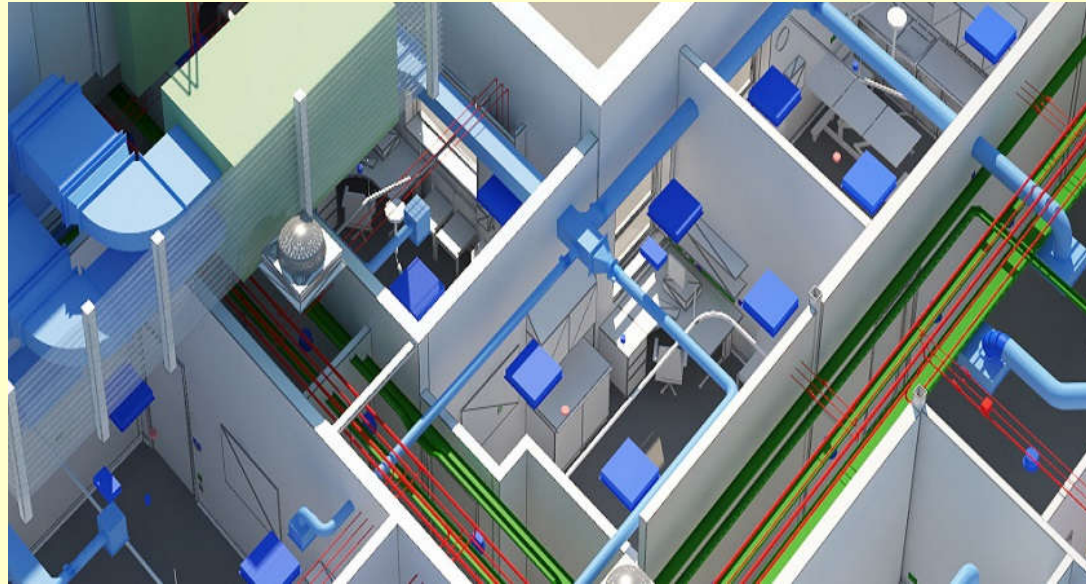




10. Electrical Services Part 3

10.2 Practical skills and considerations

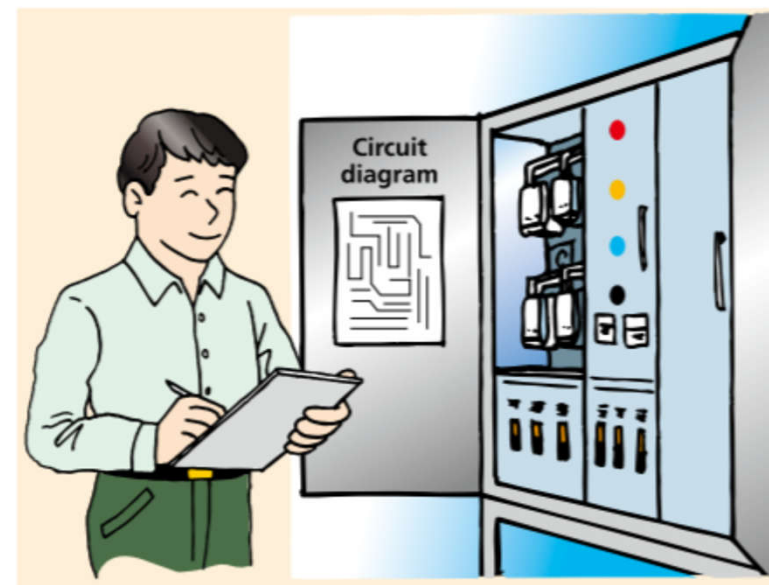


Ir Dr. Sam C. M. Hui
Department of Mechanical Engineering
The University of Hong Kong
E-mail: cmhui@hku.hk

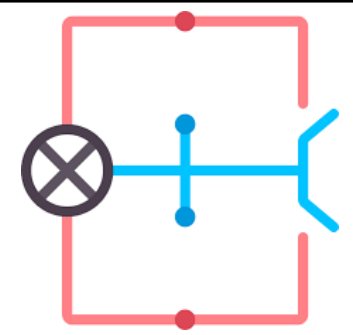
Contents 內容



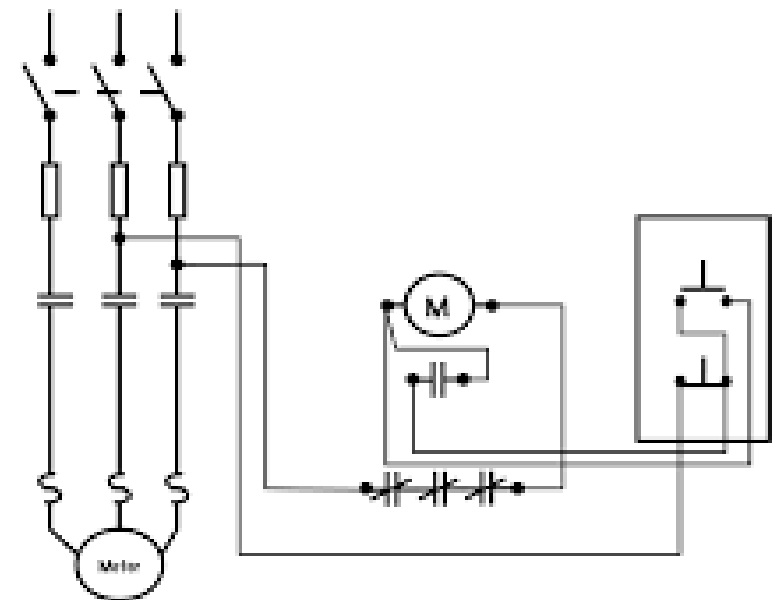
- Schematic diagrams 示意圖
- Electrical cables 電纜
- Wiring installation 接線安裝
- Space coordination 空間協調

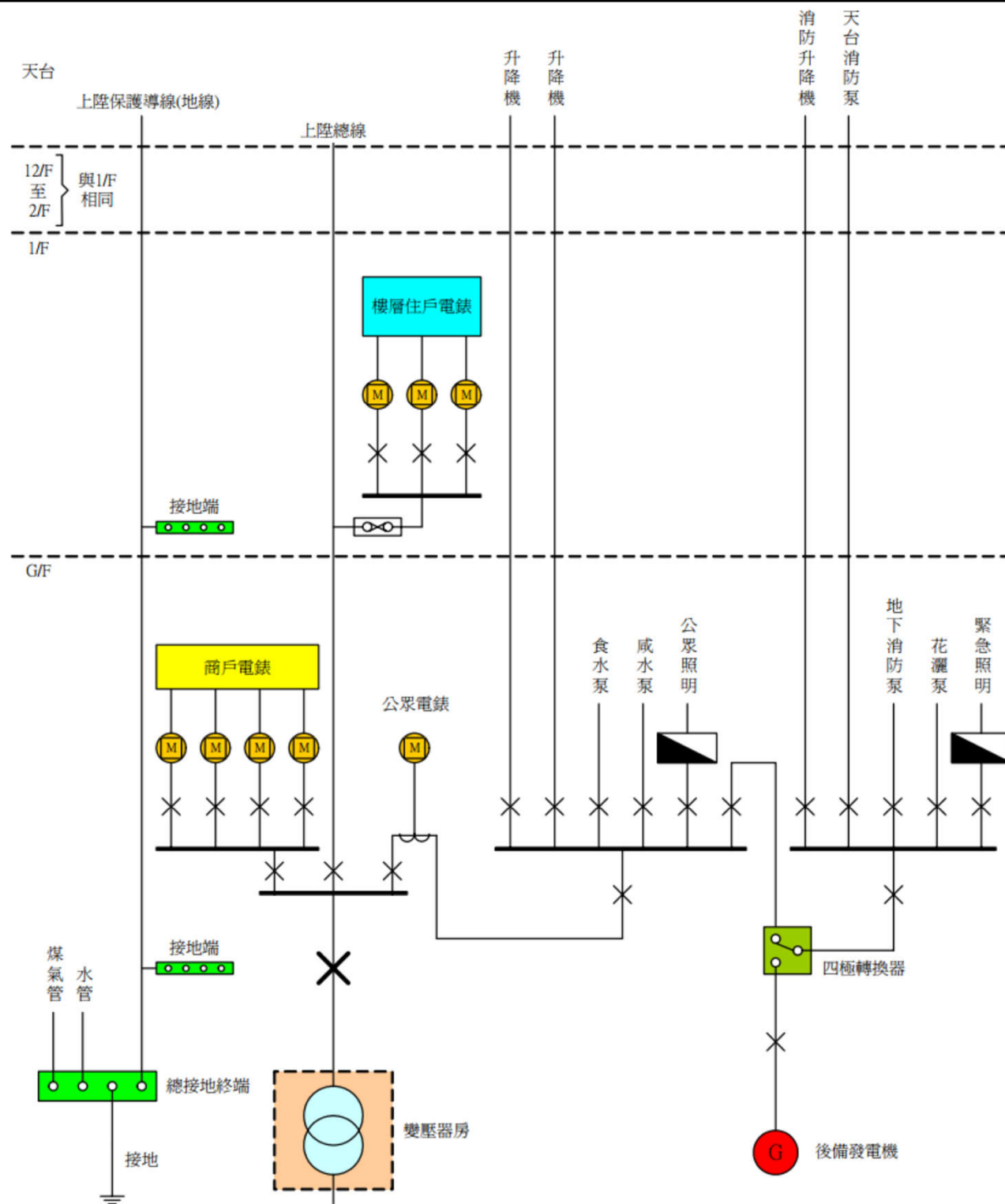


Schematic diagrams



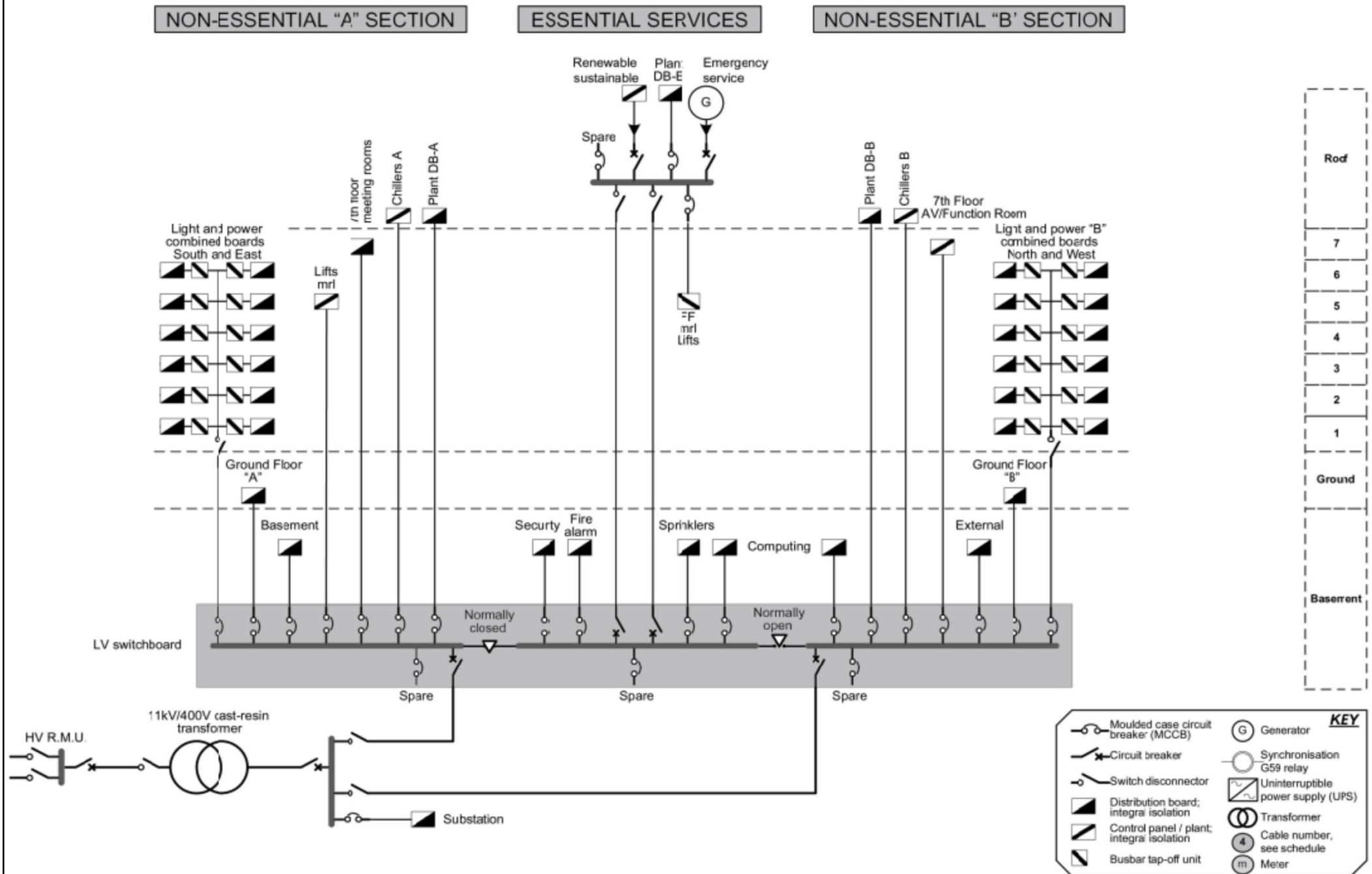
- Schematic diagram 示意圖
 - A diagram that uses lines to represent the wires and symbols to represent components. It is used to show how the circuit functions
- Types of schematic diagrams
 - Circuit drawing (diagram)
 - Line/schematic diagram
 - Wiring diagram
 - Block diagram



