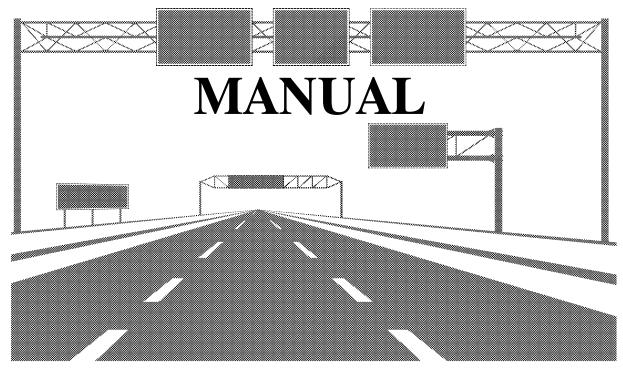
# **SIGN SUPPORT**





Ministry of Transportation Policy, Planning & Standards Division Engineering Standards Branch Bridge Office April, 2007

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Revision		Entored by	Date
No. Dated		Entered by	Date
	This manual includes R	evision #12, dated March 2007.	
			1

To all users of the:

#### SIGN SUPPORT MANUAL

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			e Highway and Transportation	Officials
ASTM Ame	erican Society for Te	esting an	d Materials	
BREAKAWA	Y SIGN SUPPORT	a pre	c sign support system design determined location and n red upon by a vehicle	
BRIDGE MO	UNTED SIGN SUPF	PORT	A static sign support structu to the side of a bridge	ire attached
BUTTERFLY	STATIC SIGN SUP	PORT	A static sign support for intermediate size sign consisting of a single vertic steel column or leg, and tw trusses located on either column or leg.	boards, al structural o overhead
CANTILEVE	R STATIC SIGN SU	PPORT	A static sign support for i size sign boards, consisting vertical structural steel col and an overhead truss	g of a single
CHANGEABLE MESSAGE SIGN (CMS) Light emitting electronic display system to provide up-to-date information that changes periodically, to freeway motorists of traffic conditions ahead and suggest alternative routing in a timely and safe manner				mation that o freeway ions ahead
CHANGEABI	LE MESSAGE SIGN	I SUPPC	5 11	tems and cal supports el), and an
S		ess vort	the sign board on cantilever s ex shedding and galloping	
MAXIMUM E		eight fror e sign bo	n the top of lowest footing to t bard	he centre of
NLGA Natio	NLGA National Lumber Grades Authority			

SIGN SUPPORT MANUAL			
2007 04 02	DEFINITIONS PAGE vii		
OHBDC OI	ntario Highway Bridge Design Code		
ORDER FOR	MS Preprinted forms containing all information needed to purchase components to assemble a sign support		
OVERHEAD	MONOTUBE SIGN SUPPORT A static sign support intended for small sign boards, and consisting of two vertical steel columns spanned by either a single structural steel member or by steel cables		
STATIC SIG	N (OR SIGN BOARD) A flat surface displaying permanent visual information		
STRUCTURE	E I.D. NUMBER Number assigned to a sign support structure by the Region, to provide a unique identifier for each sign structure		
SIGN SUPPO	DRT A structure to support static signs (sign boards) or changeable message sign systems		
STANDARD	DRAWING A structural drawing as shown on the hardcopies distributed with this Manual. It is available as an electronic CAD file requiring the user to add site specific information		
STEEL COLU	JMN SIGN SUPPORT A static sign support structure consisting of two or more vertical steel columns, either breakaway or non-breakaway		
TIMBER SIG	N SUPPORT A static sign support structure consisting of two or more breakaway or non-breakaway vertical timber posts		
TRI-CHORD	STATIC SIGN SUPPORT A static sign support structure consisting of a galvanized steel overhead truss constructed in the form of a three chord system and having prismatic vertical legs		
WALKWAY	A permanent platform provided on some sign support structures, at the level of the sign board(s) facilitating ease of installation and maintenance of the sign board(s)		

	SIGN SUPPORT MANUAL						
2000 05 15	NOTATION	PAGE viii					
	spacing of sign support posts, or spacing of top crossarm connection plates, or edge distance of upper column splice bolts, or length of stiffener or friction plate, or outside diameter of shear plate, or horizontal spacing of shear plates for type b supports, or horizontal edge distance for splice bolt holes, or outside diameter of sign support post.						
	width of sign board, or end distance to first crossarm connection plate, or diameter of shear plate bolt hole, or depth of stiffener or friction plate, or length of panel in CMS end components.						
	horizontal distance from exterior sign support post to edge of sign board, or thickness of shear plate groove, or distance from end of crossarm to exterior sign support post, or spacing of T connectors on crossarms.						
CMS	changeable message sign						
CS	horizontal centroidal axis of sign board.						
	height of sign board, or depth of shear plate groove, or spacing of bolt hole cutouts.						
	vertical distance from edge of sign board to first crossarm, or edge distance to bolt hole cutout, or Inside depth of shear plate groove, or horizontal distance from left support to leftmost sign board, or length of upper post, or horizontal distance from the centreline of the sign support post to centre of the sign board, or horizontal distance from the centreline of the sign support leg to to centreline of the end vertical element of the sign component.						
EL.CS	elevation of CS.						
EL.EP	elevation of EP.						
	elevation of the highest point on the highway under the sign, inclusion shoulders, curbs, and medians.	uding					
EL.Pi	elevation at top of footing Pi.						
EP	edge of pavement of travelled portion of highway.						

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F	vertical spacing of crossarms, or allowable bending stress in timber post, or inside diameter of shear plate, or horizontal distance from left support to 2 <sup>nd</sup> leftmost sign board.	
G	perpendicular distance from edge of pavement to first column, or horizontal distance from left support to 3 <sup>rd</sup> leftmost sign board, or horizontal distance from front face of traffic barrier to face of support structure.	
Н	lateral sign overhang beyond end T, or horizontal distance from left support to 4 <sup>th</sup> leftmost sign board.	
Hi	vertical distance from Pi to CS.	
Hmax	maximum Hi.	
J	edge distance of 2 <sup>nd</sup> lowest bolt group from bottom of member, or horizontal distance from edge of sign board to outside T connector, or horizontal distance from left support to splice location.	
К	spacing of internal bolt hole groups for crossarms, or horizontal distance from edge of sign board to inside T connector, or horizontal distance from right support to splice location, or a dimension used to impose a camber on cantilever sign supports to allow for dead load deflections.	
L	length of top crossarm, or length of column, or length of upper column section, or length of lower post.	
Mb	a parameter used to compute column length for breakaway sign supports.	
Mnb	a parameter used to compute column length for non-breakaway sign supports.	
Pi	top of footing.	
SLS	Service Limit States, as defined in The Ontario Highway Bridge Design Code.	
Х	horizontal distance from left footing to control line.	
Y	horizontal distance from right footing to control line.	

**DIVISION 1 - INTRODUCTION** 

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#### INTRODUCTION

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#### 1 INTRODUCTION

#### 1.1 <u>GENERAL</u>

The Sign Support Manual has been prepared to assist ministry offices, or others, in procuring and erecting all types of sign supports and for preparing the contract documents.

#### 1.2 **DIVISIONS**

The Manual contains the following divisions:

- Division 2 General Information
- Division 3 Cantilever Static Sign Supports
- Division 4 Tri-Chord Static Sign Supports
- Division 5 Steel Column Sign Supports
- (Breakaway and Non-Breakaway)
- Division 6 Timber Sign Supports (Breakaway and Non-Breakaway)
- Division 7 Overhead Monotube Sign Supports
- Division 8 Changeable Message Sign Supports
- Division 9 Bridge Mounted Sign Supports

The divisions of the Manual are self-contained and may be issued and revised at different times.

#### 1.3 NUMBERING SYSTEM

Each division is numbered as shown above. Within the divisions, the material is further subdivided into sections and sub-sections, numbered decimally. Reduced copies of standard drawings, which are included in the Manual to explain their use, carry their original numbers, and in some cases, Figure numbers relating to the Manual numbering system. Such drawings also carry their latest revision dates at the time of their preparation.

#### 1.4 <u>REVISIONS</u>

When additions or revisions are necessary, they will be made available through Publications Ontario or the online MTO Research Library, as detailed in Section 1.6.

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#### INTRODUCTION

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#### 1.5 **METRICATION**

The supports covered by Division 9 are primarily fabricated from aluminum extruded members which have not been metricated at this time. Thus, supports in this division are detailed in soft converted metric units except as for the drawings detailing the chord clamp, the service walk grating, and the two-post railing, which are detailed in imperial units.

All dimensions are in millimetres unless otherwise stated.

#### 1.6 **DISTRIBUTION**

Copies of the Manual and revisions may be obtained from:

**Publications Ontario** 800 Bay Street Toronto, Ontario Canada, M7A 1N8

Tel.:	416-326-5300
	800-668-9938
TTY:	800-268-7095
Fax:	613-566-2234
Website:	www.publications.gov.on.ca
Online:	www.mto.gov.on.ca/english/transrd/

#### 1.7 **STANDARD DRAWINGS**

Transparent copies of standard drawings for use in the production of contract documents are not available. Electronic CAD files containing standard drawings in AutoCAD may, however, be obtained from the MTO Bridge Office or the CPS.

**DIVISION 2 - GENERAL INFORMATION** 

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**GENERAL INFORMATION** 

#### 2 **GENERAL INFORMATION**

#### 2.1 <u>SCOPE</u>

This Manual contains information needed to prepare the contract drawings, tender quantities and special provisions for sign supports covered in Division 3 to 9.

#### 2.2 STANDARD SIGN SUPPORTS

Only standard sign supports are described in this Manual and listed within their respective divisions.

All non-standard sign supports must be custom designed.

Overhead truss sign supports (Type 1) previously covered in this Manual have been withdrawn and replaced by Tri-chord static sign supports.

#### 2.3 ASSUMPTIONS, CRITERIA AND LIMITATIONS

Design code assumptions, criteria and limitations for each sign support type is described in the respective divisions of this Manual.

Drawings and special provisions for Tri-chord, cantilever, changeable message, steel, and timber breakaway sign supports are sufficiently standardized that Regional Structural Section staff or others may process them. Bridge mounted sign supports must be designed to suit the geometry of the bridge by the Regional Structural Sections or others.

#### 2.4 STANDARD DRAWINGS

#### 2.4.1 INFORMATION TO BE ADDED TO STANDARD DRAWINGS

Standard drawings shall be reviewed together with the corresponding text in the Manual to determine what information, if any, needs to be added to them.

Where information in tables and dimensions are added to standard drawings for their completion, the drawings shall bear the seal, date and signature of a Professional Engineer. This Engineer accepts full responsibility for the accuracy of the added information only.

Where engineering design changes are made on standard drawings that affect the original design, these drawings shall be identified as "Modified" and bear the seals, dates and signatures of two Professional Engineers. These Engineers accept full responsibility for the design that results from these changes.

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**GENERAL INFORMATION** 

#### 2.4.2 SCALES FOR ADDED DETAILS

Plan views should normally be drawn at 1:50 scale.

Details should be drawn to a sufficiently large scale to ensure legibility after reduction to contract book size.

#### 2.5 **PROCESSING OF DOCUMENTS**

#### 2.5.1 PREPARATION OF ELECTRICAL DRAWINGS

In general, supplementary illumination is not required for static signs because of the reflective ability of sign facing materials, and in some cases the impact of roadway lighting. Regional Traffic Section determines when sites require illumination.

If the sign is to be illuminated, then two copies of the General Arrangement drawing are required to be sent to regional electrical design staff. They will arrange for the preparation of the electrical drawings if they are required.

For the Changeable Message Signs (CMS), the Advanced Traffic Management Section should be consulted

#### 2.5.2 CONTRACT PREPARATION SYSTEM

Capital construction contract tender documents are produced for the ministry by using the Contract Preparation System (CPS). This is an integrated application facility for the preparation of tender item documents, item quantity sheets, modified and fill-in special provisions, etc., for road design, structural, and electrical work. Whenever sign supports are to be supplied and erected as (part of) a contract, applicable tender documents shall be prepared and forwarded to the Regional Planning and Design Office with a covering transmittal letter. The tender items to be used, where applicable, for sign support footings and sign support structures are as shown in Table 2.5.2.

The accompanying transmittal letter shall instruct Regional Planning and Design to complete the following items:

- (i) Traffic Control
- (ii) Supply and erect sign board, for static sign supports
- (iii) Requirements in the tender documents for the design, supply, installation and testing of the light emitting changeable message signs.

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GENERAL INFORMATION

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OPSS Spec. No.	ITEM	UNIT				
911	Coating New Structural Steel Sign Support Structures					
915	Concrete in Ground Mounted Static Sign Support Footings (Tri-Chord and Cantilever)					
915	Concrete in Median Mounted Static Sign Support Footings (Tri-Chord and Cantilever)	Each				
915	Concrete in Steel Monotube Overhead Sign Support Footings	Each				
915	Concrete in Steel Column Breakaway Sign Support Footings	Each				
915	Concrete in Steel Column Non-Breakaway Sign Support Footings	Each				
915	Concrete in Ground Mounted Changeable Message Sign Support Footings	Each				
915	Concrete in Median Mounted Changeable Message Sign Support Footings	Each				
915	Steel Monotube Overhead Sign Support Structure	Each				
915	Steel Column Breakaway Sign Support Structures	Each				
915	Steel Column Non-Breakaway Sign Support Structures	Each				
915	Timber Column Breakaway Sign Support Structures	Each				
915	Cantilever Static Sign Support Structures, Class (Class 1, 2, or 3)					
915	Aluminum Bridge Mounted Sign Support Structures	Each				
915	Tri-Chord Static Sign Support Structures, Span ( <i>span range to be inserted as per Table</i> ).m See SPAN RANGE TABLE below.	Each				
915	Changeable Message Sign Support Structures, Span ( <i>span range to be inserted as per Table</i> ) m See SPAN RANGE TABLE below.					
	SPAN RANGE TABLE					
Spans:	0 - 15.99 *22.00 - 24.9931.00 - 33.9916.00 - 18.9925.00 - 27.9934.00 - 36.0019.00 - 21.9928.00 - 30.99					
* This rang	e does not apply to Changeable Message Sign Support Structures.					

## TABLE 2.5.2 CPS ITEMS FOR SIGN SUPPORTS

**GENERAL INFORMATION** 

## 2.5.3 DISTRIBUTION OF COMPLETED DRAWINGS AND CONTRACT DOCUMENTS

Copies of the completed drawings and applicable contract documents shall be distributed as follows:

REGIONAL PLANNING AND DESIGN (Manager) - 2 copies (Northwestern Region has requested two additional copies).

ESTIMATING OFFICE (Manager) - 1 copy For the preparation of the cost estimate.

REGIONAL CONSTRUCTION STAFF (District Engineer) - 1 copy To make provision for the supply and erection of the sign and to alert District staff of future sign locations.

#### 2.6 TRAFFIC PROTECTION

Columns of non-breakaway sign supports, monotube sign supports, Tri-Chord, CMS, and cantilever sign supports must be protected from traffic travelling the adjacent roadways. Protection must be provided in the form of guiderail, barrier wall, a retaining wall or some similar feature having at least as much stiffness and strength as a guiderail and presenting a smooth face to traffic.

Breakaway type sign supports are designed to minimize the effect of vehicle/support impact upon the occupants of the vehicle and so do not require protection. Nevertheless, impact will cause damage and perhaps some injury. This should be considered in determining sign location.

#### 2.7 SOIL CONDITIONS

Footing proportions provided in this Manual are intended to apply to normal soil conditions, that is, competent soils of uniform composition. Site foundation conditions requiring special design consideration include:

- bedrock is at or near the surface
- footing is located in rock fill
- soil is exceptionally soft or loose.

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GENERAL INFORMATION

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#### 2.8 FROST DEPTH

Frost layer depths for a specific site location may be obtained from Design Aids DA4-1, DA4-2 and DA4-3, Contours of frost depth for Northern Ontario, Southern Ontario, and List of Towns, respectively, are given in the Appendix of this Division.

These values may be used if the recommendations of a geotechnical engineer are not available.

#### 2.9 **REFERENCE WIND PRESSURE**

Values for the local reference wind pressure can be obtained from the Tables A2.9(a) to (c) given in the Appendix of this Division. The information shown in these tables were obtained from the proposed CSA Standard Canadian Highway Bridge Design Code.

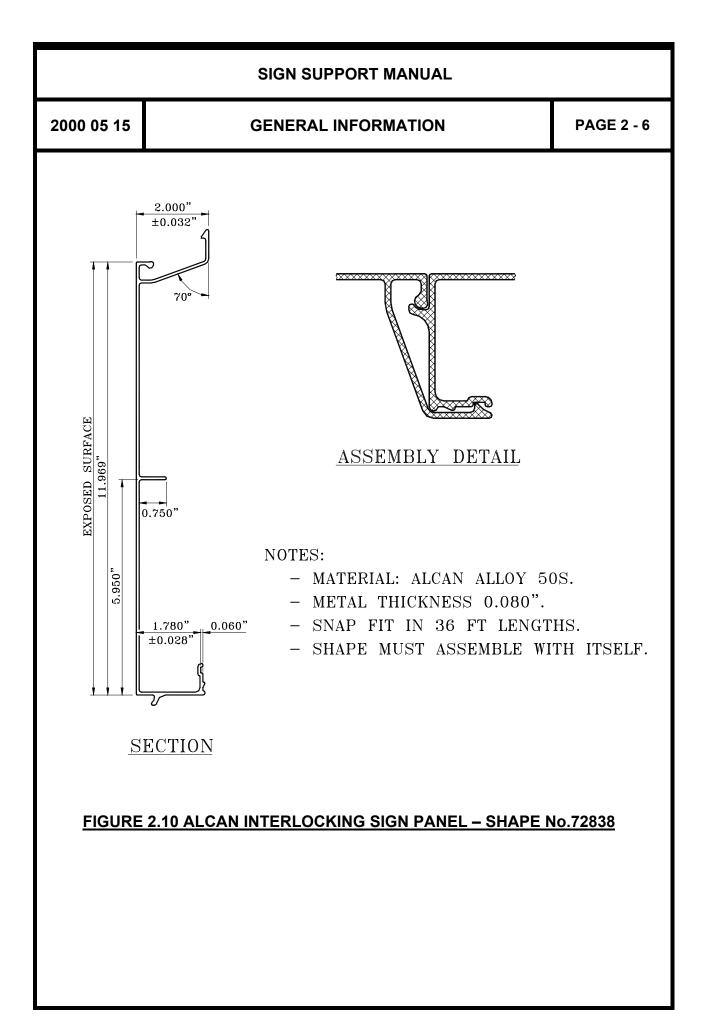
#### 2.10 SIGN BOARDS

All static sign support designs are based on the aluminum Alcan Interlocking Sign Panel, Shape No. 72838, as shown in Figure 2.10. Alcan standard extrusion tolerances and finishes will apply unless otherwise specified.

#### 2.11 CHANGEABLE MESSAGE SYSTEMS

The requirements for the design, supply, installation and testing of Light Emitting Changeable Message Signs (CMS) are covered by the associated Special Provisions.

The major features of the changeable message sign shall consist of: signcase and face, display matrix, driving electronics, photosensor control. environmental control and protection, mounting hardware, and associated cables and wiring.



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2000 05 15		GENERAL INFORMATION	PAGE 2 - 7				
		APPENDIX TO DIVISION 2					
		GENERAL INFORMATION					
тар	LE A2.9						
DA4-1		CONTOURS OF FROST DEPTHS FOR NORTHERN ONTARIO					
DA4	02	CONTOURS OF FROST DEPTHS FOR SOUTHERN ONTARIO					
DA4-	-3	TABLE OF FROST DEPTHS FOR ONTARIO BY LOCATION					

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### **GENERAL INFORMATION**

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ONTARIO LOCATION	HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:		ONTARIO LOCATION	PRESS	HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:		
	10 yr	25 yr	50 yr		10 yr	25 yr	50 yr
Ailsa Craig	395	480	550	Chatham	320	380	430
Ajax	430	510	570	Chelmsford	285	375	450
Alexandria	305	360	400	Chesley	330	410	475
Alliston	220	280	330	Clinton	375	455	525
Almonte	295	360	410	Coboconk	260	315	350
Ansonville	305	360	400	Cobourg	465	535	595
Armstrong	205	240	260	Cochrane	260	310	350
Arnprior	275	330	370	Colborne	440	510	565
Atikokan	200	235	260	Collingwood	255	325	385
Aurora	305	380	440	Cornwall	300	360	410
Bancroft	230	280	320	Corunna	350	415	465
Barrie	210	280	330	Deep River	260	315	350
Barriefield	350	415	460	Deseronto	320	380	430
Beaverton	240	305	360	Dorchester	330	410	480
Belleville	320	380	430	Dorion	300	355	390
Belmont	350	435	500	Dresden	320	380	430
Bowmanville	460	535	590	Dryden	200	235	260
Bracebridge	260	315	350	Dunbarton	430	510	575
Bradford	240	305	360	Dunnville	335	385	425
Brampton	315	380	430	Durham	310	380	435
Brantford	310	365	400	Dutton	340	410	470
Brighton	415	485	540	Earlton	315	390	450
Brockville	315	380	430	Edison	230	275	310
Brooklin	385	460	520	Elmvale	235	305	365
Burk's Falls	260	315	350	Embro	330	410	475
Burlington	360	415	460	Englehart	290	360	415
Caledonia	315	365	400	Espanola	280	360	420
Cambridge	265	310	350	Exerter	375	455	525
Campbellford	290	360	415	Fenelon Falls	250	310	355
Camp Borden	215	280	335	Fergus	260	310	355
Cannington	245	310	360	Fonthill	335	385	425
Carleton Place	295	360	410	Forest	390	460	520
Cavan	310	380	435	Fort Erie	365	415	460
Centralia	375	455	525	Fort Frances	230	275	310
Chapleau	190	235	270	Gananoque	350	415	465

