7

Introduction to wiring systems

In this chapter you will learn about the general features of wiring systems, including:

- factors affecting the selection of a particular wiring system
- open wiring, aerial and catenary support systems
- ducting and trunking or troughing enclosures
- cable tray and ladder supports
- underground wiring.

7.1 Introduction

As indicated by *Clause 0.5.54*, an electrical installation consists of all the wiring and associated equipment used to convey and control electrical currents between the source of supply and the energy-consuming devices (lighting and appliances) on the consumer's premises.

The necessary distribution of power within a consumer's premises is achieved by wiring systems. Broadly speaking, a wiring system can be regarded as consisting of the cables or conductors and the method used for their support, protection against damage and protection against the risk of electric shock. 'Wiring system' can refer to a type of cable, a type of cable installed in a certain way, or various combinations of cables or conductors, cable support systems and cable enclosures.

Thermoplastic-sheathed (TPS) wiring is the most widely used wiring system. Although it is used with some of the systems covered in this chapter, it is dealt with in detail in Chapter 8. Also, conduit systems and mineral-insulated metal-sheathed (MIMS) cable and other fire-retardant cables are covered in Chapters 9 and 10 respectively. Wiring systems applicable to special situations and hazardous areas are dealt with in Volume 2, Chapters 19 and 20.

At this stage you should aim to gain knowledge of the characteristics and application of wiring systems in general use so that you are able to select the most appropriate wiring system for a specific situation.

7.2 Selection of a suitable wiring system

No universal wiring sysrem can be claimed as being the best for all applications, but there is usually a system that may be selected as being the best or most suitable for a particular application, after due consideration of all technical and economic aspects.

The decision to employ a particular wiring system will depend on many factors and the way they affect the installation. Factors to be considered must include the following:

- *Type of building structure*. Whether the building is timber, steel, aluminium or concrete, and what its function is, will have a considerable influence on the wiring system chosen. As an example, the type of wiring used in a prefabricated steel structure, such as a temporary field maintenance workshop, would differ from that supplying similar equipment permanently installed in a concrete building.
- *Appearance* of the completed installation. As an example, open wiring on porcelain cleat insulators (see *Clause 3.18*) would be a satisfactory wiring system for many installations if it were necessary to consider only the factors listed here, but its applications are severely limited, mainly because of its poor appearance. As a further example, the wiring system suitable for a factory would certainly be adequate and suitable, electrically and mechanically, for the wiring of a church, but its appearance would almost certainly offend in this environment.
- *Ambient temperature* of the environment in which the system operates. This is important because different cables and enclosure materials have different operating-temperature limits (see Chapter 16, Volume 2); therefore, a system used for office wiring would be unsuitable for the temperatures encountered in a boiler house or a sauna room.
- *Mechanical hazards* likely to affect the wiring system. For example, the conditions present in an engineering workshop differ from those in the roof space of a domestic dwelling, where wiring is less likely to be disturbed.
- *Hazards associated with the environment*, which sometimes make a specific wiring type necessary. These include situations where explosive gas or vapours are present, or other special situations such as refrigerating rooms, lift wells, caravan parks, commercial garages, operating theatres and spray-painting booths.
- *Cost* is a major consideration together with the above factors, where these factors apply. Most often the main concern is the initial cost of the system. However, in installations for industrial production facilities, hospitals, prestigious buildings and the like, the reliability of the wiring system is a major consideration. Here the operating and maintenance costs with respect to the wiring system will be of concern, including depreciation and the estimated life of the system.

There are many other situations where an unusual or special environment exists whose presence will be the deciding factor in the choice of a wiring system.

From the foregoing it is obvious that the selection of a suitable wiring system requires a practical knowledge of the many systems available and a knowledge of their suitability for differing situations.

7.3 Open wiring, aerials, catenary support

Open wiring

Open wiring is essentially a surface method with no concealed wiring (with some minor exceptions); as the name implies, the whole of the wiring is open to view (see Fig. 7.1 and *Clause 3.18.2*). The main advantage of the system is that the initial cost is low compared with that of other systems in which the cables are protected by

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 applications. Furthermore, this system occupies more space than other systems and is not suitable for complicated circuits.

Insulated conductors run as an open-wiring system are installed in accordance with *Clause 3.18*, which specifies the required clearances and support methods. *Table 3.8*, which is associated with this clause, covers the necessary spacing for supports.

Because the system is exposed, it is prone to mechanical damage, and *Clause 3.18.5* requires that mechanical protection be provided if the wiring is within 2 m of the floor inside a building or 2.5 m of the ground outside.

Conduit is the usual form of protection employed. Protection is also required where the cables pass through a barrier such as a wall or partition, unless the opening is large enough to maintain the clearances of *Clause 3.18.3*. If the barrier is a fire-resisting one, *Clause 1.2.4.3* must be observed.

The usual support method is by porcelain cleats or button insulators, although *Clause 3.18.4.1* permits other methods. The system was popular for under-awning low-voltage supply mains at shopping centres, and other applications are:

- extra-low-voltage installations
- factory and industrial installations
- switchboard wiring
- temporary wiring
- earth electrode wiring.

Open wiring using insulated conductors is particularly suitable for extra-low-voltage installations, but note that *Clause 7.15.2.2* prohibits its use in hazardous 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-induction-furnace installation shown in Figure 7.2.

Aerials

Bare or insulated conductors, directly exposed to the weather and supported above the ground, are classed as 'aerial conductors' (see *Clauses 0.5.5* and *0.5.6*).

The major part of an energy distributor's distribution system is by bare aerial conductors. The rules of AS 3000 do not apply to these but relate to all aerial wiring on the consumer's premises, including aerial consumer's mains if they exist. Figure 7.3 shows a typical street pole supporting low-voltage distributors with connections to service lines, which are usually parallel-webbed, twisted or bundled, aerial insulated cables.

The section of a distribution system in the Northern Territory using steel poles (stobies) with both high- and low-voltage distributors is depicted in Figure 7.4. Note the twin twisted aerial feeding the temporary builder's service. The street distributor conductors would be either hard-drawn copper or aluminium, and both types are also used as aerial conductors on domestic and industrial installations.

Two other aerial cable types are mentioned (see *Clause 3.14.1*): neutral screened cable, shown in Figure 3.6 of Chapter 3, and thermoplastic- or elastomer-insulated cables, such as twisted aerial insulated cable.

Appendix D of AS 3000 is devoted to aerial line data, covering sizes of timber poles and posts, steel poles and pipes, spacing between conductors, span lengths and necessary clearances. *Example 14* in *G2.7* of *Appendix G* is a guide to the use of the *Appendix D* tables.

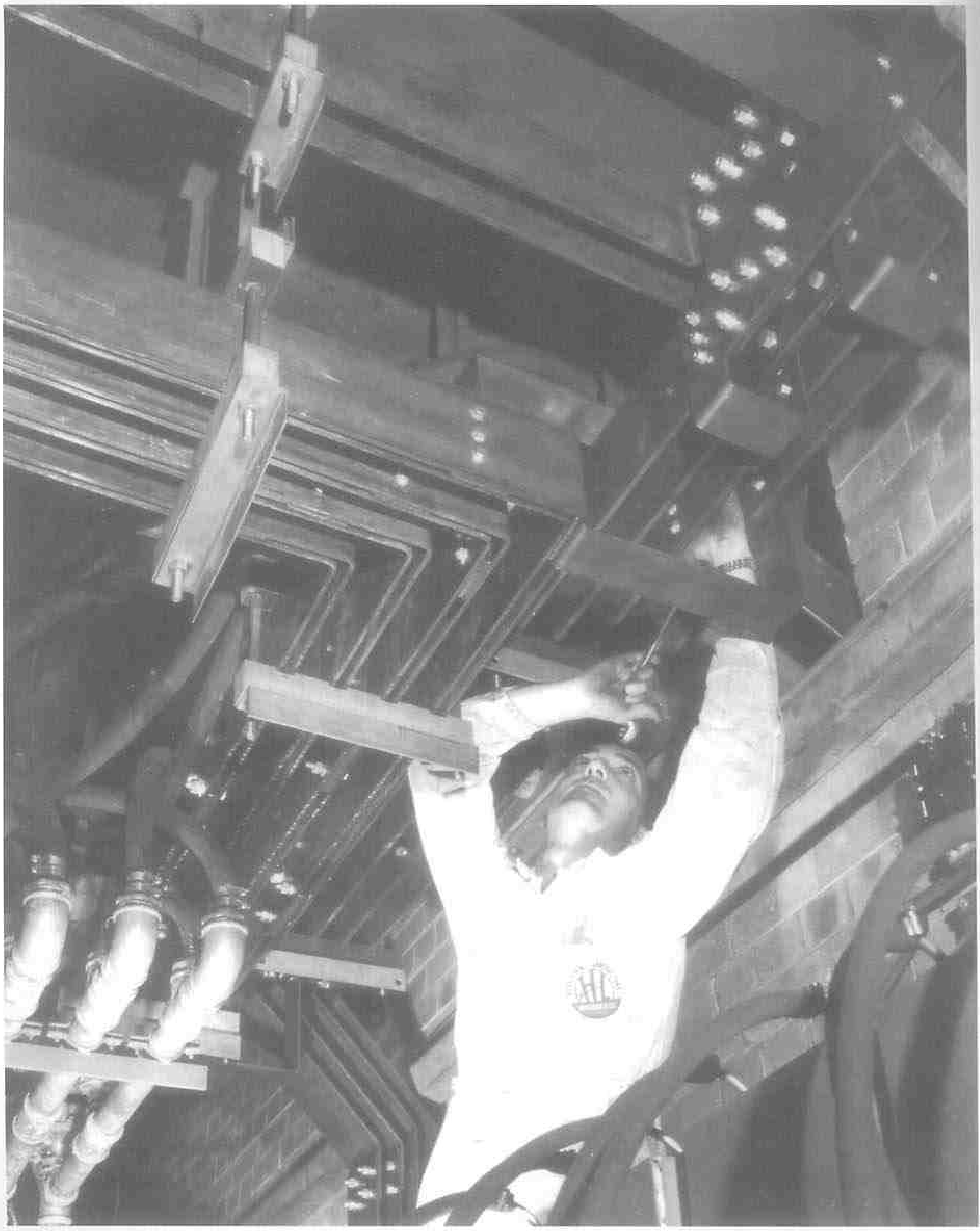


Fig. 7.2 *5000 A busbars on a triple induction furnace* HODGSON & LEE

Reference to the *Appendix D* tables and *Table B5* for aerial current rating and voltage drop should provide the necessary data with regard to conductor size, depth of hole or post in the ground, type and size of support, conductor height above ground or structures, and clearance from other lines, buildings or structures. Other relevant information is found mainly in *Clause 3.14* of AS 3000.

