NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical&Electronic Engineering

ELECTRİCAL INSTALLATION OF A HIGH SCHOOL

Graduation Project

EE400

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ABSTRACT

Inthepresentdaywehave a branchforenginering as illuminationenginnering. Sowe can understanttheimportance of theillumination.Forsatisfyingtheconsumerrequirements, electricalinstallationshould be welldesignedandappliedwith a professionalknowledge, because in thepresentdaywhenwearechoosing an armatureweare not lookingonlytoitspowervalue.Weareconsideringthelumen of thelampthetypeanddesign of thearmatureifitssuitableor not fortheproject, andsometimestheworkingtemperature.

Ourproject is abouttheelectricalinstallation of a highschoolwhichisformedbyfourfloorwiththeattic,andthisprojectneedswellknowledgeab outelectricalinstallationandalsoresearchingthepresentsystems.Thisprojectconsisttheinstal lation of lightingcircuits,theinstallation of sockets,centerheating,telephone,tvand data socketsandbellsystems.

TABLE OF CONTENTS

INTRODUCTION

Design an electrical installation project, in most efficient way,is one of the essential subject in Electrical Engineering.This is taken into consideration in our project.

In this project all the related,electrical installation and some rules designing will be shown according priority.

Chapter one gives information abotut types of lamps and advantages of flourescent lamp and dis advantages of it

Chapter two gives information about type of circuit breaker(mcb,mccb,rcd, contactor, and aparatus) and technical details of them

Chapter three gives information about types of switches,sockets and buttons

Chapter four gives informatin about conductors and cables

Cahapter five based on earting and techniques

Chapter six and seven are devoted to two essential subjects.In these chapters ‘Voltage Drop and Power Factor Correction’ one cowered in daily applications.

Chapter seven is composed of the entire calculations in the project.The calculations are illumination, power,current,voltage drop, calculations and also ‘Total Investment’ is reffered in this chapter.

Chapter eight gives informatin aboutdistribution board

The conclusion presents useful pointsand important results obtained from the theory and also comment belong to the students who preparedthe Project.

1.LIGHTING

1.1.Overview

Lighting plays a most important role in many buildings, not only for functional purposes (simply supplying light) but to enhance the environment and surroundings. Modern offices, shops, factories, shopping malls, department stores, main roads, football stadium, swimming pools – all these show not only the imagination of architects and lighting engineers but the skills of the practising electrician in the installation of luminaries.

Many sources of light are available today with continual improvements in lighting efficiency and colour of light.

Lm: This is a unit of luminous flux or (amount of light) emitted from a source.

Luminous efficacy: This denotes the amount of light produced by a source for the energy used; therefore the luminous efficacy is stated in 'lumens per watt' (lm / W).

A number of types of lamps are used today: filament, fluorescent, mercury vapour, sodium vapour, metal Halide, neon. All these have specific advantages and applications

1.2.Filament Lamps

Almost all filament lamps for general lighting service are made to last an average of at least 1000 hours. This does not imply that every individual lamp will do so, but that the short-life ones will be balanced by the long-life ones; with British lamps the precision and uniformity of manufacture now ensures that the spread of life is small, most individual lamps in service lasting more or just less than 1000 hours when used as they are intended to be used.

In general, vacuum lamps, which are mainly of the tubular and fancy shapes, can be used in any position without affecting their performance. The ordinary pear-shaped gas filled lamps are designed to be used in the cap-up position in which little or no blackening of the bulb becomes apparent in late life. The smaller sizes, up to 150 W, may be mounted horizontally or upside-down, but as the lamp ages in these positions the bulb becomes blackened immediately above the filament and absorbs some of the light. Also vibration may have a more serious effect on lamp life in these positions Over the 150 W size, burning in the wrong position leads to serious shortening of life.

1.2.1.Coiled – Coil lamps

By double coiling of the filament in a lamp of given wattage a longer and thicker filament can be employed, and additional light output is obtained from the greater surface area of the coil, which is maintained at the same temperature thus avoiding sacrificing life. The extra light obtained varies from 20 % in the 40 W size to 10 % in the 100 W size.

1.2.2.Effect of Voltage Variation

Filament lamps are very sensitive to voltage variation. A 5 % over-voltage halves lamp life due to over-running of the filament. A 5% under-voltage prolongs lamp life but leads to the lamp giving much less than its proper light output while still consuming nearly its rated wattage. The rated lamp voltage should correspond with the supply voltage. Complaints of short lamp life very often arise directly from the fact that mains voltage is on the high side of the declared value, possibly because the complainant happens to live near a substation

1.2.3.Bulb Finish

In general, the most appropriate use for clear bulbs is in wattages of 200 and above in fittings where accurate control of light is required. Clear lamps afford a view of the intensely bright filament and are very glaring, besides giving rise to hard and sharp shadows. In domestic sizes, from 150 W downwards, the pearl lamp – which gives equal light output – is greatly to be preferred on account of the softness of the light produced. Even better in this respect are silica lamps; these are pearl lamps with an interior coating of silica powder which completely diffuses the light so that the whole bulb surface appears equally bright, with a loss of 5% of light compared with pearl or clear lamps. Silica lamps are available in sizes from 40 – 200 W. Double life lamps compromise slightly in lumen output to provide a rated life of 2,000 hours.

1.2.4.Reflector Lamps

For display purposes reflector lamps are available in sizes of 25W to 150W. They have an internally mirrored bulb of parabolic section with the filament at its focus, and a lightly or strongly diffusing front glass, so that the beam of light emitted is either wide or fairly narrow according to type. The pressed-glass (PAR) type of reflector lamp gives a good light output with longer life than a blown glass lamp. Since it is made of borosilicate glass, it can be used out-of-doors without protection

1.2.5.Tungsten Halogen Lamps

The life of an incandescent lamp depends on the rate of evaporation of the filament, which is partly a function of its temperature and partly of the pressure exerted on it by the gas filling. Increasing the pressure slows the rate of evaporation and allows the filament to be run at a higher temperature thus producing more light for the same life.

If a smaller bulb is used, the gas pressure can be increased, but blackening of the bulb by tungsten atoms carried from the filament to it by the gas rapidly reduces light output. The addition of a very small quantity of a haline, iodine or bromine, to the gas filling overcomes this difficulty, as near the bulb wall at a temperature of about 300^{0}C this combines with the free tungsten atoms to form a gas. The tungsten and the haline separate again when the gas is carried back to the filament by convection currents, so that the haline is freed the cycle.

Tungsten halogen lamps have a longer life, give more light and are much smaller than their conventional equivalents, and since there is no bulb blackening, maintain their colour throughout their lives. Mains-voltage lamps of the tubular type should be operated within 5 degrees of the horizontal. A 1000W tungsten halogen lamp gives 21 000 lm and has a life of 2000 hours. These lamps have all but replaced the largest sizes of g.I.s. lamps for floodlighting, etc. They are used extensively in the automotive industry. They are also making inroads into shop display and similar areas in the form of 1v. (12 V.) Single-ended dichroic lamps.

1.3.Discharge Lamps

Under normal circumstances, an electric current cannot flow through a gas. However, if electrodes are fused into the ends of a glass tube, and the tube is slowly pumped free of air, current does pass through at a certain low pressure. A faint red luminous column can be seen in the tube, proceeding from the positive electrode; at the negative electrode a weak glow is also just visible. Very little visible radiation is obtainable. But when the tube is filled with certains gases, definite luminous effects can be obtained. One important aspect of the gas discharge is the ‘negative resistance characteristic ’. This means that when the temperature of the material (in this case the gas) rises, its resistance decreases – which is the opposite of what occurs with an ‘ohmic’ resistance material such as copper. When a current passes through the gas, the temperature increases and its resistance decreases. This decrease in resistance causes a rise in the current strength which, if not limited or controlled in some way, will eventually cause a short circuit to take place. Thus, for all gas discharge lamps there is always a resistor, choke coil (or inductor) or leak transformer for limiting the circuit current. Though the gas-discharge lamp was known in the early days of electrical engineering, it was not until the 1930s that this type of lamb came onto the market in commercial quantities. There are two main types of electric discharge lamp.

(a) Cold cathode.
(b) Hot cathode.

1.3.1.Cold Cathode Lamp

The cold-cathode lamp uses a high voltage (about 3.5kV) for its operation. For general lighting purposes they are familiar as fluorescent tubes about 25mm in diameter, either straight, curved or bent to take a certain form. The power consumption is generally about 8 W per 30 cm; the current taken is in milliamps. The electrodes of these lamps are not preheated. A more familiar type of cold-cathode lamp is the neon lamp used for sign and display lighting. Here the gas is neon which gives a reddish light when the electric discharge takes place in the tubes. Neon lamps are also available in very small sizes in the form of 'pygmy' lamps and as indicating lights on wiring accessories (switches and socket-outlets). This type of lamp operates on mains voltage. Neon signs operate on the high voltage produced by transformers.

