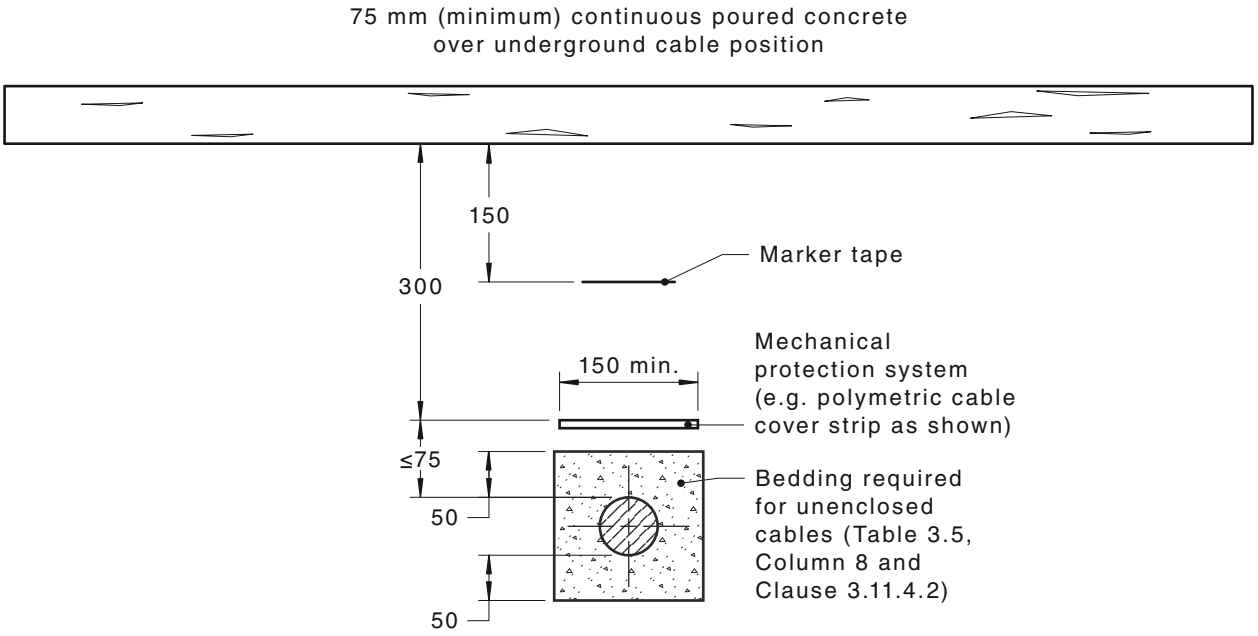
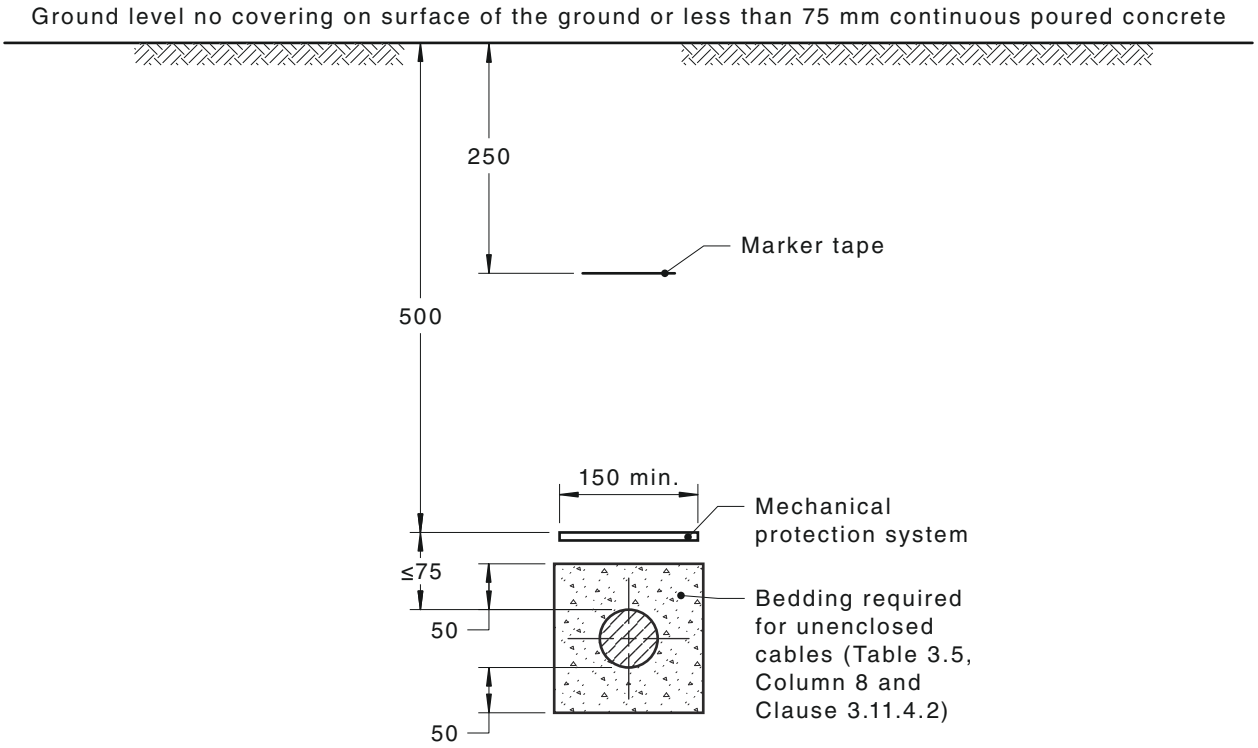


