SAFE ELECTRICAL INSTALLATION

- LOAD CURRENT
- SELECTING THE SIZE OF CABLE APPROPRIATE TO LOAD CURRENT
- CONSIDERING THE VOLTAGE DROP

- LOAD CURRENT
- AS 3000:2007 Maximum Demand Calculation

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Australian Electrician Training

AS3000

Appendix C1-Page 371 to 373 Domestic Installation
C2-Page 380 to 381 Non domestic installation
C3-Page 384 Energy demand based on floor area

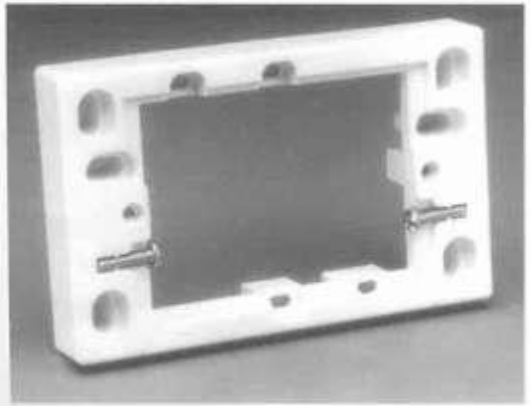


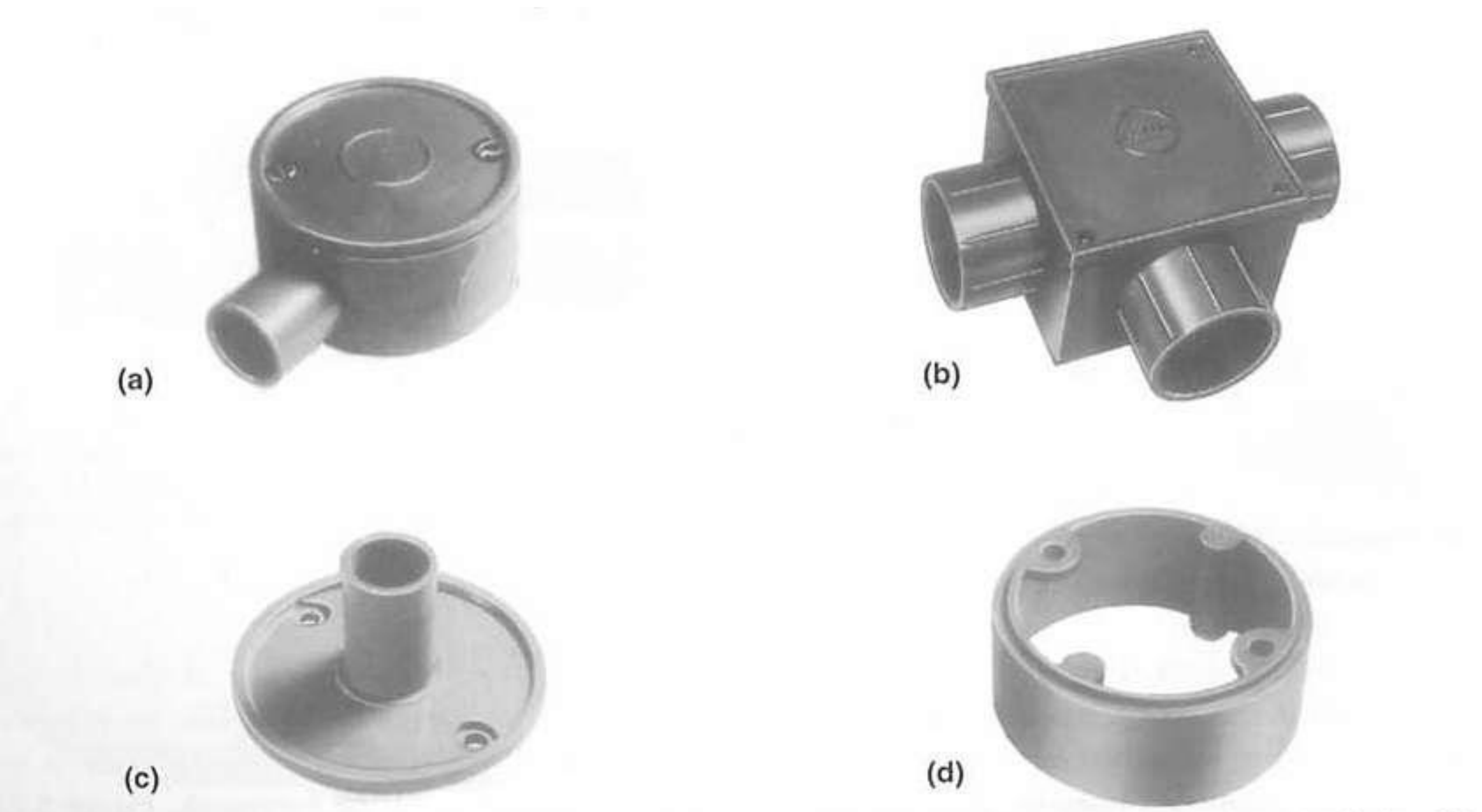
Fig. 5.13 *Single-gang plastic mounting block, available in depths of 13 mm, 18 mm and 37 mm* HPM INDUSTRIES

Switch

Based

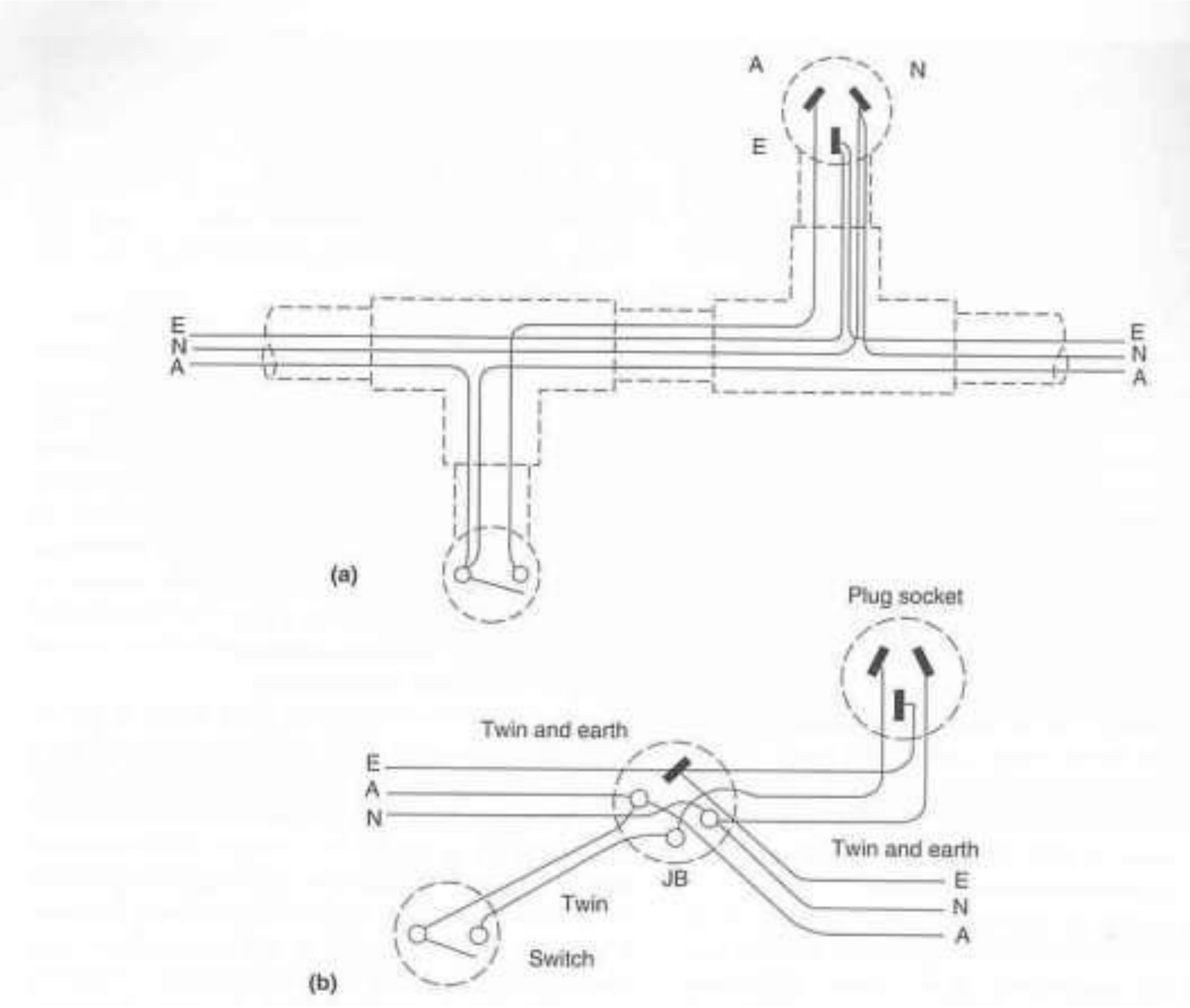
ig. 5.20 *PVC inspection-type elbow and tee*

Conduit connector Elbow, Tee



5.23 **(a)** *One-way round PVC junction box;* **(b)** *Three-way square PVC junction box;* **(c)** *Round PVC junction-box take-off plate;* **(d)** *junction-box extension ring* GERARD INDUSTRIES

Junction box

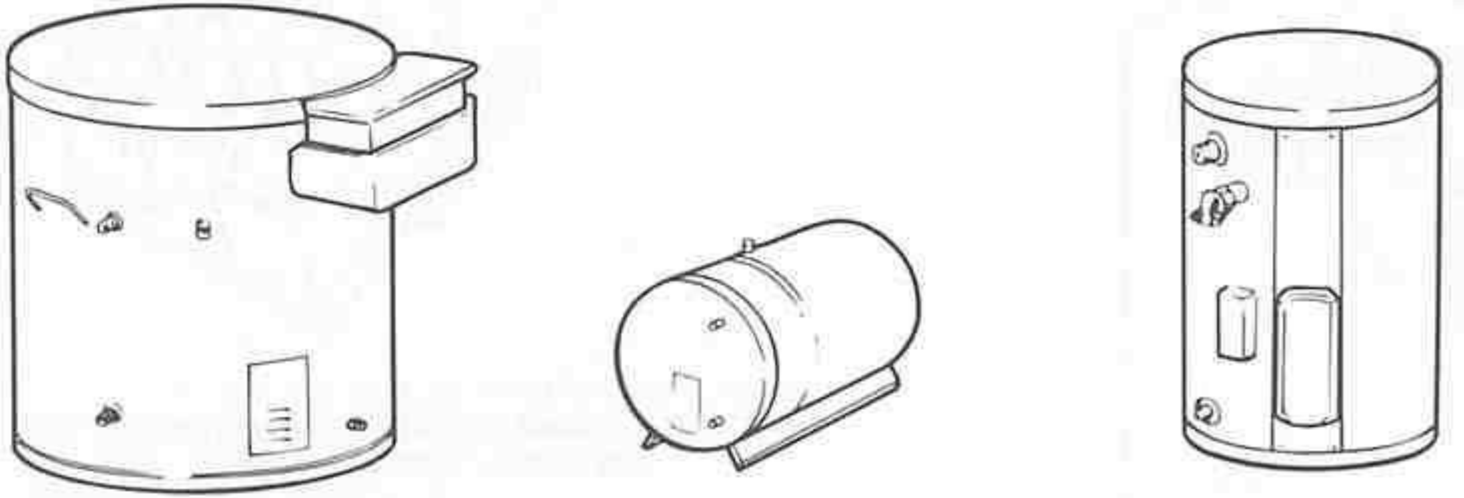


Wiring Circuit

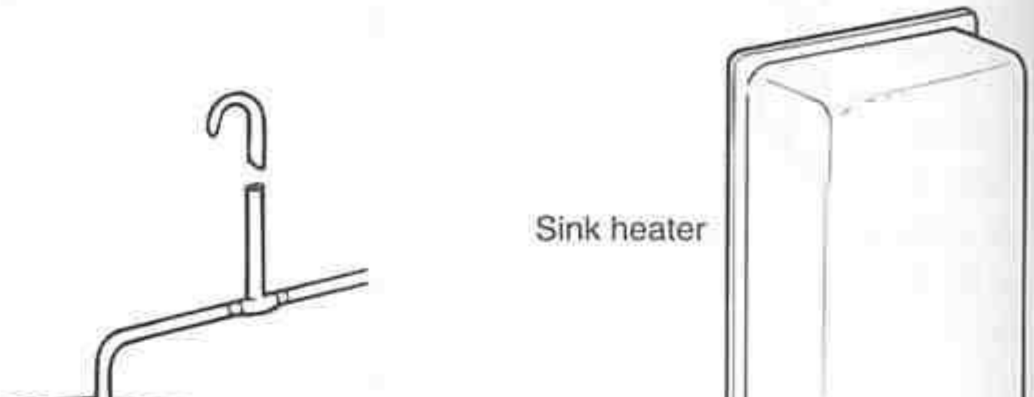
Should mains water pressure be too high, a pressure-reducing valve should be fitted by a plumber into the inlet line. Note that it is normal for some hot water to be released during the latter part of the water-heating cycle; but should leakage persist, this is an indication that inlet water pressure is too high or that the relief valve is faulty. In some states, a cold-water expansion valve is fitted to the cold-water inlet and set to drip continually during the heating cycle.

heater.

In the small storage system, the unit is located at the hot-water outlets to be supplied; with the larger unit supplying multipoints, the location is as close as possible to the outlet most often used. In a domestic installation, this is usually the kitchen sink. The location of a large tank is influenced by the type of building structure, which also influences the type of heater used. Figure 21.11 illustrates some possible locations and types.



(a) Side-fed (b) Electrode-type boiler (c) Mains-pressure



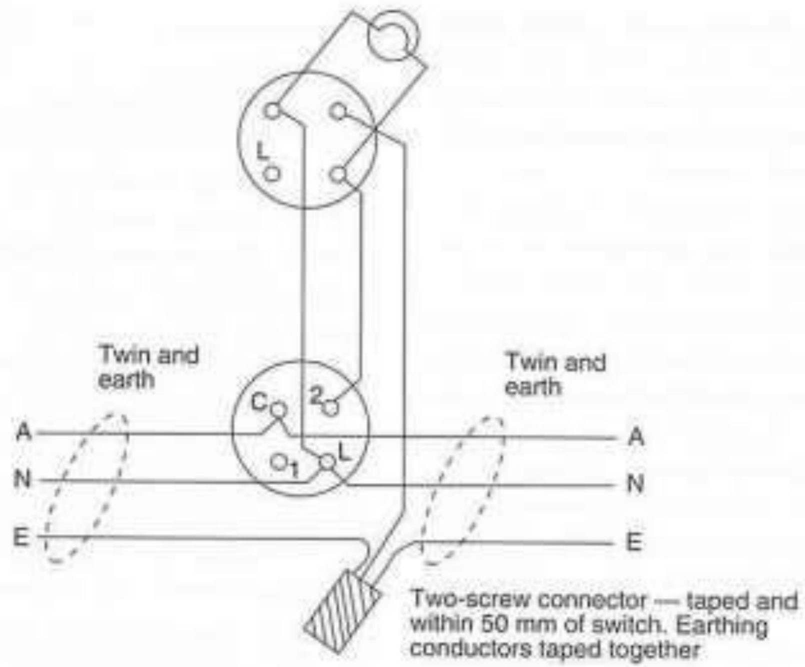
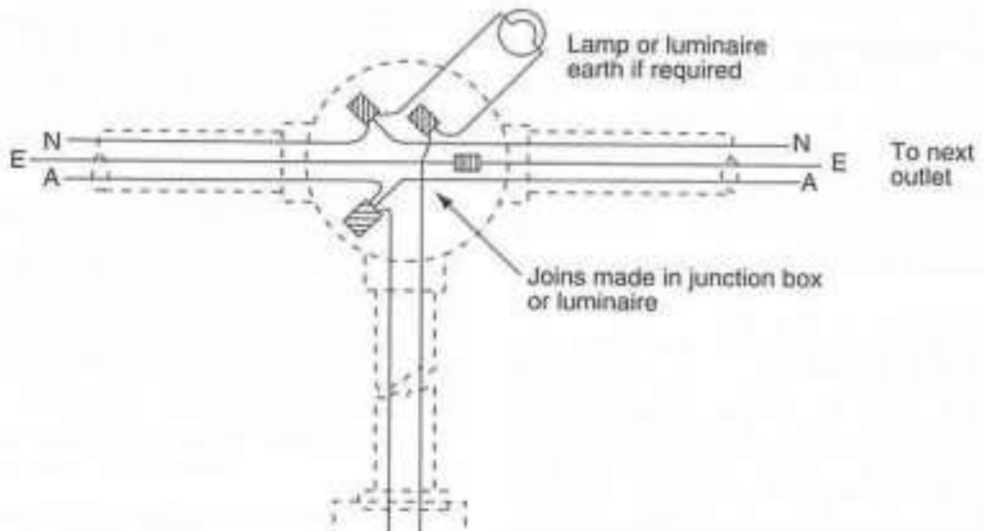
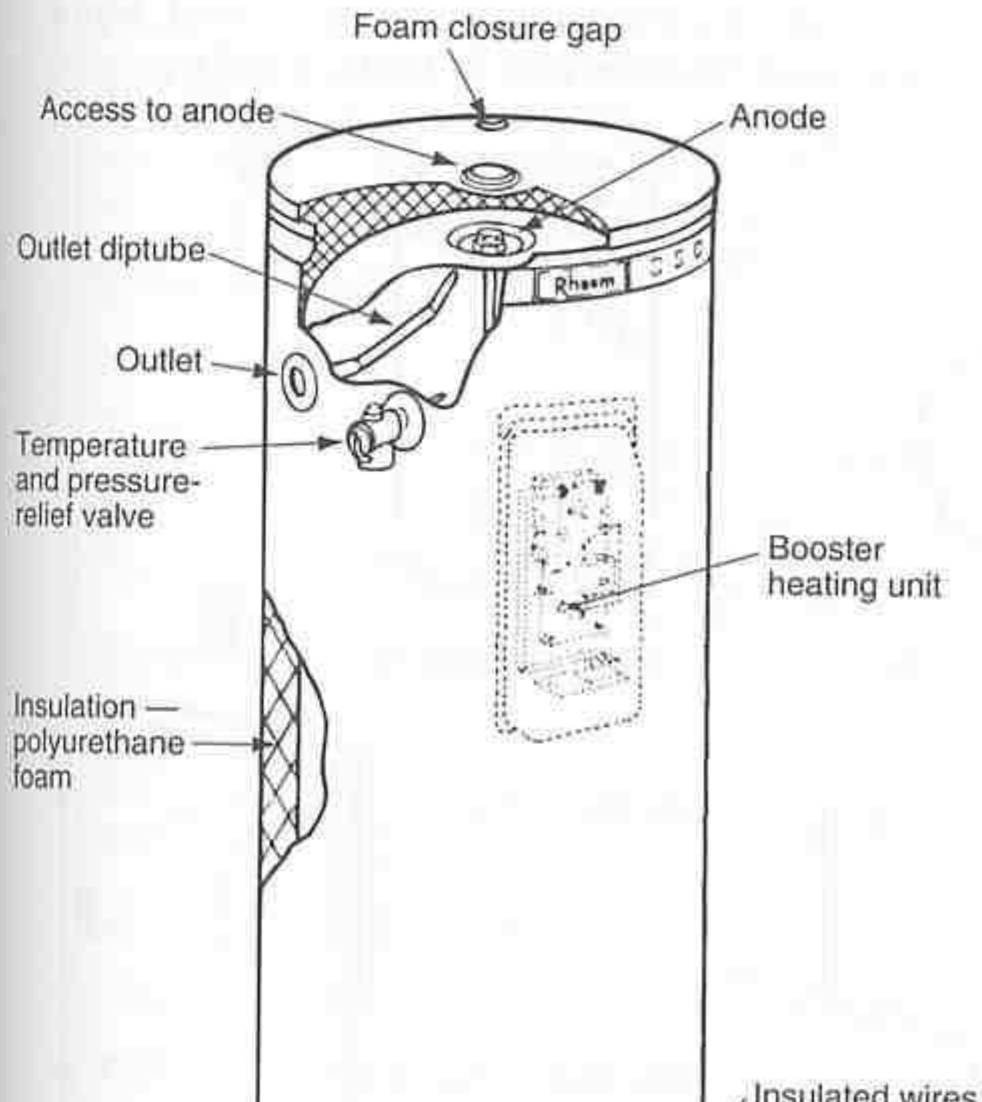