#### TABLE A2.9(a) REFERENCE WIND PRESSURE FOR ONTARIO

Source: Proposed CSA Standard Canadian Highway Bridge Design Code

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### **GENERAL INFORMATION**

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ONTARIO LOCATION	HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:				HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:		
	10 yr	25 yr	50 yr		10 yr	25 yr	50 yr
Georgetown	275	330	375	Leamington	355	415	465
Geraldton	210	245	275	Lindsay	265	325	380
Glencoe	310	380	435	Lion's Head	330	410	475
Goderich	395	480	550	Listowel	340	410	470
Gore Bay	300	350	390	London	365	455	535
Graham	205	240	260	Lucan	395	480	555
Gravenhurst	260	315	350	Maitland	315	380	430
Grimsby	365	415	460	Markdale	285	360	415
Guelph	250	295	325	Martin	205	240	260
Guthrie	215	280	335	Matheson	300	360	410
Hagersville	335	385	425	Mattawa	245	285	315
Haileybury	315	380	435	Midland	255	325	385
Haliburton	260	315	350	Milton	320	380	430
Hamilton	365	415	460	Milverton	310	380	435
Hanover	335	410	475	Minden	260	315	350
Hastings	290	360	415	Mississauga	370	435	495
Hawkesbury	310	365	405	Mitchell	350	435	505
Hearst	200	245	280	Moosonee	260	315	350
Honey Harbour	255	325	385	Morrisburg	300	360	410
Hornepayne	190	235	270	Mount Forest	290	360	410
Huntsville	260	315	350	Muskoka Airport	260	315	350
Ingersoll	330	410	475	Nakina	210	245	275
Iroquois Falls	300	360	405	Napanee	320	380	430
Jarvis	330	380	425	Newcastle	460	535	595
Jellicoe	200	235	260	New Liskeard	315	380	435
Kapuskasing	230	275	310				
Kemptville	295	360	410	Newmarket	260	325	385
Kenora	230	275	310	Niagara Falls	330	380	425
Killaloe	260	315	350	North Bay	260	300	340
Kincardine	400	480	545	Norwood	290	360	415
Kingston	350	415	465	Oakville	375	435	490
Kinmount	260	315	350	Orangeville	250	310	355
Kirkland Lake	295	360	410	Orillia	260	315	350
Kitchener	275	330	370	Oshawa	430	510	575
Lakefield	265	325	380	Ottawa	295	360	410
Landsdowne House	240	285	315	Owen Sound	330	410	475

#### TABLE A2.9(b) REFERENCE WIND PRESSURE FOR ONTARIO

Source: Proposed CSA Standard Canadian Highway Bridge Design Code

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2000 05 15

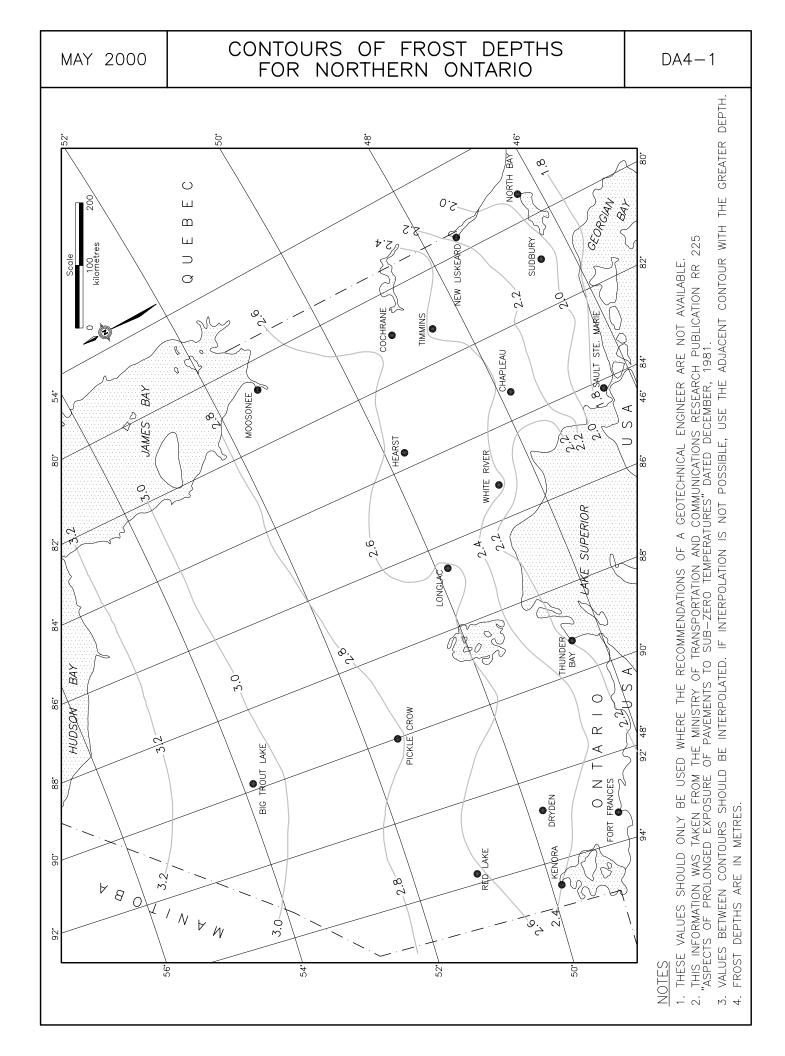
#### **GENERAL INFORMATION**

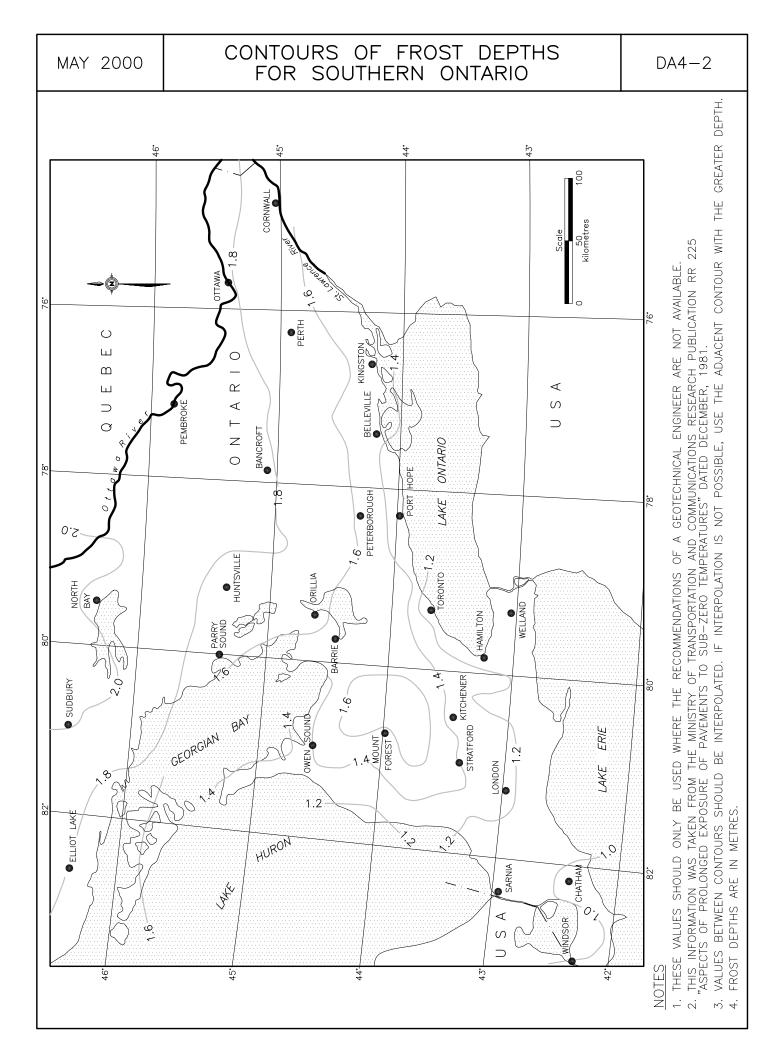
PAGE 2 - 10

	HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:				HOURLY MEAN WIND PRESSURE, (in Pascals) FOR RETURN PERIODS OF:		
	10 yr	25 yr	50 yr		10 yr	25 yr	50 yr
Pagwa River	190	240	275	Smooth Rock Falls	235	285	320
Paris	310	365	405	Southampton	380	460	525
Parkhill	400	480	545	South Porcupine	275	330	375
Parry Sound	245	325	395	South River	230	280	325
Pembroke	260	315	350	Stirling	280	345	400
Penetanguishene	255	325	385	Stratford	335	410	475
Perth	295	360	410	Strathroy	355	435	500
Petawawa	260	315	350	Streetsville	350	415	465
Peterborough	290	360	415	Sturgeon Falls	255	310	355
Petrolia	350	415	465	Sudbury	290	390	465
Picton	375	435	490	Sundridge	230	280	325
Plattsville	295	360	410	Tavistock	340	410	475
Point Alexander	260	315	350	Temagami	275	330	375
Porcupine	275	330	375	Thamesford	330	410	475
Port Burwell	345	415	470	Thedford	405	485	545
				Thunder Bay	300	355	390
Port Colborne	365	415	455	Tilsonburg	310	380	435
Port Credit	370	435	495	Timmins	255	310	355
Port Dover	360	415	465	Toronto	390	460	520
Port Elgin	395	480	550	Trenton	350	415	465
Port Hope	465	535	595				
Port Perry	310	380	435	Trout Creek	240	285	320
Port Stanley	340	410	470	Trout Lake	335	385	425
Prescott	315	380	430	Uxbridge	285	360	415
Princeton	300	360	410	Vanier	295	360	410
Raith	205	240	260	Vittoria	355	415	465
Red Lake	220	255	285	Walkerton	355	435	500
Renfrew	260	310	350	Wallaceburg	320	380	430
Ridgeway	365	415	455	Waterloo	275	330	370
Rockland	300	360	410	Watford	340	410	470
St. Catharines	365	415	460	Wawa	300	355	390
St. Marys	350	435	505	Welland	330	380	425
St. Thomas	330	410	475	WestLorne	345	415	470
Sarnia	350	415	465	Whitby	430	510	575
Sault Ste. Marie	320	365	400	White River	210	245	275
Schreiber	300	355	390	Wiarton	330	410	475
Seaforth	375	455	525	Windsor	360	420	470
Simcoe	330	380	425	Wingham	350	435	505
Sioux Lookout	205	240	260	Woodstock	305	380	435
Smiths Falls	295	360	410	Wyoming	350	415	465
Smithville	335	385	425				

### TABLE A2.9(c) REFERENCE WIND PRESSURE FOR ONTARIO

Source: Proposed CSA Standard Canadian Highway Bridge Design Code





MAY 2000

## TABLE OF FROST DEPTHS FOR ONTARIO BY LOCATION

DA4-3

Actinolite	1.6
Alexandria	1.8
Algonquin Park	
Stn.	1.9
Alliston	1.5
Apsley	1.7
Armstrong	2.7
Arnprior	2.7 1.8 1.7 2.4
Arthur	1.7
Atikokan	2.4
Attawapiskat	2.9
Bancroft	1.8
Bannockburn	1.7
Barbers Bay	2.4
Barkway	1.7
Barrie	1.5
Barry's Bay	1.9
Beaverton	1.6
Belleville	1.9 1.6 1.4
Belleville Big Trout Lake	3.1
Bobcaygeon	17
Bond Head	1.5
Bracebridge	1.7
Bradford	1.5
Brantford	1.2
Britt	1.2 1.9 1.5 1.8 1.8 1.2
Brockville	1.5
Burk's Falls	1.8
Brockville Burk's Falls Calabogie	1.8
Caledonia	1.2
Campbellford	1.5
Carleton Place	1.8
Cartier	2.1
Casselman	1.8
Chapleau	2.4
Chatham	2.4 1.0 1.7
Chatham Cloyne	1.7
Cochrane	2.5
Colborne	1.4
Crosby	
Deep River	1.9
Denbigh	1.8
Dorset	1.8
Dryden	2.5
Dunchurch	1.8
Dunnville	1.2
Durham	1.6
Ear Falls	2.5

Eganville	1.9
Elmira	1.5
Englehart	2.3
English River Estaire	2.3 2.5 2.0 1.3
Estaire	2.0
Exeter	1.3
Foleyet	2.4
Forest	1.1
Fort Erie	1.2
Fort Frances	2.3
Fort Hope	2.8
Gananoque	1.4 1.4 2.6
Georgetown	1.4
Geraldton	2.6
Glencoe	1.1
Goderich	1.2
Gogama	2.3
Gravenhurst	1.7
Grimsby	1.0
Haliburton	1.8
Hamilton	1.2
Havelock	1.6
Hawkesbury	1.6 1.8
Hearst	2.6
Hornepayne	2.5
Huntsville	1.8
Hurkett	2.3
Ignace	2.5
Iroquois Falls	2.4
Kapuskasing	2.5
Kashabowie	2.4
Kemptville	1.7 2.4
Kenora	2.4
Kincardine	1.2
Kingston	1.5
Kiosk	2.0
Kirkland Lake	2.4
Kitchener	1.4
Lake St. Peter	1.9
Lansdowne	
House	2.9
Leamington	1.0
Lindsay	1.6
Listowel	1.6
Little Current	1.7
London	1.2
Longlac	2.6
Long Point	1.1

Loon	2.2
Lucan	1.3
Lucknow	1.2
Manitouwadge	2.4
Manotick	1.7
Marathon	2.1
Markdale	1.6
Mattawa	2.0 2.3 2.2
Mine Centre	2.3
Montreal River	2.2
Moosonee	2.7
Morrisburg	1.6
Mount Forest	1.6
Napanee	1.5
Nestor Falls	2.4
New Liskeard	2.1
Niagara Falls	1.1
Nipigon	1.1 2.3
Noelville	2.0
Norland	1.7
North Bay	2.0
Oakville	1.2
Oil City	1.1
Orangeville	1.6
Orient Bay	2.4
Orillia	2.4 1.6 1.3
Oshawa	1.3
Ottawa	1.8
Owen Sound	1.4
Pagwa River	2.5
Palmerston	1.6
Parry Sound	1.7
Pembroke	1.7
Penetanguishene	1.5
Perth	1.7 1.5 1.7 1.6
Peterborough	1.6
Pickle Lake	2.8
Picton	1.4
Poland	1.8
Pontypool	1.4
Port Carling	1.7
Port Hope	1.3
Powassan	1.9
Rainy River	2.3
Raith	2.4
Red Lake	
Renfrew	1.8
Richmond Hill	1.4

Ridgetown	1.4
Rockland	1.8
Sarnia	1.1
Sault Ste. Marie	1.1 1.8
Savant Lake	2.6
Savant Lake Schreiber	2.3
Seaforth	1.4
Shelburne	1.7
Simcoe	1.2
Sioux Lookout	2.5
Smiths Falls	1.7
Smooth Rock	2.6
Falls	2.0
Southampton	1.3
South River	1.9
Spanish	1.8
Stayner	1.5
Stratford	1.4
Strathroy	1.2
St Thomas	1.2
St. Thomas	1.2
Sturgeon Falls	2.0
Sudbury	1 5
Sutton Temagami	2.1 1.5 2.1
Temagami	2.1
Terrace Bay	2.2
Thessalon	1.7
Thornbury	1.6
Thunder Bay	2.2
Tilbury	1.0
Tillsonburg	1.2
limmins	1.2 2.4 1.4
lobermory	1.4
Timmins Tobermory Toronto Trenton	1.2
ii oileoli	1.4
Upsala	2.4
Uxbridge	1.5
Walkerton	1.4
Wallaceburg	1.0
Wawa	2.1
Welland	1.1
West Lorne	1.1
White River	2.4
Whitney	2.0
Wiarton	1.4
Winchester	1.7
Windsor	1.0
Wingham	1.4
Woodstock	1.3

#### NOTES

- 1. THESE VALUES SHOULD ONLY BE USED WHERE THE RECOMMENDATIONS OF A GEOTECHNICAL ENGINEER ARE NOT AVAILABLE.
- 2. THIS INFORMATION WAS TAKEN FROM THE MINISTRY OF TRANSPORTATION AND COMMUNICATIONS RESEARCH PUBLICATION RR 225 "ASPECTS OF PROLONGED EXPOSURE OF PAVEMENTS TO SUB-ZERO TEMPERATURES" DATED DECEMBER, 1981.
- 3. FROST DEPTHS ARE IN METRES.

**DIVISION 3 - CANTILEVER STATIC SIGN SUPPORTS** 

2007 04 02

CANTILEVER STATIC SIGN SUPPORTS

## 3 <u>CANTILEVER STATIC SIGN SUPPORTS</u>

#### 3.1 <u>GENERAL</u>

#### 3.1.1 TYPES OF SIGN SUPPORTS

There are three types of cantilever sign supports:

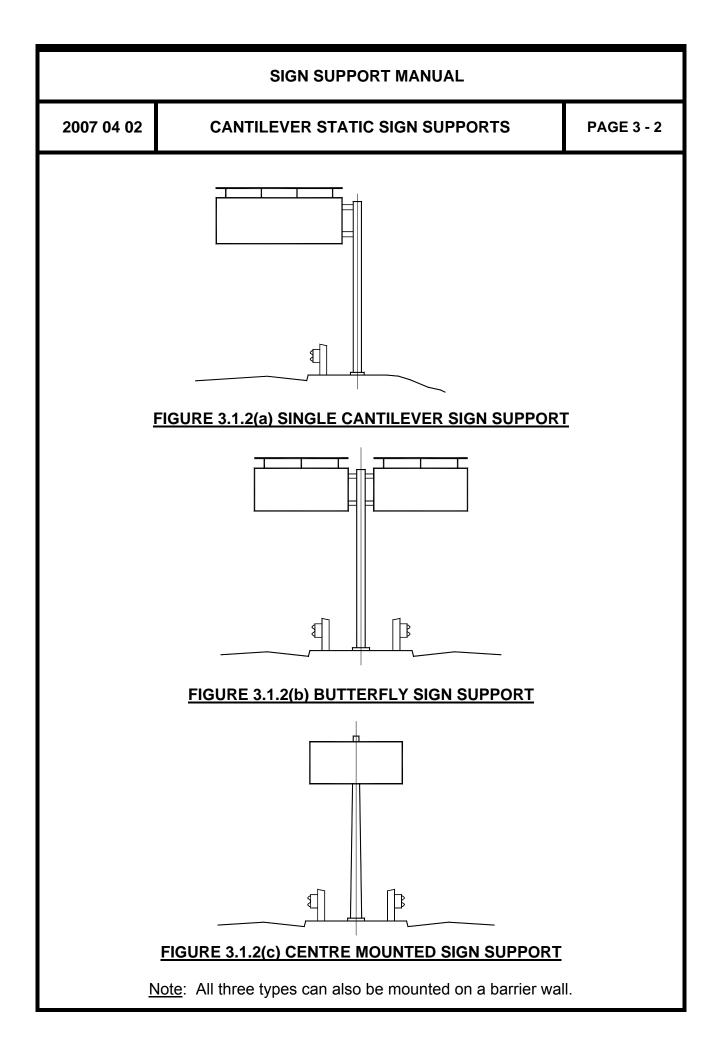
Single Cantilever:	one sign, mounted to one side of the vertical support member, Figure 3.1.2(a) (See SS118-24)
Butterfly (Double Cantilever):	two signs, each mounted on opposite sides of the "T" style support, Figure 3.1.2(b). (See SS118-22)
Centre Mounted:	one sign, mounted over the vertical support member, Figure 3.1.2(c). No standard is currently available.

## 3.1.2 STANDARD SIGN SUPPORTS

Standard cantilever sign supports are designed to support static sign boards. The sign supports are fabricated in structural steel and designed to the requirements of the Canadian Highway Bridge Design Code CAN/CSA-S6-00 (CHBDC).

The sign supports contained in this Division are designed for sign boards and site conditions that meet the following criteria:

- (a) Maximum sign board area and eccentricity limits based on Figures 3.2.2(a) to (h)
- (b) For the butterfly sign support, the maximum sign area is the total area of both sides. The sign area of one side shall not be greater than 2 times that of the other.
- (c) Depth of sign board up to 2740 mm
- (d) All sign boards include an aerodynamic damper attachment (See Figure 3.3.2 and Appendix)
- (e) Reference wind pressure up to 600 Pa for a return period of 50 years. The effect of wind funnelling (CHBDC 3.10.1.1) is not considered.
- (f) Location of supports and vertical clearances that meet the requirements of the CHBDC
- (g) Competent soil conditions, excluding rock fill.



#### 3.1.3 LIMITATIONS

For economic and practical reasons these supports should be placed as close as possible to the edge of the travelled portion of the highway (See 3.1.6). For this reason these supports will probably be in the Clear Recovery Zone and should be protected as discussed in Section 2.6.

For ground mounted footings, the top of footing elevation shall be a minimum of 300 mm above the finished grade. This could be increased up to 1000 mm in order to limit the leg height. The dimension from the top of the footing to the centreline of the bottom arm shall not exceed 6500 mm. Therefore, the total height from grade to centreline of the bottom arm cannot exceed 7500 mm.

For Class 3 and 4 Cantilever sign supports, when the ratio of arm length to column height exceeds 1.5, consideration should be given to the use of a Tri-Chord rather than a Cantilever sign support. Tri-Chord static sign supports are discussed in Division 4 of this Manual.

#### 3.1.4 CANTILEVER SIGN SUPPORTS

Cantilever sign supports are fabricated from structural steel and are designed for ground mounting or on concrete median barriers. The typical layout plan and sign support elevation are shown in Figures 3.1.4 (a) through (d).

The vertical support member is straight and made from round or octagonal shape sections. Fabricators may choose to fabricate the octagonal shape from steel plate. Octagonal sections have to meet the requirements shown on SS118-22 and SS118-24. The maximum allowable length of the vertical support member is 8200 mm, which is a limit imposed by design. It is connected at the base to a concrete footing by a bolted anchorage system.

The horizontal arms are usually interconnected by verticals and diagonals. All of these members are fabricated from circular HSS sections. Sign boards are centered vertically between the horizontal arms, and are attached to these members by means of Z-brackets (See Fig. A3.1). The horizontal arms are connected to the vertical support member by a bolted flange welded to the support. For butterfly sign supports, horizontal arms shall be located at the same elevation and extend in both directions.

An aerodynamic damper along the full width of all sign boards is required to suppress vortex shedding and galloping instabilities of the structure under various wind conditions. The damper is attached to each Z-bracket by means of stainless steel bolts. The damper assembly is fabricated from structural aluminum and is comprised of a damper plate, gusset plates and support angles (See Figure 3.3.2).

**CANTILEVER STATIC SIGN SUPPORTS** 

All structural steel components are galvanized after fabrication. The support leg is subsequently coated with an approved paint system.

## 3.1.5 FOOTINGS

Sign support footings consist of a single reinforced concrete caisson. Details differ according to their location, and are of two types, for ground mounted and median mounted signs. (See Standard Drawings SS118-3, SS118-4 and/or SS118-5).

The indicated footing depths are required for each support. Footing proportions apply to normal competent soil conditions of uniform composition. Parameters upon which the design is based are given in Section 3.5.4.

Encountered soil conditions such as rock, rock fill, land fill, and poor soft material require the footing to be designed by an Engineer.

#### 3.1.6 CLEARANCE

For ground mounted footings, the leg of the sign structure and footings projecting above the barrier, should be located a minimum horizontal distance 'G' from the traffic protection barrier as specified in the Roadside Safety Manual.