When referring to the tables or Rules, do not confuse a 'pole', the size of which is specified by butt

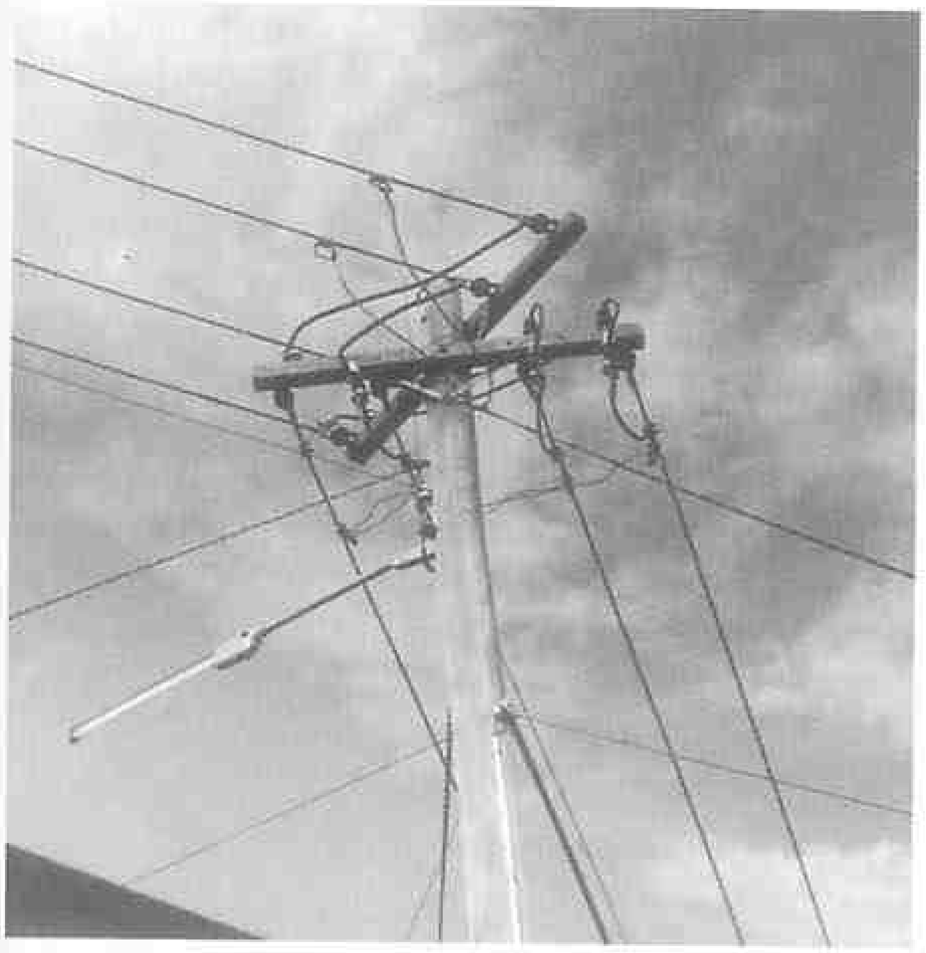


Fig. 7.3 *Bare aerial street distributors*

and head diameters, with a 'post', where the timber is sawn to uniform dimensions through its length.

The dimensions for poles given in the tables of *Appendix D*, AS 3000, would be the head diameter, as the tables referred to in *Clause 3.14.7.4(b)* specify minimum dimensions.

Note that concreting around a pole must finish 250 mm below ground level, as specified in *Clause 3.14.7.2*, to permit pole treatment against fungus and insect attack. This also allows future inspections and treatment of the pole base to be carried out.

All wooden poles and posts must be of approved timber, and *Clause 3.14.7.4(a)* requires the removal of sapwood up to 450 mm above ground level for untreated poles. Although not specified in the Rules, the sapwood of treated poles should also be removed if the pole is to be concreted in; otherwise deterioration of the sapwood will cause the pole to become loose in the concrete.

Hardwood is specified for wooden cross-arms, tallow wood being the best, and cross-arm struts or braces are necessary if the arm length exceeds 1.5 m.

Note that the minimum size for a copper aerial conductor is 6 mm^2, for aluminium 16 mm^2, that all steel fittings used must be galvanised, and that other metals must be non-corrosive or protected against corrosion.

The two most common insulator types used on low-voltage work are the pin type and the shackle type. Shackle types are used at all strain positions (that is, terminations and angles), and pin types on intermediate positions where there is no uplift and the angle of deviation of the line is not more than 30°. Some shackle-type terminations at point-of-attachment positions are shown in Figures 7.5(a), (b) and (c).

Figure 7.5(d) shows the interconnection of twin twisted aerials, in this instance between an energy distributor's service line and a consumer's underground mains. The consumer's mains have been taken through the inside of the pole.

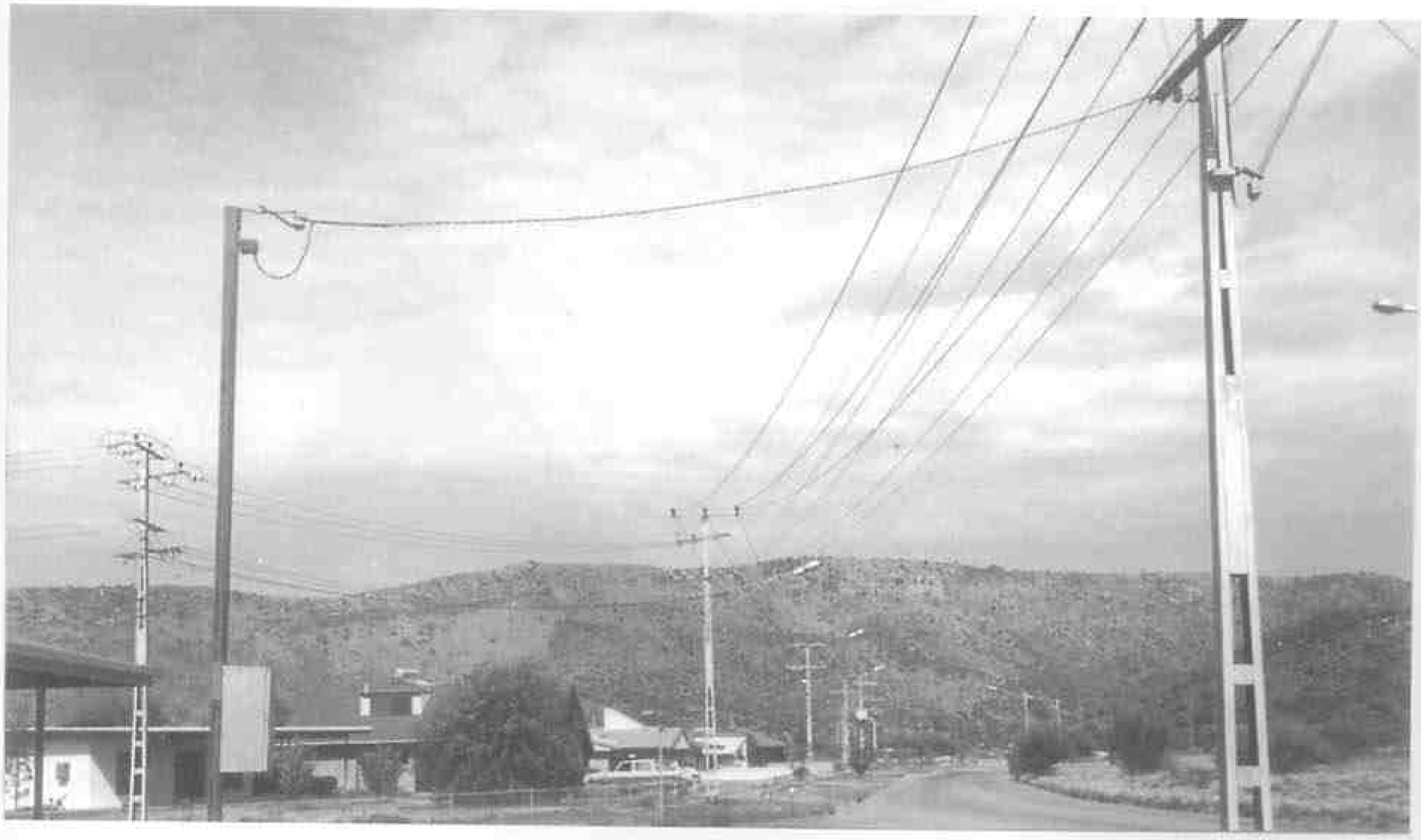
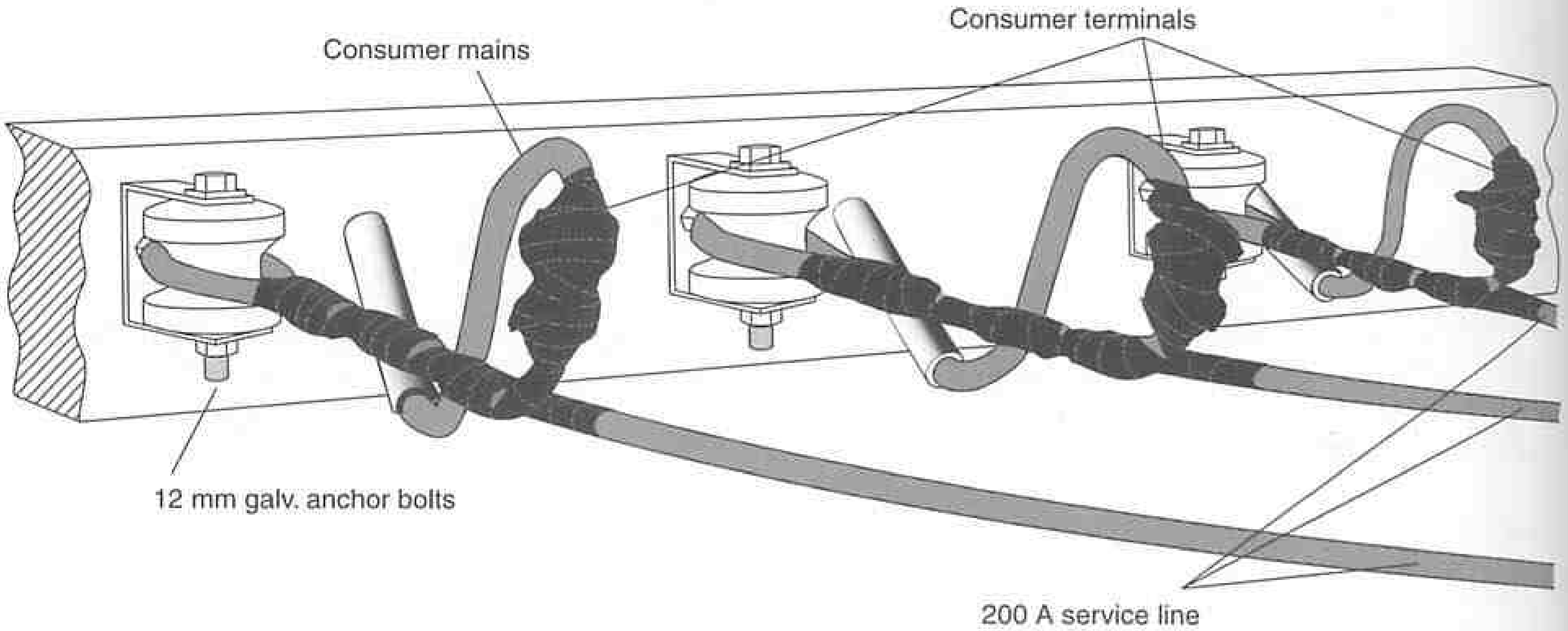