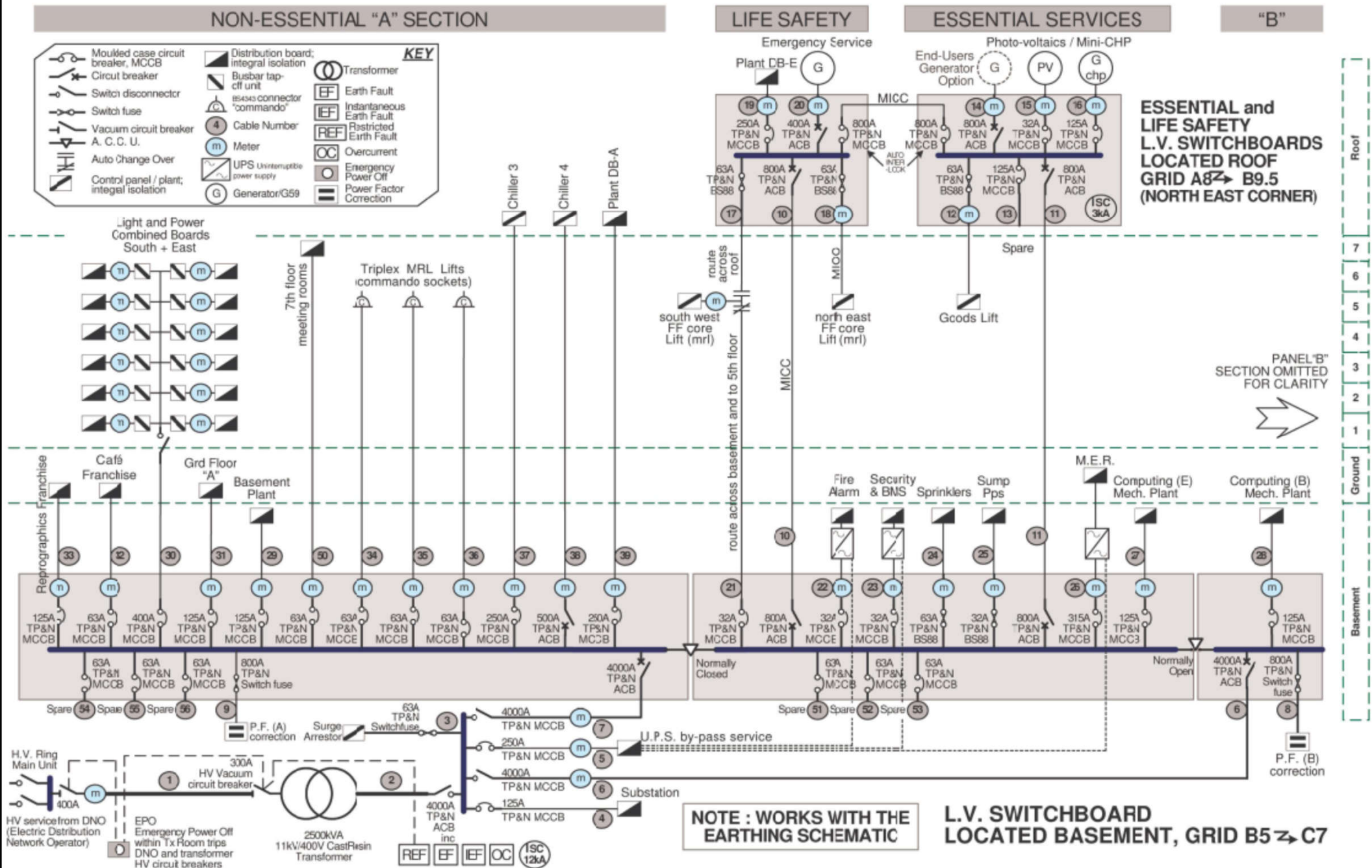


Typical
schematic
diagram for
fixed electrical
installation of
building
大廈公眾固定
電力裝置圖

Sketch electrical schematic diagram

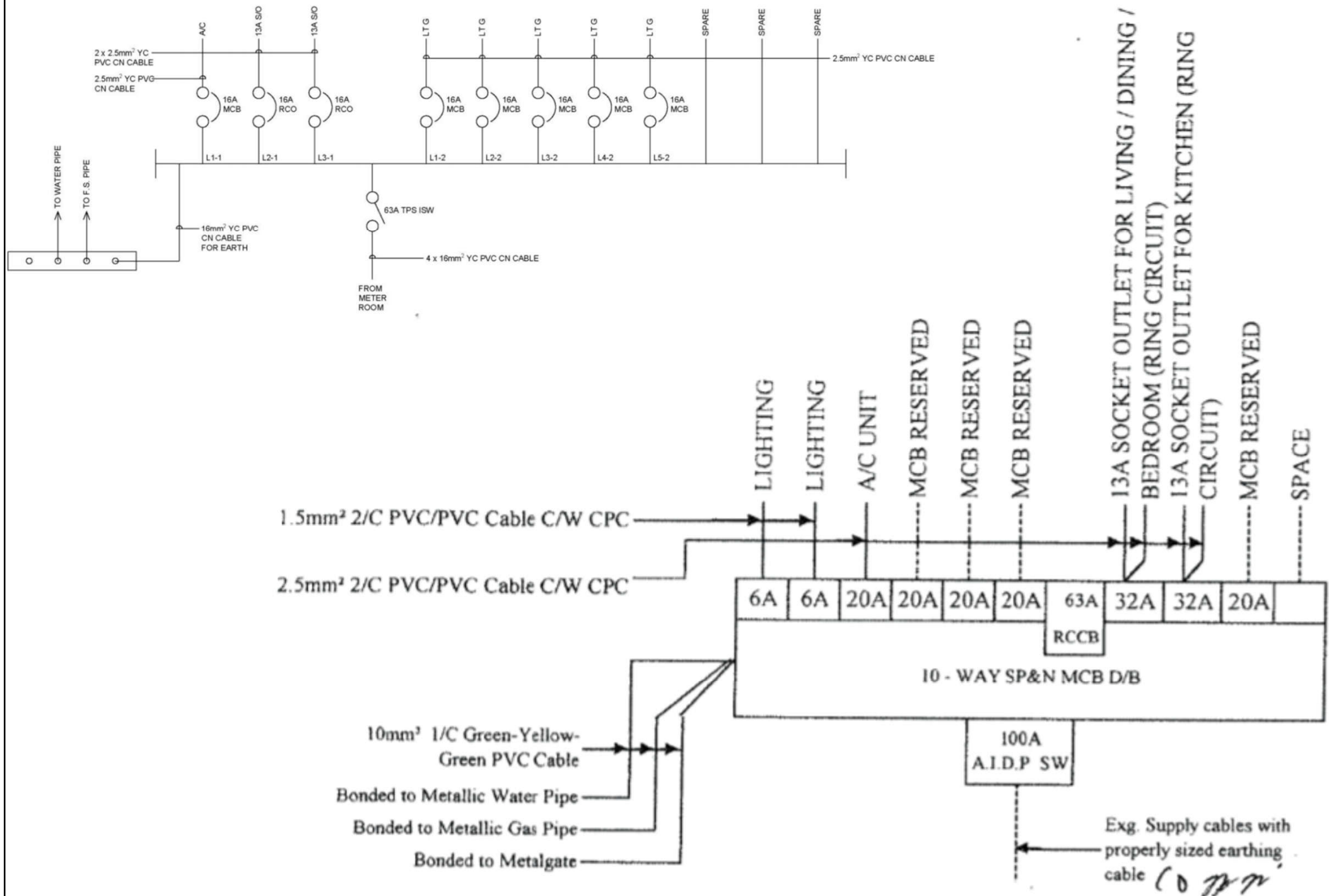


Detail electrical schematic diagram



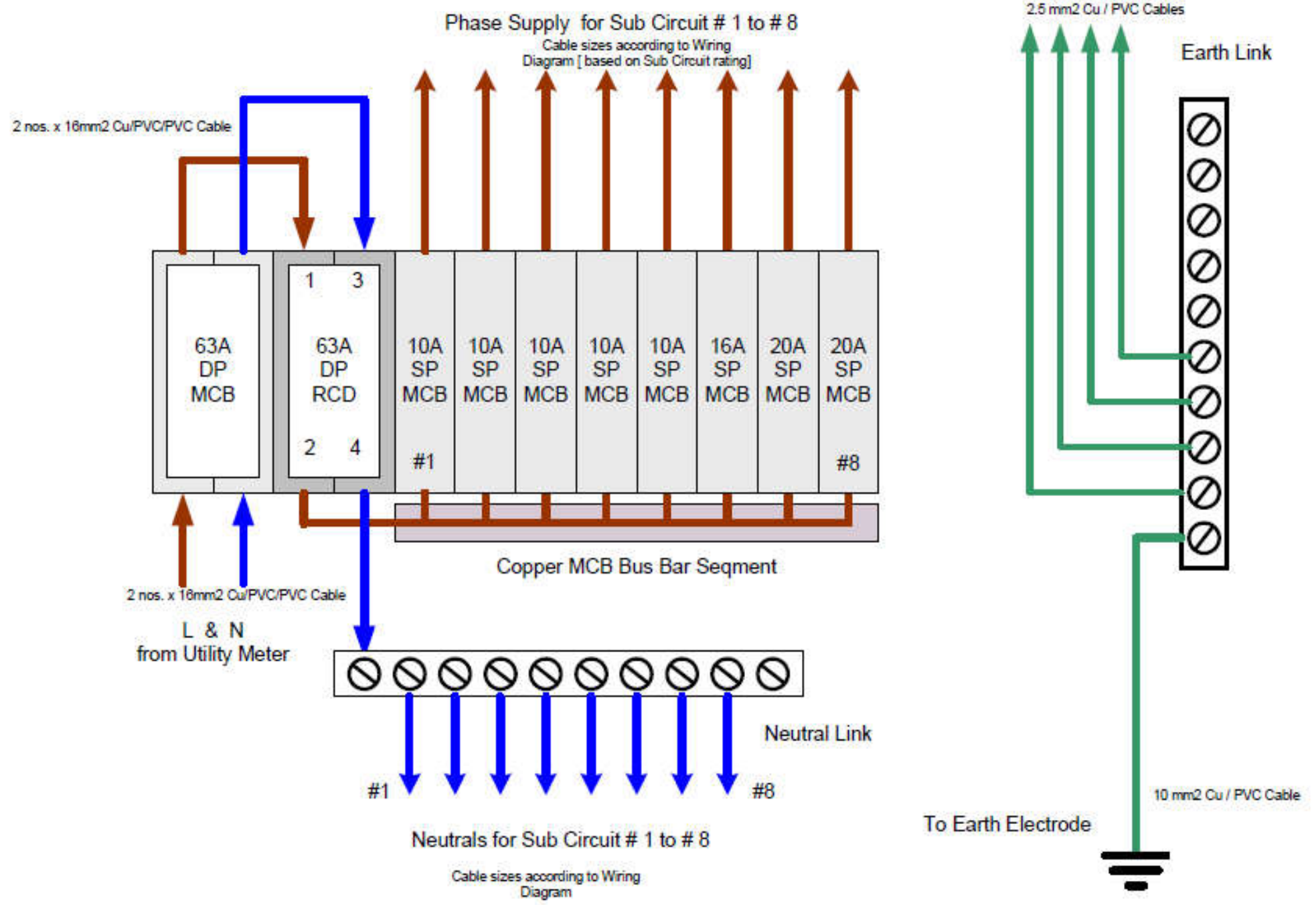
[Source: BSRIA, Design Framework for Building Services]

