STRUCTURAL DESIGN OF ROAD SIGNS

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VOLUME SET	R		
Chapter 1	R	Chapter 11	R
Chapter 2	R	Chapter 12	R
Chapter 3	R	Chapter 13	R
Chapter 4	R	Chapter 14	R
Chapter 5	R	Chapter 15	R
Chapter 6	R	Chapter 16	R
Chapter 7	R	Chapter 17	R
Chapter 8	R	Chapter 18	R
Chapter 9	R	Chapter 19	R
Chapter 10	R		

CHAPTER 15:
STRUCTURAL DETAILS OF ROAD SIGNS

CONTENTS

15.0.1 Sections and Subsections

15.0.2 Figures

15.0.3 Tables

CHAPTER 15:
STRUCTURAL DETAILS OF ROAD SIGNS

15.1 INTRODUCTION

15.1.1 General

1 This chapter provides guidelines for the adequate and safe provision of road signs and their support structures, including the fastenings required to hold the component parts of the signs together as an integrated structure, able to withstand various environmental conditions such as the climate, loadings and vandalism.

2 A range of environmental conditions may affect the type of sign and support structure recommended for a certain location. The most relevant factors are:

(a) climatic/weather conditions normally pertaining in environments such as - coastal, desert, forest, pollution, snow/ice, and wind;

(b) the complexity of the immediate environment i.e. urban, suburban, rural, nature conservation area;

(c) road factors i.e. road class, speed limit, lane configuration, geometry;

(d) road side conditions such as cut or fill, soil types, sidewalks (paved or otherwise) illumination;

(e) clearances available for ground-mounted or overhead signs (longitudinal, lateral and vertical);

(f) safety considerations for the road user in terms of visibility, retroreflectivity, frangibility.

3 Desirable characteristics of complete sign structures are also:

(a) limited material, installation and maintenance costs;

(b) ease of installation in terms of manpower and equipment requirements;

(c) readily available materials;

(d) an acceptable level of safety compromise, in that the sign structure is sufficiently frangible to limit impact hazard but is strong enough to limit vandalism.

4 The environmental, location, and safety considerations are discussed further in Section 15.2 in terms of their influence on the choice of materials. Sections 15.3 to 15.6 deal with the choices of materials for each of the main component parts which make up the whole sign structure.

15.1.2 Scope of Coverage

1 The chapter contains detail relevant to the smallest and largest road signs according to classified types, and according to their two most common mounting positions, namely ground mounted, to the side of the roadway, and overhead, above the roadway.

2 The size and shape of signs, determined by their function and operating environment, dictates the type of support structure required. The function and location also determines the signface colours, and whether the signface is retroreflective, semi-matt or even illuminated.

3 The main thrust of the contents of the chapter is to discuss the available methodologies for the planning, design, construction and implementation of new road signs of all types.

4 REGULATORY and WARNING signs comprise what are normally considered small signs, although there are other small sign types. The functional details of these classes of sign are covered in Volume 1, in Chapters 2 and 3 respectively, and their signface dimensional details are covered in the same chapters in Volume 4. The application of Regulatory and Warning signs is covered in Volume 2, Chapter 3. Single Regulatory and Warning signs are normally ground mounted, requiring only one SUPPORT POLE. This could be a FREE-STANDING POLE specific to the sign, or a HOST SUPPORT POLE like an existing street light pole. Signs such as these, with an area of 1,5 m^2 or less, do not require extensive BACK PLATE stiffening, often having only two horizontal struts at the rear. (Signs with an area in the region of 1,5 m^2 may occasionally require two supports depending on the type of support being used and the prevailing wind levels.)

5 Small GUIDANCE signs such as some LOCATION (STREET NAME sign GL1) signs, ROUTE MARKER signs, and TRAILBLAZER signs may also only require a single support pole. The more common medium sized LOCATION, DIRECTION, TOURISM, LOCAL DIRECTION and DIAGRAMMATIC signs will normally require two supports, and occasionally three, without diagonal bracing poles. These signs will be sized in the range 1,5 m^2 to 8 m^2 and will require more extensive BACK PLATE stiffening in the form of framing and reinforcing. Because of this the weight increases and wind load, impact load and imposed loads must be recognised and planned for. Details of the functions of individual Guidance sign types are covered in Volume 1, Chapter 4, and their dimensions are given in Volume 4, Chapters 4 to 8.

6 Large ground mounted GUIDANCE signs are occasionally specified and these are likely to require three or even four SUPPORTING POLES which may well need to be braced if the sign height dictates. These signs, which may range in area from 8 m^2 to over 20 m^2, require extensive framing and reinforcing to the BACK PLATE, to resist wind and other loads. The mass and size of the sign dictate bigger and heavier support structures, impact safety concepts such as breakaway bases, and stronger, and heavier, fastening brackets for

connecting the component parts of the sign together.

7 Any of the sign types mentioned above could be mounted on overhead support structures if the location and environment warrant such mounting. Overhead signs are generally used on roads carrying heavy volumes of traffic, with more than two lanes in each direction, for the following reasons, either singly or in combination:

(a) when a message is applicable to one or more specific lanes, but not necessarily all lanes;

(b) where traffic, due to its sheer numbers or the frequency of large vehicles, or both, will result in ground mounted signs being regularly obscured for many drivers;

(c) when there is no space for signs at the side of the road;

(d) where the positioning of a ground mounted sign may represent an unacceptable hazard.

8 The support structure for overhead signs, being more complex in form and design, requires extensive planning and design of the signboard BACK PLATE, the STRUCTURE, the FIXINGS, and the FOUNDATION for the supports. Support structures may be any of the following types:

(a) simple to heavy portal structures;

(b) simple to heavy cantilever structures;

(c) host structures such as existing bridges.

Portal and cantilever structures can be manufactured to a number of basic structure types, such as sections, trusses, trestles and cable, or cable-stayed structures.

9 VARIABLE MESSAGE signs are likely to play an increasing safety and traffic management role, on freeways and other strategically important roads, particularly in metropolitan areas, and areas subject to severe weather patterns. These signs perform a critical function by providing drivers with real-time information. VARIABLE MESSAGE signs may be supported in the same way as any other form of sign and they can be relatively small in size or fairly large. Due to the nature of their manufacture they are always likely to be heavier that conventional signs and their construction is likely to be specialised. As such, aspects of their construction is illustrated in this chapter, but is not covered in depth. Due to the fact that they are most commonly warranted when traffic volumes are high they are likely to be most commonly supported on overhead structures. A common prerequisite for the provision of VARIABLE MESSAGE signs is an electricity supply. VARIABLE MESSAGE signs are dealt with in detail in Volume 1, Chapter 9 and their application is covered in Volume 2, Chapter 19.

10 Whilst most of the above-mentioned sign types and structures are for new sign applications, certain structural changes may be necessary to existing signs. The most likely modifications to existing signs are:

(a) fixing cover plates, either blank or containing revised text, over existing incorrect text;

(b) fixing of adhesive "stickers", either blank or containing revised text, over existing incorrect text;

(c) adding or removing of one or more panels to correct messages on signfaces;

(d) replacing damaged or updated parts of signs and structures;

(e) recycling and re-erecting complete signs.

11 Figures 15.1 to 15.3 illustrate the basic sign types discussed above.

12 Signs may be mounted in the two basic positions, ground mounted or overhead, on supports of the following material types:

(a) timber poles;

(b) steel tubes or rolled sections;

(c) aluminium tubes or rolled sections;

(d) fabricated steel supports.

13 These support materials may have the following types of cross-section:

(a) circular (or approximately so in the case of timber poles);

(b) square section;

(c) D-section;

(d) I or U channel section;

(e) welded lattice frame;

(g) welded box sections.

14 The more commonly used sign support structure types are shown in Figures 15.4 and 15.5, and the structural design process is illustrated in a flow chart form in Figure 15.6.

15.1.3 Objectives

1 The primary objective of this chapter is to assist those involved with the design of signs and sign structures. The chapter thus provides guidelines for the adequate and safe design of road signs and their support structures, including the fastening of the component parts together into an integrated structure able to withstand wind, impact and other loads. Since vandalism is a significant problem, it has also been an objective to provide measures to safeguard signs from vandalism.

2 It has been a particular objective to include the widest possible coverage of the various materials which may be chosen to manufacture the components such as the back plates, fasteners supports, and foundations, and to identify their advantages and disadvantages. This approach, coupled with various methods of design, should enable the best solution to be found for a particular problem.

3 Although coverage of the chapter is extensive, to the extent that some materials and methods used in other countries are included, there will always be a place for the purpose designed sign structure to suit specific requirements or environments.

15.1.4 The Component Parts of a Sign Structure

1 A road sign structure consists of the following parts:

(a) the SIGNFACE;

(b) the BACK PLATE or SIGN BOARD;

(c) the SIGN SUPPORTS;

(d) the SUPPORT FOUNDATIONS;

(e) the FASTENINGS or MOUNTING BRACKETS.

(continued on page 15.1.8)

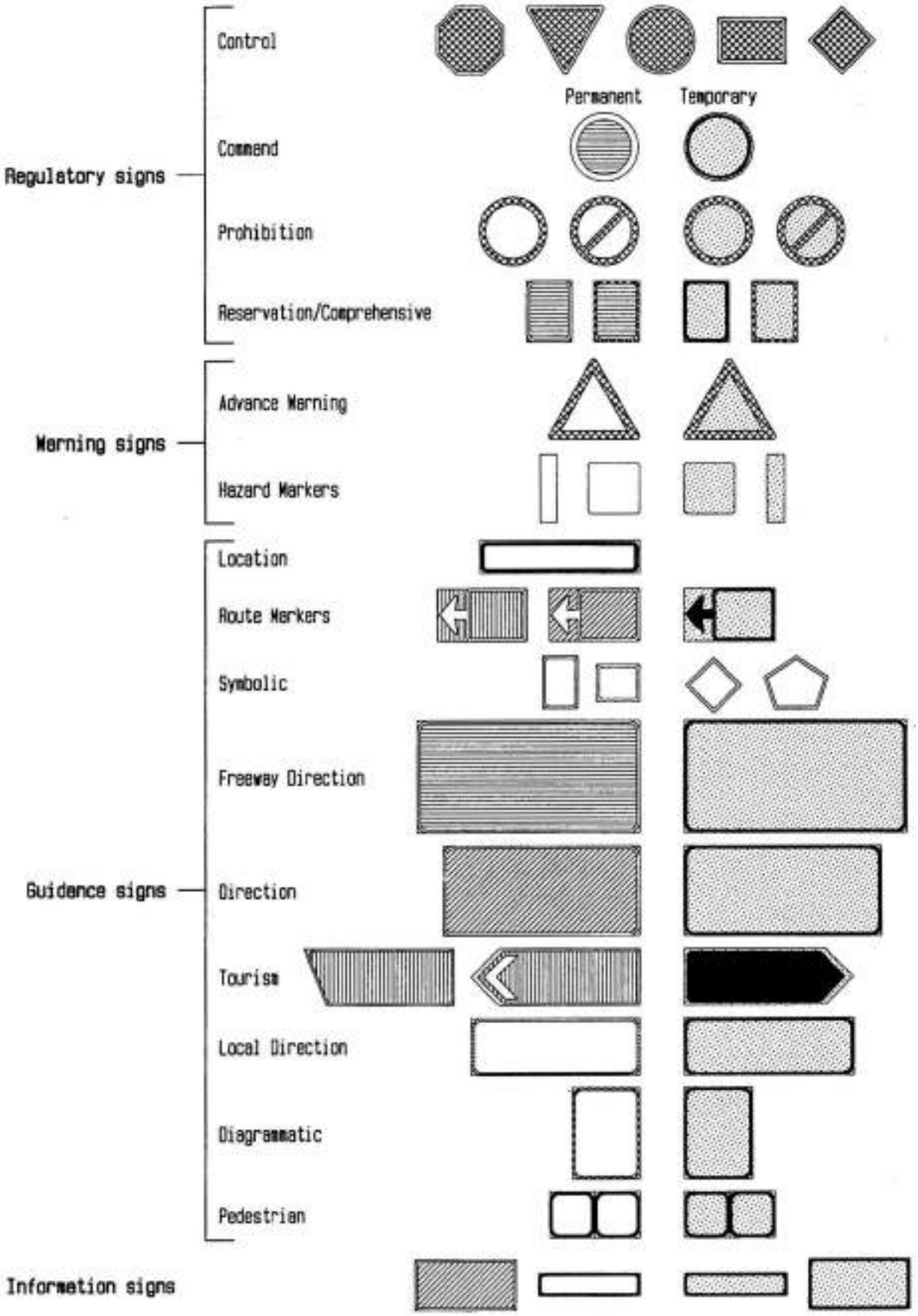
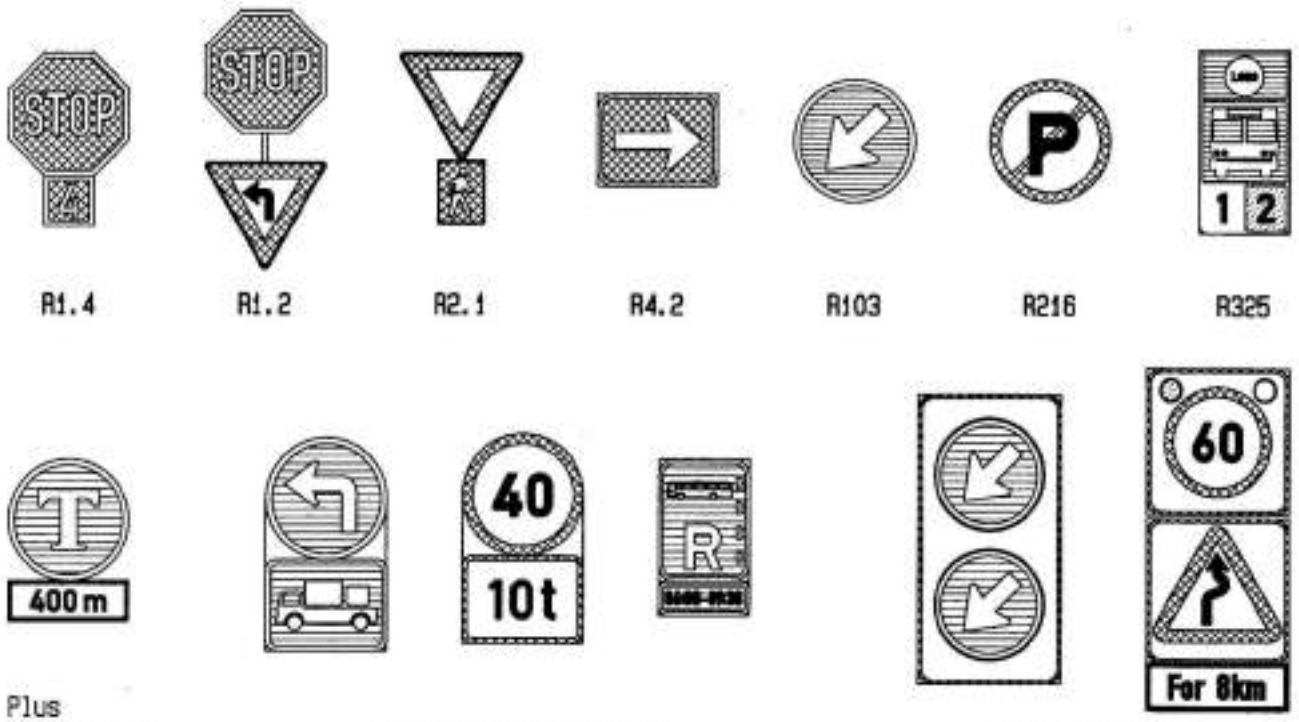
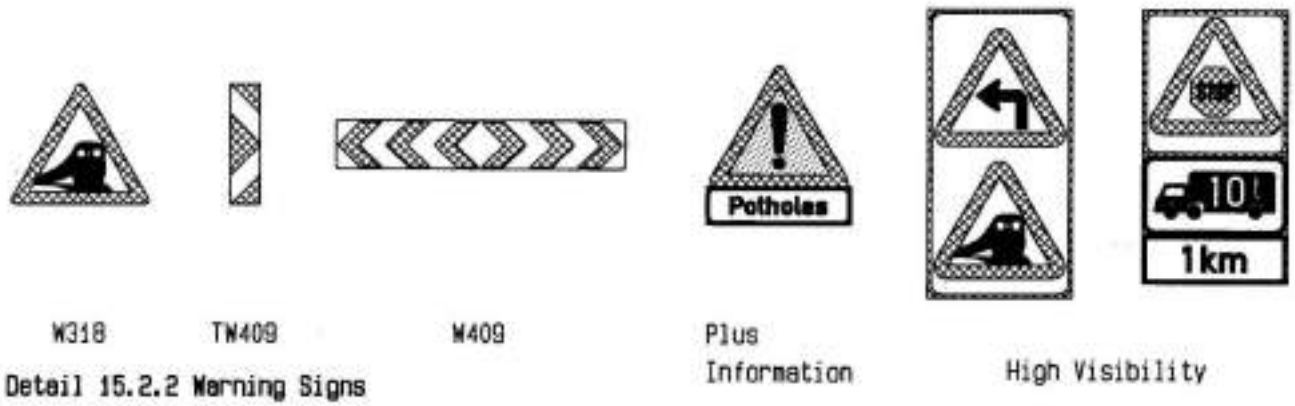


Fig 15.1 **Road Sign Shape, Size and Colour Classification**



Detail 15.3.1 Regulatory Signs - Typical (and not so Typical)



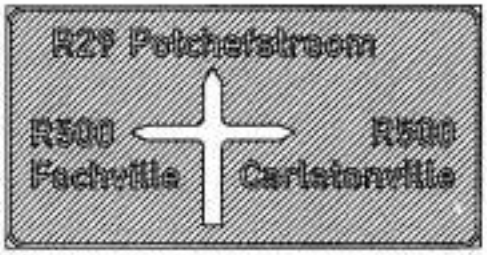
Detail 15.2.2 Warning Signs

Detail 15.2.3 Guidance - Small Format - Signs

NB Examples have been chosen to demonstrate range of shapes and sizes

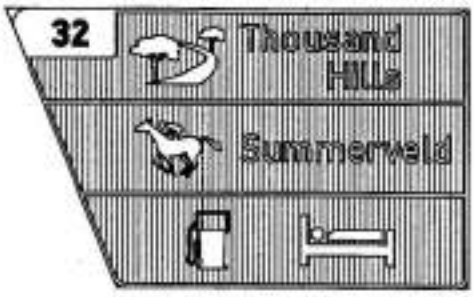
Fig 15.2 **Typical Road Sign Types - 1**

Typical Direction Sign



Large Direction Sign

Diagrammatic Signs



Large Tourism Sign

Local Direction Sign

Toll Route Sign

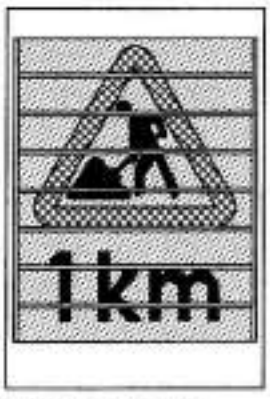
Ground Mounted Signs

Overhead Signs

Two Overhead Freeway Direction Signs Mounted Side-by-Side

Detail 15.3.1 Guidance Signs - Typical Medium to Large Format Signs

Slide Alternative



Rotating Plank

LED or Fibre Optic

Detail 15.3.2 Variable Message Signs

Fig 15.3 Typical Road Sign Types - 2

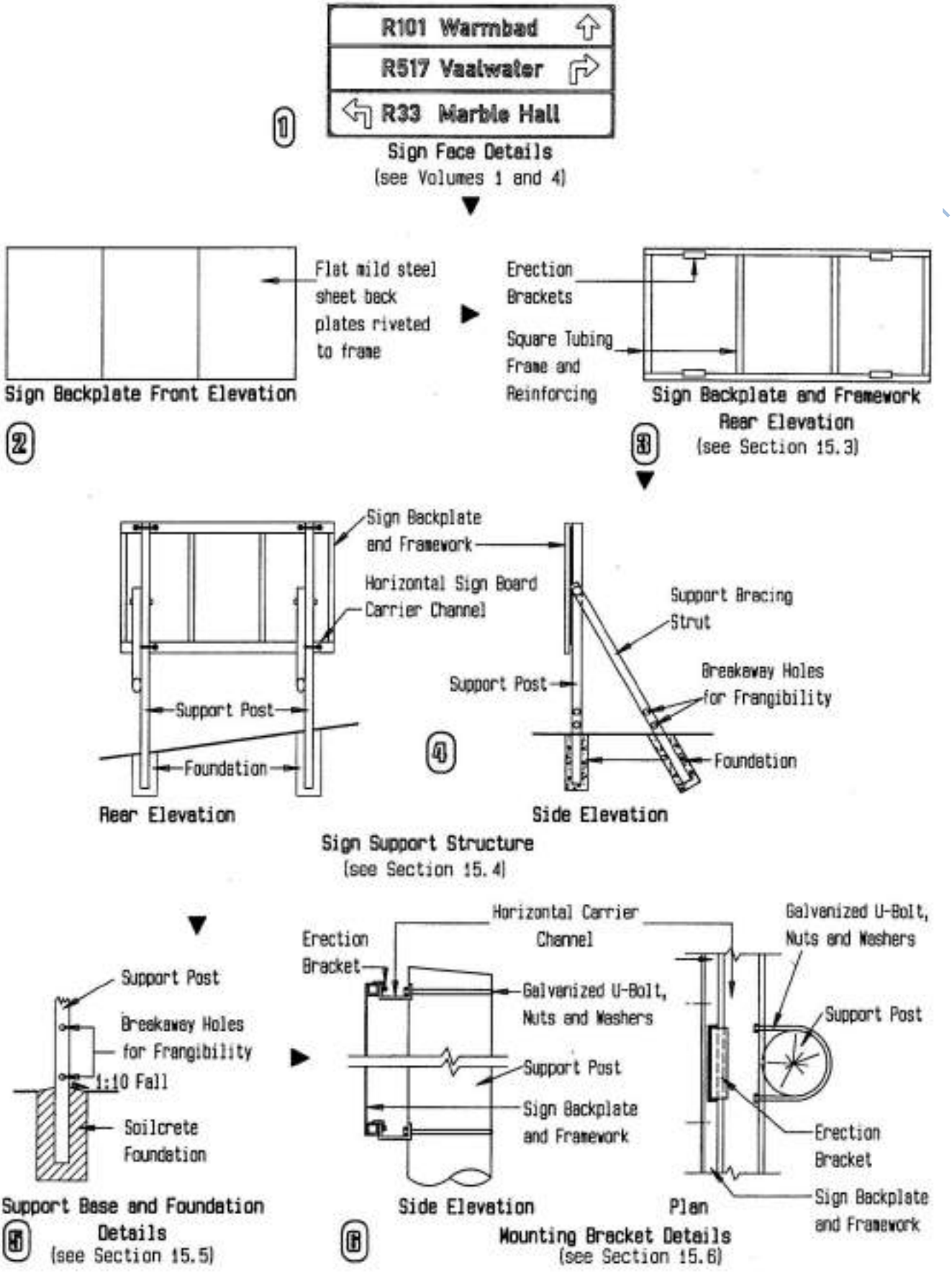


Fig 15.4 **Key to Ground Mounted Sign Component Parts**

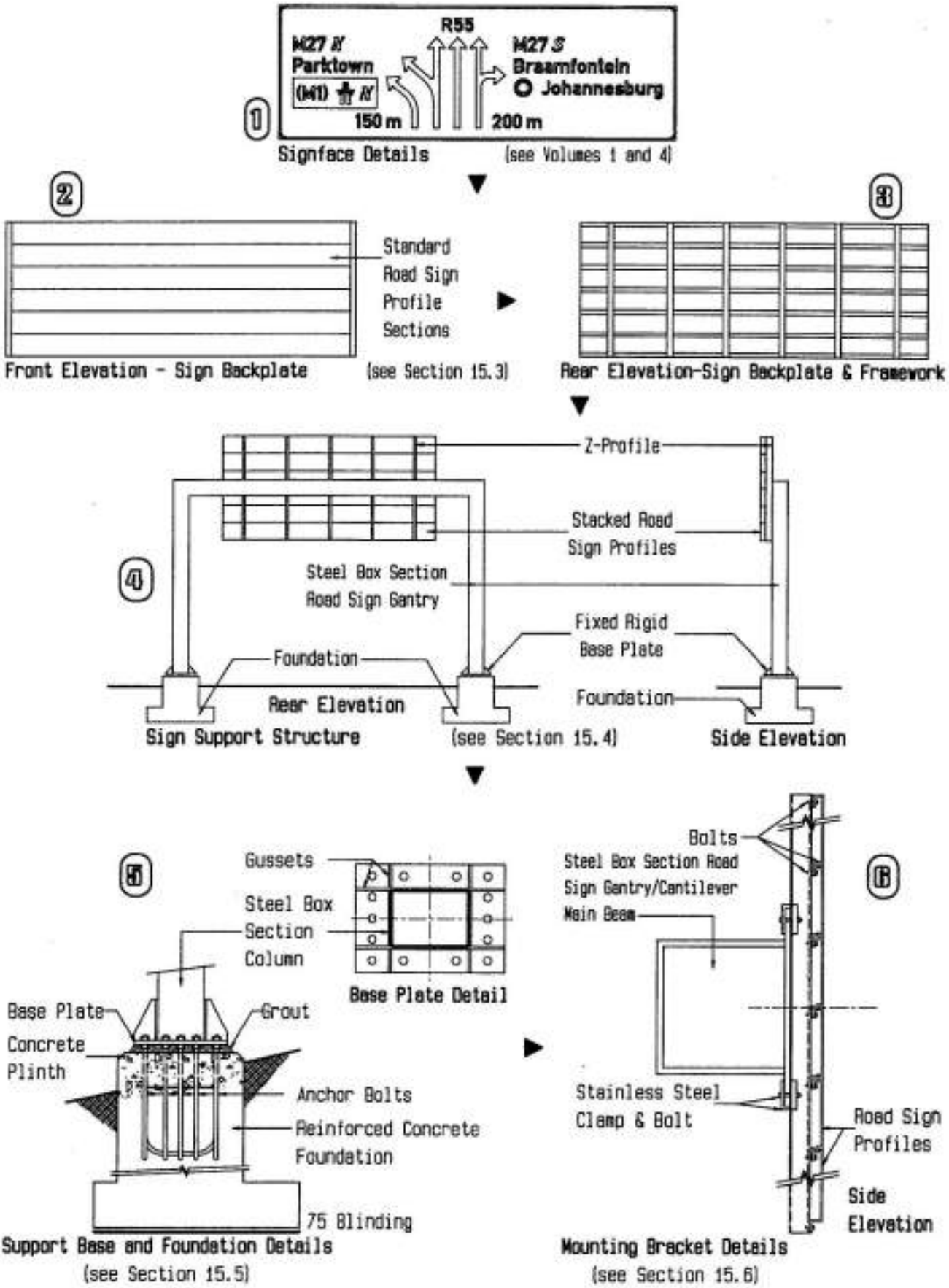


Fig 15.5 **Key to Overhead Sign Component Parts**

(continued from page 15.1.2)

2 The SIGNFACE is the front face of the sign board and contains the message the sign has been provided to communicate to drivers. In effect the Signface consists of everything such as arrows, border, symbols, route numbers and destination names applied to the BACK PLATE, either by painting, or by sticking retroreflective and/or semi-matt materials to it. The principles and design criteria for Signface design are covered in depth in Volumes 1 and 4, and will not be dealt with in this chapter. The Signface design determines the shape, size and height of the overall sign.

3 The BACK PLATE or Sign Board is the board, made up of sheets or panels of timber-board, steel, aluminium or in certain instances fibreglass or plastic that the Signface detail is applied to. The Back Plate's shape, size and height above ground level determines the wind loading, which in turn determines the layout of the parts from which the Back Plate is manufactured, including framing and reinforcing to resist the wind load and any resultant distortion moments or vibration. The Back Plate's mass or dead load, including the framing and reinforcing, together with the anticipated wind loading, determines the number, size, type and length of supports necessary to hold the sign in place, and whether these supports need to be further braced or not.

4 SIGN SUPPORTS for ground mounted signs are vertical poles/structures consisting of single, multiple, braced, compound, timber, steel or concrete poles. The poles may have a circular cross section, or D-section, I-section or ladder section. Sign Supports for ground mounted signs erected close to the travelled way without protective guardrails, should be frangible i.e. of yielding or breakaway construction in order to reduce the degree of vehicle damage and the risk of injury to occupants during impact. The Sign Support's size, type, length and horizontal clearance from the edge of the road determines its frangibility, whether created by means of drilled breakaway holes (timber), slip base, frangible or hinged joints (designed into a structure), or by small diameter thin-walled mild steel pipe that will bend on impact. The size, type, number and base frangibility detail of supports in conjunction with the size, mass and height of the sign board above ground level, determines the FOUNDATION treatment for the supports. A critical issue in the structural design of ground mounted signs is the type of support to be used.

5 The SIGN SUPPORTS for overhead signs will normally comprise a structure fabricated from rolled or welded steel and will consist of columns and a beam. Existing street furniture, bridges or structural walls can also be host Sign Support systems. The heavier rigid support structures used for overhead signs should be protected from impact by continuous or strategically placed sections of guardrail.

6 The FOUNDATION of a sign support system can vary from simply the existing soil bearing capacity to a large reinforced concrete footing. Installation of the sign supports can be accomplished by driving them into the soil, by placing the pole in a concrete footing, or by placing a sleeve, base plate stirrup, or hold-down bolts in a concrete or reinforced concrete Foundation. The size depth and reinforcement design of a Foundation is determined by the soil type and the size, type, number and base detail of the supports. The bigger the sign and its support structure, the more complex/specialised the Foundation design i.e. the Foundations for cantilevered or portal structures for overhead signs require to be of a significant size and have extensive reinforcing.

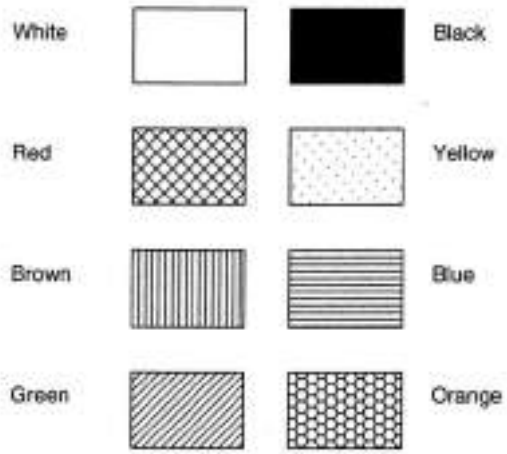
7 FASTENINGS or Mounting Brackets are the hardware (nuts, bolts, straps and brackets) used for connecting the sign board to the supports. The type, number and positioning of the Fasteners depends on the sign board frame and reinforcing used in its design and on the size and type of supports used. Certain types of Back Plate design will involve the use of specific types of Fastening in the assembly of the Back Plate itself. Fastenings can be stainless steel straps, mild steel U-clamps or aluminium special purpose brackets. There are many types of bracket on the market for different mounting methods. Some of these are custom designed for particular types of sign board manufacture and may require special tools in their application.

8 The component parts of ground mounted and overhead signs are shown in Figures 15.4 and 15.5. The different component parts of the sign structure, with the exception of the Signface, are covered in detail in subsequent sections. The structural design process is illustrated in a flow chart form in Figure 15.6.

15.1.15 Road Traffic Sign Colour Indication

1 The chapters of Volume 2 of the South African Road Traffic Signs Manual (SARTSM) are not prepared in colour. Relevant examples used to illustrate appropriate signs, signals and markings are shaded in a black and white coding which is illustrated below.

2 The basic principles of the road traffic sign colour coding system are shown, in colour, in the SADC-RTSM Volume 1, Chapter 1, Section 1.4, and in the Contents sections of relevant Volume 1 and 4 Chapters.



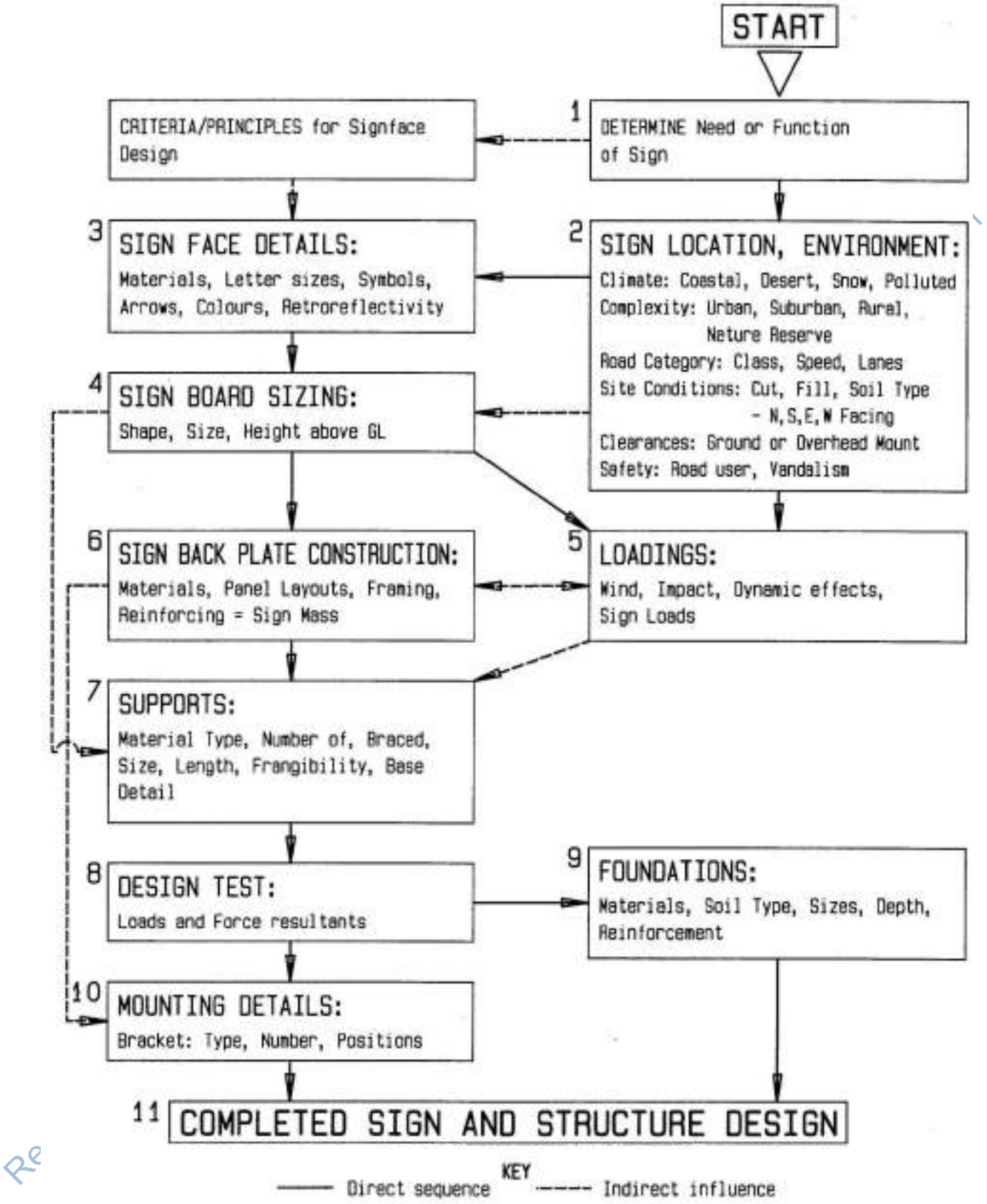


Fig 15.6 Flowchart Indicating the Structural Design Process for Road Signs

15.2 SIGN LOCATION ENVIRONMENT

15.2.1 General

1 The Sign Location Environment, or immediate surroundings and approach to the sign, has a direct influence on the design of the sign and of its support structure. The most relevant environmental conditions are:

(a) climatic/weather conditions;

(b) complexity of the surroundings and approach;

(c) road factors;

(d) roadside conditions;

(e) clearances;

(f) safety considerations.

15.2.2 Climatic or Atmospheric Conditions

1 The choice of sign structure components should be influenced by climatic conditions because of the possible corrosive action, above average wind loads, sand-blasting, snow/ice loads and excessive temperature extremes and ranges associated with prevailing or worst-case weather in various areas or regions. In this context the component materials making up signs should be compatible so that deterioration or failure owing to electrolytic action and/or differential thermal expansion does not occur. Component materials must also be manufactured to such quality and dimensional tolerances, and be correctly treated so that they perform as required under specific climatic and atmospheric conditions.

2 Certain climatic or atmospheric conditions have a direct effect on the strength of the sign structural components, for example:

(a) wind loads in coastal, desert or semi-desert and mountain areas;

(b) ice or snow loads, mainly in very cold mountain areas.

3 The strength of the sign structure i.e. the size of the elements, their profiles and types of material, should thus be designed to suit the specific climatic or atmospheric effects in addition to allowing for the sign structure's own total mass, or dead load (as well as potential impact loads, if required).

4 Other climatic or atmospheric conditions which can have a more indirect effect on the treatment required and expected life of the sign structural components, and on design details of specific sign installations include:

(a) abrasive or sand-blasting effect in desert or semi-desert areas;

(b) corrosion, rust or rotting caused by standing water, dampness or salt fog/spray;

(c) cracking, blistering, wrinkling, flaking or fading brought about by excessive temperatures and by changes in temperature, mainly in desert and semi-desert areas;

(d) scratching, rotting and pestilences occurring in dense areas of vegetation in sub-tropical and Mediterranean areas;

(e) dry season veld fires;

(f) corrosion, rusting or rotting effects which occur as a result of air, soil and water pollution in aggressively and chemically polluted areas.

5 It is therefore important to allow for such climatic and/or atmospheric effects when choosing sign structure components. For example the following choices may reduce or eliminate the described effects:

(a) aluminium will perform better in coastal or polluted areas but care should be taken not to mix aluminium and steel in direct contact situations;

(b) steel is better suited to a desert area than timber;

(c) plastics or fibreglass can withstand corrosion, rot and rust and are therefore suited to wet areas, however, plastic materials which are to be faced with retroreflective sheeting have to be carefully chosen to avoid the effects of the release of chemicals and oils used in the plastic manufacturing process; plastics are also desirable for safety reasons for temporary signs used at roadworks sites, where lateral clearances are likely to be at a minimum and impacts may occur frequently; under the latter conditions plastic materials are available which can "recover" after a number of impacts which can have cost benefits in roadworks situations;

(d) timber is commonly used, but treatment is important for the resistance to rot and termites, however, such treatment may have a detrimental effect if the sign is subjected to fire.

6 Specific types of prevailing weather conditions, such as fog or mist, which result in significantly reduced visibility, can warrant the installation of variable message signs (see Chapter 19).

TABLE 15.1 CLIMATIC OR ATMOSPHERIC CONDITIONS TABLE 15.1

Environment	Condition	Effects on Sign
Coastal	Salty/wet/windy	Corrosion, rust, wind load
Desert or semi-desert	Hot/cold – dry/windy	Temperature differences, wind speed/load, dust/sand blast (incl. signface)
Mountain	Cold/wet	Snow/ice in winter, low temps, rust, wind
Sub-tropical/ Mediterranean	Wet/high humidity	Corrosion, rot, rust, vegetation growth
Pollution	Chemical in air/soil/water	Corrosion, discolouration (signface)

15.2.3 Road Environment Complexity in Sign Vicinity

1 Road signs are normally provided according to specific requirements of road class hierarchy. The classes of roads joining or crossing one another, and whether such junctions lie in urban, peri-urban or rural areas, affect the number, size, type and specific location of signs to be provided at the junctions, or on the approaches to the junctions. These factors also have an effect on the choice of sign structure design.

2 Table 15.2 and Figure 15.7 indicate typical descriptions of urban, peri-urban and rural areas in relation to road class, and type of environment, in terms of various relevant factors. Table 15.3 also identifies these descriptions for certain special areas which can be considered as being essentially tourist areas.

3 This attention to the environment in which signs are to be placed is intended to create an awareness that even the materials used in sign structures can be made environmentally suitable. In a nature conservation area, for example, it is appropriate to choose natural materials that might not normally be specified i.e. timber for the back plate and the sign supports. Similarly the choice of materials for the component parts of signs in an urban area should recognise the risk of vandalism and accidental damage, and should cater for minimising the effects of these risks.

15.2.4 Road Factors

1 As mentioned in Subsection 15.2.3 the road classes of roads joining or crossing each other influences the choice of type, number and location of signs at such junctions. This is because different levels of class of intersecting road require different levels of signing, i.e. there is a road signing hierarchy. The road classes and their relationship with different environments are shown in Figure 15.7.

2 The geometric layout of a junction may also have an influence on the choice of type, number and location of signs and, therefore, on the choice of sign structure component. Factors which may affect such choices are sight distances, and lateral and vertical clearances to the sign supports and back plate. Road geometry may range from intersecting dual carriageway roads down to intersecting single, 2-lane 2-way, roadways. Between these limits are a wide selection of roadway and lane configurations, and in some instances the junction may include one or more turning roadways or slip roads. Junction control may by STOP sign R1, YIELD sign R2 or by traffic signals.

3 The road class, geometric layout, number of lanes, slip roads, together with the traffic density and speed, determines whether the sign installation should be a ground mounted structure or an overhead structure, or whether variable message signs or some other special application is necessary. For example it is a standard warrant that if there are three or more lanes overhead signs are required. This requirement almost automatically means that traffic volumes are high, however, if very high volumes exist on a two lane road it may still be advisable to install overhead signs. The presence of multiple lanes and higher speeds will also dictate the positioning of signs, in order that sufficient time exists for drivers to read the sign, and then to react and change lanes as necessary to carry out their required action, and this in turn will influence sign sizes and mounting requirements and thereby, the structured design of the signs. Figure 15.6 illustrates the relationship between the road factors and other factors, in the sign structure design process.

TABLE 15.2 VICINITY COMPLEXITY TABLE 15.2

Vicinity	Space Problems	Traffic Volumes	Average Speeds (km/h)	Lanes	Advertising	Vandalism	Pedestrian Volumes
Urban	High	High	40-60	3-7	High	Medium	High
Suburban	Medium	Medium	60-80	2-5	Medium	High	Medium
Peri-urban	Low	Low-Medium	80-100	2-3	Low-Medium	Medium	Medium
Rural	Nil	Low	80-120	2-3	Low	Low	Low
Nature Conservation	Nil	Low	40-60	2	Nil	Low	Low

TABLE 15.3 ROAD ENVIRONMENT IDENTIFICATION TABLE 15.3

Items	Urban	Peri-Urban	Rural	Special Area
Environment Description	Built up areas: CBD areas, Suburbs, residential or commercial stands	On fingers of built up areas:Small holdings, Industrual plots, Nature reserves, Recreation places	Open areas: Farms, Small Towns / Communities	Open areas: Natural, Conservation, Rest Camps, Service areas, Tourist areas
Boundaries	Within Municipal Boundaries	On fringes of Municipal Boundaries or just outside them	Outside Municipal Boundaries	Specific to the special area
Route / Road Identification	Road/Street Names (M-Route Numbers)	Road / Street Names Route Numbers	Route Numbers (N, R or T)	Route Numbers (T)
Junction Identification	Road/Street Names I/C Numbers (freeways)	Road / Street Names I/C Numbers (freeways)	I/C Numbers (freeways) Farm Names + Junction Numbers	Route Markers
Access Spacing (in general Access Spacing increase with Mobility increase)	Decreased spacing due to direct access for smaller stands	Limited access due to larger plots	Greater spacing because of intermittent farm accesses	Intermittent
Mobility: Decrease	Due to traffic volumes, accesses	Due to development	Due to changing Road surfaces & standards	Due to animals or road surfaces, Due to better road surfaces and fenced off
Increase	Due to provision of more lanes + limited access	Due to provision of more lanes + limited access	Due to better Road surfaces & standards	
Average Speeds on Roads	60-80	80-100	100-120	Less than 60
Traffic Volumes	High	Medium	Low	Low
Pedestrian Volumes	High	Medium	Low	Very low
Traffic Control	Mostly Traffic Lights Traffic Officers	Stop signs or traffic Lights	Stop sign mostly	Stop signs
Advertising signs	Too many	Many	Few	No
Street Lights	Yes	Possible	No	No
Space Problems for signing	Many	Better	Few	Nil
Road Classification for Signing	Urban	Urban or Rural	Rural	Tourist Routes

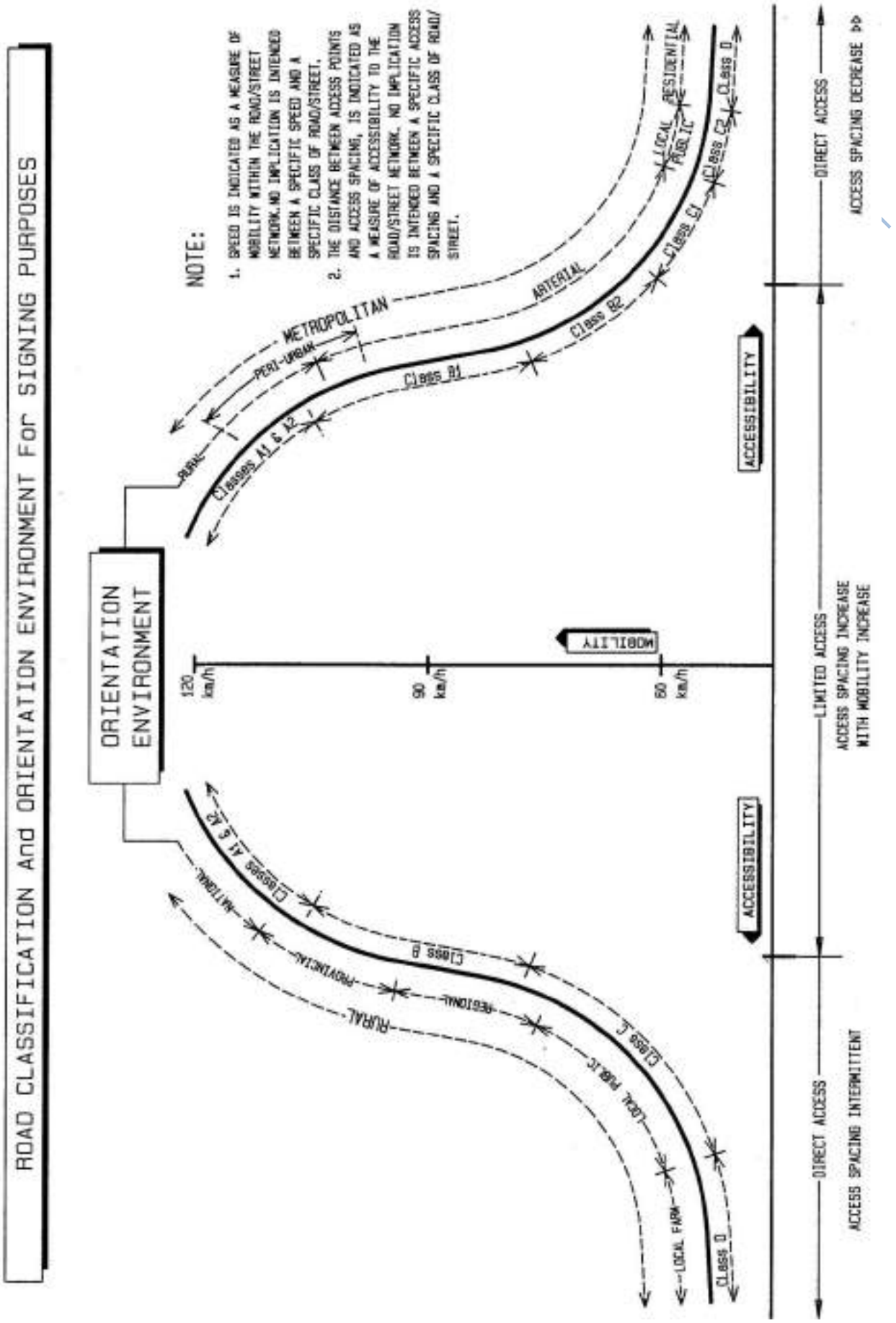


Fig 15.7 Road Classification and Orientation Environment for Signing Purposes

15.2.5 Road Side Conditions

1 Road Side Conditions influence sign structure design, particularly aspects of the design of the support poles and their foundation. Typical road side circumstances that will have an influence on the selection and design of supports and foundations include:

(a) cut or fill earthworks;

(b) marshy ground or other problematic soil types;

(c) other adjacent fixed structures which may cause the sign to have a special mounting or support design;

(d) a pedestrian sidewalk.

2 When a road sign has to be positioned on a section of road that is in either cut or fill earthworks the support pole lengths will be unequal to the extent that one support may be considerably longer than normal and one considerably shorter. Under such circumstances consideration may be given to locating the sign in a position which reduces the effects of the side slope, within limits covered in the following relevant chapters - Chapter 5: *Freeway Signing,* Chapter 6 : *Toll Route Signing,* Chapter 9 : *Urban Guidance Signing* and Chapter 10 : *Rural Signing*. When a sign is located in a cut the sign must remain clearly visible from the appropriate distance and should have a clearance to the cut slope of at least 1200 mm. This requirement may result in a need to modify the cut slope, and possibly over some distance, to effectively "skylight" the sign for approaching drivers. The need for this type of treatment should particularly be assessed when rehabilitating the signs on a section of road, and when a new sign differs significantly in length from the one that it replaces.

3 Marshy road side conditions, if they exist for any significant distance along a road, will require special foundation treatment which could be costly. However, this cost is likely to be relative since the design of the road itself is likely to need special, and costly treatment.

4 Reference is made in a number of places in the chapter to the possible need for special sign mounting requirements when another structure coincides with the desired location of a road sign. Such situations are likely to have unique features which will not lend themselves to a standardised solution. However, certain aspects are covered in Subsection 15.4.

5 Signs located over a pedestrian sidewalk have to be mounted at a safe vertical clearance of at least 2500 mm. A greater height may even be desirable to inhibit vandalism. Medium to large signs, such as direction signs will commonly need two support poles, even in an urban environment. It is recommended that these poles be located sufficiently far apart to not create an unnecessary obstruction for pedestrians, even if this sometimes requires a longer sign than is strictly necessary to carry the required message. The lateral clearance from a kerbface is also important, since a vehicle impact on a sign over a sidewalk could have serious consequences for pedestrians on the sidewalk at the time.

6 In urban areas sign positions have to be carefully coordinated with those of street lighting poles since the latter can have a detrimental effect on the legibility and readability of the sign. The solution to this problem could involve an adjustment in the vertical, lateral and/or longitudinal position of the sign, or even some special type of support arrangement if options to reposition are limited.

7 The type of soil present at the proposed sign site will affect the foundation design and possibly the number of supports required. An appropriate soil classification is given in Tables 15.5 and 15.6 and a chart in Figure 15.8. Some of the engineering problems associated with various soil types are covered in Table 15.4. A further detailed discussion on soil materials appears in Section 15.5 where the choices of foundation and anchor types are indicated.

15.2.6 Sign Positioning

1 The basic mounting positions of signs are either overhead, above or over the centre of the road lane/s, or ground mounted adjacent to and on the left of the road. Duplicate signs may also be used on the right side of the road for extra emphasis particularly on one-way roadways. See Figure 15.9 for the sign face display area distinction between the two mounting positions.

(continued on page 15.2.8)

TABLE 15.4 RESIDUAL SOILS AND POSSIBLE ENGINEERING PROBLEMS TABLE 15.4

Residual Soil Category	Common Example	Soil Texture	Problems to Anticipate
Residual acid crystaline rock	Residual Granite	Clay sand	Collapsible grain structure; high erodibility
Residual basic igneous rock	Residual diabase	Clay	Heave compressibility
Residual calcareous rock	Residual dolomite	Chert rubble	Sinkhole development; doline development
Residual argillaceous rock	Residual mudrock	Silt or siltclay	Heave; slope instability
Residual arenaceous rock	Residual sandstone	Sand	Problems not common, but collapsible grain structure may develop from highly felspathic sandstone

TABLE 15.5	UNIFIED SOIL CLASSIFICATION SYSTEM COARSE-GRAINED SOILS	TABLE 15.5
Group Symbols	Typical Names	
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
CL	Inorganic clays of low to medium plasticity, gravel clays, sandy clays, silty clays, lean clays	
OL	Organic silts and organic silty clays of low plasticity	
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
CH	Inorganic clays of high plasticity, fat clays	
OH	Organic clays of medium to high plasticity, organic silts	
PT	Peat and other highly organic soils	

TABLE 15.6	UNIFIED SOIL CLASSIFICATION SYSTEM FINE-GRAINED SOILS	TABLE 15.6
Group Symbols	Typical Names	
GW	Well-graded gravels, gravel-sand mixtures, little or no fines	
GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	
GM	Silty gravels, gravel-sand-silt miztures	
GC	Clayey gravels, gravel-sand-clay mixtures	
SW	Well-graded sands, gravelly sands, little or no fines	
SP	Poorly-graded sands, gravelly sands, little or no fines	
SM	Silty sands, sand-silt mixtures	
SC	Clayey sands, sand-clay mixtures	

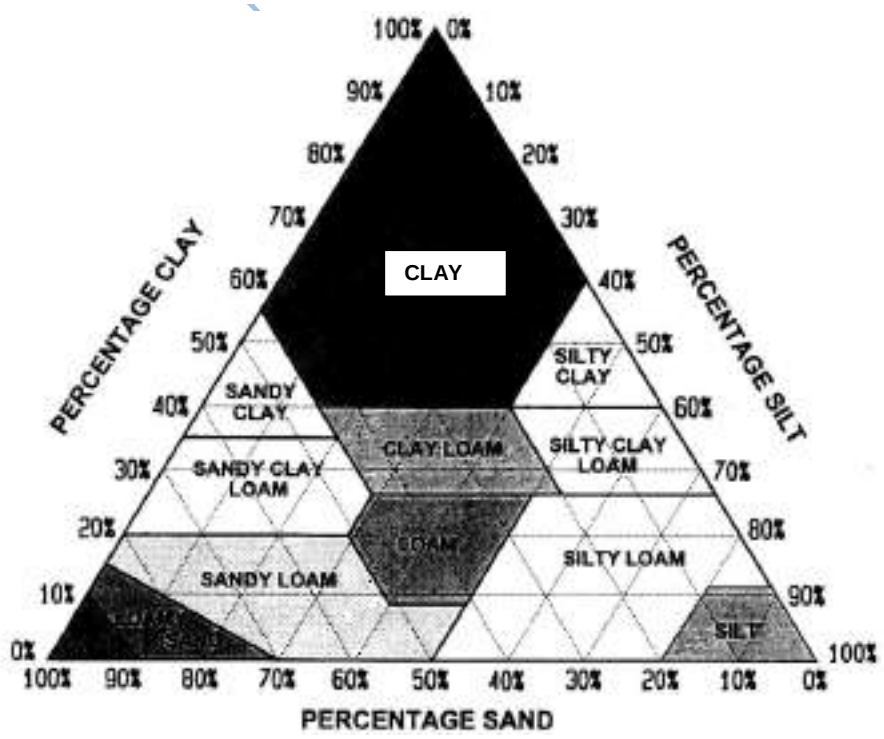
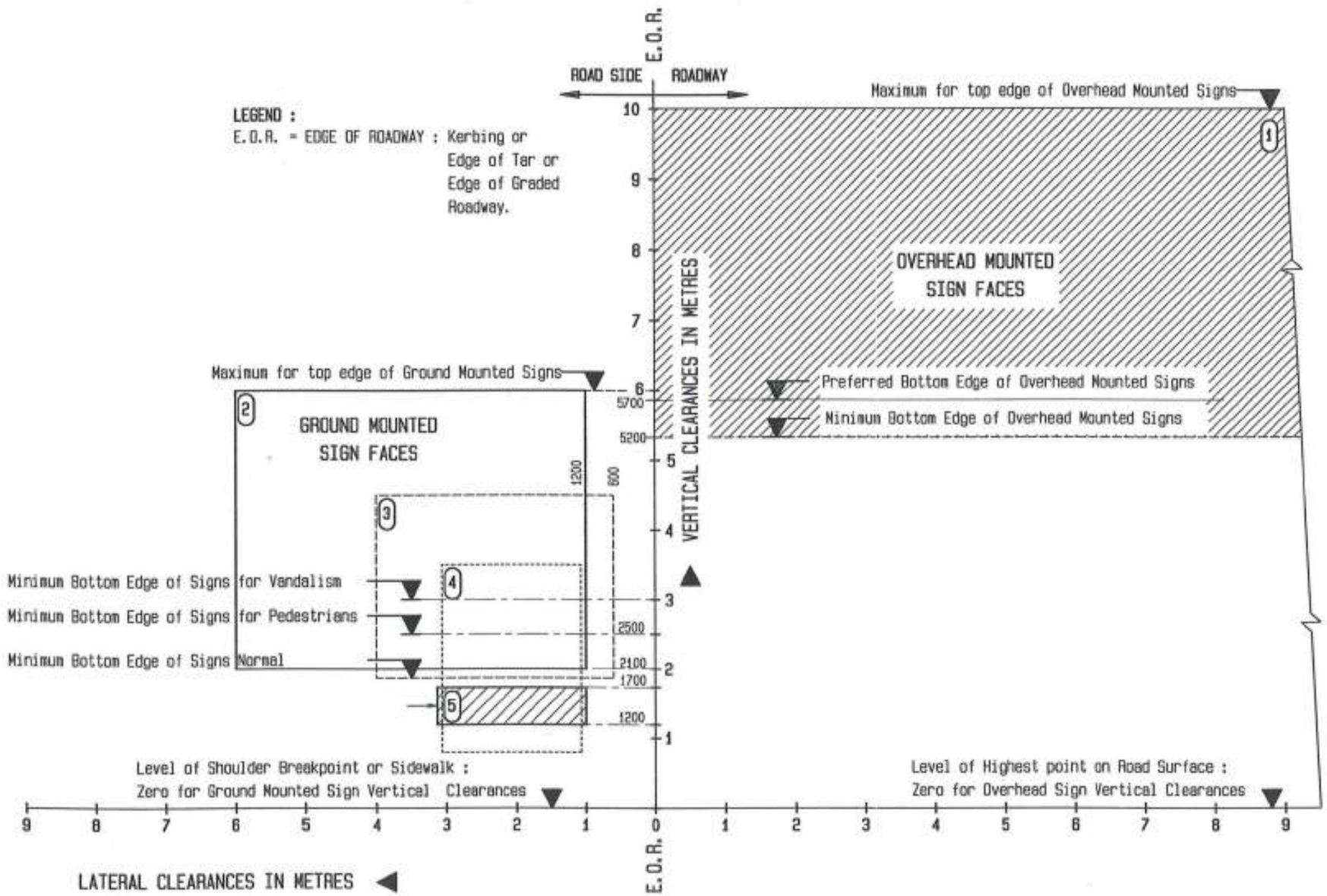


Fig 15.8 **Soil Texture Classification Chart**



NOTES:

Elevation Area in which sign types will be displayed/located:

(1) Overhead signs on Cantilevers or Gantries.

(2) Ground Mounted Direction, Tourism, Local Direction and Location signs on single or multiple supports (sign face areas > 1.5 m^2).

(3) Ground Mounted Street Name, Warning, Regulatory, Route Markers and small Information signs on single supports mostly (sign face areas <=1.5 m^2).

(4) Ground Mounted Diagrammatic, Chevron, Countdown and Gore signs on single or multiple supports (sign face areas <=4.5 m^2).

(5) The total height of smaller signs should preferably not be in this hatched parameter area due to danger of contact with car windscreens on impact, subject to support failure mechanism.

Fig.15.9
Elevation Signface Display Area

(continued from page 15.2.5)

All signs displayed within the elevation area parameters on the left hand side of the Edge of Road (EOR) line will be taken as ground mounted. All signs displayed above a road within the elevation area parameters on the right hand side of the Edge of Road line will be taken as overhead mounted signs.

2 Figure 15.9 also indicates four sign face display areas where four different sign groups may appear according to their sizes and approximate vertical and lateral clearance positions. The sign types appearing in each sign face display area are the following:

(a) overhead mounted signs in display area 1;

(b) larger, sign face areas > 1,5 m^2, ground mounted direction, tourism, local direction and location signs in display area 2;

(c) smaller, sign face areas <= 1,5 m^2, ground mounted street name, warning, regulatory, route marker and information sign types in display area 3; and

(d) specialised, sign face areas <= 4,5 m^2, ground mounted diagrammatic, chevron, countdown and gore sign types in display area 4.

3 The position of all road sign structures are normally specified in terms of three parameters, namely:

(a) longitudinally in relation to the roadway alignment;

(b) laterally in relation to the road cross-section;

(c) vertically in relation to different height levels i.e. shoulder breakpoint/sidewalk surface for ground mounted signs and highest point on road surface for overhead mounted signs.

4 According to their function road signs are located longitudinally, either at the point to which the sign refers, or in advance of the point to which they refer, with longitudinal distances between signs appropriate to the speed on the road.

5 As a general rule a road sign should be visible from a distance in metres numerically equal to the operating speed of the road in kilometres per hour.

6 If some longitudinal obstruction exists which impairs sight distance to a sign, or the location of the sign itself, the tendency should always be to move the sign further from the junction rather than closer to it (see Figure 15.10). Particular care must be taken when erecting advance direction signs to avoid confusion with minor junctions or driveways.

7 Guidance signs located at a junction should, where possible, be positioned so that turning traffic passes in front of the sign rather than behind it, particularly if the approach is subject to control by a STOP or YIELD sign or traffic signals.

8 Details of sign distances and longitudinal positioning of signs are also given in Figures 15.13 to 15.17.

9 Signs are located laterally according to their functions /types, at clearances appropriate to the following road cross-sectional types:

(a) roads with kerbing or guardrails;

(b) surfaced roads with surfaced shoulders (no kerbing or guardrails);

(c) surfaced roads with gravel shoulders (no kerbing or guardrails);

(d) gravel roads (no kerbing or guardrails).

10 The minimum lateral clearance is related to the function and size of the sign and whether the sign support post/s is/are frangible or not. In general signs in the smaller warning or regulatory group are located nearest to the edge of the road, while signs in the larger guidance group, having heavier and larger support posts, are positioned a bit further away from the edge of the road. The edge of the road could be one of the following: the kerb, the edge of tar or the edge of a graded roadway where there is no kerbing. The rigid, heavy, non frangible support posts for overhead cantilever or gantry signs are positioned at a much greater lateral clearance than both the ground mounted signs groups mentioned above. See Figures 15.11 to 15.19.

11 Any rigid or heavy sign support structure (i.e. those support posts with no frangibility treatment) that is laterally located closer to the roadway than the minimum allowed for the road cross-sectional type should be safeguarded by guardrails because sign supports may represent significant hazards to road users.

12 Signs and their supports should also be positioned so as not to obstruct sidewalks and consideration must be given to modifying the side slope to permit effective reading of a sign if it is located in a cut which may obscure the sign.

13 It is not recommended that signs be placed significantly further from the edge of road or shoulder than indicated in the figures because this will reduce sign conspicuity and therefore driver's chances of seeing the signs.

14 Details of minimum lateral offsets are given in Figure 15.11, and lateral clearances specific to sign types in Figures 15.12 to 15.17.

15 Vertically signs are located according to their functions/types as overhead mounted or ground mounted. For overhead mounted signs the minimum and maximum vertical heights are measured from the highest point on the roadway and for ground mounted signs from either the shoulder breakpoint or sidewalk level. While there is a recommended height for the top edge of ground mounted signs the minimum clearances to the bottom edge of these signs will be appropriate to one of the following circumstances:

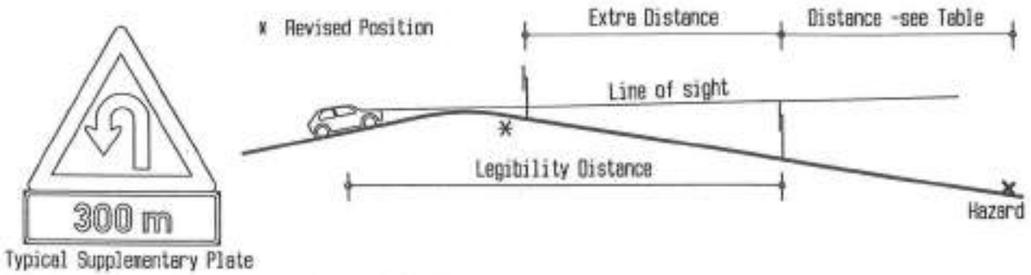
(a) a normal minimum clearance above shoulder break point;

(b) a minimum clearance above the sidewalk to allow for pedestrians;

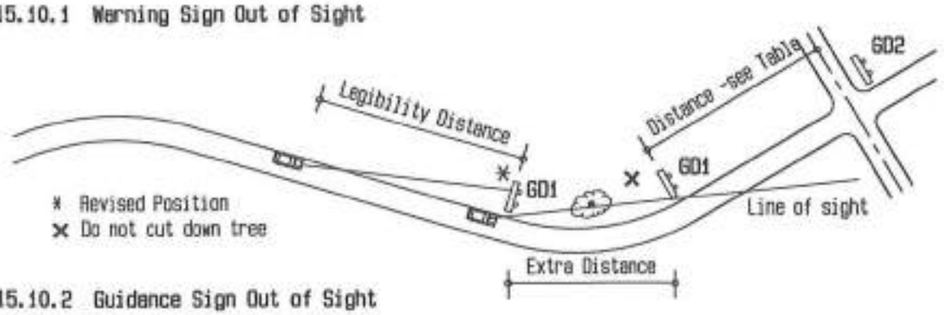
(c) a minimum clearance to safeguard the sign against vandalism.

16 Research has shown that there is a risk, when a single support carrying a small sign like a regulatory or warning sign at a total sign height of between 1600 mm to 2000 mm is impacted by a motor car, that the sign may be flung forward by the collapse of the support through the vehicle windscreen. This risk is greatest for signs mounted on frangible steel supports.

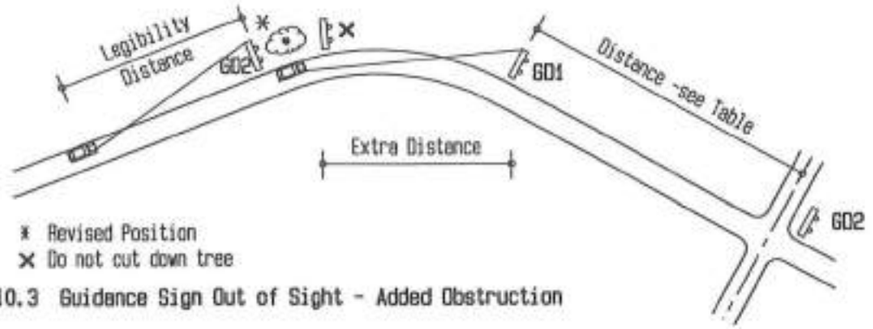
(continued on page 15.2.11)



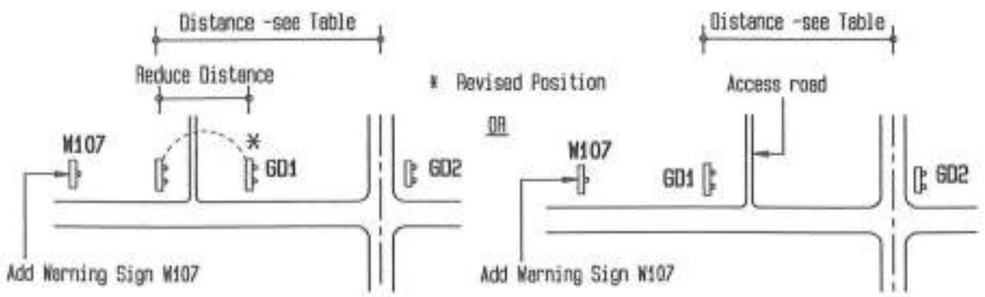
Detail 15.10.1 Warning Sign Out of Sight



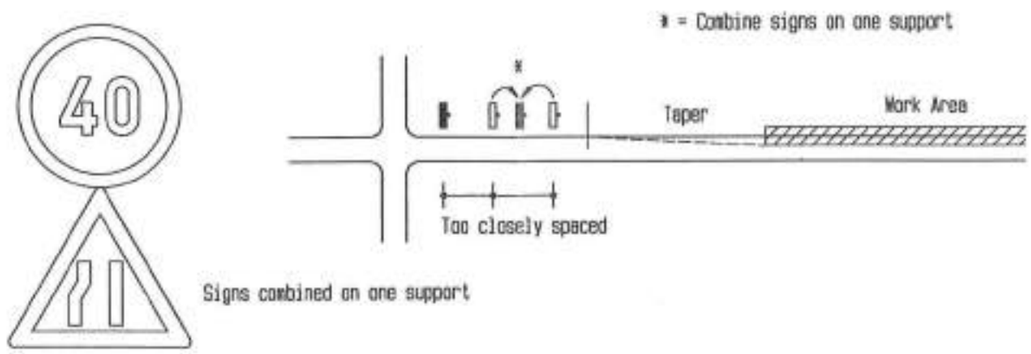
Detail 15.10.2 Guidance Sign Out of Sight



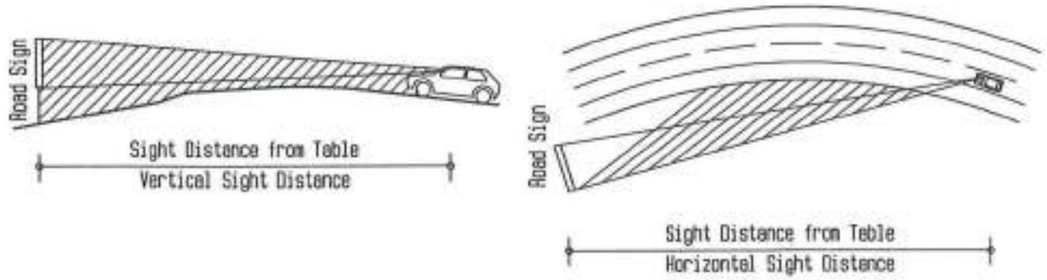
Detail 15.10.3 Guidance Sign Out of Sight - Added Obstruction



Detail 15.10.4 Closely Spaced Junctions



Detail 15.10.5 Insufficient Longitudinal Space for Several Signs



Detail 15.10.6 Clear Line of Sight to Larger Guidance Signs

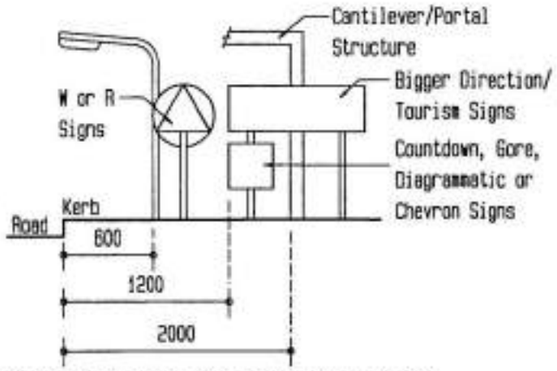
CLEAR SIGHT DISTANCE REQUIREMENTS	
Letter Size (mm)	Sight Distance (m)
490	380
420	340
350	300
280	260
210	220
140	180
112	160

NOTES:

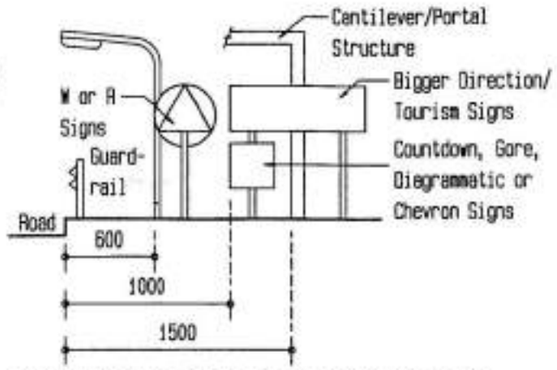
1 As an alternative to respositioning signs the shaded area may be clered of obstructions.

2 The "Clear Sight Distance" values include the legibility distance for the letter size PLUS 100 m to allow for observation of the sign prior to reading.

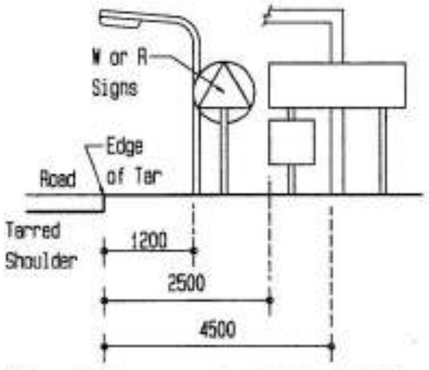
Fig 15.10
Typical Problems and Aspects of Longitudinal Positioning of Road Signs



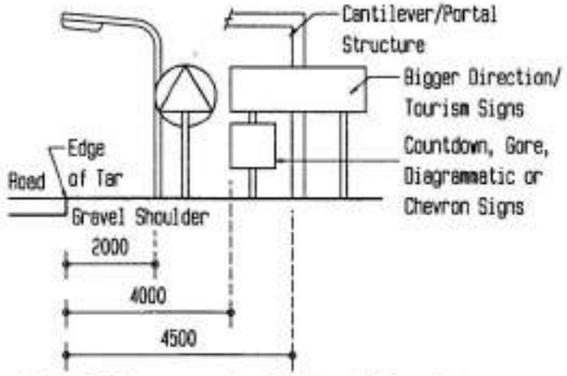
Lateral Clearances for Roads with Kerbing



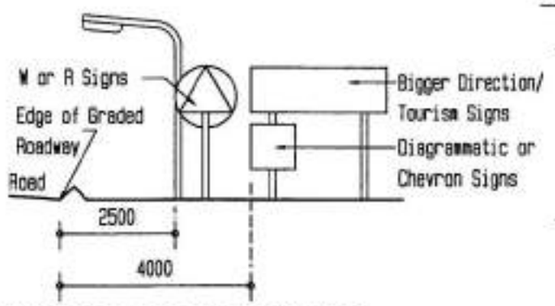
Lateral Clearances for Roads with Guardrails



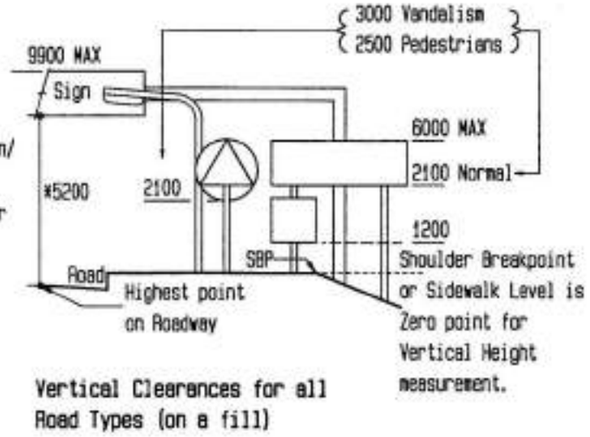
Lateral Clearances for Roads with Tarred Shoulders Only



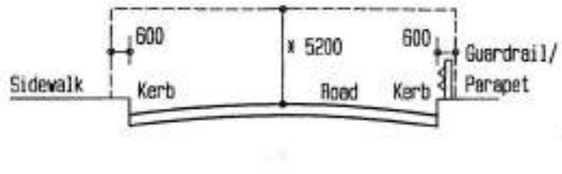
Lateral Clearances for Roads with Gravel Shoulders Only



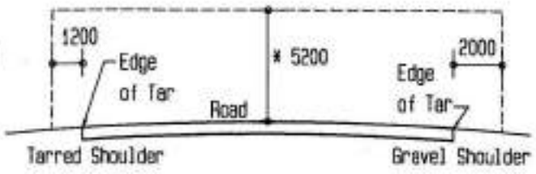
Lateral Clearances for Gravel Roads



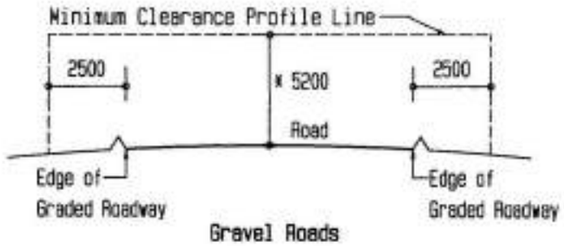
Vertical Clearances for all Road Types (on a fill)



Surfaced Roads with Kerbing/Guardrails

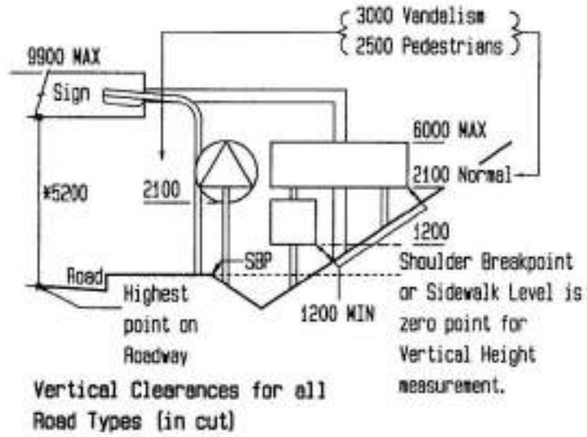


Surfaced Roads with No Kerbing/Guardrails



Gravel Roads

Detail 15.11.2: Minimum Clearance Diagrams for Different Road Types



Vertical Clearances for all Road Types (in cut)

NOTES :

1. * Height measured from highest point on Roadway.
2. Minimum Clearance Profile line is the absolute minimum and no structure/tree/ cable whatsoever should infringe there upon.
3. Note that the minimum lateral clearances for larger signs or structures are preferred bigger than the minimum clearance profile line shown in Detail 2.
4. Refer to SARTSM for more details on longitudinal positioning and clearances.
5. Minimum lateral clearances indicated are also applicable to medians in dual carriageway situations
6. Note that the lateral clearances are always measured from the edge of the sign and not from the support except for overhead sign structures.

Detail 15.11.1 : Minimum Lateral and Vertical Clearances for Different Sign Types

Fig 15.11
Minimum Clearances for Different Road and Sign Types

(continued from page 15.2.8)

17 Signs which are mounted very low are liable to become easily obscured and will collect dirt as well as being susceptible to damage in the event of veld fires and roadside maintenance work. However, some signs need to be mounted lower, see Figure 15.13 and 15.14, to be effective e.g. hazard markers.

18 Signs which are mounted very high, including overhead signs, are difficult to see at night, particularly if headlamps are dipped due to oncoming traffic.

19 Details of minimum vertical clearances are given in Figure 15.11, and vertical clearances specific to sign types in Figures 15.12 to 15.16.

20 When existing signs are modified by adding panels the sign edges of the modifications should not encroach into the minimum clearances.

21 The clearances for variable message signs must adhere to the minima of the specific sign types and their mounting position, as if they were normal signs.

22 Further details on sign positioning are covered in Volume 1, Chapter 1: *General Principles,* and various other chapters in Volume 2 of the SARTSM.

15.2.7 Safety Considerations

1 Safety considerations related to sign structures are basically those that involve:

(a) the sign structure loadings i.e., the effect that wind, ice, live and impact loads, in excess of the structure's own dead load or total mass, have on the structure's ability to withstand these and still be of service to the motorist;

(b) the sign and structure's ability to withstand vandalism and still be serviceable to the motorist (discussed in more detail in Subsection 15.2.8).

2 Sign support structures should be designed to resist vibration in wind, which may result in failure due to fatigue of the material. A wind load illustration is given in Figure 15.19 indicating distortion moment lines compared with the collision performance of a sign structure. The wind load deflects the back plate reinforcing profiles, and causes the moment lines. If the distances of two posts is optimised, both the negative and positive moments are equal (this is true if the distance from the outer edge of frame is 1/5 of L and the distance between the posts is 3/5 of L). If these moments are equal, the tensions are minimized.

3 Wind load = W, shall be the load produced by pressure of wind on the signs and the support structures corresponding to an appropriate wind speed for the area. Wind pressure shall be calculated from the relationship,

Pm = 0,0000473 (Cg Vm)2 x Cs x Ch kPa

where Pm = wind pressure in kilopascal

Vm = wind speed in kilometres per hour (km/h) (50 year mean recurrence interval)

Cg = wind gust factor = 1,3

Cs = shape coefficient for structural member (Table 15.7)

Ch = height coefficient for height above ground level measured to the centroid of the loaded area

kPa = kilopascal

4 Wind pressure will usually be calculated for the 5 m -10 m level. For site conditions elevated considerably above the surrounding terrain, where the influence of ground surface friction on the wind is reduced, consideration should be given to using height coefficients for higher levels. See SANS 10160:2010 Tables 16 and 17 for detail of force coefficients regarding walls and hoardings, and Table 15.7 for wind load coefficients hereafter.