The minimum vertical distance from the bottom of the sign board to the highest point on the highway, including shoulders, curbs and medians, shall not be less than 5300 mm and 5600 mm to the lower arm. Small lane designation sign boards with limited strength connections are allowed to project below this level because damage to them does not cause damage to the structure.

**CANTILEVER STATIC SIGN SUPPORTS** 

## 3.1.7 DETERMINING ARM LENGTH AND PANEL LENGTHS

The length of the arms shall extend to 50mm from the end of the sign.

The number and spacing of the panels shall be based on the following criteria (this shall be calculated on both sides for butterfly sign supports):

- (1) A minimum of 2 panels. (If it is calculated that only one panel is required, the arms shall be fabricated without verticals/diagonals and installed individually).
- (2) A maximum panel spacing of 2600mm.
- (3) An equal panel length spacing except as modified in (4) below
- (4) The size of the panel nearest to the leg may be adjusted if there is a conflict between the Z-bracket nearest to a leg and the panel point gusset plate. (see also Section 3.1.8).

See Section 3.2.3 and 3.2.4 for examples.

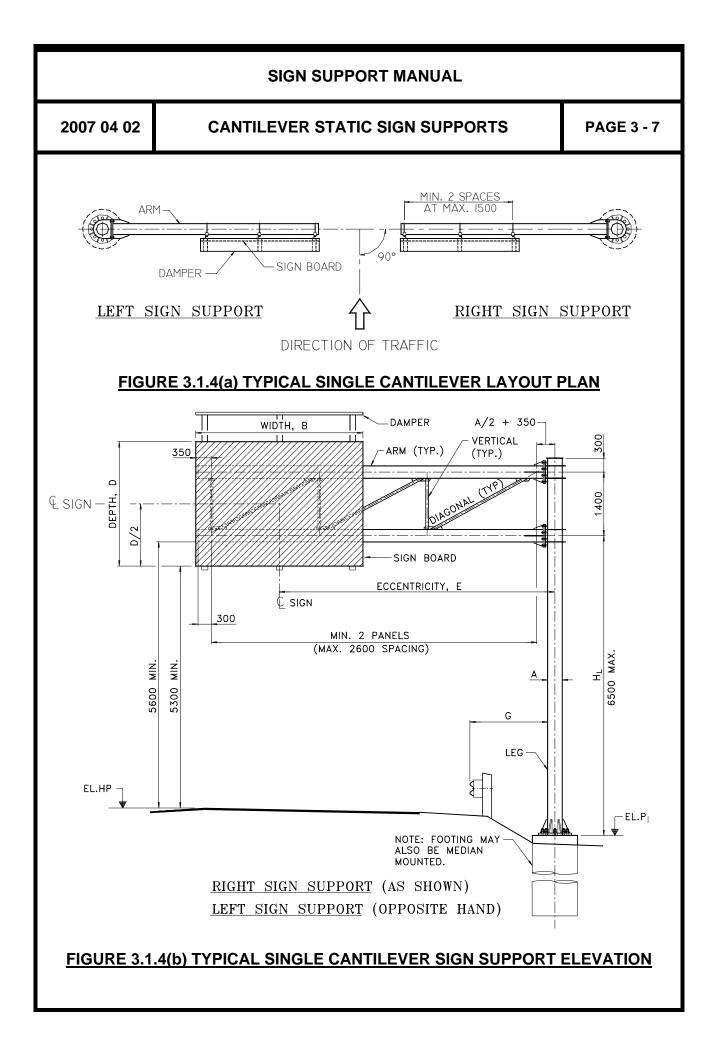
## 3.1.8 DETERMINING THE LOCATION OF Z-BRACKETS

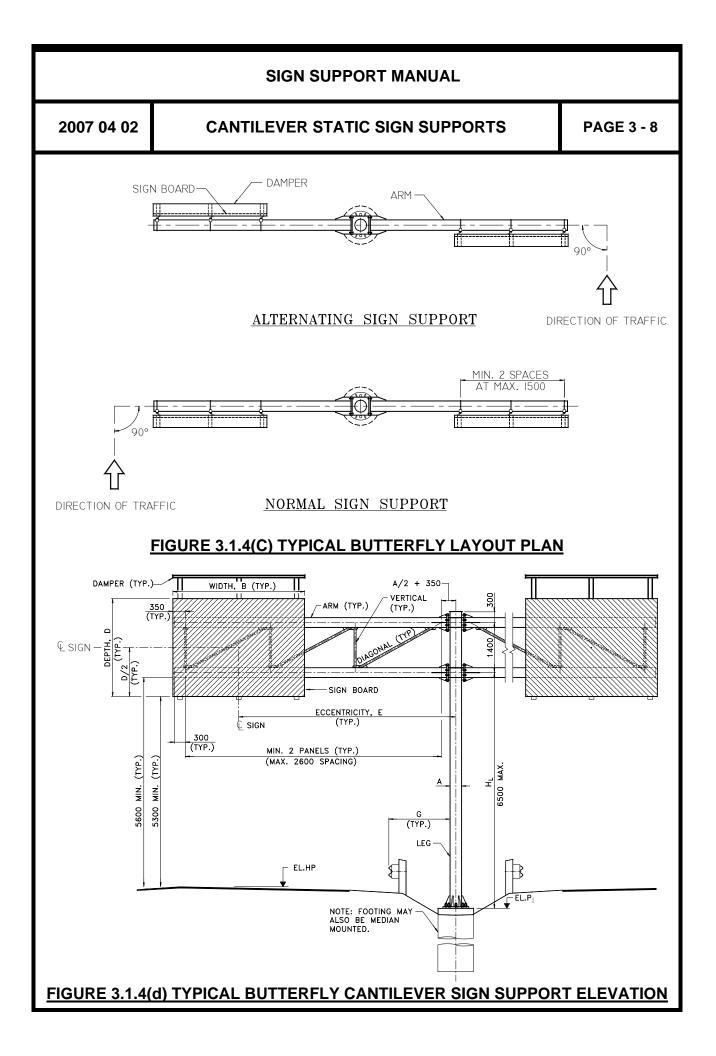
The number and spacing of Z-brackets for the attachment of the sign board to the structure shall be based on the following criteria (this shall be calculated on both sides for butterfly sign supports):

- (1) Maximum spacing of 1500 mm.
- (2) The number of Z-brackets should be kept to a minimum but no less than 3 brackets per sign.
- (3) The intermediate Z-brackets should be equally spaced where possible.
- (4) A fixed distance of 200 mm from the centre of the Z-bracket to the end of the sign board except as required in (5).
- (5) If there is conflict between the Z bracket closest to the leg and a panel point connection gusset plate, the location of the Z-bracket can be adjusted as follows:
  - (a) Adjust the distance to the end of the sign board. This shall be a minimum of 125 mm and maximum of 500 mm from the centre of the Z-bracket. (see SS118-25).

AND/OR

SIGN SUPPORT MANUAL			
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	(b) Adjust the length of panel closest to the leg.		
(6)	Check for conflict with the diagonal/vertical arm connect sign board is in place. Where this occurs the designer Z-bracket to avoid the conflict (while maintaining the ab- if necessary, change the size of the truss panel poin 3.1.7) nearest to the leg to cause the gusset plate conn- away from this location.	shall move the ove limits) and, it (see Section	
See	Section 3.2.3 and 3.2.4 for examples.		
Once deter	e the number and location of the Z-brackets and panel por mined the designer shall add this information to Tables dard drawings.		





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## **CANTILEVER STATIC SIGN SUPPORTS**

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## 3.2 PROCEDURES

#### 3.2.1 GENERAL

There are four designs (called <u>Classes</u>) for single cantilever and butterfly sign supports. Each Class has a specified set of member dimensions, resulting in different load carrying capacities, (i.e. a Class 4 support can hold a much larger sign than a Class 1 support). The Class is dependent on the sign area, A, the eccentricity, E, and the 50-year Reference Wind Pressure, q, for the proposed location.

## 3.2.2 DATA REQUIRED

For each sign support, the following data is required:

(1) For Single Cantilever Sign Supports:

The sign board dimensions (D x B) and eccentricity, E. Maximum sign area vs. eccentricity curves are shown in Figures 3.2.2(a) to (d) for four different ranges of reference wind pressure. Only the combinations shown <u>below</u> the upper limit line are permissible

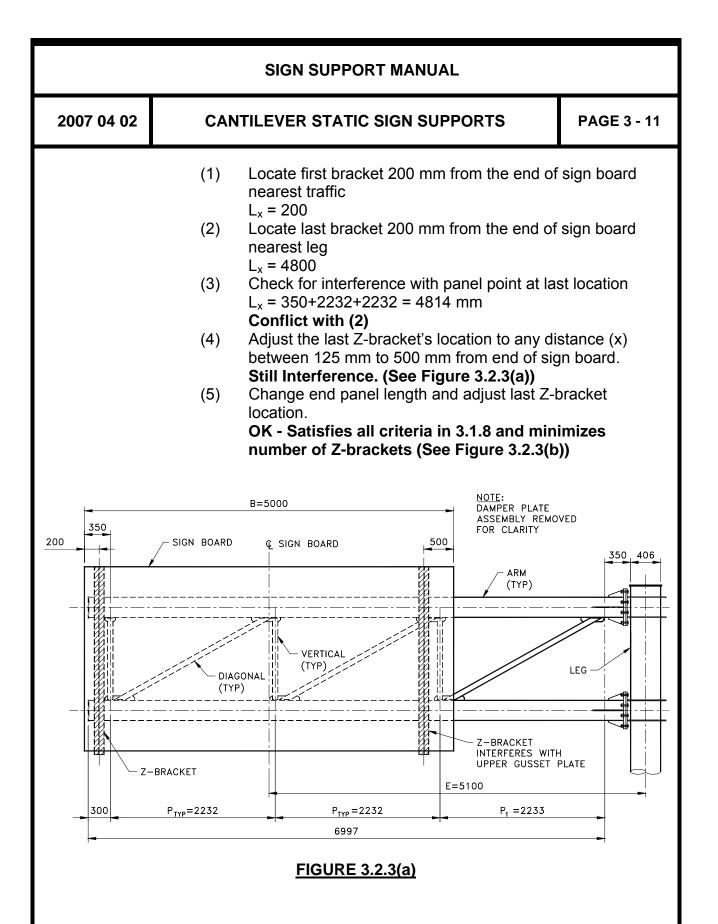
#### (2) For Butterfly Sign Supports:

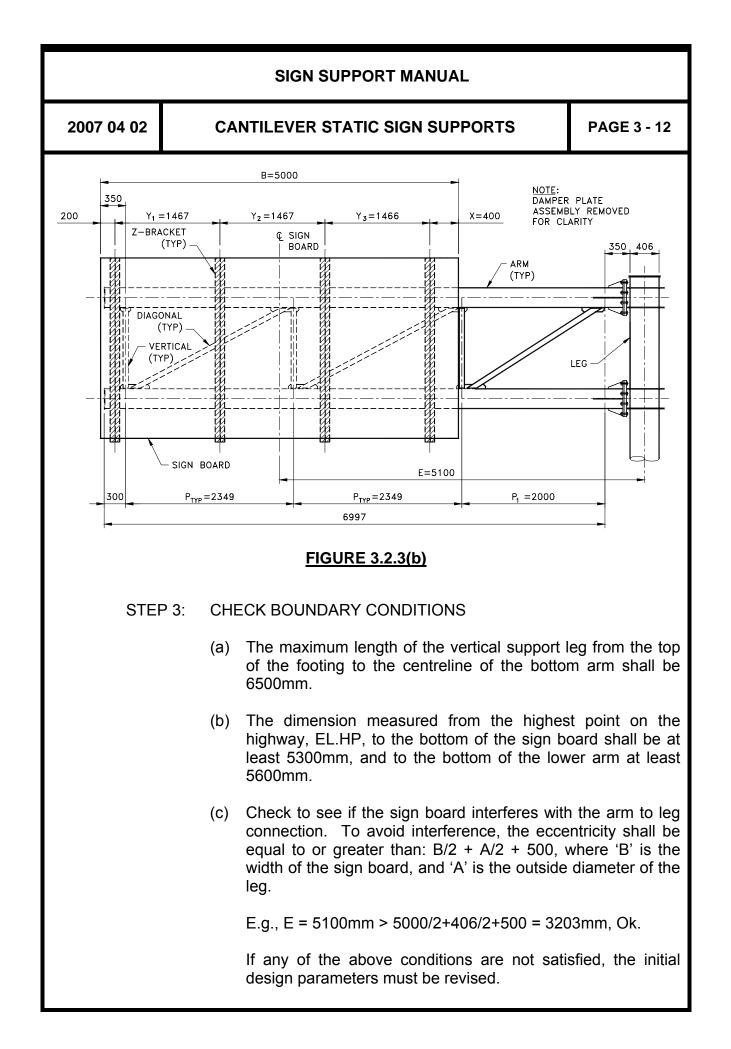
The sign board area (A  $_{left}$  and A  $_{right}$ ) and eccentricities (E  $_{left}$  and E  $_{right}$ ) from both sides.

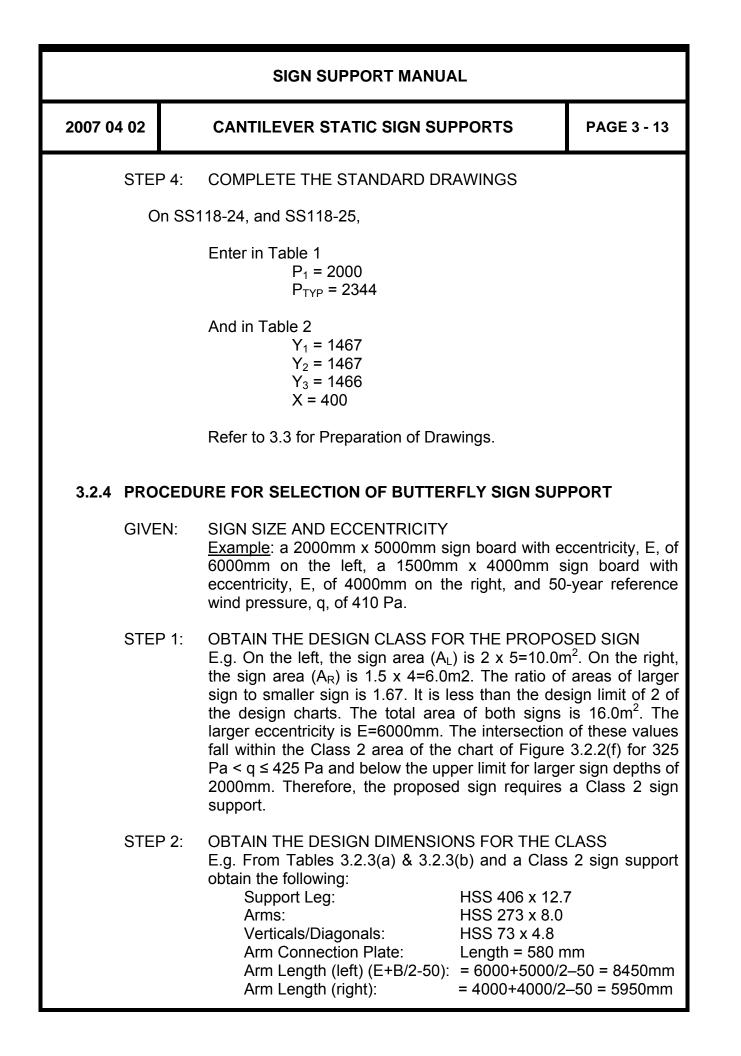
Maximum total sign area (A <sub>left</sub> + A <sub>right</sub>) vs. eccentricity (maximum of E <sub>left</sub> and E <sub>right</sub>) curves are shown in Figures 3.2.2(e) to (h) for four different ranges of reference wind pressure. Only the combinations shown <u>below</u> the upper limit are permissible.

- (3) The 50-year reference wind pressure, q. This value can be obtained for Ontario from Table A2.9(a) to (c) in the Appendix in Division 2 of the Manual.
- (4) The site location and orientation of the support.
   For a proposed highway or a highway under reconstruction, the location should be specified as a station. The orientation or layout shall be as shown in Figures 3.1.4(a) and 3.1.4 (c).
- (5) The elevation of the highest point on the highway under the sign board, and the final ground elevations under the sign structure footing, at the sign station.

SIGN SUPPORT MANUAL					
2007 04 02	CANTILEVER STATIC SIGN	CANTILEVER STATIC SIGN SUPPORTS			
3.2.3 PROCEDURE FOR SELECTION OF SINGLE CANTILEVER SIGN SUPPORT					
GIVE	N: SIGN SIZE AND ECCENTRIC <u>Example</u> : 2500mm x 5000mn 5100mm, and 50-year reference	n sign board with ec			
STEI	P 1: OBTAIN THE DESIGN CLASS E.g. The intersection of the 12.5m <sup>2</sup> and E = 5100 mm fall on Figure 3.2.2(c) for 425Pa limit for sign depth of 25000 requires a Class 2 sign support	values for sign are within the Class 2 a < q $\leq$ 525Pa, and b mm. Therefore, the	a of 2.5 x 5 = rea of the chart below the upper		
STE	<ul> <li>OBTAIN THE DESIGN DIMEN</li> <li>E.g. From Tables 3.2.3(a) &amp; 3</li> <li>obtain the following: Support Leg: Arms: Verticals/Diagonals: Arm Connection Plate: Arm Length (E+B/2-50): Dimension 'K' for Cambe</li> </ul>	3.2.3(b) and a Class HSS 406 x 12.7 HSS 273 x 8.0 HSS 73 x 4.8 Length = 580 n = 5100+5000/2	2 sign support		
	CALCULATE PANEL LENGTHS (see 3.1.7):				
	The total length of all panels	= E+B/2-A/2-700 = 5100+5000/2-40 = 6697 mm	6/2-700		
	Total number panels required	= 6697/2600 = 2.57, say 3 pane	ls		
	Average panel length	= 6697/3 = 2232.3			
	P <sub>1</sub> = 2233, P <sub>TYP</sub> = 2232				
	LOCATE Z-BRACKETS (see 3.1.8):				
	Let L <sub>x</sub> = distance of Z-bracket traffic.	from end of sign boa	rd closest to		

