

Section 3

Overhead Services

Service and Installation Rules of New South Wales
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3 Overhead Services

3.1 INTRODUCTION

This Section outlines the requirements for the installation of an overhead service rated at 100-400A.

3.1.1 Approval for an Overhead Service

The electricity distributor may determine whether premises will be supplied by an overhead service. The electricity distributor must approve the:

- (a) Connection point.
- (b) Type of construction.
- (c) Point of attachment, and
- (d) Route of service.

Accredited Service Providers are qualified to determine whether an overhead service is required.

3.1.2 Alternative to an Overhead Service

If a customer does not wish to take supply from an overhead service for any reason, an underground service may be provided (refer to Section 2) and the customer may be required to bear any additional costs incurred by the electricity distributor.

3.1.3 Distributor's Street Poles

The electricity distributor will not erect a street pole to facilitate connection of the electrical installation to the electricity distributor's network unless, in the electricity distributor's opinion, no practical alternative is available.

3.1.4 Specific Railway Requirements

Application in writing must be made to the RailCorp for the route, construction, and point of attachment for an overhead service on railway land.

Special conditions apply which will be advised on application. Written approval from the RailCorp is required for any proposed route.

3.1.5 Existing Service – Alterations and Additions

This clause outlines the requirements for alteration and addition of either of the following:

- (a) Overhead service.
- (b) Point of Attachment (PoA).

- (c) Consumers mains (including aerial consumers mains).

Table 3.1 summarises these requirements for the most common alterations and additions and the customer is required to fund the work unless otherwise stated.

Note: Only accredited service providers are permitted to perform the overhead service work outlined in Table 3.1.

The requirements should be confirmed with the electricity distributor if doubt exists (before commencing work).

3.1.5.1 Retaining an Existing Service

Where work is being carried out, and it is proposed to retain the existing overhead service cables or a property crossing (see Table 3.1), all of the following provisions must apply:

- (a) The service cable and its associated fittings must be in good condition.
- (b) The service cable must be PVC or XLPE insulated.
- (c) All other aspects of the installation must comply with the Service and Installation Rules of NSW, i.e. access to and height of the point of attachment, service clearances, etc.

Note: In certain instances (refer to Table 3.1) the electricity distributor as part of its maintenance responsibility will fund the replacement of the service line where conditions (a) and (b) above are not satisfied. The customer must fund any work required to satisfy condition (c) above.

The customer should make arrangements with the electricity distributor to replace the service cable (where the electricity distributor has agreed to fund the new service) in conjunction with the alterations or additions. Where the electricity distributor carries out this work the customer will be required to pay for the cost of the disconnection and reconnection (of the new service cable) at the point of supply.

Alternatively, an accredited Service Provider (Level 2, Category 3 – Overhead) can complete this service replacement work. The electricity distributor will not reimburse accredited service providers for this work.

Table 3.1: Requirements for existing overhead services and consumers mains (100 - 400A) affected by alterations and additions

Nature of the Alterations or Additions	Service Cable Requirements	Consumers Mains Requirements
Upgrading the consumers mains (cable being replaced)	Install as new if cable rating exceeded. If rating satisfactory apply clause 3.1.5.1 to determine need for replacement.	Install as new
Repairing the <i>consumers mains</i>	N/A	Repair as existing
Altering/relocating the PoA	Install as new if service needs to be extended	Install as new if cable rating exceeded
Increasing the number of phases (additional service cable required).	The service must now comply with these Rules	Install as new if cable rating exceeded
Increasing the number of phases (no additional service cable required).	Refer to Clause 3.1.5.1	Install as new if cable rating exceeded
Upgrading the service (cable being replaced)	Install as new	Install as new if cable rating exceeded
Re-routing a cross-property service line	Install as new	Install as new if cable rating exceeded

Note: Unless otherwise stated the customer must fund this work.

Reference to 'as new' means the final installation must comply with the current requirements of the Service and Installation Rules of NSW and AS/NZS 3000 as applicable.

Note: 100A service cables must not be paralleled to form 200A or greater. Existing 6mm² PVC insulated service cable has a rating of 70A/conductor.

3.2 SERVICE ROUTE AND POINT OF ATTACHMENT

3.2.1 Special Overhead Considerations

The following factors should be taken into consideration:

- The location of the electricity distributor's poles in the street supplying adjacent properties.
- A transformer located on the pole selected for the connection of a service.
- The position, including its height above ground, of the point of attachment.
- The existence of trees and large shrubs.
- Required clearances.
- The location of any additional pole.
- The selection of the point of attachment to ensure that the route of the service is clear of swimming pools, vegetation and other relevant building features such as doors, windows, balconies and entrances.
- The location of other utility services, refer to clause 3.5.3.1.
- Mitigation of bush fire risks in accordance with the electricity distributor's Bush Fire Risk Management Plan and Procedures.

Connections are not permitted at pole substations unless no practical alternative exists. The electricity distributor must approve the proposed connection in advance.

3.2.2 Service Route, Point of Attachment and Phase Selection

Single-phase customers should be connected to the following phase arrangement:

- Reconnect existing service cable to the same phase as previously connected, or
- Connect the new overhead service cable as listed in Table 3.2.

Table 3.2: Phase Selection

For lot or street number ending in:	Connect to:
1	A phase
2	B phase
3	C phase
4	A phase
5	B phase
6	C phase
7	A phase
8	B phase
9	C phase
10	A phase
20	B phase
30	C phase

3.2.3 Phase Selection for Single Phase Controlled Loads, supplied from a 3 Phase Service

Where a single-phase controlled load (e.g. off peak hot water system) is installed on a premises supplied from a three-phase service, apply Table 3.2 for the connection of the single-phase controlled load.

3.2.4 Crossing of Adjoining Property

A route crossing an adjoining property is only acceptable provided a suitable easement is obtained over the property. The only acceptable methods to prevent crossing of private properties are:

- (a) A post/pole erected by the customer on the customer's property in accordance with clause 3.7. The point of supply will be at the post/pole.
- (b) Where approved by the electricity distributor's construction standards a suspended service (or mid span suspended service from ABC mains) not exceeding 100A, may be used where:
 - i) The customer's property is on the same side of the street as the distribution system.
 - ii) The distance between the line poles does not exceed 45m.
 - iii) The suspended service line at 90° to the mains does not exceed 20m

(longer distances may be approved by the electricity distributor).

- iv) Written application for each individual installation must be submitted to the distributor.

A private pole should be installed to avoid a suspended service. A mid span/suspended service is only permitted as a last resort. Unusual building and distribution pole locations may warrant a suspended service which should be discussed with the distributor.

The electricity distributor will not consider the installation of a distribution pole unless there is no practical alternative.

Note: If a customer is required to relocate an existing cross property overhead service, that is not installed with an easement, the customer is responsible for the associated cost.

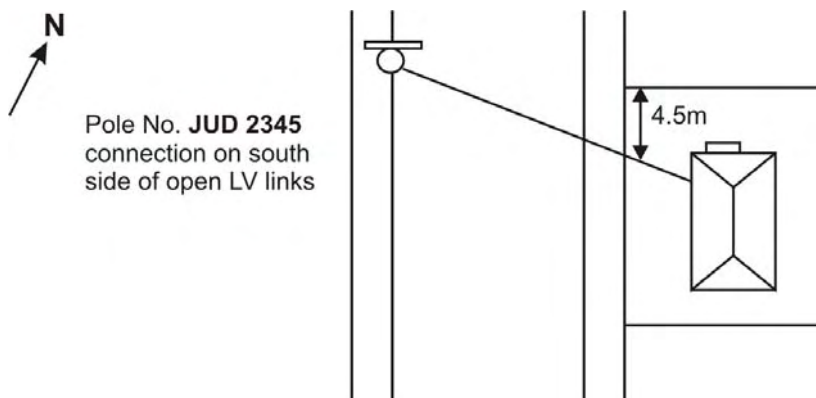
3.2.5 Crossing of Swimming Pool Zones

An overhead service or unprotected aerial consumers mains must not cross a swimming pool zone as defined by AS/NZS 3000.

3.2.6 Details of Service Route

When notifying the electricity distributor of completed works, the accredited service provider must supply details of the service including a sketch of the route. The Notification of Service Work (NOSW) form to be submitted to the electricity distributor provides a means of supplying this information. Refer to Figure 3.1 for a typical sketch and see clause 1.8 for NOSW requirements.

Figure 3.1: Typical sketch of an 'As Constructed' Overhead Service from the Distributor's pole to the point of supply



Note: The following details must be included in the sketch:

1. Pole number and if the pole has an LV open point (links) which side of the links the service connection was made
2. Distance between the point where the service crosses the front boundary and the nearest side boundary of the customer's property.

3.3 CONSUMERS MAINS

3.3.1 Electrically Un-Protected Aerial Consumer Mains

Electrically Unprotected aerial consumers mains must comply with the same requirements as the overhead service with regard to cable size and compliance with the Australian Standards referred to in clause 3.4.

3.3.2 Other than Aerial

Electrically Unprotected consumers mains must have a minimum cross sectional area of 16mm² copper or 25mm² Aluminium, XLPE insulated.

3.3.3 Alterations and Additions

Alterations or additions to existing consumers mains must be treated as a new installation. Refer to clause 1.5.11. This need not be applied where additional phase conductors are added to existing electrically unprotected single-phase consumers mains provided the cross-sectional area of the additional conductors is not smaller than the existing conductors.

3.3.4 Bush Fire Precautions

Electrically Unprotected aerial consumers mains must be installed with regard to mitigation of bush fire risks in areas defined as bush fire areas by the Rural Fire Service and the electricity distributor's Bush Fire Risk Management Plan and procedures in accordance with AS/NZS 3000.

3.3.5 Electrically Protected Aerial Consumers Mains

Electrically protected aerial consumers mains must comply with the requirements of AS/NZS 3000.

3.4 CABLE REQUIREMENTS

3.4.1 Minimum Requirements

The minimum requirements for overhead service cable are:

- (a) Compliance with AS/NZS 3560.1 Electric cables - 'XLPE insulated-aerial bundled - For working voltages up to and including 0.6/1kV'.

If these requirements are incompatible with the electricity distributor's distribution system design standards the electricity distributor will specify the conductor size.

Table 3.3 specifies the only service cables that may be used for various service ratings. Any intermediate service ratings (based on the assessed demand of the installation) must use the next largest service rating/cable available, eg a 350 Amp assessed service rating must use 2 x 95mm² Al 4-core cables (ie a 400 Amp service).

Table 3.3

Cable CSA (mm ²)	Conductor Material	Cable Cores	Service Rating (Amps)
25	Al	1 x twin or 4 core	100
95	Al	1 x 4 core	200
2 x 95	Al	2 x 4 core	400

Note: Prior to carrying out work at the point of attachment contact the accredited service provider installing the overhead service to ascertain the cable type and configuration to be used.