5 In the absence of detailed information on wind speeds, the minimum wind design loads shall be taken as:

(a) for ground mounted signs at least 0,75 kPa or 0,75 kN/m^2 (75 kg/m^2) because their total height is generally less than 6 m;

(b) for overhead mounted signs at least 1,25 kPa or 1,25 kN/m^2 (125 kg/m^2) with a total height less than 10 m (1,5 kPa or 1,5 kN/m^2 preferred for South African conditions in general).

6 Sign and sign structures should also be proportioned to avoid resonance at critical wind speeds by limiting their vertical deflection. This will generally be accomplished by using the value $d^2/122$ (in metres) as a limit for dead load deflection where "d" is the sign depth in metres. Additional to this dead load camber a permanent camber equal to L/1000 should be provided for sign bridges/portals, butterfly and cantilever structures, where L is the distance from the support post.

7 The dead load = D, shall consist of the total mass (self-weight) of the sign and supporting structure, including appurtenances/fittings or attachments.

8 A live load = L, should be allowed for walkways and will be a single load of 230 kg distributed over 600 mm transversely applied to walkways, and located so as to produce maximum stress in the supporting parts of the structure.

9 The collision or vehicle impact load that a structure must cater for should be a 100 kN static load acting in any direction on any one column at a height of 1,2 m above ground level. In order to be deemed acceptable, posts should thus comply with the following requirements:

(a) the post should sustain a moment of 1,05 R (i.e. 1,05 x the theoretical moment of resistance) at its critical section (usually the connection to the base plate or the frangible joint) with

(i) failure at the joint, or

(ii) deflection at the point of application of the load exceeding 0,05h, where h is the height of the point of application above the plane of the bottom of the base plate.

10 When the wind load and collision load act simultaneously on the support 25% over-stresses are accepted.

TABLE 15.7 WIND LOAD COEFFICIENTS TABLE 15.7

Type of Member	Shape of Coefficient (C_s)		Height Coefficient (C_h)	
	Shape of Member			
	Flat or Angular	Cylindrical	Height above ground level	C_h
Single member or truss	1,69	1,08	0-5 m	0,8
Two members or trusses, one in front of the other	2,86	1,86	5-10 m	1,0
Three trusses forming a triangular cross section	2,60	1,73	10-15 m	1,1
			15-30 m	1,25
Sign panel (by ratio of width to depth)			30-90 m	1,5
1:1	1,12			
2:1	1,19			
5:1	1,20			
10:1	1,23			
15:1	1,30			

11 The allowable stresses for various materials shall be in accordance with SABS or BSS specifications. Members subject to combined stress due to bending, axial compression and torque shall be designed so that the quantity

$fa/Fa + fb/Fb + (fs)^2/(Fs)^2$, shall not exceed unity,

where fa = average compression stress

Fa = allowable compressive stress for concentrically loaded member determined for maximum slenderess ratio

fb = maximum compressive stress due to bending

Fb = allowable compressive bending stress for member with no axial load

fs = maximum torsional shear stress

Fs = allowable shear stress = 0,33 Fy

Fy = guaranteed yield strength.

12 Figure 15.19 indicates the different design loads as to where they are acting or required on a sign structure.

13 There are certain aspects of the crashworthiness of sign structures that may help to maintain continued performance after being damaged, but which will minimise collision damage to vehicles and possible loss of life. The measures to increase crashworthiness or safeguard the sign structure may be any of, or a combination of, the following features:

(a) lateral and vertical clearance increases;

(b) the use of various frangible base, breakaway, methods for the supports;

(c) the use of deformable support materials;

(d) the provision of kerbing and guardrails.

14 The lateral clearances for positioning sign structures increase with an increase in sign back plate size which dictates an increase in support sizes. Thus signs that are smaller, < 1,5 m^2, will often be mounted on bendable or breakable single supports nearest to the edge of the road. Signs that are larger, > 1,5 m^2, are normally mounted on heavier multiple, frangible base, supports about double the lateral distances of smaller signs from the edge of the road, while the rigid and heavy upright supports for overhead signs are placed at about double the lateral distance for signs > 1,5 m^2, from the edge of the road.

15 The provision of kerbing and/or guardrails protects sign structures to a degree that allows the structures to be located roughly half the normal lateral clearance nearer to the edge of the road. The minimum lateral clearances are indicated in Figure 15.11.

16 Sign supports erected close to the travelled roadway without guardrails, should be of a yielding or breakaway construction in order to reduce vehicle damage and injury to occupants in the event of vehicles colliding with the supports. The basic concept of a breakaway sign support is that of a structure which possesses sufficient moment of resistance to withstand wind loads, yet offers low shear resistance at the base to a colliding vehicle. In the event of a collision the structure should yield or break away. Failure should occur in such a way that:

(a) serious secondary collision of the sign or support with the vehicle is avoided;

(b) energy absorbed from the impacting vehicle is kept to a minimum (a maximum reduction of 17 km/h in the speed of the impacting vehicle is considered acceptable), and damage to the vehicle is low.

17 The treatment of supports with various frangible base methods basically has two breakaway results namely:

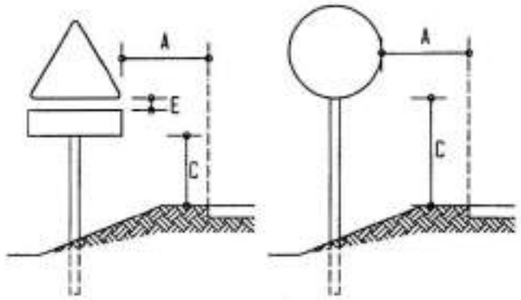
(a) allowing the vehicle to pass over the sign and structure;

(b) allowing the vehicle to pass under the sign.

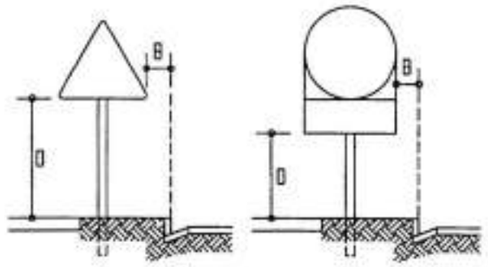
These results are indicated in Figure 15.18.

18 A breakaway resulting in the vehicle passing over the sign and structure is mostly applicable to the smaller sign types, < 4,5 m^2,

(continued on page 5.2.17)

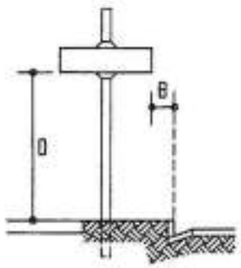


Shoulder (no kerb)

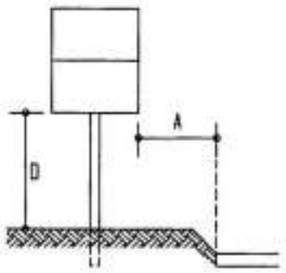


with Kerb and Sidewalk

Detail 15.12.1 Regulatory and Warning Signs

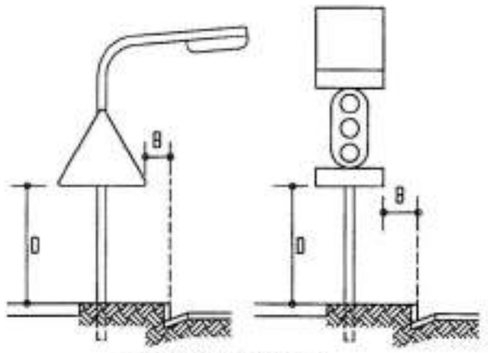


with Kerb and Sidewalk



Shoulder (no kerb)

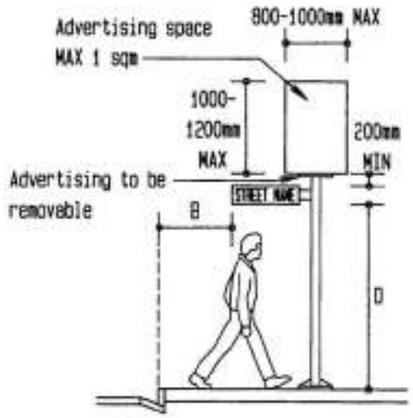
Detail 15.12.2 Location and Route Marker Signs



with Kerb and Sidewalk

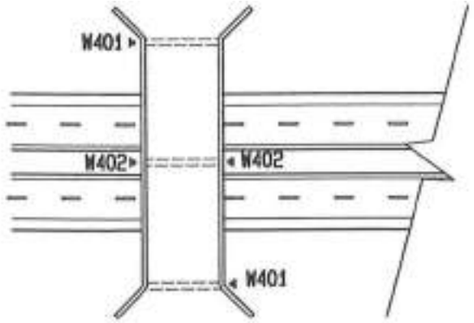
Detail 15.12.3 Small Signs on Host Supports

TABLE PERMANENT SIGN PLACEMENT DIMENSIONS			
Dimension	Minimum (mm)	Preferred (mm)	Maximum (mm)
A	1200	1500	2000
B	500	750	-
C	600	2100	2500
D	2100	2500	3000
E	0	0	200

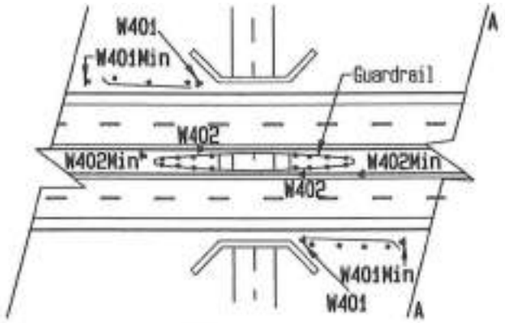


Detail 15.12.4 Advertising with STREET NAME

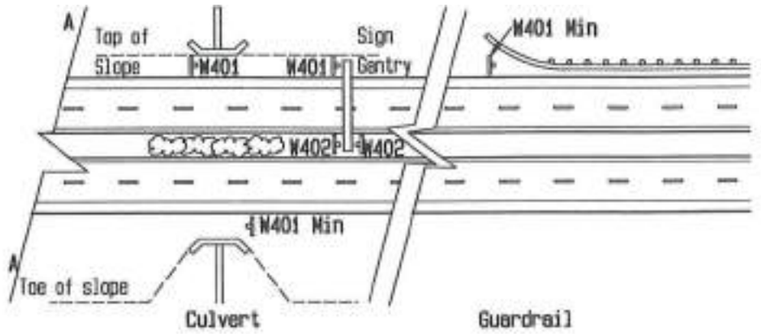
Fig 15.12 Lateral and Vertical Clearances for Small Single Support Signs



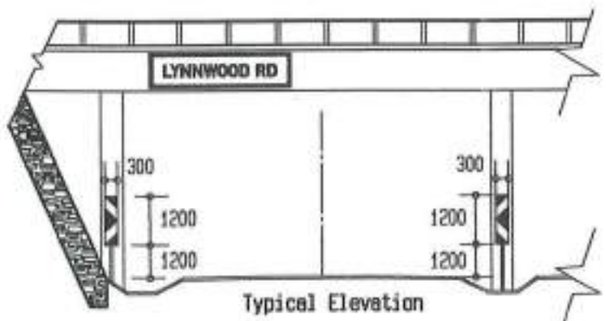
Overpass or Gantry



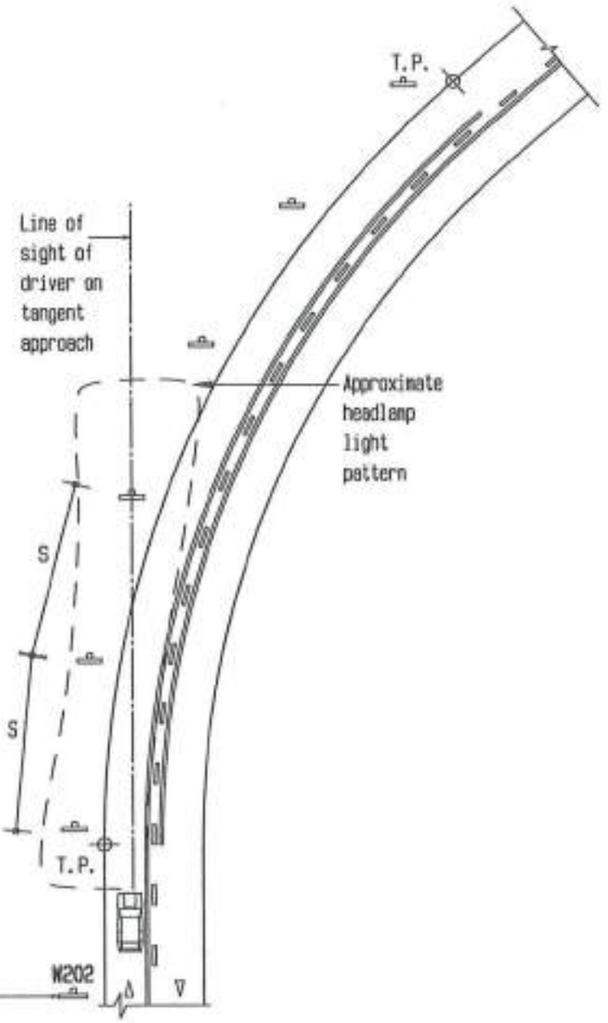
Underpass



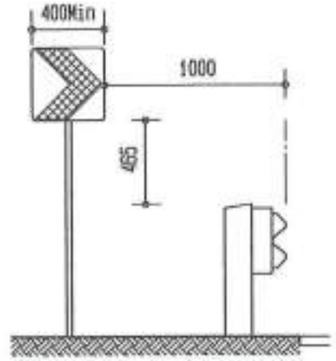
Guardrail



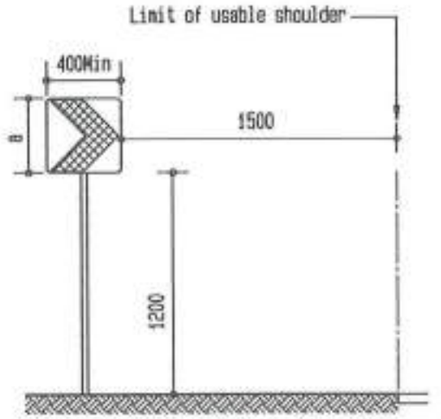
Detail 15.13.1 Typical Use of Hazard Markers at Roadside Structures



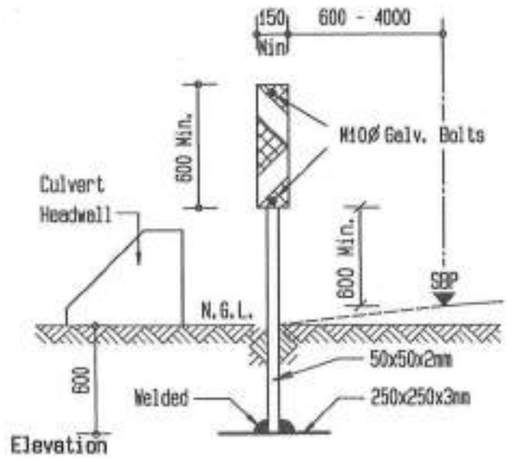
Detail 15.13.3
Sharp Curve Chevron Spacing based on Tangent approach



Detail 15.13.4 W405 Sharp Curve Chevron With Guardrail

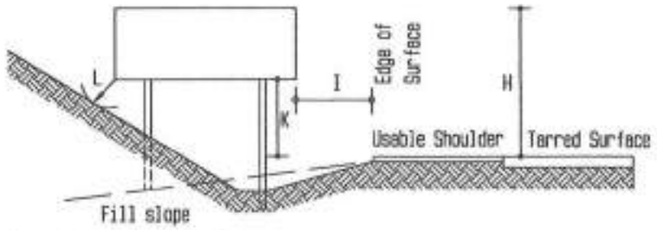


Detail 15.13.5 W405 Sharp Curve Chevron Without Guardrail

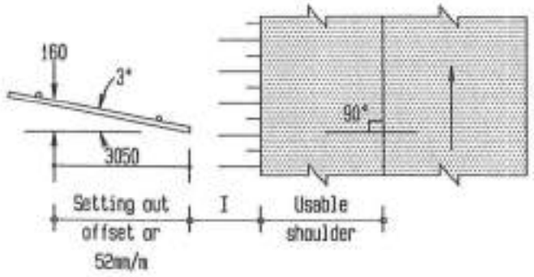


Detail 15.13.2 Typical Installation-Minimum Size W401/W402

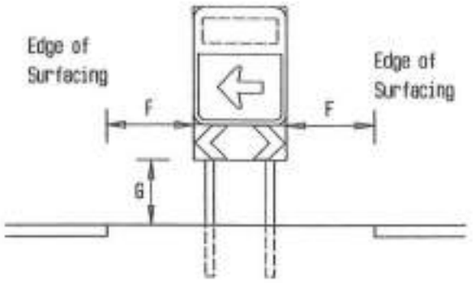
Fig 15.13
Positioning of Hazard Markers



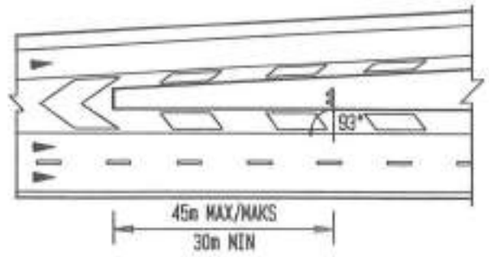
Beyond a Usable Shoulder

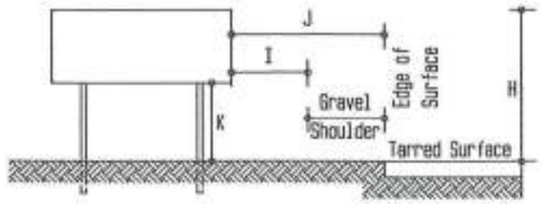


Sign Offset to Avoid Specular Reflection

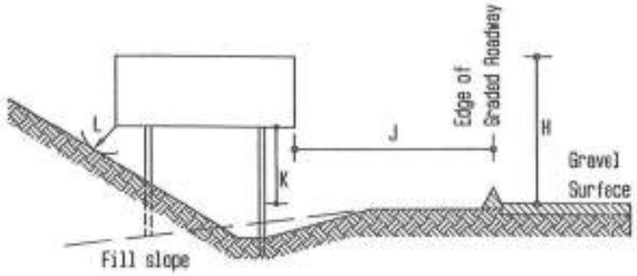


Detail 15.14.2 Gore Sign





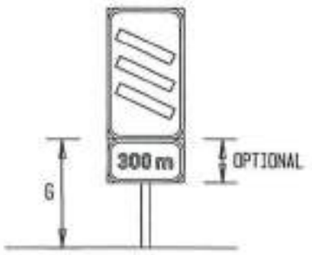
Ground Mounted Direction Signs - Class A and Class B Roads



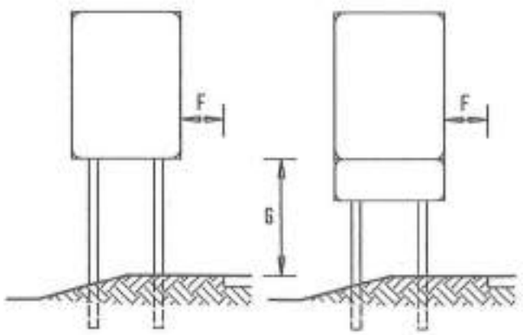
Ground Mounted Direction Sign - Class C Roads

PERMANENT SIGN PLACEMENT DIMENSIONS			
Dimension	Minimum (mm)	Preferred (mm)	Maximum (mm)
H	-	-	6000
I	1500	2500	-
J	2500	4000	-
K	1600	2000	2400
L	1200	-	-

Detail 15.14.4 Direction Signs

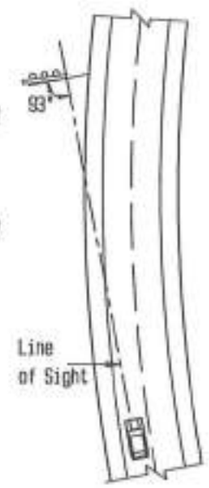


Detail 15.14.3 Countdown Signs



Detail 15.14.4 Diagrammatic Sign

Lateral Setback of Countdown Signs to Avoid Obscuring of Exit Sign - GA3

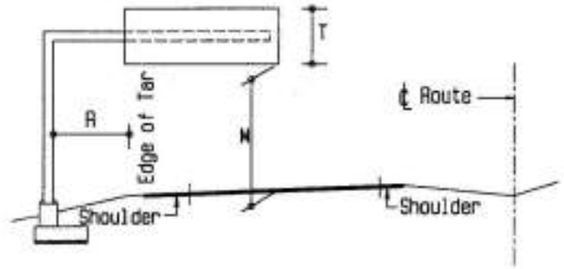


Adjustment to Sign Orientation on Right Hand Curve

PERMANENT SIGN PLACEMENT DIMENSIONS			
Dimension	Minimum (mm)	Preferred (mm)	Maximum (mm)
F	1200	1500	2000
G	800	1200	1600

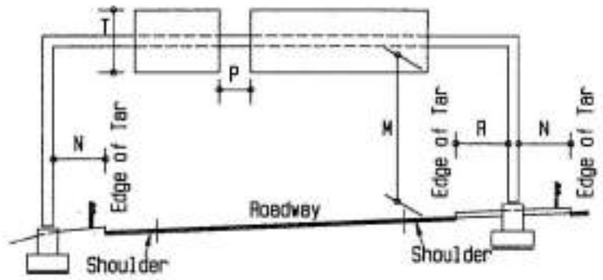
(Details 15.14.1 to 15.14.3)

Fig 15.14
Lateral and Vertical Clearances for Larger Multiple Support Signs

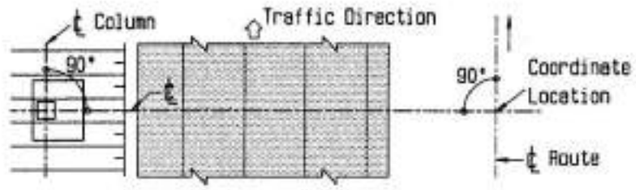


Detail 15.15.1 Typical Cantilever

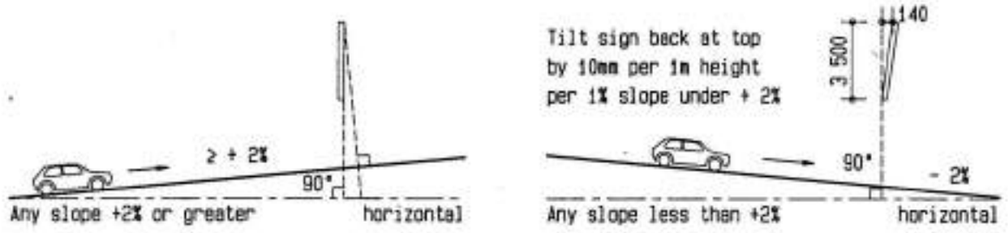
PERMANENT SIGN PLACEMENT DIMENSIONS			
Dimension	Minimum (mm)	Preferred (mm)	Maximum (mm)
M	5200	5700	6200
N	1500	2000	-
P	50	1000	-
A	4000	4500	-
T	1800	-	4200



Detail 15.15.2 Typical Gantry



Detail 15.15.3 Overhead Sign Positioning



Detail 15.15.4 Adjustment of Signface to Avoid Specular Reflection

Fig 15.14 Lateral and Vertical Clearances for Overhead Sign Structures

(continued from page 5.2.12)

mounted on single supports. These supports should either be:

(a) of a diameter < 76 mm and, if a steel tube type, of wall thickness less than 3 mm allowing for a fracture or bending breakaway; or

(b) a larger diameter, deformable tube type support with a split base socket allowing for initial yield by bending followed by a split and release of the base socket.

Both these methods are used all over the world because of minimum damage to vehicles and easy repair or replacement of a damaged sign.

19 Breakaways resulting in the vehicle passing under the sign are applicable to the larger sign types > 1,5 m^2, mostly mounted on multiple supports. Because of the width of larger signs, and the multiple supports, vehicles mostly crash through only one of the supports, passing under the sign, and leaving the sign intact for service to other motorists. There are basically three breakaway methods which can result in vehicles passing under the sign namely:

(a) fracture at breakaway holes drilled in timber or steel tube type supports at their bases;

(b) fracture at welded-on base plates where small diameter, thin walled tube, ladder type supports shear at the welded on base plate;

(c) fracture at inclined or horizontal slip bases, allowing for the sign to either be forced upwards and over the vehicle, if it is a smaller single support sign, or for the support to hinge just below the sign to allow the vehicle to pass under it, for larger signs; Figure 15.18 illustrates these breakaway actions.

20 Because there is no breakaway allowance for the heavier and rigid upright supports of cantilever or gantry structures for overhead mounting of signs these supports should be located at least 4 m - 4.5 m from the edge of the road if no kerbing or guardrails are provided. These support structures are a hazard to vehicles and should be safeguarded with guardrails if they are located nearer to the edge of road than the minimum distance allowed for the road cross sectional type.

21 It is also important that modifications to existing signs do not alter or negate the affect of the breakaway method used for the supports.

22 Figure 15.17 indicates the minimum lateral distances, from the edge of the road, for positioning the different support frangibility types according to the level of frangibility offered by each.

15.2.8 Anti-Vandalism Measures

1 Anti-vandalism measures are actually part of the safety considerations related to sign structures, discussed in Section 15.2.7 previously, or their ability to withstand vandalism and still be serviceable to the motorist.

2 Vandalism in some areas, especially metropolitan areas, can create a significant problem. Wilful defacement and destruction of road signs includes graffiti, gun blasts, splashes or sprays of paint, stickers or posters stuck on sign faces, and outright theft.

3 Some forms of vandalism can have serious consequences, e.g. the alteration of a speed limit sign, the theft of a stop sign, or the reorientation of directional signs/arrows to point along a hazardous path. All such malicious mischief should be corrected as soon as it is discovered and the public should be encouraged to report occurrences of this nature.

4 To combat acts of vandalism and to minimise their effects, the following measures are frequently effective:

(a) the use of sign materials that will continue to perform even though damaged;

(b) the use of temporary materials or easily replaceable materials or facings;

(c) the use of commercially available vandal-resistant hardware/fasteners;

(d) the use of anchor rods, cleats or locking pins to prevent rotation or removal of the sign or its support posts;

(e) the installation of signs high enough to be out of reach;

(f) the placement of signs away from the edge of road at the maximum lateral offset allowed for the sign types;

(g) the use of a warning sticker or plaque on the back of a sign or on the sign post below the sign to identify it as an official device subject to criminal prosecution against acts of vandalism;

(h) the use of special cleaning materials for the removal of paint and stickers from sign faces;

(i) the use of gravel filled tube supports to prevent theft;

(j) use of stiffeners or reinforcing on the backs of smaller signs to prevent bending;

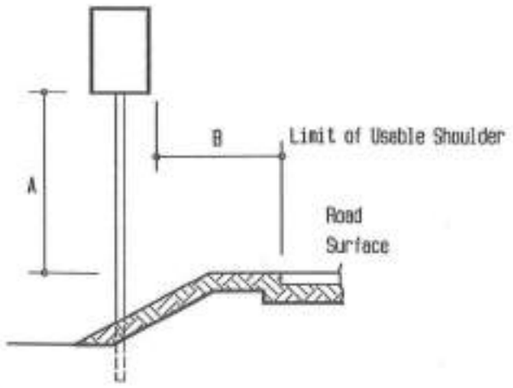
5 Figure 15.20 indicates some of the anti-vandalism measures mentioned above:

(a) Detail 15.20.1 - locating clearances to allow for vandalism;

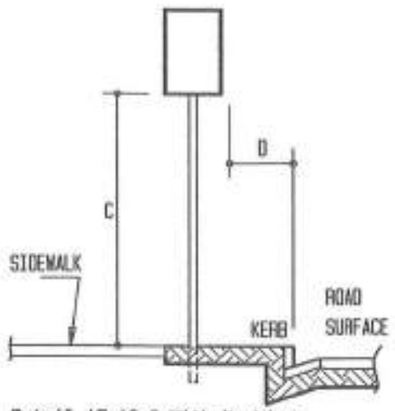
(b) Detail 15.20.2 - sign structures to prevent sign bending, rotation or removal;

(c) Detail 15.20.3 - commercially available anti-vandal fasteners;

(d) Detail 15.20.4 - warning sticker or plaque.



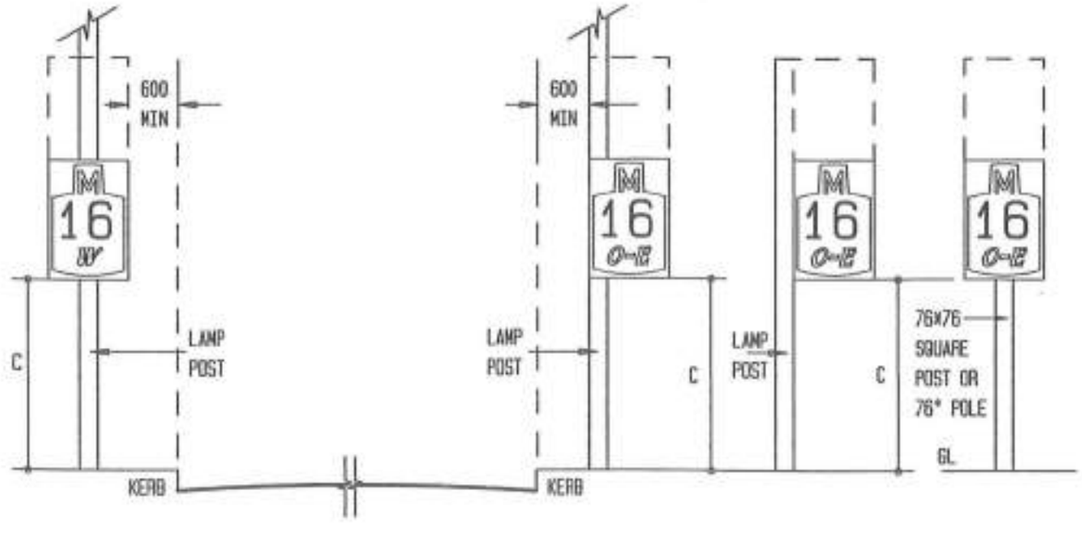
Detail 15.16.1 Shoulder (no Kerb Line)



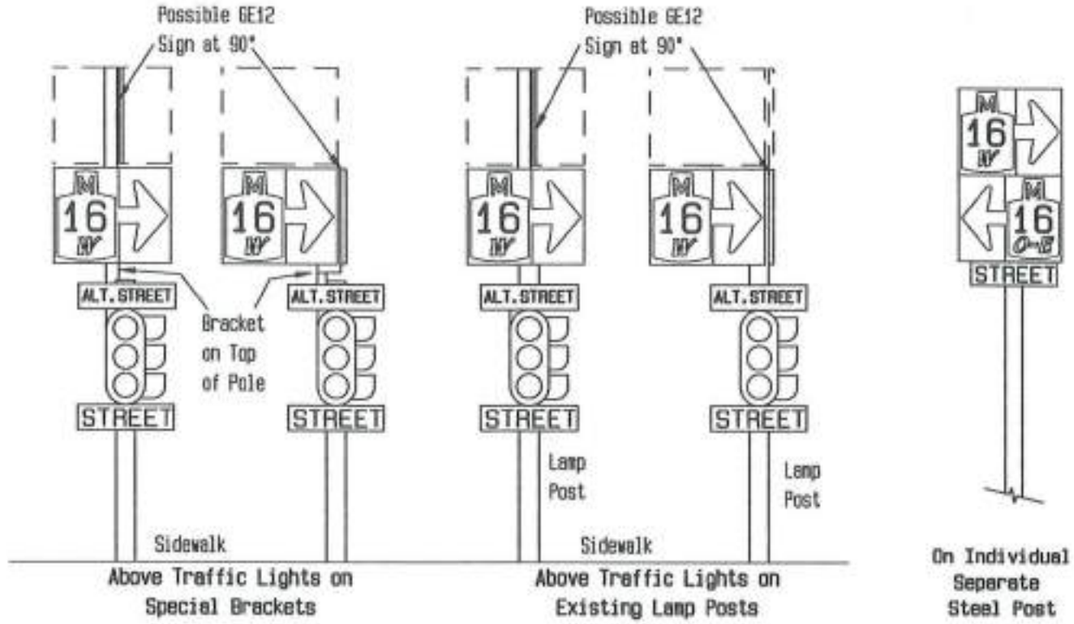
Detail 15.16.2 With Kerbing

	PREFERRED	MINIMUM
A	3000	2100
B	2500	1500
C	3000	2100
D	1500	600

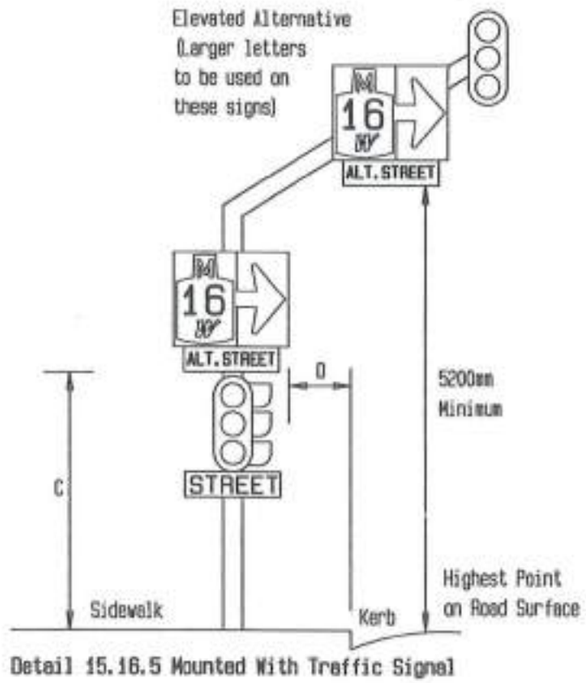
Confirmation signs should be located on existing street furniture wherever possible. Signs may be mounted centrally on poles, or cantilevered left or right according to pole positions in relation to a kerb line. Signs may be mounted on the right side of one-way roadways.



Detail 15.16.3 Route Marker Mounting Between Junctions (Confirmation Signs)



Detail 15.16.4
Route Marker Mounting in Relation to other Road Traffic Signs at Intersections/Junctions

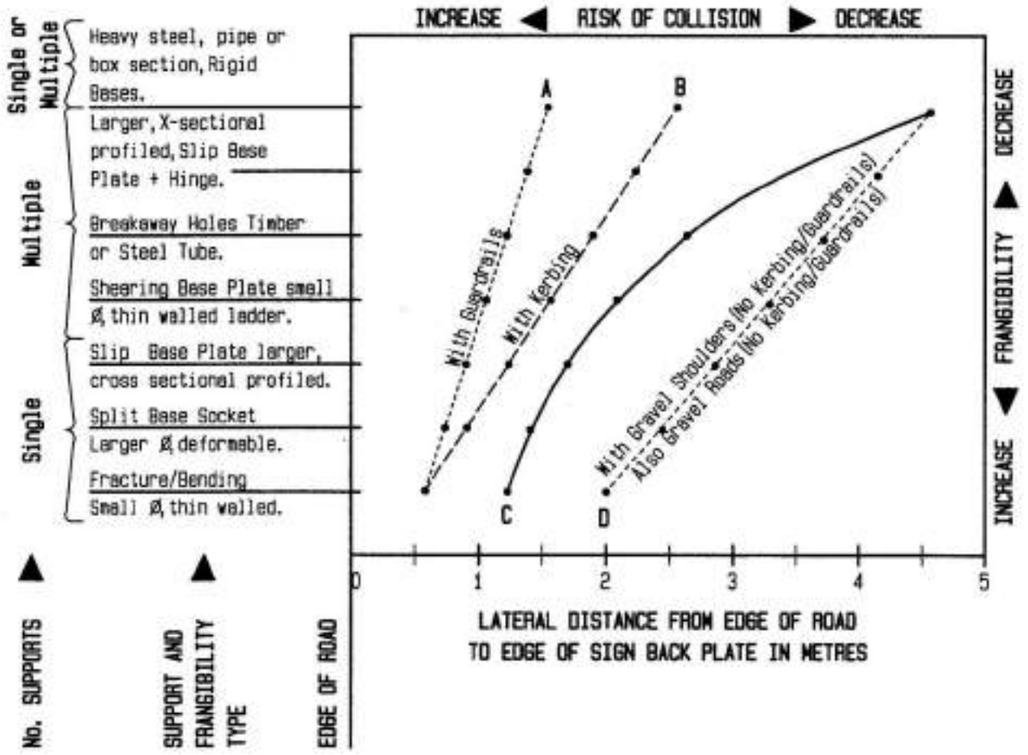


Detail 15.16.5 Mounted With Traffic Signal

NOTES:

1. Higher mounting heights are preferred for visibility over trucks and buses and also to deter vandalism.
2. The minimum mounting height should be used for signs on their own individual posts.
3. The longitudinal position of confirmation route marker signs is 30m - 60m beyond a junction.
4. Repeat confirmation signs are recommended between junctions at 450m - 550m intervals for 60km/h, and at 650m - 750m intervals for 80km/h operating speeds.
5. Advance route marker signs may be provided at from 60m to 240m in advance of a junction when there are multiple lanes and/or when sight distance to the junction is poor.

Fig 15.16
Positioning of Hazard Markers



NOTES:

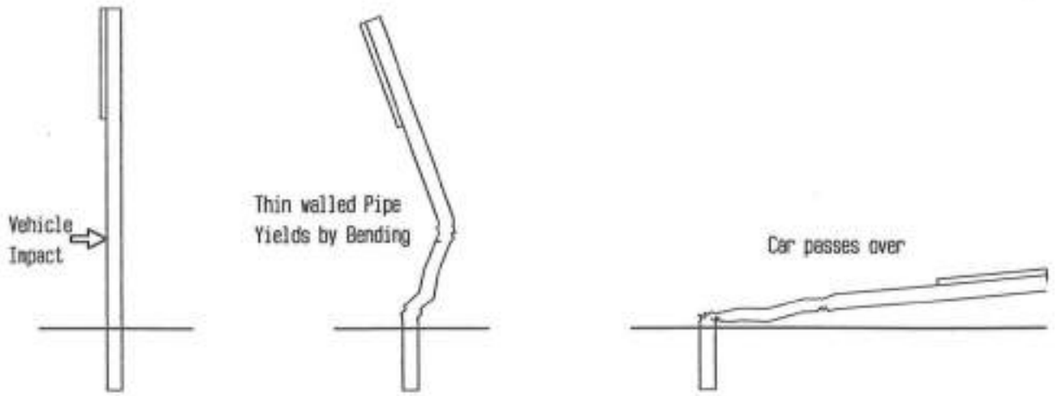
(1) The lateral distance will always be measured from the edge of the road to the sign back plate edge nearest to the road and not to the supports except in the case of overhead sign cantilever or gantry structures where it will be measured to the support face.

(2) The edge of road for the graph lines shown above will be:
- the kerb for roads with quadrails or kerbing - lines A and B,
- the edge of surfacing for roads with/without surfaced shoulders - lines C and D,
- the edge of graded roadway for gravel roads - line D.

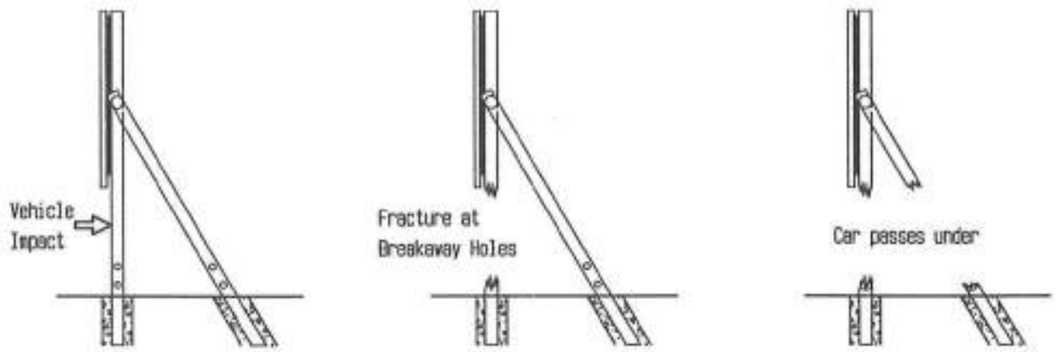
(3) The lateral distances that can be determined from the graph are the minimums. For details specific to the different sign and road types refer to Figures 15.11 to 15.20.

(4) The graph is only an attempt to indicate the relationship between the support frangibility type and the lateral positioning thereof regarding the safety considerations applicable, and does not indicate the lateral positioning distances for different sign types as such.

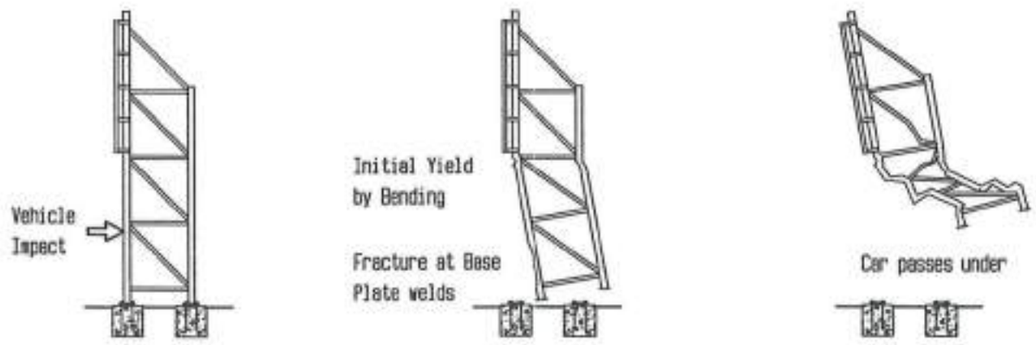
Fig 15.17 Safety Level Offered by Different Frangibility Types



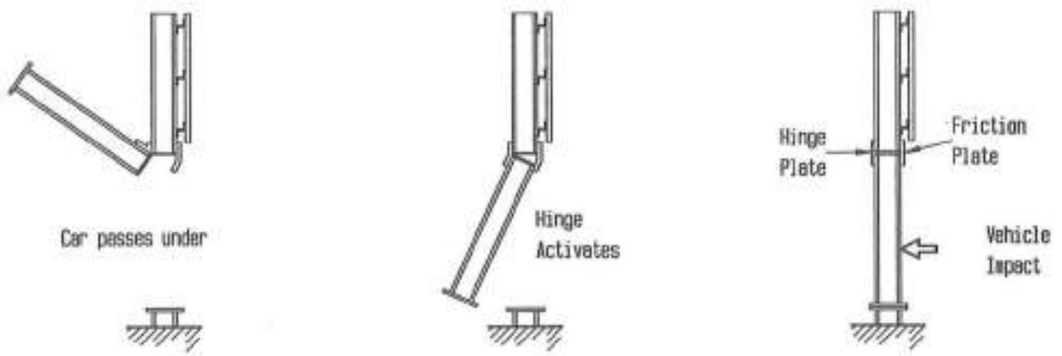
Detail 15.18.1 Breakaway Action - Bending Note: For use with Single Post Sign Systems



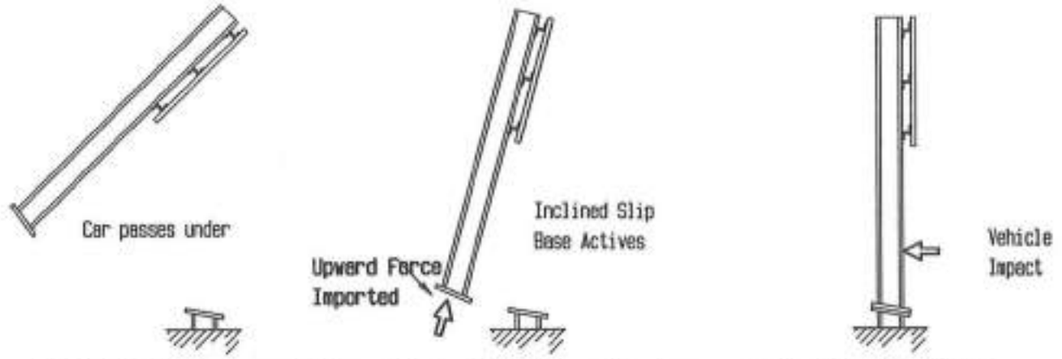
Detail 15.18.2 Breakaway Action - Fractures Note: This device is used for signs with two or more posts



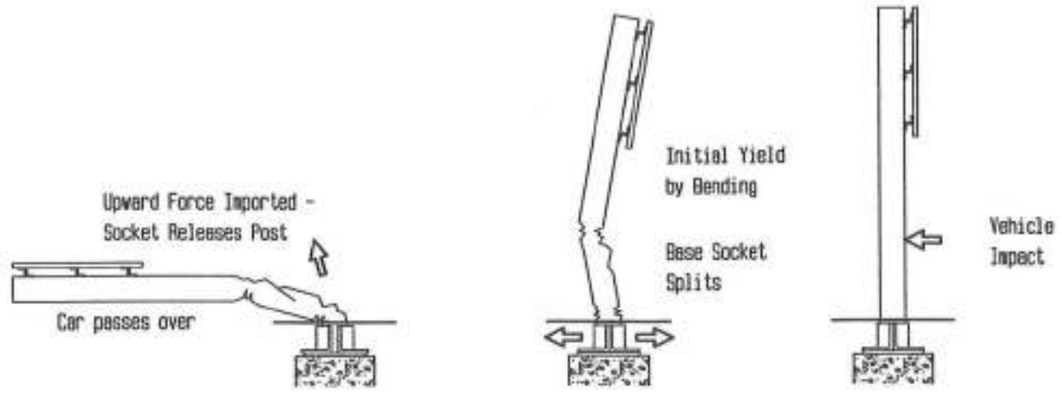
Detail 15.18.3 Breakaway Action - Shearing Base Plate Note: This device is used for signs with two or more posts



Detail 15.18.4 Breakaway Action - Horizontal Slip Base
Note: This device is used for signs with two or more posts

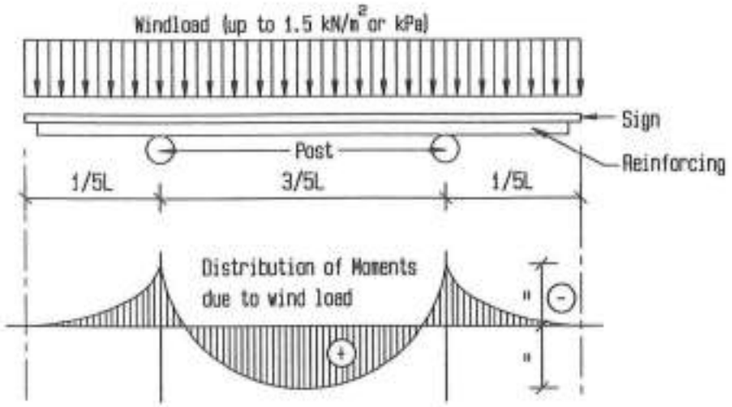


Detail 15.18.5 Breakaway Action - Inclined Slip Base Note: For use with Single Post Sign Systems

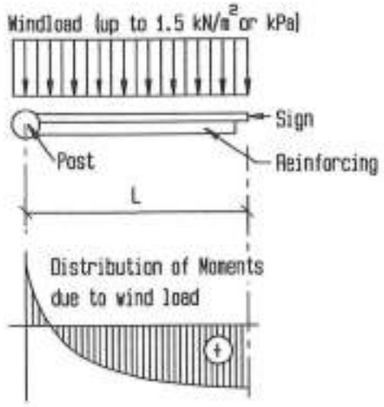


Detail 15.18.6 Breakaway Action - Split Base Socket Note: For use with Single Post Sign Systems

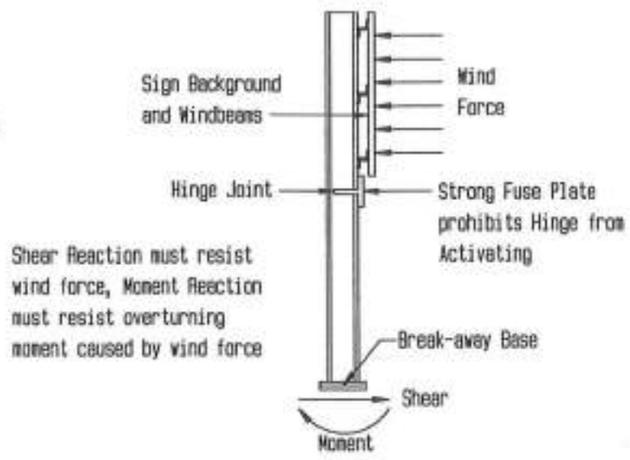
Fig 15.18
Breakaway Actions of Different Sign Support Structure Types



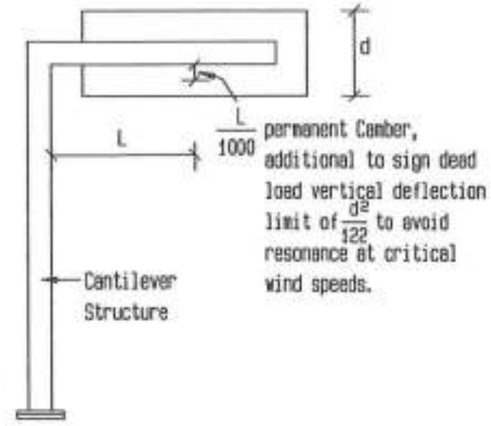
Detail 15.19.1 Distortion Momentline for Dual Posts



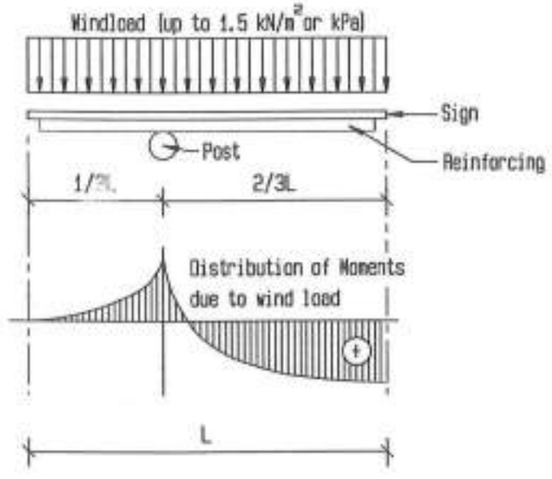
Detail 15.19.2
Distortion Momentline for Sign Post on Sign Edge



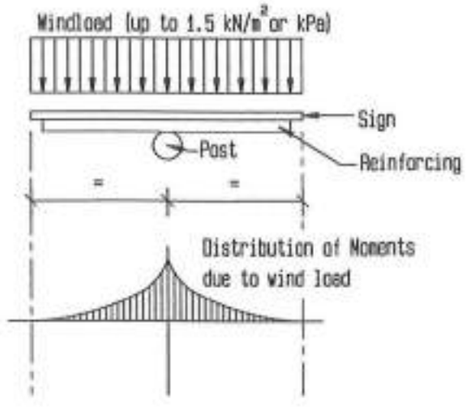
Detail 15.19.5 Wind Load Condition



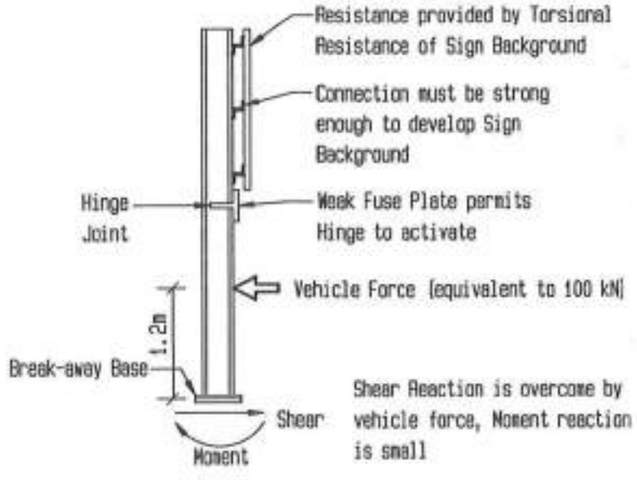
Detail 15.19.6
Dead Load Vertical Deflection and Permanent Camber



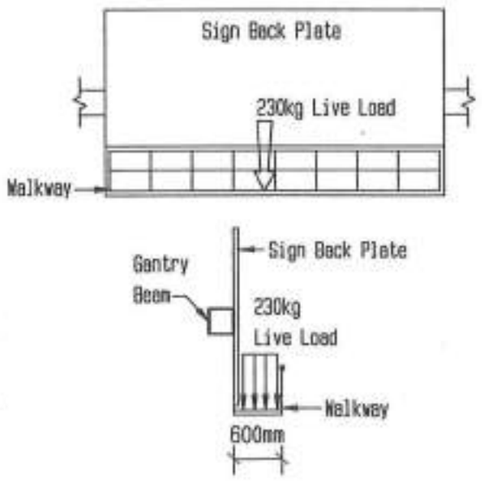
Detail 15.19.3
Distortion Momentline for off centred Single Post



Detail 15.19.4
Distortion Momentline for centred Single Post

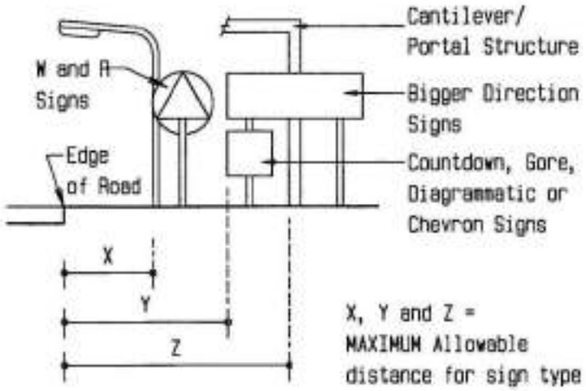


Detail 15.19.7 Collision Condition

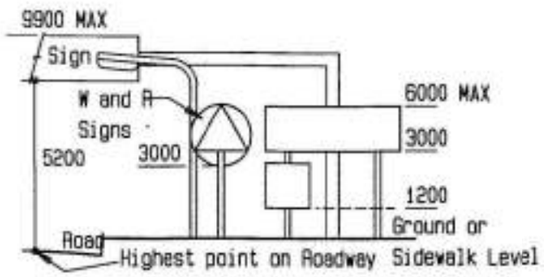


Detail 15.19.8 Live Load Application

Fig 15.19
Loads and Conditions Acting on Sign Structures

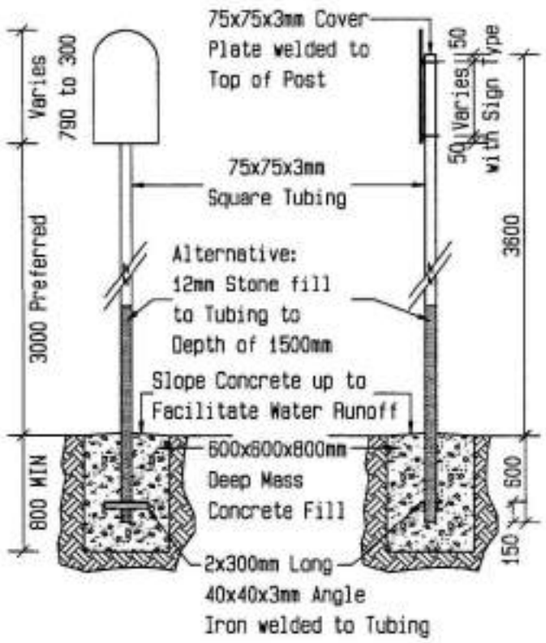


Lateral Clearances for all Road Types

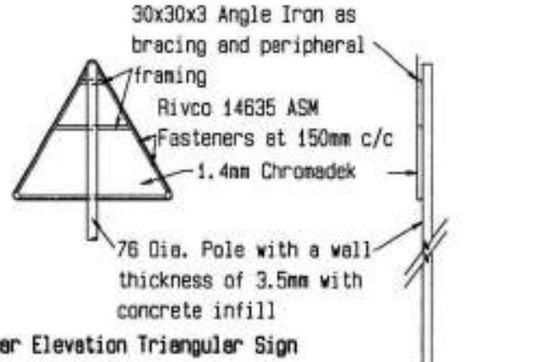


Vertical Clearances for all Road Types

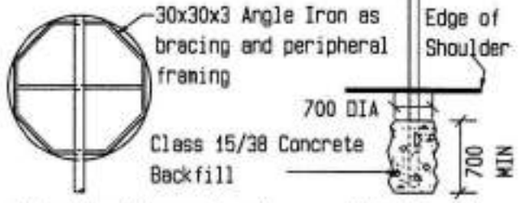
Detail 15.20.1 Clearances to allow for Vandalism



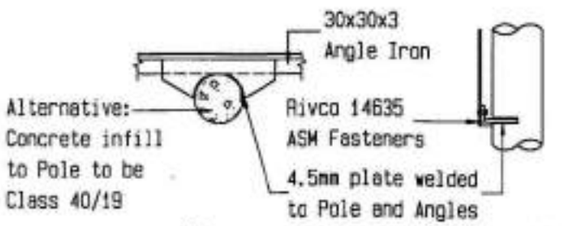
Detail 15.20.2
Sign Structures to prevent Sign bending, rotation or removal



Rear Elevation Triangular Sign



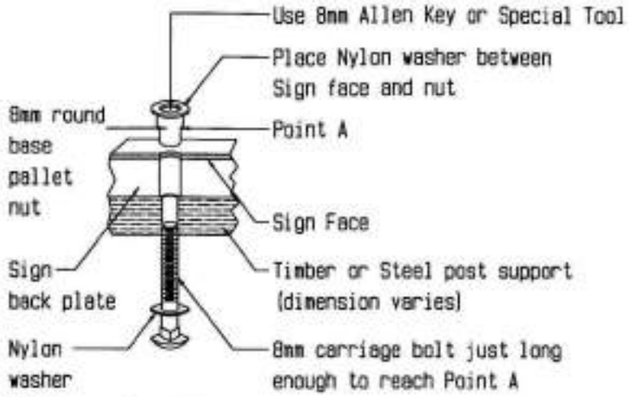
Rear Elevation Octagonal and Circular Sign **Side Elevation**



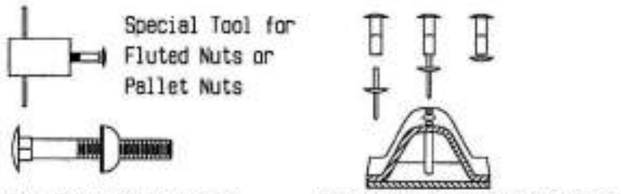
Plan **Side Elevation**

Pole Attachment Detail

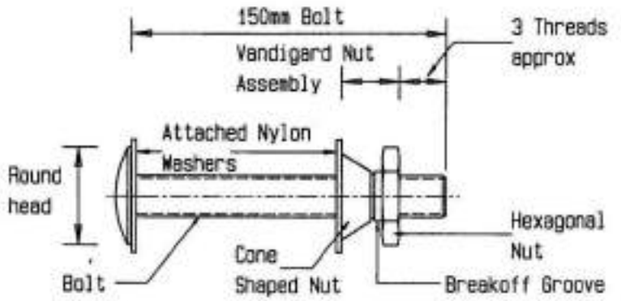
Fig 15.20
Typical Anti-Vandalism Measures



(a) "Teenut" or Pallet Fastener



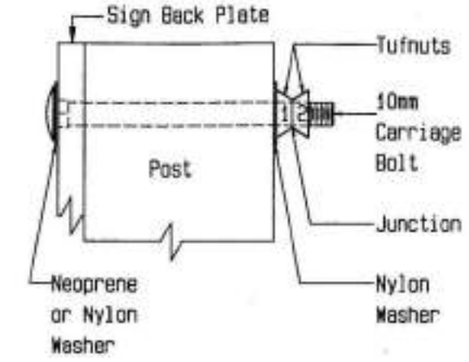
(b) General Theft Resistant Sign Fasteners



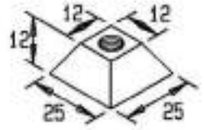
Typical Installation Procedure
Step 1: Install Nut assembly finger tight as shown.
Step 2: Tighten Nut assembly with a spanner until the Cone shaped and Hexagonal parts separate by breaking at the Breakoff Groove.
Step 3: Remove Hexagonal part of the Nut and installation is complete.

(c) "Vandigard Nut" Fastener

Detail 15.20.3 Anti-vandal Fasteners



Typical Installation Procedure
Step 1: Install first Tufnut (No 1) finger tight as shown.
Step 2: Install second Tufnut (No 2) finger tight as shown.
Step 3: Insert wrench at junction to tighten (or loosen) as necessary.
Step 4: Remove Tufnut NO 2, then installation is complete.



Single Tufnut is difficult to remove because of its shape. Always use (4) Tufnuts for each sign installation.

(d) "Tufnut" Fastener

WILLFUL DEFACING, DAMAGING OR ALTERING OF ANY ROAD SIGN OR ITS STRUCTURE IS AN OFFENCE SUBJECT TO CRIMINAL PROSECUTION WHICH MAY RESULT IN A FINE AND OR IMPRISONMENT
(LAW ? No. ? DATE)

Warning Sticker/Plaque to apppear on the back of Signs or Sign Posts at a height of ±1.5m above Ground Level.

Detail 15.20.4 Warning Stickers

15.3 CHOICE OF MATERIALS FOR AND COMPOSITION OF SIGN BACK PLATES

15.3.1 General

1 Sections 15.3-15.6 cover the choices between various types of materials, their physical properties, effectiveness and use in making up each of the components of a sign structure. A wide range of materials and structure examples are indicated with a list of advantages and disadvantages for each of the different types of component. The information is not intended to dictate actions or to endorse specific products, but rather to assist those designing sign structures to choose carefully from the many materials and fabrication methods available.

2 In general the materials for the component parts of signs should be chosen in relation to their advantages or disadvantages regarding the following:

(a) the costs for the initial material manufacture, installation and maintenance;

(b) the manpower and equipment required to manufacture, install and maintain;

(c) the safety considerations regarding passive safety (frangibility) and deformability, but the sign must be crashworthy for continued performance after an accident;

(d) the material's resistance to various forms of vandalism;

(e) the durability or performance of the material in different weather or climate conditions, or environments, that it might be located in;

(f) the difficulty and expense required to change or modify signs or the signing system in future;

(g) a standardised system versus an individual purpose made unit;

(h) compatibility of materials when different material types are to be joined or fixed together, due to the possibility of electrolytic action or differential thermal expansion that may result in failure or deterioration.

3 From the above it is clear that there are three main considerations when choosing a sign structural system, namely that the system should be:

(a) functional;

(b) flexible;

(c) economic.

4 In a constantly changing environment, it is important that changes or modifications to the sign system be made at minimum expense. A structural system may appear to be economical when installed, but may actually be costly due to the expense of making changes. Conversely, a flexible structural system with a some-what higher initial cost, may prove to be more cost-effective over time.

5 The largest cost factor in any sign structure system is determined by the individual sign units, rather than the surface or sign face graphics. A sign system based upon a standardised system is usually less expensive over its life than individually fabricated units, because of ease of erection and maintenance as well as component parts' availability. The cost of signing a new facility, or replacing an old sign, can be minimized by using standard sign units.

6 The external illumination of signs can be very costly. The need to provide such illumination should be kept to a minimum by carefully controlled design techniques.

7 Protection of the sign and structure from vandalism, pests and other environmental hazards like veld fires is a serious design, fabrication and location concern. Some compromise regarding design and cost may be necessary when environmental hazards are present.

8 Materials for signs should be compatible so that failure or deterioration owing to electrolytic action or differential thermal expansion does not occur. Alloys containing copper should not be used in contact with aluminium alloys, for example. Where two different and incompatible materials, for instance if aluminium alloy overhead sign back plates and a steel or stainless steel gantry have to be bolted together, the contact areas should be shielded from each other with adhesive PVC tape and aluminium backed "Bostik" tape, or other similar means of insulation.

9 All sign component materials should thus be chosen for their compatibility with each other, and be of such quality and size that the sign complies with all the required performance levels.

15.3.2 Back Plate Materials

1 The most widely used sign back plate materials are wood; (usually plywood or particle board), plastic (perspex, polycarbonate or GRP) and metal (aluminium or steel). All these material types are available in flat board or sheet format in various thicknesses, and the plastic and metal materials are also available in extruded format as slats, road sign profiles and other profiles. See Figure 15.21.

2 Wood or timber sign boards should be moisture, fire and termite resistant, exterior grade of the following types:

(a) laminated timber complying with the requirements of SANS 1460:1988, treated in accordance with the requirements of SANS 1288;

(b) marine type plywood or blackboard complying with the requirements of SANS 929;

(c) exterior type plywood complying with the requirements of SANS 50312:1996 and of thickness of at least 16 mm;

(d) exterior type moisture resistant particle board complying with the requirements of SANS 50312:1996.

3 Typical South African wood/timber boards, for sign back plates, available in the above grades are:

(a) "Sisondura";

(b) "Novoclad V100" particle board; and

(c) "Uniply" MR/WSP graded plywood.

4 Plastic sign boards should be exterior grade, UV resistant, clear to solid coloured, resistant to corrosion and chemicals, impact resistant, flexible but hard surfaced to be scratch resistant and finally fire resistant.

5 The plastics or acrylics that can be used for sign back plates are normally from the thermoplastic, glass reinforced polyester and perspex types as follows:

(a) acrylic polycarbonate, flat or profiled, sheeting complying with the requirements of SABS;
(b) glass reinforced polyester (GRP), flat or profiled, sheeting complying with the requirements of SANS 1150;
(c) perspex flat or profiled, sheeting complying with the requirements of SABS.

6 Typical South African plastic/acrylic boards, usable for sign back plates, are:

(a) "Ampagard";
(b) "Lexan" acrylic polycarbonate flat or profiled sheeting;
(c) "Robertson-Dekex" glass reinforced polyester flat or profiled sheeting;

and various perspex and uPVC products.

7 Metal back plates should be at least 1,2 mm thick and made from one of the following materials:

(a) aluminium alloy sheet complying with the requirements of BS 1470 and condition codes SK-HA, HS30-TF, NS3-H6, or NS4-H6;
(b) aluminium alloy extrusion complying with the requirements of BS 1474 and condition codes HE9-TF, HE9-TE or HE30-TF;
(c) galvanised steel sheet complying with the requirements of BS2989;
(d) steel sheet other than (c), coated with zinc applied by a continuous process (the coating having an average mass of at least 185 g/m^2 for both sides, a single spot measurement of at least 152 g/m^2, and a percentage of zinc, in any one side of the blank, of at least 40% of the total) followed by a suitable chemical preparation of the zinc surface, for example a double painted system (Chromadek);
(e) other kinds of metal, treated sheeting i.e. stainless steel and 3CR12 sheeting (costly}.

8 Various metals are rolled into a special road sign profile section, which is commonly used to make up a sign back plate in a manner similar to that used for extruded aluminium plate sections. In both of these cases a retroreflective facing, when specified, is added to the plate section before it is assembled into a back plate.

15.3.3 Composition of Sign Back Plates

1 When deciding which type of sign back plate sheeting or profile to use the advantages and disadvantages of each type should be considered. For example, aluminium is light weight and will not rust, but is initially more expensive than steel or wood and not very vandal resistant. It requires cross bracing for the larger sized signs. Galvanised steel is heavier and usually more rigid and will not rust if the zinc coating is not damaged and also is more economical than aluminium. Wood is of medium strength, does not normally require cross bracing and is the least expensive of the materials but is porous and susceptible to weathering, rot and pest if not treated against these. Polycarbonate is a light weight, very strong, corrosion and chemical resistant, clear or solid colour, and vandal resistant material but it is very expensive, not compatible with PVC and while it may resist fire it will get soft and deformed with continuous exposure to intense heat.

2 Where back plates need framing, bracing or stiffening the stiffening should be one of the following:

(a) flanges forming an integral part of the sign plate material;
(b) some form of frame and bracing design which may be integral with and/or secured to the sign back plate sheet or profile;
(c) a cabinet or boxed frame and internal bracing design where the sign back plate sheet or profile will be secured in or to the cabinet.

3 Examples of the different types of sign back plate framing and bracing are indicated in Figures 15.22 to 15.28 as follows:

(a) back plate and framework for signs < 1,5 m^2;
(b) back plate and framework for panelled signs 1,5 m^2;
(c) back plate and framework for stacked South African road sign profiles;
(d) back plate and framework for stacked European road sign profiles;
(e) back plate and framework for boxed, internally illuminated, or VMS signs or cabinets.

4 Back plate frames and bracing (framework) should be made from a mild steel that is hot dipped galvanized in accordance with the requirements of SANS 121:1999, or painted/powder-coated in accordance with the requirements of CKS 193, or manufactured from a non-corrodible material. The quality of the materials and the size of the members of the framework should be such that the sign back plate complies with the appropriate performance requirements.

15.3.4 Materials Comparison Tables

1 In this and subsequent sections various component types are listed with their basic advantages and/or disadvantages in a number of tables.

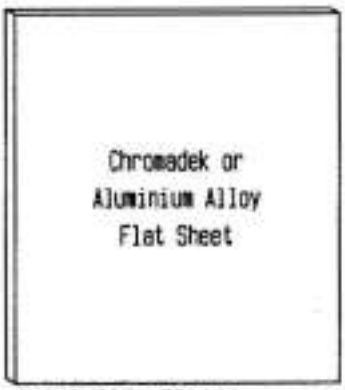
2 Some of the properties referred to as advantages or disadvantages, such as material costs or ease of manufacture, installation and/or maintenance, are graded by statements such as "low" or "minimum" up to "high" or "complex". In this way a particular property of a component may be assessed through a table for different types of component materials. Within each table the materials are generally listed in an order from "low" to "high" cost, or "low" to high" manpower requirements. A "low" cost or manpower requirement will be an advantage, whereas a "high" cost manpower requirement will be recorded as a disadvantage.

Timber Boards

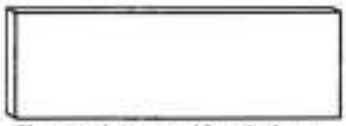
Timber Material Types:
Moisture Resistant, Exterior Grade;
* Bisondura Particle Board
* Novocland V100 Particle Board
* Uniply MR/WBP Graded plywood

Plastic Boards

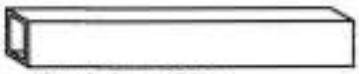
Plastic Material Types:
Clear to Opaque or Coloured;
* Perspex
* Polycarbonate
* Glass Reinforced Polyester
* Fibre Glass
* PVC



Metal Sign Plates



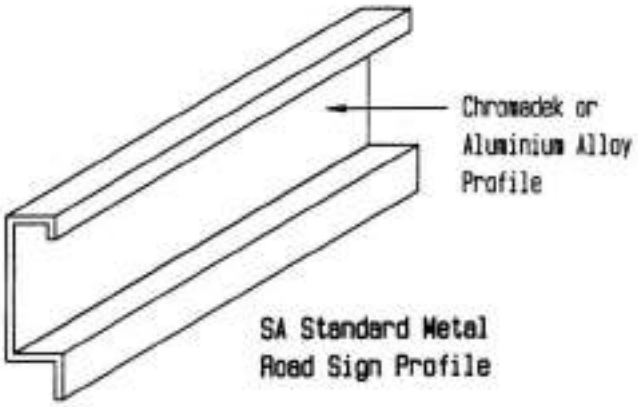
Chromadek or Aluminium Strips



Aluminium Alloy Slats or Laths

Metal Material Types:

* Galvanized Steel
* Stainless Steel
* 3 CR12
* Chromadek
* Aluminium Alloy



SA Standard Metal Road Sign Profile

European Extruded Aluminium Alloy Road Sign Profile

Fig 15.21 **Sign Back Plate Material Types**

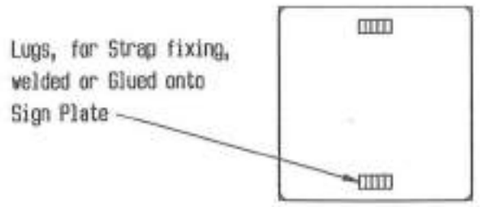
TABLE 15.8 BACK PLATE MATERIAL TYPES TABLE 15.8

Material Type	Advantages	Disadvantages
Timber Board	• Good for most climate/ weather types	• Not applicable to aggressive / polluted areas
	• Urban or Conservation area applications	• Veld fires can damage
	• Material thickness requires less bracing thus fairly rigid	• Pest resistance average performance if treated
	• Manufacture costs are lower because less framework / bracing required	• Material cost is expensive due to moisture resistance treatment
	• Installation costs low because timber easy to work with i.e.. drill, saw...	• Maintenance more expensive because of re-treatment to back plate
	• Manpower and equipment requirements for manufacture, installation and maintenance a minimum	• Vandal resistance average due to sign theft
		• Not very durable or crashworthy because of breaking and splintering
Plastic Sheet	• Excellent for use in climate / weather types where corrosion is a problem, and polluted areas. Can withstand rust and rot, even salt	• Not so good for use in desert area where temperature differences and sand-blasting is prevalent
	• Excellent pest resistance	• Veld fires can damage
	• Light weight is easy on handling	• Not recommended for conservation or rural areas
	• Clear plastics excellent for internally illuminated signs	• Requires extensive bracing and framing
	• Initial material costs average depending on plastic type used	
	• Manpower and equipment requirements for manufacture, installation and management a minimum	
	• Excellent vandal resistance, durability and crash worthiness depending on type of plastic used	
Chromadek Sheet	• Good for use in most climate / weather types	• Not recommended for use in aggressive or severely polluted areas
	• Excellent for general urban, rural, conservation area use	• Can rust if not correctly treated
	• Excellent pest resistance and good fire resistance	
	• Costs for material, manufacture, and maintenance are average	
	• Vandal resistance average	
	• Durability and crash worthiness good	
	• Manpower and equipment requirements for manufacture, installation and maintenance are below average	

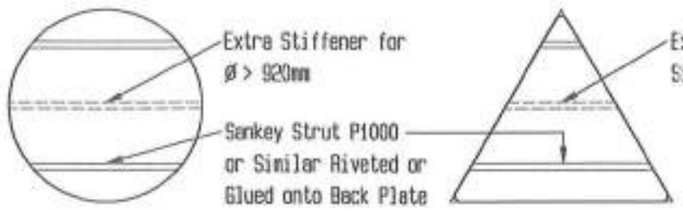
TABLE 15.8 BACK PLATE MATERIAL TYPES TABLE 15.8

Material Type	Advantages	Disadvantages
Chromadek Profiles	• Good for use in most climate or weather types • Good for general urban, rural use. • Excellent pest resistance and good fire resistance • Vandal resistance good • Manpower and equipment requirements for manufacture, installation and maintenance are below average • Durability and crash worthiness good	• Not recommended for use in aggressive or severely polluted areas • Can rust if not correctly treated • Costs for material, manufacture and maintenance are above average
Aluminium Sheets	• Excellent for all climate or weather types • Excellent for urban or rural use • Good fire and pest resistance • Cost, manpower and equipment requirement for maintenance less than average • Durability and crash worthiness excellent	• Not an environmentally friendly material • Initial material expensive • Costs for manufacture and installation above average • Manpower and equipment requirements more than average for manufacture and installation • Prone to theft due to high scrap value
Aluminium Profiles	• Excellent for all climate or weather types • Excellent for urban or rural use • Good fire and pest resistance • Cost, manpower and equipment requirement for maintenance less than average • Durability and crash worthiness excellent	• Not an environmentally friendly material • Initial material expensive • Cost for manufacture and installation expensive • Manpower and equipment requirements above average for manufacture and installation • Prone to theft due to high scrap value

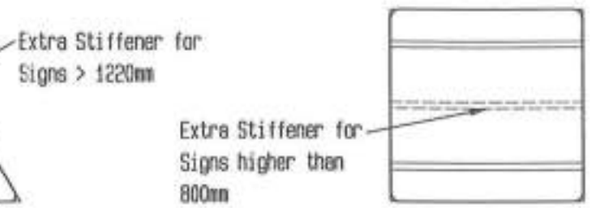
Detail 15.22.1 No Frame or Bracing (Signs < 0.36m^2)

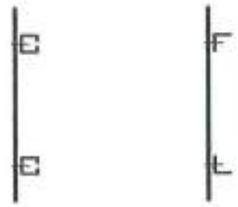


Sectional Side Elevation



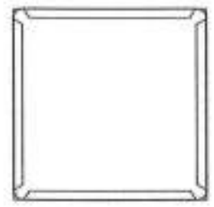
Detail 15.22.2 Simple Horizontal Bracing Only





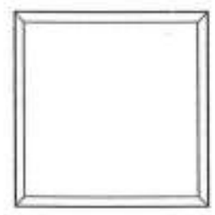
Sectional Side Elevation

Detail 15.22.3 Formed/Pressed Edges as Bracing



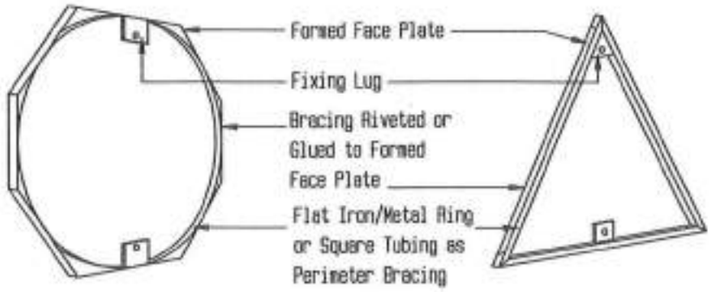
Sectional Side Elevation

Detail 15.22.4 Perimeter Bracing Only



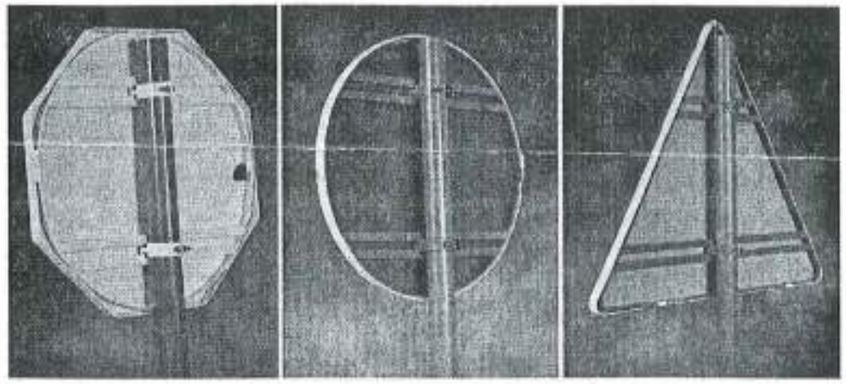
Sectional Side Elevation

Fig 15.22
Simple Sign Back Plate and Bracing for Flat Sheet Road Signs Smaller Than 1.5 m^2

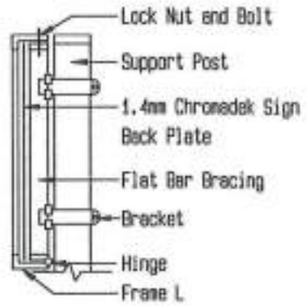


Detail 15.23.1 Formed Edges with Perimeter Bracing (SA Example)

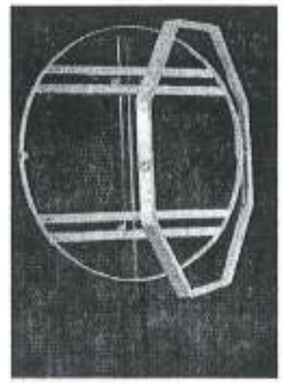
Sectional Side Elevation of 3 Examples



Detail 15.23.2 Hinged Frame with Perimeter Bracing (S.A.) Signfit Quickly)



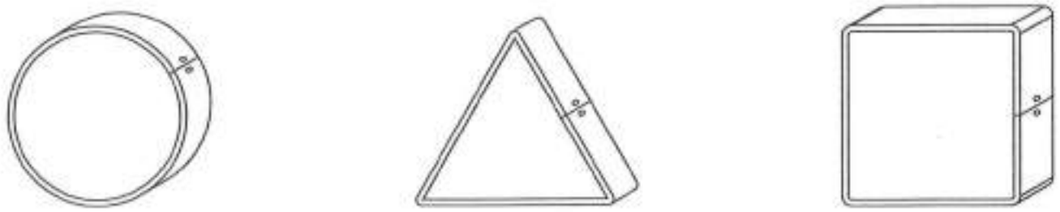
Sectional Side Elevation



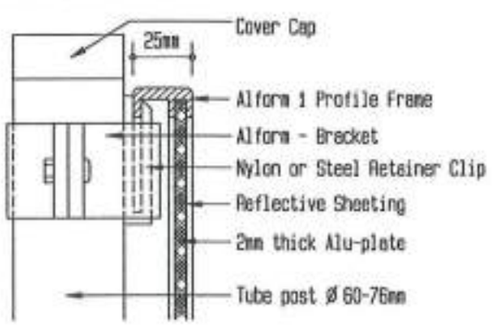
Open Hinged Frame

The smallest ALFORM version, the ALFORM 1 - system, is used for highway signs only: circular, triangular, octangular, rectangular types, less than 1.5m² in sign area. There is a frame profile only. No stiffening profile and no field splice is necessary.

