCTORS

Cables consisting of plain annealed copper cores and general purpose PVC insulation are university employed for final circuit wiring. Copper is the best conductor of electricity after silver. Copper also has good mechanical qualities: it is ductile, bends easily and is able to give reliable terminal connections. For cross-sectional areas greater than 2.5 mm², standard cables have stranded conductors.

Aluminum is one of the most abundant of metals and constitutes about one-sixth of the earth's crust. For practical purposes it forms the only serious rival to copper as a conductor. For equal resistance it requires a croons-sectional area of 1.5 times that of copper in figure below, there is growing pressure to install aluminum conductor wherever possible, because of the increase in world copper prices.

The I.E.E. Regulations however do not permit the use of aluminum conductors unless they are 16 mm² o5r above in cross-sectional area. Aluminum does not have the same tensile strength nor is it as easy to manipulate as copper; difficulties can arise when making terminal connections as a result of creep or flow of the aluminum conductor.

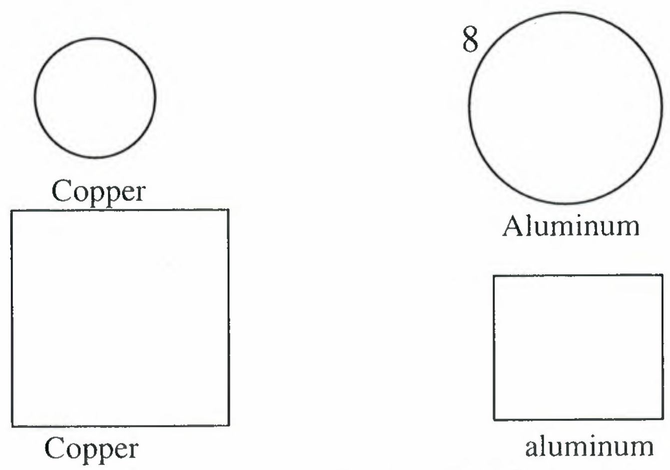


Figure. The circles represent capacities the relative cross-sectional areas and the squares represent the relative weights of copper and aluminum for an equal resistance

Table Current - carrying capacities of typical copper and aluminum cables. Bunched and enclosed in conduit or trucking. PVC non - armored single conductors.

Nominal CSA (mm²)	copper (A)	Aluminum (A)
16	74	60
25	97	78
35	119	96
50	145	120

1.7 ACCESSORIES

This term is usually understood to be referring to those parts of an installation that are necessary to complete the wiring such as switches, ceiling roses, lamp holders and socket outlets.

1.7.1 Switches

The inside of a typical household wall switch has a strip of metal (B), making contact with point 'A', completing the circuit and thereby conducting electricity to the light. This would obviously be the 'ON' position. When the insulated lever is moved down to the 'OFF' position, it pushes the metal strip away from point 'A', breaking the circuit and turning the light 'OFF'.

This type of switch (having a lever which "flips" it on and off) is called a toggle switch.

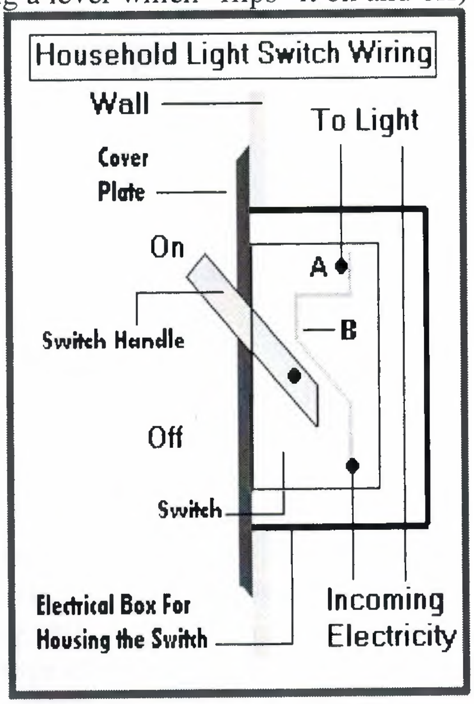


Figure 1.7.1.a House hold light switch

5 A switches may be obtained in the form of 1. Way, 2 ways, intermediate or double pole and dimmer control. Alternative methods of switch operation are dolly, rocker, and cord, pushbutton or key. In all cases an earth terminal connected to an appropriate circuit protective conductor is necessary.

Double-pole switches are available with dimensions similar to the 1-way switches, and a neon lamp may be fitted to them as part of a single assembly. Indicator lights are desirable as pilot lamps for no luminous heating or other appliances.

Where it is possible to touch the heating elements of radiators, double-pole control must be fitted.

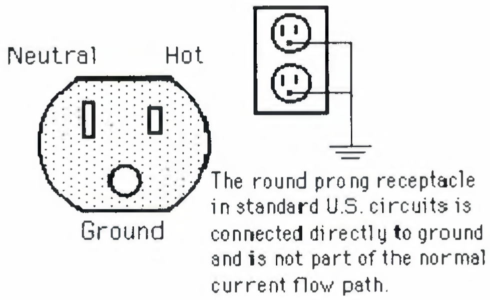
Main Switch

The main switch allows you to turn off the electricity supply to the electrical installation. Note that some electrical installations may have more than one main switch. For example, if your house is heated by electric storage heaters, you will probably have a separate main switch and consumer unit arranged to supply them

It is important to know where the consumer unit is located and that it is accessible. It is also important that you know where the main switch are in order to turn it (them) off in the event of an emergency

1.7.2 Grounding

The term "ground" refers to a connection to the earth, which acts as a reservoir of charge. A ground wire provides a conducting path to the earth which is independent of the normal current-carrying path in an electrical appliance. Attached to the case of an appliance, it holds the voltage of the case at ground potential (usually taken as the zero of voltage). This protects against electric shock. The ground wire and a fuse or breaker is the standard safety devices used with standard electric circuits.



The appliance will operate normally without the ground wire because it is not a part of the conducting path which supplies electricity to the appliance. In fact, if the ground wire is broken or removed, you will normally not be able to tell the difference. But if high voltage has gotten in contact with the case, there may be a shock hazard. In the absence of the ground wire, shock hazard conditions will often not cause the breaker to trip unless the circuit has a ground fault interrupter in it. Part of the role of the ground wire is to force the breaker to trip by supplying a path to ground if a "hot" wire comes in contact with the metal case of the appliance.

1.7.3 Ceiling roses

Modern ceiling roses are usually made from bakelite and have four terminals. In addition to the flexible cord connections one phase terminal (with a protective insulating cover) loop-in purposes and the remaining terminal is for connection to the circuit protective conductor. To comply with the I.E.E. Regulations, connections to the terminals must be enclosed a patters or box. Unless specially designed for multiple cord only one flexible cord outlet is permitted.

1.7.4 Lamp holders

In addition to the common BC (bayonet cap) type, there wide range of lamp holders:

SBC (small bayonet cap)
GES (goliath Edison screw)
ES (Edison screw)
SES (small Edison screw)
MES (miniature Edison screw)
Bi-pin

Selection of a holder from the Edison screw rang dependent on the lamp wattage. Bi-pin lamp holders are normal connection to florescent lamps. It is essential to connect the threaded portion to the neutral conductor.

Maximum fuse or miniature circuit-breaker rating is 5 A for SBC or SES 15 A for BC and b-pin holders

1.7.5 Circuit Breaker

A circuit-breaker is an automatic switch fitted to each circuit in the consumer unit which switches off in the event of a short circuit, an overload or a fault to earth on the circuit. It is not usually required to operate very often.