1.3.2.Hot-Cathode Lamp

The hot-cathode lamp is more common. In it, the electrodes are heated and it operates generally on a low or medium voltage. Some types of lamp have an auxiliary electrode for starting.

The most familiar type of discharge lamp is the fluorescent lamp. It consists of a glass tube filled with mercury vapour at a low pressure. The electrodes are located at the ends of the tube. When the lamp is switched on, an arc- discharge excites a barely visible radiation, the greater part of which consists of ultra-violet radiation. The interior wall of the tube is coated with a fluorescent powder which consists of ultra-violet rays into visible radiation or light. The type of light (that is the colour range) is determined by the composition of the fluorescent powder. To assist starting. The mercury vapour is mixed with a small quantity of argon gas. The light produced by the fluorescent lamp varies from 45 to 55 lm/W. The colours available from the fluorescent lamp include a near daylight and a colour-corrected light for use where colours (of wool, paints, etc.) must be seen correctly. The practical application of this type of lamp includes the lighting of shops, domestic premises, factories, streets, ships, transport (buses), tunnels and coal-mines.

The auxiliary equipment associated with the fluorescent circuit includes:

(a) The choke, which supplies a high initial voltage on starting (caused by the interruption of the inductive circuit), and also limits the current in the lamp when the lamp is operating.

(b) The starter;

(c) The capacitor, which is fitted to correct or improve the power factor by neutralizing the inductive effect of the choke.

The so-called 'switch less' start fluorescent lamp does not require to be preheated. The lamp lights almost at once when the circuit switch is closed. An auto-transformer is used instead of a starting switch.

1.4.Ultra –Violet Lamps

The invisible ultra-violet portion of the spectrum extends for an appreciable distance beyond the limit of the visible spectrum. The part of the u.v. spectrum which is near the visible spectrum is referred to as the near u.v. region. The next portion is known as the middle u.v. region and the third portion as the far u.v. region. 'Near' u.v. rays are used for exciting fluorescence on the stage, in discos, etc.

'Middle' u.v. rays are those which are most effective in therapeutics. 'Far' u.v. rays are applied chiefly in the destruction of germs, though they also have other applications in biology and medicine, and to excite the phosphors in fluorescent tubes.

Apart from their use in the lamps themselves fluorescent phosphors are used in paints and dyes to produce brighter colours than can be obtained by normal reflection of light from a coloured surface. These paints and dyes can be excited by the use of fluorescent tubes coated with phosphors that emit near ultra violet to reinforce that from the discharge. They may be made of clear glass in which case some of the visible radiation from the arc is also visible, or of black 'Woods' glass which absorbs almost all of it. When more powerful and concentrated sources of u.v. are required, as for example, on stage, 125W and 175W MB lamps with ‘Woods’ glass outer envelopes are used.

Since the ‘black light’ excites fluorescence in the vitreous humour of the human eye, it becomes a little difficult to see clearly, and objects are seen through a slight haze. The effect is quite harmless and disappears as soon as the observer’s eyes are no longer irradiated.

Although long wave u.v. is harmless, that which occurs at about 3000nm is not, and it can cause severe burning of the skin and ‘snow blindness’. Wavelengths in this region, which are present in all mercury discharge, are completely absorbed by the ordinary soda lime glass of which the outer bulbs of high pressure lamps and fluorescent tubes are made, but they can penetrate quartz glass. A germicidal tube is made in the 30W size and various types of high pressure mercury discharge lamps are made for scientific purposes. It cannot to be too strongly emphasised that these short-wave sources of light should not be looked at with the naked eye. Ordinary glass spectacles (although not always those with plastics lenses) afford sufficient protection.

Note that if the outer jacket of an MBF or MBI lamp is accidentally broken, the discharge tube may continue to function for a considerable time. Since short-wave u.v. as well as the other characteristic radiation will be produced these lamps can be injurious to health and should not be left in circuit.

1.5.Flourescent Lamp

A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor in argon or neon gas, resulting in a plasma that produces short-wave ultraviolet light. This light then causes a phosphor to fluoresce, producing visible light.

Unlike incandescent lamps, fluorescent lamps always require a ballast to regulate the flow of power through the lamp. In common tube fixtures (typically 4 ft (122 cm) or 8 ft (244 cm) in length), the ballast is enclosed in the fixture. Compact fluorescent light bulbs may have a conventional ballast located in the fixture or they may have ballasts integrated in the bulbs, allowing them to be used in lampholders normally used for incandescent lamps.

1.5.1.Electrical Aspects of Operation

Fluorescent lamps are negative differential resistance devices, so as more current flows through them, the electrical resistance of the fluorescent lamp drops, allowing even more current to flow. Connected directly to a constant-voltage mains power line, a fluorescent lamp would rapidly self-destruct due to the uncontrolled current flow. To prevent this, fluorescent lamps must use an auxiliary device, a ballast, to regulate the current flow through the tube; and to provide a higher voltage for starting the lamp.

While the ballast could be (and occasionally is) as simple as a resistor, substantial power is wasted in a resistive ballast so ballasts usually use an inductor instead. For operation from AC mains voltage, the use of simple magnetic ballast is common. In countries that use 120 V AC mains, the mains voltage is insufficient to light large fluorescent lamps so the ballast for these larger fluorescent lamps is often a step-up autotransformer with substantial leakage inductance (so as to limit the current flow). Either form of inductive ballast may also include a capacitor for power factor correction.

In the past, fluorescent lamps were occasionally run directly from a DC supply of sufficient voltage to strike an arc. The ballast must have been resistive rather than reactive, leading to power losses in the ballast resistor (a resistive ballast would dissipate about as much power as the lamp). Also, when operated directly from DC, the polarity of the supply to the lamp must be reversed every time the lamp is started; otherwise, the mercury accumulates at one end of the tube. Fluorescent lamps are essentially never operated directly from DC; instead, an inverter converts the DC into AC and provides the current-limiting function.

1.5.2.Advantages

Fluorescent lamps are more efficient than incandescent light bulbs of an equivalent brightness. This is because a greater proportion of the power used is converted to usable light and a smaller proportion is converted to heat, allowing fluorescent lamps to run cooler. A typical 100 Watt tungsten filament incandescent lamp may convert only 10% of its power input to visible white light, whereas typical fluorescent lamps convert about 22% of the power input to visible white light - see the table in the luminous efficacy article. Typically a fluorescent lamp will last between 10 to 20 times as long as an equivalent incandescent lamp when operated several hours at a time. Consumer experience suggests that the lifetime is much lower when operated for very short frequent intervals.

1.5.3.Disadvantages

Health issues

If a fluorescent lamp is broken, mercury can contaminate the surrounding environment. A 1987 report described a 23-month-old toddler hospitalized due to mercury poisoning traced to a carton of 8-foot fluorescent lamps that had broken. The glass was cleaned up and discarded, but the child often used the area for play.

Elimination of fluorescent lighting is appropriate for several conditions. In addition to causing headache and fatigue, 8 and problems with light sensitivity, they are listed as problematic for individuals with epilepsy, lupus, chronic fatigue syndrome, and vertigo

Ballasts

Fluorescent lamps require a ballast to stabilize the lamp and to provide the initial striking voltage required to start the arc discharge. This increases the cost of fluorescent light fixtures, though often one ballast is shared between two or more lamps. Electromagnetic ballasts with a minor fault can produce an audible humming or buzzing noise.

Figure 1.1 Ballasts

Power Factor

Simple inductive fluorescent lamp ballasts have a power factor of less than unity. Inductive ballasts include power factor correction capacitors.

Power Harmonics

Fluorescent lamps are a non-linear load and generate harmonics on the electrical power supply. This can generate radio frequency noise in some cases. Suppression of harmonic generation is standard practice, but imperfect. Very good suppression is possible, but adds to the cost of the fluorescent fixtures.

Optimum Operating Temperature

Fluorescent lamps operate best around room temperature (say, 20 °C or 68 °F). At much lower or higher temperatures, efficiency decreases and at low temperatures (below freezing) standard lamps may not start. Special lamps may be needed for reliable service outdoors in cold weather. A "cold start" electrical circuit was also developed in the mid-1970s.

Dimming

Fluorescent light fixtures cannot be connected to a standard dimmer switch used for incandescent lamps. Two effects are responsible for this: the waveshape of the voltage emitted by a standard phase-control dimmer interacts badly with many ballasts and it becomes difficult to sustain an arc in the fluorescent tube at low power levels. Many installations require 4-pin fluorescent lamps and compatible dimming ballasts for successful fluorescent dimming.

