NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

GRADUATION PROJECT

ELECTRICAL INSTALLATION DESIGN

EE400

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Supervisor: Assoc.Prof.Dr.ÖZGÜR C. ÖZERDEM

Mohammed KMAİL

Nicosia – 2014

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CHAPTER TWO INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

INTRODUCTION

Technical staff in the field of electricity , the electrical installation plans and it should be able to read exactly must be able to conduct a complete application by the way . Therefore, vocational education and training on the basis of technical plans are of great importance . Besides, this plan covered by describes properties of materials and shapes them known symbols , materials suitable Selecting the plan and performing installations related laws, specifications , regulations and standards are also required to comply . Therefore, consisting of 8 units , respectively, in the book of the Electrical Installation Plan general information relevant to the topic and legislation has been given, briefly discussed the materials used in electrical installations , an important issue Lighting and computational techniques have been investigated, holds an important place in the installation of low-voltage installations described , reactive power compensation issues are mentioned , protection and safety in electrical installations subject treated , lighting and interior installations and examples of strong current plans were undertaken separately is corroborated by the application . In short, students may need a lot of information about electrical installation plans and teaching prepared in order to be included in this book have been studied. After receiving this information graduating students After working in related occupations and work in the case of adapting will be easy to comprehend . Prepared this book to students and technical staff working on these issues and believe will be beneficial to I wish success for our students .

Chapter one presents the electrical installation specifications, which are The General Technical Specifications for Buildings are published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

Chapter two; 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 not only more energy efficient, they are offering many more possibilities to improve the quality of lighting our homes, indoors and out.

Chapter three;. cables, 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 ONE

ELECTRICAL INSTALLATION SPECIFICATIONS

1.1 Over View

The General Technical Specifications for Buildings published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

1.2 General Specifications

All works, Materials Manufacturing, fabricating, testing and commissioning shall be governed by latest conditions of the following standards:

1- The general technical specification
2- National Codes
3- 16th Edition of IEE
4- British Standard
5- IEC Recommendation

In case of any conflicts arising between this Specification and Standard/Codes, the Contractor shall refer the matter to the Engineer and for Clarifications.

The Contractor shall submit a complete set of Shop Drawings for Engineer's approval prior one month to commencing the work at least. The Contractor shall submit a logical schedule of work for the project activities to the Engineer for approval, beside, the Contractor shall submit weekly, monthly, progress report.

The Contractor shall obtain the Engineer's written approval for all materials, equipment, accessories ...etc., prior to the procurement of any material, submittals shall be early stages, supplying of materials to the site shall be coordinated with the engineer and to his approval.

The Contractor shall submit for approval all drawings, diagrams, catalogues, dimensions, samples and any other information that may be required by the Engineer .Location of some electrical fixtures may be modified to suit the site conditions and/or to comply with safety measures. No claims will be accepted in such cases.

Testing and commissioning is an essential part of this Contract. The Contractor shall provide the testing instruments required. All tests shall be conducted and witnessed by the Engineer and the results shall be certified and signed by the Contractor and the Engineer. Original copies of testing certificates shall be kept with the Engineer.

The Contractor shall submit one complete set of transparent as-built drawings, CD disc and three blue print sets to the Engineer along with all manuals, wiring diagrams, operating instructions, maintenance instructions, list of recommended spare parts for two years and vendors names and addresses .All documents of this contract are complementary to each other and should be red as whole. [7]

1.3 Materials and Testing

The whole of the Works shall be executed with the materials indicated in the subsequent clauses of this Specifications .Where the names of manufacturers are stated, together with a detailed specification of their products.

Where such exists, the equipment shall comply with the requirements of the appropriate current standards as mentioned in item 1-2 and shall be of the best of their respective kinds, free from all flaws and defects.

1.4 Labour Restrictions

The Contractor shall employ none but workmen skilled in their respective trades and must not employ unskilled laborers in lieu of skilled workmen

1.5 Conduits

Only the following types of conduits and related fittings and accessories shall be used for the installation covered by this specification.

1.5.1 Rigid Non-Metallic Conduits (U/PVC)

Rigid non-metallic conduits including sleeves and elbows shall comply with BS6099, PART 2, SECT.2.21, 1982.

1.5.2 Rigid Metallic Conduit

Rigid metal conduit including sleeves and elbows shall comply with BS4568.

1.5.3 Flexible Non-Metallic Conduit

Flexible non-metallic conduit shall be suitable for installation in conjunction with rigid non-metallic conduits by the use of the same fittings and connectors .

1.5.4 Flexible Metal Conduit

Flexible metal conduit shall comply with NEC-Article 350. Conduit shall be suitable for installation in conjunction with rigid metal conduit, by the use of the same fittings and connectors. A separate conduit and wiring system is to be provided for each installation, i.e. lighting, general purpose sockets, power, telephone, etc.

Draw wires shall be left in all conduit runs for other services .Conduits shall not be run than 0.15m to any steam or hot water pipes and shall be run underneath such pipes rather than over them. The conduits shall not be run closer than 0.05m to any telephone, bell or other signaling .All joints in PVC conduits, shall be cemented with a waterproof adhesive.

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Draw wires shall be left in all conduit runs for other services .Conduits shall not be run than 0.15m to any steam or hot water pipes and shall be run underneath such pipes rather than over them. The conduits shall not be run closer than 0.05m to any telephone, bell or other signaling .All joints in PVC conduits, shall be cemented with a waterproof adhesive.

Where conduits cross a building expansion joint due allowance shall be made in the design or the run with an approved expansion joint .All circular PVC boxes shall be provided with steel insert clips to provide additional support for lighting fittings .

Flexible metal conduits, watertight where required, shall be provided between the conduit system and electrical motors or other apparatus subject to vibration. They shall be complete with brass double female adaptors and shall be soldered to either end of all flexible conduits and connected to solid conduit entries using smooth bore male brass bushes.

Earth continuity through flexible conduits shall be provided by a separate earth continuity conductor .Minimum size of conduits shall be 20 mm. diameter, unless otherwise indicated or approved. Conduit runs shall not exceed 10 m in length without the incorporation of a pull box.

Conduits shall not cross pipe shafts, or vent duct openings. Riser conduits shall be supported at each floor level by approved clamp hangers.

All conduit and accessories shall be produced of the same manufacturer. Conduits and accessories installed (concealed) shall be of heavy gauge U-PVC conduits and shall comply with BS 4607; Class A.

Conduits shall have capacities as listed in the following table 1.1, unless stated other wise. In any case the space factor shall never exceed 40%. Pull boxes shall be located at convenient intervals at accessible positions.

Table 1.1: Conductor Conduit Size.

Size mm2	20	25	32	38	50
1.5	7	12	20	--	--
2.5	4	8	12	--	--
4.0	3	6	10	--	--
6.0	3	5	8	--	--
10.0	--	3	6	8	--
16.0	--	--	3	4	5
25.0	--	--	--	4	6
35.0	--	--	--	4	6
50.0	--	--	--	--	4

1.6 Pull and Junction Boxes

Pull and junction boxes shall be suitable for use in conjunction with the selected raceway systems.

1.6.1 Outlet Boxes

For concealed installation, outlet boxes shall be plastic, fastened with amply sized screws. For exposed installation, outlet boxes shall be either sheet metal of heavy-duty plastic, mounted exposed and rigidly connected to the conduit system by suitable bushings Comply with BS 5733.

1.6.2 Terminations

Terminations in junction boxes, floor boxes, distribution boxes and outlet boxes shall be of the screwed type.

1.7 Wires and Cables

Wires and cables shall be fabricated of stranded copper conductors in accordance with BS6004, 1984. The insulation of all wires and cables shall be rated for at least 70 deg. C for polyvinyl chloride (PVC) and 90 deg. D for thermoplastic (PE) cables. The identification by color for conductors in multicore wires and cables shall comply with IEC 446. XLPE cables shall comply with IEC 502 as shown on Drawings or schedules. Fire resistance insulation complying with UL1424-105 °C; especially for fire alarm systems.

1.7.1 Wires for Power, Lighting and Controls.

Wires are single-core insulated or multicore insulated and sheathed conductors which are used only for light-duty indoor applications. The conductor insulation and the sheath shall be polyvinyl chloride .All cables buried in the ground shall incorporate armor.

The cables installed in positions which may be exposed to direct sunlight shall be of a type resistant to damage by ultra-violet light or shall be suitably covered to protect from ultra-violet light .All cable conductor shall be fitted with a correctly sized cable socket or thimble and a means of identification. The cable sockets may be of the sweated or crimped compression types. The cables connected in parallel shall be of the same type, cross sectional area, length and disposition and be arranged so as to carry substantially equal load currents . [2]

1.7.2 L.V. Main Cables

L.V. Main Cables shall be 4 core; 600/1000 volts grade PVC insulation, single steel wire armoured. The conductors shall be circular standard copper. The armouring of L.V. main cables shall not be used as the sole circuit protective conductor (CPC). The sizes of protective conductor shall be calculated in accordance with Tables 54E and F of IEE Regulations or equal. L.V. cables if to be buried direct in the ground. They shall be buried to a depth of 70 cm. in trenches which have been cleared of all rocks and rubble and into which a 5 cm. sand layer shall be placed across the full width and along the entire length of the trench. The cables shall be laid on this sand bed and covered with a further 10 cm. layer of sand before the trench is backfilled and compacted. Concrete tiles shall be placed on the top of the second layer of sand as shown on the Drawing with suitable material.

Where L.V. cables cross sidewalks or road, they shall be drawn into heavy gauge PVC conduit of 15cm. ϕ. Concrete layer of thickness 10 cm. shall cover this UPVC conduit. In addition a warning PVC tape shall be laid in the cable trench during

the backfilling process so that the cable marker strip is 15 cm., beneath the finished compacted surface of the trench. Where L.V. cables are installed in a concrete trench, these cables shall be fixed to the base and sides of the trench by means of using cable cleats at intervals not exceeding 900 mm, between centers of adjacent fixings. The cable separation between adjacent cables shall not be less than double the diameter of the cable. [2]

1.7.2.1 Wires for Communication

Wires for communication are single-core or multicore insulated and sheathed conductors which are used only for light-duty indoor applications .

1.7.2.2 Communication Cables

Communication cables are multicore insulated, shielded and sheathed tinned copper conductor cables for indoor and outdoor installation in conduits, ducts or for direct burial .

1.8 Switches

Switches shall be mounted with the operating handle in upward position when in the "ON" position. Switches used on lighting branch circuits shall be quick make, quick break, with silver alloy contacts, rocker, operated with quick operating mechanism rated at 10 amperes 250 volts AC or higher capacity as required by the circuit controlled in accordance with the Specifications. Switches shall be single, three or four way flush mounted type and shall be waterproofed where required. Switches shall be to BS 3676 : 1989.Type MK or approved equal

1.9 stair switches

For stairs I used sensor switches, there is many types of sensor switches like TSM
1S, TSM1E and TSEN1. In this project I used the last one TSEN1 because the stair distance not so much.

1.10 Power Outlets

The switch socket outlets shall be as indicated on the drawings, all in accordance with BS1363 and BS546 as appropriate. These outlets shall be of the same manufactuer

throughout the installation. To different between the normal power supply receptacles from the essential & or the computer receptacles. Each system receptacles shall be distinctively colored or marked for identification.

1.11 Socket Outlets

Socket outlets shall be of the standard, 3-pin, single phase, with or without switch, flush mounted type of moulded plastic designed to fit with the appropriate plates as specified.

- Waterproof socket outlet without switch shall be used in washing room and kitchens.
- Single phase socket outlets shall be 13A, 230 volts, earthed, shuttered type.

Switches for electric water heater shall be flush 20 amp. DP switches with pilot lamp and marked (Water Heater).

1.12 Water Proof Receptacles

It shall be seal splash proof, switched and with pilot light. The dust and waterproofing shall be IP54 when plug is inserted in receptacle. Receptacle shall be semi-flush with wall.

1.13 INDUSTRIAL RECEPTACLES:

These receptacles shall be industrial type as shown on the Drawings, and shall be designed for AC230V to 660V. Receptacles shall be three, four or five-pole. The enclosure shall be plastic, splash proof or made watertight.

1.14 Telephone Systems

Telephone cabinet (TC) shall be provided as shown on the Drawings for adequate number of extensions, for the distribution of wires or cables between the main distribution frame and the extension outlets.

Telephone outlets shall be flush mounting type. These shall be of the same make and plate finish of the adjacent socket outlets.

1.15 Main and Sub main Distribution Boards

The (MDB) shall be fabricated, tested and commissioned in compliance with Electrical power Authority requirements and Engineer's approval. Free standing cubicle panel board consisting of 2mm thick steel sheet hammer painted, gray color with lockable hinged doors, locks and switches, rubber gaskets, dust proof to IP54. Sufficient holes for glands in removable rigid steel sheet gland plate to be provided.

The structure of the main sub main electrical panel boards shall be form two. All panel boards must include proper floor attachment facilities, and terminal panels in the top section and bottom section, in accordance with the location of the cable output.

The internal wiring shall be laid in proper PVC trunking, identified at both ends by PVC numbers. If flexible cables used inside the panel, then the cables of be soldered prior to being compressed into lugs. The lugs to be of tinned copper compression type. Bolted lugs are NOT allowed.

All bus bars and live terminals inside any electrical panel shall be isolated and not accessible by any means to ensure safe and normal cooperation of the panel. Bus bars ratings shall exceed 1.5 times the main circuit breaker rating of the panel.

1.16 Bus-Bars

The panel boards will contain bus-bars for phases R,S,T neutral and ground, without paint. These bus-bars shall be made of copper, with lead cooked and their cross-section must be compatible, thermally and mechanically, with the short-circuit currents specified in the plans, and in any case not less than 60KA on 415v. For 1 section. All panels shall have sufficient space for ventilation and maintenance purposes plus extra room to allow for the possibility of adding 25% of the installed circuit breakers. A separate cubicle shall be incorporated in the switchboard for accommodation of the Supply Authority's Metering Equipment. It shall meet the Supply Authority requirement and approval. In the main Switchboard the following facilities to BS89, shall be included : three Ammeters, one Voltmeter with Voltmeter selector switch, one Power factor meter, three Color coded pilot lamps, & M.R.C. fuses for voltage circuit protection. The MDB, for each building shall be provided with protection moulded case circuit breakers. Full schematic and control drawings shall be kept in a pocket at the inner side of the front door for maintenance. Engraved metal or PVC labels to be fixed at the mimic diagram to identify the components of the panel. Fixing Devices for free standing, supports, earthing... etc. shall be installed.

All cables and conduits connections to panels shall be firmly and securely connected mechanically and electrically by using proper glands, male pushes, femals pushes, locknut, by soldering or compression type lugs, clamps, supports ... etc., bolted lugs and NOT allowed . Contactors, when used, shall be protected by circuit breakers. Contactor rating shall be not less than 125% of its relative circuit breaker rating unless otherwise specified. [2]

1.17 Distribution Boards

Distribution Panel Bards feeding lights, socket outlets and other appliances shall be totally enclosed, dust protected and vermin proofed. The enclosure of these Panel Boards shall be of robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall be robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall contain an on load isolator and miniature circuit breakers or the size and number specified in Drawings and a neutral connector block of ample size to ensure that a separate way is available on the connector block for the neutral conductor of each circuit. The construction of the enclosure of those distribution boards shall be executed in a way such that to operate the mi-

niature circuit breakers, it is necessary to open the hinged door and to ensure access to the interior components and to the internal wiring, it is necessary to dismantle and remove a separate barrier within the enclosure. Miniature circuit breakers shall have a breaking capacity of 6000 amps. All miniature circuit breakers shall be equipped with thermal overload trips to operate at 125% rated current and instantaneous magnetic trips.

1.17.1 Circuit Breakers

Protective devices as shown shall be of the moulded case type up to an capacity of 630A. Trip-free circuit breakers shall be used with thermal and magnetic over current tripping devices for each line. Adjustable thermal tripping devices shall be adjustable from approx. 70% to full load rating . The magnetic tripping devices to be of the adjustable type .Circuit breakers with an capacity of 1000A and above shall be equipped with a motor-operated closing mechanism. All circuit breakers shall indicate clearly whether they are open or closed and shall have an interrupting rating not less than the maximum available short-circuit current at the supply terminals. The moulded case circuit breakers providing complete circuit over current protection by having inverse time and instantaneous tripping characteristics and where applicable, be current limiting. Circuit breakers shall be operated by a toggle type handle and shall have a quick made over current switching mechanism that is mechanically trip free. Circuit breakers 150 ampere and below shall be thermal magnetic trip with inverse time current characteristics.

1.17.2 Miniature Circuit Breakers

Miniature circuit breakers shall be of the narrow type and shall be for manual operation with trip-free release. Miniature circuit breakers shall be equipped with the thermal over current and a magnetic short-circuit tripping element .

The interrupting capacity of miniature circuit breakers shall not be less than 6AK off (230 V AC). Miniature circuit breakers shall have tripping characteristics in accordance with IEC 898 and IEC 947-2. Residual current circuit breakers shall comply with BS4293 .

1.17.3 Air Circuit Breaker (ACB)

The incoming supply shall terminate at the main air break circuit breakers on the switchboard. The air break circuit breaker shall comply with BS4752 VED0660 for use on a 380 volts 3 phase 50 Hz wire system .The bus bar sectionalizer shall be the same type (ACB) .The circuit breaker shall be horizontally isolated, horizontal draw-out pattern, air break type. The circuit breaker closing mechanism shall be motorized. The operating mechanism shall have a mechanical ON/OFF indicator and a manual trip device fitted with means for locking, test terminal blocks, healthy trip lamp (coloured white) as associated pushbuttons, set of auxiliary switches, supply available lamp, cable boxes complete with glands of suitable size fore the accommodation of the incoming and out going cables entering from below. Auxiliary contacts for the indication of breaker state. Slow closing of the circuit breaker to facilitate maintenance and con-

tact adjustment shall be provided .The incoming ACB's sectionalizer ACB shall be interlocked so as the sectionalize can only be made on when one of the incomers is off .

The air circuit breaker shall include sufficient auxiliary contacts and mechanical interlocking mechanisms to facilitate the possible future addition of a second supply feed so that full electrical and mechanical safety interlocking of all feed circuits can conveniently be arranged. A relay shall be incorporated for over current and earth fault protection at the incoming air circuit breaker. [3]

1.18 Power Factor Correction

Supply, install, test and commission power factor correction equipment automatically controlled multi-stage static bank type 200 / 400 V. Capable of correcting the power factor to 0-9 lagging all loads conditions.

The equipment's shall comply with BS 1650 suitable for operation on 440 volt 3 phase 4 wire connection 50 HZ. Supply shall be Generally As Follows:

- Enclosure
- Steel cubicle type extendable modular form of construction to IP 44.

Multiple units of static capacitors manufactured from impregnated metalized paper and plastic film, having self healing capacity, each unit shall be fitted with:

- Over pressure device
- Thermal protection device
- Discharge resistor

On load pattern for closing and breaking the supply, the operating handle shall be interlocked with cubicle door to prevent access while the isolator closed.

Multistage automatic type with two spare stages for the addition of future banks. Digital reading type, display of fate.

- Cos ∅
- Voltage
- Current
- Temperature control

With harmonic overload protection. Resonance control(protection from resonance) and automatic C/K controller.

Supply install test and commission power factor correction equipment automatic controlled multi-stage static bank type capable of correction the power factor to a minimum of 0.9 under all load conditions suitable to operate on 440 V 3PHASE 50HZ . Capacitor shall be multiple units of static type. [3]

1.19 Earthing System

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

1.20.1 TN-S SYSTEM:

The TN-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 of the secondary distribution system.

1.20.2 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 .

1.20.3 Earthing Copper Plates

Earthing copper plates shall be approximately 5mm high and 500mm wide or equal area. Plates shall be placed vertical, upper corner 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.

1.20.4 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.

1.21 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 BS6651, NFPA 780, and VDE0185. 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. [3]

1.22 Summary

In this chapter, the electrical installation specifications have been declared generally, in compliance with the latest global regulations such as the British System (BS) *where the conditions of designing works can be found.*

CHAPTER TWO

INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

2.1 Over View

In this chapter, a fully detailed explanation is going to be included, thus, new lighting products are not only more energy efficient, they offer many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looks at some of the new technologies for residential lighting, compares the cost benefits, identifies four basic strategies to apply, then provides specific examples of how to put the new strategies into practice throughout the home rooms

2.2 INSTALLATION OF LIGHTING SYSTEM AND LUMINAIRES

2.2.1 Pendant

Tube pendant shall comprise a dome cover and a biscuit ring and a piece of screwed steel conduit of suitable length to give the required mounting height of the luminaire.

Plain pendant shall comprise a ceiling rose and a cord-grip lampholder connected by a flexible cord having a suitable length to give the required mounting height of the lamp shade.

2.2.2 Luminaire Mounted on Pattress

When a luminaire is not provided with facility for a surface cable entry, the luminaire shall be mounted on pattress. The cable shall then enter the luminaire from the rear through a slot and a hole formed in the pattress.

2.2.3 Ceiling Rose

Ceiling rose shall not be used for the attachment of more than one outgoing flexible cord or cable unless it is specially designed for multiple pendants.

2.2.4 Cable in Enclosed Luminaire

Cables within an enclosed type luminaire shall be of heat resistant type. Cables entering the luminaire shall be protected by heat resistant insulating sleeves. The sleeves within the luminaire shall be extended to a distance of 150mm outside the luminaire.

Heat resisting cables shall be selected in accordance with the appropriate tables given in IEC 60364.

2.2.5 Stroboscopic Effect

Luminaires, other than those using tungsten filament lamps or fluorescent lamps with electronic ballast, installed over rotating machinery, shall be arranged so that at least two luminaires connected to different phases are used to illuminate the moving parts of the machinery. Alternatively where different phases are not available or the use of which is impracticable, separate tungsten filament lamps shall be used in addition to gas discharge lamps to eliminate the stroboscopic effect.

2.2.6 Painting

Unless otherwise specified, lighting equipment and luminaires other than those indicated to be self-finished such as stainless steel, anodized aluminium, etc, shall have factory-finished.

Metal parts such as cover plates for adaptable boxes, blanking plate for any boxes and conduit pendants, etc. shall be painted white or a suitable colour to match the interior finish of a particular location.

2.2.7 Special Requirements for Outdoor Luminaires

Outdoor luminaires shall be able to withstand the weather. Metal work should be protected against corrosion, and parts which have to be removed for access to the interior shall be provided with proper gaskets to restrict the entrance of moisture and dirt. Mounting brackets shall be heavily galvanized and stainless steel or galvanized bolts and nuts shall be used.

The adjustment bolts and nuts of a luminaire which is mounted on high level shall be captive to prevent accidental loss during servicing. Safety chains shall be provided to hold the luminaire from falling. A luminaire installed in a location within hand reach shall be of robust construct, fitted with an impact-resistant transparent or diffusing front panel, and shall have secret key fixings for the panel to the body of the luminaire. Where necessary, wire guards

shall be fitted over the front panel to give extra protection.

2.3 INSTALLATION OF SOCKET OUTLETS

2.3. 1 General

Socket outlet intended for supplying a fixed or stationary appliance shall be located as near as possible to the appliance. Socket outlet shall be mounted at a height of 1350mm above finished floor level in kitchens, sculleries, ironing rooms and the like. In other locations, they shall be mounted at 300mm from finished floor level, 75mm from surface top measured from bottom of socket outlet or as specified

2.3. 2 Shaver Supply Unit

The complete unit shall be enclosed in a galvanized metal box for flush mounting, or a galvanized cast iron or plastic surface box for surface mounting.

2.3. 3 Socket Outlet at Hazardous Area

The installation of socket outlets in hazardous areas should be avoided as far as possible. Where it is absolutely essential to install a socket outlet in such area, the socket outlet shall be type 'e' - increased safety conforming to IEC 60309-3 and shall be controlled by a sparkless switch. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position. The plug shall have shrouded pins and the design of the pin contacts shall be such as to guard against development Section B3of hot spots or sparking. Requirements for wiring installation in hazardous areas are specified in Sub-section B7.4.

2.3. 4 Socket Outlet of Surface Conduit System

In plant room, switch room or similar area where surface conduits are installed, socket outlets shall be metalclad or bronze front plate.

2.3. 5 Socket Outlet for Different Voltage System

Socket outlet and plug for one voltage system shall not be interchangeable with those for use at other voltage and/or frequency systems in the same installation.

NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

GRADUATION PROJECT

ELECTRICAL INSTALLATION DESIGN

EE400

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Mohammed KMAİL

Nicosia – 2014

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CHAPTER TWO INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

INTRODUCTION

Technical staff in the field of electricity , the electrical installation plans and it should be able to read exactly must be able to conduct a complete application by the way . Therefore, vocational education and training on the basis of technical plans are of great importance . Besides, this plan covered by describes properties of materials and shapes them known symbols , materials suitable Selecting the plan and performing installations related laws, specifications , regulations and standards are also required to comply . Therefore, consisting of 8 units , respectively, in the book of the Electrical Installation Plan general information relevant to the topic and legislation has been given, briefly discussed the materials used in electrical installations , an important issue Lighting and computational techniques have been investigated, holds an important place in the installation of low-voltage installations described , reactive power compensation issues are mentioned , protection and safety in electrical installations subject treated , lighting and interior installations and examples of strong current plans were undertaken separately is corroborated by the application . In short, students may need a lot of information about electrical installation plans and teaching prepared in order to be included in this book have been studied. After receiving this information graduating students After working in related occupations and work in the case of adapting will be easy to comprehend . Prepared this book to students and technical staff working on these issues and believe will be beneficial to I wish success for our students .

Chapter one presents the electrical installation specifications, which are The General Technical Specifications for Buildings are published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

Chapter two; 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 not only more energy efficient, they are offering many more possibilities to improve the quality of lighting our homes, indoors and out.

Chapter three;. cables, 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 ONE

ELECTRICAL INSTALLATION SPECIFICATIONS

1.1 Over View

The General Technical Specifications for Buildings published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

1.2 General Specifications

All works, Materials Manufacturing, fabricating, testing and commissioning shall be governed by latest conditions of the following standards:

1- The general technical specification
2- National Codes
3- 16th Edition of IEE
4- British Standard
5- IEC Recommendation

In case of any conflicts arising between this Specification and Standard/Codes, the Contractor shall refer the matter to the Engineer and for Clarifications.

The Contractor shall submit a complete set of Shop Drawings for Engineer's approval prior one month to commencing the work at least. The Contractor shall submit a logical schedule of work for the project activities to the Engineer for approval, beside, the Contractor shall submit weekly, monthly, progress report.

The Contractor shall obtain the Engineer's written approval for all materials, equipment, accessories ...etc., prior to the procurement of any material, submittals shall be early stages, supplying of materials to the site shall be coordinated with the engineer and to his approval.

The Contractor shall submit for approval all drawings, diagrams, catalogues, dimensions, samples and any other information that may be required by the Engineer .Location of some electrical fixtures may be modified to suit the site conditions and/or to comply with safety measures. No claims will be accepted in such cases.

Testing and commissioning is an essential part of this Contract. The Contractor shall provide the testing instruments required. All tests shall be conducted and witnessed by the Engineer and the results shall be certified and signed by the Contractor and the Engineer. Original copies of testing certificates shall be kept with the Engineer.

The Contractor shall submit one complete set of transparent as-built drawings, CD disc and three blue print sets to the Engineer along with all manuals, wiring diagrams, operating instructions, maintenance instructions, list of recommended spare parts for two years and vendors names and addresses .All documents of this contract are complementary to each other and should be red as whole. [7]

1.3 Materials and Testing

The whole of the Works shall be executed with the materials indicated in the subsequent clauses of this Specifications .Where the names of manufacturers are stated, together with a detailed specification of their products.

Where such exists, the equipment shall comply with the requirements of the appropriate current standards as mentioned in item 1-2 and shall be of the best of their respective kinds, free from all flaws and defects.

1.4 Labour Restrictions

The Contractor shall employ none but workmen skilled in their respective trades and must not employ unskilled laborers in lieu of skilled workmen

1.5 Conduits

Only the following types of conduits and related fittings and accessories shall be used for the installation covered by this specification.