Fig. 6.8 *Looping at switch using twin and earth cable*



falling-level type described below overcomes this problem;

- falling-level type, such as the one illustratd in Figure 21.8(b), where the water level falls as the hot water is drawn off, in a manner somewhat similar to a large urn. The cold water inlet has a magnetic valve con-



STATE ELECTRICITY COMMISSION OF VICTORIA

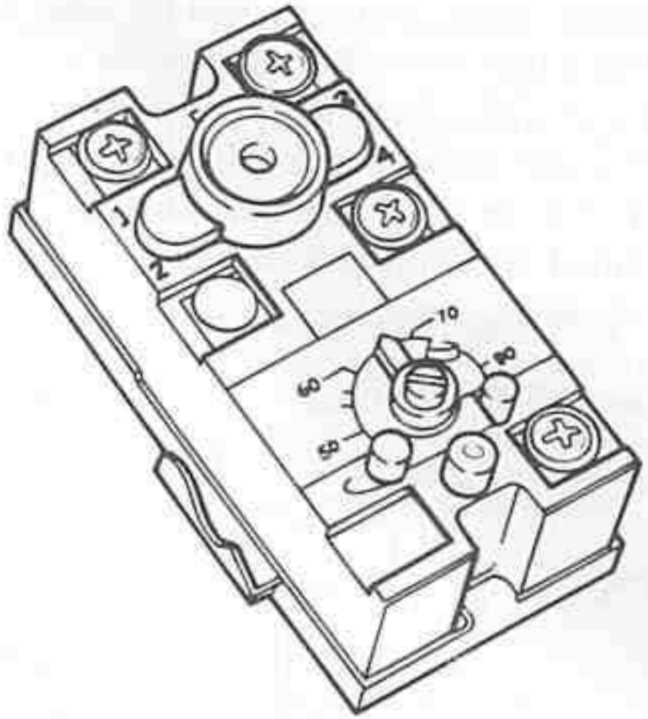


Fig. 21.9(c) *Combined thermostat and overtemperature cut-out*
STATE ELECTRICITY COMMISSION OF VICTORIA

nected so that it will not allow cold water into the heater until the water in the heater has reached a predetermined temperature;

- mains-pressure type, which has no feed tank, is unvented and is connected direct to the cold-water main for
  (a) operation at full mains pressure, or
  (b) operation at medium pressure with a pressure-

PROBLEM (1)

Determine the maximum demand of a single domestic electrical installation supplied at single-phase with the following load:

24 lighting points
10 m of lighting track
9 x10 A single socket-outlets
8 x 10 A double socket-outlets
1 x 50 W exhaust fan
1x 1 000 W strip heater
1x 15 A socket-outlet
1x10000 W range
1x4800 W water heater
1x 3000 W tennis court lighting

SEE WHITE BOARD-MANUAL CALCULATION, COPY IT

MAXIMUMDEMAND

(a) 24 light points ------------------------------------= 24 pt

Lighting track, Foot Note (d) 2 pt/m x 10m= 20 pt

Exhaust fan (also taken as light point) = 1 pt

Total light points = 45 pt

Table C1, Load group A Column 2

1st 20 pt =3A

2nd 20 pt = 2A

3rd 5pt (part of every 20 pt) = 2 A

Total = 7A

(b) Tennis court lighting 3 KW outdoor lighting exceeding 1000w

75% connected load = 0.75 x 3000/240 = 9.4A

(c) Socket outlet

9 x 10A Single socket outlet = 9 pt

8 x 10A Double socket outlet 8 x 2 = 16 pt

Strip heater = 1 pt

= 26 pt

Load Group B (i)

10A for 1st 1 to20pt,add 5A for additional 20 pt

Total 26 pt ----= 10+5 =15 A

Load Group B (i)

10A for 1st 1 to20pt,add 5A for additional 20 pt

Total 26 pt ----= 10+5 =15 A

(d) 15A socket outlet – Load group B(ii)

1x 15 A socket outlet = 10A

(e) 10 KW Range

Load group (c) 50%

$0.5 \times 10 \times 10^3/240 = 20.8A$

(f) 4.8KW water heater---Storage heater---Load group (F)

Full load = $4.8 \times 10^3 / 240$ = 20A

Maximum demand (a)+(b)+(c)+(d)+(e)+(f)

7+9.4+15+10+20.8+20= 82.2A

= 84.4 A

C2.3.2.2 *Example 2*

Determine the maximum demand of the heaviest loaded phase in a domestic electrical installation comprising—

26	lighting points
24	10 A single-phase single socket-outlets
1	15 A single-phase socket-outlet
1	16600 W three-phase electric range consisting of two 5000 W hotplates and one 6600 W oven
1	4000 W single-phase airconditioning unit
1	12960 W three-phase instantaneous water heater
1	3600 W single-phase clothes dryer

and arranged for connection across a three-phase supply as follows:

Red	***White***	***Blue***
		26 lights
15 A socket-outlet	15 × 10 A socket-outlets	9 ×10 A socket-outlets
5000 W hotplate	5000 W hotplates	6600 W oven
4000 W airconditioner		
4320 W instantaneous water heater	4320 W instantaneous water heater	4320 W instantaneous water heater
	3600 W clothes dryer	

Solution

The method of determining the demand in the heaviest loaded phase, in

Equipment	Load Group	Column	RED	WHITE	BLUE
Lighting 26 lights 1st 20 pt = 3A- 2nd 20 pt = 2A Total 5A	A(i) ----------- -	2 ---------	 ------ --	 ------→	 5A
10A Socket outlet 15 x 10A socket outlet 9 x 10A socket outlet	B(i) ----------- ---	2 ---------- ----------	 ---→ ------ --	 10A -----→	 10A

<u>Range</u> 5 KW Hot pla 5x 10^3 x 0.5 =----------------= 10.9A 240	C -----	2	10.9	10.9	10.9

Equipment	Load Group	Column	RED	WHITE	BLUE
Lighting 26 lights 1st 20 pt = 3A 2nd 20 pt = 2A Total = 5A	A(i)	2			5A
10A Socket outlet 15 x 10A 9 x 10A	B(i)	2		10A	10A

Equipment	Load Group	Column	RED	WHITE	BLUE
Range 5 KW Hot Plate $\frac{5 \times 10^3 \times 0.5}{240} = 10.9A$ 6.6 KW Range $\frac{6.6 \times 10^3 \times 0.5}{240} = 12.7A$	C	2	10.9A	10.9A	12.7A
Instantaneous Water Heater $\frac{4.8 \times 10^3 \times 0.33}{240} = 7.5A$	E	2	7.5A	7.5A	7.5A

Equipment	Load Group	Column	RED	WHITE	BLUE
4KW Aircon 5 KW Hot Plate $\frac{4 \times 10^3 \times 0.75}{240} = 12.5A$	D	2	12.5A		
3.6 KW Cloth Dryer $\frac{3.6 \times 10^3 \times 0.5}{240} = 7.5A$	C	2			7.5A
Total			10.9+7.5+12.5	10+10.9+7.5+7.5	5+10+12.7+7.5
			RED=38.9A	WHITE=33.9A	BLUE=34.7A

- **SELECTING THE SIZE OF CABLE APPROPRIATE TO LOAD CURRENT**

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Table 3(1)-Unenclosed in air Page 30+31

Table 3(2)-Enclosed in air   Page 32+33

Table 3(3)-Direct buried underground Page 34

Table 3(4)Underground wiring enclosure Page 35

Depending on Type of cable (column 2), Reference drawing (Column 3),Method of installation (column 5),

Current carrying capacity of the cable needs to be selected from Column 4 (Refer the further tables and columns)

&

Depending on number of circuits, derating factor needs to be chosen from the tables in column 5

of Table 3(1) , 3(2), 3(3) & 3(4)

Selection

Select the cable size (Sqmm) based on the current

Voltage drop needs to be concerned

$$Vd = \frac{Vc \times L \times I}{1000}$$

Where Vd= Three phase voltage drop (Volt)

L= Length of the circuit (m)

I= Maximum demand current (A)

Vc= Three phase unit voltage drop (mV/A-m)

Note

Three phase voltage drop = 1.7321 x Single phase voltage drop

Three phase voltage drop = 0.866 x Single phase voltage drop

SINGLE-CORE INSULATED AND SHEATHED COPPER CONDUCTORS LAID IN TREFOIL--- Table 40 Page 103 (AS3008)

SINGLE-CORE INSULATED AND SHEATHED COPPER CONDUCTORS, LAID FLAT TOUCHING OR IN A WIRING
ENCLOSURE---Table 41 Page 104 (AS3008)

MULTICORE WITH CIRCULAR COPPER CONDUCTORS—Table 42 Page 105(As3008)

SINGLE-CORE INSULATED AND SHEATHED ALUMINIUM CONDUCTORS, LAID IN TREFOIL –Table 43 Page 106 (AS3008)

SINGLE-CORE INSULATED AND SHEATHED ALUMINIUM CONDUCTORS, LAID FLAT TOUCHING—Table 44 Page 107 (As3008)

MULTICORE CABLES WITH CIRCULAR ALUMINIUM CONDUCTORS—Table 45-Page 108 (As3008)

SINGLE-CORE FLEXIBLE CORDS AND FLEXIBLE CABLES, LAID IN TREFOIL- Page 109 Table 46 (AS3008)

SINGLE-CORE FLEXIBLE CORDS AND FLEXIBLE CABLES, LAID FLAT TOUCHING OR IN A WIRING ENCLOSURE- Page 110- Table 47(AS3008)

MULTICORE FLEXIBLE CORDS AND FLEXIBLE CABLES Page 111-Table 48 (AS3008)

SINGLE-CORE AND MULTICORE MIMS, LAID IN TREFOIL- Page 112 Table 49(AS3008)

AERIAL WITH BARE OR INSULATED COPPER CONDUCTORS Page 113—Table 50(AS3008)

Checking

From table 40 to 50,

based on the cable size (Sq-mm), unit voltage drop Vc is determined,

Then Voltage drop Vd is calculated by using

$$Vd = \frac{Vc \times L \times I}{1000}$$

According to AS3000, the voltage drop must not be more than +/- 5% of supply voltage.

It means that

- for three phase 415V, the voltage drop must not be more than 20.75V
- for single phase 240V, the voltage drop must not be more than 12 V

If voltage drop is more than 5% of supply voltage, select the one size bigger cable.

- Find Vc calculate Vd

If voltage drop is still more than 5% of supply voltage, select another bigger size,

- Find Vc calculate Vd

until Vd is less than 5% of supply voltage

Cable Installation Procedure

Cables with minimum cable separation in air as shown for horizontal and vertical mounting and installed—

(a)spaced from a wall or vertical surface;

(b)upported on ladders, racks,perforated trays, cleats or hanger;

(c) suspended from a catenary wire

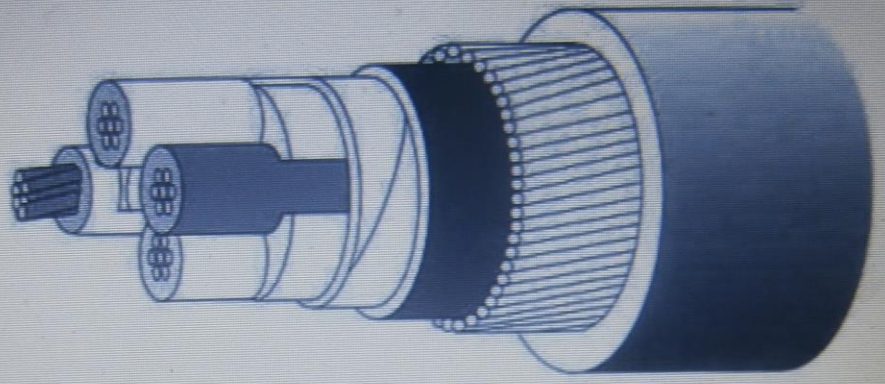

Fig. 4.7 0.6/1 kV PVC-insulated, PVC-bedded, steel-wire-armoured, PVC-sheathed cable made to AS 3147, copper conductors, 75°C three-core circular and earth OLEX CABLES

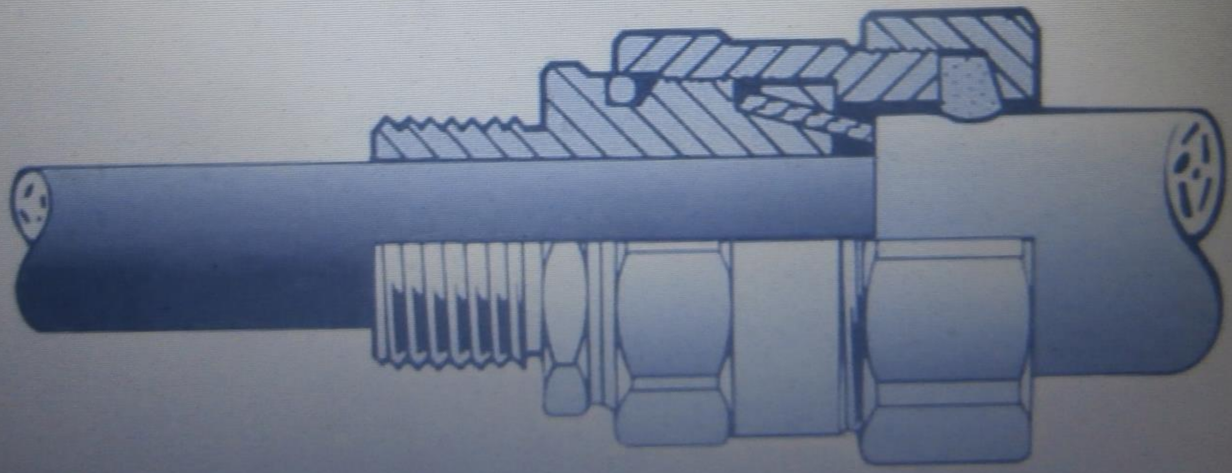

Fig. 4.8 Weatherproof gland for armoured circular PVC cable OLEX CABLES

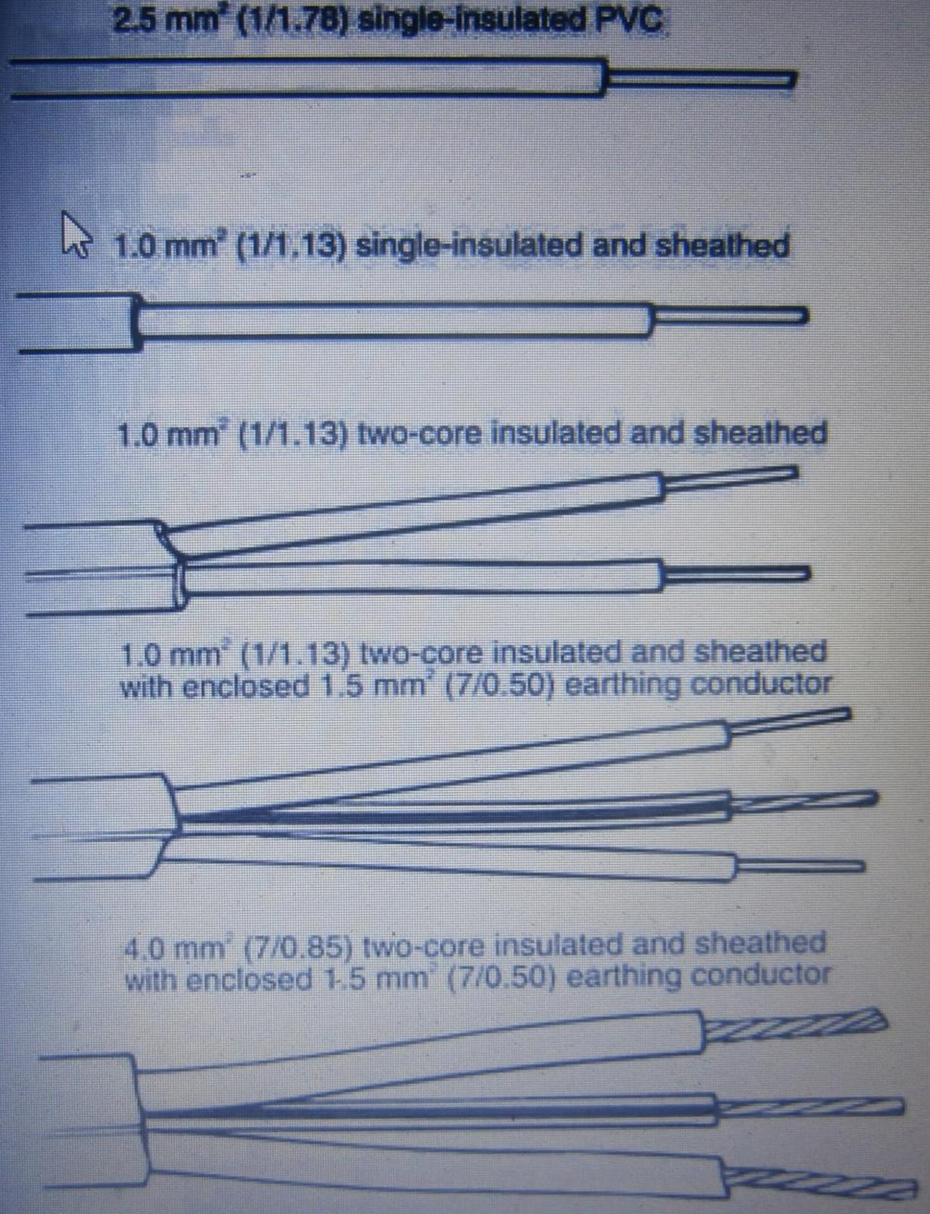

Fig. 4.10 *Some commonly used cables*

Flat-type TPS c
wiring, as it is neater
The cable core consi
copper conductors w
cable is available in
without an earthing
sheath. The standard
most commonly used
are red and black for
blue for three-core ca
is now commonly use
wires. Some energy c
of black as a switch w

Circular-type TP
tion as the flat type d
together with fillers,
pattern, taped and sh
This type of cable is
commercial installatio
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stranded copper cond
300 mm² and with st
the range 16 mm² to
colour is orange. Cor
and green/yellow for t
white, blue and green
cables. Cables of CSA

Cables with minimum cable separation in air as shown for

horizontal and vertical mounting and installed—

(a)spaced from a wall or vertical surface;

(b) supported on ladders, racks, perforated trays, cleats or hanger;