3.4.2 Existing Overhead Service Cable Ratings

When a customer applies for the connection of additional loads the existing overhead service must be replaced where the assessed maximum demand will exceed its current carrying capacity. Overhead services less than 7/044 (6mm²) must always be replaced.

Refer to clause 3.1.5.1 regarding the retention of an existing service.

3.5 SPANS, TENSIONS AND CLEARANCES

3.5.1 Maximum Span

The maximum span for an overhead service up to 100A is 50m. For a service greater than 100A the maximum span is 30m. The electricity distributor may consider spans exceeding these distances when requested.

3.5.2 Tensions

The tensions of overhead services are set out in Table 3.8.

Where the requirements set out in this document do not meet the site criteria, a suitable structure and its mounting may be designed. It must be certified by a structural engineer using the information in Table 3.7 and other publications (e.g. ENA C(b)1—'Guidelines for the Design and Maintenance of Overhead Distribution and Transmission Lines').

3.5.3 Clearances from Structures, Vegetation and Ground

Maintain minimum clearances above ground, and from trees, shrubs and structures, when calculating the height of the supports required for the service. Minimum clearances depend on:

- (a) Whether the ground under the service is likely to be used by vehicular traffic.

- (b) The nature of any nearby structure.

- (c) Trees and shrubs. Make adequate allowance for growth and the effect of wind. A minimum clearance of 1.5m is required from bare conductors and 0.5m from insulated conductors.

The required clearances are set out in Table 3.4 and illustrated in Figures 3.2, 3.3 and 3.4.

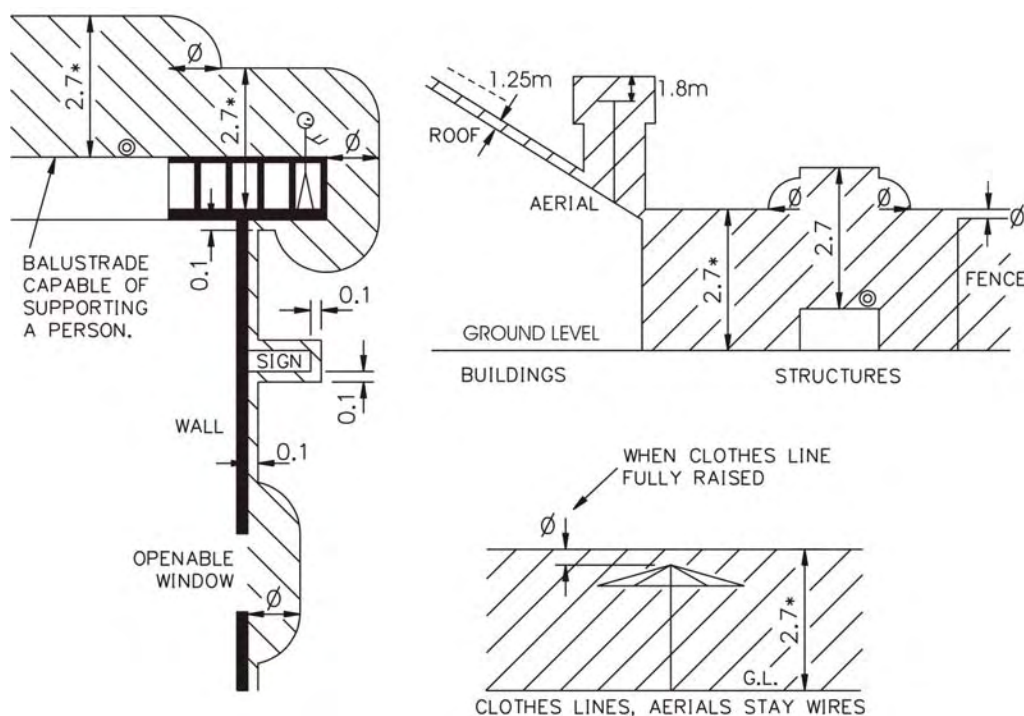
Allow for any proposal to change the ground level or build a structure along the route of the overhead service. Overhead services must not be installed where the required clearances are not obtainable at the time of installation.

The take-off from the electricity distributor's pole for the overhead service will be in the vicinity of the low voltage crossarm. The height of the crossarm varies between 6.7 and 8 metres.

When selecting the point of attachment and route of the overhead service, allow for:

- (d) The maximum sag when determining the final ground clearance, and
- (e) The swing of conductors for clearance to structures.

Figure 3.2: Typical Clearance Situations - Elevation



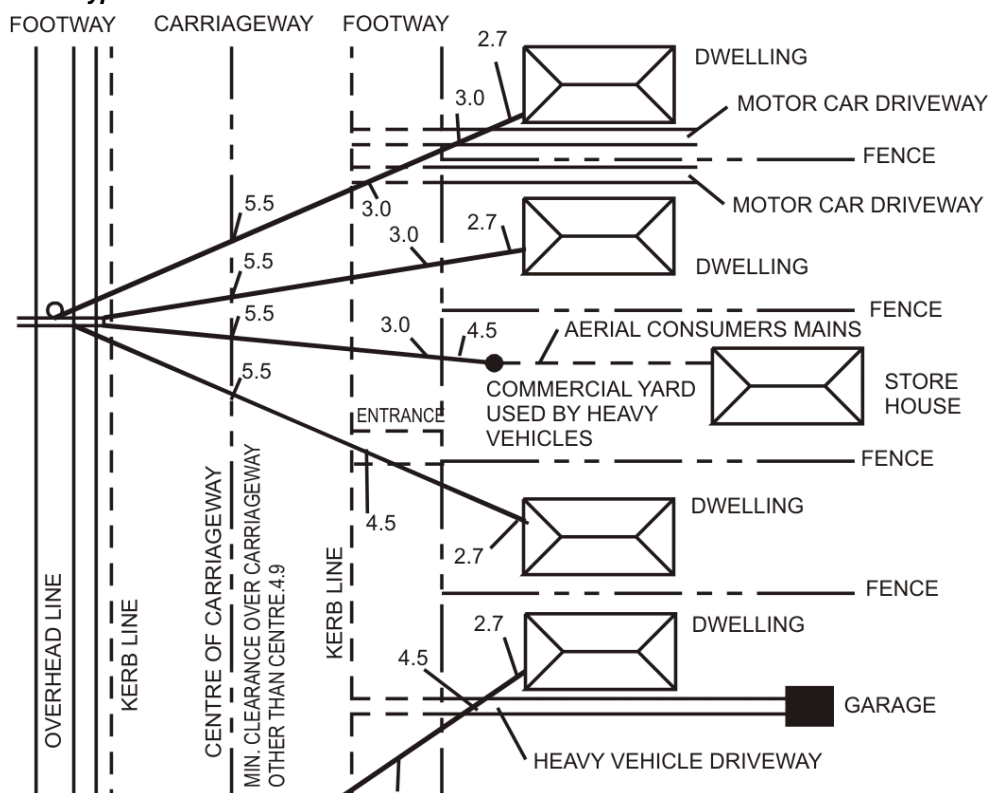
Note: These clearances must be achieved under all conditions (refer to Note 3 of Table 3.3)

Ø 'Out of normal reach' = 1.25m (refer to Note 4 of Table 3.3).

* Not used by vehicles

⊙ Surface

Figure 3.3: Typical Clearance Situations - Plan



Note: These clearances must be achieved under all conditions (refer to Note 3 of Table 3.4)

Table 3.4: Minimum Clearances to Insulated Overhead Service

	From the insulated service conductors to the surface of:	Minimum clearances (metres)
1	Any part of a freeway or arterial road	5.5 vertically
2	The centre of a carriageway of a public road	5.5 vertically
3	Any part of a carriageway of a public road (other than the centre)	4.9 vertically
4	Vehicular crossing of a footway in a public road (other than a residential driveway)	4.5 vertically
5	Vehicular crossing of a footway in a public road for a residential driveway and any other part of a footway	3.0 vertically
6	Land which is not associated with a dwelling and which is likely to be used by vehicles, including non urban small acreages and hobby farms	4.5 vertically
7	Land which is, or is likely to be used by vehicles and is associated with a dwelling	3.0 vertically
8	Land not likely to be used by vehicles	2.7 vertically
9	Those parts of any structure normally accessible to persons. (See Note 1)	2.7 vertically
10	Any area above a roof	1.25 metres
11	Any area around a radio or TV aerial	1.8
12	Those parts of any structure not normally accessible to persons. (See Note 2) (including below a projecting slab, balcony or sign)	0.1 in any direction
13	The edge of any opening window, balcony, verandah, clothes line or fence etc	Out of normal reach (see Note 4)
14	Point of attachment	3m vertically not normally accessible without a ladder or other device (see Notes 1-4)
15	Farmland where mechanical equipment is used	5.5 vertically
16	Trees and shrubs	0.5 in any direction
17	Vicinity of boat ramps, launching areas (avoid if possible)	10.0 vertically
18	Communications conductors	0.6 in any direction

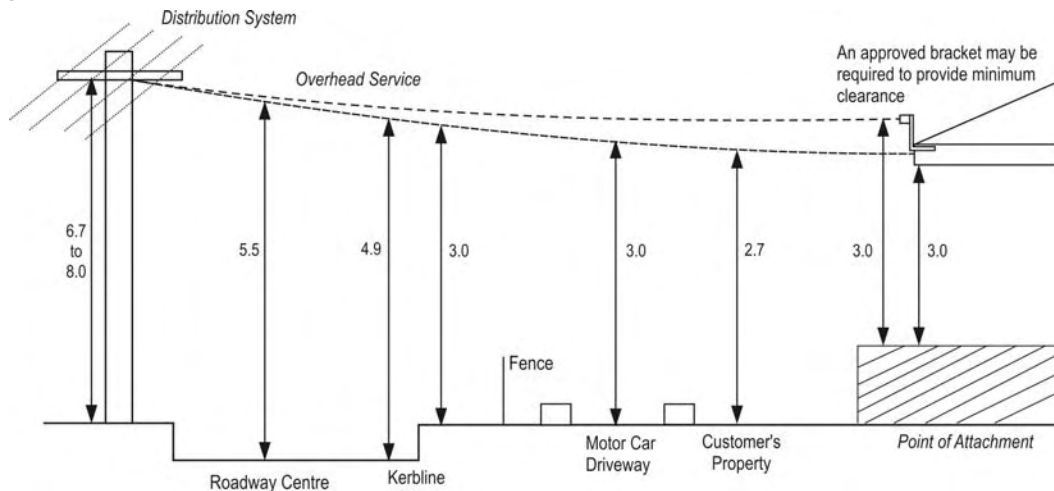
Notes:

Interpret the requirements set out in Table 3.4 as follows:

1. **Structure Normally Accessible to Persons** includes:
 - (a) The whole area of any flat roof accessible without the use of a ladder.
 - (b) Any part of a hip or gable roof accessible without a ladder up to the nearest hip or gable.
 - (c) Any portion of a balustrade or other structure which will support a person and is accessible without a ladder.
2. **Not Normally Accessible to Persons** excludes roofs and includes any portion of a fence, balustrade, advertising sign or other structure which will not support a person or is not accessible without a ladder.
3. **The minimum clearances** in Table 3.4 must be achieved under all conditions regardless of:
 - (a) Conductor swing due to the influence of wind.
 - (b) Conductor sag due to the influence of load current and ambient temperature.