A circuit-breaker is much the same size as a fuse holder, but gives more precise protection than cartridge fuses. When they 'blow' or 'trip', they are simply reset instead of needing replacement or rewiring

Figure 1.7.5 circuit breaker

1.7.6 Socket outlets

The accessory may be of the switched or un switched version provided the supply is a. c Domestic ratings are 2,5,13 and 15 A; where required for industrial establishments, the range is extended to 16,30,32,63 and 125 A.

Utmost care must be taken in making connections so that the switch of switch-socket outlets is connected to the live conductor. Any extended use of flexible cord connectors is to be deprecated. Where fitted they should be of the non-reversible type so as to retain the correct connections for switches and thermostats.

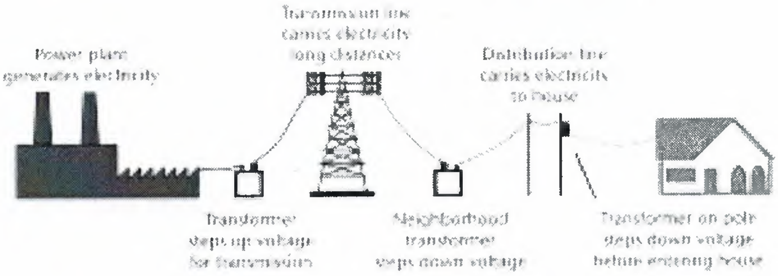
All socket outlets in one room must be connected to the same phase. Where it may not be possible to fulfill this condition in industrial premises, then the socket outlet on one phase is to be grouped together. The minimum distance between socket outlets on different phases should be 2 m.

1.6 TRANSMISSION AND DISTRIBUTION

The electricity produced by a generator travels along cables to a transformer, which changes electricity from low voltage to high voltage. Electricity can be moved long distances more efficiently using high voltage.

Transmission lines are used to carry the electricity to a substation. Substations have transformers that change the high voltage electricity into lower voltage electricity. From the substation, distribution lines carry the electricity to homes, offices and factories, which require low voltage electricity

TRANSPORTING ELECTRICITY



1.6.1 Three Phase 4 Wire Distributions

Before electricity is distributed it has to be generated. Generators are still based on the principle discovered by Michael Faraday in 1831. Whenever a wire is made to cross or cut a magnetic field, an e.m.f. is generated in the conductor if it is stationary and there is relative movement of the field. Mechanical energy is there by converted into electrical energy.

In power stations huge ace. generators (alternators) of 100 MW (100×10^2W) capacity, consisting essential of magnetic poles rotating past three groups of windings set at 120° with respect to each other, produce a 3 phase supply of 11 to 25 kV. The winding may be brought out six terminals and are usually delta interlines are usually delta interconnected so that only three supply lines are required. The main method of producing rotation is by powerful steam jets directed to drive the blades of turbo generators. Coal or oil is used to raise the superheated steam. In nuclear power stations, uranium rods under controlled conditions set up intense heat and form an alternative method of producing steam to drive the alternators.

The three phase voltage from the generating plants is transformed to 132 kV before being fed into the National Grid transmission network. At certain selected sections voltage of 375 kV or even 400 kV form a super grid.

Since P= VI cosØ watts it follows that for a given value of power an increase in voltage brings a corresponding current reduction. This fall in current contributes to economic transmission by reducing (a) conductor cross sectional area, (b) IR voltage drop and (c) I^2R power loss in the cables.

Fourteen Electricity Boards, working in conjunction with the Central Electricity Generating Board (C.E.G.B.), control transformer stations. At these transformer stations the Grid voltage is stepped down to 66, 33 or 11 kV; these voltages in turn are used to supply local substations. From a substation the voltage is further reduced to 415V / 240 V for consumers', industrial, commercial, domestic and other insulations. High rise Blocks of flats or offices may posses their own substation at 11 kV and the larger. Factories may be served by two substations. To minimize the possibility of breakdown and in the interest of cable economy, outgoing distribution cables from the substations are usually connected in the form of one or more ring mains.

Electricity Board substations would normally house H V meters (to record energy taken from the C.E.G.B. lines), HV/ LV transformer and LV switchgear Additional transformers are installed should the sum of the calculated loads be more than 200 kVA

Because of the high voltage and corresponding dangers involved only authorized personnel are allowed entry into substations. All gear should be so sited as to facilitate maintenance work and checking should be carried out at regular intervals.

1.6.2 Intakes

The term refers to the position in a building where the supply and main controls are situated; so that intakes normally form the main distribution centers. As an essential requirement all such control gear must be accessible and posses facilities for overload and earth leakage protection. All gear must be properly labeled with full and clear details of circuits controlled and also include current rating of fuses.

Intakes in new buildings require careful planning at an early stage. Consultation is necessary between the architects, electrical and building contractors and other interested bodies. By means of good design the placing of consumer's control gear and metering under the stairs of private houses can be avoided. This position is often chosen, but dangers may arise because the electrical equipment is inaccessible, and there is also the possibility of the equipment being close to inflammable materials.

The sitting of industrial intakes requires special consideration. If possible a separate switch room should be reserved for the control gear. There should also be facilities for future extensions by spare capacity switchgear and fuse ways.

Economy of cable runs is achieved by positioning the distribution center near to the geographical load center.

1.6.3 Domestic Intakes

The sequence of the supply and control gear is shown by the line diagram in (figure1.6a). Outgoing final sub circuits are supplied by the distribution fuse board. Except for large premises requiring separate fuse boards, it is now considered normal practice to combine the switch fuse and distribution board into a single consumer's control unit (figure1.6 b)

Miniature circuit breakers (MCB) should be used in preference to fuses, as they enable the supply to be speedily restored after a fault has been cleared. Fuse carriers themselves are all too easily fitted with the wrong size of fuse wire, especially if of the rewritable type.

It is incorrect procedure to bunch outgoing neutral conductors into one terminal. For each of two-wire outgoing circuits, the neutral should be connected in the same sequence as the fuse or MCB connection.

It is dangerous to use borrowed neutrals; that is, in order to save cable, to take a neutral from one circuit to feed another circuit. Every circuit must be electrically separate

The wiring to storage heating loads as recorder by off peak meters, and normally requiring a contactor and time- switch, must be distinct and controlled by separate switchgear.

