NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

ILLUMINATION PROJECT

Graduation Project
EE-400

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ABSTRACT

The subject of our Project is the ilimunation. Ilumination is in general consists of generation, distribution, economy and measurement of light. The benefits of good ilimunation are good sight, helping to keep eyes healthy, less accidents, increase productivity, increase economic potential, increase security, increase convertibility.

The main objective of this thesis is to make ilumination calculations of a building according to architectural plan that we have. While doing these calculations we tried to use the best methods in order to get the true results. Our aim was to make the most suitable design according to these calculations. Efficiency and cost were very important.

INTRODUCTION

Our Project is about illumination engineering in buildings and illumination calculation.

The first chapter is about the definition of illumination. It involves generation, distribution, economy and measurement of light. After these are ınentioned, forınulas and tables are given.

The second chapter is about circuit types, usage and history. And also contains the ıneaning of circuit. What types of circut Ring circuıt ıneans use history or Radial and Converting circuıt against.After diff erent Ring circuıt or Radial and Radial Converting circuıt after Ring or Converting circuıt afterwards switch of electricty of the tiınes ıneans and consumers units fusebox however about chapter never consuıner units finally this chapter Replace the cover of the fuse box. Switch the power on and test sockets on the old and new part of your new ring circuit. Ave resorch

Third chapter we have resorched light switch and History of culture Light switch After chapter means of ligth switch or connecting of switch afterwards what is the desing of light switch and the inside of light switch however this chapter which kind of light switch means of kind toggle,rocket swich,mercury switch,electronic switch after configuratıon usages today industry in delil.

In foruth chapter we have searched about standart of domestıc AC power plugs and soceetsafter used by World maps by plug/socket and voltage/frequency we have explaned differences of these types of plugs and socets however this chapter about Proliferation of standards and ınore means table Standard wire colours for flexible cable or Standard wire colours for fixed cable means this chapter

In fifth chapter we about of electirical safety and means this chapter safety descriptıon after kind of the electrıcal saf ety Engineer Contractor Maintenance Manufacturer this chapter however modes of electric safety or this section part real time mode or reactive mode ınore this safety resources plus apllication safety biriefly aim methots is human healty .

In last chapter we have mentroned about importance of circuıt breakers in todays. We talked this chapter Cırcuıt Breaker of The Means and Operation MCB this factor important factortypes of circuıt breaker working prencible human life. More chapter about Arc Interruption MCB and talking kind of Types of Circuit Breaker after this chapter about rated current c,{(Sômmon Trip Breakers and What is difference between an isolator and MCB in an electric circuit? Plus this part very important What is acb/mccb or What is acb/mccb difference in electrically/mechanically.

1.ILLUMINATION METHODS

This methods are used for interior illumination to iliminate the medıum successfully. The proper type should be decided. The standart illumınatıon level data is obtained from the sdantard table

1.lBenefit of the Good IUuminatıon

- Good sigth
- Help to keep eyes healty
- Less accidents
- Increase productıvty
- Increase securty
- lncrease comfortability

DENKLEMLER

DENKLEM	SEMBOLÜ	AÇIKLAMA
$Z=\frac{\Phi T}{\Phi L}$	Z	Ampul sayısı
	0T	Gerekli toplam ış_ık akısı (lm)
	0L	Bir am_2.ulün y~rdiği ışık akısı (lm.)
	k	Bölge indel<_sijmahal boyutlarına bağh olarak)
$k=\frac{axb}{h(a+b)}$	a	Uzunluk (m)
	b	Geni_ş_lik (m)
	h	Işık kaynağının çalışma düzlemine ola_ll_ yüksekliği (m)
	H	Işık kaynağının zeminden yüksekliği (m)
	Hl	Çalışma düzleminin z~minden yül<_~ekliği
	E	Gerekli aydı1 1lıtseviyesi (LUX) tal:)l9dan seçilir
$ØT=\frac{ExAxd}{\eta}$	A	Aydınlatılac:a!< bölgenin alanı (m")
	d	Tesisin kirlenme faktörü (Tablodan se_ç_ilir)
	η	Tesisin ışığı yansıtma verimi. Aydınlatma sahasını sınırlayan tavan, duvar ve zeminin yansıtma faktörlerine, bölge indeksine ve seçilen armatür tipine ba_ğlı olarak tal:)lodan seçilir.

VERİLER

ODA BOYUTLARI	KİRLENME FAKTÖRÜ: 1.25	AYDINLIK ŞİDDETİ	ARMATÜR TİPİ	"TL" 54/40 w ampulün verdiği
a=13 m	TAV AN: AÇIK 0.8	E=500 LUX	TMS 240	ışık akısı 0L
b=5.5 m.	DUVAR: HAFİF KOYU 0.5	(TABLODAN SEÇİLİR)	LAMBA TİPİ	
H=3 m.	ZEMIN: KOYU 0.1		"TL" 54/40 W.	2100 Lümen

HESAPLAMA YÖNTEMİ

SIRA NO	İSTENİLEN	DENKLEM	HESAPLAMA	SONUÇ
1	h	lh=H-hl	h=3-0.85 m.	h=2.15 m.
2	k	k= {}Xb / hx_a+ b)	k= 13x5.5. / 2.15x(13 +5.5)	k=2
3	rı	Tesisin aydınlanma etkinlik faktörü (Tablodan seçilir) =0.46		
4	d	Tesisin kirlenme faktörü (Tablodan seçilir) d=l.25		
5	A	IA=axb	A=13x5.5 m	IA=71.5m
6	0T	l0T=_ff_ Ex&d	0T= 500x71.5x1 .25 / 0.46	l0T=97146
7	Z	Z=$L (1) T	Z=7IID 97146	IZ=46 adet
8	"TL" 54/40 W	Z=46 adet fluoresant ampul kullanılacak		
9	TMS 240	Bir armatürde 2 adet "TL" 54/40 W. fluoresant ampul olduğuna göre		
10	Z/2	büro aydınlatmasında 23 adet TMS 240 armatür kullanılacaktır.		

Büro aydınlatmasını armatür sayısına göre tekrarlarsak

11	E	E= (fı LxZ.xrı / axA	E= 21 Oüx46 xO .46 / 1 .2sx71 .S	E=497 LUX

Bir büro aydınlatmasında E= 497 Lux'lük bir aydınlatma seviyesi elde edilir.

YANSITMA BİLGİLERİ

YAPI MALZEMELERİ		DUVAR BOYALARI	
Ak ağaç,huş ağacı	0,50	eyaz	0,30-0,70
Meşe,açık renk,parlatılmış	0,25-0,35	çık gri	0,40-0,60
Meşe,koyu renk,parlatılmış	0,01-0,15	Orta gri	0,25-0,35
Sunta,krem rengi	0,50-0,60	Koyu gri	0,10-0,15
Granit	0,20-0,25	avı	0,15-0,20
Kireç taşı	0,35-0,55		0,45-0,55
Mermer,parlatılmış	0,30-0,70	Koyu yeşil	0,15-0,20

Tavan, duvarlar ve çalışma düzlemi-nin ışık yansıtma katsayıları.

Tavan	Duvarlar	Çalışma Düzlemi
0,8	0,8	0,3
0,8	0,5	0,3
0,8	0,3	0,3
0,5	0,5	0.3
0,5	0,3	0,3
0,7	0,7	0,2

2. TYPES OF CIRCUIT

- RiNG CIRCUIT
- RADIAL CIRCUIT
- CONVERTING CIRCUIT

2.1. WHAT IS THE RiNG CIRCUIT

In electricity supply, a **ring final circuit** or **ring circuit** (informally also **ring main** or just **ring)** is an electrical wiring technique developed and primarily used in the United Kingdom that provides *two* independent conductors for live, neutral and protective earth within a building for each connected load or socket.

This design enables the use of smaller-diameter wire than would be used in a radial circuit of equivalent total amperage. Ideally, the ring acts like two radial circuits proceeding in opposite directions around the ring, the dividing point between them dependent on the distribution of load in the ring. If the Joad is evenly split across the two directions the amperage in each direction is half of the total, allowing the use of wire with half the current-carrying capacity. In practice, the load does not always split evenly, so thicker wire is used.

2.1.1 Description

In a single-phase system, the ring starts at the consumer unit (also known as "fuse box" or "breaker box"), visits each socket in tum, and then retums to the consumer unit. In a three-phase system, the ring (which is almost always single-phase) is fed from a single-pole breaker in the distribution board.

Ring circuits are commonly used in British wiring with fused 13 A plugs to BS 1363. They are generally wired with 2.5 mm^2 cable and protected by a 30 A fuse, an older 30 A circuit breaker, ora European harmonised 32 A circuit breaker. Sometimes 4 mm^2 cable is used if very long cable runs (causing volt drop issues) or derating factors such as thermal insulation are involved. 1.5 mm^2 mineral-insulated copper-clad cable ('pyro') may also be used (as mineral insulated cable can withstand heat more effectively than normal.PVC) though obviously more care must be taken with regard to voltage drop on longer runs.

Many lay people in the UK refer to any circuit as a "ring" and the term "lighting ring" is often heard from novices. it is not unheard of to see lighting circuits wired as rings of cable (though usually still with a breaker below the cable rating) in DIY installations.

2.1.2. History and usage

The ring circuit and the associated BS 1363 plug and socket system were developed in Britiain during 1942-1947.[IJ They are commonly used in the United Kingdom and to a lesser extent in the Republic of Ireland. it is likely that they are also used in parts of the Commonwealth of Nations, where Britain had design influence in the past.

The ring main came about because Britain had to embark on a massive rebuilding programme following World War n.!". There was an acute shortage of copper, and it was necessary to come up with a scheme that used far less copper than would normally be the case. The scheme was specified to use 13 Anıp fused socket outlets and several designs for the plugs and sockets appeared. Only the square pin (BS1363) system survives, but the round pin D&S system was still in use in many locations well into the 1980s. This latter plug had the distinctive feature that the fuse was also the live pin and unscrewed from the plug body.

The ring circuit was devised during a time of copper shortage to allow two 3 kW heaters to be used in any two locations and to allow some power to small appliances, and to keep total copper use Jow. it has stayed the most common circuit configuration in the UK although the 20 A radial (essentially breaking each ring in half and putting the halves on a separate breaker) is becoming more common. Splitting a ring into two 20 A radials can be a useful technique where one leg of the ring is damaged and cannot easily be replaced.

Another advantage of ring circuits in their early days was an economy of cable and labour, due to the fact that one could simply connect a cable between two existing *15A radially* wired sockets *to* make one *30A ring,* then *adding* as many sockets as were desired. *This* was an important consideration in the austerity of the 1940s. *This would* leave the ring supplied by 2x 15A fuses, which worked well enough in practice, even if unconventional.

Many pre-war (round pin) installations used double pole fusing. When 2x 15A radials were converted to a ring on these systems, the ring would then be supplied by no less than 4 fuses! It is rare to find such circuits still in service today

2.2. CONVERTING A RADIAL CIRCUIT

1 convertıng a radial circuit to

2 older consumer unıts-fusebox

3 never consumer unıts

4 finally

2.2.1. Radial Circuit and Wiring

A radial circuit is a mains power circuit found in some homes to feed sockets and lighting points. **it** is simply a length of appropriately rated cable feeding one power point then going on to the next.

The circuit terminates with the last point on it. It does not return to the consumer unit or fuse box as does the more popular circuit, the ring main. To see the wiring at the back of the socket please go to the ring main project.

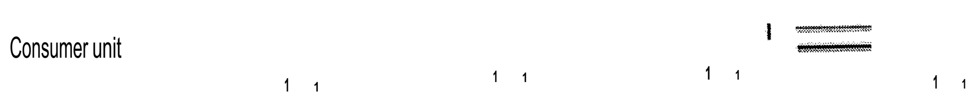


Fig.2.2.1 :Radıal Circuıt

The descriptions below apply only to a circuit for power sockets.Lighting circuits are dealt with in a separate project.

There is no limit to the number of sockets used on a radial circuit providing the circuit is contained within an area not exceeding 50 square m, and, just like a ring main, spurs, or extra sockets, can be added.

The number of spurs must not exceed the number of existing sockets. The images below are all rated for use with a radial circuit and can be bought by clicking on them.

2.2.2. Meaning of Convertıng a Radial Circuit

There are two types of radial circuit; 20amp circuits wired with 2.5mm2 cable and 30amp circuits wired with 4mm2. The principle of the radial circuit, is that the mains cable leaves the consumer unit and passes through each socket until it reaches and ends at the last socket.

Alternatively, on a ring circuit the mains cable leaves the consumer unit passes through every socket and then returns to the consumer unit.

The advantage of the ring circuit is that electricity can reach the sockets from two directions and so reduces the load on the cable. For other advantages see Types of electrical circuit.

The two diagrams show the difference between the radial and ring circuits. The top diagram shows the existing radial circuit, the bottom diagram shows the original radial circuit converted into a ring circuit. (The new part of the circuit is shown in orange).

Fig.2.2.2 :Radial circuit

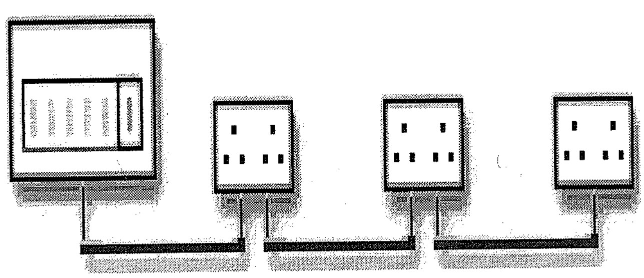
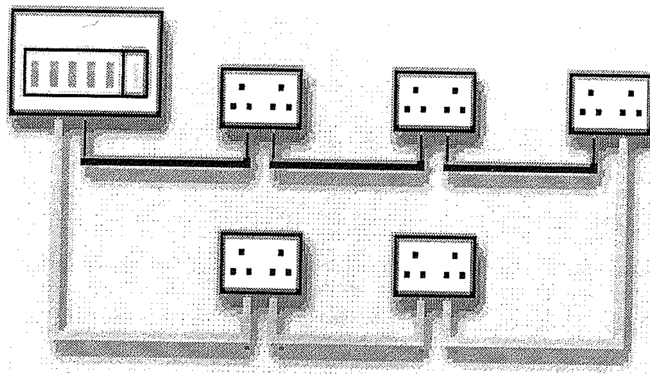


Fig.2.2.2.1 :Radial circuit converted to ring circuit



Ring circuits are wired with 2.5mm_2 cable and always have a 30amp fuse/ 32 amp MCB. If your existing radial circuit is a 30amp circuit with 4mm_2 cable you can simply complete the new part of the circuit using 2.5mm_2 cable retuming from the last socket to the consumer unit.