Examples of schematic wiring diagrams

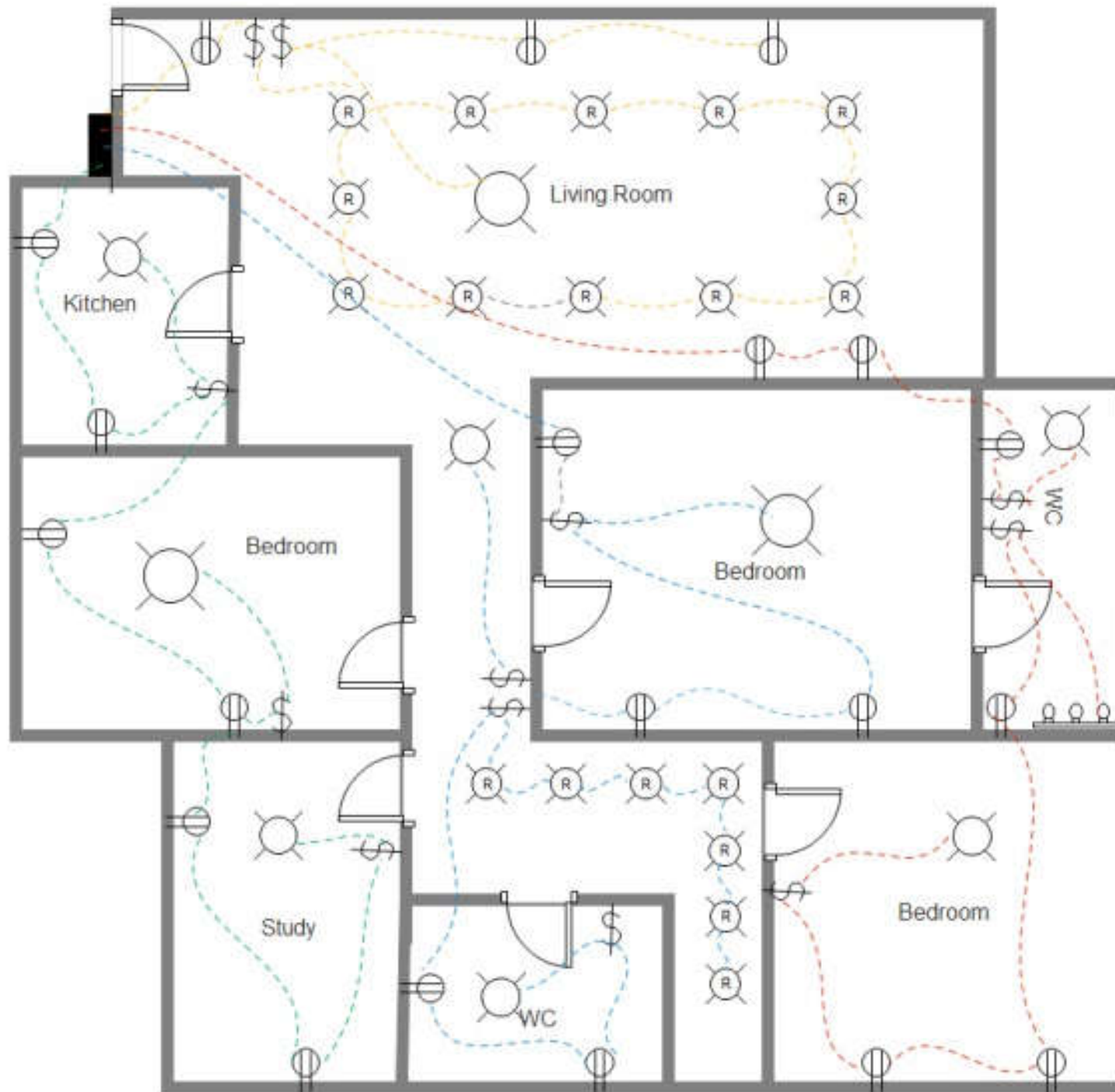


Example of sub-circuit wiring diagram

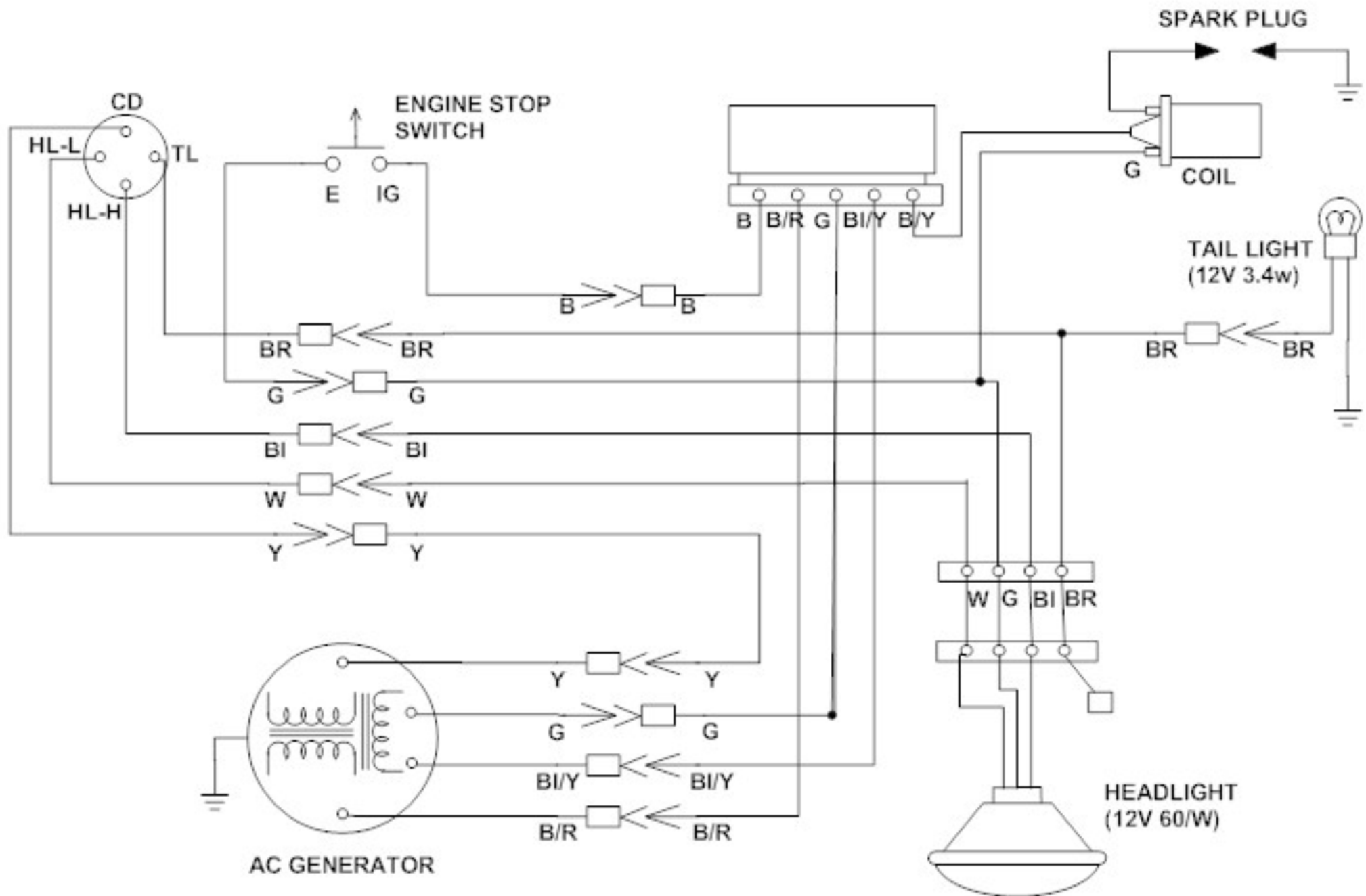
Wiring of the Distribution Board [Consumer Unit] with RCD



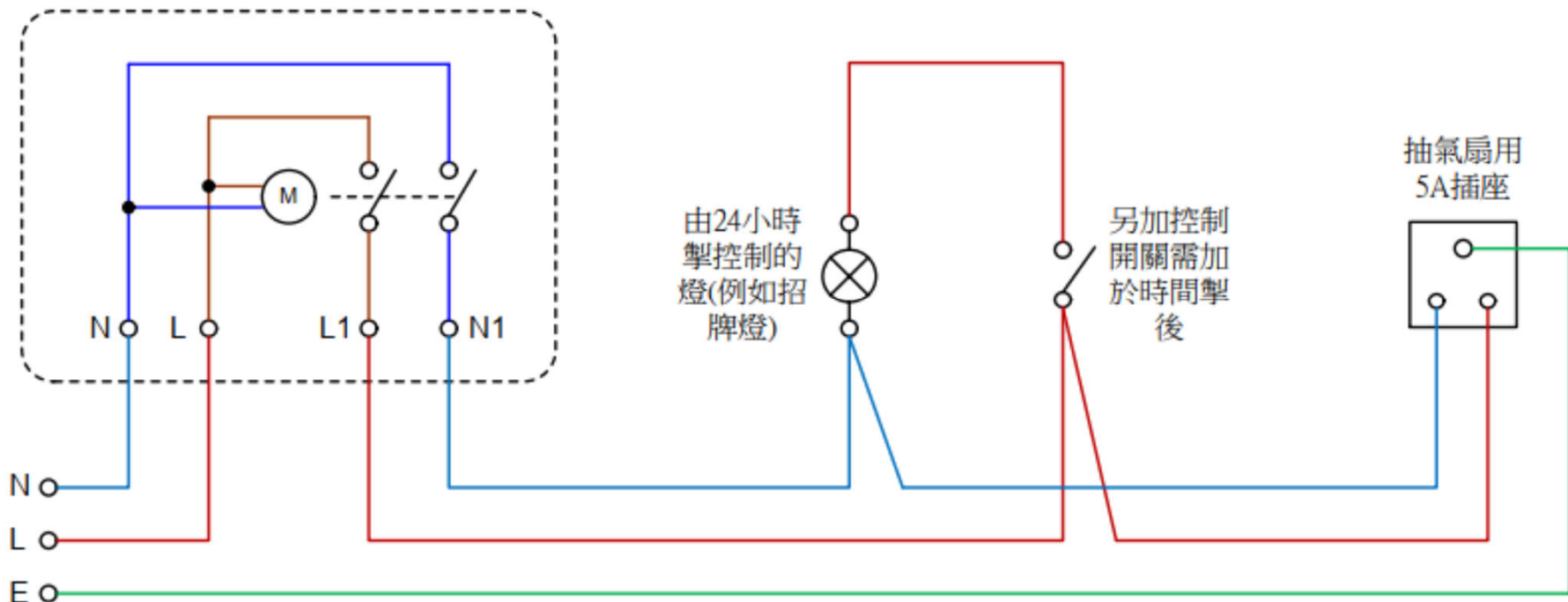
House wiring diagram



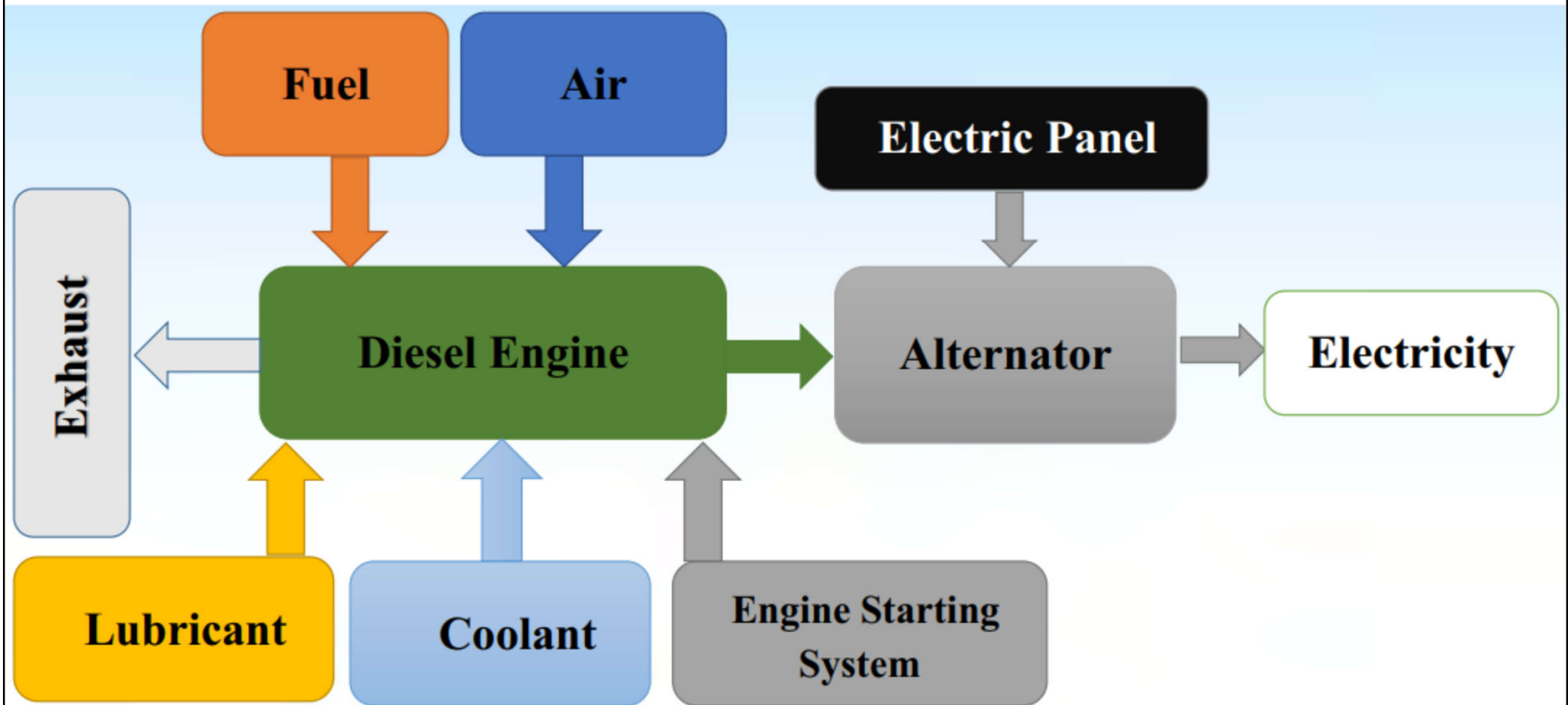
Example of equipment wiring diagram



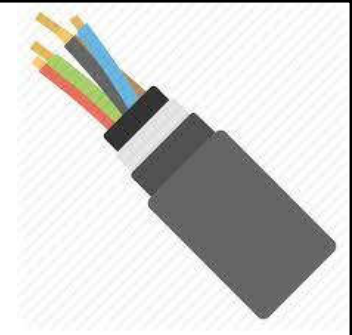
24 Hours Timer Circuit (24小時時間掣電路)



Block diagram of a generator



Electrical cables



- Categories of cable:
 - 1. Power
 - 2. Control
 - 3. Special, e.g. communications
- Power cable contains one, two, three or four cores etc.
- Size of copper conductor expressed in sq millimeters (mm^2)