1.5.1 Rigid Non-Metallic Conduits (U/PVC)

Rigid non-metallic conduits including sleeves and elbows shall comply with BS6099, PART 2, SECT.2.21, 1982.

1.5.2 Rigid Metallic Conduit

Rigid metal conduit including sleeves and elbows shall comply with BS4568.

1.5.3 Flexible Non-Metallic Conduit

Flexible non-metallic conduit shall be suitable for installation in conjunction with rigid non-metallic conduits by the use of the same fittings and connectors .

1.5.4 Flexible Metal Conduit

Flexible metal conduit shall comply with NEC-Article 350. Conduit shall be suitable for installation in conjunction with rigid metal conduit, by the use of the same fittings and connectors. A separate conduit and wiring system is to be provided for each installation, i.e. lighting, general purpose sockets, power, telephone, etc.

Draw wires shall be left in all conduit runs for other services .Conduits shall not be run than 0.15m to any steam or hot water pipes and shall be run underneath such pipes rather than over them. The conduits shall not be run closer than 0.05m to any telephone, bell or other signaling .All joints in PVC conduits, shall be cemented with a waterproof adhesive.

Where conduits cross a building expansion joint due allowance shall be made in the design or the run with an approved expansion joint .All circular PVC boxes shall be provided with steel insert clips to provide additional support for lighting fittings .

Flexible metal conduits, watertight where required, shall be provided between the conduit system and electrical motors or other apparatus subject to vibration. They shall be complete with brass double female adaptors and shall be soldered to either end of all flexible conduits and connected to solid conduit entries using smooth bore male brass bushes.

Earth continuity through flexible conduits shall be provided by a separate earth continuity conductor .Minimum size of conduits shall be 20 mm. diameter, unless otherwise indicated or approved. Conduit runs shall not exceed 10 m in length without the incorporation of a pull box.

Conduits shall not cross pipe shafts, or vent duct openings. Riser conduits shall be supported at each floor level by approved clamp hangers.

All conduit and accessories shall be produced of the same manufacturer. Conduits and accessories installed (concealed) shall be of heavy gauge U-PVC conduits and shall comply with BS 4607; Class A.

Conduits shall have capacities as listed in the following table 1.1, unless stated other wise. In any case the space factor shall never exceed 40%. Pull boxes shall be located at convenient intervals at accessible positions.

Table 1.1: Conductor Conduit Size.

Size mm2	20	25	32	38	50
1.5	7	12	20	--	--
2.5	4	8	12	--	--
4.0	3	6	10	--	--
6.0	3	5	8	--	--
10.0	--	3	6	8	--
16.0	--	--	3	4	5
25.0	--	--	--	4	6
35.0	--	--	--	4	6
50.0	--	--	--	--	4

1.6 Pull and Junction Boxes

Pull and junction boxes shall be suitable for use in conjunction with the selected raceway systems.

1.6.1 Outlet Boxes

For concealed installation, outlet boxes shall be plastic, fastened with amply sized screws. For exposed installation, outlet boxes shall be either sheet metal of heavy-duty plastic, mounted exposed and rigidly connected to the conduit system by suitable bushings Comply with BS 5733.

1.6.2 Terminations

Terminations in junction boxes, floor boxes, distribution boxes and outlet boxes shall be of the screwed type.

1.7 Wires and Cables

Wires and cables shall be fabricated of stranded copper conductors in accordance with BS6004, 1984. The insulation of all wires and cables shall be rated for at least 70 deg. C for polyvinyl chloride (PVC) and 90 deg. D for thermoplastic (PE) cables. The identification by color for conductors in multicore wires and cables shall comply with IEC 446. XLPE cables shall comply with IEC 502 as shown on Drawings or schedules. Fire resistance insulation complying with UL1424-105 °C; especially for fire alarm systems.

1.7.1 Wires for Power, Lighting and Controls.

Wires are single-core insulated or multicore insulated and sheathed conductors which are used only for light-duty indoor applications. The conductor insulation and the sheath shall be polyvinyl chloride .All cables buried in the ground shall incorporate armor.

The cables installed in positions which may be exposed to direct sunlight shall be of a type resistant to damage by ultra-violet light or shall be suitably covered to protect from ultra-violet light .All cable conductor shall be fitted with a correctly sized cable socket or thimble and a means of identification. The cable sockets may be of the sweated or crimped compression types. The cables connected in parallel shall be of the same type, cross sectional area, length and disposition and be arranged so as to carry substantially equal load currents . [2]

1.7.2 L.V. Main Cables

L.V. Main Cables shall be 4 core; 600/1000 volts grade PVC insulation, single steel wire armoured. The conductors shall be circular standard copper. The armouring of L.V. main cables shall not be used as the sole circuit protective conductor (CPC). The sizes of protective conductor shall be calculated in accordance with Tables 54E and F of IEE Regulations or equal. L.V. cables if to be buried direct in the ground. They shall be buried to a depth of 70 cm. in trenches which have been cleared of all rocks and rubble and into which a 5 cm. sand layer shall be placed across the full width and along the entire length of the trench. The cables shall be laid on this sand bed and covered with a further 10 cm. layer of sand before the trench is backfilled and compacted. Concrete tiles shall be placed on the top of the second layer of sand as shown on the Drawing with suitable material.

Where L.V. cables cross sidewalks or road, they shall be drawn into heavy gauge PVC conduit of 15cm. ϕ. Concrete layer of thickness 10 cm. shall cover this UPVC conduit. In addition a warning PVC tape shall be laid in the cable trench during

the backfilling process so that the cable marker strip is 15 cm., beneath the finished compacted surface of the trench. Where L.V. cables are installed in a concrete trench, these cables shall be fixed to the base and sides of the trench by means of using cable cleats at intervals not exceeding 900 mm, between centers of adjacent fixings. The cable separation between adjacent cables shall not be less than double the diameter of the cable. [2]

1.7.2.1 Wires for Communication

Wires for communication are single-core or multicore insulated and sheathed conductors which are used only for light-duty indoor applications .

1.7.2.2 Communication Cables

Communication cables are multicore insulated, shielded and sheathed tinned copper conductor cables for indoor and outdoor installation in conduits, ducts or for direct burial .

1.8 Switches

Switches shall be mounted with the operating handle in upward position when in the "ON" position. Switches used on lighting branch circuits shall be quick make, quick break, with silver alloy contacts, rocker, operated with quick operating mechanism rated at 10 amperes 250 volts AC or higher capacity as required by the circuit controlled in accordance with the Specifications. Switches shall be single, three or four way flush mounted type and shall be waterproofed where required. Switches shall be to BS 3676 : 1989.Type MK or approved equal

1.9 stair switches

For stairs I used sensor switches, there is many types of sensor switches like TSM
1S, TSM1E and TSEN1. In this project I used the last one TSEN1 because the stair distance not so much.

1.10 Power Outlets

The switch socket outlets shall be as indicated on the drawings, all in accordance with BS1363 and BS546 as appropriate. These outlets shall be of the same manufactuer

throughout the installation. To different between the normal power supply receptacles from the essential & or the computer receptacles. Each system receptacles shall be distinctively colored or marked for identification.

1.11 Socket Outlets

Socket outlets shall be of the standard, 3-pin, single phase, with or without switch, flush mounted type of moulded plastic designed to fit with the appropriate plates as specified.

- Waterproof socket outlet without switch shall be used in washing room and kitchens.
- Single phase socket outlets shall be 13A, 230 volts, earthed, shuttered type.

Switches for electric water heater shall be flush 20 amp. DP switches with pilot lamp and marked (Water Heater).

1.12 Water Proof Receptacles

It shall be seal splash proof, switched and with pilot light. The dust and waterproofing shall be IP54 when plug is inserted in receptacle. Receptacle shall be semi-flush with wall.

1.13 INDUSTRIAL RECEPTACLES:

These receptacles shall be industrial type as shown on the Drawings, and shall be designed for AC230V to 660V. Receptacles shall be three, four or five-pole. The enclosure shall be plastic, splash proof or made watertight.

1.14 Telephone Systems

Telephone cabinet (TC) shall be provided as shown on the Drawings for adequate number of extensions, for the distribution of wires or cables between the main distribution frame and the extension outlets.

Telephone outlets shall be flush mounting type. These shall be of the same make and plate finish of the adjacent socket outlets.

1.15 Main and Sub main Distribution Boards

The (MDB) shall be fabricated, tested and commissioned in compliance with Electrical power Authority requirements and Engineer's approval. Free standing cubicle panel board consisting of 2mm thick steel sheet hammer painted, gray color with lockable hinged doors, locks and switches, rubber gaskets, dust proof to IP54. Sufficient holes for glands in removable rigid steel sheet gland plate to be provided.

The structure of the main sub main electrical panel boards shall be form two. All panel boards must include proper floor attachment facilities, and terminal panels in the top section and bottom section, in accordance with the location of the cable output.

The internal wiring shall be laid in proper PVC trunking, identified at both ends by PVC numbers. If flexible cables used inside the panel, then the cables of be soldered prior to being compressed into lugs. The lugs to be of tinned copper compression type. Bolted lugs are NOT allowed.

All bus bars and live terminals inside any electrical panel shall be isolated and not accessible by any means to ensure safe and normal cooperation of the panel. Bus bars ratings shall exceed 1.5 times the main circuit breaker rating of the panel.

1.16 Bus-Bars

The panel boards will contain bus-bars for phases R,S,T neutral and ground, without paint. These bus-bars shall be made of copper, with lead cooked and their cross-section must be compatible, thermally and mechanically, with the short-circuit currents specified in the plans, and in any case not less than 60KA on 415v. For 1 section. All panels shall have sufficient space for ventilation and maintenance purposes plus extra room to allow for the possibility of adding 25% of the installed circuit breakers. A separate cubicle shall be incorporated in the switchboard for accommodation of the Supply Authority's Metering Equipment. It shall meet the Supply Authority requirement and approval. In the main Switchboard the following facilities to BS89, shall be included : three Ammeters, one Voltmeter with Voltmeter selector switch, one Power factor meter, three Color coded pilot lamps, & M.R.C. fuses for voltage circuit protection. The MDB, for each building shall be provided with protection moulded case circuit breakers. Full schematic and control drawings shall be kept in a pocket at the inner side of the front door for maintenance. Engraved metal or PVC labels to be fixed at the mimic diagram to identify the components of the panel. Fixing Devices for free standing, supports, earthing... etc. shall be installed.

All cables and conduits connections to panels shall be firmly and securely connected mechanically and electrically by using proper glands, male pushes, femals pushes, locknut, by soldering or compression type lugs, clamps, supports ... etc., bolted lugs and NOT allowed . Contactors, when used, shall be protected by circuit breakers. Contactor rating shall be not less than 125% of its relative circuit breaker rating unless otherwise specified. [2]

1.17 Distribution Boards

Distribution Panel Bards feeding lights, socket outlets and other appliances shall be totally enclosed, dust protected and vermin proofed. The enclosure of these Panel Boards shall be of robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall be robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall contain an on load isolator and miniature circuit breakers or the size and number specified in Drawings and a neutral connector block of ample size to ensure that a separate way is available on the connector block for the neutral conductor of each circuit. The construction of the enclosure of those distribution boards shall be executed in a way such that to operate the mi-

niature circuit breakers, it is necessary to open the hinged door and to ensure access to the interior components and to the internal wiring, it is necessary to dismantle and remove a separate barrier within the enclosure. Miniature circuit breakers shall have a breaking capacity of 6000 amps. All miniature circuit breakers shall be equipped with thermal overload trips to operate at 125% rated current and instantaneous magnetic trips.

1.17.1 Circuit Breakers

Protective devices as shown shall be of the moulded case type up to an capacity of 630A. Trip-free circuit breakers shall be used with thermal and magnetic over current tripping devices for each line. Adjustable thermal tripping devices shall be adjustable from approx. 70% to full load rating . The magnetic tripping devices to be of the adjustable type .Circuit breakers with an capacity of 1000A and above shall be equipped with a motor-operated closing mechanism. All circuit breakers shall indicate clearly whether they are open or closed and shall have an interrupting rating not less than the maximum available short-circuit current at the supply terminals. The moulded case circuit breakers providing complete circuit over current protection by having inverse time and instantaneous tripping characteristics and where applicable, be current limiting. Circuit breakers shall be operated by a toggle type handle and shall have a quick made over current switching mechanism that is mechanically trip free. Circuit breakers 150 ampere and below shall be thermal magnetic trip with inverse time current characteristics.

1.17.2 Miniature Circuit Breakers

Miniature circuit breakers shall be of the narrow type and shall be for manual operation with trip-free release. Miniature circuit breakers shall be equipped with the thermal over current and a magnetic short-circuit tripping element .

The interrupting capacity of miniature circuit breakers shall not be less than 6AK off (230 V AC). Miniature circuit breakers shall have tripping characteristics in accordance with IEC 898 and IEC 947-2. Residual current circuit breakers shall comply with BS4293 .

1.17.3 Air Circuit Breaker (ACB)

The incoming supply shall terminate at the main air break circuit breakers on the switchboard. The air break circuit breaker shall comply with BS4752 VED0660 for use on a 380 volts 3 phase 50 Hz wire system .The bus bar sectionalizer shall be the same type (ACB) .The circuit breaker shall be horizontally isolated, horizontal draw-out pattern, air break type. The circuit breaker closing mechanism shall be motorized. The operating mechanism shall have a mechanical ON/OFF indicator and a manual trip device fitted with means for locking, test terminal blocks, healthy trip lamp (coloured white) as associated pushbuttons, set of auxiliary switches, supply available lamp, cable boxes complete with glands of suitable size fore the accommodation of the incoming and out going cables entering from below. Auxiliary contacts for the indication of breaker state. Slow closing of the circuit breaker to facilitate maintenance and con-

tact adjustment shall be provided .The incoming ACB's sectionalizer ACB shall be interlocked so as the sectionalize can only be made on when one of the incomers is off .

The air circuit breaker shall include sufficient auxiliary contacts and mechanical interlocking mechanisms to facilitate the possible future addition of a second supply feed so that full electrical and mechanical safety interlocking of all feed circuits can conveniently be arranged. A relay shall be incorporated for over current and earth fault protection at the incoming air circuit breaker. [3]

1.18 Power Factor Correction

Supply, install, test and commission power factor correction equipment automatically controlled multi-stage static bank type 200 / 400 V. Capable of correcting the power factor to 0-9 lagging all loads conditions.

The equipment's shall comply with BS 1650 suitable for operation on 440 volt 3 phase 4 wire connection 50 HZ. Supply shall be Generally As Follows:

- Enclosure
- Steel cubicle type extendable modular form of construction to IP 44.

Multiple units of static capacitors manufactured from impregnated metalized paper and plastic film, having self healing capacity, each unit shall be fitted with:

- Over pressure device
- Thermal protection device
- Discharge resistor

On load pattern for closing and breaking the supply, the operating handle shall be interlocked with cubicle door to prevent access while the isolator closed.

Multistage automatic type with two spare stages for the addition of future banks. Digital reading type, display of fate.

- Cos ∅
- Voltage
- Current
- Temperature control

With harmonic overload protection. Resonance control(protection from resonance) and automatic C/K controller.

Supply install test and commission power factor correction equipment automatic controlled multi-stage static bank type capable of correction the power factor to a minimum of 0.9 under all load conditions suitable to operate on 440 V 3PHASE 50HZ . Capacitor shall be multiple units of static type. [3]

1.19 Earthing System

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

1.20.1 TN-S SYSTEM:

The TN-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 of the secondary distribution system.

1.20.2 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 .

1.20.3 Earthing Copper Plates

Earthing copper plates shall be approximately 5mm high and 500mm wide or equal area. Plates shall be placed vertical, upper corner 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.

1.20.4 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.

1.21 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 BS6651, NFPA 780, and VDE0185. 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. [3]

1.22 Summary

In this chapter, the electrical installation specifications have been declared generally, in compliance with the latest global regulations such as the British System (BS) *where the conditions of designing works can be found.*

CHAPTER TWO

INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

2.1 Over View

In this chapter, a fully detailed explanation is going to be included, thus, new lighting products are not only more energy efficient, they offer many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looks at some of the new technologies for residential lighting, compares the cost benefits, identifies four basic strategies to apply, then provides specific examples of how to put the new strategies into practice throughout the home rooms

2.2 INSTALLATION OF LIGHTING SYSTEM AND LUMINAIRES

2.2.1 Pendant

Tube pendant shall comprise a dome cover and a biscuit ring and a piece of screwed steel conduit of suitable length to give the required mounting height of the luminaire.

Plain pendant shall comprise a ceiling rose and a cord-grip lampholder connected by a flexible cord having a suitable length to give the required mounting height of the lamp shade.

2.2.2 Luminaire Mounted on Pattress

When a luminaire is not provided with facility for a surface cable entry, the luminaire shall be mounted on pattress. The cable shall then enter the luminaire from the rear through a slot and a hole formed in the pattress.

2.2.3 Ceiling Rose

Ceiling rose shall not be used for the attachment of more than one outgoing flexible cord or cable unless it is specially designed for multiple pendants.

2.2.4 Cable in Enclosed Luminaire

Cables within an enclosed type luminaire shall be of heat resistant type. Cables entering the luminaire shall be protected by heat resistant insulating sleeves. The sleeves within the luminaire shall be extended to a distance of 150mm outside the luminaire.

Heat resisting cables shall be selected in accordance with the appropriate tables given in IEC 60364.

2.2.5 Stroboscopic Effect

Luminaires, other than those using tungsten filament lamps or fluorescent lamps with electronic ballast, installed over rotating machinery, shall be arranged so that at least two luminaires connected to different phases are used to illuminate the moving parts of the machinery. Alternatively where different phases are not available or the use of which is impracticable, separate tungsten filament lamps shall be used in addition to gas discharge lamps to eliminate the stroboscopic effect.

2.2.6 Painting

Unless otherwise specified, lighting equipment and luminaires other than those indicated to be self-finished such as stainless steel, anodized aluminium, etc, shall have factory-finished.

Metal parts such as cover plates for adaptable boxes, blanking plate for any boxes and conduit pendants, etc. shall be painted white or a suitable colour to match the interior finish of a particular location.

2.2.7 Special Requirements for Outdoor Luminaires

Outdoor luminaires shall be able to withstand the weather. Metal work should be protected against corrosion, and parts which have to be removed for access to the interior shall be provided with proper gaskets to restrict the entrance of moisture and dirt. Mounting brackets shall be heavily galvanized and stainless steel or galvanized bolts and nuts shall be used.

The adjustment bolts and nuts of a luminaire which is mounted on high level shall be captive to prevent accidental loss during servicing. Safety chains shall be provided to hold the luminaire from falling. A luminaire installed in a location within hand reach shall be of robust construct, fitted with an impact-resistant transparent or diffusing front panel, and shall have secret key fixings for the panel to the body of the luminaire. Where necessary, wire guards

shall be fitted over the front panel to give extra protection.

2.3 INSTALLATION OF SOCKET OUTLETS

2.3. 1 General

Socket outlet intended for supplying a fixed or stationary appliance shall be located as near as possible to the appliance. Socket outlet shall be mounted at a height of 1350mm above finished floor level in kitchens, sculleries, ironing rooms and the like. In other locations, they shall be mounted at 300mm from finished floor level, 75mm from surface top measured from bottom of socket outlet or as specified

2.3. 2 Shaver Supply Unit

The complete unit shall be enclosed in a galvanized metal box for flush mounting, or a galvanized cast iron or plastic surface box for surface mounting.

2.3. 3 Socket Outlet at Hazardous Area

The installation of socket outlets in hazardous areas should be avoided as far as possible. Where it is absolutely essential to install a socket outlet in such area, the socket outlet shall be type 'e' - increased safety conforming to IEC 60309-3 and shall be controlled by a sparkless switch. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position. The plug shall have shrouded pins and the design of the pin contacts shall be such as to guard against development Section B3of hot spots or sparking. Requirements for wiring installation in hazardous areas are specified in Sub-section B7.4.

2.3. 4 Socket Outlet of Surface Conduit System

In plant room, switch room or similar area where surface conduits are installed, socket outlets shall be metalclad or bronze front plate.

2.3. 5 Socket Outlet for Different Voltage System

Socket outlet and plug for one voltage system shall not be interchangeable with those for use at other voltage and/or frequency systems in the same installation.

2.3. 6 Application in Bathroom

Shaver supply units complying with BS EN 60742 can be installed inside a room containing a fixed bath or shower and inside a toilet. Socket outlets inside such a room, if so required under the contract, shall be installed in accordance with requirements of Code 26A(3)(j) of Code of Practice for Electricity (Wiring) Regulations.

2.4 INSTALLATION OF EARTHING SYSTEM

2.4.1 GENERAL

All metalworks associated with an electrical installation but not forming part of a live conductor, including exposed conductive parts and extraneous conductive parts, shall be solidly and effectively bonded and earthed in accordance with IEC 60364 and the Code of Practice for the Electricity (Wiring) Regulations.

2.4. 2 MAIN EARTHING TERMINAL

A solid copper main earthing terminal of ample size shall be provided for every electrical installation at a position near the main incoming switch or switchboard for the connection of :

(a) the circuit protective conductors,

(b) the main equipotential bonding conductors,

(c) the functional earthing conductors,

(d) the earthing conductors and

(e) the lightning protective system bonding conductors.

to create the equipotential zone. The main earthing terminal shall be connected to Earth via an earthing conductor to an earth electrode or a group of electrodes.

Where an installation distributes to a number of buildings or units, a separate main earthing terminal shall be provided for each individual building or unit at the point of intake thereby creating a separate equipotential zone in each building or unit. [10]

2.4. 3 EARTH ELECTRODE

2.4. 3.1 Types of Earth Electrode

The following types of earth electrode are permitted :

(a) rod electrode

(b) tape electrode

(c) plate electrode

Unless otherwise specified in the Particular Specification or Drawings, rod electrode shall be installed. Metalwork of public gas or water services shall not be used as the sole protective earth electrode.

2.4. 4 Rod Electrode

Rod electrode shall be of mild steel inner core with a bonded hard drawn copper sleeve of an approved type. The overall diameter of the rod shall not be less than 15mm and the thickness of the copper sleeve shall not be less than 0.25mm. The minimum length shall be 2.4m. Additional lengths, whenever required, shall each be of 1.2m, connected together by a coupling. The penetrating end of the rod electrode shall be a hardened steel point. Rod electrode shall be driven into the ground within an earth pit. Only approved tools e.g. electric hammer or pneumatic hammer shall be used for this installation. In case the earthing resistance achieved by one rod is not sufficiently low for the purpose required, additional lengths or additional rods shall be installed. For the latter application, additional rods shall be driven into the ground outside the resistance area of the previously installed rod(s). Under normal circumstances, a mutual separation of 3.5m is considered adequate.

2.4. 5 Tape Electrode

Tape electrode shall be untinned copper strip of not less than 25 x 3mm in cross section. Tape electrode shall be used only if specified by the Architect.

In case where several tapes are required for connection in parallel to achieve a low earthing resistance, they may be installed in parallel lines or they may radiate from a point.

2.5 Types of Indoor Lighting

An incandescent bulb is usually made of clear or frosted glass, screws into a "medium base" socket, generally lasts from 750 to 1000 hours, and emits a warm white light. The word "incandescent" translated from Latin means "glowing with heat." Light is produced when the electric current heats the bulb's filament; 90 percent of the energy is used to heat the filament and only 10 percent goes into making light. Therefore, most of the energy used by the bulb is given off as waste heat, not light.

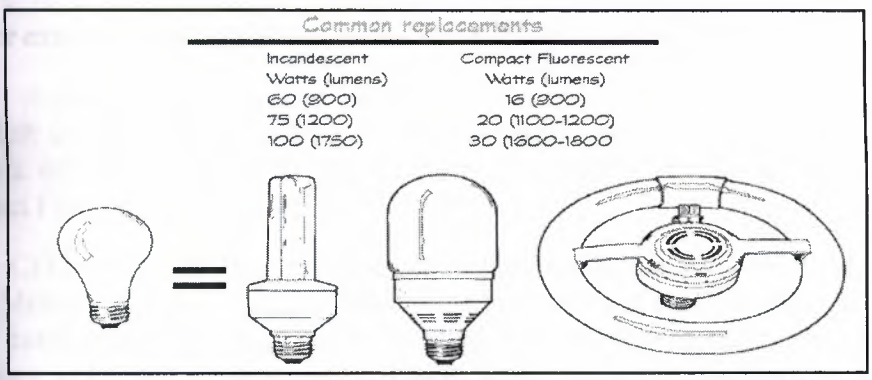

Fig.2.1 Compact fluorescents come in a variety of shapes and sizes to fit different fixtures.

2.5.1 Compact fluorescent lamp

A compact fluorescent lamp (CFL), also called compact fluorescent light, energy-saving light, and compact fluorescent tube, is a fluorescent lamp designed to replace an incandescent lamp; some types fit into light fixtures formerly used for incandescent lamps. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and compact electronic ballast in the base of the lamp.

Compared to general-service incandescent lamps giving the same amount of visible light, CFLs use one-fifth to one-third the electric power, and last eight to fifteen times longer. A CFL has a higher purchase price than an incandescent lamp, but can save over five times its purchase price in electricity costs over the lamp's lifetime.[2] Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal. In many countries, governments have established recycling schemes for CFLs and glass generally.

CFLs radiate a spectral power distribution that is different from that of incandescent lamps. Improved phosphor formulations have improved the perceived color of the light emitted by CFLs, such that some sources rate the best "soft white" CFLs as subjectively similar in color to standard incandescent lamps.

The parent to the modern fluorescent lamp was invented in the late 1890s by Peter Cooper Hewitt the Cooper Hewitt lamps were used for photographic studios and industries. Development of fluorescent lamps that could fit in the same volume as comparable incandescent lamps required the development of new, high-efficacy phosphors that could withstand more power per unit area than the phosphors used in older, larger fluorescent tubes[8].

There are two types of CFLs: integrated and non-integrated lamps. Integrated lamps combine the tube and ballast in a single unit. These lamps allow consumers to replace incandescent lamps easily with CFLs. Integrated CFLs work well in many standard incandescent light fixtures, reducing the cost of converting to fluorescent. 3-way lamp bulbs and dimmable models with standard bases are available.

Non-integrated CFLs have the ballast permanently installed in the luminaire, and only the lamp bulb is usually changed at its end of life. Since the ballasts are placed in the light fixture, they are larger and last longer compared to the integrated ones, and they don't need to be replaced when the bulb reaches its end-of-life. Non-integrated CFL housings can be both more expensive and sophisticated. They have two types of tubes: a bi-pin tube designed for conventional ballast, and a quad-pin tube designed for electronic ballast or conventional ballast with an external starter. A bi-pin tube contains an integrated starter, which obviates the need for external heating pins but causes incompatibility with electronic ballasts.

A photograph of various lamps illustrates the effect of color temperature differences. From left to right: Compact Fluorescent: General Electric, 13 W, 6,500 K; Incandescent: Sylvania 60 W Extra Soft White; Compact Fluorescent: Bright Effects, 15 W, 2,644 K; Compact Fluorescent: Sylvania, 14 W, 3,000 K

CFLs emit light from a mix of phosphors inside the bulb, each emitting one band of color. Modern phosphor designs balance the emitted light color, energy efficiency, and cost. Every extra phosphor added to the coating mix improves color rendering but decreases efficiency and increases cost. Good quality consumer CFLs use three or four phosphors to achieve a "white" light with a color rendering index (CRI) of about 80, where the

maximum100 represents the appearance of colors under daylight or a black-body (depending on the correlated color temperature).

Characteristic spectral power distributions (SPDs) for an incandescent lamp (left) and a CFL (right). The horizontal axes are in nanometers and the vertical axes show relative intensity in arbitrary units[10]

2.5. 2 Color and temperature

Color temperature can be indicated in kelvins or mireds (1 million divided by the color temperature in kelvins). The color temperature of a light source is the temperature of a black body that has the same chromaticity (i.e. color) of the light source. A notional temperature, the correlated color temperature, the temperature of a black body which emits light of a hue which to human color perception most closely matches the light from the lamp, is assigned.