The requirements of Table 3.4 may be achieved if the maximum allowable service line sag for a particular conductor size and span is added to the minimum clearance. Refer to Table 3.8.
4. **Out of Normal Reach** means 1.25m from any normally accessible position. The requirement that an overhead service must be out of normal reach of persons may be achieved in some cases by the provision of a permanent insulated barrier (consult with the electricity distributor).

Figure 3.4: Clearances to Overhead Service - Elevation



Note: These clearances must be achieved under all conditions (refer to Note 3 of Table 3.4)

The point of attachment is to be 3m minimum above the ground, floor or platform level.

3.5.3.1 Clearances to other Utility Services

The accredited service provider is responsible for obtaining the required minimum clearance of 600mm between the proposed overhead service and aerial communications conductors.

3.5.3.2 Searches for Underground Utility Services

Contractors must carry out a search for underground utility services, prior to excavating for private poles, etc. Adequate clearances must be obtained between private poles and underground utility services. Check with the appropriate utility to determine any required clearances.

Initial search information can be obtained from Dial Before You Dig.

Utilities may include:

- water
- sewer
- drainage
- gas
- communication cables
- power cables

- railway power, signalling and communication cables (which as well as being located on railway land can be located in public streets, parks, etc).



Dial Before You Dig

Phone 1100 - free call (except from mobiles)

Website www.1100.com.au

Australia's major service providers have made available a single web-enabled information service for information on the location of underground communications, gas, water and electricity infrastructure. Use the website ensure that you 'Dial Before You Dig' before any excavation. If calling, be ready to provide the operator with:

- name and address
- name of company
- contact telephone number
- fax number for return information
- contact name on site
- site address and both nearest cross streets
- start date of proposed work
- type of work being carried out

3.6 ACCESS TO SERVICE AND POINT OF ATTACHMENT

The overhead service and point of attachment must be erected with readily available access. The area below the point of attachment should provide a firm, level base with sufficient space to safely erect a standard 4m/7m extension ladder. A space for the ladder 1m square with the centre of the space 1.5m from the base of the point of attachment is satisfactory.

Unacceptable access to a point of attachment examples are:

- (a) Access using a second ladder, except where the point of attachment is above a shop or commercial building's awning.
- (b) Resting a ladder against the balustrade of a balcony to get access to a point of attachment.

- (c) Access to the point of attachment by walking upon a building or verandah roofs.
- (d) Access through a building. Exterior stairs may be used to gain access to a balcony.
- (e) Access from adjacent private property.

The point of attachment must not be accessible without the use of a ladder or other device to assist climbing. If necessary, install a protective guard to prevent unauthorised access. When access is from an awning or balcony, its construction should allow safe working practices to be followed in attaching an overhead service to the building.

3.7 FACILITIES TO BE PROVIDED BY THE CUSTOMER

3.7.1 Point of Attachment

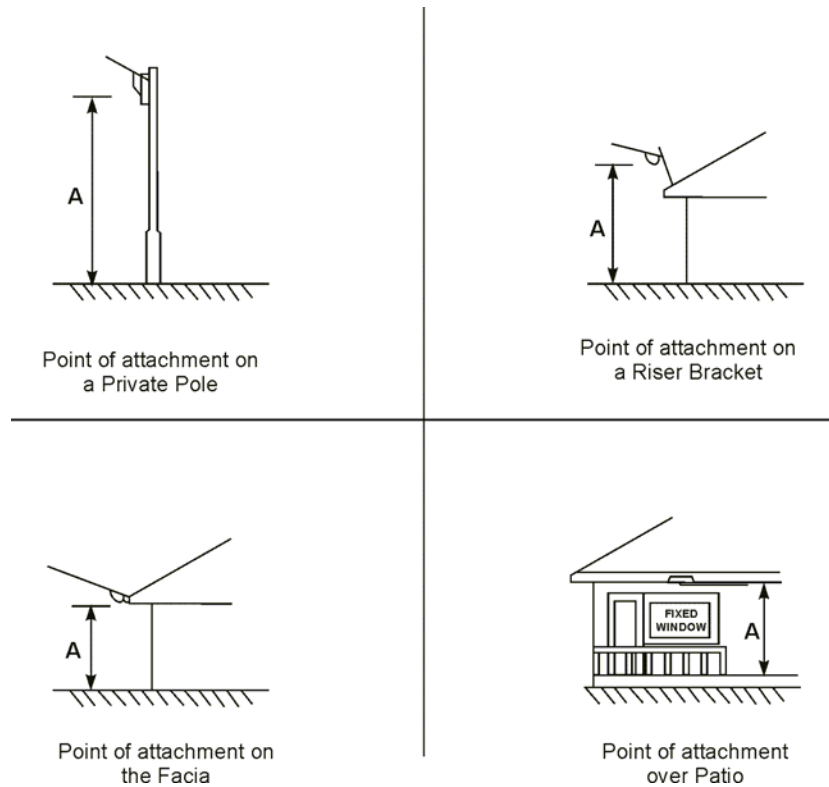
The point of attachment must be located on the aspect of the building facing the distribution mains, or on a customer pole or other structure accessible to the distribution system.

The point of attachment must be selected to prevent the crossing of adjoining properties. Refer to clause 3.2.4.

The overhead service support structures must be able to withstand the tensions listed in Table 3.8.

The minimum height of the point of attachment fixing is 3m, the maximum height on a building or structure is 6.7m above ground. Figure 3.5 illustrates the minimum height at the point of attachment. The unsuitable areas for a point of attachment are shown in Figure 3.6.

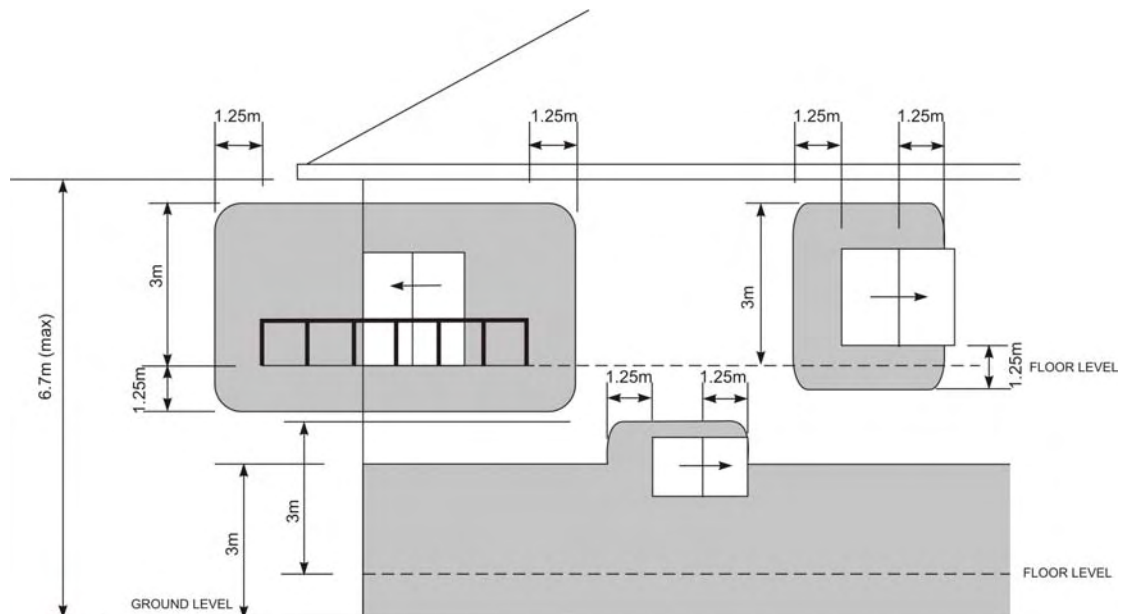
Figure 3.5: Typical Points of Attachment - Elevation



A = 2.7m - minimum height to the bottom of the drip loop

Note: The minimum height of the point of attachment is 3m.

Figure 3.6: Unsuitable Points of Attachment shown shaded



Note: The *point of attachment* should not be located in the shaded areas as shown above.

3.7.2 Private Post/Pole

Where a private post/pole is to be installed, it must be sized and located to avoid the use of an additional electricity distributor's pole in the street. The circumstances which may require the installation of an additional post/pole are set out as follows.

Note: The overhead service terminates at the point of supply. This is the first support on the customer's premise. Refer to Figure 1.1.

3.7.2.1 Private Posts/Poles

Private posts/poles are to be erected in any of the following circumstances:

- (a) As an alternative to a road crossing pole, which would otherwise be necessary to be used, to maintain clearance requirements for the overhead service crossing the road.
- (b) The customer wishes to install underground consumers mains within the premises (a sketch of the route of the underground consumers mains should be provided in accordance with Section 2).
- (c) No suitable point of attachment is available on the building.
- (d) The crossing of adjacent premises has to be avoided and a suspended service (where permitted by the electricity distributor) is not practicable.
- (e) The span would be excessive due to the distance from the electricity distributor's pole to the building. Spans exceeding the distances set out in clause 3.5.1 are treated as excessive.
- (f) To provide required clearances.
- (g) To provide supply to a battle-axe block.

A private post/pole must be installed within 1 metre of the front property street alignment.

3.7.2.2 Labelling of Private Post/Pole

A customer's pole must be clearly labelled to indicate it is a 'PRIVATE POLE' to differentiate it from the electricity distributor and other utility poles. The height of the lettering must be a minimum of 20mm.

3.7.2.3 General Requirements

Customers may have to obtain approval from the local council before a post/pole is erected on the customer's premises.

Cross arms are not required on customer's posts/poles because the cables are supported using a single bolt per support. Open wire services must have the bolts separated by 250mm minimum.

If the point of attachment on the customer's post/pole exceeds 6.7m in height, pole steps must be fitted to the pole. Pole steps must not be installed within 6m of ground level. They must have a rise not exceeding 450mm, be

located on alternate sides and spaced with 120mm between them.

A post/pole supporting an overhead service and aerial consumers mains must comply with the requirements of both AS/NZS 3000 and these Service Rules. It should comply with the most onerous of these requirements.

Posts/poles must be securely set in the ground.

If the soil does not provide enough support, eg in built-up ground or soft soil, secure posts/poles either by setting them at a greater depth than normally required, or by using bearing blocks or shoes. Refer to Table 3.5 and its notes.

Where, because of unusual circumstances, the butt of the post/pole cannot be sunk to the required depth in the ground, an alternative construction, such as flange mounting on a reinforced concrete structure, may be accepted.

