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ABSTRACT

After drawing the plan of the building and architectural Project, we start to make Electrical plan.the points hat we have to be careful in an Electric plan are included in rules which are determined by EMO. In this points, totality is supplied in Project by making the calculation of illumination, current control calculation and voltage regülation drop. The rest of them are details. These details are specials rooms and places (Swimming pools, historical places , opareting rooms etc). According to features of these place, we use same cables such as (NYY, NYM ,NYA,FVV) and same buttons such as (Komitatör, Vavien,Dimmer,Light) We supply the build by using AG-OG transformer according to power of the build whose Electrical plan was drawen. If we had used the three phase motor or elevatör we would have determined the tolerance coefficient of demand of power calculation according to rules of EMO.

In coclusion, no matter which electric Project is used,Electrical engineers are not independent. They have to be act according to determined registiration

TABLE OF CONTENTS

CHAPTER -1-

HISTORICAL REVIEW OF INSTALLATION WORK

As one might expect to find in the early beginnings of any industry, the application, and the methods of application, of electricity for lighting, heating and motive power was primitive in the extreme. Large-scale application of electrical energy was slow to develop. The first wide use of it was for lighting in houses, shops and offices. By the 1870s, electric lighting had advanced from being a curiosity to something with a definite practical future. Arc lamps were the first form of lighting, particularly for the illumination of main streets. When the incandescent –filament lamp appeared on the scene electric lighting took on such a prominence that it severely threatened the use of gas for this purpose. But it was not until cheap and reliable metal-filament lamps were produced that electric lighting found a place in every home in the land. Even then, because of the low power of these early filament lamps, shop windows continued for some time to be lighted externally by arc lamps suspended from the fronts of buildings.

The earliest application of electrical energy as an agent for motive power in industry is still electricity's greatest contribution to industrial expansion. The year 1900 has been regarded as a time when industrialists awakened to the potential of the new form of power.

Electricity was first used in mining for pumping. In the iron and steel industry, by 1917, electric furnaces of both the arc and induction type were producing over 100.000 tons of ingots and castings. The first all-welded ship was constructed in 1920; and the other ship-building processes were operated by electric motor power for punching, shearing, drilling machines and woodworking machinery.

The first electric motor drives in light industries were in the form of one motor-unit per line of shafting. Each motor was started once a day and continued to run throughout the whole working day in one direction at a constant speed. All the various machines driven from the shafting were started, stopped, reversed or changed in direction and speed by mechanical means. The development of integral electric drives, with provisions for starting, stopping and speed changes, led to the extensive use of the motor in small kilowatt ranges to drive an associated single machine, e.g. a lathe. One of the pioneers in the use of motors was the firm of Bruce Peebles, Edinburgh. The firm supplied, in the 1890s, a number of weatherproof, totally-enclosed motors for quarries in Dumfriesshire, believed to be among the first of their type in Britain. The first electric winder ever built in Britain was supplied in 1905 to a Lanark oil concern. Railway electrification started as long ago as 1883, but it was not until long after the turn of this century that any major development took place.

Electrical installations in the early days were quite primitive and often dangerous. It is on record that in 1881, the installation in Hatfield House was carried out by an aristocratic amateur. That the installation was dangerous did not perturb visitors to the house who "...when the naked wires on the gallery ceiling broke into flame ... nonchalantly threw up cushions to put out the fire and then went on with their conversation".

Many names of the early electrical pioneers survive today. Julius Sax began to make electric bells in 1855, and later supplied the telephone with which Queen Victoria spoke between Osborne, in the Isle of Wight, and Southampton in 1878. He founded one of the earliest purely electrical manufacturing firms which exists today and still makes bells and signalling equipment.

The General Electric Company had its origins in the 1880's as a company which was able to supply every single item which went to form a complete electrical installation. In addition it was guaranteed that all the components offered for sale were technically suited to each other, were of adequate quality and were offered at an economic price.

Specialising in lighting. Falk Stadelman & Co. Ltd began by marketing improved designs of oil lamps then gas fittings, and ultimately electric lighting fittings.

Cable makers W.T. Glover & Co. were pioneers in the wire field. Glover was originally a designer of textile machinery, but by 1868 he was also making braided steel wires for the then fashionable crinolines. From this type of wire it was a natural step to the production of insulated conductors for electrical purposes. At the Crystal Palace Exhibition in 1885 he showed a great range of cables; he was also responsible for the wiring of the exhibition.

The well-known J. & P. firm (Johnson & Philips) began with making telegraphic equipment, extended to generators and arc lamps, and then to power supply.

The coverings for the insulation of wires in the early days included textiles and gutta-percha. Progress in insulation provisions for cables was made when vulcanised rubber was introduced, and it is still used today. The first application of a lead sheath to rubber-insulated cables was made by Siemens Brothers. The manner in which we name cables was also a product of Siemens Brothers. The manner in which we name cables was also a product of Siemens, whose early system was to give a cable a certain length related to a Standard resistance of 0.1 ohm. Thus a No. 90 cable in their catalogue was a cable of which 90 yards had a resistance of 0.1 ohm. Cable sizes were also generally known by the Standard Wire Gauge.

For many years ordinary VRI cables made up about 95 per cent of all insulations. They were used first in wood casing, and then in conduit. Wood casing was a very early invention. It was introduced to separate conductors, this separation being considered a necessary safe-guard against the two wires touching and so causing fire. Choosing a cable at the turn of the century was quite a task. From one catalogue alone, one could choose from fifty-eight sizes of wire, with no less than fourteen different grades of rubber insulation. The grades were described by such terms as light, high medium or best insulation. Nowadays there are two grades of insulation: up to 600 V and 600 V /1,000 V. And the sizes of cables have been reduced to a more practicable seventeen.

During the 1890s the practice of using paper as an insulating material for cables was well established. One of the earliest makers was the company which later became a member of the present-day BICC Group. The idea of using paper as an insulation material came from America to Britain where it formed part of the first wiring system for domestic premises. This was twin lead sheathed cables. Bases for switches and other accessories associated with the system were of cast solder, to which the cable sheathing was wiped, and then all joints sealed with a compound. The compound was necessary because the paper insulation when dry tends to absorb moisture.

In 1911, the famous 'Henley Wiring System 'came on the market. It comprised flat-twin cables with a lead-alloy sheath. Special junction boxes, if properly fixed, automatically affected good electrical continuity. The insulation was rubber. It became very popular. Indeed, it proved so easy to install that a lot of unqualified people appeared on the contracting scene as 'electricians'. When it received the approval of the IEE Rules, it became an established wiring system and is still in use today.

At the time the lead-sheathed system made its first appearance, another rival wiring system also came onto the scene. This was the CTS system (cab-tyre-sheathed). It arose out of the idea that if a rubber product could be used to stand up to the wear and tear of motor-car tyres on roads, then the material would well be applied to cover cables. The CTS name eventually gave way to TRS (tough-rubber sheath), when the rubber-sheathed cable system came into general use.

The main competitor to rubber as an insulating material appeared in the late 1930s. This material was PVC (polyvinylchloride), a synthetic material which came from Germany. The material, though inferior to rubber so far as elastic properties were concerned, could withstand the effects of both oil and sunlight. During the Second World War PVC, used both as wire insulation and the protective sheath, became well established.

As experience increased with the use of TRS cables, it was made the basis of modified wiring systems. The first of these was the Callender farm-wiring system introduced in 1937. This was tough-rubber sheathed cables with a semi-embedded braiding treated with a green –coloured compound. This system combined the properties of ordinary TRS and HSOS (house-service overhead system) cables.

So far as conductor material was concerned, copper was the most widely used? But aluminium was also applied as a conductor material. Aluminium, which has excellent electrical properties, has been produced on a large commercial scale since about 1890. Overhead lines of aluminium were first installed in 1898. Rubber-insulated aluminium cables of 3/0.036 inch and 3/0.045 inch were made to the order of the British Aluminium Company and used in the early years of this century for the wiring of the staff quarters at Kinlochleven in Argyllshire. Despite the fact that lead and lead-alloy proved to be of great value in the sheathing of cables, aluminium was looked to for a sheath of, in particular, light weight. Many experiments were carried out before a reliable system of aluminium-sheathed cable could be put on the market.

Perhaps one of the most interesting systems of wiring to come into existence was the MICS (mineral-insulated copper-sheathed cable) which used compressed magnesium oxide as the insulation, and had a copper sheath and copper conductors. The cable was first developed in 1897 and was first produced in France. It has been made in Britain since 1937, first by Pyrotenax Ltd, and later by other firms. Mineral insulation has also been used with conductors and sheathing of aluminium.

One of the first suggestions for steel used for conduit was made in 1883. It was then called 'small iron tubes '. However, the first conduits were of bitumised paper. Steel for conduits were of bitumised paper. Steel for conduits did not appear on the wiring scene until about 1895. The revolution in conduit wiring dates from 1897, and is associated with the name'Simplex'

Which is common enough today. It is said that the inventor, L. M. Waterhouse, got the idea of close-joint conduit by spending a sleepless night in a hotel bedroom staring at the bottom rail of his iron bedstead. In 1898 he began the production of light gauge close-joint conduits. A year later the screwed-conduit system was introduced.

Non-ferrous conduits were also a feature of the wiring scene. Heavy-gauge copper tubes were used for the wiring of the Rylands Library in Manchester in 1886. Aluminium conduit, though suggested during the 1920s, did not appear on the market until steel became a valuable material for munitions during the Second World War.

Insulated conduits also were used for many applications in installation work, and are still used to meet some particular installation conditions. The 'Gilflex' system, for instance, makes use of a PVC tube which can be bent cold, compared with earlier material which required the use of heat for bending.