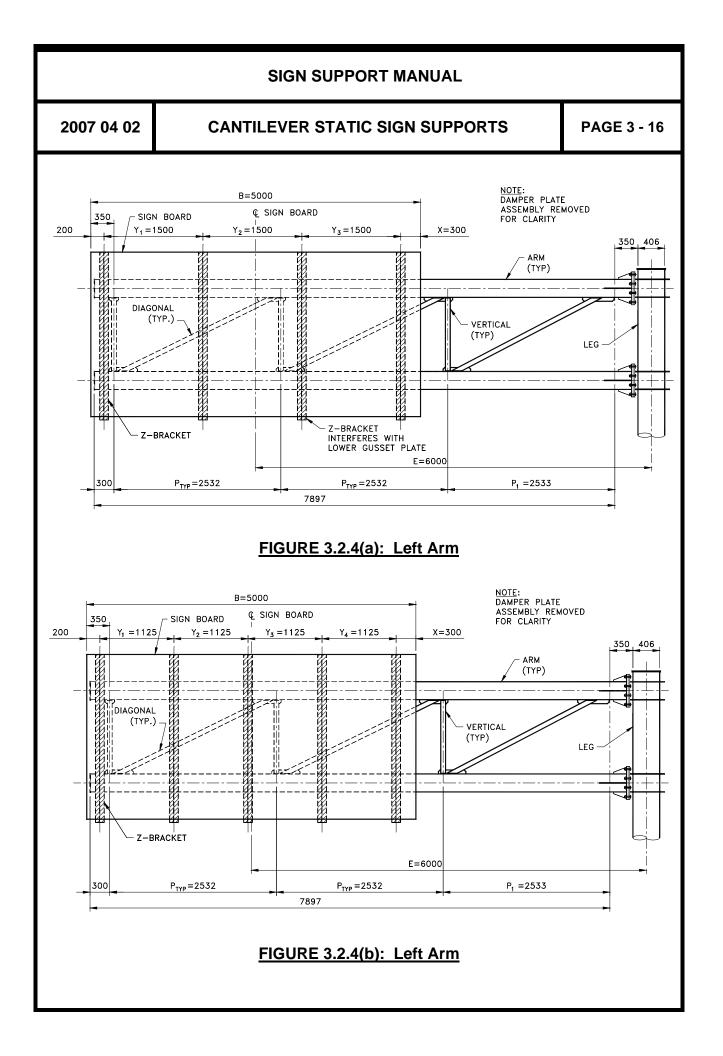


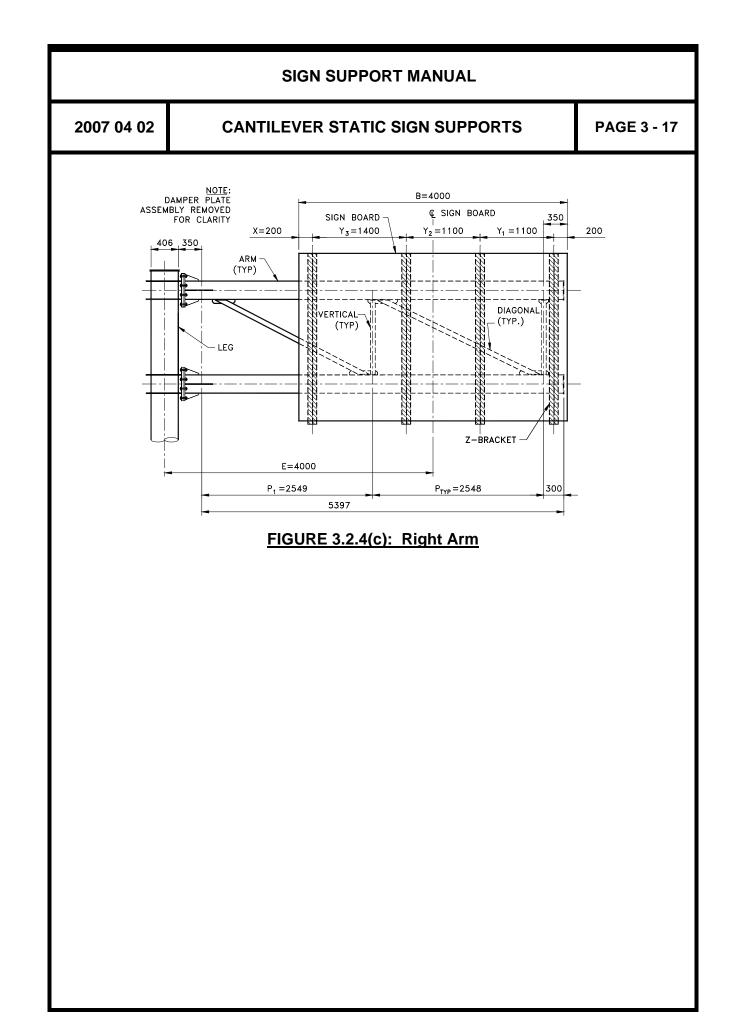




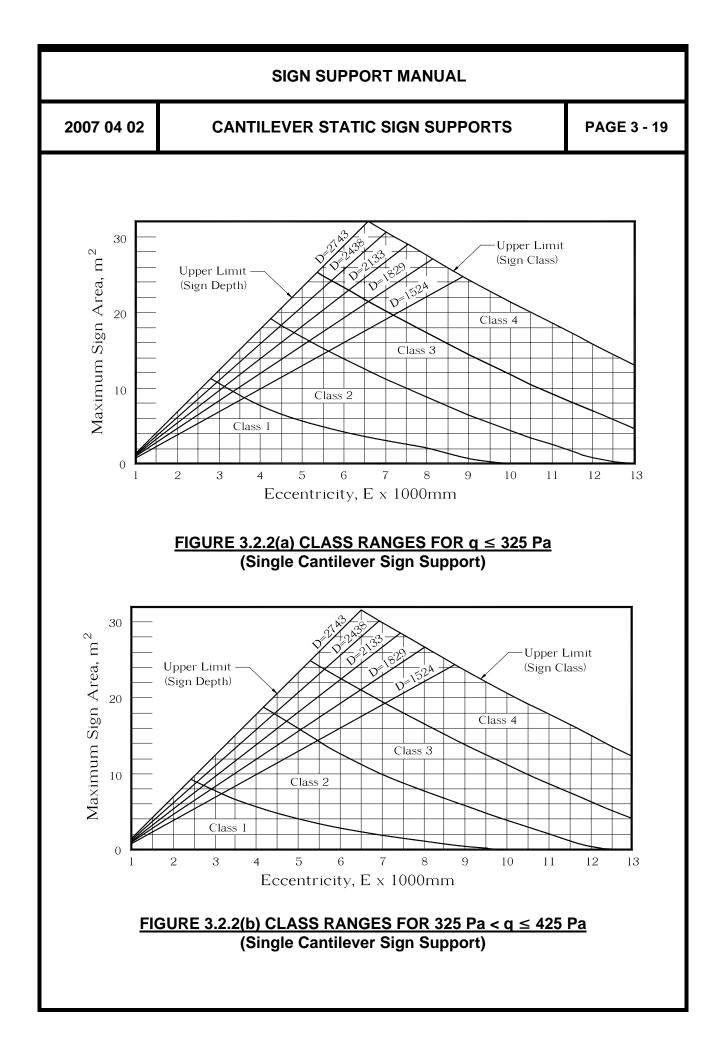
SIGN SUPPORT MANUAL					
2007 04 02	CANTILEVER STATIC SIGN	CANTILEVER STATIC SIGN SUPPORTS			
	Dimension 'K' for Camber (left): = 70 mm Dimension 'K' for Camber (right): = 65 mm				
	CALCULATE PANEL LENGTH	IS (see 3.1.7):			
	LEFT The total length of all panels	= E+B/2-A/2-700 = 6000+5000/2-40	6/2-700		
	Total number panels required Average panel length	= 2.92, say 3 pane = 7597/3	ls		
	P <sub>1</sub> =	= 2532.33 2533, P <sub>TYP</sub> = 2532			
	RIGHT The total length of all panels Total number panels required Average panel length	The total length of all panels = $E+B/2-A/2-700$ = 4000+4000/2-406/2-700 = 5097 mm = 5097/2600 = 1.96, say 2 panels			
	P <sub>1</sub> = 2549, P <sub>TYP</sub> = 2548				
	LOCATE Z-BRACKETS (see 3.1.8):				
	LEFT Let L <sub>x</sub> = distance of Z-bracket from end of sign board closest to traffic.				
	<ul> <li>Locate first bracket 200 mm from the end of sign board nearest traffic</li> <li>L<sub>x</sub> = 200</li> </ul>				
	<ul> <li>(2) Locate last bracket 200 mm from the end of sign board nearest leg L<sub>x</sub> = 4800</li> <li>(3) Check for interference with panel point at last location L<sub>x</sub> = 350+2532+2532 = 5414 mm No Conflict with (2), but length between 1<sup>st</sup> and last bracket of 4600mm precludes the possibility of</li> </ul>				
	minimizing the numbe	•			

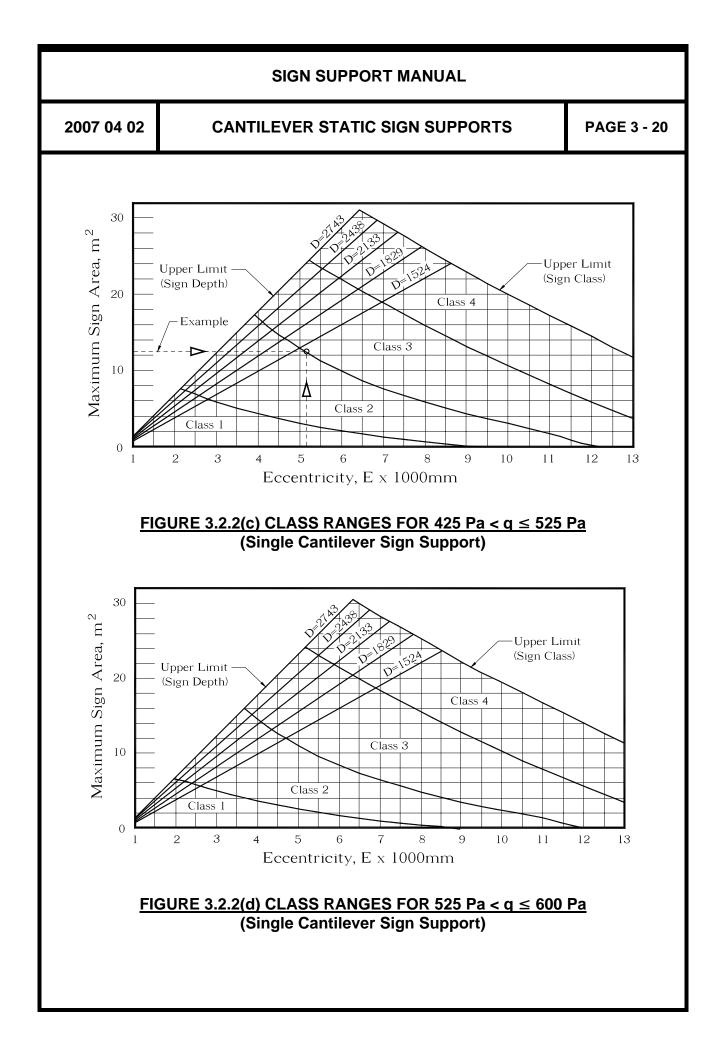
SIGN SUPPORT MANUAL			
2007 04 02	CAN	ITILEVER STATIC SIGN SUPPORTS	PAGE 3 - 15
	(4) (5) (6)	Adjust the last Z-bracket's location to any dis between 125 mm to 500 mm from end of sig 300mm. <b>Z-bracket interferes with lower gusset pla</b> <b>Figure 3.2.4(a)).</b> Keep the Z-bracket locations and maximize spacing (P <sub>1</sub> ) to 2599. <b>Z-bracket still interfe</b> <b>gusset plate.</b> Number of Z-bracket locations has been inc to 5. <b>OK - Satisfies all criteria in 3.1.8 and</b> <b>number of Z-brackets (See Figure 3.2.4(b</b> )	an board – try ate. (See the end panel eres with lower reased from 4 minimizes
	RIGH	IT	
	(7)	Locate first bracket 200 mm from the end of nearest traffic (away from leg). $L_x = 200$	sign board
	(8)	Locate last bracket 200 mm from the end of nearest leg $L_x = 3800$	sign board
	(9)	Check for interference with panel point at las L <sub>x</sub> = 350+2548 = 2898 mm No Conflict with (8) OK - Satisfies all criteria in 3.1.8 and min number of Z-brackets (See Figure 3.2.4(c	imizes

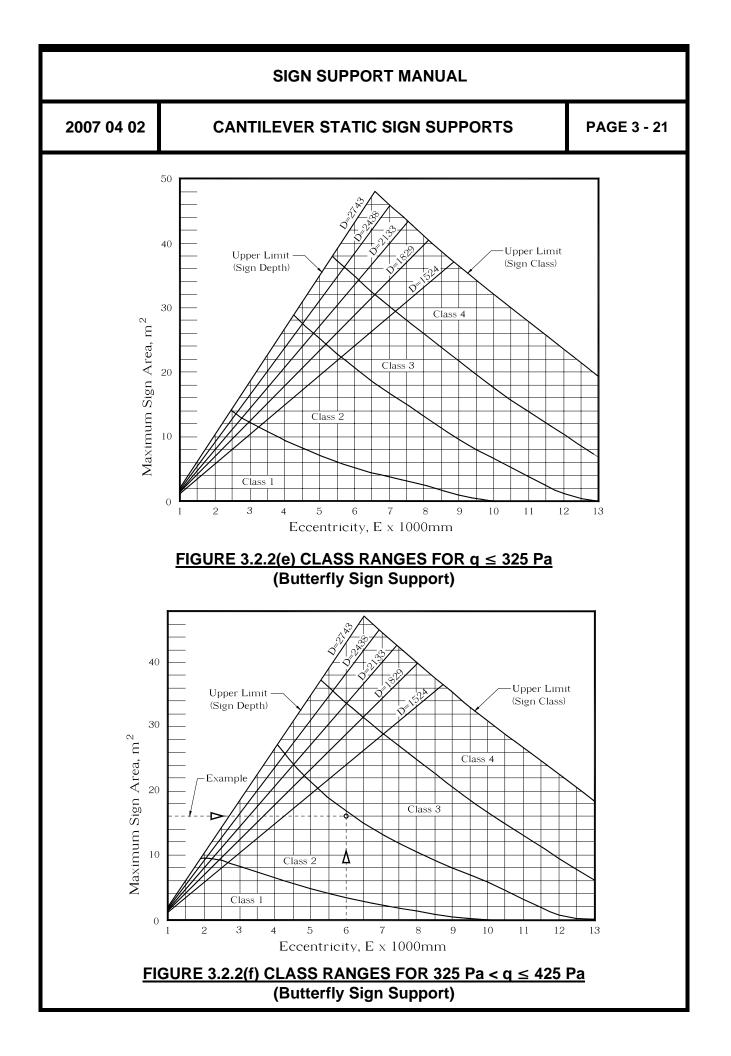


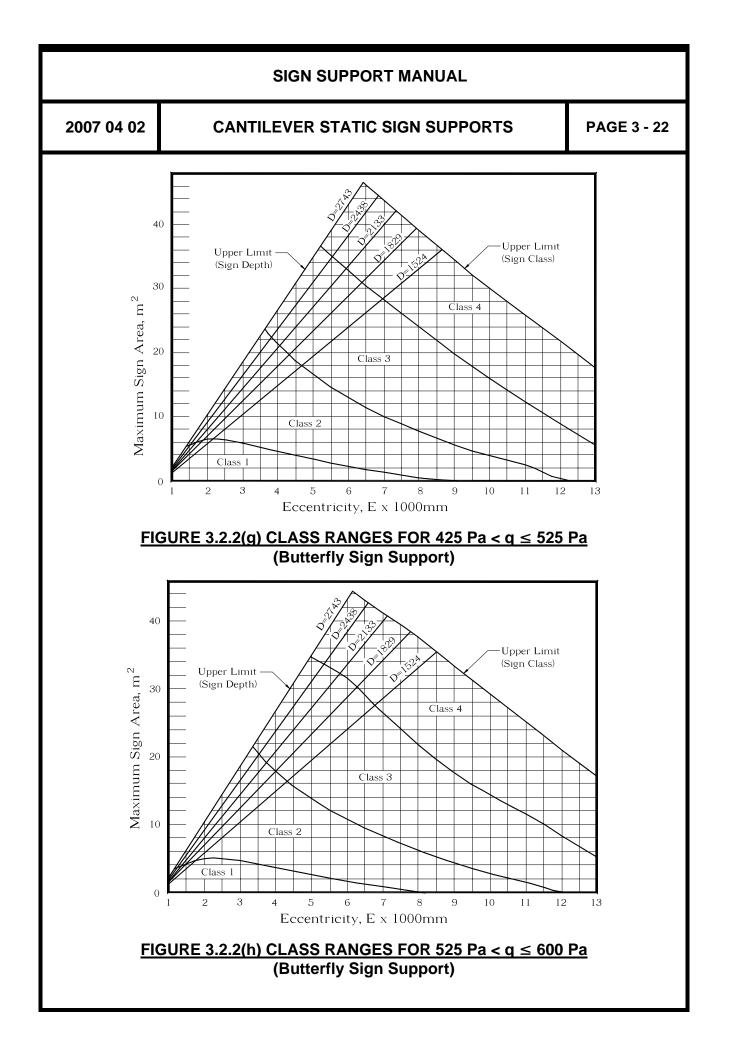


SIGN SUPPORT MANUAL					
2007 04 02	C	ANTILEVER STATIO	C SIGN SUPPORTS	PAGE 3 - 18	
STE	⊃3: C⊦	IECK BOUNDARY (	CONDITIONS		
	(a)		ngth of the vertical support l the centreline of the botton	•	
	(b)	point on the highv	point on the highway, EL.HP, to the bottom of the sign board shall be at least 5300mm, and to the bottom of the lower arm		
	(c)	) Check to see if the sign board interferes with the arm to leg connection. To avoid interference, the eccentricity shall be equal to or greater than: B/2 + A/2 + 500, where 'B' is the width of the sign board, and 'A' is the outside diameter of the leg.			
			00mm > 5000/2+406/2+500 00mm > 4000/2+406/2+500		
	If any of the above conditions are not satisfied, the initial design parameters must be revised.				
STE	STEP 4: COMPLETE THE STANDARD DRAWINGS				
On SS118-22, and SS118-25,					
		ter in Table 1 LEFT RIGHT	P <sub>1</sub> = 2533 P <sub>TYP</sub> = 2532 P <sub>1</sub> = 2549 P <sub>TYP</sub> = 2548		
	An	d in Table 2 LEFT	$Y_1 = 1500$ $Y_2 = 1500$ $Y_3 = 1500$ x = 300		
	RIGHT $Y_1 = 1100$ $Y_2 = 1100$ $Y_3 = 1400$ x = 200				
	Refer to 3.3 for Preparation of Drawings.				









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## **CANTILEVER STATIC SIGN SUPPORTS**

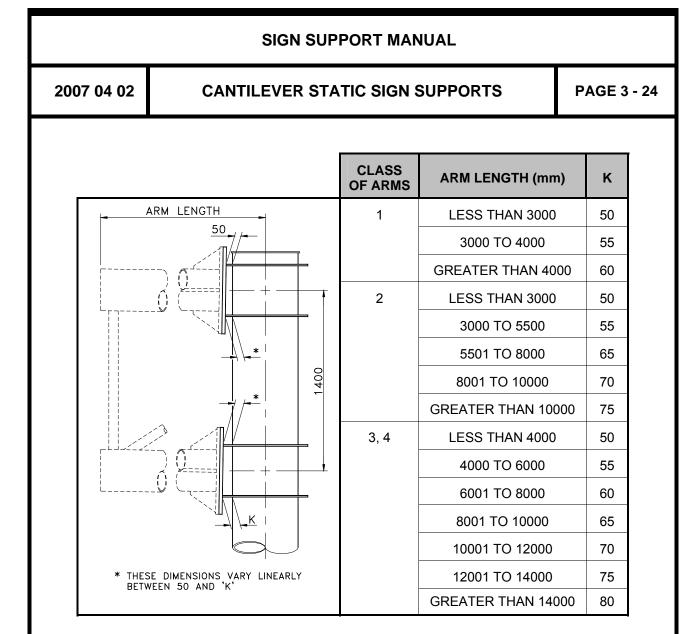
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	CLASS 1	CLASS 2	CLASS 3	CLASS 4
LEG OUTSIDE DIAMETER, A (mm) (1)	324	406	508	610
LEG THICKNESS, t (mm) (1)	9.5	12.7	12.7	12.7
ARMS	HSS 168 x 8.0	HSS 273 x 8.0	HSS 356 x 12.7	HSS 508 x 12.7
VERTICALS/DIAGONALS	HSS 73 x 4.8	HSS 73 x 4.8	HSS 73 x 4.8	HSS 89 x 4.8
ARM CONNECTION PLATE LENGTH, P (mm) (2)	498	580	682	784
ARM CONNECTION PLATE THICKNESS, TI (mm) (2)	25	25	30	30
ARM CONNECTION PLATE THICKNESS, T2 (mm) (2)	12	12	15	15
BOLT CIRCLE DIAMETER AT BASE, D1 (mm) (2)	750	750	750	850
BASE PLATE DIAMETER, D2 (mm) (2)	900	900	900	1000
WELD SIZE AT BASE, F (mm) (2)	10	10	13	13

**<u>Notes</u>:** (1) The vertical support legs are fabricated from round or octagonal sections. For octagonal sections, A is measured across the flats. (See 3.1.4).

(2) The dimensions P, T1, T2, D1, D2 and F are detailed on SS118-22 and SS118-24.

## TABLE 3.2.3(a) DESIGN DIMENSIONS FOR CLASS 1, 2, 3 AND 4



#### TABLE 3.2.3(b) DESIGN DIMENSIONS FOR CLASS 1, 2, 3 AND 4

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CANTILEVER STATIC SIGN SUPPORTS

#### 3.3 **PREPARATION OF DRAWINGS**

#### 3.3.1 DATA REQUIRED

Prior to design, "Key Plan and Frame Dimension" information must be prepared to enable the working drawings to be detailed. This information should form part of the contract document and must show for one or more structures, the following information:

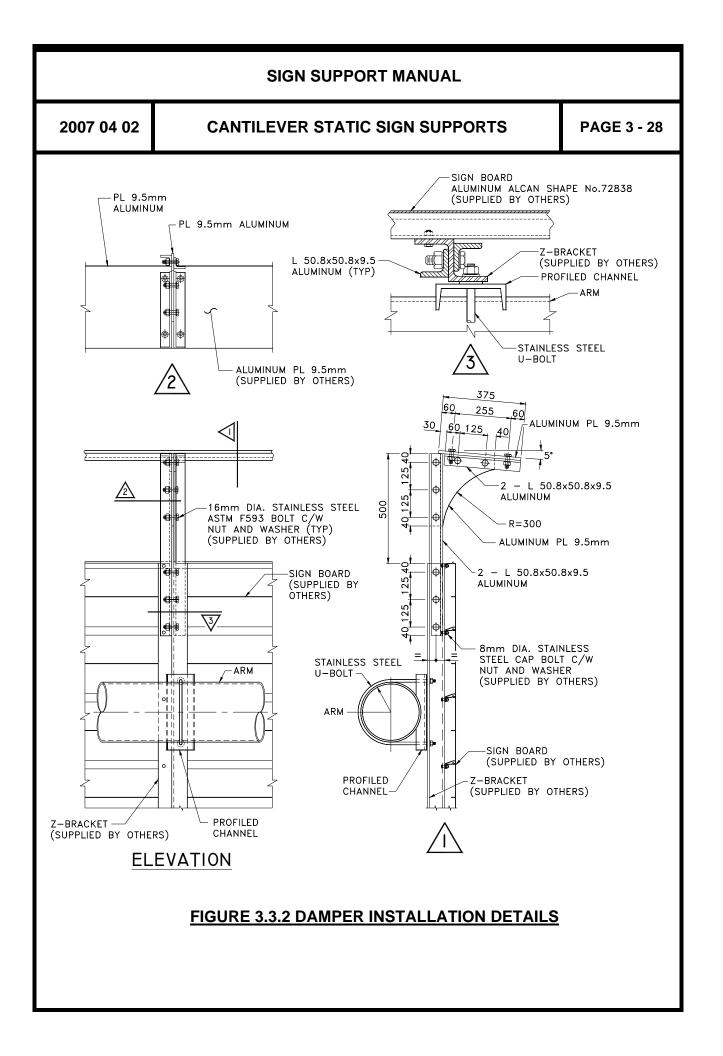
- (1) A key plan, indicating the approximate location of each support.
- (2) The Structure I.D. number.
- (3) The eccentricity, measured from centreline of the sign board to the centreline of support leg. This is required for both signs on butterfly sign supports.
- (4) The control line or the centreline of the roadway, and the offset of the leg from the control line.
- (5) The elevation of the highest point on the roadway surface under the support structure. Consider both sides of leg for butterfly sign supports.
- (6) The dimension measured from the top of footing to the centreline of the bottom arm. This height shall not exceed 6500 mm.
- (7) The top of footing elevation. The elevation shall be a minimum 300 mm above finished grade. This could be increased up to 1000 mm in order to limit the column leg height as stated in (6).
- (8) The elevation of the ground line at the support footing.
- (9) The offset of the centreline of footing from the control line, either as a note or as a dimension.
- (10) The station of the support structure on a designated highway centreline or control line.
- (11) A designation for the sign support as a "Left Sign Support" or "Right Sign Support". Left and Right for this purpose, are defined as if looking in the direction of the traffic, as shown in Figure 3.1.4(a) and (b). For butterfly sign supports, a "Normal Sign Support" would have both sign boards facing the same direction for use in gore areas or medians separating core/collectors, while an "Alternating Sign Support" would

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	CANTILEVER STATIC SIGN SUPPORTS	PAGE 3 - 26
	have the two signs facing opposite directions for use on Figures 3.1.4(c) and (d))	medians. (See
(12)	The footing type (see 3.1.5). For ground mounted dimension 'G' from the front face of the traffic protection leg or the footing, whichever is closer (See 3.1.6).	
(13)	For the sign board, the following additional information is	s required:
	<ul> <li>An outline in dashed line showing the sign board(s) on the support,</li> </ul>	to be mounted
	- The dimensions B and D of the sign board(s).	
3.3.2 SIGN	I SUPPORT DRAWINGS	
SS11	supports are to be supplied and erected as part of a cont 8-23, SS118-24, SS118-25, SS118-3 and/or SS118-4 or ed. Up to 5 sign supports can be detailed on one sheet.	
W.P.	Appendix contains reduced prints of these drawings. Th numbers should be added to the title block. The sheet no the drawings for the entire contract are assembled.	
	S118-22/23/24/25 there are two tables to be completed o ch table, one vertical column of data is used for each sign.	•
The S	Standard Drawings shall be sealed, dated and signed acc	ording to 2.4.1.
The c	data required to complete <u>Table 1 - General</u> consists of the	e following:
(i) (ii)	Local Reference Wind Pressure, (Pa) Frost Depth. Frost depths are given in the Appendix of Division 2 of t may be used if the recommendations of a geotechnic	
(iii) (iv) (v) (vi) (vi)	not available. Station Structure I.D. number Sign Orientation. Specify <b>L</b> for Left Sign or <b>R</b> for R butterfly sign supports, specify <b>N</b> for normal or <b>A</b> for al (See Figure 3.1.4(a) and Figure 3.1.4(c)). Sign Size(s) (D x B) Sign Class (See 3.2)	• •

	SIGN SUPPORT MANUAL				
2007 04 02	4 02 CANTILEVER STATIC SIGN SUPPORTS PAGE 3 - 27				
<ul> <li>(viii) Eccentricity from the centreline of the vertical support leg to the centre of the sign board(s), E</li> <li>(ix) Barrier-to-Support clearance(s), G (See 3.1.6).</li> <li>(x) Elevation of the highest point on the highway under the sign, including shoulders, curbs and medians, EL.HP</li> <li>(xi) Elevation at top of the support footing, EL.P<sub>1</sub></li> <li>(xii) Member Dimensions: A, t; arm size, P and K (left and right); tabulated on Table 3.2.3 for all support Classes.</li> <li>(xiii) Number of Panels (Zero indicates that arm is so short that verticals/diagonals are not required – see 3.1.7(1).</li> <li>(xiv) Length of Panels.</li> <li>(xv) Footing Type (See 3.1.5).</li> <li>(xvi) Design Information P, D1, D2, F, T1 and T2 (See Table 3.2.3(a)).</li> <li><u>Table 2 - Z-Bracket Locations</u> is to be completed with the dimensions required to locate the z-brackets for mounting the sign board to the support. The length of the z-bracket shall also be included.</li> </ul>					
DESCRIPTION QUANTITY					
12.7mm DIA	A STAINLESS STEEL U-BOLT	2 per Z-Brack	et		

12.7mm DIA. STAINLESS STEEL U-BOLT	2 per Z-Bracket
STAINLESS STEEL NYLON INSERT STOP NUT	4 per Z-Bracket
STAINLESS STEEL WASHER	8 per Z-Bracket
PROFILED CHANNEL (C130x13)	2 per Z-Bracket
Z-BRACKET	See 3.1.7
ALUMINUM ALCAN SHAPE No.72838	See 2.10
8mm DIA. STAINLESS STEEL CAP BOLT C/W NUT	(No. of Aluminum Alcan Shapes + 1)
AND WASHER (SIGN BOARD)	per Z-Bracket
DAMPER VERTICAL ANGLE	2 per Z-Bracket
DAMPER GUSSET	1 per Z-Bracket
DAMPER HORIZONTAL ANGLE	2 per Z-Bracket
DAMPER PLATE	1 per Sign board (See Note below)
16mm DIA. STAINLESS STEEL ASTM F593 BOLT C/W NUT AND WASHER (DAMPER)	12 per Z-Bracket

<u>Note</u>: The damper plate may be comprised of two or more plate elements. The length of each component plate shall be, at least, twice the distance between Z-brackets.