Commonly used cable types

**PVC
Insulated
Single-
core**



**PVC
Insulated
PVC
Sheathed
Twin-core
(flat)**



**Steel
Wired
Armored**



**Multi-core
circular**



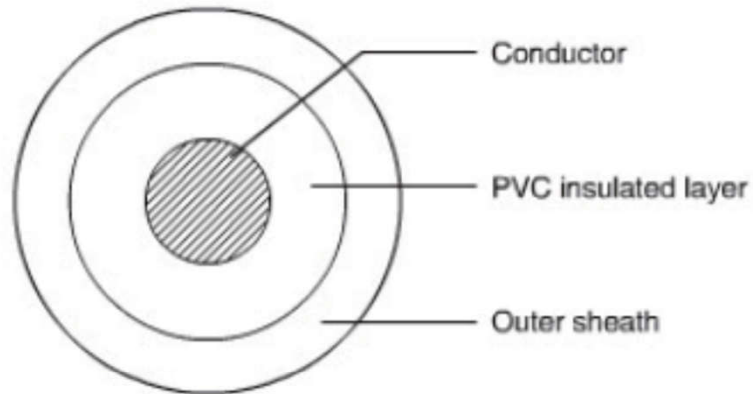
**Mineral
Insulated
Copper
Clad**



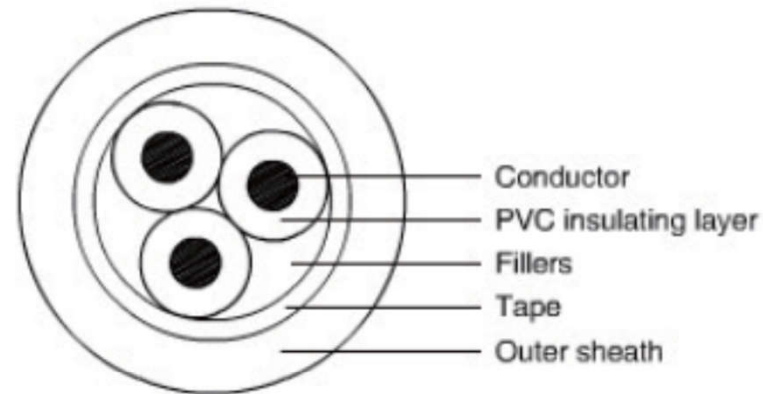
**Fire
Retardant
Cable**



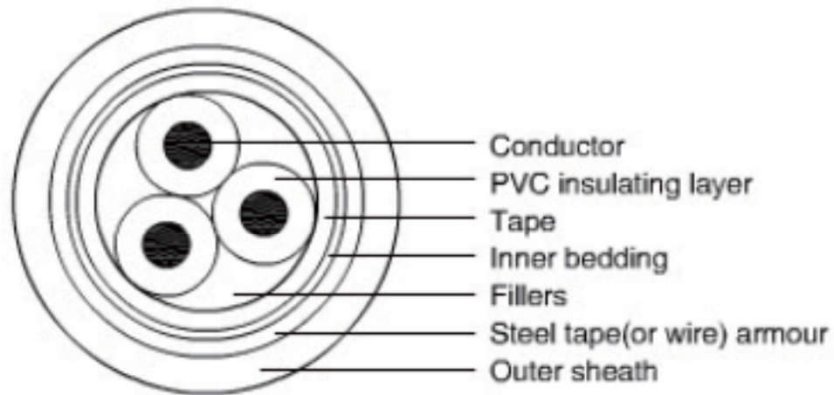
Component of cable



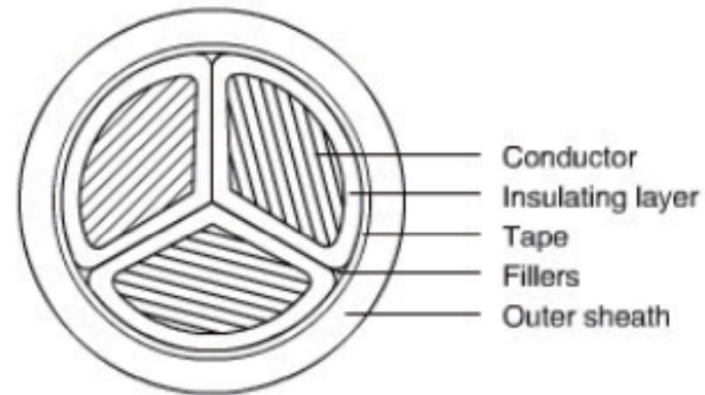
One core power cable



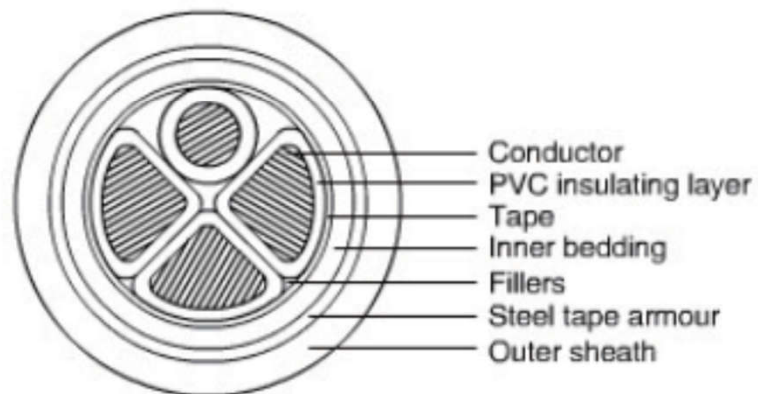
Three cores power cable



Three cores power cable



Three cores sector power cable



(3 + 1) cores sector armored power cable

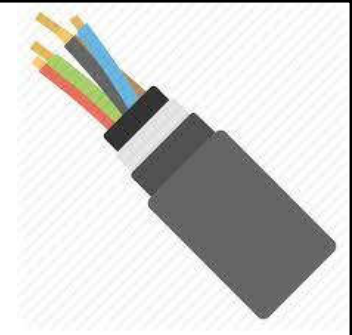


Colours for cable identification

Old Cable Colour Code		
	Single Phase	Three Phase
Phase Conductor (Line)	 Red or	 Line 1 Red
	 Yellow or	 Line 2 Yellow
	 Blue	 Line 3 Blue
Neutral Conductor	 Black	
Protective Conductor (Earth)	 Green-and-Yellow	

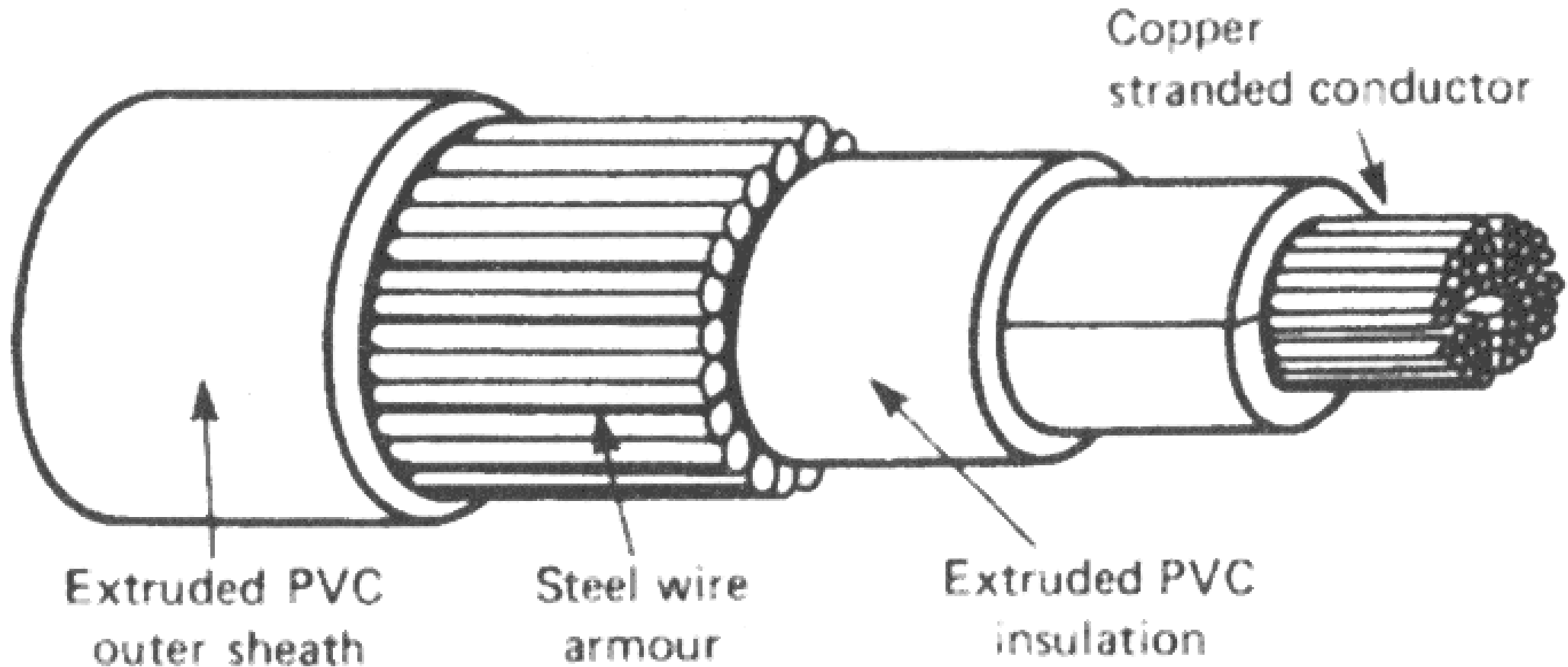
New Cable Colour Code		
	Single Phase	Three Phase
Phase Conductor (Line)	 Brown	 Line 1 Brown
		 Line 2 Black
		 Line 3 Grey
Neutral Conductor	 Blue	
Protective Conductor (Earth)	 Green-and-Yellow	

Electrical cables



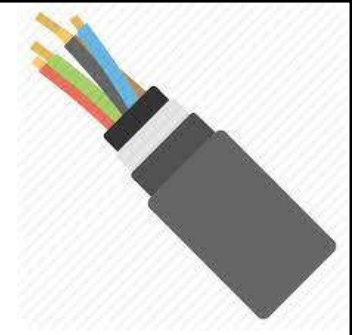
- General requirements of cable system
 - Routing & installation
 - Workmanship: support, spacing, bending, etc.
 - Passing through walls & floors (e.g. fire barriers)
- Types of cable
 - PVC insulated
 - PVC sheathed non-armoured
 - Armoured or metallic-sheathed cable

Typical cable structure & components



Armoured three phase four wire cable
for laying below ground level

Electrical cables

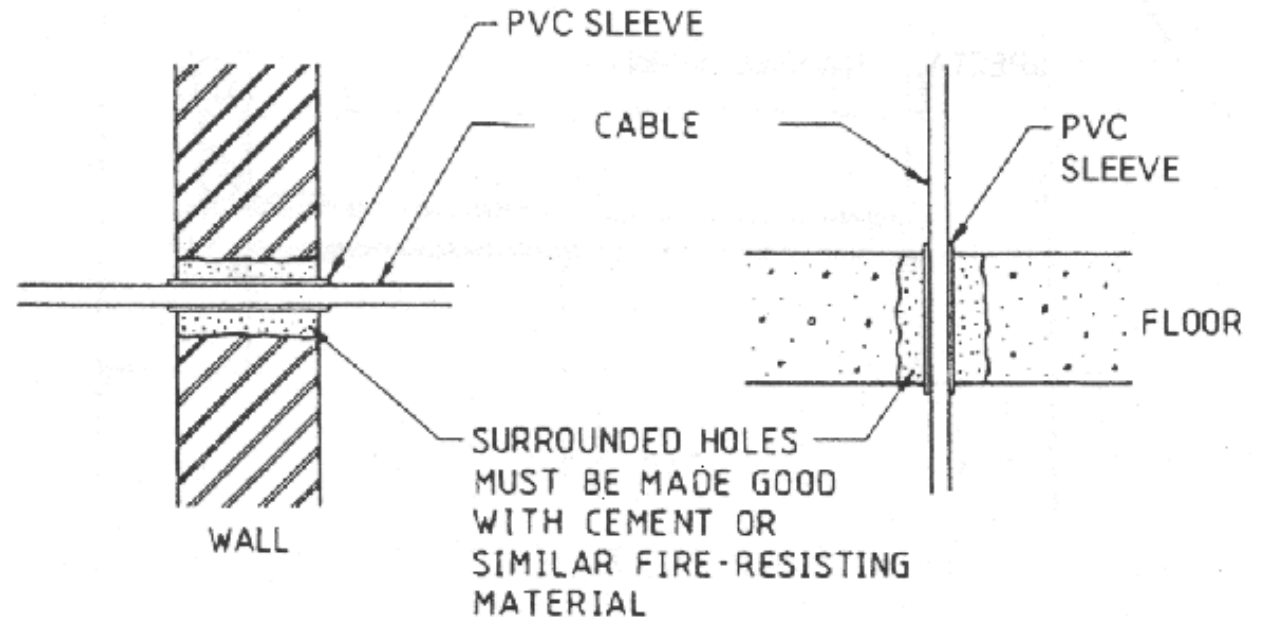
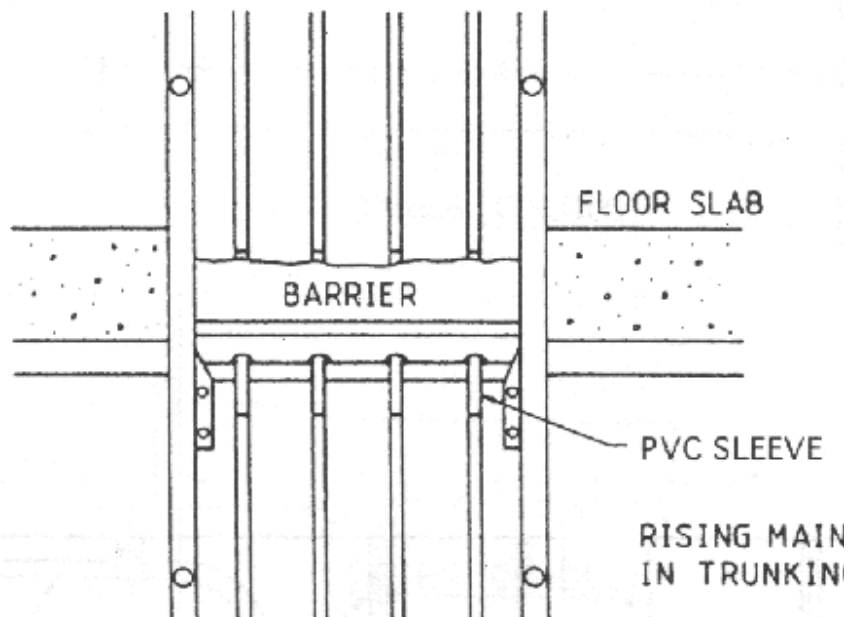
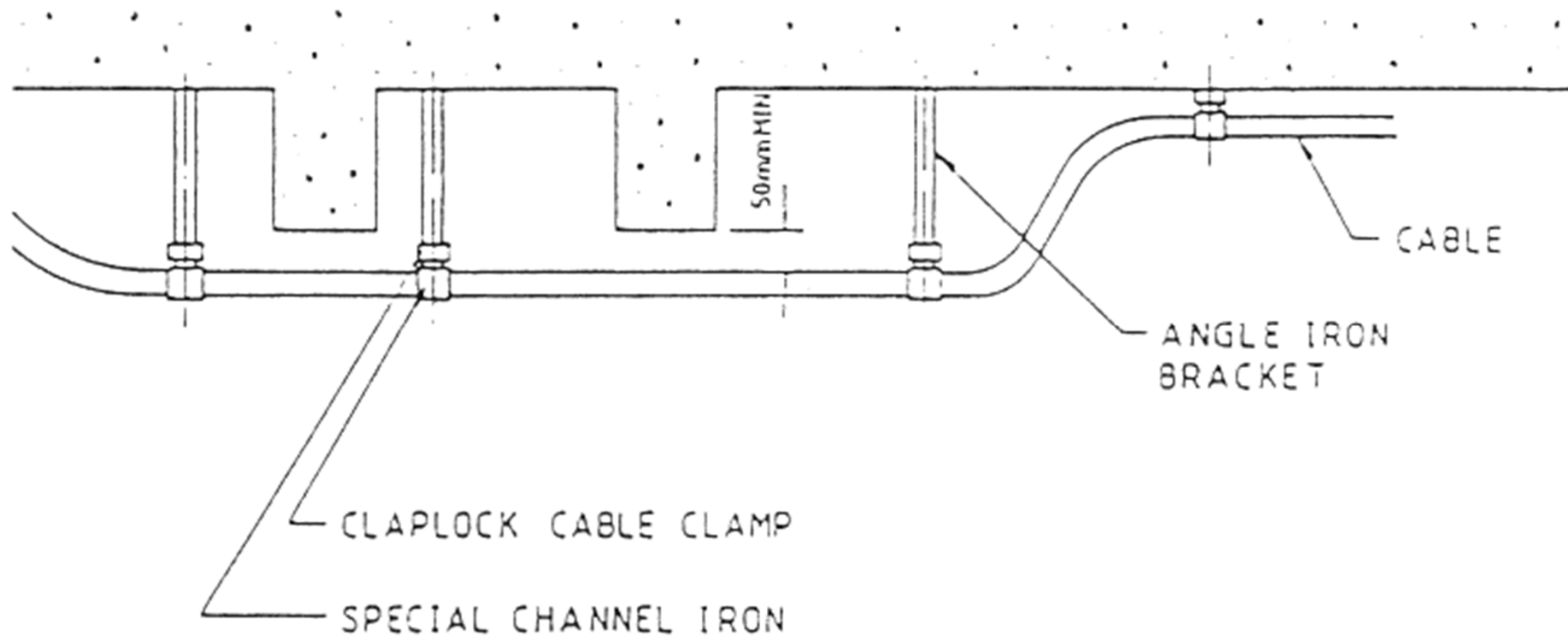


- LV cable installation method & containment
 - Bare in air (e.g. overhead lines)
 - Buried underground
 - Surface mount
 - In conduits
 - In trunkings
 - On cable trays
 - On cable ladders
 - In cable trenches