If however your existing radial circuit is a 20amp circuit using 2.5mm_2 cable, then you can complete the loop back to the consumer unit with 2.5mm_2 cable but the fuse will have to be upgraded from a 20amp to a 30amp fuse.

The usual reason to convert a radial to a ring circuit is because the return stretch of cable can be used to add more sockets to the house.

Initially, plan the route of the retum cable noting the locations of any extra sockets you require. To locate the position of the !ast socket on a radial circuit, first switch off the power by the main switch on the consumer unit.

2.3. SWITCH OFF ELECTRICITY AT THE MAINS

All of the sockets on the radial circuit will have two cables going into them, hcmp,,;,;. the !ast position on the radial circuit will only have a single cable. ünce this has been located the cable for the new part ofthe ring circuit should be connected to it.

Ensuring that the power supply is off, remove the conductors from the last point on the radial circuit. Twist together the conductors from the old cable with the new cable i.e. red to red, black to black and green/yellow to green/yellow, (if the earth wire is bare then it should have a green/yellow sleeve placed over the its bare part). Insert the twisted conductors back in their appropriate screw terminals on the back of the socket i.e. red to Live (L), black to Neutral (N) and green/yellow to Earth (E or ~), and replace the socket.

Use the remaining length of new cable to retum to the consumer unit. If you desire more sockets, leave a generous loop of cable at the new socket points. These points can be installed ata later time (See Installing a power socket).

At this point the power should still be OFF. The cover of the consumer unit should now be removed. **DANGER:** despite the fact that the electricity is switched off, the cables from the meter are still live, so be very careful.

Locate the fuseway/MCB with the single cable going out for the radial circuit you are dealing with.

2.4. Older Consumer Units-Fusebox

For the older consumer unit with fuses, remove the fuse for the circuit you are working on. This exposes the plastic mounting which holds the fuse. This mounting is held in place with a small screw in its centre, by removing this mounting you can gain access to the screw terminal that hold the radials' circuit cable in place - remove this wire.

ünce you have access, twist the old wire with the new live (red) wire and place in the screw terminal. Tighten the screws and replace the fuse mounting and fuse.

If the fuse is 20amp it will need change it to a 30amp fuse. Now find the existing neutral (black) cable from the existing radial circuit and remove it. Twist it together with the new neutral cable and replace.

Tighten the screw terminal back up. Finally find the existing earth cable and repeat the process, twisting the old with the new and then replacing in the screw terminal and tightening.

2.5. Never Consumer Units

For the consumer unit with MCBs (Miniature Circuit Breakers), the red conductor of the existing radial circuit is held in place by a visible screw terminal on the top of the relevant MCB. Undo the screw terminal and remove the wire.

The MCB for the new ring circuit must be rated 30/32amp, if it is not then it must be changed before proceeding. Twist the old red wire with the new live (red) wire and secure it back into the screw terminal. Now remove the existing neutral (black) conductor for the radial circuit yuo are working on. Twist it together with the new neutral cable and replace. Tighten the screw terminal back up. Finally find the earth cable and repeat the process, twisting the old wire with the new and then replacing.

2.6.Finally

Replace the cover of the fuse box. Switch the power on and test sockets on the old and new part of your new ring circuit.

3. LIGHT SWITCH

3.1. History of culture Light switch

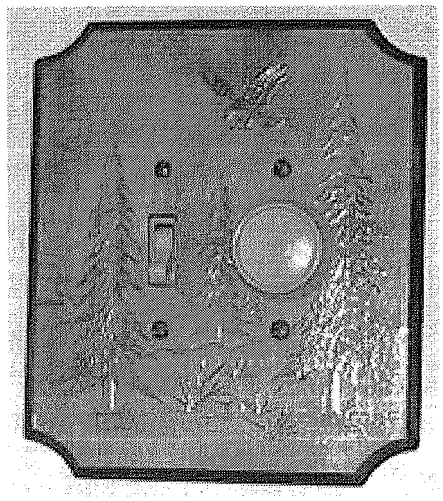


Fig.3.1 :Light Switch

Two lightswitches in one box. The switch on the right is a dimmer switch. The switch box is covered by a decorative plate.

The first light-switch employing quick-break technology was invented by John Holmes in 1884 in the Shieldfield district of Newcastle-Upon-Tyne. Light switches are usually built into the walls of the house. Surface mounting is also fairly common though is seen more in commercial industrial and outbuilding settings than in houses.

Because of electrical safety considerations in many countries their design and installation is regulated either by law or by widely accepted industry standards. In practice however in most countries any requirements for permits or certification are widely ignored and replacing a light switch is considered a simple "do-it-yourself" task with the parts being widely available.

Because of regulatory issues and the fact that light switches aren't something that people are usually too bothered with the looks of they are usually durable and conservative in design. They frequently remain in service for many decades, often being changed only when a portion of a house is rewired. it is not extremely unusual to see century-old light switches still in functional use.

The dimensions, mechanical designs, and even the general appearance of light switches changes very slowly with time. Manufacturers introduce various new forms and styles, but for the most part decoration and fashion concems are limited to the faceplates. Even the "modem" dimmer switch with knob is at least four decades old, and even in the newest construction the familiar toggle and rocker switch appearances predominate.

The shape and size of the boxes and faceplates as well as what is integrated (for example in the UK it is normal to have the switch built into the plate) varies a lot by country. The direction which represents "on" also varies by country. In the United States it is universal for the "on" position ofa toggle switch to be "up", whereas in the UK, Australia, and New Zealand it is "down."

3.2. What is the Meaning of Light Switch

A **light switch** is a switch, most commonly used to operate electric lights, permanently connected equipment, or electrical outlets.In modem homes most lights are operated using switches set in walls, usually 6-10 inches (15-25 cm) away from a door, to operate overhead ceiling lights. in torches (flashlight) the switch is often near the bulb, but may be in the tail, or even the entire head itself may constitute the switch (rotated to tum the light on and off).Home light switches, being in reality a metal or plastic box with a switch in it, commonly have switch plate covers called wall plates. These are plastic, ceramic or metal, and prevent accidental contact with live terminals of the switch. Wall plates are available in different styles and colours to blend in with the style of a room.

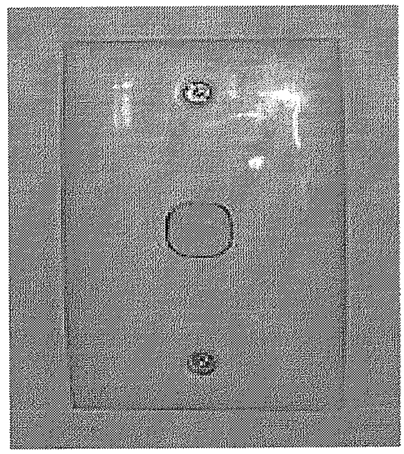


Fig 3.2 :A typical "down" light switch - this one is on. The design shown here is prevalent Australia-wide

A dimmer **switch** is a kind of light switch that allows a light to be dimmed or brightened continuously. Conceptually, a variable resistor in series with a lamp would allow adjustment of its brightness, but this would be inefficient and costly owing to power dissipated in the resistance as heat.

Historically, and still used for some theatrical lighting, a variable autotransformer can be used to adjust the voltage applied to the lamps, and so, the brightness; but this equipment is too large to fit into a standard wall box.

Solid-state thyristor switches allow for control of lighting by blocking part of the alternating current for an adjustable time delay, thereby allowing only part of the current through the dimmer and reducing the power input to the lamp.

Nearly all dimmers use phase cutting systems based on triacs, controlled by a rotary or sliding knob or, more recently, a touch-sensitive plate. The components are small and low-cost and easily fit into wall boxes designed for on-off switches.

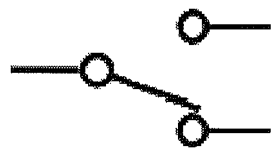
Dimmers are intended only for use with permanently-installed lighting fixtures, and generally work best with incandescent lamps. Certain fluorescent fixtures used for commercial lighting can be dimmed, but these have special wiring requirements.

Tungsten-halogen lamps may give unsatisfactory service life if operated on a dimmer since the intemal redeposition of filament metal may not work properly at lower filament temperatures; see dimmer for more information.

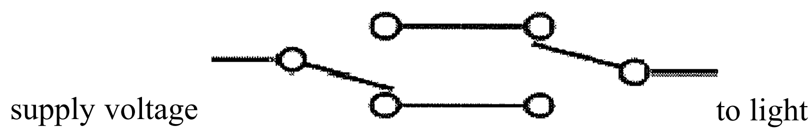
3.2.1. Three-way and four-way

Three-way and four-way switches make it possible to control a light from multiple locations, such as the top and bottom of a stairway, or either end of a long hallway. These switches are extemally similar to normal, single-pole switches, but have extra connections which allow, in effect, two circuits to be controlled, which can be thought of as the "on" circuit and the "off" circuit. Toggling the switch disconnects one circuit and connects the other.

Electrically, a three-way switch is a single-pole, double-throw (SPDT) switch:



By connecting two of these switches together back-to-back, it can be arranged that toggling either switch changes the state of the light from off to on, or on to off:



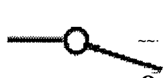
A four-way switch has two pairs of terminals which it connects either straight through, or crossed over:

-0-0-,

;-II.

~

By connecting one or more four-way switches in-line with three-way switches at either end, the light can be controlled from three or more locations. Toggling any switch changes the state of the light from off to on, or on to off:



supply voltage 0-~-0 to light

3.3. Design of Light Switch

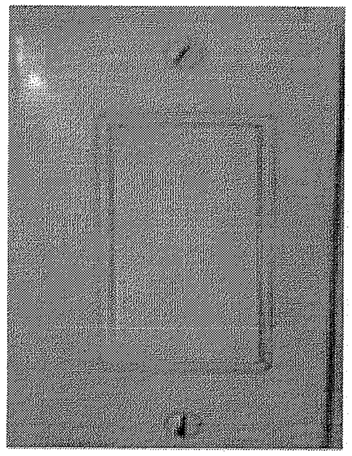


Fig.3.3 :A rocker switch, with a cover screwed in to prevent electrical shocks caused by water coming into contact with the wires.

In the case of light switches, the circuit to be switched is within 10% of 230 volts at 5A 6A or 10A for ali European and most African and Asian countries, whereas Japan and most of the Americas use a supply between 100 and 127 volts with maximum circuit currents of up to 15 or 20 amperes so the overall power per circuit is similar. In the US it was formerly considered acceptable to mix outlets and lighting on the same circuit; however, building codes in effect for the past three decade in most areas have required that lighting and receptacles be on separate circuits. In the UK putting normal 13A BS1363 sockets on a lighting circuit is frowned upon (though not explicitly prohibited) but 2A or 5A BS546 outlets are often put on lighting circuits to allow control of free-standing lamps from the room's light switches. in the U.S., this is very common in mobile homes. It is common in American site-built housing for living rooms and bedrooms to have a switched receptacle on the receptacle circuit for the same purpose.

3.4. Light Switch Of Internal Operation

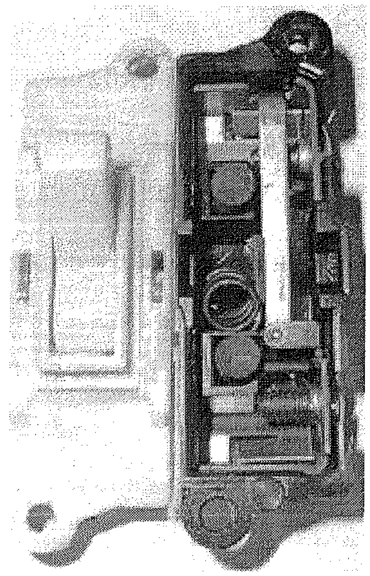


Fig.3.4 :Intemal operation ofa toggle switch (explanation)

A switch is most vulnerable when the contacts are opening or closing. As the switch is closed, the resistance of the switch changes from nearly infinite to nearly zero. At infinite resistance, no current flows and no power is dissipated. At zero resistance, there is no voltage drop and no power is dissipated. When the switch changes state however, there is a brief instant of partial contact when resistance is neither zero nor infinite and power is dissipated. During that transition the contacts heat up. If the heating is excessive, the contacts can be damaged or even weld themselves closed.

Thus the switch is designed to make the transition between effectively infinite resistance and effective zero resistance as swiftly as possible. This is achieved by the initial operation of the switch lever mechanism storing potential energy, usually as stress in a spring. When sufficient energy is stored, the mechanism in the switch "breaks over" driving the contacts through the transition from open to close, or close to open, without further input by the switch operator.

in addition, during the transition when the contact is broken there is an additional issue that if an inductive load is being switched, the stored energy in the inductor is dissipated as an arc within the switch, prolonging the transition and worsening the heating effect on the contacts. Thus switches are commonly rated by the current they are designed to break, as this is the most stringent constraint.

The arc that results when the switch operates corrodes the switch contacts, in time leading to erosion of the contact surface and fouling of the contact area by corrosion byproducts. A switch therefore has a finite life, again often being rated at a given number of cycles of disconnection at a specified current. Operation outside its design envelope will shorten the switch life very drastically.

To combat contact corrosion a switch is usually designed to have a wipe action such that the contact corrosion is cleaned off the area of the contact that forms the low resistance path when the switch is closed. It's also designed so that the initial point of contact, and thus the majority of the contact corrosion, occurs at a sacrificial part of the contact, rather than the face that is in contact when the switch is fully closed. Depending on the switch rating and price, the contact area of the switch is often a sophisticated construction of brass contact, silver contact button, and plated finish to minimize the amount of contact corrosion and thus extend the life of the switch.

Many higher current switch designs rely on the separation arc to assist in dispersing contact corrosion, and that a switch designed for high current/high voltage use may become unreliable if operated at very low currents and low voltages because the contact corrosion builds up excessively without an arc to disperse it.

When a pair of contacts is badly designed, or overloaded in relation to its design, if the contacts are visible two kinds of "sparks" may be seen. On closure, a few sparks like those from a flint-and-steel may appear as a tiny bit of metal is heated to incandescence, melted, and thrown off. On opening, a bluish arc may occur with a detectable "electrical" (ozone) smell; afterwards the contacts may be seen to be darkened and pitted. Damaged contacts have higher resistance, rendering them more vulnerable to further damage and causing a vicious circle in which the contacts soon fail completely.

To make a switch safe, durable, and reliable, it must be designed so that the contacts are held firmly together under positive force when the switch is closed. It should be designed so that regardless of how the person operating the switch manipulates it, the contacts always close or open quickly. Despite this, a switch should not be held between its two positions (on or off); this is especially true on older mechanisms.

The spring that stores the energy necessary for the snap action of the switch mechanism, in many small switch designs is made ofa beryllium copper alloy, that is hardened to form a spring as part of the fabrication of the contact. The same part often also forms the body of the contact itself, and is thus the current path. Abusing the switch mechanism to hold the contacts in a transition state, Of severely overloading the switch, will heat and thus anneal the spring, reducing Of eliminating the "snap action" of the switch, leading to slower transitions, more enefgy dissipated in the switch, and progressive failure.