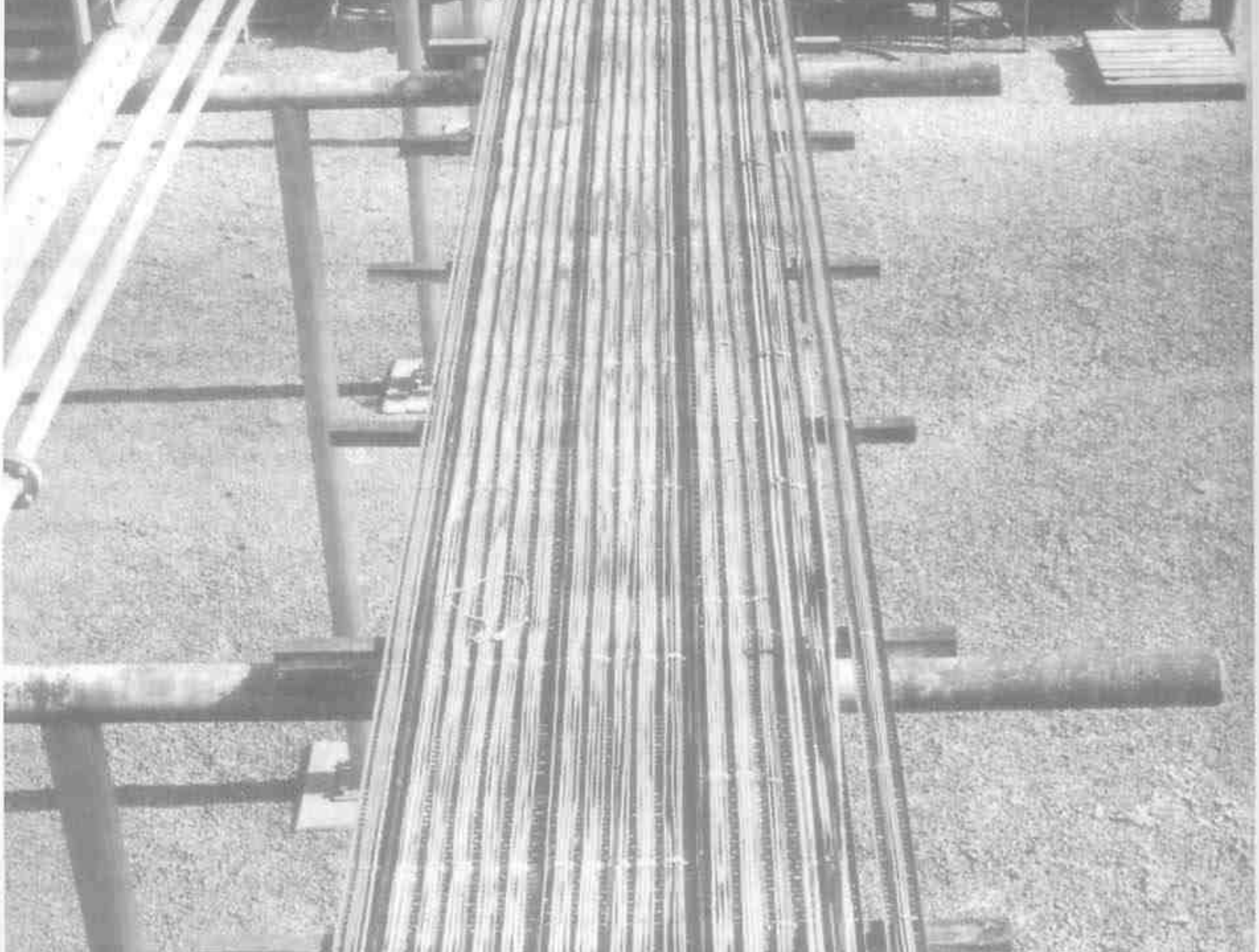

Fig. 7.10(b) *PVC trunking* AUSTRALIAN PLASTIC PROFILES

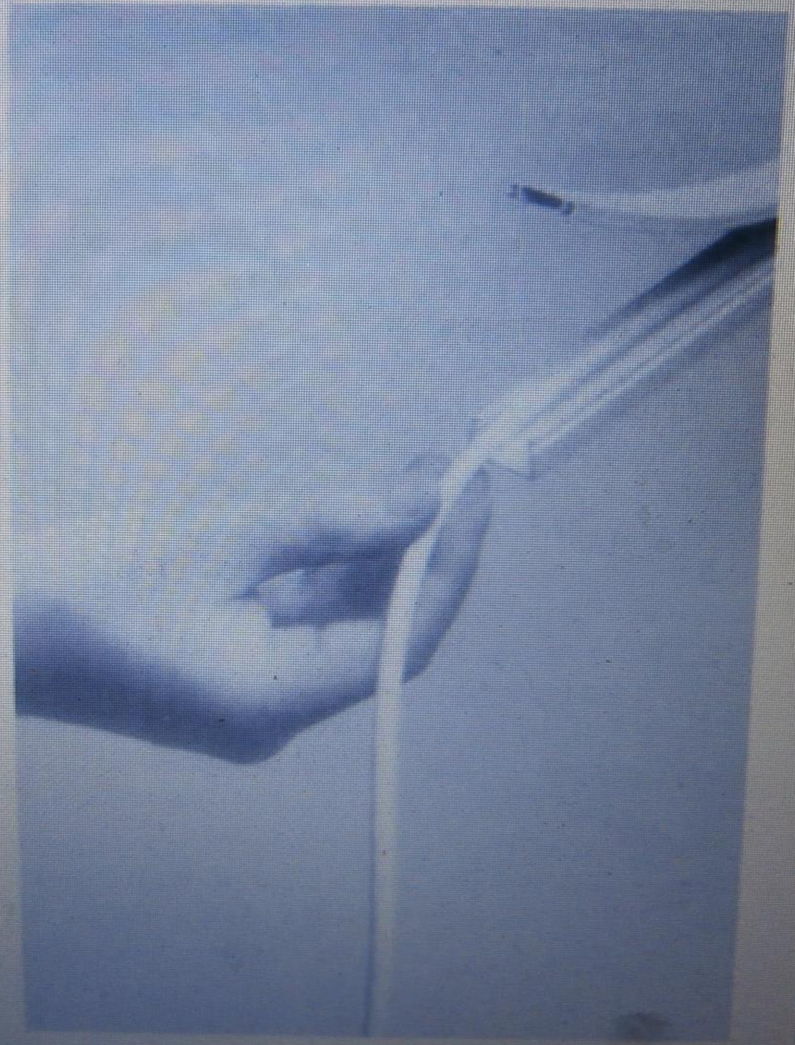

Fig. 7.10(c) *Miniature PVC trunking*

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a skirting board. Th
is manufactured fro
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trunking into compa
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steel faced with a the
matched to the trunk
Skirting trunk sh
the floor covering is
the walls by screws; a
steel cover strip is fitt
trated is sometimes m
the removable cover it
under the Rules of
mounted on cable trun
ments of *Clause 4.6* are
Wood trunking or
first introduced, was pr
enclosed wiring in the
usually done by the build
lete, but wood is still pe

in a structure into which cables are drawn. A conduit or pipe is classed as a 'cable duct' if its diameter exceeds 75 mm.

Fig. 7.14 *Perforated-tray cable support (background) and ladder support (foreground)* OLEX CABLES

vision studios is one in which the duct is embedded in the floor screed and thus concealed. Access to the duct is made easier by the provision of large boxes at the junction of the duct sections, with flush or recessed removable lids. The ducts are usually partitioned to provide space for other services such as fire alarm, data and communication cabling, radio and public address systems.

Additions or extensions may be tapped direct into the duct with special tools, and the duct may be run right up to the walls to permit the wiring system to be continued by using some other enclosure, such as trunking, conduit, skirting trunking or TPS cable.

The ducts may be of metal, of which there are many types and systems, some patented by the manufacturers. Figure 7.15 shows a two-channel infloor ducting system; three-, four- and five-channel systems also are available. Metal ducting systems have an advantage over insulated types in that they form a complete earthed metal screen against radio and television interference.

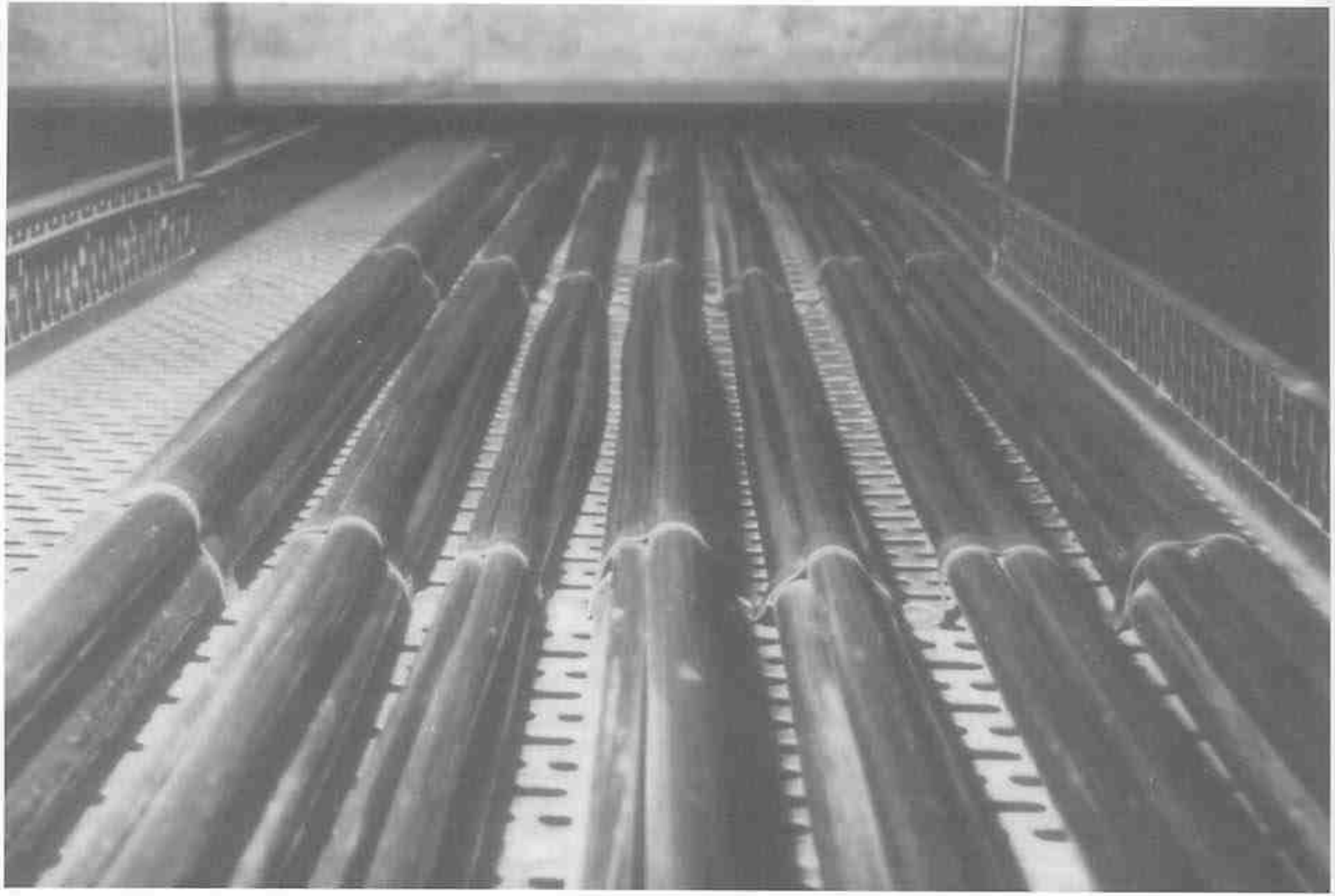

Fig. 10.22 *Parallel cables banded to permit flow of circulating currents*

(c) suspended from a catenary wire

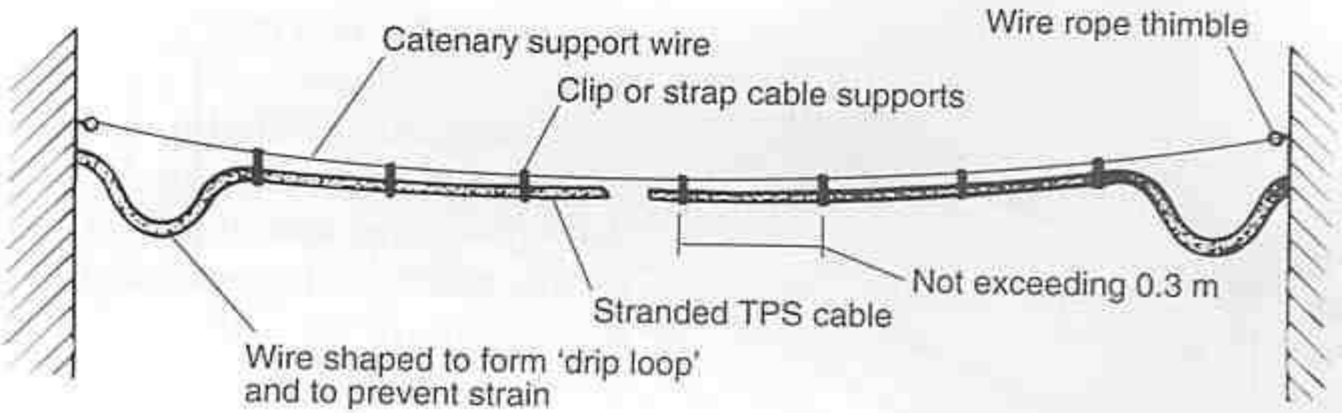

Fig. 7.9 *Principle of supporting cables by catenary (see Clause 3.15)*

4 mm^2 two-core and earth TPS cable is to be supported over a 15 m span by an 8.5 mm^2 low-carbon-steel catenary wire; what minimum sag is permissible? From *Table 3.4*, approximate mass of two-core and earth 4 mm^2 cable is 0.24 kg/m, and mass of catenary wire is 0.07 kg/m, a total of 0.31 kg/m. Closest gross mass value above 0.31 in *Table 3.5* is 0.4 kg/m, and this corresponds ro a minimum sag of 0.11 m for a 15 m span.

Figure 7.9 illustrates some of the principles of

Trunking

Some trunking or troughing systems are designed for surface work, while others are suitable for embedding in a concrete 'pour' or being otherwise installed as concealed wiring, provided that access provisions are incorporated in the design. Most of the systems, even those that are concealed, have the advantage of accessibility for repairs or additions.

A system may initially be designed with trunking large enough to accommodate extra or larger cables, and

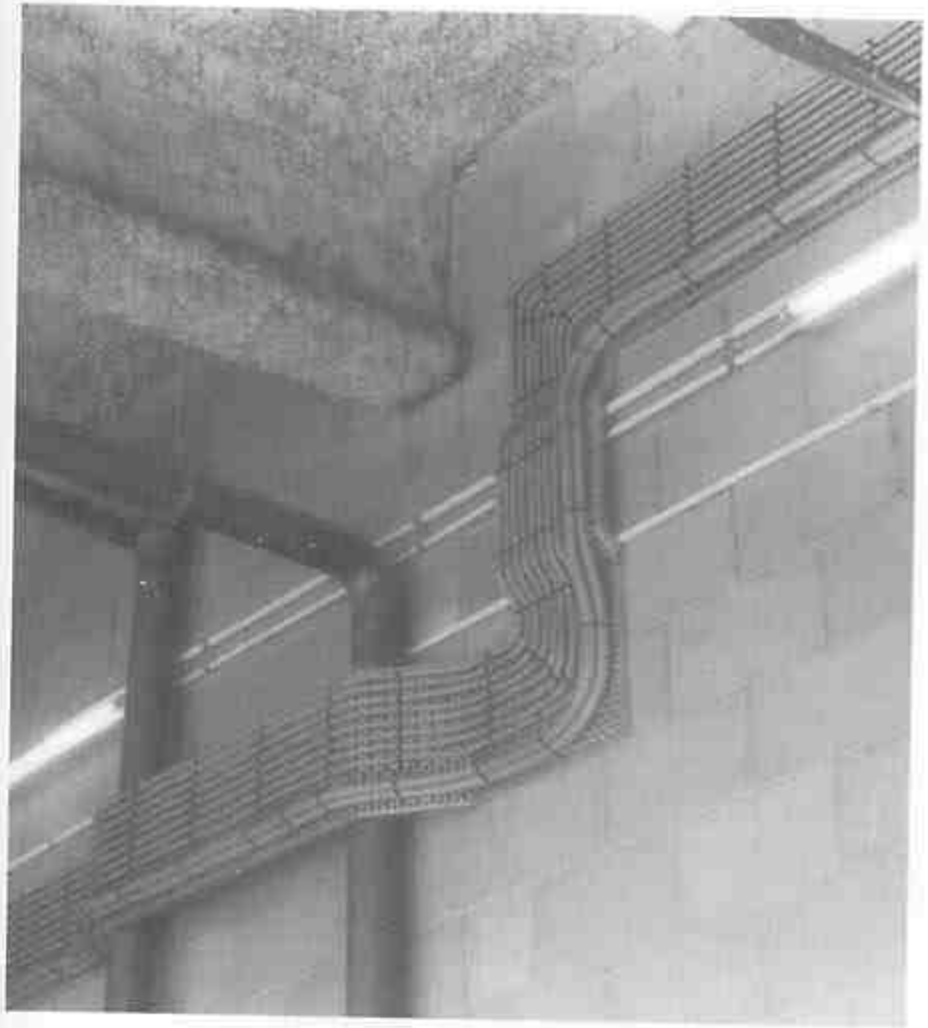

Fig. 8.5(a) *Cables installed in groups. Mutual heating reduces current-carrying capacity of cables*

whichever is the greater (see *Clause 3.20.3.2*). Figure 8.6 shows cables installed in a garage without a ceiling.

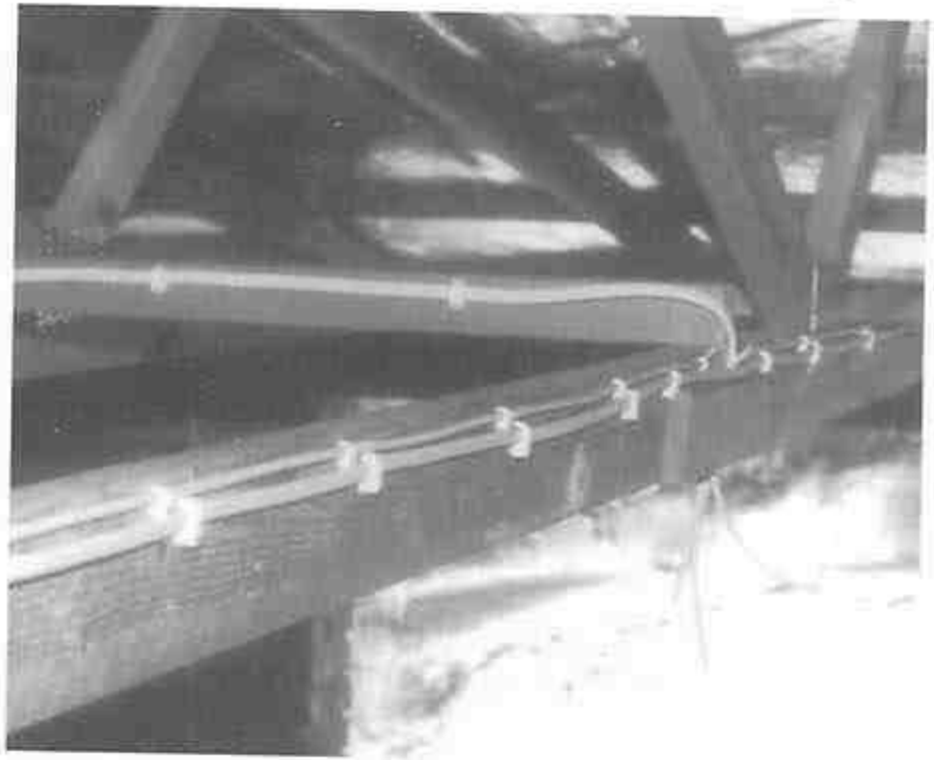

Fig. 8.6 *Cables 'likely to be disturbed'*

If the cable is installed in a ceiling space having an access space exceeding 0.6 m in height, it must be fixed so as to prevent appreciable sagging of the cable, typically fixed at maximum intervals of 1.2 m. This fixing is not required if the cable is laid on a continuous horizontal surface on which a person may not stand, such as the ceiling of Figure 8.8(c). Where TPS cables cross

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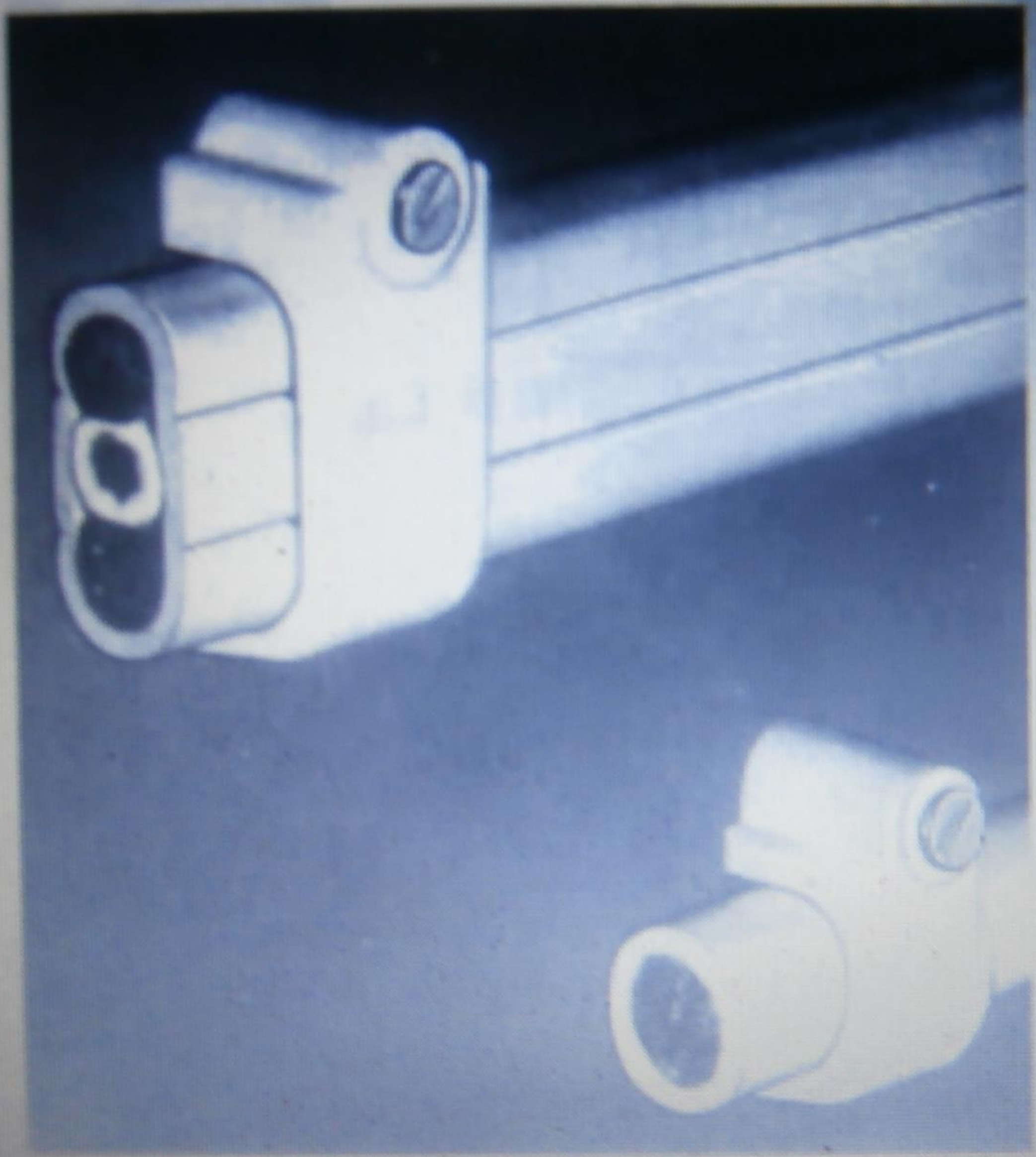


Fig. 8.4(b) Plastic clips for TPS cable

Fig. 7.1 *Crane collector wires*

enclosures or sheathing. Another advantage is that the whole of the installation is readily accessible for repairs, maintenance, additions or alterations, location of faults and the quick isolation of faulty equipment.