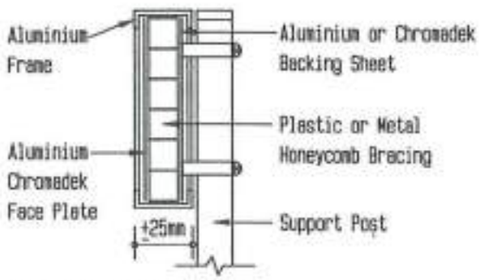
Detail 15.23.3 Profiled Frame only (German Alform System)



Detail 15.23.4 Framed Sandwiched Bracing (European System)



Sectional Side Elevation



Sectional Side Elevation

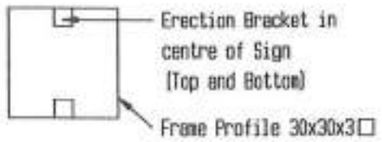
Fig 15.23
Sign Back Plate and Edge Bracing for Flat Sheet Road Signs Smaller Than 1.5 m²

TABLE 15.9 BACK PLATE FRAMEWORK FOR SIGNS <1.5m² **TABLE 15.9**

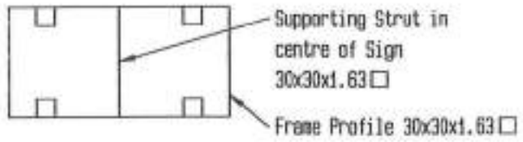
Framework Type	Advantages	Disadvantages
No Frame or Bracing	• Good for most climate/weather types • Good for most environments • Costs for material, manufacture, installation and maintenance very low • Manpower and equipment requirements for manufacture, installation and maintenance a minimum	• Only for smaller signs with sizes less than 0,36 m² or else the material needs to be thicker than 1,4 mm which is costly • No vandal resistance. Can be bent, damaged or stolen, easily • Average durability because it can be bent back to original form
Simple Horizontal Bracing	• Good for most climate/weather types • Good for most environments • Costs for material, manufacture, installation and maintenance low • Manpower and Equipment requirements for manufacture, installation and maintenance low • Sign stiffer because of bracing and cannot be bent as easily thus more vandal resistance • Larger sizes possible because of bracing	• Somewhat more expensive than the above sign because of horizontal stiffeners and fasteners
Formed/pressed edges as bracing	• Good for most climate/weather types • Good for most environments • Costs for material, manufacture, installation and maintenance still low • Manpower and equipment a bit more sophisticated for manufacture but low • Thinner material can be used because pressed edges provide rigidity • Vandal resistance still good, cannot bend easily • Signface looks neat, can avoid drilling of holes	• More expensive than signs with horizontal stiffeners because of specialised machines needed to press edges • Pressed edges only appropriate for smaller signs
Perimeter Bracing (commonly a separate frame)	• Good for most climate/weather types • Good for most environments especially vandal prone areas • Very rigid sign • Larger signs can be made • Vandal resistance excellent	• Expensive to manufacture because of more material, labour and equipment required • Sign heavier than above mentioned sign types • Treatment of welded joints must be correctly done to rust

TABLE 15.9 **BACK PLATE FRAMEWORK FOR SIGNS <1.5m²** **TABLE 15.9**

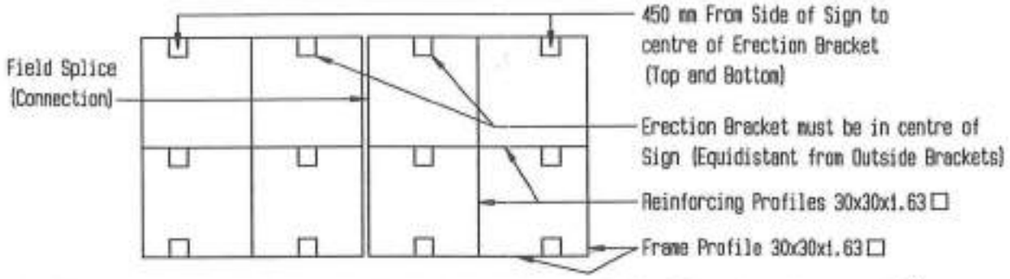
Framework Type	Advantages	Disadvantages
Formed edges with Perimeter Bracing	• Same advantages as for signs with only formed edges or perimeter Bracing but more rigid and better looking	• More expensive to manufacture than signs with only formed edges or perimeter bracing • Possible rust traps between bracing and pressed edges
SA Signfit Quicky	• Same advantages as for signs with formed edges or perimeter bracing • Easy to install and maintain	• Expensive to manufacture • Possible rust traps between frame and sign back plate • Vandal resistance average because of hinge and locking nut
German Alform System	• All Aluminium construction easy and long lasting • Good for all weather and environment types • Very neat looking • System can be used for larger signs as well • Weight savings • Easy to install and maintain	• Vandal resistence low due to aluminium theft • Expensive because of formed, profiled frame and thicker Back Plate
European Framed Sandwich	• Very neat looking • Good for most weather and environment types • Mostly aluminium construction	• Vandal resistance low because of aluminium theft • Expensive to manufacture because of aluminium parts and labour involved



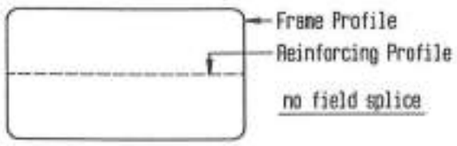
Detail 15.24.1 SA Square Tubing Frame for Signs of ±1.5 m² with a Single Support Post



Detail 15.24.2 SA Square Tubing Frame and Reinforcing for Sign of 1.5 m² to 8 m² with 2 or 3 Support Posts



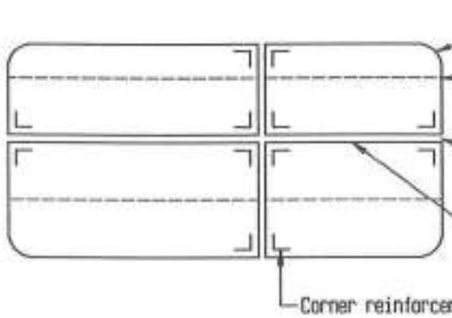
Detail 15.24.3 SA Flat Sheet Chromadek Panels and Square Tubing Frame for Signs > 8 m²



The medium sized version of ALFORM 2-system is used for signs ranging between 1.5 m² and 4.5 m² only. The system consists of two profile-types:

- frame profile with a depth of 40 mm
- a stiffening profile to reinforce the back of the sign, if the height exceeds 750 mm

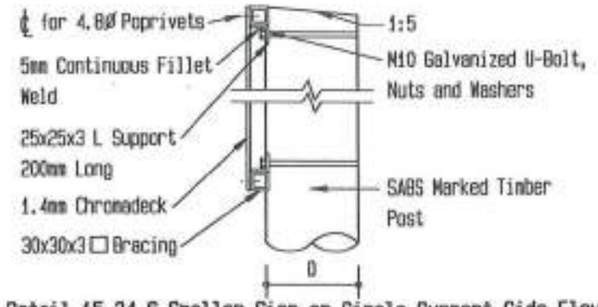
Detail 15.24.4 German Alform 2 System: Aluminium Flat Sheet Panels for Signss > 1.5 m² up to 4.5 m²



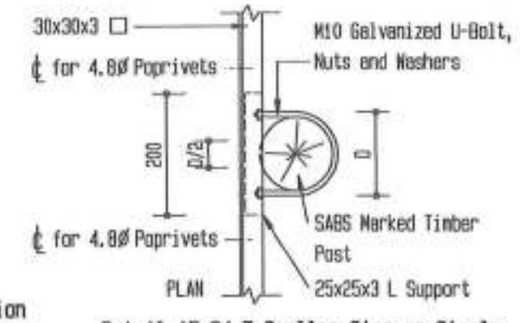
The ALFORM 3-system is used for all signs larger than 4.5 m² up to approx. 60 m². The system consist of 5 different profiles:

- frame profile, with a depth of 60 mm
- reinforcing profile
- connecting profile for field splices
- corner profile to connect frame with reinforcing profile
- connecting profile to connect frame profile with rounded corner profile

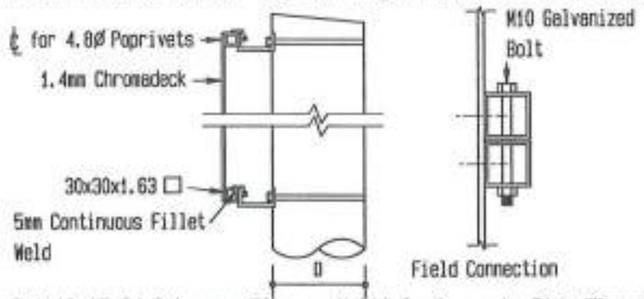
Detail 15.24.5 German Alform 3 System: Aluminium Flat Sheet Panels for Signs > 4.5 m²



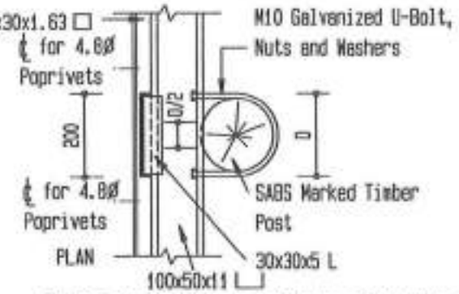
Detail 15.24.6 Smaller Sign on Single Support Side Elevation



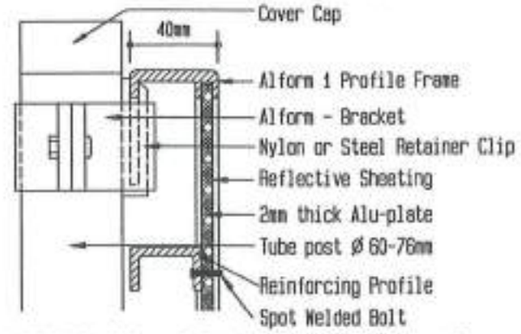
Detail 15.24.7 Smaller Sign on Single Support Plan



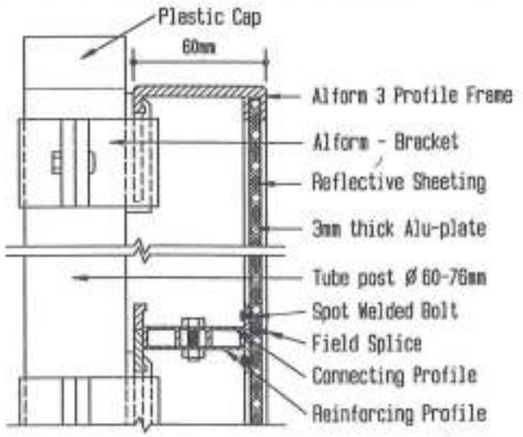
Detail 15.24.8 Larger Sign on Multiple Supports Side Elevation



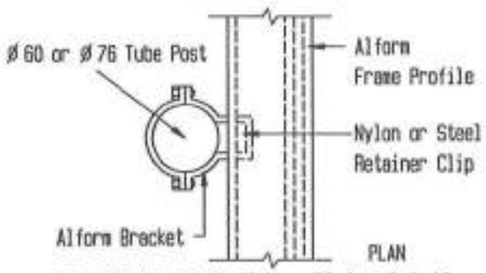
Detail 15.24.9 Larger Sign on Multiple Supports Plan



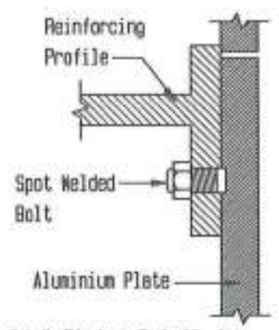
Detail 15.24.10 Alform 2 System for Medium Size Signs



Detail 15.24.12 Alform 3 System for Larger Signs

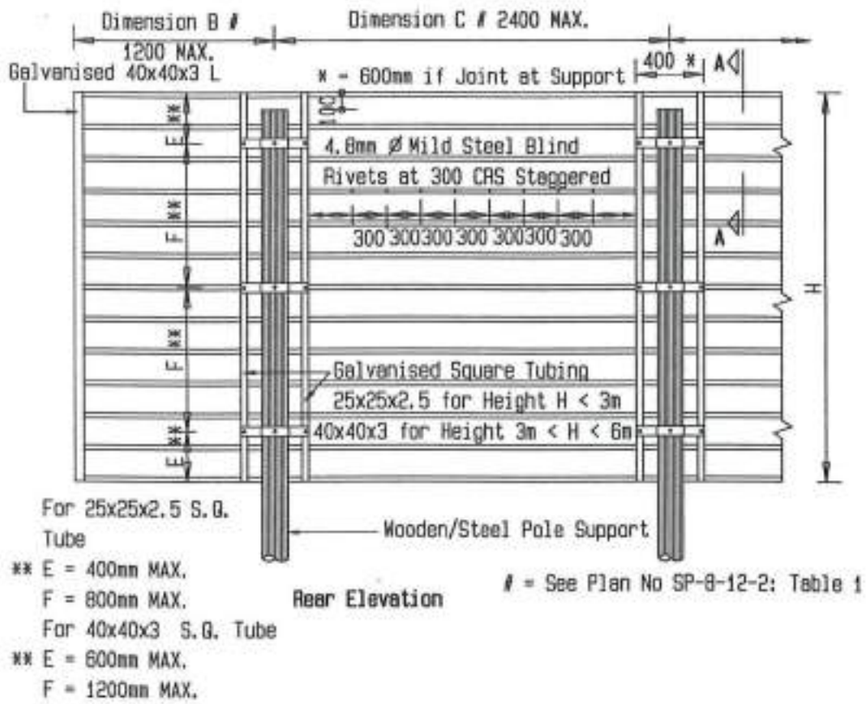


Detail 15.24.11 Alform Fixing Detail



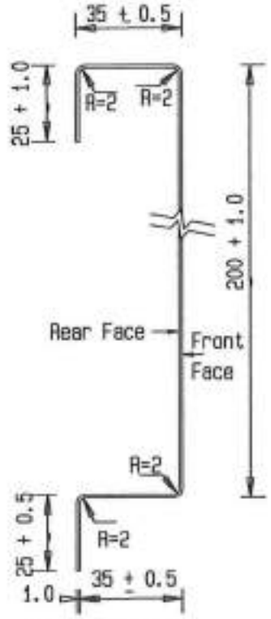
Detail 15.24.3 Fixing Detail for Reinforcing Profile

Fig 15.24
Sign Back Plate and Framework for Flat Sheet Panelled Road Signs >=1.5 m²

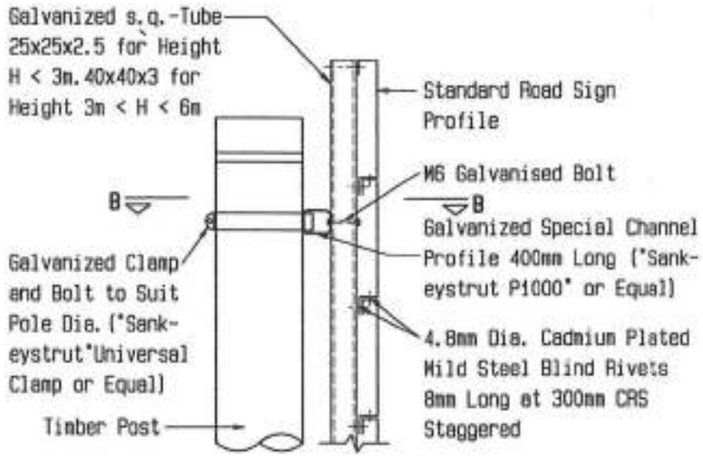


Rear Elevation

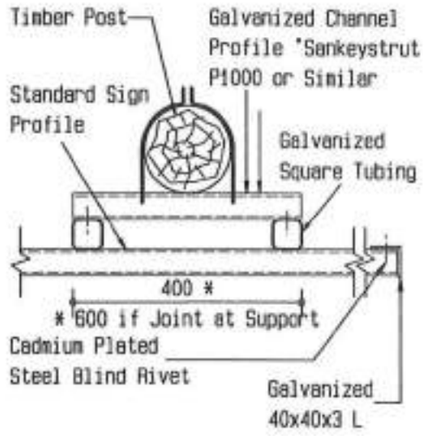
Detail 15.25.1 Ground Mounted Road Sign Back Plate consisting of Stacked Chromadek Road Sign Profiles



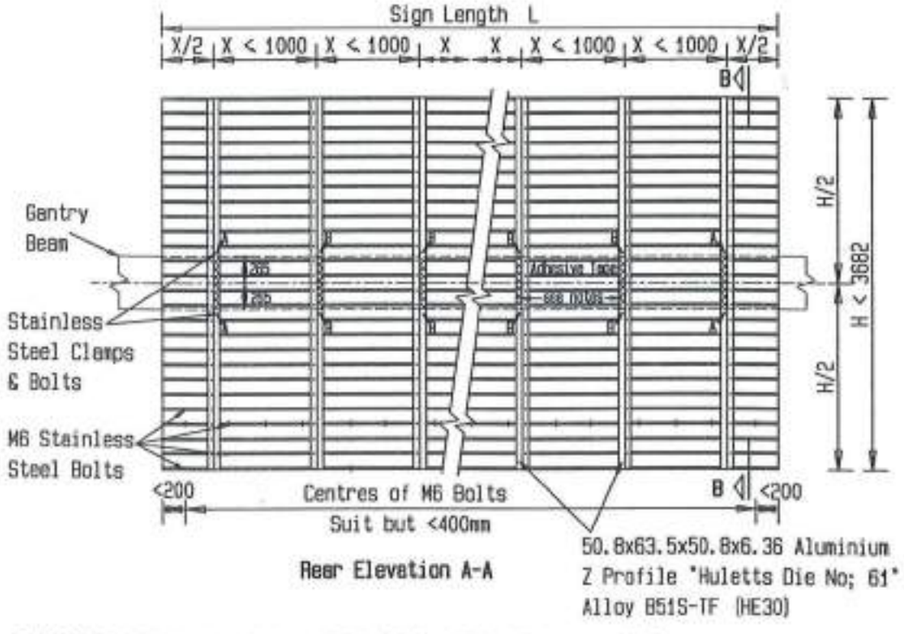
Detail 15.25.2
South African Chromadek/
Aluminium Road Sign Profile



Detail 15.25.3 Part Sectional Side Elevation A-A

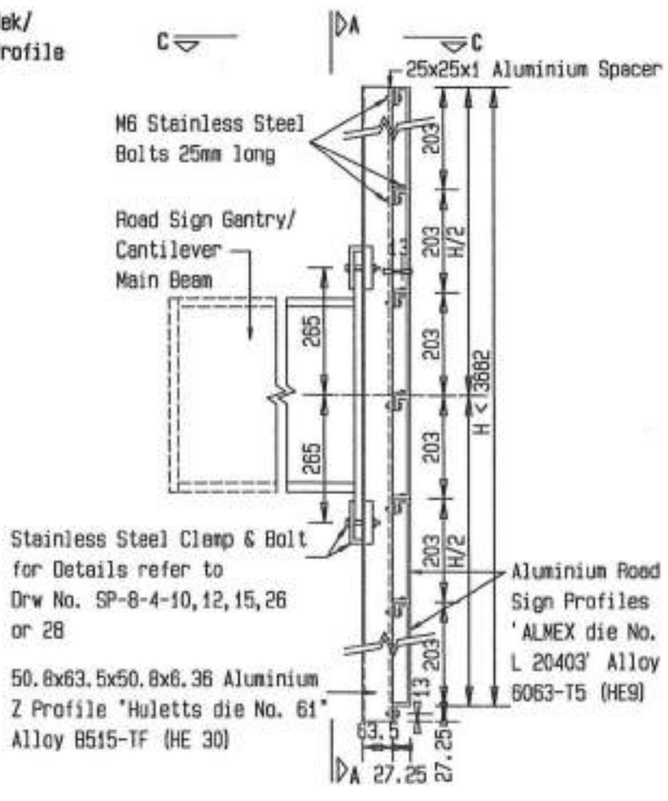


Detail 15.25.4 Part Sectional Plan B-B

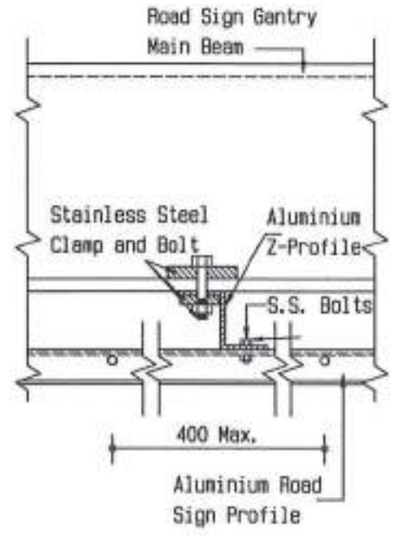


Rear Elevation A-A

Detail 15.25.5 Overhead Mounted Road Sign Back Plate consisting of Stacked Aluminium Alloy Road Sign Profiles



Detail 15.25.6 Sectional Side Elevation B-B



Detail 15.25.7 Part Sectional Plan C-C

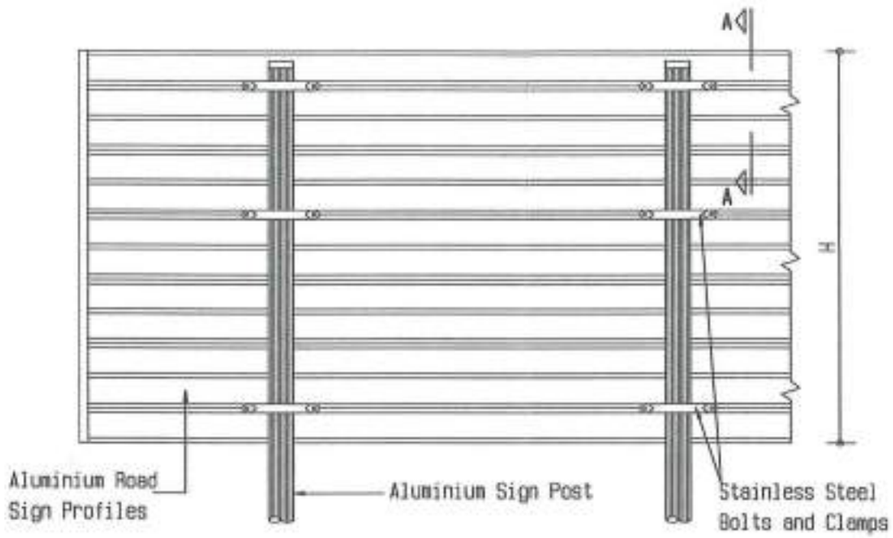
Fig 15.25
Sign Back Plate and Framework for Stacked SA Road Sign Profiles

TABLE 15.10 BACK PLATE FRAMEWORK FOR FLAT SHEET PANELLED SIGNS >=1.5m^2 TABLE 15.10

Framework Type	Advantages	Disadvantages
SA Chromadek Sheets and Square Tubing Frame	• Well known existing system • System appropriate to signs of 1.5 m^2 and up to 20 m^2 • System appropriate to most climate/weather types • System good for most environments • Material costs low for bigger signs • Manufacture and installation costs low because of separate panels • Maintenance easy because of separate panels • Manpower and equipment requirements not many and not very sophisticated • Materials freely available • Vandal resistance above average • Can be mounted in many positions ie. ground and overhead • Versatile application • Durability good if properly maintained	• Welding of frame to be of good quality and must be treated for rust • Many rivets necessary to fix sheet to frame • Rivet heads on sign back plate a problem for signface material application • Heavier than German Alform System
German Alform System	• Not well known in SA • System appropriate to all sign sizes • System appropriate to all climate/weather types • Very neat looking and light weight • All aluminium construction easy and long lasting • Weight savings Easy to install and maintain because of less parts and separate panels • Manpower and equipment requirements minimum for manufacture, installation and maintenance • Less bolting and riveting together than SA panels	• Vandal resistance low because of aluminium theft • More expensive because of formed profile frame and thicker back plate • Sophisticated equipment needed to manufacture formed framework

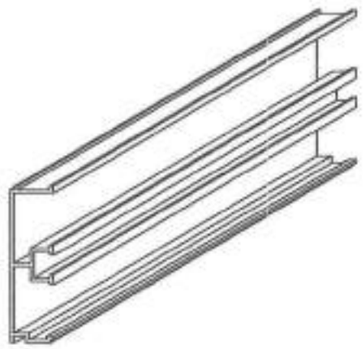
TABLE 15.11 BACK PLATE FRAMEWORK FOR STACKED SIGN PROFILES TABLE 15.11

Framework Type	Advantages	Disadvantages
SA Chromadek Profiles	• Well known existing system	• Lots of bolting and riveting between profiles required in manufacture
	• System appropriate to any sign size	• Rust, snow and sand traps because of profile form
	• System appropriate to most climate/weather types	• Material, manufacture, installation costs higher than for flat sheet signs
	• System appropriate to most environments	• Manpower and equipment required for manufacture and installation more intensive
	• No rivets on backplate face	• Durability average due to rust and if bent or dented parts must be replaced
	• Less framing or bracing on the back because of profiled panels provides horizontal stiffness	• Joints on back plate face presents a problem for signface message application
	• Signs can be ground mounted or overhead mounted	
	• Maintenance easy because profiles can be replaced easily	
	• Vandal resistance excellent	
	• Crashworthyness excellent, does not bend easily	
SA Aluminium Profiles	• Well known existing system	• Vandal resistance low because of aluminium theft
	• System appropriate to any sign size	• Lots of bolting and riveting between profiles required in manufacture
	• No rivets on backplate face	• Extruded profiles more expensive between profiles
	• System excellent for all climate/weather types	
	• System appropriate to most environment	• Snow and sand traps because of profile form
	• Less framing or bracing on the back because of profiled panels provedes horizontal stiffness	• Costlier than flat sheet signs
	• Signs can be ground mounted or overhead mounted	• Manpower and equipment required in manufacture and installation more intensive
	• Maintenance easy because profiles can be replaced easily	
	• Durability excellent - no rust	
European Aluminium Profiles	• Not well known in SA	• More sophisticated and expensive profile form
	• Easier attachment brackets for mounting	
	• Other advantages as for SA aluminium profiles	• Other disadvantages as for SA aluminium profiles

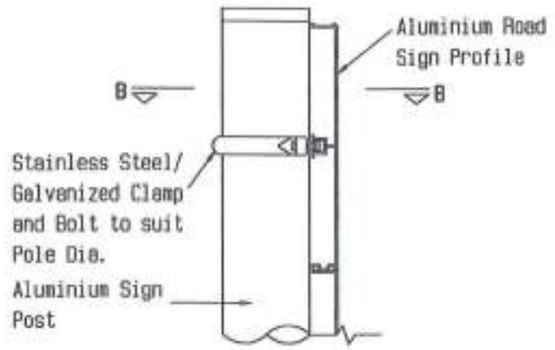


Rear Elevation

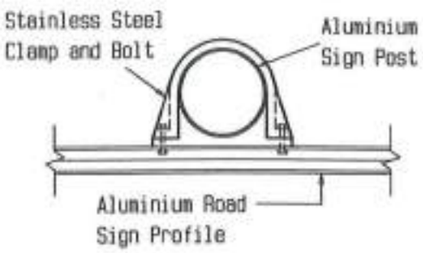
Detail 15.26.1
Ground Mounted Road Sign Back Plate consisting of
Stacked European Aluminium Road Sign Profiles



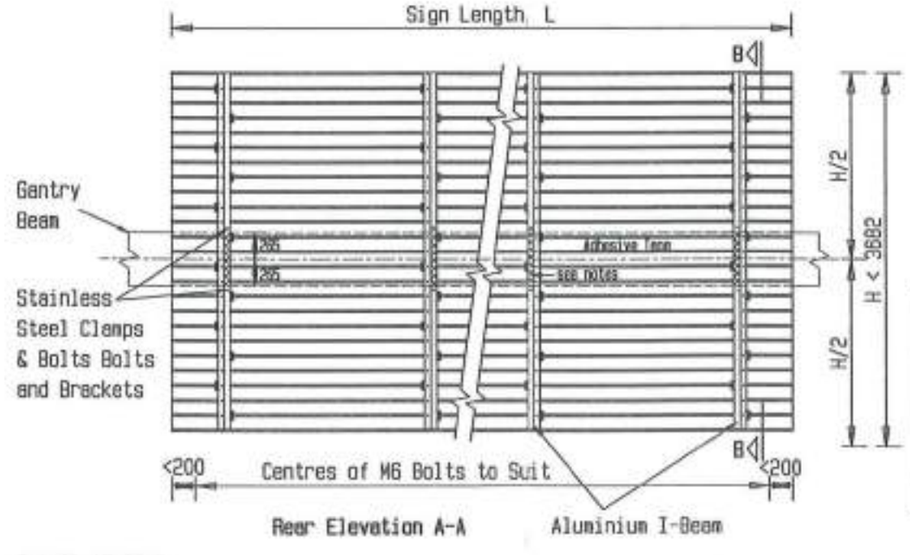
Detail 15.26.2
European Aluminium
Road Sign Profile



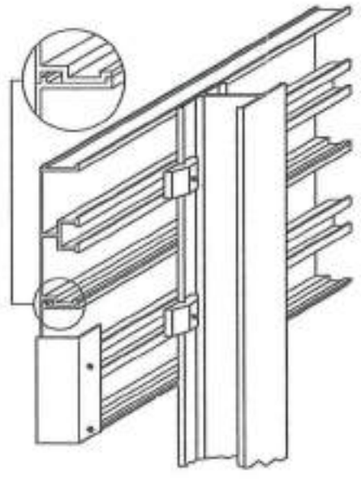
Detail 15.26.3
Part Sectional Side Elevation A-A



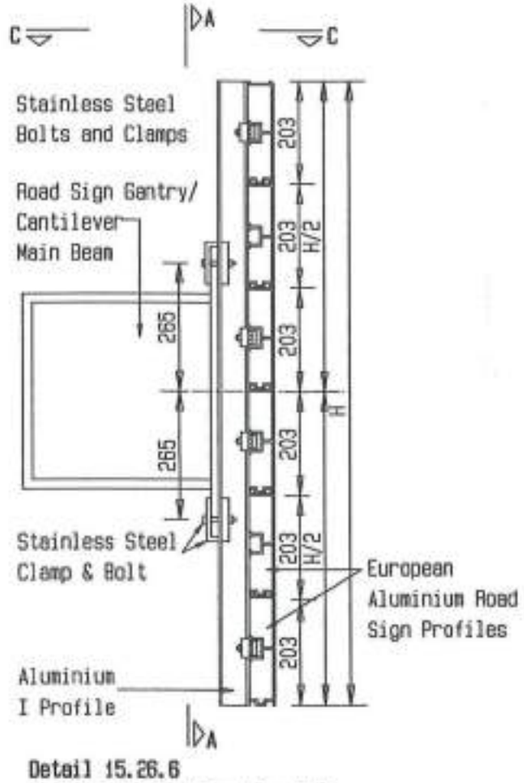
Detail 15.26.4
Part Sectional Plan B-B



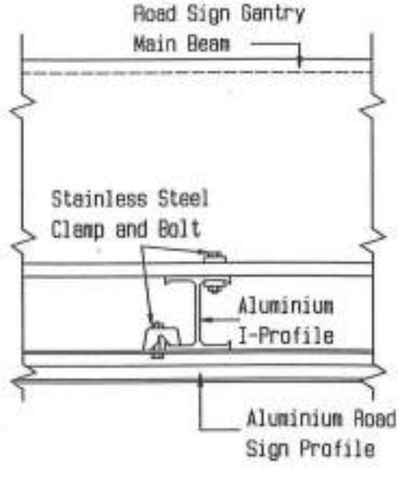
Detail 15.26.5
Overhead Mounted Road Sign Back Plate consisting
of Stacked European Aluminium Road Sign Profiles



Detail 15.26.6
Detail of I-Beam Bracing

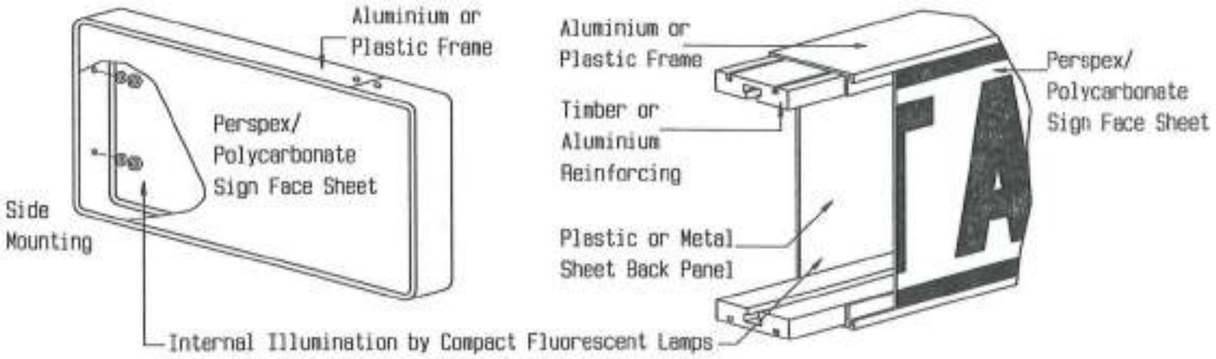


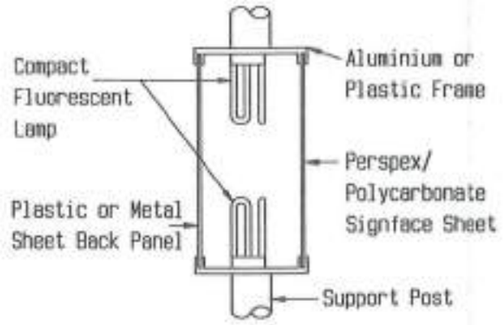
Detail 15.26.6
Sectional Side Elevation B-B



Detail 15.26.8
Part Sectional Plan C-C

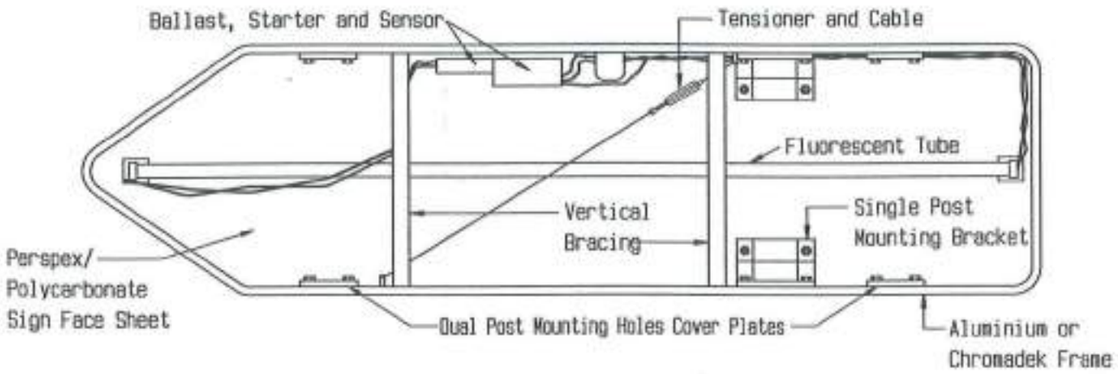
Fig 15.26
Sign Back Plate and Framework for
Stacked European Road Sign Profiles

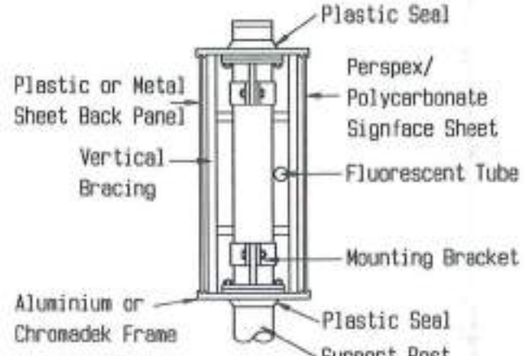




Sectional Detail

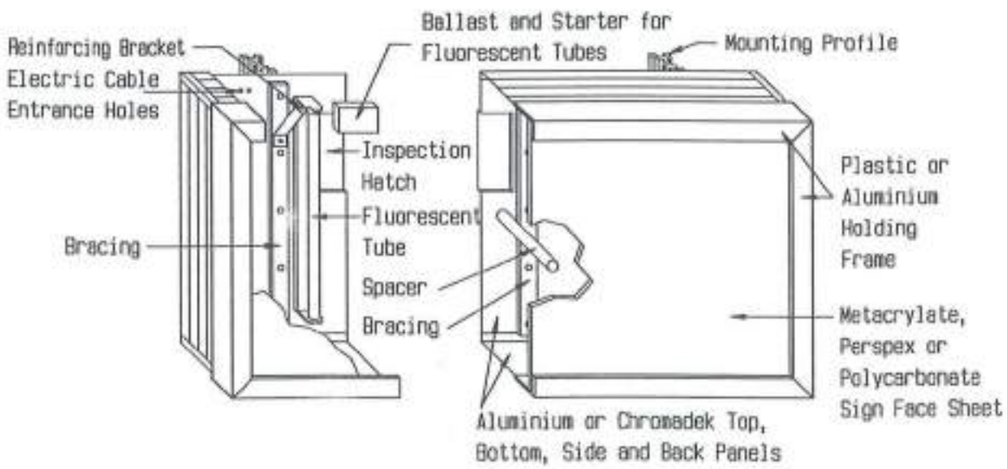
Detail 15.27.1 Small Simply Boxed and Illuminated Signs

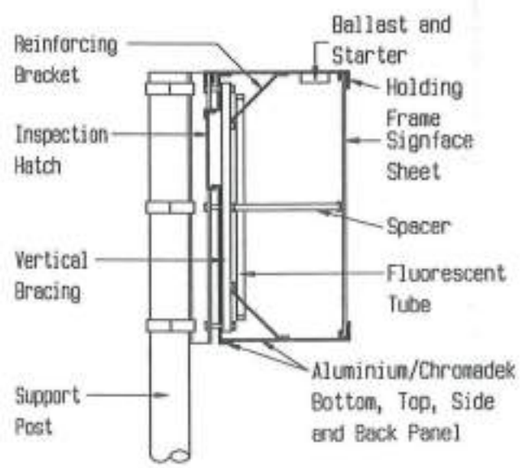




Sectional Detail

Detail 15.27.2 Medium sized, internally braced/tensioned Boxed Signs





Detail 15.27.3 Large Complex, internally braced/reinforced Boxed Signs

Sectional Detail

Fig 15.27
Sign Back Plate and Framework for Internally Illuminated Boxed Road Signs

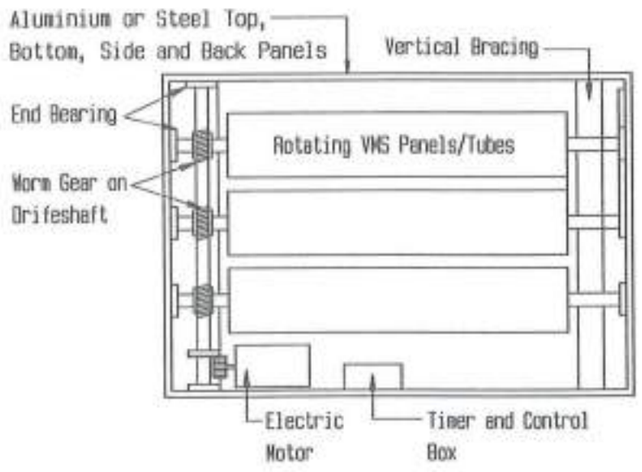
TABLE 15.12 BACK PLATE FRAMEWORK FOR BOXED SIGNS TABLE 15.12

Framework Type	Advantages	Disadvantages
Small Simply Boxed	• Ideal for small internally illuminated boxed sign applications	• Compact fluorescent lamps not as effective as tubes
	• Suitable for urban environments	• Not vandal resistant because of material types used
	• Material, manufacture, installation costs average	• Not for use in polluted area
	• Manpower and equipment requirement low for manufacture, installation and maintenance	• Electrical connection needed
	• Durability average	• Not fire resistant
	• Light weight	• Not very crashworthy - will break
	• No special mounting brackets necessary for mounting	• Only for small boxed signs < 1.5 m^2
Internally Braced/ Tensioned Boxed	• Suitable for small to medium <=4,5 m^2 sign sizes	• Vandal resistence better than for simply boxed because of hidden brackets but materials still a liability
	• More rigid than simply boxed sign	• Not for use in a highly polluted area
	• Suitable for urban environments	• Electrical connection needed
	• Very neat looking - no visible brackets	• Not fire resistant
	• Very versatile mounting options either one or two posts	• Not very crashworthy - will break
	• Material, manufacture, installation costs average	• Special brackets and tensioner with cable needed for mounting
	• Light weight	• Trained labour and special equipment needed to manufacture, install and maintain
	• Can be swivelled around post for any direction if single post mounted	
	• Durability better than simply boxed because of more bracing	
Large Internally Bráced Boxed	• For internally illuminated boxed signs larger than 4,5 m^2	• Expensive to manufacture, install and maintain because of size
	• Suitable for urban areas	• Trained labour and special equipment needed to manufacture, install and maintain
	• Fire resistance above average because of higher mounting levels	• Electrical connection needed
	• Vandal resistance above average	• Heavy construction
	• Durability average	• Heavy supports needed with heavy carrier beams and brackets for mounting
	• Crash worthyness good because of heavy supports	

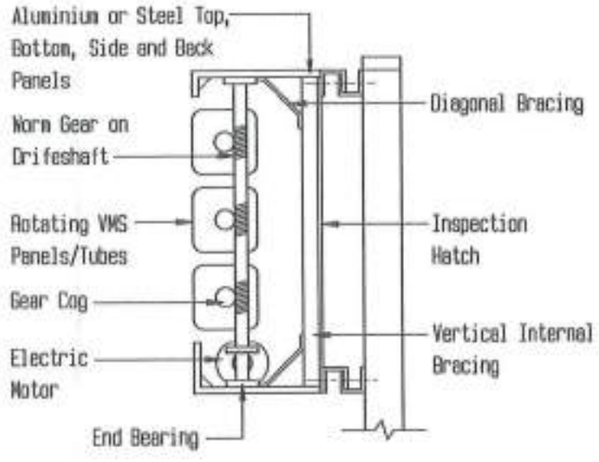
TABLE 15.12 BACK PLATE FRAMEWORK FOR BOXED SIGNS **TABLE 15.12**

Framework Type	Advantages	Disadvantages
Matrix of Rotating Discs	• Versatile because of more than one message	• Specialised applications
	• Higher visibility because of movement	• Electrical connection necessary
		• Expensive to manufacture, install and maintain
		• Trained labour and special equipment needed to manufacture, install and maintain
		• Not for use in polluted areas
		• Electro-mechanical system needs more maintenance - many moving parts
		• Purpose made boxes and illumination for signs
		• Needs illumination
Rotating Cylinders	• Versatile because of multiple message display	• Same disadvantages as for Rotating Discs
	• Higher visibility because of movement	• Specialised applications
Fibre Optic	• Versatile because of multiple message display	• Sophistication makes for expensive manufacture, installation and maintenance
	• High visibility because of halogen illumination	• Trained labour and special equipment needed to manufacture, install and maintain
	• No electrical motors or gears for maintenance	• Specialised applications

Detail 15.28.1 Boxed Motorised Rotating VMS Panels Composition

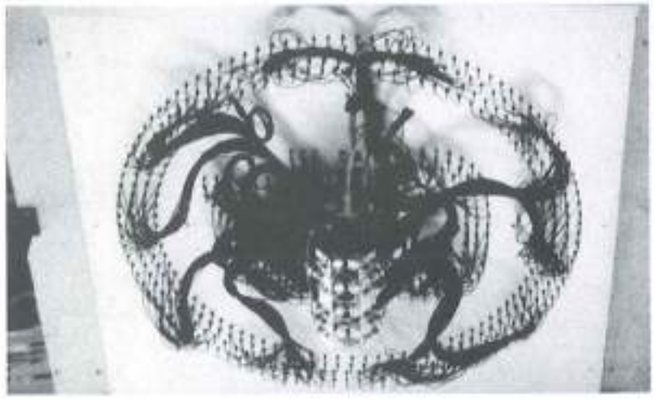


Internal Layout (Front Panel Removed)

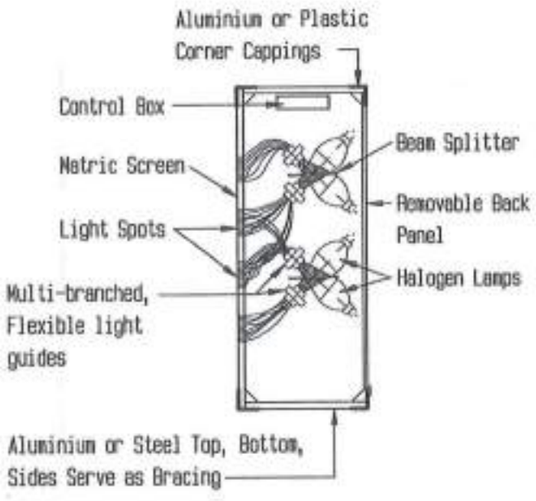


Sectional Side Elevation

Detail 15.28.2 Boxed Fibre Optic VMS Composition



Back Plate View (Fibre Optic Cables Layout)



Sectional Side Elevation

Fig 15.28
Sign Back Plate and Framework for Variable Message Road Signs

15.4 CHOICE OF MATERIALS FOR AND COMPOSITION OF SIGN SUPPORT STRUCTURES

15.4.1 General

1 The general considerations, mentioned in Section 15.3.1, regarding the selection of materials for the component parts of signs, are also applicable to this section for choosing materials for sign supports and structures.

15.4.2 Sign Support Materials

1 The most widely used sign support materials are timber poles (usually treated circular poles), steel or aluminium pipes or tubes (different cross sectional profiles) and steel or aluminium rolled or extruded sections (different cross sectional profiles). Infrequent use of reinforced concrete posts (solid pole or pipe), asbestos cement pipes and glass reinforced polyester (GRP) poles or pipes also takes place. The material types are indicated in Figure 15.29.

2 Wooden or timber posts should be moisture, fire and termite resistant exterior grade complying with the requirements of SANS 457:2000 and with a cross section of at least 100 mm x 100 mm or peeled poles of nominal diameter 120 mm. They should be creosote impregnated in accordance with SANS 673:2008, with creosote complying with the requirements of SANS 538:2007 or SANS 539:2007. Hard pinewood poles are preferred because of their fracture properties, and suitability for post peeling and preservative treatment.

3 Steel supports complying with the requirements for Grade 43C of BS 4360, of outside diameter at least 50 mm, wall thickness of at least 3,5 mm and hot-dip galvanized in accordance with the requirements of SANS 121:1999, or painted/powder coated in accordance with the requirements of CKS 193. Cross sectional profiles in steel could be any of the pipes, tubes and rolled or extruded profiles. Welding of steel work should be carried out as per the standards prescribed in BS1856 or BS693, whichever is applicable. Steel tubular structures fabricated by welding, and to be painted, shall have sealed joints for members inaccessible for inside painting after fabrication.

4 Aluminium alloy supports should be of drawn tube format complying with the requirements of BS1471 and condition codes HT30-TF or HT9-TF, or of extrusion profiles complying with the requirements of BS 1474 and condition codes HE9-TF or HE30-TF.

5 When reinforced or prestressed concrete posts are used as supports they should be complying with the requirements of SANS 470 and SANS 676.

6 Asbestos cement pipes used as sign supports should comply with the requirements of SANS 819.

7 Glass reinforced polyester (GRP) poles or pipes used as sign supports should comply with the requirements of SANS 141.

8 Another consideration when choosing support materials is the breakaway method to be used for signs placed in locations where there is the risk of vehicle impact i.e. the posts of the structure should be of frangible construction. There are various methods of achieving frangibility for instance the use of breakaway holes drilled in the supports at their bases or the use of base plates. In the case of parts with base plates, usually steel or aluminium supports, the base plates should be made from a material similar to that from which the posts were made and the base plate should be protected against corrosion by the same method as that applied to the parent posts. The quality of the finish of the base plate should be such that it complies with the appropriate requirements, similar to that of the parent post.

15.4.3 Composition of Sign Support Structures

1 The critical issue in selecting and installing signs is the type of support structure used for ground mounted or for overhead mounted signs, and the advantages and disadvantages of the different types and materials should be considered. Tables 15.13 and 15.16 indicate the advantages and disadvantages. Road signs in general vary considerably in size. For high speed traffic on freeways larger signs are required than for traffic on urban streets. Larger signs are also necessary where traffic volumes are heavy or background activities compete for the driver's attention. The sign size, location and safety requirements determine the size and type of sign supports required. Single posts are frequently used for regulatory, warning and smaller information signs. For larger signs two or more supports may be required. The basic structures for ground mounted signs are the following:

(a) single support;

(b) multiple supports;

(c) multiple braced supports;

(d) multiple compound supports (ladder or lattice);

(e) host support.

2 Sign supports are generally made of mild steel, aluminium or wood. In deciding which type of material to use the advantages and disadvantages of each type should be considered. The shapes of mild steel supports are tubular, box section or rolled steel joists. Aluminium is used for smaller sign supports and for overhead sign bridges. Wooden or timber sign supports are generally either dressed wood of rectangular section, or `post peeled' poles treated with creosote.

3 Larger ground mounted signs often require heavier rolled I-beam or tube type supports. These sections should only be used with a breakaway mechanism when they may be hit by an errant vehicle. Legs of the larger overhead sign mounting cantilever or gantry structures, however, are more rigid and should be protected by either a lateral distance from the roadway or with guardrails. The basic support structures for overhead mounted signs are:

(a) cantilever structure;

(b) portal or gantry structures : cable, trestle, truss or lattice, box section;

(c) host structure.

4 A sign support structure must be durable and structurally adequate for given wind and ice loads. Multiple supports should be used where design wind loads indicate that a single support would be inadequate. Vertical supports for sign bridges

designed to transfer stress or moment to the bridge through the joints should be connected so as to make the transfer effective. Sometimes small signs must be mounted overhead using a span wire or cable as a support structure. Span wire sign installations must be anchored at both the top and the bottom to avoid excessive swinging in the wind. To save installation costs and minimise sidewalk obstructions, signs could be placed on supports existing for other purposes, such as traffic signals, street lights, new jersey barriers, walls and overhead bridge structures.

5 Sign supports erected close to the travelled roadway without guardrails, should be of a yielding, bending, fracture or breakaway construction in order to reduce vehicle damage and injury to occupants in the event of vehicles colliding with them. The basic concept of a breakaway sign support is that of a structure which possesses sufficient moment of resistance to withstand wind loads, yet offers low shear resistance at the base to a colliding vehicle. In the event of a collision the structure should yield or breakaway. Failure should occur in such a way that:

(a) serious secondary collision of the sign or support with the vehicle is avoided;

(b) energy absorbed from the impacting vehicle is kept to a minimum (a maximum reduction of 17 km/h in the speed of the impacting vehicle is considered acceptable), and damage to the vehicle is low.

6 Thus a major consideration in the choice of support for a sign structure is its frangibility, also referred to in Section 15.2.7, in case of impact by a vehicle. Frangibility for single support ground mounted signs can be obtained by one of the following methods:

(a) fracture or bending for simple timber or small diameter, thin walled pipe or tube supports;

(b) breakaway sleeve or threaded coupling for pipe or tube supports;

(c) breakaway slip base plates for pipe, tube or other profiled supports for small to large signs;

(d) bending and breakaway for large diameter, deformable, pipe with sub-surface split base sockets.

7 Frangibility for multiple support ground mounted signs can be obtained by one of the following methods:

(a) bending for small diameter thin walled pipes or tubes;

(b) breakaway holes drilled through timber or steel support posts or pipes, and bracing supports, just above their bases;

(c) shearing base plates for ladder supports consisting of small diameter thin walled pipes;

(d) breakaway slip base and hinged below sign sections, for pipe, tube or other profiled supports;

8 Because of the size of supports needed for overhead sign structures no frangibility treatment is possible and these supports, being heavy steel pipe or box sections, are normally mounted on rigid base plates. These rigid structures present a hazard to vehicles and should be protected by either a lateral distance displacement or a guardrail. See Section 15.2.7 for more details.

9 Table 15.16 indicates the different frangibility types as they relate to the different support structures while Figures 15.32 to 15.35 indicates the different frangibility methods graphically.

10 Welding of steel work should be carried out according to the standards prescribed in BS 1856, BS 693 or BS 938, whichever is applicable. Also important in cases where aluminium plate or sections will be in contact with steel work, the contact surface should be painted with a bituminous paint. Where bolts and nuts are used to secure different metals, they should be cadmium plated or stainless steel.

11 The trend towards subcompact and mini sized vehicles continues throughout the world today. **Sign support structures' criteria and design should allow for these smaller vehicles, especially since many of the structures that used to be considered adequate will not meet current criteria.** New installations should meet current AASHTO criteria and where possible, existing installations should be upgraded to current criteria. The paragraphs hereafter summarises some of the application requirements for the different support structures.

12 Wooden sign supports have certain advantages. They are not subject to corrosion and are not likely to require much maintenance. If wooden poles are `post-peeled' the appearance should be acceptable. Wooden poles should be treated with creosote under pressure to give a long expected life. This means that the poles would not normally be painted. Breakaway properties, for supports with 100 mm Ø, are obtained simply and inexpensively by drilling the required holes, preferably prior to creosote treatment. Note that the size of the breakaway holes, to be drilled, is related to the diameter of the support. If necessary, drilling and cutting can be done on site and the exposed portions dipped in hot creosote. Hard pinewood poles are preferred because of their fracture properties, and suitability for post-peeling and preservative treatment. Wooden supports are also appropriate for use as single support or multiple supports for larger signs. If larger signs require multiple supports with bracing diagonal supports the bracing supports should have breakaway holes similar in size to the vertical supports. Breakaway holes are drilled, through supports, at right angles to the direction of traffic on the roadway.

13 Single small diameter, 32 mm to 76 mm nominal diameter, yielding (wall thickness less than 3 mm) mild steel posts driven into the soil or set into concrete, bend over if impacted by a vehicle and are unlikely to cause injury to unrestrained occupants. In a collision with a 76 mm nominal diameter steel post some injury to an unrestrained occupant is probable, while the correct use of seatbelts would almost certainly prevent injury. Single 50 mm to more than 65 mm nominal diameter, wall thickness more than 3 mm, steel posts can be made breakaway by incorporating a standard pipe coupling (threaded socket) located just above ground level. Under impact the pipe pulls out of the socket or shears across the threads. This system works satisfactorily when the clearance to the underside of the sign exceeds

(continued on page 15.4.7)

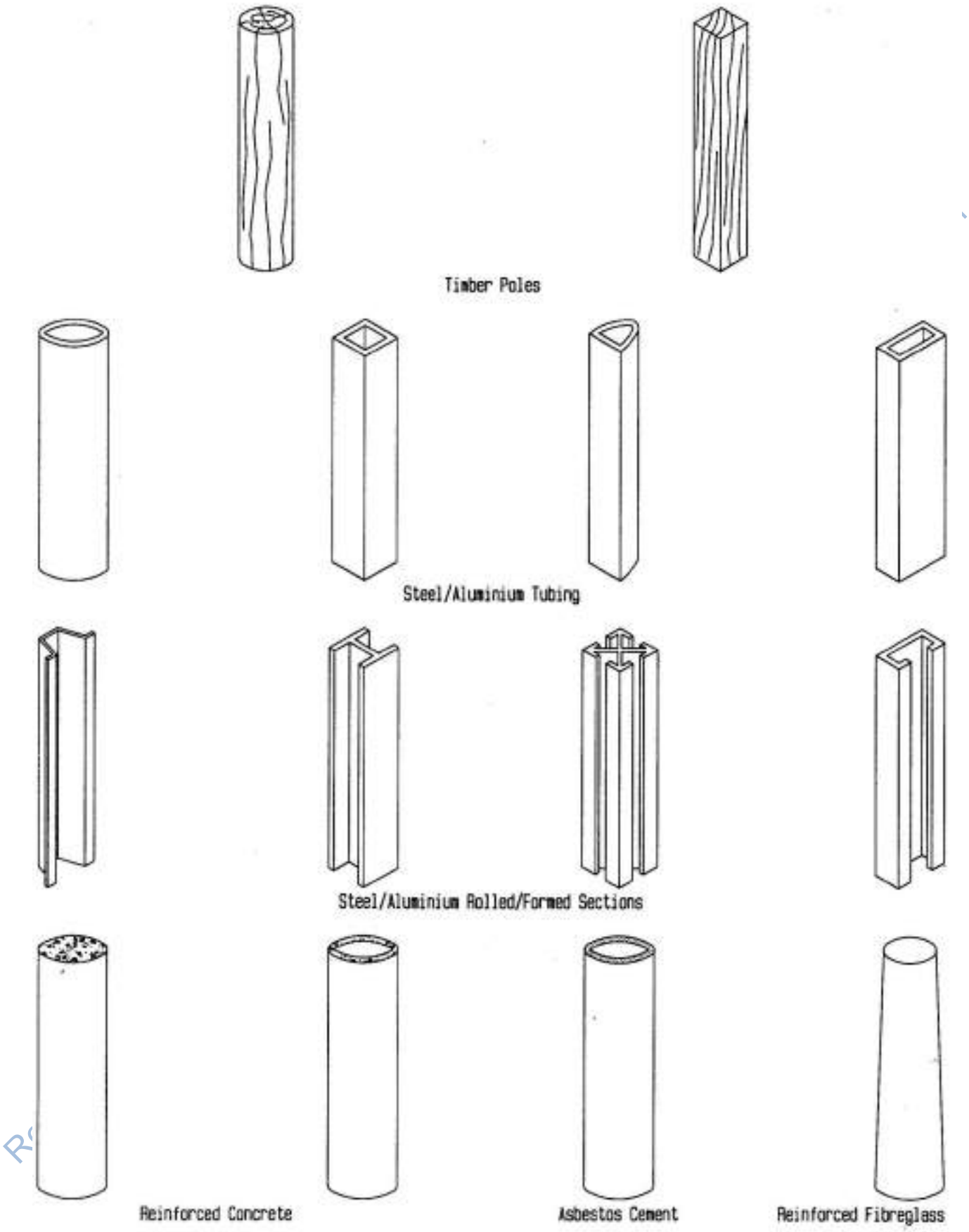


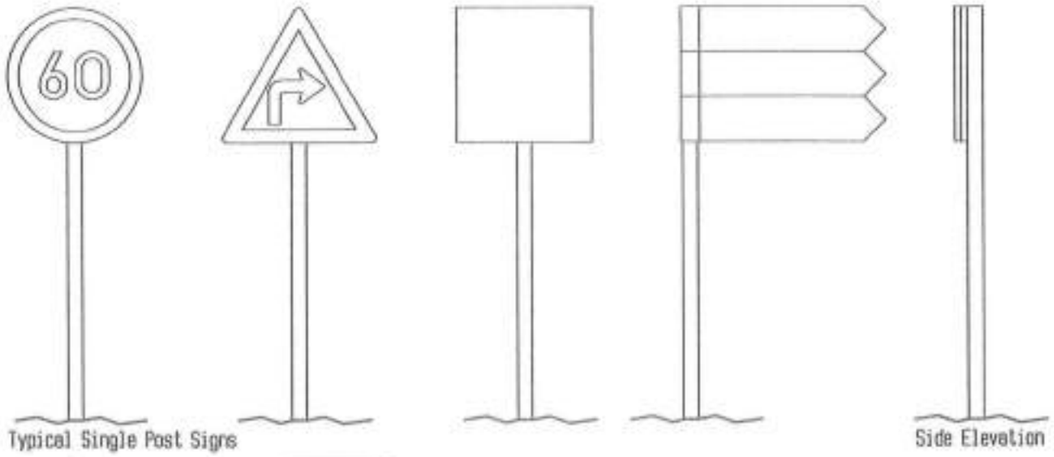
Fig 15.29 **Typical Sign Support Material Types**

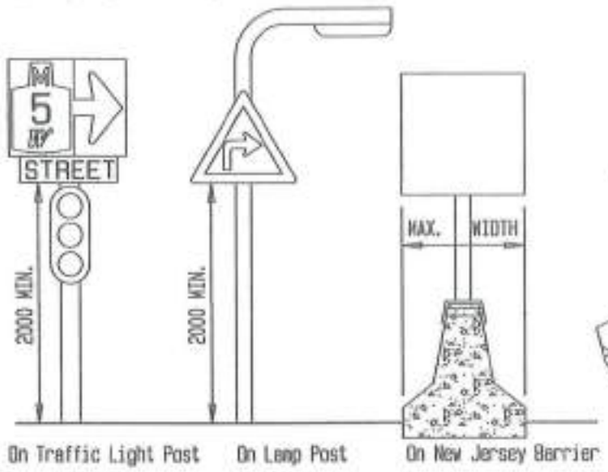
TABLE 15.13 SIGN SUPPORT MATERIAL TYPES TABLE 15.13

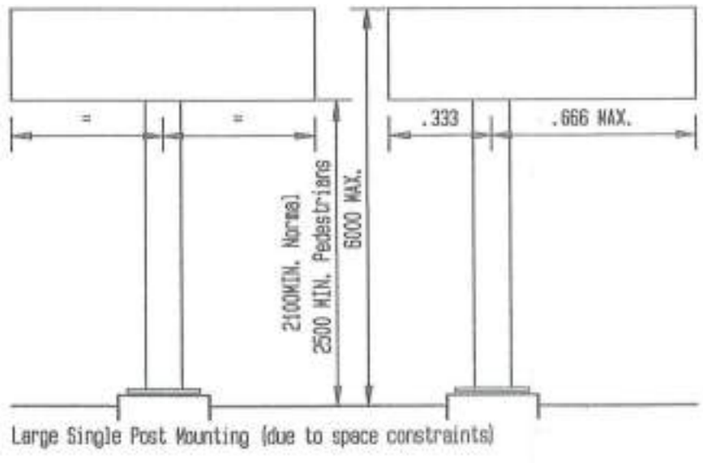
Material Type	Advantages	Disadvantages
Timber	• Low cost/cheaper than steel	• Veld fires may damage
	• Frangibility - fracture properties better than for steel (breakaway holes near base)	• Termite food
	• Drilling and cutting on site	• Must be treated properly with chemicals against pests and rot
	• Allows strap fixing of signs	• Shorter life span than steel
	• Cannot rust	• Prone to rotting at base if not treated correctly
	• Suitable for use in urban, rural and conservation areas	• Top ends need capping/binding
	• Material and installation costs low	• Not suitable for use in desert areas, because of sand-blast effect, or polluted areas because of rot
	• Manpower and equipment requirements low for installation and maintenance	• Vandal resistance below average due to ease of theft
Steel Tubing	• Widely used for sign supports	• Posts of sizes ϕ> 76 mm (> 3 mm wall thickness) needs frangible treatment i.e.. break away holes, slip bases, etc.
	• Fragibility - bends if ϕ < 76 mm and wall thickness < 3 mm	• Drilling and cutting not so easy on site
	• Allows for internal illuminated sign - cables inside tube - vandal resistant and safe	• Needs galvanising, plasticising treatment against corrosion and rust
	• Many profiles to choose from i.e. pipe, square, D-section, rectangular	• Top ends need caps
	• Used in most climate/weather types	• Painted support need maintenance more frequently than galvanised
	• Veld fire and pest resistant	• Not really suited for polluted or very wet areas without treatment
	• Can be used in urban and rural areas	
	• Costs for material, manufacture, installation and maintenance low	
	• Durability better than for timber	
Aluminium Tubing	• Especially suited for coastal and polluted areas	• Vandal resistance low due to theft
	• Easier to cut and drill	• Veld fires might damage
	• Lightweight	• Top ends need caps
	• Pest resistant	
	• Particularly suitable for urban use	
	• Bending or fracture properties better than for steel(frangibility)	
	• Tubing allows for internally illuminated signs	

TABLE 15.13 SIGN SUPPORT MATERIAL TYPES TABLE 15.13

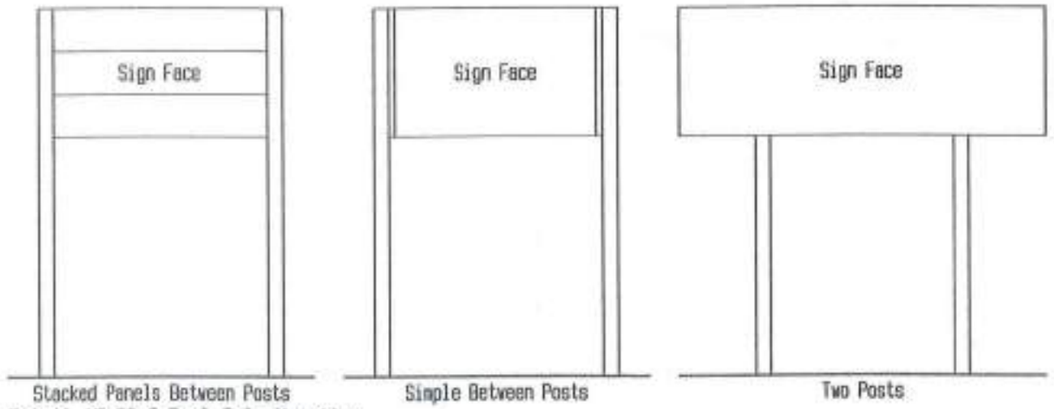
Material Type	Advantages	Disadvantages
Steel Rolled Sections	• Mounting of signs can be easier due to available flanges	• Generally more expensive than tubing
	• Cross sectional profile may make it easier for sliding in panels	• Needs specialised fragibility treatment due to cross sections
	• Some of the other properties mentioned under steel tubing are also applicable to sections	• Some of the disadvantages mentioned under steel tubing are also applicable to sections
Aluminium Rolled Sections	• Some of the advantages of aluminium tubing also applicable to rolled sections	• Similar disadvantages to aluminium tubing
	• Mounting of signs easier due to available flanges	• Generally more expensive than tubing
	• Many different cross sectional profiles available	• Needs specialised frangibility treatment due to cross sections
Reinforced Concrete	• Long lasting	• Too rigid, poor frangibility
	• Pest resistant	• Heavy
	• Rigid	• Not crashworthy
	• Vandal Resistant	• Not easy to manufacture, install and maintain
Asbestos Cement	• Good frangibility properties	• Asbestos dangerous for health when drilling or sawing
	• Long lasting	• Not easy to work with
	• Better for handling than concrete	• Not crashworthy
	• Fire, theft, rust, pest, corrosion resistant	
Reinforced Fibreglass	• Excellent frangibility properties	• Fire may damage
	• Rust and corrosion resistant	• Expensive
	• Pest resistant	• Not crashworthy
	• Easy to work with - sawing and drilling	
	• Light weight	



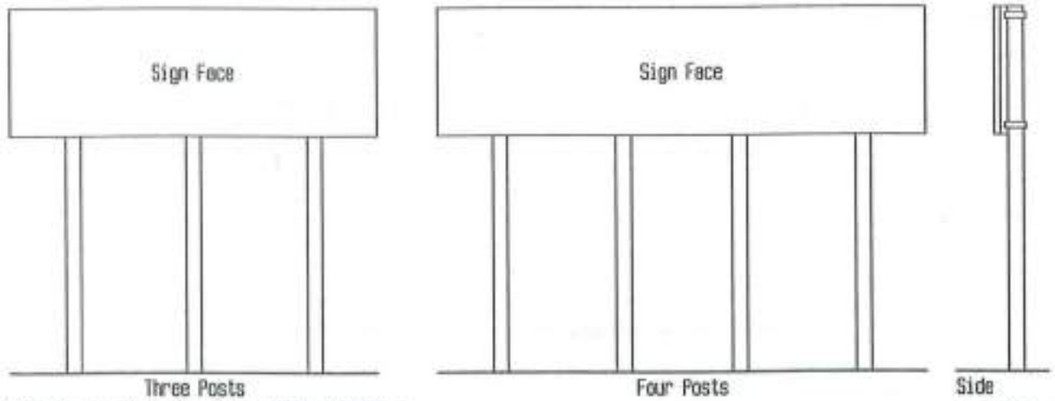




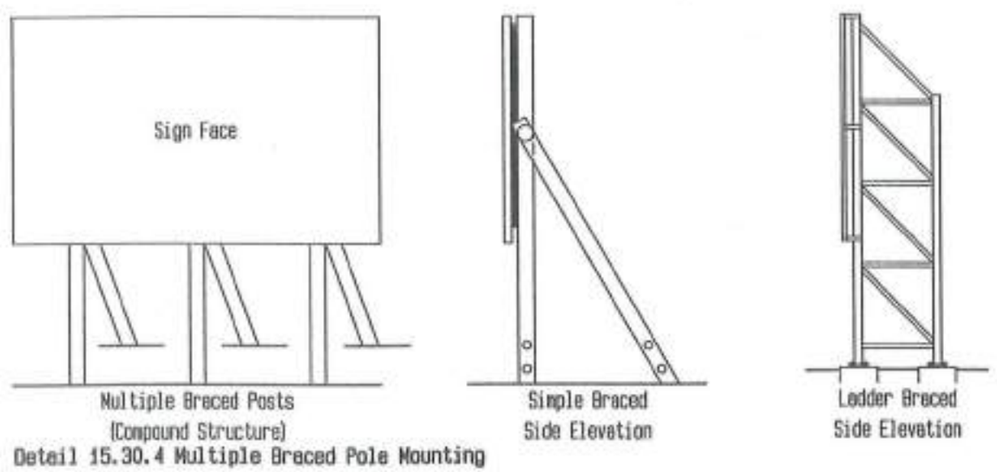
Detail 15.30.1
Single Post Types of Mounting



Detail 15.30.2 Dual Pole Mounting



Detail 15.30.3 Multiple Pole Mounting



Detail 15.30.4 Multiple Braced Pole Mounting

Fig 15.30
Sign Support Structure Types for Ground Mounted Signs

(continued from page 15.4.2)

2,1 m. If the clearance is less then 2,1 m some secondary collisions with the windshields of the impacting vehicle may occur. Small diameter, thin walled pipe supports could also be used for the mounting of smaller signs between two posts.

14 The breakaway type of single post mounted in a slip base is frequently used to support small signs. The base plate, for single support signs, is mounted at an angle of 20^{o} for smaller signs, 10^{o} for larger signs, to the horizontal, facing upwards and away from approaching traffic. In the event of a vehicle striking the post the holding down bolts release, allowing the inclined base to slip up and off the base stub post. The post and sign rotate over the vehicle as it passes underneath without the sign hitting the top of the vehicle. Tubular posts larger than 65 mm diameter, wall thickness more than 3 mm, box-section posts or rolled steel joists can be mounted on slip bases. The slip base design is not suited to lightweight thin-walled pipe supports which may be liable to crushing at the point of impact. This may delay the release of the base and cause the sign to strike the top of the vehicle. Nor is this type of support suited to installation on narrow medians or traffic islands separating traffic flowing in opposite directions. In the event of an impact from the opposite direction the inclined slip base may tend to bring the sign down through the windscreen. Where the impact may be from either direction the slip base should be set horizontally instead of being inclined. Where a tubular steel post of 76 mm Ø is required, the use of multi-directional slip base is an option. This type of base incorporate a series of riser plates to impart an upward velocity component to the sign support on vehicle impact. The upward movement of the support causes it to go over the top of the vehicle and so reduces the danger of secondary collision.

15 The sub-surface split base socket is used extensively in Europe for the mounting of small to medium sized ground mounted signs on single supports. The supports are normally larger than or equal to 76 mm diameter, wall thickness more than 3 mm, deformable steel/aluminium pipes, the bases of which are held in place by special, 150 mm split sockets below ground/sidewalk surface level. The split of the sockets are at right angles to the direction of traffic on the roadway. The philosophy behind this type of support structure, normally located on the sidewalk, is that the support will yield initially by bending in the case of a vehicle impact. The split base socket will then split apart and release the support base allowing the vehicle to pass over the sign structure. In Europe a few standardised support sizes and split socket sizes are in use having the advantage of quick and easy installation or maintenance. The sub-surface socket and base fixing methods makes for a very neat installation, especially in paved sidewalk areas. Making good after an accident is especially easy and quick, by just replacing the support, the socket bolts and making good the paving.

16 The mounting of what should be normally multiple support ground mounted signs, on single supports frequently occurs in urban areas. This type of support is usually dictated by space constraints, for example pedestrian walkways or bicycles paths, or even under-ground cables or pipes not allowing for a second or third post footing. The single support post size will be larger than for multiple supports with diameters or cross sectional sizes more than 150 mm, wall thicknesses more than 6 mm, in order to cater for the wind load and size of sign. This makes for a rigid structure that will be mounted on a rigid base plate allowing no frangibility. The lateral clearance from the roadway should be increased or the structure should be protected by kerbing or guardrails. The main advantage is that one post requires one foundation only and the structure allows free movement around and under it.

17 The hinged joint and slip base breakaway type of steel support has also been used on freeways and urban arterial roads for multiple support ground mounted signs. Mild steel box-section posts, rolled steel joists or other sections are used. In the event of a vehicle striking a support the holding down bolts allow it to split off the horizontal lower base plate. The support then rotates about the hinged joint, just below the sign's lower edge, formed by the uncut face of the section, clearing the vehicle as it passes under the sign (see Fig 15.33). Due to fatigue failure resulting from vibrations set up by the wind, the use of brittle cast iron fracture plates at the hinged joint has been changed to the slotted steel friction fuse plate (notched slip plate) shown. Windy conditions have also been known to cause holding down bolts of the slip-base to vibrate out. This can be overcome by inserting a thin non-slotted bolt-keeper gasket between the slip base plates. The base stub post is generally set in concrete and should project sufficiently to be kept clear of the surrounding ground level, but not high enough to snag the underside of an impacting vehicle. Slip bases require continual maintenance to ensure that they do not become covered over by soil and vegetation which may result in corrosion and subsequent failure to respond satisfactorily under impact conditions. Correct tensioning of the connecting bolts at the hinged-joint and slip-base is essential to proper functioning of breakaway sign supports.

18 Steel pipes with breakaway holes drilled near the bases could also be used for multiple support ground mounted signs, instead of timber poles. The sizes of the breakaway holes, in a similar manner to timber posts, are related to the diameter and the wall thickness of the support pipe. If bracing supports are required these should have similar sized breakaway holes to the upright supports. Steel pipes with diameters of 100 mm - 150 mm, and wall thicknesses of 2 mm - 3,5 mm, are often used. A disadvantage of non-galvanised pipes is that they should be painted, whereas treated timber supports need no painting.

19 Two to four ladder supports, consisting of small diameter (50 mm - 76 mm) thin walled (less than 3 mm) steel pipes welded into a ladder or lattice structure, with welded on base plates, could be used for multiple support ground mounted signs. The important issues to the composition of each ladder support are the size, and wall thickness, of the steel pipes and the requirement that the base plate should be welded to the pipe and without additional stiffeners/gussets. This is important for the shear function of the base plate because the weld is the friction point of the structure. The advantages of using ladder supports are numerous:

(continued on page 15.4.10)

TABLE 15.14 SIGN SUPPORT STRUCTURE TYPES FOR GROUND MOUNTED SIGNS TABLE 15.14

Structure Type	Advantages	Disadvantages
Free Standing Single Post for Minor Signs	• Cheap • Easy and quick to erect • Minimum mounting brackets • Good frangibility • Many material types can be used	• Problem to erect tidily (vertical/plumb)
On Existing Single Traffic Signal Post	• Most conspicuous position • No extra support needed	• Only street name, route marker, one way, no entry, left or right turn or prohibition signs allowed • Special mounting brackets or extension support needed
On Existing Single Lamp Post	• No extra support needed • Easy and quick to mount	• Only recommended for smaller warning, regulatory, street name or route marker signs
Single Post On New Jersey Barrier	• Useful for display of smaller warning and regulatory signs - better visibility	• Not recommended for larger signs because of width restriction • Special mounting brackets and extension support needed
Single Post Mounting for Multiple Post Signs	• Ideal for areas with vertical or lateral space constraints i.e. pedestrian or parking area allowance	• Support post can be very big and heavy if the signs are too large i.e. > 10 m^2 • Not easy and very time consuming to erect • Sign back plate width and height constraints • Frangibility or safeguarding measures a necessity
Two, Three or Four Posts Only	• Generally used for medium to large signs but with backplate height < 1,2 m • Width of sign prescribes multiple posts • Timber or variety of cross sectional steel / aluminium supports possible • Manufacture and installation costs and resource requirements low and unsophisticated • Easy to maintain	• Frangibility or safeguarding measures a necessity i.e. provide breakaway holes • If timber supports treat against pests and rot • If steel supports treat against rust and corrosion • Signs back plate height less than 1.2 m
Multiple Braced Posts	• Generally used for medium to large signs where sign back plate height > 1.2 m • Height of sign prescribes diagonal support bracing/struts • Timber or steel tube supports • Material costs low	• Frangibility by breakaway holes • If timber support treat against pests and rot • If steel supports treat against rust and corrosion

TABLE 15.14 SIGN SUPPORT STRUCTURE TYPES FOR GROUND MOUNTED SIGNS **TABLE 15.14**

Structure Type	Advantages	Disadvantages
	• Manufacture and installation cost and resource requirements low and unsophisticated	
	• Easy to maintain	
Multiple Ladder Braced Posts	• Horizontals can be used for scaffolding for sign mounting	• Must be manufactured in a proper workshop by skilled labour
	• Frangibility excellent i.e. ϕ60 mm or ϕ76 mm posts - 3 mm wall thickness forms ladder	• Must be treated against rust and corrosion
	• Welded-on base plate will provide shear function (weld is friction point)	• Measures needed against vandalism because ladder affords easy access to sign
	• 2 tube diameters will allow for the mounting of 95% of sign sizes using only one or two bracket types	• Expensive to manufacture
	• Very strong and rigid but lightweight	
	• Suited for any sign type and width - just add more ladders	
	• Widely used in Europe and America	
	• Easy to assemble and maintain	
	• Pest and fire resistant	

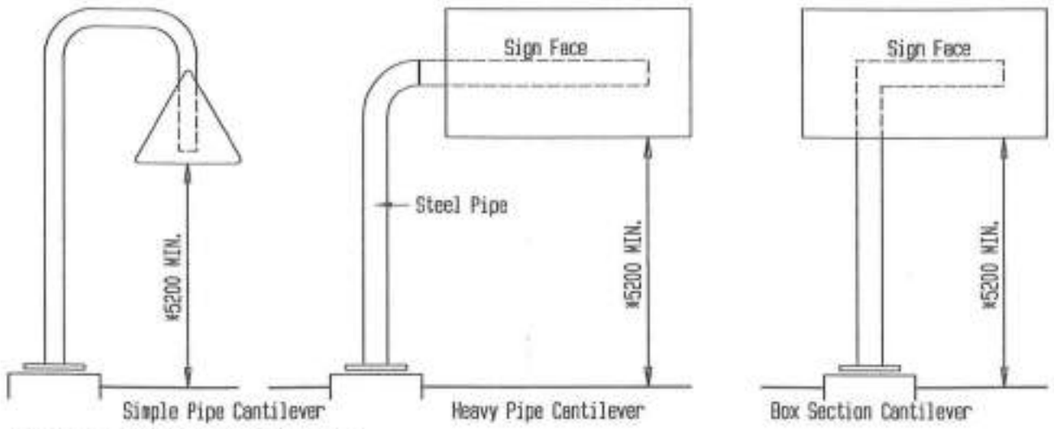
(continued from page 15.4.7)

(a) the size and wall thickness of the pipes is within the range allowed for bending frangibility for ground mounted sign supports, without additional protection by kerbing or guardrails;
(b) 90% of all signs could be mounted on ladders of one common size; the number and length of ladders will just increase but the size of pipes will be the same throughout (standardisation);
(c) crashworthiness is very good because vehicles will just move through the sign structure on impact, the ladder will shear at the base plate and yield by bending;
(d) because only two pipe sizes are used all sign sizes can be mounted using two bracket types only;
(e) the horizontal welded tubes in the ladders allows for scaffolding for easy mounting of signs.