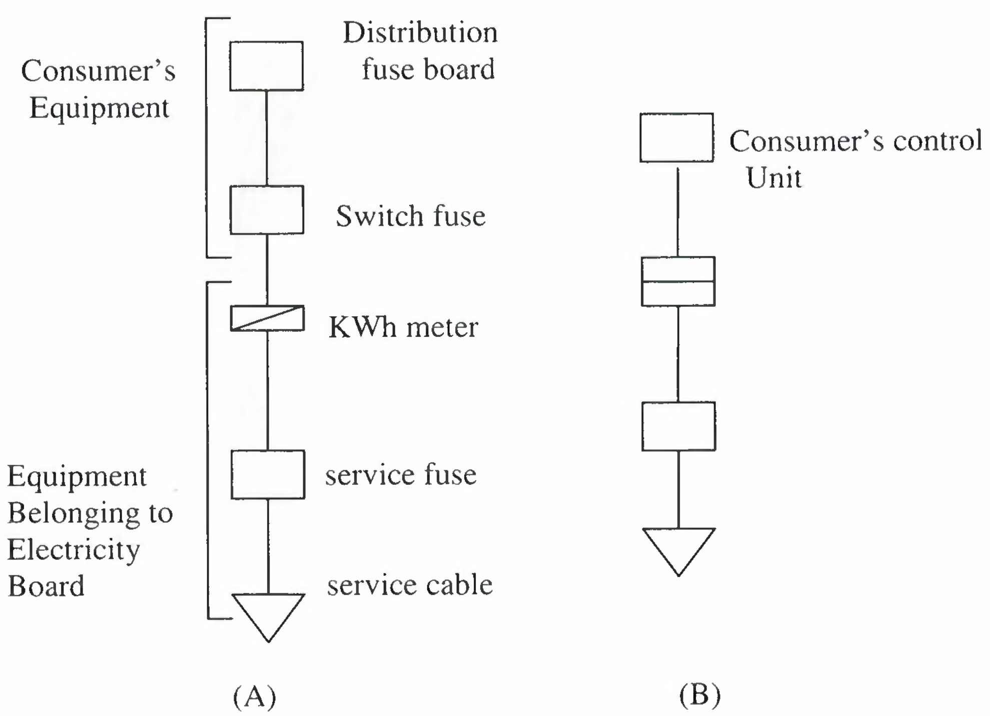


Figure 1.6 Alternative forms of domestic intake equipment

CHAPTER TWO LIGHTING LIGHTINING

2.1 BASIC CONSIDERATION

In line with recent developments, there is now international agreement that the term luminance should be used in place of 'illumination value' and 'illumination level'.

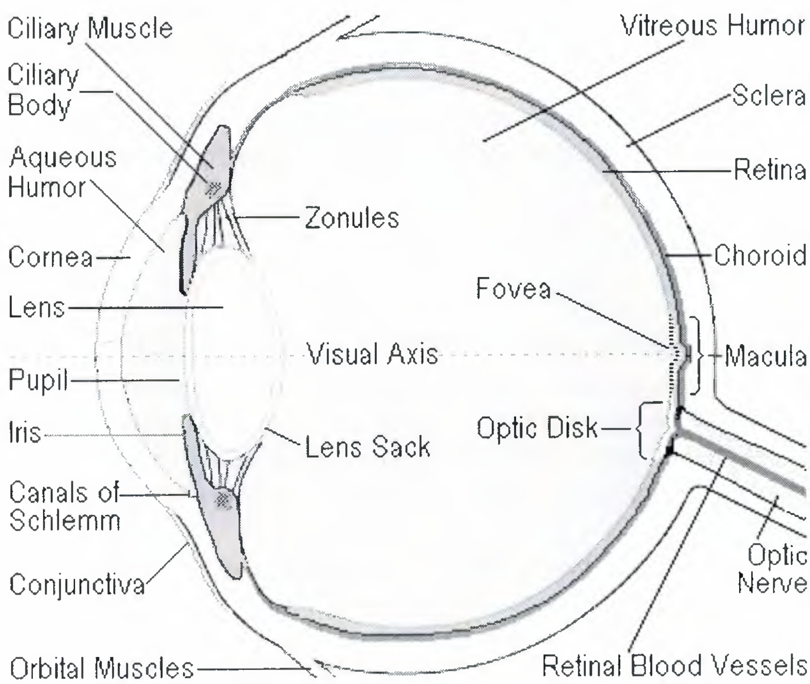
The importance of electric lighting in modern life is becoming increasingly appreciated. Bad lighting may not only bring a feeling of discomfort and fatigue but has also been the cause of many accidents.

On the other hand, good lighting helps towards providing pleasant surroundings and makes a definite contribution towards safety.

Whatever the light is suitable for a particular situation depends upon many factors; these include quantity and quality of the light, color, contrast and direction.

2.1.1 The eye

The human eye plays an all-important part as it is responsible for 80 cent of the information that we obtain fro our work. Rays from the object to be seen strike the sensitive retina and these impressions are then transmitted along the optic nerve to the brain to give the sensation of vision.



2.1.1 Glare

An elementary understanding of the function of the eye is important in appreciating the harmful effects of glare. If a bright is produced. Rays from this bright source, in addition to those from reflective surfaces, could damage the sensitive retina.

To minimize these harmful effects, the iris acts as a shutter and operates so as to reduce the amount of light entering the eye. Thus a bright light under these circumstances actually hinders instead of improving vision.

2.2 TUNGSTEN LAMPS

Lighting was one the first application of electricity and still remains of very great importance. Despite the many efficient electric light sources available, the ordinary tungsten filament lamp has as extremely wide application. its many features merit close examination by the student.

The filament is made to grow white hot and thereby transmit the electrical energy input into light output. Owing to this intense heat, if the lamp is installed near materials that could easily be set alight, proper heat guards are required.

For increasing light output the tungsten wire is wound into a tight coil, which reduces heat loss, and is then formed into the characteristic crescent shape near the centre of the bulb. The bulb contains an inert gas, which may be argon or nitrogen. The coiled-coil lamp is obtained by winding these coils into a small number of turns and results in a further increase in the lamp efficiency.

The life of a tungsten lamp is rated at approximately 1000 hours when mounted in the vertical cap-up position. A reduction in lamp life occurs when fitted at an angle away from the vertical.

2.3 LAMP FUSES

Another important feature is the sea let-in fuse, which is connected to each of the copper-clad nickel iron lead-in wires, The failure of the lamp result from the white hot filament becoming progressively thinner through evaporation; ultimately the filament breaks, normally owing to the sudden cooling when switching off – causing contraction, which snaps the weakened wire filament – or because the lamp is knocked, jolted or bumped.

Without these totally enclosed fuses, the sudden failure of the lamp could result in harmful effects such as shattering the glass bulb to smithereens, or causing short-circuit at the lamp and so blowing the circuit fuse, plunging other rooms into darkness.

2.4 TYPES OF LAMP

Twelve distinct sizes make up the General Lighting Service (G.L.S.) range: 25W, 40W, 60W, 75W, 100W, 150W, 200W, 300W, 500W, 750W, 1000W and 1500W, all for a maximum voltage of 250V.

75W and 150W spotlight lamps are designed to produce concentrated beam,

In addition there is rough-service lamp with sturdy filaments for the onerous conditions of service encountered on building sites.

Clear, internally frosted (pearl) and white are the not finishes. Popular lamp sizes may be obtained in a variety colors such as red, blue, green, yellow, amber or pink.

The 15W pigmy sign lamp or red pilot lamp often fitted to indicate whatever a supply is flowing three non-luminous apparatus. When fixed outside a cupboard, the red glow will clearly show that the heater inside the cupboard is being used.

2.5 FINAL SUB-CIRCUITS

Lighting track system may be protected by a 30A fuse; elsewhere 5 A circuits are normal.

In the interests of good planning the permitted number should be restricted to a maximum of ten outlets. Further, there should be at least two lighting final sub-circuits for any premises.

2.6 LAMP HOLDERS

The most common is the cord-grip Bakelite bayonet cap (BC). Small bayonet cap holders (SBC) have a general use for decorative candle lamps. Both BC and Edison screw (ES) lamp holders are available for 100 W and 150 W lamps. Goliath Edison screw (GES) types are necessary for the higher wattages.

Screwed lamp holders require special care in ensuring that the threaded portion is connected to the neutral conductor. Brass lamp holders must be solidly bonded to earth. Certain holders have an important safety feature: a locking screw or similar device to prevent unscrewing of the top cover when taking off the shade ring, thus exposing the live terminals.

2.7 CEILING ROSES

These accessories are the vital link between the circuit wiring and the flexible pendant light cord. To make connections, the flex ands must be tightly twisted by hand doubled over before entering the ceiling rose terminals. To avoid a continuous downward pull on these terminal connections, effective use must be made of the flexible cord grips.