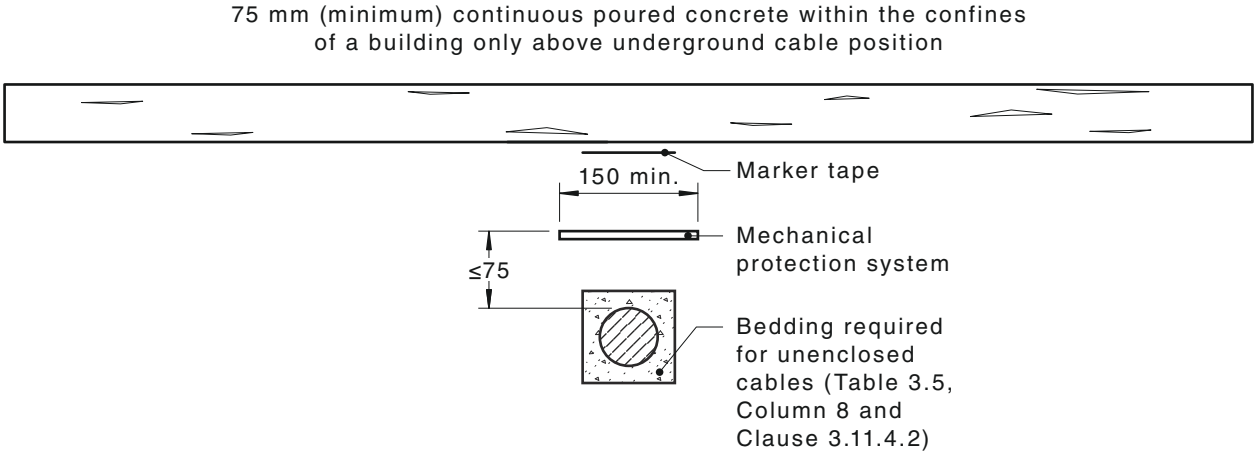
DIMENSIONS IN MILLIMETRES

FIGURE 3.13 EXAMPLE OF A CATEGORY B UNDERGROUND WIRING SYSTEM WITH CABLE LOCATED BELOW POURED CONCRETE OF 75 mm MINIMUM THICKNESS