In all such cases, you must obtain a structural engineer's certification that the mounting has been designed to meet the requirements set out in clause 3.7.6 before construction may proceed.

The required length of the post/pole above ground must be assessed when selecting post/pole sizes to obtain necessary clearances.

Table 3.5: Sinking of Posts/Poles in Ground

Posts/poles must be set in the ground, as listed below, taking into account the soil quality as specified.

Free Length to Lowest	Depth In Ground (metres)		
	Poor Soil	Medium Soil	Good Soil
3.0	1.6	1.3	1
3.3	1.6	1.3	1
3.6	1.6	1.3	1
3.9	1.6	1.3	1
4.2	1.8	1.5	1.2
4.5	1.8	1.5	1.2
4.8	1.8	1.5	1.2
5.1	1.8	1.5	1.2
5.4	1.8	1.5	1.2
5.7	1.8	1.5	1.2
6.0	1.9	1.6	1.3
6.3	1.9	1.6	1.3
6.6	1.9	1.6	1.3
6.9	1.9	1.6	1.3
7.2	1.9	1.6	1.3

Notes:

1. Free Length

The free length to the lowest conductor support shown in the Table is the distance between the lowest conductor support and ground level.

2. Soil Quality

Soil quality is defined according to ENA C(b)1- 2003 'Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines'.

- (a) Poor - Soft clay, poorly compacted sand and soils that tend to absorb large amounts of water (150kPa/m).
- (b) Medium - Compact medium clay, well bonded sandy loam, bonded sand and gravel with reasonable surface water drainage (300kPa/m).
- (c) Good - Well compacted rock soil, hard clay and well bonded sand and gravel with good surface water drainage (600kPa/m).

3. Posts/Poles set in Concrete

Where a post/pole is set in concrete:

- (a) It must be located centrally in a bore hole sized in accordance with Table 3.6.
- (b) The concrete should be finished:
 - i) Not less than 250mm below ground level for a wooden post/pole.
 - ii) At 100mm above ground level for a steel post/pole in a manner utilising a watershed.
- (c) It is equivalent to improving the soil quality by one step, i.e. from poor to medium or from medium to good. This corresponds to a reduction in the required sinking depth of the pole.
- (d) It should be left undisturbed for three days, or long enough to ensure that the concrete has developed adequate strength prior to attaching the overhead service.

4. Posts/Poles set in Solid Rock

Where a post/pole is set in solid rock, the depth in ground may be reduced by 0.3m.

Table 3.6: Minimum Size Bore Holes for Posts/Poles

Post/Pole Size	Post/Pole Material	Minimum Bore Hole Diameter
All sizes	Timber or Steel	Post/pole diameter plus 100mm

3.7.2.4 Timber Posts/Poles

Timber posts and poles must be of hardwood or other suitable timber as specified by AS 2209 1994 'Timber-Poles for overhead lines'.

- (a) Tables 3.9 and 3.11 sets out the minimum sizes of timber posts or poles of untreated hardwood timber with durability of Class 1 and 2 and strength rating of S3 or better.
- (b) AS/NZS 3000 sets out the minimum sizes for preservative treated hardwood or softwood timbers with durability Class 4 or better and a strength grade S6 or better.

The base of timber posts/poles and surrounding ground must be treated against insect and fungal attack by environmentally approved methods.

Timber posts/poles must be capped at the top to prevent water penetration.

The distance between the top anchor bolt and the top of the post/pole must not be less than 200mm.

3.7.2.5 Steel-pipe Posts/Poles

The required sizes/grades of steel-pipe posts/poles are set out in Tables 3.15 to 3.18.

Steel-pipe posts/poles must be capped at the top to prevent water entry.

3.7.3 Attachments to Buildings or Structures

3.7.3.1 Responsibility for Design

It is the customer's responsibility to ensure that the support is designed and installed in accordance with sound engineering practice. It must be suitable for the direction of pull imposed by the proposed or existing overhead service.

The electricity distributor does not accept responsibility for damage to the customers premises resulting from normal tension in the overhead service or causes beyond the electricity distributor's control. If necessary the services of a structural engineer should be sought where doubt exists as to the strength of an attachment. Publication ENA C(b)1- 2003, 'Guidelines for the Design and Maintenance of Overhead Distribution and Transmission Lines', gives guidelines for the design of structures for the support of overhead services.

3.7.3.2 Alternative to attaching to a Building

If a customer wishes to avoid attaching the overhead service to the building, this can generally be done by erecting a post/pole and installing underground consumers mains.

3.7.3.3 Horizontal and Vertical Struts

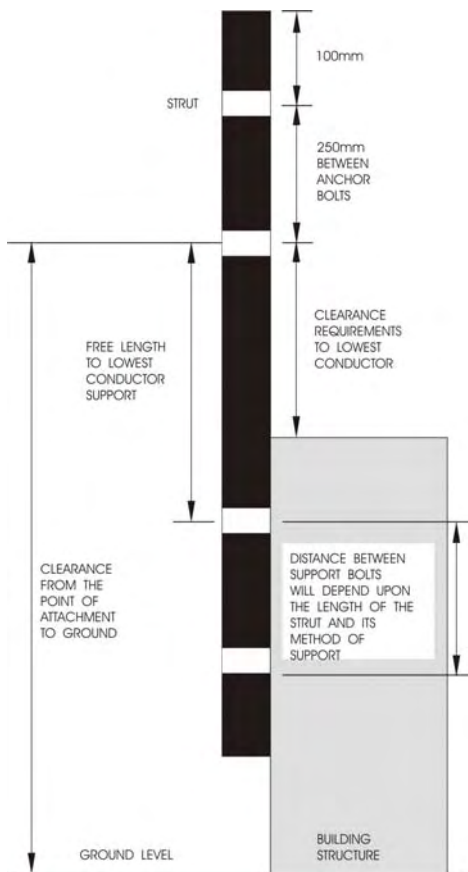
A strut is a straight length of support. Once it is bent, off-set or braced it is then classed as a bracket.

The sizes of horizontal and vertical struts are set out in Tables 3.10, 3.12, 3.13, 3.15 to 3.18. Timber or hollow steel struts must be capped at the top to prevent water penetration.

Note: The free length to the lowest conductor support shown in the Tables is the distance between the lowest conductor support and the closest fixing bolt on a structure (see Figure 3.7).

Two fixing bolts must be used at a minimum distance of 600mm apart to fix the strut to a structure.

Figure 3.7: Typical Strut Mounting



3.7.3.4 Service Brackets

For a 100A overhead service you may use an approved service bracket to obtain the required clearances, outlined in Table 3.4.

Service brackets must be fabricated from minimum grade 250 steel. Any joints must be welded. They must bear a manufacturer's label indicating that they are similar in all relevant

respects to a prototype bracket which the electricity distributor has previously approved for that classification. Refer to Table 3.7.

Choosing a bracket: Refer to Figure 3.8 for description and Table 3.7 for strength.

An explanation of Table 3.7 follows:

Bracket Rise: The numbers 2 to 6 indicate the free length or rise in 150mm steps to 900mm. The rise of the bracket is the dimension from the centre line of the mounting bolts to the centre line of the lowest anchor bolt(s) for the overhead service.

Number of Anchor Bolts and Hooks: The last number in the bracket description indicates the number of 12mm anchor bolts provided for on the bracket to secure the overhead service. The customer provides the bolts. The bolts may be replaced with hooks, as illustrated in Figure 2.9, welded or bolted to the bracket.

Strength Rating: The symbols A, B and D are used to indicate strength. The design strengths for A, B and D brackets are 0.59, 1.18 and 2.1kN respectively. The design strengths provide for a factor of safety to meet the specifications in clause 3.7.6.

Example: A bracket having a classification 2B2 would have a free length of 300mm above its mounting point and provision for 2 bolts to anchor insulators. It would be suitable for a loading of up to 1.18kN. A 2D2 bracket would be similar in characteristics to the 2B2 but suitable for a loading of up to 2.1kN. It would therefore be an acceptable alternative where a 2B2 bracket is specified. Similarly a bracket having a higher rise than that specified is satisfactory.

Table 3.7: Bracket Description

Bracket Rise		Strength Rating	No. of Anchor Bolts and Hooks
2		A	1 or 2

Bracket Rises	mm
2	300
3	450
4	600
5	750
6	900

Bracket Strength Rating kN	
A	0.59
B	1.18
D	2.1

Bracket Use

1. If a bracket's strength rating or rise is unavailable, use the next size up e.g., need a 2A1 bracket - use a 2B1 or a 3A1.
2. If allowing for future 3 phase, a higher strength is required with an additional anchor bolt, e.g. 1 phase 10m span needs a 2A1 - a 2 or 3 phase 10m span needs 2B2 therefore 2B2 needs to be installed initially. Refer to Table 3.8 for minimum bracket strength rating.
3. One hook or bolt on each bracket is required for each *overhead service*.

3.7.4 Protection against Corrosion

Where steel is used for posts, brackets, struts, hooks, hardware or fittings associated with an overhead service it must be galvanised to meet the specifications in AS 4534, 4680 and 4792.

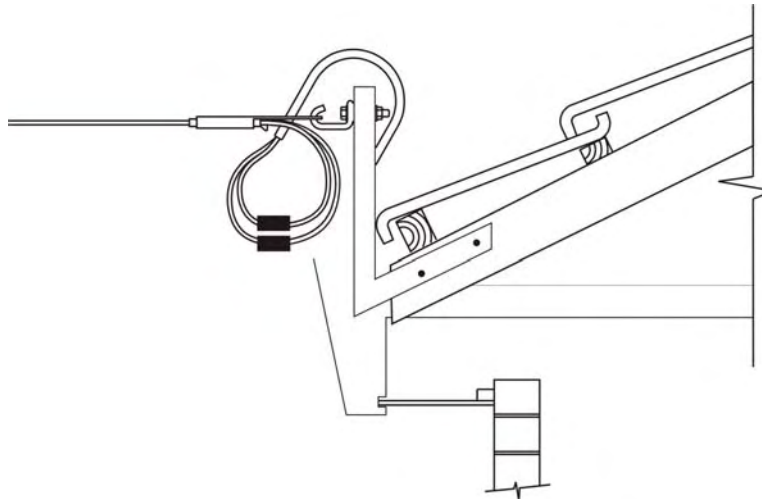
The hot-dip process must be used. Replace the zinc on any small area where the zinc coating has been removed with a durable zinc rich coating.

The electricity distributor may allow other forms of protection where the locality is not suitable for galvanising.

3.7.5 Earthing Metallic Supports

Refer to AS/NZS 3000 for the earthing requirements of metallic supports for aerial service conductors (poles, service brackets, struts, hooks, fittings and attachments, etc).

Figure 3.8: Service Bracket Installation Example



3.7.6 Strength Requirements of Attachments and Supports

Overhead services are installed with an initial tension which will subsequently vary within normal limits.