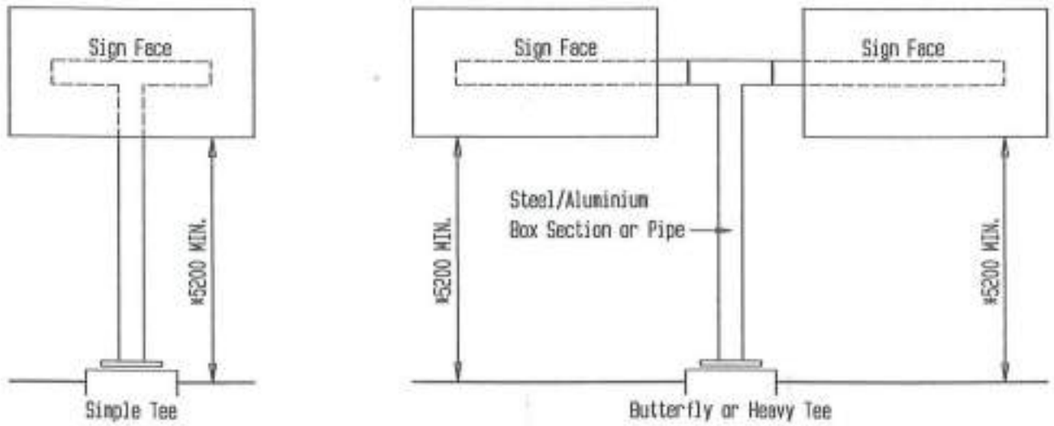
20 The major disadvantages of ladder or lattice supports are that thin walled tubing is difficult to weld, maintenance is complicated, and ladders are not suited for erection on the slopes of steep cut or fill road cross-sections. All the welds should be properly executed and pipe ends capped to guard against rust and corrosion.

21 Another structure type that can be used for multiple support ground mounted signs is the A-frame or trestle. The A-frame for ground mounted signs is not suited to erection on steep side slopes and the appearance is less pleasing than other types of support. Lightweight tubular steel members or perforated aluminium U-sections may be used. The A-frame sign support structure could be made up of tubular steel members connected by pins through frangible joint connectors. On impact the joints fracture and the pins shear. The support is designed to buckle in the area of high bending moment near the upper connection point, allowing the support to clear the vehicle as it passes under the sign. The thin-walled tubing used for the A-frame is difficult to weld and maintenance is complicated. The A-frame support structure could also be made up of lightweight perforated U-section aluminium members. The connections are made by means of bolted angle-section connectors. The support is so designed that the lightweight members will buckle and the bolted connections will shear upon impact by a vehicle.

22 Some of the ground mounted sign support structures are indicated in Figure 15.30 while the support structures for overhead mounted signs are indicated in Figure 15.31.

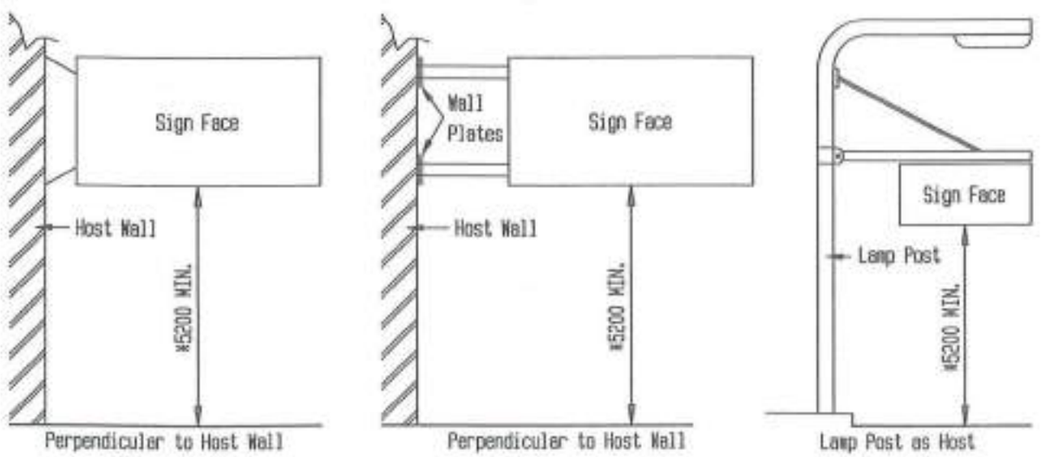


Detail 15.31.1 Simple Cantilever

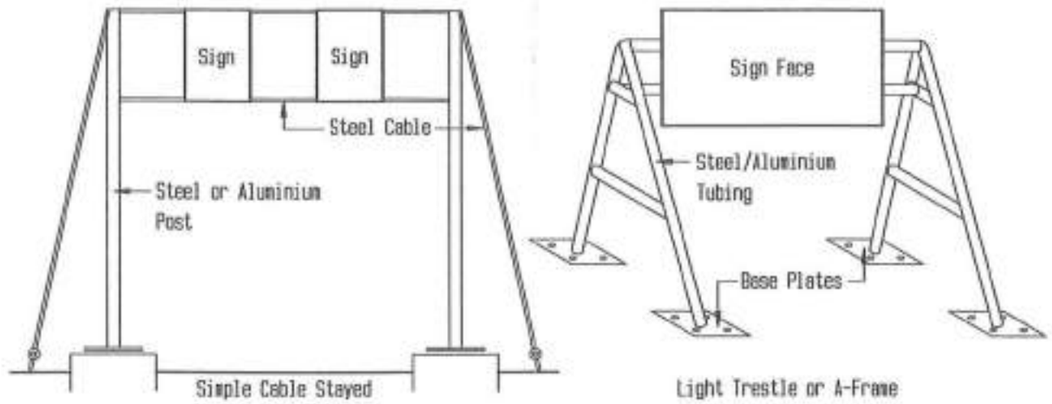


Detail 15.31.2 Multiple Cantilever

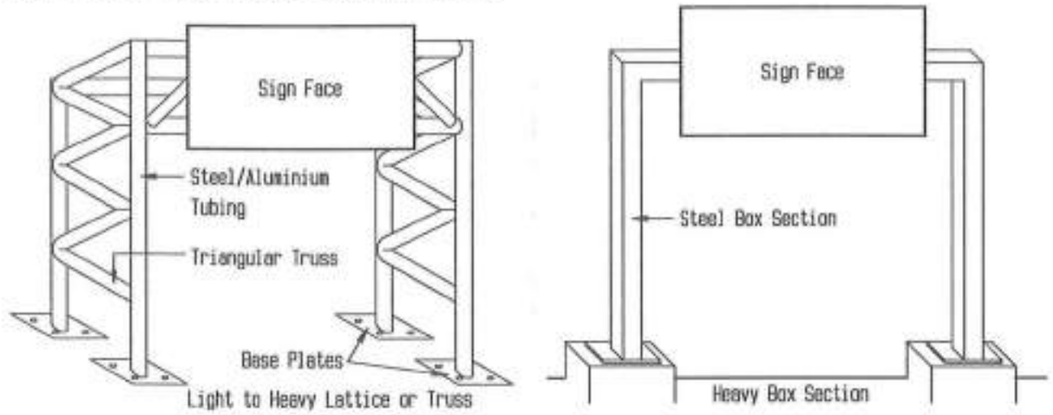
* Vertical clearance from highest point on roadway



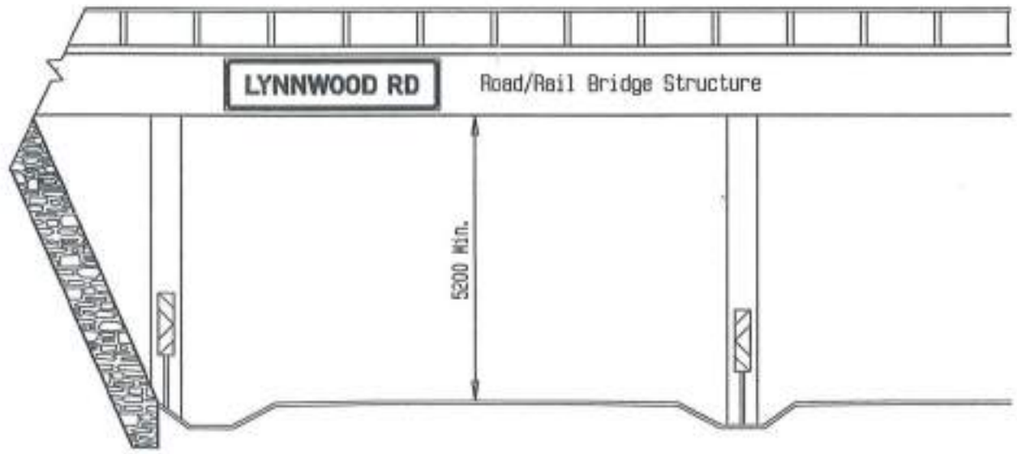
Detail 15.31.3 Host Support Cantilever



Detail 15.31.4 Light Portal /Gantry Structures



Detail 15.31.5 Heavy Portal /Gantry Structures



Detail 15.31.6 Host Overhead Structures

Fig 15.31
Sign Support Structure Types for Overhead Mounted Signs

TABLE 15.15 SIGN SUPPORT STRUCTURE TYPES FOR OVERHEAD MOUNTED SIGNS **TABLE 15.15**

Structure Type	Advantages	Disadvantages
Simple Pipe Cantilever	• Light weight • For roads with vertical and or lateral space constraints • Visually pleasing looks • Mostly for use in urban areas • Costs for material, manufacture, installation and maintenance low • Excellent vandal resistance and durability • Pest and fire resistant	• Only for smaller (<=1.5 m^2) signs • Should be treated against rust and corrosion • Pipe bending machine required to bend cantilever post • Frangibility could be a problem because of more rigid construction
Heavy Pipe or Box Section Cantilever	• For the mounting of larger signs • For use in urban areas mostly • Excellent vandal resistance and durability • Pest and fire resistant • For roads with vertical and/or lateral space constraints or freeways	• Heavy and rigid / large footing • No frangibility • Should be treated against rust and corrosion • Specialised welding and equipment needed to manufacture • Skilled labour needed to manufacture and install • Expensive to manufacture, install and maintain
Simple Tee	• For location in a gore or on an island • Excellent vandal resistance and durability • Pest and fire resistant	• No frangibility protect with guardrails • Should be treated against rust and corrosion
Butterfly or Heavy Tee	• For use in a gore area or median where there are space constraints • Excellent vandal resistance and durability • Pest and fire resistant • Mostly used in urban areas	• Not a very stable structure • No frangibility - must be protected with guardrails • Heavy structure / footing • Should be treated against rust and corrosion • Specialised equipment and skilled labour needed to manufacture/erect
Perpendicular to Host Wall	• For use where lateral space constraints No upright support posts • Excellent vandal resistance and durability • Pest and fire resistant • No frangibility problems	• Not recommended for larger signs • Special purpose-made structure needed • Should be treated against rust and corrosion • Host wall must be able to cary the sign mass and mounting structure

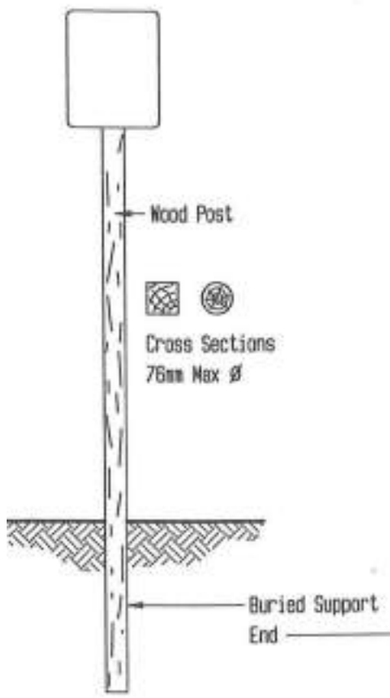
TABLE 15.15 SIGN SUPPORT STRUCTURE TYPES FOR OVERHEAD MOUNTED SIGNS **TABLE 15.15**

Structure Type	Advantages	Disadvantages
Lamp Post Cantilever	• For use in high density CBD area • Light weight • Excellent vandal resistance	• Not recommended for larger signs • Special purpose made mounting structure needed • Should be treated against rust and corrosion
Simple Cable Portal	• Lightweight and cheap • Easy to erect and maintain • Can be designed to be frangible	• Not recommended for larger signs • High wind speeds should influence use • Cables are a theft risk
Trestle or A-Frame Portal	• Horizontals can be used for scaffolding for sign mounting • Pest and fire resistant • Light trestle ideal for urban use because of stability	• Proper welding by skilled labour to manufacture • Must be treated against rust and corrosion • Measures needed against vandalism because structure affords easy access to sign
Lattice or Truss Portal	• Horizontals can be used for scaffolding for sign mounting • Pest and fire resistant • Durable and stable structure	• Same as above for A-frame
Heavy Pipe or Box Section Portal	• Excellent vandal resistance and durability • Excellent pest and fire resistance • Urban areas mostly • For roads with more than 3 lanes	• No frangibility - heavy and rigid • Should be treated against rust and corrosion • Specialised welding and equipment needed to manufacture • Skilled labour needed to manufacture • Expensive to manufacture, install and maintain
Over - bridge Host Structure	• No upright support posts needed • Pest and fire resistant • No frangibility problems	• Special purpose made mounting structure needed • Mounting structure should be treated against rust and corrosion • Host structure must be able to cary sign mass and mounting structure • Vandal resistance dependent on whether sign can be reached from top of bridge

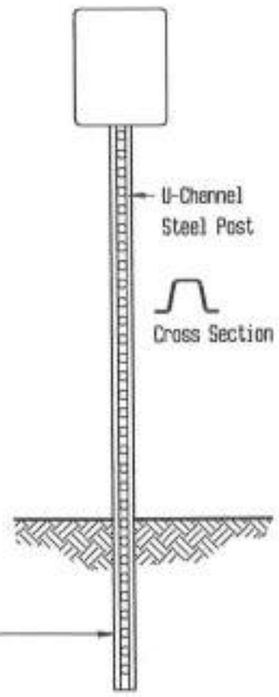
TABLE 15.16 **SUMMARY OF SUPPORT STRUCTURES, FRANGIBILITY TYPES AND FOUNDATIONS** TABLE 15.16

Sign Mounting Position	Number of Support Posts	Support Structure Type	SUPPORT SIZE		Support Frangibility Type	FOUNDATIONS		
			Ø or Profile Section	Wall Thickness		Anchor Type	Foundation Material	Top Level
Ground Mounted	Single	Simple Timber	76 mm MAX	-	Fracture, no Base Treatment	Buried or Knocked in Support End	Natural	GL
		Small Diameter Thin Walled Pipe/Tube	76 mm MAX	3 mm Max	Bending, no Base Treatment			
		Heavier Pipe/Tube Thicker walled	> 65 mm	>3 mm	Breakaway-Sleeve or Threaded Coupling at Base of Support	Sleeve or Stub Post	Soilcrete	GL
		Larger Diameter, Deformable Pipe for larger signs	>=76 mm	> 3 mm	Bending and Breakaway-Initial Bending, then Release by Sub-surface Split Base Socket	Anchor Hook Bolts	Mass Concrete	GL -150mm MIN
		Pipe/Tube or other profiled steel or aluminium support for small to medium sized signs	>=76 mm	> 3,5 mm	Breakwawy- 20°, 10° and Horizontal Slip Base Plates depending on Small or Large Sign and direction of traffic	Base Stub Post	Soilcrete	GL
		Large diameter heavy pipe/tube or profiled support for multiple post sign mounted on single post	> 150 mm	> 5 mm	No Frangibility-Rigid Base Plate	Anchor Bolt Group	Reinforced Concrete	GL +50 mm MAX
	Multiple	Simple between Small Diameter, thin walled pipe/tube	76 mm MAX	3 mm MAX	Bending, no Base Treatment	Support End	Optional Soilcrete	GL
		Two to four Supports, Braced or Not, Timber or Pipe	TIMBER >= 100 mm STEEL PIPE > 76 mm	- 2-3,5 mm	Breakaway holes. Sizes appropriate to support diameter at base	Support End	Soilcrete	GL
		Two to four Ladder Support, Small Diameter, Thin Walled Pipes	50-76 mm MAX	< 3 mm	Shearing Base Plate	Anchor Hook Bolts	Mass Concrete	GL +50 mm MAX
		Two to Four Supports, not Braced, Heavier Pipe or Tube or other Profiled Steel Posts	>= 76 mm	> 3,5 mm	Breakaway-horizontal Slip Base Plate at Base, and Hinge just below sign	Base Stub Post	Soilcrete	GL
Overhead Mounted	Single Cantilever	Simple Pipe or Tube for Small Sign	> 150 mm	> 6 mm	No Frangibility-Rigid Base Plate bolted to Hook bolts set in Concrete Foundation, for all Cantilever Support Types	Anchor Bolt Group	Reinforced Concrete	GL +50 mm MAX
		Simple Pipe, Tube or other Profile Tee						
		Butterfly						
		Heavy Pipe or Box Selection						
		Perpendicular to Host						
	Portal or Gantry with two legs	Simple Cable Stayed	> 150 mm	> 6 mm	No Frangibility-Rigid Base Plate bolted to Hook bolts set in Concrete Foundation, for all Cantilever Support Types	Anchor Bolt Group	Reinforced Concrete	GL +50 mm MAX
		A-frame or Trestle						
		Heavy Ladder and Truss						
		Heavy Pipe or Box Section						

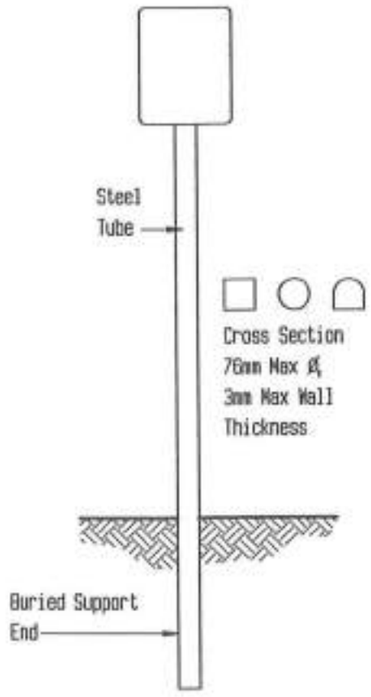
Note: Table 15.16 is applicable to Sections 15.4 and 15.5.



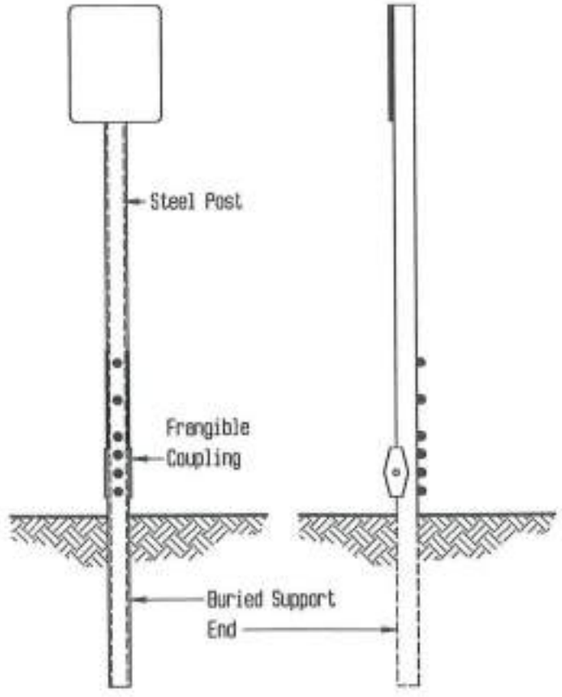
Detail 15.32.1 Fracture Breakaway



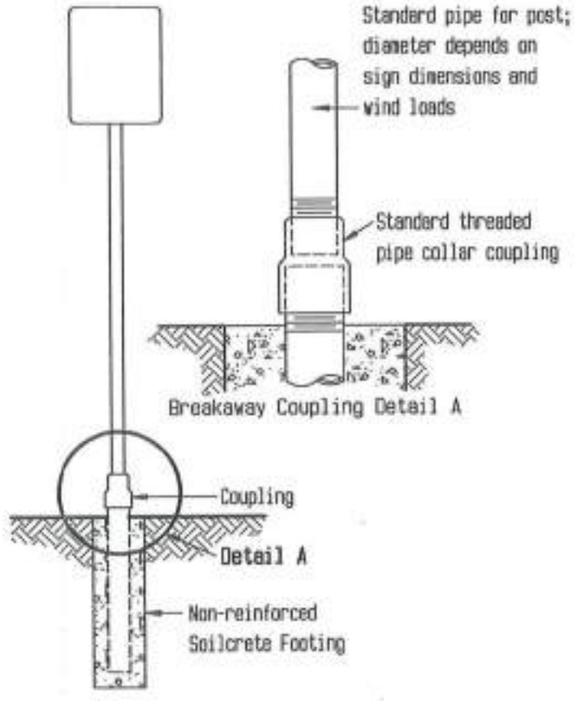
Detail 15.32.2 Bending Breakaway



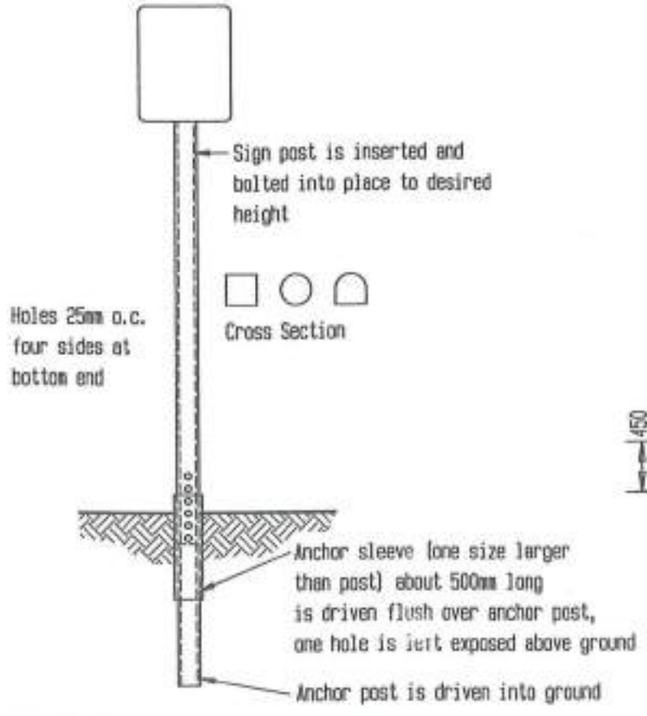
Detail 15.32.3 Bending Breakaway



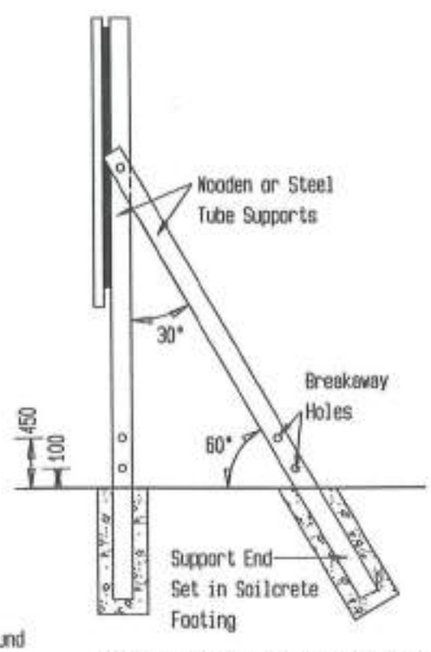
Detail 15.32.4 Frangible Coupling Breakaway



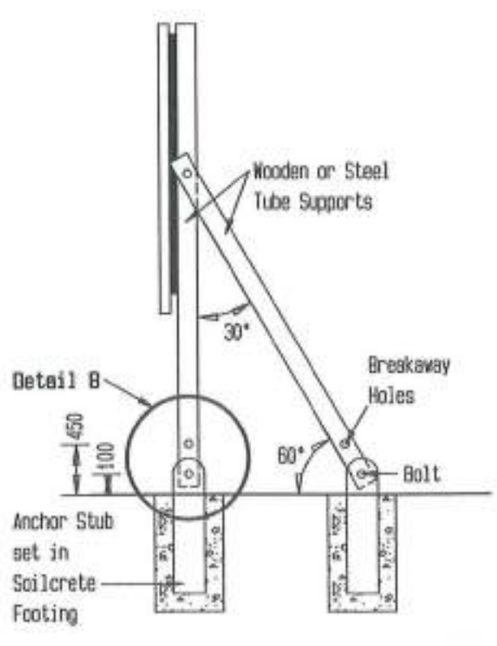
Detail 15.23.5 Threaded Coupling Breakaway



Detail 15.32.6 Sleeve Coupling Breakaway



Detail 15.23.7 Fracturing at Breakaway Holes, for Multiple Support Sign Structures



Detail 15.32.8 Fracture at Coupling and Breakaway Holes, for Multiple Support Sign Structures

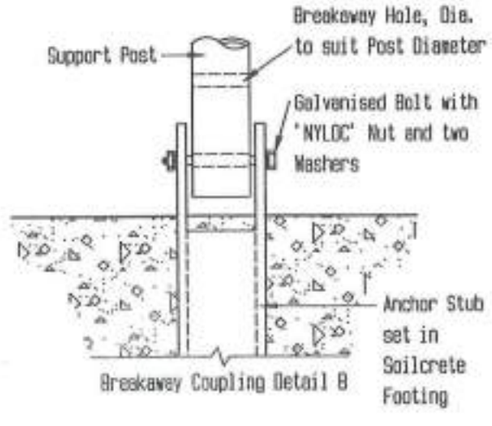
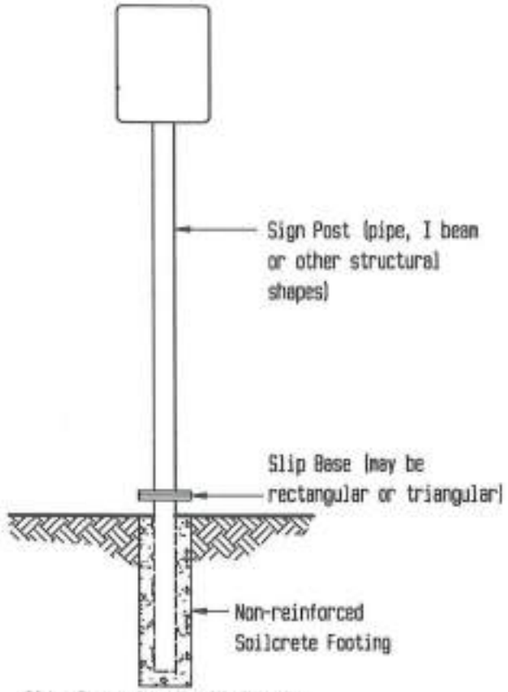
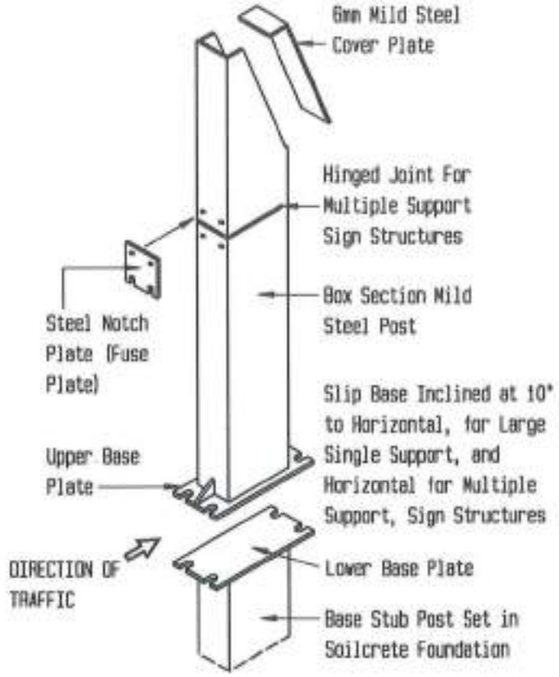


Fig 15.32
Support Frangibility:
Fracture or Bending Breakaway Types for Structures without Base Plates

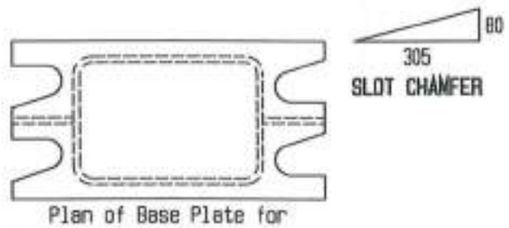


Slip Base for Small Single Support Sign Structures

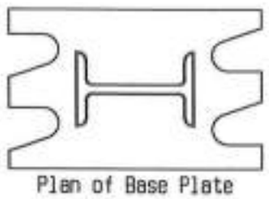


Slip Base for Large Single Support or Multiple Support Sign Structures

Plan of Triangular Base Plate for Small Pipe Support

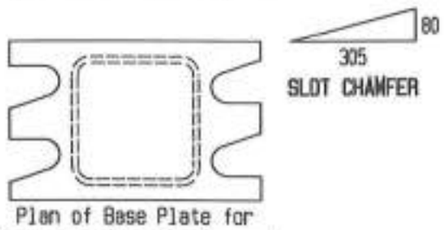


Plan of Base Plate for Rectangular Box Section Support



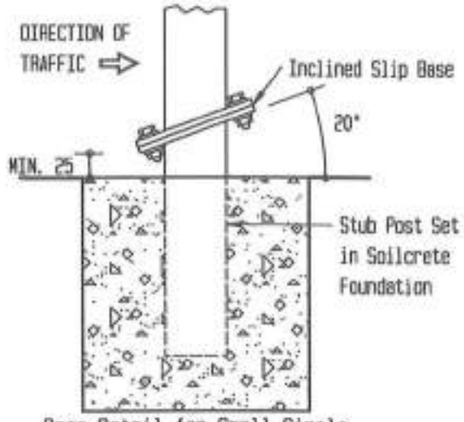
Plan of Base Plate for I-Beam Support

Detail 15.33.1 Small Slip Base

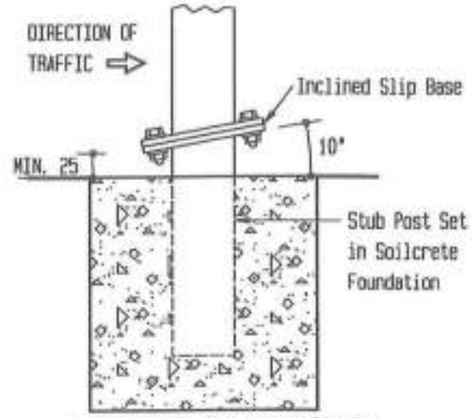


Plan of Base Plate for Square Box Section Support

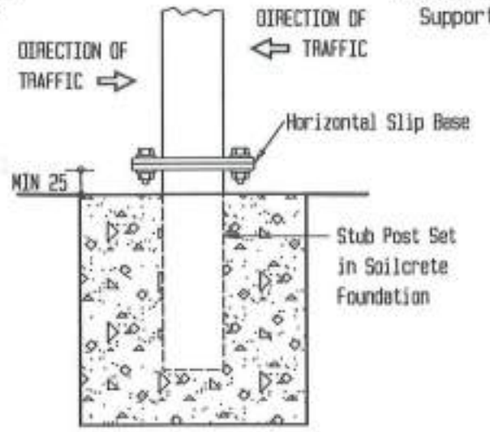
Detail 15.33.2 Large Multiple Slip Bases



Base Detail for Small Single Support Sign Structures

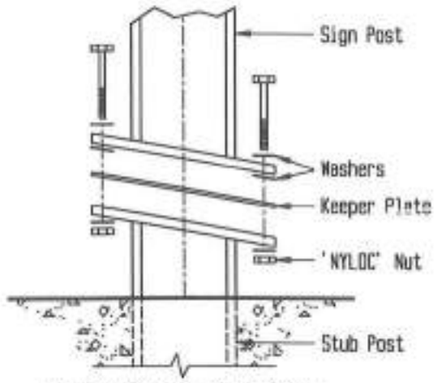


Base Detail for Large Single Support Sign Structures

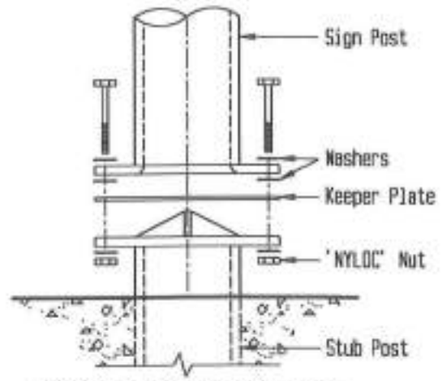


Base Detail for Multiple Support or Single Support (Bi-directional Traffic) Sign Structures

Detail 15.33.3 Installation Requirements



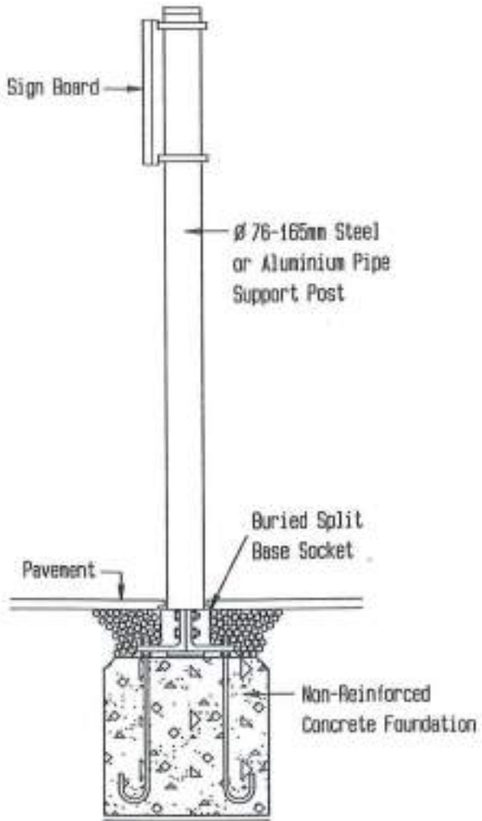
Joining Detail of Inclined Rectangular Base Plates



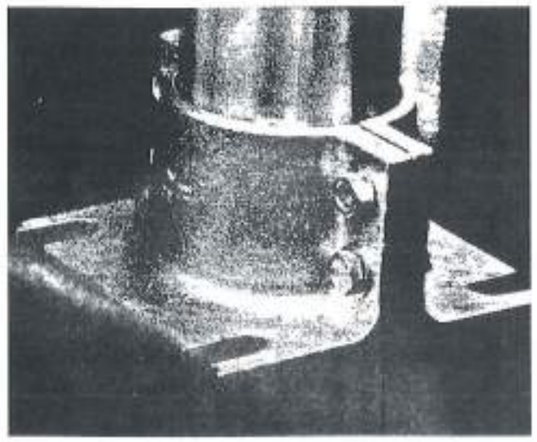
Joining Detail of Triangular Base Plates

Detail 15.33.4 Assembly Requirements

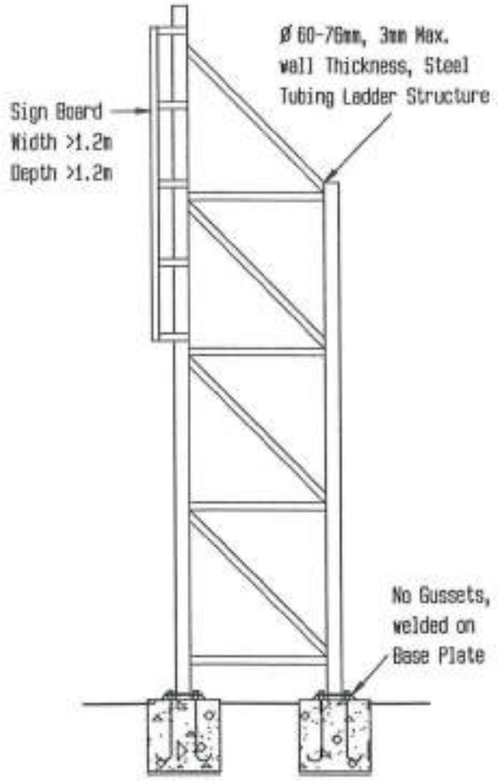
Fig 15.33
Support Frangibility:
Structures with Slip Base Plates



Detail 15.34.1
Split Base Socket for Medium to Large,
Single Support, Sign Structures

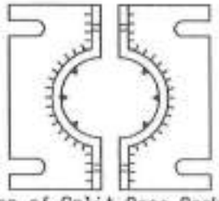


Detail 15.34.2
Isometric View of Typical
Split Base Socket



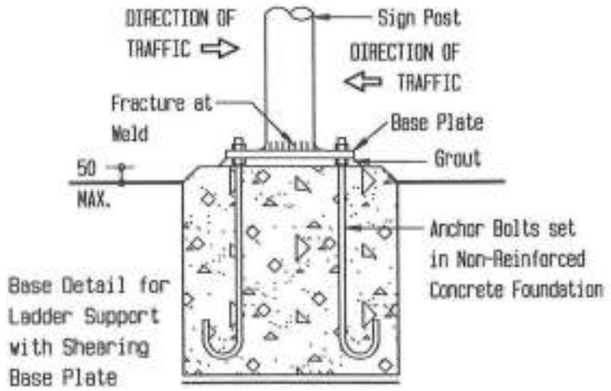
Shearing Base Plate for Ladder
Support Sign Structure

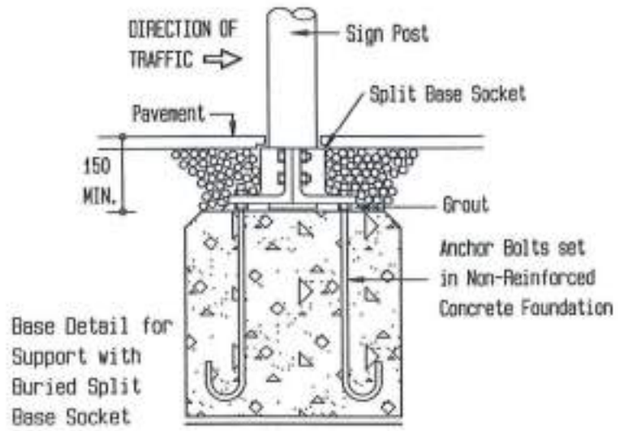
Plan of Shearing Base Plate

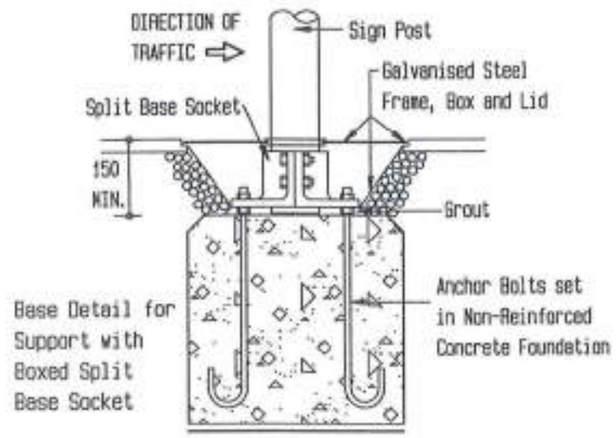


Plan of Split Base Socket

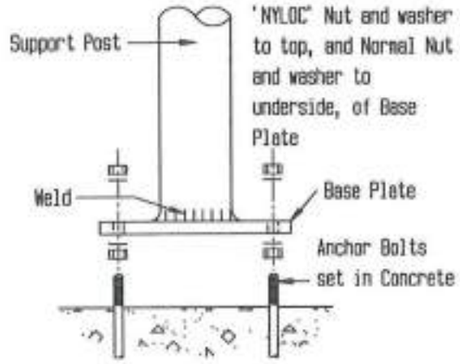
Detail 15.34.3
Dual Base Support for Medium to Large
Multiple Support Sign Structures



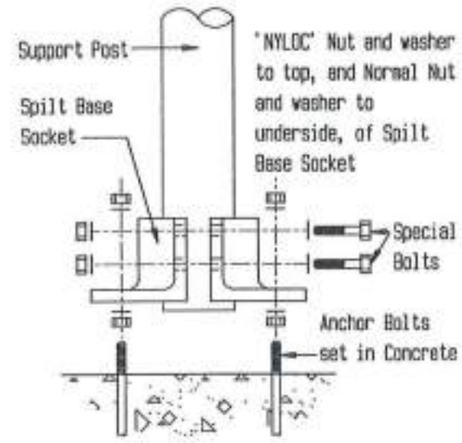




Detail 15.34.4 Base Details

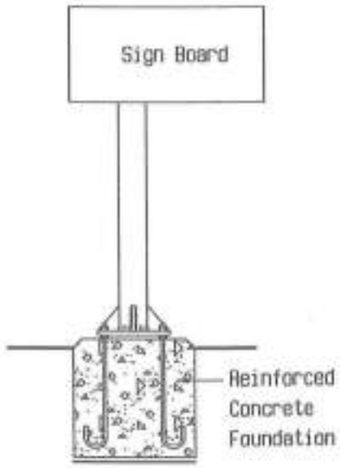


Detail 15.34.5
Mounting Detail for Support
with Sheering Base Plate

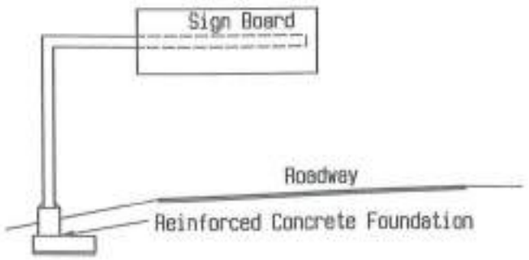


Detail 15.34.6
Mounting Detail for Support
with Spilt Base Socket

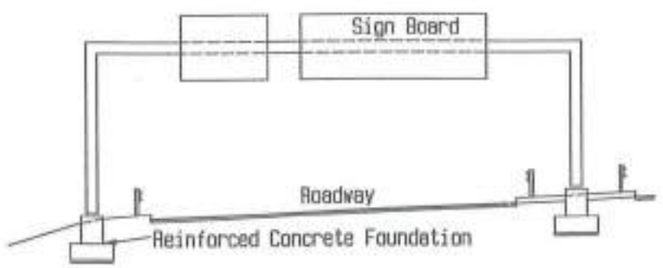
Fig 15.34
Support Frangibility:
Structures with Shearing Base Plates and Splitting Base Sockets



Fixed Base for Lighter Single Support Sign Structure



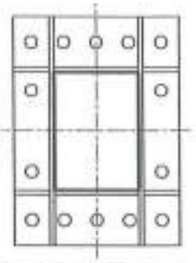
Fixed Base Plate for Heavy Box Section Cantilever Support Structure



Fixed Base Plate for Heavy Box Section Portal Support Structure

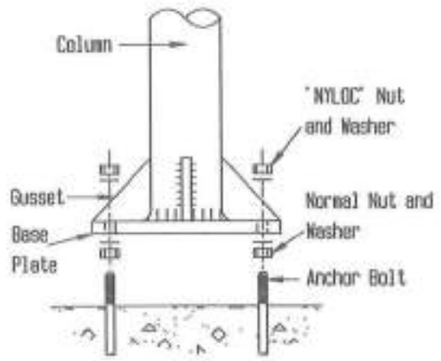
Detail 15.35.1 Basic Rigid Structure Types

Plan of Fixed Base Plate for Lighter Single Support Structures

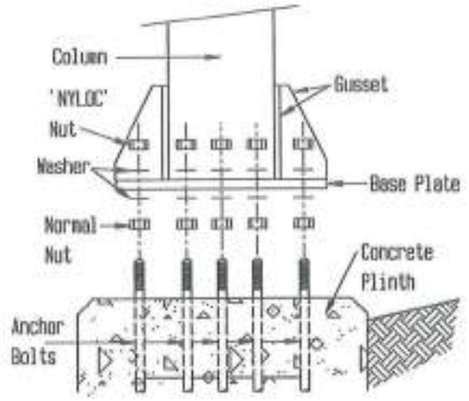


Plan of Fixed Base Plate for Heavier Box Section Support Structures

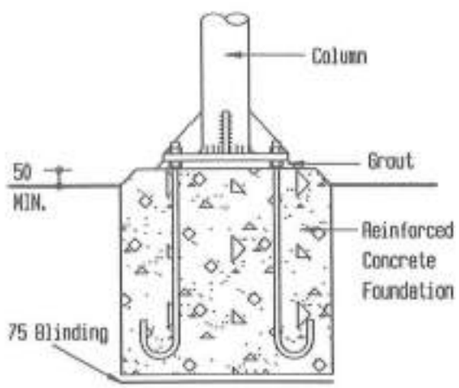
Detail 15.32.2 Base Plates



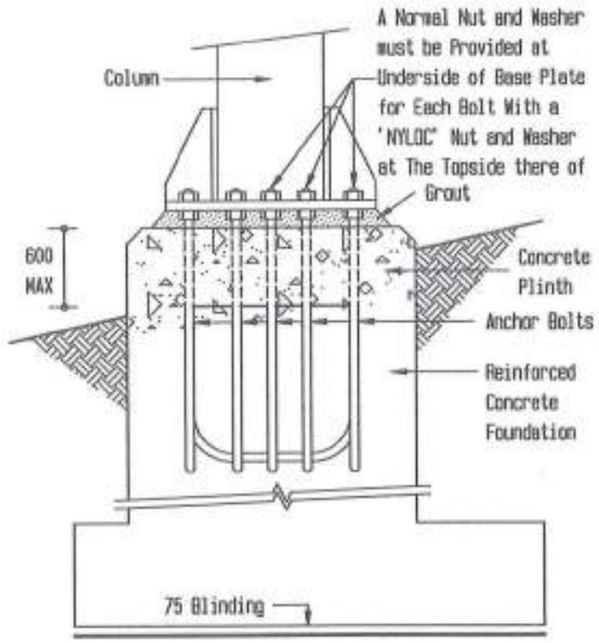
Detail 15.35.3 Mounting Detail for Light Single Support Structure with Fixed Base Plate



Detail 15.35.4 Mounting Detail for Heavy Box Section Support with Fixed Base plate



Detail 15.35.5 Base Detail for Lighter Single Support Structures with Fixed Base Plate



Detail 15.35.6 Base Detail for Heavier Box Section Support Structures with Fixed Base Plates

Fig 15.35
Support Frangibility:
Rigid Structures with Fixed Base Plates

15.5 CHOICE OF SUPPORT FOUNDATIONS AND ANCHOR TYPES

15.5.1 General

1 Some of the general considerations, mentioned in Section 15.3.1, regarding the selection of materials for the component parts of signs, are also applicable to this section for choosing support foundations and anchor types.

2 Installation of sign supports is often accomplished by either driving the post into the soil, drilling and backfilling after placement of the post, or by placing the post in a concrete footing.

3 The smaller type sign posts are usually driven into the ground with a hammer or pneumatic hammer. If a rectangular sleeve or anchor stub post is placed in the ground or sidewalk, then the sign post can simply be slipped into the sleeve and bolted down.

4 Multiple support post installation for ground mounted roadside or freeway signs must be sunk well into the ground, with soilcrete foundations. For larger overhead sign structures reinforced concrete footings are commonly used. To erect these larger ground mounted and overhead mounted signs, heavy equipment such as cranes will be required.

5 It is thus clear that there are different foundation types to suit the different support base anchor types/means for the different sign sizes. To complicate matters further the depth and size of foundations are dictated by the founding material or soil types.

15.5.2 Soil Materials

1 The type of soil material present at a proposed sign site will affect the foundation design and possibly the number of supports required. Good soil information can lead to substantial savings and tighter foundation design because the design parameters are well defined. The more comprehensive the information, the more economically can a good structure be built.

2 If in doubt regarding the characteristics of the soil, an engineer should be consulted or soil samples taken from a test hole to a soil laboratory for analysis. Based on the results of this analysis, a recommendation can be made regarding the best foundation structure to use. One or two test holes should be dug on the site or the engineer's instructions should be followed.

3 There are various types of clay and not all of them should be regarded as bad. Some are soft but are still stable. Collapsible soils are usually not very dense because of the high proportion of voids present. Heaving or active clays contain minerals which cause the soil mass to react strongly to changes regarding moisture content. These clays will swell when more moisture is added and will shrink as they dry out.

4 The treatment of soft soils is usually to make the foundations wider to reduce the pressure to an acceptable level so that the soil will be able to withstand the load with little or no settlement. Should the soil prove to be too soft or wet then a raft foundation or piling is recommended. A pile is a concrete column driven into the earth which either carries the load down to a stronger, more stable, soil below or by hanging in friction on the soil around its shank.

5 The consistency of cohesive and granular soils as well as the hardness of rocks is indicated in Tables 15.17 to 15.19 in this section. In Subsection 15.2.5, soil texture classifications appear as Tables 15.5 and 15.6 and a chart as Figure 15.8, while the typical engineering problems, usually related to residual soils, are also indicated in Table 15.4.

6 The founding materials in general terms, and the means of excavation commonly exercised, are:

(a) marshy or waterlogged soils - excavation by dredger or in coffer dams;

(b) mud and clay - excavation by dredger and shovel;

(c) sand excavation by shovel;

(d) medium hard ground - pick and shovel to excavate;

(e) hard ground - pick and jackhammer occasionally;

(f) rock or granite - drilling and blasting.

7 Where the founding material is man-made, i.e. on concrete or steel structures, or in aggressive or polluted soils, special engineering solutions for sign supporting foundations or structures are required. Problem locations should however be avoided, being uneconomical. Subject to road and sign class, sign structures can be moved to a location with better founding materials. Founding materials which do not normally present foundation problems, or require major engineering input, are: sand, medium hard ground and hard ground.

8 While the depth of a foundation is mostly determined by the total length of the support(s) above ground level, in turn the support length is determined by the depth of the sign back plate. The foundation horizontal size (length and width or diameter) is determined by the soil materials as well as the sign back plate area. The foundation for a support base located in a soft sand material is much larger in size, and therefore volume, than a foundation for the same support and sign located in medium hard to hard soil materials. Thus poor soil conditions will always require larger or better anchoring of sign supports, and therefore larger foundations. This sometimes applies even for smaller sign supports that would normally have been driven in or buried, had the soil material been medium hard to hard.

9 Some support bases, however, require non-reinforced to reinforced concrete foundations, no matter what the soil material type is. These supports are normally for the larger signs with frangibility treatment to their bases i.e. those with anchor stub posts or base plates/sockets and those with breakaway holes drilled through the supports.

15.5.3 Composition of Anchor and Foundations

1 There are basically three foundation types according to the sign structure types from small to large ground mounted sign structures, to even larger overhead mounted sign structures. The three basic foundation types, with derivatives, according to sign structure sizes are:

(continued on page 15.5.4)

TABLE 15.17 **CONSISTENCY OF COHESIVE SOILS** **TABLE 15.17**

		Silts and clays and combinations of silts and clays with sand, generally slow draining	Unconfined compressive strength (kN/m2)
S1	Very soft	Pick head can easily be pushed into the shaft of handle. Easily moulded by fingers.	25 - 35
S2	Soft	Easily penetrated by thumb; sharp end of pick can be pushed in 30 mm to 40 mm; moulded by fingers with some pressure.	35 - 70
S3	Firm	Indented by thumb with effort; sharp end of pick can be pushed in up to 10 mm; very difficult to mould with fingers. Can just be penetrated with an ordinary hand spade.	70 - 100
S4	Stiff	Penetrated by thumb-nail; slight indentation produced by pushing pick point into soil; cannot be moulded with fingers. Requires hand pick for excavation.	100 - 300
S5	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of pick point. Requires power tools for excavation.	300 and more.

NOTES ON SOIL TYPES (See Figure 15.8):

(1) Sand consists of discrete particles between 2,5 mm to 0,074 mm (No. 200BS sieve) in size and normally visible to the naked eye.
Sand is clearly distinguishable by the presence of gritty particles which do not break down when rubbed on the palm of the hand.

(2) Silt consists of fine particles, smaller than 0,074 mm and larger than 0,002 mm. In general silt particles are barely felt when rubbed with water on the palm.
When this wetted soil is placed on the tongue, the particles can be felt grating against the enamel of the teeth.

(3) Clay consists of very fine particles less than 0,002 mm. The particles are flaky and when rubbed on the palm with water has a soapy or greasy feeling. No sensation of grittiness can be detected when tasted.

(4) Gravel consists of fragments of rock between 2,5 mm and 200 mm (No. 7HS sieve). The shape of the particles should be described as follows:
(a) rounded shape
(b) oval shape
(c) rounded corners
(d) corners slightly bevelled
(e) corners sharp or irregular.

(5) Boulders are fragments of rock larger than 200 mm. Rock types and range of size should be recorded also whether there is a matrix in the voids and does it fill the voids or not.

TABLE 15.18	HARDNESS OF ROCKS	TABLE 15.18
	Description of Hardness	Unconfined Compressive Strength (MPa)
R1 Very soft rock	Material crumbles under firm (moderate) blows with the sharp end of a geological pick and can be peeled off with a knife: it is too hard to cut a triaxial sample by hand	0,7 to 3,0
R2 Soft Rock	Can just be scraped and peeled with a knife: indentations 1 mm to 3 mm show in the speciman with firm (moderate) blows of the pick point	3,0 to 10,0
R3 Hard Rock	Cannot be scraped or peeled with a knife; hand-held speciman can be broken with a hammer end of the geological pick and a single firm (moderate) blow	10,0 to 20,0
R4 Very hard rock	Hand-held speciman breaks with hammer end of geological pick under more than one blow	20,0 to 70,0
R5 Extremely hard rock	Speciman requires many blows with a geological pick to break through intact material	More than 70,0

TABLE 15.19	CONSISTENCY OF GRANULAR SOILS	TABLE 15.19
	Gravels and clean sands, generally free draining	Typical dry density (kg/m^3)
Very loose	Crumbles very easily when scraped with a geological pick	Less than 1450
Loose	Small resistance to penetration by sharp end of geologial pick	1450 to 1600
Medium dense	Considerable resistance to penetration by sharp end of geologial pick	1600 to 1750
Dense	Very high resistance to penetration by sharp end of geologial pick; requires many blows of pick for excavation	1750 to 1925
Very dense	High resistance to repeated blows by sharp end of geologial pick; requires power tools for excavation	More than 1925

(continued from page 15.5.1)

(a) no foundations for small single support signs;

(b) non-reinforced foundations consisting of: soilcrete foundations for drilled breakaway hole supports and anchor/base stub posts for threaded pipe and slip base plate couplings; and mass concrete foundations for supports with split base sockets or shearing base plates;

(c) reinforced concrete foundations for the large ground mounted or overhead mounted sign structures with rigid base plates.

2 The anchor types employed with the foundation types are the following:

(a) buried or driven support ends in soil, no foundation;

(b) support end or anchor/base stub post set in soilcrete foundation;

(c) anchor hook bolts set in mass concrete foundation;

(d) anchor bolt groups in reinforced concrete foundation;

3 The support ends and anchor stub posts are for supports with no base plates while all the other anchor types allow for supports with base plates or split base sockets.

4 Soilcrete foundations normally comprise of a mixture of 50% crushed stone, 40% selected granular material from the excavation or imported, and 5% Portland Cement, compacted into the hole at optimum moisture content to a density of 95% MAASHTO. The advantages of soilcrete foundations are that it is economical and easy to use and in the event of an impact on a sign support it is easy to demolish and to cast a new foundation using materials mainly from the site.

5 Non-reinforced mass concrete foundations are used for sign supports that are fixed to the foundation with anchor bolts through base plates or split base sockets. This method of using hooked anchor bolts to anchor the support requires a more rigid and heavier foundation to allow the breakaway of the base plate or socket effectively without damaging or lifting the foundation. This is especially applicable to support structures utilising shearing base plates and split base sockets. Often, after an impact, a new support with new base plate can be reinstated using the original foundation and anchor bolts.

6 Large and heavy reinforced concrete foundations are required for single supported large ground mounted signs and support legs for cantilever/gantry structures for overhead mounted signs. These foundations and their reinforcing are normally specifically designed, for the size and weight of the sign and support structure. The rigid structure is attached to the foundation with multiple anchor bolts through a rigid gusseted base plate. Engineering input will be required on the design for these larger footings.

7 The casting and finishing of foundations require a measure of exactness in the alignment of the anchor bolts, so that these eventually will fit into the holes of the support base plate, and the top levels of the foundations which allows for the type of base plate/socket or stub and its height above/below the ground level according to the shoulder break point or highest point on the road level. A casting jig is often used to set and keep the anchor bolts in position during casting. Where the top levels of foundations are at or above ground level these should be finished off with a sufficient fall to allow proper drainage of water away from the support and base plate.

8 The required foundation top levels in relation to the ground level for the different support structure types are:

(a) maximum 500 mm above Ground Level (GL) for fixed base plates of cantilever and gantry structures;

(b) maximum 50 mm above GL for shearing and other fixed base plates;

(c) 0 mm, at GL for breakaway holes or slip base plates;

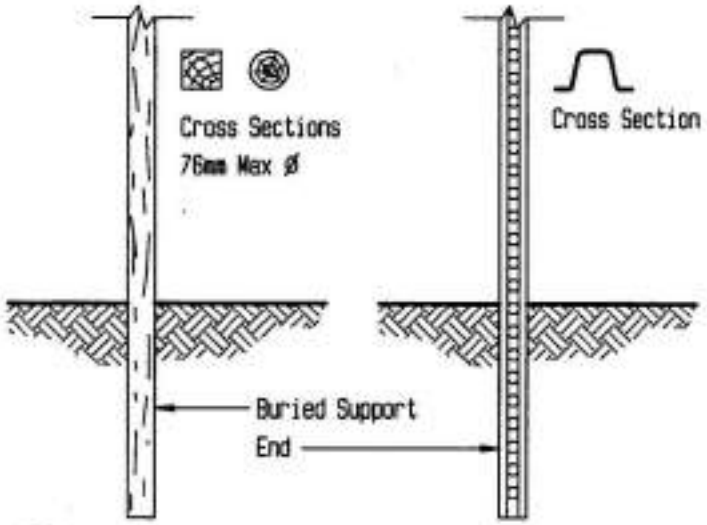
(d) minimum 150 mm below GL for split base sockets.

9 Figures 15.36 to 15.39 indicate examples of the different anchor and foundation types discussed.

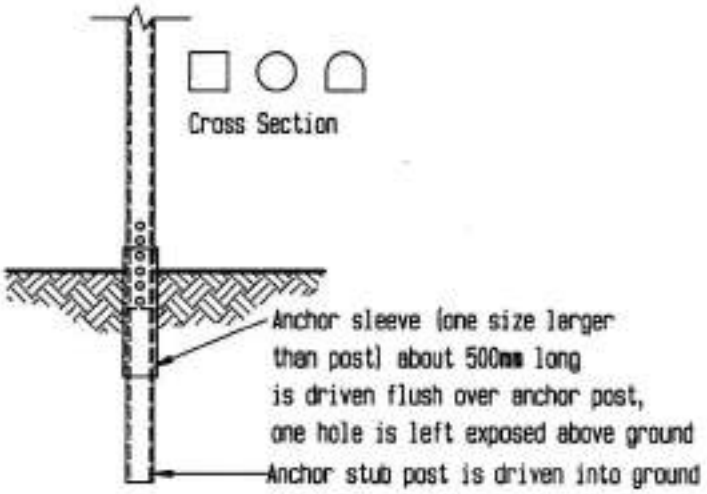
10 Figure 15.40 indicates special foundations or founding materials which may occur. These situations require special measures, specific to the materials present, to be designed by an engineer.

11 Table 15.16, in Section 15.4, indicates a summary of the different anchor and foundation types tabulated with the different support and frangibility types.

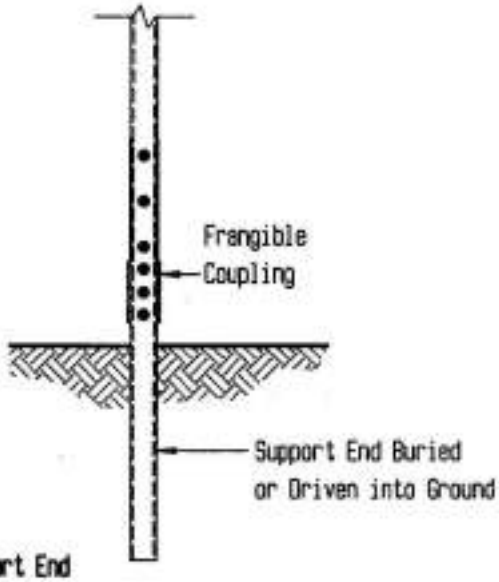
12 Table 15.20 illustrates the advantages and disadvantages of different support base frangibility and foundation



Detail 15.36.1 Buried Support Ends

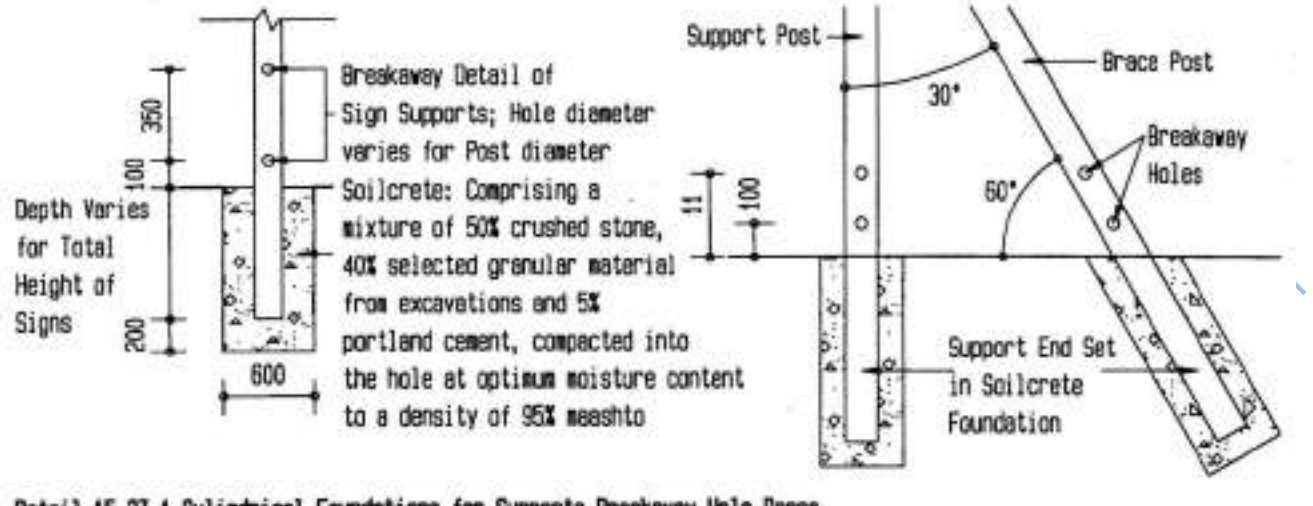


Detail 15.36.2 Driven Support End with Anchor Sleeve

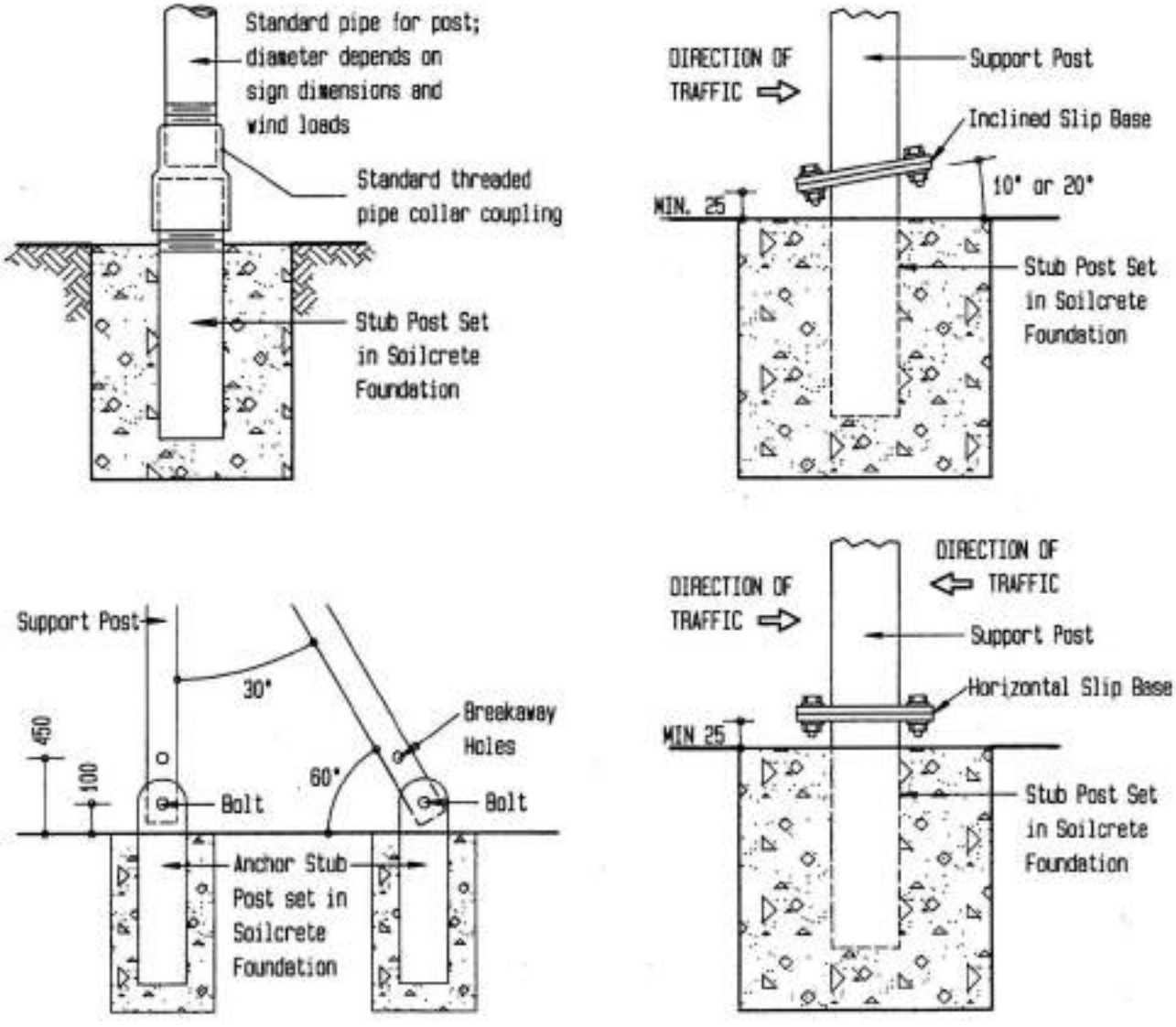


Detail 15.36.3 Driven Support End

Fig 15.36 Buried or Driven Support Ends with No Foundations

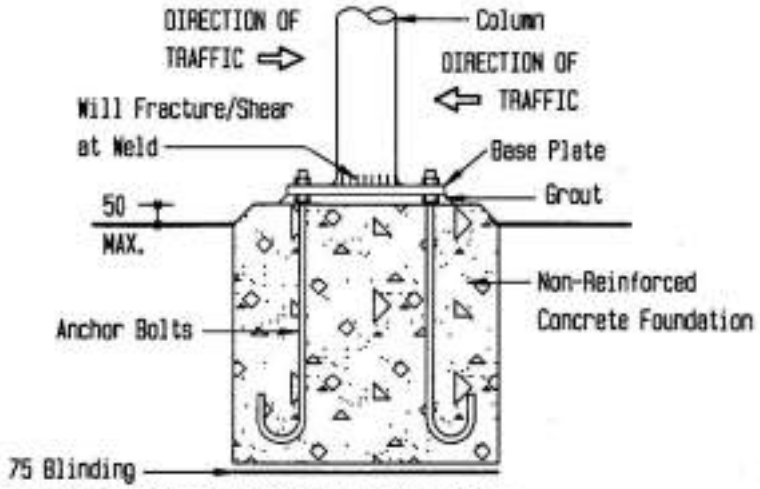


Detail 15.37.1 Cylindrical Foundations for Supports Breakaway Hole Bases

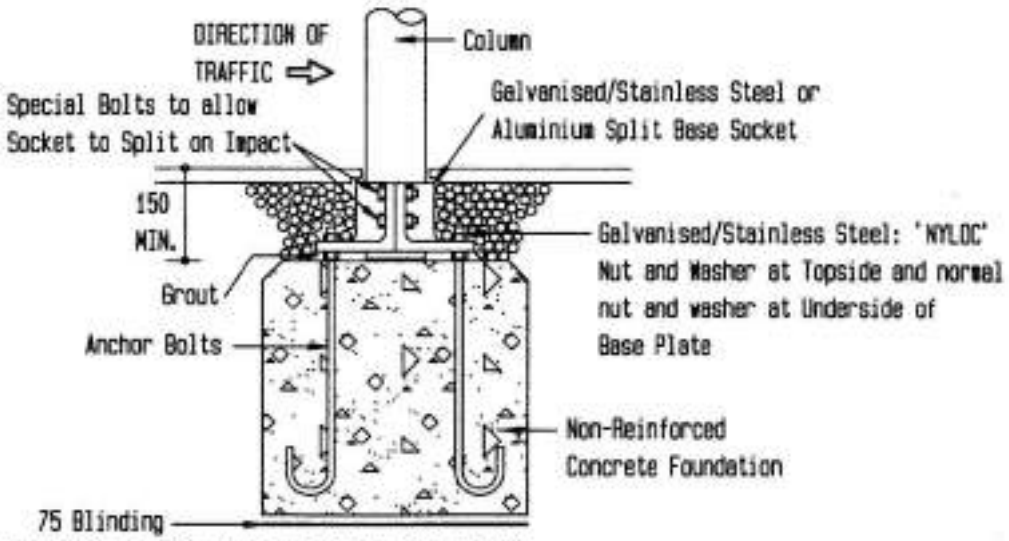


Detail 15.37.2 Cylindrical Foundations for support Stub Posts

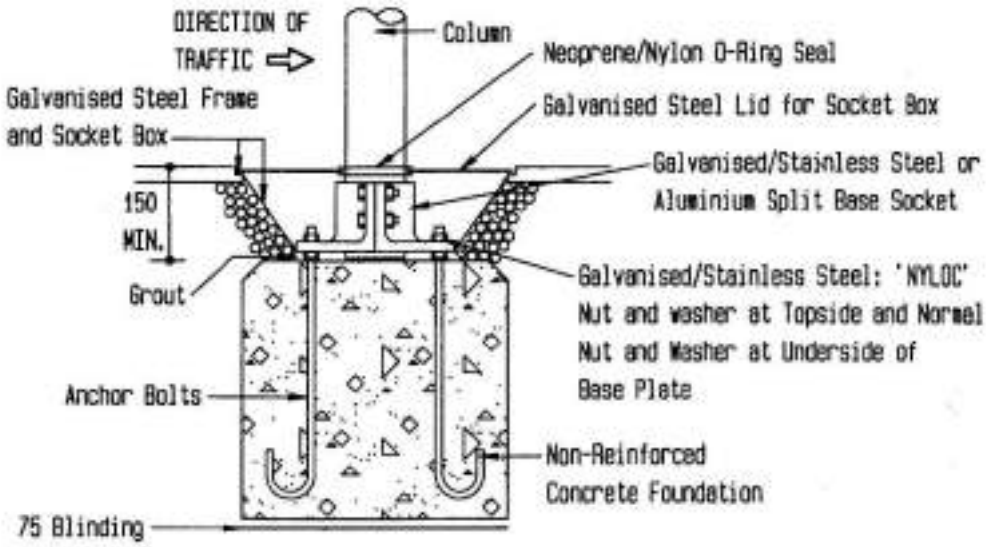
Fig 15.37 Non-Reinforced Foundations: Support End/Base Stub Post Set in Soilcrete



Detail 15.38.1 Block Foundation for Supports with Shering Base Plates



Detail 15.38.2 Block Foundation for Supports with Split Base Sockets



Detail 15.38.3 Block Foundation for Supports with Boxed Split Base Sockets

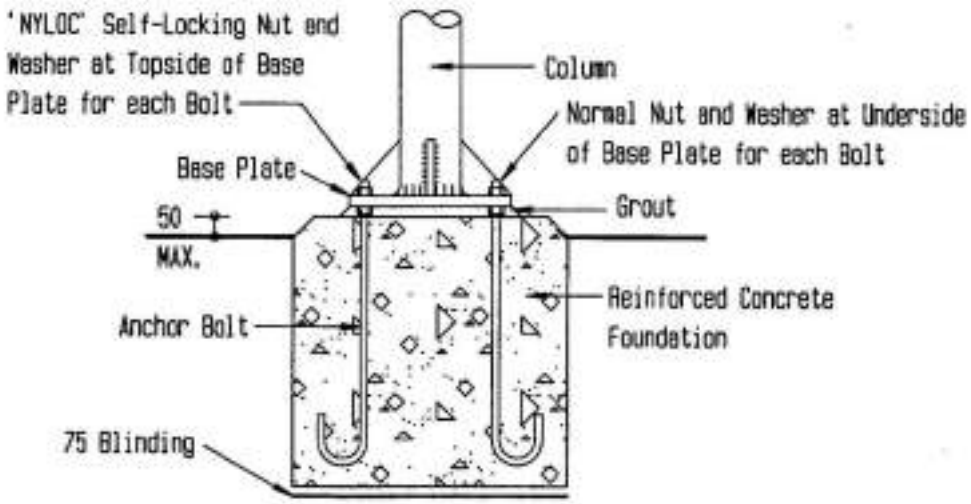
Fig 15.38 Non-Reinforced Foundations: Anchor Bolts Set in Concrete

TABLE 15.20 SUPPORT BASE FRANGIBILITY AND FOUNDATION TYPES **TABLE 15.20**

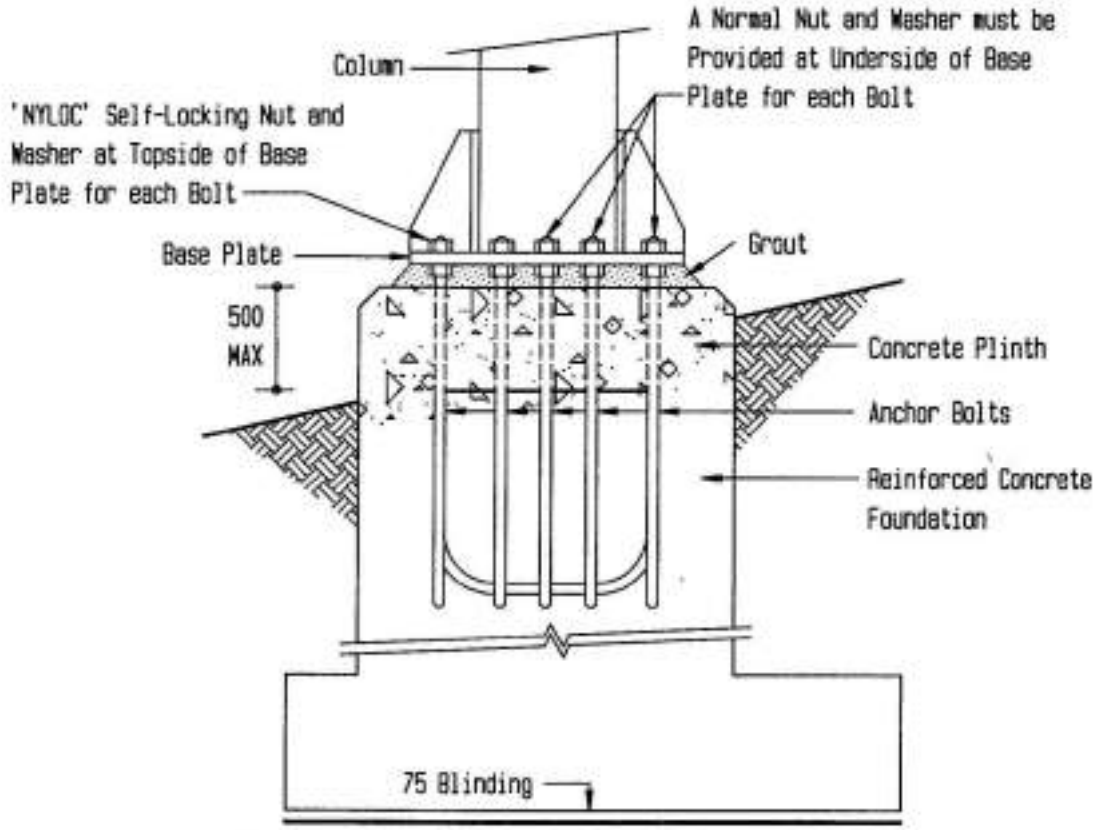
Footing Type	Advantages	Disadvantages
Fracture Breakaway. No Foundation.	• Buried or knocked in support end • Frangibility good • Cheap installation and maintenance	• Only applicable to single supported, smaller signs • <= 76 mm ϕ timber supports only • Timber must be treated against pests, rotting • Veldfires will damage • Vandal resistance low due to theft
Bending Breakaway. No Foundation.	• Same as above • Excellent pest and fire resistance • Durability and crashworthiness good • Cheap installation and maintenance	• Only applivable to single supported, smaller signs • 76 mm ϕ MAX, 3 mm MAX wall thickness tubing • If steel treat against rust and corrosion • Vandal resistance low due to theft
Sleeve/Frangible Coupling Breakaway. No Foundation.	• Same as above for bending...	• Same as above for bending...
Threaded Pipe Coupling Breakaway. Soilcrete Foundation.	• Same as above for bending...	• Same as above for bending...
Fracture at Breakaway Holes. Soilcrete Foundations	• For multiple support sign structures • Timber or steel pipe supports • Cater for a wide range of sign sizes - generally used • Good frangibility • Good durability and crashworthiness • If steel pipes - pest and fire resistant • Soilcrete foundations instead of mass or reinforced concrete foundations	• Steel pipes must be treated against rust and corrosion • Timber supports must be treated against pests and rot • Veldfires may damage timber supports
Slip Base Plates Breakaway. Soilcrete Foundations.	• Variety of signs catered for - small-to-large single support or multiple supported signs • Variety of cross sectional formats of support can be used • Excellent pest and fire resistance • Good durability and crashworthiness • Good frangibility • Soilcrete foundations instead of mass concrete or reinforced concrete foundations	• Inclined slip base plates for single supports and horizontal slip base plates for multiple supports - inclination an issue • Keeper plate needed to keep baseplates in place but to allow sliding if vehicle impacts • Hinged joint, higher up support, necessary for multiple supported signs using slip base plates • Steel needs treatment against rust and corrosion • Skilled labour and specialised equipment needed to manufacture and erect

TABLE 15.20 SUPPORT BASE FRANGIBILITY AND FOUNDATION TYPES TABLE 15.20

Footing Type	Advantages	Disadvantages
Shearing Base Plate Breakaway. Concrete Foundation with Anchor Bolts.	• Weld at base plate is friction point for structure • Widely used in Europe • Durability and crashworthiness good • No reinforcing necessary for foundation • Smaller foundations because of lighter structure	• Structure must be able to bend and deform i.e. ϕ <= 76 mm, wall thickness < 3 mm pipes • Skilled labour and specialised equipment to manufacture ladder support structure • Only applicable to multiple ladder support structures • Anchor bolts in mass concrete need to be set in correct position before casting • Mass concrete foundations needed • Steel need to be treated against rust and corrosion
Split Base Socket Breakaway. Concrete Foundation with Anchor Bolts.	• Support breakaway due to base socket splitting and releasing it • Widely used in urban areas in Europe - normally on side walks • Durability and crashworthiness good • Maintenance very easy • No reinforcing necessary for foundation	• Only applicable to single support structures for small to medium sized signs i.e. <= 10 m^2 signs • Support must be deformable to yield initially before disengagement of the base socket • Skilled labour and special equipment needed to manufacture base socket and to install it • Anchor bolts in mass concrete need to be set in correct position before casting • Mass concrete foundations needed • Steel need to be treated against rust and corrosion • Support Φ's standardised to only about 5 sizes because of split base sockets to match
Rigid, Fixed Base Plate. Reinforced Concrete Foundations with Anchor Bolts	• Excellent pest and fire resistance • Durable and vandal resistant • Only four anchor bolts necessary makes for easy positioning of slotted base plate • Normally used for multiple support signs mounted on a single support due to space constraints	• Applicable to lighter single support sign structures • No frangibility - structure must be protected • Reinforced concrete foundation needed • Steel need to be treated against rust and corrosion
Rigid, Fixed Base Plate for Overhead Cantilever or Gantry Structures. Reinforced Concrete Foundations with Anchor Bolts	• Excellent pest resistance • Durable and vandal resistant • Stable in all conditions	• Heavy structure - No frangibility - structure must be protected with guardrails or clearances • Large reinforced concrete foundation needed • Steel need to be treated against rust an corrosion • Skilled labour and special equipment needed to manufacture and erect • Expensive to manufacture and erect

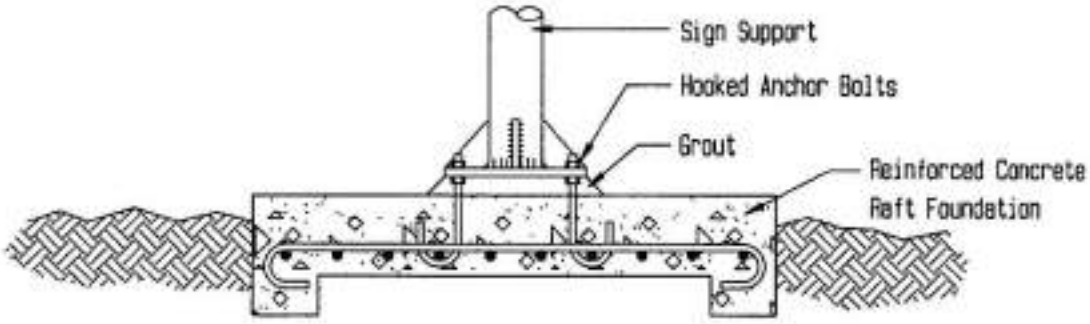


Detail 15.39.1 Block Foundation for Heavier Steel Tube or Box Section Supports

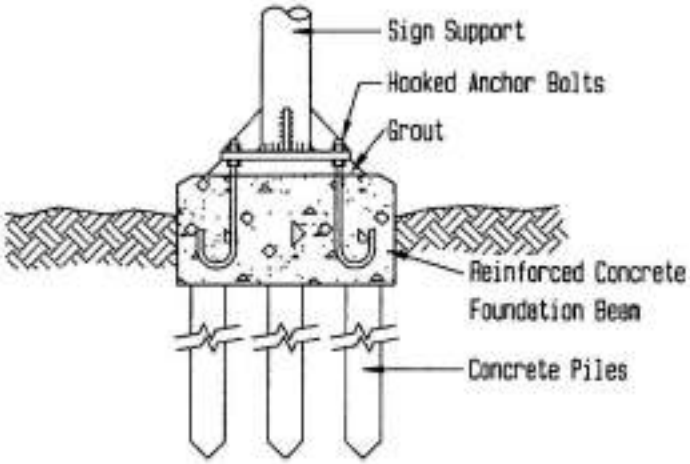


Detail 15.39.2 Plinth and Slab Foundation for Overhead Sign Gantries

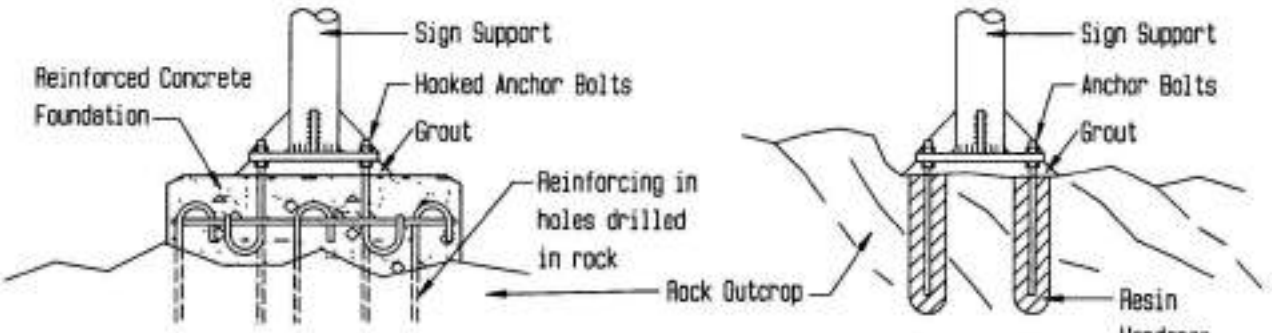
Fig 15.39 Reinforced Foundations: Anchor Bolts and Reinforcing Set in Concrete



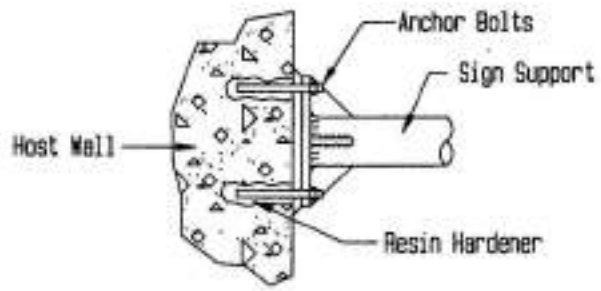
Detail 15.40.1 Raft Foundation in soft sand



Detail 15.40-2 Piled Foundation for waterlogged or marshy soils



Detail 15.40.3 Foundation on Rocky/Granite Outcrop



Detail 15.40.4 Host: Conc/Steel Bridge/Wall es Foundation/Footing

Fig 15.40 **Special Foundations**

15.6 CHOICE OF FASTENERS FOR MOUNTING SIGN BACK PLATES

15.6.1 General

1 Some of the general considerations, mentioned in Section 15.3.1, regarding the selection of materials for the component parts of signs, are also applicable to this section for choosing the fasteners to fix the sign back plates to the support structures.