2.TYPE OF CIRCUIT BREAKER

2.1.Mccb

2.1.1.Application

The current limiting MCCB Superior series is suitable for circuit protection in individual enclosures, switchboards, lighting and power panels as well as motor-control centers. The MCCB is designed to protect systems against overload and short circuits up to 65kA with the full range of accessories.

2.1.2.Mechanism

The MCCB Superior series is designed to be trip-free. This applies when the breaker contacts open under overload and short circuit conditions and even if the breaker handle is held at the ON position. To eliminate single phasing, should an overload or short circuit occur on any one phase, a common trip mechanism will disconnect all phase contacts of a multipole breaker.

2.1.3.Material

The Superior series circuit breakers' housing is made of BMC material, which is unbreakable and has a very high dielectric strength, to ensure the highest level of insulation. The same material is also used to segregate the live parts in between the phases.

2.1.4.Accessories

To enhance the Superior series MCCB, internal and external modules can be fitted onto the breaker. They are as follows:

- shunt trip coil • undervoltage release
- auxiliary switch • alarm switch
- motorized switch • rotary handle
- plug-in kit (draw-out unit)
- auxiliary& alarm switch

2.1.5.The Technology of Tripping Devices

2.1.5.1.Mccb Arc Chamber

The MCCB arc chamber is specially designed with an arc channel as aflow guide to improve the capability of extinguishing the arc and reducing the arc distance.

Mounting screws are used to insert thread nuts in the MCCB base. Thecover can withstand high electromagnetic force during a short-circuit; this prevents the MCCB cover from tearing off. This is an improvement over self-taping screw of other models.

2.1.5.2.Fixed Contact

The MCCB fixed contact does not have any mounting screws near thecontact points. A steel screw can generate heat and the magnetic flux surrounding the conductor carrying the current can create a very high temperature. If a short-circuit occurs, it will cause the contact points to be welded or melted.

2.1.5.3.Materials

The base and cover of the MCCB are made of a specially formulated material, i.e. bold moulded compound (BMC). It has a high-impact thermal strength, fire resistant and capable of withstanding high electromagnetic forces that occur during a short-circuit. Majority MCCB manufacturers in the market use pheonolic compounds with less electrical and mechanical strength.

2.1.5.4.Repulsive Force

An electromagnetic repulsive force is where the force works between acurrent of the movable conductor and a current (I) in the reversed direction of the fixed conductor. This is an improvement of the electromagnetic force during breaking over other models.

2.1.5.5.Time-Delay Operation

Time-delay operation occurs when an overcurrent heats and warps the bimetal to actuate the trip bar.

2.1.5.6.Proper MCCB for Protection

It is very important to select and apply the right MCCB for a long lasting and rouble free operation in a power system. The right selection requires a detailed understanding of the complete system and other influencing factors. The factors for selecting a MCCB are as follows:

1) nominal current rating of the MCCB

2) fault current Icu, Ics

3)other accessories required

4) number of poles

2.1.5.7.Nominal Current

To determine the nominal current of a MCCB, it is dependent on the full load current rating of the load and the scope of load enhancement in future.

2.1.5.8.Fault Current Icu, Ics

It is essential to calculate precisely the fault current that the MCCB will have to clear for a healthy and trouble-free life of the system down stream. The level of fault current at a specific point in a power system depends on following factors:

a) transformer size in KVA and the impedance

b) type of supply system

c) the distance between the transformer and the fault location

d) size and material of conductors and devices in between the transformer and the fault location

2.2.Mcb(Miniature Circuit Breaker)

MCBs are miniature circuit breakers with optimum protection facilities of overcurrent only.These are manufactured for fault level of up to 10KA only with operating current range of 0.5 to 63 Amps (the ranges are fixed), single,double and three pole verson.These are used for smaller loads -electronic circuits,house wiring etc. MCCBs are Moulded case Circuit breakers,with protection facilities of overcurrent, earth fault.it has a variable range of 50% to 100% operating current.They can be wired for remote as well as local operation both.They are manufactured for fault levels of 16KA to 50KA and operating current range of 25A to 630Amps.They are used for aplication related with larger power flow requirement.

Figure 2.1. Mcb(Miniature Circuit Breaker)

2.3.RCD(ResidualCurrent Device)

A residual current device (RCD), or residual current circuit breaker (RCCB), is an electrical wiring device that disconnects a circuit whenever it detects that the electric current is not balanced between the phase ("hot") conductor and the neutral conductor. Such an imbalance is sometimes caused by current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit. A lethal shock can result from these conditions; RCDs are designed to disconnect quickly enough to mitigate the harm caused by such shocks.

Figure 2.2 RCD

2.4.Contactor

A contactor is an electrically controlled switch (relay) used for switching a power circuit. A contactor is activated by a control input which is a lower voltage / current than that which the contactor is switching. Contactors come in many forms with varying capacities and features. Unlike a circuit breaker a contactor is not intended to interrupt a short circuit current.

Contactors range from having a breaking current of several amps and 110 volts to thousands of amps and many kilovolts. The physical size of contactors ranges from a few inches to the size of a small car.

Contactors are used to control electric motors, lighting, heating, capacitor banks, and other electrical loads.

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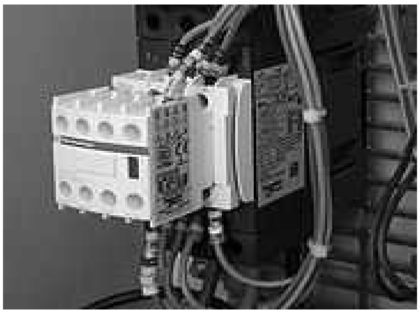


Figure 2.3

2.4.1.Construction

A contactor is composed of three different systems. The contact system is the current carrying part of the contactor. This includes Power Contacts, Auxiliary Contacts, and Contact Springs. The electromagnet system provides the driving force to close the contacts. The enclosure system is a frame housing the contact and the electromagnet. Enclosures are made of insulating materials like Bakelite, Nylon 6, and thermosetting plastics to protect and insulate the contacts and to provide some measure of protection against personnel touching the contacts. Open-frame contactors may have a further enclosure to protect against dust, oil, explosion hazards and weather.

Contactors used for starting electric motors are commonly fitted with overload protection to prevent damage to their loads. When an overload is detected the contactor is tripped, removing power downstream from the contactor.

Some contactors are motor driven rather than relay driven and high voltage contactors (greater than 1000 volts) often have arc suppression systems fitted (such as a vacuum or an inert gas surrounding the contacts).

Magnetic blowouts are sometimes used to increase the amount of current a contactor can successfully break. The magnetic field produced by the blowout coils force the electric arc to lengthen and move away from the contacts. The magnetic blowouts in the pictured Albright contactor more than double the current it can break from 600 Amps to 1500 Amps.

Sometimes an Economizer circuit is also installed to reduce the power required to keep a contactor closed. A somewhat greater amount of power is required to initially close a contactor than is required to keep it closed thereafter. Such a circuit can save a substantial amount of power and allow the energized coil to stay cooler. Economizer circuits are nearly always applied on direct-current contactor coils and on large alternating current contactor coils.

Contactors are often used to provide central control of large lighting installations, such as an office building or retail building. To reduce power consumption in the contactor coils, two coil latching contactors are used. One coil, momentarily energized, closes the power circuit contacts; the second opens the contacts.

A basic contactor will have a coil input (which may be driven by either an AC or DC supply depending on the contactor design) and generally a minimum of two poles which are controlled.