The maximum mass that is permitted to be supported by twin flexible cords is as follows.

Conductor cross-sectional Area (mm²)	Mass (kg)
0.50	2
0.75	3
1.00	5

Unless specially designed for multiple flex outlets, only one flexible cord may be connected to a ceiling rose.

2.8 HEAT PROTECTION

Since the tungsten lamp filament may reach a temperature around 3000°C, these light bulbs must be fitted with effective guards where placed near flammable materials. The use of heat-resisting flexible cards is recommended for pendant light fittings; they may be made of silicone rubber or fiberglass.

Similarly, final connections to batten holders or enclosed luminaries should also be fitted with heat-resisting tails of butyl rubber or ethylene propylene insulation. Alternatively heat-resisting sleeves could be used for the flexible cord terminations.

2.9 DIMMERS

Lamp dimming is now easily accomplished by the solid-sty thruster dimming switch, obvious uses being for TV lounges children's bedrooms, photographic and projection rooms a hospital wards.

For one-way switch control the rotary knob is used for maximum load of 1 kW. Two-way switch control requires on-off switch together with the edge rotary dimmer comment.

Some extra care is necessary when making the active connections so that any bare cable does not make contact the printed circuit of the dimmer switch.

2.10 MAINTENANCE

Dust and dirty on lamps and fittings represent a loss in light, which may amount to as much as one-third of the rated output. Therefore regular cleaning and maintenance are essential to produce efficient performance.

For any large installation, random lamp renewals cleaning of the luminaries are certainly not the answer to problem if breakdowns are to be avoided. Cleaning provide the opportunity for vulnerable points, especially flexible cord connections.

CHAPTER THREE

3. ILLUMINATION CALCULATIONS

3.1 AVERAGE LIGHTING CALCULATIONS

Average lighting calculation at working plane the illuminance at the related with dimension of the room and position of the lamps with maintenance of the lamp

$$\varnothing_{total} = \frac{E_{av}.\ A.\ d}{\eta}$$

$\varnothing_{total}$ = the total luminance flux

E_{av} = need of illumination intensity

η = utilization factor

A = the area of working place

d = maintenance factor

$$K\ (\text{Room Index}) = \frac{a\ \ b}{h\ (a + b)}$$

a = the length of the working plane
b = width of the working plane
h = distance between lamps and working plane
h = H-(h1-h2)
H = distance between lamps and ceiling
h1 = distance of working
h2 = to length of lamp

If K (Room index) is calculated and the color of the wall, ceiling and ground are known then η could be found from the table

3.1.1 ROOM FOR TWO PEOPLE:

$a = 4.8$ m
$b = 3.5$ m
$h = H-(h1-h2) = 3.20-(0.70-0) = 2.5$m

A (area) = $a \times b = 4.8 \times 3.5 = 16.8$ m²

$$K \text{ (Room Index)} = \frac{a \times b}{h\,(a+b)} = \frac{16.8}{2.5(4.8+3.5)} = 0.80$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

$\eta = 0.31$ (to find table 1 according to room index value of 0.80)

$d = 1.25$

$E = 75$ lux (to selected according to electrical installation standards)

$$\varnothing_{total} = \frac{E_{av}.\ A.\ d}{\eta} = \frac{75 \times 16.8 \times 1.25}{0.31} = 5080 \text{ lumen}$$

$\varnothing_L = 1900$ lumen (to using 36 w's economical energy lamps)

$$n = \frac{\varnothing_{total}}{\varnothing_L} = \frac{5080}{1900} = 2.67 = 2 \text{ (to put 2 lamps in the room)}$$

3.1.2 ROOM FOR FOUR PEOPLE:

a = 7.7 m
b = 4.7 m
h = H-(h1-h2) = 3.20-(0.70-0) = 2.5m

A (area) = a x b = 7.7 x 4.7 = 36.19 m²

$$K \text{ (Room Index)} = \frac{a \times b}{h\,(a+b)} = \frac{36.19}{2.5(7.7+4.7)} = 1.16$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

$$\eta = \frac{1.16 \times 0.36}{1} = 0.44 \quad \text{(to find table 1. according to room index 1)}$$

d = 1.25

E = 75 lux (to selected according to electrical installation standards)

$$\varnothing_{total} = \frac{E_{av}.\ A.\ d}{\eta} = \frac{75 \times 36.2 \times 1.25}{0.44} = 8277 \text{ lumen}$$

$\varnothing_L$ = 1900 lumen (to using 36 w's economical energy fluorescent lamps)

$$n = \frac{\varnothing_{total}}{\varnothing_L} = \frac{8277}{1900} = 4.35 = 4 \text{ (to put 4 lamps in the room)}$$

3.1.3 MANAGER ROOM'S:

a = 4.8 m
b = 3.5 m
h = H-(h1-h2) = 3.20-(0.70-0) = 2.5m

A (area) = a x b = 4.8 x 3.5 = 16,8 m²

$$K \text{ (Room Index)} = \frac{a \times b}{h\,(a+b)} = \frac{16{,}8}{2.5(4.8+3.5)} = 0.80$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

η = 0.31 (to find table 1. according to room index value of 0.80)

d = 1.25

E = 150 lux (to selected according to electrical installation standards)

$$\O_{total} = \frac{E_{av}.\,A.\,d}{\eta} = \frac{150 \times 16{,}8 \times 1.25}{0.31} = 10000 \text{ lumen}$$

$\O_L$ = 2x2350 = 4700 lumen (to using 2x36 w's economical energy fluorescent Lamps)

$$n = \frac{\O_{total}}{\O_L} = \frac{10000}{4700} = 2,\ 12 = 2 \text{ (to put 2 lamps in the room)}$$

3.1.4 LOBBY: (first part)

a = 9.8 m
b = 9.5 m
h = H-(h1-h2) = 3.20-(0.70-0) = 2.5m

A (area) = a x b = 9.8 x 9.5 = 93.1 m²

$$K \text{ (Room Index)} = \frac{a \times b}{H(a+b)} = \frac{93.1}{2.5(9.8+9.5)} = 1.92$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

$$\eta = \frac{1.92 \times 0.51}{2} = 0.48$$ (to find table 1 according to room index value of 2 and to make proportion)

d = 1.25

E = 100 lux (to selected according to electrical installation standards)

$$\varnothing_{total} = \frac{E_{av.}\, A.\, d}{\eta} = \frac{100 \times 93.1 \times 1.25}{0.48} = 24244 \text{ lumen}$$

$\varnothing_L$ = 2x2850 = 5700 lumen (to using 2x36 w's economical energy fluorescent Lamps)

$$n = \frac{\varnothing_{total}}{\varnothing_L} = \frac{24244}{5700} = 4.25 = 4$$ (to put 4 lamps in the room)

3.1.5 LOBBY (second part):

a = 6.3 m
b = 3.8 m
h = H-(h1-h2) = 3.20-(0.70-0) = 2.5m

A (area) = a x b = 6.3 x 3.8 = 23.94 m²

$$K \text{ (Room Index)} = \frac{a \times b}{h(a+b)} = \frac{23.94}{2.5(6.3+3.8)} = 0.86$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

$$\eta = \frac{0.86 \times 0.31}{0.8} = 0.33$$ (to find table 1 according to room index value of 0.8 and to make proportion)

d = 1.25

E = 100 lux (to selected according to electrical installation standards)

$$\varnothing_{total} = \frac{E_{av}.\ A.\ d}{\eta} = \frac{100 \times 24 \times 1.25}{0.33} = 9090 \text{ lumen}$$