The major disadvantage of open wiring lies in its appearance, which is usually poor, thus limiting its

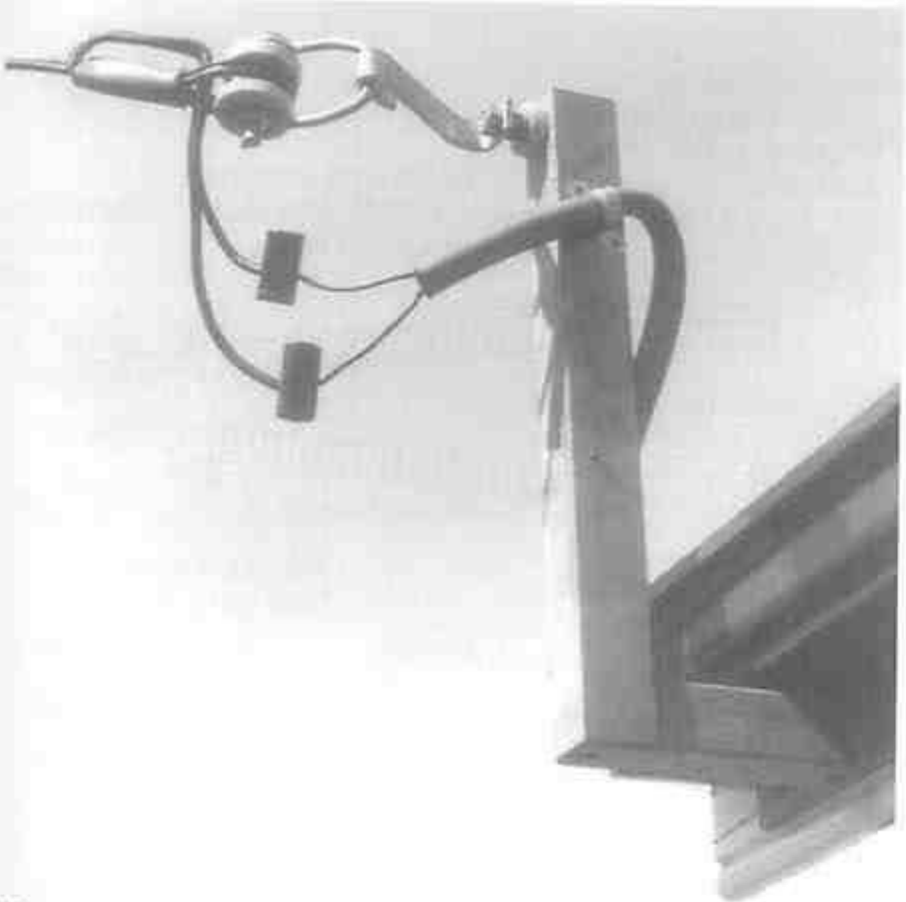
locations, theatres or public halls.

When open wiring utilising bare conductors on suitable insulators is to be used, consideration must be given to the fact that exterior aerial wiring, using mostly bare but sometimes insulated conductors, is a type of open wiring. The use of aerials, however, is so extensive that for the purpose of the *SAA Wiring Rules* it has been given a category of its own ('Aerials'), covered by its own definition (*Clause 0.5.5*) and its own separate Rules.

You must remember that, if the same wiring construction as used for aerials exterior to a building is used within a building, and if bare conductors are employed, then *Clause 3.17* applies. This Rule specifies the necessary spacing and conditions for the support, location and control of the system, together with other precautions to be observed.

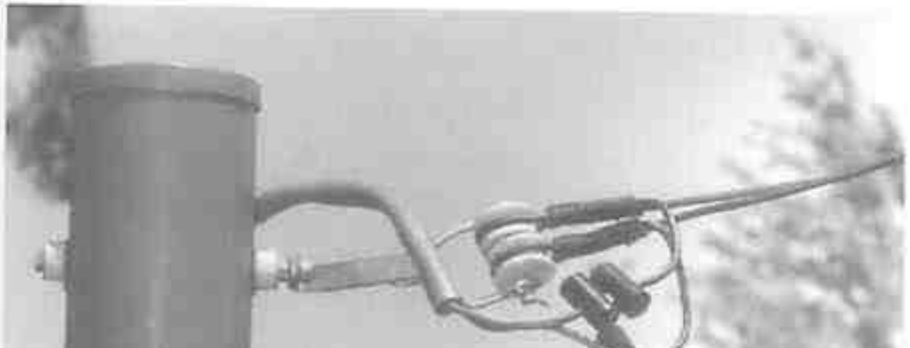
Applications for the installation of bare conductors (other than aerials) are limited, but they include collector wires for cranes and trains, busbar wiring on exterior and interior switchboards, outdoor substations, and extra-low-voltage applications such as wiring for electroplating installations.

Open busbars are used to carry the heavy current demand of large industrial plant, such as the triple-



(c)

(a)



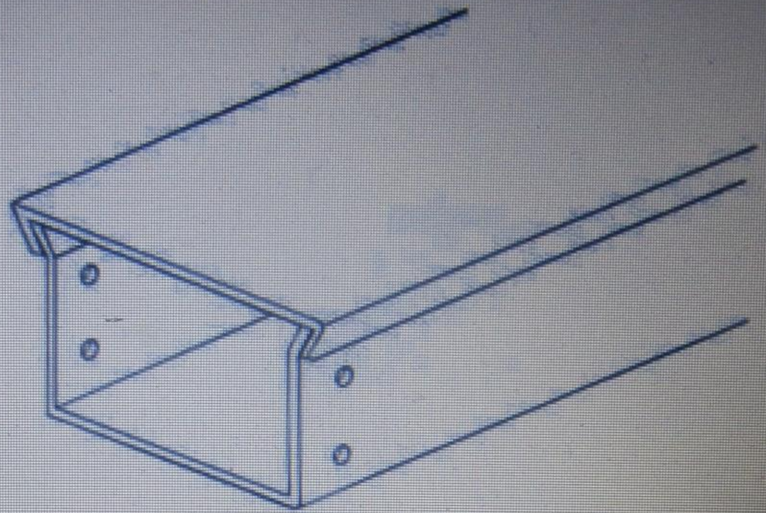


Fig. 7.10(a) *Steel trunking*

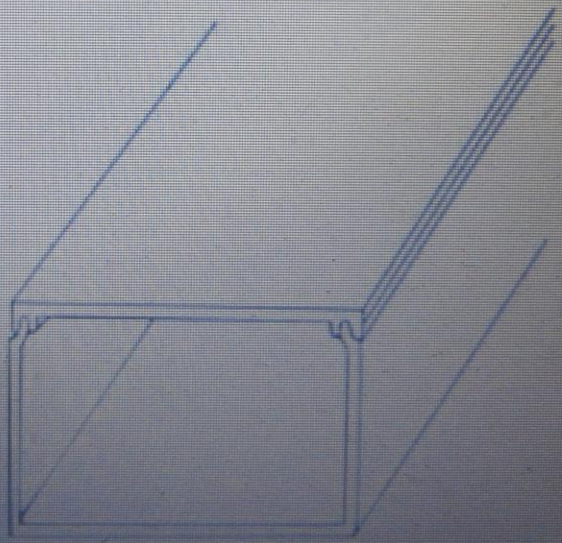


Fig. 7.10(b) *PVC trunking* AUSTRALIAN PLASTIC PROFILES

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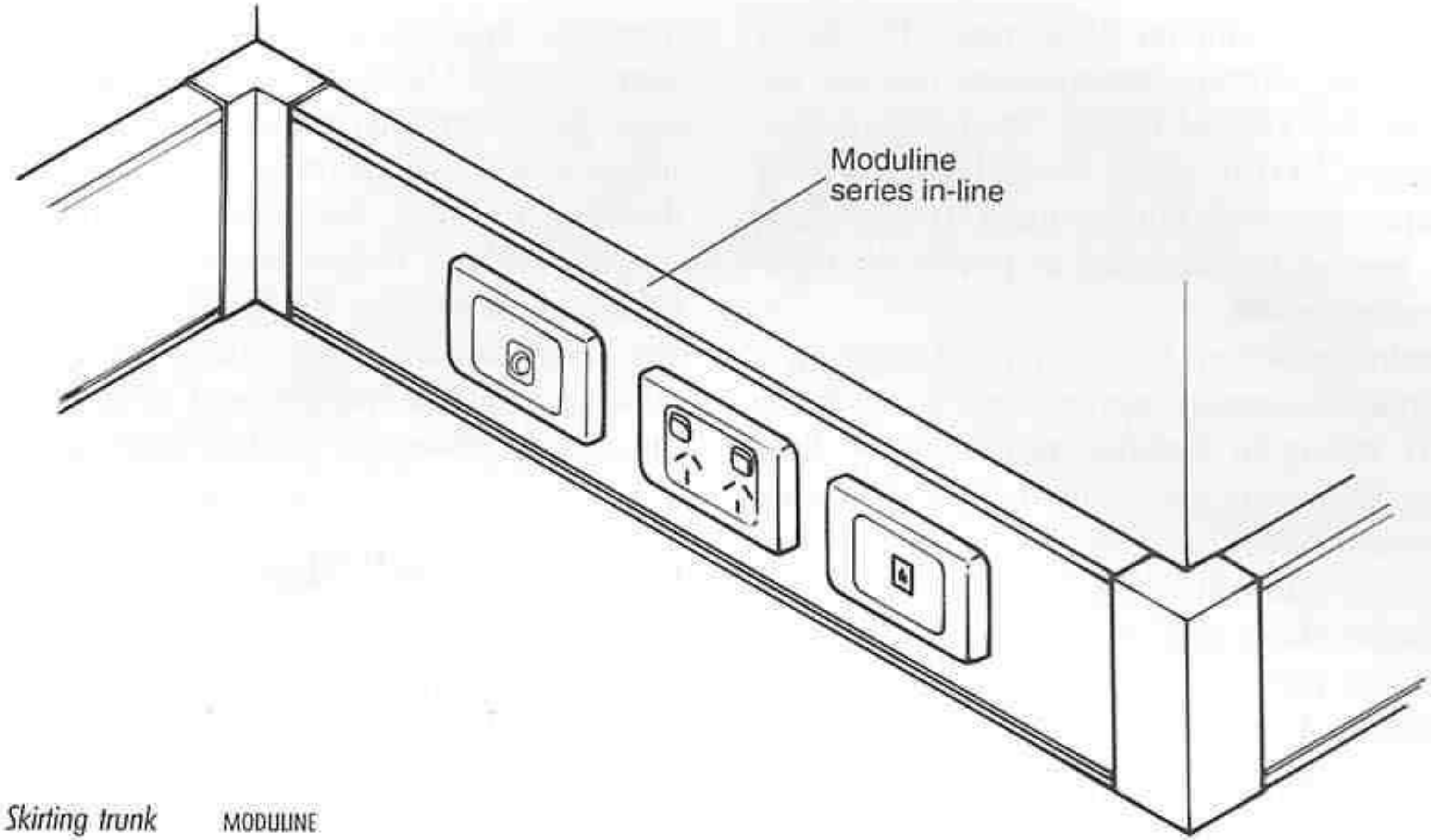
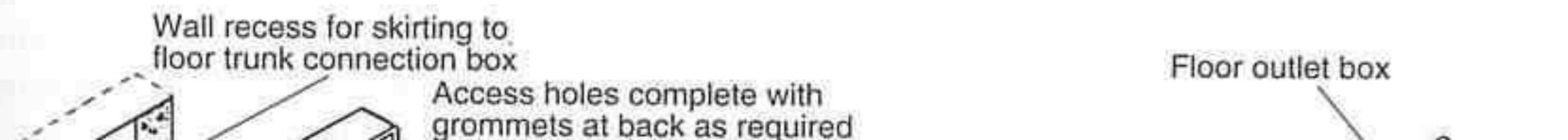


Fig. 7.11(a) *Skirting trunk* MODULINE



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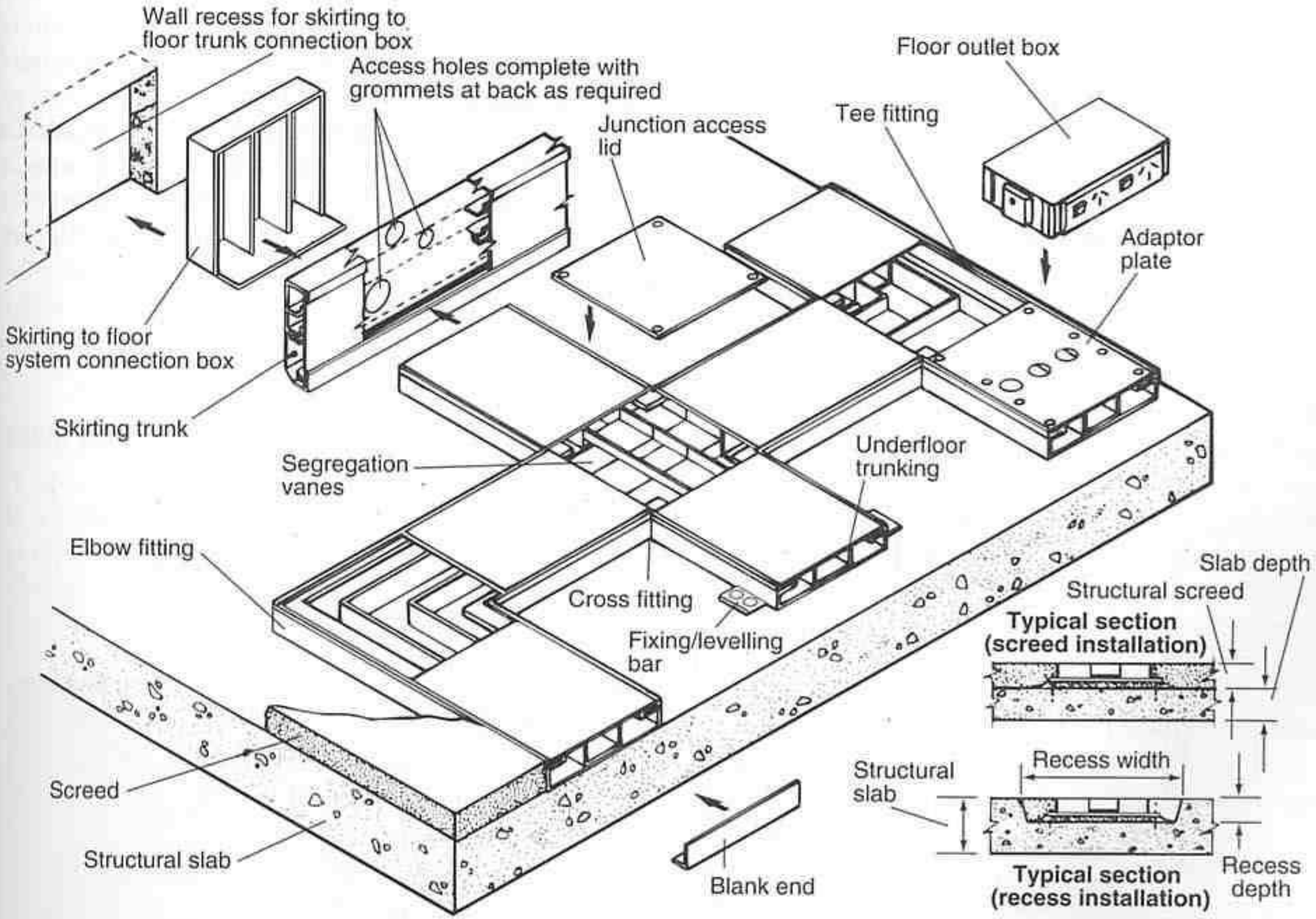

Fig. 7.11(b) *Underfloor trunking system* MODULINE

rarely used, except sometimes on isolated sections as

substations and power houses. The trunk is fitted with ically designed to provide a practicable system for dis- and vertically, and both are available in steel or alumin-

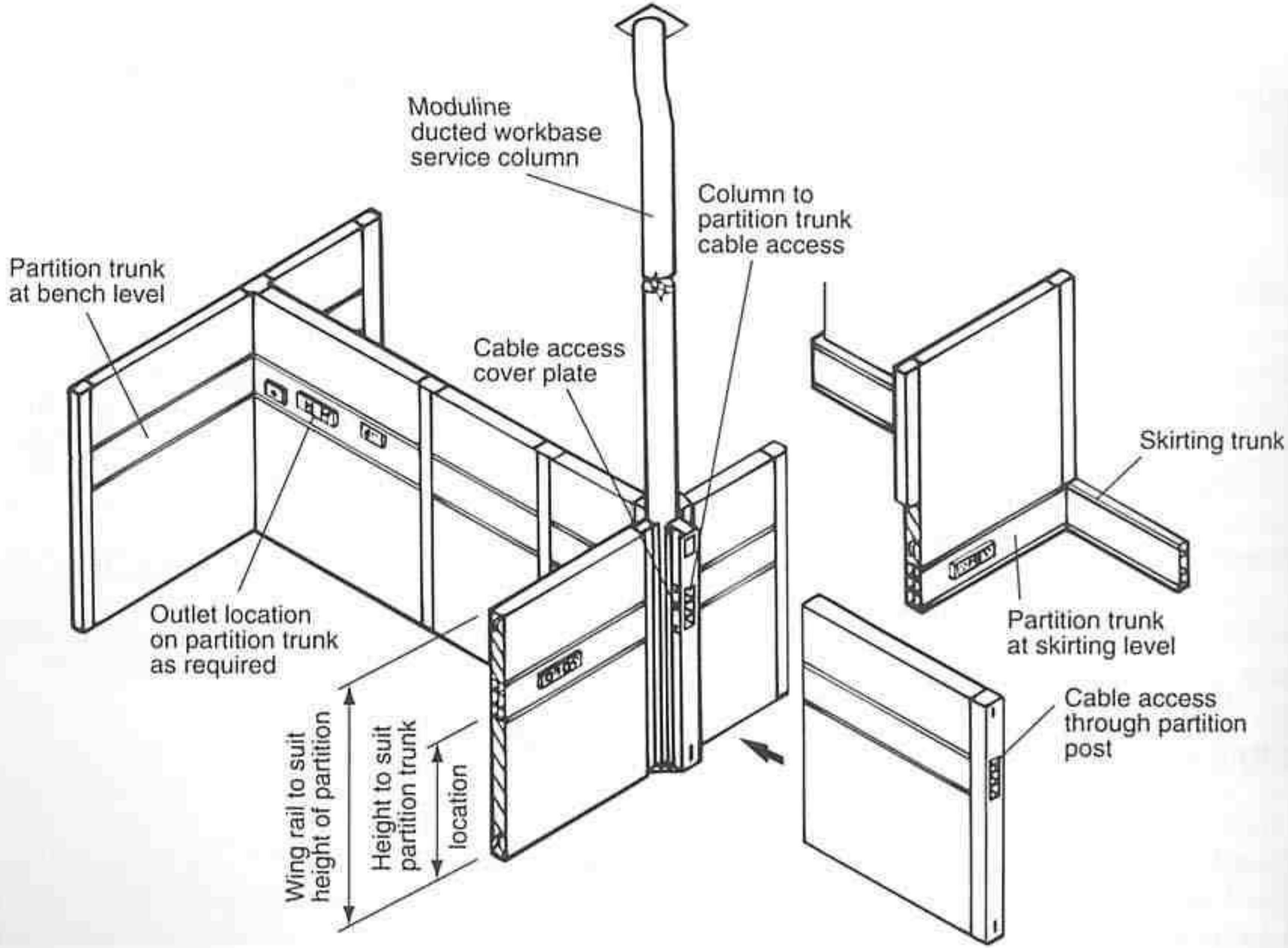

Fig. 7.12 *Ducted service column used in conjunction with partition trunking* MODULINE

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Fig.