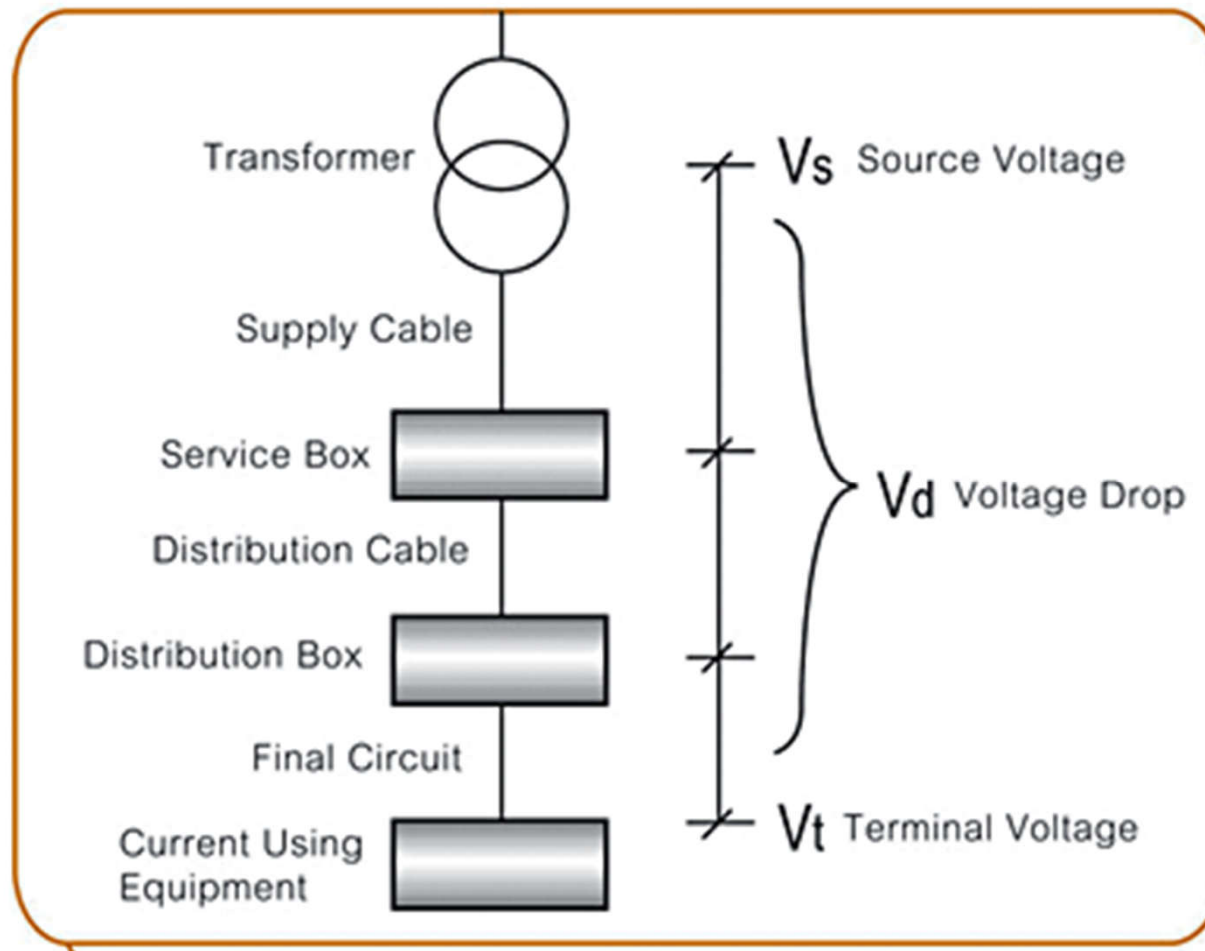
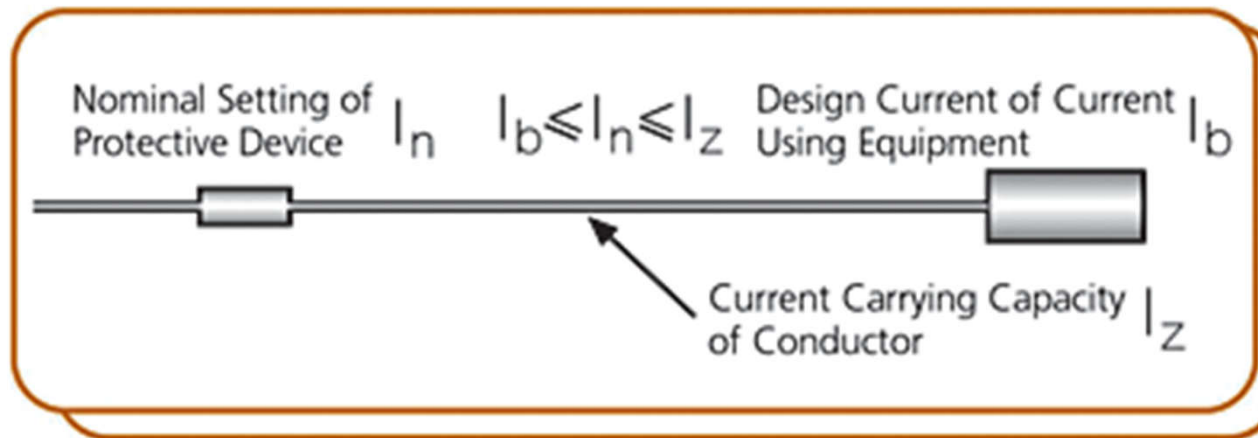
Issues of concern:

- *Mechanical protection and protection from ambient environment for both the conductors and the insulation;*
- *Characteristics & conditions of site or application; and constraints to installation work;*
- *Ease of access for maintenance and addition & alternation work; etc.*

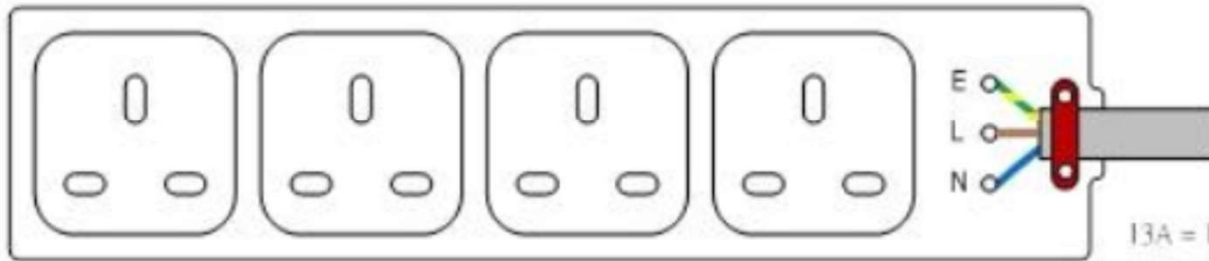
Cable installation details



Method of sizing cable conductors



13A Trailing Socket (13A 拖蘇電路)

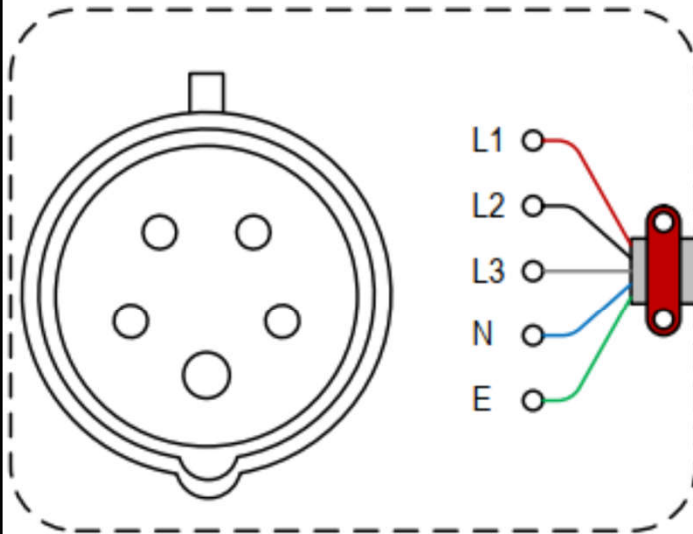


13A = 1.25mm² 3芯軟線

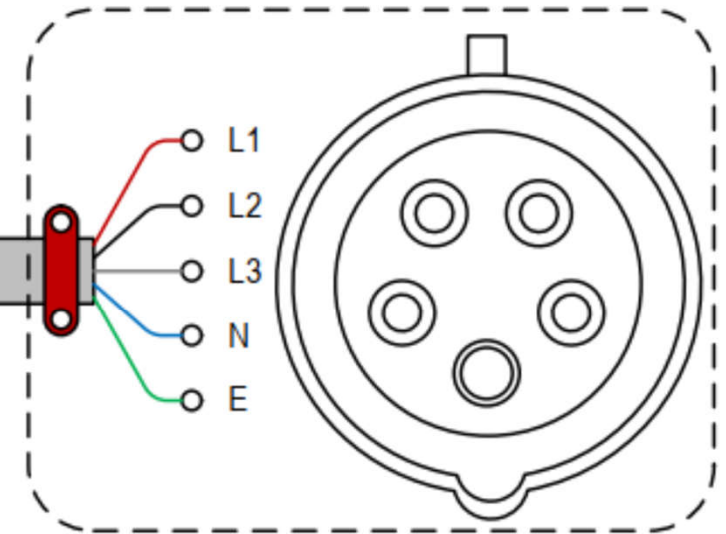


16A Industrial Plug & Coupler Trailing Socket

(16A工業插頭及插座電路)



插頭接線端



插座接線端



Ingress Protection (IP) Chart

Solids

- 1** Protection against solid objects greater than 50 mm in diameter
- 2** Protection against solid objects greater than 12,5 mm in diameter
- 3** Protection against solid objects greater than 2,5mm in diameter
- 4** Protection against solid objects greater than 1 mm in diameter
- 5** Dust protection
- 6** Dustproof

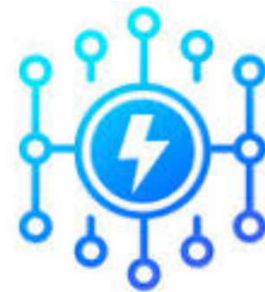


IP65

Water

- 1** Have to protect against spraying liquids on the device from vertical angle
- 2** Have to protect against spraying liquids on the device from 0-15° angle
- 3** Have to protect against spraying liquids on the device from 0-60° angle
- 4** Have to protect against splashing liquids on the device from any direction
- 5** Have to protect against flushing liquids on the device from any direction
- 6** Have to protect against heavily flushing liquids on the device from any direction
- 7** Have to protect for less than 30 minutes of sinking into the water
- 8** Have to protect for continuously sinking into the water

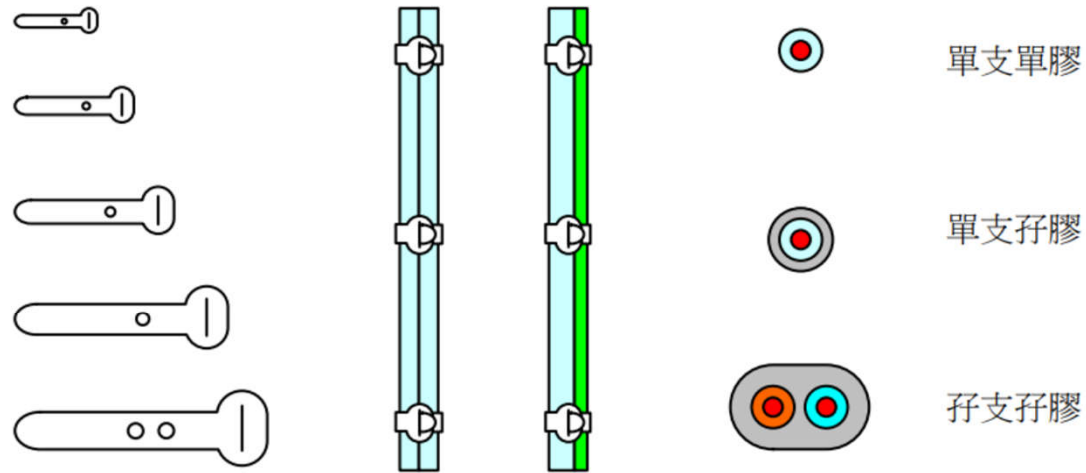




Wiring installation

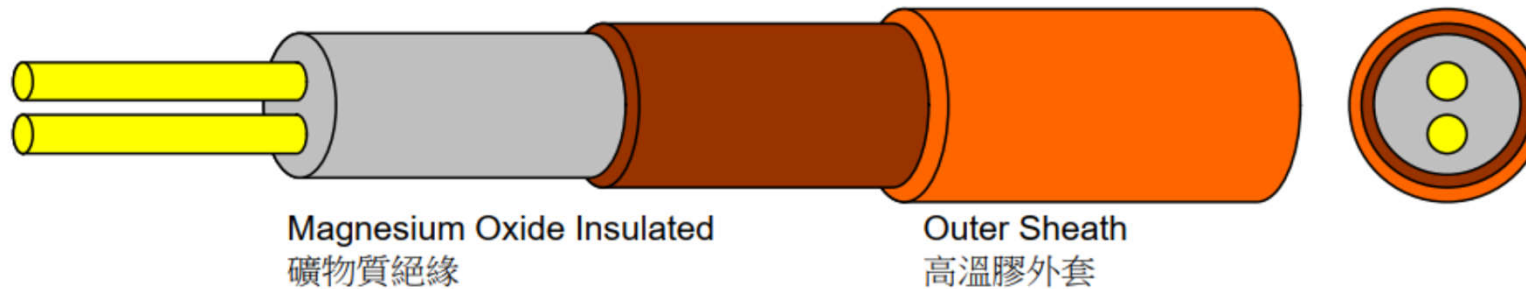
- Electrical wiring system 電力裝置佈線系統
 - Surface wiring 明線佈線
 - PVC insulated cable PVC 膠作絕緣線
 - Mineral insulated copper core (MICC) 銅皮線
 - Cable tray 線架/梳茜 (perforated, ladder, wire basket)
 - Enclosed wiring 暗線佈線
 - Conduit system 燈喉系統
 - Trunking system 線槽系統
 - Cable trench 線坑