The customer must secure anchor bolts, struts or service brackets in such a way that the load (refer to Table 3.8) is safely transmitted to a structurally adequate portion of the building.

The customer must ensure that the building or structure, and the means of fixing the anchor bolts or bracket to it, are at least sufficiently strong to take the normal tension of the overhead service, as indicated in Table 3.8.

3.7.6.1 Fixing of Attachments and Supports on Buildings

Fix brackets to a structurally adequate part of the building using galvanised steel bolts at each fixing hole provided in the bracket. The bolt must be 12mm diameter except where brackets are fixed to a rafter in which case, 10mm diameter is satisfactory. Nailing of nogging between rafters, and attachment of the bracket to the nogging is not acceptable. Figure 3.8 shows a typical service bracket installation.

Do not attach a strut or service bracket to a brick or masonry wall unless the load on the mounting bolts is transferred to a structural member (unless otherwise approved by a structural engineer).

3.7.6.2 Number and Size of Anchor Bolts

The customer's contractor must install the required number of galvanised steel anchor bolts or hooks to provide a secure point of attachment for the overhead service. The following service line and anchor bolt arrangements are typical:

100A service (single-phase) - one twisted twin insulated cable and one 12mm diameter anchor bolt.

100A service (two or three phase) - one bundled four core insulated cable and one 12mm diameter anchor bolt.

Note: The 12mm anchor bolt may be replaced with a formed hook bolt or a hook welded to a metal structure. See clause 3.7.6.3, Figure 3.9 for details of 100A service hooks.

200A service - one bundled conductor cable and one 16mm diameter minimum anchor bolt.

300/400A service - two bundled conductor cables and two 16mm diameter minimum anchor bolts.

If the head of a bolt is not readily accessible, it must be securely fixed to prevent rotation. Bolts must have at least 25mm of thread projecting and be complete with finger-tight galvanised steel nuts.

Where more than one anchor bolt or hook is used, they must be spaced 250mm minimum, 400mm maximum vertically or horizontally apart.

3.7.6.3 Service Hook

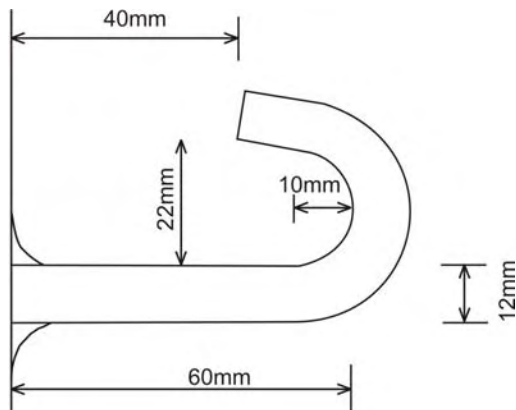
The hook must be minimum 12mm diameter, grade 250 steel rod.

It must be formed into shape using a die without sharp edges and without using heat treatment.

The hook may be:

- (a) Welded to the metal structure so that the bond strength is not less than that of the rod.
- (b) Bolted to the structure using 12mm diameter bolts.
- (c) Threaded like a coach screw hook and screwed to an adequate structural member.

Figure 3.9: 100A Service Hook



3.7.6.4 Fixing Anchor Bolts to Concrete and Brick Walls

Anchor bolts may be fixed to:

- (a) A reinforced concrete wall (at least 300mm from any opening).
- (b) A reinforced concrete slab provided the point of fixing is in the centre of the slab and at least 300mm from a corner.
- (c) Brick walls provided the load on the bolts is transferred off the wall to another structurally adequate portion of the building (unless otherwise approved by a structural engineer).

Note:

1. Wall plugs must not be used.
2. Expansion fittings must not be used in brick walls.
3. Chemically set bolts may be used provided the manufacturer's instructions are followed.

3.7.6.5 Stays

Struts and service brackets must rely on their fixing bolts for support. Secondary supports by way of a stay or brace are not permitted.

3.7.6.6 Abnormal Loading

In the event of a vehicle colliding with a pole in the street or a tree falling across the overhead service, the load imposed on the building may be as high as the total breaking strain of the conductors. This load is given in Table 3.8. The customer can either strengthen the structure to provide for this, or accept the risk of an accident occurring.

3.8 BUILDERS SERVICE

An overhead service may be installed for the purposes of building construction. A suitable meter box enclosure mounted on either a removable pole/post or on a post made up of two sections of timber bolted together (split post) is acceptable. Refer to clause 3.8.1 for details.

Post/pole sizes must comply with either Tables 3.9, 3.10 or 3.14 to 3.18, must be in good condition and inspected prior to each use by the contractor.

Refer to Figure 3.10 for typical installation details.

Refer to clause 3.7.2 for more detailed service post/pole requirements if relevant.

3.8.1 Split-Posts

A split-post may be used for a builders' service installation supplied by a 100A overhead service, provided it is:

- (a) Fixed together with two 16mm diameter bolts and washers, 600mm apart, with a minimum of 150mm to the timber ends.
- (b) Of a minimum 150mm x 150mm cross-sectional area. The top of the ground portion is to be capped or chamfered.
- (c) Erected so that the lengths of the bolts are in line with the proposed direction of the service line and the base section sunk to the depth required for permanent posts.

Refer to Figure 3.10 for typical installation.

3.8.2 Consumers Mains

The unprotected consumers mains associated with an overhead service on a builders service post/pole, may have a minimum size of 6mm² copper thermoplastic insulated and sheathed cable (maximum demand permitting) when installed in PVC flexible plain conduit to AS/NZS 2053 Part 4-1995 'Conduits and fittings for electrical installations Part 4: Flexible plain conduits and fittings of insulating material'.

3.9 UNDERGROUND SUPPLY FROM OVERHEAD DISTRIBUTION SYSTEM (UGOH)

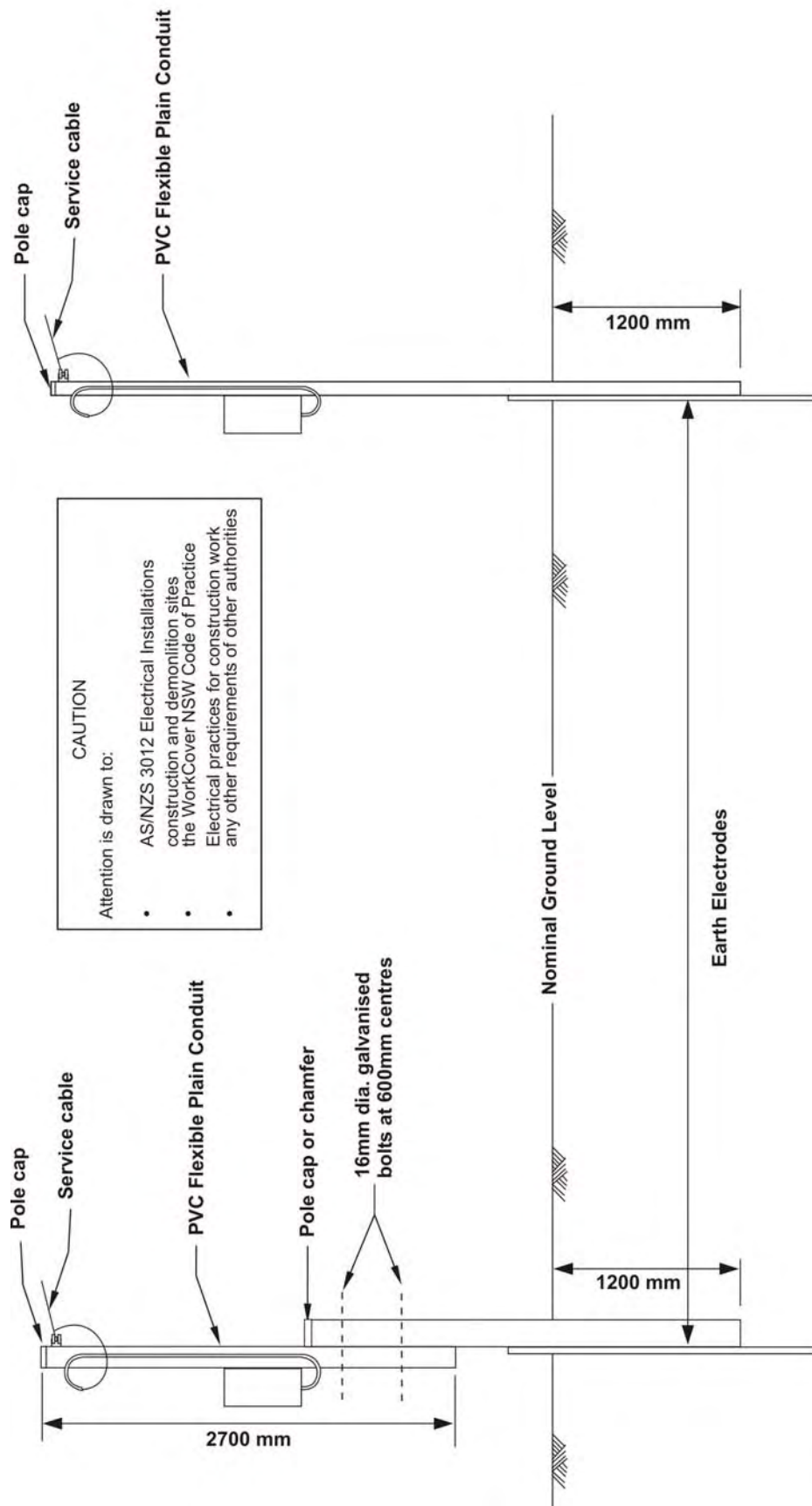
Refer to Section 2 - Underground Services.

3.10 AERIAL WIRING SYSTEM AS CONSUMERS MAINS

Aerial wiring systems on the load side of the point of supply are aerial consumers mains. Aerial consumers mains must comply with clause 3.3 and AS/NZS 3000.

If the form of construction of the aerial consumers mains is not covered by AS/NZS 3000 refer to publication ENA C(b)1- 2003 'Guidelines for the Design and Maintenance of Overhead Distribution and Transmission Lines'.

Figure 3.10: Typical Builders Service

**Notes:**

1. Pole should be positioned to ensure adequate overhead service line clearances.
2. These installations are acceptable for underground distribution systems.
3. The electrical installation must comply with the AS/NZS 3000.
4. Unprotected consumers mains associated with an overhead service line on a builder's service post/pole, may have a minimum size of 6mm² copper (maximum demand permitting) when installed in PVC flexible plain conduit to AS 2053 Part 4 - 1995.

3.11 MINIMUM SIZES OF POSTS, POLES AND STRUTS FOR OVERHEAD SERVICES

The following Tables specify the required sizes of conductor support structures. The Tables cover the standard overhead service conductors used in NSW. The conductor support structures covered are:

- (a) Timber posts and poles.
- (b) Square timber struts.
- (c) Angle iron struts.
- (d) Steel poles.
- (e) Steel square section.
- (f) Fabricated steel pole.