Busway systems

Another system of power distribution widely used in Australia and New Zealand is the busway system, which consists of solid copper or aluminium conductors supported by insulated barriers at intervals within a formed duct, trunk or similar enclosure. Its application lies mainly

circuit breakers (see Fig. 7.16).

The system has the advantage of effectively reducing the number of distribution boards and submains, thereby simplifying the wiring layout. This is indicated in Figure 7.17, where the four distribution boards, four submains and twenty subcircuits, all marked X on the figure, would not be required if the busway system were used. If the distribution boards fed light and power

Fig. 7.16 *Plug-in busway* VASS ELECTRICAL INDUSTRIES

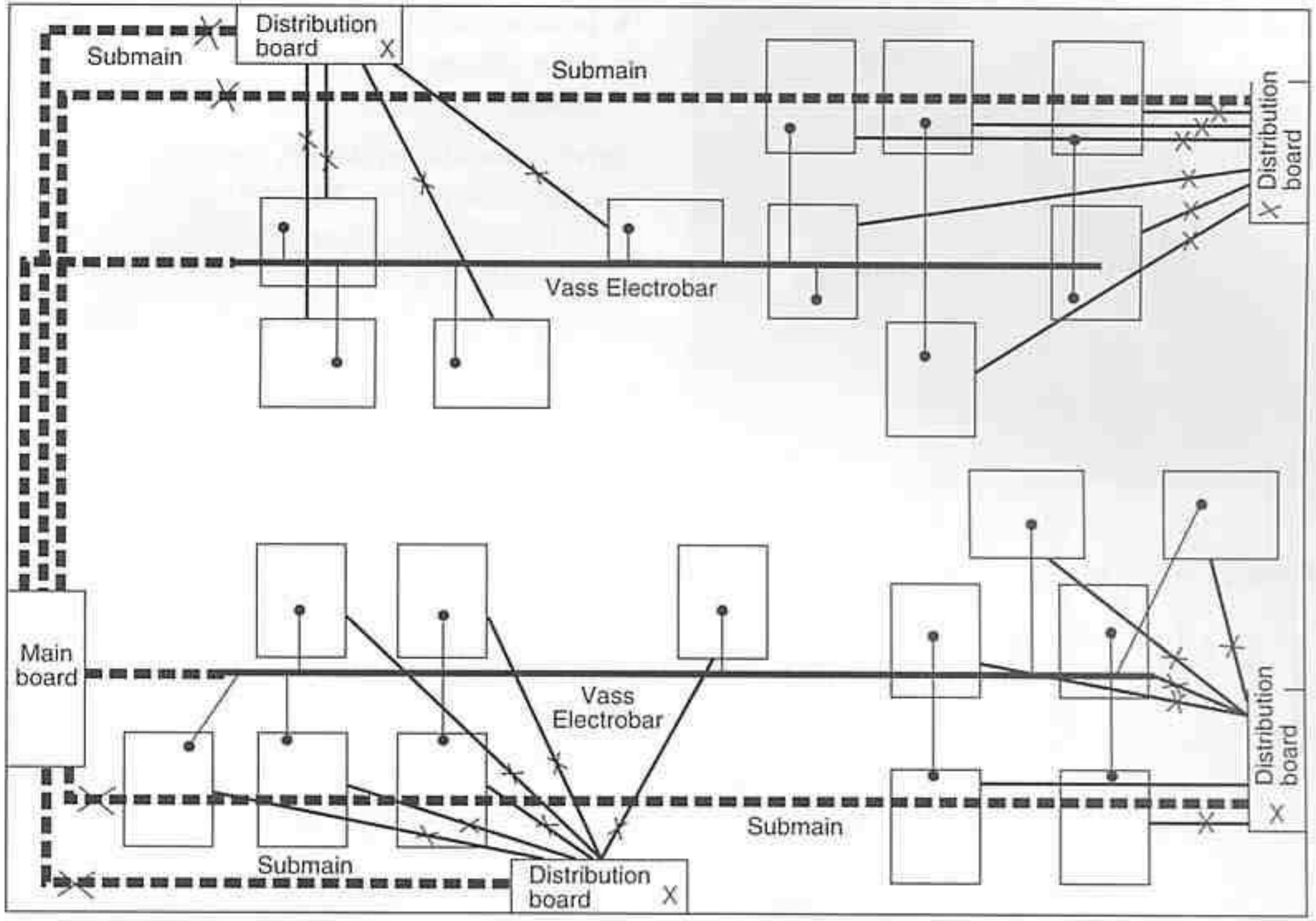

Fig. 7.17 *Comparison of conventional wiring and a busway system* VASS ELECTRICAL INDUSTRIES

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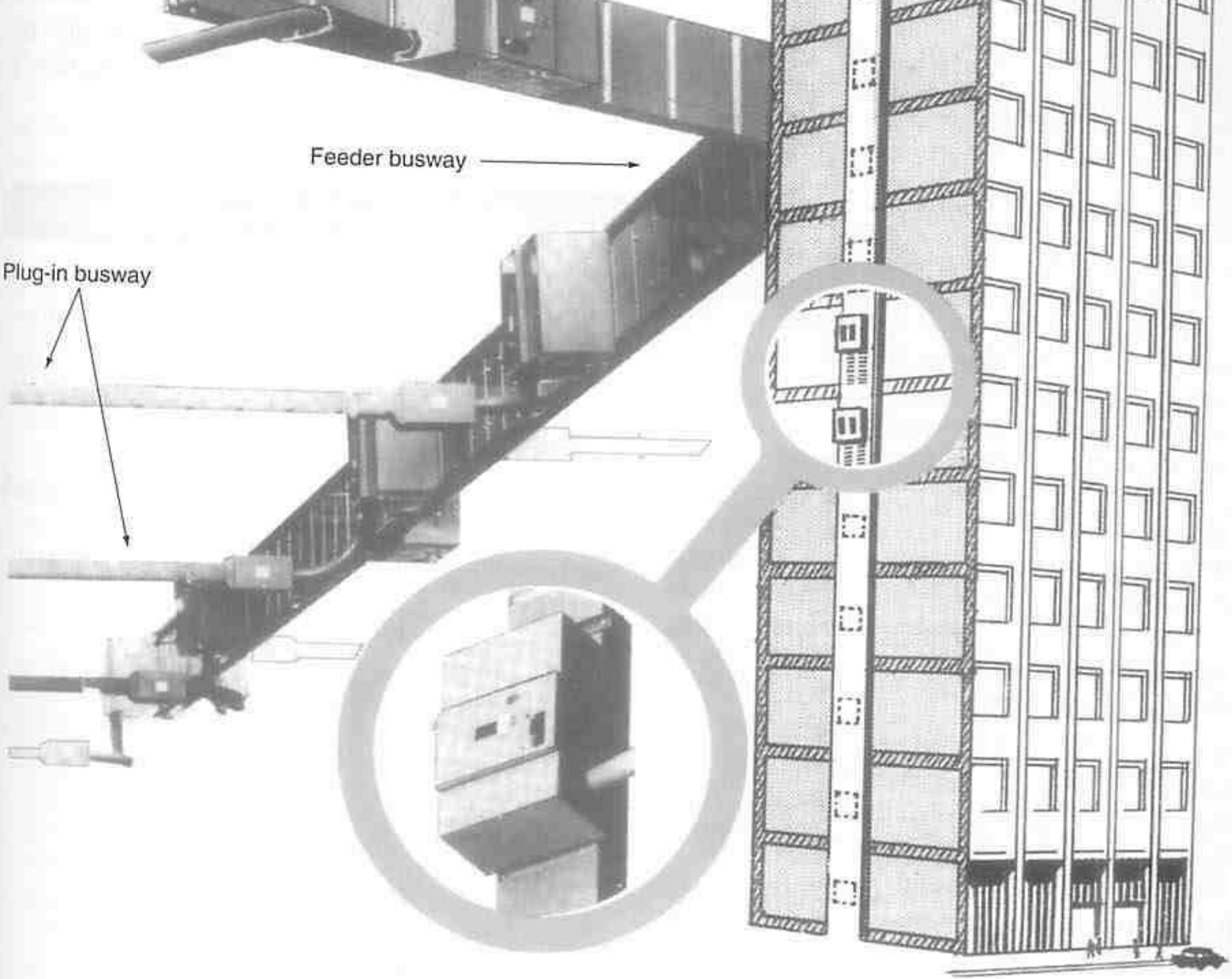

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Fig. 7.20 *Feeder busway for high-rise building. Inset: typical horizontal take-off feeder* VASS ELECTRICAL INDUSTRIES

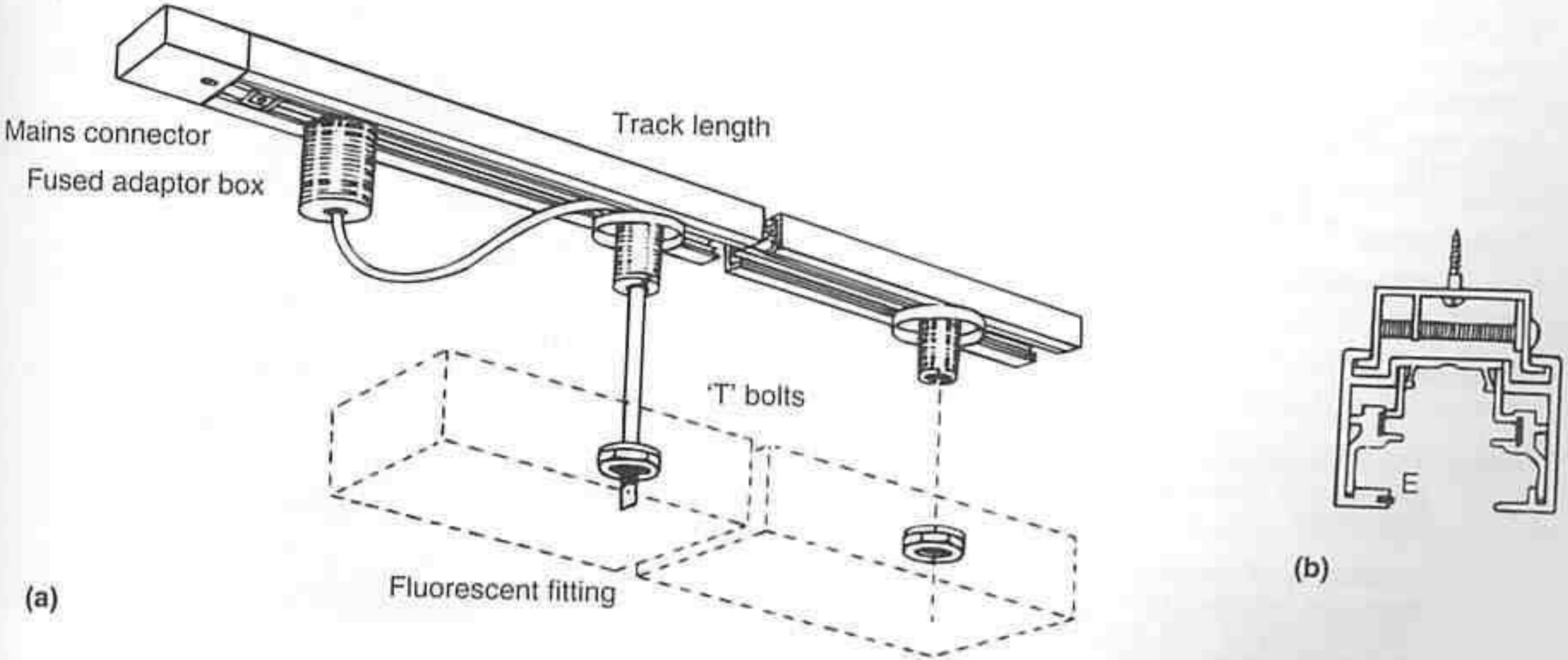

Fig. 7.21 **(a)** *Typical track system;* **(b)** *End view of track extrusion module*

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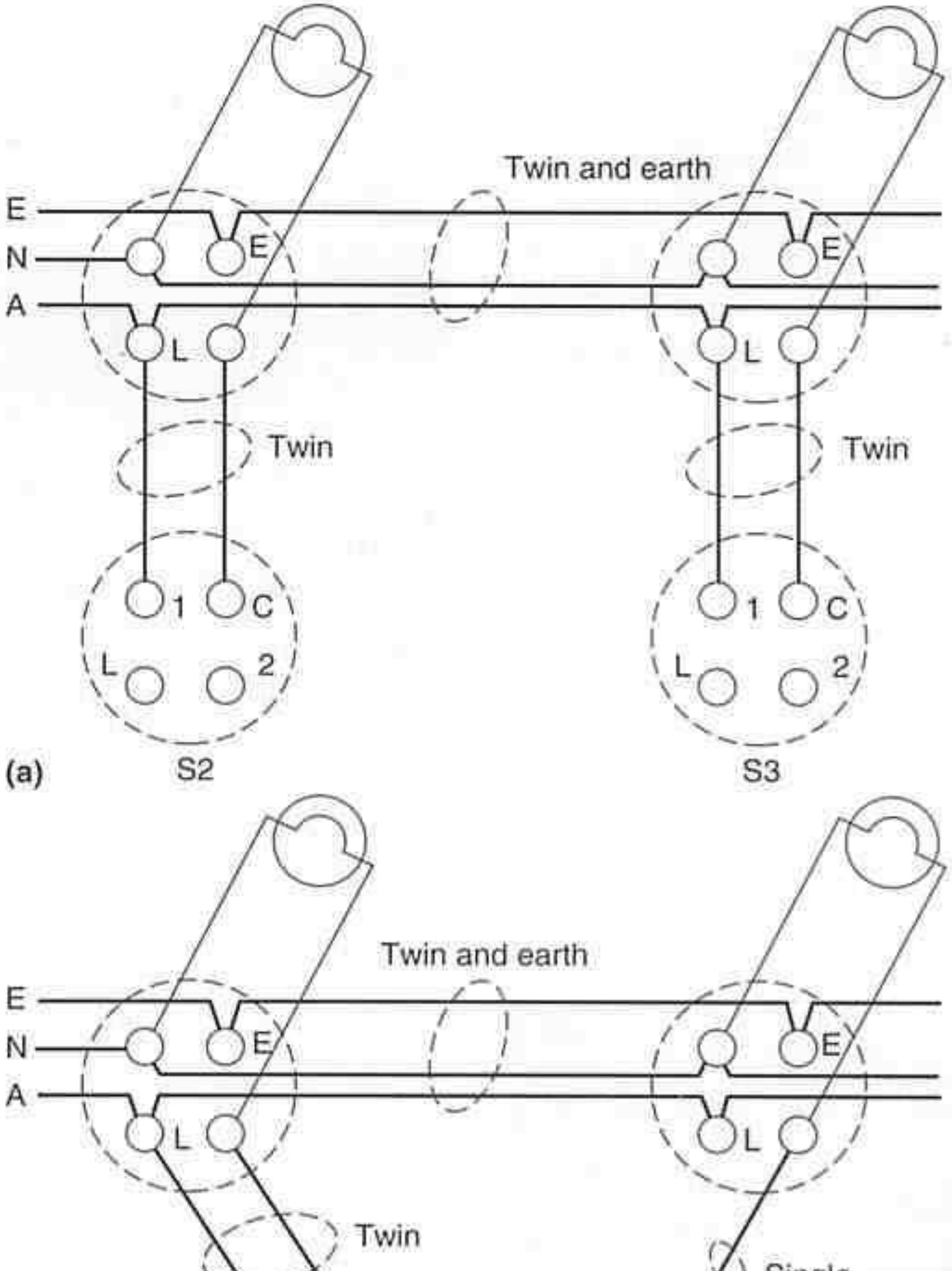