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**CANTILEVER STATIC SIGN SUPPORTS** 

#### 3.4 MAINTENANCE AND INSPECTION

All components must be properly inspected and maintained according to the requirements described in the Sign Support Inspection Guidelines, 2002.

Long term durability of sign supports is dependent on routine maintenance and inspection. In order to prevent corrosion damage and fatigue problems to the anchorage assembly, and to allow for proper inspection of the assembly, the following shall be ensured:

- (i) The base of the vertical support leg shall be kept free from dirt and debris
- (ii) The surrounding ground level shall be a minimum of 300 mm below the top of the footing

The base plate and arm connection welds shall be inspected regularly for fatigue cracking. Check tightening of connection and anchor bolts periodically. Clear vent holes of truss members if there is debris or salt build-up.

#### 3.5 **DESIGN INFORMATION**

#### 3.5.1 GENERAL

Design and detailing data contained in this Division conforms to the requirements of the Canadian Highway Bridge Design Code CAN/CSA-S6-00 unless otherwise stated.

Calculations are based on Standard CAN/CSA-G40.21-M92 Grade 300W or ASTM A500 Grade C or API-5L-X46 (for round section of outside diameter equal to or greater than 508mm) for structural steel, and 30MPa concrete and Grade 400 reinforcing steel for footings.

The total weight of the sign board used in design is  $0.169 \text{ kN/m}^2$  (3.52 psf), including the self-weight of the standard aluminum ALCAN shape No.72838. The total weight of the damper varies between 0.15 and 0.20 kN/m of sign board, depending on the width of sign.

Dead load deflection is compensated by cambering the arms and sign board by means of adjusting the dimension 'K' at the arm to leg connections (See Table 3.2.3(b)).

SIGN SUPPORT MANUAL			
2007 04	02	CANTILEVER STATIC SIGN SUPPORTS	PAGE 3 - 30
a ti ti	applie he le he w comb	becified in CHBDC, the arms and leg are designed for the ed to all truss members, sign boards and attachments. F eg, this is applied in conjunction with a torsion load obtained wind loading on components that reduce the primary torsion binations considering snow loading on the damping etion have also been included.	or the design of ed by neglecting on effect. Load
fe E F	or S Editio Resis	ue wind loads were obtained from the AASHTO Standard tructural Supports for Highway Signs, Luminaries and Tr on, 2001. These were based on a number of reports ind stant Design of Cantilevered Signal, Sign and Light Sup perative Highway Research Program, NCHRP Report 412.	affic Signals 4 <sup>th</sup> cluding "Fatigue ports." National
a	an ae	98, MTO retained Rowan Williams Davies & Irwin Inc. (R eroelastic model study of a single Cantilever Sign Support e study were:	,
i)	,	o calculate the natural frequencies for various configure upports,	urations of the
ii	,	identify any aerodynamic instabilities, such as scillations and galloping, and	vortex-induced
ii	,	provide wind loads and fatigue analysis required to upport design.	verify the sign
a Ii r ii r N r	ampli nves result nforr recor Vlode repor	ing testing, it became apparent that galloping oscillations of itude were likely to occur on the signs under certain v stigation of a solution to the galloping problem was then of t of this work a damping device was added to contro- mation relating to this wind tunnel test, including co- mmendations, are contained in the publication "Final Repo- el Study for Cantilever Sign Supports, Ontario, Canada." t may be obtained from Rowan Williams Davies & Irwin heers, 650 Woodlawn Road West, Guelph, Ontario, Canada	vind conditions. arried out. As a of galloping. All onclusions and ort - Aeroelastic ' Copies of this Inc., Consulting
3.5.2 E	DER	IVATION OF DESIGN CURVES	
г	The	design curves for the cantilever type sign supports f	ound in Figure

The design curves for the cantilever type sign supports found in Figure 3.2.2(a) to (h), were derived by determining the member responses under various sign areas, eccentricities and wind loads. Member responses were checked for ultimate, serviceability and fatigue limits states. The analysis was then confirmed with the use of a three-dimensional finite element model.

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## **CANTILEVER STATIC SIGN SUPPORTS**

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## 3.5.3 DEFLECTIONS

The deflections for the leg and arm members were limited for vertical and horizontal clearances and aesthetic considerations. In addition the structures were analysed by RWDI to ensure that the deflections under wind loading were not enough to excite large amplitude galloping. The arms were essentially cambered upwards for dead loads by extending the bottom connection to the leg. The lateral deflection of the concrete foundation has been limited to an instantaneous rotation of 0.01 radians (0°30') under wind loading and a rotation of 0.003 radians (0°10') under prolonged dead load. The lateral deflection of the top of the leg due to wind load has been limited to a rotation of 0.015 radians (0°50'), or 1.5% of the leg height. The lateral deflection at the tip of the arms due to the wind load caused by bending of the leg and arms and twisting of the leg, has been limited to 3% of the arm length. The vertical deflection at the tip of the arms due to vertical wind load (truck gusts, galloping and natural wind), caused by bending of the leg and arms, has been limited to 1.5% of the arm length.

The above limits are within those specified by AASHTO'S Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals 4<sup>th</sup> Edition 2001.

## 3.5.4 FOUNDATIONS

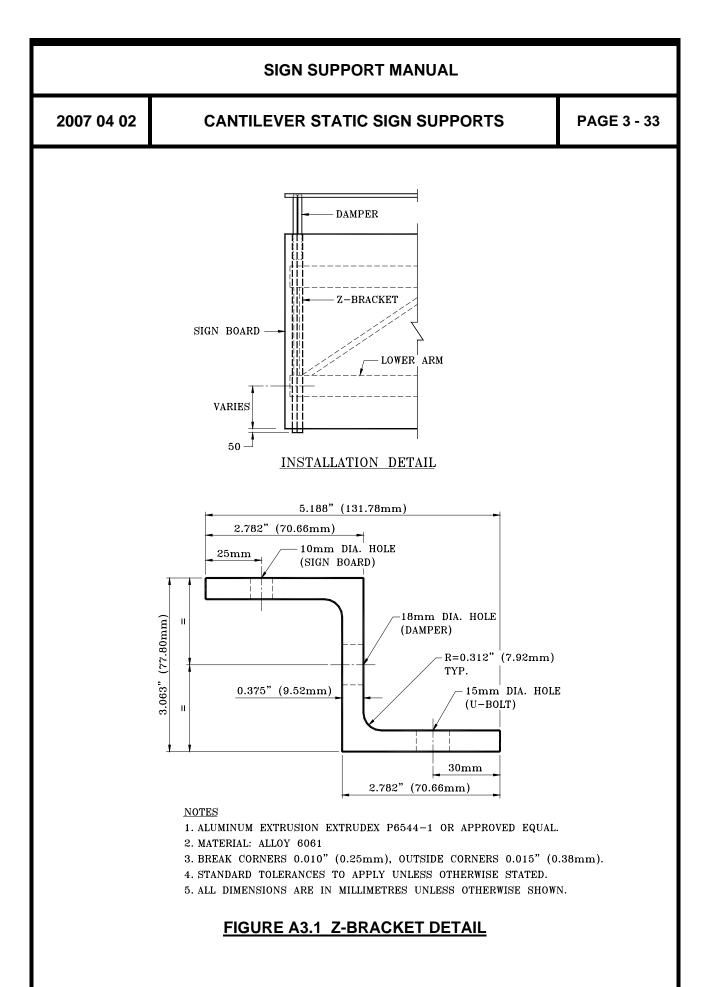
The caisson foundations were modelled in S-Frame as beam elements with spring constants representing earth pressure. Springs constants in the dead load direction (for sustained load) were assumed to be 1/3 the value of those in the live load direction (for instantaneous load). Any resisting earth pressure in the frost depth layer was discounted.

		CASE 1 (Sand)	CASE 2 (Soft clay)
LENGTH OF CAISSON BELOW FROST LAYER	Upper <b>2/3</b>	φ = 28 °	C <sub>u</sub> = 25 kPa
	Lower <b>1/3</b>	φ = 30 °	C <sub>u</sub> = 50 kPa

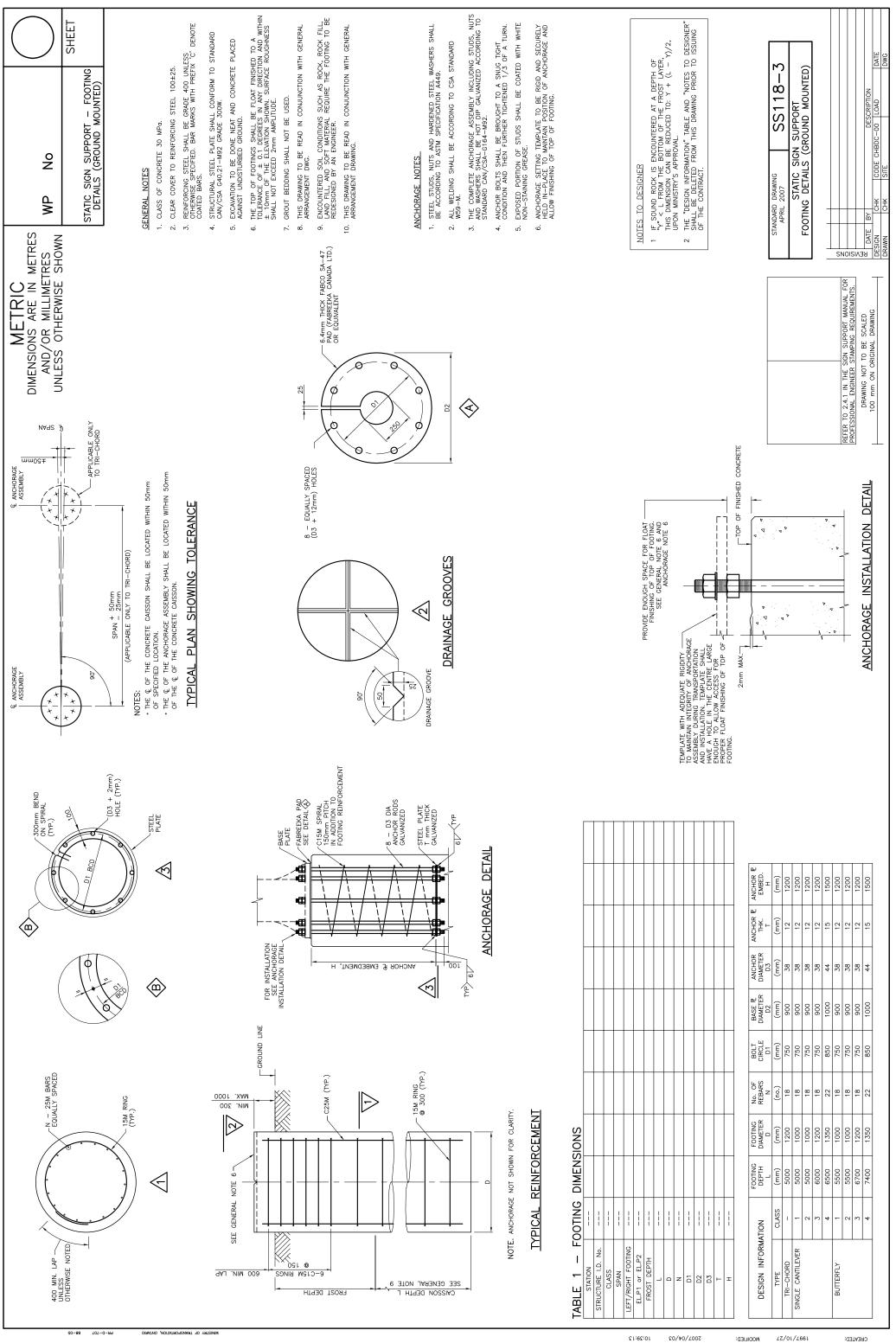
SIGN SUPPORT MANUAL					
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APPENDIX TO DIVISION 3					
CANTILEVER STATIC SIGN SUPPORTS					
F	GURE A3.1	Z-BRACKET DETAIL			
S	S118-22	BUTTERFLY STATIC SIGN SUPPOR GENERAL ARRANGEMENT	г		
SS118-23		BUTTERFLY STATIC SIGN SUPPORT	г		
SS118-24		SINGLE CANTILEVER STATIC SIGN SUPPORT GENERAL ARRANGEMENT			
S	S118-25	CANTILEVER STATIC SIGN SUPPOR SIGN CONNECTION & DAMPER DET			
<u>N</u>	IOTE				

See Appendix to <u>Division 4</u> for reduced size prints of the following Standard Drawings:

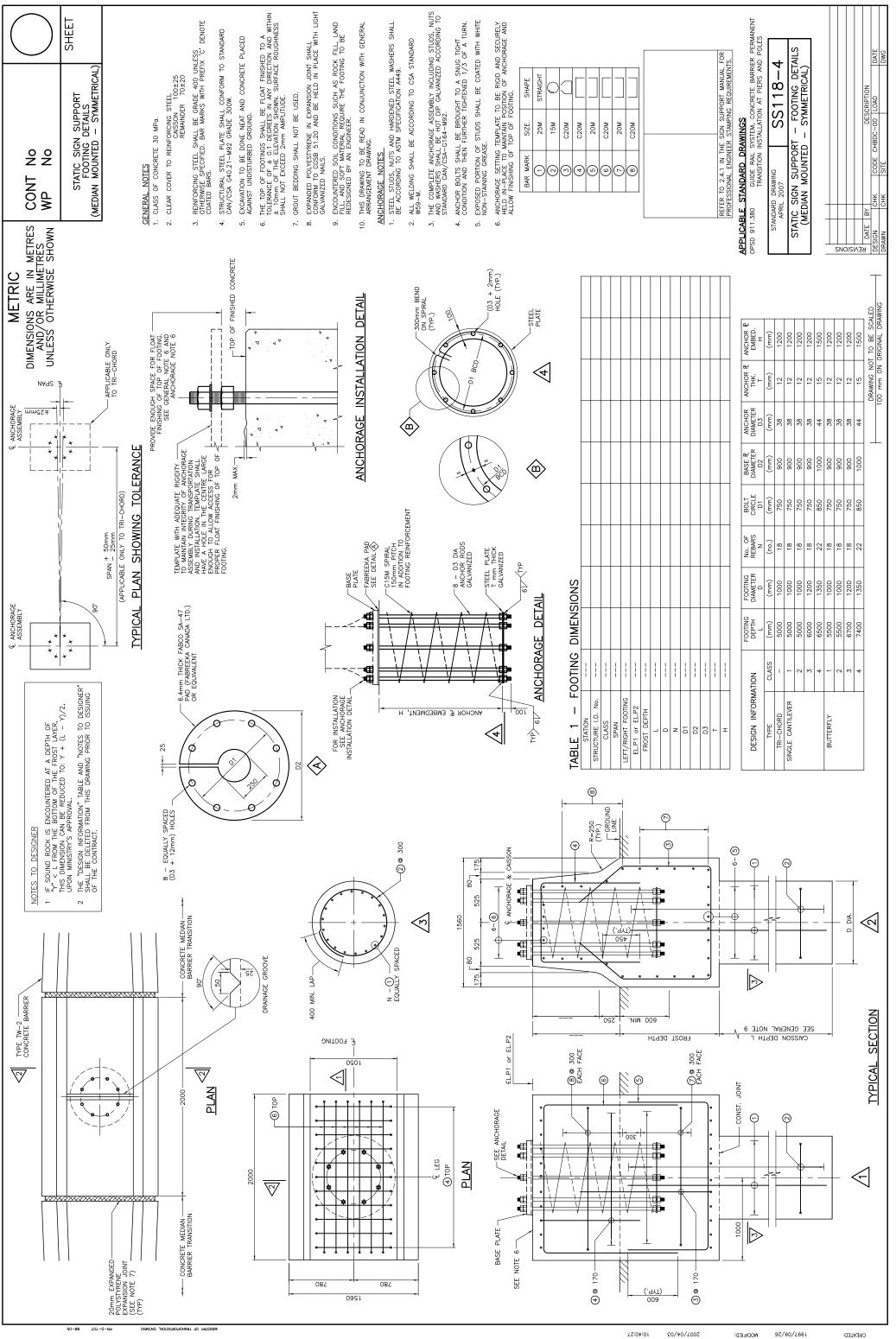
- **SS118-3** STATIC SIGN SUPPORT FOOTING DETAILS (GROUND MOUNTED)
- **SS118-4** STATIC SIGN SUPPORT FOOTING DETAILS (MEDIAN MOUNTED SYMMETRICAL)
- **SS118-5** STATIC SIGN SUPPORT FOOTING DETAILS (MEDIAN MOUNTED ASYMMETRICAL)



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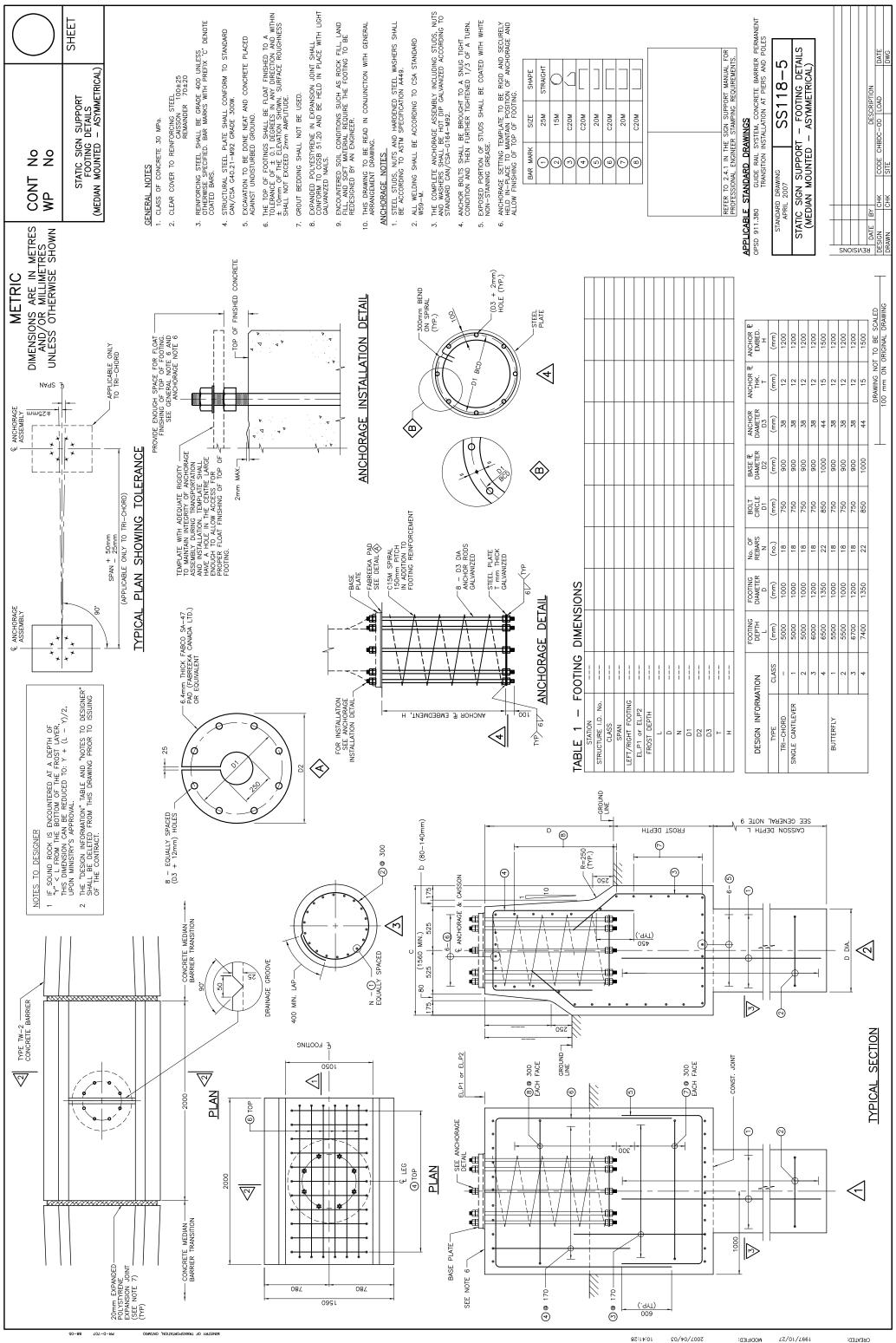