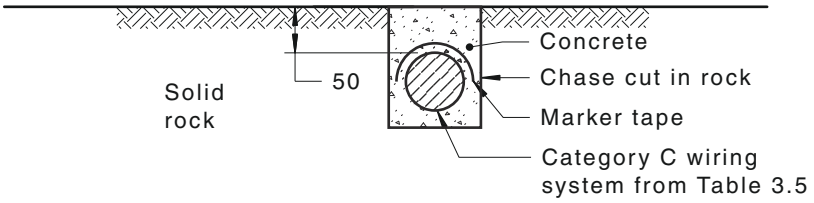
DIMENSIONS IN MILLIMETRES

FIGURE 3.14 EXAMPLE OF A CATEGORY B UNDERGROUND WIRING SYSTEM WITH CABLE LOCATED BELOW NATURAL GROUND



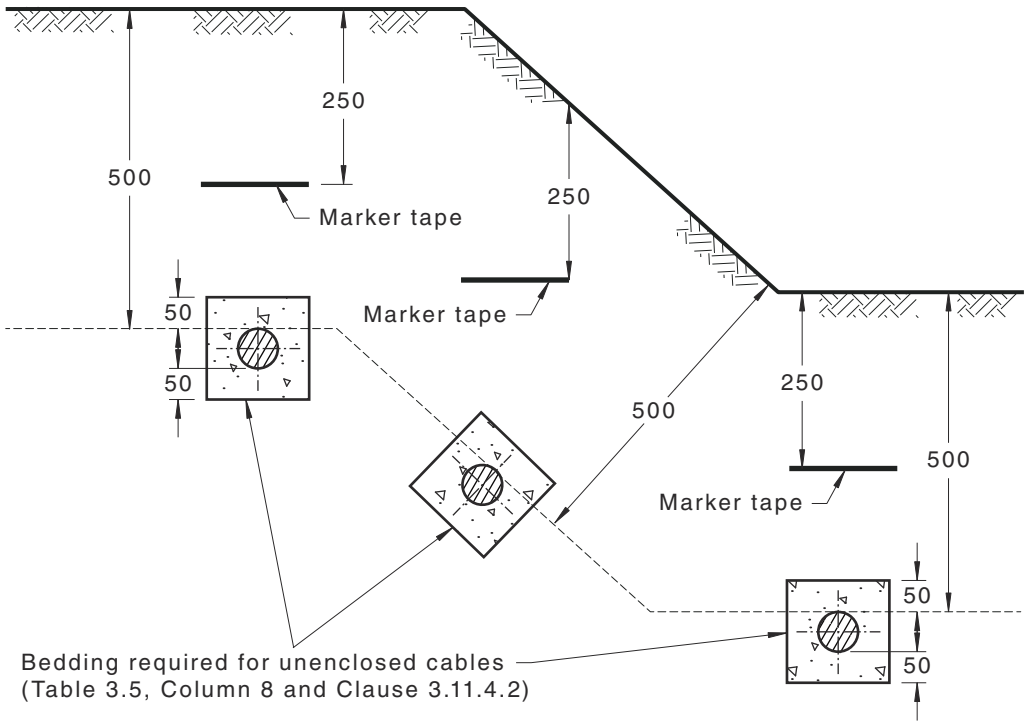
DIMENSIONS IN MILLIMETRES

FIGURE 3.15 EXAMPLE OF A CATEGORY B UNDERGROUND WIRING SYSTEM WITH CABLE LOCATED DIRECTLY BELOW POURED CONCRETE OF 75 mm MINIMUM THICKNESS WITHIN THE CONFINES OF A BUILDING



DIMENSIONS IN MILLIMETRES

FIGURE 3.16 EXAMPLE OF A CATEGORY C UNDERGROUND WIRING SYSTEM



DIMENSIONS IN MILLIMETRES

FIGURE 3.17 EXAMPLE OF AN UNDERGROUND WIRING SYSTEM IN SLOPING GROUND

3.11.4.6 *Marking and recording of underground cable location*

To minimize damage to underground wiring systems during manual or mechanical excavation works, the location of underground wiring shall be marked or recorded as follows:

(a) Permanent cable marker signs shall be provided to indicate the point where a cable enters or leaves a structure.

Exception: Cable entry signs need not be provided where the position of underground cable entry into the ground is obvious.

or

(b) The route of any underground cable shall be recorded on a plan to enable the location of the cable to be determined in the future. This plan shall be located at the switchboard from which the circuit originates. The plan locating the consumer mains shall be kept at the main switchboard of the installation to which it is connected.

Exception: Marking of underground wiring is not required within the confines of a building.