3.5. Types of Light Switch

3.5.1. Push Button

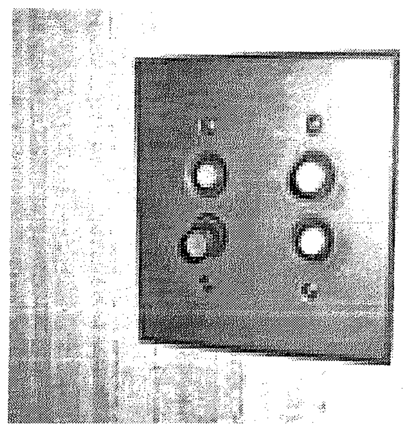


Fig.3.51 :A push button light switch.

Prior to the toggle switch a popular design was the push-button switch, composed of a depressed button oriented below or beside a raised button. Pushing the raised button opens or closes the contacts while popping out the previously depressed button so the process can be reversed. Push button switch reproductions are available on the market today for vintage or authentic styling.

3.5.2. Toggle

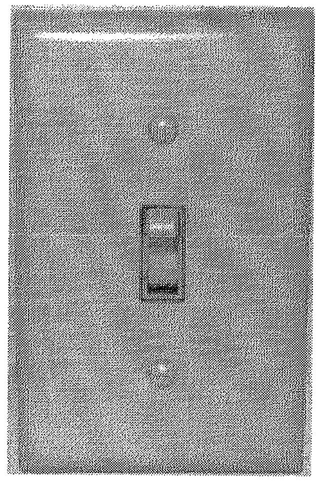


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Fig **3.5.2** :A toggle light switch.

The traditional light-switch mechanism is a toggle mechanism that provides "snap-action" through the use of an "overcenter" geometry. The switch handle does not control the contacts directly, but through an intermediate arrangement of springs and levers. Tuming the handle does not initially cause any motion of the contacts, which in facı continue to be positively held open by the force of the spring. Tuming the handle gradually stretches the spring. When the mechanism passes over the center point, the spring energy is released and the spring, rather than the handle, drives the contacts rapidly and forcibly to the closed position with an audible "snapping" sound. The snap-action switch is a mechanical example of negative resistance.

This mechanism is very safe, reliable, and durable, but produces a loud snap or click. (Many people have at some point in their lives made an attempt to reduce this noise by operating the handle slowly or gingerly. Of course this is to no avail, since the very purpose of the mechanism is to ensure that the electrical portion of the switch always operates rapidly and forcefully - and noisily - regardless of how the handle is manipulated).

As of 2004 in the United States, the toggle switch mechanism was almost entirely supplanted by "quiet switch" mechanisms. "Quiet switch" mechanisms still possess a form of snap action, but which is very weak as compared to its predecessor.

They are therefore equipped with larger, high-quality contacts that are capable of switching domestic loads without damage, despite the less-positive action.

3.5.3. **Rocker** Switches

An altemative North American design is the rocker, more commonly know as "decorator" or the Leviton trade name "Decora". This design sits flush to the wall, and is activated by "rocking" a large paddle , rather than pushing a short handle up and down. Besides mechanical switches, a large variety of other devices, such as dimmers, electronic switches, motion sensors, nightlights, receptacles, low voltage connectors, and GFCis are available in decorator style giving a consistent look to an installation. Disadvantages are that there are fewer styles of cover plates available, and it's more difficult to see at a distance what position a switch is in.

3.5.4. Mercury Switches

Before the 1970s, mercury switches were popular. They cost more than other designs, but were totally silent in operation. The switch handle simply tipped a glass vial, causing a large drop of mercury to roll from one end to the other. As it rolled to one end, the drop of mercury bridged a pair of contacts to complete the circuit. Many of them also would glow faintly when they were "off" to aid people in finding them when the room was dark. The vial was hermetically sealed, but concems about the release of toxic mercury when the switches were damaged or disposed of led to the abandonment of this design. in the U.S. there has never been any effort to recall or replace existing mercury switches, and millions of them remain in use.

3.5.5. Electronic Switches

In principle, it is easy to design silent switches in which the mechanical contacts do not directly control the current, but simply signal a solid-state device such as a thyristor to complete the circuit. Many variations on this theme have been created and marketed. "Touch-plate" devices can be operated by touching or merely waving a hand near the switch. Public buildings such as hospitals frequently save energy by using "motion-detector" switches. As of 2006 these remain specialty items, probably because of the greater cost of ensuring safety in the more-complex electronic designs. Unless carefully designed, electronic devices are subject to catastrophic failure in circumstances such as lightning-induced power surges.

4. DOMESTIC AC POWER PLUGS AND SOCKETS

Dornestic power plugs and sockets are devices that connect the horne appliances and portable light fixtures cornrnonly used in hornes to the cornmercial power supply so that electric power can flow to thern. Plugs and sockets used for *domestic* purposes are often the same as those used in industrial or comrnercial applications for circuits of sirnilar voltage and current rating.

Power plugs are male electrical connectors that fit into female electrical sockets. They have contacts that are pins or blades that connect rnechanically and electrically to holes or slots in the socket. Plugs usually have a *live* or *hot* contact, a *neutral* contact, and an optional *earth* or *Ground* contact. Many plugs rnake no distinction between the live and neutral contacts, and in sorne cases they have two live contacts. The contacts rnay be steel or brass, either zinc, tin or nickel plated.

Power sockets, *power receptacles,* or *power outlets* are fernale electrical connectors that have slots or holes which accept the pins or blades of power plugs inserted into thern and deliver electricity to the plugs. Sockets are usually designed to reject any plug which is not built to the sarne electrical standard. Some sockets have a pin that connects to a hole on the plug, fora ground contact.

There are significant differences between American English and British English in talking about power plugs and sockets

British English	American English	Meaning
mains power	*tine* power	The primary electrical power supply wires entering a building, connected to the *Main* fuses or breakers.
domestic power		Single-phase 230v power as used in a single-family residence

earth connection	*ground or grounding* connection	Safety connection to the earth or ground
live connection	*hat* connection	Phase ("active") connection
neutral connection	*neutral* connection	return connection
lead, mains wire/wiring	cord/cable	Flexible electric cable from plug to appliance
socket, electrical wall outlet, power point	outlet, receptacle, socket	Female part of an electrical connection or electrical fitting in a wall outlet
pin, plug	prong or plug	Male part of an electrical connector

In the United States, the word *domestic* is unfamiliar and meaningless. American power terminology does not refer to *domestic power* or *domestic plugs,* and make no distinction between *home* and *industrial* plug and socket types, as defined in this article. In high-density residences such as an apartment building, both single-phase and three-phase power may be present, and both types of power are also present in purely commercial and industrial environments, so the distinction of *domestic power* as being for home-use only is vague at best.

in the United States, the live contact may be called *live* or *hot,* and is the more narrow, flat connector. The neutral contact may be called *cold, neutral, return, the grounded conductor,* or (in the National Electrical Code), the *identified conductor,* and is the wider, flat connector. The earth contact is called *ground* or *the grounding conductor*, and is the round connector.

In the United Kingdom the word "line" is occasionally used to denote the live terminal or wire. In electrical engineering, the *line* voltage is that between the live conductors of the three-phase distribution system, while the *phase* voltage is that between live and neutral.

Live conductors are called *phases* when there is more than a single phase in use. Pins are also known as *prongs, contacts* or *terminals.*

Standard wire colours for flexible cable

Region	Live	Neutral	Pfötective earth/ground
EU, Australia & South Africa (IEC 60446)	brown	blue	green & yellow
Australia & New Zealand (AS/NZS 3000:2000 3.8.1)	red	black	green/yellow
United States and Canada	black *(brass)*	white *(si/ver)*	green *(green)*

Standard wire colours for fixed cable

Region	Live	Neutral	Protective earth/ground
EU {IEC 60446) including UK from 31 March 2004	brown	blue	green & yellow
Australia	red	black	green & yellow (core is usually bare and should be sleeved at terminations)
United States and Canada	black, red, blue(brass)	white *(si/ver)*	green or bare (*green*)

Note: the colours in this table represent the most common and preferred standard colours for single phase wiring however others may be in use, especially in older installations.

4.1.Prolif eration of standards

During the first fifty years of cornrnercial use of electric power, standards developed rapidly based on growing experience. Technical, safety, and econornic factors influenced the developrnent of all wiring devices and a nurnber of different varieties were invented. Gradually the desire for trade elirninated sorne standards that had been used only in a few countries. Forrner colonies rnay retain the standards of the colonizing country, occasionally (as with the UK and a nurnber of its forrner colonies) after the colonizing country has changed its standard. Sornetirnes offshore industrial plants or overseas rnilitary bases use the wiring practices of their controlling country instead of the surrounding region. In sorne countries there is no single national standard with rnultiple voltages, frequencies and plug designs in use, creating extra cornplexity and potential safety problerns for users.

in recent years many countries have settled on one of a few *de facto* standards, although there are legacy installations of obsolete wiring in most countries of the world. Some buildings have wiring that has been in use for almost a century and which pre-dates all modern standards.

Fig 4.1 :IEC power cord with CEE 7/7 plug at left end.

Many rnanufacturers of electrical devices like personal computers have adopted the practice of putting a single world-standard IEC connector on the device, and supplying for each country a power cord equipped with a standard IEC connector on one end and a national power plug at the other. The device itself is designed to adapt to a wide range of voltage and frequency standards. This has the practical benefit of reducing the amount of testing required for approval, and reduces the nurnber of different product variations that must be produced to serve world markets.

4.2. World maps by plug/socket and voltage/frequency

List of countries with mains power plugs, voltages and frequencies

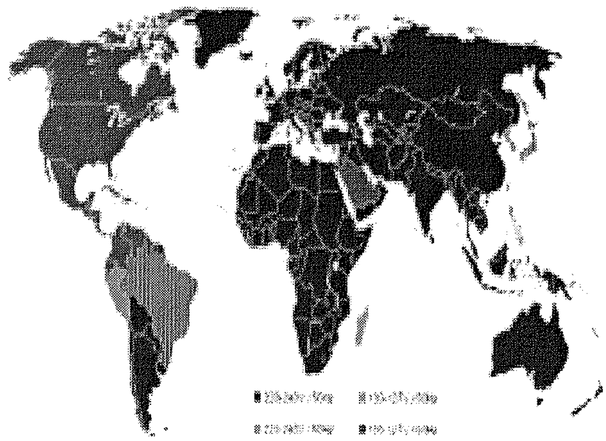


Fig 4.2 : Voltage/Frequency

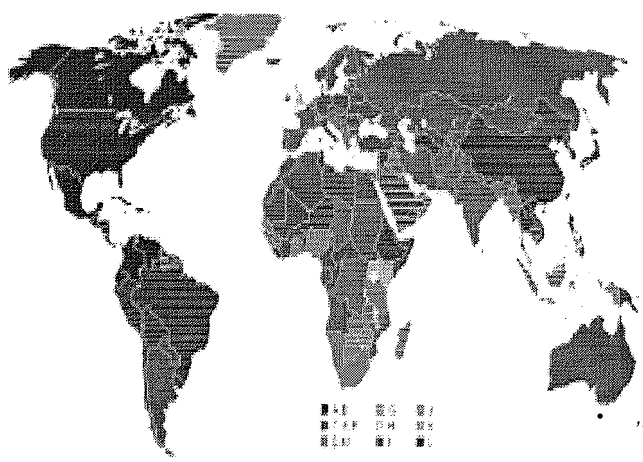


Fig 4.2.1 :Plugs.

There are two basic standards for voltage and frequency in the world. üne is the North American standard of I 10-120 volts at 60 Hz, which uses plugs A and B, and the other is the European standard of 220-240 volts at 50 Hz, which uses plugs C through M. The differences arose for historical reasons as discussed in the article Mains electricity.

Countries on other continents have adopted one of these two voltage standards, although some countries use variations or a mixture of standards. The outline maps show the different plug types, voltages and frequencies used around the world.l " colour-coded for easy reference.

4.3. Types of Plug and Sockets

Electrical plugs and their sockets differ by country in shape, size and type of connectors. The type used in each country is set by national standards legislation. In this article each type is designated by a letter designation from a U.S. govemment publication, plus a short comment in parentheses giving its country of origin and number of contacts. Subsections then detail the subtypes of each type as used in different parts of the world.

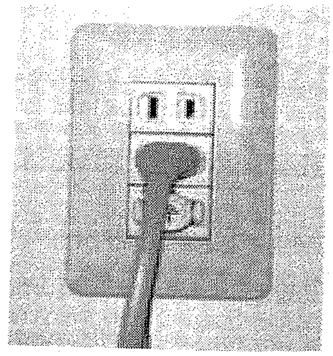
Note that IEC Class I refers to earthed equipment. IEC Class il refers to unearthed equipment protected by double insulation

4.3.1. Type A (North American/Japanese 2-pin)

NEMA 1-15 (North American 15 A/125 V ungrounded

Standardized by the U.S. National Electrical Manufacturers Associatiorı' and adopted by 38 other countries, this simple plug with two flat parallel pins, or blades, is used in most of North America and on the east coast of South America on devices not requiring a ground connection, such as lamps and "double-insulated" small appliances. NEMA 1-15 sockets have been prohibited in new construction in the United States and Canada since 1962, but remain in many older homes and are still sold for replacement use only. Type A plugs are still very common because they are compatible with type B sockets.

Early designs could be inserted either way, but some modem plugs make the neutral blade wider than the live blade; such a *polarized plug* can be inserted only one way. New polarized plugs will not fit in old type A sockets, but both old and new type A plugs will fit in new type A and type B sockets. Some devices that do not distinguish between neutral and live, such as sealed electronic power supplies, are still sold with both pins narrow.



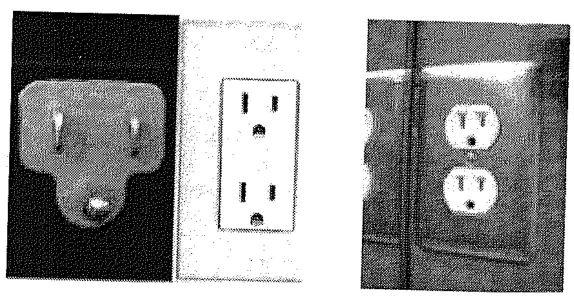
Japanese unearthed sockets with a grounding post fora washing machine.

JIS C 8303, Class **II (Japanese 15 A/100 V ungrounded)**

Some older Japanese outlets and multiplug adapters are non-polarized -- the slots in the sockets are the same size - and will only accept non-polarized plugs. Japanese plugs should be able to fit into modem North American outlets without trouble, but North American appliances with polarized plugs may require adapters or replacement non-polarized plugs to connect to older Japanese outlets; or even replacement of the wall socket itself.