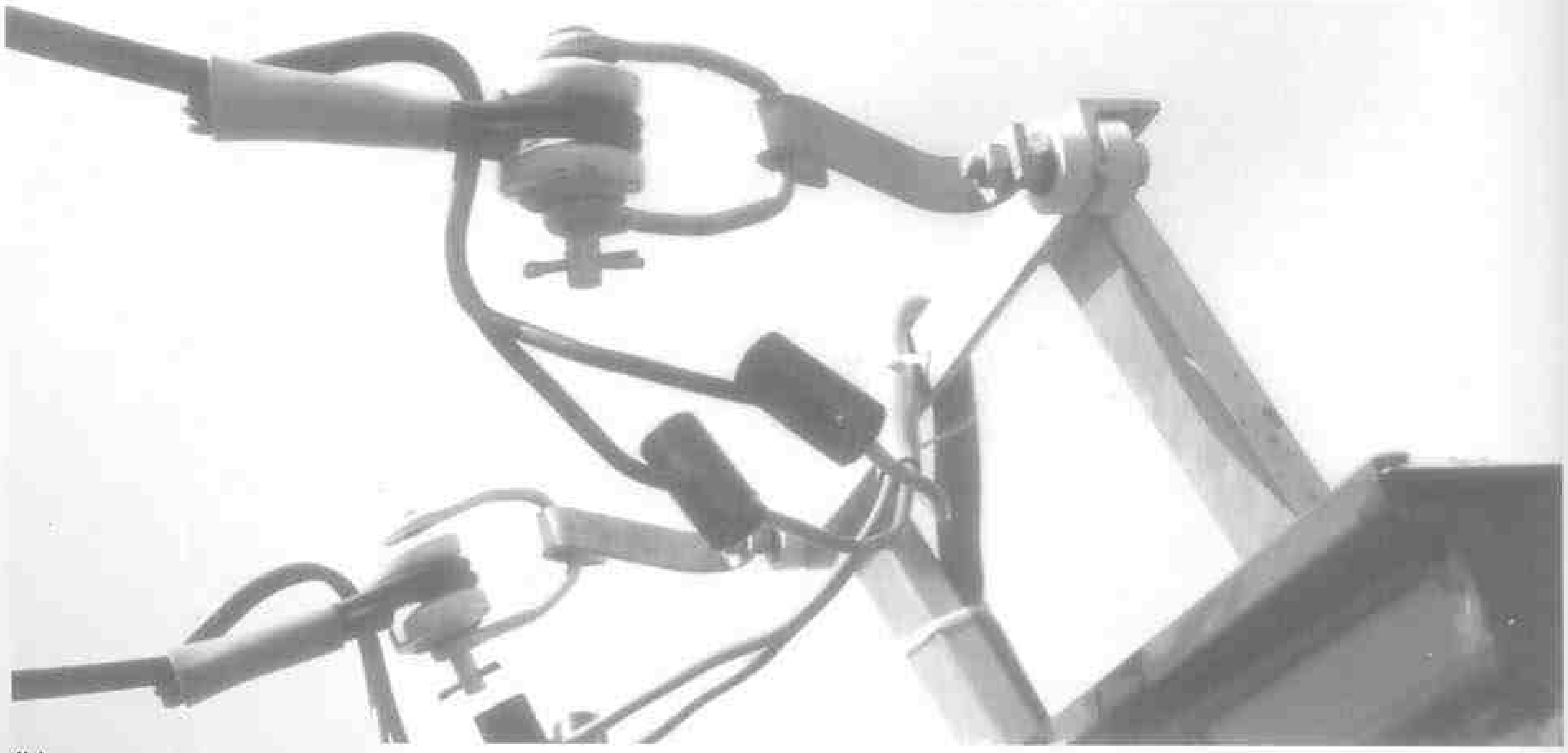
Fig. 7.4 *Steel poles used on high-voltage and low-voltage distribution in Alice Springs*

Earthing of the pole is not required, provided that the consumer's mains are double-insulated and that the aerial conductors are separated from the metallic support by double insulation. It can be seen that the double insulation is provided by the shackle insulator, to which the cable is attached, and the insulator supporting the stirrup hook.

Connections between aerial conductors and those of an installation at the point of attachment of a service line, or any other similar connections to a building, are made at terminals within a mains connection box; one is shown in Figure 7.4 on the builder's service pole in the foreground. For a more detailed illustration of a mains connection box, refer to Chapter 5, Figure 5.39(a). The popular alternative method is to bring the mains straight out and connect them directly to the aerials. This may be done because modern cables are classed as 'weatherproof'. The connections of Figure 7.5 use this method. Figure 7.6 shows the inside and outside views of an anchorage and consumer's mains ready for connection to the energy distributor's aerials.

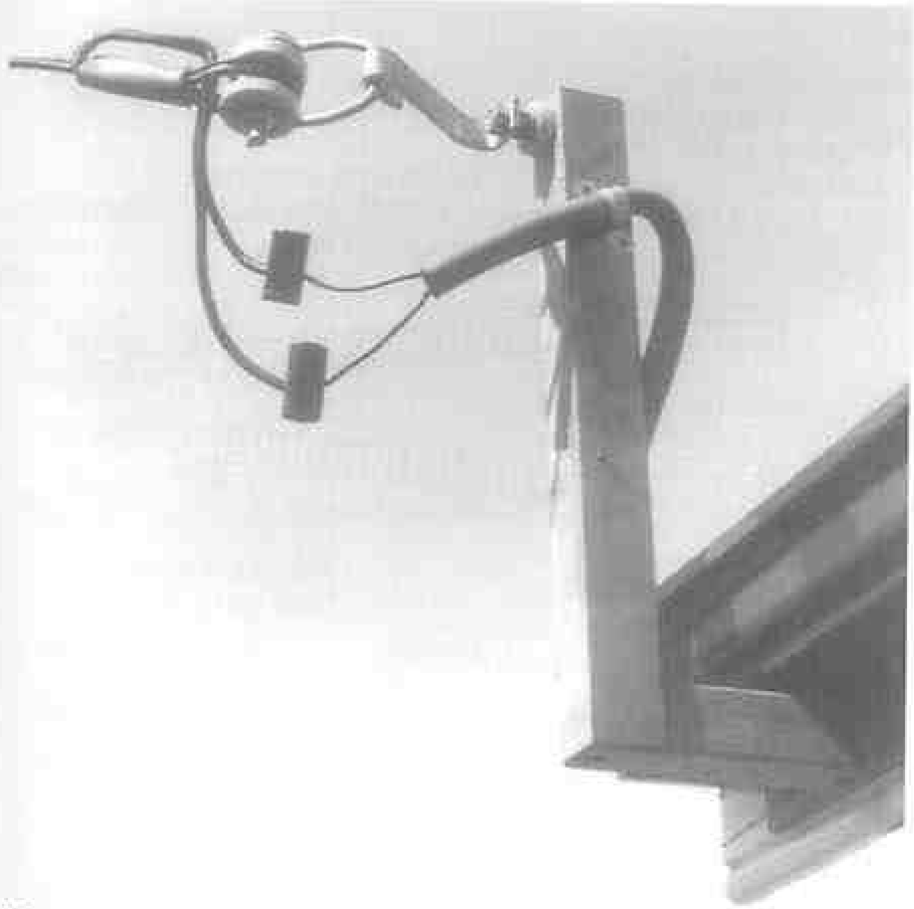
The details of one approved method of line termination for twin parallel-webbed cable are shown in Figure 7.7. There are other approved termination methods for neutral-screened, parallel-webbed or twisted aerial insulated conductors, such as the wedge clamp of Figure 7.8(a) or the Neuclamp (trade name) used on a neutral-screened cable termination in Figure 7.8(b).



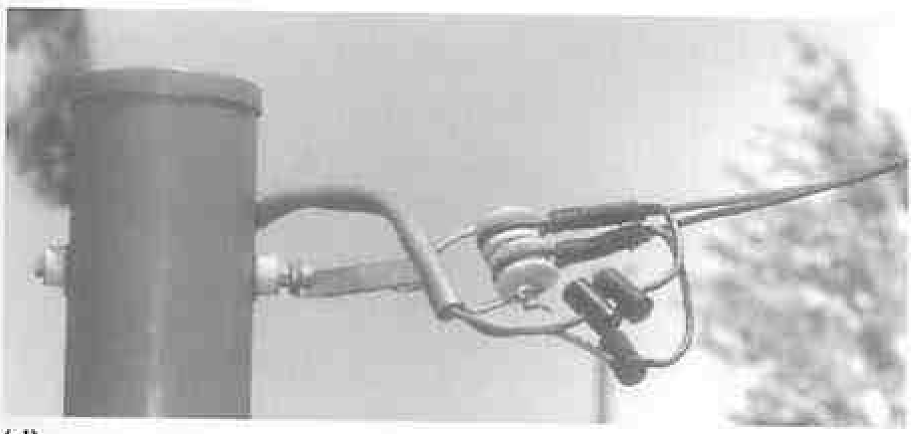


(b)

Fig. 7.5 (a) and (b) *Aerial terminations* ENERGY AUSTRALIA



(c)



(d)

Fig. 7.5 (c) and (d) *Aerial terminations* ENERGY AUSTRALIA

Connections to aerials not in tension, that is, aerial 'tails' (those of the previous paragraph fall within this category), may be soldered or mechanically connected by approved connectors. Soldering is rarely used. Widely used methods are by split bolt (Brophy) connectors as in Figure 7.5, parallel groove clamps, line clamps, compression sleeves (see Chapter 4) and crimp joints. Because there is a risk of annealing hard-drawn conductors by heating, soldered joints are not allowed in aerial conductors in tension. Any mechanical joints used must not deform or reduce the tensile strength of the conductor. In addition, if a mechanical joint is used to join conductors in tension, the joint must be at least as strong as the conductors joined. Among approved types are:

- twisted or McIntyre join, where a seamless oval-shaped copper tube of the correct size is slipped over the two overlapped conductors and twisted into a spiral;
- compression sleeve splice, which employs a technique similar to the fitting of a compression lug (see Chapter 4, Fig. 4.16);
- preformed splices of correct size, which consist of helically formed wire strands that are wrapped onto the conductors to be joined;
- lock tie join made by hand between the two conductor ends by splicing and locking each individual strand; this splice is still permissible, but it is seldom used due to the time and labour involved.