Accessories for use with wiring systems were the subject of many experiments; many interesting designs came onto the market for the electrician to use in his work. When lighting became popular, there arose a need for the individual control of each lamp from its own control point. The 'branch switch' was used for this purpose. The term ' switch ' came over to this country from America , from railway terms which indicated a railway ' point ' , where a train could be ' switched ' from one set of tracks to another. The 'switch', so far as the electric circuit was concerned, thus came to mean a device which could switch an electric current from one circuit to another.

It was Thomas Edison who, in addition to pioneering the incandescent lamp, gave much thought to the provision of branch switches in circuit wiring. The term 'branch' meant a tee-off from a main cable to feed small current-using items. The earliest switches were of the 'turn' type, in which the contacts were wiped together in a rotary motion to make the circuit. The first switches were really crude efforts: made of wood and with no positive ON or OFF position. Indeed, it was usual practice to make an inefficient contact to produce an arc to 'dim' the lights! Needless to say, this misuse of the early switches, in conjunction with their wooden construction, led to many fires. But new materials were brought forward for switch construction such as slate, marble, and, later, porcelain. Movements were also made more positive with definite ON or OFF positions.

The 'turn' switch eventually gave way to the 'tumbler' switch eventually gave way to the 'tumbler' switch in popularity. It came into regular use about 1890. Where the name 'tumbler' originated is not clear; there are many sources, including the similarity of the switch action to the antics of Tumbler Pigeons. Many accessory names which are household words to the electricians of today appeared at the turn of the century: Verity's McGeoch, Tucker and Crabtree. Further developments to produce the semi-recessed, the flush, the ac only, and the 'silent' switch proceeded apace. The switches of today are indeed of long and worthy pedigrees.

It was one thing to produce a lamp operated from electricity. It was quite another thing to device a way in which the lamp could be held securely while current was flowing in its circuit. The first lamps were fitted with the wire tails for joining to terminal screws. It was Thomas Edison who introduced, in 1880, the screw-cap which still bears his name. It is said he got the idea from the stoppers fitted to kerosene cans of the time. Like much another really good idea, it superseded all its competitive lamp holders and its use extended through America and Europe. In Britain, however, it was not popular. The bayonet-cap type of lamp holder was introduced by the Edison & Swan Co. about 1886. The early type was soon improved to the lamp holders we know today

Ceiling roses, too, have an interesting history; some of the first types incorporated fuses. The first rose for direct attachment to conduit came out in the early 1900s, introduced by Dorman & Smith Ltd.

The first patent for a plug and socket was brought out by Lord Kelvin, a Pioneer of electric wiring systems and wiring accessories. The accessory was used mainly for lamp loads at first, and so carried very small currents. However, domestic appliances were beginning to appear on the market, which meant that sockets had to carry heavier currents. Two popular items were irons and curling-tong heaters. Shuttered sockets were designed by Crompton in 1893. The modern shuttered type of socket appeared as a prototype in 1905, introduced by 'Diamond H'. Many sockets were individually fused, a practice which was later extended to the provision of a fuse in the plug. These fuses were, however, only a small piece of wire between two terminals and caused such a lot of trouble that in 1911 the Institution of Electrical Engineers banned their use. One firm which came into existence which the socket-and-plug was M.K. Electric Ltd. The initials were for 'Multi-Kontakt' and associated with a type of socket-outlet which eventually became the Standard design for this accessory. It was Scholes, under the name of 'Wylex', who introduced a revolutionary design of plug-and-socket: a hallow circular earth pin and rectangular current-carrying pins. This was really the first attempt to 'polarise', or to differentiate between live, earth and neutral pins.

One of the earliest accessories to have a cartridge fuse incorporated in it was the plug produced by Dorman & Smith Ltd. The fuse actually formed one of the pins, and could be screwed in or out when replacement was necessary. It is a rather long cry from those pioneering days to the present system of standard socket-outlets and plugs.

Early fuses consisted of lead wires; lead being used because of its low melting point. Generally, devices which contained fuses were called 'cut-outs', a term still used today for the item in the sequence of supply-control equipment entering a building. Once the idea caught on of providing protection for a circuit in the form of fuses, brains went to work to design fuses and fuse gear. Control gear first appeared encased in wood. But ironclad versions made their due appearance, particularly for industrial use during the nineties. They were usually called 'motor switches', and had their blades and contacts mounted on a slate panel. Among the first companies in the switchgear field were Bill & Co., Sanders & Co. and the MEM Co., whose 'Kantark' fuses are so well known today. In 1928 this company introduced the 'splitter' which affected a useful economy in many of the smaller installations.

It was not until the 1930s that the distribution of electricity in buildings by means of busbars came into fashion, though the system had been used as far back as about 1880, particularly for street mains. In 1935 the English Electric Co. introduced a busbar trunking system designed to meet the needs of the motor-car industry. It provided the overhead distribution of electricity into which system individual machines could be tapped wherever required; this idea caught on and designs were produced and put onto the market by Marryat & Place, GEC and Ottermill.

Trunking came into fashion mainly because the larger sizes of conduit proved to be expensive and troublesome to install. One of the first trunking types to be produced was the 'spring conduit' of the Manchester firm of Key Engineering. They showed it for the first time at an electrical exhibition in 1908. It was semi-circular steel troughing with edges formed in such a way that they remained quite secure by a spring action after being pressed into contact. But it was not until about 1930 that the idea took root and is now established as a standard wiring system.

CHAPTER -2-

HISTORICAL REVIEW OF WIRING REGULATIONS

The history of the development of non-legal and statutory rules and regulations for the wiring of buildings is no less interesting than that of wiring systems and accessories. When electrical energy received a utilisation impetus from the invention of the incandescent lamp, many set themselves up as electricians or electrical wiremen. Others were gas plumbers who indulged in the installation of electrics as a matter of normal course. This was all very well: the contracting industry had to get started in some way, however ragged. But with so many amateurs troubles were bound to multiply. And they did. It was not long before arc lamps, sparking commutators, and badly insulated conductors contributed to fires. It was the insurance companies which gave their attention to the fire risk inherent in the electrical installations of the 1880s. Foremost among these was the Phoenix Assurance Co., whose engineer, Mr. Heapy, was told to investigate the situation and draw up a report on his findings.

The result was the phoneix Rules of 1882. The Rules were produced just a few months after those of the American Board of Fire Underwriters who are credited with the issue of the first wiring rules in the world.

The phoneix Rules were however, the better set and went through many editions before revision was thought necessary. That these Rules contributed to a better Standard of wiring, and introduced a high factor of safety in the electrical wiring and equipment of buildings, was indicated by a report in 1892 which showed the high incidence of electrical fires in the USA and the comparative freedom from fires of electrical origin in Britain.

Three months after the issue of the Phoneix Rules for wiring in 1882, the Society of Telegraph Engineers and Electricians (now the Institution of Electrical Engineers) issued the first edition of Rules and Regulations for the Prevention of Fire Risks arising from Electric Lighting. These rules were drawn up by a committee of eighteen men which included some of the famous names of the day: Lord Kelvin, Siemens and

Crompton. The Rules, however, were subjected to some criticism. Compared with the phoenix Rules they left much to be desired. But the Society was working on the basis of laying down a set of principles rather than, as Heapy did, drawing up a guide or 'Code of Practice'. A second edition of the Society's Rules was issued in 1888. The third edition as issued in 1897 and entitled General Rules recommended for wiring for the supply of Electrical Energy.

The rules have since been revised at fairly regular intervals as new developments and the results of experience can be written in for the considered attention of all those concerned with the electrical equipment of buildings. Basically the regulations were intended to act as a guide for electricians and others to provide a degree of safety in the use of electricity by inexperienced persons such as householders. The regulations were, and still are, not legal; that is, they cannot be enforced by the law of the land. Despite this apparent loophole, the regulations are accepted as a guide to the practice of installation work which will ensure, at the very least, a minimum Standard of work. The Institution of Electrical Engineers (IEE) was not alone in the insistence of good standards in electrical installation work. In 1905, the Electrical Trades Union, through the London District Committee, in a letter to the Phoenix Assurance Co., said '.... They view with alarm the large extent to which bad work is now being carried out by electric light contractors .... As the carrying out of bad work is attended by fires and other risks, besides injuring the Trade, they respectfully ask you to ... uphold a higher Standard work '.

The legislation embodied in the factory and workshop acts of 1901 and 1907 had a considerable influence on wiring practice. In the latter Act it was recognized for the first time that the generation, distribution and use of electricity in industrial premises could be dangerous. To control electricity in factories and other premises a draft set of Regulations was later to be incorporated into statutory requirements.

While the IEE and the statutory regulations were making their positions stronger, the British Standards Institution brought out, and is still issuing, Codes of Practice to provide what are regarded as guides to good practice. The position of the Statutory Regulations in this country is that they form the primary requirements which must by law be satisfied. The IEE Regulations and codes of practice indicate supplementary requirements. However, it is accepted that if an installation is carried out in accordance with the IEE Wiring Regulations, then it generally fulfils the requirements of the Electricity Supply Regulations. This means that a supply authority can insist upon all electrical work to be carried out to the standard of the IEE Regulations, but cannot insist on a standard which is in excess of the IEE requirements.

The position of the IEE 'Regs', as they are popularly called, is that of being the installation engineer's 'bible'. Because the Regulations cover the whole field of installation work, and if they are complied with, it is certain that the resultant electrical installation will meet the requirements of all interested parties. There are, however, certain types of electrical installations which require special attention to prevent fires and accidents. These include mines, cinemas, theatres, factories and places where there are exceptional risks.