Table 3.8 gives the forces exerted by service lines. This is a function of:

- (g) The type of conductor being used.
- (h) The span length.
- (i) The design sag.

These factors combine to give the **normal tension of an overhead service in kN**. The last column of Table 3.8 indicates the minimum pole or strut strength required (S rating).

Using this strength rating refer to the following Tables 3.8 to 3.18 to select the appropriately sized post, pole or strut. Make sure the S rating selected from Tables 3.9 to 3.18 is equal or greater than the required S rating derived from Table 3.8.

Notes:

1. The free length to lowest conductor support shown in the tables is the distance between the lowest conductor support and:
 - i) the ground for a pole or post
 - ii) the closest fixing bolt on a structure for a strut.
2. Galvanised steel-pipe posts with outside diameters up to and including 165mm are Grade 250 - steel water pipe commercially available in 6.5m lengths. Posts specified with diameters of 168mm or greater are of Grade 350 structural steel circular hollow sections and may need to be specially ordered. The electricity distributor must assume that steel pipe posts, installed by contractors, are Grade 250, unless the contractor can substantiate otherwise.
3. Service spans above 30m for 1 x 95mm² or 2 x 95mm² (4 core LV ABC) must only be approved for connection to street mains, following an investigation by the electricity distributor. The tension of these overhead services, may damage the distribution system construction.
4. Any post/pole supporting an overhead service and aerial consumer mains must comply with the requirements of both AS/NZS 3000 and these Rules. It should comply with the most onerous of these requirements.

EXAMPLE 1

Problem:

Erect a 100A 3 phase service (using 1 x 25mm² Al 4 core LV ABC) a distance of 19 metres.

What:

- (a) Sag required for the span.
- (b) Height of conductor support to give clearances to ground or other structures.
- (c) Size structure is required.

Solution:

From Table 3.8

Pick:

- (a) 100A 3 phase from size of service column.
- (b) 1 x 25mm² Al from conductor size column.
- (c) 20m from span column.

Table 3.8 gives:

- (a) Normal tension of service line = 0.77 kN.
- (b) Maximum sag = 0.6m.
- (c) Minimum bracket strength rating = B1.
- (d) Minimum pole or strut strength rating = S11.

Table 3.4 gives:

- (a) Inspecting the route of the service line shows that 3m is required.
- (b) Adding 0.6m sag to 3m gives a free length to lowest conductor support = 3.6m.

If the structure is a **square hardwood post**:

- (a) Refer to Table 3.9.
- (b) For a free length to lowest conductor support of 3.6m.
- (c) Select an S rating of S11 or higher gives.
- (d) Minimum size is a 125mm x 125mm post.

If the structure is a **square hardwood strut (figure 3.7)**:

- (a) Refer to Table 3.10.
- (b) For a free length to lowest conductor support of say 1.4m to obtain clearances.
- (c) Select an S rating of S11 or higher.
- (d) Minimum size is 100mm x 100mm strut.

If the structure is an **angle iron strut grade 250**:

- (a) Refer to Table 3.12.
- (b) For a free length to lowest conductor support of 0.2m.
- (c) Select an S rating of S11 or higher gives.
- (d) Minimum size is 40mm x 40mm, thickness = 6mm.

Other conductor support structures are handled using the same method.

Table 3.8: Force Exerted by Overhead Service Lines

Size of Service	Service Line Conductor Size mm ²	Weight of Conductor (kg/m)	Service Line Span (m)	Normal Service Line Sag (m)	Maximum Allowable Service Line Sag (m)	Normal Service Line Tension (kN)	Minimum Service Line Breaking Tension (kN)	Minimum Bracket Strength (S rating)	Minimum Pole or Strut Strength Rating
100 A 1 phase	1 x 16 Cu Twisted Twin XLPE#	0.35	10	0.09	0.2	0.49	12.4	A1	S4
			15	0.17	0.4	0.58		A1	S7
			20	0.26	0.6	0.67		B1	S9
			30	0.43	1.0	0.92		B1	S13
			40	0.57	1.3	1.23		D1	S17
			50	0.73	2.0	1.50		D1	S20
	1 x 25 Al Twisted Twin XLPE	0.2	10	0.09	0.2	0.28	7	A1	S1
			15	0.17	0.4	0.33		A1	S2
			20	0.26	0.6	0.38		A1	S3
			30	0.43	1.0	0.52		A1	S5
			40	0.57	1.3	0.70		B1	S10
			50	0.73	2.0	0.86		B1	S12
100 A 3 phase	2 x 16 Cu Twisted Twin XLPE	0.7	10	0.09	0.2	0.97	24.8	B2	S14
			15	0.17	0.4	1.16		B2	S16
			20	0.26	0.6	1.35		D2	S18
			30	0.43	1.0	1.83		D2	S22
			40	0.57	1.3	2.46			S25
			50	0.73	2.0	3.00			S28
	1 x 25 Al 4 core LVABC	0.4	10	0.09	0.2	0.56	14	A1	S6
			15	0.17	0.4	0.66		B1	S8
			20	0.26	0.6	0.77		B1	S11
			30	0.43	1.0	1.05		B1	S15
			40	0.57	1.3	1.40		D1	S19
			50	0.73	2.0	1.71		D1	S21
200 A 3 phase	1 x 95 Al 4 core LVABC	1.35	10	0.09	0.2	1.88	53.2	D1	S23
			15	0.17	0.4	2.23			S24
			20	0.26	0.6	2.57			S26
			30	0.59	1.0	2.57			S26
			40	1.05	1.3	2.57			S26
			50	1.64	2.0	2.57			S26
300/400 A 3 phase	2 x 95 Al 4 core LVABC	2.7	10	0.09	0.2	3.75	106.4		S29
			15	0.17	0.4	4.47			S30
			20	0.26	0.6	5.14			S31
			30	0.59	1.0	5.14			S31
			40	1.05	1.3	5.14			S31
			50	1.64	2.0	5.14			S31

Note: **Maximum allowable service line sag (m):** has to be allowed for when determining adequate clearances (refer to Note 3 of Table 3.4).

Data provided for reference and for alterations where the service doesn't need to be extended. Refer clause 3.1.5.1 and Table 3.1.

Table 3.9: Square Hardwood Post (100MPa timber to AS 2209) Strength Ratings

Free length to lowest conductor support (m)	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground
	100mm x 100mm	100mm x 100mm	125mm x 125mm	125mm x 125mm	150mm x 150mm	150mm x 150mm	175mm x 175mm	175mm x 175mm	200mm x 200mm	200mm x 200mm
3.0	S7	S7	S17	S17	S20	S24	S21	S29	S23	S29
3.3	S4	S4	S15	S15	S19	S23	S20	S28	S22	S29
3.6	S3	S3	S14	S14	S17	S22	S19	S26	S20	S28
3.9			S12	S12	S15	S20	S17	S26	S20	S28
4.2			S10	S10	S19	S19	S22	S25	S23	S29
4.5			S8	S8	S18	S18	S20	S24	S23	S28
4.8			S7	S7	S16	S16	S20	S23	S21	S28
5.1			S4	S4	S15	S15	S19	S23	S20	S28
5.4			S3	S3	S13	S13	S17	S21	S20	S26
5.7			S3	S3	S12	S12	S20	S20	S20	S26
6.0					S11	S11	S18	S19	S20	S24
6.3					S10	S10	S17	S17	S19	S23
6.6					S7	S7	S16	S16	S17	S23
6.9					S5	S5	S15	S15	S17	S22
7.2					S3	S3	S14	S14	S15	S20

Table 3.10: Square Hardwood Struts (100MPa timber to AS 2209) Strength Ratings

Free length to lowest conductor support (m)	100mm x 100mm	125mm x 125mm	150mm x 150mm	175mm x 175mm	200mm x 200mm
0.3					
0.6	S29				
0.9	S27	S32			
1.2	S23	S29	S32		
1.5	S20	S28	S32		
1.8	S17	S25	S29		
2.1	S14	S23	S29	S32	
2.4	S12	S21	S28	S32	
2.7	S10	S20	S27	S30	
3	S7	S18	S25	S29	S32

Table 3.11: Round Hardwood Pole (100MPa timber to AS 2209) Strength Ratings

Free length to lowest conductor support (m)	Height reduced from base 8m/2kN	Height reduced from base 8m/4kN	Height reduced from base 8m/6kN	Height reduced from base 9.5m/2kN	Height reduced from base 9.5m/4kN	Height reduced from base 9.5m/6kN
3.0	S23	S29	S32	S23	S29	S32
3.3	S23	S29	S32	S23	S29	S32
3.6	S23	S29	S32	S23	S29	S32
3.9	S23	S29	S32	S23	S29	S32
4.2	S23	S29	S32	S23	S29	S32
4.5	S23	S29	S32	S23	S29	S32
4.8	S23	S29	S32	S23	S29	S32
5.1	S23	S29	S32	S23	S29	S32
5.4	S23	S29	S32	S23	S29	S32
5.7	S23	S29	S32	S23	S29	S32
6.0	S23	S29	S32	S23	S29	S32
6.3	S23	S29	S32	S23	S29	S32
6.6		S29	S32	S23	S29	S32
6.9		S29	S32	S23	S29	S32
7.2		S29	S32	S23	S29	S32

Free length to lowest conductor support (m)	Height reduced from top 8m/2kN	Height reduced from top 8m/4kN	Height reduced from top 8m/6kN	Height reduced from top 9.5m/2kN	Height reduced from top 9.5m/4kN	Height reduced from top 9.5m/6kN
3.0	S29			S32		
3.3	S29			S30		
3.6	S28			S29		
3.9	S28	S32		S29		
4.2	S28	S32		S29		
4.5	S27	S32		S28		
4.8	S27	S32		S28	S32	
5.1	S25	S30		S28	S32	
5.4	S24	S30	S32	S27	S32	
5.7	S23	S29	S32	S27	S32	
6.0	S23	S29	S32	S27	S32	
6.3	S23	S29	S32	S25	S30	
6.6				S24	S30	
6.9				S24	S30	S32
7.2				S23	S29	S32

Notes:

- Height reduced from top:** A standard pole is reduced in length by cutting off a section from the top of the pole.
- Height reduced from base:** A standard pole is reduced in length by cutting off a section from the bottom of the pole.
- The Table shows, reducing the height from the:
 - top increases the kN rating of the pole
 - bottom results in an unchanged kN rating of the pole.