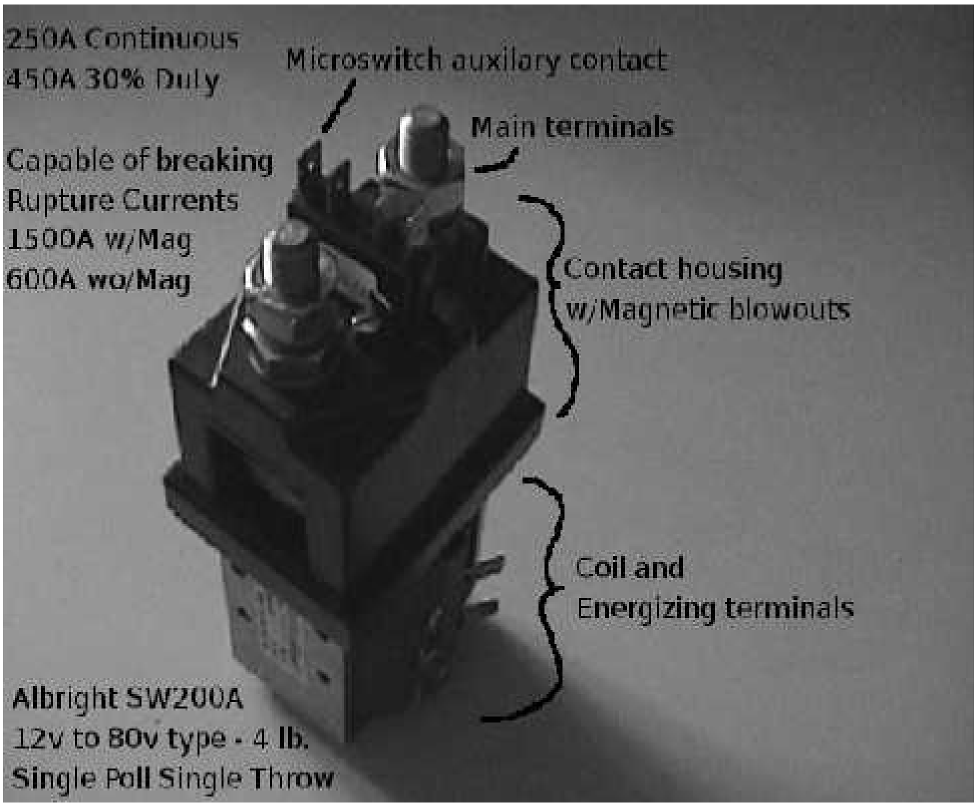


Figure 2.4 Construction

2.4.2.Operating Principle

Unlike general-purpose relays, contactors are designed to be directly connected to high-current load devices, not other control devices. Relays tend to be of much lower capacity and are usually designed for both Normally Closed and Normally Open applications. Devices switching more than 15 amperes or in circuits rated more than a few kilowatts are usually called contactors. Apart from optional auxiliary low current contacts, contactors are almost exclusively fitted with Normally Open contacts.

When current passes through the electromagnet, a magnetic field is produced which attracts ferrous objects, in this case the moving core of the contactor is attracted to the stationary core. Since there is an air gap initially, the electromagnet coil draws more current initially until the cores meet and reduct the gap, increasing the inductive impedance of the circuit.

For contactors energized with alternating current, a small part of the core is surrounded with a shading coil, which slightly delays the magnetic flux in the core. The effect is to average out the alternating pull of the magnetic field and so prevent the core from buzzing at twice line frequency.

Most motor control contactors at low voltages (600 volts and less) are "air break" contactors, since ordinary air surrounds the contacts and extinguishes the arc when interrupting the circuit. Modern medium-voltage motor controllers use vacuum contactors.

Motor control contactors can be fitted with short-circuit protection (fuses or circuit breakers), disconnecting means, overload relays and an enclosure to make a combination starter. In large industrial plants many contactors may be assembled in motor control centers.

2.4.3.Ratings

Contactors are rated by designed load current per contact (pole), maximum fault withstand current, duty cycle, voltage, and coil voltage. A general purpose motor control contactor may be suitable for heavy starting duty on large motors; so-called "definite purpose" contactors are carefully adapted to such applications as air-conditioning compressor motor starting. North American and European ratings for contactors follow different philosophies, with North American contactors generally emphasizing simplicity of application while European rating philosophy emphasizes design for the intended life cycle of the application. A contactor basically consists of two parts; signaling and actual.

A motor rated contactor (AC3) would be better than a relay (AC1) because of arc suppression design for inductive loads. Relays generally don't have arc suppression (arcing plates). That is what pitting on the contact surface is caused by. For arduous starting conditions, use AC4 ratings.

3.SWITCHES, SOCKETS AND BUTTONS

3.1. Switches

Different type of switches can use on the electrical equipment of apartment. Switches have to be made suitable to TS – 41

Switch is equipment that it can on and off the electrical energy of an electrical circuit. The current can not be lower from 10 Ampere for using by 250 V. Electric circuit.

Switches are in three (4) groups

1 – Single key

2 – Commutator

3 _ vaevien

4 – Button

3.1.1.Single Key

This switch can on and off a lamp or lamps only from one place. These switches are use usually in kitchen, toilets, room etc…

3.1.2.Commutator

This switch can on and off two different lamp or lamps from one place at the same time or different time.

These switches are used usually for a wall lamp, drawing room.

3.1.3.Vaevien

This switch can on and off a lamp or lamps of the same time from different place. These switches are used usually in the balcony which has two doors or in the kitchen which have two doors.

3.1.4.Well hole switches

These switches can on and off the lamp or lamps more than two (2) different place at the same time.

These switches are used at the stair.

3.2.Socket

Sockets are very important in our life because we need sockets in our home or in our work. To operate electrical devices sockets that we use have to be made to TS _ 40

Sockets are in two groups for a safety.

1 – Normal sockets

2 - Ground sockets

3.3.Buttons

Buttons are used for a door bell. When we push to the buttons then it is operate when we stop to the push button then it stops.

4.CONDUCTORS AND CABLES

4.1.Overview

A ‘conductor’ in electrical work means a material which will allow the free passage of an electric current along it and which presents very little resistance to the current. If the conducting material has an extremely low resistance (for instance a copper conductor) there will be only a slight warming effect when the conductor carries a current. If the conductor material has a significant resistance (for instance, iron wire) then the conductor will slow the effects of the electric current passing through it, usually in the form of an appreciable rise in temperature to produce a heating effect.

A ‘cable’ is defined as a length of insulated conductor (solid or stranded), or of two or more such conductors, each provided with its own insulation, which are laid up together. The conductor, so far as a cable is concerned, is the conducting portion, consisting of a single wire or of a group of wires in contact with each other.

The practical electrician will meet two common conductor materials
Extensively in his work: copper and aluminium.

As a conductor of electricity, copper has been used since the early days of the electrical industry because it has so many good properties. It can cope with onerous conditions. It has a high resistance to atmospheric corrosion. It can be jointed without any special provision to prevent electrolytic action. It is tough, slow to tarnish, and is easily worked. For purposes of electrical conductivity, copper is made with a very high degree of purity (at least 99.9 per cent). In this condition it is only slightly inferior to silver.

Aluminium is now being used in cables at an increasing rate. Although reduced cost is the main incentive to use aluminium in most applications, certain other advantages are claimed for this metal. For instance, because aluminium is pliable, it has been used in solid-core cables. Aluminium was under as a conductor material for overhead lines about seventy years ago, and in an insulated form for buried cables at the turn of the century. The popularity of aluminium increased rapidly just after the Second World War, and has now a definite place in electrical work of all kinds.

4.2.Conductors

Conductors as found in electrical work are most commonly in the form of wire or bars and roods. There are other variations, of course, such as machined sections for particular electrical devices (e.g. contactor contacts). Generally, wire has a flexible property and is used in cables. Bars and rods, being more rigid, are used as busbars and earth electrodes. In special form, aluminium is used for solid-core cables

Wire for electrical cables is made from wire-bars. Each bar is heated and passed through a series of grooved rollers until it finally emerges in the form of a round rod. The rod is then passed through a series of lubricated dies until the final diameter of wire is obtained. Wires of the sizes generally used for cables are hard in temper when drawn and so are annealed at various stages during the transition from wire-bar to small-diameter wire. Annealing involves placing coils of the wire in furnaces for a period until the metal becomes soft or ductile again.

Copper wires are often tinned. This process was first used in order to prevent the deterioration of the rubber insulation used on the early cables. Tin is normally applied by passing the copper wire through a bath containing molten tin. With the increasing use of plastic materials for cable insulation there was a tendency to use untinned wires. But now many manufacturers tin the wires as an aid in soldering operations.

Untinned copper wires are, however, quite common. Aluminium wires need no further process after the final drawing and annealing.

All copper cables and some aluminium cables have conductors which are made up from a number of wires.

These conductors are two basic types:

- stranded
- Bunched.

The latter type is used mainly for the smaller sizes of flexible cable and cord.

The solid-core conductor (in the small sizes) is merely one single wire.

Most stranded conductors are built up on a single central conductor. Surrounding this conductor are layers of wires in a numerical progression of 6 in the first layer, 12 in the second layer, 18 in the third layer and so on. The number of wires contained in most common conductors is to be found in the progression 7, 19, 37, 61, 127.

Stranded conductors containing more than one layer of wires are made in such a way that the direction of lay of the wires in each layer is of the reverse hand to those of adjacent layers. The flexibility of these layered conductors is good in the smaller sizes (E.g. 61/2.25 mm).

When the maximum amount of flexibility is required the ‘bunching’ method is used. The essential difference of this method from ‘stranding’ is that all the wires forming the conductor are given the same direction of lay. A further improvement in flexibility is obtained by the use of small-diameter wires, instead of the heavier gauges as used in stranded cables.