Japanese standard wire sizes and the resulting current ratings are somewhat different from those used elsewhere in the world. Japanese voltage is only 100 volts - Iower than American voltage - and the frequency in eastem lapan is only 50 hertz instead of 60, so even ifa North American plug can be inserted into a Japanese socket, it does not always mean the device will work properly.

4.3.2. Type **B (Anıerican 3-pin or U-ground)**



On the left is a **North American grounded (earthed)** plug, and in the center is a **decora** style outlet. A more common style of NEMA 5-15 duplex outlet is shown on the right. This socket will also

NEMA **5-15 (North American 15 A/125 V grounded)**

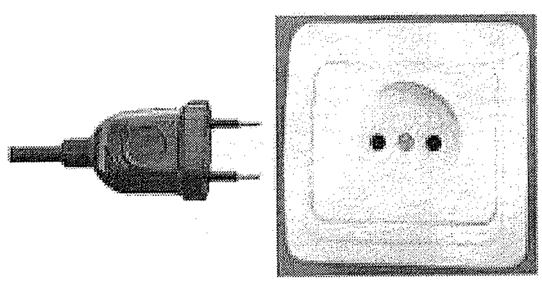
The type B plug has two flat parallel blades like type A, but has a round ground or earthing pin (American standard NEMA 5-15/Canadian standard CSA 22.2, *N*~ 42).[7] it is rated for 15 amperes at 125 volts. The ground pin is longer than the live and neutral blades, so the device is grounded before the power is connected. The neutral blade in the type B socket is wider than the live one to prevent polarized type A plugs being inserted upside-down. Type B plugs often have both pins narrow since the ground pin enforces polarity.

The 5-15 socket is standard in all of North America (Canada, the United States and Mexico). it is also used in Central America, the Caribbean, northem South America (Colombia, Ecuador, Venezuela and part of Brazil), Japan, Taiwan and Saudi Arabia.

With type B outlets, if you look directly at the outlet with the ground at the bottom, the neutral slot is on the left, and the live slot is on the right. They may also be installed with the ground at the top or on either side. If the plug is polarized, the widest pin is the neutral connector.

in the theater, this connector is sometimes known as *PBG* for "Parallel Blade with Ground", or *Hubbell,* the name ofa common manufacturer.

in new residential construction since about 1992, a 20-amp receptacle with a T-slot for the neutral blade allows either 15-ampere parallel blade plugs or 20-ampere plugs to be used.



CEE 7/16 plug and socket

JIS C 8303, Class 1 (Japanese 15 A/100 V grounded)

4.3.4. Type C (European 2-pin)

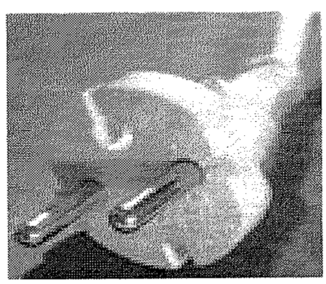
CEE 7/16 (Europlug 2.5 A/250 V unearthed)

This two-pin plug is probably the single most widely used intemational plug, popularly known as the Europlug. The plug is unearthed and has two round, 4 mm pins, which usually converge slightly. lt can be inserted into any socket that accepts 4 mm round contacts spaced 19 mm apart. It is described in CEE 7/16. [9] and is also defined in Italian standard CEI 23-5 and Russian standard GOST 7396

The Europlug is used in Class II applications throughout continental Europe (Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Macedonia, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey). It is also used in Middle East, most of Africa, Argentina, Chile, Uruguay, Peru, Bolivia, Brazil, Bangladesh, Indonesia, Pakistan as well as the former Soviet republics, and many developing nations.

This plug is intended for use with devices that require 2.5 A or less. Because it can be inserted in either direction into the socket, live and neutral are connected at random.

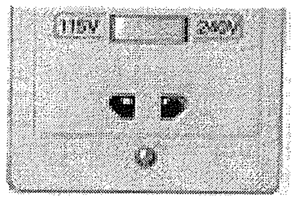
The separation and length of the pins allow its safe insertion in most CEE 7/17, French type E, Type H (Israeli 3-pin), CEE 7/4 (Schuko), CEE 7/7 and Type L (Italian 3-pin) outlets.



CEE 7/17 plug

CEE 7/17 (German/French 16 A/250 V unearthed)

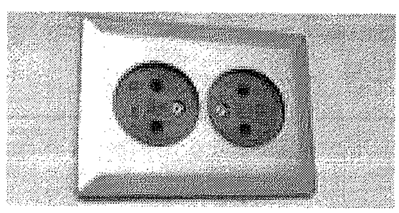
This plug also has two round pins but the pins are 4.8 mm in diameter like types E and F and the plug has a round plastic or rubber base that stops it being inserted into small sockets intended for the Europlug. Instead, it fits only into large round sockets intended for types E and F. The base has holes in it to accommodate both side contacts and socket earth pins. It is used for large Class II appliances. Used in South Korea for all domestic non-earthed appliances, it is also defined in Italian standard CEI 23-5.



BS 4573 socket

BS 4573 (UK shaver)

In the United Kingdorn and Ireland, there is a special version of the type C plug for use with shavers (electric razors) in bath or shower rooms.l"" It has 5 mm diameter pins 16.6 mm apart, .and the sockets for this plug can often take unearthed CEE 7/16, US and/or Australian plugs as well. Sockets are often able to supply either 230 V or 1 15 V. in wet zones, they must contain an isolation transforrner compliant with BS 3535.



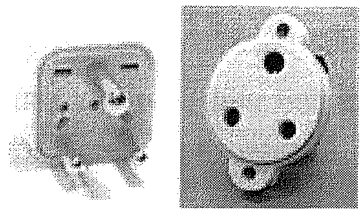
Unearthed socket compatible with both Schuko and French plugs

Variations in sockets

Some Type C sockets can only take 4 mm pins or have plastic barriers in place to prevent Schuko or French plugs from entering. However, many can take 4.8 mm pinsand have enough room for a 4.8 mm pin round Schuko or French plug to be

4.3.4. **Type D (Old British 3-pin)**

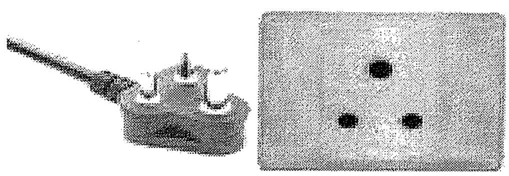
BS 546 (5 A/250 V earthed)



D Plug

India / Pakistan has standardised on a plug which was originally defined in British standard BS 546. It has three large round pins in a triangular pattem. The BS 546 standard is also used in parts of the Middle East (Kuwait, Qatar) and parts of Asia and the Far East that were electrified by the British. This type was also previously used in South Africa, but has been phased out in favour of the 15 A version there. Similarly, in Ghana, Kenya, and Nigeria, the plug has been mostly replaced by the British 3-pin (Type G). This 5 A plug, along with its 2 A cousin, is sometimes used in the UK for centrally switched domestic lighting circuits, in order to distinguish them from normal power circuits.

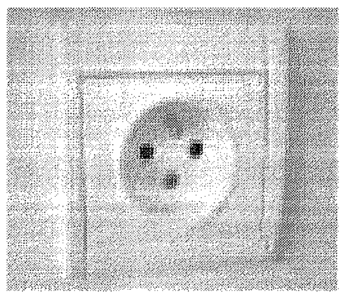
BS 546 (15 A/250 V earthed)

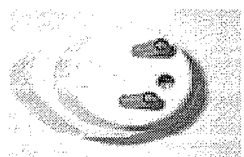


MPlug

This plug is sometimes referred to as type M, but it is in fact merely the 15 A version of the plug above, though its pins are much larger at 7.05 mm x 21.1 mm. Live and neutral are spaced 25.4 mm apart, and earth is 28.6 mm away from each of them. Although the 5 A version is standard in India, Pakistan, Sri Lanka, Nepal, and Namibia, the 15 A version is also used in these countries for larger appliances. Some countries like South Africa use it as the main domestic plug and socket type, where sockets always have an on-off switch built into them. The Type M is almost universally used in the UK for indoor dimmable theatre and architectural lighting installations. It is also often used for non-dimmed but centrally controlled sockets within such installations. The main reason for doing this is that fused plugs, while convenient for domestic wiring (as they allow 32 A socket circuits to be used safely), are not convenient if the plugs and sockets are in hard-to-access locations (like lighting bars) or if using chains of extension leads (since it is hard to figure out which fuse has blown). Both of these situations are common in theatre wiring. This plug is also widely used in Israel, Singapore, and Malaysia for air conditioners and clothes dryers

4.3.5. Type E (Fren eh 2-pin, fernale earth)





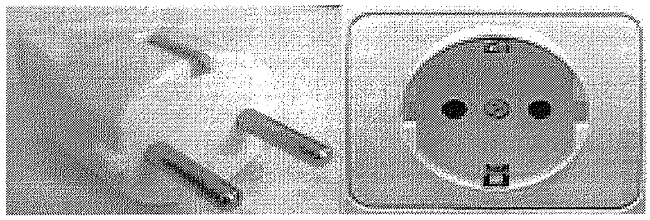
French type E

France, Belgium, Poland, Czech Republic, Slovakia (after 1 July 2008 also Denmark) and some other countries have standardised on a socket which is not compatible with the CEE 7/4 socket (type F) that is standard in Germany and other continental European countries. The reason for incompatibility is that earthing in the E socket is done by a round male pin permanently mounted in the socket. Sockets are installed with the earth pin upwards and wired with left as live and right as neutral. The plug itself is round with two round pins measuring 4.8 x 19 mm, spaced 19 mm apart and a hole for the socket's earth pin. it will accept Europlug and CEE 7/17 plugs.

As with the German plug below this plug will fit some other types of socket either easily or with force. However, there is no earth connection with such sockets. Also in some cases forcing the plug in may damage the socket.

4.3.6. Type F (German 2-pin, side clip earth)

CEE 7/4 (German "Schuko" 16 A/250 V earthed)



For more details on this topic, see Schuko.

The type F plug, defined in CEE 7/4 and commonly called a "Schuko plug", is like type E except that it has two earthing elips on the sides of the plug instead of a female earth contact. The Schuko connection system is symmetrical and allows live and neutral to be reversed. The socket also accepts Europlugs and CEE 7/17 plugs. It supplies up to 16 amperes. Above that, equipment must either be wired permanently to the mains or connected via another higher power connector such as the IEC 309 system. It's also used in Spain, Portugal and Sweden.

"Schuko" is an abbreviation for the Gcrman word *Schutzkonıakt,* which means "Protective (that is, earthed) contact".

Although Schuko sockets are unpolarized, it is rccommended to wire them the same way French sockets are wired (live on left and neutral on right, when looking at the socket), but unfortunately, phase wiring is not yet officially standardised in most of the countries that use this socket type (please sce the main Schuko article for details).

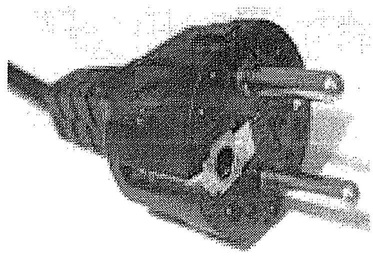
Gost 7396 (Russian 10 A/250 V earthed)

The countrics of the CIS use a standard plug and sockct similar to the Schuko standard, defined in Russian Standard Gost 7396. The contacts are also 19 mm apart, but the diameter of the pins is 4.0 mm instead of 4.8 mm. And hence the connectors are rated at 10 rather than 16 amps. it is possible to insert Russian plugs into Schuko outlets, but Russian sockets will not accept type E or F plugs because the holes are too small. This sockct also accepts Europlugs, but does not accept CEE 7/17 plugs because they use the larger pin size.

Many official standards in Eastern Europe are virtually identical to the Schuko standard. üne of the protocols goveming the reunification of Gernnany required that the DIN and VDE standards would prevail without exception, so the forıner East Germany had to conform to the Schuko standard. Most other Eastem European countries use the Schuko standard intemally but, prior to its collapse, they exported large volumes of appliances to the Soviet Union with the Soviet standard plug installed. Because of that, many of the Russian plugs found their way into other Eastem European countries.

4.3.7. Type E and F hybrid

CEE **7/7 (French/German 16 A/250 V earthed)**



/;JCEE 7/7 plug

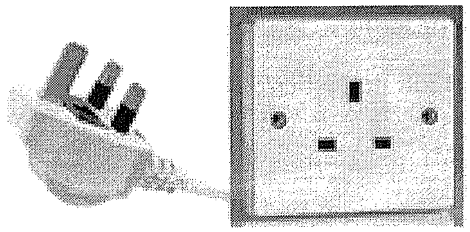
In order to bridge the differences between sockets E and F, the CEE 7/7 plug was developed. It has earthing elips on both sides to connect with the CEE 7/4 socket and a feınale contact to accept the earthing pin of the type E socket. It's also used in Spain and Portugal. Nowadays, when appliances are sold with type E/F plugs attached, the plugs are CEE 7/7 and non-rewirable. This means that the *plugs* are now identical between countries like France and Germany; only the *sockets* are different.

Type E and F plugs that are not compatible with both types of socket are only found if a cheap replacement plug has been attached to a cord that originally had another plug. Better-quality replacements are standard CEE 7/7 and are compatible with both Schuko and French standard sockets.

Note that the CEE 7/7 plug is polarized to prevent the live and neutral connections from being reversed when used with a type E outlet, but allows polarity reversal when inserted into a type F socket. The plug is rated at 16 A. Above that, equipment must either be wired permanently to the mains or connected via another higher power connector such as the IEC 309 system.

4.3.8. Type G (British 3-pin)

BS 1363 (British 13 A/230-240 V 50 Hz earthed and fused)



BS 1363

The British Standards 1363 plug. [11] This design is not only in used in the United Kingdom and Ireland, but also in Sri Lanka, Bahrain, UAE, Qatar, Yemen, Oman, Cyprus, Malta, Gibraltar, Botswana, Ghana, Hong Kong, Macau, Brunei, Malaysia, Singapore, Kenya, Uganda, Nigeria, Iraq, Tanzania and Zirnbabwe. BS 1363 is also standard in several of the former British Caribbean colonies such as Belize, Dominica, St. Lucia, St. Vincent and Grenada. It is also used in Saudi Arabia in 230v installations although 110V installations using the NEMA connector are more common.