Surface wiring system 明線佈線系統



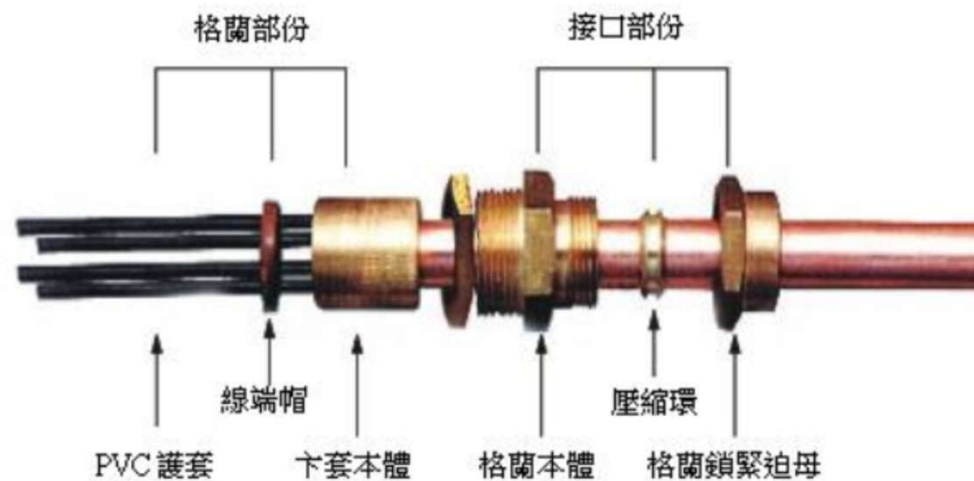
Copper Conductors
銅導體

Copper Sheath
銅外皮



Magnesium Oxide Insulated
礦物質絕緣

Outer Sheath
高溫膠外套



PVC 護套

線端帽

卡套本體

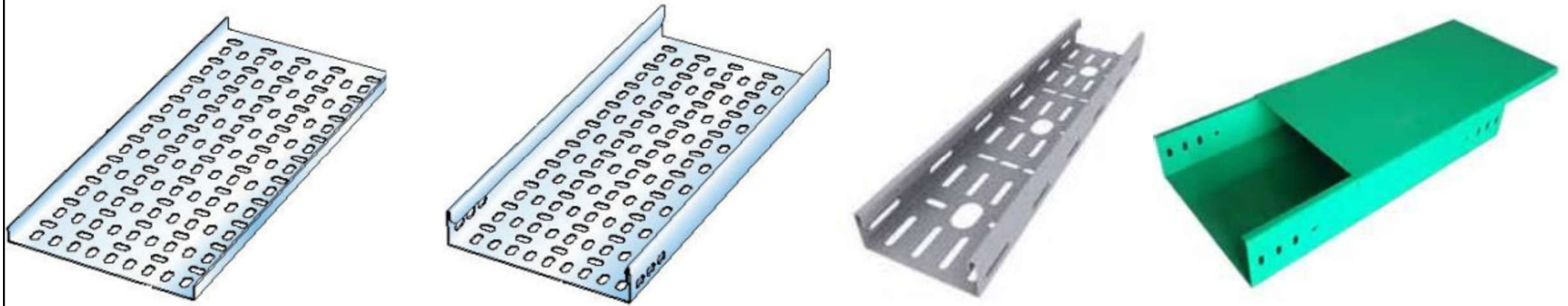
格蘭本體

壓縮環

格蘭鎖緊迫母



Perforated & ladder cable trays 梳孔及梯型線架

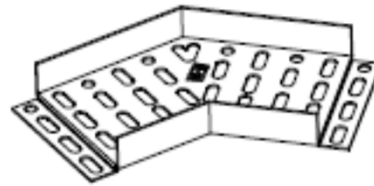


Cable tray fitting & accessories

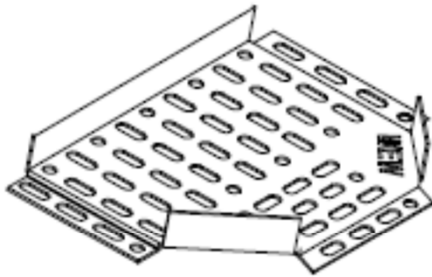
90° Bends EB 90



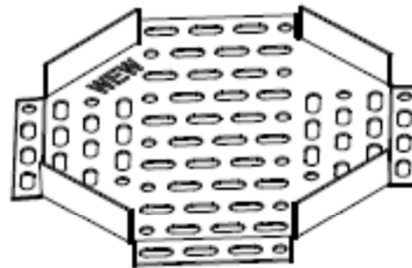
45° Bends EB 45



Tees ET



Crossovers EX

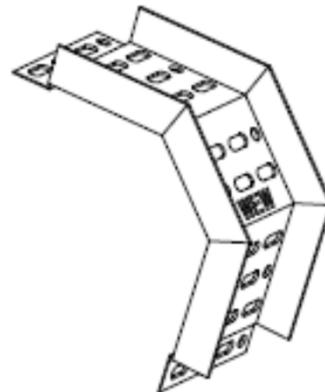


90° Internal risers
EIR

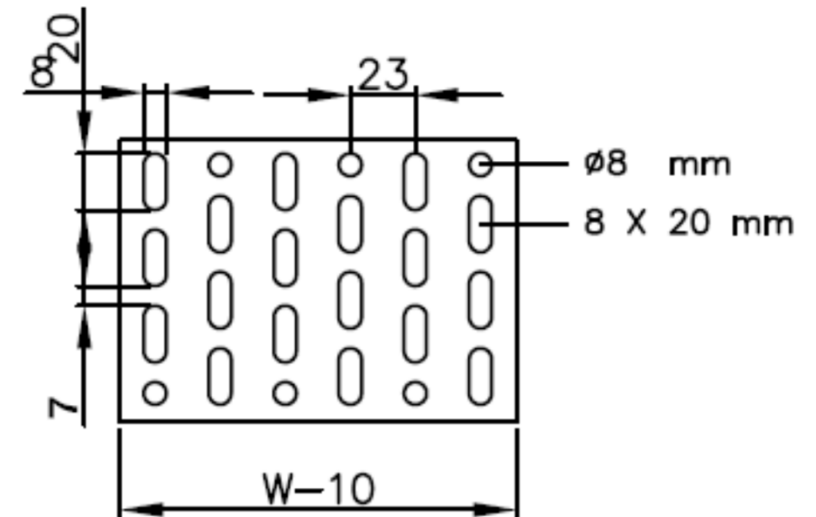
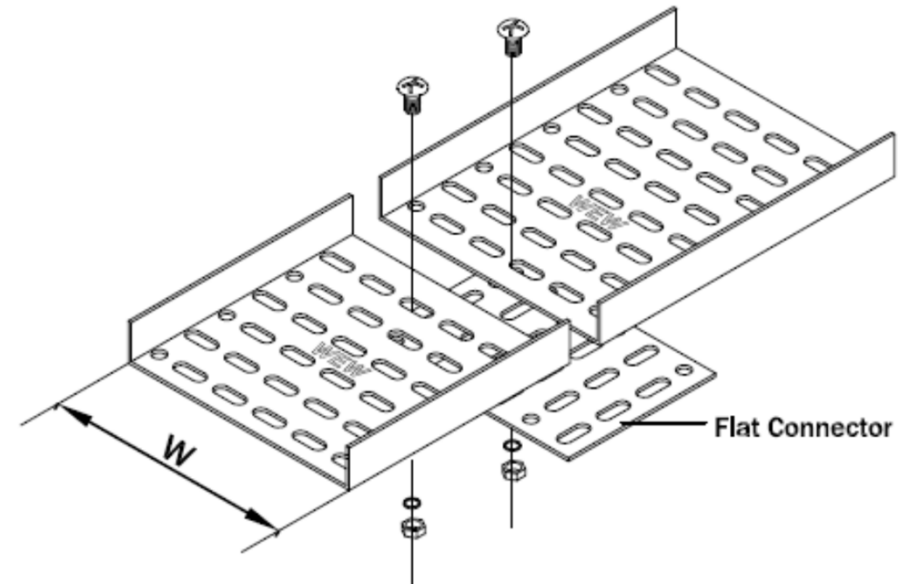


45° is available

90° External risers
EER

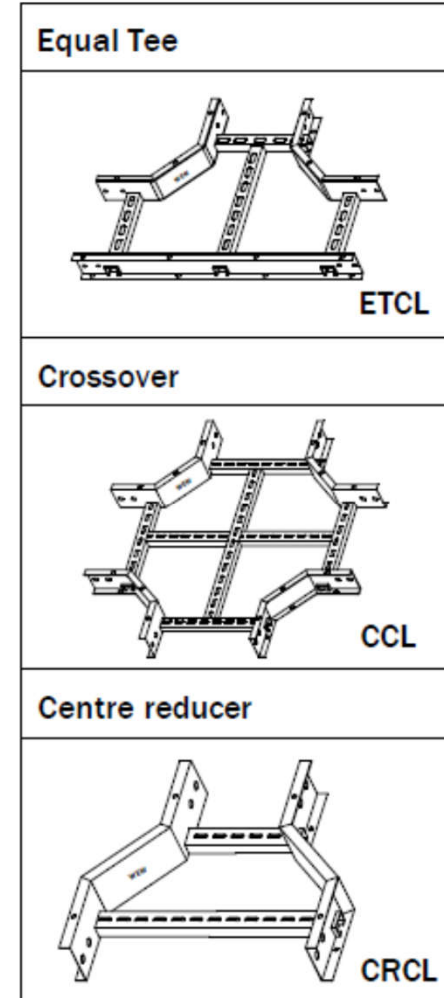
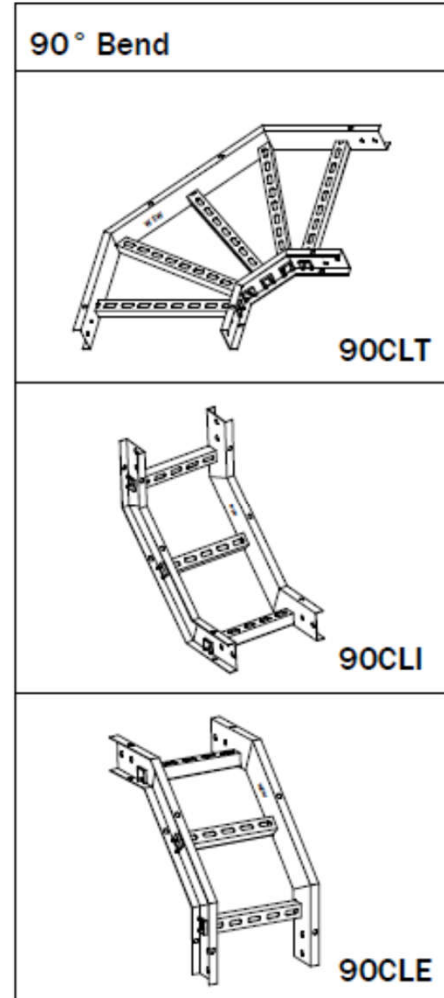
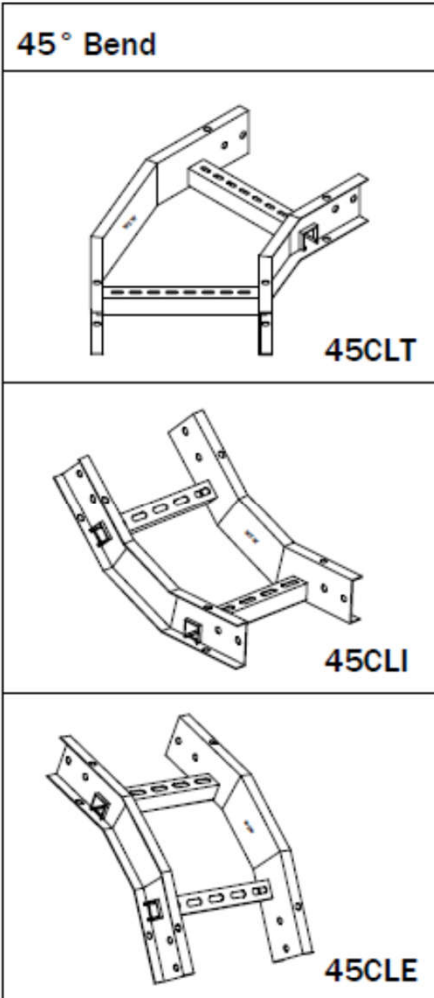
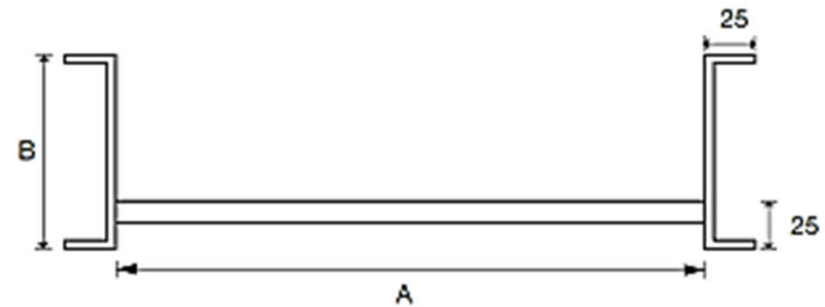
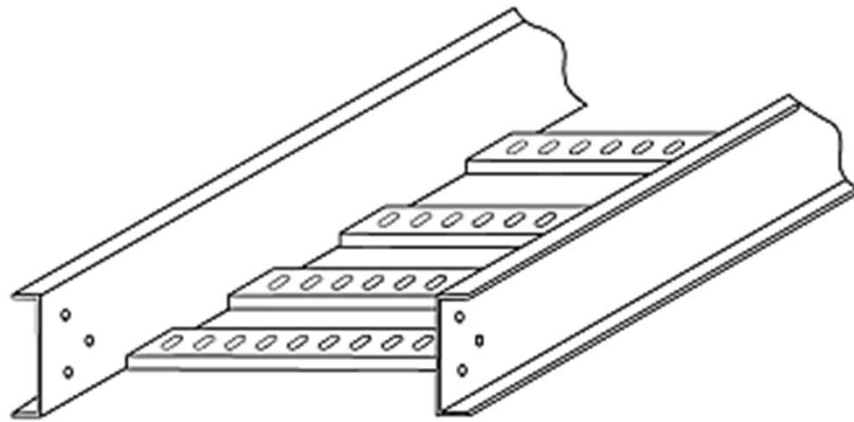