$\varnothing_L$ = 2x2850 =5700lumen (to using 2x36 w's economical energy fluorescent Lamps)

$$n = \frac{\varnothing_{total}}{\varnothing_L} = \frac{9090}{5700} = 1.59 = 1$$ (to put 1 lamps in the room)

3.1.6 WC:

a = 2.7 m
b = 2 m
h = H-(h1-h2) = 3.20-(0.70-0) = 2.5m

A (area) = a x b = 2.7 x 2 = 5.4 m²

$$K \text{ (Room Index)} = \frac{a \times b}{h\,(a + b)} = \frac{5.4}{2.5(\,2.7 + 2)} = 0.45$$

Ceiling color: white
% 80 (selected table ....)
Wall color : white
% 50 (selected table.....)

$$\eta = \frac{0.45 \times 0.24}{0.6} = 0.2$$ (to find table 1. according to room index value Of 0.6 and to make proportion)

d = 1.25

E = 50 lux (to selected according to electrical installation standards)

$$\text{Ø}_{total} = \frac{E_{av}.\ A.\ d}{\eta} = \frac{50 \times 5.4 \times 1.25}{0.2} = 1637 \text{ lumen}$$

Ø_L = 730 lumen (to using 60 w's enkandesan lamps)

$$n = \frac{\text{Ø}_{total}}{\text{Ø}_L} = \frac{1637}{730} = 2.3 = 2$$ (to put 2 lamps in the room)

- **Lighting calculation for dust rooms**

a= 4 m

b= 5.2 m

A= **a**x**b** =20.8 m²

$K = \frac{a.b}{h(a+b)}$ = (4x5.2)/1.3(4+5.2) = **1.7**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.30$

E = 1**00** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x20.8)/(0.8x0.30) = 8666.66 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 8666.6/1380 = 6.2(put 6 lamps)

- **Lighting calculation for lavabo rooms**

a= 3.4 m

b= 4.5 m

A= **a**x**b** =15.3 m²

$K = \frac{a.b}{h(a+b)}$ = (3.4x4.5)/1.3(3.4+4.5) = **1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x15.3)/(0.8x0.28) = 6830.35 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 6830.35/1380 = 4.9(put 4 lamps)

- **Lighting calculation for washing room**

The measurements are taken from the AUTOCAD of the room where

a= 2.2 m

b= 3 m

A= **a**x**b** =6.6 m²

$K = \frac{a.b}{h(a+b)}$ = (2.2x3)/1.3(2.2+3) =**1.43≈1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x6.6)/(0.8x0.20) =4125 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 4125/1380 = 2.9(put 2 lamps)

- **Lighting calculation for serves room**

The measurements are taken from the AUTOCAD of the room where

a= 1.3 m

b= 2.6 m

A= **a**x**b =**3.38 m²

$K = \frac{a.b}{h(a+b)}$ = (1.3x2.6)/1.3(2.6+1.3) = **0.67**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x3.38)/(0.8x0.20) =2112.5 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 2112.5/1380 = 1.53(put 1 lamp)

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x3.38)/(0.8x0.20) =2112.5 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 2112.5/1380 = 1.53(put 1 lamp)

- **Lighting calculation for corridor**

a= 1.5 m

b= 29 m

A= **a**x**b** **=**43.5 m²

$K = \frac{a.b}{h(a+b)}$ **=** (1.5x29)/1.3(1.5+29) = **1.09≈1**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.15$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x43.5)/(0.8x0.15) = 36250 lumen

$\varnothing_L$= 3750 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ =36250 /3750 = 9.67(put 10 lamps)

- **Lighting calculation for bath rooms**

I used 1 incandescent lamp, but it must be replaced on the wall

- **Lighting calculation for all Balcones**

I replaced 1 incandescent lamp on each Balcony

- **Lighting calculation for room 2,5,7,8,10,11**

The measurements are taken from the AUTOCAD of the room where

a= 5.5 m

b= 3.5 m

A= **a**x**b** **=**18.5 m²

$K = \frac{a.b}{h(a+b)}$ = (3.5x5.5)/1.3(3.5+5.5) =18.5/11.7=**1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x18.5)/(0.8x0.28) =8258.9 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$$n = \frac{\phi_{total}}{\phi_L} = 8258.9/1380 = 5.98\text{(put 6 lamps)}$$

- **Lighting calculation for room 3,4**

The measurements are taken from the AUTOCAD of the room where

a= 3.5 m

b= 8 m

A= **a**x**b** =28 m²

$$K = \frac{ab}{h(a+b)} = (3.5x8)/1.3(3.5+8) = \mathbf{1.87}$$

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.33$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x28)/(0.8x0.33) = 10606 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$$n = \frac{\phi_{total}}{\phi_L} = 10606/1380 = 7.68\text{(put 8 lamps)}$$

- **Lighting calculation for room 9**

The measurements are taken from the AUTOCAD of the room where

a= 3.3 m

b= 4.3 m

A= **a**x**b** =14.19 m²

$K = \dfrac{a.b}{h(a+b)}$ = (3.3x4.3)/1.3(3.3+4.3) =**1.43≈1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = 1**00** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x14.19)/(0.8x0.28) = 6334.8 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \dfrac{\phi_{total}}{\phi_L}$ = 6334.8/1380 = 4.59(put 4 lamps)

- **Lighting calculation for king room 1,2**

The measurements are taken from the AUTOCAD of the room where

a= 5.5 m

b= 8 m

A= **a**x**b** =44 m²

$K = \dfrac{a.b}{h(a+b)}$ = (5.5x8)/1.3(5.5+8) =**1.43≈1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.37$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x44)/(0.8x0.37) =14864.87 lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 14864.87/1380 = 10.77(put 10 lamps)

- **Lighting calculation for washing room**

The measurements are taken from the AUTOCAD of the room where

a= 2.2 m

b= 3 m

A= **a**x**b** =6.6 m²

$K = \frac{a.b}{h(a+b)}$ **=** (2.2x3)/1.3(2.2+3) =**1.43≈1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x6.6)/(0.8x0.20) =4125 lumen

$Ø_L$= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 4125/1380 = 2.9(put 2 lamps)

- **Lighting calculation for serves room**

The measurements are taken from the AUTOCAD of the room where

a= 1.3 m

b= 2.6 m

A= **a**x**b** **=**3.38 m²

$K = \frac{a.b}{h(a+b)}$ = (1.3x2.6)/1.3(2.6+1.3) = **0.67**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

To find the value of η we use table

η = 0.20

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x3.38)/(0.8x0.20) =2112.5 lumen

$Ø_L$= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 2112.5/1380 = 1.5(put 1 lamp)

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x3.38)/(0.8x0.20) =2112.5lumen

ØL= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ =2112.5 /1380 =1.5 (put 1 lamp)

- **Lighting calculation for corridor**

The measurements are taken from the AUTOCAD of the room where

a= 1.5 m

b= 14.5 m

A= **a**x**b** =21.75 m²

$K = \frac{a.b}{h(a+b)}$ = (1.5x14.5)/1.3(1.5+14.5) = **1.04≈1**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.15$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

$\text{Ø}t$=A.E/Mη = (100x21.75)/(0.8x0.15) =18125 lumen

Ø_L= 1380 lumen (to using 36 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 18125/3750 = 4.8(put 5 lamps)