A true color temperature is characteristic of black-body radiation; a fluorescent lamp may approximate the radiation of a black body at a given temperature, but will not have an identical spectrum. In particular, narrow bands of shorter-wavelength radiation are usually present even for lamps of low color temperature ("warm" light).[10]

As color temperature increases, the shading of the white light changes from red to yellow to white to blue. Color names used for modern CFLs and other tri-phosphor lamps vary between manufacturers, unlike the standardized names used with older halophosphate fluorescent lamps. For example, Sylvania's Daylight CFLs have a color temperature of 3,500 K, while most other lamps called daylight have color temperatures of at least 5,000 K

Saturated color CFLs are also produced, less commonly:

Red, green, orange, blue, and pink, primarily for novelty purposes

Blue for phototherapy

Yellow, for outdoor lighting, because it does not attract insects

Black light (UV light) for special effects

2.5. 3 Lifespan

CFLs typically have a rated service life of 6,000 to 15,000 hours, whereas standard incandescent lamps have a service life of 750 or 1,000 hours. However, the actual lifetime of any lamp depends on many factors, including operating voltage, manufacturing defects, exposure to voltage spikes, mechanical shock, frequency of cycling on and off, lamp orientation, and ambient operating temperature, among other factors.

The life of a CFL is significantly shorter if it is turned on and off frequently. In the case of a 5-minute on/off cycle the lifespan of some CFLs may be reduced to that of incandescent light bulbs. The U.S. Energy Star program suggests that fluorescent lamps be left on when leaving a room for less than 15 minutes to mitigate this problem. CFLs produce less light later in their lives than when they are new. The light output decay is exponential, with the fastest losses being soon after the lamp is first used. By the end of their lives, CFLs can be expected to produce 70–80% of their original light output.[16] The response of the human eye to light is logarithmic. One photographic "f-stop" reduction

represents a halving in actual light, but is subjectively quite a small change.A 20–30% reduction over many thousands of hours represents a change of about half an f-stop. So, presuming the illumination provided by the lamp was ample at the beginning of its life, such a difference will be compensated for by the eyes.

2.5. 4 Comparing cost and efficiency

Why would a person spend $5 to $20 to purchase a CFL bulb rather than incandescent for 50 cents? Because CFLs use 75 percent less energy to operate, they last up to 10 times longer, and they produce more lumens (light) per watt (electricity used) than incandescent bulbs. Although CFLs cost more initially, they are a better bargain in the long run.

The two basic pieces of information needed to find the best buy are printed on the light bulb package: watts and lumens. Watts, often the only number people look at when buying a light bulb, indicates how much energy the bulb consumes but nothing about the light output. The average lumens is the amount of light given off by the bulb. To determine a bulb's efficiency, look at the amount of lumens per watt. Surprisingly, some bulbs that are labeled as long-life may last longer, however light output is significantly lower. For example: A 75-watt incandescent bulb uses 75 watts of electricity to provide 1,200 lumens. A 20- watt compact fluorescent uses only 20 watts of electricity, one-fourth the amount, to provide the same 1,200 lumens. To determine the real cost of lighting, add the cost of the bulb (initial cost plus replacements) and the electricity cost. Compare the operating cost of a single 20-watt CFL and a 75-watt incandescent for 10,000 hours.

	Bulb cost (Initial X replacement)	Electricity cost (10.000 hours)	Total
75W Incand.	1$ X 13 = 13$	48.75 $	61.75 $
20W CFL	20$ X 1 = 20$	13.00 $	33.00$

Table2.3.4 the operating cost of a single 20-wattCFL and a 75-watt incandescent for 10,000 hours.

2.5. 5 Compare Color and Quality of Light

The quality of light produced by a bulb can vary depending on the light source, and is expressed in two ways: color temperature and color rendering. Color temperature (or correlated color temperature, CCT) is measured in degrees Kelvin, and may or may not be listed on the product package. Light bulbs with a number below 3500K are considered "warm," and are more reddish in color; light bulbs with a number above 4000K are considered "cool," and are more bluish in color. Color rendering is measured by the Color Rendering Index (CRI), which rates the amount of illumination compared to a light source with a known CRI. Only lights with the same temperature rating are compared with each other. A simple way to find a light bulb that will produce the best color temperature and color

rendering for most lighting needs is to look for an ENERGY STAR light, which will have a CRI of 80 or higher and a color temperature between 2700K and 3000K.

2.6 Evaluating the Home's Lighting Needs

To evaluate the home's current lighting conditions, tour the home in the evening and turn on the lights as you go from room to room. Is each area receiving adequate amounts of lighting? Lighting generally falls into one of three categories:

2.6.1 Accent lighting

Use accent lighting to highlight specific objects, such as artwork, shelves or plants. It can also illuminate wall surfaces in a soft wash of light or accentuate the texture of the surface.

2.6.2 Task lighting

Direct light to specific activity areas with task lighting lamps and fixtures. Lights under cabinets to illuminate kitchen work surfaces or a reading lamp next to that favorite chair are two common examples of task lighting.

2.6.3 Ambient lighting

Distribute light broadly throughout a space with ambient lighting fixtures, such as the traditional single ceiling fixture located in the center of a room. Ambient lighting by itself is still adequate for general activities that are not visually demanding, but will not give the quality of light needed for reading or sewing. To make sure areas of the home meet desired lighting needs, choose and locate accent fixtures first, then choose and locate task lighting fixtures. If additional light is still needed, use ambient lighting fixtures.

2.7 Swimming Pool lights

2.7.1 How to Install Underwater Swimming Pool Lights

İnstalling underwater swimming pool lights does not have to entail a major pool renovation project or even require the pool to be drained. With the right kind of lighting and a little electrical know-how, pool lighting can be installed in a single afternoon.

Step 1: Choosing a Light

When choosing a light it is important to consider project time. What parts will have to be replaced (like batteries)? What about pool size and the amount of electrical work required? To avoid draining your pool and drilling holes in it, it is best to select a suction-mounted light.

For a fast and easy install, with no electrical work, a battery operated light is the best solution. However, batteries will need regular replacement and the life of the light will be shorter than that of a corded model. Choose corded lights according to pool wall type.

Step 2: Assemble Light

Assemble the light according to manufacturer specifications and check all seals for water tightness. This can be done by submerging the light in shallow water and watching for bubbles.

Step 3: Set up Power Supply

For a battery operated light, install batteries and move on to step 4.

For a corded light, you will need to set up a power source. If there is a GFCI outlet close enough to the pool that the light cord will reach, mount the light transformer to the wall next to the outlet and plug the light in. Move on to step 4.

If there is no available outlet, you will need to install a waterproof junction box on an existing power line. First, turn off the power supply at the circuit breaker. Locate the power line to the pool pump or filter. Cut the line with wire cutters and expose the wire by using a stripper to remove the sheath. Install your junction box according to manufacturer specifications. If desired, mount the junction box on a wall, the pump or filter mount. Tie the light into the junction box. Check all fittings to make sure seals are water tight.

If the light does not have its own switch and you don't want it to be on while the pump or filter are on, you will also need to install a switch for the light. Check all seals before moving on to step 4.

Step 4: Install Light

Test the light to insure that it is working properly. Mount the light on the pool wall according to manufacturer specifications.

If you have a hard wall pool and are using a corded light, remove the edging over the area where you are going to install the light. Run the cord over the pool edge and then replace the edging. If you have a soft wall pool and are using a corded light, anchor the cord to the pool railing according to the manufacturer specifications. With these easy steps, you can install your own underwater pool light and begin enjoying your pool at night.

2.7.2 How Much Energy Does a Pool Pump Use?

To predict a planned swimming pools' impact on your electric bill, determine how much energy a pool pump uses. Check the specifications to determine the horsepower (hp) of the pump. The electricity used by pumps and engines are measured in horsepower, whereas the electricity delivered to your house is measured in kilowatt hours (kWh). A kilowatt hour is the amount of power drawn by a one kilowatt load over the course of one hour.

The most typical size for pool pumps is 1 hp, but check the manufacturer's specifications if you are in doubt. 1 hp is equivalent to approximately 0.7456 kilowatts. The amount of power a pump will use depends on how long the pump runs during the day. The length of time the pump runs is determined by pool occupancy, prevalence of airborne debris, and algae-inhibiting chemicals. Higher filtration needs result in longer run times. Convert the pump horsepower to kilowatts and multiply by the daily run time. This is the amount of energy that will be reflected on your next utility bill.

2.8 The new technology Using 4 Strategies

Four strategies could be used to perform the new technologies, thus, these are fully detailed listed as following.

2.8.1 Strategy 1

Strategy one is to replace standard incandescent light bulbs with ENERGY STAR labeled CFLs. No other new product in the lighting industry has had as great an impact as the ENERGY STAR labeled CFL. Modern CFLs have taken the best aspects of fluorescents high efficiency and long life while eliminating previous problems of poor color, flicker and noise. Achieve the most benefit by switching to ENERGY STAR labeled CFLs wherever high wattage incandescent bulbs are used more than three hours per day often in the kitchen and family room. Some specialty CFLs can now be used with dimmer switches. More and more types of CFLs will work well outdoors in Minnesota's cold climate.

2.8.2 Strategy 2

Strategy two is to replace standard incandescent ceiling fixtures (especially in the kitchen and laundry area) with ENERGY STAR labeled fluorescent fixtures. ENERGY STAR labeled light fixtures, when used with ENERGY STAR CFLs, help save money on utility bills and offer long life, convenience, better quality and safety than standard fixtures. Over their lifetimes, ENERGY STAR-qualifying fixtures will cost less than half as much to operate and can even eliminate the need to replace up to 40 standard incandescent light bulbs over the life of the fixture. ENERGY STAR-rated fixtures are available in many styles including table lamps, torchieres, wall sconces, under-cabinet lighting and outdoor security lighting. Some indoor fixtures are dimmable or have two-way switches, and all outdoor fixtures have photo sensors (they turn on at night, off in the morning) and some also have motion sensors. Any fixture bearing the ENERGY STAR label must meet safety and reliability guidelines and offer minimum warranties of two years—well above industry standard. In addition, these fixtures operate at much lower temperatures than many traditional lamps so they reduce fire risks [11].

2.8.3 Strategy 3

Replace incandescent spot and flood lights with BST -2520 B placed on top of pole , outdoor lighting suitable for illumination of squares, side work ,park ,garden ,etc top-cover made of aluminum sheet 4 mm thickness and voltage HİT –CE 70 -150 W I used in my project 70 W ,the height 3-4 m and the weight 8.28 kg the reason for used this type ,I have trees and this type of lamb for the garden trees . This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights.

2.8.4 Strategy 4

Use automatic sensor lighting controls in stair rooms, car garage it will be easy for the customers .say for a number of easy-to-install lighting controls are available that will increase lighting flexibility, home security and energy savings:

Electronic dimmers, especially popular in dining rooms, regulate the brightness of incandescent and tungsten halogen lights and can create an informal, relaxed atmosphere and they save energy. The lower the brightness, the lower the energy consumption.

Motion sensing light switches turn lights on and off automatically when someone enters stairs of garage, offering "no hands" light control for stairs , and garage

Electronic timers provide precise, automatic on/off control of light fixtures and are often used for home security or garage. For instance, timers will turn specific lights on automatically at on when enters and off at leaves.

2.9 Putting the Strategies to Work at Home

Experts know that the right lighting can dramatically change the look and feel of a room. Listed below are several ideas to enhance the beauty of the home and to increase lighting energy efficiency room by room.

2.9.1 İN THE KİTCHEN

Mount low-profile fluorescent tube fixtures under wall cabinets located above work surfaces to provide the required light for food preparation and clean-up. They should be mounted as close to the front of the cabinet as possible to avoid countertop glare. A good choice is a thin T16 fluorescent tube lamp.

2.9.2 IN THE BEDROOM

Soft, ambient lighting is usually adequate and attractive for bedrooms,

In a bedroom, install one ENERGY STAR ceiling fixture using one ENERGY STAR 30-42 watt CFLs.in small bedroom I used 30 to 32 w and big or master room I used 46 w CFLs.

2.9.3 IN THE BATHROOM

Use ENERGY STAR linear fluorescent bulbs and fixtures on above of the mirror for the best cosmetic lighting. Fixtures using compact fluorescent bulbs can provide high-color rendering and match the "warm glow" of incandescence while using less energy, and must be water-proof.

2.9.4 TYPES OF OUTDOOR LİGHTİNG

Recent developments in outdoor lighting have greatly expanded the possibilities to increase the safety, security and beauty of the home and property as well as saving energy. With Minnesota's cold, northern climate, check the light fixture or bulb for cold weather performance. - Many fixtures can use, This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights. Additionally, so in this project my chose was HİT 100 W G12 and code LS 0002.413, for streets and parking

Figure 2.10: sole street lamps.

HİD fixtures rules for outdoor applications, specific lighting system designed for street lighting or parking

The system is designed and optimized for lighting streets, squares, parking, lots, parks, gardens

Operating temperature -25°C - +50°C, Ingress Protection IP66, mechanical Impact resistance IK08.

The system complies with European standards EN 60598 and ENEC certificated and there is another type of outdoor lighting BST-2520B it if for the gardens , the voltage HİT –CE max 150 w , ,it is standard in lox hotels in the world ,the top cover of aluminum sheet 4 mm thickness ,height 3-4 m and the weight about 8.28 m.

Figure 2. 2.10 vista garden

NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

GRADUATION PROJECT

ELECTRICAL INSTALLATION DESIGN

EE400

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Mohammed KMAİL

Nicosia – 2014

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CHAPTER TWO INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

INTRODUCTION

Technical staff in the field of electricity , the electrical installation plans and it should be able to read exactly must be able to conduct a complete application by the way . Therefore, vocational education and training on the basis of technical plans are of great importance . Besides, this plan covered by describes properties of materials and shapes them known symbols , materials suitable Selecting the plan and performing installations related laws, specifications , regulations and standards are also required to comply . Therefore, consisting of 8 units , respectively, in the book of the Electrical Installation Plan general information relevant to the topic and legislation has been given, briefly discussed the materials used in electrical installations , an important issue Lighting and computational techniques have been investigated, holds an important place in the installation of low-voltage installations described , reactive power compensation issues are mentioned , protection and safety in electrical installations subject treated , lighting and interior installations and examples of strong current plans were undertaken separately is corroborated by the application . In short, students may need a lot of information about electrical installation plans and teaching prepared in order to be included in this book have been studied. After receiving this information graduating students After working in related occupations and work in the case of adapting will be easy to comprehend . Prepared this book to students and technical staff working on these issues and believe will be beneficial to I wish success for our students .

Chapter one presents the electrical installation specifications, which are The General Technical Specifications for Buildings are published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

Chapter two; 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 not only more energy efficient, they are offering many more possibilities to improve the quality of lighting our homes, indoors and out.

Chapter three;. cables, 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 ONE

ELECTRICAL INSTALLATION SPECIFICATIONS

1.1 Over View

The General Technical Specifications for Buildings published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

1.2 General Specifications

All works, Materials Manufacturing, fabricating, testing and commissioning shall be governed by latest conditions of the following standards:

1- The general technical specification
2- National Codes
3- 16th Edition of IEE
4- British Standard
5- IEC Recommendation

In case of any conflicts arising between this Specification and Standard/Codes, the Contractor shall refer the matter to the Engineer and for Clarifications.

The Contractor shall submit a complete set of Shop Drawings for Engineer's approval prior one month to commencing the work at least. The Contractor shall submit a logical schedule of work for the project activities to the Engineer for approval, beside, the Contractor shall submit weekly, monthly, progress report.

The Contractor shall obtain the Engineer's written approval for all materials, equipment, accessories ...etc., prior to the procurement of any material, submittals shall be early stages, supplying of materials to the site shall be coordinated with the engineer and to his approval.

The Contractor shall submit for approval all drawings, diagrams, catalogues, dimensions, samples and any other information that may be required by the Engineer .Location of some electrical fixtures may be modified to suit the site conditions and/or to comply with safety measures. No claims will be accepted in such cases.

Testing and commissioning is an essential part of this Contract. The Contractor shall provide the testing instruments required. All tests shall be conducted and witnessed by the Engineer and the results shall be certified and signed by the Contractor and the Engineer. Original copies of testing certificates shall be kept with the Engineer.

The Contractor shall submit one complete set of transparent as-built drawings, CD disc and three blue print sets to the Engineer along with all manuals, wiring diagrams, operating instructions, maintenance instructions, list of recommended spare parts for two years and vendors names and addresses .All documents of this contract are complementary to each other and should be red as whole. [7]

1.3 Materials and Testing

The whole of the Works shall be executed with the materials indicated in the subsequent clauses of this Specifications .Where the names of manufacturers are stated, together with a detailed specification of their products.

Where such exists, the equipment shall comply with the requirements of the appropriate current standards as mentioned in item 1-2 and shall be of the best of their respective kinds, free from all flaws and defects.

1.4 Labour Restrictions

The Contractor shall employ none but workmen skilled in their respective trades and must not employ unskilled laborers in lieu of skilled workmen

1.5 Conduits

Only the following types of conduits and related fittings and accessories shall be used for the installation covered by this specification.

1.5.1 Rigid Non-Metallic Conduits (U/PVC)

Rigid non-metallic conduits including sleeves and elbows shall comply with BS6099, PART 2, SECT.2.21, 1982.

1.5.2 Rigid Metallic Conduit

Rigid metal conduit including sleeves and elbows shall comply with BS4568.

1.5.3 Flexible Non-Metallic Conduit

Flexible non-metallic conduit shall be suitable for installation in conjunction with rigid non-metallic conduits by the use of the same fittings and connectors .

1.5.4 Flexible Metal Conduit

Flexible metal conduit shall comply with NEC-Article 350. Conduit shall be suitable for installation in conjunction with rigid metal conduit, by the use of the same fittings and connectors. A separate conduit and wiring system is to be provided for each installation, i.e. lighting, general purpose sockets, power, telephone, etc.

Draw wires shall be left in all conduit runs for other services .Conduits shall not be run than 0.15m to any steam or hot water pipes and shall be run underneath such pipes rather than over them. The conduits shall not be run closer than 0.05m to any telephone, bell or other signaling .All joints in PVC conduits, shall be cemented with a waterproof adhesive.

Where conduits cross a building expansion joint due allowance shall be made in the design or the run with an approved expansion joint .All circular PVC boxes shall be provided with steel insert clips to provide additional support for lighting fittings .

Flexible metal conduits, watertight where required, shall be provided between the conduit system and electrical motors or other apparatus subject to vibration. They shall be complete with brass double female adaptors and shall be soldered to either end of all flexible conduits and connected to solid conduit entries using smooth bore male brass bushes.

Earth continuity through flexible conduits shall be provided by a separate earth continuity conductor .Minimum size of conduits shall be 20 mm. diameter, unless otherwise indicated or approved. Conduit runs shall not exceed 10 m in length without the incorporation of a pull box.

Conduits shall not cross pipe shafts, or vent duct openings. Riser conduits shall be supported at each floor level by approved clamp hangers.

All conduit and accessories shall be produced of the same manufacturer. Conduits and accessories installed (concealed) shall be of heavy gauge U-PVC conduits and shall comply with BS 4607; Class A.

Conduits shall have capacities as listed in the following table 1.1, unless stated other wise. In any case the space factor shall never exceed 40%. Pull boxes shall be located at convenient intervals at accessible positions.

Table 1.1: Conductor Conduit Size.

Size mm2	20	25	32	38	50
1.5	7	12	20	--	--
2.5	4	8	12	--	--
4.0	3	6	10	--	--
6.0	3	5	8	--	--
10.0	--	3	6	8	--
16.0	--	--	3	4	5
25.0	--	--	--	4	6
35.0	--	--	--	4	6
50.0	--	--	--	--	4

1.6 Pull and Junction Boxes

Pull and junction boxes shall be suitable for use in conjunction with the selected raceway systems.

1.6.1 Outlet Boxes

For concealed installation, outlet boxes shall be plastic, fastened with amply sized screws. For exposed installation, outlet boxes shall be either sheet metal of heavy-duty plastic, mounted exposed and rigidly connected to the conduit system by suitable bushings Comply with BS 5733.

1.6.2 Terminations

Terminations in junction boxes, floor boxes, distribution boxes and outlet boxes shall be of the screwed type.

1.7 Wires and Cables

Wires and cables shall be fabricated of stranded copper conductors in accordance with BS6004, 1984. The insulation of all wires and cables shall be rated for at least 70 deg. C for polyvinyl chloride (PVC) and 90 deg. D for thermoplastic (PE) cables. The identification by color for conductors in multicore wires and cables shall comply with IEC 446. XLPE cables shall comply with IEC 502 as shown on Drawings or schedules. Fire resistance insulation complying with UL1424-105 °C; especially for fire alarm systems.

1.7.1 Wires for Power, Lighting and Controls.

Wires are single-core insulated or multicore insulated and sheathed conductors which are used only for light-duty indoor applications. The conductor insulation and the sheath shall be polyvinyl chloride .All cables buried in the ground shall incorporate armor.

The cables installed in positions which may be exposed to direct sunlight shall be of a type resistant to damage by ultra-violet light or shall be suitably covered to protect from ultra-violet light .All cable conductor shall be fitted with a correctly sized cable socket or thimble and a means of identification. The cable sockets may be of the sweated or crimped compression types. The cables connected in parallel shall be of the same type, cross sectional area, length and disposition and be arranged so as to carry substantially equal load currents . [2]

1.7.2 L.V. Main Cables

L.V. Main Cables shall be 4 core; 600/1000 volts grade PVC insulation, single steel wire armoured. The conductors shall be circular standard copper. The armouring of L.V. main cables shall not be used as the sole circuit protective conductor (CPC). The sizes of protective conductor shall be calculated in accordance with Tables 54E and F of IEE Regulations or equal. L.V. cables if to be buried direct in the ground. They shall be buried to a depth of 70 cm. in trenches which have been cleared of all rocks and rubble and into which a 5 cm. sand layer shall be placed across the full width and along the entire length of the trench. The cables shall be laid on this sand bed and covered with a further 10 cm. layer of sand before the trench is backfilled and compacted. Concrete tiles shall be placed on the top of the second layer of sand as shown on the Drawing with suitable material.

Where L.V. cables cross sidewalks or road, they shall be drawn into heavy gauge PVC conduit of 15cm. ϕ. Concrete layer of thickness 10 cm. shall cover this UPVC conduit. In addition a warning PVC tape shall be laid in the cable trench during

the backfilling process so that the cable marker strip is 15 cm., beneath the finished compacted surface of the trench. Where L.V. cables are installed in a concrete trench, these cables shall be fixed to the base and sides of the trench by means of using cable cleats at intervals not exceeding 900 mm, between centers of adjacent fixings. The cable separation between adjacent cables shall not be less than double the diameter of the cable. [2]

1.7.2.1 Wires for Communication

Wires for communication are single-core or multicore insulated and sheathed conductors which are used only for light-duty indoor applications .

1.7.2.2 Communication Cables

Communication cables are multicore insulated, shielded and sheathed tinned copper conductor cables for indoor and outdoor installation in conduits, ducts or for direct burial .

1.8 Switches

Switches shall be mounted with the operating handle in upward position when in the "ON" position. Switches used on lighting branch circuits shall be quick make, quick break, with silver alloy contacts, rocker, operated with quick operating mechanism rated at 10 amperes 250 volts AC or higher capacity as required by the circuit controlled in accordance with the Specifications. Switches shall be single, three or four way flush mounted type and shall be waterproofed where required. Switches shall be to BS 3676 : 1989.Type MK or approved equal

1.9 stair switches

For stairs I used sensor switches, there is many types of sensor switches like TSM
1S, TSM1E and TSEN1. In this project I used the last one TSEN1 because the stair distance not so much.

1.10 Power Outlets

The switch socket outlets shall be as indicated on the drawings, all in accordance with BS1363 and BS546 as appropriate. These outlets shall be of the same manufactuer

throughout the installation. To different between the normal power supply receptacles from the essential & or the computer receptacles. Each system receptacles shall be distinctively colored or marked for identification.

1.11 Socket Outlets

Socket outlets shall be of the standard, 3-pin, single phase, with or without switch, flush mounted type of moulded plastic designed to fit with the appropriate plates as specified.

- Waterproof socket outlet without switch shall be used in washing room and kitchens.
- Single phase socket outlets shall be 13A, 230 volts, earthed, shuttered type.

Switches for electric water heater shall be flush 20 amp. DP switches with pilot lamp and marked (Water Heater).

1.12 Water Proof Receptacles

It shall be seal splash proof, switched and with pilot light. The dust and waterproofing shall be IP54 when plug is inserted in receptacle. Receptacle shall be semi-flush with wall.

1.13 INDUSTRIAL RECEPTACLES:

These receptacles shall be industrial type as shown on the Drawings, and shall be designed for AC230V to 660V. Receptacles shall be three, four or five-pole. The enclosure shall be plastic, splash proof or made watertight.

1.14 Telephone Systems

Telephone cabinet (TC) shall be provided as shown on the Drawings for adequate number of extensions, for the distribution of wires or cables between the main distribution frame and the extension outlets.

Telephone outlets shall be flush mounting type. These shall be of the same make and plate finish of the adjacent socket outlets.

1.15 Main and Sub main Distribution Boards

The (MDB) shall be fabricated, tested and commissioned in compliance with Electrical power Authority requirements and Engineer's approval. Free standing cubicle panel board consisting of 2mm thick steel sheet hammer painted, gray color with lockable hinged doors, locks and switches, rubber gaskets, dust proof to IP54. Sufficient holes for glands in removable rigid steel sheet gland plate to be provided.

The structure of the main sub main electrical panel boards shall be form two. All panel boards must include proper floor attachment facilities, and terminal panels in the top section and bottom section, in accordance with the location of the cable output.

The internal wiring shall be laid in proper PVC trunking, identified at both ends by PVC numbers. If flexible cables used inside the panel, then the cables of be soldered prior to being compressed into lugs. The lugs to be of tinned copper compression type. Bolted lugs are NOT allowed.

All bus bars and live terminals inside any electrical panel shall be isolated and not accessible by any means to ensure safe and normal cooperation of the panel. Bus bars ratings shall exceed 1.5 times the main circuit breaker rating of the panel.

1.16 Bus-Bars

The panel boards will contain bus-bars for phases R,S,T neutral and ground, without paint. These bus-bars shall be made of copper, with lead cooked and their cross-section must be compatible, thermally and mechanically, with the short-circuit currents specified in the plans, and in any case not less than 60KA on 415v. For 1 section. All panels shall have sufficient space for ventilation and maintenance purposes plus extra room to allow for the possibility of adding 25% of the installed circuit breakers. A separate cubicle shall be incorporated in the switchboard for accommodation of the Supply Authority's Metering Equipment. It shall meet the Supply Authority requirement and approval. In the main Switchboard the following facilities to BS89, shall be included : three Ammeters, one Voltmeter with Voltmeter selector switch, one Power factor meter, three Color coded pilot lamps, & M.R.C. fuses for voltage circuit protection. The MDB, for each building shall be provided with protection moulded case circuit breakers. Full schematic and control drawings shall be kept in a pocket at the inner side of the front door for maintenance. Engraved metal or PVC labels to be fixed at the mimic diagram to identify the components of the panel. Fixing Devices for free standing, supports, earthing... etc. shall be installed.

All cables and conduits connections to panels shall be firmly and securely connected mechanically and electrically by using proper glands, male pushes, femals pushes, locknut, by soldering or compression type lugs, clamps, supports ... etc., bolted lugs and NOT allowed . Contactors, when used, shall be protected by circuit breakers. Contactor rating shall be not less than 125% of its relative circuit breaker rating unless otherwise specified. [2]

1.17 Distribution Boards

Distribution Panel Bards feeding lights, socket outlets and other appliances shall be totally enclosed, dust protected and vermin proofed. The enclosure of these Panel Boards shall be of robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall be robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall contain an on load isolator and miniature circuit breakers or the size and number specified in Drawings and a neutral connector block of ample size to ensure that a separate way is available on the connector block for the neutral conductor of each circuit. The construction of the enclosure of those distribution boards shall be executed in a way such that to operate the mi-

niature circuit breakers, it is necessary to open the hinged door and to ensure access to the interior components and to the internal wiring, it is necessary to dismantle and remove a separate barrier within the enclosure. Miniature circuit breakers shall have a breaking capacity of 6000 amps. All miniature circuit breakers shall be equipped with thermal overload trips to operate at 125% rated current and instantaneous magnetic trips.