(a)

(b)

Fig. 7.6 *A consumer's mains prepared for connection to the supply:* **(a)** *shows fixing of the consumer's mains and enclosure in flexible PVC conduit inside the building;* **(b)** *shows the consumer's mains enclosed in the flexible PVC conduit outside the building. Note that the conduit is fixed in a downward direction to prevent the entry of water*

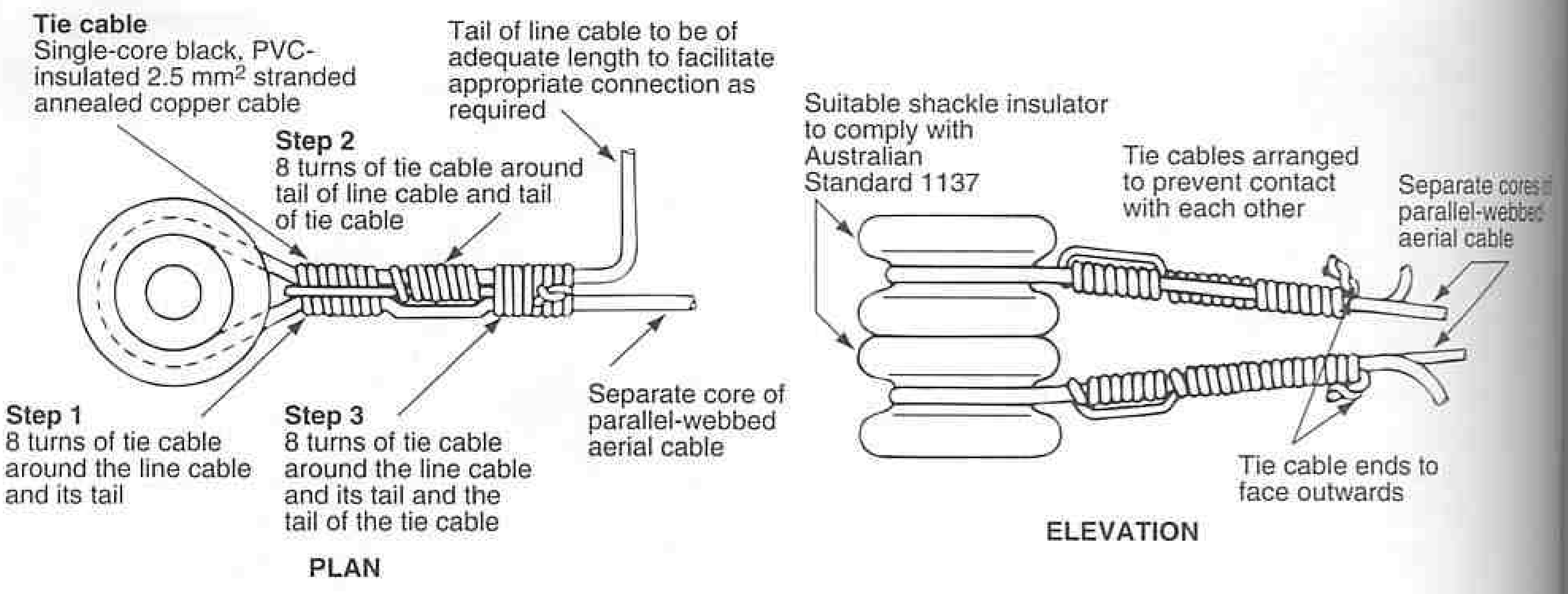


Fig. 7.7 *Detail of the termination on shackle insulators 80 A service: two-core PVC-insulated 16 mm² hard-drawn copper unsheathed parallel-webbed aerial cable*

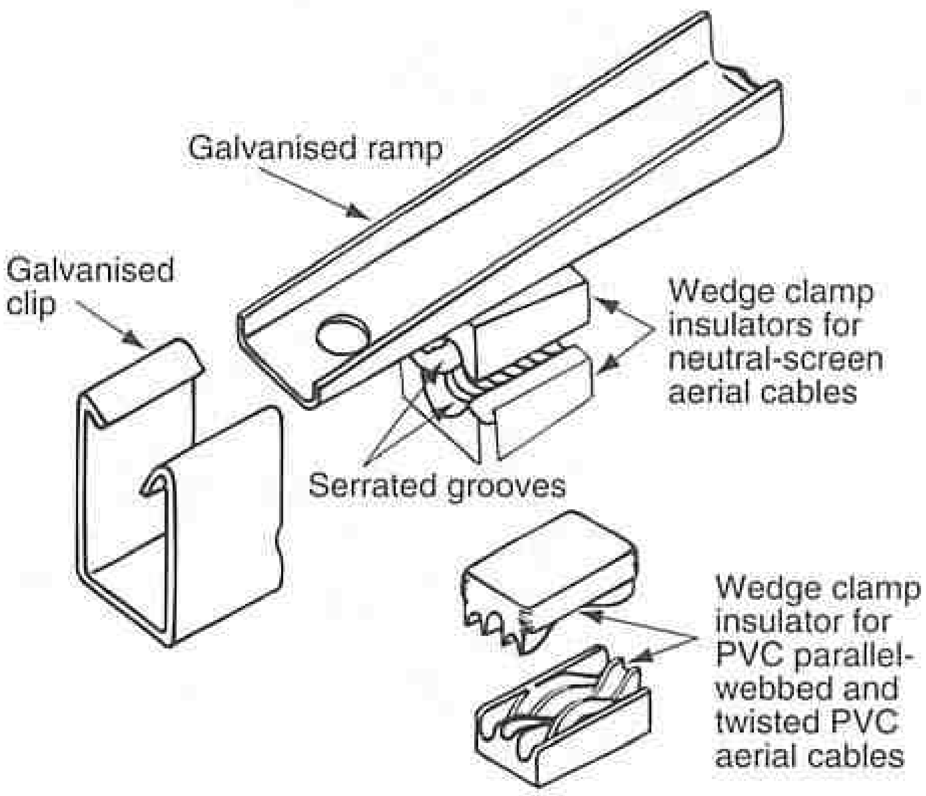


Fig. 7.8(a) *Wedge-type aerial clamp*

Fig. 7.8(b) *Neuclamp termination*

Connections to aerials between points of tension are also permitted using mechanical connectors, but the connections must be made without sweating (see *Clause 3.14.14.4*). However, connection to some type of aerial 'tail' is to be preferred, as there is always the risk of a high-resistance join's developing. If such a join develops, the resultant heat and arcing at the joint may cause conductor failure, with the possibility of the aerial's falling to the ground; a similar fault on a tail connection usually only results in an open circuit at the tail.

Particularly note that the foregoing methods apply to bare or insulated aerial conductors only. No joints in or connections to a neutral-screened cable, a parallel-webbed or twisted cable, or a multicore cable in tension are permissible (see *Clause 3.14.13.3*).

Catenary support

Provided that a cable has stranded conductors (for flexibiliy) and is double insulated, the catenary system of support may be used. If the cable is to be installed outdoors, it must also be of a type suitable for exposure to direct sunlight.

The maximum catenary support span is limited to 45 m by *Clause 3.15.3(a)*; however, the system is usually employed only for short spans because long spans would be uneconomical compared with aerial construction.

A catenary support wire must not be less than 7/1.25 mm, must consist of hard-drawn copper or galvanised mild steel, and must have adequate strength to support the load. Drip loops are compulsory at each end of the run. If the current-carrying capacity of the catenary wire is adequate, it may be used as an earthing conductor. The clearances for catenary wiring are the same as those for aerial conductors, as given in *Table 3.3* of AS 3000.

To ensure that the tension in the catenary does not exceed safe limits, the minimum sag values are listed in *Table 3.5*, against the approximate cable mass for the supported cables listed in *Table 3.4*. For example: a

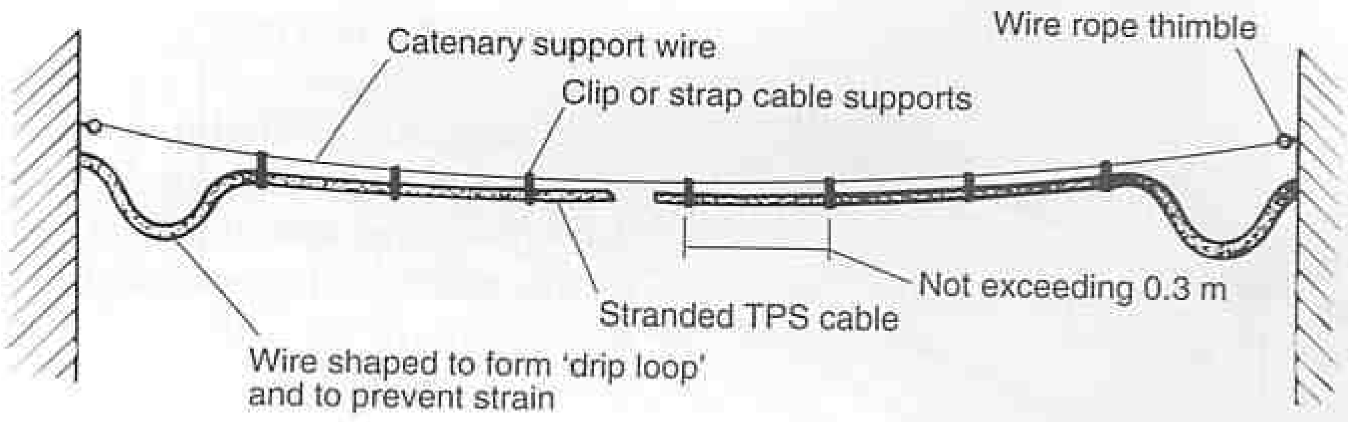


Fig. 7.9 *Principle of supporting cables by catenary (see* Clause 3.15*)*

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 catenary support.