- **Lighting calculation for bath rooms**

I used 1 incandescent lamp, but it must be replaced on the wall

- **Lighting calculation for all Balcones**

I replaced 1 incandescent lamp on each Balcony

- **Lighting calculation for store 2,3**

The measurements are taken from the AUTOCAD of the room where

a= 1.2 m

b= 2 m

A= **a**x**b** =3 m²

$K = \frac{a.b}{h(a+b)}$ = (1.5x2)/1.3(1.5+2) == **0.65**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

η = 0.20

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x3)/(0.8x0.20) =1875 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ =1875 /1380 = 1.3(put 1 lamp)

- **Lighting calculation for room kazan 1**

The measurements are taken from the AUTOCAD of the room where

a= 3.5 m

b= 7.5 m

A= **a**x**b =**26.25 m²

$K = \frac{a.b}{h(a+b)}$ = (3.5x7.5)/1.3(3.5+7.5) =26.25/14.3=**1.83**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.31$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x26.25)/(0.8x0.31) =10584.6 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 10584.6 /1380 = 7.6(put 8 lamps)

- **Lighting calculation for room kazan 2**

The measurements are taken from the AUTOCAD of the room where

a= 2 m

b= 3 m

A= **a**x**b** =6 m²

$K = \frac{a.b}{h(a+b)}$ = (2x3)/1.3(2+3) =6/6.5=**0.92**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x6)/(0.8x0.20) =3750 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 3750/1380 = 2.7(put 2 lamps)

- **Lighting calculation for store 4**

The measurements are taken from the AUTOCAD of the room where

a= 1.3 m

b= 1.8 m

A= **a**x**b** =2.34 m²

$K = \frac{a.b}{h(a+b)}$ **=** (1.3x1.8)/1.3(1.3+1.8) == **0.50**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

η = 0.20

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x2.34)/(0.8x0.20) =1462.5 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 1462.5 /1380 = 1.05(put 1 lamp)

- **Lighting calculation for kitchen**

The measurements are taken from the AUTOCAD of the room where

a= 7.5 m

b= 10 m

A= **a**x**b** =75 m²

$K = \frac{a.b}{h(a+b)}$ **=** (7.5x10)/1.3(7.5+10) == **3.2**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x75)/(0.8x0.28) =33482.1 lumen

ØL= 3750 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 33482.1 /3750 = 8.9(put 8 lamps)

The measurements are taken from the AUTOCAD of the other side

a= 2.5 m

b= 3.5 m

A= **a**x**b** =8.75 m²

$K = \frac{a.b}{h(a+b)}$ = (2.5x3.5)/1.3(2.5+3.5) =**1.1**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

To find the value of η we use table

$\eta = 0.15$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x8.75)/(0.8x0.15) =7291.6 lumen

ØL= 3750 lumen (to using 58 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 7291.6/3750 = 1.9(put 2 lamps)

- **Lighting calculation for personal washing dishes room**

The measurements are taken from the AUTOCAD of the room where

a= 3 m

b= 3.5 m

A= **a**x**b** =10.5 m²

$K = \frac{a.b}{h(a+b)}$ **=** (3x3.5)/1.3(3+3.5) == **1.28**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

η = 0.25

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x10.5)/(0.8x0.25) =5250 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 5250/1380 = 3.8(put 4 lamps)

- **Lighting calculation for personal room 2**

The measurements are taken from the AUTOCAD of the room where

a= 3.5 m

b= 4.8 m

A= **a**x**b** =16.8 m²

$K = \frac{a.b}{h(a+b)}$ = (3.5x4.8)/1.3(3.5+4.8) == **1.28**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

η = 0.28

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x16.8)/(0.8x0.28) = 7500 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 7500/1380 = 5.4 (put 6 lamps)

- **Lighting calculation for drink store**

The measurements are taken from the AUTOCAD of the room where

a= 3.5 m

b= 6 m

A= **a**x**b** =21 m²

$K = \frac{a.b}{h(a+b)}$ = (3.5x6)/1.3(3.5+6) == **1.7**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.30$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x21)/(0.8x0.30) = 8750 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 8750/1380 = 6.3 (put 6 lamps)

- **Lighting calculation for linen store, library**

The measurements are taken from the AUTOCAD of the room where

a= 2.2 m

b= 3.5 m

A= **a**x**b =**7.7 m²

$K = \frac{a.b}{h(a+b)}$ **=** (2.2x3.5)/1.3(2.2+3.5) == **1.7**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x7.7)/(0.8x0.20) = 4812.5 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 4812.5/1380 = 3.4 (put 4 lamps)

- **Lighting calculation for heating room**

The measurements are taken from the AUTOCAD of the room where

a= 3.5 m

b= 3.8 m

A= **a**x**b** =13.3 m²

$K = \frac{a.b}{h(a+b)}$ = (3.5x3.8)/1.3(3.5+3.8) == **1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

η= 0.28

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x13.3)/(0.8x0.28) = 5937.5 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 5937.5/1380 = 4.3 (put 4 lamps)

- **Lighting calculation for store 1**

The measurements are taken from the AUTOCAD of the room where

a= 2.5 m

b= 4 m

A= **a**x**b** =10 m²

$K = \frac{a.b}{h(a+b)}$ = (2.5x4)/1.3(2.5+4) == **1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.20$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x10)/(0.8x0.20) = 6250lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 6250/1380 = 4.5 (put 4 lamps)

- **Lighting calculation for linen store 2**

a= 3.4 m

b= 4.5 m

A= **a**x**b** =15.3 m²

$K = \frac{a.b}{h(a+b)}$ = (3.4x4.5)/1.3(3.4+4.5) = **1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x15.3)/(0.8x0.28) = 6830.3 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 6830.3/1380 = 4.9 (put 4 lamps)

- **Lighting calculation for corridor 2**

I used 1 incandescent lamp, but it must be replaced on the wall

a= 1.5 m

b=11 m

A= **a**x**b** = 16.5m²

$K = \frac{a.b}{h(a+b)}$ = (1.5x11)/1.3(1.5+11) = 1.015

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white, walls are quite white

To find the value of η we use table

$\eta =$ **0.15**

E = **100** lux (to selected according to electrical installation standards where it is a general bedroom).

M = **0.8**

Øt=A.E/Mη = (100x16.5)/(0.8x0.15) = **13750**lumen

$\emptyset_L$= 3750 lumen (to using 58 w's (from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ =13750/3750 = 3.6 (put 4 lamps)

- **Lighting calculation for corridor 1**

The measurements are taken from the AUTOCAD of the room where

a= 1.5 m

b=8 m

A= **a**x**b** = 12m²

$K = \frac{a.b}{h(a+b)}$ = (1.5x8)/1.3(1.5+8) =0.97

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white, walls are quite white

To find the value of η we use table

η = **0.15**

E = **100** lux (to selected according to electrical installation standards where it is a general bedroom).