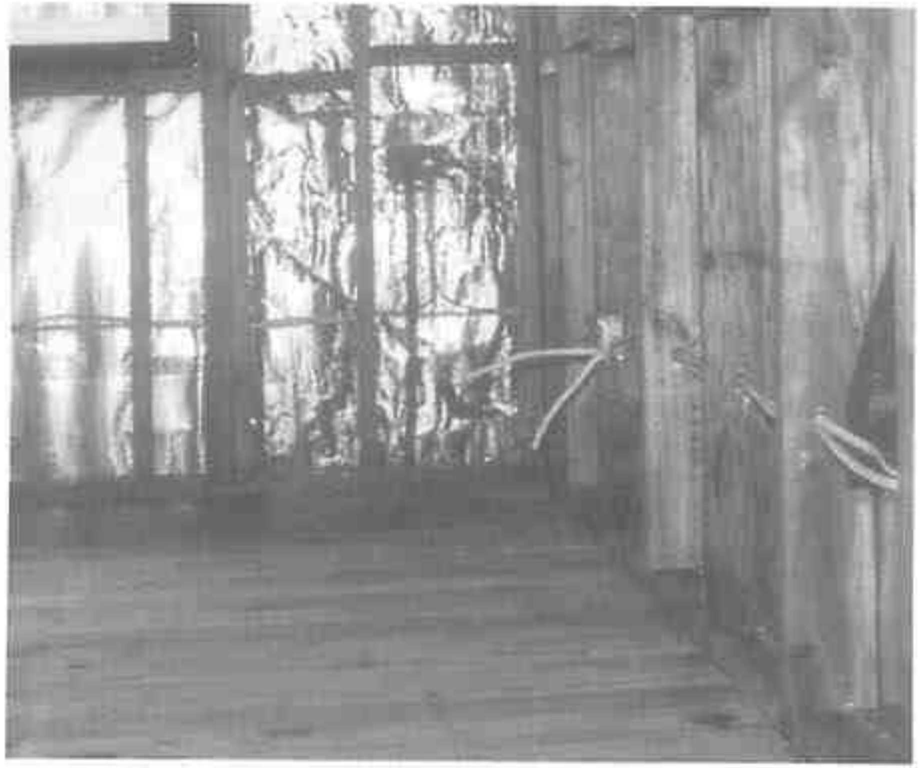

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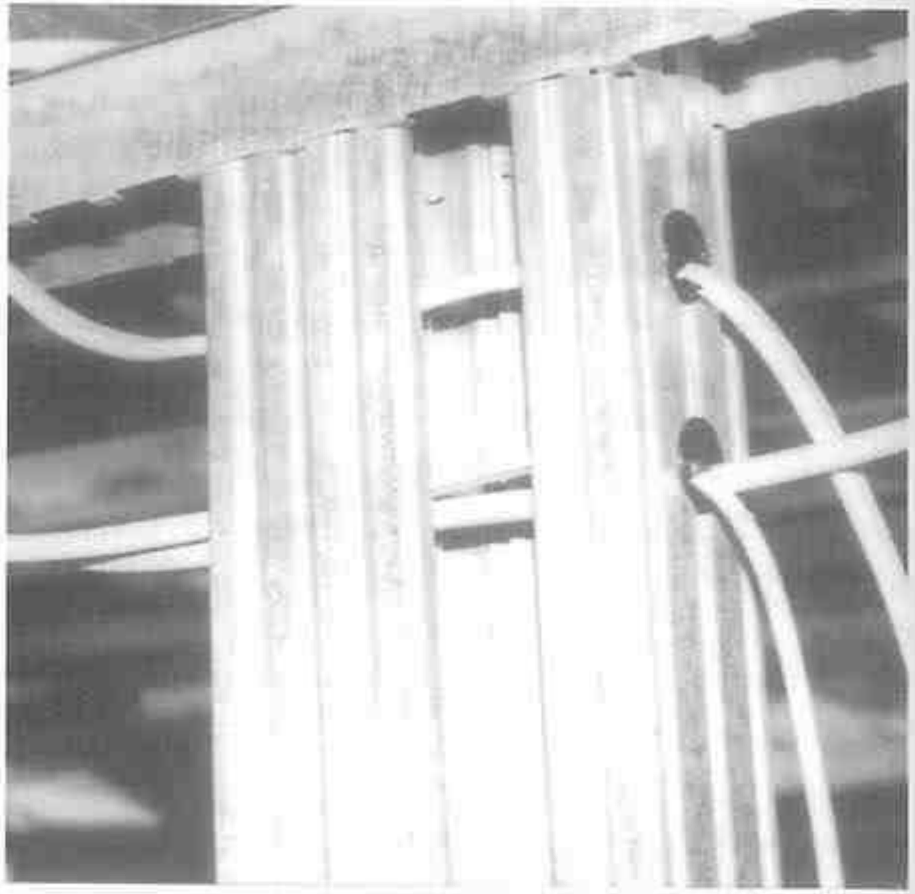

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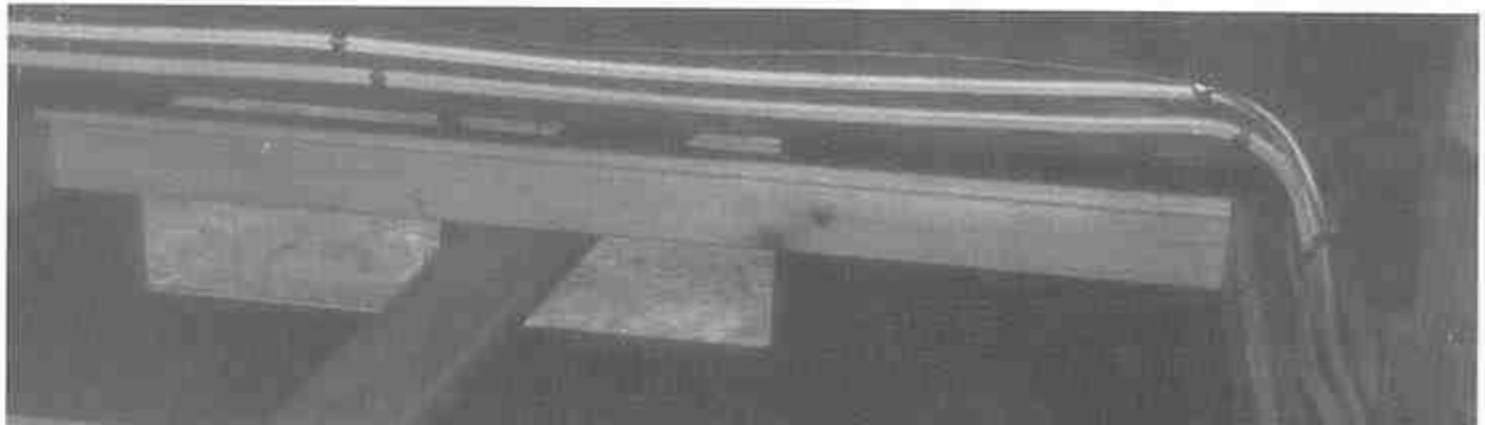

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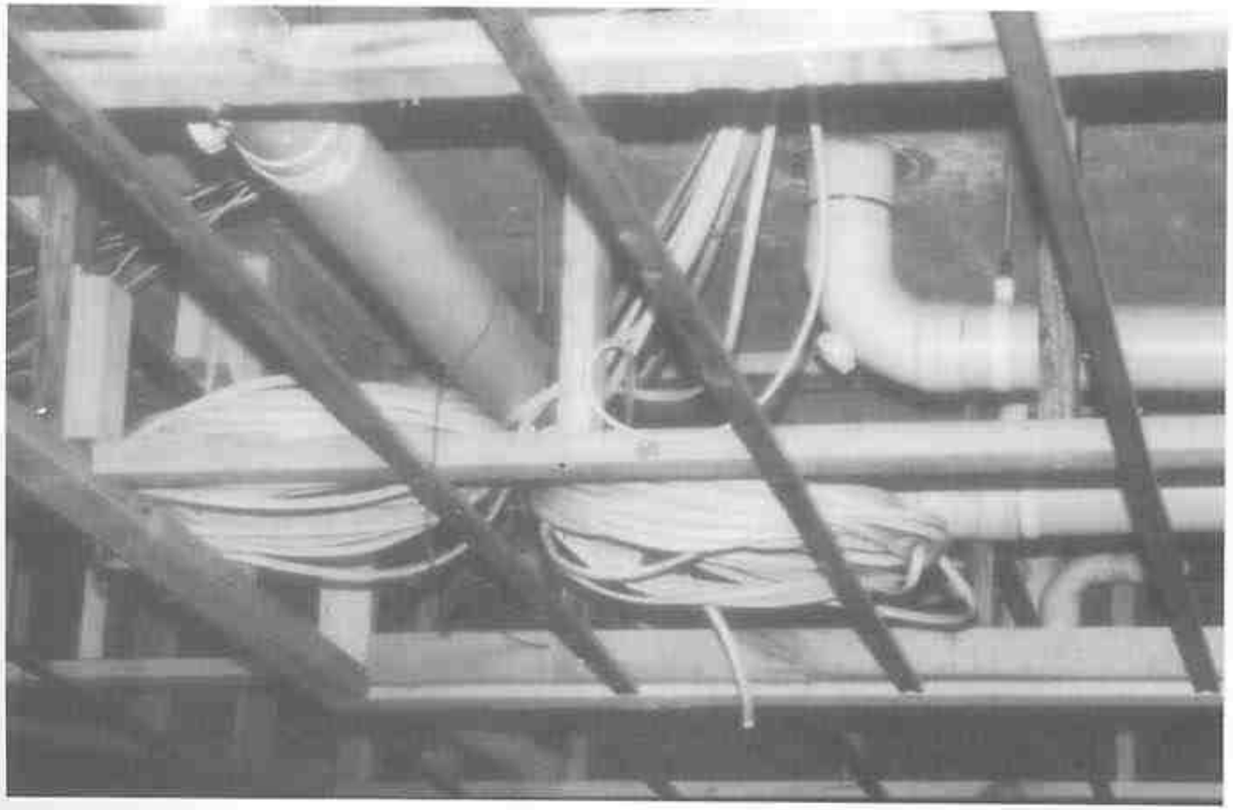


(d)

Fig. 8.7 *Methods of installing TPS cables 'not likely to be disturbed':* **(a)** *through or in the space between wall studs;* **(b)** *through grommets provided in steel-framed walls;* **(c)** *on timber work in a ceiling;* **(d)** *in a suspended ceiling*

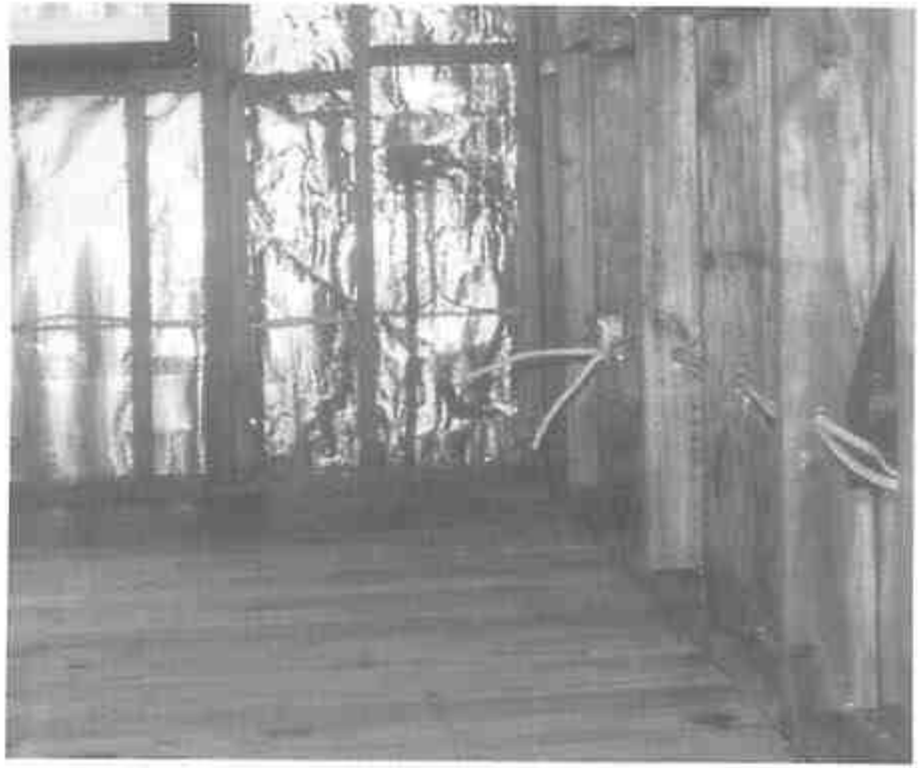
Cables of the one circuit touching and installed—

(a) clipped direct to a wall, floor, ceiling or similar surface;

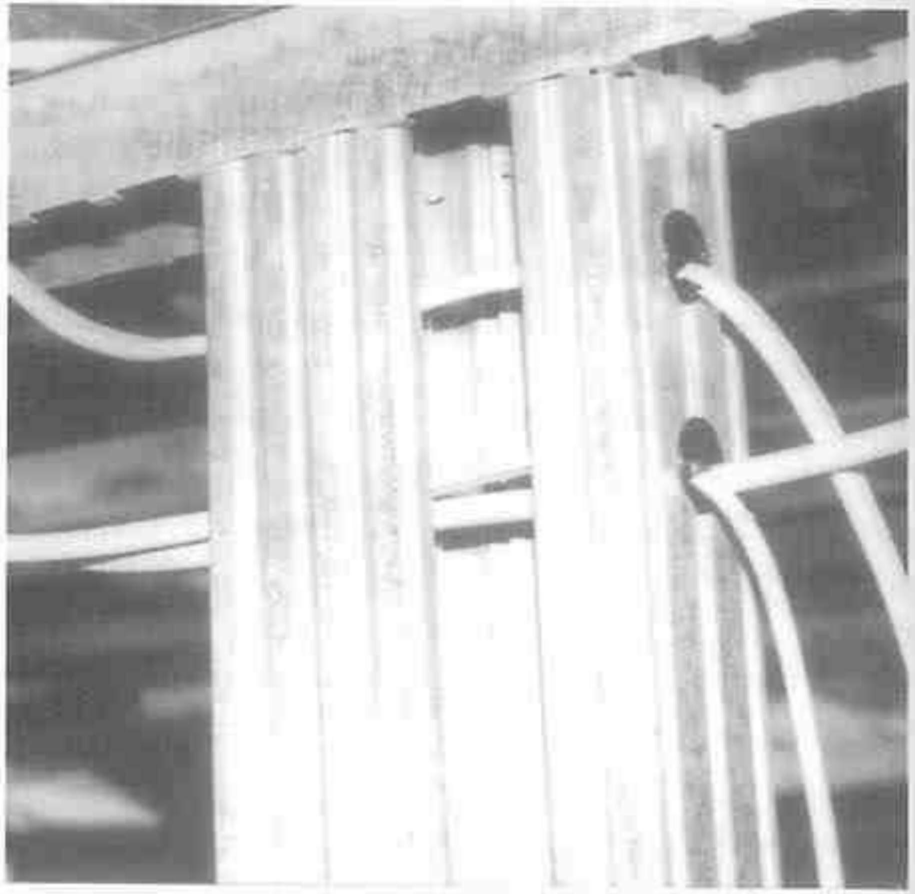
(b) in a ventilated trench or open trunking;

(c) buried directly in a plaster or render on a wall; or

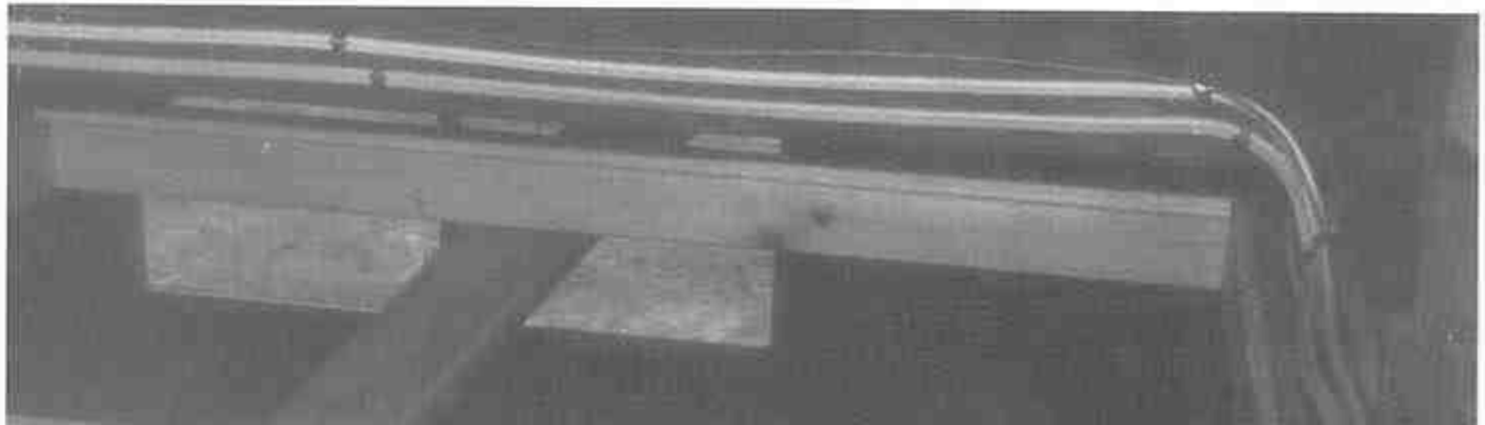
(d) in a switchboard or similar enclosure.



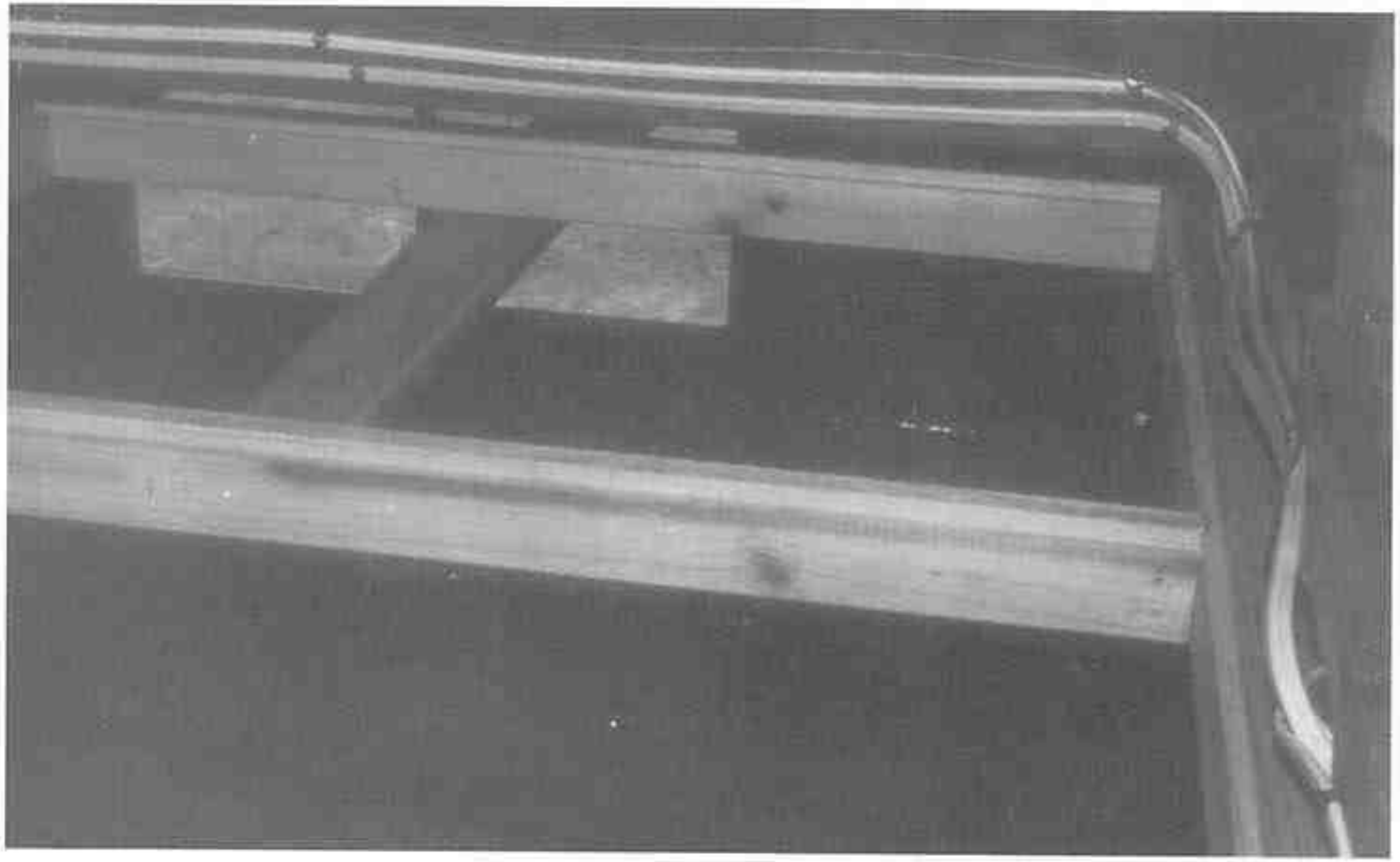
(a)



(b)