22/01/2661 6wb.Č−811a



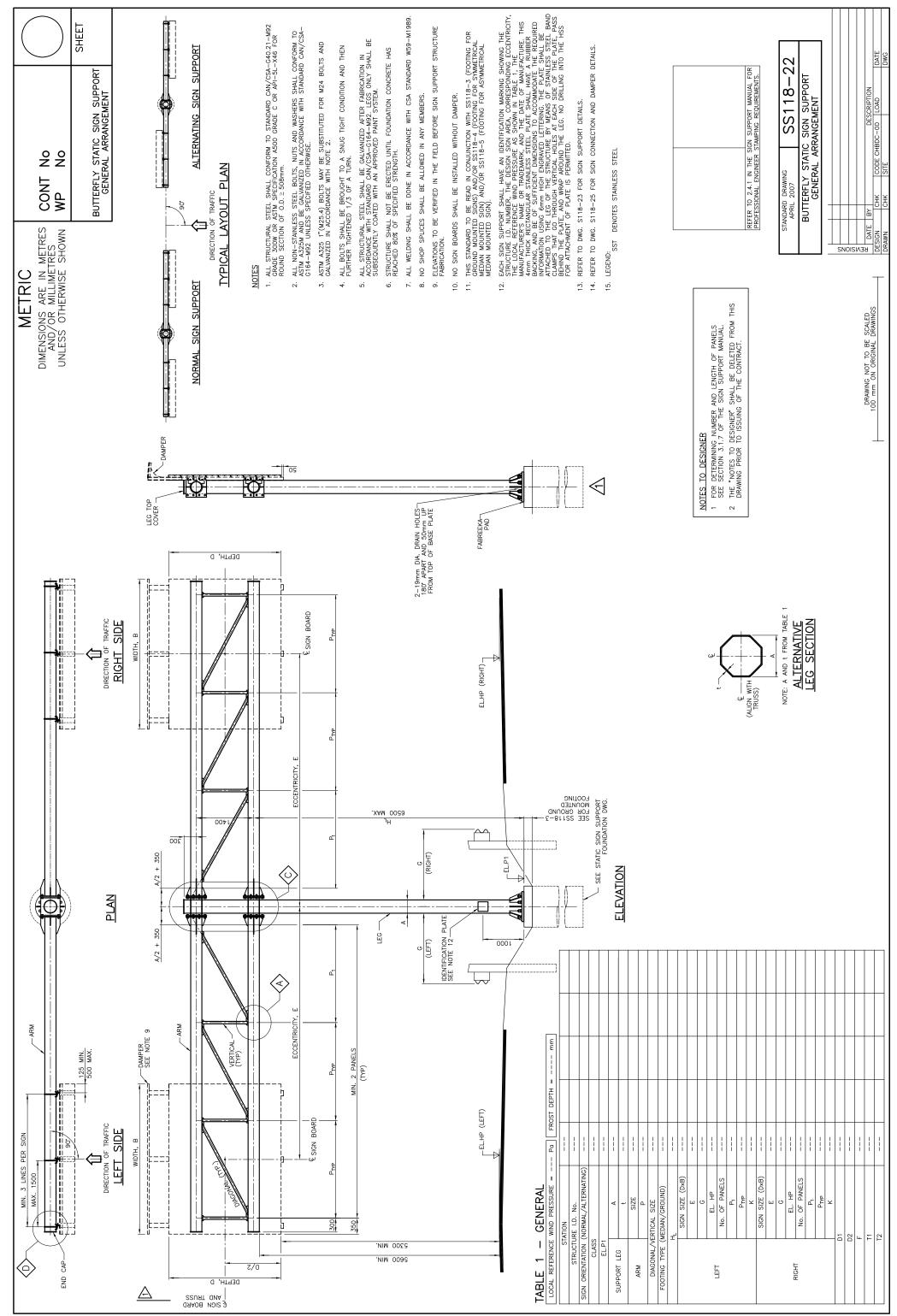
72:04:01

92/60/2661 pwb.4-811s DRAWING NAME:



72/01/7001 CREATED: pwb.2-811s DRAWING NAME:

<sup>2007/04/03</sup> 82:14:01



90-88 707-0-99 MINISTRY OF TRANSPORTATION,

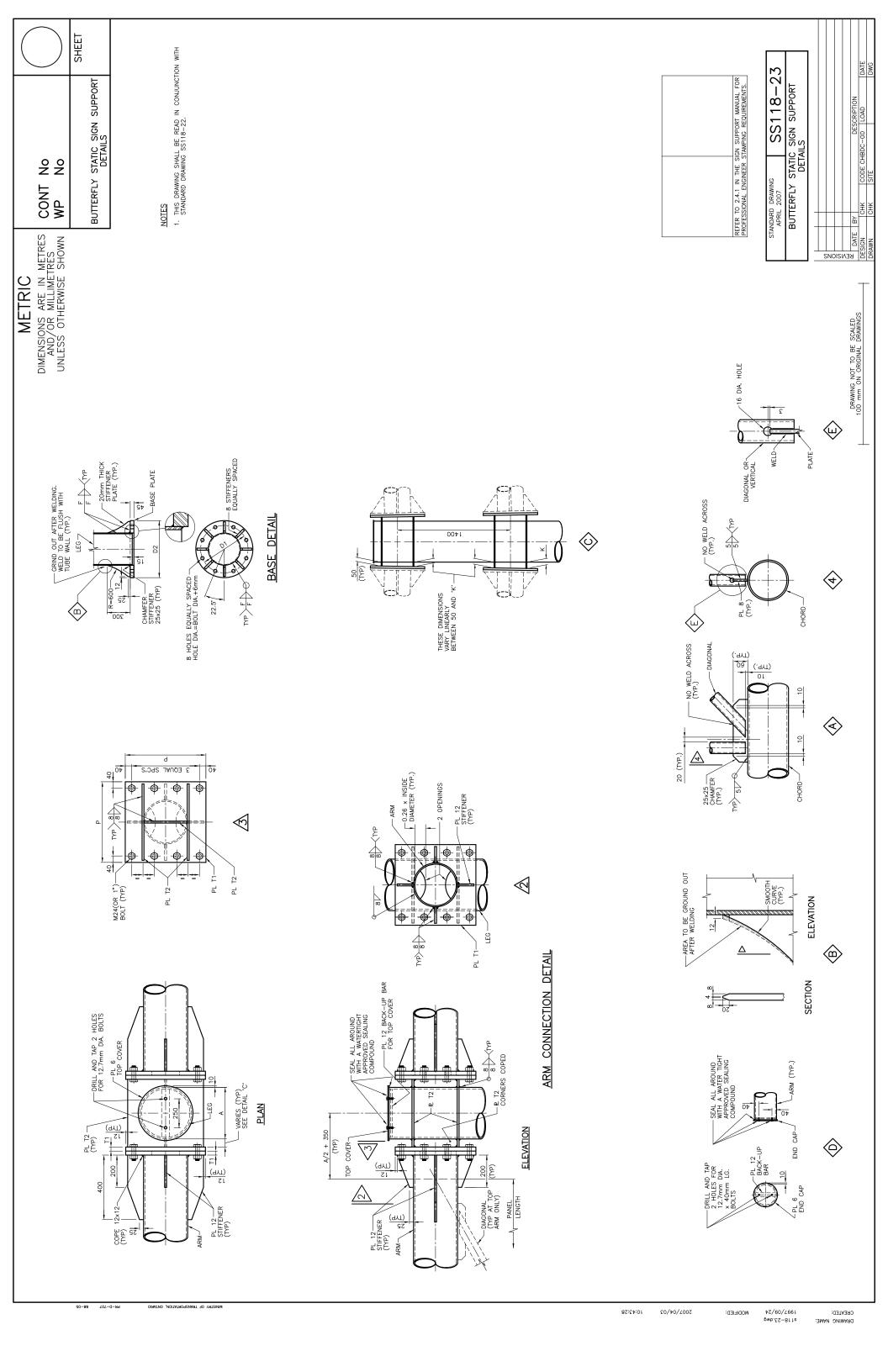
10:42:16

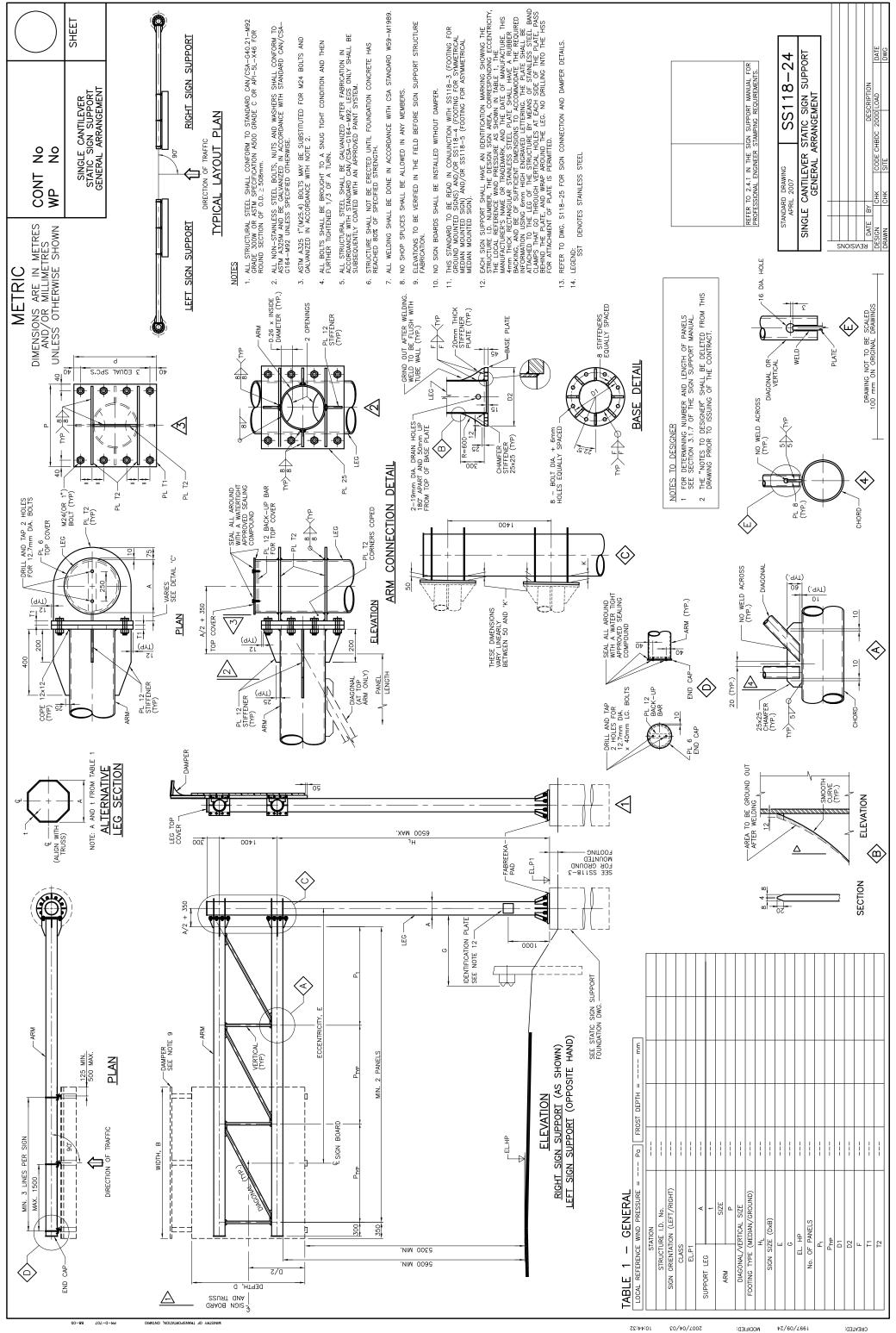
WODILIED:

CREATED: DRAWING NAME:

2007/04/03

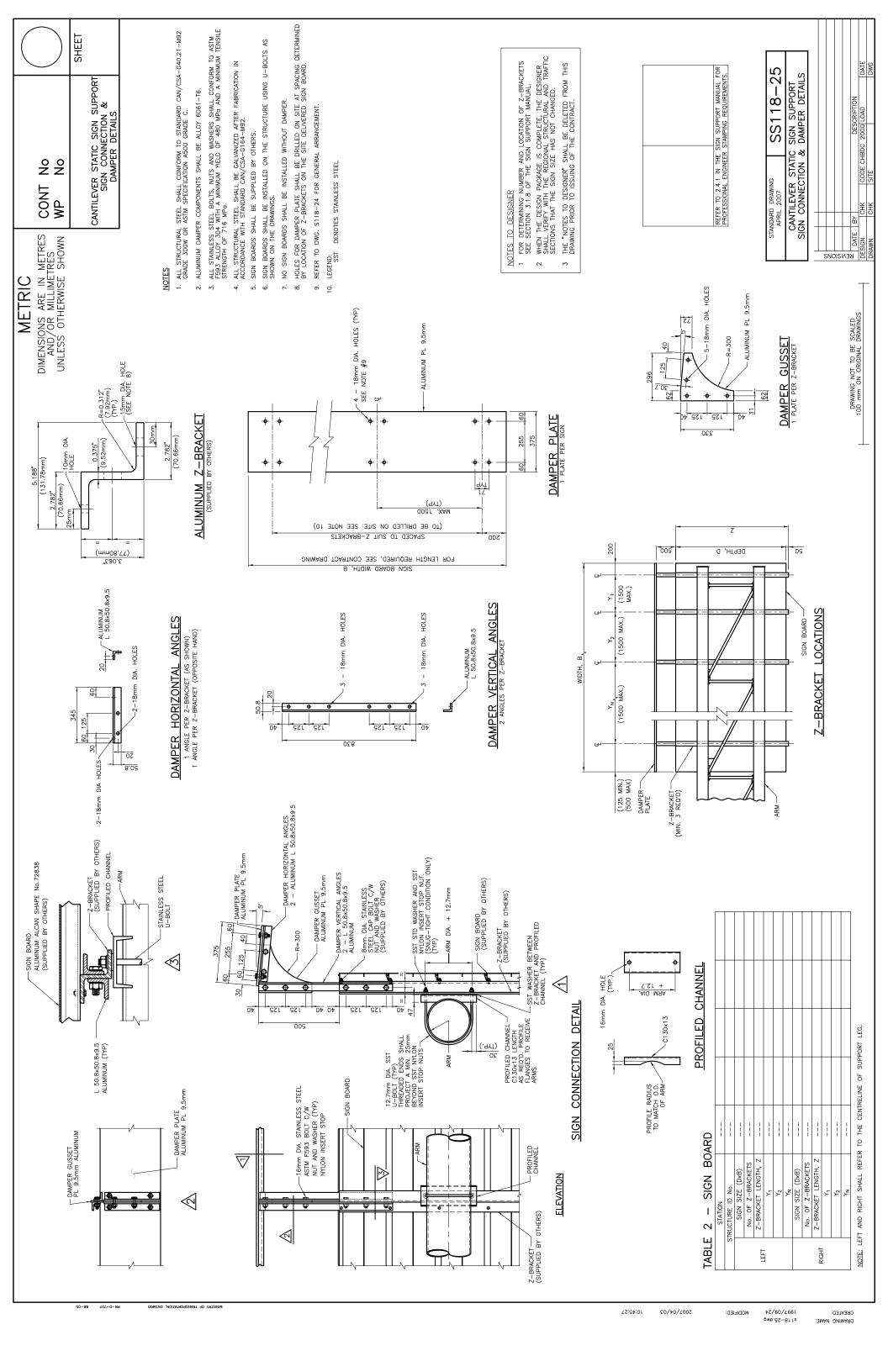
**⊅**Z/60/∠66l ewb.22-811s





pwb.42-811s :=

DRAWING NAME:



**DIVISION 4 - TRI-CHORD STATIC SIGN SUPPORTS** 

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**TRI-CHORD STATIC SIGN SUPPORTS** 

### 4 TRI-CHORD STATIC SIGN SUPPORTS

### 4.1 <u>GENERAL</u>

### 4.1.1 STANDARD SIGN SUPPORTS

Standard Tri-Chord overhead truss sign supports are used to support static sign boards. These trusses are fabricated in galvanized structural steel and designed to the requirements of the Ontario Highway Bridge Design Code.

The sign supports contained in this Section are designed for sign boards and site conditions that meet the following criteria:

- (a) Spans from 14000 to and including 36000 mm
- (b) Maximum total sign board area of 45 square metres for a reference wind pressure of 600 Pa at a return period of 50 years, unless modified as described in 4.2.3 (Case 2)
- (c) Depth of sign board from 1525 mm up to 2740 mm
- (d) All sign boards shall be vertically centered on the truss
- (e) Location of supports and vertical clearance according to the requirements of the OHBDC
- (f) Competent soil conditions excluding rock fill.

### 4.1.2 LIMITATIONS

For economic and practical reasons these supports should be placed as close as possible to the edge of the travelled portion of the highway (see 4.1.5). Therefore, the supports will probably be in the clear recovery zone and should be protected as discussed in Section 2.6. They could also be located on median barriers.

For ground mounted footings, the top of footing elevation shall be a minimum of 300 mm above the finished grade. This could be increased up to 1000 mm in order to limit the leg height. The dimension from the top of the footing to the centreline of the bottom chord shall not exceed 6500 mm (see Figure 4.1.3(b)).

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**TRI-CHORD STATIC SIGN SUPPORTS** 

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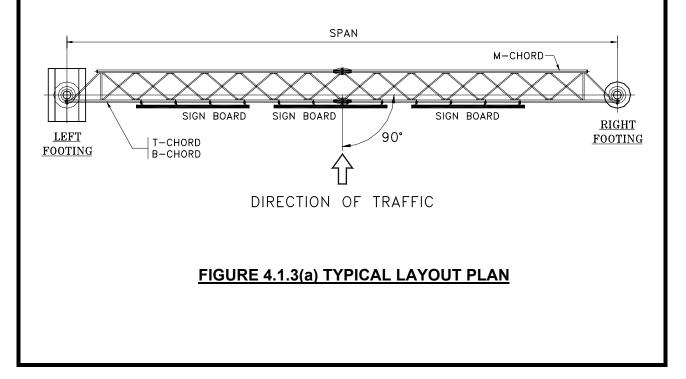
### 4.1.3 DESCRIPTION OF SIGN SUPPORTS

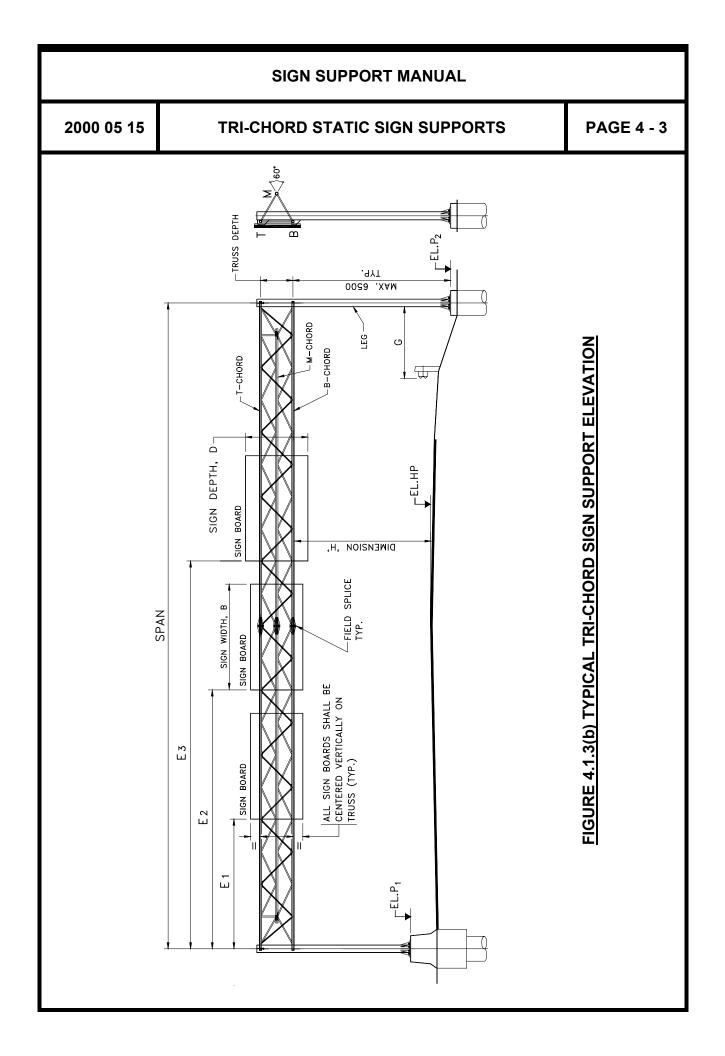
The Tri-Chord sign support system is fabricated from structural steel and is comprised of two vertical support legs and a three-chord truss. The system is non-modular and is fabricated based on specific site requirements. These supports are designed for ground mounting or supported on concrete median barriers. The typical layout plan and elevation are shown in Figures 4.1.3 (a) and (b), respectively.

The vertical support members (legs) are straight and made from single circular HSS sections. They are connected at the base to concrete footings by a bolted anchorage. The column lengths of the supports are not standard. At a particular location the legs may be of different heights provided the truss is installed with its centreline horizontal.

The three chords are interconnected by diagonals in a gusset type connection, forming a spatial core. All members are fabricated from circular HSS sections. All sign boards are attached to the front top and bottom chords by means of Z-brackets. The front chords are connected to the vertical support members by corbels. The middle or back chord is connected to the front chords by end diagonals.

All components are galvanized after fabrication. The support legs are subsequently coated with an approved paint system





### **TRI-CHORD STATIC SIGN SUPPORTS**

### 4.1.4 FOOTINGS

Sign support footings consist of a single reinforced concrete caisson. Details differ according to their location, and generally are of two types, as shown on the drawings: for ground mounted signs and for median mounted signs. (See Standard Drawings SS118-3, SS118-4 and SS118-5).

The indicated footing depths are the minimum required for each support. Footing proportions apply to competent soil conditions of uniform composition. Parameters upon which the design is based are given in Section 4.5.4.

Encountered soil conditions such as rock fill, land fill, and soft material require the footing to be redesigned by an Engineer.