2 The basic hardware used to erect signs consists of bolts, washers, clamps, fittings and brackets. These fasten the sign to the post and solidify the connection so that wind, vandals, or impact by outside forces do not destroy or degrade the intended use of the sign. These fasteners are usually made of steel or aluminium, plated or galvanised for protection from the elements. Braces, U-bolts and clamps of aluminium or steel are used when multiple sign installations, large signs, or wind conditions necessitate stronger attachment to the post than a single or double bolt. For circular timber, aluminium or steel posts or pipes, the sign may be clamped or strapped/banded to the support.

3 Fasteners and braces should be designed to insure that signs will remain attached to the post throughout the impact sequence should they be impacted by an errant vehicle.

4 In cases where clamps, bolts and nuts are to be used to secure different metals, they should be cadmium plated or stainless steel. In cases where aluminium plate or sections will be in contact with steel, the contact surfaces should be painted with a bituminous paint or protected by the application of adhesive PVC tape or Aluminium backed `Bostic' tape to shield the different materials from each other.

5 Attachments or carriers for signs, providing the means for connecting the sign back plate to the structure, should be made from mild steel that is hot-dip galvanized in accordance with the requirements of SABS 763 or from a stainless steel complying with the requirements of Part IV of BS 970 or from other non-corrodible materials. The quality of the materials and the size of the members for an attachment should be such that the sign complies with the appropriate performance requirements. Typical attachments are horizontal carrier channels and vertical, Z-or I-profile, carriers.

15.6.2 Composition of Mounting Hardware

1 When deciding which type of mounting fasteners and attachments to use the advantages and disadvantages of each type should be considered. This is a very important decision because the mounting method is the deciding factor in the quantity of resources (financial, labour and equipment) needed for the erection and future maintenance of the sign. Certain fasteners are specialised, and specific to a certain sign or mounting method, which may be very expensive, but very simple and quick to install. Sometimes the back plate construction or the mounting position will enforce the use of a certain fastener type. The advantages and disadvantages of the mounting types are indicated in Tables 15.22 and 15.23.

2 The sign back plate types are normally of two derivatives:

(a) those that are not framed or reinforced or only simply braced, usually for sign sizes smaller than 1,5m^2;

(b) and those that are framed and reinforced for sign sizes larger than, but including 1,5m^2.

3 The back plate types under the not framed/reinforced or simply braced group are the following:

(a) signs smaller than 0,5m^2 with no reinforcing;

(b) signs smaller than 1,5m^2 with simple horizontal stiffeners, usually "Sankey" struts or "O-line" channels;

(c) signs smaller than 1,5m^2 with pressed/formed edges.

4 The sign back plate types with frames and bracing can be any of the following:

(a) signs larger than, but including 1,5m^2, with perimeter frames and intermediate reinforcing, usually consisting of square tubing;

(b) signs larger than, but including 1,5m^2, made of stacked aluminium or Chromadek road sign profiles or planks;

(c) signs that are boxed into cabinets, usually internally illuminated or variable message signs (VMS).

5 There are two basic mounting positions, ground and overhead, for the sign types mentioned above. These mounting positions could be on single, multiple, cantilever, gantry, and other support structures. Sign back plates may be fixed to the support structure by using one of the following mounting or installation methods:

(a) direct riveting or bolting through the sign sheet, lugs or bracing framework;

(b) indirect fixing by means of brackets, saddles or clamps;

(c) indirect fixing to vertical or horizontal carrier beams or channels fixed to the support structure.

6 The final fastener is almost always a rivet, bolt or strap, however, modern adhesives are now commonly being used in place of these conventional fasteners. The use of adhesives has the added benefit of reducing or eliminating the need to have rivet or bolt heads on the front surface of the back plate.

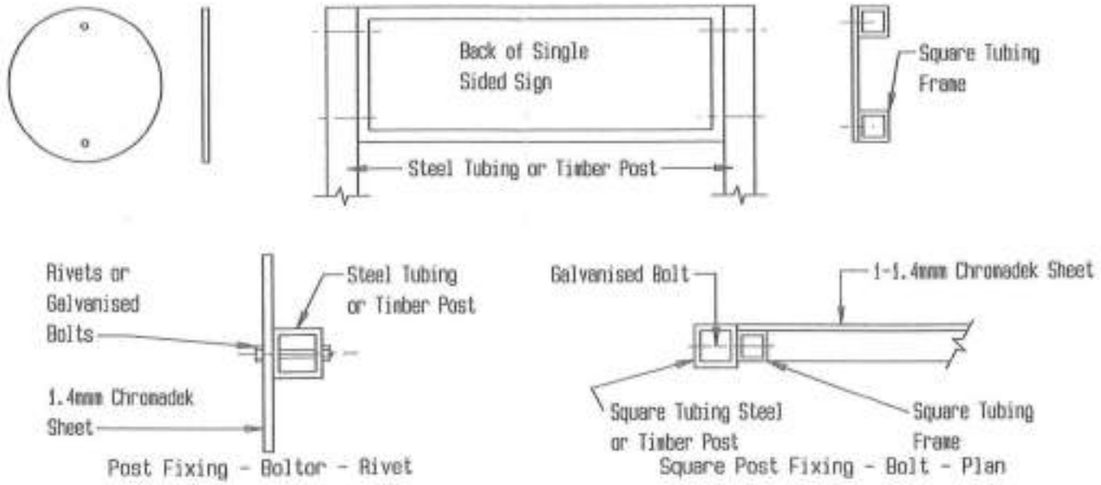
7 Table 15.21 indicates the different fastener types as they relate to the different sign back plate types while Figures 15.41 to 15.49 indicate different mounting methods and fasteners.

TABLE 15.21 **FASTENER TYPES** **TABLE 15.21**

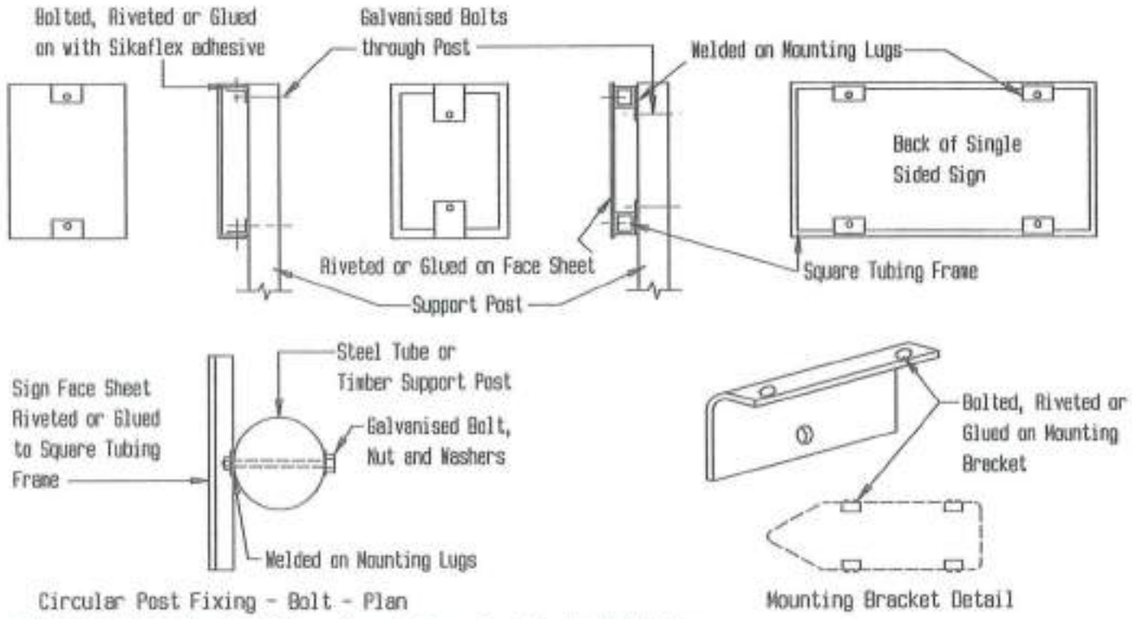
Sign Back Plate Type	Mounting			
	Position	Support Structure	Carrier	Fastener
Not braced < 0.5 m^2	GM	Single Support	Nil	Rivet or bolt directly to support
	GM	Single Support	Nil	Strapped through welded/glued on lug
Simply braced horizontally < 1.5 m^2	GM	Single Support	"O-line" or "Sankey" Channel	"O-line" clamp and bolt
	GM	Single Support	Upper and lower T-bar	Bracket and bolts or saddle clamps and strap
Simply braced - pressed / formed edges < 1.5 m^2	GM	Single Support	Pressed edges	Bolted through lugs or bracket
Perimeter frame and bracing >= 1.5 m^2	GM	Single Support	Perimeter Frame and Bracing	Bolted through lugs or brackets
	GM	Multiple Supports	Perimeter Frame	Bolted through frame directly
	GM	Multiple Supports	Perimeter Frame	Bolted through lugs or L-brackets
	GM	Multiple Supports	"O-line" or "Sankey" Channel	"O-line" clamp and bolt or bracket and strap
	GM	Multiple Supports	Heavy horizontal Carrier Channel	L-backets and bolts
	GM	Large Single Support for Multiple Support Sign	Heavy horizontal Carrier Channel	L-backets and bolts
	OH	Cantilever or Gantry Support Structure	Z-profile vertical carrier	Stainless steel clamps and bolts
	GM	Single Support	German "Alform" profiled frame	"Alform" bracket, spring clip and bolt
	GM	Multiple Supports	German "Alform" profiled frame and reinforcing	Nil. Clip in planks
Stacked Profiles >= 1.5 m2 single sided planks	GM Wall	Between Posts or against wall	Vertical "Multiclip" retainer strip and frame	Hidden internal bracket and bolts
Double sided planks	GM	Between Posts	Planks profile	
SA Road Sign Profiles - Aluminium or Chromadek	GM	Multiple Supports	Vertical square tubing carriers with horizontal "Sankey/O-line" strut	"Sankey" clamp and bolt
SA Road Sign Profiles - Aluminium or Chromadek	GM	Large Single Support for Multiple Support Sign	Horizontal channel carrier	Clamps and bolts

TABLE 15.21 **FASTENER TYPES** **TABLE 15.21**

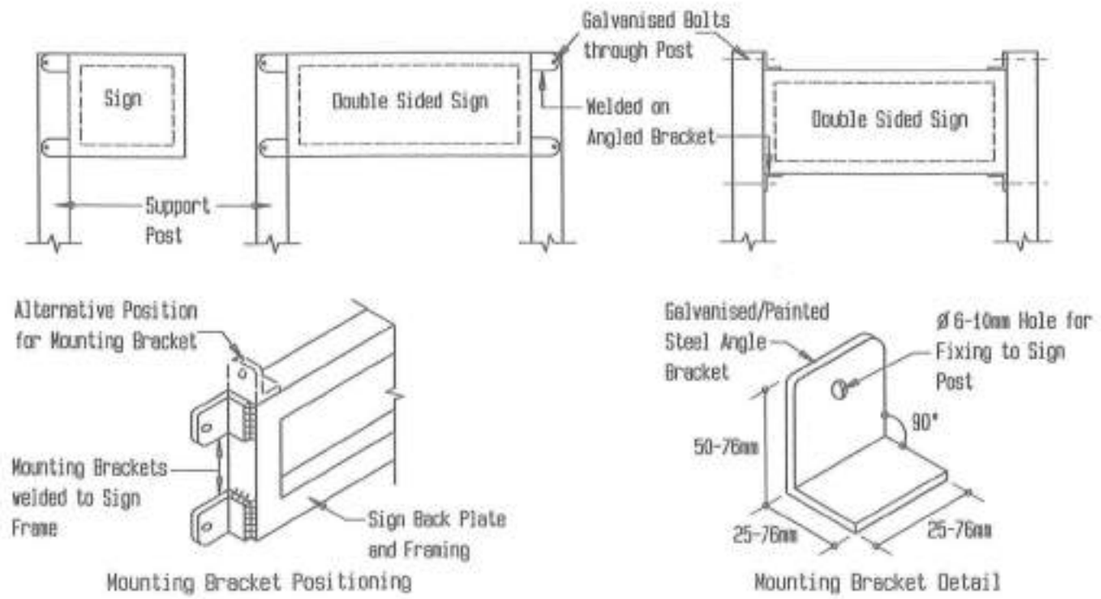
Sign Back Plate Type	Mounting			
	Position	Support Structure	Carrier	Fastener
SA Road Sign Profiles - Aluminium or Chromadek	OH	Cantilever or Gantry	Vertical Z-profile carrier	Stainless steel - clamps and bolts
Cabinets: Simple Double Sided or Boxed	GM	Single or Multiple Supports	Perimeter Frame	Bolt directly through frame or welded on L-brackets
Small to Medium Sized Double sided or Boxed	GM	Single or Multiple Supports	Perimeter Profiled Frame	Internal "Lindapter" cavity fixing bolts directly through frame or square tube bracket
Internal illuminated boxed signs sliding over post/s	GM	Single or Multiple Supports	Profiled frame and internal bracing and tensioner cables	Internal pipe clamps, brackets and bolts
VMS Boxes	GM or OH	Single or Multiple or Cantilever or Gantry	Vertical Profile and/or Horizontal Channel Carriers	Clamps and bolts
Large Boxed Signs	GM or OH	Single or Multiple or Cantilever or Gantry	Vertical Profile and/or Horizontal Channel Carriers	Purpose made clamps and bolts or permanently fixed



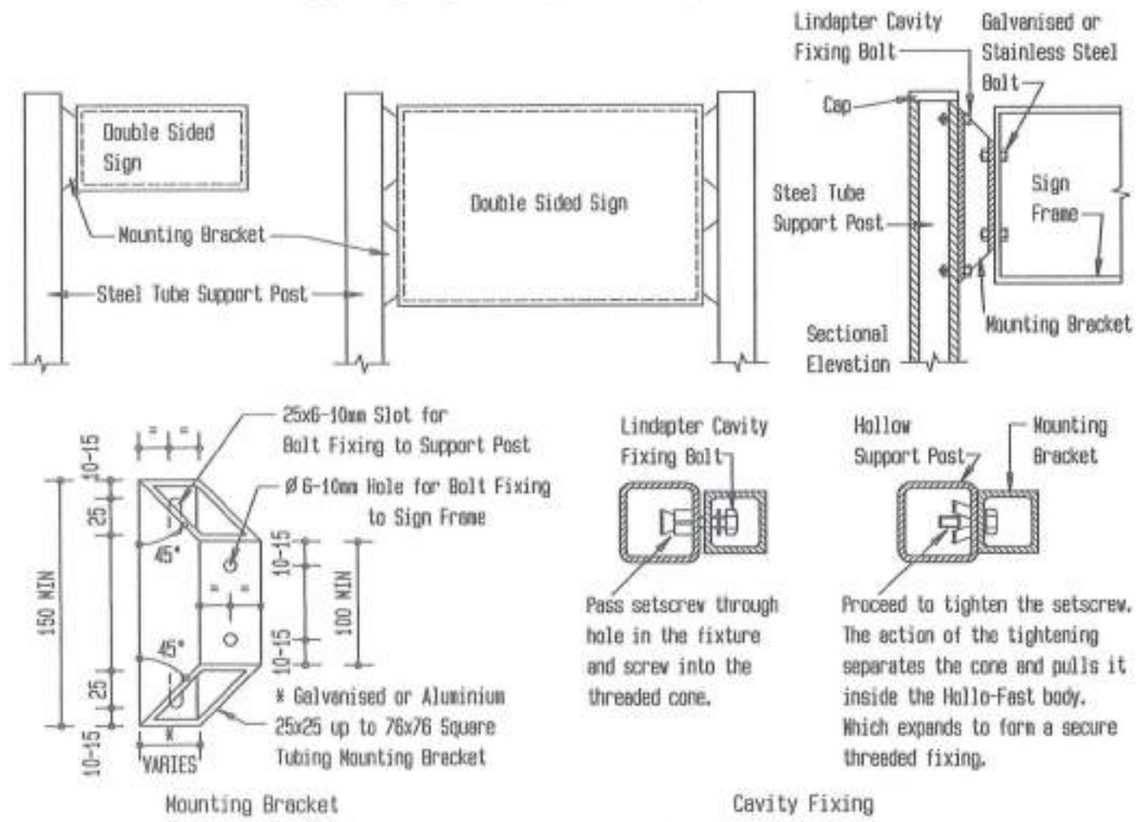
Detail 15.41.1 Direct Bolting through Sign Backplate or Framing



Detail 15.41.3 Direct Bolting through Lugs for Single Sided Signs

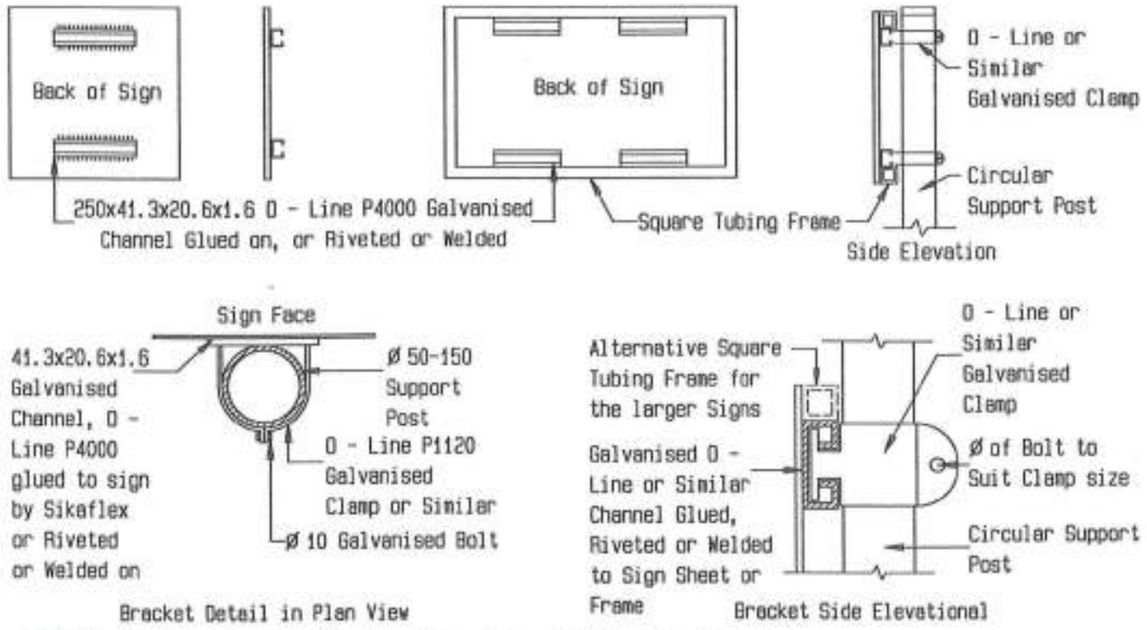


Detail 15.42.2 Direct Bolting through, welded on, Angled Bracket for Double Sided or Boxed Signs

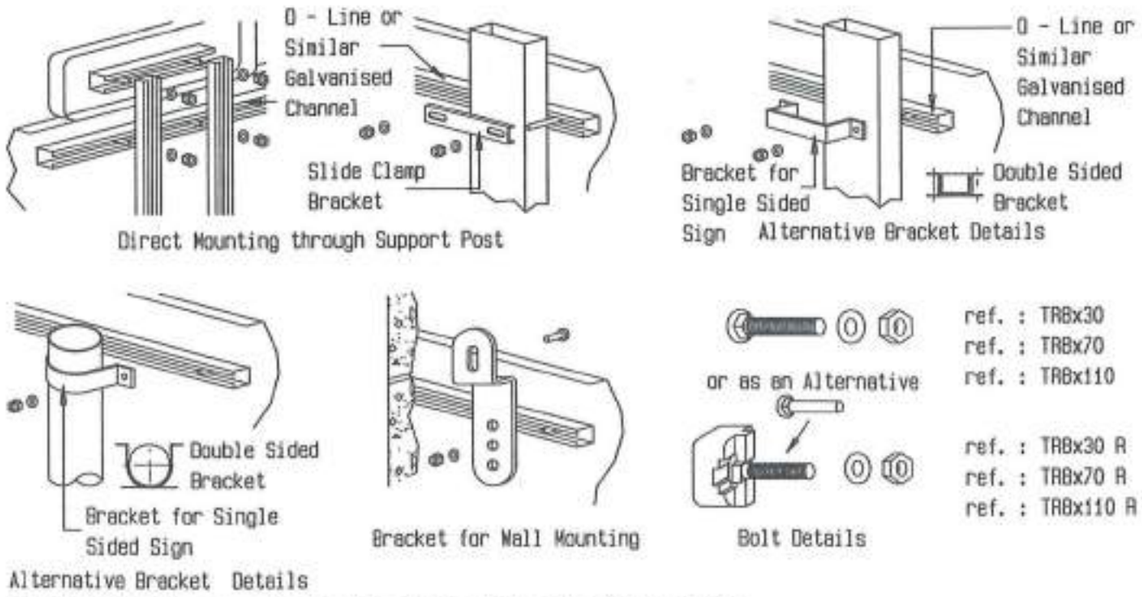


Detail 15.41.4 Invisible Fixing, by Square tubing mounting Bracket, for Double Sided or Boxed Signs

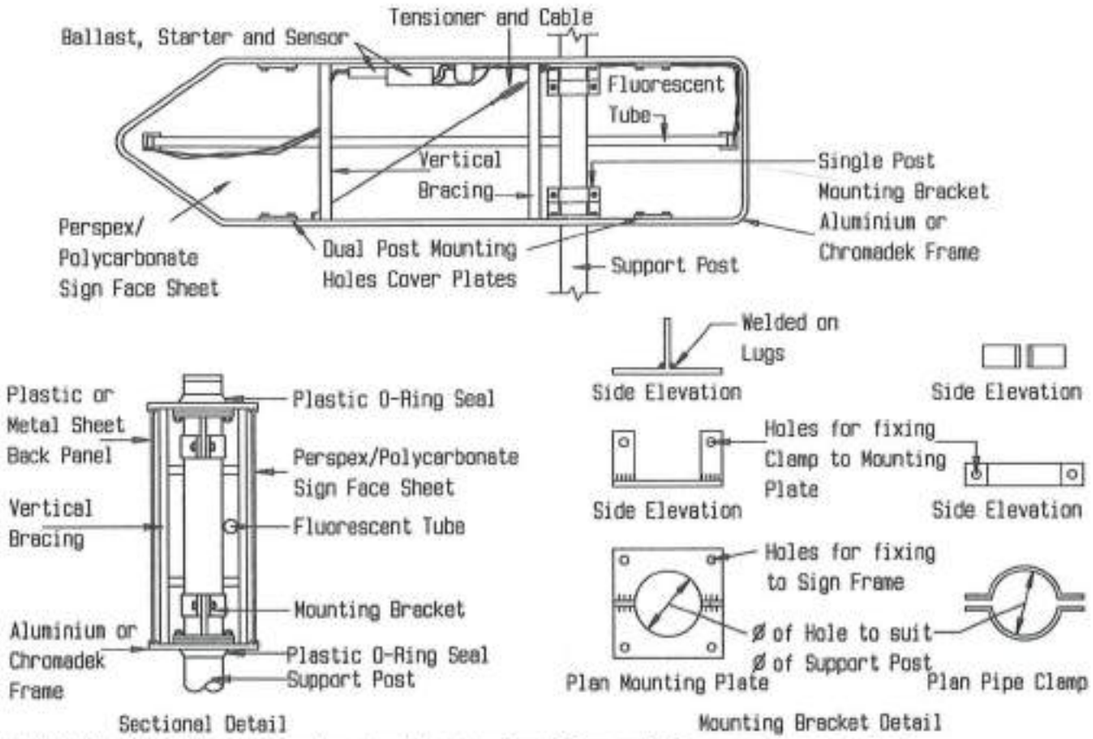
Fig 15.41
Mounting for Small or Medium Sized Signs:
Riveting, Bolting and Lugs



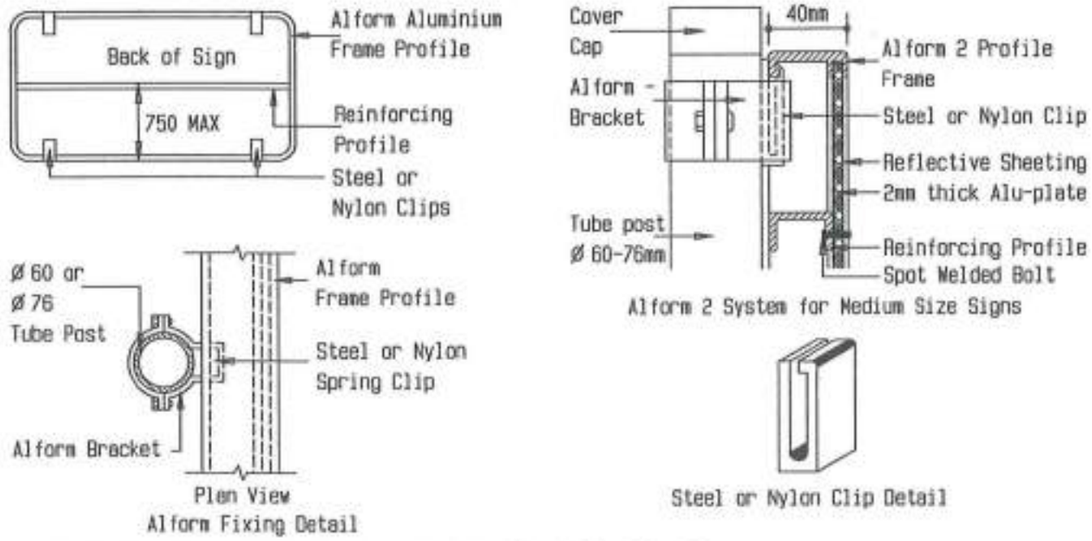
Detail 15.42.1 Mounting Brackets for fixing Signs with Channels/Rails



Detail 15.42.2 Mounting Brackets for fixing Signs with Channels/Rails



Detail 15.42.3 Internal Mounting Brackets for Boxed Signs sliding over Suppport Posts



Detail 15.42.4 German Alform 2 System for Mounting Medium Size Signs

Fig 15.42
Mounting for Small or Medium Sized Signs: Channels and Clamps

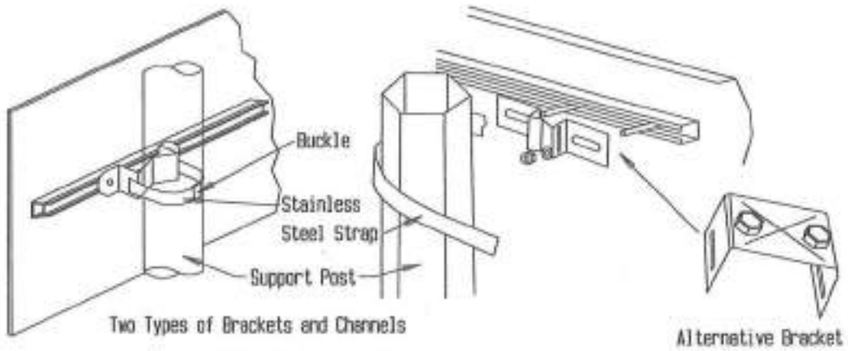
TABLE 15.22 MOUNTING BRACKETS FOR SMALL TO MEDIUM SIZED SIGNS TABLE 15.22

Mounting Type	Advantages	Disadvantages
Rivets Direct	• Quick and easy to install smaller signs • Unskilled labour, with a rivet gun and drill as tools, can install	• Only appropriate to signs < 0,36 m^2 • Vandals can easily remove or bend signs • Can only be riveted to a pipe or tube-type support • Not recommended for long term installation
Bolts Direct or through Frame	• Can bolt through any material • Quick and easy to install smaller signs • Unskilled labour, with drill and spanners as tools, can install • Most prevalent method for installing small to medium sized signs with a perimeter frame • If bolted through a frame the sign cannot be bent by vandals and is more rigid and durable	• Vandals can easily remove • Bolts must be stainless steel or galvanised against rust • If only bolted through sign sheet vandals can easily remove or bend • This method appropriate to one sided signs mostly • More labour involved if frame provided for back plate
Lugs and Bolting	• Variety of mounting options possible i.e. between posts • Double sided or boxed signs installation possible • Can bolt through any material • Quick and easy to install by unskilled labour with a drill and spanners • Rigid and durable mounting	• Lugs must be welded, bolted, riveted or glued onto sign frame or back plate if no frame • More labour involved when manufacturing sign back plate
Invisible Hardware Mounting Bracket	• Very neat installation • Fixing nuts and bolts hidden within bracket • Variety of mounting options possible i.e. single/multiple brackets • Double sided or boxed signs installation possible • Rigid and durable installation	• Only Lindapter Cavity fixing bolts, to fix to tube type supports, to be used • More labour involved when mounting sign because of more drilling and bolting than usual
Channels and Clamps	• Well known, prevalent method of mounting signs in SA • O-line channels and clamps freely available in different sizes • Variety of other types of brackets and channels also available	• Clamps, channels and bolts should be galvanised against rust • More labour involved to glue, rivet, bolt channels to back plates

TABLE 15.22 MOUNTING BRACKETS FOR SMALL TO MEDIUM SIZED SIGNS **TABLE 15.22**

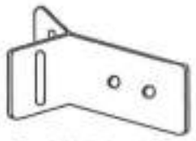
Mounting Type	Advantages	Disadvantages
	• Levelling and alignment of signs easy when mounting	
Internal Mounting Brackets	• Very neat installation	• More labour and equipment involved in manufacture and mounting
	• Ideal for boxed/internally illuminated signs	• Mounting brackets purpose made for sign and post
	• Single or dual support mounting	
	• Sign can swivel around post to point in any direction and will need locking pins or bolts to keep in position	
	• Electric cables can safely be hidden	
German Alform Spring Clip Bracket	• Neat installation	• Only appropriate to German Alform sign frame profiles or modifications thereon
	• Used all over Europe	
	• No drilling needed to mount any sized sign	
	• Unskilled labour can install easily and quickly	
Straps and Brackets	• Variety of brackets for strap mounting available	• Straps must be stainless steel
	• No drilling needed to mount signs	• Appropriate to smaller up to medium (4.5 m^2) signs only
	• Unskilled labour can install easily and quickly	
Saddle Clamps	• Bracket provide some rigidity to signs	• Older type of mounting method
		• Appropriate to smaller signs only
		• Drilling necessary
Multi Clip Retained Slats	• Ideal for wall mounted slat type signs of many sizes	• Specialised, purpose made frames , corners, slats and retainers needed for installation
	• Easy to install and maintain	• Expensive to manufacture because of all aluminium construction
	• Vandal resistant in that slats cannot be removed without special key	• Theft due to aluminium construction
Slide-in Stacked Slats	• Normally used for advertising signs or internal feature signing of buildings	• Specialised, purpose made frames, slats, retainer lugs and support posts
	• Easy to install, change and maintain	• Expensive to manufacture because of all aluminium construction
	• Neat installation	• Theft due to aluminium construction

60x40x2 Chromadek or Galvanised Strap Lugs, welded or glued on

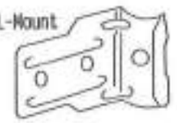


Two Types of Brackets and Channels

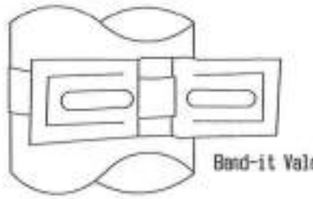
Alternative Bracket



Band-it Y-Bracket

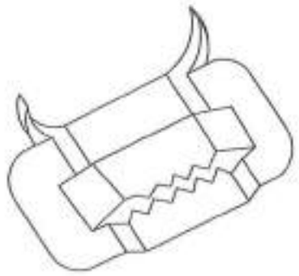


Band-it L-Mount



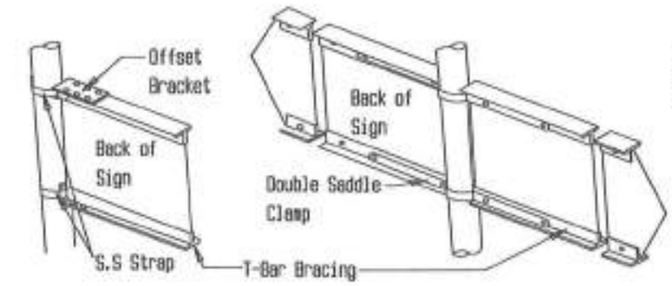
Band-it Valmount

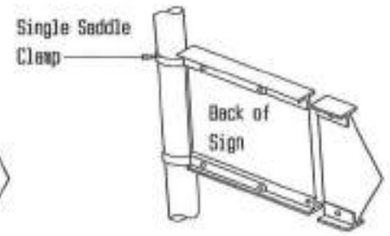
Alternative Mounting Bracket Details

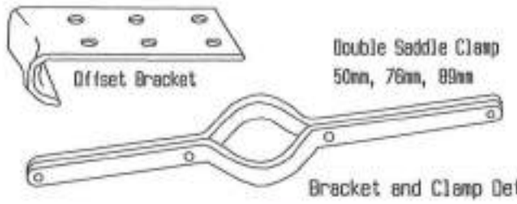


Stainless Steel Strap Buckles

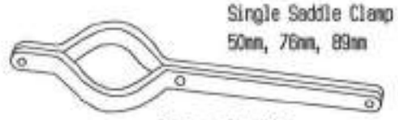
Detail 15.43.1 Strap and Lug/Bracket,Channel Mounting of Smaller Signs





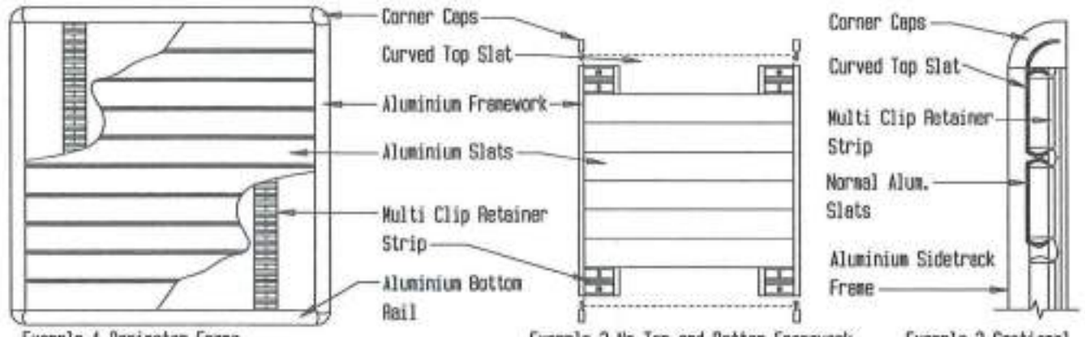


Bracket and Clamp Details



Clamp Details

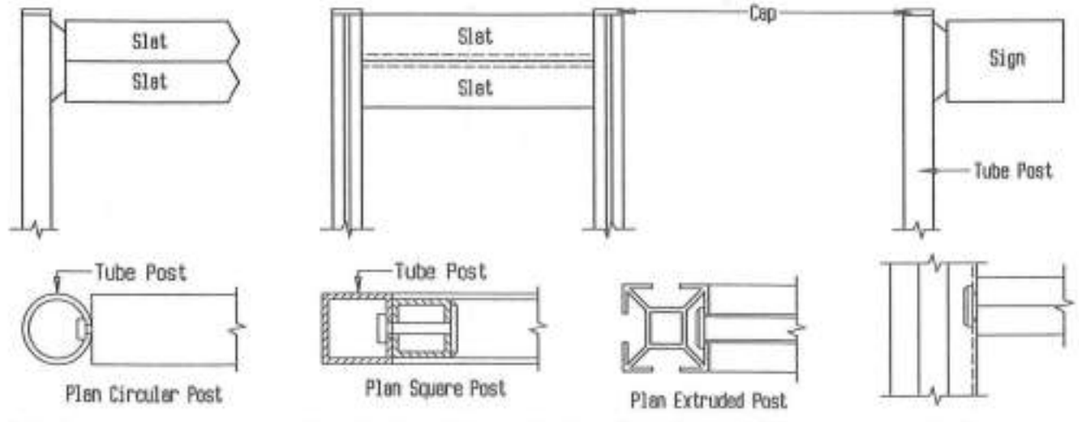
Detail 15.43.3 2Strap and Saddle Clamp Mounting of Smaller Signs



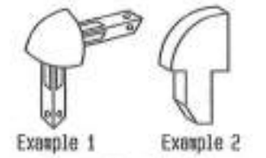
Example 1 Perimeter Frame

Example 2 No Top and Bottom Framework

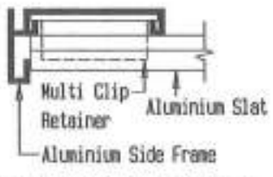
Example 2 Sectional Side Elevation



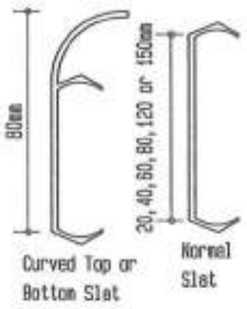
Detail 15.43.2 Bolt Retainer Mounting for Slide in Stacked Aluminium Profiled Slats (Two Sided)



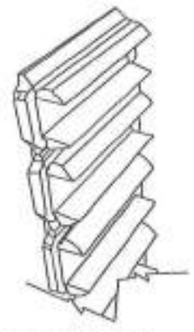
Corner Cap Details



Part Sectional Plan View



Aluminium Slat Detail



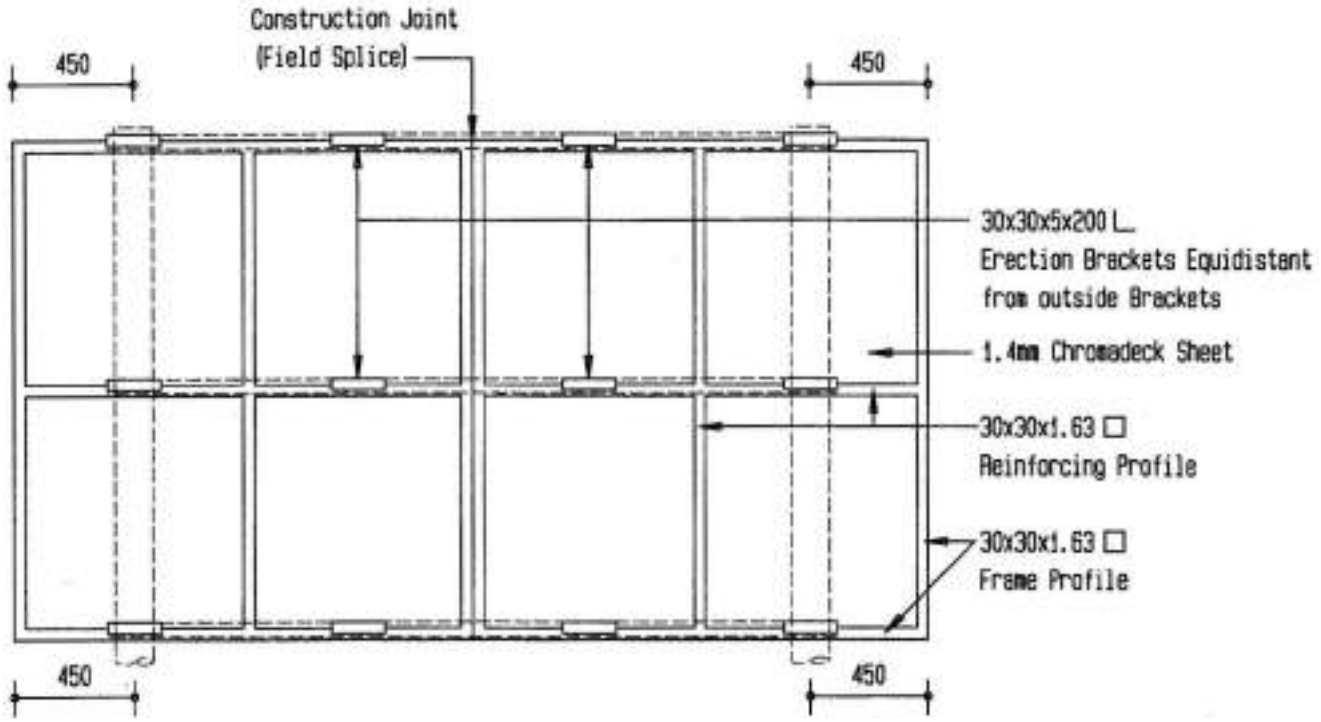
Multi Clip Retainer Detail

The Sidetrack fixing renders the sign virtually vandal-proof. The only way to remove a panel is to insert the Key into the gap below it. The key releases the panel allowing removal or replacement by authorised personnel only.

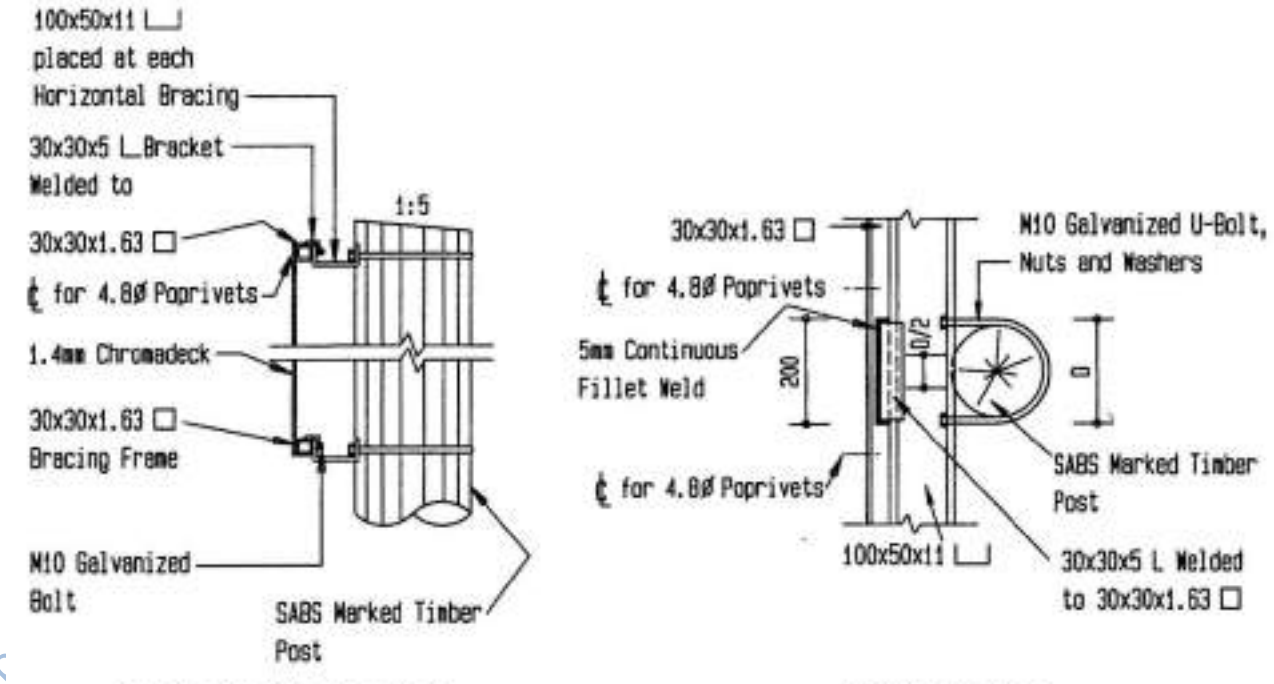
Slat Removal Key Detail

Detail 15.43.4 Clip Retainer Mounting for Stacked Aluminium Profiled Slats (Against Wall or Between Post Mounting - Single Sided)

Fig 15.43
Mounting for Small or Medium Sized Signs: Straps, Saddles, Retainer Clips or Slide In



Detail 15.44.1
Rear Elevation of Back Plate for Ground Mounting on Multiple Supports



Sectional Side Elevation

Sectional Plan

Detail 15.44.2
Fixing Details for Large Road Sign Boards to Two or More Supports

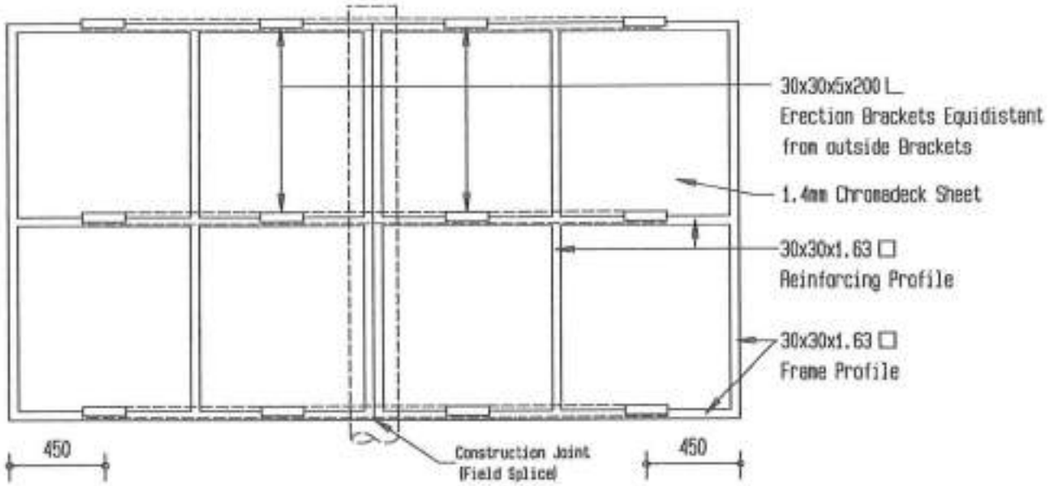
Fig 15.44 Ground Mounting of Larger Signs: Flat Sheet Chromadek Signs

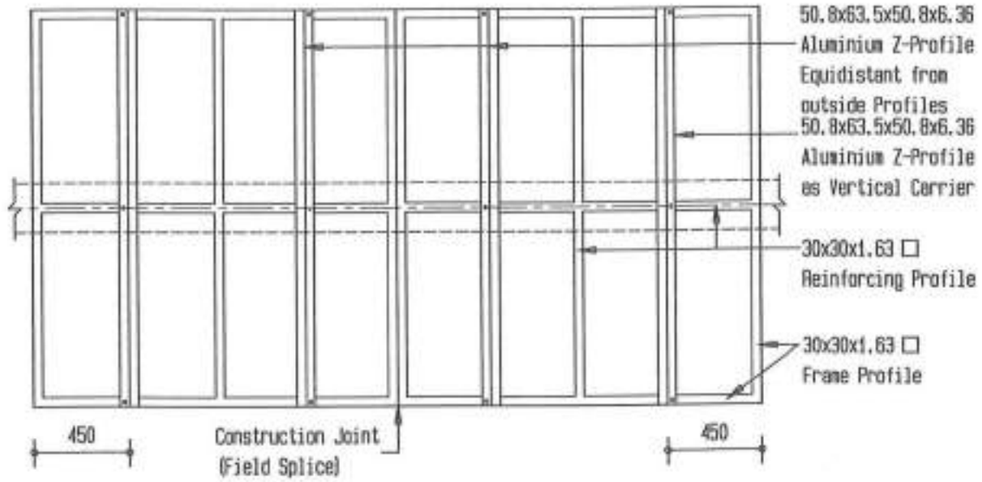
TABLE 15.23 MOUNTING BRACKETS FOR LARGER SIGNS TABLE 15.23

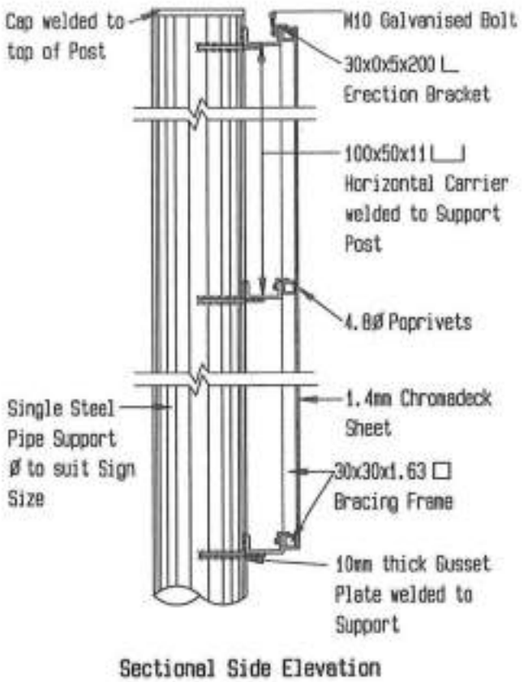
Mounting Type	Advantages	Disadvantages
Ground Mounting of Flat Sheet Chromadek Sign on Multiple Supports	• Most prevalent method in S.A. for Ground Mounted Signs • Normal mounting position for this type of sign • Welded-on erection brackets make mounting easy • Easy to mount, hang and tighten bolts	• Heavy horizontal carrier channels necessary between supports • Alignment problems with carrier channels when erecting and tightening U-bolts • Skilled labour and special equipment needed to install
Ground Mounting of Flat Sheet Chromadek Sign on Single Support	• Optional mounting position for this type of sign • Welded on erection brackets will suffice for mounting in this position • Easy to mount i.e. hang and tighten bolts • Uses same method for mounting than for multiple supports above	• Heavy horizontal carrier channels, welded to support and gusset plates, needed • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install
Overhead Mounting of Flat Sheet Chromadek Sign on Cantilever or Gantry	• Optional mounting position for this type of sign • Uses standard method for overhead mounting	• Vertical carrier Z-profiles replace erection brackets and horizontal carrier channels • More bolting and riveting than for ground mounting • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install
Ground Mounting of Stacked Chromadek Sign Profiles on Multiple Supports	• Generally used method in S.A. • Normal mounting position for this type of sign	• Lots of bolting and riveting before mounting of sign • Skilled labour and special equipment needed to instal
Ground Mounting of Stacked Chromadek Sign Profiles on Single Support	• Optional mounting position for this type of sign • Uses similar method to overhead mounting of signs	• Vertical carrier Z-profiles needed for erection • More bolting and riveting than for ground mounting • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install
Overhead Mounting of Stacked Chromadek Sign Profiles on Cantilever or Gantry	• Optional mounting position for this type of sign • Uses standard method to overhead mounting of signs	• Vertical carrier Z-profiles needed for erection • More bolting and riveting than for ground mounting • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install

TABLE 15.23 MOUNTING BRACKETS FOR LARGER SIGNS TABLE 15.23

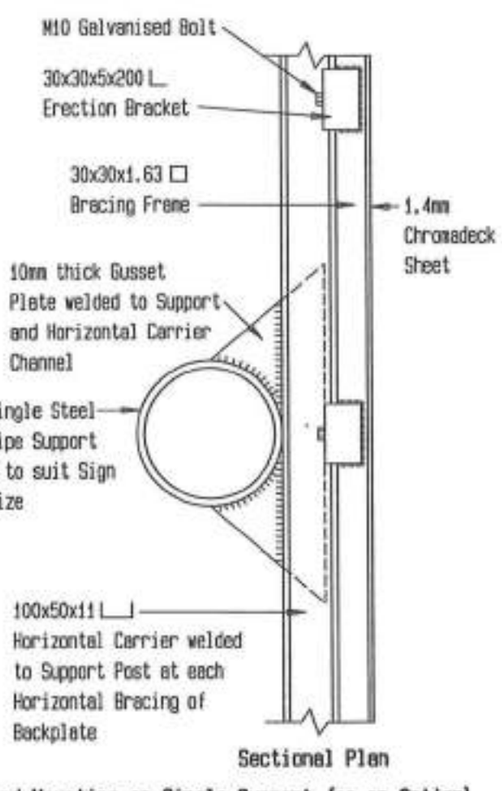
Mounting Type	Advantages	Disadvantages
Ground Mounting of Stacked Aluminium Sign Profiles on Multiple Supports	• Optional mounting position for this type of sign in S.A. • Light weight • Uses same method for ground mounting as for Chromadek profiles	• Lots of bolting and riveting before mounting sign • Skilled labour and special equipment needed to install
Ground Mounting of Stacked Aluminium Signs Profiles on Single Supports	• Optional mounting position for this type of sign in S.A. • Light weight • Uses similar method to overhead mounting of signs	• Vertical carrier Z-profiles needed for erection • More bolting and riveting than for ground mounting • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install
Overhead Mounting of Stacked Aluminium Signs Profiles on Cantilever or Gantry	• Normal mounting position for this type of sign in S.A. • Standard method for overhead mounting of signs • Light weight • Uses standard method to overhead mounting of signs	• Vertical carrier Z-profiles needed for erection • More bolting and riveting than for ground mounting • Alignment and levelling problems when installing • Skilled labour and special equipment needed to install







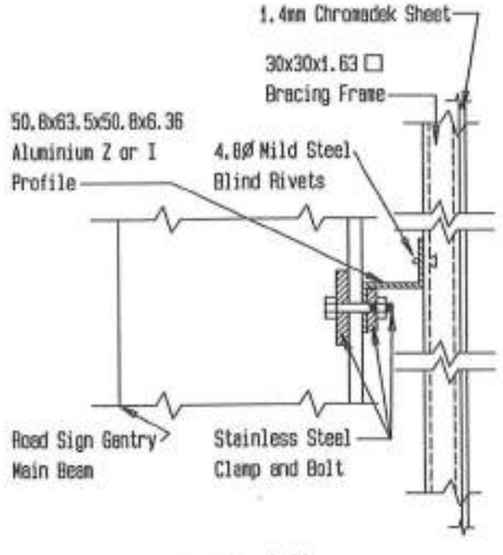
Sectional Side Elevation



Sectional Plan

Detail 15.45.1 Rear Elevation of Back Plate for Ground Mounting on Single Support (as an Option)

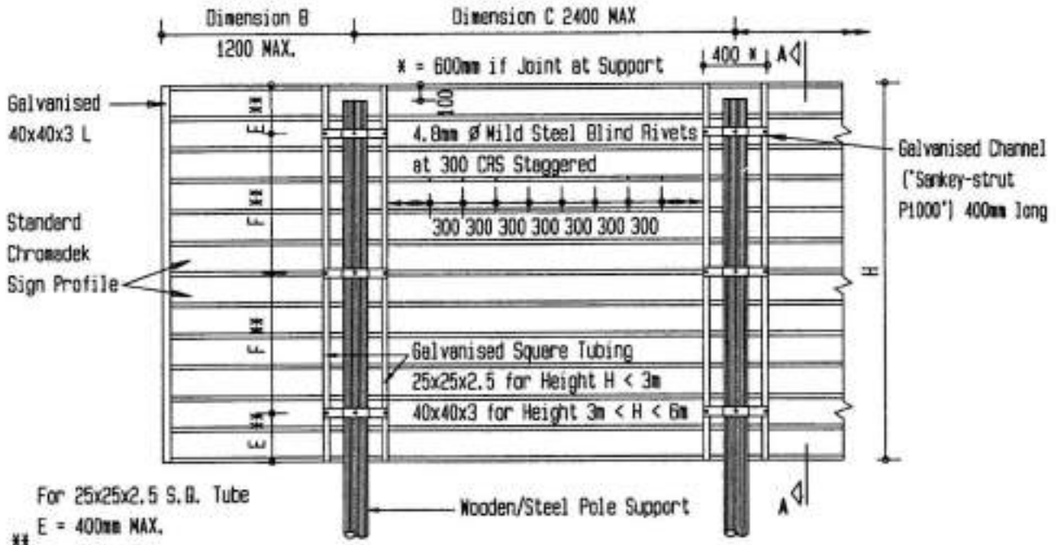
Sectional Side Elevation



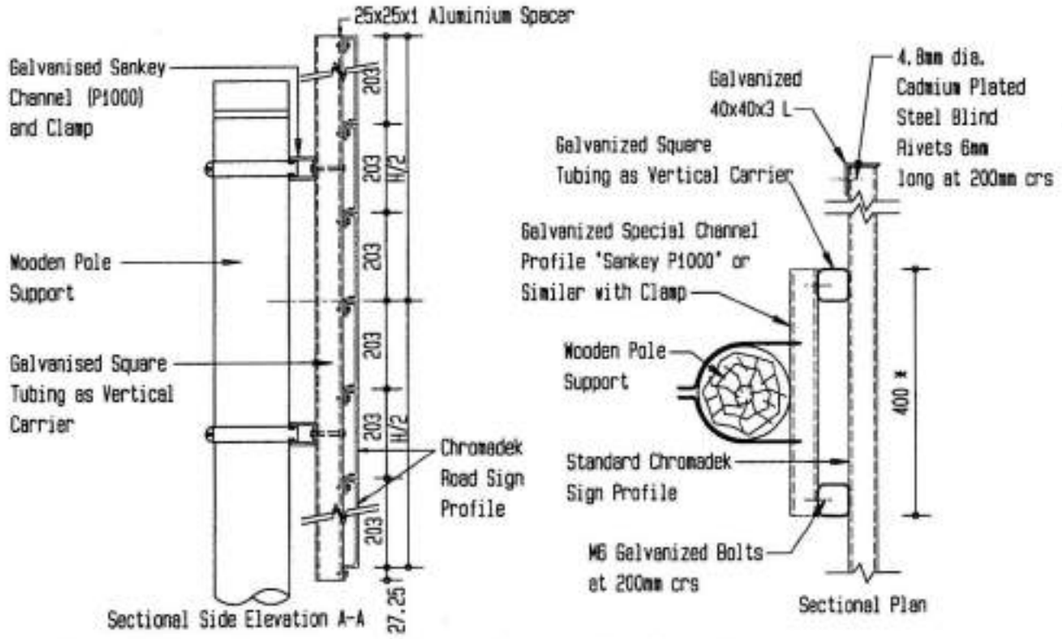
Sectional Plan

Detail 15.45.2 Rear Elevation of Back Plate for Overhead Mounting on Cantilever/Gantry (as an Option)

Fig 15.45
Mounting for Larger Signs:
Sheet Chromadek Signs

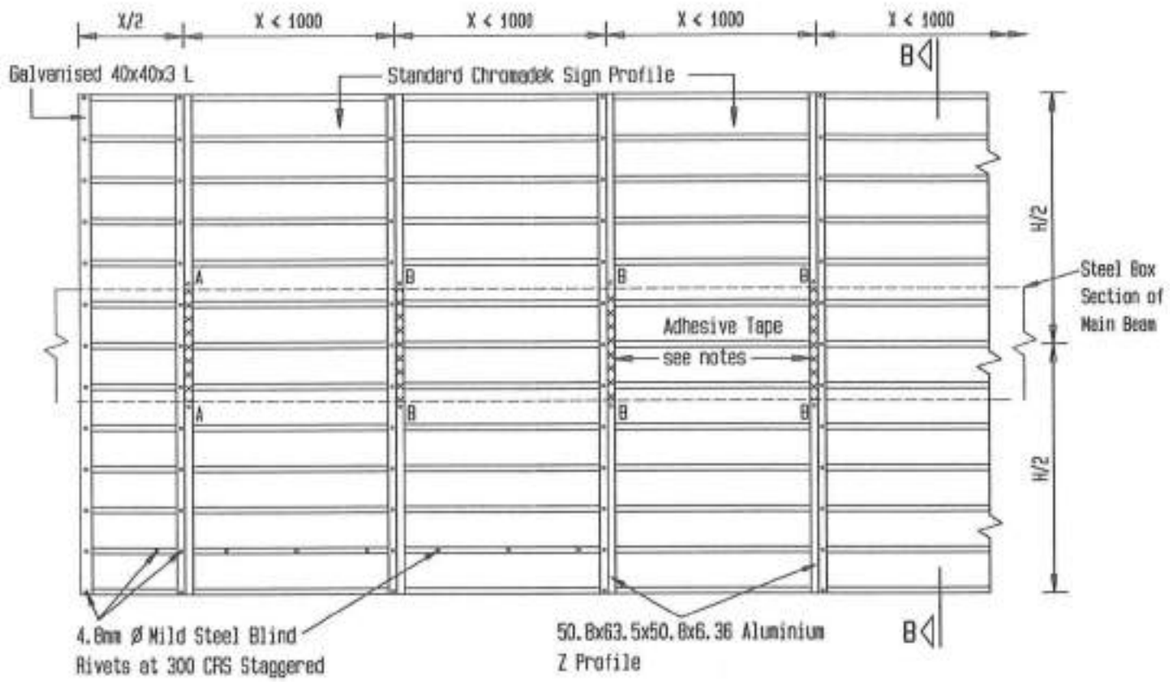


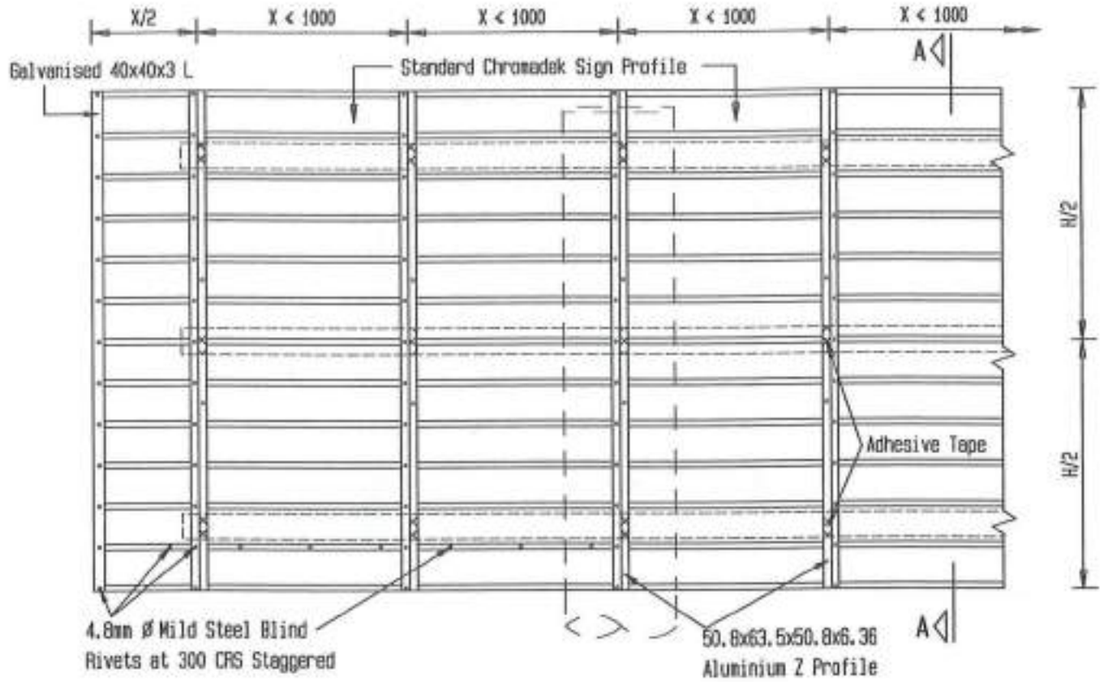
Detail 15.46.1 Rear Elevation of Back Plate for Ground Mounting on Multiple Supports

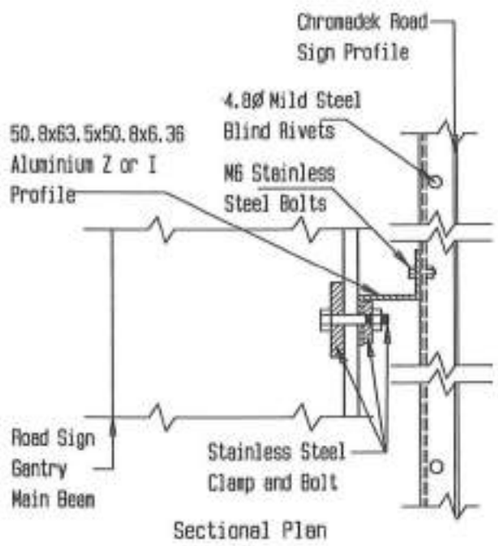


Detail 15.46.2 Fixing Details for Backplate to Two or More Supports

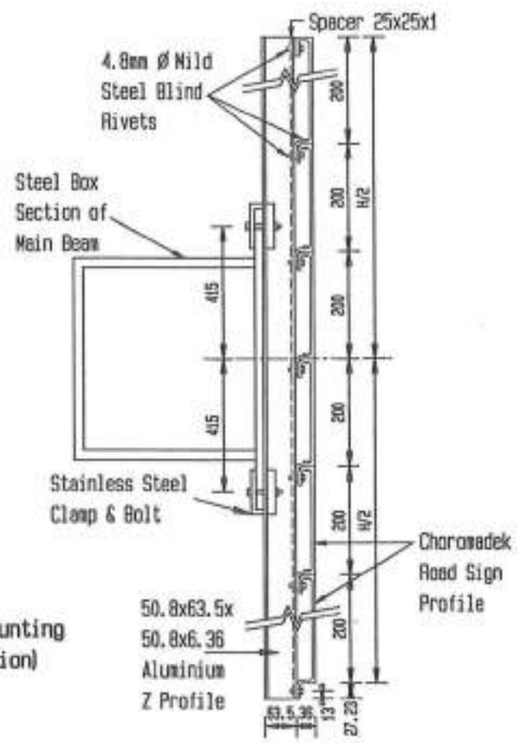
Fig 15.46 Ground Mounting of Larger Signs: Stacked Chromadek Profile Signs

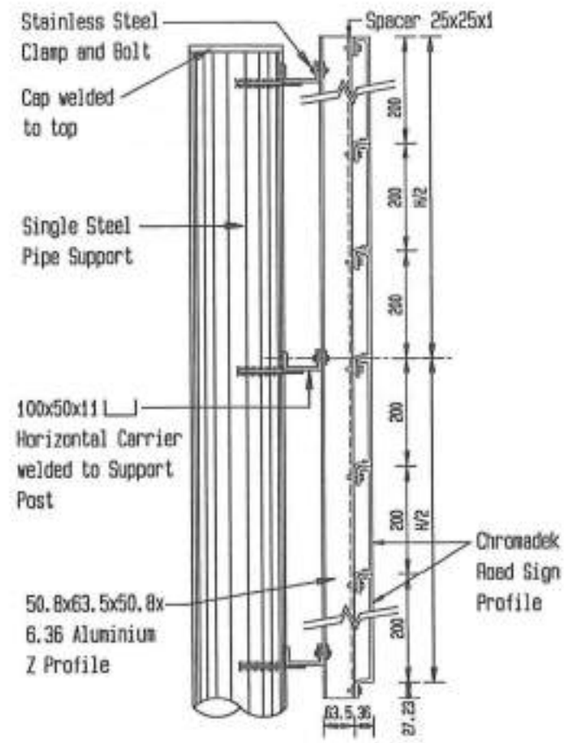


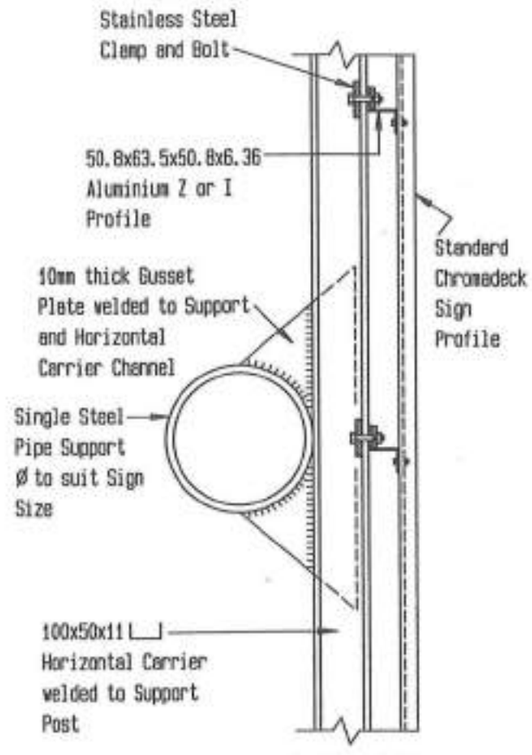




Detail 15.47.1 Rear Elevation of Back Plate for Overhead Mounting on Cantilever or Portal Structure (as an option)

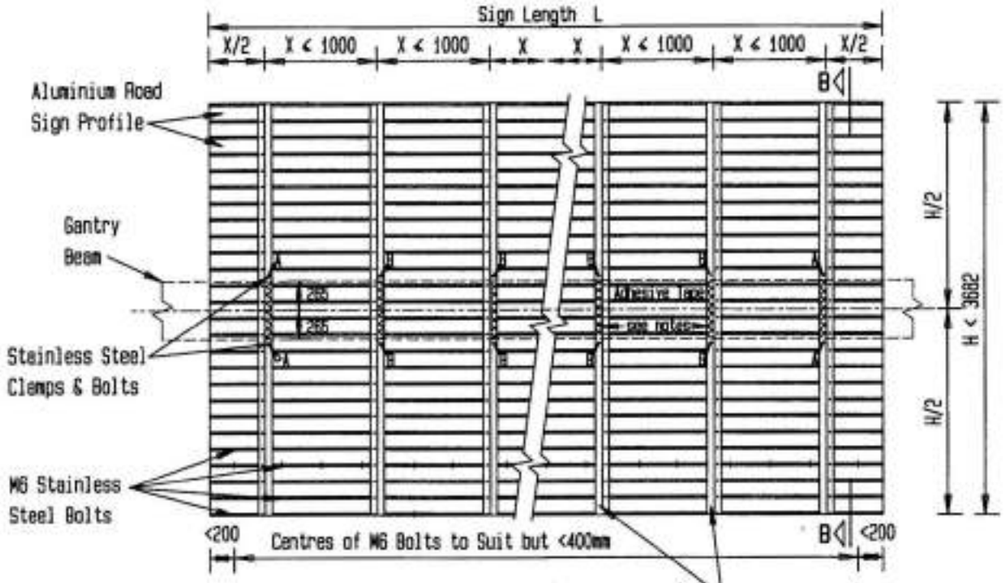




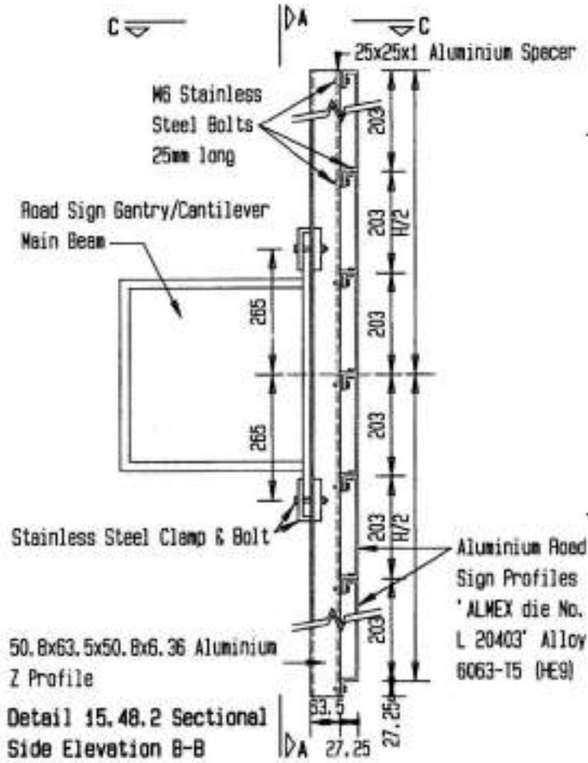


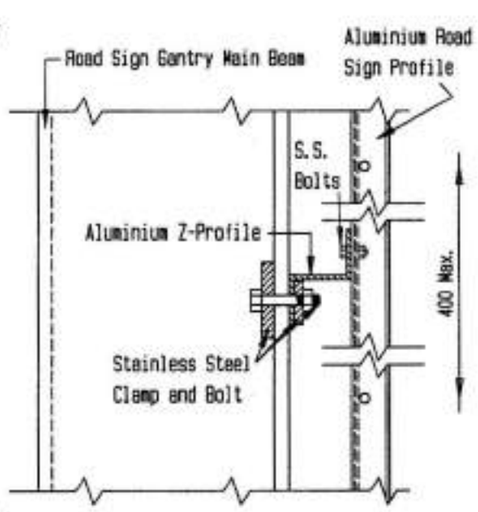
Detail 15.47.2 Rear Elevation of Back Plate for Ground Mounting on Single Post (as an option)

Fig 15.47
Mounting for Larger Signs:
Stacked Chromadek Profile Signs



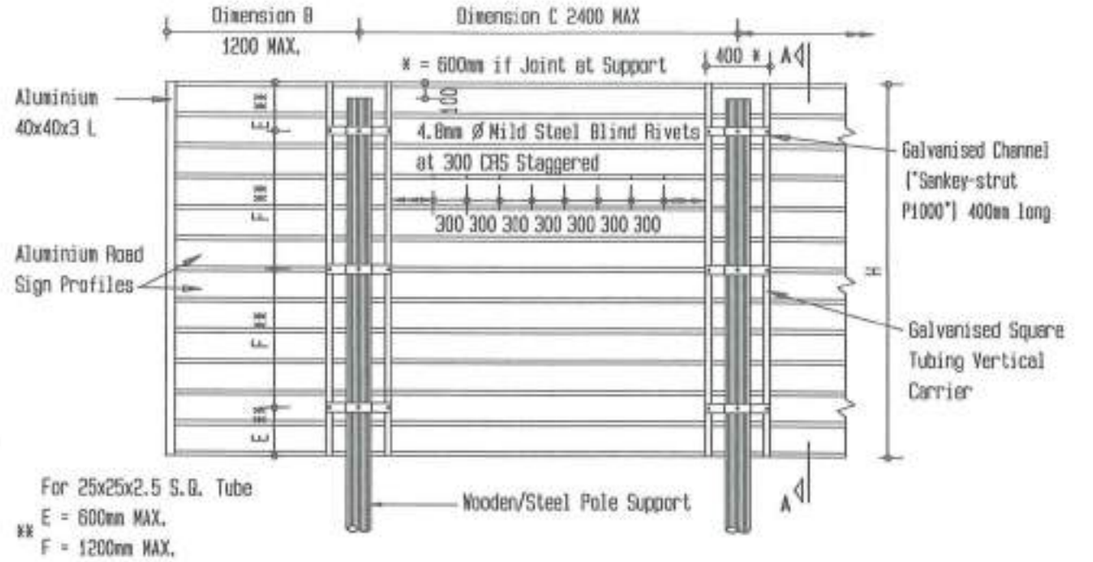
Detail 15.48.1 Rear Elevation of Back Plate for Overhead Mounting on Cantilever/Gantry Structure

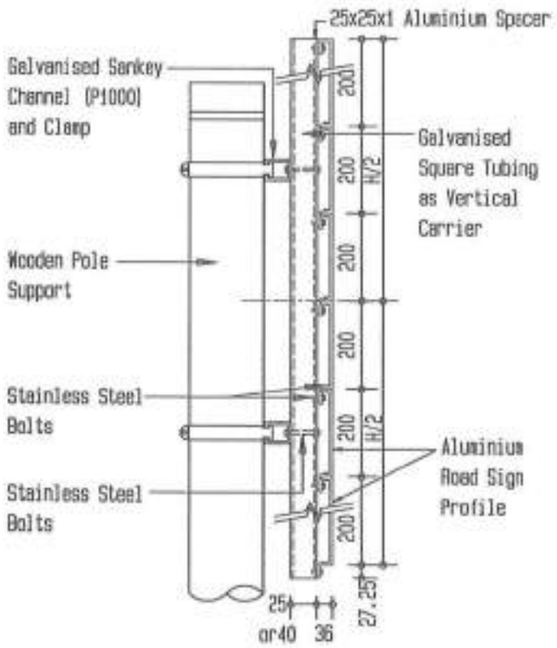




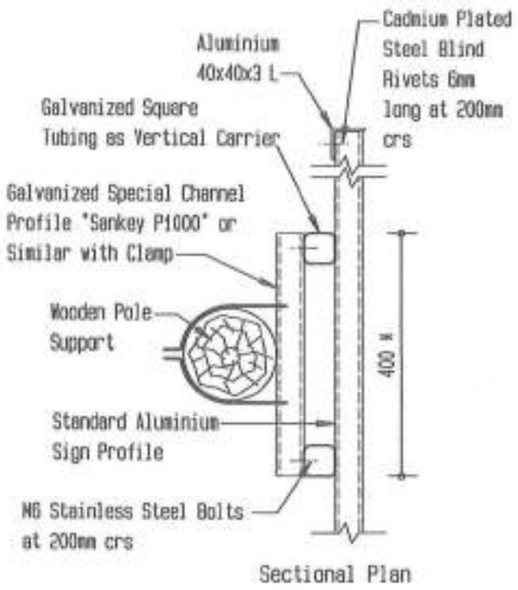
Detail 15.48.3 Part Sectional Plan C-C

Fig 15.48 Overhead Mounting of Larger Signs: Stacked Aluminium Profile Signs



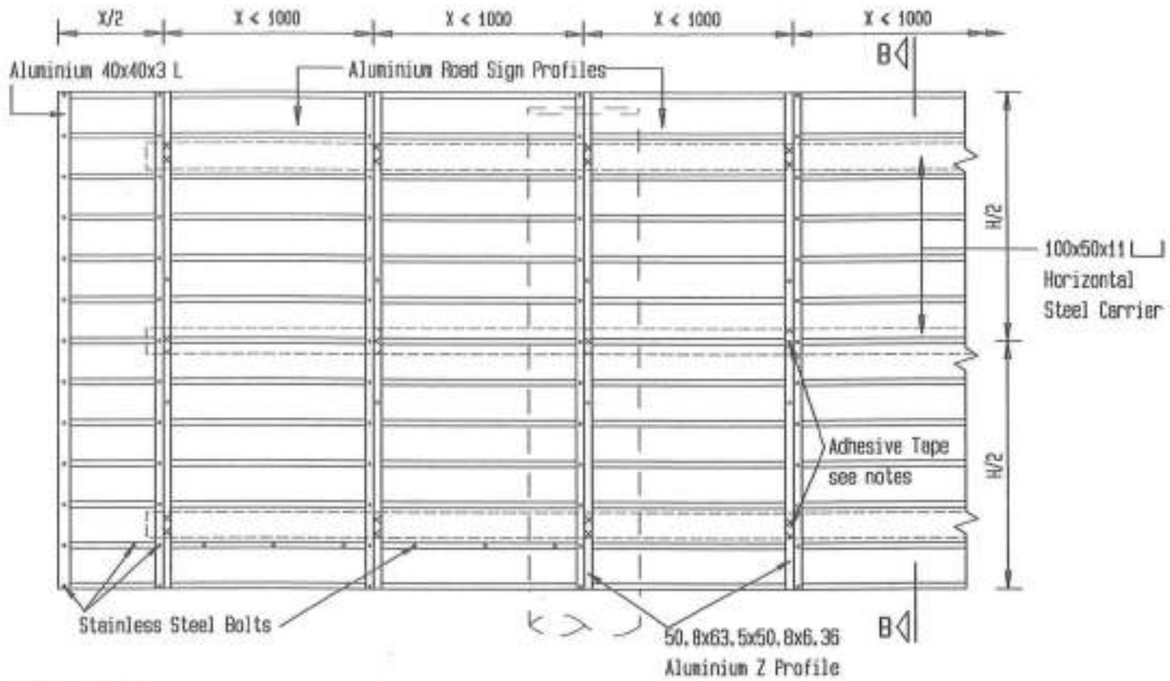


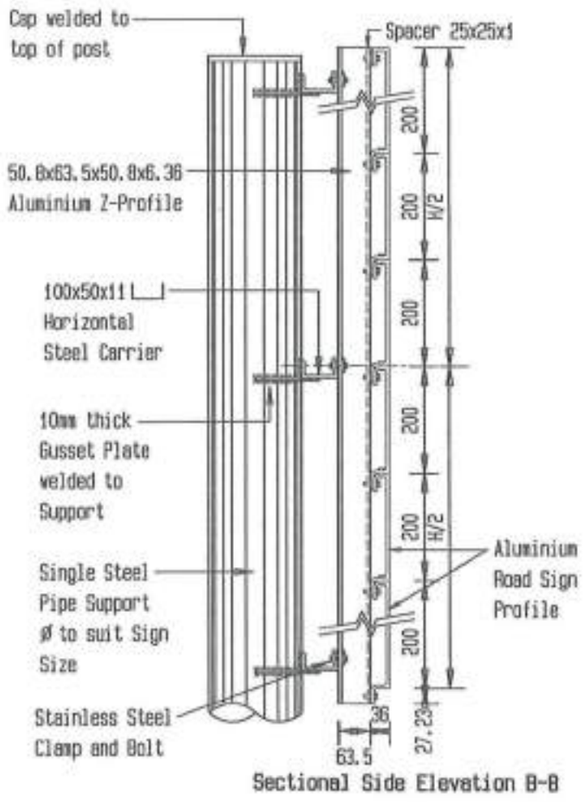
Sectional Side Elevation A-A



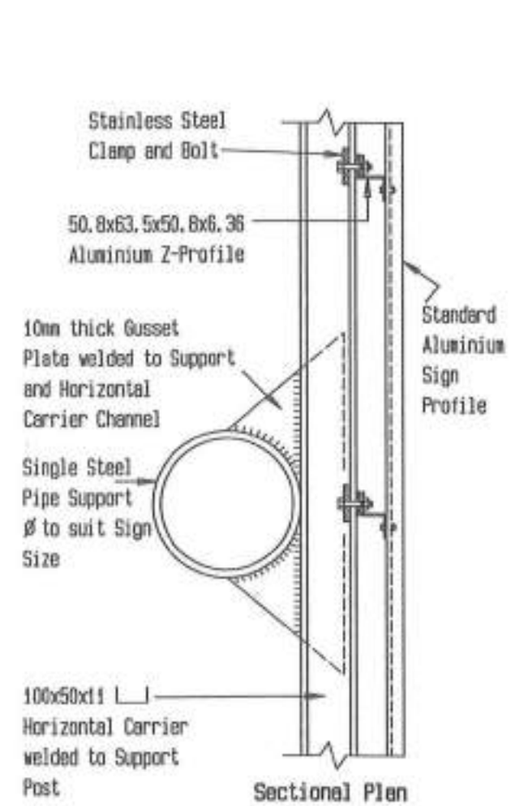
Sectional Plan

Detail 15.49.1 Rear Elevation of Back Plate for Ground Mounting on Multiple Posts (as an option)





Sectional Side Elevation B-B



Sectional Plan

Detail 15.49.2 Rear Elevation of Back Plate for Ground Mounting on Single Post (as an option)

Fig 15.49
Mounting for Larger Signs:
Stacked Aluminium Profile Signs

15.7 DESIGN AND IMPLEMENTATION - GROUND MOUNTED SIGNS

15.7.1 General

1 In general the design of Road Sign Structures has to do with the choosing of sign structural components that should be functional, flexible and economic. All their component materials should also be chosen for their compatibility with each other, and be of such quality and size that the sign complies with all the appropriate requirements of the regulations and performance levels stated for a specific environment.