1.17.1 Circuit Breakers

Protective devices as shown shall be of the moulded case type up to an capacity of 630A. Trip-free circuit breakers shall be used with thermal and magnetic over current tripping devices for each line. Adjustable thermal tripping devices shall be adjustable from approx. 70% to full load rating . The magnetic tripping devices to be of the adjustable type .Circuit breakers with an capacity of 1000A and above shall be equipped with a motor-operated closing mechanism. All circuit breakers shall indicate clearly whether they are open or closed and shall have an interrupting rating not less than the maximum available short-circuit current at the supply terminals. The moulded case circuit breakers providing complete circuit over current protection by having inverse time and instantaneous tripping characteristics and where applicable, be current limiting. Circuit breakers shall be operated by a toggle type handle and shall have a quick made over current switching mechanism that is mechanically trip free. Circuit breakers 150 ampere and below shall be thermal magnetic trip with inverse time current characteristics.

1.17.2 Miniature Circuit Breakers

Miniature circuit breakers shall be of the narrow type and shall be for manual operation with trip-free release. Miniature circuit breakers shall be equipped with the thermal over current and a magnetic short-circuit tripping element .

The interrupting capacity of miniature circuit breakers shall not be less than 6AK off (230 V AC). Miniature circuit breakers shall have tripping characteristics in accordance with IEC 898 and IEC 947-2. Residual current circuit breakers shall comply with BS4293 .

1.17.3 Air Circuit Breaker (ACB)

The incoming supply shall terminate at the main air break circuit breakers on the switchboard. The air break circuit breaker shall comply with BS4752 VED0660 for use on a 380 volts 3 phase 50 Hz wire system .The bus bar sectionalizer shall be the same type (ACB) .The circuit breaker shall be horizontally isolated, horizontal draw-out pattern, air break type. The circuit breaker closing mechanism shall be motorized. The operating mechanism shall have a mechanical ON/OFF indicator and a manual trip device fitted with means for locking, test terminal blocks, healthy trip lamp (coloured white) as associated pushbuttons, set of auxiliary switches, supply available lamp, cable boxes complete with glands of suitable size fore the accommodation of the incoming and out going cables entering from below. Auxiliary contacts for the indication of breaker state. Slow closing of the circuit breaker to facilitate maintenance and con-

tact adjustment shall be provided .The incoming ACB's sectionalizer ACB shall be interlocked so as the sectionalize can only be made on when one of the incomers is off .

The air circuit breaker shall include sufficient auxiliary contacts and mechanical interlocking mechanisms to facilitate the possible future addition of a second supply feed so that full electrical and mechanical safety interlocking of all feed circuits can conveniently be arranged. A relay shall be incorporated for over current and earth fault protection at the incoming air circuit breaker. [3]

1.18 Power Factor Correction

Supply, install, test and commission power factor correction equipment automatically controlled multi-stage static bank type 200 / 400 V. Capable of correcting the power factor to 0-9 lagging all loads conditions.

The equipment's shall comply with BS 1650 suitable for operation on 440 volt 3 phase 4 wire connection 50 HZ. Supply shall be Generally As Follows:

- Enclosure
- Steel cubicle type extendable modular form of construction to IP 44.

Multiple units of static capacitors manufactured from impregnated metalized paper and plastic film, having self healing capacity, each unit shall be fitted with:

- Over pressure device
- Thermal protection device
- Discharge resistor

On load pattern for closing and breaking the supply, the operating handle shall be interlocked with cubicle door to prevent access while the isolator closed.

Multistage automatic type with two spare stages for the addition of future banks. Digital reading type, display of fate.

- Cos ∅
- Voltage
- Current
- Temperature control

With harmonic overload protection. Resonance control(protection from resonance) and automatic C/K controller.

Supply install test and commission power factor correction equipment automatic controlled multi-stage static bank type capable of correction the power factor to a minimum of 0.9 under all load conditions suitable to operate on 440 V 3PHASE 50HZ . Capacitor shall be multiple units of static type. [3]

1.19 Earthing System

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

1.20.1 TN-S SYSTEM:

The TN-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 of the secondary distribution system.

1.20.2 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 .

1.20.3 Earthing Copper Plates

Earthing copper plates shall be approximately 5mm high and 500mm wide or equal area. Plates shall be placed vertical, upper corner 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.

1.20.4 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.

1.21 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 BS6651, NFPA 780, and VDE0185. 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. [3]

1.22 Summary

In this chapter, the electrical installation specifications have been declared generally, in compliance with the latest global regulations such as the British System (BS) *where the conditions of designing works can be found.*

CHAPTER TWO

INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

2.1 Over View

In this chapter, a fully detailed explanation is going to be included, thus, new lighting products are not only more energy efficient, they offer many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looks at some of the new technologies for residential lighting, compares the cost benefits, identifies four basic strategies to apply, then provides specific examples of how to put the new strategies into practice throughout the home rooms

2.2 INSTALLATION OF LIGHTING SYSTEM AND LUMINAIRES

2.2.1 Pendant

Tube pendant shall comprise a dome cover and a biscuit ring and a piece of screwed steel conduit of suitable length to give the required mounting height of the luminaire.

Plain pendant shall comprise a ceiling rose and a cord-grip lampholder connected by a flexible cord having a suitable length to give the required mounting height of the lamp shade.

2.2.2 Luminaire Mounted on Pattress

When a luminaire is not provided with facility for a surface cable entry, the luminaire shall be mounted on pattress. The cable shall then enter the luminaire from the rear through a slot and a hole formed in the pattress.

2.2.3 Ceiling Rose

Ceiling rose shall not be used for the attachment of more than one outgoing flexible cord or cable unless it is specially designed for multiple pendants.

2.2.4 Cable in Enclosed Luminaire

Cables within an enclosed type luminaire shall be of heat resistant type. Cables entering the luminaire shall be protected by heat resistant insulating sleeves. The sleeves within the luminaire shall be extended to a distance of 150mm outside the luminaire.

Heat resisting cables shall be selected in accordance with the appropriate tables given in IEC 60364.

2.2.5 Stroboscopic Effect

Luminaires, other than those using tungsten filament lamps or fluorescent lamps with electronic ballast, installed over rotating machinery, shall be arranged so that at least two luminaires connected to different phases are used to illuminate the moving parts of the machinery. Alternatively where different phases are not available or the use of which is impracticable, separate tungsten filament lamps shall be used in addition to gas discharge lamps to eliminate the stroboscopic effect.

2.2.6 Painting

Unless otherwise specified, lighting equipment and luminaires other than those indicated to be self-finished such as stainless steel, anodized aluminium, etc, shall have factory-finished.

Metal parts such as cover plates for adaptable boxes, blanking plate for any boxes and conduit pendants, etc. shall be painted white or a suitable colour to match the interior finish of a particular location.

2.2.7 Special Requirements for Outdoor Luminaires

Outdoor luminaires shall be able to withstand the weather. Metal work should be protected against corrosion, and parts which have to be removed for access to the interior shall be provided with proper gaskets to restrict the entrance of moisture and dirt. Mounting brackets shall be heavily galvanized and stainless steel or galvanized bolts and nuts shall be used.

The adjustment bolts and nuts of a luminaire which is mounted on high level shall be captive to prevent accidental loss during servicing. Safety chains shall be provided to hold the luminaire from falling. A luminaire installed in a location within hand reach shall be of robust construct, fitted with an impact-resistant transparent or diffusing front panel, and shall have secret key fixings for the panel to the body of the luminaire. Where necessary, wire guards

shall be fitted over the front panel to give extra protection.

2.3 INSTALLATION OF SOCKET OUTLETS

2.3. 1 General

Socket outlet intended for supplying a fixed or stationary appliance shall be located as near as possible to the appliance. Socket outlet shall be mounted at a height of 1350mm above finished floor level in kitchens, sculleries, ironing rooms and the like. In other locations, they shall be mounted at 300mm from finished floor level, 75mm from surface top measured from bottom of socket outlet or as specified

2.3. 2 Shaver Supply Unit

The complete unit shall be enclosed in a galvanized metal box for flush mounting, or a galvanized cast iron or plastic surface box for surface mounting.

2.3. 3 Socket Outlet at Hazardous Area

The installation of socket outlets in hazardous areas should be avoided as far as possible. Where it is absolutely essential to install a socket outlet in such area, the socket outlet shall be type 'e' - increased safety conforming to IEC 60309-3 and shall be controlled by a sparkless switch. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position. The plug shall have shrouded pins and the design of the pin contacts shall be such as to guard against development Section B3of hot spots or sparking. Requirements for wiring installation in hazardous areas are specified in Sub-section B7.4.

2.3. 4 Socket Outlet of Surface Conduit System

In plant room, switch room or similar area where surface conduits are installed, socket outlets shall be metalclad or bronze front plate.

2.3. 5 Socket Outlet for Different Voltage System

Socket outlet and plug for one voltage system shall not be interchangeable with those for use at other voltage and/or frequency systems in the same installation.

2.3. 6 Application in Bathroom

Shaver supply units complying with BS EN 60742 can be installed inside a room containing a fixed bath or shower and inside a toilet. Socket outlets inside such a room, if so required under the contract, shall be installed in accordance with requirements of Code 26A(3)(j) of Code of Practice for Electricity (Wiring) Regulations.

2.4 INSTALLATION OF EARTHING SYSTEM

2.4.1 GENERAL

All metalworks associated with an electrical installation but not forming part of a live conductor, including exposed conductive parts and extraneous conductive parts, shall be solidly and effectively bonded and earthed in accordance with IEC 60364 and the Code of Practice for the Electricity (Wiring) Regulations.

2.4. 2 MAIN EARTHING TERMINAL

A solid copper main earthing terminal of ample size shall be provided for every electrical installation at a position near the main incoming switch or switchboard for the connection of :

(a) the circuit protective conductors,

(b) the main equipotential bonding conductors,

(c) the functional earthing conductors,

(d) the earthing conductors and

(e) the lightning protective system bonding conductors.

to create the equipotential zone. The main earthing terminal shall be connected to Earth via an earthing conductor to an earth electrode or a group of electrodes.

Where an installation distributes to a number of buildings or units, a separate main earthing terminal shall be provided for each individual building or unit at the point of intake thereby creating a separate equipotential zone in each building or unit. [10]

2.4. 3 EARTH ELECTRODE

2.4. 3.1 Types of Earth Electrode

The following types of earth electrode are permitted :

(a) rod electrode

(b) tape electrode

(c) plate electrode

Unless otherwise specified in the Particular Specification or Drawings, rod electrode shall be installed. Metalwork of public gas or water services shall not be used as the sole protective earth electrode.

2.4. 4 Rod Electrode

Rod electrode shall be of mild steel inner core with a bonded hard drawn copper sleeve of an approved type. The overall diameter of the rod shall not be less than 15mm and the thickness of the copper sleeve shall not be less than 0.25mm. The minimum length shall be 2.4m. Additional lengths, whenever required, shall each be of 1.2m, connected together by a coupling. The penetrating end of the rod electrode shall be a hardened steel point. Rod electrode shall be driven into the ground within an earth pit. Only approved tools e.g. electric hammer or pneumatic hammer shall be used for this installation. In case the earthing resistance achieved by one rod is not sufficiently low for the purpose required, additional lengths or additional rods shall be installed. For the latter application, additional rods shall be driven into the ground outside the resistance area of the previously installed rod(s). Under normal circumstances, a mutual separation of 3.5m is considered adequate.

2.4. 5 Tape Electrode

Tape electrode shall be untinned copper strip of not less than 25 x 3mm in cross section. Tape electrode shall be used only if specified by the Architect.

In case where several tapes are required for connection in parallel to achieve a low earthing resistance, they may be installed in parallel lines or they may radiate from a point.

2.5 Types of Indoor Lighting

An incandescent bulb is usually made of clear or frosted glass, screws into a "medium base" socket, generally lasts from 750 to 1000 hours, and emits a warm white light. The word "incandescent" translated from Latin means "glowing with heat." Light is produced when the electric current heats the bulb's filament; 90 percent of the energy is used to heat the filament and only 10 percent goes into making light. Therefore, most of the energy used by the bulb is given off as waste heat, not light.

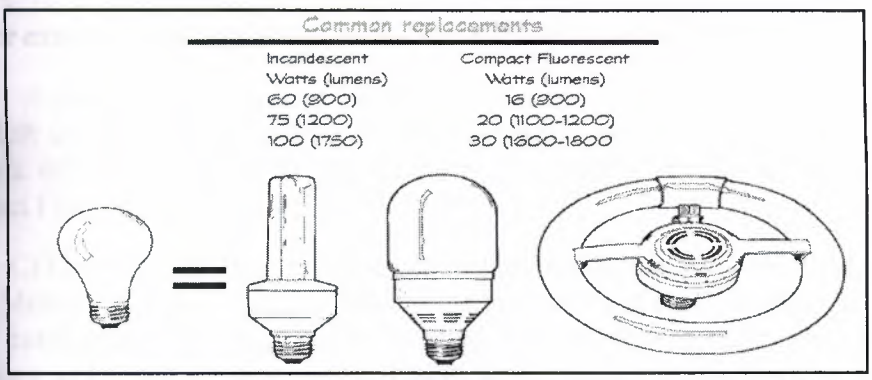


Fig.2.1 Compact fluorescents come in a variety of shapes and sizes to fit different fixtures.

2.5.1 Compact fluorescent lamp

A compact fluorescent lamp (CFL), also called compact fluorescent light, energy-saving light, and compact fluorescent tube, is a fluorescent lamp designed to replace an incandescent lamp; some types fit into light fixtures formerly used for incandescent lamps. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and compact electronic ballast in the base of the lamp.

Compared to general-service incandescent lamps giving the same amount of visible light, CFLs use one-fifth to one-third the electric power, and last eight to fifteen times longer. A CFL has a higher purchase price than an incandescent lamp, but can save over five times its purchase price in electricity costs over the lamp's lifetime.[2] Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal. In many countries, governments have established recycling schemes for CFLs and glass generally.

CFLs radiate a spectral power distribution that is different from that of incandescent lamps. Improved phosphor formulations have improved the perceived color of the light emitted by CFLs, such that some sources rate the best "soft white" CFLs as subjectively similar in color to standard incandescent lamps.

The parent to the modern fluorescent lamp was invented in the late 1890s by Peter Cooper Hewitt the Cooper Hewitt lamps were used for photographic studios and industries. Development of fluorescent lamps that could fit in the same volume as comparable incandescent lamps required the development of new, high-efficacy phosphors that could withstand more power per unit area than the phosphors used in older, larger fluorescent tubes[8].

There are two types of CFLs: integrated and non-integrated lamps. Integrated lamps combine the tube and ballast in a single unit. These lamps allow consumers to replace incandescent lamps easily with CFLs. Integrated CFLs work well in many standard incandescent light fixtures, reducing the cost of converting to fluorescent. 3-way lamp bulbs and dimmable models with standard bases are available.

Non-integrated CFLs have the ballast permanently installed in the luminaire, and only the lamp bulb is usually changed at its end of life. Since the ballasts are placed in the light fixture, they are larger and last longer compared to the integrated ones, and they don't need to be replaced when the bulb reaches its end-of-life. Non-integrated CFL housings can be both more expensive and sophisticated. They have two types of tubes: a bi-pin tube designed for conventional ballast, and a quad-pin tube designed for electronic ballast or conventional ballast with an external starter. A bi-pin tube contains an integrated starter, which obviates the need for external heating pins but causes incompatibility with electronic ballasts.

A photograph of various lamps illustrates the effect of color temperature differences. From left to right: Compact Fluorescent: General Electric, 13 W, 6,500 K; Incandescent: Sylvania 60 W Extra Soft White; Compact Fluorescent: Bright Effects, 15 W, 2,644 K; Compact Fluorescent: Sylvania, 14 W, 3,000 K

CFLs emit light from a mix of phosphors inside the bulb, each emitting one band of color. Modern phosphor designs balance the emitted light color, energy efficiency, and cost. Every extra phosphor added to the coating mix improves color rendering but decreases efficiency and increases cost. Good quality consumer CFLs use three or four phosphors to achieve a "white" light with a color rendering index (CRI) of about 80, where the

maximum100 represents the appearance of colors under daylight or a black-body (depending on the correlated color temperature).

Characteristic spectral power distributions (SPDs) for an incandescent lamp (left) and a CFL (right). The horizontal axes are in nanometers and the vertical axes show relative intensity in arbitrary units[10]

2.5. 2 Color and temperature

Color temperature can be indicated in kelvins or mireds (1 million divided by the color temperature in kelvins). The color temperature of a light source is the temperature of a black body that has the same chromaticity (i.e. color) of the light source. A notional temperature, the correlated color temperature, the temperature of a black body which emits light of a hue which to human color perception most closely matches the light from the lamp, is assigned.

A true color temperature is characteristic of black-body radiation; a fluorescent lamp may approximate the radiation of a black body at a given temperature, but will not have an identical spectrum. In particular, narrow bands of shorter-wavelength radiation are usually present even for lamps of low color temperature ("warm" light).[10]

As color temperature increases, the shading of the white light changes from red to yellow to white to blue. Color names used for modern CFLs and other tri-phosphor lamps vary between manufacturers, unlike the standardized names used with older halophosphate fluorescent lamps. For example, Sylvania's Daylight CFLs have a color temperature of 3,500 K, while most other lamps called daylight have color temperatures of at least 5,000 K

Saturated color CFLs are also produced, less commonly:

Red, green, orange, blue, and pink, primarily for novelty purposes

Blue for phototherapy

Yellow, for outdoor lighting, because it does not attract insects

Black light (UV light) for special effects

2.5. 3 Lifespan

CFLs typically have a rated service life of 6,000 to 15,000 hours, whereas standard incandescent lamps have a service life of 750 or 1,000 hours. However, the actual lifetime of any lamp depends on many factors, including operating voltage, manufacturing defects, exposure to voltage spikes, mechanical shock, frequency of cycling on and off, lamp orientation, and ambient operating temperature, among other factors.

The life of a CFL is significantly shorter if it is turned on and off frequently. In the case of a 5-minute on/off cycle the lifespan of some CFLs may be reduced to that of incandescent light bulbs. The U.S. Energy Star program suggests that fluorescent lamps be left on when leaving a room for less than 15 minutes to mitigate this problem. CFLs produce less light later in their lives than when they are new. The light output decay is exponential, with the fastest losses being soon after the lamp is first used. By the end of their lives, CFLs can be expected to produce 70–80% of their original light output.[16] The response of the human eye to light is logarithmic. One photographic "f-stop" reduction

represents a halving in actual light, but is subjectively quite a small change.A 20–30% reduction over many thousands of hours represents a change of about half an f-stop. So, presuming the illumination provided by the lamp was ample at the beginning of its life, such a difference will be compensated for by the eyes.

2.5. 4 Comparing cost and efficiency

Why would a person spend $5 to $20 to purchase a CFL bulb rather than incandescent for 50 cents? Because CFLs use 75 percent less energy to operate, they last up to 10 times longer, and they produce more lumens (light) per watt (electricity used) than incandescent bulbs. Although CFLs cost more initially, they are a better bargain in the long run.

The two basic pieces of information needed to find the best buy are printed on the light bulb package: watts and lumens. Watts, often the only number people look at when buying a light bulb, indicates how much energy the bulb consumes but nothing about the light output. The average lumens is the amount of light given off by the bulb. To determine a bulb's efficiency, look at the amount of lumens per watt. Surprisingly, some bulbs that are labeled as long-life may last longer, however light output is significantly lower. For example: A 75-watt incandescent bulb uses 75 watts of electricity to provide 1,200 lumens. A 20- watt compact fluorescent uses only 20 watts of electricity, one-fourth the amount, to provide the same 1,200 lumens. To determine the real cost of lighting, add the cost of the bulb (initial cost plus replacements) and the electricity cost. Compare the operating cost of a single 20-watt CFL and a 75-watt incandescent for 10,000 hours.

	Bulb cost (Initial X replacement)	Electricity cost (10.000 hours)	Total
75W Incand.	1$ X 13 = 13$	48.75 $	61.75 $
20W CFL	20$ X 1 = 20$	13.00 $	33.00$

Table2.3.4 the operating cost of a single 20-wattCFL and a 75-watt incandescent for 10,000 hours.

2.5. 5 Compare Color and Quality of Light

The quality of light produced by a bulb can vary depending on the light source, and is expressed in two ways: color temperature and color rendering. Color temperature (or correlated color temperature, CCT) is measured in degrees Kelvin, and may or may not be listed on the product package. Light bulbs with a number below 3500K are considered "warm," and are more reddish in color; light bulbs with a number above 4000K are considered "cool," and are more bluish in color. Color rendering is measured by the Color Rendering Index (CRI), which rates the amount of illumination compared to a light source with a known CRI. Only lights with the same temperature rating are compared with each other. A simple way to find a light bulb that will produce the best color temperature and color

rendering for most lighting needs is to look for an ENERGY STAR light, which will have a CRI of 80 or higher and a color temperature between 2700K and 3000K.

2.6 Evaluating the Home's Lighting Needs

To evaluate the home's current lighting conditions, tour the home in the evening and turn on the lights as you go from room to room. Is each area receiving adequate amounts of lighting? Lighting generally falls into one of three categories:

2.6.1 Accent lighting

Use accent lighting to highlight specific objects, such as artwork, shelves or plants. It can also illuminate wall surfaces in a soft wash of light or accentuate the texture of the surface.

2.6.2 Task lighting

Direct light to specific activity areas with task lighting lamps and fixtures. Lights under cabinets to illuminate kitchen work surfaces or a reading lamp next to that favorite chair are two common examples of task lighting.

2.6.3 Ambient lighting

Distribute light broadly throughout a space with ambient lighting fixtures, such as the traditional single ceiling fixture located in the center of a room. Ambient lighting by itself is still adequate for general activities that are not visually demanding, but will not give the quality of light needed for reading or sewing. To make sure areas of the home meet desired lighting needs, choose and locate accent fixtures first, then choose and locate task lighting fixtures. If additional light is still needed, use ambient lighting fixtures.

2.7 Swimming Pool lights

2.7.1 How to Install Underwater Swimming Pool Lights

İnstalling underwater swimming pool lights does not have to entail a major pool renovation project or even require the pool to be drained. With the right kind of lighting and a little electrical know-how, pool lighting can be installed in a single afternoon.

Step 1: Choosing a Light

When choosing a light it is important to consider project time. What parts will have to be replaced (like batteries)? What about pool size and the amount of electrical work required? To avoid draining your pool and drilling holes in it, it is best to select a suction-mounted light.

For a fast and easy install, with no electrical work, a battery operated light is the best solution. However, batteries will need regular replacement and the life of the light will be shorter than that of a corded model. Choose corded lights according to pool wall type.

Step 2: Assemble Light

Assemble the light according to manufacturer specifications and check all seals for water tightness. This can be done by submerging the light in shallow water and watching for bubbles.

Step 3: Set up Power Supply

For a battery operated light, install batteries and move on to step 4.

For a corded light, you will need to set up a power source. If there is a GFCI outlet close enough to the pool that the light cord will reach, mount the light transformer to the wall next to the outlet and plug the light in. Move on to step 4.

If there is no available outlet, you will need to install a waterproof junction box on an existing power line. First, turn off the power supply at the circuit breaker. Locate the power line to the pool pump or filter. Cut the line with wire cutters and expose the wire by using a stripper to remove the sheath. Install your junction box according to manufacturer specifications. If desired, mount the junction box on a wall, the pump or filter mount. Tie the light into the junction box. Check all fittings to make sure seals are water tight.

If the light does not have its own switch and you don't want it to be on while the pump or filter are on, you will also need to install a switch for the light. Check all seals before moving on to step 4.

Step 4: Install Light

Test the light to insure that it is working properly. Mount the light on the pool wall according to manufacturer specifications.

If you have a hard wall pool and are using a corded light, remove the edging over the area where you are going to install the light. Run the cord over the pool edge and then replace the edging. If you have a soft wall pool and are using a corded light, anchor the cord to the pool railing according to the manufacturer specifications. With these easy steps, you can install your own underwater pool light and begin enjoying your pool at night.

2.7.2 How Much Energy Does a Pool Pump Use?

To predict a planned swimming pools' impact on your electric bill, determine how much energy a pool pump uses. Check the specifications to determine the horsepower (hp) of the pump. The electricity used by pumps and engines are measured in horsepower, whereas the electricity delivered to your house is measured in kilowatt hours (kWh). A kilowatt hour is the amount of power drawn by a one kilowatt load over the course of one hour.

The most typical size for pool pumps is 1 hp, but check the manufacturer's specifications if you are in doubt. 1 hp is equivalent to approximately 0.7456 kilowatts. The amount of power a pump will use depends on how long the pump runs during the day. The length of time the pump runs is determined by pool occupancy, prevalence of airborne debris, and algae-inhibiting chemicals. Higher filtration needs result in longer run times. Convert the pump horsepower to kilowatts and multiply by the daily run time. This is the amount of energy that will be reflected on your next utility bill.

2.8 The new technology Using 4 Strategies

Four strategies could be used to perform the new technologies, thus, these are fully detailed listed as following.

2.8.1 Strategy 1

Strategy one is to replace standard incandescent light bulbs with ENERGY STAR labeled CFLs. No other new product in the lighting industry has had as great an impact as the ENERGY STAR labeled CFL. Modern CFLs have taken the best aspects of fluorescents high efficiency and long life while eliminating previous problems of poor color, flicker and noise. Achieve the most benefit by switching to ENERGY STAR labeled CFLs wherever high wattage incandescent bulbs are used more than three hours per day often in the kitchen and family room. Some specialty CFLs can now be used with dimmer switches. More and more types of CFLs will work well outdoors in Minnesota's cold climate.

2.8.2 Strategy 2

Strategy two is to replace standard incandescent ceiling fixtures (especially in the kitchen and laundry area) with ENERGY STAR labeled fluorescent fixtures. ENERGY STAR labeled light fixtures, when used with ENERGY STAR CFLs, help save money on utility bills and offer long life, convenience, better quality and safety than standard fixtures. Over their lifetimes, ENERGY STAR-qualifying fixtures will cost less than half as much to operate and can even eliminate the need to replace up to 40 standard incandescent light bulbs over the life of the fixture. ENERGY STAR-rated fixtures are available in many styles including table lamps, torchieres, wall sconces, under-cabinet lighting and outdoor security lighting. Some indoor fixtures are dimmable or have two-way switches, and all outdoor fixtures have photo sensors (they turn on at night, off in the morning) and some also have motion sensors. Any fixture bearing the ENERGY STAR label must meet safety and reliability guidelines and offer minimum warranties of two years—well above industry standard. In addition, these fixtures operate at much lower temperatures than many traditional lamps so they reduce fire risks [11].

2.8.3 Strategy 3

Replace incandescent spot and flood lights with BST -2520 B placed on top of pole , outdoor lighting suitable for illumination of squares, side work ,park ,garden ,etc top-cover made of aluminum sheet 4 mm thickness and voltage HİT –CE 70 -150 W I used in my project 70 W ,the height 3-4 m and the weight 8.28 kg the reason for used this type ,I have trees and this type of lamb for the garden trees . This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights.

2.8.4 Strategy 4

Use automatic sensor lighting controls in stair rooms, car garage it will be easy for the customers .say for a number of easy-to-install lighting controls are available that will increase lighting flexibility, home security and energy savings:

Electronic dimmers, especially popular in dining rooms, regulate the brightness of incandescent and tungsten halogen lights and can create an informal, relaxed atmosphere and they save energy. The lower the brightness, the lower the energy consumption.

Motion sensing light switches turn lights on and off automatically when someone enters stairs of garage, offering "no hands" light control for stairs , and garage

Electronic timers provide precise, automatic on/off control of light fixtures and are often used for home security or garage. For instance, timers will turn specific lights on automatically at on when enters and off at leaves.