3.11.5 Spacing from other underground services

All underground wiring systems shall be spaced not less than 100 mm from other underground services.

Wiring systems shall be suitably marked with warning tape in accordance with Clause 3.11.4.5 and maintain a separation from telecommunications, gas and water services in accordance with Table 3.7.

Further requirements for the separation of telecommunications, gas and water systems from low voltage wiring systems are provided in Clause 3.9.8.4.

TABLE 3.7

MINIMUM SEPARATION OF UNDERGROUND SERVICES

Type of service	Minimum separation to low voltage electrical service identified in accordance with Clause 3.11.4.5 and mechanically protected(1) mm	Minimum separation of conductive enclosures to low voltage electrical earthing electrode(1) mm
Water service not greater than DN65(2)	100	500
Water service greater than DN65(2)	300	500
Sanitary drainage	100	500
Stormwater drainage	100	600
Gas	100	500
Telecommunications	100	

NOTES:

1 Authorities, such as water and gas suppliers and electricity distributors, may require their services to be spaced at a greater distance from underground wiring systems. Also see Figure 3.10.

2 DN = internal diameter of pipe.

Exceptions:

1 Two or more underground wiring systems may be grouped together where they are associated with the same electrical installation.

2 The requirements of this Clause (Clause 3.11.5) may be varied where a number of services are installed touching in a common trench, provided that each service is installed in a separate enclosure that identifies the service.

3 Separation distances between conductive enclosures and the earthing electrode are not required where all conductive enclosures are bonded within the installation.

3.12 AERIAL WIRING SYSTEMS

NOTE: The use of aerial wiring systems may be prohibited by the relevant regulatory authority in some areas, particularly those areas at risk of bushfire.

3.12.1 Types of conductor

Conductors used as aerial conductors shall be—

(a) hard-drawn bare conductors;

(b) polymeric insulated cables;

(c) neutral-screened cables; or

(d) parallel-webbed, twisted or bundled insulated cables.

3.12.2 Arrangements

3.12.2.1 *Insulation of aerial conductors*

Aerial conductors shall be insulated in the following situations:

(a) For any conductor span that is attached to a building or structure.

Exception: This requirement need not apply to aerial conductors between and supported by two independent poles or similar independent supports.

(b) For any conductor span within arm's reach of any building, building opening or structure.

(c) Above areas where sailing craft or irrigation pipes are used (see Table 3.8).

(d) In areas declared by the responsible fire authority as being subject to bushfires, where required by the regulatory authority or the electricity distributor.

3.12.2.2 *Minimum size*

The minimum size of aerial conductors shall be as follows:

(a) *Copper and aluminium conductors* Copper or aluminium conductors installed as aerial conductors shall have not less than seven strands and shall be not smaller than 6 mm^2 for copper or 16 mm^2 for aluminium.

(b) *Steel conductors* Steel conductors installed as aerial conductors shall have not less than three strands.

3.12.3 Clearances

3.12.3.1 *General*

Aerial conductors for low voltage systems shall be installed such that clearances from ground, buildings and structures other than public roadways are not less than those given in Table 3.8.

NOTE: These clearances do not apply to pole supports or independent supports for the aerial conductors themselves.

Clearances shall be maintained in any direction from any position to which any part of such conductors may either sag at a maximum conductor temperature of 115°C or move as a result of wind pressure.

When aerial conductors are being strung, an additional clearance shall be provided so that the distances specified in Table 3.8 are obtained up to a maximum conductor temperature of 115°C.

NOTE: Table D2 of Appendix D uses sag allowances that make provision for additional clearances.

Where aerial conductors terminate above or to the side of a building or structure, a suitable clearance to prevent contact with the building or structure shall be provided.

Connections between aerial conductors and circuit wiring shall not be regarded as aerial conductors but shall be out of arm's reach from the ground or from an elevated area.

NOTE: Regulatory authorities may have additional requirements regarding aerial conductor clearances.

3.12.3.2 *Safety warnings*

Suitable devices or notices, warning of the presence of aerial conductors, shall be erected in locations where such conductors are erected—

(a) above areas used by sailing craft;

(b) where long lengths of conductive piping, such as irrigation pipes, may reasonably be expected to be raised or otherwise handled;

(c) where loading or unloading of high vehicles is likely to occur; or

(d) in other locations where the risk of inadvertent contact with aerial conductors may reasonably be anticipated.