M = **0.8**

$\emptyset$t=A.E/Mη = (100x12)/(0.8x0.15) = 10000 lumen

$\emptyset_L$= 3750 lumen (to using 58 w's (from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 10000/3750 = 2.6 (put 3 lamps)

- **Lighting calculation for bath rooms**
-

I used 1 incandescent lamp, but it must be replaced on the wall

- **Lighting calculation for market 1**

The measurements are taken from the AUTOCAD of the room where

a= 5.5 m

b= 7.5 m

A= **a**x**b** =41.25 m²

$K = \frac{a.b}{h(a+b)}$ = (5.5x7.5)/1.3(5.5+7.5) = **2.4**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.37$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x41.25)/(0.8x0.37) =13935.8 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 13935.8 /1380 = 10(put 10 lamps)

- **Lighting calculation for market 2,3** a= 7 m

b= 11 m

A= **a**x**b** =77 m²

$K = \frac{a.b}{h(a+b)}$ = (7x11)/1.3(7+11) = **3.2**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.41$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x77)/(0.8x0.41) = 23475.6 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 23475.6 /1380 = 17(put 16 lamps)

- **Lighting calculation for market 4**

a= 5.5 m

b= 7 m

A= **a**x**b** =38.5 m²

$K = \frac{a.b}{h(a+b)}$ = (5.5x7)/1.3(5.5+7) = **2.3**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.35$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x38.5)/(0.8x0.35) = 13750 lumen

$Ø_L$= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 13750/1380 = 9.96 (put 10 lamps)

- **Lighting calculation for market 7**

a= 5.5 m

b= 6.5 m

A= **a**x**b** =35.75 m²

$K = \frac{a.b}{h(a+b)}$ = (5.5x6.5)/1.3(5.5+6.5) = **2.29**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.35$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x35.75)/(0.8x0.35) = 12767.8 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 12767.8 /1380 = 9.25 (put 10 lamps)

- **Lighting calculation for telephone central**

a= 3 m

b= 3.5 m

A= **a**x**b** **=**10.5 m²

$K = \frac{a.b}{h(a+b)}$ **=** (3x3.5)/1.3(3+3.5) = **2.29**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.24$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x10.5)/(0.8x0.24) = 5468.75 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 5468.75 /1380 = 3.96 (put 4 lamps)

- **Lighting calculation for accounting**

a= 4 m

b= 7 m

A= **a**x**b** =28 m^2

$K = \frac{a.b}{h(a+b)}$ = (4x7)/1.3(4+7) = **1.95**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.33$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x28)/(0.8x0.33) = 10606 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 10606/1380 = 7.68 (put 8 lamps)

- **Lighting calculation for room 9**

a= 3.5 m

b= 4.8 m

A= **a**x**b** =16.8 m^2

$K = \frac{a.b}{h(a+b)}$ = (3.5x4.8)/1.3(3.5+4.8) = **1.5**

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white walls quite white

To find the value of η we use table

$\eta = 0.28$

E = **100** lux (to selected according to electrical installation standards)

M = **0.8**

Øt=A.E/Mη = (100x16.8)/(0.8x0.28) = 7500 lumen

ØL= 1380 lumen (to using 100 w's economical energy lamps)(from lamp specification)

$n = \frac{\phi_{total}}{\phi_L}$ = 7500/1380 = 5.43 (put 6 lamps)

- **Lighting calculation for bath rooms**

I used 1 incandescent lamp, but it must be replaced on the wall

- **Lighting calculation for corridor**

The measurements are taken from the AUTOCAD of the room where

a= 1.5 m

b=8 m

A= **a**x**b** = 12m²

$K = \frac{a.b}{h(a+b)}$ = (1.5x8)/1.3(1.5+8) =0.97

h = H-(h1-h2) = 3-(0.9-0.8)=1.3m

Consider that the color of the Ceiling is white, walls are quite white

To find the value of η we use table

η = **0.15**

E = **100** lux (to selected according to electrical installation standards where it is a general bedroom).

M = **0.8**

$Øt=A.E/M\eta$ = (100x12)/(0.8x0.15) = **10000** lumen

$Ø_L$= 3750 lumen (to using 58 w's (from lamp specification)

$$n = \frac{\phi_{total}}{\phi_L} = 10000/3750 = 2.6 \text{ (put 3 lamps)}$$

- **Lighting Calculation for Reception, Information**

I replaced 1 florescent lamp each of them

CHAPTER FOUR

VOLTAGE AND CURRENT CALCULATIONS

4.1 VOLTAGE CALCULATION FORMULA

4.1. a For three phases:

$$\% e = \frac{100 \times L \times N}{K \times S \times U^2} < 3 \text{ (must be like this)}$$

Result:

$$\% e = \frac{0.0124 \times L \times N}{S} < 3$$

- L......................: distance of the line (m)
- N.....................: power (KW)
- S......................: conductive cross section (mm^2)
- K.....................: conductive coefficient
- U.....................: voltage (380 volt)
- %e...................: calculation voltage (percent)

4.1. b for single phase

$$\% e = \frac{200 \times L \times N}{K \times S \times U^2} < 1,5$$

Result:

$$\% e = \frac{0,074 \times L \times N}{S} < 1,5$$

- U....................: voltage (220 volt)

4.2 FORMULAS CURRENT CONTROL:

4.2. a for three phases:

$$N = \sqrt{3} \times U \times I \times COS\emptyset$$

$$I = \frac{N}{\sqrt{3} \times U \times COS\emptyset}$$

- N................: power (w)
- I..................: current (A)
- U................: voltage (380 volt)

4.2. b Single phase:

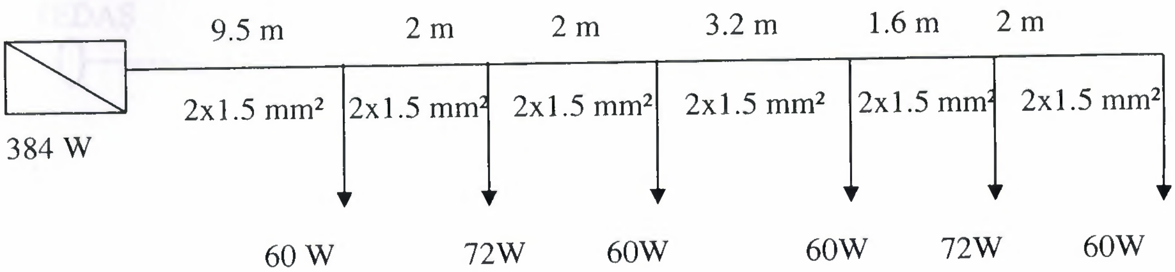
$$N: U \times I \times COS\emptyset$$

$$I = \frac{N}{U \times COS\emptyset}$$

- U.................: voltage (220 volt)

4.3 LIGHTINGS:

TG-1

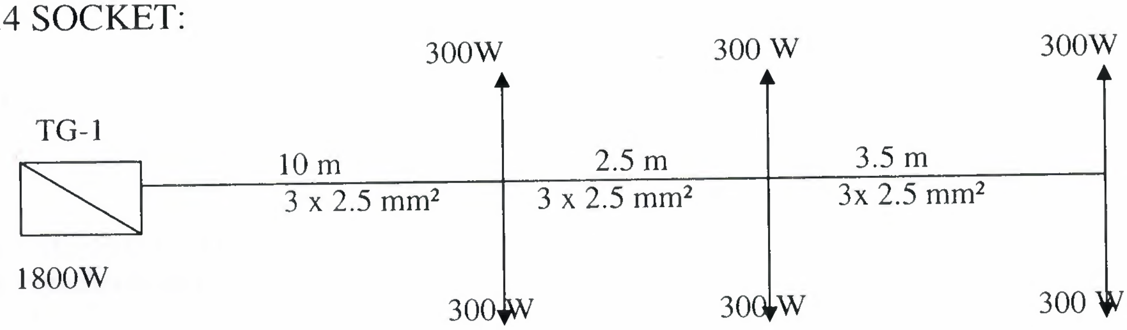


$$\%e = 0.074 \times [(9.5 \times 0.384/1.5) + (2 \times 0.324/1.5) + (2 \times 0.252/1.5) + (3.2 \times 0.192/1.5) + (1.6 \times 0.132/1.5) + (2 \times 0.060/1.5)] = 0.285$$