Table 3.12: Angle Iron Struts Grade 250
(cross-section dimensions x thickness (mm)) Strength Ratings

Free length to lowest conductor support (m)	25x25 x 6	30x30 x 5	30x30 x 6	40x40 x 3	40x40 x 5	40 x 40 x 6	45x45 x 3	45x45 x 5	45x45 x 6
0.3	S1	S2	S3	S3	S10	S12	S7	S13	S16
0.6					S2	S3	S1	S3	S6
0.9								S1	S2
1.2									
1.5									
1.8									
2.1									
2.4									
2.7									
3									

Free length to lowest conductor support (m)	50x50 x 3	50x50 x 5	50x50 x 6	50x50 x 8	55x55 x 5	55 x 55 x 6	65 x 65 x 5	65 x 65 x 6	65 x 65 x 8	65 x 65 x 10
0.3	S10	S16	S20	S21	S19	S24	S23	S27	S28	S29
0.6	S2	S7	S10	S12	S10	S16	S14	S17	S20	S23
0.9		S2	S3	S6	S3	S10	S7	S11	S15	S17
1.2			S2	S3	S1	S5	S3	S7	S11	S12
1.5				S1		S3	S2	S3	S7	S9
1.8						S1		S2	S3	S5
2.1								S1	S3	S3
2.4									S1	S2
2.7										S1
3										

Free length to lowest conductor support (m)	75 x 75 x 5	75 x 75 x 6	75 x 75 x 8	75 x 75 x 10	90 x 90 x 6	90 x 90 x 8	90 x 90 x 10	100 x 100 x 6	100 x 100 x 8	100 x 100 x 10	100 x 100 x 12
0.3	S26	S28	S30	S32	S30	S32		S32			
0.6	S17	S21	S24	S27	S24	S28	S29	S27	S29	S30	S32
0.9	S11	S15	S19	S21	S20	S23	S27	S23	S27	S28	S29
1.2	S7	S11	S15	S17	S16	S20	S23	S19	S23	S24	S27
1.5	S3	S7	S11	S14	S12	S16	S20	S15	S20	S23	S24
1.8	S2	S4	S8	S11	S10	S14	S16	S12	S17	S20	S23
2.1		S3	S5	S7	S7	S11	S14	S10	S14	S17	S20
2.4		S1	S3	S5	S3	S9	S11	S7	S11	S15	S17
2.7			S2	S3	S3	S6	S10	S3	S10	S13	S16
3			S1	S2	S1	S3	S7	S3	S7	S11	S14

**Table 3.13: Angle Iron Struts Grade 300 Strength Ratings
(cross-section dimensions x thickness (mm))**

Free length to lowest conductor support (m)	125 x 125 x 8	125 x 125 x 10	125 x 125 x 12	125 x 125 x 16	150 x 150 x 10	150 x 150 x 12	150 x 150 x 16	150 x 150 x 19	200 x 200 x 13
0.3									
0.6									
0.9	S30	S32							
1.2	S28	S30	S32		S32				
1.5	S27	S28	S30	S32	S32	S32			
1.8	S24	S28	S28	S30	S29	S32			
2.1	S23	S27	S28	S29	S28	S30	S32	S32	
2.4	S21	S24	S27	S28	S28	S29	S32	S32	
2.7	S20	S23	S25	S28	S27	S28	S30	S30	S32
3	S19	S21	S23	S27	S25	S28	S29	S30	S32

Table 3.14: Fabricated Riverton Octagonal Steel Pole Strength Ratings

Free length to lowest conductor support (m)	Octagonal Pole
3.0	
3.3	
3.6	
3.9	
4.2	
4.5	
4.8	S16
5.1	S16
5.4	

Note: These poles should not be modified.

Table 3.15: Grade 250 Steel Pipe (diameter x thickness (mm)) Strength Ratings

Free length to lowest conductor support (m)	34 x 3.2	34 x 4	34 x 4.5	42 x 3.2	42 x 4	42 x 4.9	48 x 3.2	48 x 4	48 x 5.4	60 x 3.6	60 x 4.5	60 x 5.4	76 x 3.6
0.3	S15	S17	S19	S22	S23	S26	S24	S27	S28	S29	S32	S32	
0.6	S5	S7	S10	S12	S15	S17	S16	S19	S22	S23	S27	S28	S28
0.9	S2	S3	S3	S7	S10	S11	S11	S13	S17	S19	S21	S23	S24
1.2		S1	S2	S3	S5	S7	S7	S10	S12	S15	S17	S20	S21
1.5				S2	S3	S4	S3	S6	S10	S11	S14	S16	S18
1.8					S1	S2	S2	S3	S7	S9	S11	S14	S15
2.1							S1	S2	S3	S6	S10	S11	S13
2.4									S2	S3	S7	S10	S11
2.7										S3	S4	S6	S10
3										S2	S3	S3	S7
3.3											S2	S2	S5
3.6												S1	S3
3.9													S3
4.2													S2
4.5													S1

Free length to lowest conductor support (m)	76 x 4.5	76 x 5.9	89 x 4	89 x 5	89 x 5.9	102 x 4	102 x 5	114 x 4.5	114 x 5.4	140 x 5	140 x 5.4	165 x 5	165 x 5.4
0.6	S29	S32	S32			S32							
0.9	S27	S28	S28	S30	S30	S29	S32	S32					
1.2	S23	S27	S27	S28	S29	S28	S29	S30	S32				
1.5	S20	S23	S23	S27	S28	S26	S28	S29	S30	S32			
1.8	S18	S21	S21	S24	S25	S23	S27	S28	S29	S32	S32		
2.1	S16	S20	S19	S23	S23	S21	S24	S27	S28	S30	S30	S32	
2.4	S14	S17	S17	S20	S21	S20	S23	S24	S27	S29	S29	S32	S32
2.7	S12	S15	S15	S19	S20	S18	S22	S23	S25	S28	S29	S31	S32
3	S11	S14	S14	S17	S19	S16	S20	S23	S24	S28	S28	S30	S30
3.3	S9	S12	S12	S16	S17	S15	S19	S20	S23	S27	S28	S29	S30
3.6	S7	S10	S11	S14	S15	S13	S17	S20	S22	S27	S27	S29	S29
3.9	S4	S7	S10	S12	S14	S12	S16	S18	S20	S24	S27	S28	S28
4.2	S3	S5	S7	S11	S12	S11	S15	S17	S20	S23	S24	S28	S28
4.5	S2	S3	S5	S9	S11	S10	S14	S16	S19	S23	S23	S27	S28
4.8	S2	S3	S4	S7	S9	S7	S12	S15	S17	S22	S23	S27	S27
5.1	S1	S2	S3	S5	S7	S7	S11	S14	S16	S21	S22	S25	S27
5.4		S1	S3	S3	S5	S5	S10	S12	S15	S20	S21	S24	S25
5.7		S1	S2	S3	S3	S3	S7	S11	S14	S19	S20	S23	S24
6			S1	S3	S3	S3	S7	S10	S12	S18	S20	S23	S23
6.3			S1	S2	S3	S3	S5	S9	S11	S17	S19	S23	S23
6.6				S1	S2	S2	S3	S7	S10	S16	S17	S21	S23
6.9				S1	S2	S1	S3	S7	S9	S15	S16	S20	S21
7.2					S1		S3	S5	S7	S14	S15	S20	S20

Table 3.16: Grade 350 Steel Pipe (diameter x thickness (mm)) Strength Ratings

Conductor Support (m)	34 x 2	34 x 2.6	42 x 2	42 x 2.6	48 x 2.3	48 x 2.9	60 x 2.3	60 x 2.9	76 x 2.3	76 x 2.9	89 x 2.6	89 x 3.2	89 x 4.8	89 x 5.5	102 x 2.6	102 x 3.2	114 x 3.2	114 x 3.6	114 x 4.8	114 x 6	140 x 3	140 x 3.5	165 x 3	165 x 3.5	168 x 4.8	168 x 6.4	219 x 4.8	219 x 6.4
0.3	S15	S17	S21	S23	S25	S28	S29	S30	S32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.6	S5	S7	S11	S15	S17	S20	S23	S25	S28	S29	S30	S32	-	-	S32	S32	S32	-	-	-	-	-	-	-	-	-	-	-
0.9	S2	S3	S5	S10	S11	S14	S17	S20	S23	S27	S28	S29	S32	S32	S29	S30	S30	S32	-	-	-	-	-	-	-	-	-	-
1.2	-	-	S3	S4	S7	S10	S14	S16	S20	S23	S25	S28	S29	S30	S28	S29	S30	S32	-	-	S32	-	-	-	-	-	-	-
1.5	-	-	-	S1	S3	S5	S11	S13	S17	S21	S23	S24	S28	S29	S26	S28	S29	S30	S32	-	S32	S32	-	-	-	-	-	-
1.8	-	-	-	-	S1	S2	S7	S10	S14	S19	S20	S23	S27	S28	S23	S27	S28	S29	S30	S32	S30	S32	-	-	-	-	-	-
2.1	-	-	-	-	-	-	S3	S6	S12	S16	S18	S20	S25	S27	S21	S24	S27	S28	S29	S32	S29	S30	S32	-	-	-	-	-
2.4	-	-	-	-	-	-	S2	S3	S10	S14	S16	S19	S23	S24	S20	S23	S25	S27	S28	S29	S28	S29	S30	S32	-	-	-	-
2.7	-	-	-	-	-	-	S1	S2	S6	S11	S14	S17	S21	S23	S18	S20	S23	S24	S28	S29	S27	S28	S29	S30	-	-	-	-
3	-	-	-	-	-	-	-	-	S3	S7	S11	S14	S19	S20	S16	S20	S23	S23	S27	S28	S27	S28	S29	S32	-	-	-	-
3.3	-	-	-	-	-	-	-	-	S3	S5	S10	S11	S16	S17	S15	S17	S21	S23	S27	S28	S24	S27	S28	S29	S32	-	-	-
3.6	-	-	-	-	-	-	-	-	S1	S3	S7	S10	S14	S15	S12	S15	S20	S21	S24	S27	S23	S27	S28	S29	S32	-	-	-
3.9	-	-	-	-	-	-	-	-	-	S2	S4	S7	S12	S14	S10	S13	S17	S19	S20	S24	S23	S24	S27	S28	S30	-	-	-
4.2	-	-	-	-	-	-	-	-	-	-	S3	S5	S10	S11	S7	S11	S15	S17	S20	S23	S21	S23	S24	S27	S30	S32	-	-
4.5	-	-	-	-	-	-	-	-	-	-	S1	S3	S7	S10	S6	S9	S14	S15	S19	S21	S20	S23	S24	S27	S29	S32	S32	-
4.8	-	-	-	-	-	-	-	-	-	-	S2	S3	S6	S7	S4	S7	S12	S14	S17	S20	S19	S21	S23	S25	S29	S32	S32	-
5.1	-	-	-	-	-	-	-	-	-	-	S1	S2	S4	S6	S3	S5	S11	S12	S15	S18	S18	S20	S23	S24	S28	S30	S32	-
5.4	-	-	-	-	-	-	-	-	-	-	-	S1	S3	S4	S3	S3	S9	S11	S14	S16	S16	S19	S21	S23	S28	S29	S32	-
5.7	-	-	-	-	-	-	-	-	-	-	-	S1	S3	S3	S2	S3	S7	S9	S12	S15	S15	S17	S20	S23	S27	S29	S32	-
6	-	-	-	-	-	-	-	-	-	-	-	-	S2	S3	S1	S3	S6	S7	S11	S14	S14	S15	S20	S23	S27	S29	S30	-
6.3	-	-	-	-	-	-	-	-	-	-	-	-	-	S2	S1	S2	S4	S6	S10	S12	S12	S14	S19	S21	S24	S28	S30	S32
6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	S1	-	S1	S3	S5	S9	S11	S11	S13	S17	S20	S24	S28	S29	S32
6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	S1	-	S1	S3	S3	S7	S10	S10	S12	S16	S19	S23	S27	S29	S32
7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	S1	-	-	S3	S3	S6	S9	S9	S11	S15	S17	S23	S27	S29	S32