When more than one core is to be enclosed within a single sheath, oval and sector-shaped conductors are often used.

It is of interest to note that when working out the dc resistance of stranded conductors, allowance must be made for the fact that, apart from the central wire, the individual strands in a stranded conductor follow a helical path – and so are slightly longer than the cable itself. The average figure is 2 per cent. This means that if a stranded conductor is 100 m long, only the centre strand is this length. The other wires surrounding it will be anything up to 106 m in length.

Because aluminium is very malleable, many of the heavier cables using this material as the conductor have solid cores, rather than stranded. A saving in cost is claimed for the solid-core aluminium conductor cable.

Conductors for overhead lines are often strengthened by a central steel core which takes the weight of the copper conductors between the poles or pylons. Copper and aluminium are used for overhead lines.

Conductor sizes are indicated by their cross sectional area (csa). Smaller sizes tend to be single strand conductors; larger sizes are stranded. Cable sizes are standardized, starting at 1 mm^2, and then increasing to 1.5, 2.5, 4, 6, 10, 16, 25 and 35 mm^2. As cable sizes increases in csa the gaps between them also increase. The large sizes of armoured mains cable from 25 mm^2 tend to have shaped stranded conductors.

4.3.Cables

The range of types of cables used in electrical work is very wide: from heavy lead-sheathed and armoured paper-insulated cables to the domestic flexible cable used to connect a hair-drier to the supply. Lead, tough-rubber, PVC and other types of sheathed cables used for domestic and industrial wiring are generally placed under the heading of power cables. There are, however, other insulated copper conductors (they are sometimes aluminium) which, though by definition are termed cables, are sometimes not regarded as such. Into this category fall those rubber and PVC insulated conductors drawn into some form of conduit or trunking for domestic and factory wiring, and similar conductors employed for the wiring of electrical equipment. In addition, there are the various types of insulated flexible conductors including those used for portable appliances and pendant fittings.

The main group of cables is ‘ flexible cables ’ , so termed to indicate that they consist of one or more cores, each containing a group of wires, the diameters of the wires and the construction of the cables being such that they afford flexibility.

Single-core

These are natural or tinned copper wires. The insulating materials include butyl-rubber (known also as 85 °C rubber insulated cables), silicone-rubber (150 °C, EP-rubber) (Ethylene propylene), and the more familiar PVC. The synthetic rubbers are provided with braiding and are self-coloured. The IEE Regulations recognize these insulating materials for twin-and multi-core flexible cables rather than for use as single conductors in conduit or trunking wiring systems. But they are available from cable manufacturers for specific installation requirements. Sizes vary from 1.00 to 36 mm^2 (PVC) and 50 mm^2 (synthetic rubbers).

Two-core

Two –core or ‘twin’ cables are flat or circular. The insulation and sheathing materials are those used for single-core cables. The circular cables require cotton filler threads to gain the circular shape. Flat cables have their two cores laid side by side.

Three-core

These cables are the same in all respects to single and two-core cables except, of course, they carry three cores.

Composite Cables

Composite cables are those which, in addition to carrying the current-carrying circuit conductors, also contain a circuit-protective conductor.

To summarize, the following groups of cable types and applications are to be found in electrical work, and the electrician, at one time or another during his career, may be asked top install them.

Wiring Cables

Switchboard wiring; domestic and workshop flexible cables and cords. Mainly copper conductors.

Power Cables

Heavy cables, generally lead-sheathed and armoured; control cables for electrical equipment. Both copper and aluminium conductors.

Mining Cables

in this field cables are used for trailing cables to supply equipment; shot-firing cables; roadway lighting; lift-shaft wiring; signalling, telephone and control cables. Adequate protection and fireproofing are features of cables for this application field.

Ship-Wiring Cables

These cables are generally lead-sheathed and armoured, and mineral-insulated, metal-sheathed. Cable must comply with Lloyd’s Rules and Regulations, and with Admiralty requirements.

Overhead Cables

Bare, lightly-insulated and insulated conductors of copper, copper-cadmium and aluminium generally, sometimes with steel core for added strength. For overhead distribution cables are PVC and in most cases comply with British Telecom requirements

Communications Cables

This group includes television down-leads and radio-relay cables; radio frequency cables; telephone cables.

Welding Cables

These are flexible cables and heavy cords with either copper or aluminium conductors.

Electric-sign Cables

PVC and rubber insulated cables for high-voltage discharge lamps (neon, etc.).

Equipment Wires

Special wires for use with instruments often insulated with special materials such as silicone, rubber and irradiated polythene.

Appliance-wiring Cables

This group includes high-temperature cables for electric radiators, cookers and so on. Insulation used includes nylon, asbestos and varnished cambric.

Heating Cables

Cables for floor-warming, road-heating, soil-warming, ceiling-heating and similar applications.

Flexible Cords

A flexible cord is defined as a flexible cable in which the csa of each conductor does not exceed 4 mm^2. The most common types of flexible cords are used in domestic and light industrial work. The diameter of each strand or wire varies from 0.21 to 0.31 mm. Flexible cords come in many sizes and types; for convenience they are grouped as follows:

Twin-twisted

These consist of two single insulated stranded conductors twisted together to form a two-core cable. Insulation used is vulcanised rubber and PVC. Colour identification in red and black is often provided. The rubber is protected by a braiding of cotton, glazed-cotton, rayon-braiding and artificial silk. The PVC insulated conductors are not provided with additional protection.

Three-core (twisted)

Generally as twin-twisted cords but with a third conductor coloured green, for earthing lighting fittings.

Twin-circular

This flexible cord consist of two conductors twisted together with cotton filler threads, coloured brown and blue, and enclosed within a protective braiding of cotton or nylon. For industrial applications, the protection is though rubber or PVC.

Three-core (circular)

Generally as twin-core circular expect that the third conductor is coloured green and yellow for earthing purposes.

Four-core (circular)

Generally as twin-core circular. Colours are brown and blue.

Parallel-twin

These are two stranded conductors laid together in parallel and insulated to form a uniform cable with rubber or PVC

Twin-core (flat)

This consists of two stranded conductors insulated with rubber, coloured red and black, laid side and braided with artificial silk.

Flexible Cables

These cables are made with stranded conductors, the diameters being 0.3, 0.4, 0.5 and 0.6 mm. They are generally used for trailing cables and similar applications where heavy currents up to 630 an are to be carried, for instance, to welding plant.

5.EARTHING

5.1.Overview

The purpose of earthing is to ensure that no person operating an electrical installation can receive an electric shock which could cause injury or a fatality. In simple terms, ‘ earthing ’ involves the connection of all metalwork associated with the electrical installation with protective conductors (CPCs) which are terminated at a common point, the main earth terminal. This terminal is further connected to a proven earth connection which can be the supply authority’s wire-armoured supply cable, an over head line conductor or an earth electrode driven directly into the soil. The availability of one or other of these connections depends on the type of electrical system used to supply electricity.

Apart from the ‘ exposed conductive parts ’ found in an installation, there is other metalwork which has nothing to do with the electrical installation but which could become live in the event of a fault to earth. This metalwork is known as ‘extraneous conductive parts’ and includes hot and cold water pipes, radiators, structural steelwork, metal-topped sink units and metallic ducting used for ventilation. These parts are connected by means of,

(a) Main bonding conductors and (b) supplementary bonding conductors. The former are used to bond together metallic services at their point of entry into a building. The latter are used to bond together metallic pipes and the like within the installation. These bonding conductors are also taken to the installation’s main earth terminal. Thus all metalwork in a building is at earth potential.

Once all CPCs and bounding conductors are taken to the main earth terminal, the building is known as an ‘equipotential zone’ and acts as a kind of safety cage in which persons can be reasonably assured of being safe from serious electric shock. Any electrical equipment taken outside the equipotential zone, such as an electric lawnmower, must be fed from a socket-outlet which incorporates a residual current device (RCD). The word ‘equipotential’ simply means that every single piece of metal in the building is at earth potential.

The earthing of all metalwork does not complete the protection against electric shock offered to the consumer. Overcurrent devices are required to operate within either 0.5 second or 4 second if a fault to earth occurs. And the use of RCDs also offers further protection in situations when an earth fault may not produce sufficient current to operate overcurrent protective devices.