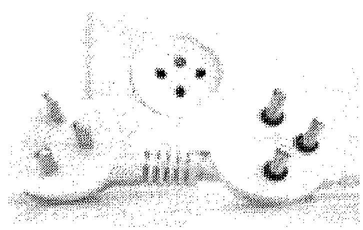
This plug, commonly known as a "13-amp plug", is a large plug that has three rectangular prongs forming a triangle. Live and neutral are 4 x 6 x 18 mm spaced 22 mm apart. 9 mm of insulation over the base of the pins prevents people from touching a bare connector while the plug is partly inserted. Earth is 4 x 8 x 23 mm.

The plug is unusual in that it has a fuse inside, for protection, in addition to a circuit breaker in the distribution panel. The fuse is required to protect the cord, as British wiring standards allow very high-current circuits to the socket. Accepted practice is to choose the smallest standard fuse (3 A, 5 A, or 13 A) that will allow the appliance to function. Using a 13 A fuse on an appliance with thin cord is considered bad practice. The fuse is 1 inch long, conforming to standard BS 1362.

UK wiring regulations (BS 7671) require sockets in homes to have shutters over the live and neutral connections for safety reasons (e.g. to prevent children from inserting metal objects into them). These are incorporated into all BS 1363 sockets and are opened by the insertion of the (longer) earth pin. The shutters also help prevent the use of plugs made to other standards. On plugs for Class II appliances that do not require an earth, the pin is often plastic and serves only to open the shutters and to enforce the correct orientation of live and neutral. it is sometimes possible to open the shutters with a screwdriver to insert Type C Plugs or other plug types, but this should be avoided as such plugs will not have a fuse and will often not fit properly at best.

BS 1363 plugs and sockets started appearing in 1946 and BS 1363 was first published in 1947. By the end of the 1950s, it had replaced the earlier standard (type D) (BS 546) in new installations, and by the end of the 1960s, most earlier type D installations had been rewired to BS 1363 standards. Socket-outlets usually include switches on them for convenience. BS 1363 is considered a very safe system[ciiaiion r=: but the plugs are much larger and heavier than corresponding Euro plugs.

4.3.9. Type H (lsraeli 3-pin)



Two lsraeli plugs and one socket. The left plug is the old standard, the one on the right is the 1989 revision.

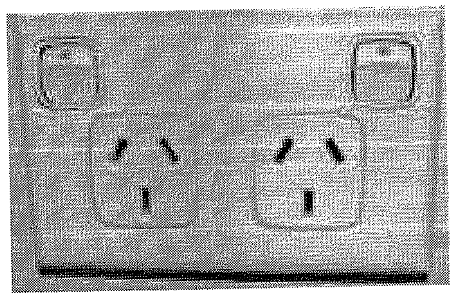
SI 32 (lsraeli 16 A/250 V earthed)

This plug, defined in Si 32 (IS16A-R), is unique to Israel and is incompatible with ali other sockets. it has three flat pins to form a Y-shape. "Live" and "Neutral" are spaced 19 mm apart. The Type H plug is rated at 16 A but in practice the thin flat pins cause the plug to overheat when connecting large appliances. in 1989, the Si 32 was revised to use three round 4 mm pins in the same locations as the older standard.

Sockets made since 1989 accept both flat and round pins in order to be compatible with both old and new plugs. This also allows the Type H socket to accommodate type C plugs which are used in Israel for non-grounded appliances. Older sockets, from about the 1970s, have both flat and round holes for "Live" and "Neutral" in order to accept both Type C and Type **H** plugs. As of 2008, "pure" Type **H** sockets (which accept only old standard Type **H** plugs) are very rare in Israel.

This plug is also used in the areas controlled by the Palcstinian National Authority in the West Bank and all of the Gaza Strip.

4.3.10. Type I (Australian/New Zealand & Chinese/Argentine 2/3-pin)



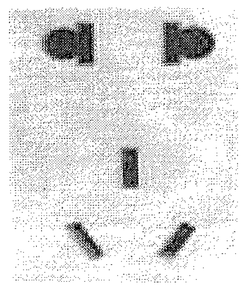
Australian switched 3-pin dual power point (socket)

AS 3112 (Australian 10 A/240 V)

This plug, used in Australia, New Zealand, Fiji and Papua New Guinea, has an earthing pin, and two flat pins forming an upside down V-shape.[12] The flat blades measure 6.5 x 1.6 mm and are set at 30° to the vertical ata nominal pitch of 13.7 mm. Australasian wall sockets almost always have switches on them for extra safety, as in the UK. An unearthed version of this plug with two angled power pins but no earthing pin is used with small double-insulated appliances, but the power (wall) outlets always have three pins, including an earth pin.

There are several AS/NZS 3112 plug variants,[13] including one with a wider earth pin used for devices drawing up to 15 A; sockets supporting this pin will accept 10 A plugs. There is also a 20 A variant, with all three pins oversized, and 25 32 A variants, with the 20 A larger pins and the earthing pin forming an inverted "L" for the 25 A and a horizontal "U" for the 32 A (the 5 variants {10; 15; 20; 25 & 32 ampere sockets} will accommodate all the plugs that are equal or of a lesser current carrying capacity, but not a higher value; i.e. a 10 A plug will be accommodated by all sockets but a 20 A plug will fit only 20, 25 and 32 A outlets).

Australia's standard plug/socket system was originally codified as standard C112 (floated provisionally in 1937, and adopted asa formal standard in 1938), which was superseded by AS 3112 in 1990. As of 2005, the latest major update is AS/NZS 3112:2004, which mandated insulated pins[14] by 2005. However, equipment and cords made before 2003 can still be used.



Chinese sockets accepting plug types A, C and I (standard)

CCC Mark

CPCS-CCC (Chinese 10 A/250 V)

Although the pins on the Chinese plug are 1 mm longer, the Australasian plug can be used with mainland Chinese socket. The standard for Chinese plugs and sockets is set out in GB 2099.1-1996 and GB 1002-1996. As part of China's commitment for entry into the WTO, the new CPCS (Compulsory Product Certification System) has been introduced, and compliant Chinese plugs have been awarded the CCC (China Compulsory Certification) Mark by this system. The plug is three wire, grounded, rated at 10 A, 250 V and used for Class 1 applications.

In China, the sockets are installed upside down relative to the Australian one.

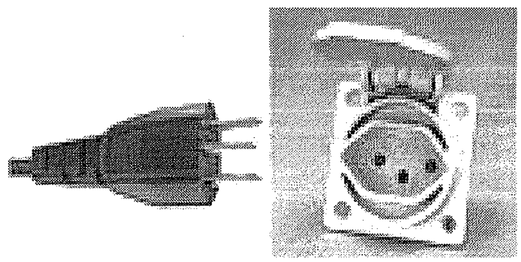
China also uses American/Japanese "Type A" sockets and plugs for Class-II appliances. However, the voltage across the pins of a Chinese socket will always be 220, no matter what the plug type.

IRAM 2073 (Argentine 10 A/250 V)

The Argentine plug is a three-wire earthed plug rated at 10 A, 250 V defined by IRAM and used in Class 1 applications in Argentina and Uruguay.

This plug is similar in appearance to the Australasian and Chinese plugs. The pin length is same as the Chinese version. The most important difference from the Australasian plug is that the Argentine plug is wired with the live and neutral contacts reversed.

4.3.11. Type J (Swiss 3-pin)

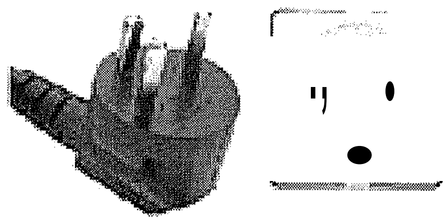


SEV 1011 (Swiss 10 A/250 V)

Switzerland has its own standard which is described in SEV 1011. (ASE1O11/1959 SW1OA-R) This plug is similar to the type C europlug (CEE 7/16), except that it has an earth pin off to one side. Swiss sockets can take Swiss plugs or europlugs (CEE 7/16). This connector system is rated for up to 10 amperes. There is also a less common variant with 3 square pins rated for 16 A. Above 16 A, equipment must either be wired permanently to the electrical supply system with appropriate branch circuit protection, or connected to the mains with an appropriate high power industrial connector.

Switzerland also has a two-pin plug, with the same pin shape, size and spacing as the SEV 1011's live and neutral pins, but with a more flattened hexagonal form. it fits into both Swiss sockets (round and hexagonal) and CEE 7/16 sockets, and is rated for up to 10 A.

4.3.12. Type K (Danish 3-pin)



Danish 107-2-D 1, standard DK 2-1 a, with round power pins and half round ground pin

0 *0*

v

Outlet for Danish computer equipment plug's tilted flattened pins and half round ground pin (mainly used in professional environment), standard DK 2-5a

Section 107-2-Dl (Danish 10 A/250 V earthed)

This Danish standard plug is described in the Danish Plug Equipment Section 107~2-Dl Standard sheet (SRAFl 962/DB 16/87 DNlOA-R). The plug is similar to the French type E except that it has an earthing pin instead of an earthing hole (and vice versa on the socket). This makes the Danish socket more unobtrusive than the French socket which is a cavity into the wall to protect the earthing pin from mechanical damage (and to protect from touching the live pins).

The Danish socket will also accept the type C CEE 7/16 Europlug or type E/F CEE 7/17 Schuko-French hybrid plug. Type F CEE 7/4 (Schuko), type E/F CEE 7/7 (Schuko-French hybrid), and earthed type E French plugs will also fit into the socket but should not be used for appliances that need earth contact. The current rating on both plugs is 10 A.

A variation (standard DK 2-5a) of the Danish plug for use only on surge protected computer circuits exists. It fits into the corresponding computer socket and the normal type K socket, but normal type K plugs deliberately don't fit into the special computer socket.

There is a variation for hospital equipment with a rectangular left pin, it is used for life support equipment.

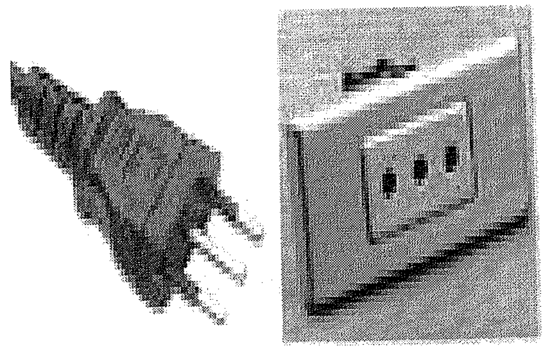
Traditionally all Danish sockets were equipped with a switch to prevent touching live pins when connecting/disconnecting the plug. Today, sockets without switch are allowed, but then it is a requirement that the sockets have a cavity to prevent touching the live pins. However, the shape of the plugs generally makes it difficult to touch the pins when connecting/disconnecting.

Since the early 1990s grounded outlets have been required in all new electric installations in Denmark. Older outlets need not be grounded, but all outlets - including old installations - are required to be protected by RCD/GFCI (HFI in Danish) no later than 1 July 2008.

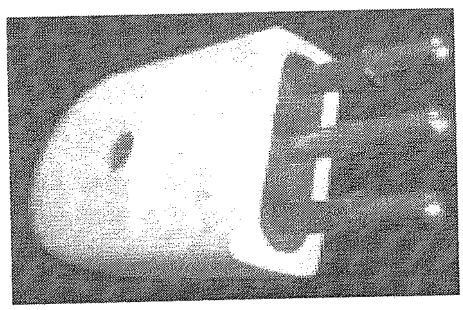
After 1 July 2008 Wall outlets for type E (French 2-pin, female earth) will be permitted for installations in Denmark.

Sockets for the Schuko F type will not be permitted. The reason is that a large number of currently used Danish plugs will jam when inserted into a Schuko socket. This may cause damage to the socket. lt may also result in a bad connection of the pins, which implies the risk of overheating and fire.

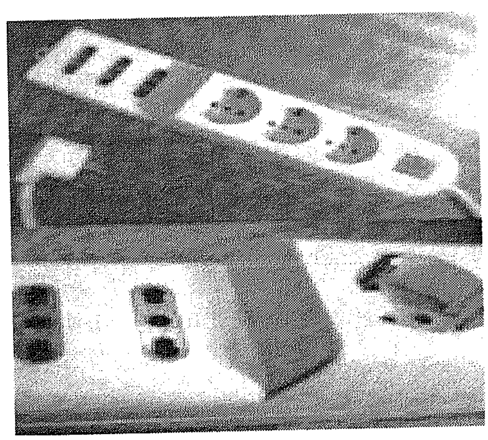
Adapter plugs exist to allow connection of other plugs (British, American ete.) to Danish (non-cornputer) outlets. These usually are not sold at the local Danish supermarket so visitors wishing to be safe may contact an electrician. However, many intemational travel adapter sets sold outside Denmark match type C CEE 7/16 (Europlug) and type E/F CEE 717 (Schuko-French hybrid) plugs which can readily be used in Denmark as explained above.



23-16/VII with socket



23-16/VII rewirable



Italian power strip showing both types of hybrid socket

4.3.13. Type L (Italian 3-pin)

The Italian earthed plug/socket standard, CEI 23-16/VII, includes two models rated at 10 A and 16 A that differ in contact diameter and spacing. Both are symmetrical, allowing the live and neutral contacts to be inserted in either direction. CEE 7/16 (type C) unearthed Europlugs are also in common use, and standardized in Italy as CEI 23-5. Appliances with CEE 7/7 Schuko-French plugs are often sold in Italy, but not every socket will accept them, since the pins of the CEE 7/7 Schuko-French plugs are slightly thicker than the italian ones. Adapters are cheap and commonly used to connect CEE 7/7 plugs to CEI 23-16NII sockets. It is also possible o fit CEE 7/7 Schuko-French plugs to a common italian flat-face sockets, by firmly pushing the plug into the socket. However, this practice is not strongly reccomended, since it can cause damage to the socket by expnding its holes, and the plug may get stuck inside the socket.

CEI 23-16NH (Italian 10 A/250 V)

The 10 ampere style extends CEE 7/16 by adding a central earthing pin. Thus, CEI 23-16-VII 10 A sockets can accept CEE 7/16 Europlugs. This is the plug shown in the illustrations. Outside of Italy, this plug is found in Syria, Libya, Ethiopia, Chile, Argentina, Uruguay, various countries in North Africa, and occasionally in older buildings in Spain.

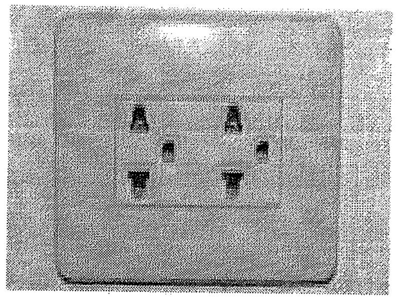
CEI 23-16NH (Italian 16 A/250 V)

The 16 ampere style looks like a bigger version of the 10 A style. The pins are a couple of millimetres further apart, and all three are slightly thicker. The packaging on these plugs in Italy may daim they are a "North European" type. They were also referred to as *industriale* ("industrial") although this is not a correct definition.