Table 3.17: Grade 350 Steel Square Section (width x thickness (mm)) Strength Ratings

Free length to lowest conductor support (m)	30 x 2	30 x 2.5	30 x 3	35 x 1.6	35 x 2	35 x 2.5	35 x 3	40 x 1.6	40 x 2	40 x 2.5	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.5	50 x 3	50 x 4	50 x 5	65 x 2	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6
0.3	S12	S15	S17	S14	S20	S19	S21	S17	S20	S23	S24	S27	S23	S26	S28	S28	S30	S32	S29	S32	S32			
0.6	S3	S5	S7	S4	S11	S10	S11	S7	S11	S14	S15	S19	S13	S17	S20	S22	S25	S27	S23	S27	S28	S29	S30	S32
0.9	S1	S2	S3	S1	S5	S3	S6	S3	S5	S7	S10	S13	S7	S11	S14	S16	S20	S22	S17	S21	S23	S27	S28	S29
1.2					S2	S2	S3	S1	S2	S3	S5	S10	S3	S7	S10	S12	S16	S18	S14	S17	S20	S23	S25	S27
1.5							S1		S1	S2	S3	S5	S2	S3	S7	S10	S13	S15	S10	S14	S17	S20	S23	S24
1.8										S1	S1	S2		S2	S3	S6	S11	S12	S7	S11	S14	S17	S20	S23
2.1														S1	S3	S3	S7	S9	S4	S10	S11	S15	S18	S20
2.4															S1	S3	S3	S4	S3	S7	S10	S13	S16	S18
2.7																S1	S2	S3	S2	S4	S7	S11	S14	S15
3																	S1	S2	S1	S3	S5	S10	S11	S12
3.3																				S2	S3	S7	S9	S10
3.6																				S1	S3	S4	S6	S7
3.9																					S2	S3	S4	S5
4.2																					S1	S2	S3	S3
4.5																						S1	S2	S3
4.8																						S1	S1	S2
5.1																							S1	S1
5.4																								S1

Free length to lowest conductor support (m)	75 x 2.5	75 x 3	75 x 3.5	75 x 4	75 x 5	75 x 6	89 x 3.5	89 x 5	89 x 6	100 x 3	100 x 4	100 x 5	100 x 6	100 x 9	125 x 4	125 x 5	125 x 6	125 x 9	150 x 5	150 x 6	150 x 9	200 x 5	200 x 6	200 x 9
0.3	S32																							
0.6	S28	S29	S30	S32	S32																			
0.9	S24	S27	S28	S29	S30	S32	S30	S32		S30	S32													
1.2	S20	S23	S24	S27	S28	S29	S28	S30	S32	S28	S30	S32												
1.5	S17	S20	S23	S24	S27	S28	S27	S29	S30	S27	S29	S30	S32		S32									
1.8	S15	S18	S20	S22	S24	S27	S24	S28	S29	S24	S28	S29	S30	S32	S30	S32								
2.1	S12	S15	S17	S20	S23	S23	S23	S27	S28	S23	S27	S28	S29	S32	S29	S32	S32							
2.4	S10	S14	S15	S17	S20	S23	S20	S24	S27	S20	S24	S28	S28	S30	S28	S30	S32		S32					
2.7	S7	S11	S14	S16	S19	S20	S19	S23	S24	S19	S23	S27	S28	S30	S28	S29	S30		S32					
3	S6	S10	S12	S14	S17	S19	S17	S21	S23	S17	S23	S24	S27	S29	S27	S29	S30	S32	S32	S32				
3.3	S3	S7	S10	S12	S15	S17	S15	S20	S23	S15	S20	S23	S25	S28	S25	S28	S29	S32	S30	S32				
3.6	S3	S6	S9	S11	S13	S14	S14	S19	S21	S13	S20	S23	S24	S28	S24	S28	S28	S32	S29	S32		S32		
3.9	S2	S4	S7	S9	S11	S12	S12	S17	S20	S11	S18	S21	S23	S28	S23	S27	S28	S30	S29	S30		S32		
4.2	S1	S3	S5	S7	S9	S11	S11	S16	S18	S10	S17	S20	S23	S27	S22	S26	S28	S30	S28	S30	S32	S32		
4.5		S3	S3	S4	S7	S9	S10	S15	S16	S9	S15	S19	S21	S24	S20	S24	S27	S29	S28	S29	S32	S31		
4.8		S2	S3	S3	S5	S7	S7	S13	S15	S7	S14	S17	S20	S23	S20	S23	S27	S29	S28	S29	S32	S30	S32	
5.1		S1	S2	S3	S3	S5	S6	S11	S13	S5	S12	S16	S18	S21	S19	S23	S24	S28	S27	S28	S32	S29	S32	
5.4			S1	S2	S3	S3	S4	S10	S11	S3	S11	S15	S16	S20	S17	S22	S24	S28	S27	S28	S30	S29	S32	
5.7				S1	S2	S3	S3	S7	S10	S3	S10	S13	S15	S19	S16	S20	S23	S28	S25	S28	S30	S29	S32	
6				S1	S2	S3	S3	S7	S9	S2	S9	S12	S14	S17	S15	S20	S23	S27	S24	S27	S30	S28	S30	
6.3					S1	S2	S2	S5	S7	S1	S7	S11	S12	S16	S14	S19	S21	S25	S23	S27	S29	S28	S30	
6.6						S1	S1	S4	S5		S5	S10	S11	S15	S12	S17	S20	S24	S23	S26	S29	S28	S29	
6.9						S1		S3	S4		S3	S8	S10	S14	S11	S17	S20	S23	S22	S24	S29	S27	S29	
7.2								S3	S3		S3	S7	S9	S12	S10	S15	S19	S23	S20	S24	S28	S27	S29	S32

Table 3.18: Grade 450 Steel Square Section (width x thickness (mm)) Strength Ratings

Free length to lowest conductor support (m)	30 x 1.6	30 x 2	35 x 1.6	35 x 2	35 x 2.3	35 x 2.5	35 x 2.8	35 x 3	40 x 1.6	40 x 2	40 x 2.3	40 x 2.5	40 x 2.8	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.3	50 x 2.5	50 x 2.8	50 x 3	50 x 4
0.3	S13	S15	S17	S20	S21	S23	S23	S24	S20	S23	S24	S25	S27	S27	S29	S24	S28	S29	S29	S30	S30	S32
0.6	S3	S6	S7	S11	S12	S13	S14	S15	S11	S14	S16	S17	S18	S19	S22	S15	S20	S23	S23	S24	S24	S28
0.9	S1	S2	S3	S4	S6	S7	S9	S10	S5	S9	S11	S11	S12	S14	S17	S10	S15	S17	S17	S19	S20	S23
1.2			S1	S2	S3	S3	S3	S3	S4	S6	S7	S9	S10	S11	S5	S11	S12	S14	S15	S15	S19	
1.5							S1	S1	S1	S2	S3	S3	S3	S3	S5	S3	S7	S10	S10	S11	S12	S15
1.8												S1	S1	S1	S2	S2	S4	S6	S7	S7	S9	S11
2.1																	S2	S3	S3	S3	S4	S7
2.4																	S1	S1	S2	S2	S3	S3
2.7																				S1	S1	S2
3																						S1

Free length to lowest conductor support (m)	50 x 5	65 x 2	65 x 2.3	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6	75 x 2	75 x 2.3	75 x 2.5	75 x 3	75 x 3.5	75 x 4	75 x 5	75 x 6	100 x 3	100 x 4	100 x 5	100 x 6
0.3		S30	S32	S32					S32											
0.6	S28	S24	S27	S28	S29	S32	S32		S27	S28	S29	S32	S32							
0.9	S24	S20	S23	S24	S27	S28	S29	S30	S23	S24	S27	S28	S29	S30	S32	S32	S32			
1.2	S21	S16	S19	S20	S23	S27	S28	S29	S19	S21	S23	S27	S28	S28	S29	S30	S29	S32		
1.5	S17	S12	S15	S17	S20	S23	S25	S27	S15	S19	S20	S23	S25	S27	S28	S29	S28	S30	S32	
1.8	S12	S10	S13	S15	S17	S21	S23	S24	S12	S15	S17	S21	S23	S24	S27	S28	S27	S29	S32	S32
2.1	S9	S7	S10	S12	S15	S19	S20	S22	S10	S13	S15	S19	S21	S23	S24	S27	S24	S28	S30	S32
2.4	S4	S4	S7	S10	S12	S15	S17	S19	S7	S11	S13	S17	S19	S20	S23	S24	S23	S28	S29	S30
2.7	S3	S3	S5	S7	S10	S12	S14	S15	S5	S9	S11	S15	S17	S19	S20	S22	S20	S27	S28	S29
3	S2	S2	S3	S4	S7	S10	S11	S12	S3	S7	S9	S13	S14	S15	S17	S19	S19	S24	S28	S28
3.3		S1	S3	S3	S3	S7	S9	S10	S2	S4	S7	S10	S11	S13	S15	S17	S17	S23	S27	S28
3.6			S1	S2	S3	S4	S6	S7	S1	S3	S4	S7	S10	S11	S13	S14	S15	S23	S24	S27
3.9			S1	S1	S2	S3	S4	S5		S2	S3	S5	S7	S9	S11	S12	S14	S21	S23	S24
4.2					S1	S2	S3	S3		S1	S3	S3	S5	S7	S9	S11	S12	S19	S21	S23
4.5						S1	S2	S3			S2	S3	S3	S4	S7	S9	S11	S17	S20	S21
4.8						S1	S1	S2				S2	S3	S3	S5	S7	S10	S15	S18	S20
5.1							S1	S1				S1	S2	S3	S3	S5	S7	S14	S16	S18
5.4								S1				S1	S1	S2	S3	S3	S5	S12	S15	S16
5.7													S1	S1	S2	S3	S3	S11	S13	S15
6														S1	S2	S3	S3	S10	S12	S14
6.3															S1	S2	S2	S8	S11	S12
6.6																S1		S7	S10	S11
6.9																S1		S5	S8	S10
7.2																		S4	S7	S9

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