7.4 Trunking, duct and busway systems

There are many systems in which cables are protected or enclosed, and this section deals with particular systems where the enclosure consists of duct or trunking, sometimes termed troughing, in which the cables are laid. Materials used for the duct or trunking include cement, concrete, steel, PVC, and fibrous compositions such as fibrous cement.

Many systems are marketed under the maker's trade name and are variously named as 'trunking', 'ducting', 'troughing' and 'cable raceway'. The enclosure classed as 'cable trunking' is defined by *Clause 0.5.94* as a trunk or trough for housing and protecting electrical cables and conductors. In practice, trunking usually has a removable lid that gives ready access to the enclosed cables and makes their installation easier.

This is distinct from the busway system, which is similar in some respects but has preformed sections complete with busbars, the sections being mechanically and electrically joined to each other during erection (see *Clause 0.5.17*). Trunking is also distinct from a cable 'duct' (*Clause 0.5.40*), which is a **closed** passage formed underground or in a structure into which the cables are drawn. Some manufacturers consider the terms 'duct', 'trunk' and 'trough' to be synonymous; hence the electrician must learn to be cautious when applying the rules to the system being used.

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 with provision for tap-off points or facilities for extensions or additions. One disadvantage is that mutual heating takes place between the cables because they are 'bunched' together within a common enclosure, and this sometimes leads to the application of a 'derating' factor to their current-carrying-capacity rating. For the same reason, a fault in the cable of one circuit in the trunking may affect adjacent cables of another circuit in the common enclosure.

The initial cost of a trunking system is relatively high, but it may be combined with other systems, such as conduit or TPS for branch runs, where trunking would be uneconomical.

The main requirements relevant to cable trunking systems are specified in *Clauses 0.5.94* and *3.31*. Other clauses that should be consulted are *Clauses 1.4.9.1(c)* and *4.6*.

Clause 3.31.4 outlines the manner in which cables may be arranged within trunking, and states the limitations on the number of cables and the manner in which trunking may be installed.

Metal trunking systems are manufactured in a range of designs, which vary with different manufacturers, a typical example being overhead or wall trunking with a removable cover or lid. Wall trunking is usually fixed direct to the wall or supported on brackets, while overhead trunking is usually laid across roof trusses or supported by hanger brackets (see Fig. 7.10).

The usual trunk section is rectangular. A full range of accessories, such as couplings, elbows, tees, and rising and falling elbows, is always available for whatever make is used, provision being made along the run for 'taking-off', usually in the form of 'knock-outs' at frequent

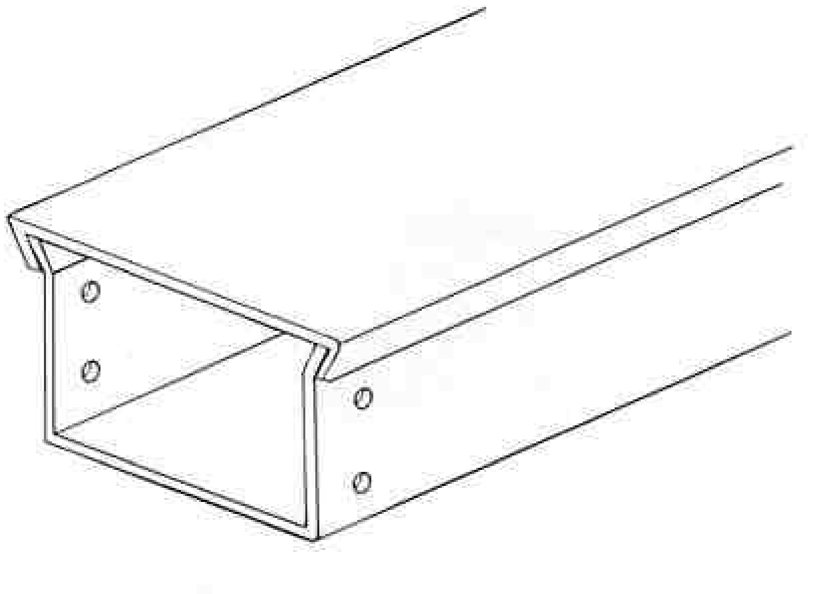


Fig. 7.10(a) *Steel trunking*

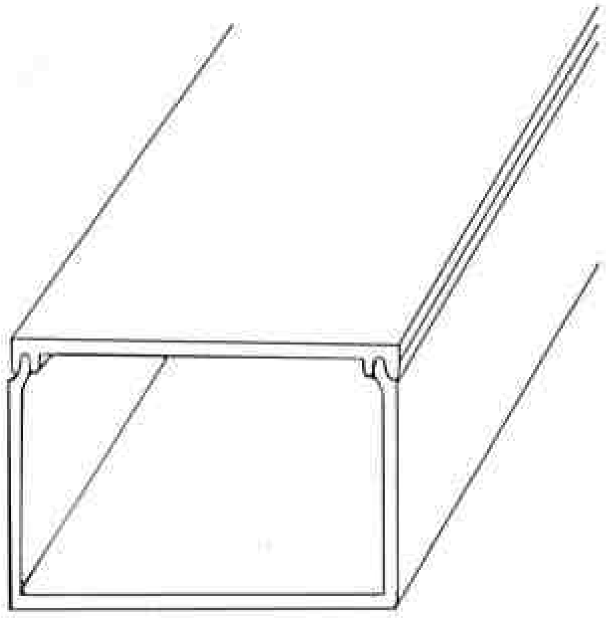


Fig. 7.10(b) *PVC trunking* AUSTRALIAN PLASTIC PROFILES

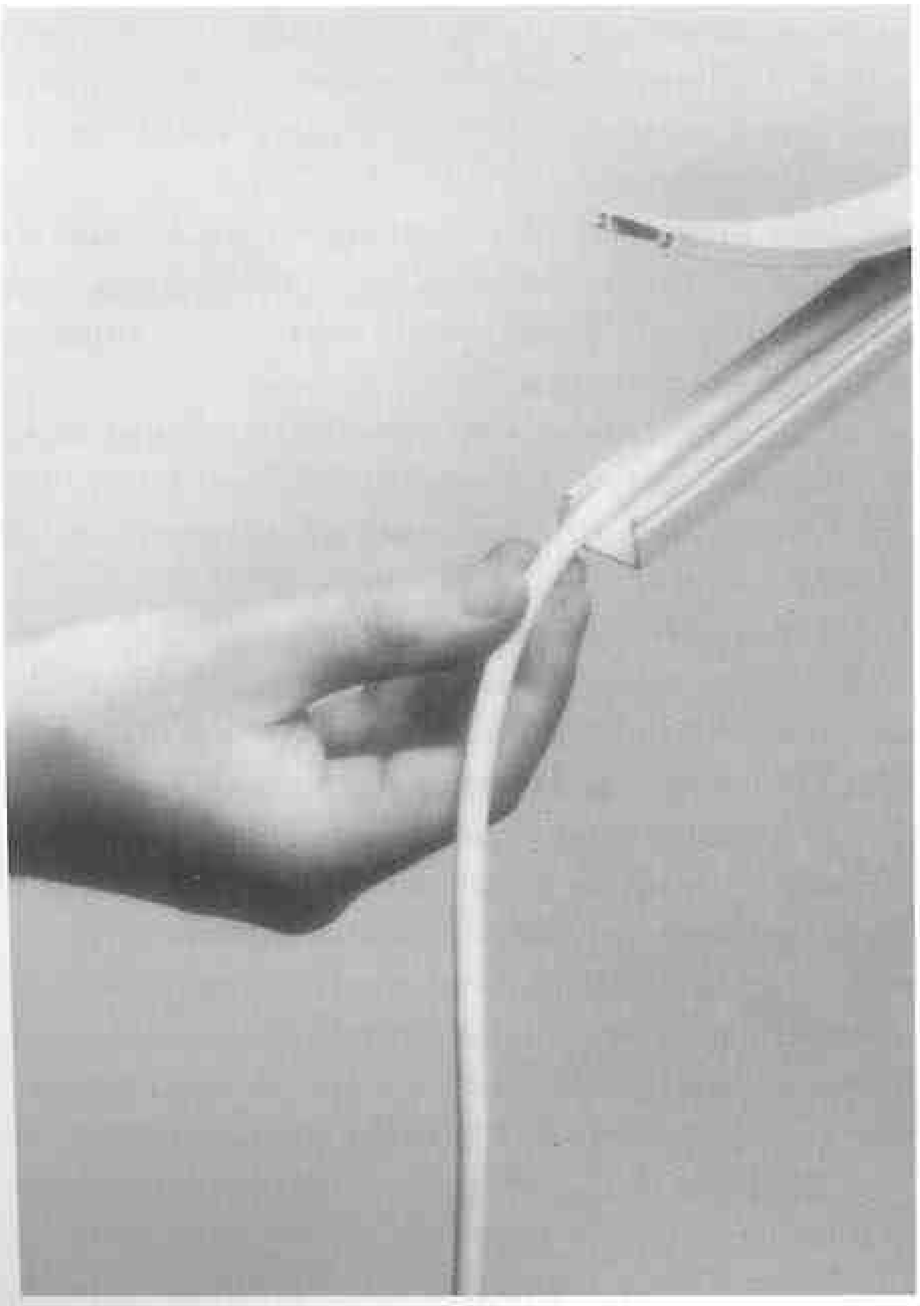


Fig. 7.10(c) *Miniature PVC trunking* HPM INDUSTRIES

intervals. A change in the wiring system, for example, duct to conduit or TPS, may be made at these 'knock-outs'.

Trunks may be divided into compartments; and if these provide approved segregation of wiring (see *Clause 1.4.9.1*), services such as 415/240 V power and light, security system wiring and telephone, signal and communication systems, may use separate compartments within the common trunk.

Insulated trunks made of PVC or a similar non-conducting material are more commonly used than metal, and these are similar to and about the same stock sizes as metal. However, their mechanical strength is less than metal, and consequently they require more mechanical support. Accessories for the trunking are usually made of the same material as the trunking. The system formed is an all-insulated one, with no continuity problems with respect to earthing of the trunk itself, but inclusion of earth wires in the system is still necessary for the earthing of exposed metal or accessories and appliances.

Heat dissipation, as in metal trunking, is a problem, and some designs on the market provide cooling by ventilation slots or holes.

Both types of PVC trunking illustrated in Figure 7.10 may be drilled and fixed with screws, or a double-sided adhesive tape may be used for securing the trunk to a suitable surface. The miniature trunking shown, marketed as Miniduct by HPM Industries, is often fixed to skirting boards or to wall surfaces in existing installations to enclose flexible cords or TPS cable.