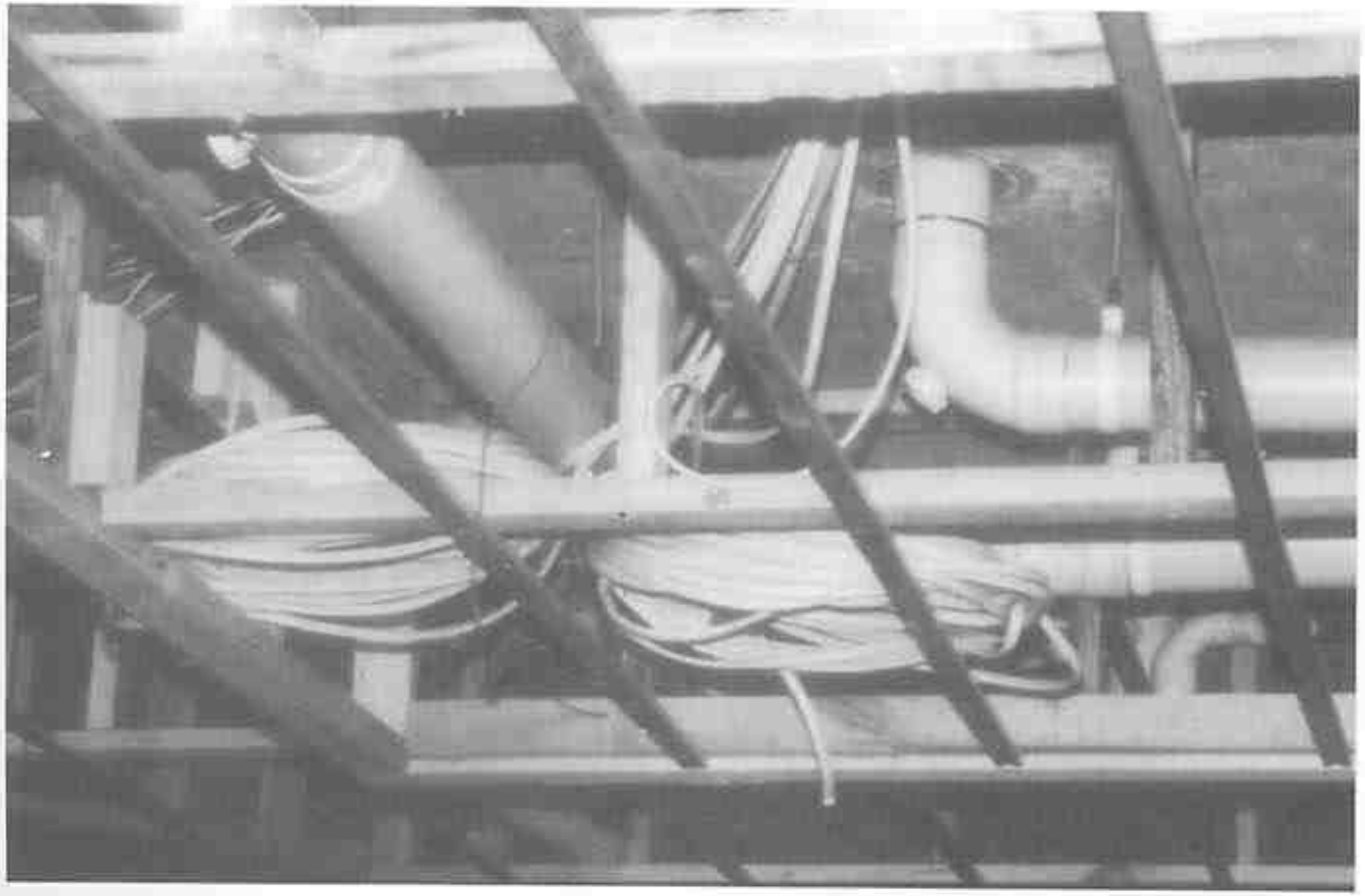


(b)



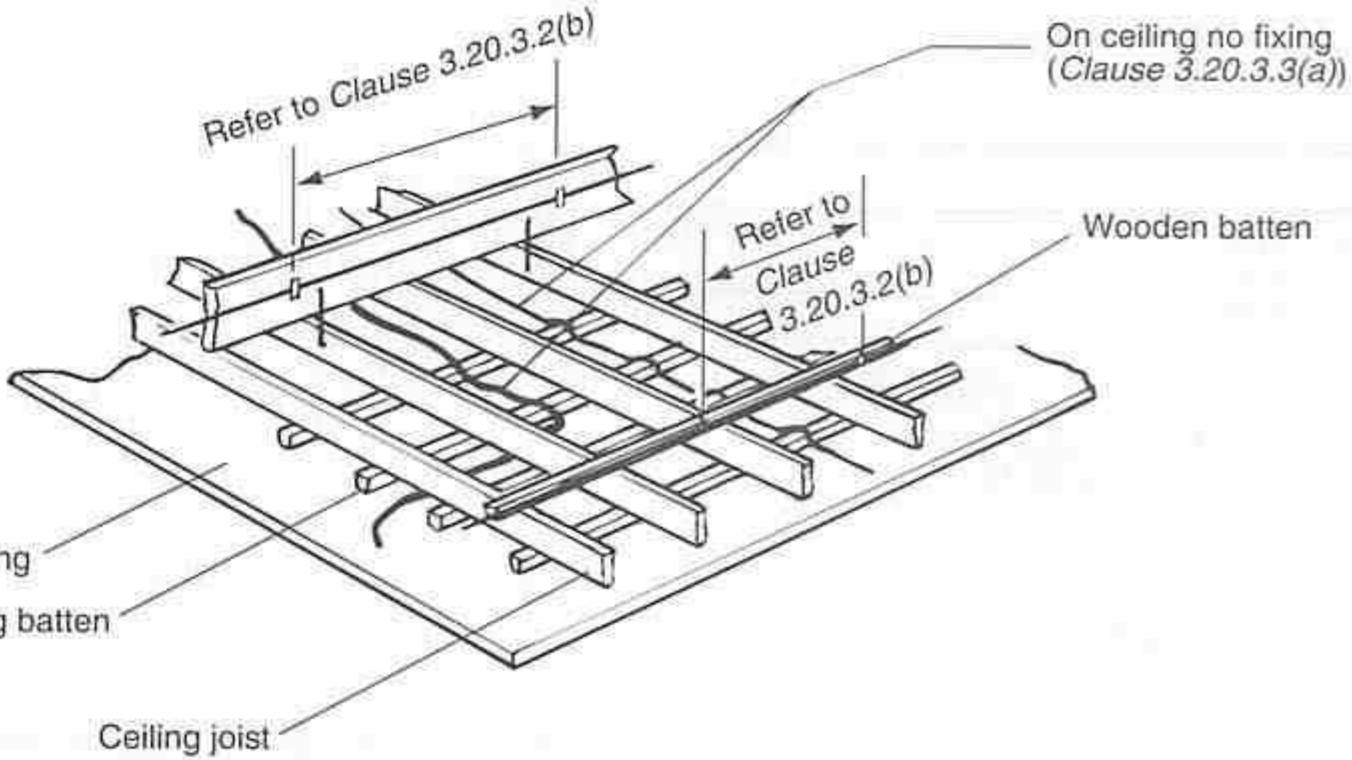
(c)

(c)

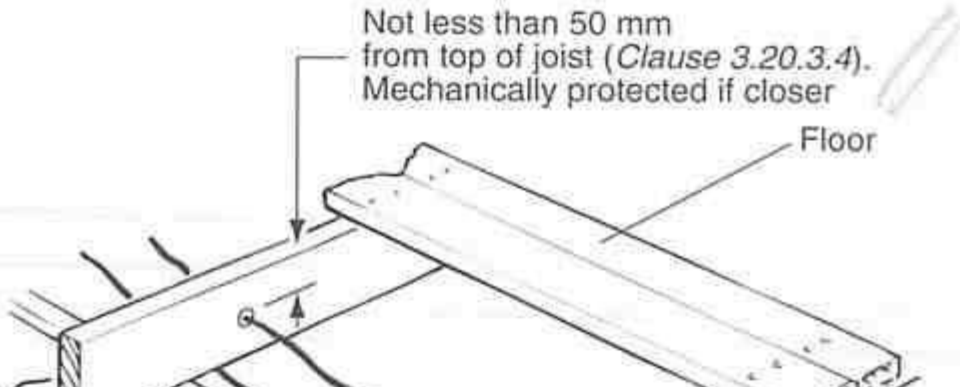


(d)

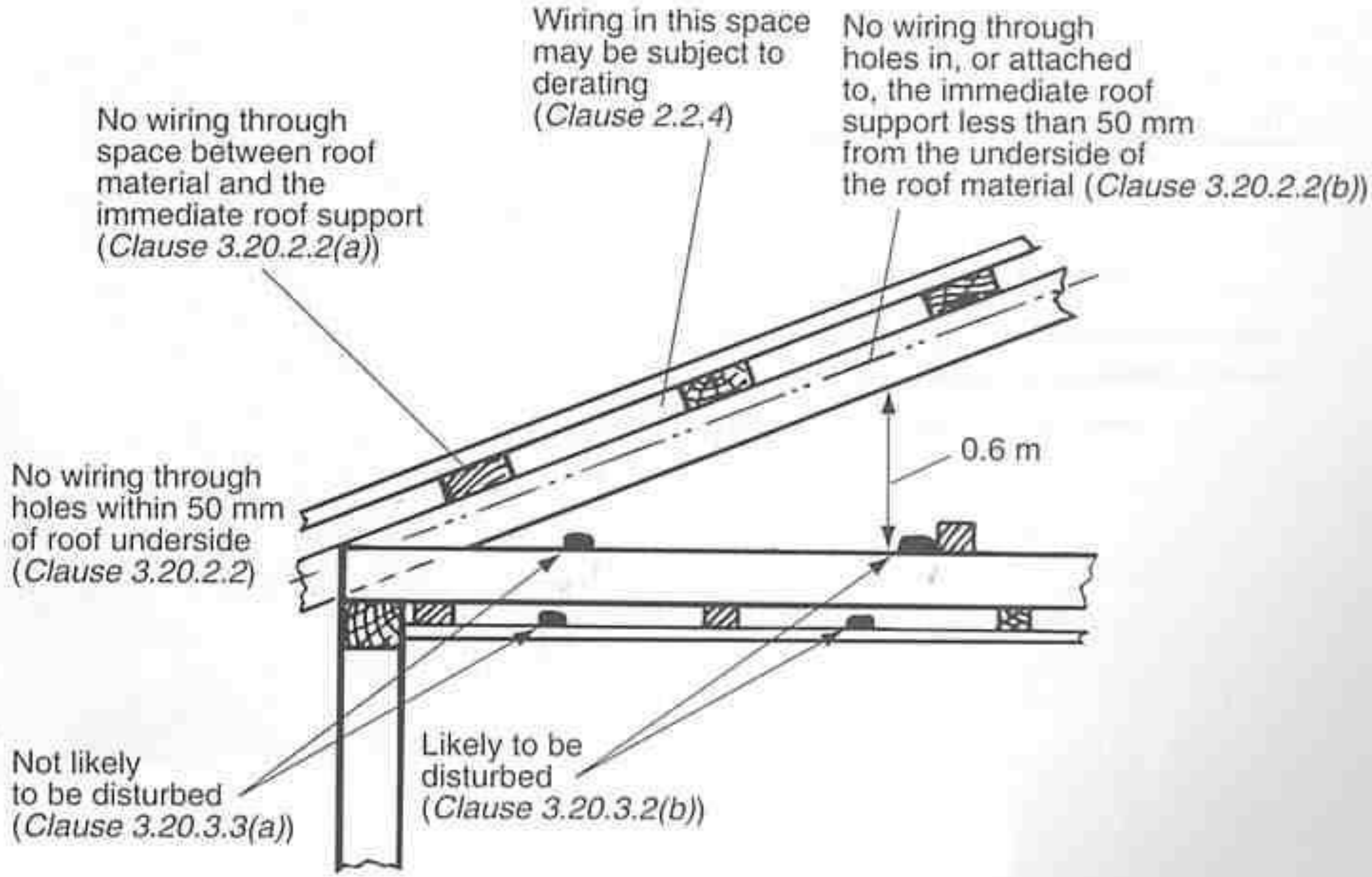
Fig. 8.7 *Methods of installing TPS cables 'not likely to be disturbed':* **(a)** *through or in the space between wall studs;* **(b)** *through grommets provided in steel-framed walls;* **(c)** *on timber work in a ceiling;* **(d)** *in a suspended ceiling*


Refer to Clause 3.20.3.2(b)
On ceiling no fixing
(*Clause 3.20.3.3(a)*)
Refer to
Clause
3.20.3.2(b)
Wooden batten
Ceiling
Ceiling batten
Ceiling joist

(a)


Not less than 50 mm
from top of joist (*Clause 3.20.3.4*).
Mechanically protected if closer
Floor

Not less than 50 mm
from underside of floorboards.
Clips not more than 2 m.
Could be laid on ceiling



(c)

Fig. 8.8 *TPS wiring:* **(a)** *in a ceiling space;* **(b)** *between a floor and an uppermost ceiling;* **(c)** *between ceiling and roof* when it is run, for example, in the space between the floor of one storey and the ceiling of the storey below. Again the precautions are against mechanical damage to the cable, due to traffic on the floor or to nails used in the fixing of flooring.

outlets. Thus the whole of the wiring loom or 'harness', including switch drops where required, is made up at floor level with considerable saving of labour. Material is also saved, as the cable 'tails' usually left at each accessory position in an in-situ installation are eliminated.

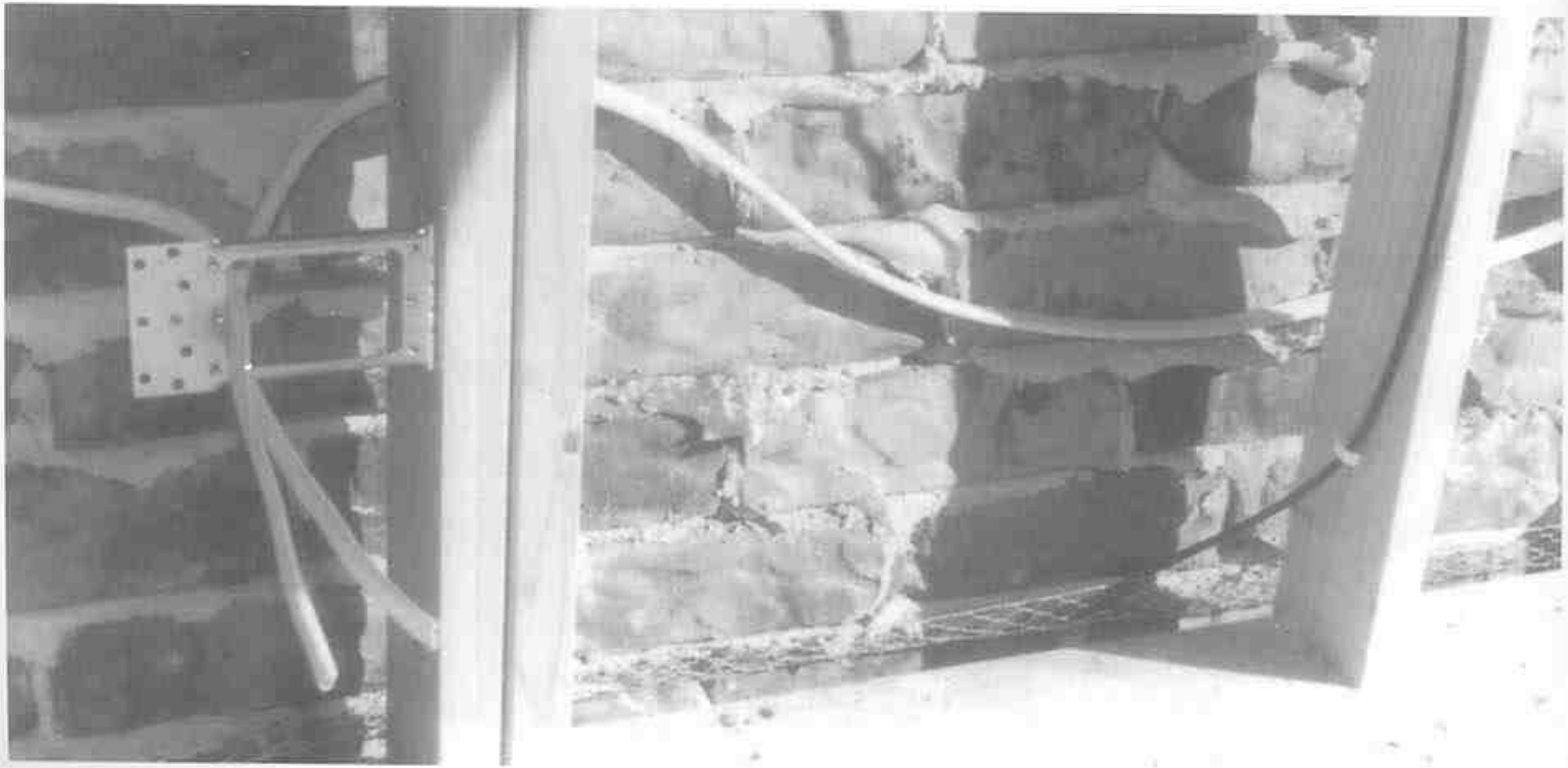


Fig. 8.9 *Cables supported on wall ties (not permitted in Victoria)*

Cables in wiring enclosures installed in—

(a) air;

(b) plaster, cement render, masonry or concrete in a wall or floor;

(c) a concrete slab on or above the surface of the ground; or

(d) a ventilated trench.

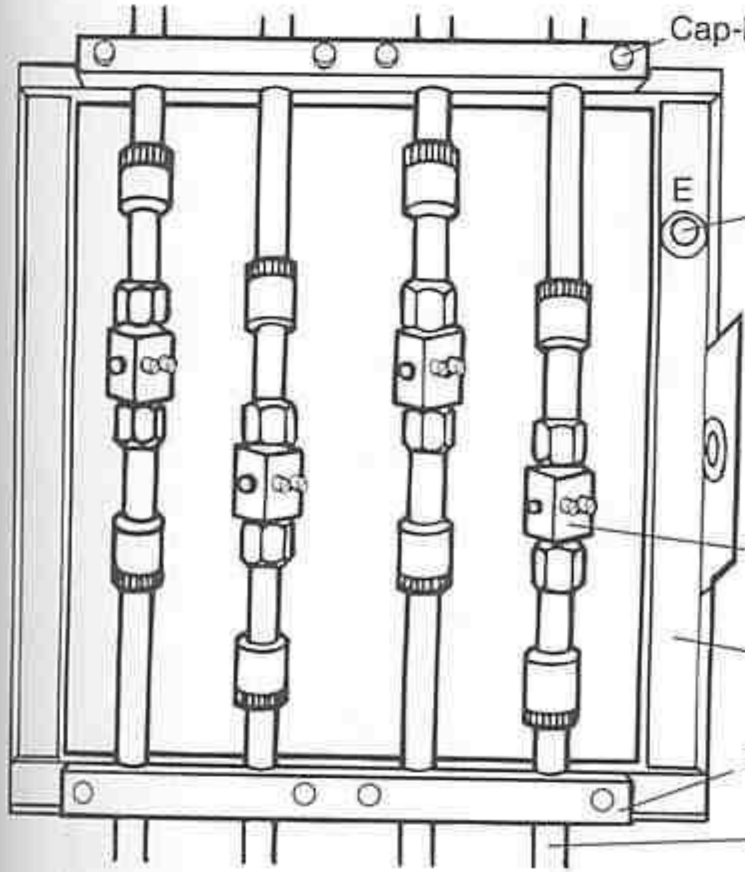


Fig. 5.39(b) *Tee-junction box used to facilitate the teeing-off of vertical mains in multistorey buildings where standard cables can be connected to a MIMS cable system*
MM CABLES PYROTENAX

5.6 Accessories for control and

contacts must be 'quick-break' and have a longer travel than ac ones.

Before installing a switch, always check to ensure that it is suitable for a particular application by checking its current rating, voltage rating, type, and whether it is designed for ac or dc operation. Remember that the switch is in series with the load; accordingly, with the load connected and the switch 'off' the full circuit voltage is present across the switch contacts.

Switches are available in a variety of shapes, types and ratings and may be single-, double- or triple-pole, two-way, intermediate, all-insulated, iron-clad, flameproof and so on in a nearly limitless variety, all of which have the same **basic** function of making and breaking circuit connections in a convenient manner. Some elementary switching circuits are discussed in Chapter 6. Remember where and how this important accessory is connected in a circuit and its principle of operation.

A study of manufacturers' catalogues and the illustrations of Figures 5.40 to 5.42 give some indication of the range of switches and controls available to the electrician. The range is so extensive that, by a review of the listings in a supplier's catalogue, it is usually possible to select a suitable switch for virtually any application.