45° is available

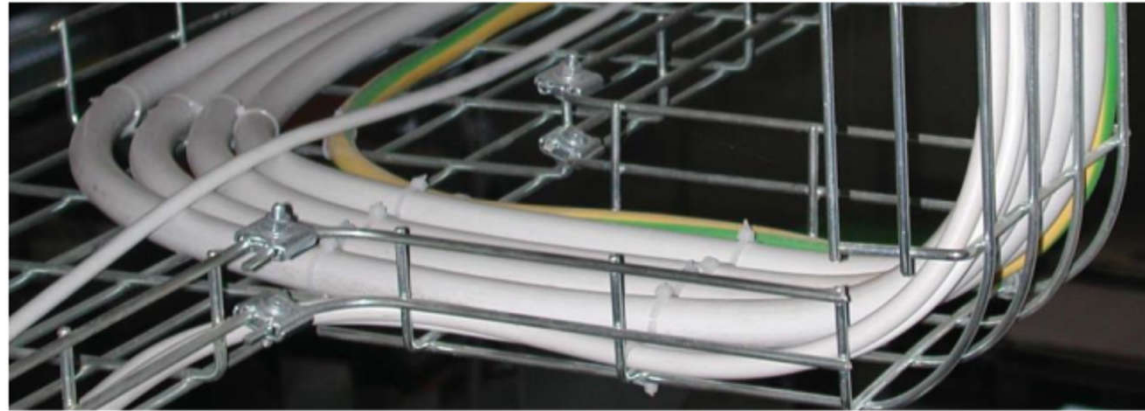


Flat Connector

Cable ladder & fittings



Wire Basket Cable Tray 網狀型線架





Wiring installation

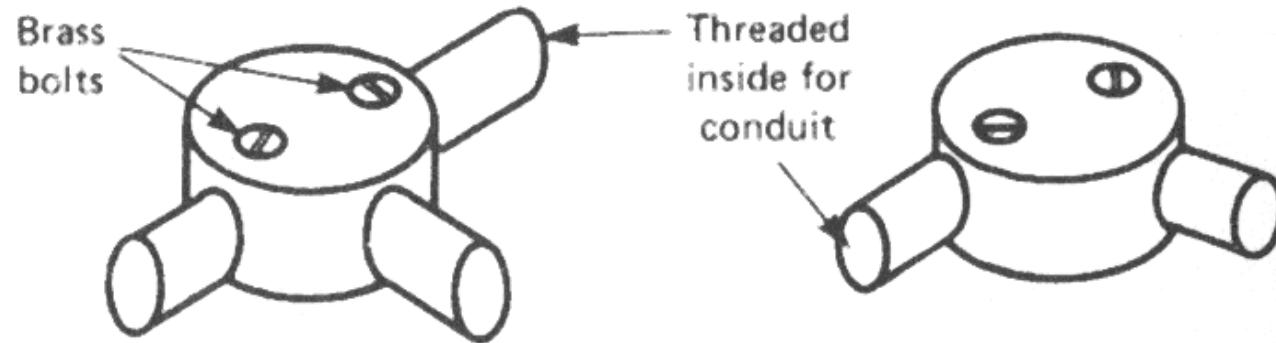
- Wiring installation enclosure: requirements
 - Enclosures as protective conductors
 - Support of enclosures
 - Fire barrier
- Types of systems
 - Steel conduit (exposed or concealed)
 - Steel trunking (overhead or underfloor)
 - Plastic or PVC conduit or trunking



Wiring installation

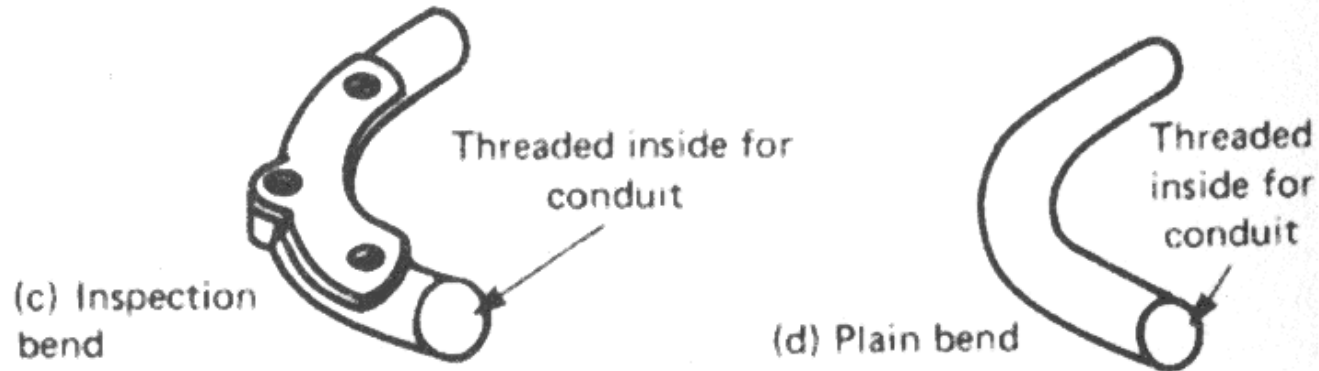
- Common types of conduit materials
 - Galvanized iron (G.I.) conduit 鍍鋅鋼喉管
 - Stainless steel (S.S.) conduit 不銹鋼喉管
 - PVC conduit 塑膠喉管
- Classes of metal conduit 金屬鋼導管的規格
 - Class 1: 喉管內外壁均作輕度保護，例如用漆油
 - Class 2: 喉管作中度保護，例如用燒瓷漆或氣乾漆油
 - Class 3: 喉管內壁用第二類的保護，外壁用第四類的保護，例如內壁用燒瓷漆，外壁用鋅浸透的防蝕處理
 - Class 4: 喉管內外壁均有深度的保護，例如用熱浸塗料或鋅浸透的防蝕處理。這類導管具有最佳的耐蝕性能