Some manufacturers market trunking systems that are deliberately designed to be inconspicuous or to tie in with the general architectural scheme when installed. One of the most popular in this category substitutes as a skirting board. The trunk illustrated in Figure 7.11(a) is manufactured from extruded aluminium alloy. Skirting trunking is available with barriers to divide the trunking into compartments to house wiring for different services, and the lid is manufactured from galvanised steel faced with a thermally bonded vinyl veneer colour-matched to the trunk body.

Skirting trunk should preferably be installed before the floor covering is laid. Trunking strip is secured to the walls by screws; after cables have been installed, the steel cover strip is fitted into place. The product illustrated is sometimes marketed as 'duct', but because of the removable cover it would be classified as 'trunking' under the Rules of AS 3000. Accessories may be mounted on cable trunking provided that the requirements of *Clause 4.6* are met.

Wood trunking or 'casing', as it was termed when first introduced, was probably one of the first types of enclosed wiring in the early days, when wiring was usually done by the builder or carpenter. It is now obsolete, but wood is still permitted as cable trunking (see *Clause 3.31.2.1*). In modern wiring installations it is

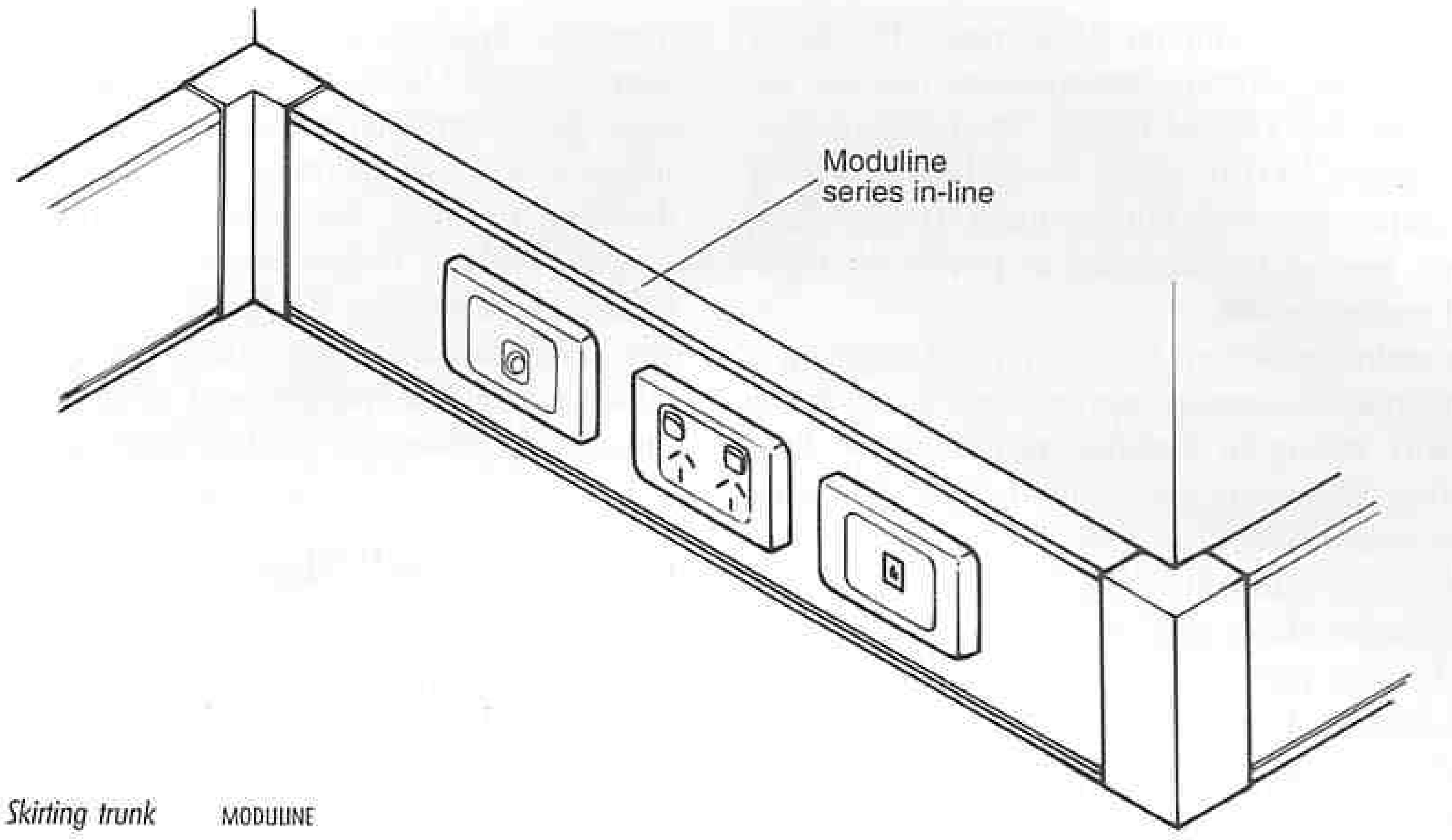


Fig. 7.11(a) *Skirting trunk* MODULINE

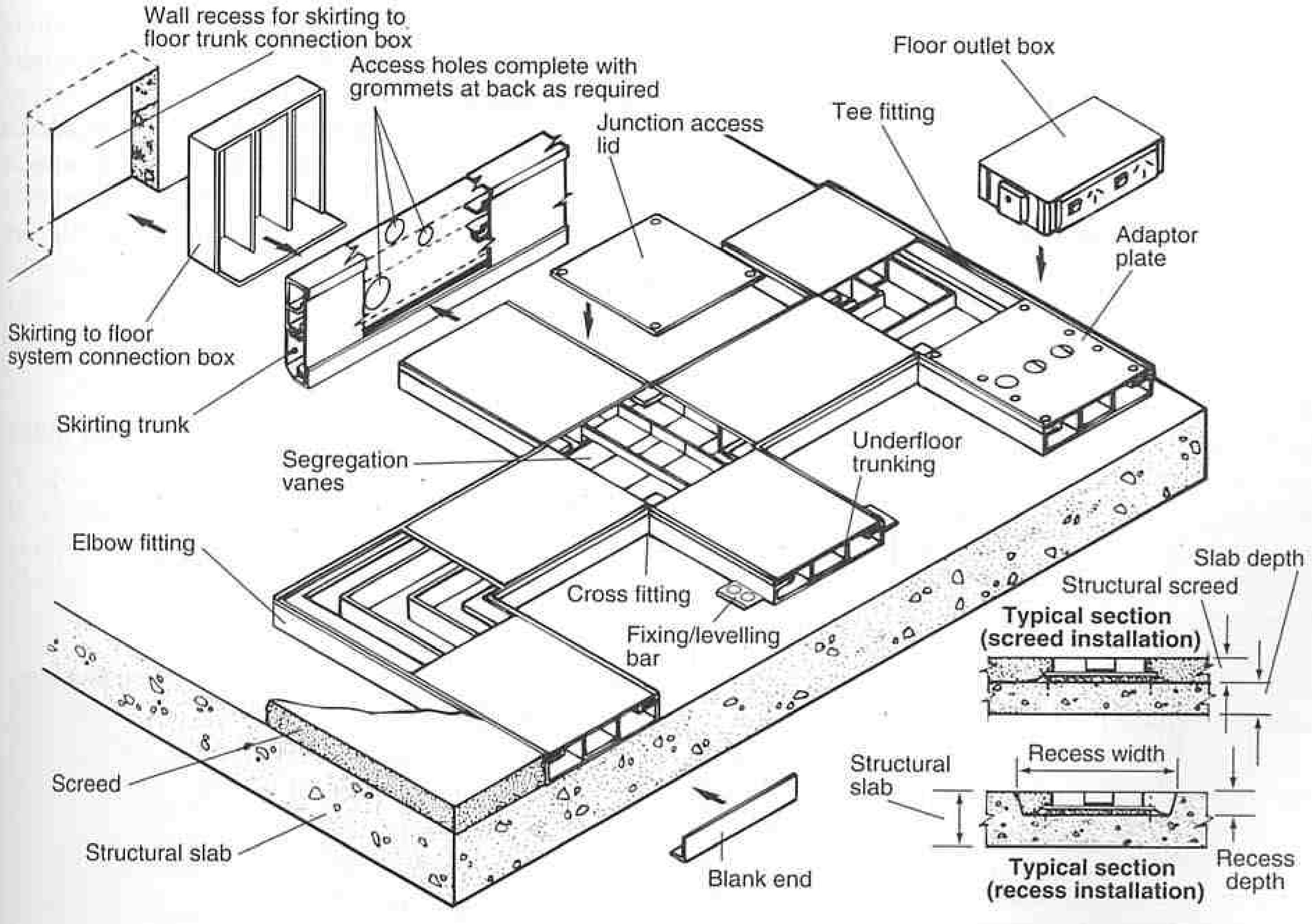


Fig. 7.11(b) *Underfloor trunking system* MODULINE

rarely used, except sometimes on isolated sections as mechanical protection.

A form of cable housing used in many installations is the underfloor trunk. This may consist of a trunk installed as a trench in the floor and is seen in factories, substations and power houses. The trunk is fitted with a lid that can be readily removed to give access to the trunk wiring.

An underfloor trunking system marketed as 'Trench-duct' by its manufacturer has removable steel plates fitted with aluminium edge trims. The lid is installed in such a way that the concretor may use the lid trim upstand as a screed datum. The system is illustrated in Figure 7.11(b), which shows how it may be used in conjunction with skirting trunk. It is available with three, four or five divisions to permit the segregation of wiring circuits.

The main application for this type of trunking is under checkout counters in supermarkets, for computer and security wiring in banking institutions, in large column-free office areas and in any heavy-traffic areas. It may be installed into a preformed recess or into a fine aggregate screed. It should be bedded down on a mortar or fine aggregate slurry strip, adjusted using the fixing/levelling brackets provided, then permanently fixed with masonry anchors. It is designed so that the lid may be fitted with vinyl tiles and form part of the floor surface, providing easy access to cables.

Figure 7.12 shows trunking designed for building into office partition walls. Although marketed as 'partition duct' it is classed as 'trunking' by AS 3000 because of the removable lid. It measures 150 mm × 50 mm and provides three services on both sides of the partition at skirting or desk height to meet special requirements. Connection facilities to skirting trunks or service columns can be provided.

Figure 7.13 illustrates one type of trunking specifically designed to provide a practicable system for distributing lighting and fire-protection services in commercial and institutional buildings. This trunking is generally mounted on the soffit of a suspended concrete slab and is designed for having light fittings and fire detectors mounted on its underside. Mill finish or natural anodised aluminium is supplied, with grey or white side-fitting PVC lids, but special colours are available. All standard light-fitting attachments may be obtained from the manufacturer of the lighting trunking, which markets the product as lighting 'duct'.