2.9 Putting the Strategies to Work at Home

Experts know that the right lighting can dramatically change the look and feel of a room. Listed below are several ideas to enhance the beauty of the home and to increase lighting energy efficiency room by room.

2.9.1 İN THE KİTCHEN

Mount low-profile fluorescent tube fixtures under wall cabinets located above work surfaces to provide the required light for food preparation and clean-up. They should be mounted as close to the front of the cabinet as possible to avoid countertop glare. A good choice is a thin T16 fluorescent tube lamp.

2.9.2 IN THE BEDROOM

Soft, ambient lighting is usually adequate and attractive for bedrooms,

In a bedroom, install one ENERGY STAR ceiling fixture using one ENERGY STAR 30-42 watt CFLs.in small bedroom I used 30 to 32 w and big or master room I used 46 w CFLs.

2.9.3 IN THE BATHROOM

Use ENERGY STAR linear fluorescent bulbs and fixtures on above of the mirror for the best cosmetic lighting. Fixtures using compact fluorescent bulbs can provide high-color rendering and match the "warm glow" of incandescence while using less energy, and must be water-proof.

2.9.4 TYPES OF OUTDOOR LİGHTİNG

Recent developments in outdoor lighting have greatly expanded the possibilities to increase the safety, security and beauty of the home and property as well as saving energy. With Minnesota's cold, northern climate, check the light fixture or bulb for cold weather performance. - Many fixtures can use, This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights. Additionally, so in this project my chose was HİT 100 W G12 and code LS 0002.413, for streets and parking

Figure 2.10: sole street lamps.

HİD fixtures rules for outdoor applications, specific lighting system designed for street lighting or parking

The system is designed and optimized for lighting streets, squares, parking, lots, parks, gardens

Operating temperature -25°C - +50°C, Ingress Protection IP66, mechanical Impact resistance IK08.

The system complies with European standards EN 60598 and ENEC certificated and there is another type of outdoor lighting BST-2520B it if for the gardens , the voltage HİT –CE max 150 w , ,it is standard in lox hotels in the world ,the top cover of aluminum sheet 4 mm thickness ,height 3-4 m and the weight about 8.28 m.

Figure 2. 2.10 vista garden

2.9.5 Calculating the Numbers of Luminaires Needed

When you add a luminaire from a database or PHILLUM file, Calculux can give you a quick estimation of the number of luminaires needed to provide the required illuminance level. The calculation is done according the so called Utilization Factor (UF) method.

2.9.6 Quick Estimation

If you enter the required illuminance level (in the Room dialogue box), Calculux will be able to determine a quick estimation of the number of luminaires needed. This calculation is done for each luminaire individually and is performed according to the UF (Utilization Factor) method described in CIE reports 40 and 52.

$$N = \frac{E * L * W}{NL * F * MF * UF}$$

Where the variables are:

N = number of luminaires needed

E = required illuminance

L = room length

W = room width

NL = number of lamps in each luminaire

F □ =lamp flux

MF = maintenance factor

UF = utilization factor

2.9.7 Utilization Factor (UF)

The Utilization Factor is calculated according to the lumen method. This method uses the CIE flux code of the luminaire, the room's dimensions and the reflection properties of its surfaces to perform the calculation. The room's dimensions are characterized by the room index K, defined as:

$$K = \frac{L * W}{(H_1 - H_0) * (L + W)}$$

Where the variables are:

L = room length

W = room width

H1 = room height

H0 = height of the working plane

The Utilization Factor can be found when the room index and the reflectance of the room are known. They are tabulated as part of the luminaire photometric data. Strictly speaking, the UF method is only valid if the luminaire arrangement and the room dimensions are exactly the same as those in the CIE reports. However, experience shows that the values are valid for most practical situations. The UF method of calculating the number of luminaires is used as a rough indication. A point calculation can always be performed. For this reason Calculux Indoor only uses the CIE method of calculating the utilisation factor as the differences between it and other methods (DIN, CIBSE, etc.) are quite small. The table below shows an example of room index values for a typical luminaire. [4]

Table 2.2: Utilization Factor Table

	Reflectances (%) for ceiling, walls and working plane										
room index K	80 50 30	80 50 10	70 50 30	70 50 20	70 50 10	70 30 10	50 30 10	50 10 10	30 30 10	30 10 10	0 0 0
0.60	0.39	0.37	0.39	0.38	0.37	0.33	0.33	0.31	0.33	0.30	0.29
0.80	0.46	0.44	0.46	0.44	0.43	0.39	0.39	0.37	0.39	0.36	0.35
1.00	0.52	0.48	0.51	0.50	0.48	0.44	0.44	0.42	0.44	0.41	0.40
1.25	0.57	0.52	0.56	0.54	0.52	0.49	0.48	0.46	0.48	0.46	0.45
1.50	0.61	0.55	0.60	0.57	0.55	0.52	0.51	0.49	0.51	0.49	0.48
2.00	0.66	0.59	0.65	0.62	0.59	0.57	0.26	0.54	0.55	0.54	0.52
2.50	0.70	0.62	0.68	0.64	0.61	0.59	0.58	0.57	0.57	0.56	0.55
3.00	0.72	0.63	0.70	0.66	0.63	0.61	0.60	0.59	0.59	0.58	0.57
4.00	0.75	0.65	0.73	0.68	0.64	0.63	0.62	0.61	0.61	0.60	0.59
5.00	0.76	0.66	0.74	0.69	0.65	0.64	0.63	0.62	0.62	0.61	0.60
	Suspension ratio: 0 Calculated acc. to CIE publication 40							LVW1077000-00			

2.9.8 Uniformity Check

In some instances, the database contains information about the maximum advisable spacing to height ratios of luminaires which provide good uniformity. These values are taken into account in the Quick estimation and can sometimes lead to a greater number of luminaires than required to provide the average illuminance level.

The uniformity check is restricted to checking the minimum numbers in length and width. This check is performed only if the luminaire maximum spacing to height ratio is given in the database. The uniformity check is based on the values as given in the data base. These values are calculated for a grid of 4 times 4 luminaires. The uniformity is calculated in the square of the middle four luminaires (as set out in CIBSE TM5).In practical situations the above conditions are not always met. [7]

2.9.9 Quality Figures

Calculux allows you to show the quality figures of the calculations. Depending on the settings of the Quality Figure tab (see Calculation menu, Presentation...) the following quality figures can be displayed: Average value calculation The average value for a grid is worked out by adding the calculated values of each point and dividing it by the number of grid points (grid dimensions; AB, AC). [7]

$$\text{Average} = \frac{\text{S calculated values for all idividual points}}{(\text{Points AB}) * (\text{Points AC})}$$

Minimum

This is the minimum calculated value.

Maximum

This is the maximum calculated value.

Minimum/maximum

This is the minimum calculated value divided by the maximum calculated value.

Minimum/average

This is the minimum calculated value divided by the average calculated value. Unified Glare Rating according to the CIE tabular method (UGRCIE) This is the Unified Glare Rating under reference conditions as specified in the CIE tabular method.

2.9.10 Report Setup

A very useful feature of Calculux is the report facility. When you have completed a lighting project you can create attractive reports to present the results of the calculations to your customers. By means of the Report Setup you can simply specify the layout of the report and components you wish to include. For example, you can include, a table of contents, 2-D and 3-D project overviews, a summary, luminaire information (including Polar or Cartesian diagram) and/or financial data. For detailed information about your calculation results you can include the following presentation formats:

* □ Textual Table;

* □ Graphical Table;

* □ Iso Contour;

* □ Filled Iso Contour;

* □ Mountain Plot.

You can also include a summary of your findings and recommendations about the best lighting solutions. If you wish, you can produce reports in several languages. The order of the calculation results can be altered (see Calculation Presentations dialogue box). However, the order of the presentation formats is governed by Calculux and cannot be altered. Calculux enables you also to print a report in portrait or landscape format with the 2D result views rotated 90°. This option (Report

menu, Print Setup, Layout tab) can be very useful. For instance, when a report which has to be printed in portrait format contains a landscape formatted 2D result view which looks relatively small. By selecting 'Rotate presentation for Portrait Printing', the 2D result views will be rotated 90°. Because of the rotation the view can be enlarged. [7]

2.10 Cost Calculations

Calculux allows you to calculate the annual energy, investment, lamp and maintenance costs for the lighting installation in your project. You can view and/or enter the data for calculating the 'annual costs' and the 'total investment' costs of the project. [4]

2.10.1 Total Investment

The Total Investment is the cost of the luminaires, lamps and the installation of the entire lighting project. The Total Investment costs are calculated according to the following formula:

$$\text{Total\_Investment} = \Sigma_{\text{lumtype}} (NT * (LPR + INSTC + (LAPR * NL)))$$

Variables:	Meaning:
INSTC	Installation costs of the particular luminaire type;
LAPR	Lamp price for the particular luminaire type;
LPR	Price of the particular luminaire type;
NL	Number of lamps for the particular luminaire;
NT	Number of luminaires of the particular type;
Σ_{lumtype}	Sum for all luminaires types.

2.10.2 Annual costs

The total annual costs are calculated according to the following formula:

Total Annual Cost = EN + AI + LC + MC

Variables:	Meaning:
EN:	Energy costs per year;
AI:	Annual investments costs for the particular luminaire type;
LC:	Lamp replacement costs per year;
MC:	Maintenance costs per year.

The formulas for these costs are: [4]

$$EN = \frac{KWHPR}{1000} * \Sigma_{swimod} \{ \{ \Sigma_{lumtype} (NT_{swimod} * LWATT) \} * BRNH_{swimod} \}$$

$$AI = AF * \Sigma_{lumtype} \{NT * (LPR + INSTC)\}$$

$$AF = \frac{R/100}{1 - \{1/[1 + R/100]\}^{**N}}$$

$$LC = \frac{\Sigma_{lumtype} \{NT * NL * LAPR\}}{RP}$$

$$MC = \frac{\Sigma_{lumtype} \{NT * MCL\}}{RP}$$

Variables:	Meaning:
AF	the annuity factor;
$BRNH_{swimod}$	the burning hours per year of the switching mode;
INSTC	the installation cost per luminaire for a particular luminaire type;
KWHPR	the kilowatt-hour price;
LAPR	the lamp price for a particular luminaire type;
LPR	the price per luminaire for a particular luminaire type;
LWATT	the total watts per luminaire for a particular luminaire type;
MCL	the maintenance cost per luminaire for a particular luminaire type;
N	the amortization period (years);
NT	the number of luminaires of a particular type;
NT_{swimod}	the number of luminaires of a particular type per switching mode;
NL	the number of lamps per luminaire for a particular luminaire type;
R	the interest rate (%);
RP	the relamping period (years) for a particular luminaire type;
$\Sigma_{lumtype}$	the sum for all luminaire types.

2.10.3 Cost calculations and light regulation factors

There is no linear relation between the value of the light regulation factor and the power consumption of a luminaire. As a result of this, when light regulation factors are used, the power consumption of the luminaire can not be calculated. So in the cost calculation the energy costs will not be given. [11]

2.11 maintenance Factor/New Value Factor

The Maintenance Factor is the ratio of the average illuminance on the plane under investigation after a specified period of use of the lighting installation, to the average illuminance obtained under the same conditions for a new installation. It is always equal or less than 1 and is used as a multiplier for calculations, based on luminaire light distribution tables. [8]

In some countries the New Value Factor (or Inverse Maintenance Factor) is used. Calculux allows you to use new value factors instead of maintenance factors. The 'Inverse Maintenance Factor' is always more than or equal to 1. The following maintenance factors are specified:

* □ General Project Maintenance Factor;

* □ Luminaire Type Maintenance Factor;

* □ Lamp Maintenance Factor.

2.11.1 General Project Maintenance Factor

This maintenance factor takes into account a general factor with which all calculation results are multiplied. It acts as a safeguarding factor and must reflect the overall conditions of the room surfaces. The value of the 'Project Maintenance Factor' is always equal or less than 1. [8]

2.11.2 Luminaire Type Maintenance Factor

This maintenance factor takes into account the reduction of light output caused by dirt deposited on or in a luminaire. The rate at which the dirt is deposited depends on the construction of the luminaire and the extent of what dirt is present in the environment. The value of the 'Luminaire Type Maintenance Factor' is always equal or less than 1.

2.11.3 Lamp Maintenance Factor

The Lamp Maintenance Factor value is always equal or less than 1 and consists of two elements:

a) Lamp Survival Factor;

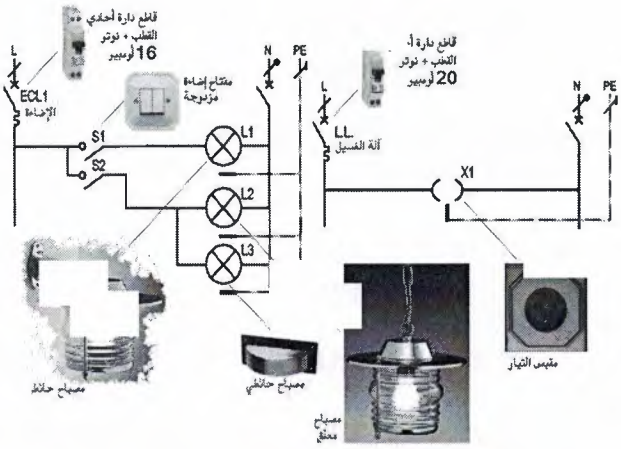
b) Lamp Lumen Depreciation Factor.

a) Lamp Survival Factor

This maintenance factor takes into account the percentage of the lamp failures during a specific number of operation hours. It is only applicable when a group replacement is to be carried out. The 'Lamp Survival Factor' is based on the assumptions about the switching cycle, supply voltage and control gear.

b) Lamp Lumen Depreciation Factor.

This maintenance factor takes into account the fact that the luminous output of all lamps decreases with use. [8]



ld be controlled from two sides as following:

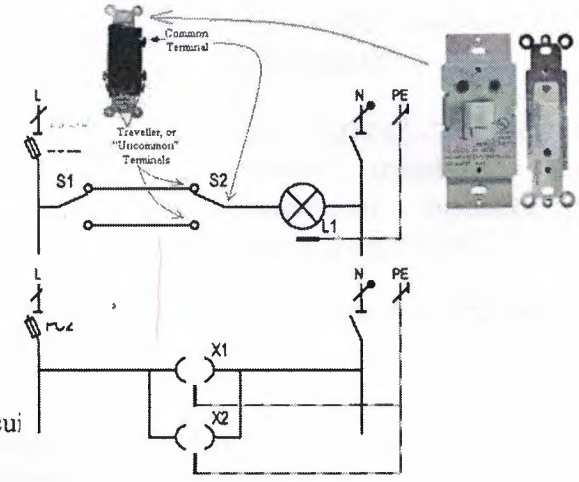


Figure 2.5 Lighting Circui

2.12 FLUORESCENT LUMINAIRE AND LAMP

2.12 .1 GENERAL

The luminaires, including the control gear, shall be suitable for operation at 220V ±6%, 50 Hz ±2%, single phase, a.c. supply.

The luminaires shall comply both in manufacturing and testing with the following international standards and their manufacturing process shall conform to the relevant quality standard of ISO 9000:

Luminaires	:	IEC 60598-2
Ballast	:	IEC 60920 and/or IEC 60921 as applicable
Electronic ballast	:	IEC 60928 and/or IEC 60929 as applicable
Capacitor	:	IEC 61048 and/or 61049 as applicable
Starter, glow type	:	IEC 60155
Starter, electronic type	:	IEC 60926 and/or IEC 60927 as applicable
Lampholder	:	IEC 60400
Lamp	:	IEC 60081 and/or IEC 60901 as applicable
Internal cable	:	IEC 60245-7 450/750V heat resistant rubber insulated cable, suitable for conductor operating temperature not exceeding 110°C

Test certificate shall be provided and the luminaires shall be marked in accordance with the requirements of IEC 60598-2.

The luminaires excluding the fluorescent lamp shall be supplied in complete set comprising control gear, lampholders, cable terminal block, etc., interconnected with cables of appropriate colour codes.

2.12 .2 TYPE OF LUMINAIRES

Group 1
This group includes batten luminaires and the combination of different reflectors or diffusers with the basic battens.
Group 2
This group covers special luminaires including glass fibre, garage pit and flame proof luminaires.
Group 3
This group covers self-contained emergency fluorescent luminaire.
Group 4
Wall-mounted fluorescent luminaire complete with shaver socket.

2.12 .3 FLUORESCENT LAMPS

2.12 .3.1 Lamp Features

Lamps shall have, but not limited to, the following features:

(a) Superb colour rendering (Ra) property with values not less than:

Areas served	Values of R_a
Car parking spaces or similar	50
Office areas or similar	80
Hospitals or other clinical functional areas	90

(b) Energy saving

(c) Compatible to the type of lamp circuit, and

(d) Tubular shape with preheated cathode and suitable for operation in ambient temperature up to 40°C and 100% relative humidity.

Table C6.7.2 – 1

Lumen Output for 26 mm Diameter (T8) Tubular Fluorescent Lamps

Rated power of lamp	Min. Lumen output				
	2700°K	3000°K	3800°K	5400°K	6500°K
18	1350	1350	1350	1300	1000
36	3350	3350	3350	3250	2300
58	5200	5200	5200	5000	3700

Table C6.7.2 – 2

Lumen Output for Circular Fluorescent Lamps

Rated power of lamp	Min. Lumen output				
	2700°K	3000°K	3800°K	5400°K	6500°K
22	1350	--	1000	--	1050
32	2050	2000	2000	--	1750
40	2900	2800	2300	--	2500

Table C6.7.2 – 3

Lumen Output for 38 mm Diameter U-tube Fluorescent Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
20	--	1150	950
40	--	2700	2400
65	--	4500	3900

Table C6.7.2 – 4

Lumen Output for 16 mm Diameter (T5) Tubular Fluorescent Lamps

Rated power of lamp (W)	Min. Lumen output		
	3000°K	4000°K	6000°K
14	1350	1350	1300
21	2100	2100	2000
28	2900	2900	2750
35	3650	3650	3500
24	2000	2000	1900
39	3500	3500	3325
54	5000	5000	4750
49	4900	4900	4650
80	7000	7000	6650

Table C6.7.2 – 5

Lumen Output for Compact Fluorescent, Single-ended, 4 Pin Base Lamps

Rated power of lamp (W)	Min. Lumen output			
	2700°K	3000°K	3800°K	5400°K
5	250	--	250	--
7	400	400	400	--
9	600	600	600	--
11	900	900	900	--
18	1200	1200	1200	750
24	1800	1800	1800	1200
36	2900	2900	2900	2400
40	3500	3500	3500	2200
55	4800	4800	4800	3000

Table C6.7.2 – 6

Lumen Output for Compact Fluorescent, Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output			
	2700°K	3000°K	3800°K	5400°K
5	250	250	250	--
7	400	400	400	375
9	600	600	600	565
11	900	900	900	850

Lumen Output for Compact Fluorescent, Triple Independent Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800

Table C6.7.2 – 9

Lumen Output for Compact Fluorescent, Triple Independent Single-ended, 4 Pin Base Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800
32	2400	2400	2400
42	3200	3200	3200

Table C6.7.2 – 10

Lumen Output for Compact Fluorescent, Four Independent Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
8	350	--	--
10	600	600	--
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800

2.13 TUNGSTEN HALOGEN LAMP

GENERAL

Tungsten lamps shall meet the safety requirements as specified in BS EN 60423. The manufacturing process shall comply with the relevant quality standard of ISO 9000 series standards.

The colour temperature of the lamp shall be within the range between 2800°K and 3200°K. The colour rendering index shall not be less than 90.

The rated average life of the lamp shall not be less than 2000 hours at 10% failure. The light output of the lamp shall not be diminished by more than 5% throughout the guaranteed life.

2.13 .1 SPECIAL REQUIREMENTS FOR MAINS VOLTAGE (220V) LAMP

The lamps shall comply with EN 60357 or other equivalent international standards suitable for operation at 220V ± 6% and 50 Hz ± 2%, single phase a.c. The luminous efficacy shall not be less than 13 lumens/lamp watt.

2.14 SPECIAL REQUIREMENTS FOR EXTRA-LOW VOLTAGE (ELV) LAMP

General

The lamp shall be suitable for operation at 12V single phase a.c. through a compact electronic step-down transformer suitable for operation at an input supply of 220V ± 6%, 50 Hz ± 2%, single phase a.c. The output shall be 12V a.c.

2.14 .1 The Transformer

The transformer shall be supplied together with the 12V lamp as an integral package by the same manufacturer or supplier.

The general and safety requirements shall comply with IEC 61046 or other equivalent international standards which shall at least cover:

(a) General requirements:

(i) tests

(ii) classification

(iii) marking

(b) Safety requirements:

(i) terminals

(ii) earthing

(iii) construction

(iv) creepage distances and clearances

(v) protection against contact with live parts

(vi) moisture resistance and insulation
(vii) electric strength

(viii) transformer heating

(ix) abnormal conditions (such as, but not limited to, no lamp

inserted, lamp resistance reduced, output terminals shortcircuited, etc.)

(x) fault conditions

(xi) screws, current-carrying parts and connections

(xii) resistance to heat and fire

(xiii) resistance to corrosion
The performance requirements shall comply with IEC 61047 or other equivalent international standards which shall at least cover:
(i) tests

(ii) classification

(iii) marking

(iv) output voltage and current

(v) total circuit power

(vi) circuit power factor

(vii) supply current

(viii) impedance at audio-frequencies

(ix) mains transient over voltages

(x) abnormal conditions (such as, but not limited to, no lamp inserted, lamp resistance reduced, output terminals shortcircuited, etc.)
(xi) endurance
The harmonics of the output current shall comply with IEC 60555-2 as stipulated in IEC 61047.

The radio interference suppression shall comply with EN 55015/A1 or other equivalent international standards.

The transformer shall be suitable for use with dimmers so that the illuminance of the lamp can be adjusted if required. In addition, the transformer shall be able to be used with d.c. supplies for emergency lighting purpose.

2.15 Summary

In this chapter, a fully detailed explanation had been presented, thus, new lighting products were not only more energy efficient, they offered many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looked at some of the new technologies for residential lighting, compared the cost benefits, identifies four basic strategies to apply, then provided specific examples of how to put the new strategies into practice throughout the home rooms.

CHAPTER THREE

INSTALLATION OF POWER CABLES, CABLE TRAYS AND CABLE LADDERS

GENERAL

3.1 Scope

This Section covers the installation of power cable, which includes those listed in Sub-section C2.2 of Section C2. It also covers the installation of the associated cabling facilities, including cable trays and cable ladders. Unless otherwise specified elsewhere, all cables shall have copper conductors.

3.1 .2 Electromagnetic Interference

To minimize the electromagnetic interference generated from single core cables, the following arrangements shall be adopted :

(a) All the single core cables shall be of the same conductor, same cross sectional areas, same type, same construction and from the same manufacturer.

(b) All the single core cables shall be of equal length, and shall follow the same route of installation.

(c) The single core cables shall not be able to operate individually.

(d) The layout of single core cables shall be arranged

3.2 CABLE MOUNTED ON SURFACE

Unless otherwise specified, power cables shall be mounted on the surface of wall or ceiling or other building structure. They shall be cleated in position by approved type cable cleats or cable saddles. Cable cleats or cable saddles shall be provided along the entire cable route according to the Table B2.2.

When specified, power cables may be supported on cable trays or cable ladders. In such cases, the requirements of Sub-sections B2.9 and B2.10 shall apply. For vertical cable runs exceeding 100m, tension releasing sections shall be provided in accordance with the recommendation of the cable manufacturer, failing which, a tension releasing section shall be provided for every 100m vertical run. [15]

TABLE B2.2

Spacing of Cable Cleats or Cable Saddles for Power Cable

Type of cable	Overall diameter of cable, d (mm)	Support spacing	
		Horizontal (mm)	Vertical (mm)
Cables with copper conductors	$d \leq 15$	350	450
	$15 < d \leq 20$	400	550
	$20 < d \leq 40$	450	600
	$40 < d \leq 60$	700	900
	$d > 60$	1100	1300
Cables with aluminium conductors	$d \leq 20$	1200	550
	$20 < d \leq 40$	2000	600
	$40 < d \leq 60$	3000	900
	$d > 60$	4000	1300

3.3 CABLE LAID IN ENCLOSED TRENCH

When more than one power cables are laid in an enclosed trench, the cables shall be installed in accordance with Table 52H of IEC 60364. Correction factors shall be applied to the current ratings as indicated in IEC 60364, where applicable.

3.4 CABLE ENCLOSED IN DUCT

3.4.1 General

Cables laid in ducts shall be sheathed and armoured. Where mineral insulated cables are specified, they shall be with PVC or XLPE outer cover as specified. Where the ducts are formed from wood, cables shall be held in position by clips, saddles, or approved fixings. The space factor in a cable duct shall not exceed 35%.

3.4.2 Drawing-in of Cables

Prior to the drawing-in of the cables, the cylindrical ducts shall be cleaned with a cylindrical brush of appropriate size. Attachment to facilitate the pulling of cables through a duct shall be made to the cores, insulation, inner and outer sheaths and not to the armour in order to avoid twisting. Attachment to the armour will only be permitted for small cables with the approval of the Architect. When pulling power cables into small ducts, an emulsion of graphite powder and soft soap in water may be used for brushing onto the cable surfaces where they enter the duct to reduce friction during pulling. The use of Section B2other

materials having equivalent functions or performance will not be precluded provided that such materials or methods shall not damage the cables and that the prior approval of the Architect has been given. When pulling-in lead-sheathed insulated power cables, the following precautions shall be taken :

(a) Maximum stress in sheath - 10,000kPa (with stocking pulling grip).

(b) Maximum stress in conductors - 70,000kPa (with pulling eye attached to conductors).

(c) Maximum pull shall be limited to 220,000 Newtons.

3.4.3 Internal Barrier

In every vertical duct, which is designed as totally enclosed without ventilation, internal barriers shall be provided to prevent the air at the top of the duct from attaining an excessively high temperature. The distance between adjacent barriers shall be the distance between floors. Where the floor to floor distance exceeds 5m, additional barriers shall be provided at an interval not exceeding 5m.

3.4.4 Fire Barrier

Where a cable duct passes through fire resistant structural elements, such as floor or wall designated as fire barriers, the opening thus formed shall be sealed with fire resistant materials having the same degree of fire resistance as the structural element. In addition, suitable internal fire barriers shall also be provided. An internal fire barrier may also serve as an internal barrier described in Sub-section B2.4.3 above.

3.5 Power Cables

Cables are designed for both high voltage and low-voltage transmission of power. Though the general construction is similar in both cases, high-voltage cables have thicker insulation and usually have smaller conductors, since low-voltage cables carrying bulk power handle the heavier Currents

3.5.1 General Construction

A power cable is made up of one, two, three or four insulated conductors enclosed in bedding. For mechanical protection, wire armoring is wrapped around the bedding, and a colored outer protective sheath, usually of PVC, is extruded over the armoring, as shown in Figure 4.1, Each insulated conductor is known as a 'core'.

NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

GRADUATION PROJECT

ELECTRICAL INSTALLATION DESIGN

EE400

Student: Barış GÜMÜŞ(20112218)

Supervisor: Assoc.Prof.Dr.ÖZGÜR C. ÖZERDEM

Mohammed KMAİL

Nicosia – 2014

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CHAPTER TWO INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

INTRODUCTION

Technical staff in the field of electricity , the electrical installation plans and it should be able to read exactly must be able to conduct a complete application by the way . Therefore, vocational education and training on the basis of technical plans are of great importance . Besides, this plan covered by describes properties of materials and shapes them known symbols , materials suitable Selecting the plan and performing installations related laws, specifications , regulations and standards are also required to comply . Therefore, consisting of 8 units , respectively, in the book of the Electrical Installation Plan general information relevant to the topic and legislation has been given, briefly discussed the materials used in electrical installations , an important issue Lighting and computational techniques have been investigated, holds an important place in the installation of low-voltage installations described , reactive power compensation issues are mentioned , protection and safety in electrical installations subject treated , lighting and interior installations and examples of strong current plans were undertaken separately is corroborated by the application . In short, students may need a lot of information about electrical installation plans and teaching prepared in order to be included in this book have been studied. After receiving this information graduating students After working in related occupations and work in the case of adapting will be easy to comprehend . Prepared this book to students and technical staff working on these issues and believe will be beneficial to I wish success for our students .