Even before the days of electricity supply on a commercial scale, the soil has been used as a conductor for electrical currents. In early telegraphy systems the earth was used as a return conductor. The early scientists discovered that charges of electricity could be dissipated by connecting a charged body to general mass of earth by using suitable electrodes, of which the earliest form was a metal plate (the earth plate). But the earth has many failings as a conductor. This is because the resistance of soils varies with their composition. When completely dry, most soils and rocks are non-conductors of electricity. The exceptions to this are, of course, where metallic minerals are present to form conducting paths. Sands, loams and rocks can therefore be regarded as non-conductors; but when water or moisture is present; their resistivity drops to such a low value that they become conductors though very poor ones. This means that the resistivity drops to such a low poor ones. This means that the resistivity of a soil is determined by the quantity of water present in it and on the resistivity of the water itself. It also means that conduction through the soil is in effect conduction through the water, and so is of an electrolytic nature.

For all that the earth is an inefficient conductor; it is widely used in electrical work. There are three main functions of earthing:

- To maintain the potential of any part of a system at a definite value respect to earth.
- To allow current to flow to earth in the event of fault, so that the protective gear will operate to isolate the faulty circuit.
- To make sure that, in the event of a fault, apparatus normally 'dead' cannot reach a dangerous potential with respect to earth.

IEE Regulation 130 – 04 states that where metalwork, other than current-carrying conductors, is liable to become charged with electricity in such a manner as to create a danger if the insulation of a conductor should become defective, or if a defect should occur in any apparatus (I) the metalwork shall be earthed in such a manner as will ensure immediate electrical discharge without danger.

The basic reason for earthing is to prevent or to minimize the risk of shock to human beings. If an earth fault occurs in an installation it means that a live conductor has come into contact with metal-work to cause the metalwork to become live that is, to reach the same potential or voltage as the live conductor. Any person touching the metalwork, and who is standing on a non insulating floor, will receive an electric shock as the result of the current flowing through the body to earth. If however, the metalwork is connected to the general mass of earth through a low resistance path, the circuit now becomes a parallel branch circuit with:

A. the human body as one branch with a resistance of, say, 10 000 ohms; and

B. the CPC fault path as the other branch with a resistance of 1 ohm or less.

The result of properly earthed metalwork is that by far the greater proportion of fault-current will flow through the low-resistance path, so limiting the amount of current is really heavy (as in a direct short circuit) then a fuse will blow or a protective device will operate. However an earth fault current may flow with a value not sufficient to blow a fuse yet more than enough to cause over heating at say, a loose connection to start a fire.

6.VOLTAGE DROP

6.1.Overview

Voltage drop is the reduction in voltage in an electrical circuit between the source and load. In electrical wiring national and local electrical codes may set guidelines for maximum voltage drop allowed in a circuit, to ensure reasonable efficiency of distribution and proper operation of electrical equipment (the maximum permitted voltage drop varies from one country to another)

Voltage drop may be neglected when the impedance of the interconnecting conductors is small relative to the other components of the circuit.

For example, an electric space heater may very well have a resistance of ten ohms, and the wires which supply it may have a resistance of 0.2 ohms, about 2% of the total circuit resistance. This means that 2% of the supplied voltage is actually being lost by the wire itself.

Excessive voltage drop will result in unsatisfactory operation of electrical equipment, and represents energy wasted in the wiring system. Voltage drop can also cause damage to electrical motors.

In electronic design and power transmission, various techniques are used to compensate for the effect of voltage drop on long circuits or where voltage levels must be accurately maintained. The simplest way to reduce voltage drop is to increase the diameter of the cable between the source and the load which lowers the overall resistance.

6.2.Voltage Drop in Direct Current Circuits

A current flowing through the non-zero resistance of a practical conductor necessarily produces a voltage across that conductor. The dc resistance of the conductor depends upon the conductor's length, cross-sectional area, type of material, and temperature.The local voltages along the long line decrease gradually from the source to the load

If the voltage between the conductor and a fixed reference point is measured at many points along the conductor, the measured voltage will decrease gradually toward the load. As the current passes through a longer and longer conductor, more and more of the voltage is "lost" (unavailable to the load), due to the voltage drop developed across the resistance of the conductor. In this diagram the voltage drop along the conductor is represented by the shaded area.

6.3.Voltage Drop in Alternating Current Circuits

In alternating current circuits, additional opposition to current flow occurs due to the interaction between electric and magnetic fields and the current within the conductor; this opposition is called "impedance". The impedance in an alternating current circuit depends on the spacing and dimensions of the conductors, the frequency of the current, and the magnetic permeability of the conductor and its surroundings. The voltage drop in an AC circuit is the product of the current and the impedance (Z) of the circuit. Electrical impedance, like resistance, is expressed in ohms. Electrical impedance is the vector sum of electrical resistance, capacitive reactance, and inductive reactance. The voltage drop occurring in an alternating current circuit is the product of the current and impedance of the circuit. It is expressed by the formula $E = IZ$, analogous to Ohm's law for direct current circuits.

6.4.Voltage Drop in Household Wiring

The majority of circuits wired within a residential building usually are not long enough or high current enough to make voltage drop a factor in selection of wiring. However this is a necessary factor in cable choice in a percentage of cases. In the case of very long circuits, for example, connecting a home to a separate building on the same property, it is often necessary to increase the size of conductors over the minimum requirement for the circuit current rating. It is also normal for a percentage of UK domestic circuits to require cable size increase to meet voltage drop specs in the UK wiring regulations.

Some wiring codes or regulations set an upper limit to the allowable voltage drop in a branch circuit. In the United States, the 2005 National Electrical Code (NEC) recommends no more than a 5% voltage drop for residential applications at the outlet. UK regulations limit voltage drop to 4% of supply voltage.

Voltage drop of a branch circuit is readily calculated, or less accurately it can be measured by observing the voltage before and after applying a load to the circuit. Excessive voltage drop on a residential branch circuit may be a sign of insufficientlysized wiring or of other faults within the wiring system, such as high resistance connections.

7-POWER FACTOR CORRECTION

7.1.Overview

Power factor correction (PFC) is the process of adjusting the characteristics of electric loads that create a power factor that is less than 1. Power factor correction may be applied either by an electrical power transmission utility to improve the stability and efficiency of the transmission network; or, correction may be installed by individual electrical customers to reduce the costs charged to them by their electricity supplier. A high power factor is generally desirable in a transmission system to reduce transmission losses and improve voltage regulation at the load.

7.2.Linear Loads

Electrical loads consuming alternating current power consume both real power, which does useful work, and reactive power, which dissipates no energy in the load and which returns to the source on each alternating current cycle. The vector sum of real and reactive power is the apparent power. The ratio of real power to apparent power is the power factor, a number between 0 and 1 inclusive. The presence of reactive power causes the real power to be less than the apparent power, and so, the electric load has a power factor of less than 1.

The reactive power increases the current flowing between the power source and the load, which increases the power losses through transmission and distribution lines. This results in additional costs for power companies. Therefore, power companies require their customers, especially those with large loads, to maintain their power factors above a specified amount (usually 0.90 or higher) or be subject to additional charges. Electricity utilities measure reactive power used by high demand customers and charge higher rates accordingly. Some consumers install power factor correction schemes at their factories to cut down on these higher costs.

Electrical engineers involved with the generation, transmission, distribution and consumption of electrical power have an interest in the power factor of loads because power factors affect efficiencies and costs for both the electrical power industry and the consumers. In addition to the increased operating costs, reactive power can require the use of wiring, switches, circuit breakers, transformers and transmission lines with higher current capacities.

Power factor correction brings the power factor of an AC power circuit closer to 1 by supplying reactive power of opposite sign, adding capacitors or inductors which act to cancel the inductive or capacitive effects of the load, respectively. For example, the inductive effect of motor loads may be offset by locally connected capacitors. Sometimes, when the power factor is leading due to capacitive loading, inductors (also known as reactors in this context) are used to correct the power factor. In the electricity industry, inductors are said to consume reactive power and capacitors are said to supply it, even though the reactive power is actually just moving back and forth between each AC cycle.

7.3.Non-linear Loads

Non-linear loads create harmonic currents in addition to the original AC current. Addition of linear components such as capacitors and inductors cannot cancel these harmonic currents, so other methods such as filters or active power factor correction are required to smooth out their current demand over each cycle of alternating current and so reduce the generated harmonic currents.

7.4.Switched-mode power supplies

A typical switched-mode power supply first makes a DC bus, using a bridge rectifier or similar circuit. The output voltage is then derived from this DC bus. The problem with this is that the rectifier is a non-linear device, so the input current is highly non-linear. That means that the input current has energy at harmonics of the frequency of the voltage.

This presents a particular problem for the power companies, because they cannot compensate for the harmonic current by adding simple capacitors or inductors, as they could for the reactive power drawn by a linear load. Many jurisdictions are beginning to legally require power factor correction for all power supplies above a certain power level.