Cable trays and ladders

A wiring system designed for installation in commercial and industrial premises is in the form of a ventilated cable tray on which sheathed cables are laid or supported. The support system is classified by AS/NZS 3008.1.1 as 'perforated tray' if not less than 30 per cent of its surface area has been removed by the perforations. Where restriction to the air flow around the cable on the support system is not greater than 10 per cent (i.e., the metalwork under the cable takes up 10 per cent or less of the plan area of the support system), it is termed 'ladder support' by the standard.

Both systems are fabricated on site, using bends and risers supplied by the manufacturer of the support system to permit change of direction both horizontally and vertically, and both are available in steel or alumin-

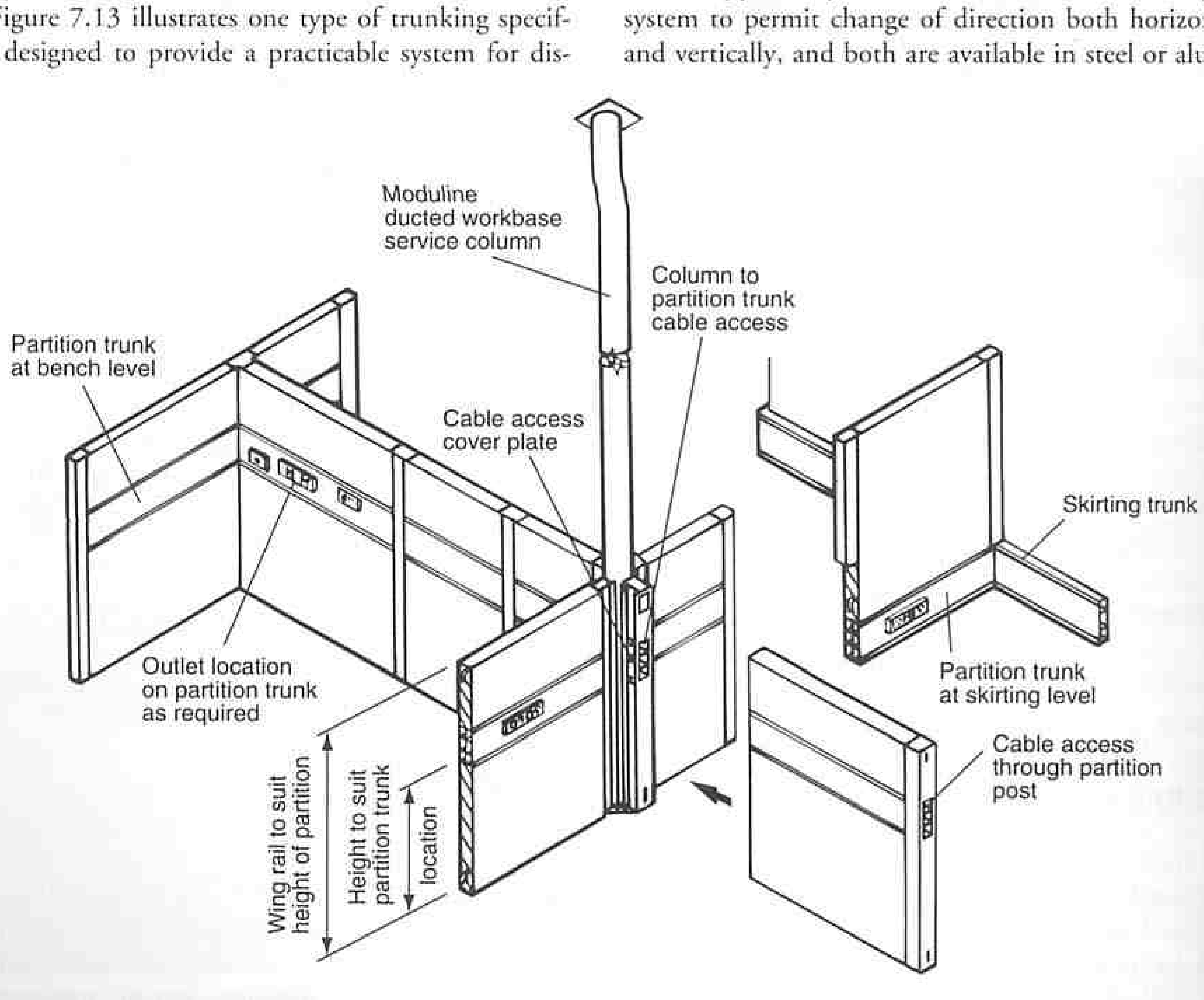


Fig. 7.12 *Ducted service column used in conjunction with partition trunking* MODULINE

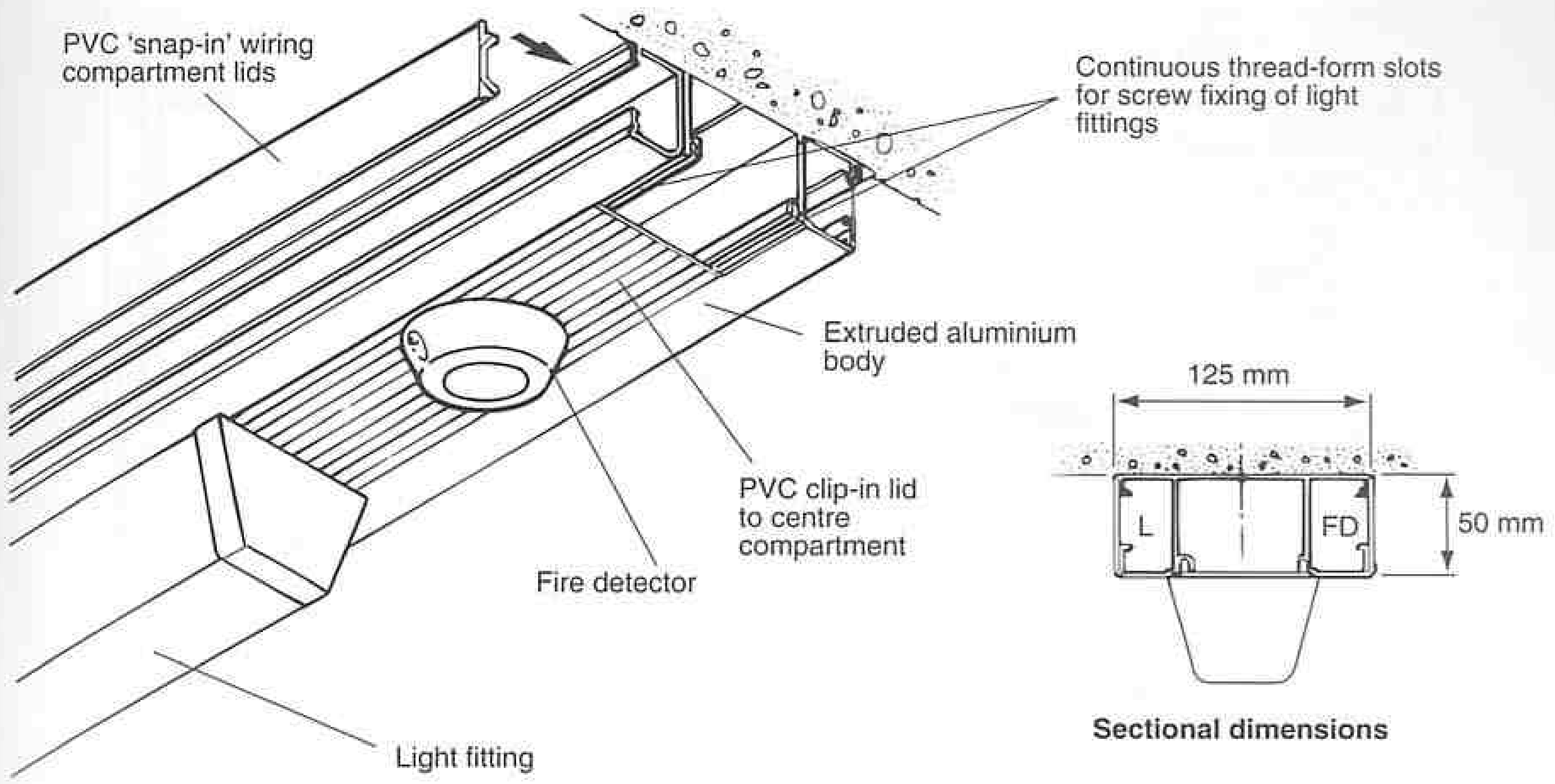


Fig. 7.13 *A system for distributing lighting and fire-protection services* MODULINE

ium. Steel is preferred for most applications because of its superior mechanical strength, and may be protected against corrosion by Zincalume (a zinc–aluminium coating, the standard finish) or by hot-dip galvanising.

Ladder support is better suited to larger cables, being available with rung spacing up to 300 mm, whereas perforated tray is used to support smaller power cables or where additional protection is required. Both types are shown in Figure 7.14.

Cable ducts

A cable duct is a closed passage formed underground or 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

The aluminium service column shown in Figure 7.12 is a duct that is provided with all the hardware required for between-slab installation and to which accessories may be fitted at desk level to supply general-purpose outlets (GPOs) and communications and computer wiring facilities. Divisions are built into the column where required for segregation of the wiring circuits. The column may be used to extend wiring from underfloor troughing or from a false ceiling to the office work station. It is also available in rectangular section.

A type of underfloor duct used to provide flexibility of services in large modern concrete buildings such as office blocks, hospitals, airport control towers and television 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.