CHAPTER -3-

RULES OF THE PROJECT

At drawing the electrical installation projects the current lines have to be 0.4 mm - 0.5 mm the low current lines have to be 0.2 mm – 0.3 mm the armatures , switches , sockets , etc … and the symbols of electrical devices have to be draw with 0.2 mm

We have to use writing template or number template when writing to Project.

The power calculating and the electrical installation Project have to be suitable to the rules of "TÜRK STANDARTLARI BAYINDIRLIK BAKANLIĞI ELEKTRİK TEKNİK ŞARTNAMESİ". At the drawing electrical installation Project the high of the electrical switches and electrical sockets, wall lamps and signal buttons. From ground are important.

At the practise

Devices :	**high from ground :**
Switches	.... 150 cm
Sockets	.... 40 cm
Wall lamps	.... 190 cm
Conduit boxes	.... 220 cm
Fuse box line	.... 200 cm

Are putted higher from the ground. The devices have to put 30 cm far from door case and have to put 50 cm. far from window case. And in modern buildings the switches have to put 100 cm – 110 cm higher from
The ground in ground floor the sockets have to put as higher as like the switches just in case the water flood.

Nowadays improved cable channel and connecting devices with sockets have to put shorter then 40 cm high on the ground and wall.

In floor plans, power line plans lines and at the outlet the number of cable, crosscut and models with pipe model and its sizes are showed.

The power lines and the electric cable lines have to be numerated and this numbers are repeated a long the power lines and electric cable lines , the power lines are showed square , the electric cable lines are showed by circle.

At the electrical installation Project specially the column and the chimney etc... The architectural detailed have to state.

At the wet ground (toilets and bathroom) using the conduit box, switches, and the sockets are not permutated. The conduit box, switches and the sockets have to put to outside this place.

When we want to put a socket inside of the bathroom it is useful to use a special water leak proof socket.

The electric meter have to put a place where without damp , without dust , harmful heating changing weather like this and have to put a place that the competent can find and make control easily without asking the person who live .

In houses every subscriber can put the electric meter outside the own door, over the wall in the well hole, inside the covered parts or a ground where well weather coming dry and suitable places

The electric meter can putted to the first enter in the places like shops, bureau, Office, etc… where the manager to see fit.

By the practise in the apartments the electric meter are putted to the ground floor in the electric meter panel.

The electric meter which has to be putted the dusted places and open area must putt the electric meter panel which made from galvanized iron.

The illumination line and socket line have to separate electric cable lines have to be numbered according to the exit and secondary panel (the numbers putted in circle).

The illumination and socket cable lines are protected by the circuit breaker. The short circuit current of the circuit breakers has to be at least 3 KA. The voltage loss has to calculate for the longest and the highest line. We can not draw a line surrounding of chimneys or columns at the Project. The switches, sockets, have to be put to a different place from chimneys and columns.

We can not put on joist or columns or near the joist or columns switches or sockets.

The electrical meter have to put to an enter of well hole in a box which have to be made from galvanization sheet.

At drawing the electrical installation projects and at the practise the lamp lines and the socket lines have to be different.

It can be connecting to the lamp line at most nine (9) lamps for the socket line it can be connecting at most seven (7) sockets.

But only the washing machine, dishwasher, and oven must have a along line and the power are different from the others.

Electrical device		power
Washing machine	....	2.5 kW.
Dish washer	....	2.5 kW.
Oven	....	2.0 kW.

By calculating the power we have to suitable this rule.

- As much as to eight (8) kw............60 %
- For the rest of power ....40 %

By the practise we can use Bergman pipe under the plaster and on the plaster. But the plastic pipe can use only under the plaster.

CHAPTER -4-

THE PROCESS ROW FOR THE ILLUMINATION DRAWING PROJECTS

With the helping the architectural plan and using plan 1/50 or 1/100 measure is drawn. If the using plan is not drawn , the information about the using purpose are taken from the owner of the goods oven , washing machine , dishwasher refrigerator places and where the socket , putted are important especially houses.

The places of the second table are has to be pointed. The second table has to be putted near the hole in the enter of the house and near the enter door.

In houses there have to be at least 2 illumination electrical cables lines. To take place. So the of illumination armature types and power of armatures and types of switches are shown when the illumination electric cable number are shown, nine (9) illumination putted can be connected to the area illuminated electric cable

According to the instructions 2 separate socket cable have to be putted kitchen for dishwasher and electrical oven, 1 separate socket cable line has to be putted in bathroom for the washing machine. Maximum seven (7) socket outlet can be connected to the one socket line. So the number of the illumination and socket electrical cable and outlet number and the power of the table are shown.

The places of the illumination switches, sockets, calling buttons are pointed the place where the door is opened or closed. The figures are downed and conduit box places are pointed.

At the drawing the electrical cables, the electrical cable lines not to be putted in chimney and around the chimney.

The illumination buttons in the well hole can be putted as possible as the near house door.

CHAPTER -5-

THE CONTROL OF VOLTAGE LOSS

The electrical devices work at the practice of determined voltage level.

We have calculated the control of the voltage loss because of that the voltage loss would not be bigger from the determined values at the instructions.

The voltage loss in the Electrical illumination circuits and in the Electrical sockets circuits is 1.5 % of the voltage phase.

One phase voltage is 220 V in the Turkey. Therefore the biggest voltage loss is 3.3 V

5.1 THE CONTROL OF ONE PHASE VOLTAGE:

If we know the current : $U = 2 * L * I * \cos Ø / X * S$

If we know the power : $U = 2 * L * N / X * S * U$

Or : $\% e = 2 * 100 * L * N / X * S * U^2$

The phase voltage is 220 V. for copper X = 56 and 2 * 100 is the fixed value and if we calculate the value for this number its:

$200 / X * U^2 = 200 / 56 * 220^2 = 74 * 10^{-6}$ can find $74 * 10^{-6}$ is equal to

$\% e = 0.0074 * L * N$ kw/s

5.2 THE CONTROL OF THREE PHASE VOLTAGE:

If we know the Current : $U = 1.73 * L * \cos Ø / X * S$

If we know the Power : $U = L * N / X * S * U$

Or : $\% e = 100 * L * N / K * S * U^2$

The three phase voltage is 380 V for copper X = 56 and 100 numbers are the fixed values and if we calculate the value for that number.

$100 / X * U^2 = 100 / 56 * 380^2 = 124 * 10^{-7}$ and we can use $123 * 10^{-7}$

$124 * 10^{-7}$ is equal to $\% e = 0.0124 * L * N$ kw/s

$\% e = 0.0123 * L * N$ kw/s

CHAPTER -6-
LIGHTING

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 efficency:

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.

6.1 FLAMENT 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.

6.1.1 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.

6.1.2 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

6.1.3 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.

6.1.4 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.

6.1.5 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 300^0C 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.

6.2 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.

6.2.1 Cold Cathode Lamp:

The cold-cathode lamp uses a high voltage (about 3.5 kV) 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.

6.2.2 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.

Mercury and Metal Halide Lamps:

The mercury spectrum has four well-defined lines in the visible area and two in the invisible ultra violet region. This u.v. radiation is used to excite fluorescence in certain phosphors, by which means some of the missing colours can be restored to the spectrum. The proportion of visible light to u.v. increases as the vapour pressure in the discharge tube so that colour correction is less effective in a high-pressure mercury lamp than in a low-pressure (fluorescent) tube.

High pressure mercury lamps are designed MBF and the outer bulb is coated with a fluorescent powder. MBF lamps are now commonly used in offices, shops and in door situations where previously they were considered unsuitable. Better colour rendering lamps have recently been introduced MBF de-luxe or MBF-DL lamps and are at presents lightly more expensive than ordinary MBF lamps.

A more *fundamental solution to the problem of colour rendering is to add the* halides of various metals to mercury in the discharge tube. In metal halide lamps (designed MBI) the number of spectral lines is so much increased that a virtually continuous emission of light is achieved, and colour rendering is thus much improved. The addition of fluorescent powders to the outer jacket (MBIF) still further improves the colour rendering properties of the lamp, which is similar to that of a de luxe natural fluorescent tube.

Metal halide lamps are also made in a compact linear from for floodlighting (MBIL) in which case the enclosed floodlighting projector takes the place of the outer jacket and in a very compact form (CSI) with a short arc length which is used for projectors, and encapsulated in a pressed glass reflector, for long range floodlighting of sports arenas, etc. In addition, single-ended low wattage (typically 150 W) metal halide lamps (MBI-T) have been developed offering excellent colour rendering for display lighting, floodlighting and up lighting of commercial interiors.

No attempt should ever be made to keep an MB and MBF lamp in operation if the outer bulb becomes accidentally broken, for in these types the inner discharge tube of quartz does not absorb potentially dangerous radiations which are normally blocked by the outer glass bulb.

Sodium Lamps:

Low pressure sodium lamps give light which is virtually monochromatic; that is, they emit yellow light at one wavelength only, all other colours of light being absent. Thus white and yellow objects look yellow, and other colours appear in varying shades of grey and black.

However, they have a very efficacy and are widely used for streets where the primary aim is to provide light for visibility at minimum cost; also for floodlighting where a yellow light is acceptable or preferred.

The discharge U-tube is contained within a vacuum glass jacket which conserves the heat and enables the metallic sodium in the tube to become sufficiently vaporized. The arc is initially struck in neon, giving a characteristic red glow; the sodium then becomes vaporised and takes over the discharge.

Sometimes leakage transformers are used to provide the relatively high voltage required for starting, and the lower voltage required as the lamp runs up to full brightness a process taking up to about 15 minutes. Modern practice is to use electronic ignitors to start the lamp which then continues to operate on conventional choke ballast. A power-factor correction capacitor should be used on the mains side of the transformer primary.