Chapter one presents the electrical installation specifications, which are The General Technical Specifications for Buildings are published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

Chapter two; 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 not only more energy efficient, they are offering many more possibilities to improve the quality of lighting our homes, indoors and out.

Chapter three;. cables, 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 ONE

ELECTRICAL INSTALLATION SPECIFICATIONS

1.1 Over View

The General Technical Specifications for Buildings published by the European and American standards with the latest editions shall govern this Contract together with the modifications and amendments as specified in this Document.

1.2 General Specifications

All works, Materials Manufacturing, fabricating, testing and commissioning shall be governed by latest conditions of the following standards:

1- The general technical specification
2- National Codes
3- 16th Edition of IEE
4- British Standard
5- IEC Recommendation

In case of any conflicts arising between this Specification and Standard/Codes, the Contractor shall refer the matter to the Engineer and for Clarifications.

The Contractor shall submit a complete set of Shop Drawings for Engineer's approval prior one month to commencing the work at least. The Contractor shall submit a logical schedule of work for the project activities to the Engineer for approval, beside, the Contractor shall submit weekly, monthly, progress report.

The Contractor shall obtain the Engineer's written approval for all materials, equipment, accessories ...etc., prior to the procurement of any material, submittals shall be early stages, supplying of materials to the site shall be coordinated with the engineer and to his approval.

The Contractor shall submit for approval all drawings, diagrams, catalogues, dimensions, samples and any other information that may be required by the Engineer .Location of some electrical fixtures may be modified to suit the site conditions and/or to comply with safety measures. No claims will be accepted in such cases.

Testing and commissioning is an essential part of this Contract. The Contractor shall provide the testing instruments required. All tests shall be conducted and witnessed by the Engineer and the results shall be certified and signed by the Contractor and the Engineer. Original copies of testing certificates shall be kept with the Engineer.

The Contractor shall submit one complete set of transparent as-built drawings, CD disc and three blue print sets to the Engineer along with all manuals, wiring diagrams, operating instructions, maintenance instructions, list of recommended spare parts for two years and vendors names and addresses .All documents of this contract are complementary to each other and should be red as whole. [7]

1.3 Materials and Testing

The whole of the Works shall be executed with the materials indicated in the subsequent clauses of this Specifications .Where the names of manufacturers are stated, together with a detailed specification of their products.

Where such exists, the equipment shall comply with the requirements of the appropriate current standards as mentioned in item 1-2 and shall be of the best of their respective kinds, free from all flaws and defects.

1.4 Labour Restrictions

The Contractor shall employ none but workmen skilled in their respective trades and must not employ unskilled laborers in lieu of skilled workmen

1.5 Conduits

Only the following types of conduits and related fittings and accessories shall be used for the installation covered by this specification.

1.5.1 Rigid Non-Metallic Conduits (U/PVC)

Rigid non-metallic conduits including sleeves and elbows shall comply with BS6099, PART 2, SECT.2.21, 1982.

1.5.2 Rigid Metallic Conduit

Rigid metal conduit including sleeves and elbows shall comply with BS4568.

1.5.3 Flexible Non-Metallic Conduit

Flexible non-metallic conduit shall be suitable for installation in conjunction with rigid non-metallic conduits by the use of the same fittings and connectors .

1.5.4 Flexible Metal Conduit

Flexible metal conduit shall comply with NEC-Article 350. Conduit shall be suitable for installation in conjunction with rigid metal conduit, by the use of the same fittings and connectors. A separate conduit and wiring system is to be provided for each installation, i.e. lighting, general purpose sockets, power, telephone, etc.

Draw wires shall be left in all conduit runs for other services .Conduits shall not be run than 0.15m to any steam or hot water pipes and shall be run underneath such pipes rather than over them. The conduits shall not be run closer than 0.05m to any telephone, bell or other signaling .All joints in PVC conduits, shall be cemented with a waterproof adhesive.

Where conduits cross a building expansion joint due allowance shall be made in the design or the run with an approved expansion joint .All circular PVC boxes shall be provided with steel insert clips to provide additional support for lighting fittings .

Flexible metal conduits, watertight where required, shall be provided between the conduit system and electrical motors or other apparatus subject to vibration. They shall be complete with brass double female adaptors and shall be soldered to either end of all flexible conduits and connected to solid conduit entries using smooth bore male brass bushes.

Earth continuity through flexible conduits shall be provided by a separate earth continuity conductor .Minimum size of conduits shall be 20 mm. diameter, unless otherwise indicated or approved. Conduit runs shall not exceed 10 m in length without the incorporation of a pull box.

Conduits shall not cross pipe shafts, or vent duct openings. Riser conduits shall be supported at each floor level by approved clamp hangers.

All conduit and accessories shall be produced of the same manufacturer. Conduits and accessories installed (concealed) shall be of heavy gauge U-PVC conduits and shall comply with BS 4607; Class A.

Conduits shall have capacities as listed in the following table 1.1, unless stated other wise. In any case the space factor shall never exceed 40%. Pull boxes shall be located at convenient intervals at accessible positions.

Table 1.1: Conductor Conduit Size.

Size mm2	20	25	32	38	50
1.5	7	12	20	--	--
2.5	4	8	12	--	--
4.0	3	6	10	--	--
6.0	3	5	8	--	--
10.0	--	3	6	8	--
16.0	--	--	3	4	5
25.0	--	--	--	4	6
35.0	--	--	--	4	6
50.0	--	--	--	--	4

1.6 Pull and Junction Boxes

Pull and junction boxes shall be suitable for use in conjunction with the selected raceway systems.

1.6.1 Outlet Boxes

For concealed installation, outlet boxes shall be plastic, fastened with amply sized screws. For exposed installation, outlet boxes shall be either sheet metal of heavy-duty plastic, mounted exposed and rigidly connected to the conduit system by suitable bushings Comply with BS 5733.

1.6.2 Terminations

Terminations in junction boxes, floor boxes, distribution boxes and outlet boxes shall be of the screwed type.

1.7 Wires and Cables

Wires and cables shall be fabricated of stranded copper conductors in accordance with BS6004, 1984. The insulation of all wires and cables shall be rated for at least 70 deg. C for polyvinyl chloride (PVC) and 90 deg. D for thermoplastic (PE) cables. The identification by color for conductors in multicore wires and cables shall comply with IEC 446. XLPE cables shall comply with IEC 502 as shown on Drawings or schedules. Fire resistance insulation complying with UL1424-105 °C; especially for fire alarm systems.

1.7.1 Wires for Power, Lighting and Controls.

Wires are single-core insulated or multicore insulated and sheathed conductors which are used only for light-duty indoor applications. The conductor insulation and the sheath shall be polyvinyl chloride .All cables buried in the ground shall incorporate armor.

The cables installed in positions which may be exposed to direct sunlight shall be of a type resistant to damage by ultra-violet light or shall be suitably covered to protect from ultra-violet light .All cable conductor shall be fitted with a correctly sized cable socket or thimble and a means of identification. The cable sockets may be of the sweated or crimped compression types. The cables connected in parallel shall be of the same type, cross sectional area, length and disposition and be arranged so as to carry substantially equal load currents . [2]

1.7.2 L.V. Main Cables

L.V. Main Cables shall be 4 core; 600/1000 volts grade PVC insulation, single steel wire armoured. The conductors shall be circular standard copper. The armouring of L.V. main cables shall not be used as the sole circuit protective conductor (CPC). The sizes of protective conductor shall be calculated in accordance with Tables 54E and F of IEE Regulations or equal. L.V. cables if to be buried direct in the ground. They shall be buried to a depth of 70 cm. in trenches which have been cleared of all rocks and rubble and into which a 5 cm. sand layer shall be placed across the full width and along the entire length of the trench. The cables shall be laid on this sand bed and covered with a further 10 cm. layer of sand before the trench is backfilled and compacted. Concrete tiles shall be placed on the top of the second layer of sand as shown on the Drawing with suitable material.

Where L.V. cables cross sidewalks or road, they shall be drawn into heavy gauge PVC conduit of 15cm. ϕ. Concrete layer of thickness 10 cm. shall cover this UPVC conduit. In addition a warning PVC tape shall be laid in the cable trench during

the backfilling process so that the cable marker strip is 15 cm., beneath the finished compacted surface of the trench. Where L.V. cables are installed in a concrete trench, these cables shall be fixed to the base and sides of the trench by means of using cable cleats at intervals not exceeding 900 mm, between centers of adjacent fixings. The cable separation between adjacent cables shall not be less than double the diameter of the cable. [2]

1.7.2.1 Wires for Communication

Wires for communication are single-core or multicore insulated and sheathed conductors which are used only for light-duty indoor applications .

1.7.2.2 Communication Cables

Communication cables are multicore insulated, shielded and sheathed tinned copper conductor cables for indoor and outdoor installation in conduits, ducts or for direct burial .

1.8 Switches

Switches shall be mounted with the operating handle in upward position when in the "ON" position. Switches used on lighting branch circuits shall be quick make, quick break, with silver alloy contacts, rocker, operated with quick operating mechanism rated at 10 amperes 250 volts AC or higher capacity as required by the circuit controlled in accordance with the Specifications. Switches shall be single, three or four way flush mounted type and shall be waterproofed where required. Switches shall be to BS 3676 : 1989.Type MK or approved equal

1.9 stair switches

For stairs I used sensor switches, there is many types of sensor switches like TSM
1S, TSM1E and TSEN1. In this project I used the last one TSEN1 because the stair distance not so much.

1.10 Power Outlets

The switch socket outlets shall be as indicated on the drawings, all in accordance with BS1363 and BS546 as appropriate. These outlets shall be of the same manufactuer

throughout the installation. To different between the normal power supply receptacles from the essential & or the computer receptacles. Each system receptacles shall be distinctively colored or marked for identification.

1.11 Socket Outlets

Socket outlets shall be of the standard, 3-pin, single phase, with or without switch, flush mounted type of moulded plastic designed to fit with the appropriate plates as specified.

- Waterproof socket outlet without switch shall be used in washing room and kitchens.
- Single phase socket outlets shall be 13A, 230 volts, earthed, shuttered type.

Switches for electric water heater shall be flush 20 amp. DP switches with pilot lamp and marked (Water Heater).

1.12 Water Proof Receptacles

It shall be seal splash proof, switched and with pilot light. The dust and waterproofing shall be IP54 when plug is inserted in receptacle. Receptacle shall be semi-flush with wall.

1.13 INDUSTRIAL RECEPTACLES:

These receptacles shall be industrial type as shown on the Drawings, and shall be designed for AC230V to 660V. Receptacles shall be three, four or five-pole. The enclosure shall be plastic, splash proof or made watertight.

1.14 Telephone Systems

Telephone cabinet (TC) shall be provided as shown on the Drawings for adequate number of extensions, for the distribution of wires or cables between the main distribution frame and the extension outlets.

Telephone outlets shall be flush mounting type. These shall be of the same make and plate finish of the adjacent socket outlets.

1.15 Main and Sub main Distribution Boards

The (MDB) shall be fabricated, tested and commissioned in compliance with Electrical power Authority requirements and Engineer's approval. Free standing cubicle panel board consisting of 2mm thick steel sheet hammer painted, gray color with lockable hinged doors, locks and switches, rubber gaskets, dust proof to IP54. Sufficient holes for glands in removable rigid steel sheet gland plate to be provided.

The structure of the main sub main electrical panel boards shall be form two. All panel boards must include proper floor attachment facilities, and terminal panels in the top section and bottom section, in accordance with the location of the cable output.

The internal wiring shall be laid in proper PVC trunking, identified at both ends by PVC numbers. If flexible cables used inside the panel, then the cables of be soldered prior to being compressed into lugs. The lugs to be of tinned copper compression type. Bolted lugs are NOT allowed.

All bus bars and live terminals inside any electrical panel shall be isolated and not accessible by any means to ensure safe and normal cooperation of the panel. Bus bars ratings shall exceed 1.5 times the main circuit breaker rating of the panel.

1.16 Bus-Bars

The panel boards will contain bus-bars for phases R,S,T neutral and ground, without paint. These bus-bars shall be made of copper, with lead cooked and their cross-section must be compatible, thermally and mechanically, with the short-circuit currents specified in the plans, and in any case not less than 60KA on 415v. For 1 section. All panels shall have sufficient space for ventilation and maintenance purposes plus extra room to allow for the possibility of adding 25% of the installed circuit breakers. A separate cubicle shall be incorporated in the switchboard for accommodation of the Supply Authority's Metering Equipment. It shall meet the Supply Authority requirement and approval. In the main Switchboard the following facilities to BS89, shall be included : three Ammeters, one Voltmeter with Voltmeter selector switch, one Power factor meter, three Color coded pilot lamps, & M.R.C. fuses for voltage circuit protection. The MDB, for each building shall be provided with protection moulded case circuit breakers. Full schematic and control drawings shall be kept in a pocket at the inner side of the front door for maintenance. Engraved metal or PVC labels to be fixed at the mimic diagram to identify the components of the panel. Fixing Devices for free standing, supports, earthing... etc. shall be installed.

All cables and conduits connections to panels shall be firmly and securely connected mechanically and electrically by using proper glands, male pushes, femals pushes, locknut, by soldering or compression type lugs, clamps, supports ... etc., bolted lugs and NOT allowed . Contactors, when used, shall be protected by circuit breakers. Contactor rating shall be not less than 125% of its relative circuit breaker rating unless otherwise specified. [2]

1.17 Distribution Boards

Distribution Panel Bards feeding lights, socket outlets and other appliances shall be totally enclosed, dust protected and vermin proofed. The enclosure of these Panel Boards shall be of robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall be robust sheet steel construction cabinet, fully rust proofed and stove enameled. The Panel Board shall contain an on load isolator and miniature circuit breakers or the size and number specified in Drawings and a neutral connector block of ample size to ensure that a separate way is available on the connector block for the neutral conductor of each circuit. The construction of the enclosure of those distribution boards shall be executed in a way such that to operate the mi-

niature circuit breakers, it is necessary to open the hinged door and to ensure access to the interior components and to the internal wiring, it is necessary to dismantle and remove a separate barrier within the enclosure. Miniature circuit breakers shall have a breaking capacity of 6000 amps. All miniature circuit breakers shall be equipped with thermal overload trips to operate at 125% rated current and instantaneous magnetic trips.

1.17.1 Circuit Breakers

Protective devices as shown shall be of the moulded case type up to an capacity of 630A. Trip-free circuit breakers shall be used with thermal and magnetic over current tripping devices for each line. Adjustable thermal tripping devices shall be adjustable from approx. 70% to full load rating . The magnetic tripping devices to be of the adjustable type .Circuit breakers with an capacity of 1000A and above shall be equipped with a motor-operated closing mechanism. All circuit breakers shall indicate clearly whether they are open or closed and shall have an interrupting rating not less than the maximum available short-circuit current at the supply terminals. The moulded case circuit breakers providing complete circuit over current protection by having inverse time and instantaneous tripping characteristics and where applicable, be current limiting. Circuit breakers shall be operated by a toggle type handle and shall have a quick made over current switching mechanism that is mechanically trip free. Circuit breakers 150 ampere and below shall be thermal magnetic trip with inverse time current characteristics.

1.17.2 Miniature Circuit Breakers

Miniature circuit breakers shall be of the narrow type and shall be for manual operation with trip-free release. Miniature circuit breakers shall be equipped with the thermal over current and a magnetic short-circuit tripping element .

The interrupting capacity of miniature circuit breakers shall not be less than 6AK off (230 V AC). Miniature circuit breakers shall have tripping characteristics in accordance with IEC 898 and IEC 947-2. Residual current circuit breakers shall comply with BS4293 .

1.17.3 Air Circuit Breaker (ACB)

The incoming supply shall terminate at the main air break circuit breakers on the switchboard. The air break circuit breaker shall comply with BS4752 VED0660 for use on a 380 volts 3 phase 50 Hz wire system .The bus bar sectionalizer shall be the same type (ACB) .The circuit breaker shall be horizontally isolated, horizontal draw-out pattern, air break type. The circuit breaker closing mechanism shall be motorized. The operating mechanism shall have a mechanical ON/OFF indicator and a manual trip device fitted with means for locking, test terminal blocks, healthy trip lamp (coloured white) as associated pushbuttons, set of auxiliary switches, supply available lamp, cable boxes complete with glands of suitable size fore the accommodation of the incoming and out going cables entering from below. Auxiliary contacts for the indication of breaker state. Slow closing of the circuit breaker to facilitate maintenance and con-

tact adjustment shall be provided .The incoming ACB's sectionalizer ACB shall be interlocked so as the sectionalize can only be made on when one of the incomers is off .

The air circuit breaker shall include sufficient auxiliary contacts and mechanical interlocking mechanisms to facilitate the possible future addition of a second supply feed so that full electrical and mechanical safety interlocking of all feed circuits can conveniently be arranged. A relay shall be incorporated for over current and earth fault protection at the incoming air circuit breaker. [3]

1.18 Power Factor Correction

Supply, install, test and commission power factor correction equipment automatically controlled multi-stage static bank type 200 / 400 V. Capable of correcting the power factor to 0-9 lagging all loads conditions.

The equipment's shall comply with BS 1650 suitable for operation on 440 volt 3 phase 4 wire connection 50 HZ. Supply shall be Generally As Follows:

- Enclosure
- Steel cubicle type extendable modular form of construction to IP 44.

Multiple units of static capacitors manufactured from impregnated metalized paper and plastic film, having self healing capacity, each unit shall be fitted with:

- Over pressure device
- Thermal protection device
- Discharge resistor

On load pattern for closing and breaking the supply, the operating handle shall be interlocked with cubicle door to prevent access while the isolator closed.

Multistage automatic type with two spare stages for the addition of future banks. Digital reading type, display of fate.

- Cos ∅
- Voltage
- Current
- Temperature control

With harmonic overload protection. Resonance control(protection from resonance) and automatic C/K controller.

Supply install test and commission power factor correction equipment automatic controlled multi-stage static bank type capable of correction the power factor to a minimum of 0.9 under all load conditions suitable to operate on 440 V 3PHASE 50HZ . Capacitor shall be multiple units of static type. [3]

1.19 Earthing System

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

1.20.1 TN-S SYSTEM:

The TN-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 of the secondary distribution system.

1.20.2 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 .

1.20.3 Earthing Copper Plates

Earthing copper plates shall be approximately 5mm high and 500mm wide or equal area. Plates shall be placed vertical, upper corner 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.

1.20.4 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.

1.21 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 BS6651, NFPA 780, and VDE0185. 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. [3]

1.22 Summary

In this chapter, the electrical installation specifications have been declared generally, in compliance with the latest global regulations such as the British System (BS) *where the conditions of designing works can be found.*

CHAPTER TWO

INSTALLATION OF GENERAL ILLUMINATION DESIGN AND POWER

2.1 Over View

In this chapter, a fully detailed explanation is going to be included, thus, new lighting products are not only more energy efficient, they offer many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looks at some of the new technologies for residential lighting, compares the cost benefits, identifies four basic strategies to apply, then provides specific examples of how to put the new strategies into practice throughout the home rooms

2.2 INSTALLATION OF LIGHTING SYSTEM AND LUMINAIRES

2.2.1 Pendant

Tube pendant shall comprise a dome cover and a biscuit ring and a piece of screwed steel conduit of suitable length to give the required mounting height of the luminaire.

Plain pendant shall comprise a ceiling rose and a cord-grip lampholder connected by a flexible cord having a suitable length to give the required mounting height of the lamp shade.

2.2.2 Luminaire Mounted on Pattress

When a luminaire is not provided with facility for a surface cable entry, the luminaire shall be mounted on pattress. The cable shall then enter the luminaire from the rear through a slot and a hole formed in the pattress.

2.2.3 Ceiling Rose

Ceiling rose shall not be used for the attachment of more than one outgoing flexible cord or cable unless it is specially designed for multiple pendants.

2.2.4 Cable in Enclosed Luminaire

Cables within an enclosed type luminaire shall be of heat resistant type. Cables entering the luminaire shall be protected by heat resistant insulating sleeves. The sleeves within the luminaire shall be extended to a distance of 150mm outside the luminaire.

Heat resisting cables shall be selected in accordance with the appropriate tables given in IEC 60364.

2.2.5 Stroboscopic Effect

Luminaires, other than those using tungsten filament lamps or fluorescent lamps with electronic ballast, installed over rotating machinery, shall be arranged so that at least two luminaires connected to different phases are used to illuminate the moving parts of the machinery. Alternatively where different phases are not available or the use of which is impracticable, separate tungsten filament lamps shall be used in addition to gas discharge lamps to eliminate the stroboscopic effect.

2.2.6 Painting

Unless otherwise specified, lighting equipment and luminaires other than those indicated to be self-finished such as stainless steel, anodized aluminium, etc, shall have factory-finished.

Metal parts such as cover plates for adaptable boxes, blanking plate for any boxes and conduit pendants, etc. shall be painted white or a suitable colour to match the interior finish of a particular location.

2.2.7 Special Requirements for Outdoor Luminaires

Outdoor luminaires shall be able to withstand the weather. Metal work should be protected against corrosion, and parts which have to be removed for access to the interior shall be provided with proper gaskets to restrict the entrance of moisture and dirt. Mounting brackets shall be heavily galvanized and stainless steel or galvanized bolts and nuts shall be used.

The adjustment bolts and nuts of a luminaire which is mounted on high level shall be captive to prevent accidental loss during servicing. Safety chains shall be provided to hold the luminaire from falling. A luminaire installed in a location within hand reach shall be of robust construct, fitted with an impact-resistant transparent or diffusing front panel, and shall have secret key fixings for the panel to the body of the luminaire. Where necessary, wire guards

shall be fitted over the front panel to give extra protection.

2.3 INSTALLATION OF SOCKET OUTLETS

2.3. 1 General

Socket outlet intended for supplying a fixed or stationary appliance shall be located as near as possible to the appliance. Socket outlet shall be mounted at a height of 1350mm above finished floor level in kitchens, sculleries, ironing rooms and the like. In other locations, they shall be mounted at 300mm from finished floor level, 75mm from surface top measured from bottom of socket outlet or as specified

2.3. 2 Shaver Supply Unit

The complete unit shall be enclosed in a galvanized metal box for flush mounting, or a galvanized cast iron or plastic surface box for surface mounting.

2.3. 3 Socket Outlet at Hazardous Area

The installation of socket outlets in hazardous areas should be avoided as far as possible. Where it is absolutely essential to install a socket outlet in such area, the socket outlet shall be type 'e' - increased safety conforming to IEC 60309-3 and shall be controlled by a sparkless switch. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position. The plug shall have shrouded pins and the design of the pin contacts shall be such as to guard against development Section B3of hot spots or sparking. Requirements for wiring installation in hazardous areas are specified in Sub-section B7.4.

2.3. 4 Socket Outlet of Surface Conduit System

In plant room, switch room or similar area where surface conduits are installed, socket outlets shall be metalclad or bronze front plate.

2.3. 5 Socket Outlet for Different Voltage System

Socket outlet and plug for one voltage system shall not be interchangeable with those for use at other voltage and/or frequency systems in the same installation.

2.3. 6 Application in Bathroom

Shaver supply units complying with BS EN 60742 can be installed inside a room containing a fixed bath or shower and inside a toilet. Socket outlets inside such a room, if so required under the contract, shall be installed in accordance with requirements of Code 26A(3)(j) of Code of Practice for Electricity (Wiring) Regulations.

2.4 INSTALLATION OF EARTHING SYSTEM

2.4.1 GENERAL

All metalworks associated with an electrical installation but not forming part of a live conductor, including exposed conductive parts and extraneous conductive parts, shall be solidly and effectively bonded and earthed in accordance with IEC 60364 and the Code of Practice for the Electricity (Wiring) Regulations.

2.4. 2 MAIN EARTHING TERMINAL

A solid copper main earthing terminal of ample size shall be provided for every electrical installation at a position near the main incoming switch or switchboard for the connection of :

(a) the circuit protective conductors,

(b) the main equipotential bonding conductors,

(c) the functional earthing conductors,

(d) the earthing conductors and

(e) the lightning protective system bonding conductors.

to create the equipotential zone. The main earthing terminal shall be connected to Earth via an earthing conductor to an earth electrode or a group of electrodes.

Where an installation distributes to a number of buildings or units, a separate main earthing terminal shall be provided for each individual building or unit at the point of intake thereby creating a separate equipotential zone in each building or unit. [10]

2.4. 3 EARTH ELECTRODE

2.4. 3.1 Types of Earth Electrode

The following types of earth electrode are permitted :

(a) rod electrode

(b) tape electrode

(c) plate electrode

Unless otherwise specified in the Particular Specification or Drawings, rod electrode shall be installed. Metalwork of public gas or water services shall not be used as the sole protective earth electrode.

2.4. 4 Rod Electrode

Rod electrode shall be of mild steel inner core with a bonded hard drawn copper sleeve of an approved type. The overall diameter of the rod shall not be less than 15mm and the thickness of the copper sleeve shall not be less than 0.25mm. The minimum length shall be 2.4m. Additional lengths, whenever required, shall each be of 1.2m, connected together by a coupling. The penetrating end of the rod electrode shall be a hardened steel point. Rod electrode shall be driven into the ground within an earth pit. Only approved tools e.g. electric hammer or pneumatic hammer shall be used for this installation. In case the earthing resistance achieved by one rod is not sufficiently low for the purpose required, additional lengths or additional rods shall be installed. For the latter application, additional rods shall be driven into the ground outside the resistance area of the previously installed rod(s). Under normal circumstances, a mutual separation of 3.5m is considered adequate.

2.4. 5 Tape Electrode

Tape electrode shall be untinned copper strip of not less than 25 x 3mm in cross section. Tape electrode shall be used only if specified by the Architect.

In case where several tapes are required for connection in parallel to achieve a low earthing resistance, they may be installed in parallel lines or they may radiate from a point.

2.5 Types of Indoor Lighting

An incandescent bulb is usually made of clear or frosted glass, screws into a "medium base" socket, generally lasts from 750 to 1000 hours, and emits a warm white light. The word "incandescent" translated from Latin means "glowing with heat." Light is produced when the electric current heats the bulb's filament; 90 percent of the energy is used to heat the filament and only 10 percent goes into making light. Therefore, most of the energy used by the bulb is given off as waste heat, not light.

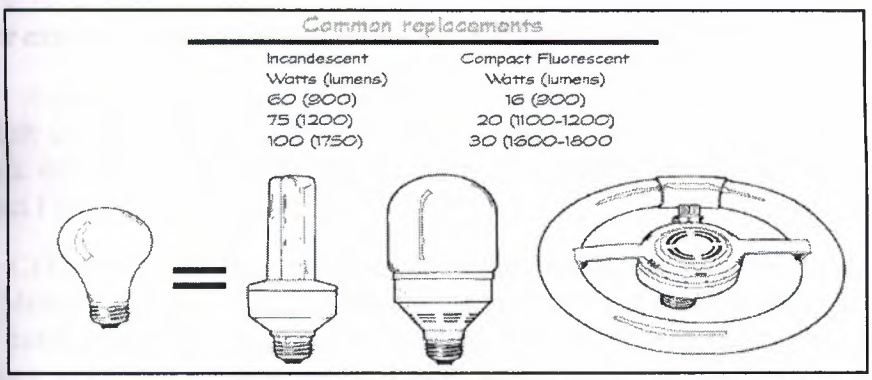


Fig.2.1 Compact fluorescents come in a variety of shapes and sizes to fit different fixtures.

2.5.1 Compact fluorescent lamp

A compact fluorescent lamp (CFL), also called compact fluorescent light, energy-saving light, and compact fluorescent tube, is a fluorescent lamp designed to replace an incandescent lamp; some types fit into light fixtures formerly used for incandescent lamps. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb, and compact electronic ballast in the base of the lamp.

Compared to general-service incandescent lamps giving the same amount of visible light, CFLs use one-fifth to one-third the electric power, and last eight to fifteen times longer. A CFL has a higher purchase price than an incandescent lamp, but can save over five times its purchase price in electricity costs over the lamp's lifetime.[2] Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal. In many countries, governments have established recycling schemes for CFLs and glass generally.