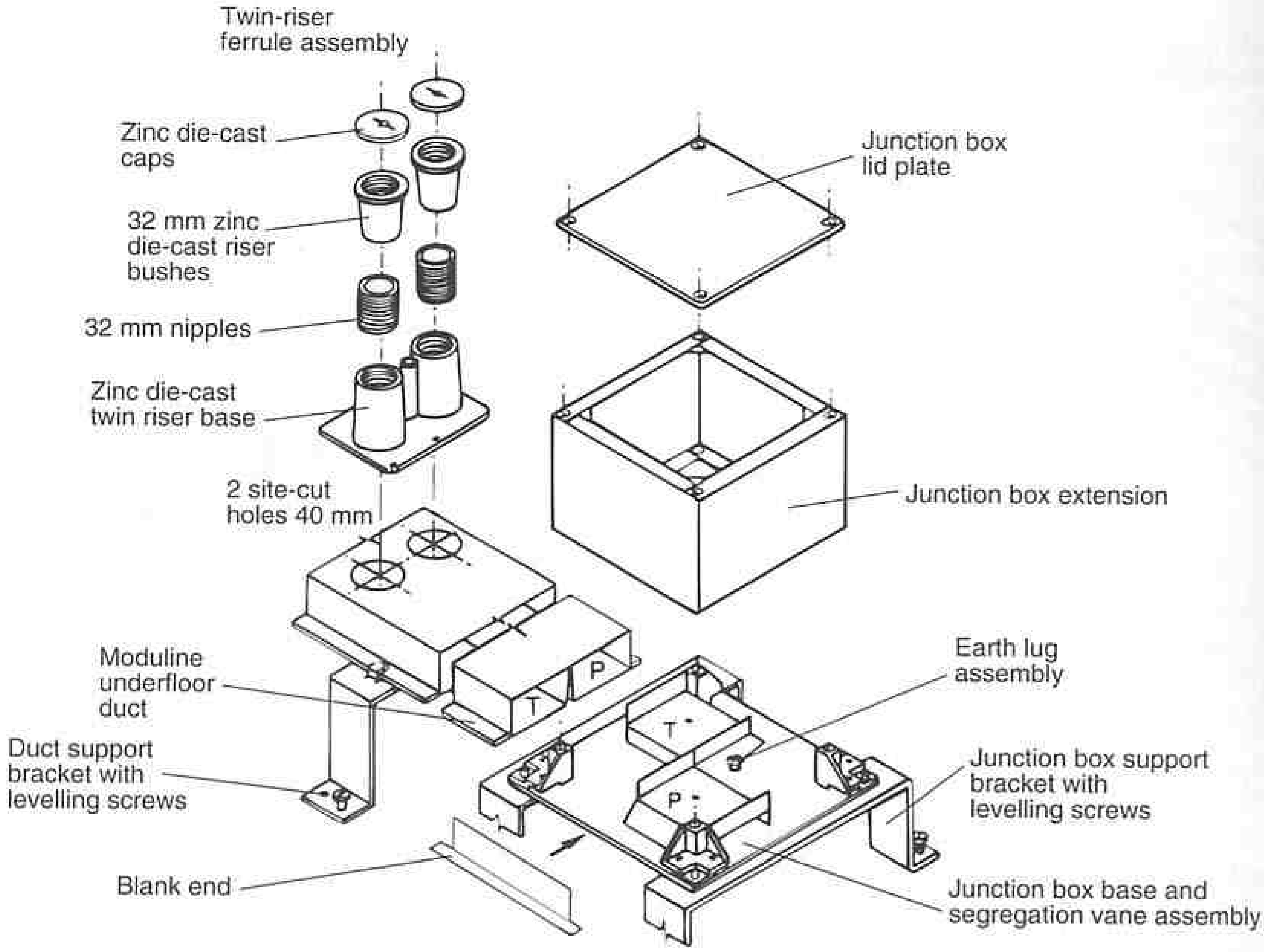


Fig. 7.15 *Flush floor ducting* MODULINE

Insulated ducts made of PVC or a similar moulded material are normally supplied in circular section for underfloor or underground use (see Fig. 7.23). One type of circular conduit is corrugated on the outside for economy and smooth on the inside to facilitate the drawing in of cables. It is made with a minimum size of 100 mm, cannot be bent or set, and is primarily used underground, mainly by major energy distributors.

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 in reticulation for high-demand concentrated loads in industry and for rising mains in multistorey buildings.

Plug-in access points are provided at regular intervals, and the available range of plug-in busways is from 80 A to 800 A, with a complete range of 'take-off boxes' from 10 A to 200 A in single-phase, three-phase and three-phase with neutral. Each circuit outgoing from the busway is protected at the take-off point by fuses or 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

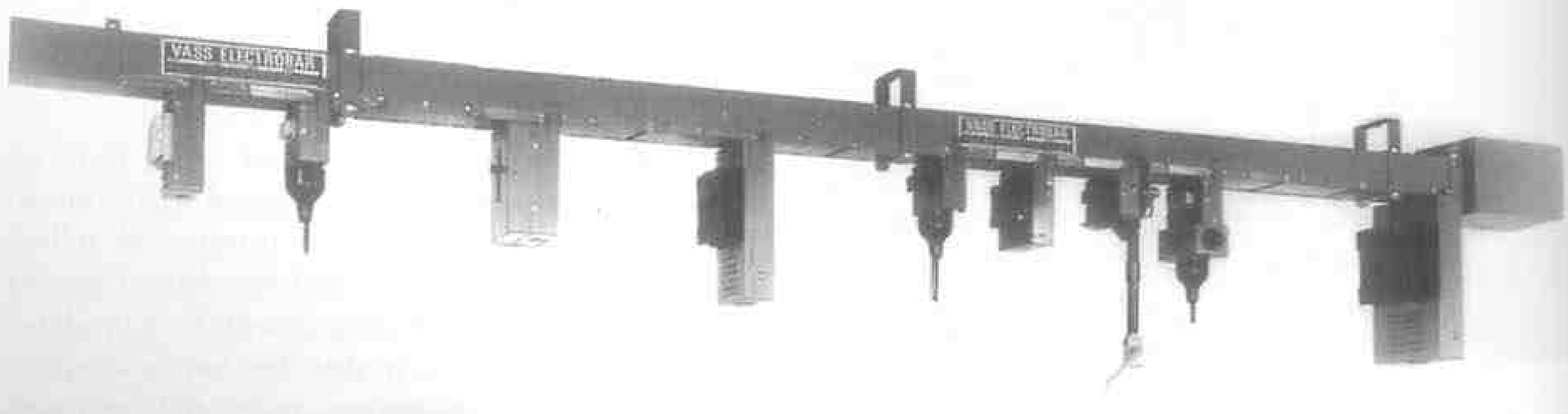


Fig. 7.16 *Plug-in busway* VASS ELECTRICAL INDUSTRIES

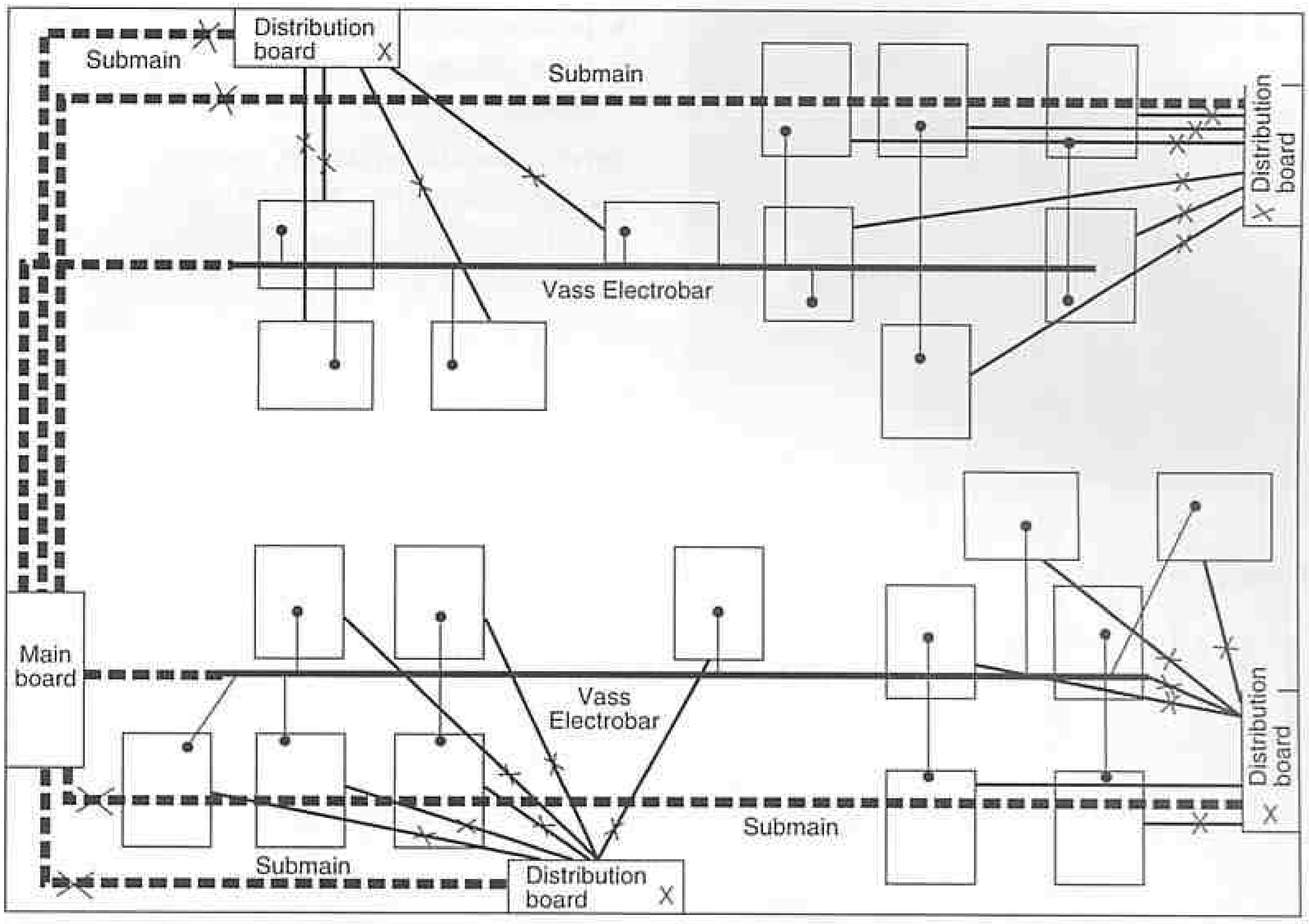


Fig. 7.17 *Comparison of conventional wiring and a busway system* VASS ELECTRICAL INDUSTRIES

circuits, these would also be supplied from the busway at central positions.

The 1200 A Electrobar feeder shown in Figure 7.18 runs through the centre of the factory, and 100 A and 315 A plug-in busway runs, as shown, can be added to either side of the feeder as required. The smaller busway is connected to the main feeder via a circuit protection device fitted to the take-off box. The take-off boxes for the 100 A and 315 A plug-in busway runs are shown in their inserted positions.

In altering a layout or adding new machinery, a plug-in take-off box is simply unplugged and reinserted at the new location.

Another type of busway system is illustrated in Figure 7.19. It consists of copper or aluminium conductors enclosed in an extruded-aluminium outer casing. The cooling fins that can be seen in the illustration enable increased dissipation of heat, and the casing

Fig. 7.18 *Aluminium feeder (1200 A) with plug-in take-offs* VASS ELECTRICAL INDUSTRIES