NOTES:

1 The responsible water authority may have additional signage requirements where aerial conductors cross a waterway.

2 The relevant authority may require aerial conductors in the vicinity of an aerodrome, airport or landing strip to carry aircraft warning devices.

TABLE 3.8
MINIMUM AERIAL CONDUCTOR CLEARANCES

All dimensions in metres

Type of aerial conductor	Minimum height above buildings, structures, ground or elevated areas				From buildings—Horizontal clearance from walls, etc.	From clothes lines, radio and television aerials, counter-poise or stay wires	From tele-communications lines[2]	Above swimming pools	Above areas where sailing craft, or irrigation pipes are used[3]
	Over areas used by vehicles	Over areas not used by vehicles	Over roofs used for traffic or resort	Over other roofs and structures					
Bare live conductors	5.5	5.0	3.7	3.0	2.0	2.0	1.2	Not permitted	Not permitted
Insulated and unsheathed live conductors	4.6	3.0	3.0	2.0	1.0	2.0	0.6	3.0	5.5
Neutral-screened cable	4.6	3.0	2.7	0.5	1.0	2.0	0.6	3.0	4.5

NOTES:

1 When erecting aerial conductors an allowance for sag and sway under operating conditions needs to be added to ensure that the above clearances are maintained. (Refer Clause 3.12.3 and Appendix D.)

2 Further information regarding required clearances for crossing telecommunication lines is contained in AS/CA S009.

3 Warning notices shall be erected where required by Clause 3.12.3.2.

4 Increased distances may be required over public roadways.

3.12.4 Distance between supports (spans)

The length of span of aerial conductors shall not exceed the values specified in Table 3.9 for the appropriate type and size of conductor.

Exception: Spans greater than the values specified in Table 3.9 may be used, provided that the design is in accordance with sound engineering practice.

NOTES:

1 An indication of acceptable stringing practice is given in Table D2 of Appendix D.

2 More detailed information is available in AS/NZS 7000.

TABLE 3.9

AERIAL CONDUCTOR MAXIMUM SPANS

Type of conductor	Size mm^2	Maximum span m
Insulated annealed copper including neutral-screened	≥6	20
Bare hard-drawn copper	≥6	60
Insulated hard-drawn copper including two-, three- and four-core twisted but excluding neutral-screened	6 10 ≥16	40 50 60
Neutral-screened cables with hard-drawn copper conductors—		
two conductors	6 or 10	40
three conductors	6 or 10	60
four conductors	6 or 10	50
two, three, or four conductors	16	60
Insulated or bare aluminium excluding neutral-screened	16 ≥25	50 60
Aerial bundled cables (aluminium conductor)	≥25	60

3.12.5 Aerial conductor supports

3.12.5.1 *General*

Supports for aerial conductors shall be insulators or purpose-designed fittings suitable for the type of cable with which they are used.

3.12.5.2 *Pin-type insulators*

Pin-type insulators shall not be used for supporting aerial conductors where—

(a) the strain tends to lift or otherwise separate the conductors from the insulators; or

(b) the direction of the conductors is changed by more than 30°.

3.12.5.3 *Hardware*

Any hardware or fittings used in association with the aerial line shall be of corrosion-resistant material, or other material suitably protected against corrosion.

3.12.5.4 *Spacing between conductors*

Conductors shall be adequately spaced to prevent contact with each other under all conditions of sag and sway.

The spacing between conductors at supports, measured in any direction, shall be not less than that shown in Table 3.10.

Exception: The spacing between conductors of a multi-core cable or cables operated in parallel may be less than that shown in Table 3.10.

NOTE: The electricity distributor may require a minimum clearance between consumer aerial lines and any electricity distributor aerial lines.

TABLE 3.10

SPACING BETWEEN AERIAL CONDUCTORS AT SUPPORTS

Span	Spacing m	
	Insulated conductors	Bare conductors
≤10	0.2	0.4
>10 ≤25	0.3	0.5
>25 ≤45	0.4	0.6
>45 ≤60	0.5	0.7

3.12.6 Poles and posts (including supports, struts and extensions to structures)

Poles and posts shall be constructed of materials suitable for the conditions of use, taking account of the following:

(a) Size.