2 The materials for the component parts of signs should be chosen with due regard to their advantages or disadvantages regarding the following:

(a) the costs for the initial material, manufacture, installation and maintenance;

(b) the manpower and equipment required to manufacture, install and maintain;

(c) the safety considerations regarding passive safety (frangibility) and deformability, but with crash-worthiness for continued performance after an accident;

(d) the material's resistance to various forms of vandalism;

(e) the durability or performance of the material in different weather or climate conditions, or the environment that it might be located in;

(f) the difficulty and expense required to change or modify signs or the signing system in future;

(g) a standardised system or an individual purpose made unit;

(h) compatibility of materials when different material types are to be joined or fixed together because of possible electrolytic action or differential thermal expansion that may result in failure or deterioration.

3 Section 15.2 discussed the sign location environment as to the influence that it has on the sign material and structure choices.

4 Sections 15.3-15.6 cover the choices between various types of materials, their physical properties, effective- ness and use in making up the components of a sign structure. A wide range of materials and structure examples are indicated with a list of advantages and disadvantages for each of the different components making up a sign structure. The information is not intended to dictate actions or to endorse specific products, but rather to assist those designing sign structures in determining the materials and fabrication methods to use from the many choices available. Fabrication methods and processes commonly used in the industry are presented.

5 The need for, or function of a sign, determines the signface type, its location and clearances for placement. The sign environment dictates the mounting position either overhead or ground mounting, the materials to be used, the support structure and details, the base and foundation type with regard to road user safety as well as treatment against vandalism.

6 The typical Design Procedure consists of the following actions:

(a) survey proposed sign environment;

(b) determine sign back plate type and size;

(c) determine number of supports;

(d) calculate wind load, bending moments and other loads as to effective signface area and total height above ground level;

(e) determine support structure type and sizes;

(f) is support bracing necessary ?

(g) decide on support structure frangibility method, i.e. the base breakaway means and support anchor type;

(h) determine foundation type and size applicable to soil type;

(i) decide on mounting and fastening details of the back plate.

7 The following types of ground mounted sign support structures are catered for in this section:

(a) single supports	- freestanding for signs $\leq$1.5 m^2
	- freestanding for normally multiple support signs $\geq$ 1.5 m^2
(b) multiple supports	- freestanding
	- braced

8 Five breakaway methods and three foundation types are indicated for use with the above support structures:

(a) simple fracture or bending with natural soil foundation;

(b) breakaway holes at support base with soilcrete foundation;

(c) slip base plates with soilcrete foundation;

(d) split base socket with non-reinforced mass concrete foundation;

(e) rigid fixed base plate with non-reinforced mass concrete foundation.

9 The following back plate, bracing and mounting details are included:

(a) back plates $\leq$ 1,5m^2 with no frames, and five mounting methods;

(b) back plates $\leq$ 1,5m^2, with frames, and five mounting methods;

(c) back plates $\geq$ 1,5m^2, flat sheet chromadek signs, with three mounting options;

(d) back plates $\geq$ 1,5m^2, stacked chromadek profile signs, with three mounting options;

(e) back plates $\geq$ 1,5m^2, stacked aluminium profile signs, with three mounting options.

10 For each type of structure complete sets of drawings and notes have been prepared which cover:

(a) minimum clearances;

(b) design;

(c) detail drawings.

15.7.2 Clearances

1 The minimum lateral and vertical clearances for different road and sign types are indicated in Figure 15.50. This figure also indicates some of the considerations for longitudinal positioning of signs.

2 It must be noted that the clearances indicated in Figure 15.50 are minimum clearances. For preferred and maximum clearances, specific to sign types and road types, designers should refer to Subsections 15.2.6 to 15.2.8 and Figures 15.10 to 15.20.

3 In general the vertical clearance, shoulder breakpoint to underside of sign, parameters are:

(a) normal height = 2 100 mm;

(b) clearance allowing for pedestrians passing under sign = 2 500 mm;

(c) clearance inhibiting vandalism= 3 000 mm;

(d) the recommended maximum top of sign back plate height above shoulder breakpoint = 6 000 mm.

4 Lateral clearances are specific to road cross-section types, sign support structure frangibility types and also to allow for vandalism. The sign's function will also influence its lateral positioning. Figure 15.50 indicates the lateral minimum clearances as well as three minimum clearance profiles for quick reference. The minimum clearance profile is the absolute minimum and no structure/tree/cable or sign should infringe this clearance.

15.7.3 Design

1 The structures must be designed in accordance with the provisions of the National Building Regulations with particular reference to the latest version of the following SABS Design Codes:

(a) SANS 0160: The General Procedures and Loading to be adopted in the Design of Buildings
(b) SANS 0162: Code of Practice for the Structural Use of Steel
(c) SANS 0100: Code of Practice for the Structural Use of Concrete
(d) SANS 0163: Code of Practice for the Design of Timber Structures

2 The structures must be designed for the following loads:

(a) mass of the structure and sign;

(b) the appropriate wind loads as specified in SANS 0160. The standard design methods and design charts are based on a wind loading of 0,75 kN/m^2 acting on the vertical surfaces of signs and structures with a total height of 6 m and less. The derivation of the wind load is covered in Section 15.2.7. Also included in Section 15.2.7 is the calculation of the wind forces in accordance with the latest edition of SANS 0160 for 40 m/sec and 45 m/sec winds, with wind load coefficients indicated in Table 15.7;

(c) a horizontal collision load equivalent to static load of 100 kNm acting 1,2 m above the base plate.

3 In order to be deemed acceptable, posts should thus comply with the following requirements:

(a) the post should sustain a moment of 1,05 A (i.e.1,05 x the theoretical moment of resistance) at its critical section (usually the connection to the base plate or the frangible joint) with:

(i) failure at the joint, or

(ii) deflection at the point of application of the impact load exceeding 0,05h, where "h" is the height of the point of application above the plane of the bottom of the base plate, measured in millimetres.

4 Sign supports erected close to the travelled roadway without guardrails should be of a yielding or breakaway construction in order to reduce vehicle damage and injury to occupants in the event of vehicles colliding with them. The basic concept of a breakaway sign support is that of a structure which possesses sufficient moment of resistance to withstand wind loads, yet offers low shear resistance at the base to a colliding vehicle. In the event of a collision the structure should yield or break away. Failure should occur in such a way that:

(a) serious secondary collision of the sign or support with the vehicle is avoided;

(b) energy absorbed from the impacting vehicle is kept to a minimum (a maximum reduction of 17 km/h in the speed of the impacting vehicle is considered acceptable), and damage to the vehicle is low.

5 The treatment of supports with various frangible base methods basically has two breakaway results namely:

(a) allowing the vehicle to pass over the sign and structure, normally used for single support signs;

(b) allowing the vehicle to pass under the sign, usually used for multiple supported signs.

These results are indicated in Figure 15.18.

6 Because there is no breakaway allowance for supports with rigid, fixed base plates, normally used on support structures for the mounting of larger signs, these supports should be located at least 4 m - 4,5 m from the edge of the road if no kerbing or guardrails are provided. These support structures are a hazard to vehicles, and should be safeguarded by guardrails if they are located nearer to the edge of road than the minimum distance allowed for the road cross sectional type.

7 The design loads must be combined in accordance with paragraph 4.4.2 of SANS 0160 in accordance with the limit states design codes. When a wind load and collision load act simultaneously on the support, 25% over-stresses are accepted. The allowable stresses for various materials shall be in accordance with SABS or BSS specifications.

8 Allowable deflections for freestanding single support structures are:

(a) the horizontal displacement of the end of the sign is limited to 1/75th of the length/width of the sign back plate;

(b) the horizontal displacement of the support junction is limited to 1/100th of the support height.

9 Allowable deflections for Multiple Support Structures are:

(a) the vertical deflection of the sign back plate must be compensated for by fabricating the carrier member with a

continuous camber to a value approximately twice the deflection under mass loads only;

(b) the horizontal deflection of the sign back plate is limited to 1/200th of the span;

(c) the horizontal deflection of the supports measured at the support and sign junction is limited to 1/100th of the support height under wind loading only. The horizontal deflection as a result of frame action under mass loads is limited to 1/350th of the support height.

15.7.4 Analysis and Design Charts

1 The design graphs which are included as Figures 15.53 and 15.55 provide design solutions to a wide range of structures, support heights and sign areas to be supported on the structures.

2 Although the wind loadings do not influence signs with a total height of less than 6 m to the same degree as for overhead mounted signs, at a total height between 6 m -10m, the graphs are necessarily arbitrary in terms of the wind loadings and allowance are not made for varying wind speeds, height above sea level and shielding factors depending on terrain category for signs less than 6 m in height. It should be noted that the designs procedure and charts have most probably been based on a "permissible stress" design code while the current code is based on a "limit states" method. Allowance is not made for the use of different grades of structural steel. These factors can affect the design and economy of the structure significantly. A rigorous purpose made design where the above factors can be properly assessed is therefore recommended. The methodology of the design charts, and the range and limit of the structures which can be designed by using the charts, are nevertheless given below.

3 The charts have been prepared for the design of single and multiple supported sign structures described in Subsection 15.7.5. The charts are based on the use of standard steel tube sections and timber poles.

4 The variables accommodated by the charts are:

(a) number of supports;

(b) support total height above ground level;

(c) area of sign face;

(d) foundation size.

5 The following information for the fabrication of the structure are obtained from the design charts Figures 15.53 and 15.55 (examples of use of the charts are illustrated):

(a) the size and number of supports required;

(b) the minimum sign height required to prevent aerodynamic oscillation;

(c) the wall thickness, diameter and mass/lineal meter of the steel tube or timber supports;

(d) the plate thickness and mass of the base plate and gusset plates;

(e) the diameter of the anchor bolts and mass of the anchor bolts groups;

(f) the minimum foundation, diameter/length and width, and height that could possibly be used, the maximum bearing pressure developed and the support anchor required in the actual foundation used.

15.7.5 Range and Limits of Standard Designs

1 The following ranges and limits are covered in the Figures 15.51 to 15.53 for freestanding single support sign structures:

(a) area of road sign face varying between 0,5 m^2 and 10,5 m^2, with the sign back plate positioned either equally or up to one third/two thirds its width over the support, and maximum sign width $\leq$3,5 m;

(b) support total height/length above GL up to 6 m maximum to cover most conditions encountered where:

(i) maximum height/depth of sign back plate 3,0 m;

(ii) fill slope is 1:3 or flatter;

(iii) cut slope does not exceed 1:1;

(iv) allowance for space restricted areas i.e. pedestrians, and vandalism.

(c) six support base frangibility methods are included:

(i) simple fracture or bending at base;

(ii) drilled breakaway holes;

(iii) sleeve or threaded pipe coupling breakaway;

(iv) inclined or horizontal slip base plates;

(v) split base sockets;

(vi) fixed, rigid base plates.

(d) three standard foundations with plinth top heights varying from 50 mm above GL, at GL and 150 mm below GL are indicated for two soil types being sand or soft clay and medium hard ground, for any of the following footings:

(i) driven in or buried support end in natural soil;

(ii) support end or support base plate stub post set in soilcrete;

(iii) support base plate stub post or hooked anchor bolts set in non-reinforced mass concrete.

2 The following ranges and limits are covered in Figures15.54 and 15.55 for freestanding and braced multiple support sign structures:

(a) area of road sign face varying between 1 m^2 and 26 m^2, with the sign back plate positioned, equally divided, over freestanding or braced multiple sup- ports, and minimum sign width >1,2 m to a maximum 6 m;

(b) support total height/length above GL up to 10 m maximum to cover most conditions encountered where:

(i) maximum height/depth of sign back plate < 1,2 m, support total length above GL < 3,5m, for freestanding multiple supports;

(ii) minimum height/depth of sign back plate ≥ 1,2 m, support total length above GL ≥ 3,5m up to 10 m, for diagonally braced multiple supports;

(iii) fill slope is 1:3 or flatter;

(iv) cut slope does not exceed 1:1;

(v) allowance for special clearance for pedestrians or vandalism.

(c) drilled breakaway holes included as support base frangibility method;

(d) one standard foundation with plinth top at GL are indicated for two soil types being sand or soft clay and medium hard ground for support ends set in soilcrete foundations as follows:

(i) 0,9 m to 1,5 m buried support end, for support length above GL from 3 m to 10 m, set in soilcrete foundation of diameter 0,9 m for sand or soft clay and 0,6 m for medium hard ground.

15.7.6 Structural Timber or Steelwork

1 Wooden or timber posts should be of moisture, fire and termite resistant exterior grade, complying with the requirements of SANS 457 and SANS marked. They should be creosote impregnated in accordance with SANS 05, with creosote complying with the requirements of SANS 538 or SANS 539 or the poles should be treated with a mixture of copper-chromium-arsenic compounds complying with the requirements of Type II of SANS 673 (Hicksons Tanalith C or equal). Hard pinewood poles are preferred because of their fracture properties, and suitability for post peeling and preservative treatment. All cuts and breakaway holes should be treated and support tops should be banded as per SANS 457.

2 Standard diameter timber poles commonly specified are the following (measured as pole top diameters):

(a) freestanding single supports – Φ 76 mm up to Φ 175 mm;

(b) freestanding or braced multiple supports - Φ 100 mm up to Φ 175 mm.

3 Steel supports complying with the requirements for Grade 43C of BS 4360, of outside diameter at least 50 mm and a, wall thickness of at least 3,5 mm, and hot-dip galvanized in accordance with the requirements of SANS 763, or painted/powder coated in accordance with the requirements of CKS 193. Cross sectional profiles in steel could be any of the pipes, tubes and rolled or extruded profiles. Welding of steel work should be carried out in terms of the standards pre- scribed in B S1856, B S693 or B SS938, whichever is applicable. Steel tubular structures fabricated by welding, which are to be painted, shall have sealed joints for members inaccessible for inside painting after fabrication. All steel tubes to be SANS marked.

4 Standard pipe sections and sizes commonly specified are the following:

(a) freestanding single supports - Φ 50 mm x 2 mm wall thickness up to Φ 165 mm x 14 mm wall thickness;

(b) freestanding or braced multiple supports- Φ 60 mm x 2 mm wall thickness up to Φ 114 mm x 3,5 mm wall thickness.

5 A consideration when choosing support materials is the breakaway method (as indicated in Sections 15.7.5 and 15.7.7) to be used for signs placed in locations where there is the risk of vehicle impact i.e. the posts of the structure should be of frangible construction. There are various methods of achieving frangibility for instance the use of breakaway holes drilled in the supports at their bases or the use of base plates. In the case of parts with base plates, usually steel or aluminium supports, the base plates should be made from a material similar to that from which the posts are made, and the base plate should be protected against corrosion by the same method as that applied to the parent posts. The quality of the finish of the base plate should be such that it complies with the appropriate requirements specified for the parent post.

15.7.7 Foundations

1 The Foundations consisting of blocks or cylinders of soilcrete or concrete are designed to support the loads to which the structural frames are subjected, including collision loads. The factors of safety for overturning of foundations are:

(a) 2,0 when subjected to wind loads only;

(b) 1,5 when subjected to wind and collision loads.

2 Design details are available for a number of standard footings. The footings are:

(a) freestanding single support sign structures - three standard cylindrical or block foundations with plinth top heights varying from 50 mm above GL, at GL and 150 mm below GL are indicated for two soil types being sand or soft clay and medium hard ground for any of the following footings:

(i) driven in or buried support end in natural soil;

(ii) support end or support base plate stub post set in soilcrete cylinders;

(iii) support base plate stub post or hooked anchor bolts set in non-reinforced mass concrete blocks.

(b) freestanding or braced multiple support sign structures - one standard cylindrical foundation type with plinth top at GL are indicated for two soil types, being sand or soft clay and medium hard ground, for support ends set in non-reinforced soilcrete foundations as follows:

(i) 0,9 m to 1,5 m buried support end, for support length above GL from 3 m to 10 m, set in soilcrete foundation of diameter 0,9 m for sand or soft clay and 0,6 m for medium hard ground.

15.7.8 Anchor Bolts

1 Details for two types of standard anchor bolts are available:

(a) Type A - hooked holding down anchor bolts in the foundation;

(b) Type B - special bolts for bolting together slip base plates and split base sockets

2 Grade 4.8 steel is specified for the hooked anchor bolts and nuts in preference to a higher grade steel (i.e. grade 8.8) for the following reasons:

(a) welding during manufacture and construction can be tolerated on grade 4.8 steel;

(b) the error is not as serious if an anchor bolt group of lower strength, (e.g. grade 4.6) is erroneously supplied and installed.

3 A template is specified to be locked in position with each hooked anchor bolt group supplied resulting in the following advantages:

(a) it will ensure that the anchor bolt group is not mis-aligned during transportation to the site;

(b) it will ensure that the centres of the anchor bolt group match the centres of the holes in the base plate.

4 Special bolts that will break apart under an impact load of ≥100 kN are specified for bolting together slip base plates and split base sockets.

15.7.9 Road Sign Back Plates

1 Structural details given on these drawings are applicable only for sign back plates having a height not exceeding 3,6 m. For details related to the text, symbols and legend, reference should be made to the relevant road sign working drawings.

2 All sheets or profiles are standard, made from pre-pained galvanised mild steel substrate (CHROMADEK or equal approved), presently available from manufacturers referred to. Preparation and painting shall be carried out in accordance with CKS 193-1977 and the paint system shall be as follows, as indicated on the drawings or directed by the Engineer:

(a) Type A back plate (all cases other than Type B below) - Silicone polyester system having a nominal 20 micron dry film thickness on the front face and a standard half-coat polyester as a backing coat; where the sign is to be covered with retrore- flective material, the front face may be finished with a primer coat (CHROMAPREP or equal);

(b) Type B back plate (signfaces to be erected in marine or chemically polluted corrosive environments) - PVC plastisol system having a 150 micron min. dry film thickness on each side of the sheet; the coat on the back face of the sign profile shall be grey in colour, G29 to SANS 1091 or similar.

3 Structural steel sections shall be of mild steel conforming to the requirements of Section 7100 of the standard specifications. Rectangular hollow sections and spe- cial channel profiles may be cold formed or commercial quality mild steel. All steel sections shall be hot-dip galvanized in accordance with clause 7105 (1) of the standard specifications after manufacture. Bolts, washers and nuts shall be as follows:

(a) Type A back plate: Galvanized steel bolts complying with the requirements of clause 5602 (b) of the standard specifications;

(b) Type B back plate: Stainless steel bolts grade 304 manufactured to SANS 136;

(c) nuts for both type A and B back plate shall be self locking "Nyloc" or equal approved;

(d) blind rivets shall be 4,8 mm Φ cadmium plated mild steel.

4 All aluminium sections and profiles used are standard profiles presently available from the manufacturers referred to. Stainless steel bolts and washers with "Nyloc" self-locking nuts or similar are specified and no insulation need be provided where these bolts are in contact with the aluminium members.

5 Corrosive resistant brackets and bolts are used to secure the sign face to the structure and in order to ensure proper alignment and securing of the sign face an erection procedure is specified.

6 As in the case of the other detail drawings, a table is provided where the length and height of each separate sign face is to be reflected without adding and/or alter- ing any figures on the actual details.

15.7.10 Detail Drawings

1 A set of detail drawings have been prepared for the two types of ground mounted sign structures as follows:

(a) minimum clearance Fig 15.50;

(b) detail drawings:

- Freestanding Single Support, Base and Foundation
  - ❖ for signs ≤ 1,5 m^2 Fig 15.51
  - ❖ for signs ≥ 1,5 m^2 Fig 15.52
  - ❖ design graphs Fig 15.53
- Multiple Support, Base and Foundation
  - ❖ freestanding supports Fig 15.54
  - ❖ braced supports Fig 15.54
  - ❖ design graphs Fig 15.55
- Back Plates and Mounting Details for Signs ≤ 1,5 m^2
  - ❖ with no frames Fig 15.56
  - ❖ with frames Fig 15.57
- Back Plates and Bracing Details for Signs ≥ 1,5 m^2
  - ❖ flat sheet chromadek signs Fig 15.58
  - ❖ stacked chromadek profiles Fig 15.60
  - ❖ stacked aluminium profiles Fig 15.62
- Mounting Details and Options for Signs ≥ 1,5 m^2
  - ❖ flat sheet chromadek signs Fig 15.59
  - ❖ stacked chromadek profiles Fig 15.61
  - ❖ stacked aluminium profiles Fig 15.63

2 Detail drawings for other types of ground mounted sign support structures for example ladder multiple supports with shearing base plates and hinged multiple supports with slip bases, may be added subject to demand.

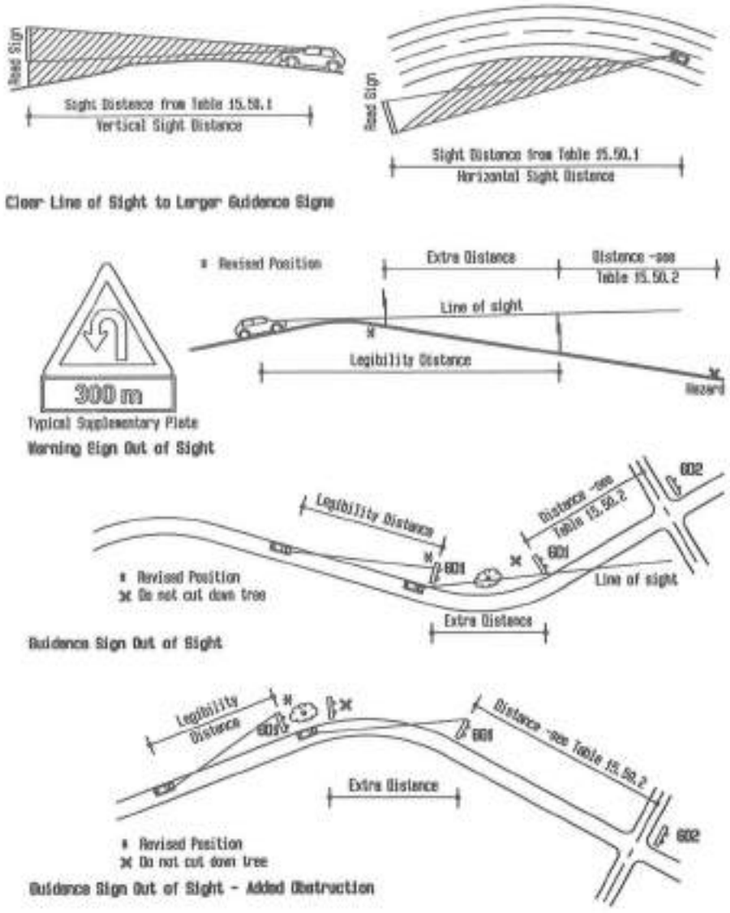
TABLE 15.50.1

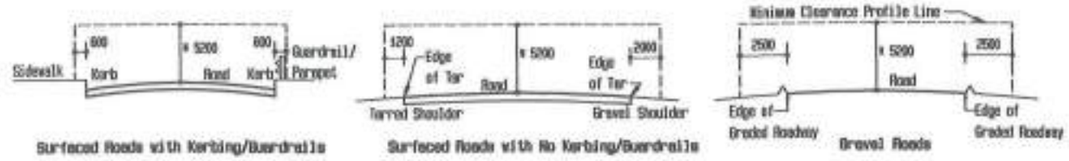
CLEAR SIGHT DISTANCE REQUIREMENTS	
Letter Size (mm)	Sight Distance (m)
490	380
420	340
350	300
280	260
210	220
140	180
112	160

TABLE 15.50.2

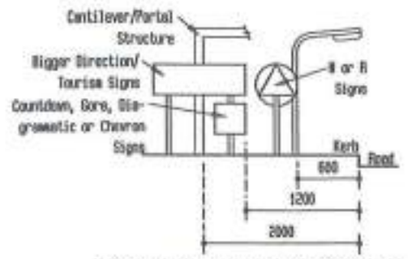
LONGITUDINAL POSITIONING	
Speed (km/h)	Distance (m)
60	120
80	160
100	240
120	330
Not Applicable to signs on Freeways	

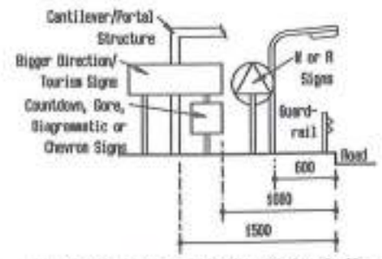
NOTES:
1. As an alternative to repositioning signs the shaded area may be cleared of obstructions.
2. The 'Clear Sight Distance' values include the legibility distance for the letter size PLUS 100m to allow for observation of the sign prior to reading.
3. The Minimum Clearance Profile line is the absolute minimum and no structure/tree/cable whatsoever should infringe this profile.
4. Note that the minimum lateral clearances for larger signs or structures are preferred to be greater than the minimum clearance profile line shown in the Quick Reference.
5. Refer to SARTSM for more details on longitudinal positioning and clearances.
6. Minimum lateral clearances indicated are also applicable to medians in dual carriageway situations
7. Note that the lateral clearances are always measured from the edge of the sign and not from the support except for overhead sign structures.
8. * Height measured from highest point on Roadway.
9. The Letter Size in Table 15.50.1 refers to the size of the largest upper-case letter on the sign.
10. For the longitudinal positioning of ground mounted signs on freeways refer to Chapter 5.

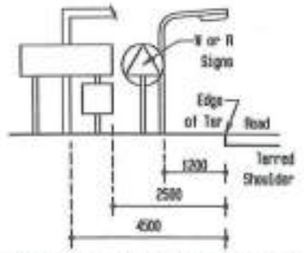


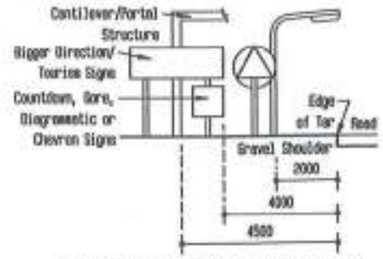


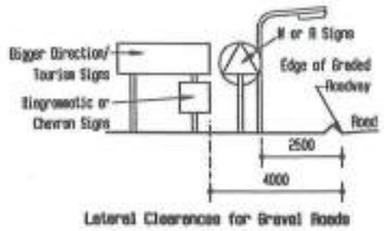
QUICK REFERENCE MINIMUM CLEARANCE PROFILES

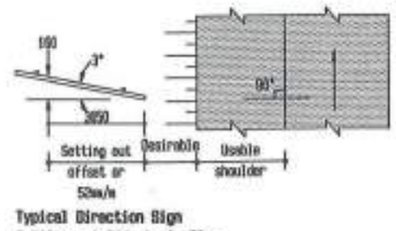


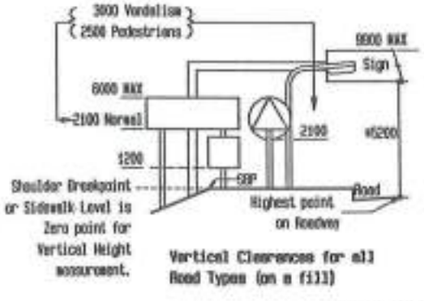


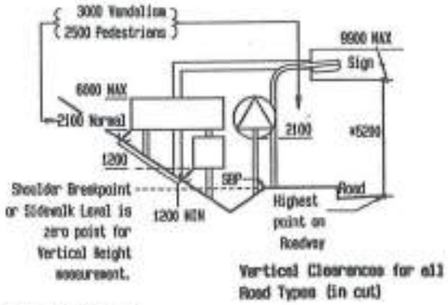






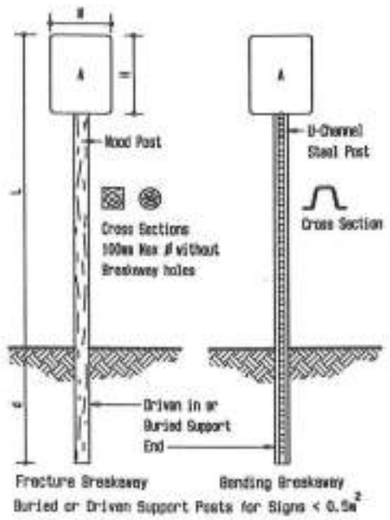




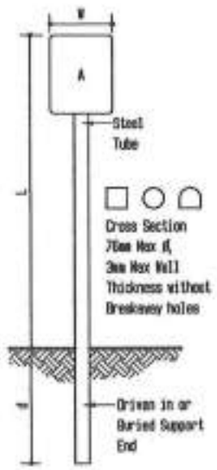


LATERAL AND VERTICAL POSITIONING

Fig 15.50
Road Traffic Signs – Minimum Clearances



Buried or Driven Support Posts for Signs < 0.5m²



Bending Breakaway

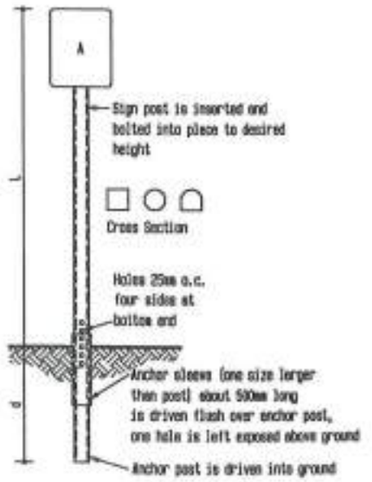
TABLE : 15.51.1	SUPPORT SIZES (mm)					
Support total length above GL	L up to 1m		L = 2m to 3m		L = 3m to 4m	
Signface Area (m²)	Timber top ø	Steel ø x wall	Timber top ø	Steel ø x wall	Timber top ø	Steel ø x wall
Up to 0.5	76	50 x 2.0	100	60 x 2.5	125	76 x 3.0
0.5 - 1.0	-	-	125	76 x 3.0	150	102 x 3.0
1.0 - 1.5	-	-	150	102 x 3.0	175	114 x 3.5
A support total length (L) above ground of between 1.2m and 1.7m is not recommended ... see Note 5.						

TABLE 15.51.2: BREAKAWAY DETAILS					
TIMBER		STEEL			
top ø	breakaway hole ø	ø x wall	breakaway hole ø	pipe coupling	slip base
76	0	50 x 2	0	0	0
100	0	60 x 2.5	0	0	0
125	32	76 x 3.0	0	OPTION	OPTION
150	40	102 x 3.0	25	OPTION	OPTION
175	50	114 x 3.5	35	OPTION	OPTION

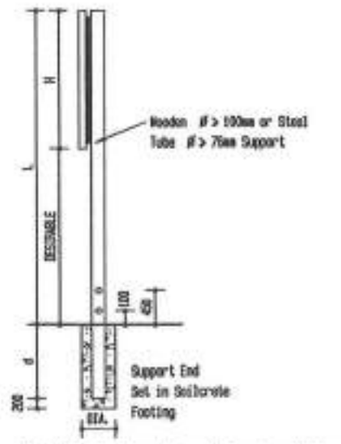
TABLE 15.51.3: FOUNDATION SIZES						
Support total Length above GL (m) L	DEPTH (m)		FOUNDATION SIZE			
	Support/Stub Buried End d	Foundation Total	Sand/Soft Clay		Medium Hard Ground	
			Dia. (m)	Volume (m³)	Dia. (m)	Volume (m³)
up to 1m	0.6	* 0.8	0.6	0.22	* 0.4	0.10
2 - 3	0.8	* 0.8	0.9	0.51	* 0.6	0.22
3 - 4	0.9	1.1	0.9	0.69	0.6	0.31
* Foundation provision may be optional - see Note 8						

GENERAL NOTES:

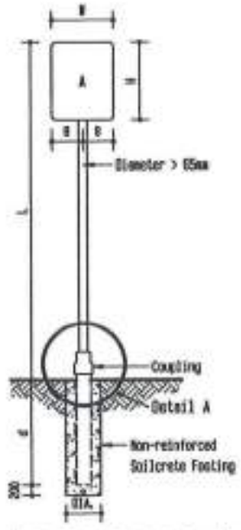
1. Timber to be SABS marked, and Cuts and Breakaway Holes to be treated (Ref. Clause 5682(b)).
2. Steel Tubes to be SABS marked.
3. These details apply to signs with a total signface area (A) < 1.5m², sign width (W) < 1.2m and support total length above ground level (L) < 4m.
4. Methodology to determine support, base and foundation details:
   (i) Effective Sign Area (A) = Sign Width x Sign Height = WxH
   (ii) Support Total Length (L) above ground level, from sign site location
   (iii) Support size according to Support total length (L) - Table 15.51.1
   (iv) Is Breakaway Base necessary - A > 1m or L > 3m, and support ø > 76mm, Wall thickness > 3mm.
   (v) Support diameter and breakaway hole diameter - Table 15.51.2.
   (vi) Foundation necessary? Size diameter and depth - Table 15.51.3.
5. A support total length above ground between 1.2m and 1.7m is not recomended because of the danger of a secondary collision with the windshield of an impacting vehicle.
6. The threaded pipe coupling and slip base coupling are only applicable to steel tube type supports with ø> 65mm because smaller diameter tubular posts are liable to crushing at the point of impact, which delays the release of the base causing the sign to strike the top of the vehicle.
7. Where the impact may be from either direction a horizontal slip base should be used instead of the 20° inclined one.
8. Foundation provision is optional for signs with A < 1m²and total height above Ground L < 3m except in poor soil conditions. In medium to hard soils the support end might be driven into the ground or buried (maybe with attached footplate). The support anchor stubs for threaded pipe and slip base couplings must be set in foundations.
9. The Soilcrete foundations consist of a mixture of 50% crushed stone, 40% selected granular material from excavations and 5% portland cement, compacted into the hole at optimum moisture content to a density of 95% MAASHTO.
10. A 200mm long peg through the buried timber support end or a 200mm long 40x40x3 angle welded to the buried steel tube support end will inhibit rotation or removal of single supports.
11. For larger ground mounted signs on multiple supports refer to Figure 15.54.
   (i) For larger ground mounted sign on single supports, due to space restrictions, refer to to Figure 15.52.
   (ii) Refer to Figure 15.53 for Graphs for single supported signs.



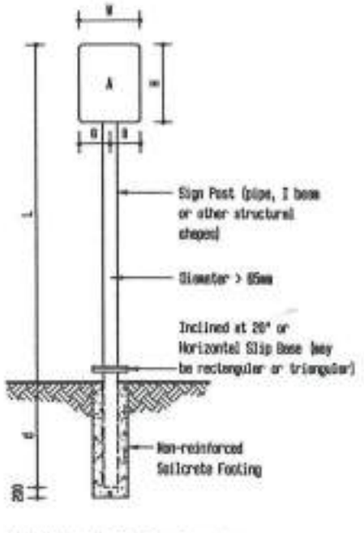
ALTERNATIVE 1: Sleeve Coupling Breakaway
Breakaway at Base Support Posts for Signs > 0.5m²



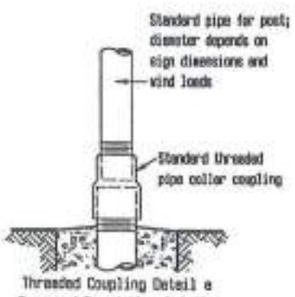
ALTERNATIVE 2: Fracturing at Breakaway Holes



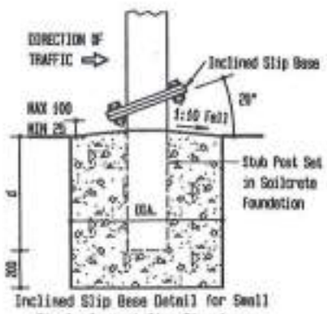
ALTERNATIVE 3: Threaded Coupling Breakaway



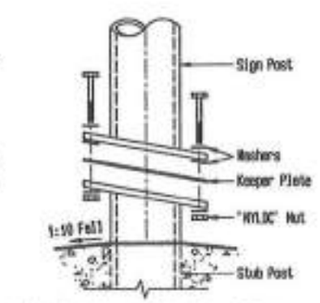
ALTERNATIVE 4: Slip Base Breakaway



Threaded Coupling Detail a
Base and Foundation Details



Inclined Slip Base Detail for Small
Single Support Sign Structures



Joining Detail of Inclined Base Plates

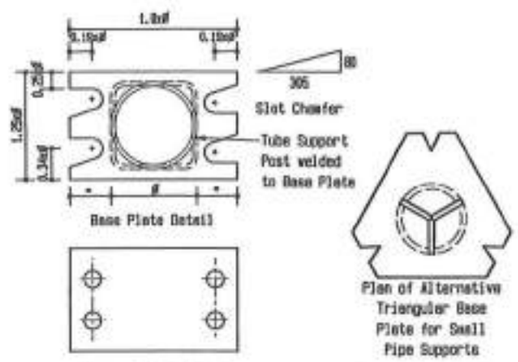


Fig 15.51
Road Traffic Signs <= 1,5 m² - Single Support, Base and Foundation Detail

TABLE 15.52.1 : DETERMINATION OF BACK PLATE CARRIER AND SUPPORT SIZES

SIZE TYPE	BACK PLATE MAX. AREA (m^2)	BACK PLATE SIZE (mm) MAX. W	max. H	CARRIER CHANNEL (channel) (No.)	SUPPORT TOTAL LENGTH above G.L.(mm)	TYPE	BENDING MOMENT Mx. Allo. (kN.m)	PIPE CROSS SECTION SIZES (mm) ø x Wall
B	0.715	1300	550	100x50x11 (2 Carriers)	3000	HB	250	76x3
C	1.98	2200	720		3400	HC	500	88x5
D	2.60	2500	830		3400	HD	1000	114x3.5
E	3.68	3300	1110		3000	HE	1500	114x6
F	5.68	3500	1600		4300	HF	2600	140x8
G	7.32	3500	2090	125x70x11 (3 Carriers)	4900	HG	2500	140x12
H	10.5	3500	3000		5400	HH	5000	165x14

NOTE: Length of Carrier Channels depends on length of sign Back Plate to be mounted

TABLE 15.52.2: DETERMINATION OF BASE SOCKET / PLATE AND BOLT SIZES

BACK PLATE SIZE TYPE	SUPPORT TYPE	BASE SOCKET / PLATE SIZES: SPLIT SOCKET 1/b x t x h (mm)	SLIP BASE l x b x t (mm)	RIGID BASE 1/b x t (mm)	BOLTS/PLATE BOLT SIZES: HOOKED ANCHOR BOLTS ø (mm)	HOOKED ANCHOR BOLTS Cut Length (mm)	CLAMPING BOLTS ø (mm)	CLAMPING BOLTS Length (mm)
B	HB	142x10x150	142x98x5	142x10	12		12	30
C	HC	188x10x150	188x111x6	188x10	14		14	33
D	HD	252x10x150	252x142x6	212x10	16		16	45
E	HE	252x10x150	252x142x6	212x10	16		16	45
F	HF	283x15x150	283x174x8	283x15	20		20	55
G	HG	283x15x150	283x174x8	283x15	20		20	55
H	HH	367x20x150	367x226x8	367x15	25		25	60

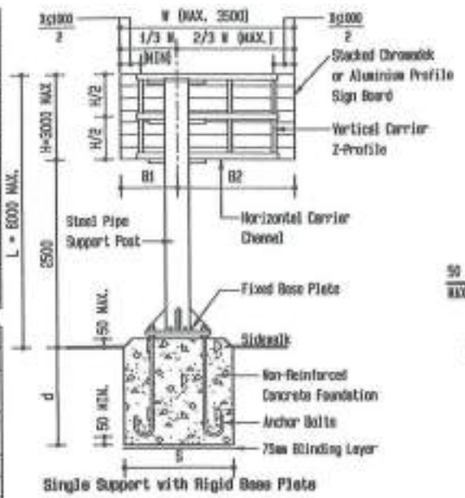
TABLE 15.52.3 : DETERMINATION OF FOUNDATION SIZES

BACK PLATE SIZE TYPE	SUPPORT TYPE	SOIL TYPE	FOUNDATION SIZES FOR BASE TYPE: SPLIT SOCKET a x d(m)	SPLIT SOCKET Volume (m^3)	SLIP BASE PLATE a x d(m)	SLIP BASE PLATE Volume (m^3)	RIGID BASE PLATE a x d(m)	RIGID BASE PLATE Volume (m^3)
B	HB	S/SC	0.6x0.5	0.120	0.5x0.6	0.150	0.5x0.6	0.150
		MHG	0.4x0.4	0.064	0.4x0.6	0.096	0.4x0.6	0.096
C	HC	S/SC	0.8x0.65	0.234	0.8x0.6	0.216	0.8x0.6	0.216
		MHG	0.6x0.5	0.06	0.6x0.6	0.096	0.4x0.6	0.096
D	HD	S/SC	0.8x0.8	0.512	0.8x0.8	0.512	0.8x0.8	0.512
		MHG	0.5x0.65	0.163	0.8x0.8	0.216	0.8x0.8	0.216
E	HE	S/SC	0.8x0.8	0.729	0.9x0.9	0.729	0.9x0.9	0.729
		MHG	0.65x0.7	0.298	0.7x0.7	0.343	0.7x0.7	0.343
F	HF	S/SC	1.0x1.0	1.0	1.0x1.0	1.0	1.0x1.0	1.0
		MHG	0.75x0.8	0.45	0.8x0.8	0.512	0.8x0.8	0.512
G	HG	S/SC	1.1x1.2	1.452	1.1x1.2	1.452	1.1x1.2	1.452
		MHG	0.8x0.9	0.579	0.9x0.9	0.729	0.9x0.9	0.729
H	HH	S/SC	1.25x1.3	2.03	1.25x1.3	2.03	1.25x1.3	2.03
		MHG	1.0x1.0	1.0	1.0x1.0	1.0	1.0x1.0	1.0

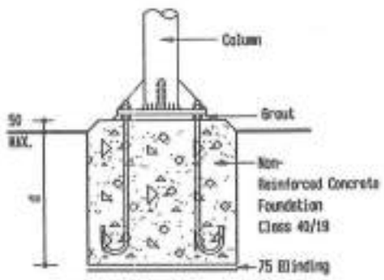
NOTE: S/SC = Sand or Soft Clay , MHG = Medium Herd Ground

NOTES:

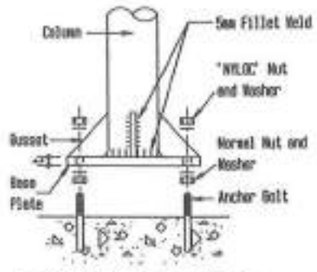
1. These signs are seen as ground mounted because the sign face display area falls within the 6m MAX height limit as required for ground mounted signs.
2. The methods of sign mounting indicated on this drawing are used where space restrictions due to pedestrian movement, car parking bays and cable or pipe positions dictate it instead of the normally multiple support signs.
3. Although the standard 2.5m vertical clearance between the sign's bottom edge and the ground level allows for pedestrains it does not allow for vehicles, except for cars, to pass under.
4. Where the impact may be from either direction a slip base plate should be set horizontally instead of being inclined at 10°.
5. A split socket allows for impact from either direction but the bolting sides of the two halves should always be positioned at right angles to the direction of travel.
6. A support with a rigid base plate must be safeguarded against impact by either a guardrail, when closer to the roadway edge of surfacing/kerbing than required, or by increasing the lateral clearance as required.
7. All steel components to be SABS marked.
8. These details apply to signs with a total area (A) ≤ 10.5m^2, sign back plate height MAX. 3m and width MAX. 3.5m and a support total length above ground level (L) < 6m.
9. Refer to Figure 15.53 for Graphs for Single Supported Signs.



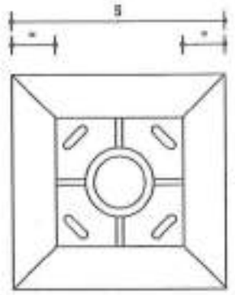
Single Support with Rigid Base Plate



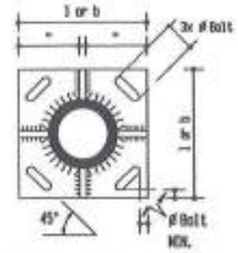
Base Detail for Lighter Single Support Structures with Fixed Base Plate



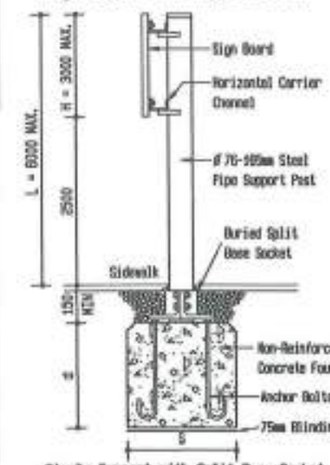
Mounting Detail for Light Single Support Structure with Fixed Base Plate



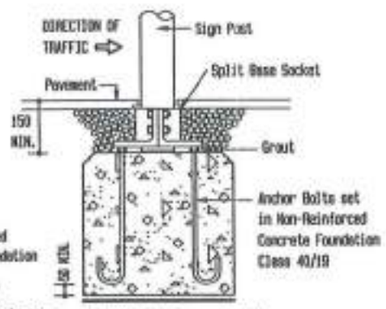
Foundation Plan



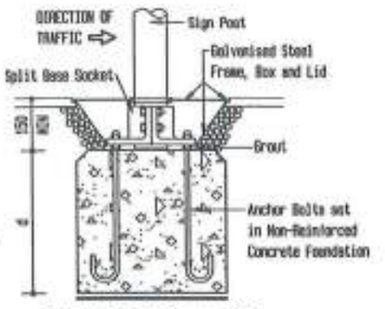
Plan of Fixed Base Plate for Lighter Single Support Structures



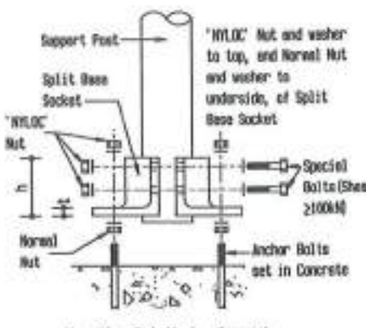
Single Support with Split Base Socket



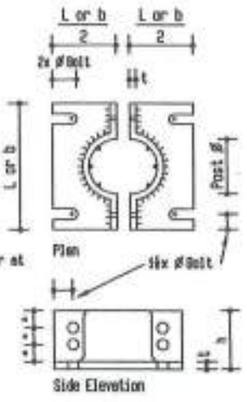
Base Detail for Support with Buried Split Base Socket



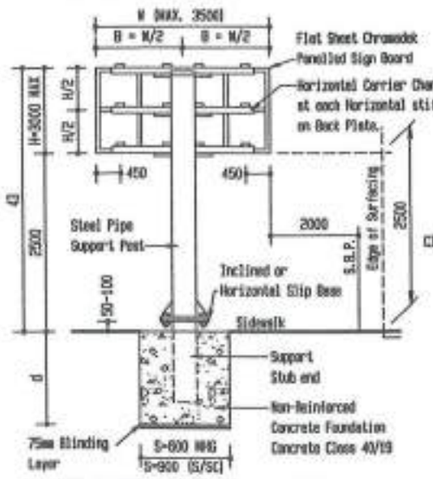
Base Detail for Support with Boxed Split Base Socket



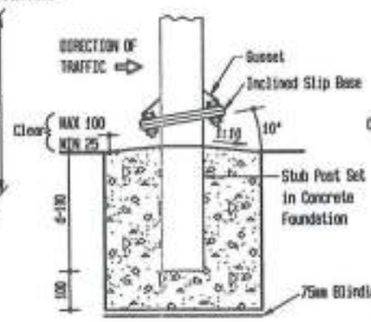
Mounting Detail for Support with Split Base Socket



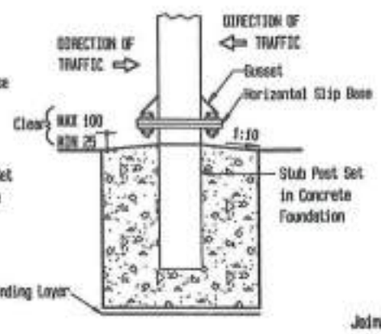
Split Base Socket Detail



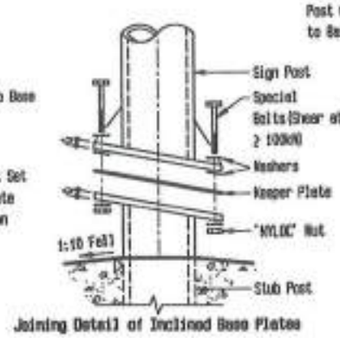
Single Support with Slip Base Plate



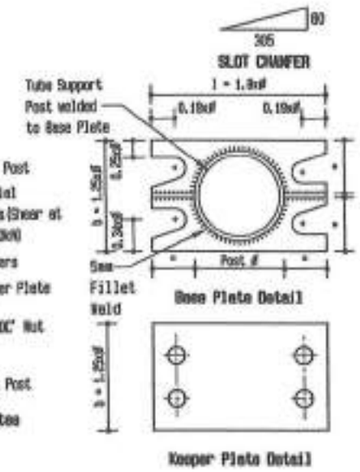
Base Detail for Single Support (One-direction Traffic)



Base Detail for Single Support (Bi-directional Traffic)



Joining Detail of Inclined Base Plates



Keeper Plate Detail

Fig 15.52
Road Traffic Signs >= 1,5 m^2 - Single Support, Base and Foundation Details (Restricted Spaces)

NOTE:

1. REFERENCE PLANS:

   THIS PLAN FORMS PART AND MUST BE READ IN CONJUNCTION WITH FIGURES 15.51 AND 15.52.

2. DESIGN LOADING:

   NOMINAL WIND LOAD ACTING ON THE SIGN FACE HAS BEEN ASSUMED AS FOLLOWS:-
   TOTAL SUPPORT LENGTH/HEIGHT (L) ≤ 2m ABOVE G.L : 0.75 kPa
   TOTAL SUPPORT LENGTH/HEIGHT (L) ≥ 6m ABOVE G.L : 1.25 kPa
   WIND LOADING IS ASSUMED TO VARY LINEARLY FOR AVERAGE SIGN HEIGHTS FALLING BETWEEN THE ABOVE LIMITS.

3. FOUNDING MATERIAL:

   FOUNDATIONS FOR FREE STANDING SUPPORTS DEPEND ON SOIL TYPE ENCOUNTERED. THE GRAPHS FOR "MEDIUM HARD GROUND" ARE APPLICABLE FOR ANY MATERIAL WHICH REQUIRES A PICK FOR EXCAVATION. FOR SOFTER FOUNDING MATERIAL THE GRAPH FOR "SAND OR SOFT CLAY" MUST BE USED. FOUNDATIONS FOR SIGNS LOCATED ON HARD ROCK MAY REQUIRE SPECIAL DESIGNS.

4. DESIGN PROCEDURE:

a) FROM FIGURES 15.51 OR 15.52 DETERMINE DIMENSIONS (B) OR (B1) AND (B2) FOR SIGN WIDTH (W) AND NUMBER OF SUPPORTS (N) = 1.

b) CALCULATE THE EFFECTIVE SIGN AREA A $\frac{W \times H}{6}$ (m^2) FOR SIGN DEPTH/HEIGHT (H) (m) AND DETERMINE TOTAL SUPPORT LENGTH/HEIGHT (L) (m) ABOVE G.L.

c) FROM DESIGN CHART (1) OR (2) (SINGLE SUPPORT), DETERMINE THE FOLLOWING:-
   - THE DIAMETER OF THE SUPPORT.
   - THE FOUNDATION DIAMETER (CHART 1), OR SQUARE SIDE (CHART 2), AND DEPTH FOR THE APPLICABLE FOUNDING MATERIAL (SEE NOTE 3).

d) WHERE THE EFFECTIVE SIGN AREA EXCEEDS 1,5 m^2 OR WHERE NECESSARY AS INDICATED ON DESIGN CHART (1), CHART (2) FOR LARGER SINGLE SUPPORTS MUST BE USED.

e) DETERMINE FROM TABLE 15.51.2 OR TABLE 15.52.2 THE FRANGIBILITY METHOD AND SIZES, EG THE DIAMETER OF BREAKAWAY HOLES TO BE DRILLED IN THE POLES, OR IF SLIP BASE PLATES ARE TO BE USED THE SIZE THEREOF.

5. EXAMPLE 1 : FOR SINGLE SUPPORTED SIGN ≤ 1.5m^2

   FOR (W) = 1.0m AND (N) = 1:
   (B) = 0.5m (EQUALLY POSITIONED OVER SUPPORT)

   FOR (W) = 1.0m (H) = 1.2m AND (N) = 1:
   EFFECTIVE SIGN AREA (A) = $\frac{1.0 \times 1.2^2}{6}$ = 1.2m^2

   FROM DESIGN CHART (1)

   FOR (A) = 1.2m^2 AND (L) = 3.5m:
   SUPPORT POST ø = 175mm (TIMBER TOP ø
   = 114mm x 3.5mm WALL (STEEL ALTERNATIVE)

   FOUNDATION TYPE = SOILCRETE
   FOUNDATION SIZE = 0.8m DIA x 1.1m DEEP (MEDIUM HARD GROUND)
   OR 0.9m DIA x 1.1m DEEP (SAND OR SOFT CLAY)

   FROM TABLE 15.52.2 (FIGURE 15.51)

   FOR FRANGIBILITY METHOD = BREAKAWAY HOLES, WITH TIMBER POST TOP ø = 175mm:
   BREAKAWAY HOLES TO BE DRILLED = 50mm DIA. SUPPORT BURIED END = 0.9m DEEP.

EXAMPLE 2 : FOR SINGLE SUPPORTED SIGN ≥ 1.5m^2

   FOR (W) = 3.5m AND (N) = 1:
   (B) = 1.75m (EQUALLY POSITIONED OVER SUPPORT)

   FOR (W) = 3.5m (H) = 1.8m AND (N) = 1:
   EFFECTIVE SIGN AREA (A) = $\frac{3.5 \times 1.8}{6}$ = 6.3m^2

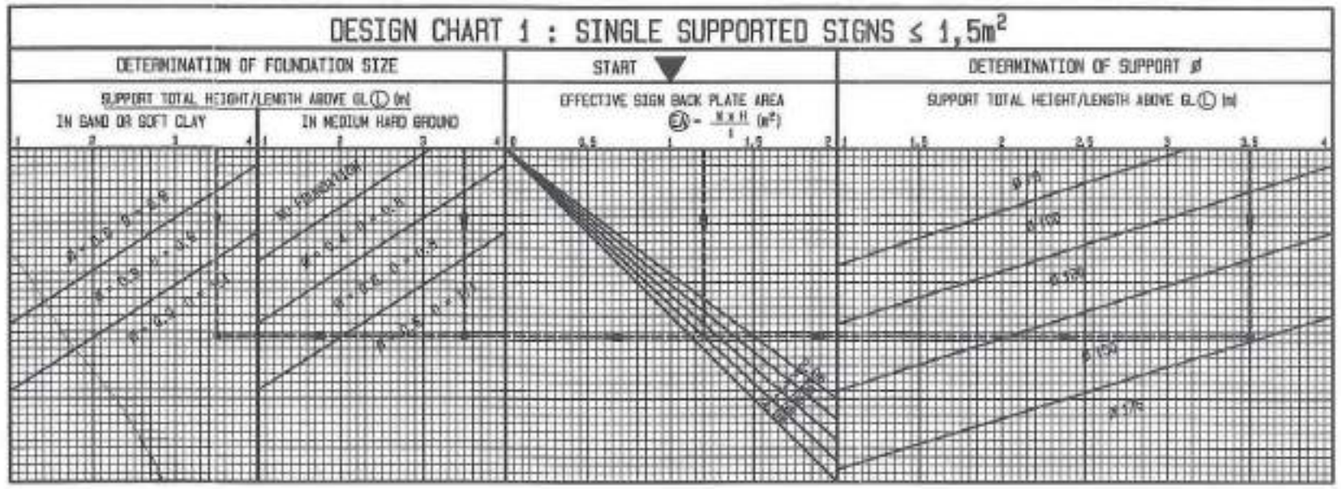
   FROM DESIGN CHART (2)

   FOR (A) = 6.3m^2 AND L = 4.3m:
   SUPPORT POST ø = 140mm (STEEL TUBE)
   WALL THICKNESS = 8mm

   FOUNDATION TYPE = NON REINFORCED CONCRETE
   FOUNDATION SIZE = 0.65m SQUARE x 0.7m DEEP (MEDIUM HARD GROUND)
   OR 0.9m SQUARE x 0.9m DEEP (SAND OR SOFT CLAY)

   FROM TABLE 15.52.2 (FIGURE 15.52)

   FOR FRANGIBILITY METHOD = NONE (RIGID BASE PLATE), WITH POST ø = 140mm AND (L) = 4.3m:
   RIGID BASE PLATE SIZE - I OR b = 281mm
   t = 15mm
   HOOKED ANCHOR BOLTS - BOLT ø = 20mm
   CUT LENGTH =



(PRELIMANARY)

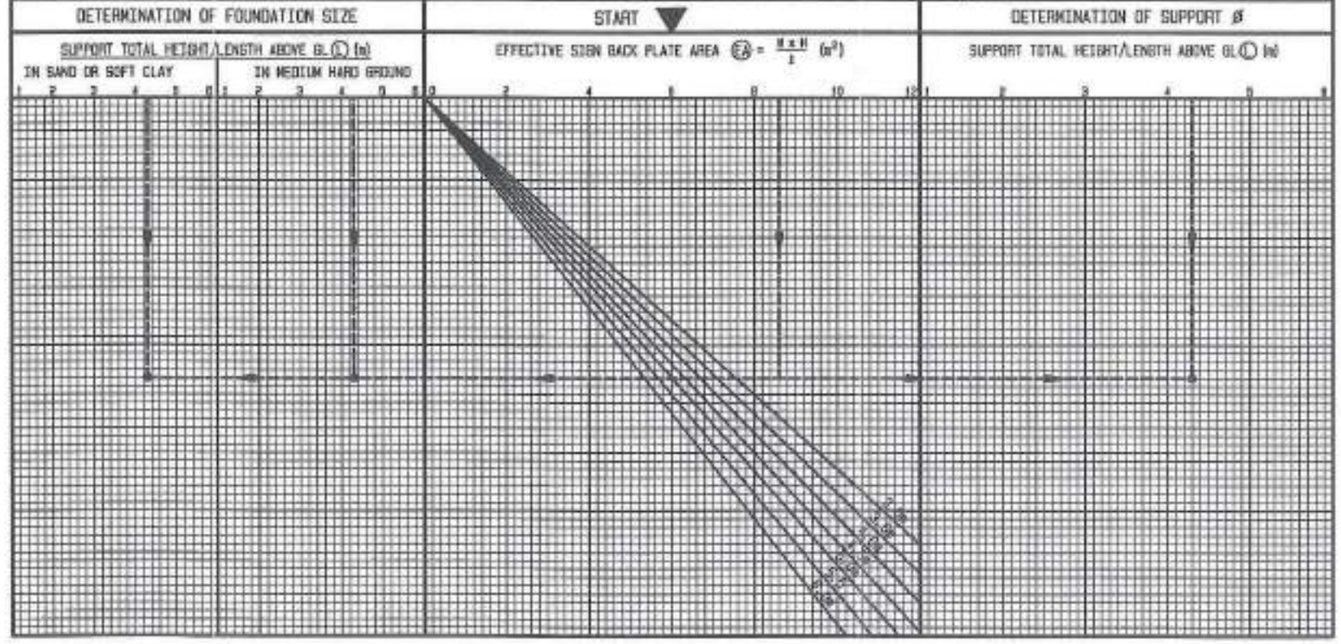


Fig 15.53
Road Traffic Signs – Design Graphs For Single Support Signs

FOR STACKED PROFILE SIGNS

TABLE 15.54.1 SIGN WIDTH & NO. OF SUPPORTS

WIDTH OF SIGN	No. OF SUPPORTS	SPACING OF SUPPORTS	
W	N	B	C
1.2m	1	$W/2$	-
1.2m - 4.0m	2	$W/5$	$3W/5$
4.0m - 7.2m	3	$W/2N$	W/N
7.2m - 9.6m	4		
9.6 - 12.0m	5		

FOR FLAT SHEET SIGNS

TABLE 15.54.2 NUMBER AND SPACING OF SUPPORTS

WIDTH OF SIGN	No. OF SUPPORTS	SPACING OF SUPPORTS	
W	N	B	C
1.2 - 1.5m	1	400 -450	400 - 600
1.5 - 3.0m	2	450	W - 900
3.0 - 4.5m	3	450	$\frac{W-900}{2}$
4.5 - 6.0m	4	450	$\frac{W-900}{3}$

TABLE 15.54.3 SUPPORT DETAILS

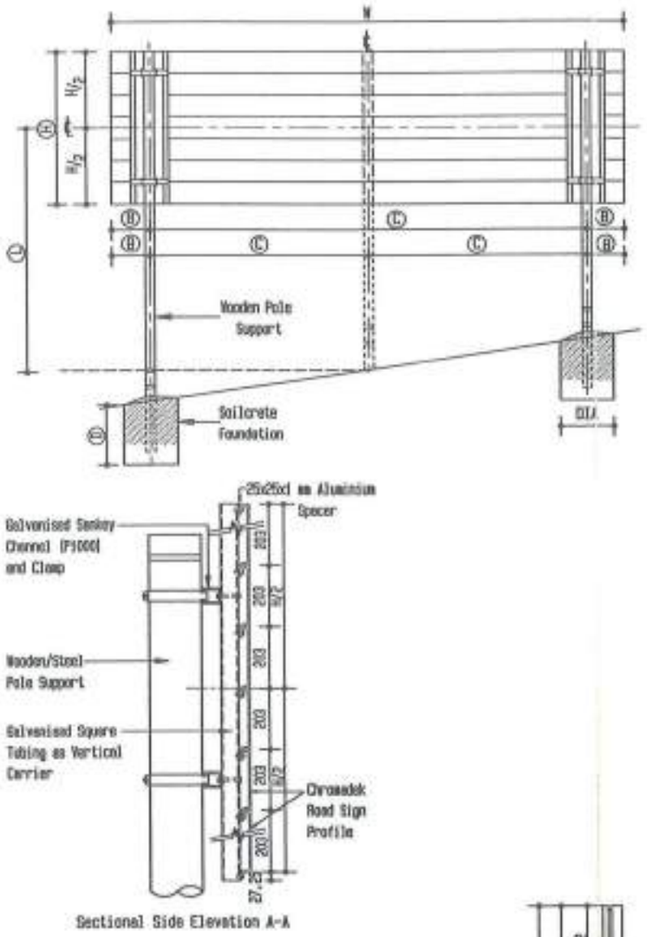
SUPPORT STRUCTURE TYPE	SUPPORT TOTAL LENGTH (L) ABOVE GROUND LEVEL (m)	SUPPORT (AND BRACE) SIZES (mm)			
		TIMBER		STEEL	
		TOP ø	BREAKAWAY HOLE ø	ø x WALL	BREAKAWAY HOLE ø
FREE STANDING SUPPORTS					
Sign Width W ≤ 0.8	2.5 - 3	150	40	102x2	25
Sign Depth H ≤ 1.2	3 - 3.5	175	50	114x3.5	35
BRACED SUPPORTS					
Sign Width W ≤ 0.8	3.5 - 5	100	25	60x2	15
Sign Depth H ≤ 1.2	5 - 7	150	40	102x2	25
	7 - 10	175	50	114x3.5	35

NOTE : * Braced supports must be used for signs with a sign Depth H≥ 1.2m where the total support length above ground level L≥ 3.5m.
* The Support and Breakaway hole diameters shown are applicable to both the uprights and diagonal brace members where supports are braced, with the breakaway hole diameter indicated for the nominal/minimum diameter of the support at ground level.

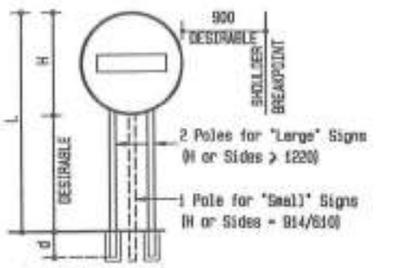
TABLE 15.54.4 FOUNDATION SIZES

SUPPORT TOTAL LENGTH (L) ABOVE GROUND LEVEL (m)	DEPTH (m)		FOUNDATION SIZES			
	SUPPORT/STUB BURIED END (d)	FOUNDATION TOTAL	SAND/SOFT CLAY		MEDIUM HARD GROUND	
			ø (m)	VOL ± (m^3)	ø (m)	VOL ± (m^3)
3	0.9	1.1	0.9	0.69	0.6	0.31
4	0.9	1.1		0.69		0.31
5	1.0	1.2		0.75		0.33
6	1.1	1.3		0.82		0.36
7	1.2	1.4		0.89		0.39
8	1.3	1.5		0.95		0.42
9	1.4	1.6		1.01		0.45
10	1.5	1.7		1.08		0.48

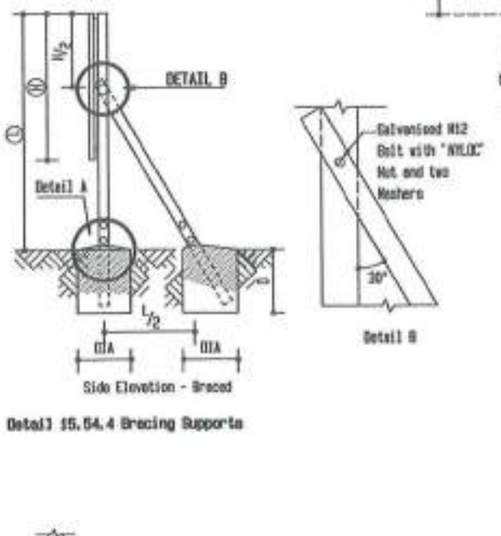
NOTE : * Where the foundation depth is 1.5m or greater, excavations must be suitably shored for the protection of workmen.



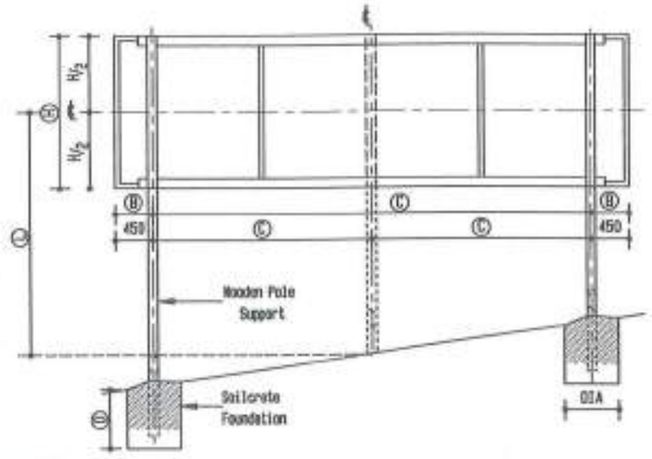
Detail 15.54.1 Sign Manufactured from Road Sign Profiles

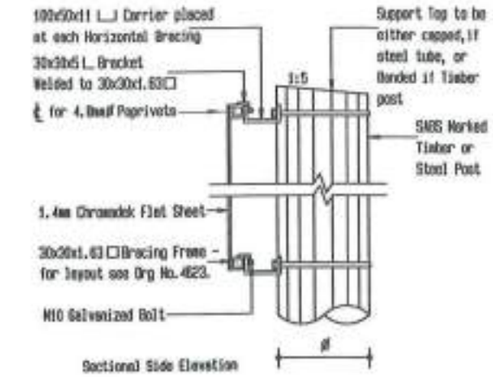


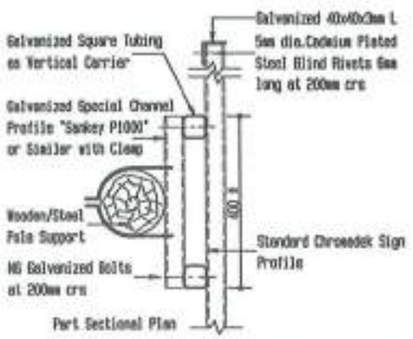
Detail 15.54.3 Mounting of Regulatory, Warning and other Minor Signs on Multiple Posts



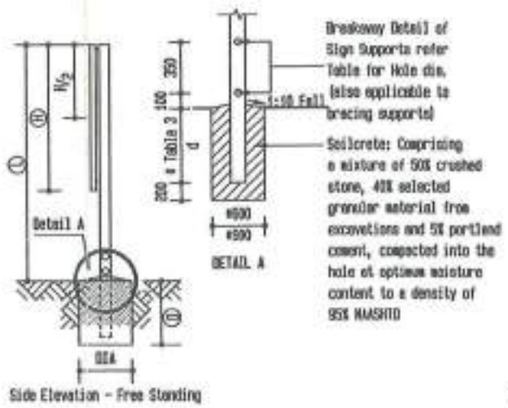
Detail 15.54.4 Bracing Supports



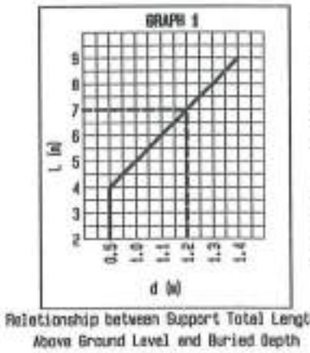




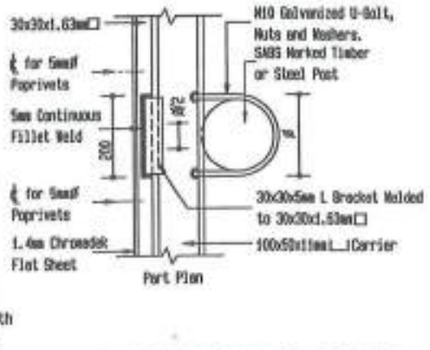
Detail 15.54.1 Sign Manufactured from Road Sign Profiles



Detail 15.54.5 Breakaway Holes and Foundations



Relationship between Support Total Length Above Ground Level and Buried Depth



Detail 15.54.2 Sign Manufactured from Flat Sheet and Frame

Notes:
1. Some means of preventing the U-bolts or 'Sankey' clamp from sliding down the support post by : either cutting a slot or hammering in a nail for timber posts or welding a lug/pin unto a steel pipe support, should preferably be provided. This action should be taken for all timber poles, even if clamp is tight on installation to allow for ultimate shrinkage of the timber post.
2. Timber to be SABS marked, and Cuts and Breakaway Holes to be treated (Ref. Clause 5602(b)).
3. Steel Tubes to be SABS marked; cuts and breakaway holes to be treated.
4. These details apply to signs with board lenght/width (W) ≤ 6.0m and Total length of Support (L) ≤ 10.0m. Larger signs must be referred to an Engineer.
5. Methodology to determine support, base and foundation details:
(i) Number of supports for sign width - Table 15.54.1/2
(ii) Effective Sign Area-(A) = $\frac{\text{Sign Width x Sign Depth}}{\text{No. of Supports}} = \frac{WxH}{N}$
(iii) Support Total Length (L) from sign site location
(iv) Is bracing of supports necessary - H≥ 1.2m or L≥ 3.5m or A≥ $2m^2$
(v) Support diameter and breakaway hole diameter- Table 15.54.3.
(vi) Foundation diameter and depth - Table 15.54.4.
6. For Sign Back Plate panel layouts and Bracing details see Figures 15.58 to 15.63.

Fig 15.54
Road Traffic Signs >= 1,5 m^2 - Multiple Support, Base and Foundation Details

NOTE:

1. REFERENCE PLANS:

   THIS PLAN FORMS PART OF AND MUST BE READ IN CONJUNCTION WITH FIGURE 15.54

2. DESIGN LOADING:

   NOMINAL WIND LOAD ACTING ON THE SIGN FACE HAS BEEN ASSUMED AS FOLLOWS:-
   AVERAGE SUPPORT LENGTH/HEIGHT Ⓛ (ABOVE G.L.) ≤ 2m : 0.75 kPa
   AVERAGE SUPPORT LENGTH/HEIGHT Ⓛ (ABOVE G.L.) ≥ 6m : 1.25 kPa
   WIND LOADING IS ASSUMED TO VARY LINEARLY FOR AVERAGE SIGN HEIGHTS FALLING BETWEEN THE ABOVE LIMITS.

3. FOUNDING MATERIAL:

   FOUNDATIONS FOR FREE STANDING SUPPORTS DEPEND ON SOIL TYPE ENCOUNTERED. THE GRAPHS FOR "MEDIUM HARD GROUND" ARE APPLICABLE FOR ANY MATERIAL WHICH REQUIRES A PICK FOR EXCAVATION. FOR SOFTER FOUNDING MATERIAL THE GRAPH FOR "SAND OR SOFT CLAY" MUST BE USED. FOUNDATIONS FOR SIGNS USING BRACED SUPPORTS ARE INDEPENDENT OF FOUNDING MATERIAL TYPE. FOUNDATIONS FOR SIGNS LOCATED ON HARD ROCK MAY REQUIRE SPECIAL DESIGNS.