A linear sodium lamp (SLI/H) with an efficacy of 150 lm/W is available and in the past was used for motorway lighting. The outer tube is similar to that of a fluorescent lamp and has an internal coating of indium to conserve heat in the arc. Mainly because of its size the SLI/H lamp has been replaced with the bigger versions of SOX lamps as described above.

Metallic sodium may burn if brought into contact with moisture, therefore care is necessary when disposing of discarded sodium lamps; a sound plan is to break the lamps in a bucket in the open and pour water on them, then after a short while the residue can be disposed of in the ordinary way. The normal life of all sodium lamps has recently been increased to 4 000 hours with an objective average of 6 000 hours.

SON High-Pressure Sodium Lamps:

In this type of lamp, the vapour pressure in the discharge tube is raised resulting in a widening of the spectral distribution of the light, with consequent improvement in its colour-rendering qualities. Although still biassed towards the yellow, the light is quite acceptable for most general lighting purposes and allows colours to be readily distinguished. The luminous efficacy of these lamps is high, in the region of 1001m per watt, and they consequently find a considerable application in industrial situations, for street lighting in city centres and for floodlighting.

Three types of lamp are available; elliptical type (SON) in which the outer bulb is coated with a fine diffusing powder, intended for general lighting; a single-ended cylindrical type with a clear glass outer bulb, used for flood-lighting, (SON.T); and a double-ended tubular lamp (SON.TD) also designed for floodlighting and dimensioned so that it can be used in linear parabolic reflectors designed for tungsten halogen lamps. This type must always be used in an enclosed fitting.

The critical feature of the SON lamp is the discharge tube. This is made of sintered aluminium oxide to withstand the chemical action of hot ionized sodium vapour, a material that is very difficult to work. Recent research in this country has resulted in improved methods of sealing the electrodes into the tubes, leading to the production of lower lamp ratings, down to 50W, much extending the usefulness of the lamps.

Most types of lamps require some from of starting device which can take the form of an external electric pulse ignitor or an internal starter. At least one manufacturer offers a range of EPS lamps with internal starters and another range that can be used as direct replacements for MBF lamps of similar rating. They may require small changes in respect of ballast tapping, values of p.f. correction capacitor and upgrading of the wiring insulation to withstand the starting pulse voltage. Lamps with internal starters may take up to 20 minutes to restart where lamps with electronic ignition allow hot restart in about 1 minute.

Considerable research is being made into the efficacy and colour rendering properties of these lamps and improvements continue to be introduced.

Recent developments have led to the introduction of SON deluxe or DL lamps. At the expense of some efficacy and a small reduction in life far better colour rendering has been obtained. They are increasingly being used in offices and shops as well as for industrial applications

6.3 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.

CHAPTER -7-

SWITCHES, SOCKETS AND BUTTONS

7.1 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

7.1.1 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…

7.1.2 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.

7.1.3 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.

7.1.4 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.

7.2 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

7.3 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.

At the electrical Project we have to fit to the rules of " BAYINDIRLIK BAKANLIGI ELEKTRİK TESİSATI ŞARTNAMESİ "

At the practice:

The switches from ground	150 cm
The sockets from ground	40 cm
The wall lamp from ground	190 cm
The conduit box from ground	220 cm
The fuse box from the ground	200 cm

CHAPTER -8-

CONDUCTORS AND CABLES

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

NEAR EAST UNIVERSITY

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Department of Electric and Electronic Engineering

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Graduation Project
EE400

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ABSTRACT

After drawing the plan of the building and architectural Project, we start to make Electrical plan.the points hat we have to be careful in an Electric plan are included in rules which are determined by EMO. In this points, totality is supplied in Project by making the calculation of illumination, current control calculation and voltage regülation drop. The rest of them are details. These details are specials rooms and places (Swimming pools, historical places , opareting rooms etc). According to features of these place, we use same cables such as (NYY, NYM ,NYA,FVV) and same buttons such as (Komitatör, Vavien,Dimmer,Light)
We supply the build by using AG-OG transformer according to power of the build whose Electrical plan was drawen. If we had used the three phase motor or elevatör we would have determined the tolerance coefficient of demand of power calculation according to rules of EMO.

In coclusion, no matter which electric Project is used,Electrical engineers are not independent. They have to be act according to determined registiration

TABLE OF CONTENTS

CHAPTER -1-

HISTORICAL REVIEW OF INSTALLATION WORK

As one might expect to find in the early beginnings of any industry, the application, and the methods of application, of electricity for lighting, heating and motive power was primitive in the extreme. Large-scale application of electrical energy was slow to develop. The first wide use of it was for lighting in houses, shops and offices. By the 1870s, electric lighting had advanced from being a curiosity to something with a definite practical future. Arc lamps were the first form of lighting, particularly for the illumination of main streets. When the incandescent –filament lamp appeared on the scene electric lighting took on such a prominence that it severely threatened the use of gas for this purpose. But it was not until cheap and reliable metal-filament lamps were produced that electric lighting found a place in every home in the land. Even then, because of the low power of these early filament lamps, shop windows continued for some time to be lighted externally by arc lamps suspended from the fronts of buildings.

The earliest application of electrical energy as an agent for motive power in industry is still electricity's greatest contribution to industrial expansion. The year 1900 has been regarded as a time when industrialists awakened to the potential of the new form of power.

Electricity was first used in mining for pumping. In the iron and steel industry, by 1917, electric furnaces of both the arc and induction type were producing over 100.000 tons of ingots and castings. The first all-welded ship was constructed in 1920; and the other ship-building processes were operated by electric motor power for punching, shearing, drilling machines and woodworking machinery.

The first electric motor drives in light industries were in the form of one motor-unit per line of shafting. Each motor was started once a day and continued to run throughout the whole working day in one direction at a constant speed. All the various machines driven from the shafting were started, stopped, reversed or changed in direction and speed by mechanical means. The development of integral electric drives, with provisions for starting, stopping and speed changes, led to the extensive use of the motor in small kilowatt ranges to drive an associated single machine, e.g. a lathe. One of the pioneers in the use of motors was the firm of Bruce Peebles, Edinburgh. The firm supplied, in the 1890s, a number of weatherproof, totally-enclosed motors for quarries in Dumfriesshire, believed to be among the first of their type in Britain. The first electric winder ever built in Britain was supplied in 1905 to a Lanark oil concern. Railway electrification started as long ago as 1883, but it was not until long after the turn of this century that any major development took place.

Electrical installations in the early days were quite primitive and often dangerous. It is on record that in 1881, the installation in Hatfield House was carried out by an aristocratic amateur. That the installation was dangerous did not perturb visitors to the house who "...when the naked wires on the gallery ceiling broke into flame ... nonchalantly threw up cushions to put out the fire and then went on with their conversation".

Many names of the early electrical pioneers survive today. Julius Sax began to make electric bells in 1855, and later supplied the telephone with which Queen Victoria spoke between Osborne, in the Isle of Wight, and Southampton in 1878. He founded one of the earliest purely electrical manufacturing firms which exists today and still makes bells and signalling equipment.

The General Electric Company had its origins in the 1880's as a company which was able to supply every single item which went to form a complete electrical installation. In addition it was guaranteed that all the components offered for sale were technically suited to each other, were of adequate quality and were offered at an economic price.

Specialising in lighting. Falk Stadelman & Co. Ltd began by marketing improved designs of oil lamps then gas fittings, and ultimately electric lighting fittings.

Cable makers W.T. Glover & Co. were pioneers in the wire field. Glover was originally a designer of textile machinery, but by 1868 he was also making braided steel wires for the then fashionable crinolines. From this type of wire it was a natural step to the production of insulated conductors for electrical purposes. At the Crystal Palace Exhibition in 1885 he showed a great range of cables; he was also responsible for the wiring of the exhibition.

The well-known J. & P. firm (Johnson & Philips) began with making telegraphic equipment, extended to generators and arc lamps, and then to power supply.

The coverings for the insulation of wires in the early days included textiles and gutta-percha. Progress in insulation provisions for cables was made when vulcanised rubber was introduced, and it is still used today. The first application of a lead sheath to rubber-insulated cables was made by Siemens Brothers. The manner in which we name cables was also a product of Siemens Brothers. The manner in which we name cables was also a product of Siemens, whose early system was to give a cable a certain length related to a Standard resistance of 0.1 ohm. Thus a No. 90 cable in their catalogue was a cable of which 90 yards had a resistance of 0.1 ohm. Cable sizes were also generally known by the Standard Wire Gauge.

For many years ordinary VRI cables made up about 95 per cent of all insulations. They were used first in wood casing, and then in conduit. Wood casing was a very early invention. It was introduced to separate conductors, this separation being considered a necessary safe-guard against the two wires touching and so causing fire. Choosing a cable at the turn of the century was quite a task. From one catalogue alone, one could choose from fifty-eight sizes of wire, with no less than fourteen different grades of rubber insulation. The grades were described by such terms as light, high medium or best insulation. Nowadays there are two grades of insulation: up to 600 V and 600 V /1,000 V. And the sizes of cables have been reduced to a more practicable seventeen.

During the 1890s the practice of using paper as an insulating material for cables was well established. One of the earliest makers was the company which later became a member of the present-day BICC Group. The idea of using paper as an insulation material came from America to Britain where it formed part of the first wiring system for domestic premises. This was twin lead sheathed cables. Bases for switches and other accessories associated with the system were of cast solder, to which the cable sheathing was wiped, and then all joints sealed with a compound. The compound was necessary because the paper insulation when dry tends to absorb moisture.