CFLs radiate a spectral power distribution that is different from that of incandescent lamps. Improved phosphor formulations have improved the perceived color of the light emitted by CFLs, such that some sources rate the best "soft white" CFLs as subjectively similar in color to standard incandescent lamps.

The parent to the modern fluorescent lamp was invented in the late 1890s by Peter Cooper Hewitt the Cooper Hewitt lamps were used for photographic studios and industries. Development of fluorescent lamps that could fit in the same volume as comparable incandescent lamps required the development of new, high-efficacy phosphors that could withstand more power per unit area than the phosphors used in older, larger fluorescent tubes[8].

There are two types of CFLs: integrated and non-integrated lamps. Integrated lamps combine the tube and ballast in a single unit. These lamps allow consumers to replace incandescent lamps easily with CFLs. Integrated CFLs work well in many standard incandescent light fixtures, reducing the cost of converting to fluorescent. 3-way lamp bulbs and dimmable models with standard bases are available.

Non-integrated CFLs have the ballast permanently installed in the luminaire, and only the lamp bulb is usually changed at its end of life. Since the ballasts are placed in the light fixture, they are larger and last longer compared to the integrated ones, and they don't need to be replaced when the bulb reaches its end-of-life. Non-integrated CFL housings can be both more expensive and sophisticated. They have two types of tubes: a bi-pin tube designed for conventional ballast, and a quad-pin tube designed for electronic ballast or conventional ballast with an external starter. A bi-pin tube contains an integrated starter, which obviates the need for external heating pins but causes incompatibility with electronic ballasts.

A photograph of various lamps illustrates the effect of color temperature differences. From left to right: Compact Fluorescent: General Electric, 13 W, 6,500 K; Incandescent: Sylvania 60 W Extra Soft White; Compact Fluorescent: Bright Effects, 15 W, 2,644 K; Compact Fluorescent: Sylvania, 14 W, 3,000 K

CFLs emit light from a mix of phosphors inside the bulb, each emitting one band of color. Modern phosphor designs balance the emitted light color, energy efficiency, and cost. Every extra phosphor added to the coating mix improves color rendering but decreases efficiency and increases cost. Good quality consumer CFLs use three or four phosphors to achieve a "white" light with a color rendering index (CRI) of about 80, where the

maximum100 represents the appearance of colors under daylight or a black-body (depending on the correlated color temperature).

Characteristic spectral power distributions (SPDs) for an incandescent lamp (left) and a CFL (right). The horizontal axes are in nanometers and the vertical axes show relative intensity in arbitrary units[10]

2.5. 2 Color and temperature

Color temperature can be indicated in kelvins or mireds (1 million divided by the color temperature in kelvins). The color temperature of a light source is the temperature of a black body that has the same chromaticity (i.e. color) of the light source. A notional temperature, the correlated color temperature, the temperature of a black body which emits light of a hue which to human color perception most closely matches the light from the lamp, is assigned.

A true color temperature is characteristic of black-body radiation; a fluorescent lamp may approximate the radiation of a black body at a given temperature, but will not have an identical spectrum. In particular, narrow bands of shorter-wavelength radiation are usually present even for lamps of low color temperature ("warm" light).[10]

As color temperature increases, the shading of the white light changes from red to yellow to white to blue. Color names used for modern CFLs and other tri-phosphor lamps vary between manufacturers, unlike the standardized names used with older halophosphate fluorescent lamps. For example, Sylvania's Daylight CFLs have a color temperature of 3,500 K, while most other lamps called daylight have color temperatures of at least 5,000 K

Saturated color CFLs are also produced, less commonly:

Red, green, orange, blue, and pink, primarily for novelty purposes

Blue for phototherapy

Yellow, for outdoor lighting, because it does not attract insects

Black light (UV light) for special effects

2.5. 3 Lifespan

CFLs typically have a rated service life of 6,000 to 15,000 hours, whereas standard incandescent lamps have a service life of 750 or 1,000 hours. However, the actual lifetime of any lamp depends on many factors, including operating voltage, manufacturing defects, exposure to voltage spikes, mechanical shock, frequency of cycling on and off, lamp orientation, and ambient operating temperature, among other factors.

The life of a CFL is significantly shorter if it is turned on and off frequently. In the case of a 5-minute on/off cycle the lifespan of some CFLs may be reduced to that of incandescent light bulbs. The U.S. Energy Star program suggests that fluorescent lamps be left on when leaving a room for less than 15 minutes to mitigate this problem. CFLs produce less light later in their lives than when they are new. The light output decay is exponential, with the fastest losses being soon after the lamp is first used. By the end of their lives, CFLs can be expected to produce 70–80% of their original light output.[16] The response of the human eye to light is logarithmic. One photographic "f-stop" reduction

represents a halving in actual light, but is subjectively quite a small change.A 20–30% reduction over many thousands of hours represents a change of about half an f-stop. So, presuming the illumination provided by the lamp was ample at the beginning of its life, such a difference will be compensated for by the eyes.

2.5. 4 Comparing cost and efficiency

Why would a person spend $5 to $20 to purchase a CFL bulb rather than incandescent for 50 cents? Because CFLs use 75 percent less energy to operate, they last up to 10 times longer, and they produce more lumens (light) per watt (electricity used) than incandescent bulbs. Although CFLs cost more initially, they are a better bargain in the long run.

The two basic pieces of information needed to find the best buy are printed on the light bulb package: watts and lumens. Watts, often the only number people look at when buying a light bulb, indicates how much energy the bulb consumes but nothing about the light output. The average lumens is the amount of light given off by the bulb. To determine a bulb's efficiency, look at the amount of lumens per watt. Surprisingly, some bulbs that are labeled as long-life may last longer, however light output is significantly lower. For example: A 75-watt incandescent bulb uses 75 watts of electricity to provide 1,200 lumens. A 20- watt compact fluorescent uses only 20 watts of electricity, one-fourth the amount, to provide the same 1,200 lumens. To determine the real cost of lighting, add the cost of the bulb (initial cost plus replacements) and the electricity cost. Compare the operating cost of a single 20-watt CFL and a 75-watt incandescent for 10,000 hours.

	Bulb cost (Initial X replacement)	Electricity cost (10.000 hours)	Total
75W Incand.	1$ X 13 = 13$	48.75 $	61.75 $
20W CFL	20$ X 1 = 20$	13.00 $	33.00$

Table2.3.4 the operating cost of a single 20-wattCFL and a 75-watt incandescent for 10,000 hours.

2.5. 5 Compare Color and Quality of Light

The quality of light produced by a bulb can vary depending on the light source, and is expressed in two ways: color temperature and color rendering. Color temperature (or correlated color temperature, CCT) is measured in degrees Kelvin, and may or may not be listed on the product package. Light bulbs with a number below 3500K are considered "warm," and are more reddish in color; light bulbs with a number above 4000K are considered "cool," and are more bluish in color. Color rendering is measured by the Color Rendering Index (CRI), which rates the amount of illumination compared to a light source with a known CRI. Only lights with the same temperature rating are compared with each other. A simple way to find a light bulb that will produce the best color temperature and color

rendering for most lighting needs is to look for an ENERGY STAR light, which will have a CRI of 80 or higher and a color temperature between 2700K and 3000K.

2.6 Evaluating the Home's Lighting Needs

To evaluate the home's current lighting conditions, tour the home in the evening and turn on the lights as you go from room to room. Is each area receiving adequate amounts of lighting? Lighting generally falls into one of three categories:

2.6.1 Accent lighting

Use accent lighting to highlight specific objects, such as artwork, shelves or plants. It can also illuminate wall surfaces in a soft wash of light or accentuate the texture of the surface.

2.6.2 Task lighting

Direct light to specific activity areas with task lighting lamps and fixtures. Lights under cabinets to illuminate kitchen work surfaces or a reading lamp next to that favorite chair are two common examples of task lighting.

2.6.3 Ambient lighting

Distribute light broadly throughout a space with ambient lighting fixtures, such as the traditional single ceiling fixture located in the center of a room. Ambient lighting by itself is still adequate for general activities that are not visually demanding, but will not give the quality of light needed for reading or sewing. To make sure areas of the home meet desired lighting needs, choose and locate accent fixtures first, then choose and locate task lighting fixtures. If additional light is still needed, use ambient lighting fixtures.

2.7 Swimming Pool lights

2.7.1 How to Install Underwater Swimming Pool Lights

İnstalling underwater swimming pool lights does not have to entail a major pool renovation project or even require the pool to be drained. With the right kind of lighting and a little electrical know-how, pool lighting can be installed in a single afternoon.

Step 1: Choosing a Light

When choosing a light it is important to consider project time. What parts will have to be replaced (like batteries)? What about pool size and the amount of electrical work required? To avoid draining your pool and drilling holes in it, it is best to select a suction-mounted light.

For a fast and easy install, with no electrical work, a battery operated light is the best solution. However, batteries will need regular replacement and the life of the light will be shorter than that of a corded model. Choose corded lights according to pool wall type.

Step 2: Assemble Light

Assemble the light according to manufacturer specifications and check all seals for water tightness. This can be done by submerging the light in shallow water and watching for bubbles.

Step 3: Set up Power Supply

For a battery operated light, install batteries and move on to step 4.

For a corded light, you will need to set up a power source. If there is a GFCI outlet close enough to the pool that the light cord will reach, mount the light transformer to the wall next to the outlet and plug the light in. Move on to step 4.

If there is no available outlet, you will need to install a waterproof junction box on an existing power line. First, turn off the power supply at the circuit breaker. Locate the power line to the pool pump or filter. Cut the line with wire cutters and expose the wire by using a stripper to remove the sheath. Install your junction box according to manufacturer specifications. If desired, mount the junction box on a wall, the pump or filter mount. Tie the light into the junction box. Check all fittings to make sure seals are water tight.

If the light does not have its own switch and you don't want it to be on while the pump or filter are on, you will also need to install a switch for the light. Check all seals before moving on to step 4.

Step 4: Install Light

Test the light to insure that it is working properly. Mount the light on the pool wall according to manufacturer specifications.

If you have a hard wall pool and are using a corded light, remove the edging over the area where you are going to install the light. Run the cord over the pool edge and then replace the edging. If you have a soft wall pool and are using a corded light, anchor the cord to the pool railing according to the manufacturer specifications. With these easy steps, you can install your own underwater pool light and begin enjoying your pool at night.

2.7.2 How Much Energy Does a Pool Pump Use?

To predict a planned swimming pools' impact on your electric bill, determine how much energy a pool pump uses. Check the specifications to determine the horsepower (hp) of the pump. The electricity used by pumps and engines are measured in horsepower, whereas the electricity delivered to your house is measured in kilowatt hours (kWh). A kilowatt hour is the amount of power drawn by a one kilowatt load over the course of one hour.

The most typical size for pool pumps is 1 hp, but check the manufacturer's specifications if you are in doubt. 1 hp is equivalent to approximately 0.7456 kilowatts. The amount of power a pump will use depends on how long the pump runs during the day. The length of time the pump runs is determined by pool occupancy, prevalence of airborne debris, and algae-inhibiting chemicals. Higher filtration needs result in longer run times. Convert the pump horsepower to kilowatts and multiply by the daily run time. This is the amount of energy that will be reflected on your next utility bill.

2.8 The new technology Using 4 Strategies

Four strategies could be used to perform the new technologies, thus, these are fully detailed listed as following.

2.8.1 Strategy 1

Strategy one is to replace standard incandescent light bulbs with ENERGY STAR labeled CFLs. No other new product in the lighting industry has had as great an impact as the ENERGY STAR labeled CFL. Modern CFLs have taken the best aspects of fluorescents high efficiency and long life while eliminating previous problems of poor color, flicker and noise. Achieve the most benefit by switching to ENERGY STAR labeled CFLs wherever high wattage incandescent bulbs are used more than three hours per day often in the kitchen and family room. Some specialty CFLs can now be used with dimmer switches. More and more types of CFLs will work well outdoors in Minnesota's cold climate.

2.8.2 Strategy 2

Strategy two is to replace standard incandescent ceiling fixtures (especially in the kitchen and laundry area) with ENERGY STAR labeled fluorescent fixtures. ENERGY STAR labeled light fixtures, when used with ENERGY STAR CFLs, help save money on utility bills and offer long life, convenience, better quality and safety than standard fixtures. Over their lifetimes, ENERGY STAR-qualifying fixtures will cost less than half as much to operate and can even eliminate the need to replace up to 40 standard incandescent light bulbs over the life of the fixture. ENERGY STAR-rated fixtures are available in many styles including table lamps, torchieres, wall sconces, under-cabinet lighting and outdoor security lighting. Some indoor fixtures are dimmable or have two-way switches, and all outdoor fixtures have photo sensors (they turn on at night, off in the morning) and some also have motion sensors. Any fixture bearing the ENERGY STAR label must meet safety and reliability guidelines and offer minimum warranties of two years—well above industry standard. In addition, these fixtures operate at much lower temperatures than many traditional lamps so they reduce fire risks [11].

2.8.3 Strategy 3

Replace incandescent spot and flood lights with BST -2520 B placed on top of pole , outdoor lighting suitable for illumination of squares, side work ,park ,garden ,etc top-cover made of aluminum sheet 4 mm thickness and voltage HİT –CE 70 -150 W I used in my project 70 W ,the height 3-4 m and the weight 8.28 kg the reason for used this type ,I have trees and this type of lamb for the garden trees . This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights.

2.8.4 Strategy 4

Use automatic sensor lighting controls in stair rooms, car garage it will be easy for the customers .say for a number of easy-to-install lighting controls are available that will increase lighting flexibility, home security and energy savings:

Electronic dimmers, especially popular in dining rooms, regulate the brightness of incandescent and tungsten halogen lights and can create an informal, relaxed atmosphere and they save energy. The lower the brightness, the lower the energy consumption.

Motion sensing light switches turn lights on and off automatically when someone enters stairs of garage, offering "no hands" light control for stairs , and garage

Electronic timers provide precise, automatic on/off control of light fixtures and are often used for home security or garage. For instance, timers will turn specific lights on automatically at on when enters and off at leaves.

2.9 Putting the Strategies to Work at Home

Experts know that the right lighting can dramatically change the look and feel of a room. Listed below are several ideas to enhance the beauty of the home and to increase lighting energy efficiency room by room.

2.9.1 İN THE KİTCHEN

Mount low-profile fluorescent tube fixtures under wall cabinets located above work surfaces to provide the required light for food preparation and clean-up. They should be mounted as close to the front of the cabinet as possible to avoid countertop glare. A good choice is a thin T16 fluorescent tube lamp.

2.9.2 IN THE BEDROOM

Soft, ambient lighting is usually adequate and attractive for bedrooms,

In a bedroom, install one ENERGY STAR ceiling fixture using one ENERGY STAR 30-42 watt CFLs.in small bedroom I used 30 to 32 w and big or master room I used 46 w CFLs.

2.9.3 IN THE BATHROOM

Use ENERGY STAR linear fluorescent bulbs and fixtures on above of the mirror for the best cosmetic lighting. Fixtures using compact fluorescent bulbs can provide high-color rendering and match the "warm glow" of incandescence while using less energy, and must be water-proof.

2.9.4 TYPES OF OUTDOOR LİGHTİNG

Recent developments in outdoor lighting have greatly expanded the possibilities to increase the safety, security and beauty of the home and property as well as saving energy. With Minnesota's cold, northern climate, check the light fixture or bulb for cold weather performance. - Many fixtures can use, This floodlight has a rated life of 3,000 hours, which is 50 percent longer than the typical rated life of regular floodlights. Additionally, so in this project my chose was HİT 100 W G12 and code LS 0002.413, for streets and parking

Figure 2.10: sole street lamps.

HİD fixtures rules for outdoor applications, specific lighting system designed for street lighting or parking

The system is designed and optimized for lighting streets, squares, parking, lots, parks, gardens

Operating temperature -25°C - +50°C, Ingress Protection IP66, mechanical Impact resistance IK08.

The system complies with European standards EN 60598 and ENEC certificated and there is another type of outdoor lighting BST-2520B it if for the gardens , the voltage HİT –CE max 150 w , ,it is standard in lox hotels in the world ,the top cover of aluminum sheet 4 mm thickness ,height 3-4 m and the weight about 8.28 m.

Figure 2. 2.10 vista garden

2.9.5 Calculating the Numbers of Luminaires Needed

When you add a luminaire from a database or PHILLUM file, Calculux can give you a quick estimation of the number of luminaires needed to provide the required illuminance level. The calculation is done according the so called Utilization Factor (UF) method.

2.9.6 Quick Estimation

If you enter the required illuminance level (in the Room dialogue box), Calculux will be able to determine a quick estimation of the number of luminaires needed. This calculation is done for each luminaire individually and is performed according to the UF (Utilization Factor) method described in CIE reports 40 and 52.

$$N = \frac{E * L * W}{NL * F * MF * UF}$$

Where the variables are:

N = number of luminaires needed

E = required illuminance

L = room length

W = room width

NL = number of lamps in each luminaire

F □ =lamp flux

MF = maintenance factor

UF = utilization factor

2.9.7 Utilization Factor (UF)

The Utilization Factor is calculated according to the lumen method. This method uses the CIE flux code of the luminaire, the room's dimensions and the reflection properties of its surfaces to perform the calculation. The room's dimensions are characterized by the room index K, defined as:

$$K = \frac{L * W}{(H_1 - H_0) * (L + W)}$$

Where the variables are:

L = room length

W = room width

H1 = room height

H0 = height of the working plane

The Utilization Factor can be found when the room index and the reflectance of the room are known. They are tabulated as part of the luminaire photometric data. Strictly speaking, the UF method is only valid if the luminaire arrangement and the room dimensions are exactly the same as those in the CIE reports. However, experience shows that the values are valid for most practical situations. The UF method of calculating the number of luminaires is used as a rough indication. A point calculation can always be performed. For this reason Calculux Indoor only uses the CIE method of calculating the utilisation factor as the differences between it and other methods (DIN, CIBSE, etc.) are quite small. The table below shows an example of room index values for a typical luminaire. [4]

Table 2.2: Utilization Factor Table

	Reflectances (%) for ceiling, walls and working plane										
room index K	80 50 30	80 50 10	70 50 30	70 50 20	70 50 10	70 30 10	50 30 10	50 10 10	30 30 10	30 10 10	0 0 0
0.60	0.39	0.37	0.39	0.38	0.37	0.33	0.33	0.31	0.33	0.30	0.29
0.80	0.46	0.44	0.46	0.44	0.43	0.39	0.39	0.37	0.39	0.36	0.35
1.00	0.52	0.48	0.51	0.50	0.48	0.44	0.44	0.42	0.44	0.41	0.40
1.25	0.57	0.52	0.56	0.54	0.52	0.49	0.48	0.46	0.48	0.46	0.45
1.50	0.61	0.55	0.60	0.57	0.55	0.52	0.51	0.49	0.51	0.49	0.48
2.00	0.66	0.59	0.65	0.62	0.59	0.57	0.26	0.54	0.55	0.54	0.52
2.50	0.70	0.62	0.68	0.64	0.61	0.59	0.58	0.57	0.57	0.56	0.55
3.00	0.72	0.63	0.70	0.66	0.63	0.61	0.60	0.59	0.59	0.58	0.57
4.00	0.75	0.65	0.73	0.68	0.64	0.63	0.62	0.61	0.61	0.60	0.59
5.00	0.76	0.66	0.74	0.69	0.65	0.64	0.63	0.62	0.62	0.61	0.60
	Suspension ratio: 0 Calculated acc. to CIE publication 40							LVW1077000-00			

2.9.8 Uniformity Check

In some instances, the database contains information about the maximum advisable spacing to height ratios of luminaires which provide good uniformity. These values are taken into account in the Quick estimation and can sometimes lead to a greater number of luminaires than required to provide the average illuminance level.

The uniformity check is restricted to checking the minimum numbers in length and width. This check is performed only if the luminaire maximum spacing to height ratio is given in the database. The uniformity check is based on the values as given in the data base. These values are calculated for a grid of 4 times 4 luminaires. The uniformity is calculated in the square of the middle four luminaires (as set out in CIBSE TM5).In practical situations the above conditions are not always met. [7]

2.9.9 Quality Figures

Calculux allows you to show the quality figures of the calculations. Depending on the settings of the Quality Figure tab (see Calculation menu, Presentation...) the following quality figures can be displayed: Average value calculation The average value for a grid is worked out by adding the calculated values of each point and dividing it by the number of grid points (grid dimensions; AB, AC). [7]

$$\text{Average} = \frac{\text{S calculated values for all idividual points}}{(\text{Points AB}) * (\text{Points AC})}$$

Minimum

This is the minimum calculated value.

Maximum

This is the maximum calculated value.

Minimum/maximum

This is the minimum calculated value divided by the maximum calculated value.

Minimum/average

This is the minimum calculated value divided by the average calculated value. Unified Glare Rating according to the CIE tabular method (UGRCIE) This is the Unified Glare Rating under reference conditions as specified in the CIE tabular method.

2.9.10 Report Setup

A very useful feature of Calculux is the report facility. When you have completed a lighting project you can create attractive reports to present the results of the calculations to your customers. By means of the Report Setup you can simply specify the layout of the report and components you wish to include. For example, you can include, a table of contents, 2-D and 3-D project overviews, a summary, luminaire information (including Polar or Cartesian diagram) and/or financial data. For detailed information about your calculation results you can include the following presentation formats:

* □ Textual Table;

* □ Graphical Table;

* □ Iso Contour;

* □ Filled Iso Contour;

* □ Mountain Plot.

You can also include a summary of your findings and recommendations about the best lighting solutions. If you wish, you can produce reports in several languages. The order of the calculation results can be altered (see Calculation Presentations dialogue box). However, the order of the presentation formats is governed by Calculux and cannot be altered. Calculux enables you also to print a report in portrait or landscape format with the 2D result views rotated 90°. This option (Report

menu, Print Setup, Layout tab) can be very useful. For instance, when a report which has to be printed in portrait format contains a landscape formatted 2D result view which looks relatively small. By selecting 'Rotate presentation for Portrait Printing', the 2D result views will be rotated 90°. Because of the rotation the view can be enlarged. [7]

2.10 Cost Calculations

Calculux allows you to calculate the annual energy, investment, lamp and maintenance costs for the lighting installation in your project. You can view and/or enter the data for calculating the 'annual costs' and the 'total investment' costs of the project. [4]

2.10.1 Total Investment

The Total Investment is the cost of the luminaires, lamps and the installation of the entire lighting project. The Total Investment costs are calculated according to the following formula:

$$\text{Total\_Investment} = \Sigma_{\text{lumtype}} (NT * (LPR + INSTC + (LAPR * NL)))$$

Variables:	Meaning:
INSTC	Installation costs of the particular luminaire type;
LAPR	Lamp price for the particular luminaire type;
LPR	Price of the particular luminaire type;
NL	Number of lamps for the particular luminaire;
NT	Number of luminaires of the particular type;
Σ_{lumtype}	Sum for all luminaires types.

2.10.2 Annual costs

The total annual costs are calculated according to the following formula:

Total Annual Cost = EN + AI + LC + MC

Variables:	Meaning:
EN:	Energy costs per year;
AI:	Annual investments costs for the particular luminaire type;
LC:	Lamp replacement costs per year;
MC:	Maintenance costs per year.

The formulas for these costs are: [4]

$$EN = \frac{KWHPR}{1000} * \Sigma_{swimod} \{ \{ \Sigma_{lumtype} (NT_{swimod} * LWATT) \} * BRNH_{swimod} \}$$

$$AI = AF * \Sigma_{lumtype} \{NT * (LPR + INSTC)\}$$

$$AF = \frac{R/100}{1 - \{1/[1 + R/100]\}^{**N}}$$

$$LC = \frac{\Sigma_{lumtype} \{NT * NL * LAPR\}}{RP}$$

$$MC = \frac{\Sigma_{lumtype} \{NT * MCL\}}{RP}$$

Variables:	Meaning:
AF	the annuity factor;
$BRNH_{swimod}$	the burning hours per year of the switching mode;
INSTC	the installation cost per luminaire for a particular luminaire type;
KWHPR	the kilowatt-hour price;
LAPR	the lamp price for a particular luminaire type;
LPR	the price per luminaire for a particular luminaire type;
LWATT	the total watts per luminaire for a particular luminaire type;
MCL	the maintenance cost per luminaire for a particular luminaire type;
N	the amortization period (years);
NT	the number of luminaires of a particular type;
NT_{swimod}	the number of luminaires of a particular type per switching mode;
NL	the number of lamps per luminaire for a particular luminaire type;
R	the interest rate (%);
RP	the relamping period (years) for a particular luminaire type;
$\Sigma_{lumtype}$	the sum for all luminaire types.

2.10.3 Cost calculations and light regulation factors

There is no linear relation between the value of the light regulation factor and the power consumption of a luminaire. As a result of this, when light regulation factors are used, the power consumption of the luminaire can not be calculated. So in the cost calculation the energy costs will not be given. [11]

2.11 maintenance Factor/New Value Factor

The Maintenance Factor is the ratio of the average illuminance on the plane under investigation after a specified period of use of the lighting installation, to the average illuminance obtained under the same conditions for a new installation. It is always equal or less than 1 and is used as a multiplier for calculations, based on luminaire light distribution tables. [8]

In some countries the New Value Factor (or Inverse Maintenance Factor) is used. Calculux allows you to use new value factors instead of maintenance factors. The 'Inverse Maintenance Factor' is always more than or equal to 1. The following maintenance factors are specified:

* □ General Project Maintenance Factor;

* □ Luminaire Type Maintenance Factor;

* □ Lamp Maintenance Factor.

2.11.1 General Project Maintenance Factor

This maintenance factor takes into account a general factor with which all calculation results are multiplied. It acts as a safeguarding factor and must reflect the overall conditions of the room surfaces. The value of the 'Project Maintenance Factor' is always equal or less than 1. [8]

2.11.2 Luminaire Type Maintenance Factor

This maintenance factor takes into account the reduction of light output caused by dirt deposited on or in a luminaire. The rate at which the dirt is deposited depends on the construction of the luminaire and the extent of what dirt is present in the environment. The value of the 'Luminaire Type Maintenance Factor' is always equal or less than 1.

2.11.3 Lamp Maintenance Factor

The Lamp Maintenance Factor value is always equal or less than 1 and consists of two elements:

a) Lamp Survival Factor;

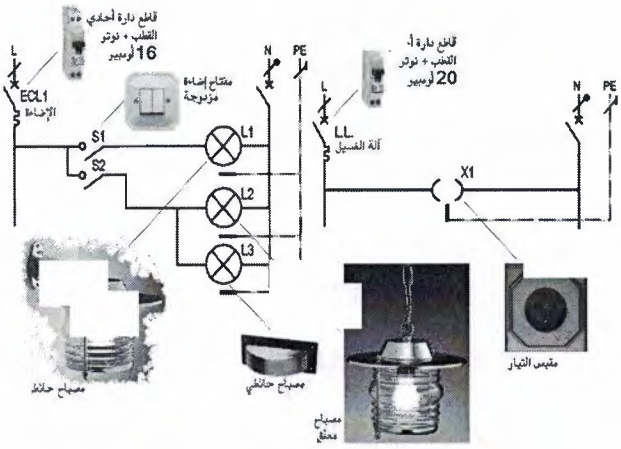
b) Lamp Lumen Depreciation Factor.

a) Lamp Survival Factor

This maintenance factor takes into account the percentage of the lamp failures during a specific number of operation hours. It is only applicable when a group replacement is to be carried out. The 'Lamp Survival Factor' is based on the assumptions about the switching cycle, supply voltage and control gear.

b) Lamp Lumen Depreciation Factor.