4.3.14. Type M (see D)

BS 546 (South African 15 A/250 V)

Type M is sometimes used to describe the 15 A version of the old British type D, used in South Africa and elsewhere. See type D for details.



A standard grounded Thai outlet supporting European 2-pin plugs and earthed and unearthedAmerican plugs

Multi standard sockets

Sockets that take a variety of incompatible plug types are often seen in developing countries where electrical standards are either lacking or unenforced. These sockets may accept both 120 V and 240 V plugs raising a significant risk of devices being damaged by the wrong voltage. Sometimes they have one or more earth holes to allow 3-pin plugs, but there is a good chance that the ground contact may not actually be connected to earth and the ground contact certainly will not mate with Schuko or French plugs. Great care should be taken to avoid incompatible voltage and grounding connections when using such outlets. Multi-standard devices designed to auto-adapt to different voltage and frequency standards, and devices which do not require a ground contact are best used with these sockets.

Proposed common standard IEC 60906-1

IEC 60906-1 (Brazilian 16 A/250 V)

In 1986, the International Electrotechnical Commission published IEC 60906-1, the specification for a plug that looks similar but is not identical to the Swiss (Type J) plug. This plug was intended to become one day the common standard for all of Europe and other regions with 230 V mains but the effort to adopt it as a European Union standard was put on hold in the mid 1990s.[15] Brazil - which uses a mix of Europlug and NEMA plugs - later adopted it as national standard NBR 14136 in 2001[16] and it will be the only plug permitted to be sold with domestic appliances in Brazil from 2009,

5. ELECTRICAL SAFETY

As an engineer, contractor, manufacturer, or maintenance personnel, and whether one's business is electrical in nature or not, electrical safety is a concem shared by all in the building industry. Approximately 300 deaths occur each year by accidental electrocutions. Over 800 people die annually due to fires caused by electrical faults. Each year, electrical mishaps account for thousands of people sustaining shock injury or bums, and electrical failures cause over 1.3 billion dollars in property damage.

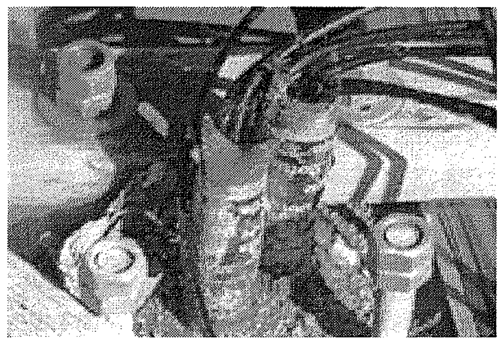


Fig 5.1 Courtesyof Tim Matyas)

As building systems become more integrated and the industry further embraces sustainable and environmental concepts into design, the importance of continued building operation is more critical. Besides familiar electrical equipment and systems, newer technologies like renewable energy systems and on-site power generation are increasingly becoming an integral part of many projects. Electrical safety issues related to photovoltaic systems and distributed energy resources, such as fuel cells and microturbines, are evolving and must not be overlooked. Electrical safety is an essential element to any successful building project from conception to day-to-day operation. Understanding the importance of electrical safety, how to recognize the forms that electrical safety can undertake, and providing resources for implementing electrical safety in one's work are all required to institute an electrical safety program.

For full understanding, electrical safety is broken down into three distinct topics of discussion: Perspectives and Responsibilities, Modes of Electrical Safety, and Electrical Safety Resources. Each topic is independent but ali three rely on the availability and enforcement of the others for full implementation of safety measures. üne without the others results in exposure to the hazardous or potentially hazardous effects of electrical energy and its impact on personnel and equipment.

5.1. SAFETY DESCRIPTION

5.1.1. Perspectives and Responsibilities

The propef mind frame is the first step to establishing responsibility to enforce standards of electrical safety. So, perspective determines the impact electrical safety has on one's work. The four perspectives are defined by recognized and accepted roles within the building industry:

- Engineef
- Contractof
- Maintenance
- Manufacturef

A perspective does not imply Of indicate an individual's role Of title within an organization. Rather, the perspective defines a frame of reference. For example, an electrician installing a junction box outdoors inspects the box for defects that may have occurred during the manufacturing process and verifies that it is intended for outdoor installation. Implementation of an adequate electrical safety program requires an electrician to be aware of not only the installation methods associated with mounting outdoor rated enclosures but also to be aware of the standards that an enclosure must meet in order to be rated for outdoor exposure. The electrician can identify with both the contractor's and manufacturer's perspectives during this "simple and routine" installation. All perspectives must be fully understood to achieve the utmost !eve! of electrical safety in one's work, see Fig. 1.

Fig.5.1.1: Perspective Interrelationships

5.1.2. Engineer's Perspective

The engineer's perspective identifies measures necessary to achieve electrical safety in the engineering design process. Hence, the engineer's perspective evolves into a responsibility that ensures electrical safety from conception of a need to the implementation of an idea. General responsibilities include:

- Equipment ratings
- Conductor ampacities
- Selective coordination of overcurrent protective devices
- Adherence to applicable codes
- Supply/demand equality
- General power distribution methods

The term engineer is not reserved only for the electrical engineer but, instead, includes all disciplines involved in the process of engineering. For example, the mechanical engineer must responsibly contribute needed electrical data for heating, ventilating, and air-conditioning (HVAC) equipment, and controls.

5.1.3. Contractor's Perspective

The contractor's perspective identifies measures necessary for electrical safety in the installation process. Hence, the contractor's perspective evolves into a responsibility that ensures electrical safety from implementation of an idea to complete realization of that idea. General responsibilities include:

- Proper mounting of equipment
- Adequate tightening or torque of connections
- Use of correct tools
- Minimizing of insulation abrasion
- Onsite coordination with other contractors
- Adherence to applicable codes

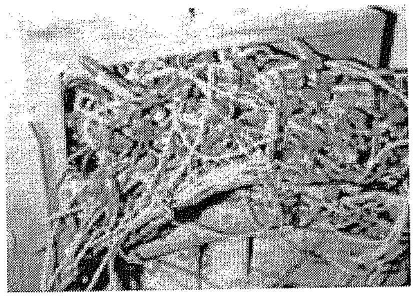


Fig 5.1.3: Courtesy of Joe Tedesco

The term contractor is not reserved only for electrical contractor but, instead, includes all trades. For example, the mechanical contractor must responsibly utilize the proper method of installation of the mechanical equipment for interconnection of electrical feeds including elevators, HVAC equipment, and controls.

5.1.4. Maintenance Perspective

The maintenance perspective identifies measures necessary for electrical safety in the operation ofa system. This perspective is one that deciphers the preventative, real-time, and reactive actions available to continued system operation. Hence, the maintenance perspective evolves into a responsibility that ensures electrical safety by implementation of preventative programs and ongoing system monitoring. General responsibilities include:

- Preventative maintenance
- Monitoring of equipment parameters
- Use of safety measures when working on equipment
- Following tag out procedures
- Use of correct tools
- Thorough knowledge of systems
- Adherence to applicable codes

5.1.5. Manufacturer's Perspective

The manufacturer's perspective identifies measures necessary for electrical safety in the creation and construction of equipment and devices. Hence, the manufacturer's perspective evolves into a responsibility that ensures electrical safety implementing the other three perspectives during the respective phases of the manufacturing process. The employment of the other three perspectives and understanding end user utilization must align singularly for the purpose of electrical safety. General responsibilities include:

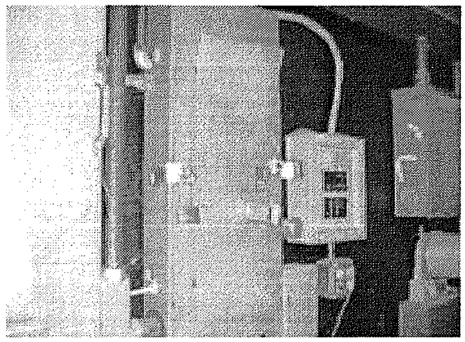


Fig 5.1.5: Courtesy of Peter L. Jannitto, Jr

- Equipment ratings
- Conductor ampacities
- Selective coordination of overcurrent protective devices
- Adherence to applicable codes
- Supply/demand equality
- General power distribution methods
- Proper mounting of equipment
- Adequate tightening or torque of connections
- Use of correct tools
- Preventative maintenance
- Monitoring of equipment parameters

5.2. Modes of Electrical Safety

ünce perspectives and responsibilities are determined, electrical safety is further defined by mode. There are three major modes:

- Preventative
- Real-Time
- Reactive

Each mode constitutes a different approach to safety and is defined by the work performed. The three modes combined form an all inclusive approach to maintaining electrical safety as an integral part of any process or program involving electricity, see Fig. 2.

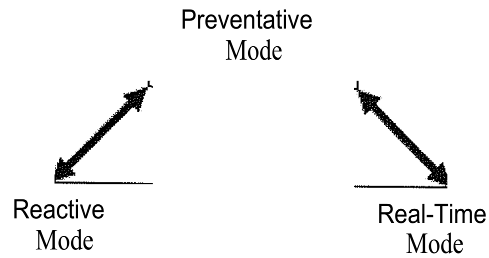


Fig.5.2: Mode Interrelations

5.2.1. Preventative Mode

The preventative mode is identified by administrative actions utilized to ward off or prevent electrical mishaps prior to work being performed. A list of actions for the preventative mode should include:

- Implementation of preventative maintenance programs
- Requiring tagout/lockout procedures
- Instituting second-checks requirements for de-energizing during troubleshooting
- Resourcing applicable codes during design

The initial step towards developing an electrical safety program for an individual or agency is to generate a list of administrative actions identified as "preventative" with respect to the nature of their work.

5.2.2. Real-Time Mode

The real-time mode is identified by procedural actions to ward off or prevent electrical mishaps while performing work. In many cases, the real-time mode is the implementation of actions identified in preventative mode. A list of actions for the real time mode should include:

- Preventative maintenance being performed
- Tagout/lockout procedures being completed during system repair
- Second-checks while de-energizing equipment

- Applying code requirements during design
- Correct installation procedure
- Proper tie-offs on equipment supports
- Torque checks

An electrical safety program for an individual or agency should generate a list procedural actions identified as "real time" with respect to the nature of their work and to coordinate those actions with the preventative mode actions.

5.2.3. Reactive Mode

The reactive mode is identified by procedural and administrative actions utilized to address electrical mishaps that are occurring or have occurred. The reactive mode tends to be the main focus of many established programs and generally gamers the most attention by others outside the building industry because of the detrimental effect electrical mishaps can cause. A list of actions for reactive mode should include:

- Fire suppression training
- Electrical shock training (see Fig. 3: Effects of Electric Shock Levels)
- CPR training
- Electrical shock victim identification
- Emergency planning
- Electrical system orientation

Arnps	**Description**
l-15mA	Perception of electrical current.
15-100 mA	Muscles contract and cannot release, severity determined by current level.
lOOmA	Ventricular fibrillation of the heart occurs.
> 2 Amps	Body receives major bums due to "frying" effect.

* Assume worst case body resistance of 3000hms with varying voltage applied to reach listed currents. Current levels and effects remain approximate due to factors such health, age, size, ete of the victim.

Fig.3.2.3 : Effects of Electric Shock Levels 60Hz*

An electrical safety program for an individual or company agency should generate a list of procedural and administrative actions identified as "reactive" with respect to the nature of their work and coordinate those actions with the preventative and real-time modes.

5.3. Electrical Safety Resources

Resources abound that enable one or one's agency to better recognize perspective and responsibility for electrical safety. With so many resources available, electrical safety program should implement a method of sourcing the information into a manner that is easily accessible. An "Electrical Safety Library" is a start to organizing and making the vast information easier to access. Equally important is the ability to access different media types. Today, not only is access to the Internet a necessity but multiple entry points are suggested. A dedicated area on the computer network for electrical information is an excellent way to manage and identify resources on hand and those becoming available. Within the database, electrical safety resources should be categorized by Perspectives and Modes. Lastly, all electrical safety resources enforced by Iocal ordinance or codes, or required by one's agency should be noted and made available to all users.

5.4. Application of Safety

Electrical safety has been a concern for ali since the time electricity became an essential part of everyone's daily lives. However, for those in the building industry, ownership of electrical safety is a necessity. The building industry and all those immediately affected by it often dictate the rules governing one's actions for the benefit of the end user. Therefore, electrical safety requires a proactive approach most often initiated at an organizational level. The perspectives, modes, and resources presented in this Resource Page should be used to establish the framework necessary for one or one's organization to develop or realign an electrical safety program better tailored to meet one's needs. It is important to note that the first step to any effective safety program is structure, followed by education and implementation.

Relevant Codes and Standards

- *National Electrical Code (NEC) -NFPA* 70-The NEC is the accepted standard for protection of persons and property from electrical installations. Familiarization NFPA 70 is a must for any one whose responsibility is designing, installing, verifying and maintaining safe and compliant electrical systems. Information can be found through the NFPA website with a membership or printed and electronic versions of the code can be purchased from NFPA and other suppliers.
- *National Electrical lnstallation Standards-The* NEIS gives definition to "neat and workmanlike manner" as required by the National Electrical Code. Each standard is submitted for approval by the American National Standards Institute (ANSI).
- *National Electrical Safety Code (NESC)-The* NESC is a product of the Institute of Electrical and Electronics Engineers (IEEE). This code provides information on the installation, operation, and maintenance of electrical systems. The intent of the publication is the safeguarding of persons performing the work. Information, like the NEC, is available with IEEE membership or by buying a printed or electronic version of the code.
- National Fire Protection Association (NFPA)-The NFPA is the definitive source for everything related to fire protection. The association has developed numerous standards that have been adopted by federal, state, and local jurisdictions as enforceable standards. The site has plenty of free information but more specific information is restricted to members only.
- National Institute for Occupational Safety and Health (NIOSH)-NIOSH is similar in mission to OSHA but differs by the singular perspective that NIOSH is the federal agency responsible for the prevention of work related disease and injury, and is part of the Centers for Disease Control and Prevention.
- Occupational Health and Safety Administration (OSHA)-OSHA is the main governmental source for effective safety practices. The website is a vast, readily accessible information resource with a thorough search engine.

6. CIRCUIT BREAKER

6.1. The Meaning of Circuit Breaker

A circuit breaker is an automatically-operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city.

Fig.6.1 :A 2 pole miniature circuit breaker

6.1.1. Operation MCB

All circuit breakers have common features in their operation, although details vary substantially depending on the voltage class, current rating and type of the circuit breaker.

The circuit breaker must detect a fault condition; in low-voltage circuit breaker this is usually done within the breaker enclosure. Circuit breakers for large currentsjğ high voltages are usually arranged with pilot devices to sense a fault current andf operate the trip opening mechanism. The trip solenoid that releases the latch is usual] energized by a separate battery, although some high-voltage circuit breakers are self-contained with current transformers, protection relays, and an intemal control power source.