The simplest way to control the harmonic current is to use a filter: it is possible to design a filter that passes current only at line frequency (e.g. 50 or 60 Hz). This filter reduces the harmonic current, which means that the non-linear device now looks like a linear load. At this point the power factor can be brought to near unity, using capacitors or inductors as required. This filter requires large-value high-current inductors, however, which are bulky and expensive.

It is also possible to perform active PFC. In this case, a boost converter is inserted between the bridge rectifier and the main input capacitors. The boost converter attempts to maintain a constant DC bus voltage on its output while drawing a current that is always in phase with and at the same frequency as the line voltage. Another switchmode converter inside the power supply produces the desired output voltage from the DC bus. This approach requires additional semiconductor switches and control electronics, but permits cheaper and smaller passive components. It is frequently used in practice. Due to their very wide input voltage range, many power supplies with active PFC can automatically adjust to operate on AC power from about 100 V (Japan) to 240 V (UK). That feature is particularly welcome in power supplies for laptops and cell phones.

7.5.Passive PFC

This is a simple way of correcting the nonlinearity of a load by using capacitor banks. It is not as effective as active PFC. Switching the capacitors into or out of the circuit causes harmonics, which is why active PFC or a synchronous motor is preferred.

7.6. Active PFC

An Active Power Factor Corrector (active PFC) is a power electronic system that controls the amount of power drawn by a load in order to obtain a Power factor as close as possible to unity. In most applications, the active PFC controls the input current of the load so that the current waveform is proportional to the mains voltage waveform (a sinewave).

Some types of active PFC are

1. Boost
2. Buck
3. Buck-boost

Active power factor correctors can be single-stage or multi-stage.

Active PFC is the most effective and can produce a PFC of 0.99 (99%).

8.DISTRIBUTION BOARD

8.1.Overview

A distribution board divides the electrical mains feed into various circuits, providing a fuse or circuit breaker for each circuit. They usually include a main switch, and often one or more Residual-current devices (RCD) or Residual Current Breakers with Overcurrent protection (RCBO).

Other Names

Distribution boards are also known as

- breaker panel
- fuse box
- fuse board
- circuit breaker panel
- consumer unit, or CU
- panelboard
- load center

8.2.Breaker arrangement

Breakers are usually arranged in two columns. In a US-style board, breaker positions are numbered left-to-right, along each row from top to bottom. For 120/240 volts, hot wires (that which are live) are black and red (blue is used as the third leg of three-phase power [208Y/120 volts]) and white for neutral. For 480Y/277 volts (always three-phase) the hot wires are brown, orange and yellow and grey is the neutral. Green or bare wires are used as grounds in both configurations. The 208Y/120 volt and 480Y/277 volt systems are both wye systems. All three phases in these systems measure either 120 or 277 volts to the neutral and 208 or 480 volts to each other. Another common system seen in older buildings is the 240D/120 center tap delta system. In this system, two phases (phase A and phase C) measure 120 volts to the neutral. Phase B in this system is a high leg aka a "stinger" leg that measures 208 volts to the neutral. Every second and fifth slot in a panel fed with this system connects with the stinger leg and must not be used to supply 120 volt single phase loads. However the stinger can be used as part of a 240 volt single or three phase circuit. Most buildings with 240D/120 service don't feed all three phases into the lighting/small appliance panel. The two 120 volt to neutral phases are split out of the main supply entrance and feed a 120/240 single phase lighting/small appliance panel. The three phase in this system is only used for air conditioning and other large motor loads. Almost all new buildings with three-phase service use the 208Y/120 volt system thus eliminating the stinger leg problem.

Illustration of breaker numbering in a North American type panelboard. Some labels are missing, and some lines have additional descriptive labels. The numbers on the toggles indicate the ampereage they will pass before tripping off and stopping all current. The top right breaker (Rated at 100 A) leads to a sub panel.

These breakers cycle through two or three phases, labelled as A, B, and C in the above diagram. This numbering system is universal across various competing manufacturers of breaker panels.

In a UK-style board, breaker positions are numbered top to bottom in the left hand column, then top to bottom in the right column. Each number is used to label one position on each phase, as below. It remains to be seen how the new wiring colours recently introduced in the UK will affect this labelling.

In both labelling styles the reason for the alternating pattern of phases is to allow for common trip breakers to have one pole on each phase.

In North America it is common to wire large heating equipment line-to-line. This takes two slots in the panel (two-pole) and gives a voltage of 240V if the supply system is split phase and 208 V if the supply system is three phase. This practice is much less common in countries that use a higher line-neutral voltage. Large motors, air conditioners, subpanels, etc., are typically three-phase (where available). Therefore a three-pole breaker is needed which takes three slots in the breaker panel.

A line can be seen directly exiting the box and running to a NEMA 5-15 electrical receptacle with something plugged into it.

8.3.Inside a UK distribution board

The three incoming phase wires connect to the busbars via an isolator switch in the centre of the panel. On each side of the panel are two busbars, for neutral and earth. The incoming neutral connects to the lower busbar on the right side of the panel, which is in turn connected to the neutral busbar at the top left. The incoming earth wire connects to the lower busbar on the left side of the panel, which is in turn connected to the earth busbar at the top right. The cover has been removed from the lower-right neutral bar; the neutral bar on the left side has its cover in place.

Down the left side of the phase busbars are two two-pole RCBOs and two single-pole breakers, one unused. Down the right side of the busbars are a single-pole breaker, a two-pole RCBO and a three-pole breaker.

The two-pole RCBOs in the picture are not connected across two phases, but have supply-side neutral connections exiting behind the phase busbars.

It is likely that the manufacturer produces 18- and 24-position versions of this panel using the same chassis which explains why there appears to be so much unused space.

8.4.Manufacturer differences

Most of the time, the panel and the breakers inserted into it must both be from the same company. Each company has one or more "systems", or kinds of breaker panels, that only accept breakers of that type. In Europe this is still the case, despite the adoption of a standard rail for mounting and a standard cut-out shape, as the positions of the busbar connections are not standardised.

It is commonly known in North America that Siemens and General Electric panels and breakers of the type shown in the above and below picture illustrations are seemingly interchangeable one-inch wide breakers. However, an installer must be cautious and abide by all equivalent regulations, as well as any state, federal, or local codes, when modifying systems or installing new overcurrent devices. A given manufacturer will often specify exactly what devices are permitted to be installed in their equipment. This is because these assemblies have been tested and approved for use by a recognized authority. Replacing or adding equipment which "just happens to fit" can result in unexpected or even dangerous conditions. Such installations should not be done without first consulting knowledgeable sources, including manufacturers.

Numerous older systems are still in use in older buildings and parts are still manufactured for these legacy applications, such as Zinsco and others.

8.5.Location and designation

For reasons of aesthetics and security, circuit breaker panels are often placed in out-of-the-way closets, attics, garages, or basements, but sometimes they are also featured as part of the aesthetic elements of a building (as an art installation, for example) or where they can be easily accessed. However, current US building codes prohibit installing a panel in a bathroom (or similar room), in closets intended for clothing, or where there is insufficient space for a worker to access it. Specific situations, such as an installation outdoors, in a hazardous environment, or in other out-of-the-ordinary locations may require specialized equipment and more stringent installation practices.

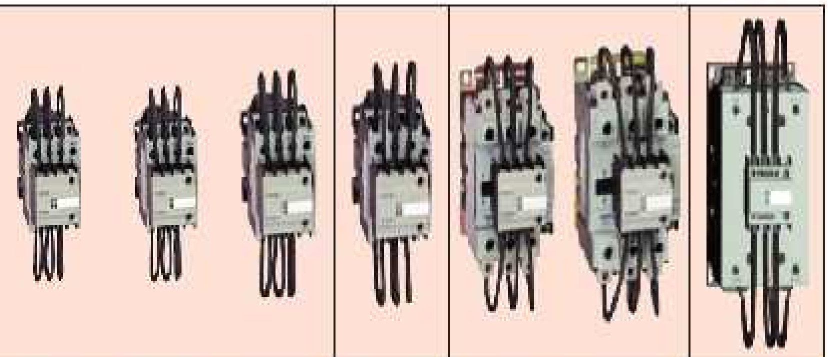
In large buildings or facilities with higher electric power demand may have multiple circuit breaker panels. In this case, the panels are often indicated by letters of the alphabet. One case is The Decon Gallery, a modern building in downtown Toronto, which has 11 breaker panels designated "A", "B", "C", "D", and so on. A backstage outlet is therefore labeled "C27". In many such buildings, each outlet is on its own circuit breaker, and the outlets are labelled in the above specified manner to facilitate easy location of which breaker to shut off for servicing, rewiring, or the like.