Fittings and coupling for steel conduit



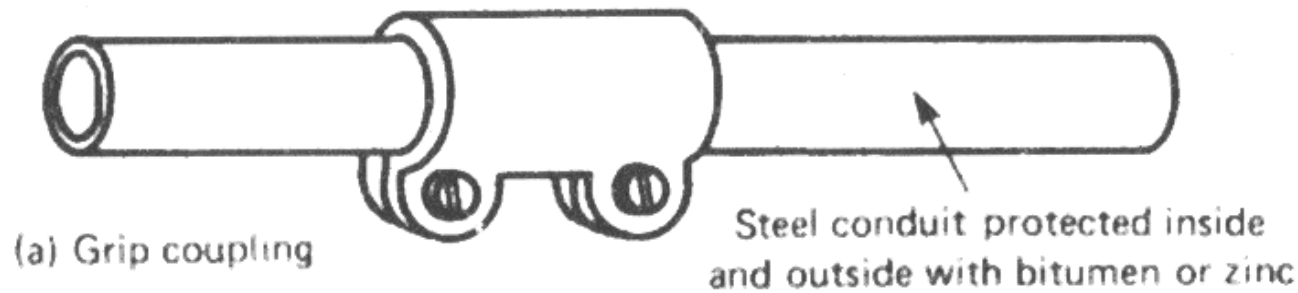
(a) Tee

(b) Elbow

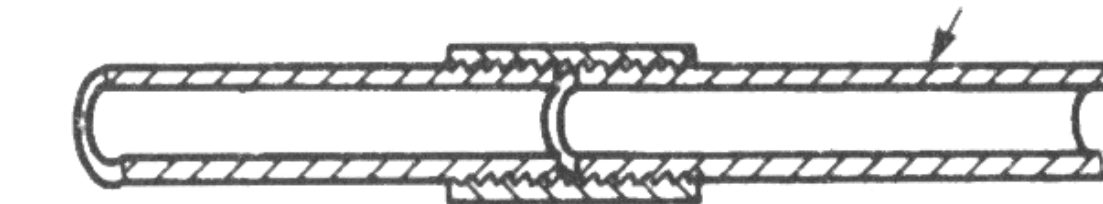


(c) Inspection bend

(d) Plain bend



(a) Grip coupling



(b) Screwed coupling

Conduit accessories



Light Brass Male Bush



Heavy Brass Male Bush



Solid Coupler



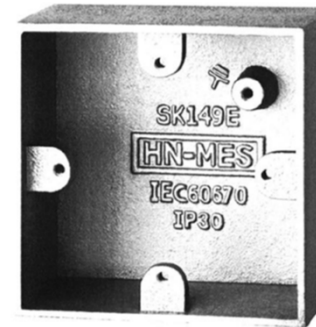
Saddle



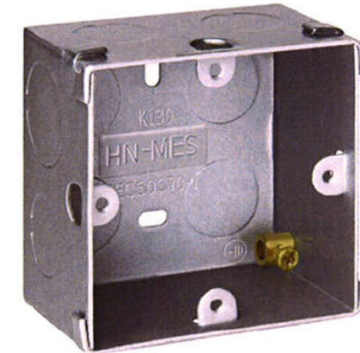
Circular Box



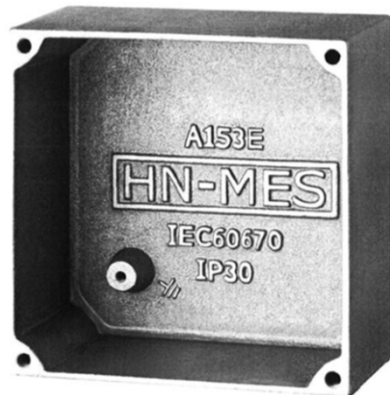
Dome Cover



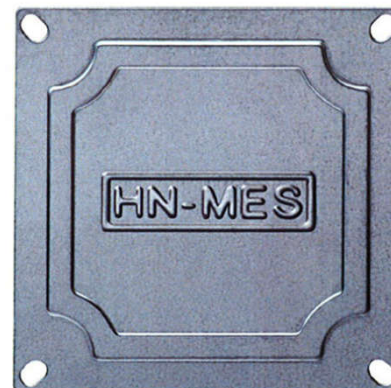
1 Gang Surface
Mount & Socket Box



1 Gang Concealed
Switch & Socket Box
w/ Earth Terminal

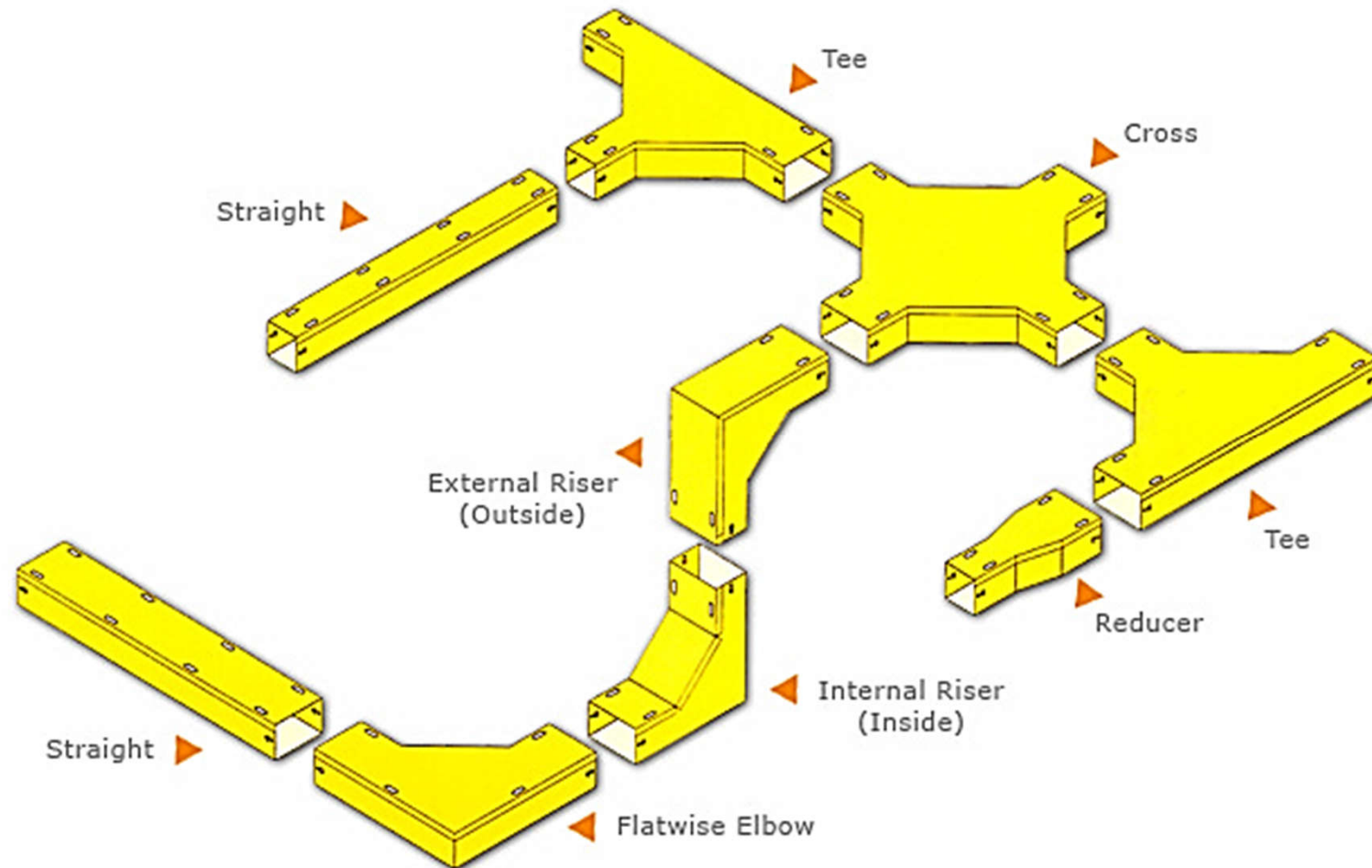


Adaptable Junction Box



Surface Cover for Adaptable Junction Box

Cable trunking



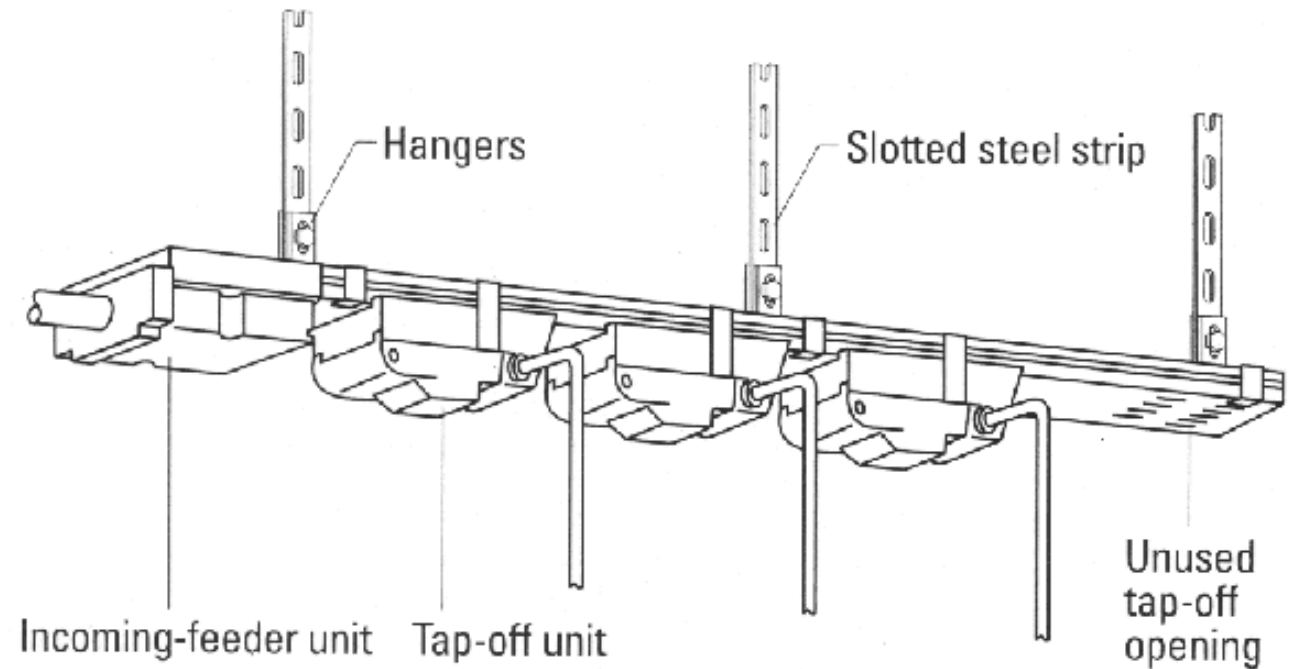
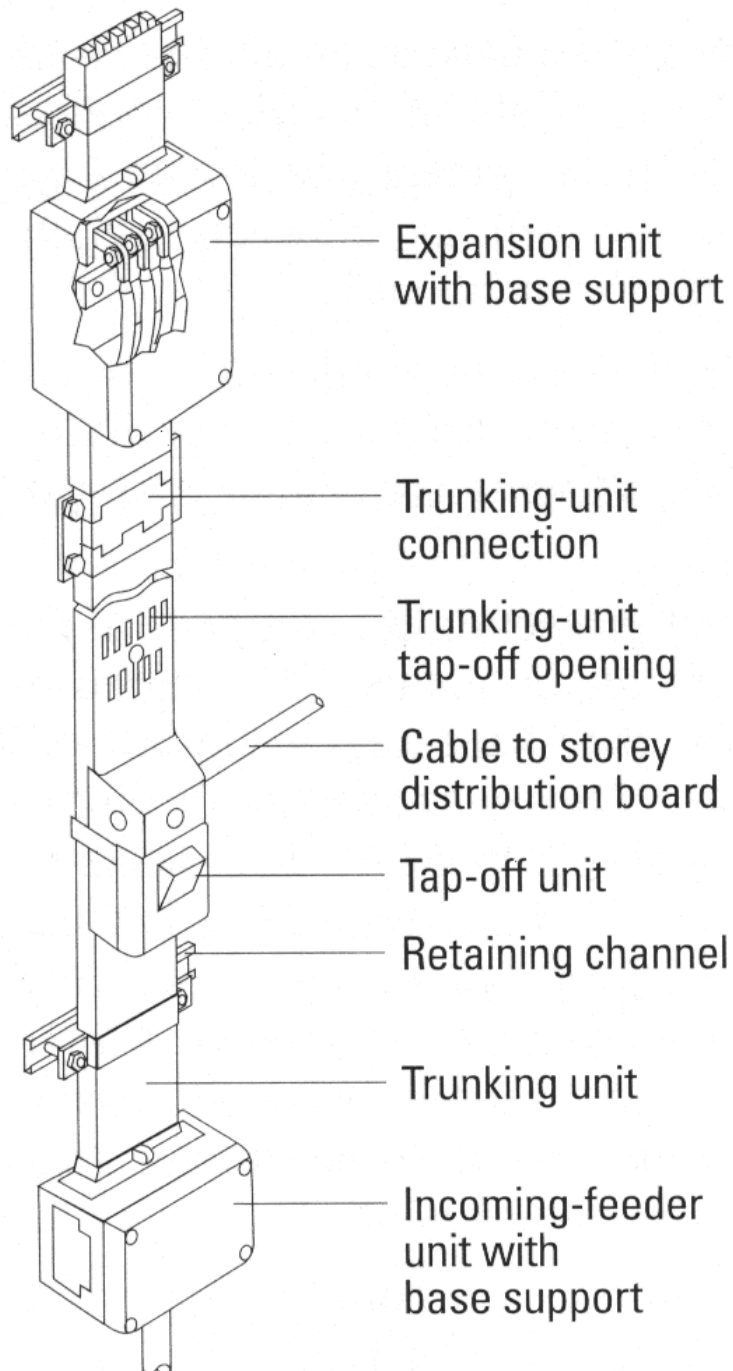


Wiring installation

- Busbar trunking system 匯流排槽系統
 - Vertical
 - Horizontal
- Components
 - Busbar casing
 - Expansion unit
 - Feeder unit
 - Tap-off unit



Vertical and horizontal busbar trunking



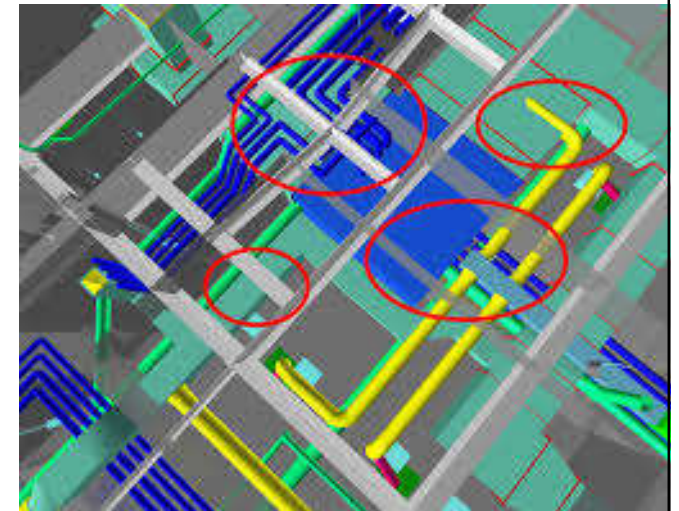
Application of Wiring System

Wiring System	Cable Type	General Use
Surface wiring	1/C PVC/PVC cables with separate cpc; 2/C PVC/PVC cables with cpc; 4/C armored cables	Temporary wiring; Low-cost housing
Conduit wiring - Concealed - Surface	1/C PVC insulated cables	Office, Private housing; Factory; Plant room
Wiring in trunking	1/C PVC insulated cables	Sub-main/lateral main distribution
Risers in communal installation	Bare Cu/Al bars in trunking Armored cables in cable duct	Rising mains for internal power distribution system
Flameproof cable	Mineral-insulated cables	Petrol station, Flammable areas

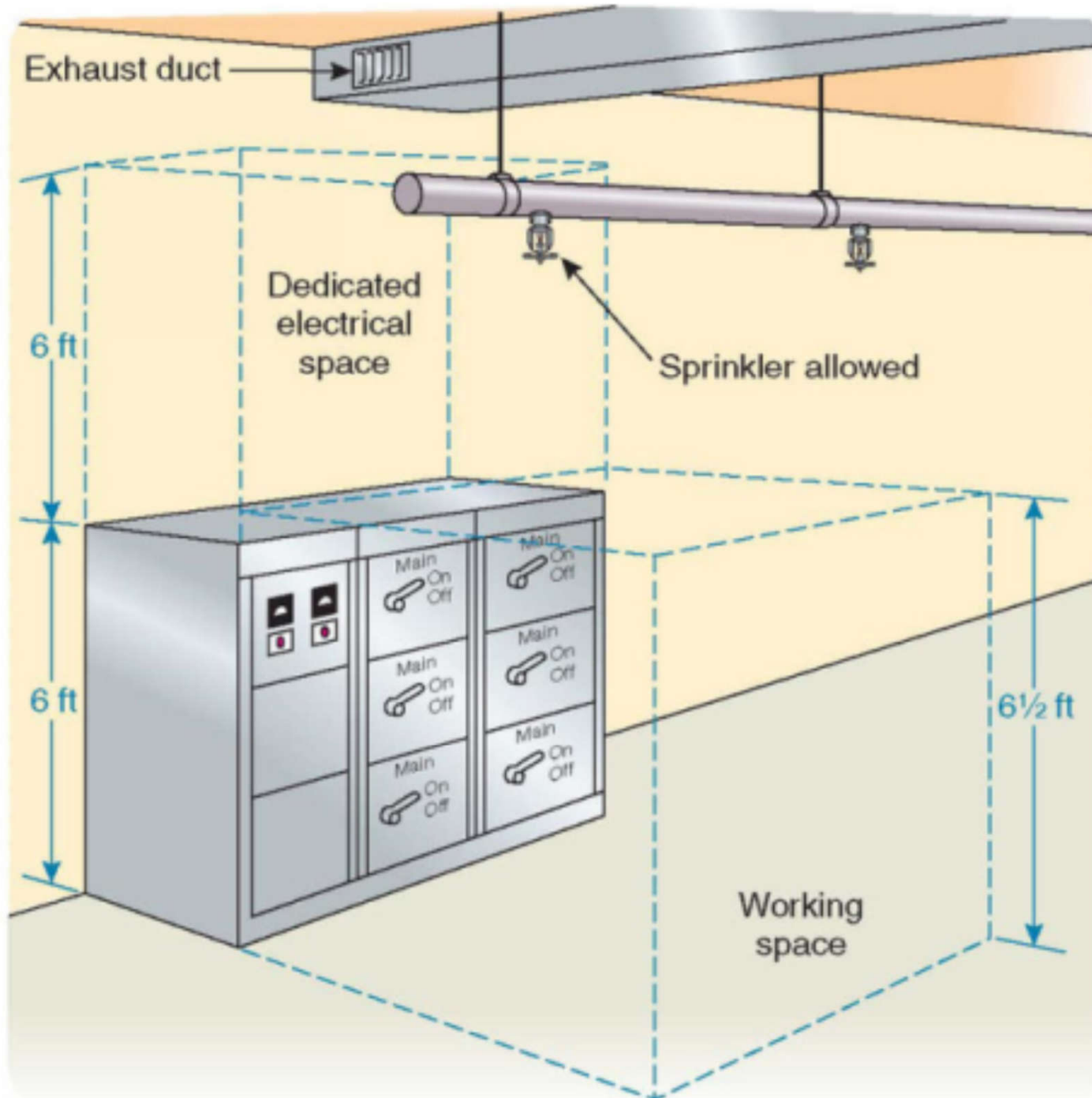
Space coordination



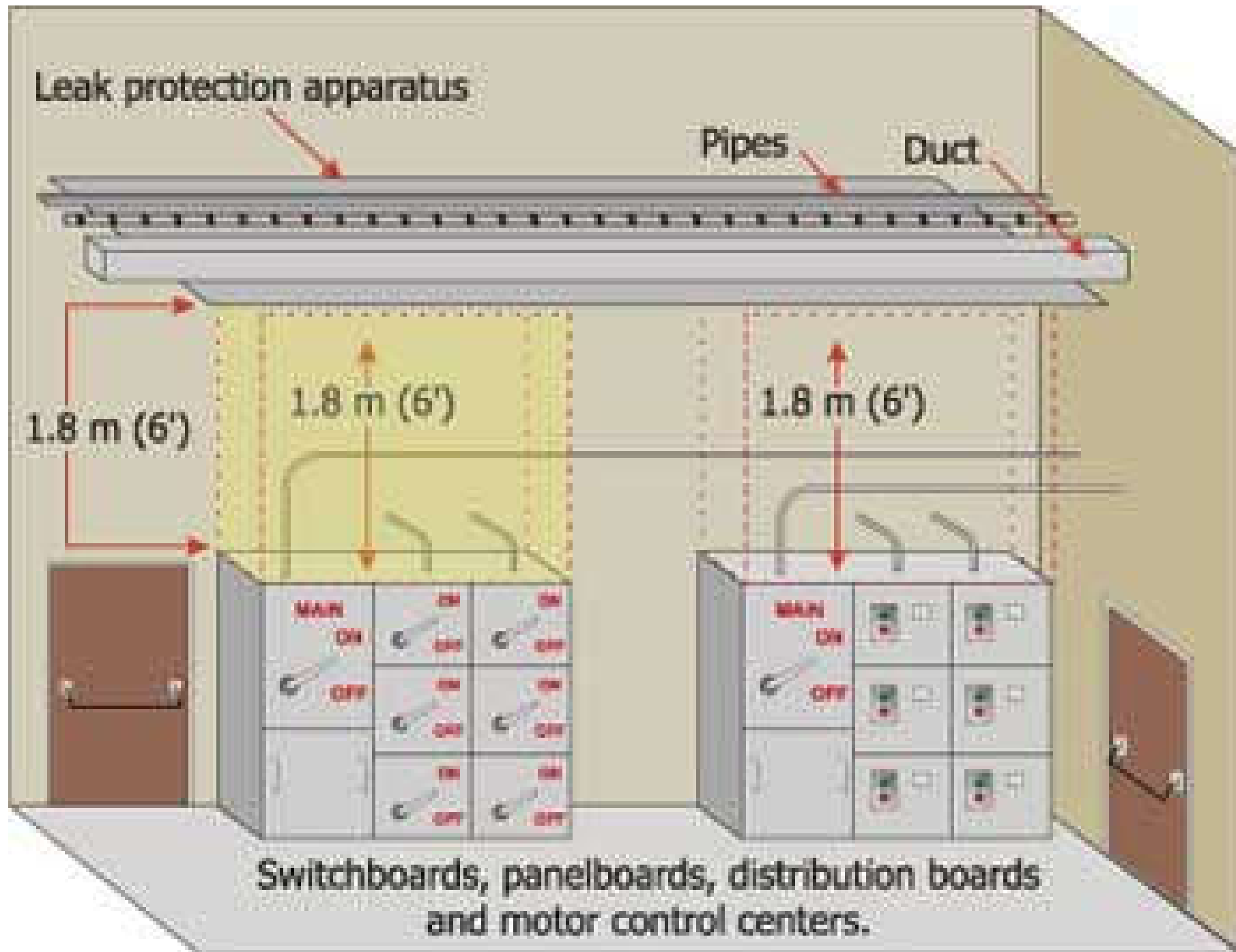
- Interdisciplinary coordination
 - Electrical systems & components
 - Fire services installations
 - HVAC installations
 - Plumbing & drainage installations
- Practical issues & electrical clearances
 - Dedicated zones to avoid leakage or condensation
 - Dedicated equipment space
 - Working space



Electrical clearances and space coordination



Dedicated electrical equipment space



Working space in front of a panelboard