In 1911, the famous 'Henley Wiring System 'came on the market. It comprised flat-twin cables with a lead-alloy sheath. Special junction boxes, if properly fixed, automatically affected good electrical continuity. The insulation was rubber. It became very popular. Indeed, it proved so easy to install that a lot of unqualified people appeared on the contracting scene as 'electricians'. When it received the approval of the IEE Rules, it became an established wiring system and is still in use today.

At the time the lead-sheathed system made its first appearance, another rival wiring system also came onto the scene. This was the CTS system (cab-tyre-sheathed). It arose out of the idea that if a rubber product could be used to stand up to the wear and tear of motor-car tyres on roads, then the material would well be applied to cover cables. The CTS name eventually gave way to TRS (tough-rubber sheath), when the rubber-sheathed cable system came into general use.

The main competitor to rubber as an insulating material appeared in the late 1930s. This material was PVC (polyvinylchloride), a synthetic material which came from Germany. The material, though inferior to rubber so far as elastic properties were concerned, could withstand the effects of both oil and sunlight. During the Second World War PVC, used both as wire insulation and the protective sheath, became well established.

As experience increased with the use of TRS cables, it was made the basis of modified wiring systems. The first of these was the Callender farm-wiring system introduced in 1937. This was tough-rubber sheathed cables with a semi-embedded braiding treated with a green –coloured compound. This system combined the properties of ordinary TRS and HSOS (house-service overhead system) cables.

So far as conductor material was concerned, copper was the most widely used? But aluminium was also applied as a conductor material. Aluminium, which has excellent electrical properties, has been produced on a large commercial scale since about 1890. Overhead lines of aluminium were first installed in 1898. Rubber-insulated aluminium cables of 3/0.036 inch and 3/0.045 inch were made to the order of the British Aluminium Company and used in the early years of this century for the wiring of the staff quarters at Kinlochleven in Argyllshire. Despite the fact that lead and lead-alloy proved to be of great value in the sheathing of cables, aluminium was looked to for a sheath of, in particular, light weight. Many experiments were carried out before a reliable system of aluminium-sheathed cable could be put on the market.

Perhaps one of the most interesting systems of wiring to come into existence was the MICS (mineral-insulated copper-sheathed cable) which used compressed magnesium oxide as the insulation, and had a copper sheath and copper conductors. The cable was first developed in 1897 and was first produced in France. It has been made in Britain since 1937, first by Pyrotenax Ltd, and later by other firms. Mineral insulation has also been used with conductors and sheathing of aluminium.

One of the first suggestions for steel used for conduit was made in 1883. It was then called 'small iron tubes '. However, the first conduits were of bitumised paper. Steel for conduits were of bitumised paper. Steel for conduits did not appear on the wiring scene until about 1895. The revolution in conduit wiring dates from 1897, and is associated with the name'Simplex'

Which is common enough today. It is said that the inventor, L. M. Waterhouse, got the idea of close-joint conduit by spending a sleepless night in a hotel bedroom staring at the bottom rail of his iron bedstead. In 1898 he began the production of light gauge close-joint conduits. A year later the screwed-conduit system was introduced.

Non-ferrous conduits were also a feature of the wiring scene. Heavy-gauge copper tubes were used for the wiring of the Rylands Library in Manchester in 1886. Aluminium conduit, though suggested during the 1920s, did not appear on the market until steel became a valuable material for munitions during the Second World War.

Insulated conduits also were used for many applications in installation work, and are still used to meet some particular installation conditions. The 'Gilflex' system, for instance, makes use of a PVC tube which can be bent cold, compared with earlier material which required the use of heat for bending.

Accessories for use with wiring systems were the subject of many experiments; many interesting designs came onto the market for the electrician to use in his work. When lighting became popular, there arose a need for the individual control of each lamp from its own control point. The 'branch switch' was used for this purpose. The term ' switch ' came over to this country from America , from railway terms which indicated a railway ' point ' , where a train could be ' switched ' from one set of tracks to another. The 'switch', so far as the electric circuit was concerned, thus came to mean a device which could switch an electric current from one circuit to another.

It was Thomas Edison who, in addition to pioneering the incandescent lamp, gave much thought to the provision of branch switches in circuit wiring. The term 'branch' meant a tee-off from a main cable to feed small current-using items. The earliest switches were of the 'turn' type, in which the contacts were wiped together in a rotary motion to make the circuit. The first switches were really crude efforts: made of wood and with no positive ON or OFF position. Indeed, it was usual practice to make an inefficient contact to produce an arc to 'dim' the lights! Needless to say, this misuse of the early switches, in conjunction with their wooden construction, led to many fires. But new materials were brought forward for switch construction such as slate, marble, and, later, porcelain. Movements were also made more positive with definite ON or OFF positions.

The 'turn' switch eventually gave way to the 'tumbler' switch eventually gave way to the 'tumbler' switch in popularity. It came into regular use about 1890. Where the name 'tumbler' originated is not clear; there are many sources, including the similarity of the switch action to the antics of Tumbler Pigeons. Many accessory names which are household words to the electricians of today appeared at the turn of the century: Verity's McGeoch, Tucker and Crabtree. Further developments to produce the semi-recessed, the flush, the ac only, and the 'silent' switch proceeded apace. The switches of today are indeed of long and worthy pedigrees.

It was one thing to produce a lamp operated from electricity. It was quite another thing to device a way in which the lamp could be held securely while current was flowing in its circuit. The first lamps were fitted with the wire tails for joining to terminal screws. It was Thomas Edison who introduced, in 1880, the screw-cap which still bears his name. It is said he got the idea from the stoppers fitted to kerosene cans of the time. Like much another really good idea, it superseded all its competitive lamp holders and its use extended through America and Europe. In Britain, however, it was not popular. The bayonet-cap type of lamp holder was introduced by the Edison & Swan Co. about 1886. The early type was soon improved to the lamp holders we know today

Ceiling roses, too, have an interesting history; some of the first types incorporated fuses. The first rose for direct attachment to conduit came out in the early 1900s, introduced by Dorman & Smith Ltd.

The first patent for a plug and socket was brought out by Lord Kelvin, a Pioneer of electric wiring systems and wiring accessories. The accessory was used mainly for lamp loads at first, and so carried very small currents. However, domestic appliances were beginning to appear on the market, which meant that sockets had to carry heavier currents. Two popular items were irons and curling-tong heaters. Shuttered sockets were designed by Crompton in 1893. The modern shuttered type of socket appeared as a prototype in 1905, introduced by 'Diamond H'. Many sockets were individually fused, a practice which was later extended to the provision of a fuse in the plug. These fuses were, however, only a small piece of wire between two terminals and caused such a lot of trouble that in 1911 the Institution of Electrical Engineers banned their use. One firm which came into existence which the socket-and-plug was M.K. Electric Ltd. The initials were for 'Multi-Kontakt' and associated with a type of socket-outlet which eventually became the Standard design for this accessory. It was Scholes, under the name of 'Wylex', who introduced a revolutionary design of plug-and-socket: a hallow circular earth pin and rectangular current-carrying pins. This was really the first attempt to 'polarise', or to differentiate between live, earth and neutral pins.

One of the earliest accessories to have a cartridge fuse incorporated in it was the plug produced by Dorman & Smith Ltd. The fuse actually formed one of the pins, and could be screwed in or out when replacement was necessary. It is a rather long cry from those pioneering days to the present system of standard socket-outlets and plugs.

Early fuses consisted of lead wires; lead being used because of its low melting point. Generally, devices which contained fuses were called 'cut-outs', a term still used today for the item in the sequence of supply-control equipment entering a building. Once the idea caught on of providing protection for a circuit in the form of fuses, brains went to work to design fuses and fuse gear. Control gear first appeared encased in wood. But ironclad versions made their due appearance, particularly for industrial use during the nineties. They were usually called 'motor switches', and had their blades and contacts mounted on a slate panel. Among the first companies in the switchgear field were Bill & Co., Sanders & Co. and the MEM Co., whose 'Kantark' fuses are so well known today. In 1928 this company introduced the 'splitter' which affected a useful economy in many of the smaller installations.

It was not until the 1930s that the distribution of electricity in buildings by means of busbars came into fashion, though the system had been used as far back as about 1880, particularly for street mains. In 1935 the English Electric Co. introduced a busbar trunking system designed to meet the needs of the motor-car industry. It provided the overhead distribution of electricity into which system individual machines could be tapped wherever required; this idea caught on and designs were produced and put onto the market by Marryat & Place, GEC and Ottermill.

Trunking came into fashion mainly because the larger sizes of conduit proved to be expensive and troublesome to install. One of the first trunking types to be produced was the 'spring conduit' of the Manchester firm of Key Engineering. They showed it for the first time at an electrical exhibition in 1908. It was semi-circular steel troughing with edges formed in such a way that they remained quite secure by a spring action after being pressed into contact. But it was not until about 1930 that the idea took root and is now established as a standard wiring system.

CHAPTER -2-

HISTORICAL REVIEW OF WIRING REGULATIONS

The history of the development of non-legal and statutory rules and regulations for the wiring of buildings is no less interesting than that of wiring systems and accessories. When electrical energy received a utilisation impetus from the invention of the incandescent lamp, many set themselves up as electricians or electrical wiremen. Others were gas plumbers who indulged in the installation of electrics as a matter of normal course. This was all very well: the contracting industry had to get started in some way, however ragged. But with so many amateurs troubles were bound to multiply. And they did. It was not long before arc lamps, sparking commutators, and badly insulated conductors contributed to fires. It was the insurance companies which gave their attention to the fire risk inherent in the electrical installations of the 1880s. Foremost among these was the Phoenix Assurance Co., whose engineer, Mr. Heapy, was told to investigate the situation and draw up a report on his findings.