### 4.1.5 CLEARANCE

For ground mounted footings, all members of the sign structure and the footing within the horizontal projection of the barrier, should be located a minimum horizontal distance 'G' from the traffic protection barrier as specified in the Roadside Safety Manual

The dimension 'H' from the centreline of the bottom chord to the highest point on the highway, including shoulders, curbs and median, shall be according to the following table:

SPAN (mm)	DIMENSION 'H' (mm)
SPAN ≤ 20000	6250
$20000 < SPAN \le 24000$	6200
$24000 < SPAN \le 28000$	6100
28000 < SPAN ≤ 32000	6000
$32000 < SPAN \le 36000$	5900

### TABLE 4.1.5 DIMENSION 'H'

TRI-CHORD STATIC SIGN SUPPORTS

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The given values of dimension 'H', comply with the requirements for the minimum vertical clearance of 5250 mm from the bottom of the deepest sign board (2743 mm) to the highest point on the highway. Small lane designation sign boards with limited strength connections are allowed to project below the bottom edge of a sign board as long as damage to them does not cause damage to the structure (see Figure A4.2).

### 4.1.6 SUPPLY AND ERECTION

Since the support structure may be erected without sign boards, sign boards and Z-brackets (Figure A4.1) are not included in the contract. They are supplied and installed by others. The spacing of Z-brackets for the attachment of the sign boards shall be equal to the depth of truss for spans less than or equal to 30000 mm, and depth of truss / 2 for spans greater than 30000 mm. Minimum number of Z-brackets per sign shall be kept to 3.

Construction shall meet the requirements of OPSS 915, Construction Specification for Sign Support Structures, and associated Special Provisions.

Each sign support shall have a corrosion-protected identification plate showing the structure I.D. number, the manufacturer's name or the trade mark, the date of manufacture, the maximum allowable sign board area and the local reference wind pressure.

### 4.2 PROCEDURES

### 4.2.1 GENERAL

The sign supports are fabricated from shop drawings based on the standard drawings on a site-specific basis.

The design of the Tri-Chord overhead sign supports is based on a reference wind pressure of 600 Pa. Based on the <u>required total sign board area</u> ( $\leq$ 45m<sup>2</sup>) and the span, the final design dimensions can be obtained from Table 4.2.2. If the <u>required total sign board area</u> is more than 45m<sup>2</sup>, see 4.2.3, Case 2.

### 4.2.2 DATA REQUIRED

For each Tri-Chord sign support, the following data is required:

- (1) The required total sign board area and span.
- (2) The location of the structure. For a proposed highway or a highway under reconstruction, the location should be specified as a station.
- (3) The elevation of the highest point on the highway under the sign boards, and the final ground elevations under the sign structure

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2000 05	5 15	TF	RI-CHORD STATIC SIGN SUPPORTS	PAGE 4 - 7	
4.2.3	PROCED	DURE I	FOR SELECTION OF SIGN SUPPORT		
	CASE 1	- SIGN	BOARD AREA LESS THAN OR EQUAL TO	15m <sup>2</sup>	
	GIVEN:	Exam	JIRED SIGN BOARD AREA AND SPAN i <u>ple</u> : a <u>required sign board area</u> of 30 m <sup>2</sup> and a <u>0 mm</u> .	span of	
	STEP 1:		AIN THE STRUCTURE DESIGN DIMENSIO GN SIGN BOARD AREA	ONS FOR THE	
		range	From Table 4.2.2, for a span of 20500 mm e of <u>20001 to 22000 mm</u> . For the given examp ained:		
		Middl Diago	b and Bottom Chord:HSS 102 x 6.4ddle or Back Chord:HSS 141 x 6.4agonals:HSS 48 x 3.2pport Leg:HSS 406 x 12.7		
	STEP 2:	CHE	CHECK BOUNDARY CONDITIONS		
		(a)	Based on the elevation of the highest point of the roadway (EL.HP) and dimension 'H' (From Table 4.1.5) corresponding to the span, calculate the elevation of the centreline of the bottom chord of the truss.		
		(b)	Based on the elevation of the centreline of the of the truss and the elevation of the ground location, calculate the height difference betweelevations.	d at the footing	
		(c)	This height difference shall be made components/portions:	e up of two	
			(1) The leg with a limitation of 6500 mm		
			(2) The projection of the footing above limitation of 1000 mm	ground with a	

This means that the above height difference can be as large as 7500 mm.

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STEI	P 3: COMPLETE THE STANDARD DRAWINGS				
	Refer to 4.3 for Preparation of Drawings.				
<u>CAS</u>	E 2 - SIGN BOARD AREA GREATER THAN 45m <sup>2</sup>				
	If the required sign board area is more than 45m <sup>2</sup> , t local reference wind pressure, q, for a return period of be determined from OHBDC Section 2, Table A2-1.7, A2.9(a) to (c) in the Appendix in Division 2 of the Ma maximum allowable total sign board area for this specifie	50 years shall or from Table nual. Then the			
	<b>45 ( 600/q)</b> $m^2$ where "q" is given	in Pa			
	E.g., For a local "q" of 430 Pa, the <u>maximum allowable to board area</u> is 45 x 600/430 = 62.7 m <sup>2</sup> .	<u>otal sign</u>			
	To complete the standard drawings, the <u>maximum allowable total sign</u> <u>board area</u> is required, and is used for the identification plate. See <u>Note 15</u> on S118-26.				

## **TRI-CHORD STATIC SIGN SUPPORTS**

	HSS (O.D. in mm)			
SPAN (mm)	TOP/BOTTOM CHORD	MIDDLE CHORD	DIAGONAL	LEG
14000 TO 20 000	102	114	48	406
20 001 TO 22 000	102	141	48	406
22 001 TO 24 000	114	141	48	457
24 001 TO 26 000	114	141	60	457
26 001 TO 28 000	141	141	60	457
28 001 TO 30 000	141	168	60	457
30 001 TO 32 000	141	168	60	457
32 001 TO 34 000	141	168	73	508
34 001 TO 36 000	168	168	73	508

WALL THICKNESS OF MEMBERS:

CHORDS	6.4 mm
DIAGONALS	3.2 mm
LEGS	12.7 mm

# TABLE 4.2.2 TRI-CHORD DESIGN DIMENSIONS(MAXIMUM ALLOWABLE SIGN BOARD AREA = 45 m²)(REFERENCE WIND PRESSURE = 600 Pa)

NOTE: For sign board areas greater than 45m<sup>2</sup>, see 4.2.3, Case 2.

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### **TRI-CHORD STATIC SIGN SUPPORTS**

### 4.3 **PREPARATION OF DRAWINGS**

#### 4.3.1 DATA REQUIRED

Prior to design, a "Key Plan and Frame Dimension" drawing(s) must be prepared to enable the working drawings to be detailed. This drawing(s) will form part of the contract document and must show for one or more structures, the following information:

- (1) A key plan, indicating the location of each support.
- (2) The Structure I.D. number.
- (3) The support span, measured from centreline to centreline of column.
- (4) The control line or the centreline of the roadway, and the offset of the left leg from the control line.
- (5) The elevation of the highest point on the roadway surface under the support structure.
- (6) The dimension 'H' measured from the highest point on the roadway surface to the centreline of the bottom chord of the Tri-Chord. This dimension shall be as indicated in Table 4.1.5.
- (7) The dimension measured from the top of footing to the centreline of the bottom chord. This dimension shall not exceed 6500 mm.
- (8) The top of footing elevation. This elevation can differ for each leg, if required. The elevation shall be a minimum of 300 mm above the finished grade. This could be increased up to 1000 mm in order to limit the column leg height as stated in (7).
- (9) The elevation of the ground-line at each footing.
- (10) The offset of each footing from the control line, either as a note or as a dimension.
- (11) The station of the support structure on a designated highway centreline or control line
- (12) A designation for each footing as a "Left Footing" or "Right Footing". Left and Right for this purpose, are defined as if looking in the direction of the traffic, as shown in Figure 4.1.3(a).

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**TRI-CHORD STATIC SIGN SUPPORTS** 

(13) The footing type for each sign support footing (see 4.1.4). For ground mounted footings, the dimension 'G' from the face of the traffic protection barrier to the leg or the footing, whichever is closer. (See 4.1.5).

- (14) For each sign board, the following additional information is required:
  - An outline in dashed lines showing each sign board to be mounted on the support,
  - The dimensions B and D of each sign board,
  - The location of each sign board with respect to the centrelines of the left column.

## 4.3.2 SIGN SUPPORT DRAWINGS

If the supports are to be supplied and erected as part of a contract, SS118-26, SS118-27, SS118-3 and/or SS118-4 and/or SS118-5 must be used. Up to 10 sign supports can be detailed on one sheet.

The Appendix contains reduced size prints of these drawings, showing what information needs to be added. The Contract and W.P. numbers should be added to the title block. The sheet number is added when the drawings for the entire contract are assembled.

On SS118-26 there are two tables to be completed on the drawing. In each table one vertical column of data is used for each sign.

## The Standard Drawings shall be sealed, dated and signed according to 2.4.1.

The data required to complete Table 1 - General consists of the following:

- (i) Station
- (ii) Structure I.D. Number
- (iii) The support span measured from centrelines of columns
- (iv) Truss depth measured centre to centre of top and bottom chords
- (v) Dimension 'H' from the centreline of the bottom chord to the highest point on the highway, including shoulders, curbs and median, as specified in 4.1.5.
- (vi) Local Reference Wind Pressure, in Pa
- (vii) Maximum Allowable Sign Board Area, m<sup>2</sup>
- (viii) Sign Sizes (D x B) for each sign board (max. D is 2743 mm)
- (ix) The location of each sign board, E<sub>i</sub>, with respect to the centreline of the left column
- (x) Elevation of the highest point on the highway under the signs, including shoulders, curbs and medians. EL.HP

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<ul> <li>(xi) Elevation at top of the left support footing, EL.P<sub>1</sub></li> <li>(xii) Elevation at top of the right support footing. EL.P<sub>2</sub></li> <li>(xiii) Member outside diameters tabulated on Table 4.2.2.</li> <li>(xiv) Left Footing Type (See 4.1.4)</li> <li>(xv) Right Footing Type (See 4.1.4)</li> </ul>				
Table 2 - <u>Sign Board: Parts/Hardware</u> is to be completed with quantities for all sign boards.				
The following table shall be used for the calculation of quantities:				
DESCRIPTION OUANTITY				

DESCRIPTION	QUANTITY
12.7mm DIA. STAINLESS STEEL U-BOLT	2 per Z-Bracket
STAINLESS STEEL NYLON INSERT STOP NUT	4 per Z-Bracket
STAINLESS STEEL WASHER	8 per Z-Bracket
PROFILED CHANNEL (C130x13)	2 per Z-Bracket
Z-BRACKET	See 4.1.7

### 4.4 MAINTENANCE AND INSPECTION

All components must be inspected and maintained according to the requirements OPSS 915, Construction Specification for Sign Support Structures.

Long term durability of sign supports is dependent on routine maintenance and inspection. In order to prevent corrosion damage and fatigue problems to the base plate and the anchorage assembly, and to allow for proper inspection of the assembly, the following shall be ensured:

- (i) The base of the vertical support leg shall be kept free from dirt and debris
- (ii) The surrounding ground level shall be a minimum of 300 mm below the top of the footing

The base plate and corbel connection welds shall be inspected regularly for fatigue cracking.

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### **TRI-CHORD STATIC SIGN SUPPORTS**

### 4.5 DESIGN INFORMATION

### 4.5.1 GENERAL

Design and detailing data contained in this Division conforms to the requirements of the 1991 edition of the Ontario Highway Bridge Design Code unless otherwise stated.

Calculations are based on Standard CAN/CSA-G40.21-M92 Grade 300W or ASTM A500 Grade C structural steel, 30MPa concrete and Grade 400 reinforcing steel for footings.

The total weight of the sign board used in design is  $0.169 \text{ kN/m}^2$  (3.52 psf), including the self-weight of the standard aluminum ALCAN shape No.72838.

Fatigue wind loads were obtained from a revision to AASHTO - 1994 Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals. These amendments were based on a number of reports including "Fatigue Resistant Design of Cantilevered Signal, Sign and Light Supports." National Cooperative Highway Research Program. Final Report - NCHRP Project 10-38.

### 4.5.2 DERIVATION OF DESIGN TABLES

The design dimensions for the Tri-Chord sign supports found in Table 4.2.2, were developed by determining the member responses under various design sign board areas, spans and wind loads. Member responses were checked for ultimate, serviceability and fatigue limits states. The analysis was then confirmed with the use of a three-dimensional finite element model. Member sizes were optimised to limit the variety of section sizes.

### 4.5.3 DEFLECTIONS

The deflections for both vertical and horizontal members are limited for clearance concerns as well as for aesthetic purposes. Vertical members are restricted to 1% (L/100), and horizontal members are restricted to 2% (L/50) lateral movement. Both limitations are well within the suggested limits provided in AASHTO's "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", 1994, which allows 2.95% lateral movement or 1°40' angular rotation from the centreline at the top of the structure in relation to the centreline at its base.

**TRI-CHORD STATIC SIGN SUPPORTS** 

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### 4.5.4 FOUNDATIONS

The caisson foundations were modelled in S-Frame as beam elements with spring constants representing earth pressure. Springs constants in the dead load direction (for sustained load) were assumed to be 1/3 the value of those in the live load direction (for instantaneous load). Any resisting earth pressure in the frost depth layer was discounted.

Assumed soil parameters below the frost layer are as follows:

		CASE 1 (Sand)	CASE 2 (Soft clay)
LENGTH OF CAISSON BELOW FROST LAYER	Upper 2/3	M = 28 °	C <sub>u</sub> = 25 kPa
	Lower 1/3	M = 30 °	C <sub>u</sub> = 50 kPa

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APPENDIX TO DIVISION 4						
E	TRI-CHORD STATIC SIGN SUPPORTS					
	IGURE A4.1 IGURE A4.2	Z-BRACKET DETAIL ARROW BOARD DETAIL				
S	S118-3	STATIC SIGN SUPPORT - FOOTING DETAILS (GROUND MOUNTED)				
S	<b>SS118-4</b> STATIC SIGN SUPPORT - FOOTING DETAILS (MEDIAN MOUNTED - SYMMETRICAL)					
S	<b>SS118-5</b> STATIC SIGN SUPPORT - FOOTING DETAILS (MEDIAN MOUNTED - ASYMMETRICAL)					
S	SS118-26 TRI-CHORD STATIC SIGN SUPPORT GENERAL ARRANGEMENT					
S	<b>SS118-27</b> TRI-CHORD STATIC SIGN SUPPORT STRUCTURE ASSEMBLY DETAILS					

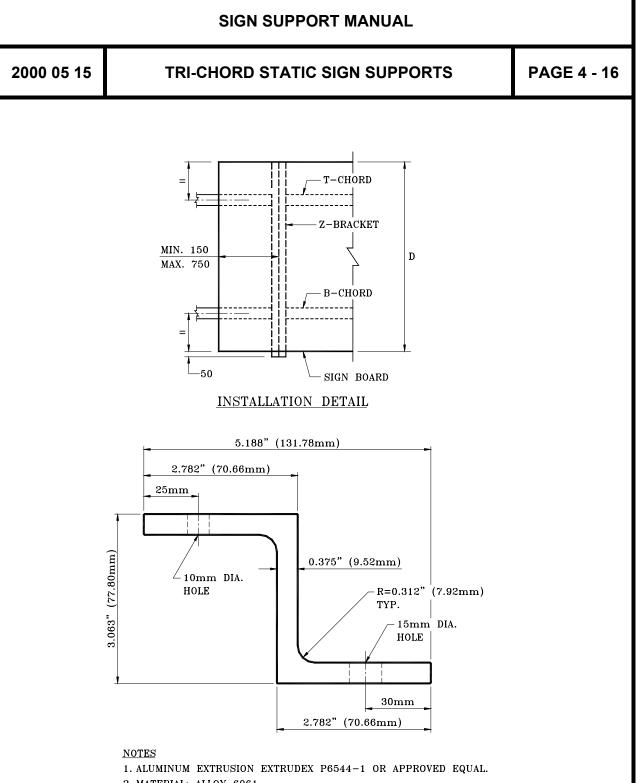
### FIGURE A4.1 Z-BRACKET DETAIL

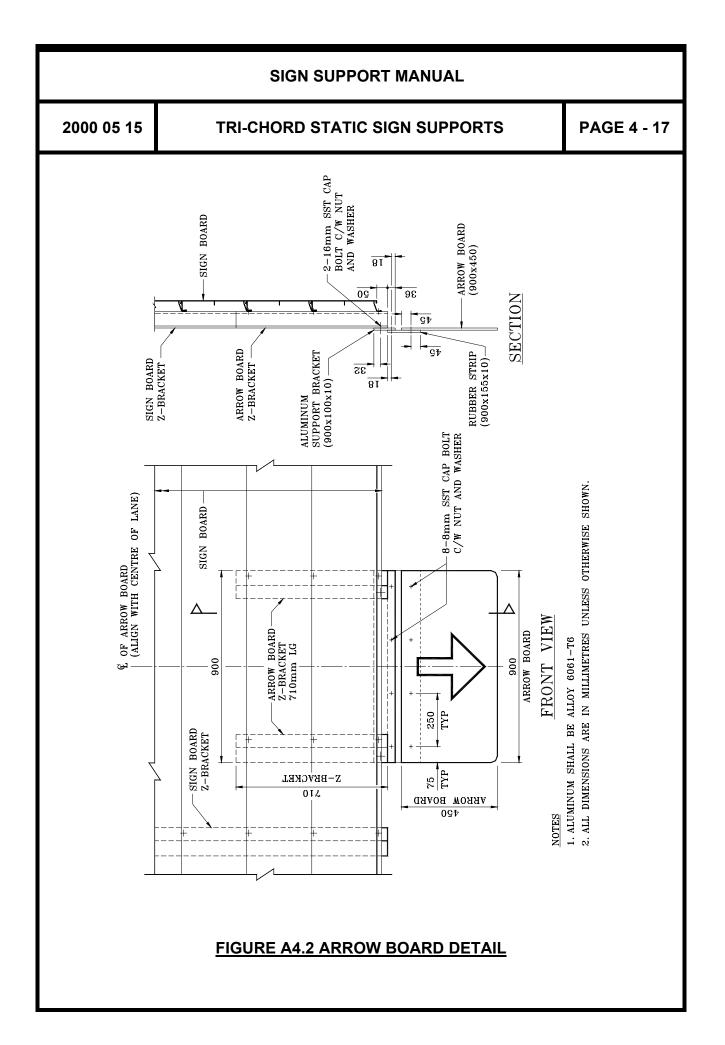
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

4. STANDARD TOLERANCES TO APPLY UNLESS OTHERWISE STATED.

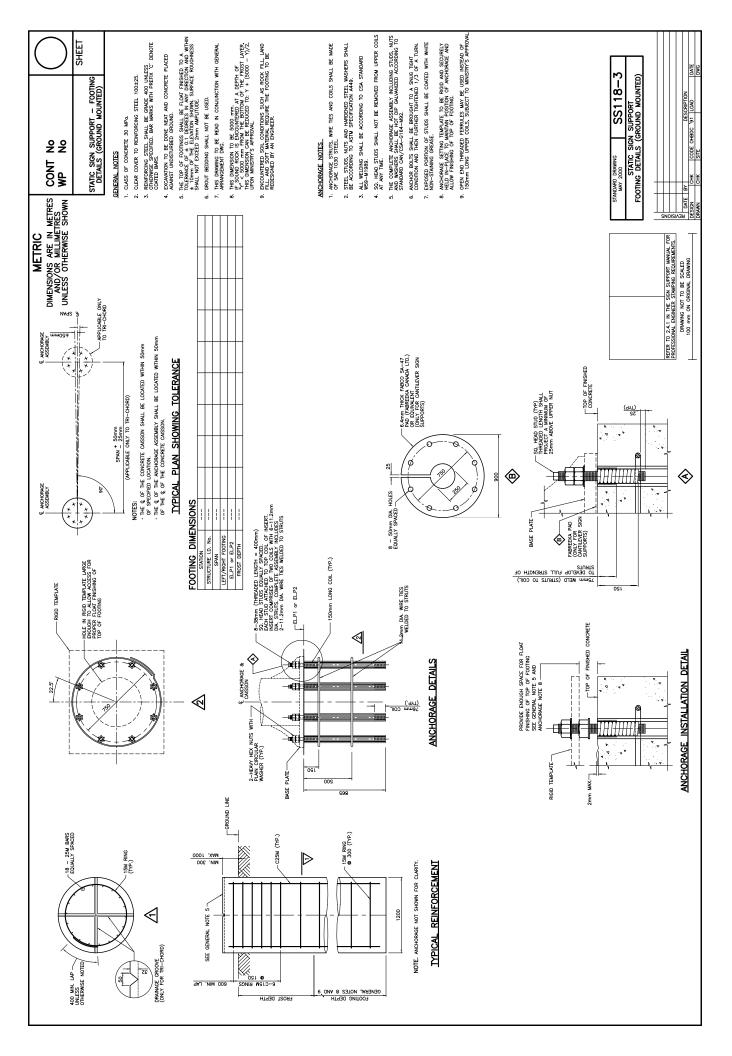
3. BREAK CORNERS 0.010" (0.25mm), OUTSIDE CORNERS 0.015" (0.38mm).