(b) Depth in ground.

NOTES:

1 Guidance on the size of a typical range of poles and posts is given in Appendix D.

2 Guidance on the depth in ground for a typical range of poles and posts of lengths up to 7 m above the ground is given in Appendix D.

The depth in ground may be reduced if the pole or post is set in solid rock, provided that the arrangement is not inferior to installation in accordance with the above requirements.

If the support of the soil is poor, the pole or post shall be sunk to a greater depth or other means used to stabilize it.

NOTE: More detailed information is available in AS/NZS 7000.

3.12.7 Joints and connections

All joints and connections in aerial conductors shall be carried out in accordance with Clause 3.7.

3.13 CABLES SUPPORTED BY A CATENARY

3.13.1 Types of cables

Cables supported by means of a catenary shall be stranded cables affording double insulation or the equivalent of double insulation.

Cables and catenary supports installed out of doors shall be suitable for exposure to direct sunlight.

NOTE: Cables are considered to be adequately supported if supported by a catenary and thereby relieved from excessive mechanical stresses.

3.13.2 Catenary supports

A catenary shall—

(a) provide uniform support;

(b) consist of material equally resistant to corrosion or deterioration;

(c) be effectively fixed at each end;

(d) be capable of withstanding mechanical stresses likely to occur, in particular, those because of wind or ice; and

(e) be mounted at a sufficient height above the ground to prevent danger to persons or livestock, or damage to the cable being supported.

NOTE: A catenary may form part of a cable, in which case it should be installed in accordance with the manufacturer's instructions.

3.13.3 Clearances

Cables supported by a catenary wire shall maintain the following clearances:

(a) In an outdoor location, as specified in Clause 3.12.3 for a neutral-screened cable.

(b) In an indoor location, not less than 100 mm from any moving parts or parts of equipment operating at an elevated temperature.

3.14 SAFETY SERVICES

Wiring systems for safety services shall, in addition to complying with this Section, be installed in accordance with the requirements of Clause 7.2.

3.15 BUSWAYS, INCLUDING RISING MAINS SYSTEMS

Busbar trunking systems (busways) shall comply with AS/NZS 3439.2 or AS/NZS 61439.6, and shall be installed in accordance with the manufacturer's instructions.

Where used as a wiring system, the installation shall be in accordance with the relevant requirements of Clause 3.9.

NOTE: See Clause 3.9.9.3 for requirements for penetration of fire-rated constructions.

3.16 EARTH SHEATH RETURN (ESR) SYSTEM

The earth sheath return (ESR) system is one where the copper sheath of a MIMS cable forms a single conductor that is used as both a protective earthing (PE) conductor and a neutral (N) conductor simultaneously.

Only a copper sheath may be used as a combined protective earthing and neutral (PEN) conductor.

These cables shall be installed in accordance with Clause 3.9.7.3 and the following:

(a) The sheath shall be of adequate cross-sectional area and conductivity.

(b) The ESR system shall be used only in electrical installations where the MEN earthing system is used. It shall commence at the location where the neutral and earthing conductors are connected to form the MEN connection.

(c) Where the combined protective earthing and neutral (PEN) conductor is changed to provide a separate neutral and protective earth to electrical equipment, then the neutral and protective earth shall not be combined again to form a combined protective earthing and neutral (PEN) conductor.

(d) The ESR system shall not be installed in hazardous areas.

(e) Conductors used in an ESR system shall not be smaller than 2.5 mm^2.

(f) At every joint in the sheathing, and at terminations, the continuity of the combined protective earthing and neutral (PEN) conductor shall be ensured by a bonding conductor in addition to the means used for sealing and clamping the external conductor.

The resistance of the bonding conductor at joints shall not exceed that of the cable sheath.

(g) Two conductors, one for protective earthing and one for the neutral, shall be used at terminations. The minimum size for the protective earthing conductor shall be in accordance with Clause 5.3.3 and Table 5.1, and the minimum size for the neutral conductor shall be 6 mm^2, or in accordance with Clause 3.5.2.