0.285 < 1.5 CROSS SECTION IS SUITABLE

$$I = \frac{384}{220} = 1.74 \text{ A}$$

4.4 SOCKET:

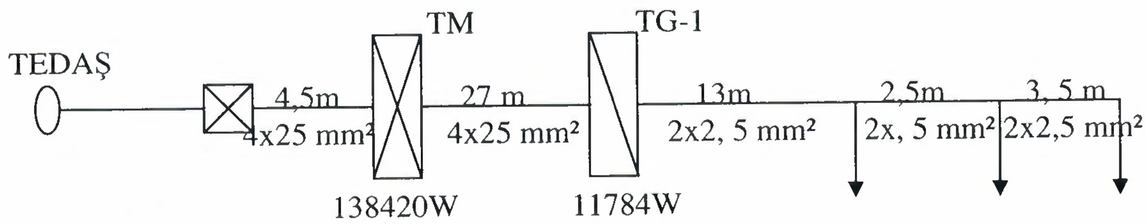


$$\%e = 0.074[(10 \times 1{,}8/2{,}5) + (2{,}5 \times 1{,}2/2{,}5) + (3{,}5 \times 0{,}6/ 2{,}5)] = 0{,}683$$

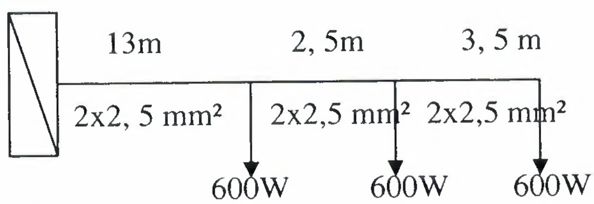
0,683 < 2, 5 SÜITABLE FOR CROSS SECTION

$$I = \frac{1800}{220} = 8,\ 18 \text{ A}$$

4.5 THE MAIN CASES VOLTAGE CALCULATION:



- FOR TG-1 CASES



$$\%e1 = 0.074 \frac{N\,L}{S} = 0.074[(10 \times 1,\, 8/2{,}5) + (2{,}5 \times 1{,}2/2{,}5) + (3{,}5 \times 0{,}6/\, 2{,}5)] = = 0{,}683$$

- FOR COLOMN LINE:

N (set power) = 11784 W = 11,784 kW
N (synchronous power) = 7070 W = 7,070 kW

$$\%e2 = \ 0{,}074 \frac{N\,L}{S} = 0.074 \frac{27 \times 7{,}070}{25} = 0{,}565$$

- FOR THE MAİN CASES:

N (set power) = 138420 W = 138,420 kW

N (synchronous power) = 83052 W = 83,052 kW

$$\%e3 = 0{,}0124 \frac{N\,L}{S} = 0.0124 \frac{4{,}5 \times 83{,}0}{25} = 0{,}185$$

%e = %e1 + %e2 + %e3 = 0, 68+ 0,565 + 0,185 = 1, 43 <% 1, 5 is suitable

4.6 POWER FACTOR OPERATION

Total Power..= 138420

$Cos\O_1$..= 0.7

$Cos\O_2$...= 0.99

Demand Power..................................= 83052

$$Q = P \times (\tan \O_1 - \tan \O_2)$$

$$Q = 83052 \times (1{,}020 - 0{,}142)$$

$$Q = 72919 \text{ VAR}$$

- Q......................: Reactive Power (VAR)
- P......................: Active Power (W)
- Cos Ø..............: Power coefficient

So to using 75 KVAR's panel

THE REPORT OF PRICE

No	Price No	Kind of mate	Unit	Amount	The price	Total cost
1	A-12.2	1x40W Florescent Tesisatı	Number	252	78000000	19656000000
2	A-4	duvar globu	Number	234	50600000	11840400000
3	A-3	tavan globu	Number	108	50600000	5464800000
4	A.12.5	2x40W floresent tesisatı	Number	24	106150000	2547600000
5	C-1.1	1x13Amp priz tesisatı	Number	357	56000000	19992000000
6	D-1.1	Telefon priz tesisatı	Number	6	61600000	369600000
7	D-8	TV prizi	Number	109	75250000	8202250000
8	I-1.4	(1x4) Yollu dağıtım panosu	Number	4	187000000	748000000
9	I-1.6	(1x8)Yollu dağıtım panosu	Number	12	318000000	3816000000
10	H-1.1.1	(3x4)Yollu 3x100Amper bus	Number	1	612500000	612500000
11	H-2.1	MCB 1faz 45 Amper	Number	12	34000000	408000000
12	H-2.1	MCB 2 faz 45 Amper	Number	12	112750000	1353000000
13	H-5.16	MCCD+ELCB 3x100Amper	Number	1	1652000000	1652000000
14	G-3.15.7	(3x25+16)mm2 çelik kablo	Meter	32	38000000	1216000000
15	T	Topraklama	meter	5	32000000	160000000
					TOTAL=	78038150000TL

CONCLUSION

Actually, when I began the project. I hadn't predicted that l have a difficulties in this level. However, it is not easy are that is seen from outside, because in real life, calculations are placed specific formulation and there is no searching in detail. I tried to get calculations in detail because my purpose is that project should include collect and permanent information.

In project electric interior installation was drawn, after necessary information's were given for illuminating calculations for that, wire cross section were calculated with falling down of necessary voltage and calculating of current control. In this project the list of the cost and summary of reconnaissance were generated after establishing unit of kompanzasyon for increasing power factor with to make kompanze of reactive power. Generating of loading schedule and preparing of column diagram.

Auto-Cad programmed has recently an importance place in engineering field in terms of facilities with providing of developing computer technology. Therefore, I got interior installation, loading schedule, column diagram with preferring Auto-Cad programmed in drawing this project and also I used Microsoft office programmed
This project helps me to see conditions of jobs in business life and process of electrical project drawn in market. I think that learnt working conditions with main frame in market and in addition with taken theory education in university

As a result, this project helps me for preparing to my business life

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- Elektrik Tesisat Planları Sözleşme Keşif ve Planlama, (Elektrik Projeleri), Ali Doğru, Hasfset-baskı,
- Elektrik İç Tesisat Yönetmeliği
- Çukurova üniversitesi alçak gerilim dağıtımı ve aydınlatma tez

TABLE OF EFFICIENCY

Ceiling	0.80				0.50				0.30	
Wall	0.50		0.30		0.50		0.30		0.10	0.30
Ground	0.30	0.10	0.30	0.10	0.30	0.10	0.30	0.10	0.30	0.10
0.60	0.24	0.23	0.18	0.18	0.20	0.19	0.15	0.15	0.12	0.15
0.80	0.31	0.29	0.24	0.23	0.25	0.24	0.20	0.19	0.16	0.17
1.00	0.36	0.33	0.29	0.28	0.29	0.28	0.24	0.23	0.20	0.20
1.25	0.41	0.38	0.34	0.32	0.33	0.31	0.28	0.27	0.24	0.24
1.50	0.45	0.41	0.38	0.36	0.36	0.34	0.32	0.30	0.27	0.26
2.00	0.51	0.46	0.45	0.41	0.41	0.38	0.37	0.35	0.31	0.30
2.50	0.56	0.49	0.50	0.45	0.45	0.41	0.41	0.38	0.35	0.34
3.00	0.59	0.52	0.54	0.48	0.47	0.43	0.43	0.40	0.38	0.36
4.00	0.63	0.55	0.58	0.51	0.50	0.47	0.47	0.44	0.41	0.39
5.00	0.66	0.57	0.62	0.54	0.53	0.50	0.50	0.46	0.44	0.40

Table-1: Table of Efficiency