The result was the phoneix Rules of 1882. The Rules were produced just a few months after those of the American Board of Fire Underwriters who are credited with the issue of the first wiring rules in the world.

The phoneix Rules were however, the better set and went through many editions before revision was thought necessary. That these Rules contributed to a better Standard of wiring, and introduced a high factor of safety in the electrical wiring and equipment of buildings, was indicated by a report in 1892 which showed the high incidence of electrical fires in the USA and the comparative freedom from fires of electrical origin in Britain.

Three months after the issue of the Phoneix Rules for wiring in 1882, the Society of Telegraph Engineers and Electricians (now the Institution of Electrical Engineers) issued the first edition of Rules and Regulations for the Prevention of Fire Risks arising from Electric Lighting. These rules were drawn up by a committee of eighteen men which included some of the famous names of the day: Lord Kelvin, Siemens and

Crompton. The Rules, however, were subjected to some criticism. Compared with the phoenix Rules they left much to be desired. But the Society was working on the basis of laying down a set of principles rather than, as Heapy did, drawing up a guide or 'Code of Practice'. A second edition of the Society's Rules was issued in 1888. The third edition as issued in 1897 and entitled General Rules recommended for wiring for the supply of Electrical Energy.

The rules have since been revised at fairly regular intervals as new developments and the results of experience can be written in for the considered attention of all those concerned with the electrical equipment of buildings. Basically the regulations were intended to act as a guide for electricians and others to provide a degree of safety in the use of electricity by inexperienced persons such as householders. The regulations were, and still are, not legal; that is, they cannot be enforced by the law of the land. Despite this apparent loophole, the regulations are accepted as a guide to the practice of installation work which will ensure, at the very least, a minimum Standard of work. The Institution of Electrical Engineers (IEE) was not alone in the insistence of good standards in electrical installation work. In 1905, the Electrical Trades Union, through the London District Committee, in a letter to the Phoenix Assurance Co., said '.... They view with alarm the large extent to which bad work is now being carried out by electric light contractors .... As the carrying out of bad work is attended by fires and other risks, besides injuring the Trade, they respectfully ask you to ... uphold a higher Standard work '.

The legislation embodied in the factory and workshop acts of 1901 and 1907 had a considerable influence on wiring practice. In the latter Act it was recognized for the first time that the generation, distribution and use of electricity in industrial premises could be dangerous. To control electricity in factories and other premises a draft set of Regulations was later to be incorporated into statutory requirements.

While the IEE and the statutory regulations were making their positions stronger, the British Standards Institution brought out, and is still issuing, Codes of Practice to provide what are regarded as guides to good practice. The position of the Statutory Regulations in this country is that they form the primary requirements which must by law be satisfied. The IEE Regulations and codes of practice indicate supplementary requirements. However, it is accepted that if an installation is carried out in accordance with the IEE Wiring Regulations, then it generally fulfils the requirements of the Electricity Supply Regulations. This means that a supply authority can insist upon all electrical work to be carried out to the standard of the IEE Regulations, but cannot insist on a standard which is in excess of the IEE requirements.

The position of the IEE 'Regs', as they are popularly called, is that of being the installation engineer's 'bible'. Because the Regulations cover the whole field of installation work, and if they are complied with, it is certain that the resultant electrical installation will meet the requirements of all interested parties. There are, however, certain types of electrical installations which require special attention to prevent fires and accidents. These include mines, cinemas, theatres, factories and places where there are exceptional risks.

CHAPTER -3-

RULES OF THE PROJECT

At drawing the electrical installation projects the current lines have to be 0.4 mm - 0.5 mm the low current lines have to be 0.2 mm – 0.3 mm the armatures , switches , sockets , etc … and the symbols of electrical devices have to be draw with 0.2 mm

We have to use writing template or number template when writing to Project.

The power calculating and the electrical installation Project have to be suitable to the rules of "TÜRK STANDARTLARI BAYINDIRLIK BAKANLIĞI ELEKTRİK TEKNİK ŞARTNAMESİ". At the drawing electrical installation Project the high of the electrical switches and electrical sockets, wall lamps and signal buttons. From ground are important.

At the practise

Devices :	**high from ground :**
Switches	.... 150 cm
Sockets	.... 40 cm
Wall lamps	.... 190 cm
Conduit boxes	.... 220 cm
Fuse box line	.... 200 cm

Are putted higher from the ground. The devices have to put 30 cm far from door case and have to put 50 cm. far from window case. And in modern buildings the switches have to put 100 cm – 110 cm higher from
The ground in ground floor the sockets have to put as higher as like the switches just in case the water flood.

Nowadays improved cable channel and connecting devices with sockets have to put shorter then 40 cm high on the ground and wall.

In floor plans, power line plans lines and at the outlet the number of cable, crosscut and models with pipe model and its sizes are showed.

The power lines and the electric cable lines have to be numerated and this numbers are repeated a long the power lines and electric cable lines , the power lines are showed square , the electric cable lines are showed by circle.

At the electrical installation Project specially the column and the chimney etc... The architectural detailed have to state.

At the wet ground (toilets and bathroom) using the conduit box, switches, and the sockets are not permutated. The conduit box, switches and the sockets have to put to outside this place.

When we want to put a socket inside of the bathroom it is useful to use a special water leak proof socket.

The electric meter have to put a place where without damp , without dust , harmful heating changing weather like this and have to put a place that the competent can find and make control easily without asking the person who live .

In houses every subscriber can put the electric meter outside the own door, over the wall in the well hole, inside the covered parts or a ground where well weather coming dry and suitable places

The electric meter can putted to the first enter in the places like shops, bureau, Office, etc… where the manager to see fit.

By the practise in the apartments the electric meter are putted to the ground floor in the electric meter panel.

The electric meter which has to be putted the dusted places and open area must putt the electric meter panel which made from galvanized iron.

The illumination line and socket line have to separate electric cable lines have to be numbered according to the exit and secondary panel (the numbers putted in circle).

The illumination and socket cable lines are protected by the circuit breaker. The short circuit current of the circuit breakers has to be at least 3 KA. The voltage loss has to calculate for the longest and the highest line. We can not draw a line surrounding of chimneys or columns at the Project. The switches, sockets, have to be put to a different place from chimneys and columns.

We can not put on joist or columns or near the joist or columns switches or sockets.

The electrical meter have to put to an enter of well hole in a box which have to be made from galvanization sheet.

At drawing the electrical installation projects and at the practise the lamp lines and the socket lines have to be different.

It can be connecting to the lamp line at most nine (9) lamps for the socket line it can be connecting at most seven (7) sockets.

But only the washing machine, dishwasher, and oven must have a along line and the power are different from the others.

Electrical device		power
Washing machine	....	2.5 kW.
Dish washer	....	2.5 kW.
Oven	....	2.0 kW.

By calculating the power we have to suitable this rule.

- As much as to eight (8) kw............60 %
- For the rest of power ....40 %

By the practise we can use Bergman pipe under the plaster and on the plaster. But the plastic pipe can use only under the plaster.

CHAPTER -4-

THE PROCESS ROW FOR THE ILLUMINATION DRAWING PROJECTS

With the helping the architectural plan and using plan 1/50 or 1/100 measure is drawn. If the using plan is not drawn , the information about the using purpose are taken from the owner of the goods oven , washing machine , dishwasher refrigerator places and where the socket , putted are important especially houses.

The places of the second table are has to be pointed. The second table has to be putted near the hole in the enter of the house and near the enter door.

In houses there have to be at least 2 illumination electrical cables lines. To take place. So the of illumination armature types and power of armatures and types of switches are shown when the illumination electric cable number are shown, nine (9) illumination putted can be connected to the area illuminated electric cable

According to the instructions 2 separate socket cable have to be putted kitchen for dishwasher and electrical oven, 1 separate socket cable line has to be putted in bathroom for the washing machine. Maximum seven (7) socket outlet can be connected to the one socket line. So the number of the illumination and socket electrical cable and outlet number and the power of the table are shown.

The places of the illumination switches, sockets, calling buttons are pointed the place where the door is opened or closed. The figures are downed and conduit box places are pointed.

At the drawing the electrical cables, the electrical cable lines not to be putted in chimney and around the chimney.

The illumination buttons in the well hole can be putted as possible as the near house door.

CHAPTER -5-

THE CONTROL OF VOLTAGE LOSS

The electrical devices work at the practice of determined voltage level.

We have calculated the control of the voltage loss because of that the voltage loss would not be bigger from the determined values at the instructions.

The voltage loss in the Electrical illumination circuits and in the Electrical sockets circuits is 1.5 % of the voltage phase.

One phase voltage is 220 V in the Turkey. Therefore the biggest voltage loss is 3.3 V

5.1 THE CONTROL OF ONE PHASE VOLTAGE:

If we know the current	:	$U = 2 * L * I * \cos Ø / X * S$
If we know the power	:	$U = 2 * L * N / X * S * U$
Or	:	$\% e = 2 * 100 * L * N / X * S * U^2$

The phase voltage is 220 V. for copper X = 56 and 2 * 100 is the fixed value and if we calculate the value for this number its:

$200 / X * U^2 = 200 / 56 * 220^2 = 74 * 10^{-6}$ can find $74 * 10^{-6}$ is equal to

$\% e = 0.0074 * L * N$ kw/s

5.2 THE CONTROL OF THREE PHASE VOLTAGE:

If we know the Current	:	$U = 1.73 * L * \cos Ø / X * S$
If we know the Power	:	$U = L * N / X * S * U$
Or	:	$\% e = 100 * L * N / K * S * U^2$

The three phase voltage is 380 V for copper X = 56 and 100 numbers are the fixed values and if we calculate the value for that number.