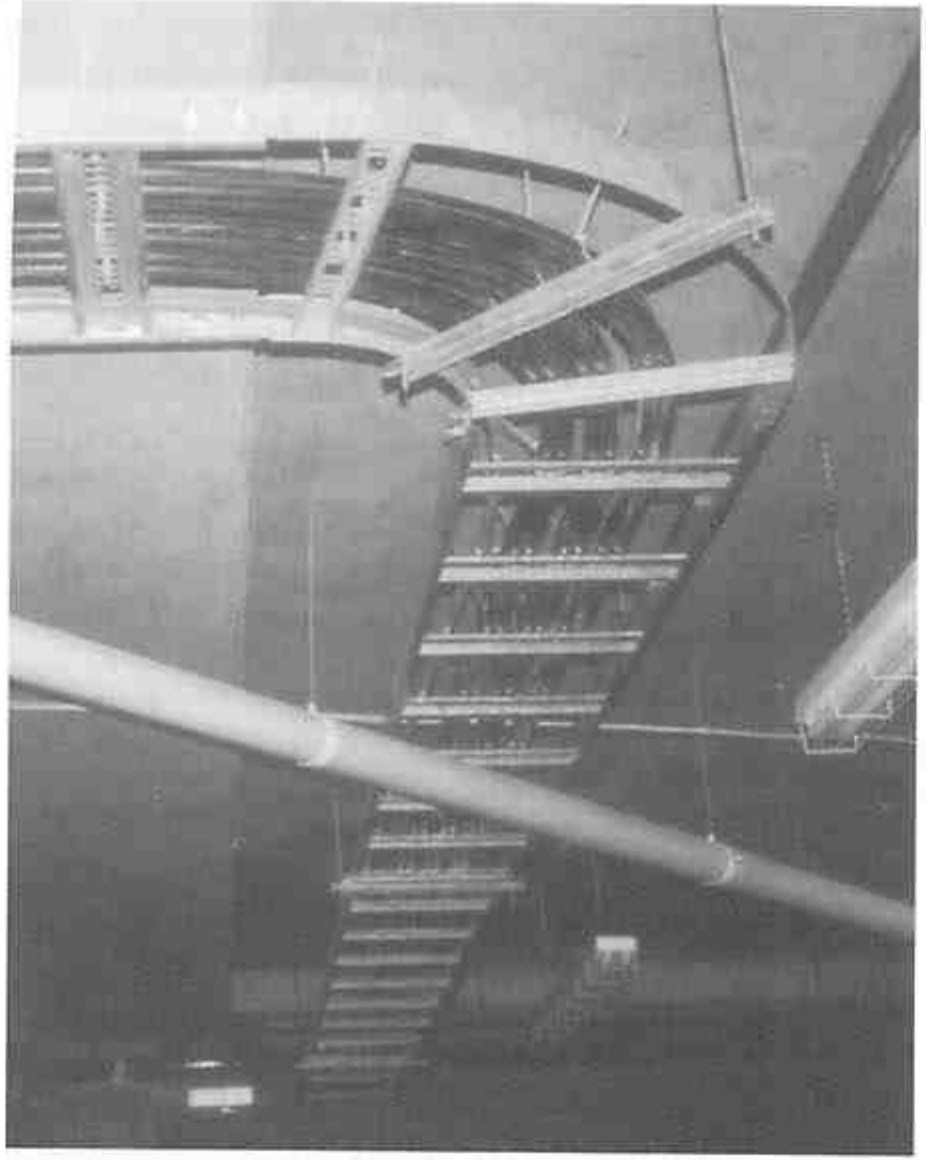


Fig. 10.1(c) *Non-metallic sheathed fire-retardant cable installation*

be such that electrical continuity is maintained when connecting devices and brass screws melt during a fire. At the time of writing (1996), joints and terminations are permitted only for applications with fire ratings of 15 minutes.

Apart from the use of special junction boxes and accessories required in the fire hazard zone, the preparation of joints and terminations for unarmoured fire-retardant cables is similar to that for ordinary PVC-insulated PVC-sheathed cables. As is seen elsewhere in this chapter, the termination and joining of MIMS cables are more complex and require the use of special tools.

General handling and installation methods are similar to those used for PVC-insulated PVC-sheathed cables. However, some types of fire-retardant cables are sheathed with a thermoplastic compound that is softer than conventional PVC; therefore it is necessary to avoid sharp edges and rough faces that might damage the cable.

Another factor to be taken into account is that some cables are designed to work at continuous operating temperatures of up to 110°C; therefore the effect of sheath temperature on adjacent combustible material must also be considered. Cable runs must be kept clear of such material, including the sheaths of other cables

Cables with a minimum depth of laying of—

(a) 0.3 m under continuous concrete paved areas; or

(b) 0.5 m in other locations.

Cables in a single enclosure laid—

(a) a minimum of 0.3 m below continuous concrete paved areas; or

(b) minimum 0.5 m in other locations.

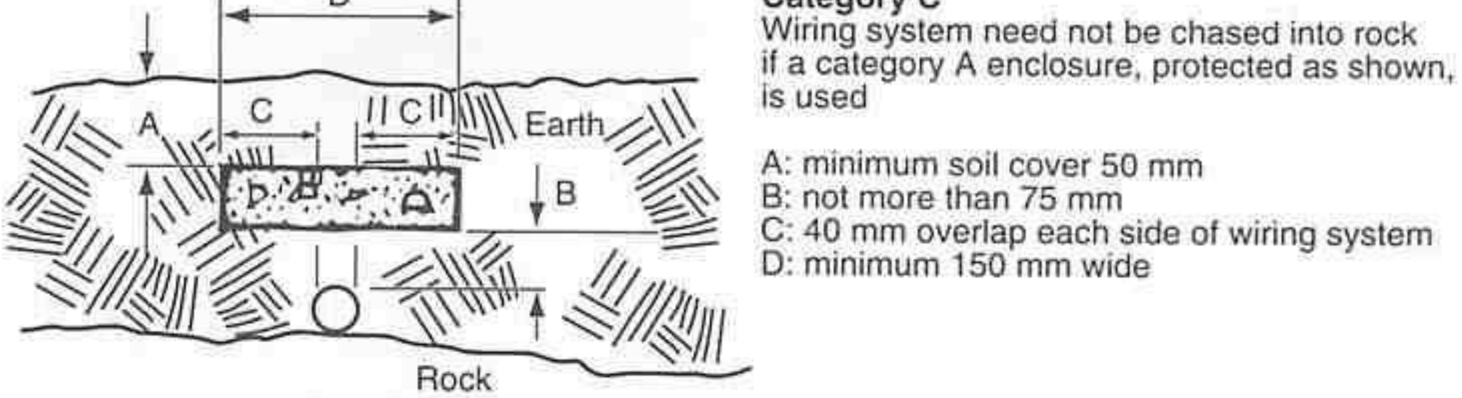


Fig. 7.24 *Underground enclosures*

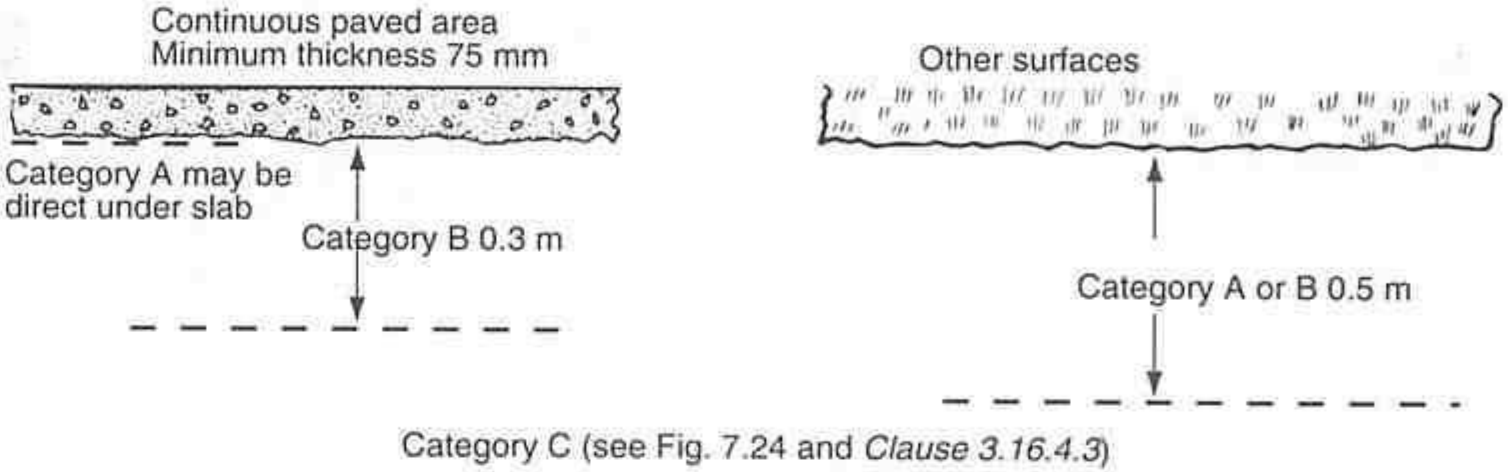


Fig. 7.25 *Depth of laying underground wiring*

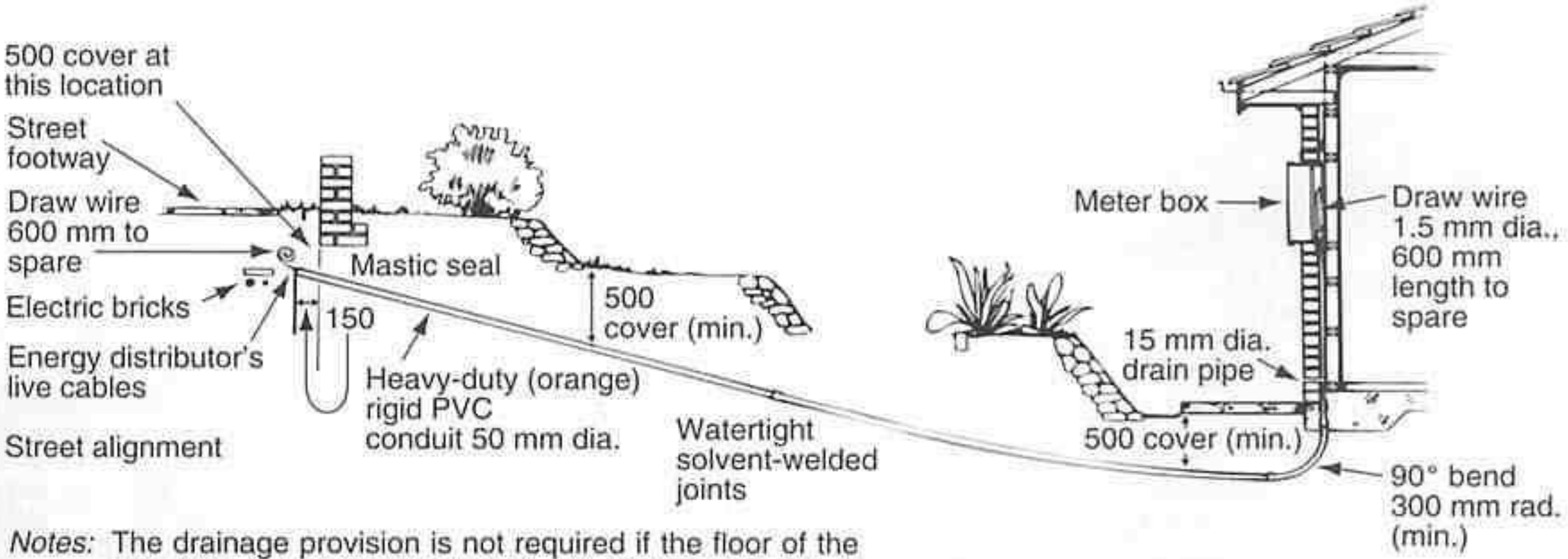
Note that the current rating of an underground cable is affected by soil temperature, depth of laying, conductor size, whether the cable is buried in the ground or in an underground duct, and whether it is single-core or multi-core. Refer to *Clauses B4.2.3* and *B4.2.4* of *Appendix B*,

clearance of 50 mm **above** the wiring system and the channel filled with fine aggregate concrete.

An acceptable alternative to chasing the rock is to install a category A system on top of the rock and provide further protection by using a continuous pour subcircuit, each circuit of the flat cable assembly is to be regarded as a final subcircuit.

- The track system is erected as a series of complete modules or sections in which the conductors are integral to the track (see Fig. 7.21(b)). In the flat cable

The electrician is usually concerned with wiring on a consumer's premises, to which *Clause 3.16* relates. This Rule sets out the various forms of acceptable enclosures, the depth of laying and protection required, and any other provisions relevant to underground wiring.



Notes: The drainage provision is not required if the floor of the premises is above street level. All dimensions are in millimetres.

Installation of underground supply services will vary from one supply area to another depending on the relevant service and installation rules of the particular energy company.

Fig. 7.22 *Underground service to a single domestic dwelling* ENERGY AUSTRALIA

Pb. THE MAXIMUM DEMAND CURRENT OF A SUBMAIN IN A NON DOMESTIC INSTALLATION IS CALCULATED TO BE 80 AMP. THE SELECTED CABLE IS 4 CORES, NON ARMOURED, V90 INSULATED AND SHEATHED CIRCULAR CABLE WITH COPPER CONDUCTORS. INSTALLATION OF THE CABLE PLACES IT SECURED FLAT ON A SINGLE PERFORATED CABLE TRAY WITH THREE OTHER CIRCUITS ALL TOUCHING. THE CABLE TRAY IS SUSPENDED 300 mm FROM THE CEILING, OPEN TO AIR AND THE CIRCUIT IS PROTECTED BY CIRCUIT BREAKER. CALCULATE CABLE SIZE

CABLE LENGTH = 100m.

TABLE 3(1) ITEM

↳ TABLE

DERATING

TABL

PERFORATED TRAY
ALL TOUCHING

NO. OF TIERS
ROWS OF CABLE SUPPORT

TABLE 3(1) (OR) 3(2)

3(1) ↓ OPEN

3(2) ↓ ENCLOSED

OPEN TO AIR → 3(1)

PERFORATED TRAY → ITEM 10, 11, 13

4 CORES → 3 CORES → ITEM 10, 11, 13

Problem

4 cores—3 active cores

V90 copper. Open to air = unenclosed, clipped to internal wall

Air---- Table 3 (1) – Unenclosed (AS3008)

Table 3 (2)- Enclosed

3 cores cable- Row 10, 11 & Row 13 (Clipped directly to wall)-

--Table 13 (75 Deg C)=Col 5 to 7 (AS3008)

CHOSEN-- Table 14 (90 Deg C)=Col 5 to 7

Table 15 (110 Deg C)=Col 4 to 5

Derating ---- Table 22 (AS3008)

With 4 other circuits-- 5 circuits

Clipped to wall- Single layer on wall- Touching

Table 22, Row 3 ,5 circuits =Derating factor 0.73

Derated current = 120/ 0.73 = 178 A

Table 14 (90 Deg C)=Col 5 (Page 63)--- 178A (213A)-----Size = 70 sqmm

Vc = ?

Unenclosed Table 40 (Page 103)--- 70 sqmm (90 Deg C) = 0.615 mv/A-m

$$Vd = \frac{Vc \times L \times I}{1000} = \frac{0.615 \times 50 \times 178}{1000} = 5.47V$$

5 % of supply voltage = 5 x 415/100=20.75V. Less than 5%,Acceptable

pb/ 3 CIRCUITS of 4 CORES HFI 90 TP CIRCULAR INSULATED AND SHEATHED NON ARMOURED COPPER CONDUCTOR CABLES ARE BURIED DIRECTLY IN THE GROUND AT A DEPTH OF 0.5m WHERE AMBIENT SOIL TEMPERATURE OF 25°C. THE CABLES ARE SPACED AT A DISTANCE OF 150mm FROM ONE ANOTHER. EACH CIRCUIT IS TO CARRY 175A WHEN PROTECTED BY C.B THE

LENGTH OF CIRCUIT IS 50m.

CALCULATE THE SIZE OF WIRE.

BURIED DIRECTLY IN TO GROUND → TABLE 3(3)

4 CORES → 3 CORES CABLE → ITEM (4) ⟶ DERATING 25(2)

↳ TABLE 13/14

COL 23/24

HFI 90 → 90°C

TABLE 15 – COL 13

TABLE 14, COL 23

TABLE 25(2)

NO. OF CABLES IN GROUP	SPACING
	150mm → 0.15m
3 CIRCUITS	0.78

$$\text{CURRENT} = \frac{175}{0.78} = 224\text{ A}$$

TABLE 14 – COL 23

$70\ mm^2$

$V_c = ?$ TABLE 42

4 CORES – MULTI CORES.

$70\ mm^2 \longrightarrow$ 90°C ↓ $0.609\ mV/A\text{-}m$

$$V_d = \frac{V_c L I}{1000} = \frac{0.609 \times 50 \times 224}{1000} = 6.83V$$

5% of 415V =

< 5

ACCEPTA

CABLE SIZ

70 m

Buried direct to ground Table 3(3) Page 34 (AS3008)

4 cores-- 3 cores cable -- Item 4 -------------Derating 25 (2)

---- Table 13/ 14 Col23/ 24

--- Table 15 Col 13

HFI 90--- 90 Deg C------------Table 14 Col 2/ 3 (Page 63)

Table 25(2) (Page 82) (AS3008)

Number of cable group

3 circuits ----------- Spacing 150mm (0.15m)== 0.78

Derated current = 175/0.78 = 224A

Table 14 Col 2/3---- 224A (229A) ----= 70 sqmm

Vc =?

4 cores-- Multicore== Table 42 (Page 105) (AS3008)

70 sqmm—90 Deg C --- 0.609 mV/A-m

$$Vd = \frac{Vc \times L \times I}{1000} = \frac{0.609 \times 50 \times 224}{1000} = 6.53V$$

5% of 415V== 415 x 5/ 100 = 20.75V

Less than 5% of Supply voltage--- Acceptable

Problem

2 Single phase socket outlet installed on the circuit protected by fuse , V75 TPI enclosed in air .Non domestic installation. Fuse rating is 32 A. Cable length is 56 m.

Also determine earth wire and neutral wire sizes.

Enclosed in air---------------Table 3(2) Page 32 (AS3008)

2 Single core cable -------- Row 1 Table 4 (for 75 Deg C),--Col 15 to17-

Table 5 (for 90 Deg C)----Col 15 to17

--Page 36

Table 6 (for 110 Deg C)—Col 11/12

Derating factor is 1.

From table 4 (Page 36) Col 15---------- 32A--- 4 sqmm

Enclosed copper--- Table 41 (Page 104)------- 4 sqmm---9.71 mv/A-m.

It is 3 Phase Vc

For Single phase Vc=3 Ph Vc/ 0.866= 9.71/0.866= 11.2mv/A-m

$$Vd = \frac{Vc \times L \times I}{1000} = \frac{11.2 \times 56 \times 32}{1000} = 20{,}09V$$

5 % of 240V = 5 x 240 /100 = 12V

From table 4 (Page 36) Col 15---------- 32A--- 4 sqmm

Enclosed copper--- Table 41 (Page 104)------- 4 sqmm---9.71 mv/A-m

It is 3 Phase Vc

For Single phase Vc=3 Ph Vc/ 0.866= 9.71/0.866= 11.2mv/A-m

$$Vd = \frac{Vc \times L \times I}{1000} = \frac{11.2 \times 56 \times 32}{1000} = 20{,}09V$$

5 % of 240V = 5 x 240 /100 = 12V

Select bigger size----6 sq-mm , From table 41 select 6.49mV/A-m

For Single phase Vc=3 Ph Vc/ 0.866 = 6.49/0.866 = 7.49mV/A-m

$$Vd = \frac{Vc \times L \times I}{1000} = \frac{7.49 \times 56 \times 32}{1000} = 13.49V$$

Vd is greater than 5 % of 240V , unacceptable.

Select bigger size----10 sq-mm , From table 41

select 3.86mv/A-m

For Single phase Vc=3 Ph Vc/ 0.866

= 3.86/0.866 = 4.45mV/A-m

$$Vd = \frac{Vc \times Lx \quad I}{1000} = \frac{7.49 \times 56 \times 32}{1000} = 7.98V$$

It is less than 5 % of 240V , acceptable.

Detailed calculation,

Please see on white board