This maintenance factor takes into account the fact that the luminous output of all lamps decreases with use. [8]



ld be controlled from two sides as following:

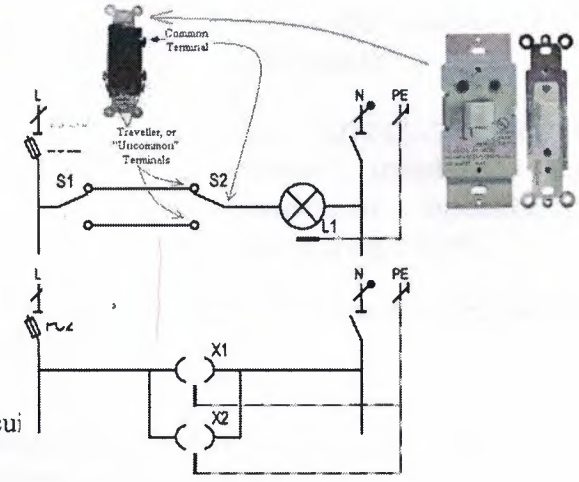


Figure 2.5 Lighting Circui

2.12 FLUORESCENT LUMINAIRE AND LAMP

2.12 .1 GENERAL

The luminaires, including the control gear, shall be suitable for operation at 220V ±6%, 50 Hz ±2%, single phase, a.c. supply.

The luminaires shall comply both in manufacturing and testing with the following international standards and their manufacturing process shall conform to the relevant quality standard of ISO 9000:

Luminaires	:	IEC 60598-2
Ballast	:	IEC 60920 and/or IEC 60921 as applicable
Electronic ballast	:	IEC 60928 and/or IEC 60929 as applicable
Capacitor	:	IEC 61048 and/or 61049 as applicable
Starter, glow type	:	IEC 60155
Starter, electronic type	:	IEC 60926 and/or IEC 60927 as applicable
Lampholder	:	IEC 60400
Lamp	:	IEC 60081 and/or IEC 60901 as applicable
Internal cable	:	IEC 60245-7 450/750V heat resistant rubber insulated cable, suitable for conductor operating temperature not exceeding 110°C

Test certificate shall be provided and the luminaires shall be marked in accordance with the requirements of IEC 60598-2.

The luminaires excluding the fluorescent lamp shall be supplied in complete set comprising control gear, lampholders, cable terminal block, etc., interconnected with cables of appropriate colour codes.

2.12 .2 TYPE OF LUMINAIRES

Group 1
This group includes batten luminaires and the combination of different reflectors or diffusers with the basic battens.
Group 2
This group covers special luminaires including glass fibre, garage pit and flame proof luminaires.
Group 3
This group covers self-contained emergency fluorescent luminaire.
Group 4
Wall-mounted fluorescent luminaire complete with shaver socket.

2.12 .3 FLUORESCENT LAMPS

2.12 .3.1 Lamp Features

Lamps shall have, but not limited to, the following features:

(a) Superb colour rendering (Ra) property with values not less than:

Areas served	Values of R_a
Car parking spaces or similar	50
Office areas or similar	80
Hospitals or other clinical functional areas	90

(b) Energy saving

(c) Compatible to the type of lamp circuit, and

(d) Tubular shape with preheated cathode and suitable for operation in ambient temperature up to 40°C and 100% relative humidity.

Table C6.7.2 – 1

Lumen Output for 26 mm Diameter (T8) Tubular Fluorescent Lamps

Rated power of lamp	Min. Lumen output				
	2700°K	3000°K	3800°K	5400°K	6500°K
18	1350	1350	1350	1300	1000
36	3350	3350	3350	3250	2300
58	5200	5200	5200	5000	3700

Table C6.7.2 – 2

Lumen Output for Circular Fluorescent Lamps

Rated power of lamp	Min. Lumen output				
	2700°K	3000°K	3800°K	5400°K	6500°K
22	1350	--	1000	--	1050
32	2050	2000	2000	--	1750
40	2900	2800	2300	--	2500

Table C6.7.2 – 3

Lumen Output for 38 mm Diameter U-tube Fluorescent Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
20	--	1150	950
40	--	2700	2400
65	--	4500	3900

Table C6.7.2 – 4

Lumen Output for 16 mm Diameter (T5) Tubular Fluorescent Lamps

Rated power of lamp (W)	Min. Lumen output		
	3000°K	4000°K	6000°K
14	1350	1350	1300
21	2100	2100	2000
28	2900	2900	2750
35	3650	3650	3500
24	2000	2000	1900
39	3500	3500	3325
54	5000	5000	4750
49	4900	4900	4650
80	7000	7000	6650

Table C6.7.2 – 5

Lumen Output for Compact Fluorescent, Single-ended, 4 Pin Base Lamps

Rated power of lamp (W)	Min. Lumen output			
	2700°K	3000°K	3800°K	5400°K
5	250	--	250	--
7	400	400	400	--
9	600	600	600	--
11	900	900	900	--
18	1200	1200	1200	750
24	1800	1800	1800	1200
36	2900	2900	2900	2400
40	3500	3500	3500	2200
55	4800	4800	4800	3000

Table C6.7.2 – 6

Lumen Output for Compact Fluorescent, Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output			
	2700°K	3000°K	3800°K	5400°K
5	250	250	250	--
7	400	400	400	375
9	600	600	600	565
11	900	900	900	850

Lumen Output for Compact Fluorescent, Triple Independent Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800

Table C6.7.2 – 9

Lumen Output for Compact Fluorescent, Triple Independent Single-ended, 4 Pin Base Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800
32	2400	2400	2400
42	3200	3200	3200

Table C6.7.2 – 10

Lumen Output for Compact Fluorescent, Four Independent Single-ended, 2 Pin Base With Built-in Starter Lamps

Rated power of lamp (W)	Min. Lumen output		
	2700°K	3000°K	3800°K
8	350	--	--
10	600	600	--
13	900	900	900
18	1200	1200	1200
26	1800	1800	1800

2.13 TUNGSTEN HALOGEN LAMP

GENERAL

Tungsten lamps shall meet the safety requirements as specified in BS EN 60423. The manufacturing process shall comply with the relevant quality standard of ISO 9000 series standards.

The colour temperature of the lamp shall be within the range between 2800°K and 3200°K. The colour rendering index shall not be less than 90.

The rated average life of the lamp shall not be less than 2000 hours at 10% failure. The light output of the lamp shall not be diminished by more than 5% throughout the guaranteed life.

2.13 .1 SPECIAL REQUIREMENTS FOR MAINS VOLTAGE (220V) LAMP

The lamps shall comply with EN 60357 or other equivalent international standards suitable for operation at 220V ± 6% and 50 Hz ± 2%, single phase a.c. The luminous efficacy shall not be less than 13 lumens/lamp watt.

2.14 SPECIAL REQUIREMENTS FOR EXTRA-LOW VOLTAGE (ELV) LAMP

General

The lamp shall be suitable for operation at 12V single phase a.c. through a compact electronic step-down transformer suitable for operation at an input supply of 220V ± 6%, 50 Hz ± 2%, single phase a.c. The output shall be 12V a.c.

2.14 .1 The Transformer

The transformer shall be supplied together with the 12V lamp as an integral package by the same manufacturer or supplier.

The general and safety requirements shall comply with IEC 61046 or other equivalent international standards which shall at least cover:

(a) General requirements:

(i) tests

(ii) classification

(iii) marking

(b) Safety requirements:

(i) terminals

(ii) earthing

(iii) construction

(iv) creepage distances and clearances

(v) protection against contact with live parts

(vi) moisture resistance and insulation
(vii) electric strength

(viii) transformer heating

(ix) abnormal conditions (such as, but not limited to, no lamp

inserted, lamp resistance reduced, output terminals shortcircuited, etc.)

(x) fault conditions

(xi) screws, current-carrying parts and connections

(xii) resistance to heat and fire

(xiii) resistance to corrosion
The performance requirements shall comply with IEC 61047 or other equivalent international standards which shall at least cover:
(i) tests

(ii) classification

(iii) marking

(iv) output voltage and current

(v) total circuit power

(vi) circuit power factor

(vii) supply current

(viii) impedance at audio-frequencies

(ix) mains transient over voltages

(x) abnormal conditions (such as, but not limited to, no lamp inserted, lamp resistance reduced, output terminals shortcircuited, etc.)
(xi) endurance
The harmonics of the output current shall comply with IEC 60555-2 as stipulated in IEC 61047.

The radio interference suppression shall comply with EN 55015/A1 or other equivalent international standards.

The transformer shall be suitable for use with dimmers so that the illuminance of the lamp can be adjusted if required. In addition, the transformer shall be able to be used with d.c. supplies for emergency lighting purpose.

2.15 Summary

In this chapter, a fully detailed explanation had been presented, thus, new lighting products were not only more energy efficient, they offered many more possibilities to improve the quality of lighting our homes, indoors and out. This chapter looked at some of the new technologies for residential lighting, compared the cost benefits, identifies four basic strategies to apply, then provided specific examples of how to put the new strategies into practice throughout the home rooms.

CHAPTER THREE

INSTALLATION OF POWER CABLES, CABLE TRAYS AND CABLE LADDERS

GENERAL

3.1 Scope

This Section covers the installation of power cable, which includes those listed in Sub-section C2.2 of Section C2. It also covers the installation of the associated cabling facilities, including cable trays and cable ladders. Unless otherwise specified elsewhere, all cables shall have copper conductors.

3.1 .2 Electromagnetic Interference

To minimize the electromagnetic interference generated from single core cables, the following arrangements shall be adopted :

(a) All the single core cables shall be of the same conductor, same cross sectional areas, same type, same construction and from the same manufacturer.

(b) All the single core cables shall be of equal length, and shall follow the same route of installation.

(c) The single core cables shall not be able to operate individually.

(d) The layout of single core cables shall be arranged

3.2 CABLE MOUNTED ON SURFACE

Unless otherwise specified, power cables shall be mounted on the surface of wall or ceiling or other building structure. They shall be cleated in position by approved type cable cleats or cable saddles. Cable cleats or cable saddles shall be provided along the entire cable route according to the Table B2.2.

When specified, power cables may be supported on cable trays or cable ladders. In such cases, the requirements of Sub-sections B2.9 and B2.10 shall apply. For vertical cable runs exceeding 100m, tension releasing sections shall be provided in accordance with the recommendation of the cable manufacturer, failing which, a tension releasing section shall be provided for every 100m vertical run. [15]

TABLE B2.2

Spacing of Cable Cleats or Cable Saddles for Power Cable

Type of cable	Overall diameter of cable, d (mm)	Support spacing	
		Horizontal (mm)	Vertical (mm)
Cables with copper conductors	$d \leq 15$	350	450
	$15 < d \leq 20$	400	550
	$20 < d \leq 40$	450	600
	$40 < d \leq 60$	700	900
	$d > 60$	1100	1300
Cables with aluminium conductors	$d \leq 20$	1200	550
	$20 < d \leq 40$	2000	600
	$40 < d \leq 60$	3000	900
	$d > 60$	4000	1300

3.3 CABLE LAID IN ENCLOSED TRENCH

When more than one power cables are laid in an enclosed trench, the cables shall be installed in accordance with Table 52H of IEC 60364. Correction factors shall be applied to the current ratings as indicated in IEC 60364, where applicable.

3.4 CABLE ENCLOSED IN DUCT

3.4.1 General

Cables laid in ducts shall be sheathed and armoured. Where mineral insulated cables are specified, they shall be with PVC or XLPE outer cover as specified. Where the ducts are formed from wood, cables shall be held in position by clips, saddles, or approved fixings. The space factor in a cable duct shall not exceed 35%.

3.4.2 Drawing-in of Cables

Prior to the drawing-in of the cables, the cylindrical ducts shall be cleaned with a cylindrical brush of appropriate size. Attachment to facilitate the pulling of cables through a duct shall be made to the cores, insulation, inner and outer sheaths and not to the armour in order to avoid twisting. Attachment to the armour will only be permitted for small cables with the approval of the Architect. When pulling power cables into small ducts, an emulsion of graphite powder and soft soap in water may be used for brushing onto the cable surfaces where they enter the duct to reduce friction during pulling. The use of Section B2other

materials having equivalent functions or performance will not be precluded provided that such materials or methods shall not damage the cables and that the prior approval of the Architect has been given. When pulling-in lead-sheathed insulated power cables, the following precautions shall be taken :

(a) Maximum stress in sheath - 10,000kPa (with stocking pulling grip).

(b) Maximum stress in conductors - 70,000kPa (with pulling eye attached to conductors).

(c) Maximum pull shall be limited to 220,000 Newtons.

3.4.3 Internal Barrier

In every vertical duct, which is designed as totally enclosed without ventilation, internal barriers shall be provided to prevent the air at the top of the duct from attaining an excessively high temperature. The distance between adjacent barriers shall be the distance between floors. Where the floor to floor distance exceeds 5m, additional barriers shall be provided at an interval not exceeding 5m.

3.4.4 Fire Barrier

Where a cable duct passes through fire resistant structural elements, such as floor or wall designated as fire barriers, the opening thus formed shall be sealed with fire resistant materials having the same degree of fire resistance as the structural element. In addition, suitable internal fire barriers shall also be provided. An internal fire barrier may also serve as an internal barrier described in Sub-section B2.4.3 above.

3.5 Power Cables

Cables are designed for both high voltage and low-voltage transmission of power. Though the general construction is similar in both cases, high-voltage cables have thicker insulation and usually have smaller conductors, since low-voltage cables carrying bulk power handle the heavier Currents

3.5.1 General Construction

A power cable is made up of one, two, three or four insulated conductors enclosed in bedding. For mechanical protection, wire armoring is wrapped around the bedding, and a colored outer protective sheath, usually of PVC, is extruded over the armoring, as shown in Figure 4.1, Each insulated conductor is known as a 'core'.

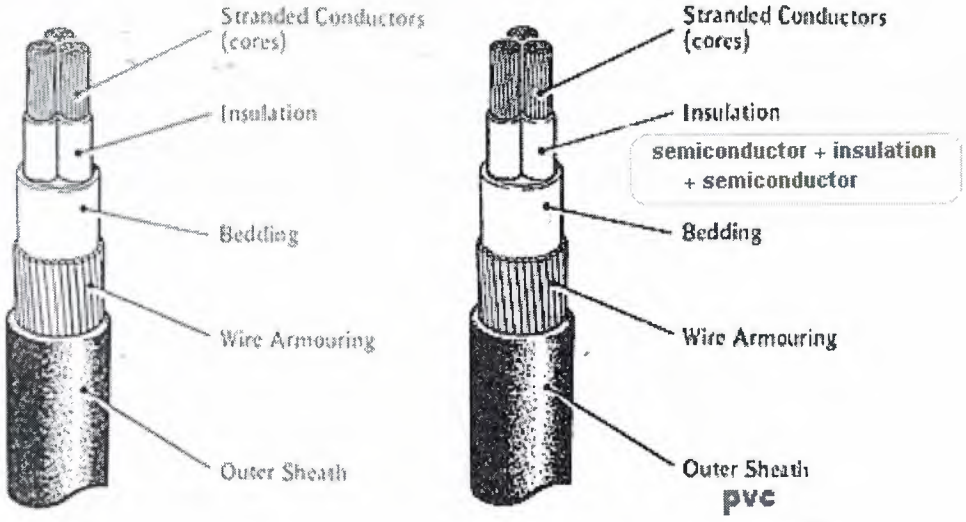


Fig.4.1 The Construction of Power Cables.

3.5.2 Conductors

The size of the copper conductor forming one of the cores of a cable is expressed in square millimeters (mm2), and the current rating of the cable is dependent upon the cross-sectional area of each core.

The very smallest cables have conductors consisting of only one strand of copper; larger cables however have stranded conductors consisting of many individual strands or wires laid up together; this gives flexibility, allowing the cable to be bent more readily during installation.

To achieve a circular conductor, the number of strands follows a particular progression: 3, 7, 19, 37, 61, and 127 etc, the diameter of each strand being chosen to achieve the desired cross-sectional area of tile whole conductor.

As seen in Figure4.2, 3-core and 4-core cables in the larger sizes have conductors with the strands laid up in a segmental formation; this achieves a better space factor and reduces the overall diameter of the cable. It also reduces the inductance of the cable due to decreased spacing between phases.Standard conductor sizes range from I.5mm2 to 400mm2 for 2-core, 3-core and 4-core cables, and from 50mm2 to I000mm2 for single-core cables. [15]

3.5.3 Insulation, Covering and Stress Relief

Natural rubber or oil-impregnated paper is no longer used for the insulation of cables up to 3810/6600V; synthetic materials are now used. For high-voltage cables the insulation is ethylene propylene rubber (EPR) and for low-voltage cables it is polyvinyl chloride (PVC).

EPR has good electrical properties and is resistant to heat and chemicals; it is suitable for a conductor temperature up to 85oC. PVC is a thermoplastic material, therefore care must be taken not

to overheat it; it is suitable for conductor temperatures up to 70°C. PVC insulated cables should not be laid when the temperature is less than 0oC because it becomes brittle and is liable to crack.

High-voltage cables have an earthed metallic screen over the insulation of each core. This screen consists of a lapped copper tape or metallic foil, and its purpose is to control the electric field within the insulation and thus the voltage gradient across it, as shown in Figure4.3. Also, it avoids any interaction of the electric stresses due to the voltages on different phase conductors within the same cable.

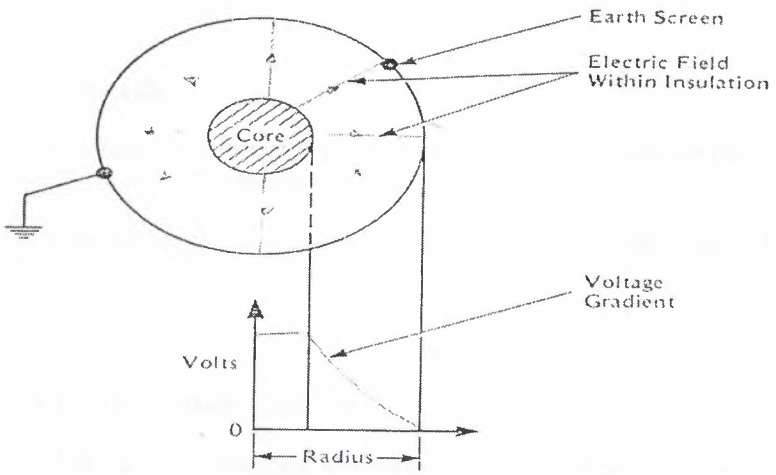


Fig.4.3 The Voltage Gradient Across High Voltage Cable Insulation.

Core insulation may be coloured red, yellow, blue and black to identify the three phases and neutral. Twin cores are coloured red and black. Single-core cables are identified by coloured PVC tape applied to the outer sheath.

3.5.4 Cable Stress Relief

The copper screen is often terminated in a 'stress cone', which may be seen in Figure 7. This is to spread the electric stress which would otherwise tend to concentrate where the screen is cut off at a cable end and could lead to breakdown. This is further discussed in para. 6.4

3.5.5 Bedding

The bedding consists of a layer of PVC extruded over the core insulation as a base for the armouring.

3.5.6 Armoring

Mechanical protection of the cable is provided by a single layer of wire strands laid over the bedding. Steel wire is used for 3-core or 4-core cables, but single-core cables have aluminum wire armoring. With 3-core or 4-core cables the vector sum of the currents in the conductors is zero, and there is virtually no resultant magnetic flux. This is not so however for a single-core cable, where eddy-current heating would occur if a magnetic material were used for the armouring. Armouring is described as Steel Wire Armoured (SWA) or Aluminium Wire Armoured (AWA). [13]

3.5.7 Outer Sheath

The outer sheath of extruded PVC protects the armouring and the cable against moisture and generally provides an overall protective covering.

High-voltage cables are identified by outer sheaths colored red; a black sheath indicates a low-voltage cable.

3.5.8 Selection of Power Cables

The following considerations are taken into account when selecting a power cable for a particular application:

3.5.9 The System Voltage and Method of Earthing

A low-voltage system usually has a solidly earthed neutral so that the line-to-earth voltage cannot rise higher than (line volts) ÷ $\sqrt{3}$. However, cables for low-voltage use are insulated for 600V rms score to earth and 1000V rms core to core.

High-voltage cables used in Shell installations are rated 1900/3300V or 3810/6600V or 6600/11000V, phase/line. In selecting the voltage grade of cable, the highest voltage to earth must be allowed for. For example, on a normal 6.6kV unearthed system, a line conductor can achieve almost 6.6kV to earth under earth-fault conditions, To withstand this, a cable insulated for 6600/11000V must therefore be used. [13]

3.5.10 The Normal Current of the Cable

The conductors within a cable have resistance, and therefore /2 R heating occurs when currents pass through them, The maximum permissible temperature of the cable depends upon the material of the insulation, and a conductor size must be chosen so that this temperature is not exceeded. Tables giving the continuous current-carrying capacities of different cables are given in manufacturers' literature and in the Regulations for the Electrical Equipment of Buildings published by the Institution of Electrical Engineers. The temperature of a cable depends not only on the rate of heat input due to the passage of load current but also on the rate at which the heat can be carried away. When using the tables of current ratings it is

important to note whether they refer to cables laid in the ground laid in ducts or laid in air. De-rating may be necessary if a number of cables are run in close proximity to each other. Another consideration in selecting a cable is the voltage (IR) drop from the source of supply to the load. A drop of 1V in a 440V circuit is of little consequence, but it is a significant percentage when the circuit operates at 24V, [13]

3.5.11 Abnormal Currents in the Cable

One abnormal condition is a sustained overload; a cable must be protected so that an overload cannot persist long enough to cause damage to the insulation by overheating. For example, for PVC cables laid in air, the overload must not be greater than 1.5 times the continuous maximum rated current and must not persist for longer than four hours. Another abnormal condition is when a cable has to carry a through short-circuit current. In this case the temperature of the conductor may be allowed to rise to a higher value, say 150°C, for the short interval between the onset of the fault and its disconnection. The short-circuit current that a given cable can withstand depends upon the speed with which the protection operates. For example, a PVC cable having conductors of 185mm2 has the following short-circuit ratings:

46kA for 0.2s

20.3kA for 1.0s

11.7kA for 3.0s

The 0.2s rating would be suitable for use with fuse protection, but where relay-operated circuit breakers are concerned, a longer time rating would be necessary. Again, tables of short-circuit ratings are available in manufacturers' literature.

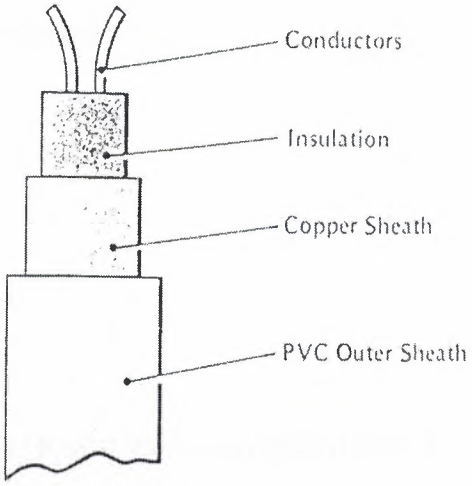
3.5.12 Control Cables

Control cables usually have conductors either 1.50mm2 or 2.50mm2 in cross-section. The insulation, bedding and outer sheath are of PVC, and they are steel wire armored. Multi core cables are available having 2, 3, 4, 7, 12, 19 and 27 cores, each core being identified by a number on the insulation. The outer sheath of control cables is colored green.

3.5.13 Mineral Insulated Cables

Mineral-insulated (MI) cables are used where the integrating of a circuit is of great importance. They are particularly resistant to fire and are used in circuits, such as communications or emergency lighting, which must continue operational as long as possible after fire has broken out. They are also very robust and resistant to mechanical damage.

Fig.4.4 Mineral Insulated Two Core Cable.



MI cables are constructed by assembling the single-strand conductor or conductors inside a seamless copper tube. After threading a number of 'tablets' of magnesium oxide insulating material onto the conductors, the whole assembly - conductors, insulation and copper tube - is drawn down through a series of dies until the magnesium oxide is crushed to a powder and the whole cable is solid. The final appearance is as in Figure 4.4. After annealing to make the cable more flexible, an outer sheath of PVC is applied. MI cables are available in single-core from 1 mm2 to 150mm2, in 2-core, 3-core and 4-core from 1mm2 to 25mm2, and in 7-core from 1 mm2 to 4mm2. Special jointing techniques and materials must be used for terminating MI cables, and great care must be taken to seal the cable ends against the entry of moisture.

3.5.14 Hod of Specifying Cables

There is a 'shorthand' method used to describe the construction of any cable, using abbreviations to indicate the nature of the various materials. For example, a low-voltage cable might be described as:

(Reference)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Abbreviation	0.6/1kV		STR	CU/PVC/PVC/SWA/PVC/HO2/HCL						

3-core, l50mm2

Interpreted this means:

1 0.6kV line to earth

2 1kV line to line

3 Stranded conductor

4 Copper conductor

5 PVC conductor insulation

6 PVC bedding

7 Steel wire armoured

8 PVC outer sheath

Another example is:

6.6/11kV STR CU/EPR/SCR/PVC/AWA/PVC/HO2/HCL

1-core, 630mm2

Where EPR indicates ethylene propylene conductor insulation SCR indicates screened AWA indicates aluminum wire armored. The last two items (9 and 10) indicate the flammability and the toxicity of the synthetic materials used in the cable. HO2 indicates that a high level of oxygen is required to sustain combustion: in the case of the Shell specification this means more than 30% oxygen in the atmosphere. HCL denotes 'Hydrochloric Level' showing that, when the synthetic materials burn, they produce hydrochloric acid gas (HCI) which is highly poisonous and very corrosive.

In particular PVC, when burnt, releases large quantities of HCI and also produces dense black smoke; for example, a 1m length of cable containing, say, 6kg of PVC can completely black out a room 1000m3 in site within five minutes of the fire starting.

3.6 Summary

A fully detailed illustrating about cables and wiring systems are included into this chapter where, it can be a reference point for any related topic.

CONCLUSION

Premises as described in this section of the electrical power installations , electrical wiring and grounding carried out in accordance with the regulations implementing the plan a description of the sample electric power installations are made. Workshop , workplaces , public and private building projects of the electric force is performed by electrical power plants prepared . An electrical project internal forces of a structure plans, architectural plans drawn on the electrical installation , vertical diagram , power distribution charts , single line diagrams , technical and special specifications, and the like . Electric power plans, scratched off the charts as far as possible should be understandable style . All machines should be made a separate feed from Lines , is imperative to take additional sub- Lines must be created using sub-panel . Electric power plans and attachments, picture negotiable provision is in respect of a project should be prepared carefully as the project required approval must bear on the cover

The responsibility of implementing the project until at least should be noted that responsibility as project developers . This force diagram symbols used in the installation plan, should be included in the initial portions . The symbols used in different projects, small differences between applications , though, everyone should use different symbols than not being able to understand . Main boards, distribution boards, electrical switches, should be easily accessible places . Lines , cable bracket, cable tray or conduit must be within the chimney edges , which can wear down over the windows and the cable passed through the area should have physical effects .

Electrical installation plan belonging to interior schemes, lighting the lamp connections, socket connections , phone and TV connections, ringtones and video sensing connections should be included. Low-voltage lighting installation plans and installation plans in the same architectural plan , as might be on a different architecture plans can be drawn . Installation can not be shown in the plans , which can not be understood diagrams are shown , in addition schemes should be available. Electric power project located within the column chart, conductor cross-section calculations , voltage drop and power dissipation accounts ruler , electrical wiring to be connected to the electricity grid system , in terms of determining the electrical parameters is required. For this reason , these calculations and impressions made as realistic as possible , electrical power installation for many years of trouble-free and reliable in terms of importance. Electrical power installation plan should relax schemas found , all the details to be shown in the column chart is not possible. For this reason, single-line diagram needs to be drawn . Show details inside the panels is the single-line diagrams are of great importance . Electrical power installation space required for the installation of lighting plan was carried out the same architectural plans shown on the plans although , in the name of preventing disorder is more suitable to be drawn separately . Administrative and office lighting installation of parts for electric indoor plumbing plans based on plans apply. However, the application of power installations for the section number of applications like fluorescent power projects located in special applications are available. Lamps, lighting calculations performed are determined is shown in detail in Section 3, the calculation is not discussed here again . From a technical point of applicability of electrical power installation plan , as well as in financial terms should be applied . For this reason , bill and the cost is also important for electric power projects .

This project help me to see conditions of jobs in business life and process of electrical project drawn in market. This project helps me in future work.

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