In even larger buildings, such as schools, hospitals and sports/entertainment venues it is not uncommon to have scores of panels, specially designated for each building depending on how the architects and electrical engineers sub divide the building. They are commonly designated as either three-phase or single-phase and normal power or emergency power. In these set-ups they may also be designated for their use, such as distribution panels for supplying other panels, lighting panels for lights, power panels for equipment and receptacles and special uses for whatever type of building they are used in. It is also not uncommon for these panels to be located throughout the building in electric closets serving a section of the building.

In a theatre a specialty panel called a dimmer rack is used to feed stage lighting instruments. Instead of just circuit breakers, the rack has a solid state electronic dimmer with its own circuit breaker for each stage circuit. This is known as a dimmer-per-circuit arrangement. The dimmers are equally divided across the three incoming phases. In a 96 dimmer rack, there are 32 dimmers on phase A, 32 dimmers on phase B, and 32 on phase C to spread out the lighting load as equally as possible. In addition to the power feed from the supply transformer in the building, a control cable from the lighting desk carries information to the dimmers in a control protocol such as DMX-512.

Distribution boards may be surface-mounted on a wall or may be sunk in to the wall. The former arrangement allows for easier alteration or addition to wiring at a later date, but the latter arrangement may look neater, particularly in a residential situation. The other problem with recessing a distribution board into a wall is that if the wall is solid a lot of brick or block may need to be removed - for this reason recessed boards are generally only fitted on new-build projects when the required space can be built in to the wall

COMPENSATION CONTUCTORS
TS 3629
IEC 60947-4-1
TS EN 60947-4-1



TYPE OF CONTUCTOR		FC12DK	FC18DK	FC25DK	FC32DK	FC65DK	FC95DK	FC150DK
Usage class	A	8	15	23	29	43	72	101
Saturation current (Ith)		25	32	40	50	80	125	200
Crossectional connection area (mm^2)		4	6	10	10	25	50	95
Saturated conductor power (kVAr)	220/240 V	3	6	7	10	15	30	40
	380/415 V	5	10	15	20	30	50	70
Saturented isolator voltage V		690	690	690	690	690	690	690
Saturated resist current kV		8	8	8	8	8	8	8
Electrical life time (open - close)		200.000	200.000	200.000	200.000	200.000	200.000	200.000
No. of assistant conductors		1NA + 1NK	1NA + 1NK	1NA + 1NK	1NA + 1NK	2NA + 1NK	2NA + 1NK	1NA veya 1NK
Weight	kg	0.39	0.40	0,58	0.60	1,36	1,58	2,65

Figure 8.1-Table of Contuctors

Table 1 Cable cross-sections

CORES AND CROSS-SECTIONAL AREA	THICKNESS OF CORE INSULATION	THICKNESS OF BEDDING		STEEL WIRE ARMOUR	THICKNESS OF OVERSHEATH	OUTER DIAMETER APPROX	RESISTANCE		CURRENT CAPACITY IN AIR AT 20° C	CABLE WEIGHT APPROX.
		EXTRUDED	LAPPED	WIRE DIAMETER			DC AT 20° C	REACTANCE		
mm^2	mm	mm	mm	mm	mm	mm	Ohm/km	Ohm/km	A	kg/km
2 x 1.5 *	0.8	0.8	-	0.9	1.3	12.5	12.10	0.105	23	340
2 x 2.5 *	0.7	0.8	-	0.9	1.4	14.0	7.280	0.101	30	420
2 x 4 **	0.8	0.8	-	0.9	1.4	16.0	4.610	0.097	41	550
2 x 6 **	0.8	0.8	-	0.9	1.5	17.0	3.080	0.091	53	650
2 x 10 **	1.0	0.8	-	1.25	1.3	20.5	1.830	0.089	74	890
2 x 16 **	1.0	0.8	0.3	1.25	1.3	22.0	1.150	0.080	120	1 080
2 x 25 **	1.2	1.0	0.3	1.6	1.7	23.5	0.727	0.079	160	1 610
2 x 35 **	1.2	1.0	0.3	1.6	1.3	27.5	0.524	0.077	200	1 970
2 x 50 **	1.4	1.0	0.3	1.6	1.9	32.0	0.387	0.076	240	2 480
3 x 1.5 *	0.8	0.8	0.3	0.9	1.4	12.3	12.10	0.105	23	310
3 x 2.5 *	0.7	0.8	0.3	0.9	1.4	13.6	7.280	0.101	30	390
3 x 4 **	0.8	0.8	0.3	0.9	1.4	15.8	4.610	0.097	41	520
3 x 6 **	0.8	0.8	0.3	1.25	1.5	18.0	3.080	0.091	53	730
3 x 10 **	1.0	0.8	0.3	1.25	1.3	21.0	1.830	0.089	74	1 010
3 x 16 **	1.0	0.8	0.3	1.25	1.3	24.0	1.150	0.080	105	1 280
3 x 25 **	1.2	1.0	0.3	1.6	1.7	29.0	0.727	0.079	140	1 820
3 x 35 ***	1.2	1.0	0.3	1.6	1.3	27.5	0.524	0.077	170	2 050
3 x 50	1.4	1.0	0.3	1.6	1.9	30.5	0.387	0.076	205	2 580
3 x 70	1.4	1.2	0.3	2.0	2.0	35.0	0.268	0.075	260	3 590
3 x 95	1.6	1.2	0.3	2.0	2.1	39.5	0.193	0.073	320	4 710
3 x 120	1.6	1.2	0.3	2.0	2.2	42.0	0.153	0.073	370	5 590
3 x 150	1.8	1.4	0.3	2.5	2.4	47.5	0.124	0.073	430	7 110
4 x 1.5 *	0.8	0.8	-	0.9	1.4	13.0	12.10	0.105	23	350
4 x 2.5 *	0.7	0.8	-	0.9	1.4	14.5	7.280	0.101	30	440
4 x 4 **	0.8	0.8	-	1.25	1.5	17.8	4.610	0.097	41	710
4 x 6 **	0.8	0.8	-	1.25	1.5	19.0	3.080	0.091	53	850
4 x 10 **	1.0	0.8	-	1.25	1.3	23.0	1.330	0.089	74	1 200
4 x 16 **	1.0	0.8	0.3	1.6	1.7	23.5	1.150	0.080	105	1 610
4 x 25 **	1.2	1.0	0.3	1.6	1.3	31.5	0.727	0.079	140	2 440
4 x 35 ***	1.2	1.0	0.3	1.6	1.9	30.5	0.524	0.077	170	2 530
4 x 50	1.4	1.0	0.3	2.0	2.0	35.5	0.387	0.076	205	3 480
4 x 70	1.4	1.2	0.3	2.0	2.1	39.0	0.268	0.075	260	4 470
4 x 95	1.6	1.2	0.3	2.0	2.2	44.5	0.193	0.073	320	5 900
4 x 120	1.6	1.2	0.3	2.0	2.4	49.5	0.153	0.073	370	7 540
4 x 150	1.6	1.4	0.3	2.5	2.5	53.5	0.124	0.073	430	8 970

CALCULATIONS

Table 2 Illumination Calculations

$$H = h_1 - (h_2 + h_3)$$
h_1 =Hight of room h_2 =Hight of work plane h_3 =Hanging distance of armature
$$K = \frac{A \times B}{(A+B) \times H}$$
A =Width of the room B = Length of the room
$$\phi t = \frac{E_o \times S}{M \times \eta}$$
ϕt =Total light flux E_o = Average illumination level (standard) S = Area of the surface M = Dirty factor η =Multiplication factor(usage factor)
$$N = \frac{\phi_T}{\phi_A \times Z}$$
N =Number of armature ϕ_A =Flux of the lamp Z = Number of lamp in the armature

CONCLUSION

In this project symbols and calculations are according to electrical standarts of Turkey.At our project the best installation techniques was considered and we increase the security level at every section of project and we do not consider about economy.Electrical installation project, carry big responsibilities.We have to be very carefull in calculation and while choosing the MCCBs,RCDs,Contactors,MCBs, sockets and cables for protection requirement of human,circuits and devices.

We connected each armature's line output of the contactor and we control the armatures by using the switch of contactor. Accours we protected the human by life using ELCB system.We connected the outputs of MCB's to protect the devices for over load and short circuit.We used C/O O/l 300 mA sensitvity for any phase to ground and neutral to grund short circuits.

We used the ring circuits which are most preferable circuit type for sockets.We connected the RCD 32A C/O 100mA sensitvity socket and cooker circuits.Our dıstrıbutions box miniature circuit breaker (MCB) connect to output of the current operated earth leakage with over load 300mA sensitivity circuit breaker for overcome the short circuit faults.So we protected both of them.

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