ünce a fault is detected, contacts within the circuit breaker must open to interrupt the circuit; some mechanically stored energy within the breaker is used to separate the contacts, although some of the energy required may be obtained from the fault current itself. The stored energy may be in the form of springs or compressed air. Small circuit breakers may be manually operated; larger units have solenoids to trip the mechanism, and electric motors to restore energy to the springs.

The circuit breaker contacts must carry the load current without excessive heating, and must also withstand the heat of the arc produced when interrupting the circuit. Contacts are made of copper or copper alloys, silver alloys, and other materials. Service life of the contacts is limited by the erosion due to interrupting the arc. Miniature circuit breakers are usually discarded when the contacts are worn, but power circuit breakers and high-voltage circuit breakers have replaceable contacts.

When a current is interrupted, an arc is generated - this arc must be contained, cooled, and extinguished in a controlled way, so that the gap between the contacts can again withstand the voltage in the circuit. Different circuit breakers use vacuum, air, insulating gas, or oil as the medium in which the arc forms. Different techniques are used to extingish the arc including:

Lengthening of the arc

Intensive cooling (in jet chambers)

Division into partial arcs

Zero point quenching

Connecting capacitors in parallel with contacts in DC circuits

Finally, once the fault condition has been cleared, the contacts must again be closed to restore power to the interrupted circuit.

6.1.2. Arc Interruption MCB

Miniature low-voltage circuit breakers use air alone to extinguish the arc. Larger ratings will have metal plates or non-metallic arc chutes to divide and cool the arc. Magnetic blowout coils deflect the arc into the arc chute.

In larger ratings, oil circuit breakers rely upon vaporisation of some of the oil to blast a jet of oil through the arc. [1]

Gas (usually sulfur hexafluoride) circuit breakers sometimes stretch the arc using a magnetic field, and then rely upon the dielectric strength of the sulfur hexafluoride (SF_6) to quench the stretched arc.

Vacuum circuit breakers have minimal arcing (as there is nothing to ionise other than the contact material), so the arc quenches when it is stretched a very small amount (<2-3 mm). Vacuum circuit breakers are frequently used in modem medium-voltage switchgear to 35,000 volts.

Air circuit breakers may use compressed air to blow out the arc, or altematively, the contacts are rapidly swung into a small sealed chamber, the escaping of the displaced air thus blowing out the arc.

Circuit breakers are usually able to terminate all current very quickly: typically the arc is extinguished between 30 ms and 150 ms after the mechanism has been tripped, depending upon age and construction of the device.

6.1.3. Short Circuit Current

Circuit breakers are rated both by the normal current that are expected to carry, and the maximum short-circuit current that they can safely interrupt.

Under short-circuit conditions, a current many times greater than normal can flow (see maximum prospective short circuit current). When electrical contacts open to interrupt a large current, there is a tendency for an arc to form between the opened contacts, which would allow the flow of current to continue. Therefore, circuit breakers must incorporate various features to divide and extinguish the arc.

The maximum short-circuit current that a breaker can interrupt is determined by testing. Application of a breaker in a circuit with a prospective short-circuit current higher than the breaker's interrupting capacity rating may result in failure of the breaker to safely interrupt a fault. In a worst-case scenario the breaker may successfully interrupt the fault, only to explode when reset, injuring the technician.

Miniature circuit breakers used to protect control circuits or small appliances may not have sufficient interrupting capacity to use at a panelboard - these circuit breakers are called "supplemental circuit protectors" to distinguish them from distribution-type circuit breakers.

6.2. Types of Circuit Breaker

Small circuit breakers are either installed directly in equipment, or are arranged in a breaker panel. The 10 ampere DiN rail mounted thermal-magnetic miniature circuit breaker is the most common style in modem domestic consumer units and commercial electrical distribution boards throughout Europe. The design includes the following components:

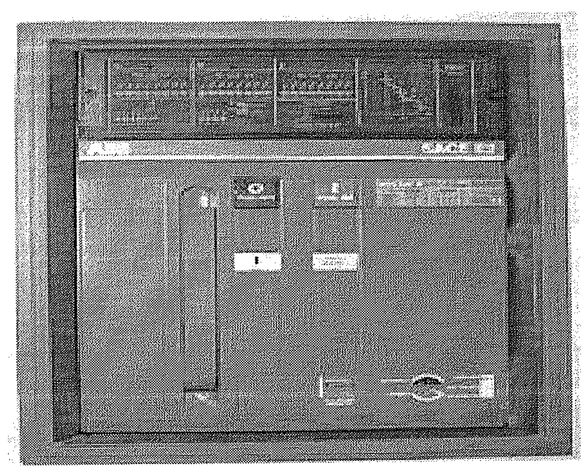


Fig.6.2:Front panel ofa 1250 A air circuit breaker manufactured by ABB. This low voltage power circuit breaker can be withdrawn from its housing for servicing. Trip characteristics are configurable via DiP switches on the front panel

1) Actuator lever - used to manually trip and reset the circuit breaker. Also indicates the status of the circuit breaker (On or Off/tripped). Most breakers are designed so they can still trip even if the lever is held or locked in the on position. This is sometimes referred to as "free trip" or "positive trip" operation.

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

3) Contacts - Allow current to flow when touching and break the flow of current when moved apart.

4) Terminals

5) Bimetallic strip

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

7) Solenoid

8) Arc divider / extinguisher

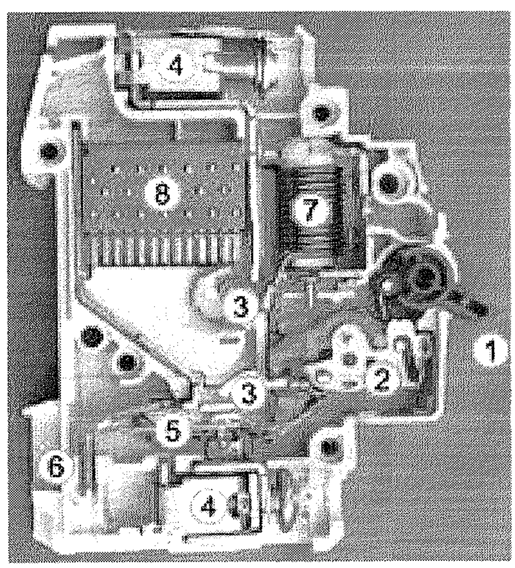


Photo of inside of a circuit breaker

6.2.1. Magnetic Circuit Breaker

Magnetic circuit breakers use a solenoid (electromagnet) whose pulling increases with the current. The circuit breaker contacts are held closed by a latch. As the current in the solenoid increases beyond the rating of the circuit breaker, the solenoid's pull releases the latch which then allows the contacts to open by spring action.. Some types of magnetic breakers incorporate a hydraulic time delay feature using a viscous fluid. The core is restrained by a spring until the current exceeds the breaker .rating. During an overload, the speed of the solenoid motion is restricted by the fluid. The delay permits brief current surges beyond normal running current for motor starting, energizing equipment, ete. Short circuit currents provide sufficient solenoid force to release the latch regardless of core position thus bypassing the delay feature. Ambient temperature affects the time delay but does not affect the current rating of a magnetic breaker.

6.2.2. Thermomagnetic Circuit Breaker

Thermomagnetic circuit breakers, which are the type found in most distribution boards, incorporate both techniques with the electromagnet responding instantaneously to large surges in current (short circuits) and the bimetallic strip responding to less extreme but longer-term over-current conditions.

6.3. Rated Current

Circuit breakers are rated both by the normal current that are expected to carry, and the maximum short-circuit current that they can safely interrupt.

Under short-circuit conditions, a current many times greater than normal can flow (see maximum prospective short circuit current). When electrical contacts open to interrupt a large current, there is a tendency for an arc to form between the opened contacts, which would allow the flow of current to continue. Therefore, circuit breakers must incorporate various features to divide and extinguish the arc. in air-insulated and miniature breakers an *arc chute* structure consisting (often) of metal plates or ceramic ridges cools the arc, and magnetic blowout coils deflect the arc into the arc chute.

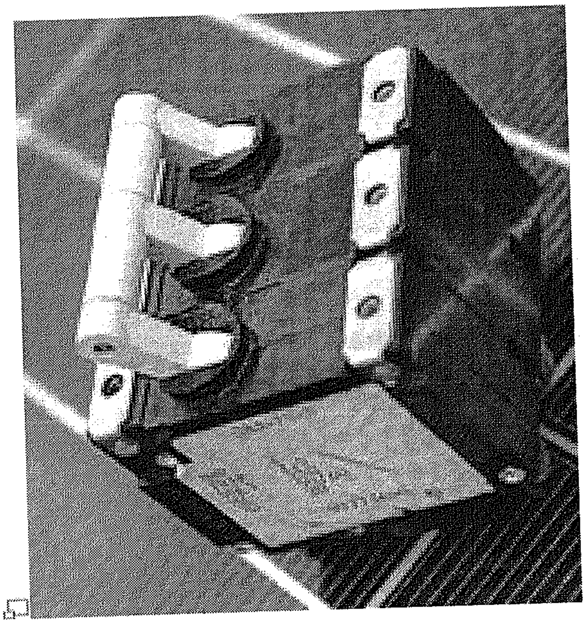
Larger circuit break:ers such as those used in electrical power distribution may use vacuum, an inert gas such as sulphur hexafluoride or have contacts immersed in oil to suppress the arc.

The maximum short-circuit current that a break:er can interrupt is determined testing. Application of a break:er in a circuit with a prospective short-circuit current higher than the break:er's interrupting capacity rating may result in failure of the break:er to safely interrupt a fault. In a worst-case scenario the break:er may successfully interrupt the fault, *only* to *explode* when reset, injuring the technician.

Intemationa1 Standard IEC 60898-1 and European Standard EN 60898-1 define the *rated current ln* of a circuit break:erfor low voltage distribution applications as the current that the break:eris designed to carry continuously (at an ambient air temperature of 30 °C). The commonly-available preferred values for the rated current are 6 A, 10 A, 13 A, 16 A, 20 A, 25 A, 32 A, 40 A, 50 A, 63 A, 80 A and 100 Ar2l (Renard series, slightly modified to include current limit of British BS 1363 sockets). The circuit breaker is labeled with the rated current in ampere, but without the unit symbol "A". Instead, the ampere figure is preceded by a letter "B", "C" or "D" that indicates the *instantaneous tripping current,* that is the minimum value of current that causes the circuit-breaker to trip without intentiona1 time delay (i.e., in less than 100 ms), expressed in terms of in:

6.4. Common **Trip** Breakers

When supplying a branch circuit with more than one live conductor, each live conductor must be protected by a break:erpole. To ensure that all live conductors are interrupted when any pole trips, a "common trip" breaker must be used.



Three pole common trip breaker for supplying a three-phase device.

This breaker has a 2 A rating

When supplying a branch circuit with more than one live conductor, each live conductor must be protected by a breaker pole. To ensure that all live conductors are interrupted when any pole trips, a "common trip" breaker must be used. These may either contain two or three tripping mechanisms within one case, or for small breakers, may extemally tie the poles together via their operating handles. Two pole common trip breakers are common on 120/240 volt systems where 240 volt loads (including major appliances or further distribution boards) span the two live wires. Three pole common trip breakers are typically used to supply three phase power to large motors or further distribution boards.

6.5. What is difference between an isolator and MCB in an electric circuit?(miniature circuit breaker)

lsolator is the term used in power transmission and distribution circuit. The unit isolates two sides. lt could be a manual isolator or a switchgear. The lsolator can not isolate on its own when there is a fault on either side of the circuit. lt has to be operated to isolate the two sides connected through it.

MCB means Moulded Circuit Breaker also it applies to miniature circuit breaker which are small capacity breakers and these too are moulded. So MCB is a breaker but moulded(sealed). The breaker is the term used to a unit which breaks (opens) the circuit.

it has the characteristic and ability to self operate and isolate(break) the circuit if there is a fault down the line. Circuit breakers are used to connect the LOAD to the power circuit(line). ünce the breaker has opened it can not get ON by itself. It is to be actuated agaın.

ISOLATORS are used for medium volt/ high volt and above. MCBs are used for low voltage.

6.6. What is acb/mccb? its function?

What is acb/mccb difference in electrically/mechanically?

As stated above an ACB is an "air circuit breaker", MCCB is a "molded case circuit breaker" .They both serve the same function, which is to isolate a circuit either because you want the power off or to isolate because there is a fault. They both use trip units which monitor the current flowing through the brk and trip when it gets too high. Difference is a ACB typically has what is called an iron frame, meaning it is pretty much all metal. It comes in both low (600V and down US) and medium voltage (2400V-27KV) and various amperage's. ACB's are designed to be completely tore down to the bare bones and rebuilt.

A MCCB has a housing that is made from non conductive material. Available for low voltage applications and comes in amperages from the single poles in the panel in your house to 3 phase and about 4000A. MCCB 's are not meant to come apart. You can get'em apart, but they really are not meant for rebuilding.