$100 / X * U^2 = 100 / 56 * 380^2 = 124 * 10^{-7}$ and we can use $123 * 10^{-7}$

$124 * 10^{-7}$ is equal to $\% e = 0.0124 * L * N$ kw/s

$$\% e = 0.0123 * L * N \text{ kw/s}$$

CHAPTER -6-
LIGHTING

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 efficency:

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.

6.1 FLAMENT 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.

6.1.1 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.

6.1.2 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

6.1.3 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.

6.1.4 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.

6.1.5 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 300^0C 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.

6.2 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.

6.2.1 Cold Cathode Lamp:

The cold-cathode lamp uses a high voltage (about 3.5 kV) 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.

6.2.2 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.

Mercury and Metal Halide Lamps:

The mercury spectrum has four well-defined lines in the visible area and two in the invisible ultra violet region. This u.v. radiation is used to excite fluorescence in certain phosphors, by which means some of the missing colours can be restored to the spectrum. The proportion of visible light to u.v. increases as the vapour pressure in the discharge tube so that colour correction is less effective in a high-pressure mercury lamp than in a low-pressure (fluorescent) tube.

High pressure mercury lamps are designed MBF and the outer bulb is coated with a fluorescent powder. MBF lamps are now commonly used in offices, shops and in door situations where previously they were considered unsuitable. Better colour rendering lamps have recently been introduced MBF de-luxe or MBF-DL lamps and are at presents lightly more expensive than ordinary MBF lamps.

A more *fundamental solution to the problem of colour rendering is to add the* halides of various metals to mercury in the discharge tube. In metal halide lamps (designed MBI) the number of spectral lines is so much increased that a virtually continuous emission of light is achieved, and colour rendering is thus much improved. The addition of fluorescent powders to the outer jacket (MBIF) still further improves the colour rendering properties of the lamp, which is similar to that of a de luxe natural fluorescent tube.

Metal halide lamps are also made in a compact linear from for floodlighting (MBIL) in which case the enclosed floodlighting projector takes the place of the outer jacket and in a very compact form (CSI) with a short arc length which is used for projectors, and encapsulated in a pressed glass reflector, for long range floodlighting of sports arenas, etc. In addition, single-ended low wattage (typically 150 W) metal halide lamps (MBI-T) have been developed offering excellent colour rendering for display lighting, floodlighting and up lighting of commercial interiors.

No attempt should ever be made to keep an MB and MBF lamp in operation if the outer bulb becomes accidentally broken, for in these types the inner discharge tube of quartz does not absorb potentially dangerous radiations which are normally blocked by the outer glass bulb.

Sodium Lamps:

Low pressure sodium lamps give light which is virtually monochromatic; that is, they emit yellow light at one wavelength only, all other colours of light being absent. Thus white and yellow objects look yellow, and other colours appear in varying shades of grey and black.

However, they have a very efficacy and are widely used for streets where the primary aim is to provide light for visibility at minimum cost; also for floodlighting where a yellow light is acceptable or preferred.

The discharge U-tube is contained within a vacuum glass jacket which conserves the heat and enables the metallic sodium in the tube to become sufficiently vaporized. The arc is initially struck in neon, giving a characteristic red glow; the sodium then becomes vaporised and takes over the discharge.

Sometimes leakage transformers are used to provide the relatively high voltage required for starting, and the lower voltage required as the lamp runs up to full brightness a process taking up to about 15 minutes. Modern practice is to use electronic ignitors to start the lamp which then continues to operate on conventional choke ballast. A power-factor correction capacitor should be used on the mains side of the transformer primary.

A linear sodium lamp (SLI/H) with an efficacy of 150 lm/W is available and in the past was used for motorway lighting. The outer tube is similar to that of a fluorescent lamp and has an internal coating of indium to conserve heat in the arc. Mainly because of its size the SLI/H lamp has been replaced with the bigger versions of SOX lamps as described above.

Metallic sodium may burn if brought into contact with moisture, therefore care is necessary when disposing of discarded sodium lamps; a sound plan is to break the lamps in a bucket in the open and pour water on them, then after a short while the residue can be disposed of in the ordinary way. The normal life of all sodium lamps has recently been increased to 4 000 hours with an objective average of 6 000 hours.

SON High-Pressure Sodium Lamps:

In this type of lamp, the vapour pressure in the discharge tube is raised resulting in a widening of the spectral distribution of the light, with consequent improvement in its colour-rendering qualities. Although still biassed towards the yellow, the light is quite acceptable for most general lighting purposes and allows colours to be readily distinguished. The luminous efficacy of these lamps is high, in the region of 1001m per watt, and they consequently find a considerable application in industrial situations, for street lighting in city centres and for floodlighting.

Three types of lamp are available; elliptical type (SON) in which the outer bulb is coated with a fine diffusing powder, intended for general lighting; a single-ended cylindrical type with a clear glass outer bulb, used for flood-lighting, (SON.T); and a double-ended tubular lamp (SON.TD) also designed for floodlighting and dimensioned so that it can be used in linear parabolic reflectors designed for tungsten halogen lamps. This type must always be used in an enclosed fitting.

The critical feature of the SON lamp is the discharge tube. This is made of sintered aluminium oxide to withstand the chemical action of hot ionized sodium vapour, a material that is very difficult to work. Recent research in this country has resulted in improved methods of sealing the electrodes into the tubes, leading to the production of lower lamp ratings, down to 50W, much extending the usefulness of the lamps.

Most types of lamps require some from of starting device which can take the form of an external electric pulse ignitor or an internal starter. At least one manufacturer offers a range of EPS lamps with internal starters and another range that can be used as direct replacements for MBF lamps of similar rating. They may require small changes in respect of ballast tapping, values of p.f. correction capacitor and upgrading of the wiring insulation to withstand the starting pulse voltage. Lamps with internal starters may take up to 20 minutes to restart where lamps with electronic ignition allow hot restart in about 1 minute.

Considerable research is being made into the efficacy and colour rendering properties of these lamps and improvements continue to be introduced.

Recent developments have led to the introduction of SON deluxe or DL lamps. At the expense of some efficacy and a small reduction in life far better colour rendering has been obtained. They are increasingly being used in offices and shops as well as for industrial applications

6.3 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 nown as the middle u.v. region and the third portion as the far u.v. region. 'Near' u.v. ays 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.

CHAPTER -7-

SWITCHES, SOCKETS AND BUTTONS

7.1 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

7.1.1 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…

7.1.2 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.

7.1.3 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.

7.1.4 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.

7.2 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

7.3 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.

At the electrical Project we have to fit to the rules of " BAYINDIRLIK BAKANLIGI ELEKTRİK TESİSATI ŞARTNAMESİ "

At the practice:

The switches from ground	150 cm
The sockets from ground	40 cm
The wall lamp from ground	190 cm
The conduit box from ground	220 cm
The fuse box from the ground	200 cm

CHAPTER -8-

CONDUCTORS AND CABLES

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 verhead lines about seventy years ago, and in an insulated form for buried cables at the urn 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.

.1 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.

8.2 INSULATORS:

Many materials are used for the insulation of cable conductors. The basic function of any cable insulation is to confine the electric current to a definite path; that is, to the conductor only. Thus, insulating materials chosen for this duty must be efficient and able to withstand the stress of the working voltage of the supply system to which the cable is connected. The following are some of the more common materials used for cable insulation:

8.2.1 Rubber:

This was one of the most common insulating materials until it was largely replaced by PVC. In old wiring systems it is found in its 'vulcanised form', which is rubber with about 5 per cent sulphur. It is flexible, impervious to water but suffers (it hardens and become brittle) when exposed to a temperature above 55°C. Because the sulphur content in the rubber attacks copper, the wires are always tinned. About the only application for rubber as insulation material for conductors nowadays is in domestic flexibles used for hand appliances such as electric irons. The working temperature is 60°C.

8.2.2 85°C rubber:

This material is a synthetic rubber designed for working temperatures up to 85°C. It is in its flexible cord format used for hot situations such as immersion heaters and night storage heaters where the heat from elements can travel into the flexible conductors. As a sheathing material it is susceptible to oil and grease and thus such flexibles are sheathed with chloro-sulphonated polyethylene (C.S.P.). This type of sheath is known as HOFR. Often used for heavy-duty applications, it is found in its larger csa sizes feeding exterior equipment such as mobile cranes and conveyors.

8.2.3 Silicone rubber:

This material is sometimes designated 150°C. Insulation and can operate in a continuous temperature up to that level. Applications of this fire-resistant cable include the wiring fire alarm, security and emergency lighting circuits where there is a need for these circuit to function in fire conditions. It is also useful when connections have to be made to terminals in enclosures in which heat might be considerable, such as in enclosed lamp fittings and heaters.

8.2.4 PVC:

This material is polyvinyl chloride and is now the most common insulating material used for cables and flexibles at low voltages. Its insulating properties are actually less than those for rubber. However it is impervious to water and oil and can be self-coloured without impairing it insulation resistance qualities. The maximum working temperature is 70°C. , above which the PVC will tend to become plastic and melt. If PVC exposed to a continuous temperature of around 115°C. It will produce a corrosive substance which will attack copper and brass terminals. At low temperatures, around 0°C., the PVC tends to become brittle and it is not recommended for PVC cables to be installed in freezing conditions. Apart from its use as conductor insulation, it is used as a sheathing material. Its most common form is in the cables used for domestic wiring and for domestic flexibles.