4. DESIGN PROCEDURE:

a) FROM TABLE 15.54.1 ON FIGURE 15.54 DETERMINE FOR SIGN WIDTH Ⓦ THE NUMBER OF SUPPORTS Ⓝ AND DIMENSIONS Ⓑ AND Ⓒ

b) CALCULATE THE EFFECTIVE SIGN AREA Ⓐ = $\frac{W \times H}{N}$ (m²) FOR SIGN DEPTH/HEIGHT Ⓗ (m) AND DETERMINE AVERAGE SUPPORT LENGTH/HEIGHT Ⓛ (m) ABOVE G.L.

c) FROM DESIGN CHART ③ (FREE STANDING SUPPORT), DETERMINE THE FOLLOWING:-
   - THE TOP DIAMETER OF THE POLE.
   - THE FOUNDATION DIAMETER AND DEPTH FOR THE APPLICABLE FOUNDING MATERIAL (SEE NOTE 3).

d) WHERE THE EFFECTIVE SIGN AREA EXCEEDS 6m² OR WHERE NECESSARY AS INDICATED ON DESIGN CHART ③, CHART ④ FOR BRACED SUPPORTS MUST BE USED. IN THIS CASE THE POLE TOP DIAMETER AND FOUNDATION SIZES OBTAINED ARE APPLICABLE TO BOTH THE UPRIGHT AND DIAGONAL BRACE MEMBERS.

e) DETERMINE FROM TABLE 15.54.3 THE DIAMETER OF HOLES TO BE DRILLED IN THE POLES SHOWN IN DETAIL "A".

5. EXAMPLE 1: (FREE STANDING MULTIPLE SUPPORTS)

   FOR Ⓦ = 5m Ⓑ = 1,8m Ⓛ = 2,7m:

   FROM TABLE 15.54.1

   Ⓝ = 3 Ⓑ = 0,830m Ⓒ = 1,670m

   Ⓐ = $\frac{5 \times 1,8}{3}$ = 3,0m²

   FROM DESIGN CHART ③

   FOR Ⓐ = 3,0m² AND Ⓛ = 2,7m:
   POLE TOP DIA. = 175mm
   FOUNDATION SIZE = 1,2m DIA. 0,8m DEEP (MEDIUM HARD GROUND) OR 1,2m DIA. 1,5m DEEP (SAND OR SOFT CLAY)

   FROM TABLE 15.54.3

   HOLES TO BE DRILLED = 50mm DIAMETER.

EXAMPLE 2: (BRACED MULTIPLE SUPPORTS)

FOR Ⓦ = 9,2m Ⓗ = 4,0m Ⓛ = 4,8m:

FROM TABLE 15.54.1,

Ⓝ = 4 Ⓑ = 1,15m Ⓒ = 2,3m

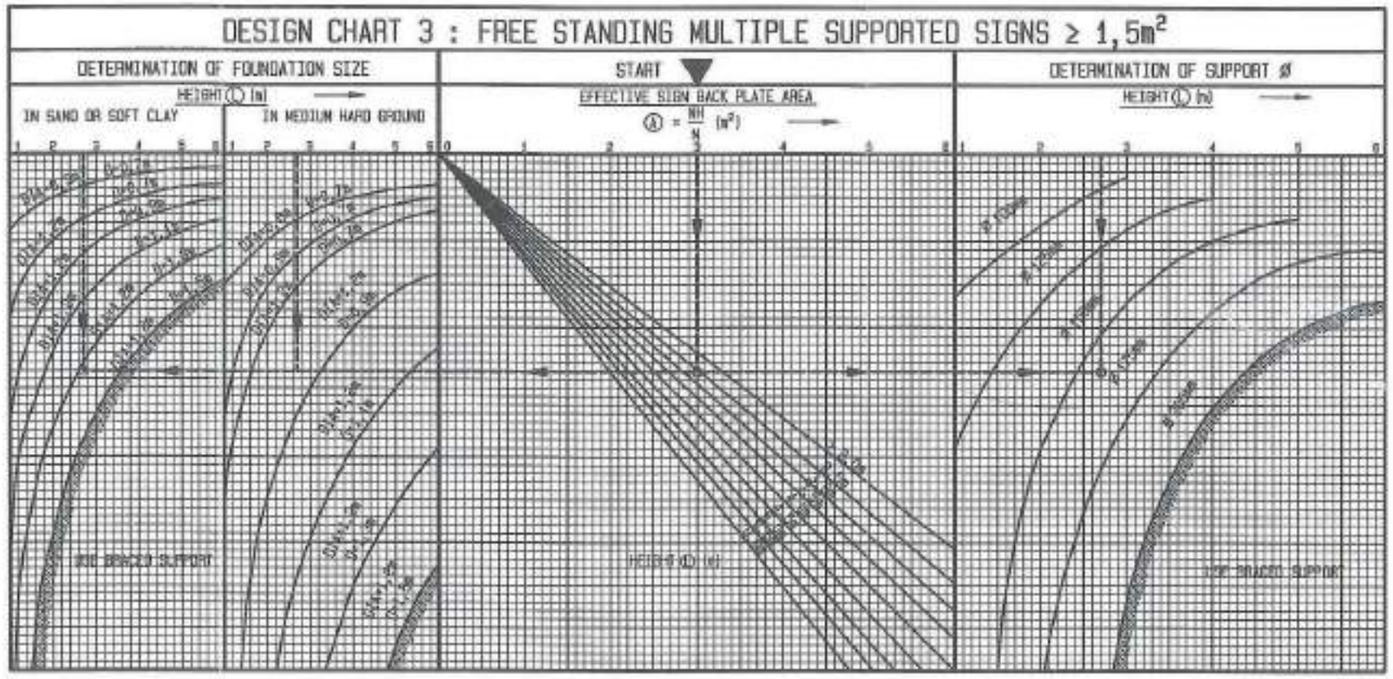
Ⓐ = $\frac{9,2 \times 4,8}{4}$ = 10,58m²

FROM DESIGN CHART ④

FOR Ⓐ = 10,58m² AND Ⓛ = 4,0m:
POLE TOP DIA. = 150mm
FOUNDATION SIZE = 1,2m DIA. 1,6m DEEP (MEDIUM HARD GROUND OR SAND/SOFT CLAY)

FROM TABLE 15.54.3

HOLES TO BE DRILLED = 40mm DIAMETER.



(PRELIMINARY)

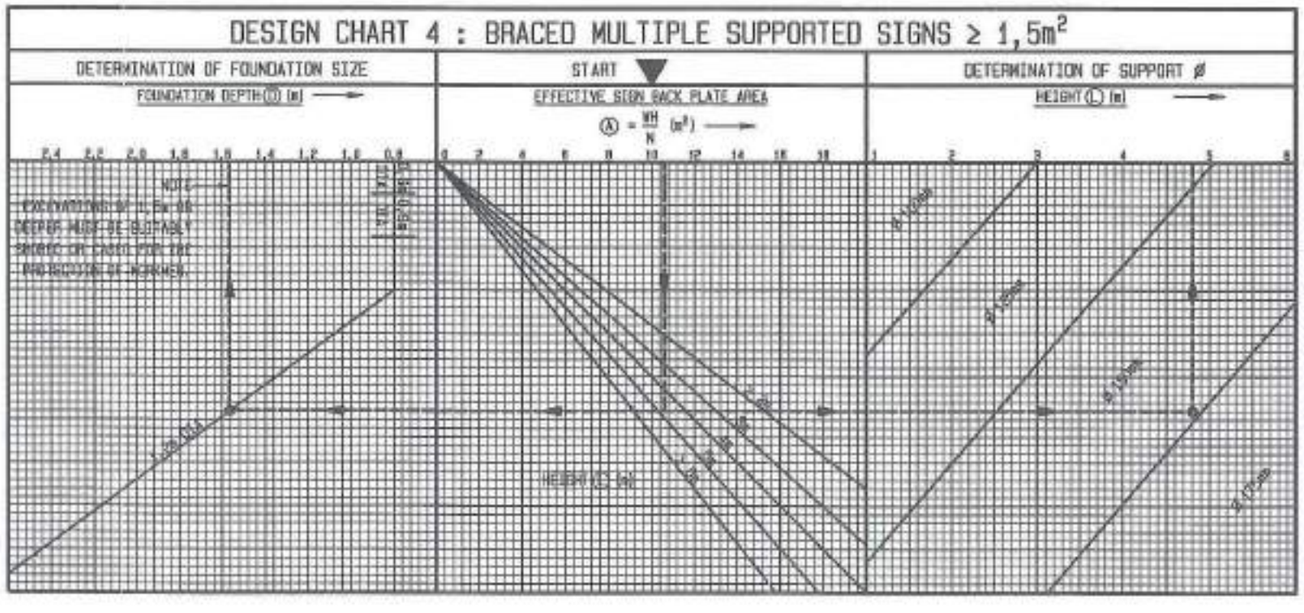
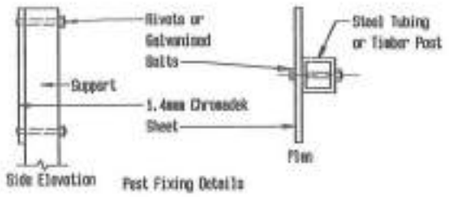


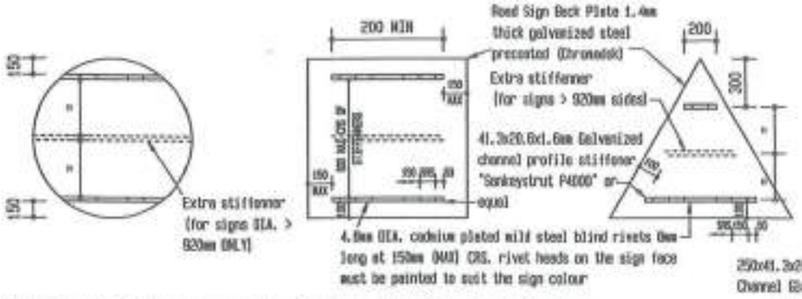
Fig 15.55
Road Traffic Signs – Design Graphs For Multiple Support Signs

No Frame or Bracing (Signs < 0.36m²)

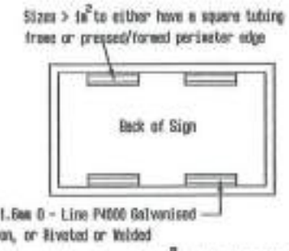


Post Fixing Details

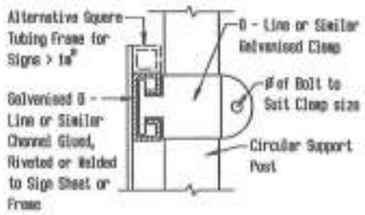
TABLE 15.56.1: SIGN BRACING AND MOUNTING OPTIONS					
Sign Back Plate		Mounting			
Type	Area	Position	Support Structure	Carrier	Fastener
Not braced	< 0.5m²	GM	Single Support	Nil	Rivet or Bolt directly to support
		GM	Single Support	Nil	Strapped through welded/glued on Lug
Simply Channel braced horizontally	< 1.5m²	GM	Single Support, or Double Support for signs wider than 1.2m	"D-line" or "Sankey" Channel	"D-line" clamps bracket and bolts or brackets and straps
Simply braced - pressed/formed edges	< 1.5m²	GM	Single Support	Pressed edges	Bolted through lugs or bracket



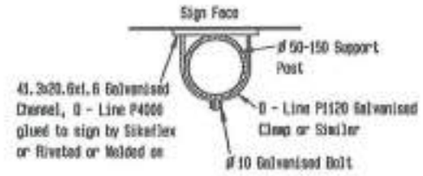
Channel Bracing for Regulatory and Warning Signs from 810mm up to 1524mm Sides or Diameters



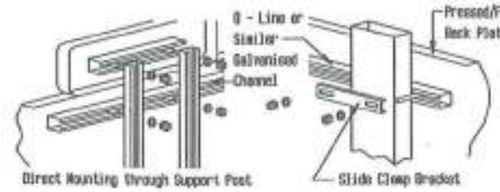
Channel Bracing for Signs > 1m² Double Supports

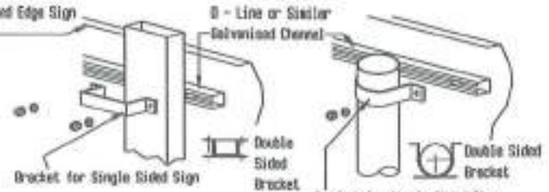


Bracket side Elevational Detail



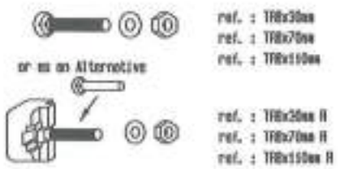
Bracket Detail in Plan View



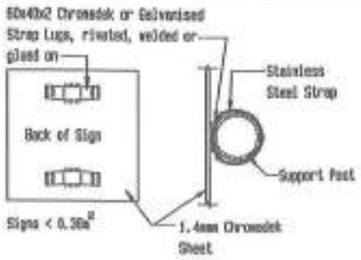


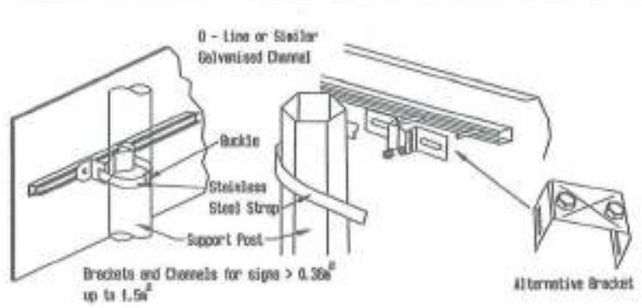
Alternative Mounting Brackets for fixing Signs with Channels/Rails

Alternative Bracket Details

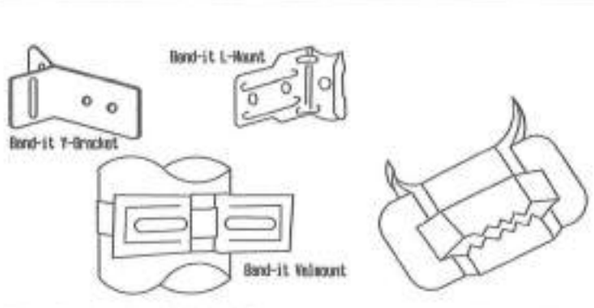


Bolt Details





Strap and Lug/Bracket and Channel Mounting Alternatives

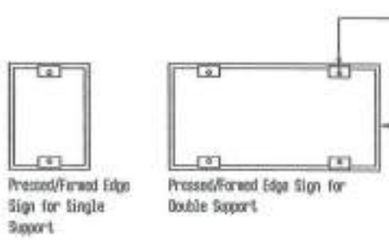


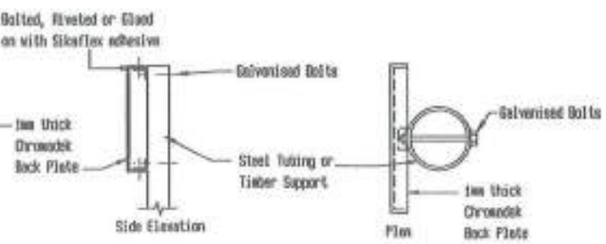
Alternative Mounting Bracket Details

Stainless Steel Strap Buckles

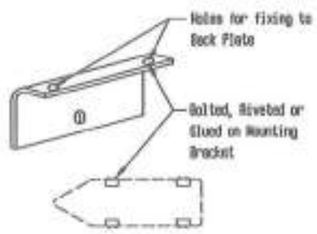
NOTES :

1. Direct bolting through sign back plate or strap and welded or glued on lug mounting, are only applicable to signs < 0.5m² and the sign back plate material should at least be 1.4mm thick Chromadek to provide some rigidity.
2. 1mm Chromadek material could be used for signs > 0.5m² but the back plate should be braced with either D-line or "Sankey strut" channels or a perimeter formed/pressed edge lip.
3. A wide range of brackets with either bolts or stainless steel straps could be used to mount the two types of back plate mentioned in note 2.
4. Refer to Figures 15.51 - 15.54 for support, base and foundation details



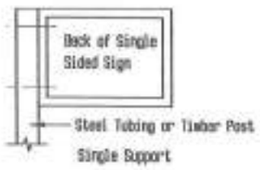


Bracket Mounting of Pressed/Formed Edge Signs



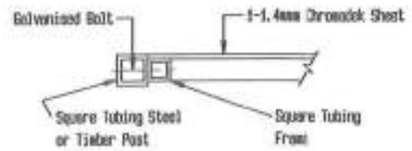
Mounting Bracket Detail

Fig 15.56
Road Traffic Signs <= 1,5 m² - Back Plates and Mounting Details (Signs with No Frames)



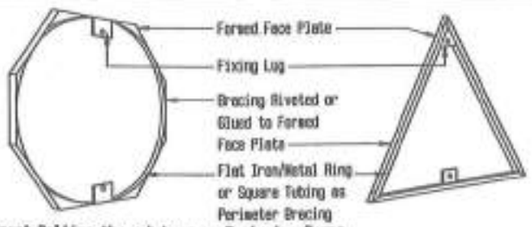
Direct Bolting through Sign Backplate Framing

Sectional Side Elevation

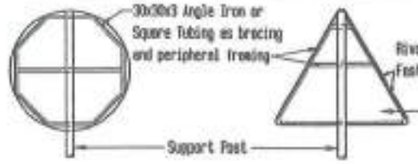


Post Fixing Details Plan

TABLE 15.57.1: SIGN BRACING AND MOUNTING OPTIONS					
Sign Back Plate		Mounting			
Type	Area	Position	Support Structure	Carrier	Fastener
Perimeter frame and bracing	> 0.5m² up to 4.5m²	GN	Single Support	Perimeter Frame and Bracing	Bolted through lugs or brackets
		GN	Single Support or Multiple Supports	Perimeter Frame □ or L	Bolted through frame directly
		GN	Single Support or Multiple Supports	Perimeter Frame	Bolted through lugs or L-brackets
Small to Medium Sized Double Sided or Boxed	> 0.5m² up to 4.5m²	GN	Single Support or Multiple Supports	Perimeter Profiled Frame	Internal: Lindapter* Cavity fixing bolts directly through frame or square tube bracket

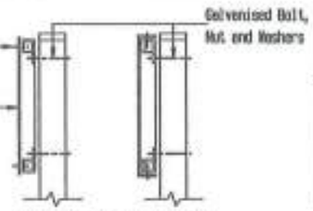


Direct Bolting through Lugs on Perimeter Frame

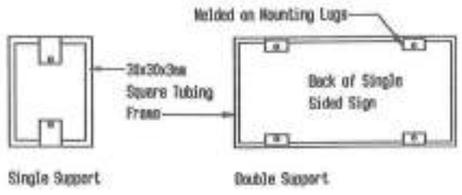


Rear Elevation Octagonal and Circular Sign

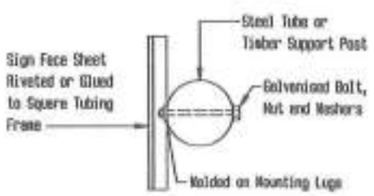
Rear Elevation Triangular Sign



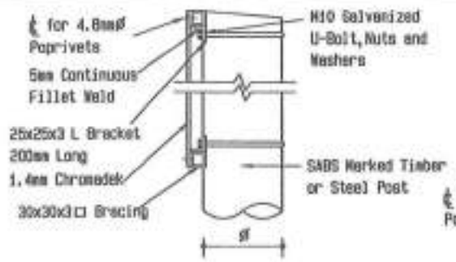
Sectional Side Elevation Lug and Bolt Mounting



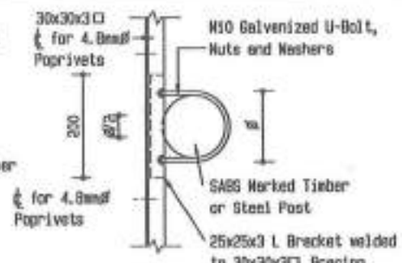
Direct Bolting through Lugs for Single Sided Signs



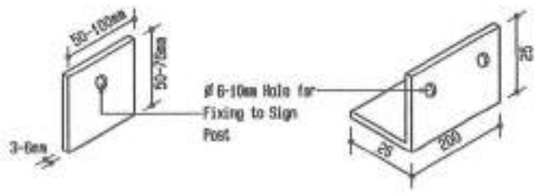
Plan-Lug and Bolt Mounting



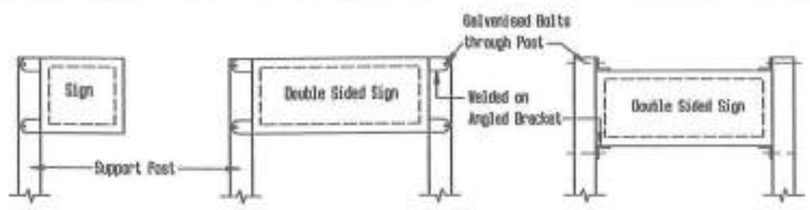
Sectional Side Elevtion



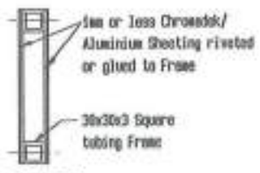
Plan



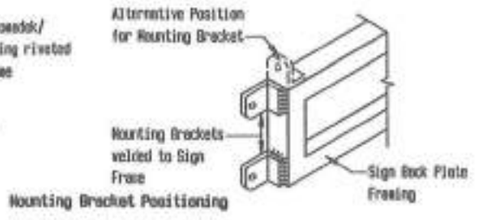
Mounting Lug/Bracket Detail



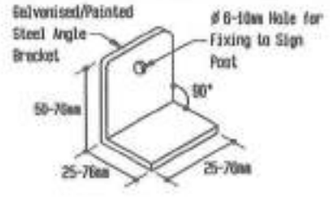
Direct Bolting through, welded on, Angled Bracket for Double Sided or Boxed Signs



Sectional Side Elevation



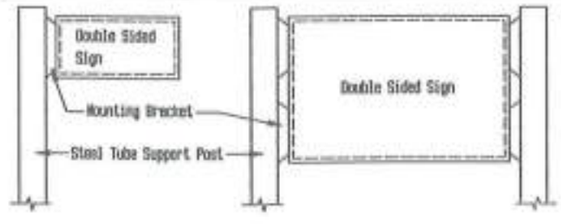
Mounting Bracket Positioning



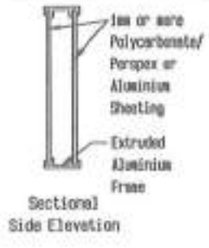
Mounting Bracket Detail

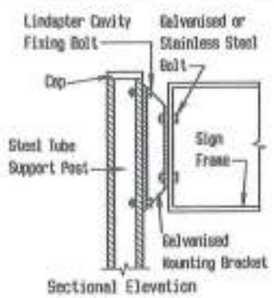
NOTES :

1. Some of the construction and mounting details, indicated on this drawing, are also applicable to signs > 1.5m², with an increase in part sizes.
2. Ideally, the frames, lugs, brackets and bolts should be of corrosive resistant materials or treated as such.
3. Corrosion protection tape to become so, applied to all contact surfaces, between steel and aluminium or as instructed by the engineer.
4. Refer to Figures 15.51 - 15.54 for support, base and foundation details.

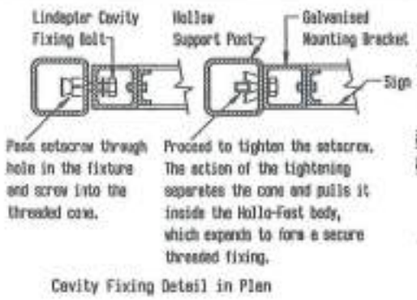


Invisible Fixing, by Square tubing mounting Bracket, for Double Sided or Boxed Signs

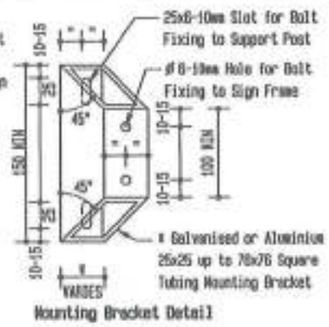




Sectional Elevation

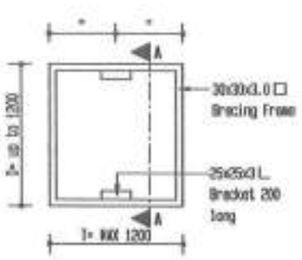


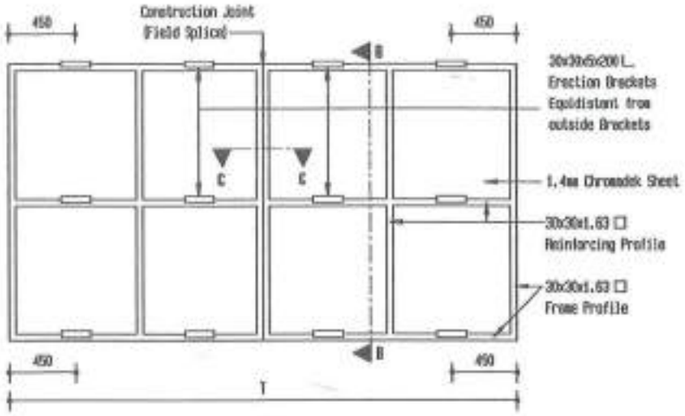
Cavity Fixing Detail in Plan

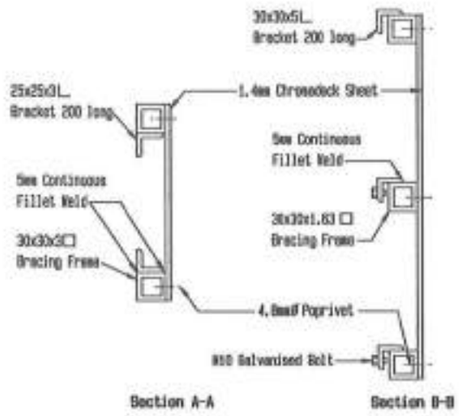


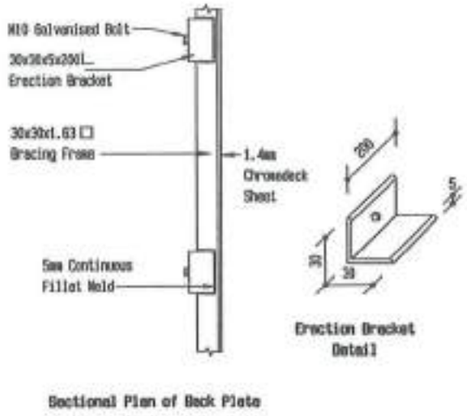
Mounting Bracket Detail

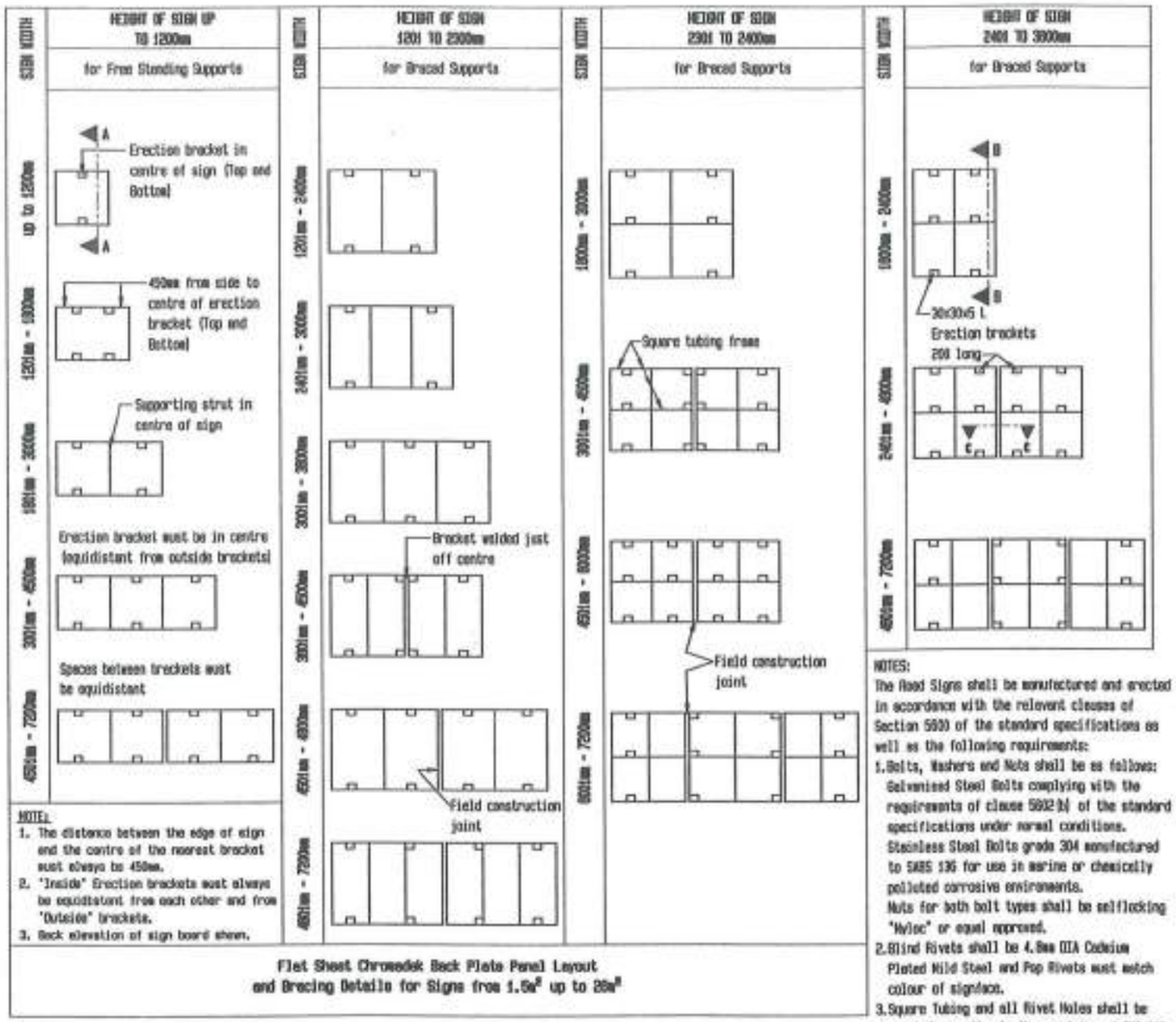
Fig 15.57
Road Traffic Signs <= 1,5 m² - Back Plates and Mounting Details (Signs with Frames)







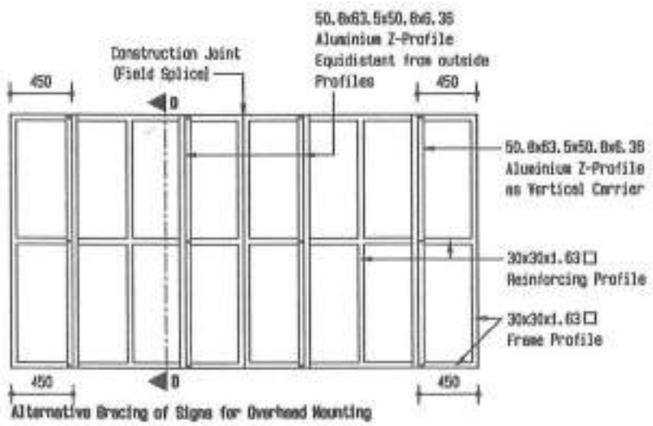


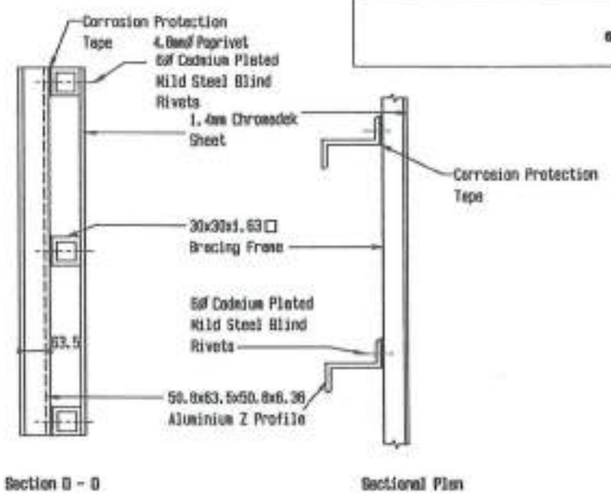


NOTES:

The Road Signs shall be manufactured and erected in accordance with the relevant clauses of Section 5800 of the standard specifications as well as the following requirements:

1. Bolts, Washers and Nuts shall be as follows:
   Galvanised Steel Bolts complying with the requirements of clause 5802(k) of the standard specifications under normal conditions.
   Stainless Steel Bolts grade 304 manufactured to SABS 136 for use in marine or chemically polluted corrosive environments.
   Nuts for both bolt types shall be selflocking "Nyloc" or equal approved.
2. Blind Rivets shall be 4.8mm DIA Cadmium Plated Mild Steel and Pop Rivets must match colour of signface.
3. Square Tubing and all Rivet Holes shall be painted according to the provision of CKS 193.
4. Reference must be made to the relevant road signface detail drawings for details of the symbols and legend for each individual signface.
5. Signs manufactured in two sections must be bolted together in the middle with 10mm bolts, nuts and washers.
6. Corrosion Protection Tape to be applied to all contact surfaces between steel and aluminium or as instructed by the Engineer.
7. For Overhead Mounting on Cantilever or Portal Structures the erection brackets should be replaced with vertical aluminium Z-profiles, in the exact positions of the erection brackets.
8. For Mounting details and options see Figure 15.59.





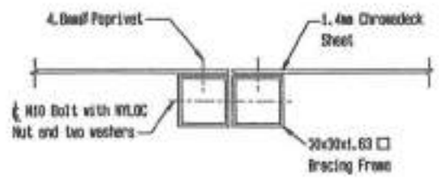
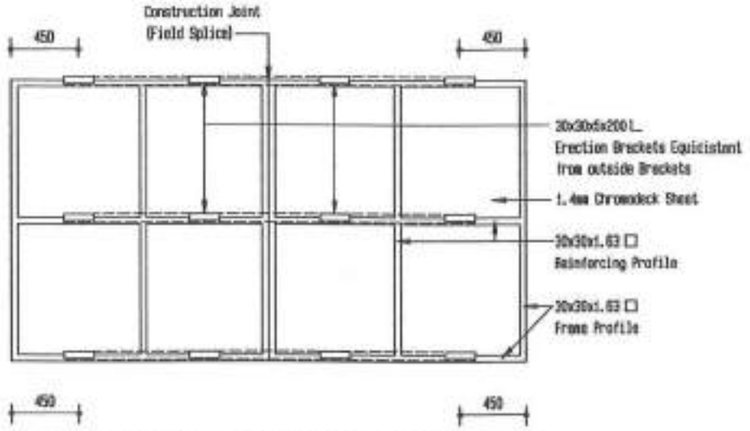


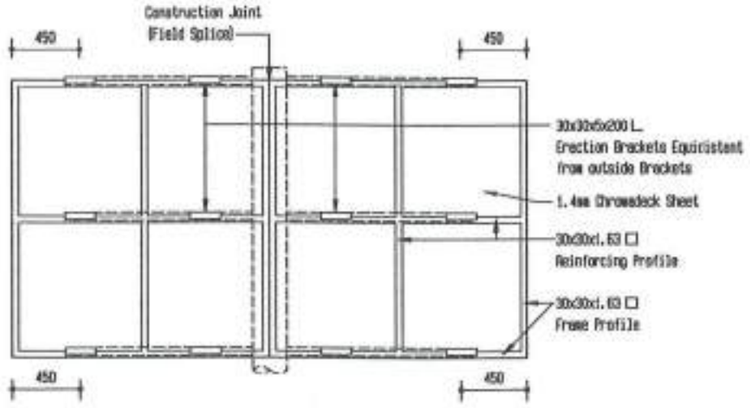
Fig 15.58
Road Traffic Signs >= 1,5 m² -
Back Plate and Bracing Details
(Flat Sheet Chromadek)

NOTES:
The Road Signs shall be manufactured and erected in accordance with the relevant clauses of Section 5680 of the standard specifications as well as the following requirements:

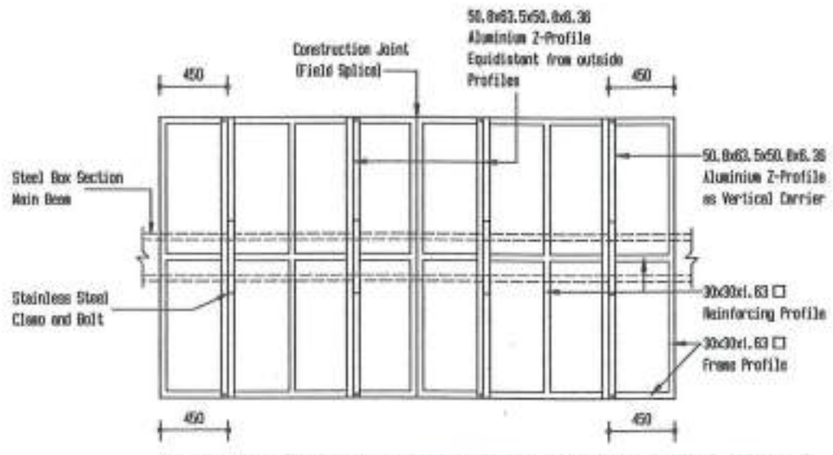
1. Bolts, Washers and Nuts shall be as follows:
   Galvanised Steel Bolts complying with the requirements of clause 5692(b) of the standard specifications under normal conditions.
   Stainless Steel Bolts grade 304 manufactured to SABS 136 for use in marine or chemically polluted corrosive environments.
   Nuts for both bolt types shall be selflocking "Nyloc" or equal approved.
2. Blind Rivets shall be 4.8mm DIA Cadmium Plated Mild Steel and Pop Rivets must match colour of signface.
3. Square Tubing and all Rivet Holes shall be painted according to the provision of CKS 193.
4. Reference must be made to the relevant road signface detail drawings for details of the symbols and legend for each individual signface.
5. Signs manufactured in two sections must be bolted together in the middle with 10mm bolts, nuts and washers.
6. Corrosion Protection Tape to be applied to all mating surfaces between steel and aluminium or as instructed by the Engineer.
7. For Overhead Mounting on Cantilever or Portal Structures the erection brackets should be replaced with vertical aluminium Z-profiles, in the exact positions of the erection brackets.
8. For back plate and bracing details see figure 15.58. For support, base and foundation details see Figure 15.54.



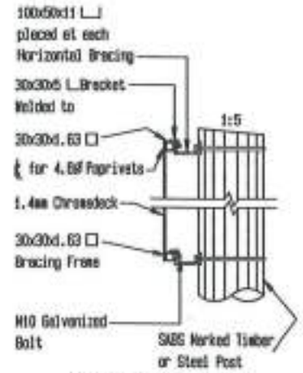
Rear Elevation of Back Plate for Ground Mounting on Multiple Supports



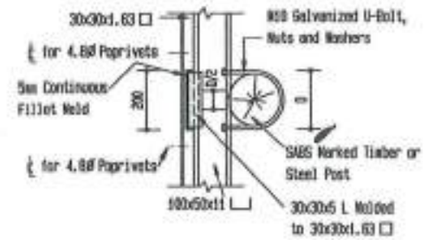
Rear Elevation of Back Plate for Ground Mounting on Single Support (as an Option)



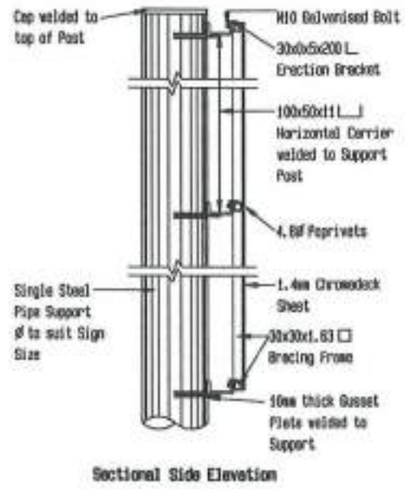
Rear Elevation of Back Plate for Overhead Mounting on Cantilever/Gantry (as an Option)



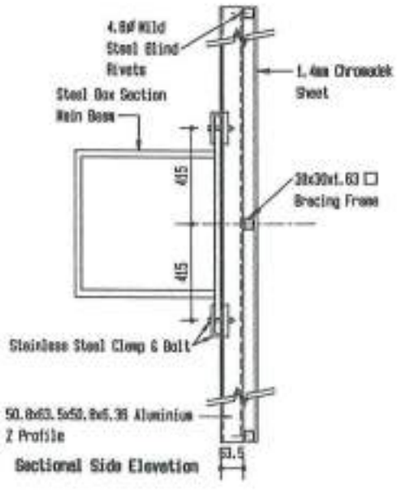
Sectional Side Elevation



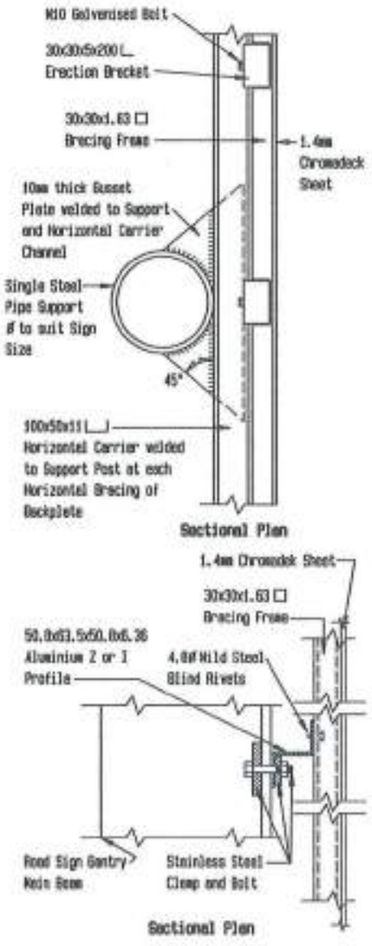
Sectional Plan



Sectional Side Elevation

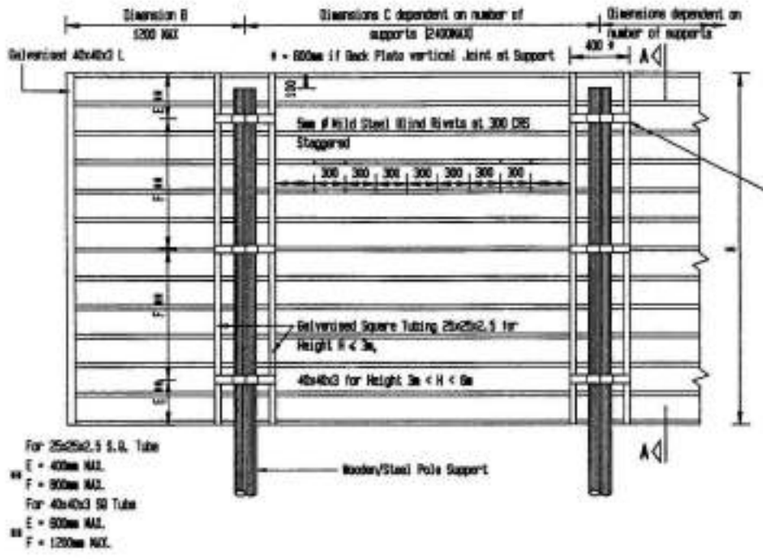


Sectional Side Elevation

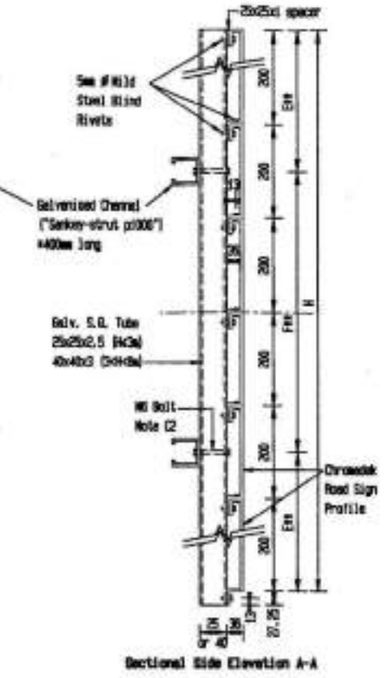


Sectional Plan

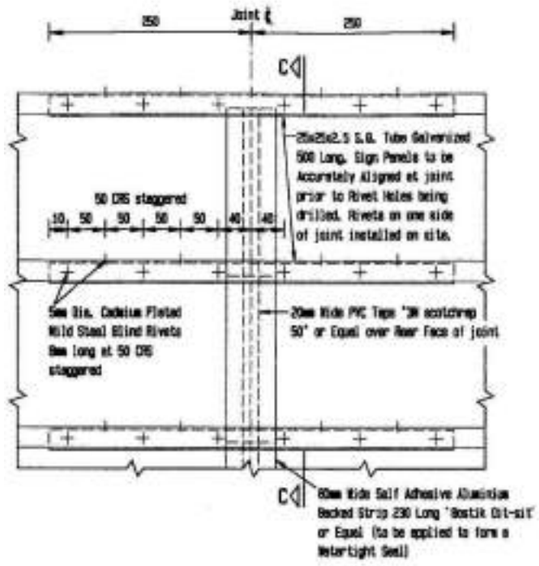
Fig 15.59
Road Traffic Signs >= 1,5 m^2 - Mounting Details and Options (Flat Sheet Chromadek)



Rear Elevation of Back Plate for Ground Mounting



Sectional Side Elevation A-A



Rear Elevation of Vertical Joining Detail

MOTES:

A. STANDARD SIGN PROFILE

1. The Standard Sign Profile shall be made from 1mm thick prepainted galvanized mild steel substrate ("Chromadek" or equal approved).
2. Preparation and painting shall be carried out in accordance with CKS 183-1977 and the paint system shall be as follows, as indicated on the drawings or directed by the engineer :-
   (i) Type "A" back plates (all cases other than type "B" below):- Silicone polyester system having a nominal 20 micron dry film thickness on the front face and a standard half-coat polyester as a backing coat. Where the sign is to be covered with retro-reflective material. The front face may be finished with a primer coat ("Chromaprep" or equal)
   (ii) Type "B" back plates (signfaces to be erected in marine or chemically pollutad corrosive environments):- PVC plastisol system having a 150 micron min. dry film thickness on each side of the sheet. The coat on the back face of the sign profile shall be grey in colour, 629 to SABS 1091 or similar.
3. The prepainted sheet shall be cut to length to a tolerance of + 2mm prior to profiling.
4. Where standard sign profiles are to be faced with retroreflective background material, application shall be carried out as for aluminium extrusions as specified in clause 5603(d) of the standard specifications.
5. Reference must be made to the relevant road sign detail drawings for details of the symbols and legend for each individual sign.
6. Measurement and payment of the backplates shall be in accordance with clause 5609 of the standard specifications. An "Extra over" rate shall be applicable for type "B" back plates.
7. A sign which exceeds 6m in length may be manufactured in two sections. The joint shall be made in accordance with details shown for vertical joining.

B. JOINT

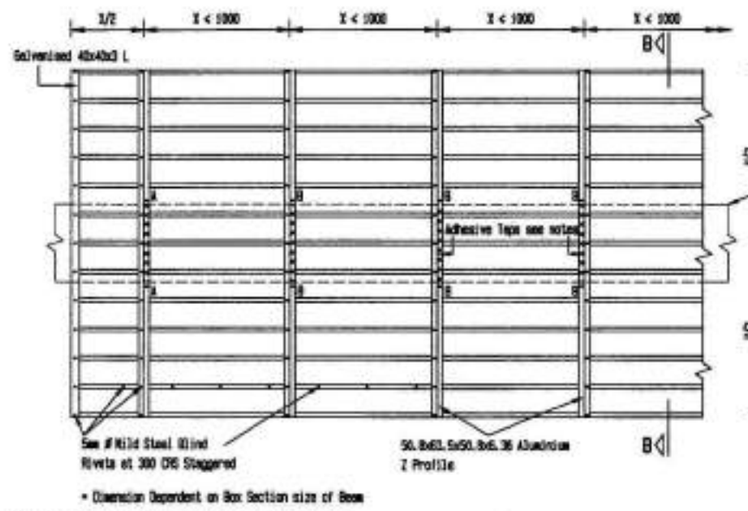
1. The joint shall be accurately aligned prior to drilling of rivet holes.
2. The gap between the adjoining halves of the sign shall at no point exceed 2mm.
3. The completed sections shall be assembled in the factory prior to delivery to site to ensure that all sections fit together properly and that legends are properly spaced and aligned.
4. At site the two sections shall again be aligned and fastened together by means of rivets placed in the pre-drilled holes.

C. STRUCTURAL STEEL SECTIONS

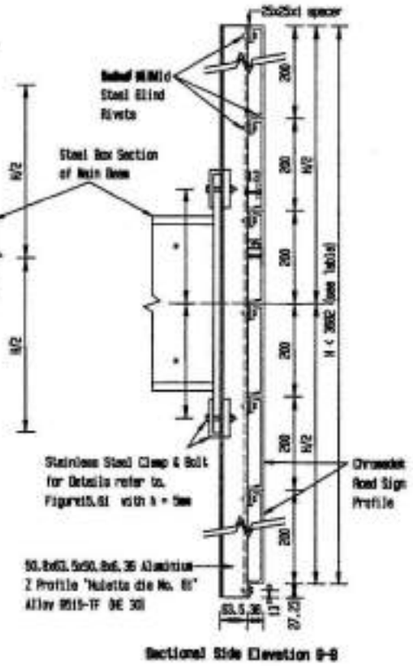
1. Shall be of mild steel conforming to the requirements of section 7100 of the standard specifications. Rectangular hollow sections and special channel profiles may be cold formed of commercial quality mild steel.
2. Bolts, Washers and nuts shall be as follows:- Type "A" sign back plates: Galvanized steel bolts complying with the requirements of clause 5602 (b) of the standard specifications. Type "B" sign back plates: Stainless steel bolts grade 304 manufactured to SABS 135. Nuts for both type "A" and type "B" sign back plates shall be selflocking "Nyloc" or equal approved.
3. Blind rivets shall be 5mm dia. cadmium plated mild steel.
4. All steel sections shall be hot dip galvanized in accordance with clause 7105 (i) of the standard specifications after manufacture.

D. SUPPORT, BASE AND FOUNDATIONS

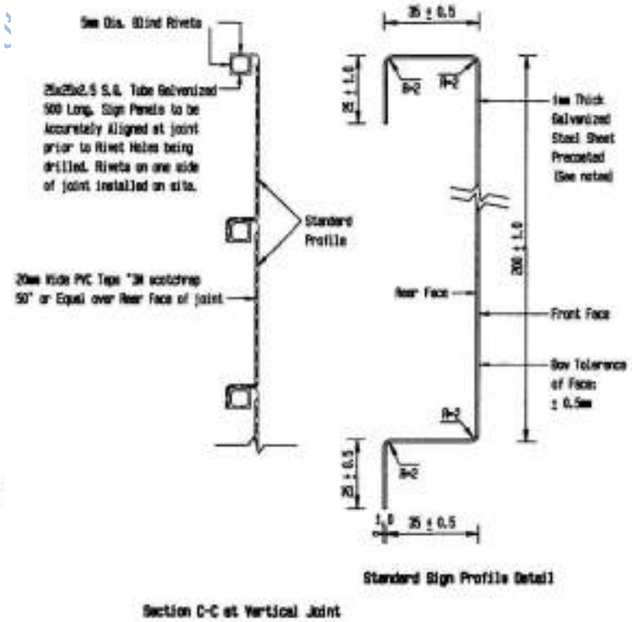
1. For Single Support, base and foundation details see Figure 15.22.
2. For Multiple support, base and foundation details see Figure 15.54.
3. For overhead gantries see NDOT standard design details.



Rear Elevation of Back Plate for Overhead Mounting (as an option)



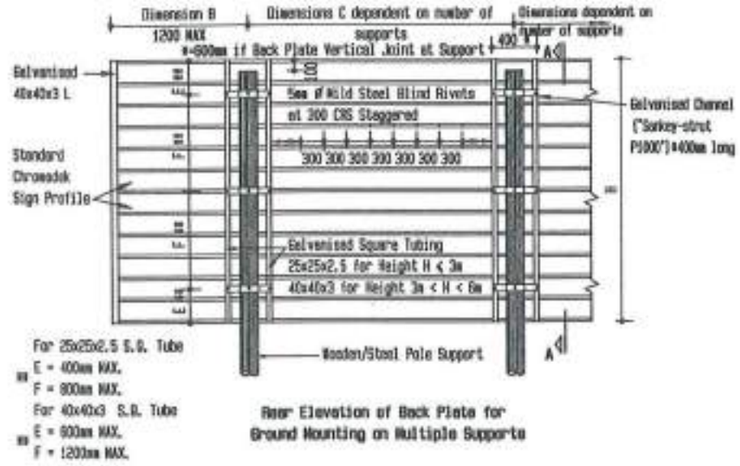
Sectional Side Elevation B-B



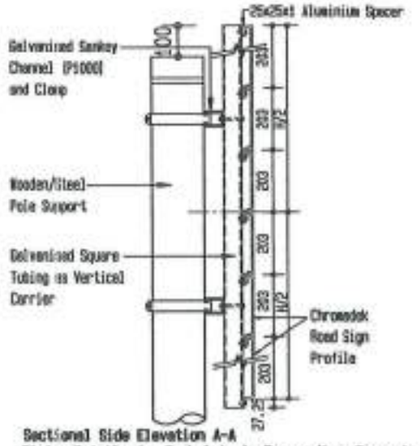
Standard Sign Profile Detail

Section C-C at Vertical Joint

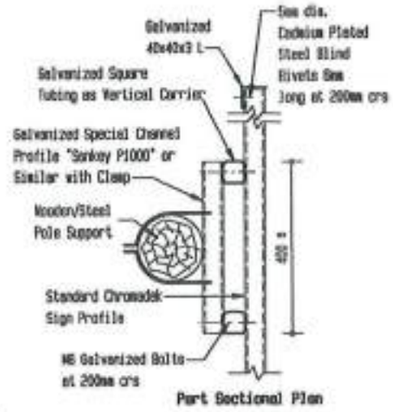
Fig 15.60
Road Traffic Signs >= 1,5 m^2 -
Back Plate and Bracing Details
(Stacked Chromadek Profiles)



Rear Elevation of Back Plate for Ground Mounting on Multiple Supports

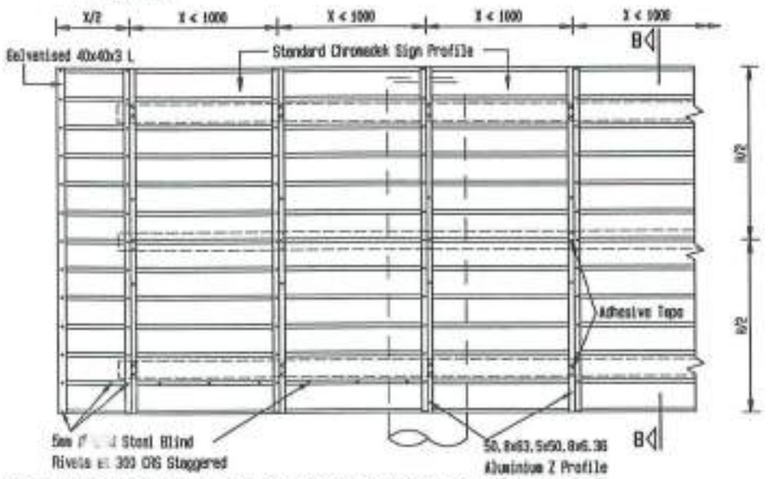


Sectional Side Elevation A-A
Fixing Details for Backplate to Two or More Supports

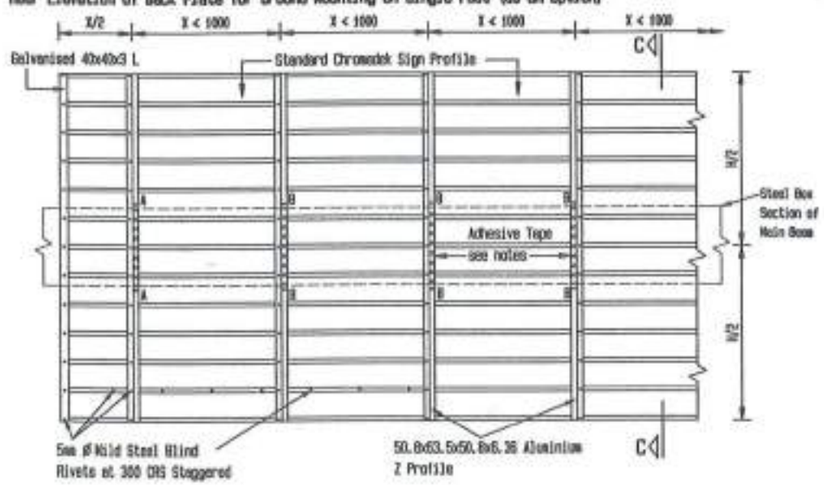


Part Sectional Plan

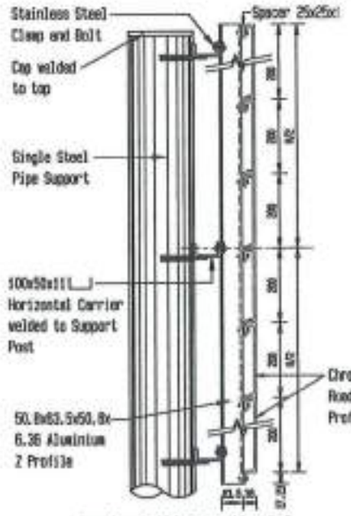
NOTES:
The Road Signs shall be manufactured and erected in accordance with the relevant clauses of Section 5600 of the standard specifications as well as the following requirements:
1. Bolts, Washers and Nuts shall be as follows:
   Galvanised Steel Bolts complying with the requirements of clause 5602(b) of the standard specifications under normal conditions.
   Stainless Steel Bolts grade 304 manufactured to SANS 136 for use in marine or chemically polluted corrosive environments.
   Nuts for both bolt types shall be selflocking "Nyloc" or equal approved.
2. Blind Rivets shall be 5mm DIA Cadmium Plated Mild Steel and Pop Rivets must match colour of Sign Face.
3. Corrosion Protection Tape to be applied to all mating surfaces between steel and aluminium or as instructed by the Engineer.
4. For Sign Back Plate and Bracing Details see Figure 15.60.



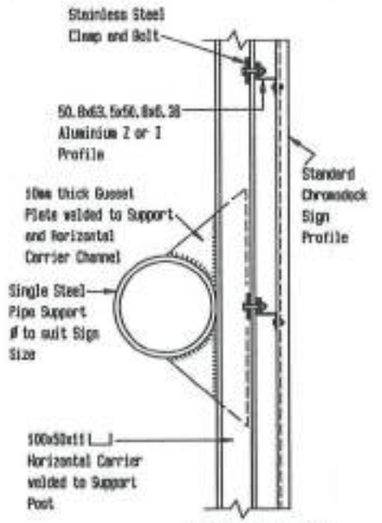
Rear Elevation of Back Plate for Ground Mounting on Single Post (as an option)



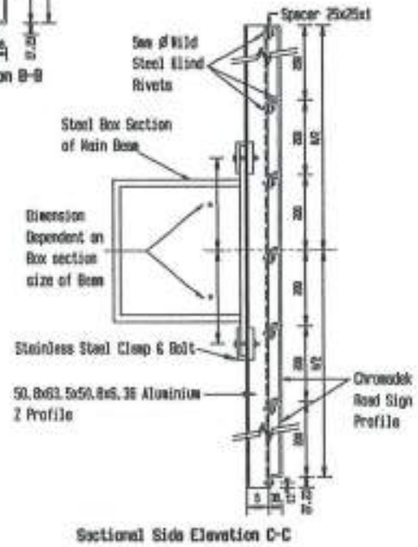
Rear Elevation of Back Plate for Overhead Mounting on Cantilever or Portal Structure (as an option)



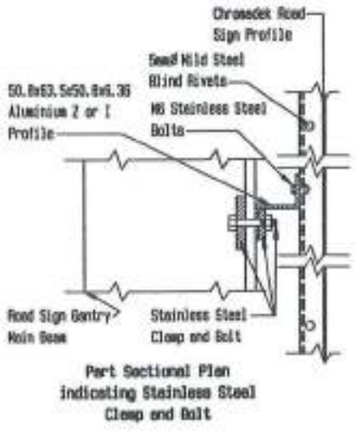
Sectional Side Elevation B-B



Part Sectional Plan

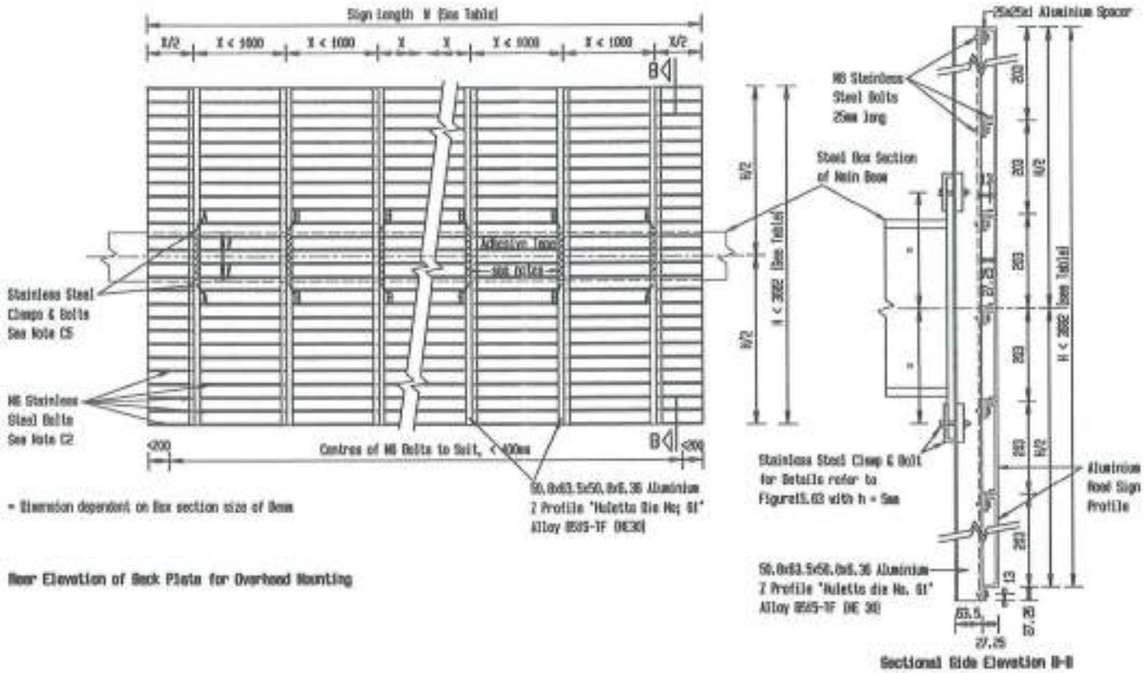


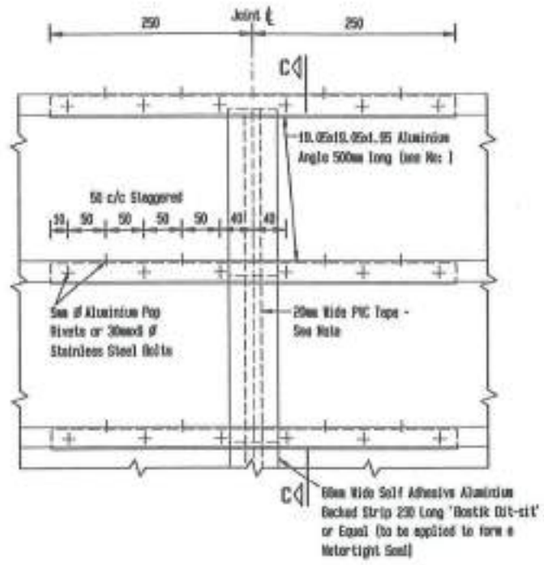
Sectional Side Elevation C-C

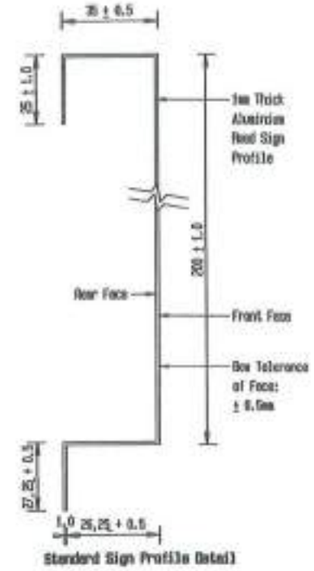


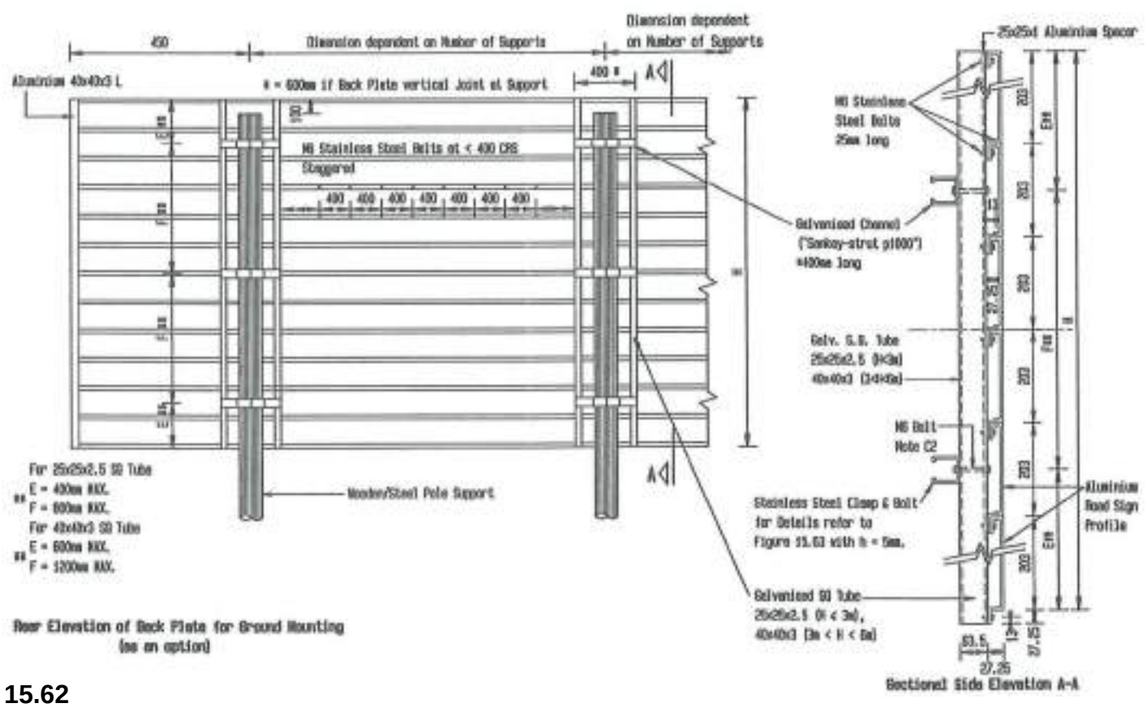
Part Sectional Plan indicating Stainless Steel Clamp and Bolt

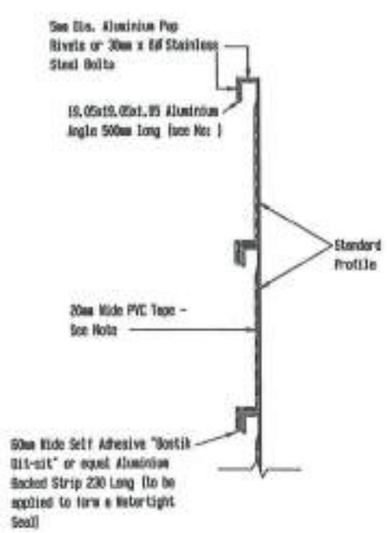
Fig 15.61
Road Traffic Signs >= 1,5 m^2 - Mounting Details and Options (Stacked Chromadek Profiles)











NOTES:

A. STANDARD SIGN PROFILE

1. The Standard Sign Profile shall be made from Grade 6063 Aluminium Alloy to BS1474 (NE8) standards, "ALNEX OSE No. L20403".
2. Where standard sign profiles are to be faced with retroreflective background material, application shall be carried out as for aluminium extrusions as specified in clause 5603 (d) of the standard specifications.
3. Reference must be made to the relevant road sign detail drawings for details of the symbols and legend for each individual sign.
4. Measurement and payment of the sign faces shall be in accordance with clause 5609 items 56.01 (b) and 56.02 of the standard specifications.
5. A sign which exceeds 5m in length may be manufactured in two sections. The joint shall be made in accordance with details shown on the drawing.

B. JOINT

1. The joint shall be accurately aligned prior to drilling of rivet or bolt holes.
2. The gap between the adjoining halves of the sign shall at no point exceed 2mm.
3. The completed sections shall be assembled in the shop prior to delivery to site to ensure that all sections fit together properly and that legends are properly spaced and aligned.
4. At site the two sections shall again be aligned and fastened together by means of rivets placed in the pre-drilled holes.
5. "3M SCOTCHRAP 50" PVC TAPE or equal covered by "BOSTIK DIT SIT" aluminium backed adhesive tape over rear face of joint.

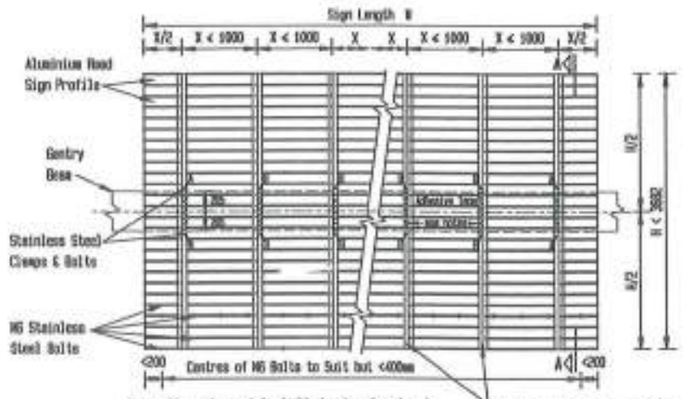
C. STRUCTURAL SECTIONS

1. Aluminium Z Extrusions shall be of Grade 6565-TF Alloy to BS 1474 (NE30), "HULETTS DIE No. 61".
2. Bolts, washers and nuts shall be as follows:-
   Stainless steel bolts grade 304 manufactured to SABS 136.
   Nuts shall be selflocking 'Nylon' or equal approved.
3. Blind rivets shall be 5mm dia. Aluminium.
4. Aluminium faces in contact with gantry faces shall be covered with a double layer black Polyvinyl Chloride plastic adhesive tape "3M SCOTCHRAP 50" or equal. Width of tape x 50mm and total thickness x 500mm.
5. Each individual overhead sign shall be erected and secured in position by means of the 4 clamps marked A the holes for clamps marked B shall be marked off and drilled once the sign boards have been erected and secured in position.

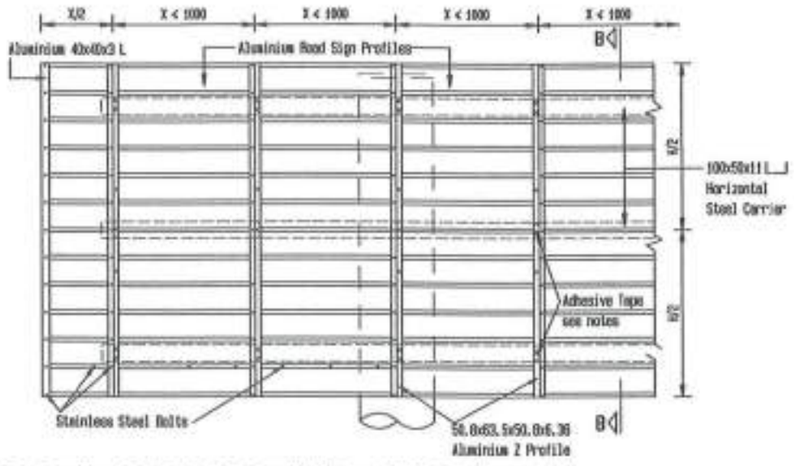
Fig 15.62
Road Traffic Signs >= 1,5 m² - Back Plate and Bracing Details (Stacked Aluminium Profiles)

NOTES:
The Road Signs shall be manufactured and erected in accordance with the relevant clauses of Section 9800 of the standard specifications as well as the following requirements:

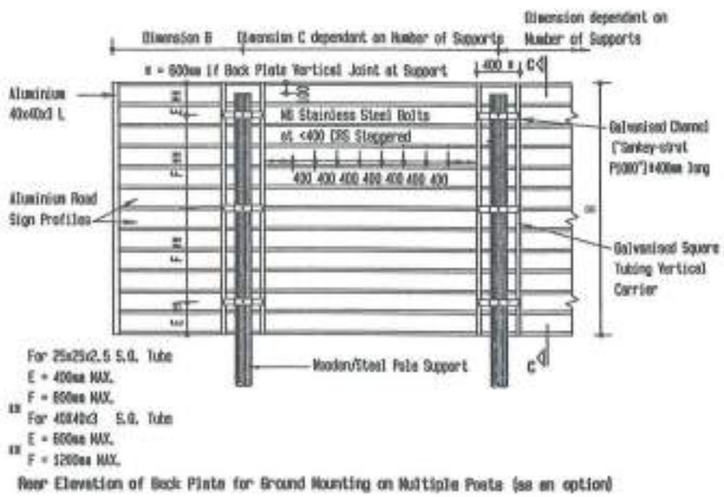
1. Bolts, Washers and Nuts shall be as follows:
   Galvanised Steel Bolts complying with the requirements of clause 9602(b) of the standard specifications under normal conditions.
   Stainless Steel Bolts grade 304 manufactured to SABS 136 for use in marine or chemically polluted corrosive environments.
   Nuts for both bolt types shall be selflocking 'Nyloc' or equal approved.
2. Blind Rivets shall be Sea DIA Cadmium Plated Mild Steel and Pop Rivets must match colour of Signface.
3. Reference must be made to the relevant road signface detail drawings for details of the symbols and legend for each individual signface.
4. Corrosion Protection Tape to be applied to all mating surfaces between steel and aluminium or as instructed by the Engineer.
5. For Back Plate and Bracing details see Figure 15.62.
6. For single, support, base and foundation details see Figure 15.22.
   For multiple support, base and foundation details see Figure 15.54
   For overhead gantry details see NOOI standard design details.



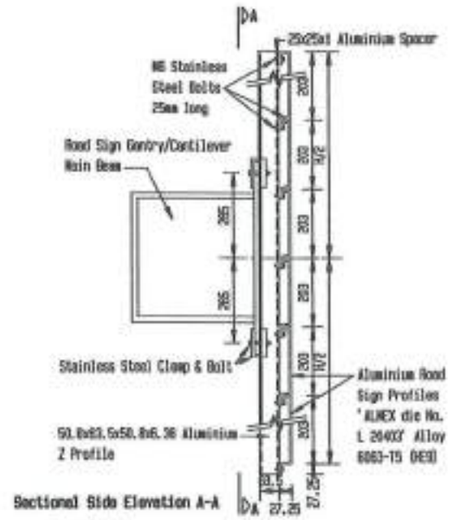
Rear Elevation of Back Plate for Overhead Mounting on Cantilever/Gantry Structure



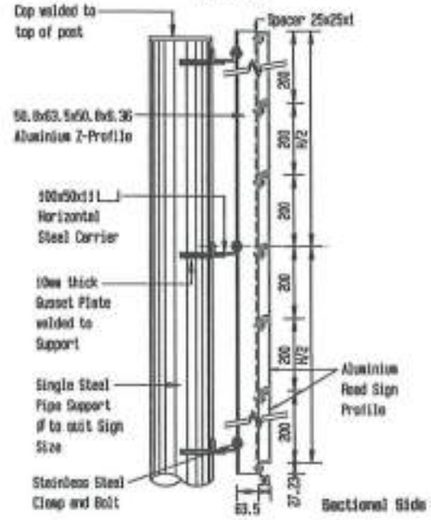
Rear Elevation of Back Plate for Ground Mounting on Single Post (as an option)



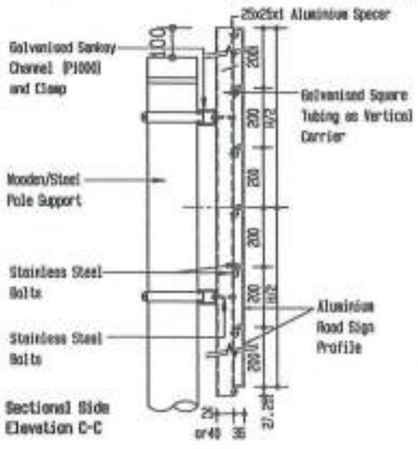
Rear Elevation of Back Plate for Ground Mounting on Multiple Posts (as an option)



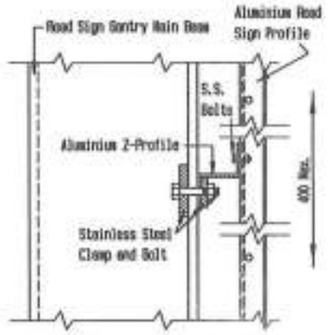
Sectional Side Elevation A-A



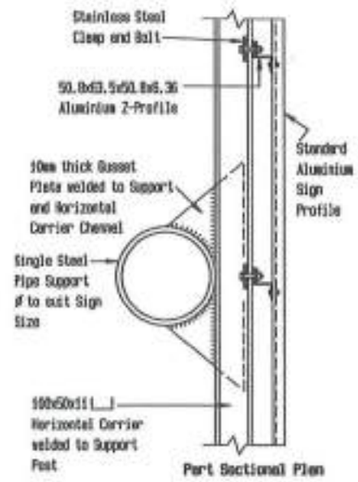
Sectional Side Elevation B-B



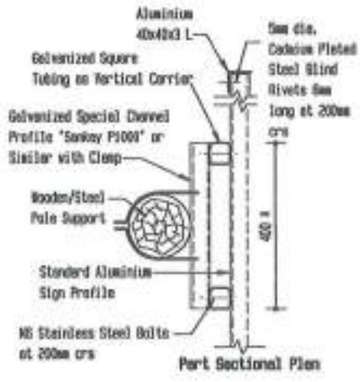
Sectional Side Elevation C-C



Part Sectional Plan indicating Stainless Steel Clamp and Bolt



Part Sectional Plan



Part Sectional Plan

Fig 15.61
Road Traffic Signs >= 1,5 m^2 - Mounting Details and Options (Stacked Aluminium Profiles)

15.8 DESIGN AND IMPLEMENTATION – OVERHEAD MOUNTED SIGNS

15.8.1 General

1 The design of structures for supporting overhead signs should normally be carried out by a structural engineer. Some roads department have, however, standardised the design procedure within specified ranges of parameters. The National Department of Transport has been using a booklet entitled *"Standard Designs for Overhead Sign Structures"* for some time.

2 This section summarises certain of the information contained in this booklet. Although a number of the design codes used in the booklet are somewhat dated, the design procedure described is perfectly adequate for most standard requirements. For more details designers should consult the material in the booklet.

3 The Department of Transport also has, in support of the booklet, a set of standard plans in their SP-B series which facilitate the design of the more common overhead sign support structures used in South Africa. Extracts from two of these drawings are included in this section, namely:

(a) drawing SP-B-4-1, as Figure 15.64,indicating clearances and Table 15.24 giving a list of applicable drawings for Portal Type Sign Gantries;

(b) drawing SP-B-4-21,as Figure 15.65, indicating clearances and Table 15.25 giving a list of applicable drawings for Cantilever Type Sign Gantries;

4 The following types of overhead sign structures are used to support road signs:

(a) portal structures consisting of vertical columns and horizontal beams;

(b) cantilever structures with vertical column and a cantilever beam extending over the traffic lanes.

5 The Department of Transport's set of drawings covers all of the following aspects:

(a) clearance distances;

(b) design loads and appropriate SABS codes;

(c) design aids and charts;

(d) detail drawings;

(e) examples to illustrate the use of design chart.

15.8.2 Clearances

1 The minimum overhead clearance measured to the underside of the sign face shall be 5,7 m. Possible future lanes must be taken into consideration when establishing the position of the minimum clearance point. It is recommended that the pre-camber of the main beam should not be included in the calculation of the overhead clearance.

2 The required horizontal clearance to the face of the left column measured from shoulder breakpoint is, for both types of structure, as follows:

(a) when guardrails are provided: 1,2 m;

(b) at collector-distributor lanes: 2,0 m;

(c) all other cases: 4,5 m.

3 On single carriageway roads the required horizontal clearance to the right column of a portal type structure is identical to that for the left column.

4 For dual carriageway roads the right column is normally located at the centre-line of the median with the following provisions:

(a) at narrow medians (median island < 8,6 m) where the clearance measured from the shoulder breakpoint to the face of the column < 4,1 m guardrails shall be provided;

(b) at wide medians (median island ≥ 9,4 m) the horizontal clearance to the face of the column shall be ≥ 4,5 m;

(c) where guardrails are provided the clearance to the face of the column shall still be a minimum of 1,2 m.