Another term you may hear is ICB which is insulated case breakers. These are fairly new, last 8-10 yrs in the US. They provide the best of both worlds, complete maintainability and a non conductive housing. These are available for low voltage applications and amperage wise just

N(number of

P(power)

N(number of

P(power)

[illegible] CALCULATIONS [illegible]

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N(number of armature)

P(power)

	8 A.cl1-N3 1-N3 li\11-clv'dv' Nlv'li\l	v' A.cl1-N3 1-N3li\11-clv'dv' Nlv'li\l	v' 310H 1-N3li\11-clv'dv'	8 310H 1-N3li\11-clv'dv'	310H 381::1	Sl:N1-S 310H 381::1	310H Seliv'1-S
E(room lux)	[illegible]	[illegible]	[illegible]	[illegible]			
d(dirty factor)		[illegible]				1,25	1,25

N(number of armature)	1	1	1	1	1	1	1
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

8. CALCULATION OF TOTAL POWER AND VOLTAGE DROP OF DISTRIBUTION BOXES

8.1 Distribution Box at Basement Floor (Doorkeeper Flat)

Total Power: 12063W

- Conductor type :4* 16mm +10mm earth NYA/PVC
- Total watt=12063W*60%=7561W
- I=7561W/(220x0.9)=38A taking 63A MCB
- Voltage drop (Vd)=G*L *I=2.2*12m*63A=1.66V   220x(2.5/ 100)=5.5V
- 1.66V<5.5V satisfied

8.2 Distribution Box at Basement Floor (Left of ShelterA)

Total Power:2993W

- Conductor type :4*10mm +6mm earth NYA/PVC
- Total watt=2293W*60%=1796W
- I=1796W/(220x0.9)=9A taking 32A MCB
- Voltage drop (Vd)=G*L *I=4.1 *12m*32A=1.575V   220x(2.5/100)=5.5V
- 1.575V<5.5V satisfied

8.3 Distribution **Box at Basenıent** Floor **(Right of** Shelter A)

Total Power:4653W

- Conductor type :4*10mm +6mm earth NYA/PVC
- Total watt=4653W*60%=2792W
- l=2792W/(220x0.9)=14.1A takıng 32A MCB
- Voltage drop (Vd)=G*L*I=4.l *12m*32A=l.575V 220x(2.5/l 00)=55V
- l.575V<5.5V satisfied

8.4 Distribution **Box at Ground Floor (Right)**

Total Power:14138W

- Conductor type :4* 16mm + 10mm earth NYA/PVC
- Total watt=14138W*60%=8482W
- 1=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*I=2.2*10m*63A=l.389V 220x(2 .5/100)=5 .5V
- 1.389V<5.5V satisfied

8.5 Distribution Box at Ground Floor (Left)

Total Power:14138W

~ Conductor type :4* 16mm +10mm earth NY A/PVC

~ Total watt=14138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L*l=2.2*15m*63A=2.079V   220x(2.5/100)=5.5V

~ 2.079V<5.5V satisfied

8.6 Distribution Box at 1. Floor (Right)

Total Power:14138W

~ Conductor type :4*16mm +lümm earth NYA/PVC

~ Total watt=14138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L *1=2.2*13m*63A=l .801 V   220x(2.5/l 00)=5.SV

~ 1.801V<5.5V satisfied

8.7 Distribution Box at 1. Floor (Left)

Total Power:14138W

~ Conductor type :4*16mm +lümm earth NYA/PVC

~ Total watt=14138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L*l=2.2*18m*63A=2.494V 220x(2.5/100)=5.5V

~ 2.494V<5.5V satisfied

8.8 Distribution Box at 2. Floor (Right)

Total Power:14138W

~ Conductor type :4*16mm +lümm earth NYA/PVC

~ Total watt=l4138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L*I=2.2*16m*63A=2.217V 220x(2.5/100)=5.5V

~ 2.217V<5.5V satisfied

8.9 Distribution Box at 2. Floor (Left)

Total Power:14138W

➢ Conductor type :4*16mm +lOmm earth NY A/PVC

➢ Total watt=14138W*60%=8482W

➢ 1=8482W/(220x0.9)=42.84A takıng 63A MCB

➢ Voltage drop (Vd)=G*L*I=2.2*21m*63A=2.910V 220x(2.5/1 00)=5.5V

➢ 2.910V<5.5V satisfied

8.10 Distribution Box at 3. Floor (Right)

Total Power:14138W

➢ Conductor type :4*16mm +lümm earth NY A/PVC

Total watt=14138W*60%=8482W

➢ 1=8482W/(220x0.9)=42.84A takıng 63A MCB

➢ Voltage drop (Vd)=G*L*l=2.2*19m*63A=2.633V 220x(2.5/100)=5.SV

➢ 2.633V<5.5V satisfied

8.11 Distribution Box at 3. Floor (Left)

Total Power:14138W

~ Conductor type :4* 16mm + 10mm earth NY A/PVC

~ Total watt=14138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L*I=2.2*24m*63A=3.326V 220x(2.5/100)=5.5V

~ 3.326V<5.5V satisfied

8.12 Distribution Box at 4. Floor (Right)

Total Power:14138W

~ Conductor type :4*16mm +lümm earth NY A/PVC

",- Total watt=14138W*60%=8482W

~ 1=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L *I=2.2*22m*63A=3.049V 220x(2.5/100)=5 .5V

~ 3.049V<5.5V satisfied

8.13 Distribution Box at 4. Floor (Left)

Total Power:14138W

- Conductor type :4*16mm +lümm earth NYA/PVC
- Total watt=14138W*60%=8482W
- 1=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*I=2.2*27m*63A=3.742V 220x(2.5/100)=5.5V
- 3.742V<5.5V satisfied

8.14 Distribution Box at 5. Floor (Right)

Total Power:14138W

- Conductor type :4*16mm +IOmm earth NYA/PVC
- Total watt=l4138W*60%=8482W
- 1=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*l=2.2*25m*63A=3.465V 220x(2.5/l 00)=5.5V
- 3.465V<5.5V satisfied

8.15 Distribution Box at 5. Floor (Left)

Total Power:14138W

- Conductor type :4*16mm +lOmm earth NYA/PVC
- Total watt=14138W*60%=8482W
- l=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*l=2.2*30m*63A=4.158V   220x(2.5/100)=5.5V
- 4.158V<5.5V satisfied

8.16 Distribution Box at 6. Floor (Right)

Total Power:14138W

- Conductor type :4* 16mm + 10mm earth NY A/PV C
- Total watt=l4138W*60%=8482W
- 1'=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L *l=2.2*28m*63A=3.880V   220x(2.5/100)=5 .5V
- 3.880V<5.5V satisfied

8.17 Distribution Box at 6. Floor (Left)

Total Power:14138W

- Conductor type :4*16mm +lOmm earth NYA/PVC
- Total watt=14138W*60%=8482W
- l=8482W/(220x0,9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*I=2.2*33m*63A=4.573V 220x(2.5/100)=5.5V
- 4.573V<5.5V satisfied

8.18 Distribution Box at 7. Floor (Right)

Total Power:14138W

- Conductor type :4*16mm +lOmm earth NY A/PVC
- Total watt=14138W*60%=8482W
- l=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L *1=2.2*31 m*63A=4.296V 220x(2.5/100)=5.5V
- 4.296V<5.5V satisfied

8.19 Distribution Box at 7. Floor (Left)

Total Power:14138W

- Conductor type :4*16mm +10mm earth NY A/PVC
- Total watt=14138W*60%=8482W
- l=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L*l=2.2*36m*63A=4.989V 220x(2.5/100)=5.5V
- 4.989V <5.5V satisfied

8.20 Distribution Box at 8. Floor (Right)

Total Power:14138W

- Conductor type :4*16rnm +IOrnm earth NY A/PVC
- Total watt=l4138W*60%=8482W
- l=8482W/(220x0.9)=42.84A takıng 63A MCB
- Voltage drop (Vd)=G*L *1=2.2*34m*63A=4.712V 220x(2.5/100)=5.5V
- 4.712V<5.5V satisfied

8.21 Distribution Box at 8. Floor (Left)

Total Power:14138W

- Y Conductor type :4*16mm +lOmm earth NYA/PVC
- Y Total watt=14138W*60%=8482W
- Y I=8482W/(220x0.9)=42.84A takıng 63A MCB
- Y Voltage drop (Vd)=G*L*I=2.2*39m*63A=5.405V 220x(2.5/100)=5.5V
- Y 5.405V<5.5V satisfied

8.22 Distribution Box at 9. Floor (Right)

Total Power:14138W

- Y Conductor type :4*16mm +lümm earth NYA/PVC
- Y Total watt=14138W*60%=8482W
- Y 1=8482W/(220x0.9)=42.84A takıng 63A MCB
- Y Voltage drop (Vd)=G*L*l=2.2*37m*63A=5.128V 220x(2.5/100)=5 .5V
- Y 5.128V<5.5V satisfied

8.23 Distribution Box at 9. Floor (Left)

Total Power:14138W

~ Conductor type :4*16mm +lümm earth NYA/PVC

~ Total watt=14138W*60%=8482W

~ l=8482W/(220x0.9)=42.84A takıng 63A MCB

~ Voltage drop (Vd)=G*L*l=2.2*42m*63A=5.821V 220x(2.5/100)=5.5V

~ 5.821 V>5.5V unsatisfied

8.24 Distribution Box at Roof

Total Power:2x9000W+294W=l 8294W

~ Conductor type :4* 16mm + 10mm earth NYA/PVC

~ Total watt=18294W*100%=18294W

~ 1=18294W/('V3x380x0.9)=30A takıng 63A MCB

>" Voltage drop (Vd)=G*L *1=2.2*48m*63A=6.65V 380x(2.5/100)=9.5V

~ 6.65V<9.5V satisfied

NORMAL KAT TESİSAT TOPLAMI(TOPLAM 36 DAİRE İÇİN)

S.NO	AÇIKLAMA	MiKTAR	BiR.iM	B.FİAT	TOPLAM
1	Askı Lamba Tesisatı	180,00	ADET	47,00	8460,00
2	Tavan Globu Tesisatı	180,00	METRE	47,00	8460,00
3	Duvar Globu Tesisatı	180,00	ADET	47,00	8460,00
4	4*75 Watt Avize TESİSAT!	36,00	ADET	70,00	2520,00
5	1*58 WATT FLORESAN TESİSAT!	36,00	METRE	110,00	3960,00
6	TEL TESİSAT!	108,00	ADET	88,00	9504,00
7	TV TESİSAT!	108,00	ADET	90,0Q	9720,00
8	1*13A PRİZ TESİSAT!	720,00	ADET	67!00	48240,00
9	1*11 YOLLU 63A Otomatikli Daömrn Panosu	24,00	ADET	150!00	3600,00
10	Tooraklama Tesisatı	144,00	ADET	25!00	3600,00
11	Kaoı Zili Tesisatı	36,00	ADET	76,00	2736,00
12	Camaşır Makinesi TESİSAT!	36,00	ADET	45,00	1620,00
13	SU MOTOR TESİSAT!	36,00	ADET	230,00	8280,00
14	3000KW SU ISITICISI TESİSAT!	36,00	ADET	45,00	1620,00

ToQlam(YTL): 12078~00

KAPICI DAİRESİ

S.NO	AÇIKLAMA	MİKTAR	BiRiM	B.FIAT	TOPLAM
1	Askı Lamba Tesisatı	5,00	ADET	47,00	235.,00
2	Tavan Globu Tesisatı	5,00	METRE	47,00	235,00
3	Duvar Globu Tesisatı	3,00	ADET	47,00	141,00
6	TEL TESİSAT!	3,00	ADET	88,00	264;00
7	TV TESİSAT!	3,00	ADET	90,00	270,00
8	1*13A PRİZ TESİSAT!	16,00	ADET	67,00	1072,00
9	1*11 YOLLU 63A Otomatikli Daôıtrrn Panosu	1,00	ADET	150,00	150,00
10	Tooraklama Tesisatı	7,00	ADET	25,00	175,00
11	Kapı Zili Tesisatı	1,00	ADET	76,00	76,00
12	[Carnaşır Makinesi TESİSATI	1,00	ADET	45,00	45,00
13	SU MOTOR TESİSATI	1,00	ADET	230,00	230,00
14	3000KW SU ISITICISI TESİSAT!	1,00	ADET	45,00	45,00
			Toplam(YTU:		2938,00

SIGINAKSAG

S.NO	ACIKLAMA	MİKTAR	BİRİM	B.FİAT	TOPLAM
1	[Ask: Lamba Tesisatı	11,00	ADET	47,00	517,00
2	Tavan Globu Tesisatı	11,00	METRE	47,00	517,00
3	Duvar Globu Tesisatı	4,00	IADET	47,00	188,00
5	2*58 WATT FLORESAN TESİSAT!	1,00	IMETEfE	130,00	130,00
8	1*13A PRİZ TESİSAT!	6,00	IADET	67,00	402,00
9	1*11 YOLLU 63A Otomatikli Daöıtrm Panosu	1,00	IADET	150,00	150,00
10	Irooraktama Tesisatı	4,00	IADET	25,00	100,00
11	Tesisatı	1,00	IADET	76,00	76,00
				Toplam(YTL>:	2080,00

SIGINAKSOL

S.NO	AÇIKLAMA	MiKTAR	BiRİM	B.FIAT	TOPI...AM
1	Askı Lamba Tesisatı	3,00	ADET	47,00	141,00
2	Tavan Globu Tesisatı	3,00	METRE	47,00	141,00
3	Duvar Globu Tesisatı	3,00	ADET	47,00	141,00
4	1*13A PRİZ TESİSAT!	5,00	ADET	67,00	335,00
5	1*11 YOLLU 63A Otomatikli Dağıtım Panosu	1,00	ADET	150,00	150,00
6	Topraklama Tesisatı	4,00	ADET	25,00	100,00
7	Kaoı Zili Tesisatı	1,00	ADET	76,00	76,00
				Toplam(YTL):	1084,00

ÇATI KAT MERDİVEN AYAKLAR! VE ASANSÖRTESİSATLARI

S.NO	ACIKLAMA	MIKTAR	BiRiM	B.FİAT	TOPLAM
1	!Tavan Globu Tesisatı	45,00	IADET	47,00	2115,00
2	[Duvar Globu Tesisatı	10,00	IADET	47,00	470,00
3	11*58 WATT FLORESAN TESİSAT!	3,00	IMETRE	130,00	390,00
4	11*11 YOLLU 63A Otomatikli Daöıtım Panosu	1,00	IADET	150,00	150,00
5	IiNTERKOM TESİSATI(30AB0NELİ	1,00	IADET	3000,00	3000,00
6	!ASANSÖR TESİSAT!	4,00	IADET	7500,00	30000,00

Toolam(YTL>: 36125!00

TOPLAM MALİYET

S.NO	AÇIKLAMA	MiKTAR
1	NORMAL KAT TESİSAT COST(TOPLAM 24	120780,00
2	DOOR KEEPER TESİSAT COST	2938,00
3	SIGINAK SAG	2080,00
4	SIGINAK SOL	1084,00
5	CATI KAI MEBQİ\I_ENVE ASAf\JSÖRTESİ~	36125,00

TOPLAM(YTL 163007!00

10. CONCLUSION

Our Projcct is about bulding illumınatıon first of we shoulded calculatıon illumınatıon methaods varıous methods are us efor ınterıor illumınatıon to illumınate the mcdium succcsful.The standart illumınatıon level data is optained from the standards tablc,thc property of armaturc is sefebted ,the calculatıon is done to get thc nccassary amount of armatures for the lcvel of the illumınatıon.

Sccand of we discussed about circuıt types their usages and them bfeir history after next sectıon we about studied about switch and their wording pirinciples configuration usages of todays.

However we have researched about used by word wide and we have explaned differences of these typcs of socets in addition to this we emplosize of electiric safety and methods of prevention against to hederdous electırıcal current for human health in last chapter we have mcntroned about importancc of circuıt breakers in todays life.

Wc talked of circuıt breakers about their important functıons types of against circuıt breakers and brify working principle importance in the human life.

In our Project we havc done illumınatıon calculatıon for given bulding desing we devıdcd what types of !anıp , plugs and sockets should be used in each room and however we calculated how many lamps should be in a room according aour aim is to prvide in this economıc and good qualıty illumınatıon and after to find the best efficıent armature or tehen according to room size we calculated how many plugs needed.

Finally our Project we havecalculated total coston bases of good quality and economic illumınatıon fort he buldıng.

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