8.2.5 Paper:

Paper has been used as an insulating material from the very early days of the lectrical industry. The paper, however, is impregnated to increase its insulating ualities and to prevent its being impaired by moisture. Paper-insulated cables, usually f the large csa sizes, are terminated in cable boxes sealed with resin, or compound, to revent ingress of moisture. The cables are sheathed with lead and armoured with steel r aluminium wire or tape. Such cables are mainly used for large loads at high voltages.

8.2.6 Mineral Insulation:

This is composed of magnesium oxide powder and is used in the type of cable nown as MIMS with the sheath usually made from copper. It was originally developed o withstand both fire and explosion, but is now used for more general applications. The able is non-ageing and can be operated with sheath temperatures of up to 250°C. Because the magnesium oxide is hygroscopic (it absorbs moisture) the cable ends must lways be sealed. The temperature limits of the seals depend on the cable's application.

8.2.7 Glass Insulation:

This material is very heat-resistant and is used for temperatures as high as 80°C. As glass-fibre, the insulation takes the form of impregnated glass-fibre lappings, vith impregnated glass-fibre braiding. This insulation is found commonly in the internal viring of electric cookers or other appliances where the cable must be impervious to noisture, resistant to heat and be tough and flexible.

3.3 CABLES:

The range of types of cables used in electrical work is very wide: from heavy ead-sheathed and armoured paper-insulated cables to the domestic flexible cable used o connect a hair-drier to the supply. Lead, tough-rubber, PVC and other types of heathed cables used for domestic and industrial wiring are generally placed under the eading 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.

8.3.1 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).

8.3.2 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.

8.3.3 Three-core:

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

8.3.4 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.

8.3.5 Wiring Cables:

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

8.3.6 Power Cables:

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

8.3.7 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.

8.3.8 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.

8.3.9 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

8.3.10 Communications Cables:

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

8.3.11 Welding Cables:

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

8.3.12 Electric-sign Cables:

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

8.3.13 Equipment Wires:

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

8.3.14 Appliance-wiring Cables:

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

8.3.15 Heating Cables:

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

8.3.16 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:

8.3.17 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.

8.3.18 Three-core (twisted):

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

8.3.19 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.

8.3.20 Three-core (circular):

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

8.3.21 Four-core (circular):

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

8.3.22 Parallel-twin:

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

8.3.23 Twin-core (flat):

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

8.3.24 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.

CHAPTER -9-

EARTHING

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.

Regulations:

The main basic requirements are:

- The complete insulation of all parts of an electrical system. This involves the use of apparatus of 'all-insulated' construction, which means that the insulation which encloses the apparatus is durable and substantially continuous.

- The use of appliances with double insulation conforming to the British Standard Specifications.

- The earthing of exposed metal parts

- The isolation of metalwork in such a manner that it is not liable to come into contact with any live parts or with earthed metalwork.

The basic requirements for good earthing are that the earthing arrangements of the consumer's installation are such that the occurrence of a fault of negligible impedance from a phase or non earthed conductor to adjacent exposed metal, a current corresponding to three times the fuse rating or 1.5 times the setting of an overcurrent circuit breaker can flow, so that the faulty circuit is made dead. The earthing arrangement should be such that the maximum sustained voltage developed under fault conditions between exposed metal required to be earthed and the consumer's earth terminal should not exceed 50 V.

The IEE Regulations detail the metalwork found in premises, called 'extraneous conductive parts ', which are required to be connected to the installations main earthing terminal. Bathroom and showers are also covered.

The CPC is the conductor which bonds all metalwork required to be earthed. If it is a separate conductor (insulated and green coloured green) it must be at least 1/1.13 (Csa = 1.00 mm^2) and need not be greater than 70 mm^2. Note that conduit and trunking may be used as the sole CPC except in agricultural installations.

Where metal conduit is used as a CPC, a high standard of workmanship in installation is essential. Joints must be really sound. Slackness in the joints may result in deterioration in, and even complete loss of, continuity. For outdoor installations and where otherwise subjected to atmospheric corrosion, screwed conduit installations, the liberal use of locknuts is recommended. Joints in all conduit systems should be painted overall after assembly. In mixed installations (e.g. aluminium-alloy conduit with steel fittings, or steel conduit with aluminium-alloy or zinc-base-alloy fittings) the following are sound recommendations to ensure the electrical continuity of joints.

All threads in aluminium or zinc alloys should be cut using a suitable lubricant. A protective material (e.g. petroleum jelly) should be applied to the threads in all materials when the joint are made up. All joints should be made tight. The use of locknuts is advised. In addition, it is recommended to apply bituminized paint to the outside of all joints after assembly. In damp conditions, electrolytic corrosion is liable to occur at contacts between dissimilar metals. To avoid this, all earthing clamps and fittings in contact with aluminium-base-alloy tubing should be of an alloy or finish which is known from experience to be suitable. Copper, or alloys with a high copper content, are particularly liable to cause corrosion when in contact with aluminium-base alloys. For this reason, brass fixing screws or saddles should not be used with conduit of fittings of aluminium base alloys. Periodical tests should be made to ensure that electrical continuity is satisfactorily maintained. Flexible conduits should not be used as a CPC. Where flexible tubing force part of an earthed metal conduit system, a separate copper-alloy CPC should be installed with the tubing and connected to it at each end.

The earth-conductor lead should be of a minimum size: 6 mm^2, expect 2.5 mm^2 is accepted for connection to an earth-leakage circuit-breaker. It must also be protected against mechanical damage and corrosion, and not less than half the largest size of the conductor to be protected, but need normally exceed 70 mm^2.

There are a number of methods used to achieve the earthing of an installation:

1. Connection to the metal sheath and armouring of a supply authority's underground supply cable

2. Connection to the continuous earth wire (CEW) provided by a supply authority where the distribution of energy is by overhead lines.

3. Connection to an earth electrode sunk in the ground for the purpose.

4. Installation of a protective-multiple earthing system.

5. Installation of automatic fault protection.

One disadvantage in using a mains water-pipe is that sections of the pipe may be replaced by sections of non-conducting material (PVC or asbestos), which makes the pipe an inconsistent earth electrode. The provision of a cable sheath as an earthing connection is very common nowadays. Usually, however, it is accepted that if, for any reason, the earthing is subsequently proved ineffective, the supply authority except in those areas which have extremely high values of soil resistivity (e.g. peat and rock). The CEW is sometimes called an aerial earth. Connection to an earth electrode sunk in the ground is the most common means of earthing. The earth electrode can be any one of the following forms :

a.Pipe:

Generally a 200 mm diameter cast-iron pipe, 2 m long and buried in a coke –filled pot. This type requires a certain amount of excavation; iron is, of course, prone to corrosion, particularly if the coke has high sulphur content.

b.Plate:

Plate electrodes are normally of cast-iron, buried vertically with
The centre about 1 m below the surface. Copper plates may also be used. Plate electrodes

Provide a large surface area and used mainly where the ground is shallow (where the resistivity is low near the surface but increases rapidly with depth). Again, excavation is required. Care is needed to protect the earth-electrode connection (to the earthing lead) from corrosion.

c.Strip:

Copper strip is most useful in shallow soil overlying rock. The strip should be buried to a depth of not less than 50 cm.

d.Rods:

Rod electrodes are very economical and require no excavation for their installation. Because buried length is more important than diameter, the extensible, small-diameter copper rod has many advantages. It can, for instance, be driven into the ground so that the soil contact with the rod is close and definite. Extensible rods are of standard lengths and made from hard-drawn copper. They have a hardened steel tip and a steel driving cap. Sometimes the copper rod has a steel rod running through its centre for strength while it is being driven into rocky soil. Ribbed earth rods have wide vertical ribs to give a high degree of mechanical stiffness, so that they are not easily bent or deflected when driven into the ground.

Because the method used to connect the earthing lead to the earth electrode is important, all clamps and clips must conform to the requirements of the IEE Regulations.

The PME method gives protection against earth-fault conditions and uses the neutral of the incoming supply as the earth point or terminal. In this system of earthing, all protected metalwork is connected, by means of the installation CPCs, to the neutral-service conductor at the supply-intake position. By doing this, line-to-earth faults are converted into line-to-neutral faults. The reason for this is to ensure that sufficient current will flow under fault conditions to blow a fuse or trip an overload circuit-breaker, so isolating the faulty circuit from the supply.

Residual-current ELCBs are now only recognized by the Regulations. The basic principle of operation depends upon more current flowing into the live side of the primary winding than leaves by the neutral or other return (earth) conductor. The essential part of the residual-current ELCB is a transformer with opposed windings carrying the incoming and outgoing current. In a healthy circuit, where the values of current in the windings are equal, the magnetic effects cancel each other out. However, a fault will cause an out-of-balance condition and create a magnetic effect in the transformer core which links with the turns of a small secondary winding. An emf is induced in this winding. The secondary winding is permanently connected to the trip coil of the circuit-breaker. The induced emf will cause a current to flow in the trip coil:
If this current is of sufficient value the coil will become energized to trip the breaker contacts. A test switch is provided.

CONCLUSION

It is important to choose the proper materials or elements in building installation and project. (The materials, such as fuse, socket, switch, cable, and conduit are used). In what condition and where they are used are investigated.

If electrical installation does not wire properly, then it can cause the fire or it can damage whole cables in the building. Therefore, electrician should be careful while drowning the electrical installation project. The project must be suitable for Turkish standard.

The Electrical Installation Project bases on how installation should be; what is paid attention in drowning the project and how it should be drowned.

(The materials used by electrician in grounding).

It is better to choose proper materials used in grounding by electrician and they should be convenient for Turkish standard institute.

This project helps us to obtain information about calculation how we make according to what rules and the importance of grounding for human life, and we get detail information on the characteristics of materials which are used in buildings.

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