5 The location of the columns on outside shoulders present no geometric problems for normal cut or fill conditions. For cut slopes ranging between 1:1 and 4:1 the footings should be specially designed and positioned to suit local conditions and requirements.

15.8.3 Design

1 The structures must be designed in accordance with the provisions of the National Building Regulations with particular reference to the latest version of the following SABS Design Codes:

(a) SANS 10160: The General Procedures and Loading to be adopted in the Design of Buildings
(b) SANS 10162: Code of Practice for the Structural Use of Steel
(c) SANS 10100: Code of Practice for the Structural Use of Concrete
(d) SANS 10163: Code of Practice for the Design of Timber Structures

2 The structures must be designed for the following loads:

(a) mass of the structure and sign;

(b) the appropriate wind loads as specified in SANS 10160; the standard design methods and design charts are based on a wind loading of the 1,5 kN/m^2 acting on the vertical surfaces of signs and gantries; the derivation of the wind load is expounded upon in Appendix A of the booklet *"Standard Designs for Overhead Sign Structures"*; also included in this Appendix A is the calculation of the wind forces in accordance with the latest edition of SANS 10160 for 40 m/sec and 45 m/sec winds;

(c) a horizontal collision load equivalent to a static load of 100 kNm acting 1.2 m above the base plate.

3 The design loads must be combined as described in paragraph 4.4.2 of SANS 10160 in accordance with the limit states design codes.

4 Allowable deflections for portal type structures are:

(a) the vertical deflection of the main beam must be compensated for by fabricating the member with a

continuous camber to a value approximately twice the deflection under mass loads only;

(b) the horizontal deflection of the main beam is limited to 1/200th of the span;

(c) the horizontal deflection of the columns measured at the column beam junction is limited to 1/100th of the column height under wind loading only. The horizontal deflection as a result of frame action under mass loads is limited to 1/350th of the column height.

5 Allowable deflections for cantilever type structures are:

(a) the horizontal displacement of the end of the beam is limited to 1/75th of the length of the cantilever;

(b) the horizontal displacement of the column beam junction is limited to 1/100th of the column height.

15.8.4 Analysis and Design Charts

1 The design graphs which are included in Appendix B of the booklet "*Standard Designs for Overhead Sign Structures*", provide design solutions to a wide range of spans, column heights, and sign areas to be supported on the structures.

2 The graphs in the booklet are necessarily arbitrary in terms of the wind loadings and allowance are not made for varying wind speeds, height above sea level and shielding factors depending on terrain category. It should be noted also that the design procedure and charts are most likely based on a permissible stress design code, while the current design code is based on a limit states method. Allowance is not made for example for the use of different grades of structural steel. These various factors can affect the design and economy of the structure significantly. For ultimate economy of design a rigorous purpose made design, where the above factors can be properly assessed can be recommended. The methodology of the design charts, and the range and limit of the structures which can be designed by using them still provide a very adequate standardised approach to structure design. For this reason the basic aspects covered by the booklet are repeated below. The various design details given in the booklet allow for designs to be carried out on blank copies of the drawings, on which the designer enters specific details relevant to the structure being designed. Some of these details, such as the signface dimensions come from outside the design procedure, whilst others are read from the various charts provided.

3 Charts are available for the design of portals and cantilever structures described in Subsection 15.8.5. The charts are based on the use of standard box steel sections.

4 The variables accommodated by the charts are:

(a) span;

(b) column height;

(c) area of signface (or sign length and position in the case of portal type structures);

(d) foundation size.

5 The following information for the fabrication of the structure is obtained from design charts SP-B-4-2, 4-4 or 4-6. (Examples in which the use of the charts is illustrated are reflected in Appendix B of the booklet):

(a) the section required;

(b) the minimum sign height required to prevent aerodynamic oscillation;

(c) the plate thickness and mass/lineal meter of the main beam and columns;

(d) the pre-camber to which the beam must be manufactured;

(e) the plate thickness and mass of the base plate and gusset plates;

(f) the diameter of the anchor bolts and mass of the anchor bolts groups;

(g) the minimum foundation width and height that could possibly be used, the maximum bearing pressure developed and the reinforcement required in the foundation slab and plinth of the actual foundation used.

15.8.5 Range and Limits of Standard Designs

1 The following ranges and limits are covered for portal type sign structures:

(a) spans varying between 16 m and 38 m to cover from a 2-lane to a 6-lane carriageway (where reduced horizontal clearances are applicable more lanes may be catered for);

(b) column heights varying between 6 m and 11 m to cover all conditions encountered where:

(i) height of sign face ≤ 3,6 m;

(ii) fill slope is 1:3 or flatter;

(iii) cut slope does not exceed 1:1;

(iv) super elevation = 6% when considered with the most adverse conditions defined above;

(c) signfaces located in any position on the structure within the following limits:

(i) height of the signface ≤ 3,6 m;

(ii) length of the signface ranges between 6 m minimum and a maximum equal to the length of the span less 4 m but not exceeding 22 m. (refer to Appendix B of the booklet for limits imposed by aerodynamic oscillation);

(d) three standard foundations with plinth heights varying between 0,8 m and 2,2 m on any one of the following foundation slabs:

(i) 6 m x 3,0 m x 0,8 m;

(ii) 6 m x 2,5 m x 0,8 m;

(iii) 6 m x 2,0 m x 0,8 m.

2 The following ranges and limits are covered for cantilever type sign structures:

(a) beam length varying between 5,67 m and 12,45 m;

(b) column height varying between 6 m and 9 m to cover all conditions encountered where:

(i) height of signface ≤ 3,6 m;

(ii) fill slope is 1:3 or flatter;

(iii) cut slope does not exceed 1:1;

(iv) super elevation = 6% when considered with the most adverse conditions defined above.

(c) area of road signface varying between 6 m^2 and 32 m^2 with the end of the signface positioned > 0,35 m beyond the end of the beam;

(d) two standard foundations with plinth heights varying between 0,8 m and 2,2 m on any one of the following foundation slabs:

(i) 5 m x 3,0 m x 0,8 m;

(ii) 5 m x 2,5 m x 0,8 m.

15.8.6 Detail Drawings

1 General arrangement drawings and a set of detail drawings are available in the booklet for the two types of overhead sign structures.

2 On the general arrangement, attention is drawn to:

(a) the stage at which the site welds shall be executed i.e.:

(i) before erection for cantilever type structures and;

(ii) after the structure has been erected and finally aligned for portal type structures.

(b) the required corrosion protection with chlorinated rubber paint system.

15.8.7 Structural Steelwork

1 The columns and beams of the portal and cantilever structures are manufactured from flat sheet of standard plate thickness. The end plates vary in thickness in accordance with the design requirements while the side plates remain constant.

2 Standard box sections used are the following:

(a) portal structures:

(i) 400 mm x 400 mm Square Hollow Section-Plate Thickness 6 mm -20 mm;

(ii) 500 mm x 400 mm Rectangular Hollow Section - Plate Thickness 8 mm -25 mm

(iii) 600 mm x 400 mm Rectangular Hollow Section - Plate Thickness 10 mm -25 mm;

(b) cantilever structures:

(i) 500 mm x 500 mm Square Hollow Section - Plate Thickness 8 mm -20 mm;

(ii) 600 mm x 500 mm Rectangular Hollow Section - Plate Thickness 10 mm -30 mm.

15.8.8 Foundations

1 The foundations consisting of plinths and bases are designed to support the loads to which the structural frames may subjected, including collision loads. **The factors of safety for overturning of foundations are:**

(a) ≤ 2,0 when subjected to wind loads only;

(b) ≤ **1,5 when subjected to wind and collision loads.**

2 Design details in the booklet drawings and reinforcement schedules are available for a number of standard bases. The bases are:

(a) portal structures:

(i) 6 m x 3,0 m x 0,8 m;

(ii) 6 m x 2,5 m x 0,8 m;

(iii) 6 m x 2,0 m x 0,8 m.

(b) cantilever structures:

(i) 5 m x 3,0 m x 0,8 m;

(ii) 5 m x 2,5 m x 0,8 m.

3 These foundations are detailed to accommodate plinth heights varying from 0,8 m minimum to 2,2 m maximum

4 The stability of the structure, when subjected to the maximum load conditions is dependent on the backfill on top of the foundation. It is therefore recommended that, if any doubt exists as to the true profile of the road prism, a foundation height greater than that reflected along line X - X on the design graphs be used. To eliminate errors and confusion during construction it is recommended that as far as practical the foundations for portal type structures should be made identical in width and height.

5 In the event that the plinth heights vary with the same width of foundation specified for both foundations in portal type structures, separate detail drawings will have to be prepared for the foundations since no allowance has been made in the bending schedule in the booklet for this arrangement.

6 A bending schedule is given in each foundation plan and the diameters of 4 bars are required (from the design graphs) before the schedule can be completed).

7 In addition, in the booklet a table is provided where the specific levels, foundation heights and bearing pressures can be indicated without adding to/or altering the actual details (see paragraph 15.8.4.2).

15.8.9 Anchor Bolts

1 Details for three types of standard anchor bolts are available. Types A and B are used with portal structures and Type C with cantilever structures.

2 Grade 4.8 steel is specified for the anchor bolts and nuts in preference to a higher grade steel (i.e. grade 8.8 for example) for the following reasons:

(a) welding during manufacture and construction can be tolerated on grade 4.8 steel;

(b) the error is not as serious if an anchor bolt group of lower strength, (e.g. grade 4.6) is erroneously supplied and installed.

3 A template is specified to be locked in position with each anchor bolt group supplied resulting in the following advantages:

(a) it will ensure that the anchor bolt group is not misaligned during transportation to the site;

(b) it will ensure that the centres of the anchor bolt group match the centres of the holes in the base plate.

15.8.10 Road Signfaces

1 Structural details given on the drawings in the booklet are

applicable only for signfaces having a height not exceeding 3,6 m. For details related to the signface symbols and legend reference is made to the relevant road drawings.

2 All aluminium sections and profiles used are standard profiles presently available from the manufacturers. Stainless steel bolts and washers with "nyloc" self-locking nuts are specified and no insulation need be provided where these bolts are in contact with the aluminium members.

3 Corrosive resistant brackets and bolts are used to secure the signface to the structure and in order to ensure proper alignment and securing of the signface an erection procedure is specified.

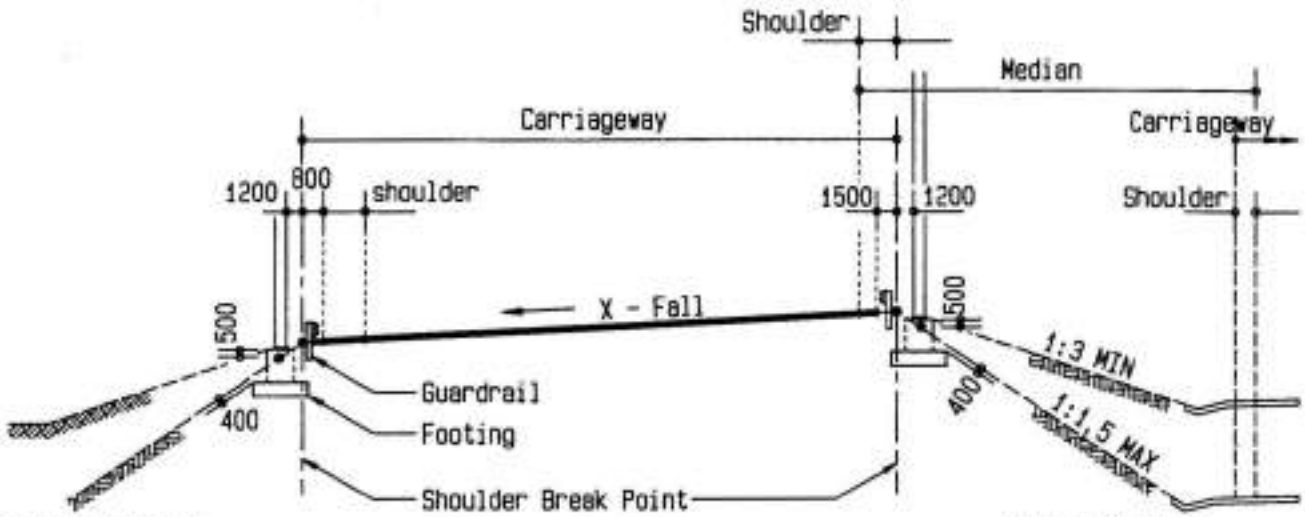
4 As in the case of other detail drawings in the booklet, a table is provided where the specific length and height of each separate signface can be indicated without adding to/or altering any figures.

TABLE 15.24 PORTAL TYPE SIGN GANTRIES TABLE 15.24

Subject		DoT Drawing Number
Clearances:		Drg. SP – B – 4 - 1
Design graphs:		
400 x 400 section	- structural steelwork	Drg. SP – B – 4 - 2
	- foundations	Drg. SP – B – 4 - 3
500 x 400 section	- structural steelwork	Drg. SP – B – 4 - 4
	- foundations	Drg. SP – B – 4 - 5
600 x 400 section	- structural steelwork	Drg. SP – B – 4 - 6
	- foundations	Drg. SP – B – 4 - 7
Examples of the use of design graphs		Drg. SP – B – 4 - 8
Detail Drawings:		
General Arrangement		Drg. SP – B – 4 - 9
Structural Steelwork		
400 x 400 section	- general details	Drg. SP – B – 4 – 10
	- sections and notes	Drg. SP – B – 4 – 11
500 x 400 section	- general details	Drg. SP – B – 4 – 12
	- sections and notes	Drg. SP – B – 4 – 13
600 x 400 section	- general details	Drg. SP – B – 4 – 14
	- sections and notes	Drg. SP – B – 4 – 15
Details of Anchor Bolts:		
Type “A” (400 x 400 section)		Drg. SP – B – 4 – 16
Type “B” (500 x 400 and 600 x 400 sections)		Drg. SP – B – 4 - 17
Details of Foundations:		
6 m x 3,0 m x 0,8 m		Drg. SP – B – 4 – 18
6 m x 2,5 m x 0,8 m		Drg. SP – B – 4 – 19
6 m x 2,0 m x 0,8 m		Drg. SP – B – 4 – 20
Detail of Road Signface (height ≤ 3600)		Drg. SP – B – 4 - 33

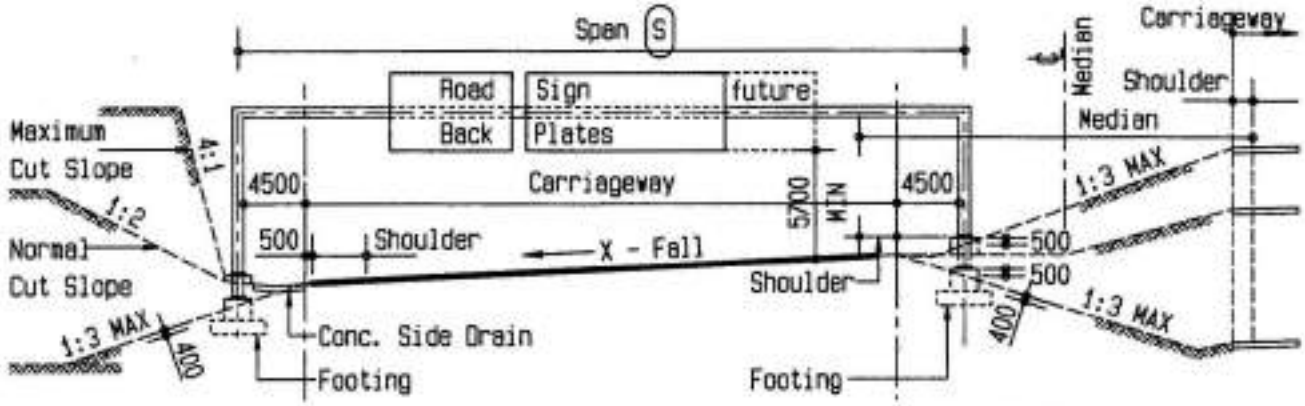
TABLE 15.25 CANTILEVER TYPE SIGN GANTRIES TABLE 15.25

Subject		DoT Drawing Number
Clearances:		Drg. SP – B – 4 – 21
Design graphs:		
500 x 500 section		Drg. SP – B – 4 – 22
600 x 500 section		Drg. SP – B – 4 – 23
Examples of the use of design graphs		Drg. SP – B – 4 - 24
Detail Drawings:		
General Arrangement		Drg. SP – B – 4 - 25
Structural Steelwork		
500 x 500 section	- general details	Drg. SP – B – 4 – 26
	- sections and notes	Drg. SP – B – 4 – 27
600 x 500 section	- general details	Drg. SP – B – 4 – 28
	- sections and notes	Drg. SP – B – 4 – 29
Details of Anchor Bolts:		
Type “C”		Drg. SP – B – 4 – 30
Details of Foundations:		
5 m x 3,0 m x 0,8 m		Drg. SP – B – 4 – 31
5 m x 2,5 m x 0,8 m		Drg. SP – B – 4 – 32
Detail of Road Signface (height ≤ 3600)		Drg. SP – B – 4 - 33



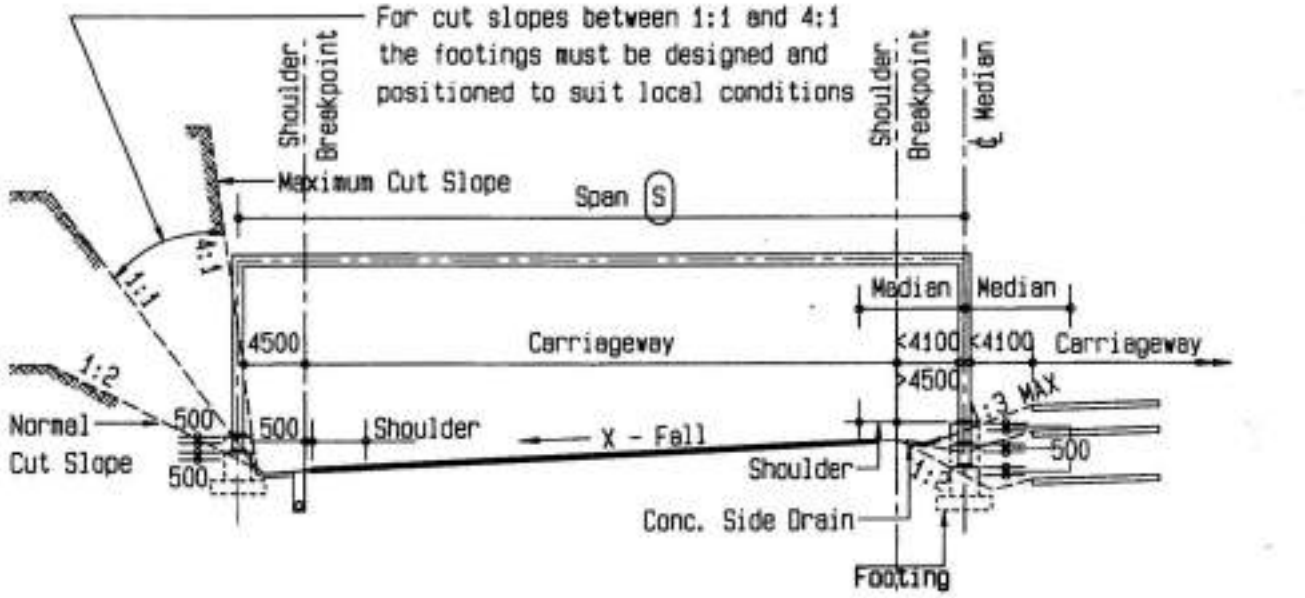
Detail 15.64.1
High Fill with Guardrail

Detail 15.64.2
Median With Guardrail



Detail 15.64.3
Outer Shoulder - No Guardrail

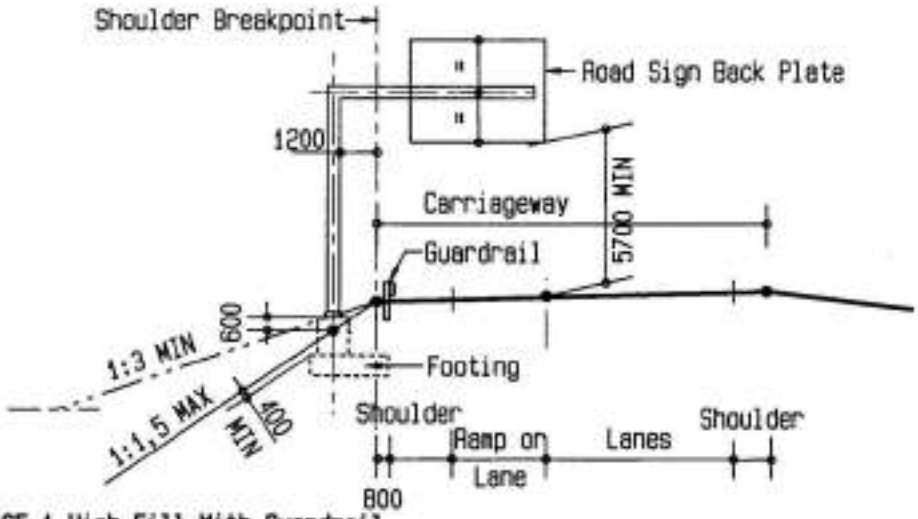
Detail 15.64.4
Wide Median - No Guardrail



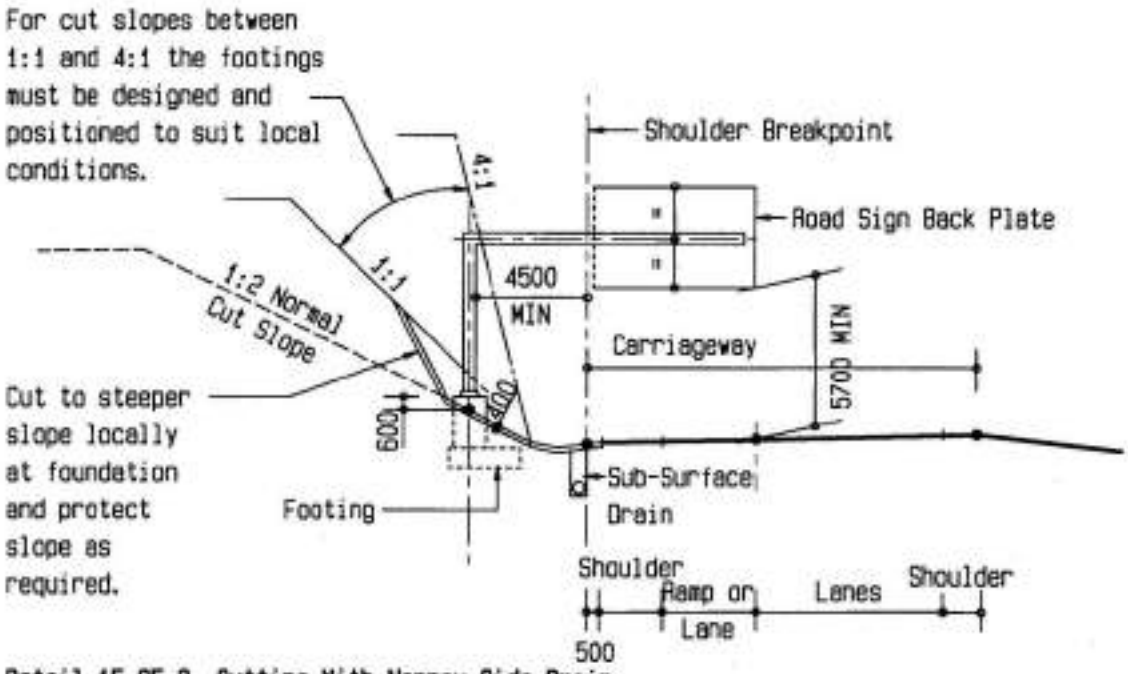
Detail 15.64.5
Cutting with Narrow Side Drain

Detail 15.64.6
Narrow Median - No Guardrail

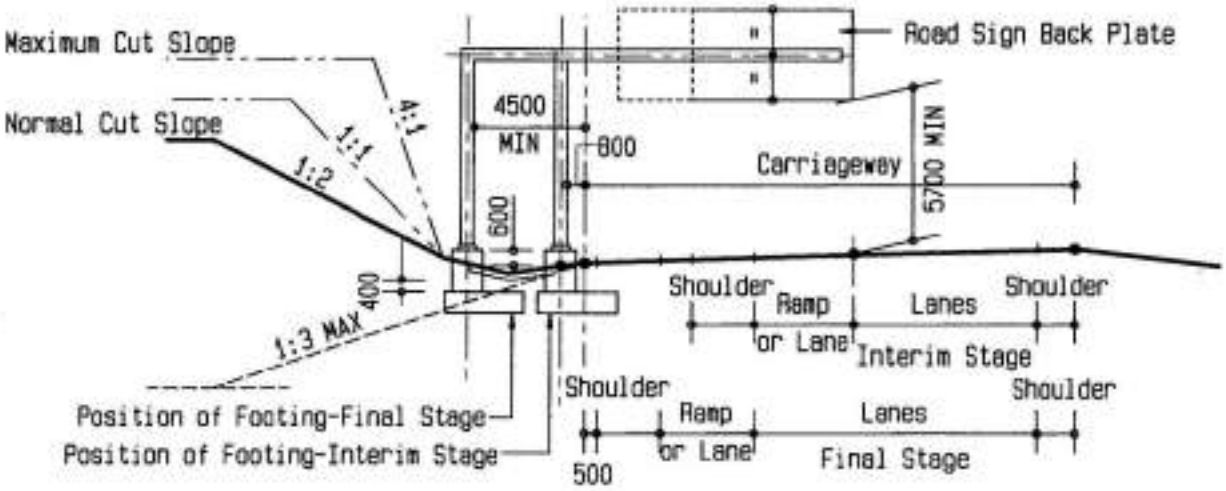
Fig 15.64 Overhead Portal Road Sign Structure Clearances



Detail 15.65.1 High Fill With Guardrail



Detail 15.65.2 Cutting With Narrow Side Drain



Detail 15.65.3 Normal Batter Slopes, Wide Side Drain and Allowance for Future Lane

Fig 15.65 Overhead Cantilever Road Sign Structure Clearances

ROAD SIGNS MANAGEMENT

SECTIONS

MAY 2012

CHAPTER 16

TITLE

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VOLUME SET	R		
Chapter 1	R	Chapter 11	R
Chapter 2	R	Chapter 12	R
Chapter 3	R	Chapter 13	R
Chapter 4	R	Chapter 14	R
Chapter 5	R	Chapter 15	R
Chapter 6	R	Chapter 16	R
Chapter 7	R	Chapter 17	R
Chapter 8	R	Chapter 18	R
Chapter 9	R	Chapter 19	R
Chapter 10	R		

CHAPTER 16:
ROAD SIGNS MANAGEMENT

CONTENTS

16.0.1 Sections and Subsections

16.0.2 Figures

16.0.3 Tables

CHAPTER 16:
ROAD SIGNS MANAGEMENT

16.1 INTRODUCTION

16.1.1 General

1 The purpose of this chapter is to give guidance to road authorities on the development of a Road Signs Management System. By maintaining road signs and markings cost-effectively, it ensures the functionality of these traffic control devices and protects them as a valuable asset. It also ensures that the increasing delictual claims against road authorities as a result of unserviceable road signs and markings are kept to a minimum.

2 When referred to, road signs in this chapter generally include road markings, however, specific issues with respect to road markings are addressed separately (see Chapter 18).

16.1.2 Road Management Systems

1 Road Management Systems (RMS) are formalised procedures used to assist the authority in assessing the current and future needs for maintenance, rehabilitation, upgrading and geometric improvements of the road system under the authority's jurisdiction. Road management comprises a number of diverse activities and in order to undertake the planning, organisation and control of these functions, some road authorities have developed a number of management systems to deal with these activities individually. The management system also forms the technical base for budgeting and application for funding.

2 A Road Signs Management System (RSMS) can be defined as a subsystem of a RMS which ensures the availability of accurate information concerning road signs on the road network.

3 The importance of a RSMS in this context has been acknowledged by the majority of the metropolitan and provincial road authorities in South Africa.

16.1.3 *Status Quo* of Road Signs Management

1 The road authorities in South Africa can be divided into different levels related to the institutional responsibilities of the different governmental levels, name:

(a) the Department of Transport / South African National Roads Agency - national and strategic roads;

(b) Provincial Road Authorities - provincial roads (nine provinces);

(c) Metropolitan Councils;

(d) Local Authorities.

2 The ability of these authorities to adequately manage and maintain the thousands of road signs on the road network depends on a systematic approach to the establishment of a RSMS.

3 The cost-effectiveness of a RSMS can only be tested when the ratio between resources (input) and output of benefits of existing systems are compared with those of a proposed effective RSMS, i.e. the implementation of an effective RSMS will ensure improvement in cost-effectiveness, not only for road users, but also for maintenance activities related to road signs.

4 Such a system is necessary to avoid deficiencies in the **planning, design, implementation and maintenance** stages of each road sign.

5 Deficiencies during any of these stages can result in a reduction in safety for motorists and increased liability exposure for road authorities. The timeous detection of these deficiencies is therefore essential and requires a committed effort, i.e. manpower and resources, from road authorities to fulfil the activities related to the implementation of a RSMS.

16.1.4 Motivation for a Road Signs Management System (RSMS)

1 The collection of relevant data, through prescribed procedures and methods, by authorised personnel, and the storage, processing and communication of the resulting information to the responsible people, can be described as an Information System.

2 With regard to road signs, data needs to be captured in a sign inventory and processed by an operational system to form the operational system. This information can then be extracted for use in the management of the road sign system through effective procedures.

3 The development of a RSMS is founded on the fact that, when a road authority knows:

(a) **what** it has invested in its road sign system;

(b) **when** it did so;

(c) **where** such investments are located;

(d) **what** is the **present condition** and expected **future condition** of each sign on the road network; and

(e) **what** is the **cost of maintenance** or rehabilitation of the road sign system;

it can more efficiently and effectively manage current and future investments in the system.

4 Through an effective RSMS it will then be possible to determine whether the road sign system:

(a) is incomplete;

(b) conforms or does not conform to the existing requirements;

(c) should be replaced; and

(d) performs according to acceptable norms.

5 In addition to the obvious advantages derived from the establishment of a RSMS, it is well known that road authorities at all levels are being affected by an upward trend in liability claims and insurance costs. The implementation of an effective RSMS will enable road authorities to act timeously in:

(a) identifying deficiencies in the road sign system;

(b) giving priority to corrective measures; and

(c) budgeting for and correcting the deficiencies.

16.1.5 Elements of a RSMS

1 Although the approach towards the development of a RSMS may differ for urban, provincial and national road networks, the elements and principles in applying such a system are the same. These elements are (see also Table 16.1):

(a) **Planning and Policy Formulation** which describes the necessary steps to firstly, establish a road signs system according to the standards and requirements in Volume 1, and secondly, to form a basis of information for the implementation of an effective RSMS - these steps are:

(i) definition of the road network within the boundaries of the road authority;

(ii) classification of roads on the network, i.e. the road hierarchy with respect to road signing;

(iii) classification of intersections according to intersecting road classes;

(iv) development of a route and guidance sign system for national, provincial and metropolitan road networks; this includes a route numbering system and the selection of destinations;

(v) the level of road sign information provision at different classes of intersections and on road links;

(vi) choice of road sign material to be applied on different classes of roads and intersections and in areas of different ambient lighting (refer to Volume 2, Chapter 17);

(vii) the standards of the substructure of road signs, i.e. footings, poles and framework (refer to Volume 2, Chapter 15);

(viii) installation guidelines for road signs;

(ix) the formulation of a policy which includes all the above mentioned aspects as they pertain to the appropriate road authority;

(b) **System Design** of road signs according to the requirements and guidelines provided in Volumes 1, and 2; this gives the layout of signs at intersections and the destination names in all directions as well as the type of road signs along road links; it normally consists of the diagrammatic layout of existing signs at an intersection on a road link and the proposed layout, should this differ;

(c) **Detail Design** of road signs, taking into account the actual conditions of the site where they will be erected (see Volume 4 for details of road sign signface detail design);

(d) **Implementation** of the road signs according to standard specifications and special conditions, normally handled as part of the Tender phase;

(e) the continuous **Maintenance and Rehabilitation** of road signs;

(f) **Schedule and Programme** for replacement of signs - cost control and budgeting from part of this element.

TABLE 16.1 STEPS TO IMPLEMENT AN RSMS TABLE 16.1

Step	Description of Activities	Deliverable
STEP 1: Formulate road sign policy	• Network definition • Road classification • Route and Guide Sign System - route optimisation - route numbering - route description • Selection of orientation names • Tourism/Facility signs policy • Level of road sign provision (primary and secondary) • Choice of road sign materials • Substructure details • RTA/SADC-RTSM code numbers • Map, diagram or GIS • Letter types and sizes • Maintenance policy for road signs	A policy document that can be used as a manual to communicate policies from the management team through to the labourers in the field and back (vertical) and also to other departments and road authorities (horizontal). INPUT TO LIBRARY MODULE
STEP 2: System design of road signs	• Reference system for road signs • System information - existing signs (use information from step 4) • Application of policy guidelines • Site layouts, lane confirgurations and special conditions • Prepare system design systematically • Link system design to GIS if available	A system design document that describes the function, positioning, type and layout of road signs at each site along the road network. INPUT TO LIBRARY MODULE
STEP 3: Detail design of road signs	• Use policy guidelines and system design to prepare detail design of road signs • Link detail design through CAD to GIS if available Note: It is normally only necessary to prepare detail designs for guidance signs, as regulatory and warning signs can be described in detail by code numbers	A detailed design of all road signs on the road network - CAD drawings. INPUT TO INVENTORY MODULE
STEP 4: Inventory of road signs	• Capturing of data as described • Link to GIS database if available	INVENTORY MODULE
STEP 5: Maintaining of road sign performance and maintenance procedures	• Note: It is normally only necessary to prepare detail designs for guidance signs, as regulatory and warning signs can be described in detail by code numbers • Capturing of maintenance data through the maintenance procedures • Update information to inventory module • Link data to GIS database	MAINTENANCE / MONITORING MODULE
STEP 6: Management of road sign system	• Extract information from database and GIS • Enquiries through computerised system • Prepare reports as requested to support decision-making	EXECUTION MODULE

16.2 IMPORTANCE OF ROAD SIGNS MANAGEMENT (RSM)

16.2.1 General

1 Road signs play an essential part in **regulating** traffic, **warning** traffic of hazardous situations ahead, and providing **guidance** and general **information**.

2 Management of this asset on the road system is of utmost importance, but perhaps it is most clearly emphasised in court decisions in the United States of America [1] in the late 1980's which made it clear that:

(a) failure to be aware that a traffic control device is defective will not protect the transportation agency from tort liability - unless the agency can show that it has an on-going programme to discover and correct ineffective devices - this task should be clearly stated in job descriptions;

(b) a detailed log should be kept for every traffic sign - this information is necessary for legal purposes and for planning replacements - the log will also be useful in determining which products and materials are most cost effective - a good record system will list the sign type, date of installation, type of support and maintenance or replacement activities.

The benefits in the field with regard to road traffic accidents are obvious. In the US Department of Transportation 1998 Annual Report on Highway Safety Improvement Programs [4], a report on the highway environment as it relates to safety, improvements in traffic signing are reported as having the highest benefit-cost (B/C) ratio of any type of highway safety improvement. From data received from 50 states, road signs achieved a top ranking with a B/C of 20,9 out of 20 different improvement types, as shown in Table 16.2.

3 If road signs are incorrect, or incorrectly placed, and cannot convey the proper message, the traffic rules cannot be enforced. The direct consequence could be an increase of traffic hazards and an increase in the number and severity of accidents.

4 An effective RSMS will improve the productivity in the fields of planning, design, implementation and maintenance operations of the personnel involved with these tasks. Maintenance teams, for example, can be supplied with full details of the maintenance task to enable them to execute the task with maximum efficiency.

5 In view of the afore-mentioned benefits, it becomes clear that the role of a RSMS within a RMS cannot be ignored, and every road manager should strive to capitalise on the proven advantages of a RSMS.

TABLE 16.2 TOP 20 TYPES OF HIGHWAY SAFETY IMPROVEMENTS TABLE 16.2

Rank	Improvement Type	Benefit Cost Ratio
1	Trafic Signs	20.9
2	Illumination	10.3
3	Upgraded Guardrail	8.1
4	Upgraded Median Barrier	7.0
5	Upgraded Bridge Rail	6.5
6	Obstacle Removal	6.4
7	Bridge-Guardrail Transition	6.3
8	New Median Barrier	5.4
9	New Traffic Signals	5.1
10	Minor Structure Improvement	4.5
11	Impact Attenuators	4.0
12	Upgrade Traffic Signals	4.0
13	Pavement grooving	3.8
14	Sight Distance Improvements	3.6
15	Median Strip	3.3
16	Railway Crossing – New Gates	2.8
17	Channelisation	2.8
18	Shoulder Widening/Improvements	2.6
19	Railway Crossing – New Lights	2.2
20	Railway Crossing – New Lights and Gates	2.1

16.3 MAINTENANCE

16.3.1 General

1 The efficient maintenance or rehabilitation of road signs is an important element of a RSMS which will not only ensure the continuous functionality of the road sign system, but will also contribute to the protection of this valuable asset of the road system.

2 Suitable maintenance policies and procedures need to be established by road authorities to ensure:

(a) safety of the road users;

(b) control and setting of priorities for maintenance activities;

(c) up to date information on the condition of road signs;

(d) an acceptable maintenance level of service for road signs.

3 The maintenance level of service (MLOS) for road signs set by road authorities depends on the importance/classification of a road section. The selected MLOS will directly affect the maintenance activities and decisions on where, when and how much maintenance is required and how available resources should be utilised.

4 The maintenance policy set by road authorities needs to be spelled out and forms part of the road signs policy document. Examples of policy statements in this regard are:

(a) minimum standards for the retroreflectivity, colour and luminance factor of signs;

(b) immediate replacement criteria for certain types of damaged signs, while others can be replaced as soon as practical or according to a maintenance programme;

(c) record keeping of accurate maintenance actions and costs;

(d) cleaning of and clearing around road signs;

(e) painting/maintenance of substructures to prevent rusting;

(f) handling of signs during transportation from factory to store to site;

(g) procedures to order, purchase and keep records of road signs;

(h) handling of complaints regarding road signs from road users.

5 A wide variety of documentation on the subject of how to maintain road signs is available locally and abroad, which can be used by road authorities to assist in formulating their maintenance policies for road signs.

16.4 DEVELOPMENT OF A ROAD SIGNS MANAGEMENT SYSTEM

16.4.1 General

1 The function of a road signs information system which forms part of the RSMS is to provide information on each road sign on the total road network with regard to the different aspects of planning, implementation, monitoring, maintenance and replacement of road signs. This information can then be utilised to establish tendencies for different characteristics of road signs to enable managers of the system to take decisions for management actions. After identifying the proposed prerequisite elements of a RSMS in Section 16.1.5, this section concentrates on the step by step development of a proposed RSMS.

16.4.2 Typical Components of a RSMS

1 The following requirements for an information system have been identified to ensure efficiency of the system, namely:

(a) a dedicated team to manage the road sign system on the roads within the authority's boundary;

(b) a map of the area and classification of the road network (available on either hard copy or GIS);

(c) the position of each road sign indicated on the map or as per system design (diagrammatic layout per intersection or road link);

(d) an inventory of the characteristics, attributes and history of each road sign (computerised database); and

(e) description and layout of the road sign face (sketch, photograph or detailed drawing).

2 The information system should be supported by:

(a) prescribed procedures for the processing/updating of data;

(b) a computerised database of sign information (linked to a GIS if available);

(c) computer equipment (hardware) to process the data;

(d) computer software programs to assist in the running of the RSMS;

(e) the operational system.

3 The afore-mentioned components form part of a typical computerised RSMS which could be divided into the following modules for implementation purposes:

(a) Inventory module;

(b) Library module;

(c) Maintenance/Monitoring module;

(d) Execution module.

16.4.3 Inventory Module

1 This module consists of the database of relevant data for each sign and it has to be designed properly to ensure that:

(a) information can be easily captured, maintained and extracted;

(b) priorities/weights can be allocated to certain attributes of road signs and set criteria for the extraction and evaluation of information;

(c) the data is compatible with other management systems such as a maintenance cost system;

(d) alpha-numeric data can easily be connected to a geographic information system (GIS) - Table 16.3 shows the typical information that needs to be included in a road sign inventory database - a more detailed description of some of the above-mentioned information, to be captured into an inventory's database, is given in Section16.6.

2 The inventory module can be described as the core of the RSMS, as all the information needed to effectively manage a sign system is captured in this module, and road authorities need to maintain it to ensure a high level of road safety for motorists. To provide this information, road authorities need to take steps to maintain some form of road sign inventory, ranging from paper files, maps, drawings, photo files to photo loggers. Sophisticated systems, such as combinations of computerised databases, video digital photo capturing databases, or mobile vehicles equipped with computers to capture sign data whilst moving, are available.

3 To date most South African road authorities concentrate mainly on the manual capturing of data through as-built drawings, or data collection forms and a manual filing system of road sign information. This valuable information can easily be transported into a computerised system and some road authorities have already embarked on such a system.

4 The advantages of a computerised sign inventory are somewhat obvious, namely:

(a) it can easily be connected to existing manual systems and existing information forms in use;

(b) it is a fast and efficient method of data management;

(c) it can handle record-keeping for the large number of road signs on the road network;

(d) reports on maintenance, condition, inspections, costs, type and quantity of road signs can easily be extracted from the system.

5 Data capturing is normally one of the most costly stages of a project. Research, however, has shown that sophisticated methods of road sign data capturing through computerised systems for large road authorities are more cost effective than traditional manual methods.

16.4.4 Library Module

1 The typical data which needs to be captured in this module to support the operations of the RSMS can be summarised as follows:

(a) the base information of the road network, be it a map, diagram or GIS;

(b) the level of road sign provision at different classes of intersections prescribed in the policy;

(c) prescribed letter sizes and letter types for all types of road signs;

TABLE 16.3 TYPICAL DATA STRUCTURE FOR A ROAD SIGN INVENTORY MODULE TABLE 16.3

Section	No	Description	Minimum Recommended Input
A. Position	1.	Reference system to allocate an identification number to each individual road sign	*
	2.	Urban and Metropolitan areas: Suburb, street name, between street A and street B, next to stand no. xx, etc.	*
	3.	Rural areas: Road number, chainage, distance	*
	4.	Route number	*
	5.	Direction of travel and direction of road sign face (N, S, W, E)	
	6.	Left or right side of road or at an intersection or on the median	
	7.	Does the road sign exist (is it planned or has it already been erected)?	*
	8.	Distance from centre line or exact position on the GIS	
	9.	Road function class (classification of road and intersection)	*
	10.	Description of environment (forest, coast line, wet, dry, etc.) through the GIS	
B. Characteristics	1.	RTA/SADC-RTSM code (code number allocated according to Volume 1)	*
	2.	Functional classification of road sign (linked to road class)	*
	3.	Sign face size (height, length, area)	*
	4.	Letter type and size	
	5.	Post (quality, size, profile, material)	
	6.	Sign board material (chromadek, wood, steel, other)	*
	7.	Signface material (background and script - class 1, 2 or 3)	*
	8.	Ground-mounted or overhead sign	*
	9.	More than one sign on one post	
	10.	Substructure and fastening details (fastening type)	
	11.	Legend of sign - message	*
C. Dates	1.	Manufactured	
	2.	Installed/Erected (motivation for erection)	*
	3.	Last maintained (actions taken and reason for maintenance)	*
	4.	Cancelled/Replaced (motivation)	*
	5.	Inspected (recorded information)	*
	6.	All dates and relevant information are captured in a history file	
D. Condition Evaluation	1.	Sign face natural weathering (SFNW) - scale 1-5	*
	2.	Sign face human damage (SFHD) - scale 1-5	*
	3.	Post natural weathering - scale 1-5	
	4.	Post human damage - scale 1-5	
	5.	Retroreflectivity measured by retroreflectometer or visually observed (sample measurement of color and luminance)	
	6.	Specific intensity per unit area (SIA) - Retroreflectivity available and required based on guidelines in Volume 2, Chapter 17	
E. General	1.	Sight distance of sign (horizontal or vertical curves)	
	2.	Complexity (urban, rural, industrial)	
	3.	Speed limit	
	4.	Lanes per direction of travel	
	5.	Flow - two-way or one-way	
	6.	Control - local authority, provincial authority, or contractor	*
	7.	CAD reference or photo ID	*
	8.	Comments - additional information (maximum 80 characters)	
	9.	Cost of different materials, manufacturing and erection of road signs	*
	10.	Maintenance cost (labour, material, equipment, transport)	*

(d) prescribed procedures to apply for the provision of a road sign (mostly applicable for tourism or local direction signs);

(e) code numbers of all types of signs as indicated in Volume 1, and a description thereof with respect to function, standard dimensions, cost parameters and materials description;

(f) guidelines set out in Volumes 1 and 4 or in the policy document of the road authority;

(g) description of numbered routes along the streets (street names) and roads (road numbers) on the road network.

16.4.5 Maintenance/Monitoring Module

1 The information in the maintenance or monitoring module consists of the updated actions and costs in relation to the day to day erection, maintenance and inspection of road signs. This information is normally extracted from job cards, work orders or inspection forms by maintenance teams as described in Section 16.7 as an example.

2 The important components of this module are:

(a) updating of information after erection, inspection or maintenance has been executed;

(b) preparation of tasks on job cards;

(c) dealing with complaints and capturing data related to road signs.

(d) inspection frequency;

(e) reason for maintenance (accidents, fire, vandalism, etc.);

(f) cost of maintenance per activity (labour, material, transport);

(g) details of claims where road signs are involved;

(h) set maintenance criteria linked to maintenance priorities, for example:

(i) If Sign Face Natural Weathering (SFNW) + Sign Face Human Damage (SFHD) is rated 2 - No maintenance;

(ii) If (SFNW) + (SFHD) is rated 5 - Urgent maintenance;

(iii) Criteria can also be set for other attributes such as minimum retroreflection levels of road sign material.

(i) after maintenance criteria have been established it is possible to list maintenance priorities according to the importance of the road (road class) or functional class of road signs;

NOTE:SFNW and SFHD are visual judgements of the condition of the sign, say on a 5 point scale where 1 means excellent condition and 5 means totally unacceptable, i.e. the road sign must be replaced immediately - see Section 16.6 for more details;

(j) maintenance action codes are selected to assist in the maintenance updating procedures and to link maintenance actions to a costing system;

(k) the cost of labour, materials, equipment and transport needs to be captured for every work order.

3 The maintenance of road signs normally forms part of a specific department at road authorities and in many cases the maintenance of road signs is only one aspect of road maintenance procedures. Section 16.7 summarises the proposed procedures related to the maintenance of road signs for road authorities.

16.4.6 Execution Module

1 The execution module serves as the management tool of the RSMS and consists mainly of reports and extraction of information in a prescribed or selected format. The process is indicated schematically in Figure 16-1.

2 The extraction of management information of road signs will vary from basic enquiries to more sophisticated enquiries as indicated in Figure 16-2. This information will enable road authorities to respond to, for example, the following questions:

(a) How many of what type of road signs are where?

(b) What is the condition of road signs?

(c) What are the rehabilitation or replacement costs of road signs?

(d) What are the budget requirements for the next five years with respect to road signs on certain routes? (This should be attended to more effectively in order to provide sufficient funds timeously.)

(e) What are the rates of deterioration of different road sign materials?

3 A computerised database and GIS will make the aforementioned extractions and updating of information very easy. Such computerised databases have been developed locally and abroad and can also be bought "off the shelf". Examples of extractions from such a database are shown in Figures 16.3 to 16.5 and in Table 16.4.

16.4.7 Personnel and Equipment Requirements

1 The personnel and equipment requirements to implement and operate a RSMS depends on the size of road network and density and distribution of road signs on the authority's road network.

2 The largest cities in South Africa may need to have dedicated Road Traffic Sign Teams who will handle all road signs and markings work. Smaller cities and larger towns could divide their areas into wards or suburbs, and personnel from the Town Engineer's Department could then fulfil these tasks as part of other maintenance duties.

3 Rural and national road authorities can spread these tasks amongst their regional or district offices to form part of an overall maintenance effort of a RMS.

4 Personnel and equipment requirements can be met using existing resources. By clearly defining procedures and ensure computerisation, road authorities can efficiently implement a RSMS.

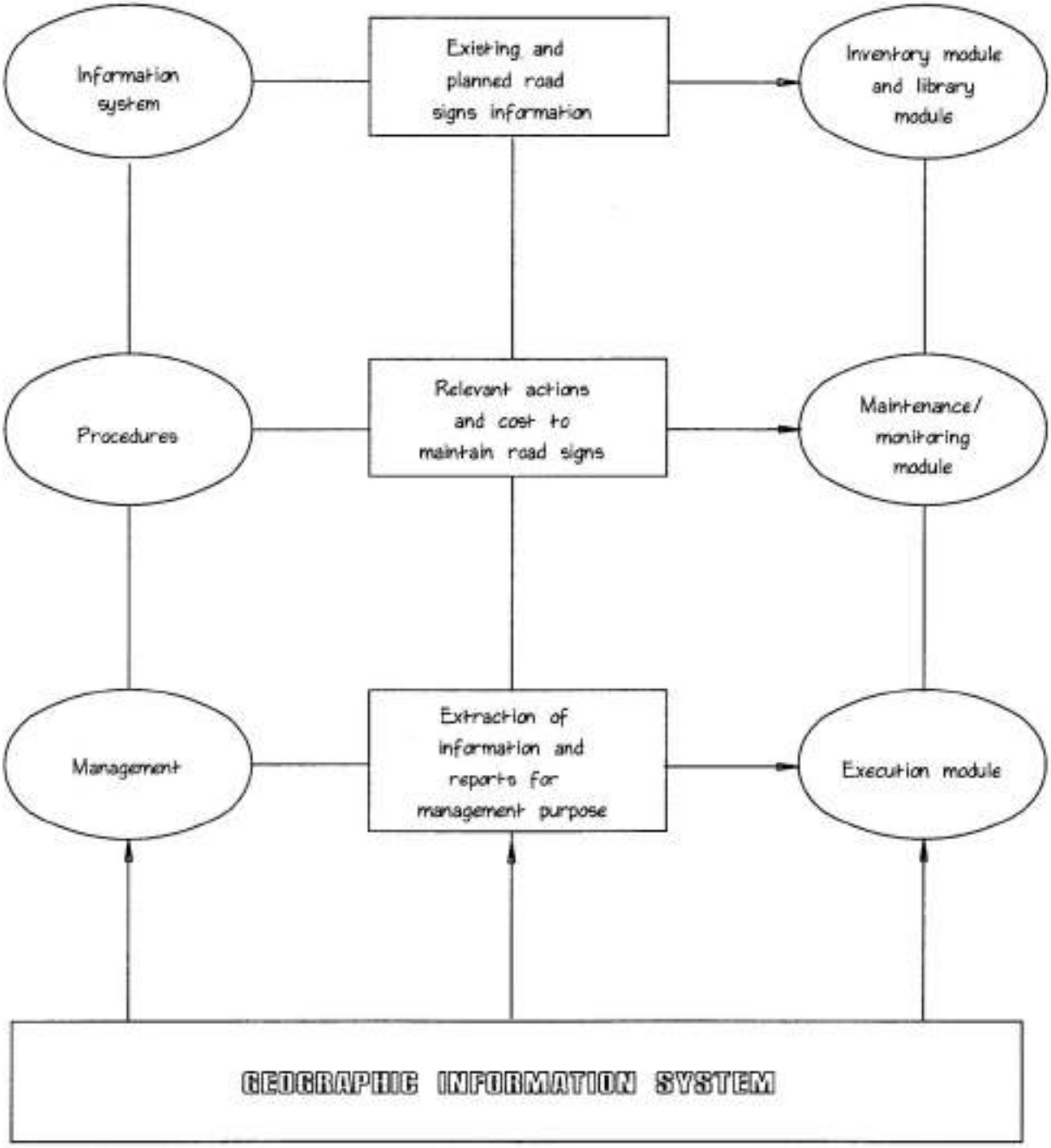
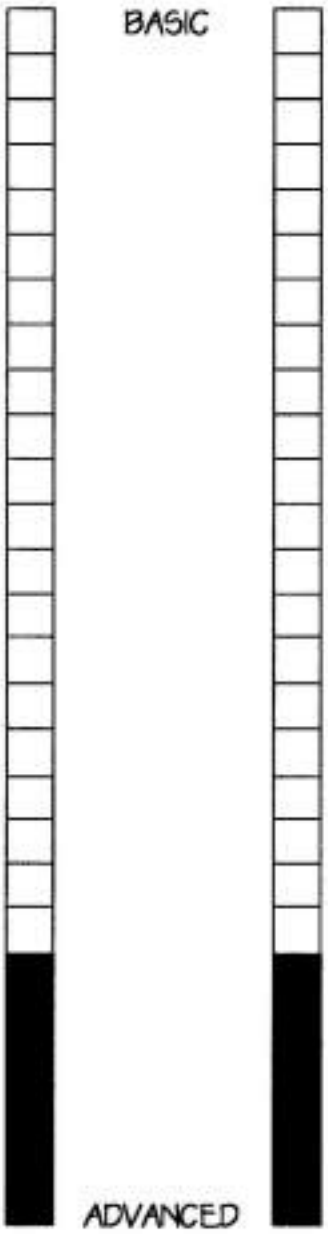


Fig 16.1 **Process of Executing an RSMS**



- Position of a road sign (GIS)
- Type of signs
- Materials used to manufacture a sign
- Dimension of signs
- Sketch or drawing of sign
- Condition of sign
- History of sign (maintenance, inspection)
- Dates of manufacture, erection, maintenance, etc.
- Reason for rehabilitation or maintenance
- Cost of maintenance or replacement
- Retroreflectivity of signs
-
-
-
-
-
-
-
-
-
- Average life of different sheeting
- Influence of orientation on the life of a road sign
- Tendencies related to reasons for sign damages
- Implementation cost for different levels of signage
- Cost savings after implementation of a RSMS
-
-

Fig 16.2 Hierarchy of Management Enquiries on Road Signs Through an RSMS

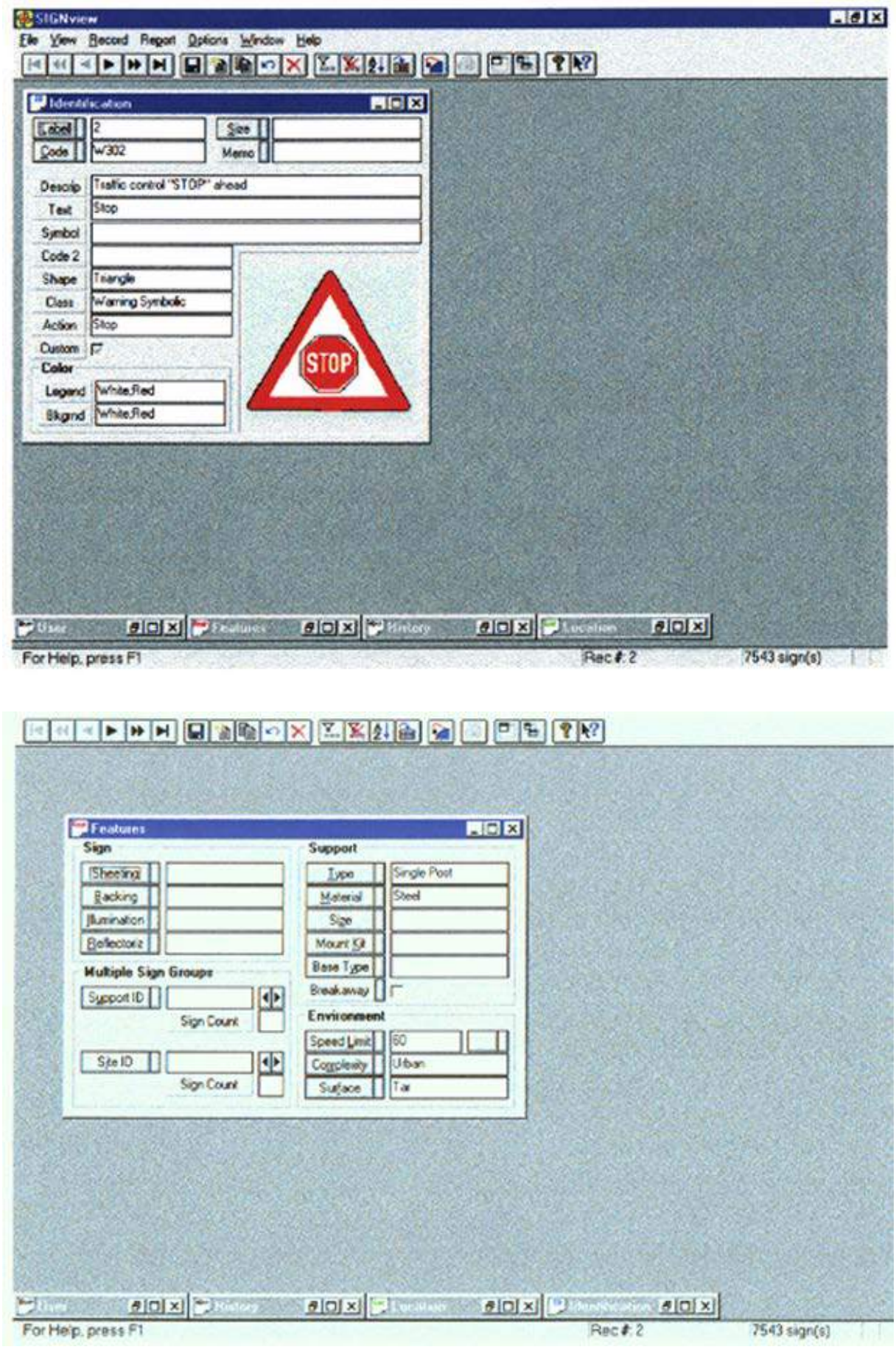
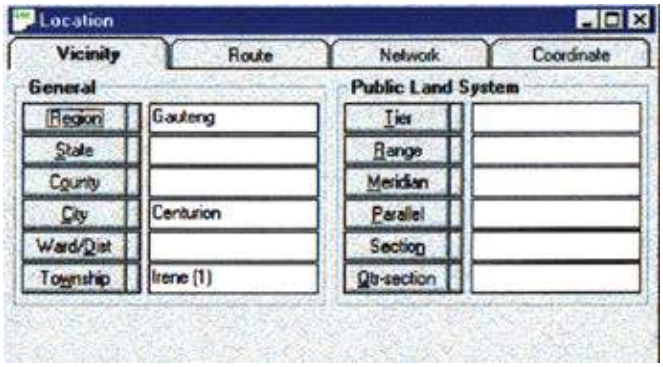
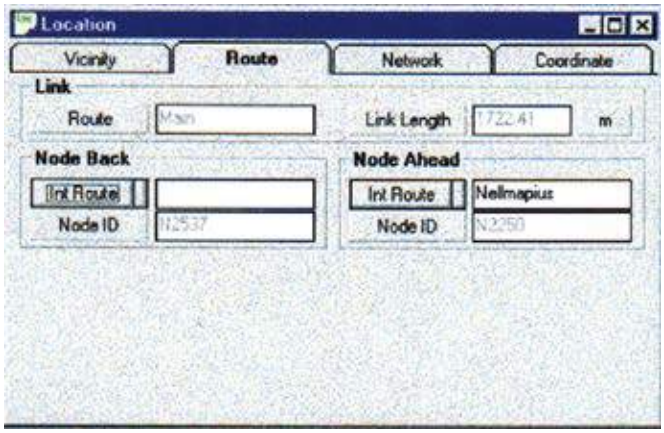
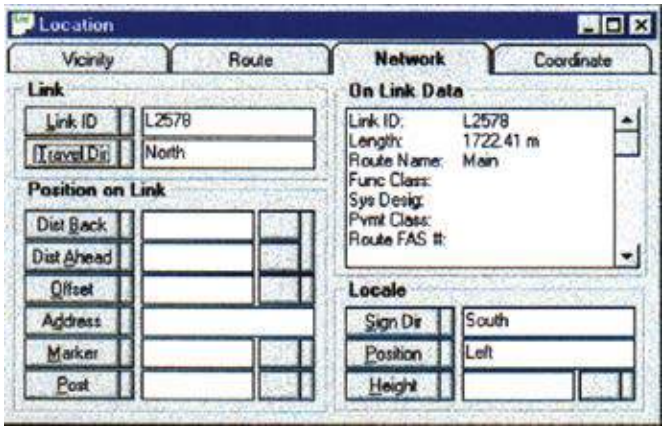


Fig 16.3 Examples of Typical RSMS Data Entry Screens - 1







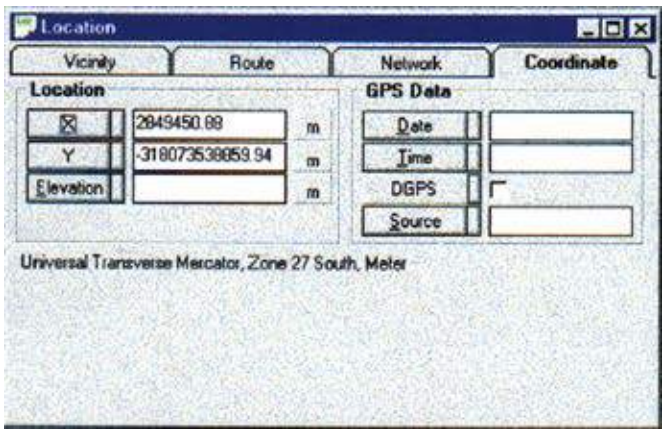


Fig 16.4 Examples of Typical RSMS Data Entry Screens – 2
Sign Location Data Entry Fields

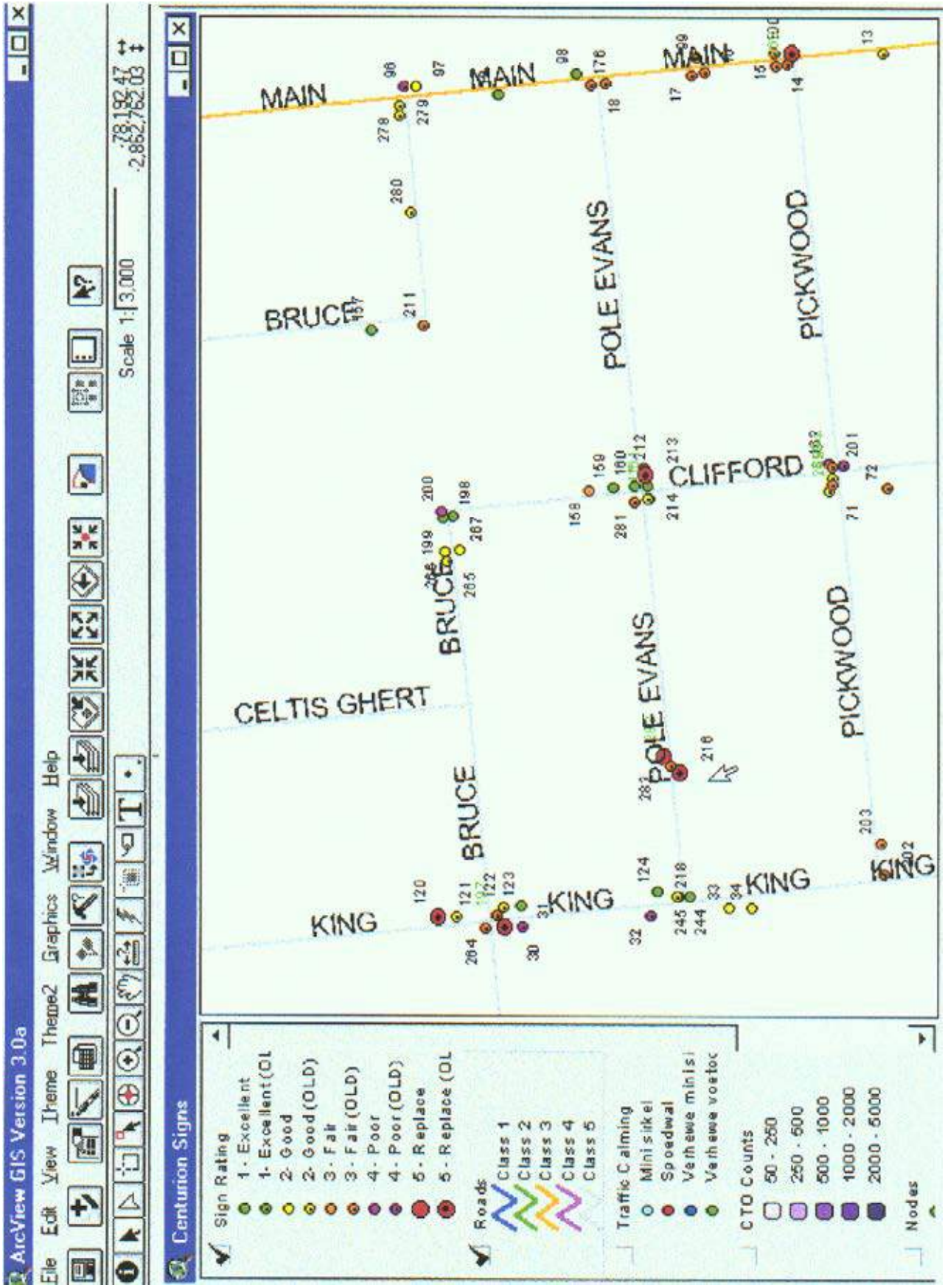


Fig 16.5 Typical GIS Representation of RSMS Sign Rating Status

TABLE 16.4 EXAMPLE OF RSMS SIGN REPLACEMENT PRINTOUT TABLE 16.4

Road Signs to be Replaced – 06/29/97

Label	Code	Sign Rating	Link ID	Route Name	Township	Position	Sign Direction
282	W402	5 - Replace	L2289	Pole Evans	Irene (1)	Road Surface	West
30	R1	5 - Replace (OLD)	L2479	King	Irene (1)	Left	South
303	W107	5 - Replace (OLD)	L2299	Nellmapius	Irene (1)	Left	West
262	R1	5 - Replace (OLD)	L2312	Verbena	Irene (1)	Left	West
216	W401	5 - Replace (OLD)	L2289	Pole Evans	Irene (1)	Road Surface	East
213	R210	5 - Replace (OLD)	L2289	Pole Evans	Irene (1)	Left	East
173	W406	5 - Replace (OLD)	L2581	Main	Irene (1)	Left Parallel	East
120	TW305	5 - Replace (OLD)	L2481	King	Irene (1)	Left	North
119	R1	5 - Replace (OLD)	L2542	King	Irene (1)	Left	North
106	R217	5 - Replace (OLD)	L2581	Main	Irene (1)	Left	North
102	R217	5 - Replace (OLD)	L2582	Main	Irene (1)	Left	North
100	R217	5 - Replace (OLD)	L2583	Main	Irene (1)	Left	North
101	W301	5 - Replace (OLD)	L2583	Main	Irene (1)	Left	North
134	R1	5 - Replace (OLD)	L2512	Krige	Irene (1)	Left	North
337	R1	5 - Replace (OLD)	L1179	Ewald	Celtisdal	Left	West
336	R2	5 - Replace (OLD)	L1179	Ewald	Celtisdal	Left	North
529	R1	5 - Replace (OLD)	L1126	Lenchen	Clubview	Left	West
423	W405	5 - Replace (OLD)	L1123	Hendrik Verwoerd	Clubview	Left	North
487	IN4	5 - Replace (OLD)	L1146	Kilkenny	Clubview	Left	West
488	R201	5 - Replace (OLD)	L1136	R28-WEST	Clubview	Left	West
489	R1	5 - Replace (OLD)	L1147	Limerick	Clubview	Left	West
528	R3	5 - Replace (OLD)	L1126	Lenchen	Clubview	Left	West
418	W406	5 - Replace (OLD)	L1121	Hendrik Verwoerd	Clubview	Right	North
408	R4_3	5 - Replace (OLD)	L1136	R28-WEST	Clubview	Right Parallel	North
525	R201	5 - Replace (OLD)	L1162	Die Uitsig	Clubview	Left	West
419	W405	5 - Replace (OLD)	L1121	Hendrik Verwoerd	Clubview	Left	North
406	R3	5 - Replace (OLD)	L1136	R28-WEST	Clubview	Right Parallel	North
397	R4_3	5 - Replace (OLD)	L1109	Jean	Clubview	Left	North
394	R1	5 - Replace (OLD)	L1130	M1-NORTH	Clubview	Left	North
392	W405	5 - Replace (OLD)	L1107	Von Willlich	Clubview	Left	North
391	W405	5 - Replace (OLD)	L1107	Von Willlich	Clubview	Left	North
365	R2	5 - Replace (OLD)	L1116	Aspen	Clubview	Left	South
349	R530	5 - Replace (OLD)	L1107	Von Willlich	Clubview	Left	South
348	W311	5 - Replace (OLD)	L1107	Von Willlich	Clubview	Left	South
340	R216	5 - Replace (OLD)	L1101	M1-SOUTH	Clubview	Cul de Sac	South
407	R3	5 - Replace (OLD)	L1136	R28-WEST	Clubview	Left	North
574	R1	5 - Replace (OLD)	L1199	Jan Kerrp	Bronberri	Left	West
581	R1	5 - Replace (OLD)	L1202	Suikerbekkie	Bronberri	Left	West
557	R208	5 - Replace (OLD)	L1190	Jacobus	Bronberri	Left	East
535	R1	5 - Replace (OLD)	L1188	N1-SOUTH	Bronberri	Left	South
583	R208	5 - Replace (OLD)	L1204	Suikerbekkie	Cranbroo	Left	South
Etc.							

16.5 IMPLEMENTATION OF AN RSMS

16.5.1 General

1 The implementation of a comprehensive RSMS will, to a great extent, depend on the motivation of the road signs managers and their teams to cost-effectively maintain and operate the system.

2 The data capturing and evaluation of road signs information is a task that has to be undertaken on a continuous basis. This task can be started by firstly including new signs that are erected or existing signs that require maintenance until the complete system has been covered.

3 The expected average life-span of signs varies between five and ten years. It is therefore clear that the RSMS has to be operational for at least five years before the complete benefits can be obtained from the system. However, it can be expected that the effective implementation of maintenance procedures will have an immediate positive effect on the system.

4 The estimated cost to implement a RSMS will differ from one road authority to another but it was calculated that for the metropolitan areas the cost of implementation over a five-year period varies between 5% and 10% of the budget for maintenance/replacement of road signs. The initial cost will be relatively high but the benefits in the long-run will be worthwhile and the system could save maintenance cost, but are also cost-related to road safety and legal claims.

5 Road signs are implemented according to the new SARTSM and the implementation of a RSMS will ensure continuity of the road signs system and should be promoted as such amongst all road authorities in South Africa.

16.5.2 Bibliography for Road Sign Management Systems

1 The following references are recommended as a reading list for those wishing more detail on the development of Road Sign Management Systems (RSMS):

1. U.S. Department of Transportation: Federal Highway Administration, Sign Management System, October 1990.
2. U.S. Department of Transportation: Federal Highway Administration, Guide to Safety Features for Local Roads and Streets, 1991.
3. U.S. Department of Transportation, The 1988 Annual Report on Highway Safety Improvement Programs, Report of the Secretary of Transportation to the United States Congress, Report No. FWHA - SA-88-003.
4. South African Roads Board; Research and Development Advisory Committee, Guidelines for the Development and Implementation of a Traffic Signs and Markings Management System, Project Report PR 88/004/3, March 1991.
5. Transportation Research Board, National Research Council, Maintenance Management of Street and Highway Signs, September 1990.
6. CSRA-CUTA, Seminar on new Traffic Signs, Sign Maintenance, J G H le Roux, May 1988.
7. Stanway Edwards Associates Inc., A Comprehensive Road Signs Maintenance Management Software Package, September 1992.
8. Barton-Aschman Associates Inc., Traffic Control Device Inventory, City of Pasadena, January 1984.
9. Stanway Edwards Associates Ing., PREMET Vervoerstudie in Loodsstudie vir die Ontwerp en Implementering van 'n Inligtingstelsel vir die Bestuur van Padtekens.
10. Sator, W.H.J., Durability of Road Signs: Field Survey, CSIR Roads and Transport Technology, Research Report DPVT 78, 1989.
11. Micheall Bernhardt, Street Scene Management, 3M, Europe
12. Freeway Guide Sign: Replacement: Policies and Criteria, FWHA Transportation Research Board, National Research Council Report 155, April 1991.

16.6 A DETAILED DESCRIPTION OF A TYPICAL DATA STRUCTURE FOR A ROAD SIGN INVENTORY MODULE

16.6.1 General

1 The description of data items to be included in the proposed data structure of the Road Signs Inventory Module of the RSMS, is given in more detail in this appendix. Refer to Table 16.3 for a summary of these data items.

16.6.2 Position

1 Data is linked to a specific position of the road sign, firstly to road sign data and secondly to road link data. The ID number of a road sign is therefore linked to its position and to the link number. The following are examples of a reference system to allocate ID numbers:

(a) Urban areas:

Grid system
- Block number in grid;
- Intersection number in block or link/node number;
- Link number at intersection;
- Road sign number on link.

(b) Rural areas:

Road number and chainage along road from starting point; a link will then be described between two points (normally intersections) on the chainage along the road.

2 Other data items in Section A of Table 16.3 are self-explanatory.

16.6.3 Characteristics

1 The RTA/SADC-RTSM code for a road sign explains its exact function. The functional classification of the road sign is, however, linked to the road classification indicated in Section A of Table 16.3 and is important for prioritisation of management actions. This functional classification can indicate the importance of the road sign for example, with regard to:

(a) the classification of the road on which the sign is located, i.e. road hierarchy;

(b) traffic volumes and lanes;

(c) the cost of the specific sign.

2 The maintenance priorities set in the maintenance module, for instance, depend on the functional classification of the road signs.

3 The different types of sign face materials can generally be classified as class 1, 2, 3. Cognisance needs to be taken of the characteristics of each class, and the cost and guarantee given by suppliers, before decisions are made on what type of material should be used. See Chapter 17 for a proposed selection criteria for sign materials.

4 The other items in Section B of Table 16.3 are self-explanatory.

16.6.4 Dates

1 The capturing of dates into the database is important to establish a record of events within the life-span of a road sign, giving the reason for erection and the reason for cancellation. This information will help to determine the performance of the road signs with respect to aging, effect on orientation, inspection frequency, rate of vandalism, etc.

16.6.5 Condition Evaluation

1 Condition evaluation can be conducted in various ways. A method used by road authorities to ensure consistent evaluations is to prepare photographs displaying different conditions that relate to the evaluation process. This is then linked to a detailed description or drawing. A scale that can be used for the condition evaluation of road signs can be described as follows.

2 The sign face natural weathering (SFNW) and sign face human damage (SFHD) can be visually evaluated on a five point scale namely:

(a) 1 - Excellent condition; new;

(b) 2 - Good condition; few signs of aging;

(c) 3 - Fair condition; shows some sign of deterioration but will be serviceable for more than three years;

(d) 4 - Poor condition; should be replaced within one to two year period; and

(e) 5 - Replace road sign immediately as it is unserviceable.

The same evaluation can be done for sign posts.

3 Research was done on the durability of road signs in South Africa [(2)] and the following are the main problems related to durability:

(a) the discolouration of the sign face;

(b) the reduction of the retroreflective value of the sign face;

(c) corrosion of the sign backing board, stiffening structures and fixing bolts.

4 The high ultra-violet content of sun rays in South Africa is responsible for (a) and (b) related to durability, whilst poor specifications are the main reason for corrosion (c).

5 Minimum standards for retroreflective values are given in Volume 2, Chapter 17. The deterioration rate of retroreflectivity values on road signs during their life-span and the influencing factors contributing to the rate of deterioration should be built into the models to allow the prediction of the condition of road signs in advance.

16.6.6 Other

1 The items under Section E of Table 16.3 are self-explanatory and provide useful information for a comprehensive database.

16.7 TYPICAL PROCEDURES FOR THE MAINTENANCE AND MONITORING OF ROAD SIGNS

16.7.1 General

1 The procedures involved in the maintenance and/or monitoring module of a RSMS are important for the following reasons:

(a) improved productivity of maintenance teams;

(b) better control of resources;

(c) objective performance measurement is possible;

(d) better control of maintenance budgets and exact cost allocation for jobs.

These procedures should be implemented by means of computerisation of a RSMS.

2 The procedures are normally fulfilled at one of two levels of detail, namely:

(a) Level 1 (see Figure 16.6):

A comprehensive set of procedures, where all maintenance, rehabilitation and inspection activities with respect to every road sign on the network, is linked to the allocation and availability of personnel, materials, equipment and transport; this level is also linked to a costing system for labour costs, machine costs, material costs and transport costs; this procedure is based on a pre-planning process of tasks on job cards;

(b) Level 2:

The afore-mentioned procedures are normally executed on a less comprehensive scale by maintenance teams - road signs maintenance is only one of their various maintenance duties and is often neglected - rehabilitation and maintenance on road signs is normally done after routine inspections and urgent requests - a few important aspects of signs are recorded on forms as input to a database.

3 Different types of forms can be used by the system to capture or transfer maintenance/monitoring information. These forms are not discussed in detail as each road authority will have its own design and form layout. However, some typical examples are:

(a) defect report or list;

(b) inspection form or list;

(c) job card for internal team;

(d) job card for contractor.

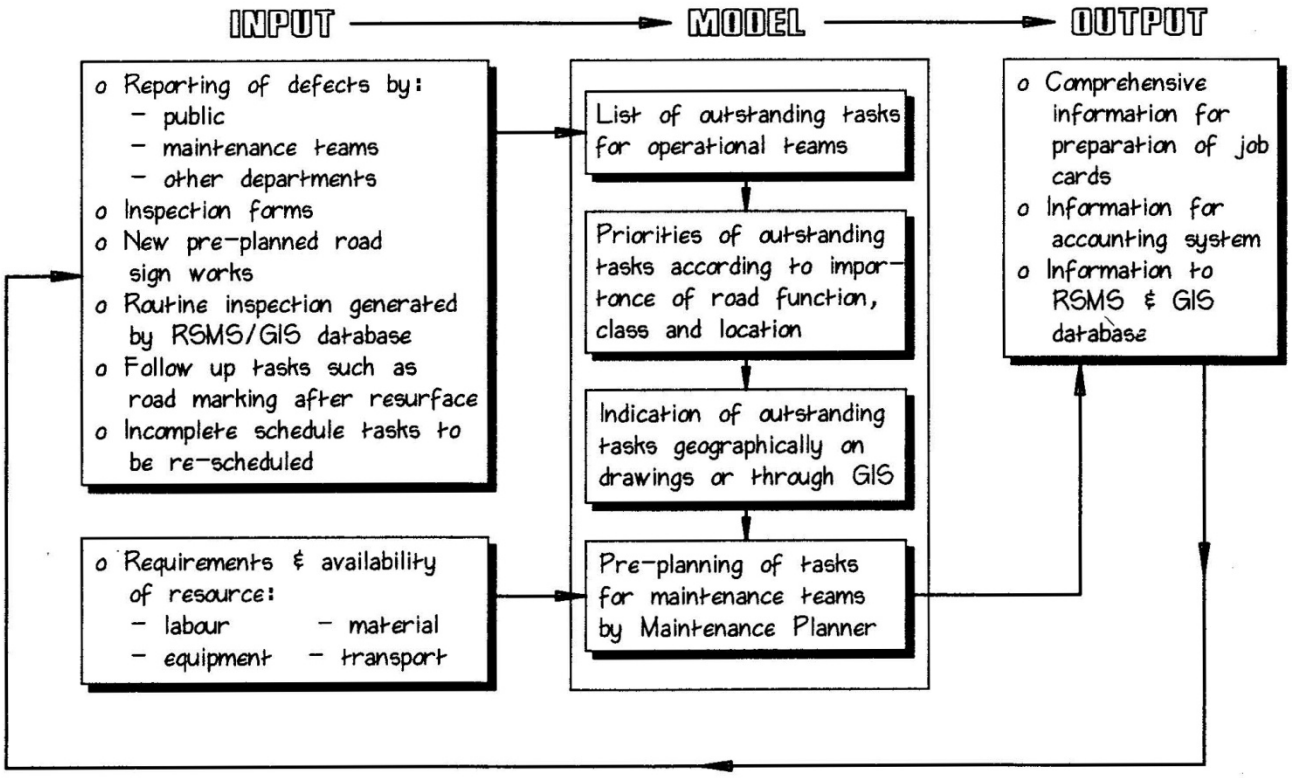


Fig 16.6 Maintenance Procedure Model