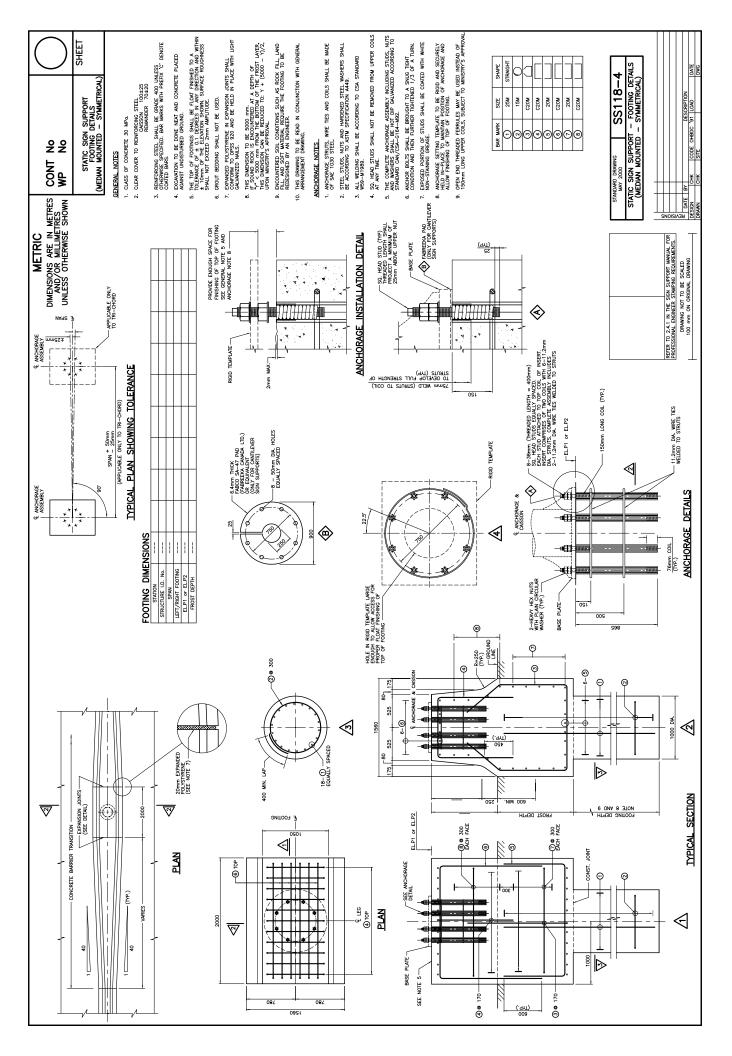
2. MATERIAL: ALLOY 6061

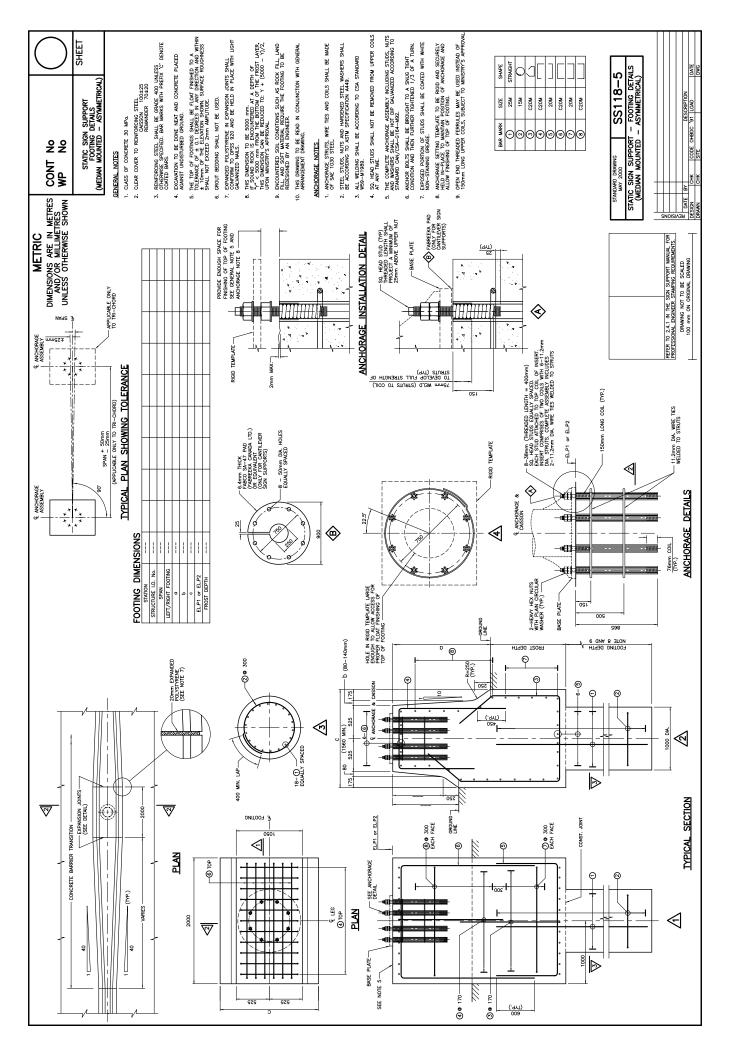


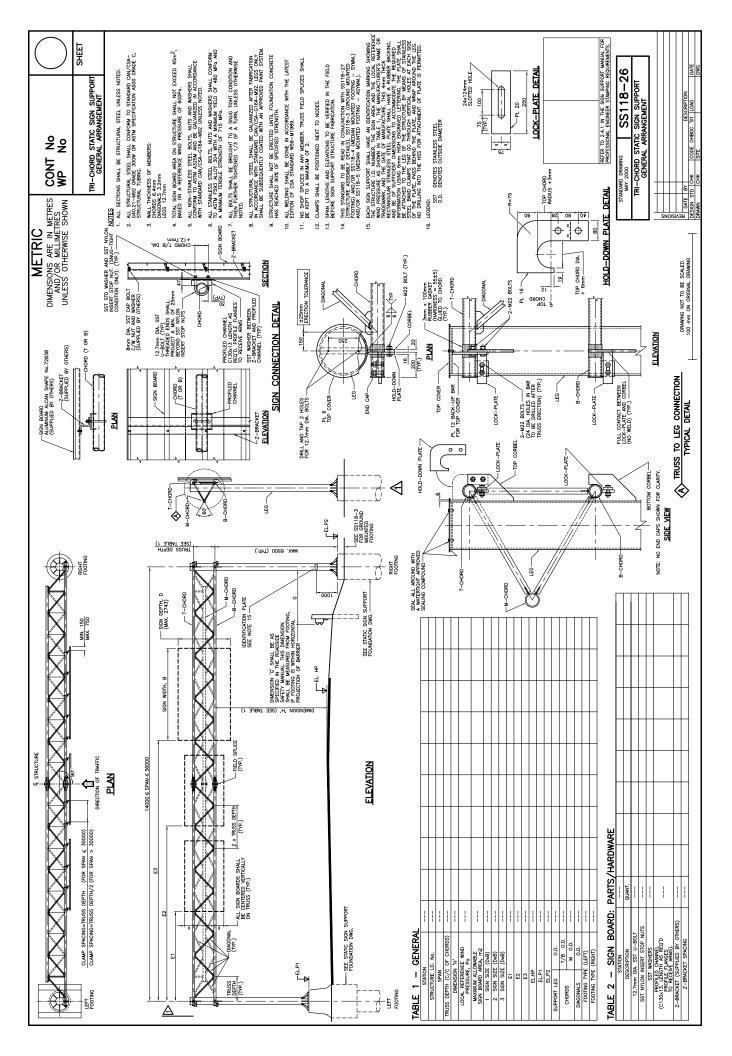


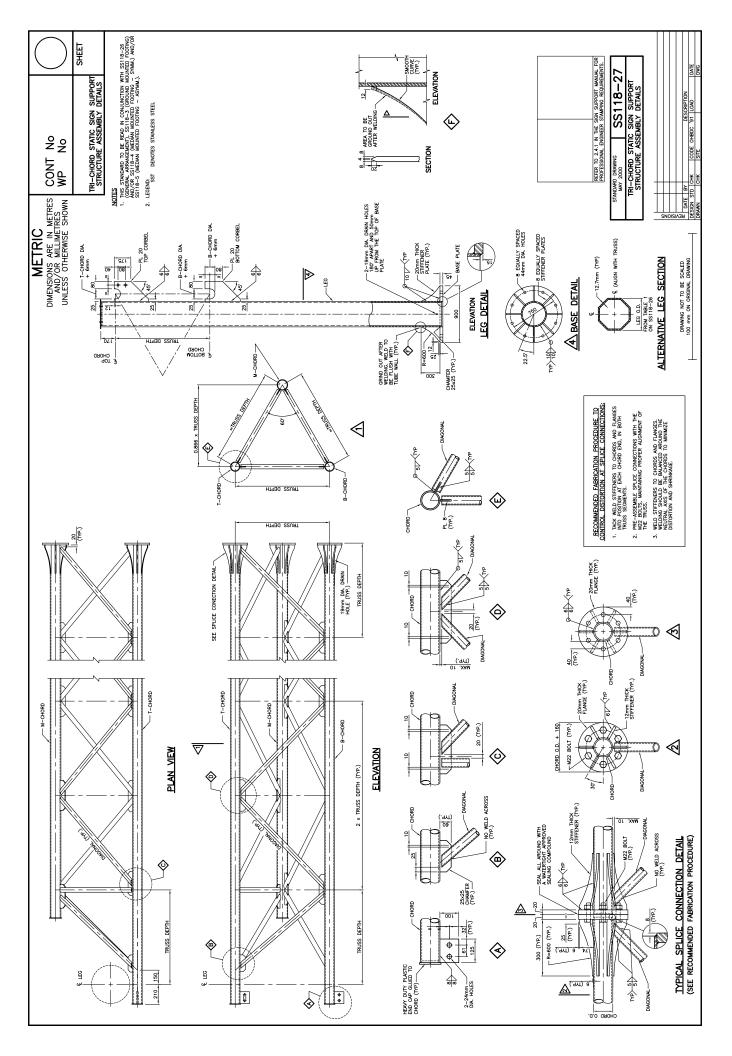
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**DIVISION 5 - STEEL COLUMN SIGN SUPPORTS** 

February 2005

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#### **STEEL COLUMN SIGN SUPPORTS**

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#### 5 <u>STEEL COLUMN SIGN SUPPORTS</u> (BREAKAWAY AND NON-BREAKAWAY TYPE)

#### 5.1 <u>GENERAL</u>

#### 5.1.1 STANDARD SIGN SUPPORTS

These galvanized steel supports have been designed to the requirements of the Canadian Highway Bridge Design Code CAN/CSA-S6-00 (CHBDC), for an hourly mean reference wind pressure with a return period of 10 years. They can be used for roadside signs ranging in depth from 1200 to 3600 mm and in width from 3000 to 7800 mm as listed in Table 5.2.2(a) to (f). For descriptions of definitions and notations see pages iv to ix of this manual.

Clause 3.10.1.1 of the CHBDC requires that roadside sign structures be designed for a 10-year hourly mean reference wind pressure where, generally, a long life expectancy is not required. In addition the consequence of their collapse due to wind is less serious than overhead type of sign structures, including luminaires and traffic signals. The design for a higher reference wind pressure, therefore, is not considered to be cost effective. There is no suggestion in CHBDC that a 25 year reference wind pressure should be used. AASHTO's 2001 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals also directs the designer to consider a 10 year design life and recurrence interval for the design of roadside sign structures.

Clause 3.10.1.1 further states that if the topography at the structure site can cause funnelling of the wind, the reference wind pressure should be increased by 20%. Since roadside sign supports in Ontario are built off to the side of highways in relatively smooth topography (in non-urban, open terrain), and predominantly not in the close vicinity of other signs or structures, funnelling of wind is not considered to be a criteria to be included for design.

In summary, this manual considers a 10 year reference wind pressure, and no effect of funnelling in the design of roadside sign structures. If designers choose to use an increased reference wind pressure by either using the 25 year return, or include funnelling, or both, they could use this manual for the higher wind pressure if applicable.

The design of the roadside sign supports given in this manual, while meeting the requirements of the CHBDC, is generally based on those of the Texas Department of Transportation. There is great similarity in details between the Texas and MTO standards. In particular, the new MTO standards in this manual no longer use slotted fuse plates but have adopted the Texas detail at the fuse plate connection (just under the signboard) of breakaway signs which utilize perforated fuse plates. Another adopted detail is the introduction of the bolt keeper plate added to the friction plate connection at the breakaway base, to prevent the column from "walking".

Clause 12.6.3.1 of the CHBDC requires that breakaway supports shall be crash tested in accordance with the requirements of NCHRP 230 (now 350). MTO has not done its own crash testing, but relies on results of tests conducted by the Texas Transportation Institute for the Texas DOT. The original crash testing was done in the 1960's, but TTI staff has reviewed the past data, and are satisfied that the details on the Texas standard

## **STEEL COLUMN SIGN SUPPORTS**

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drawing meet the requirements of NCHRP 350. Because of the very close similarity in details between MTO's standards and those of the Texas DOT, we have reasonably concluded that the breakaway sign supports detailed in this manual also meet the requirements of NCHRP 350.

In the 1994 edition of the Sign Support Manual, the Steel Column Roadside Sign Supports were required to be angled towards the traffic by 5 to 15 degrees, which although good for legibility, caused a harmful glare to the motorist when his vehicle's lights were reflected from the sign's surface. The present manual follows the recommendations of the 2001 edition of the Ontario Traffic Manual which states that ground-mounted signs should be angled horizontally slightly away from traffic, by about 3 degrees, so that glare is reduced. This layout, unfortunately, causes reduced legibility. The benefits of reduced glare, however, seem to outweigh the negative result of slightly decreased night legibility. For this reason the angling of ground-mounted signs slightly away from traffic is adopted.

#### 5.1.2 DESCRIPTION OF SIGN SUPPORTS

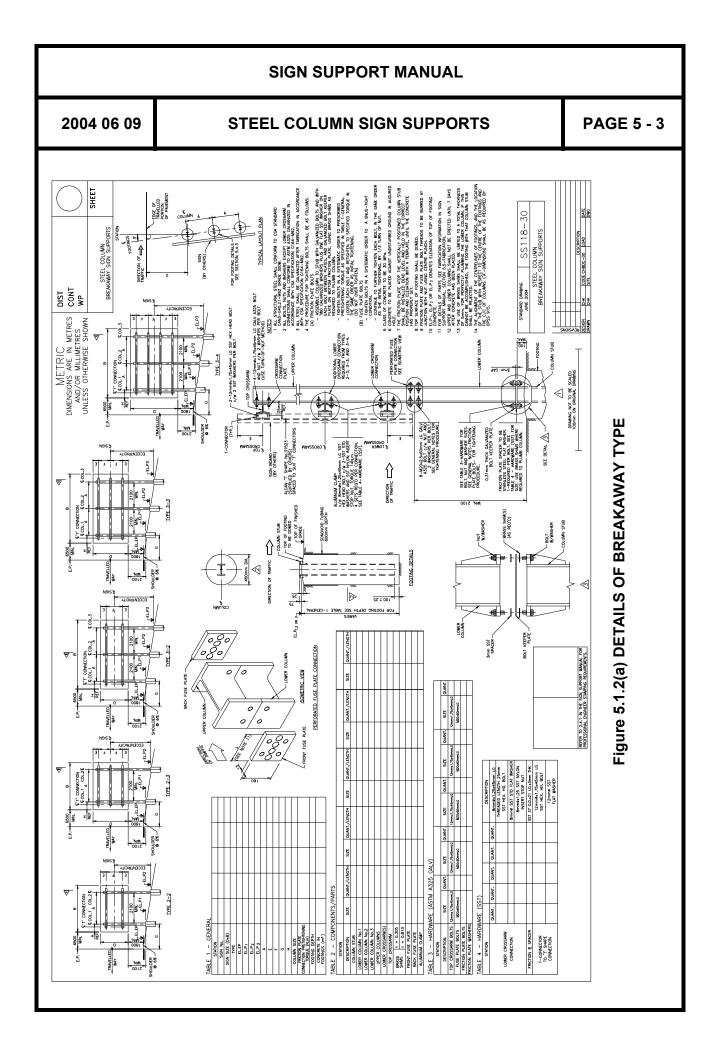
The supports consist of 2 or 3 vertical steel columns connected by 2, 3 or 4 horizontal steel crossarms. The details are shown in Figure 5.1.2(a) for Breakaway type (SS118-30) and Figure 5.1.2(b) for Non-Breakaway type (SS118-33).

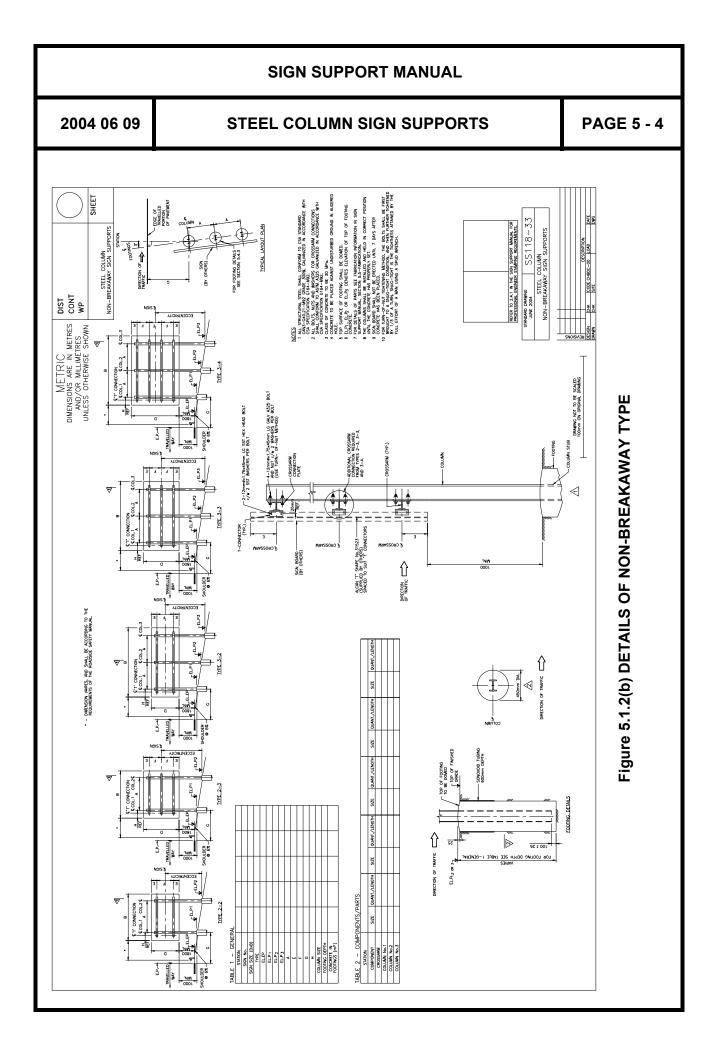
For breakaway type sign supports the sign boards and crossarms are set at a height greater than that of a passenger car. If the columns are struck, they shear off at the footing and bend upwards at the fuse plate hinges, located just above the lower edge of the sign. For the Friction Plate connection, located just above the footing, the shearing action caused by vehicular impact is ensured because of bolts in open-ended slots. Correctly torqued, the bolts resist normal wind forces but allow slippage upon impact. For the fuse plate connection, the perforations in both front and back fuse plates allow the following predicted behaviour to take place. Under normal conditions, the perforated plates have enough cross-section to resist wind forces. During vehicular impact, they have enough perforations to allow the front fuse plate to yield and tear while the back fuse plate forms a hinge at the connection, allowing the lower column to rotate upwards along with the sign. The column section below the hinge (the lower column) remains attached to the rest of the sign support.

For both connections, it is important that bolts of the correct size and tightened to the correct torque be used. For the friction plate connection, the sliding surface must be smooth, clean and free of imperfections. For the fuse plate connection, the front and back fuse plates are identical, and therefore cannot be accidentally reversed. An incorrectly installed support may fail under wind loading, or may not fail properly upon impact, perhaps causing serious injury.

As an additional safety feature and to minimize possible damage to the sign, all crossarms except the top one are attached to the columns with ductile aluminum clamps, so that if the fuse plate hinge fails to actuate, the clamps will fail, permitting separation of the lower crossarms from the column.

Sometimes, a sign will remain standing and readable despite the removal by impact of one column of the support. A strong wind however, can destroy a sign support in such a condition so repairs should be carried out as soon as possible. Except for the front and back fuse plates, the salvaged parts can generally be used again.





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## **STEEL COLUMN SIGN SUPPORTS**

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#### 5.1.3 LIMITATIONS

Steel breakaway supports are considerably more expensive than timber supports, and the latter should be considered as an alternative, especially for the smaller signs. Timber supports are discussed in Division 6 of this Manual.

Steel non-breakaway type sign supports are only intended for use behind barriers, as discussed in Section 2.6.

#### 5.1.4 TYPES OF SUPPORTS

The supports are divided into types according to the number of columns and crossarms as follows:

Type 2-2 (2 columns and 2 crossarms) Type 2-3 (2 columns and 3 crossarms) Type 3-2 (3 columns and 2 crossarms) Type 3-3 (3 columns and 3 crossarms) Type 3-4 (3 columns and 4 crossarms)

The general arrangement of columns and crossarms for the five types can be seen in Figure 5.1.2(a) for breakaway type and Figure 5.1.2(b) for non-breakaway type.

The type of support is determined by the size of the sign to be supported.

#### 5.1.5 FOOTINGS

Footings are built by placing the steel columns in concrete filled holes.

The indicated footings depths (in Section 5.4.3) are the absolute minimum required for each support based on a passive earth pressure of 68 kPa (1400 psf) at SLS. (The 68 kPa is derived from the modified Brom's equation for pole foundations in cohesive soils, and is conservative since it is based on a cohesive soil with a shear strength of 50 kPa.)

The tabulated required footing depth assumes that lateral soil resistance is based on full depth, without reduction for frost depth of soil. (This assumption is reasonable, given the size of the footing for this type of sign.)

If it is deemed that for a specific site the soil strength parameters for a particular site are less than those noted above, a site specific footing design must be carried out.

#### 5.1.6 CLEARANCE

The columns for breakaway sign supports should be located to result in a minimum horizontal clearance of 6500 mm from the edge of the travelled portion of pavement to the edge of the sign. A minimum vertical distance of 1800 mm from the edge of pavement elevation to the bottom edge of the sign shall be provided for both types of sign supports.

# **STEEL COLUMN SIGN SUPPORTS**

These clearances are provided automatically when the procedures (Section 5.3) described later are adhered to.

For non-breakaway sign supports, the minimum horizontal clearance of the sign board from the face of the protective barrier shall be as required by the Roadside Safety Manual.

For breakaway sign supports, the minimum height of column from ground elevation to the underside of the sign shall be 2100mm, and the minimum clear distance between columns shall be 2100mm.

For non-breakaway sing supports, if any portion of the sign is less than 1000mm above the ground level immediately below the sign, the sign shall be raised to ensure this minimum 1000mm clearance. This requirement is for summer and winter maintenance purposes.

#### 5.1.7 SUPPLY AND ERECTION

For steel column sign supports to be included as part of a contract, the relevant standard drawing(s) shall be completed by the designer and inserted into the contract documents.

The signboard and backing T's are supplied and fully assembled by the MTO, but are attached to the sign support by the contractor.

The attachment of the signboard to the support shall be covered by a separate item in the contract documents.

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## STEEL COLUMN SIGN SUPPORTS

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#### 5.2 **PREPARATION OF DRAWINGS**

#### 5.2.1 GENERAL

If the supply and erection of the support is to be part of a contract, Standard Drawing SS118-30 and/or SS118-33 must be used, as described in Section 5.1.2. Up to 5 sign supports can be detailed on one drawing.

#### 5.2.2 DATA REQUIRED

For each type of sign support, the following data is required:

(1) The sign size.

This must be one of the combinations of sign depth (D), and sign width (B) shown in Tables 5.2.2 (a) to (f) for three different values of reference wind pressure (465, 390 and 300 Pa) and maximum eccentricities (6900, 5700 and 4500 mm). See Figures 5.3.3(a) and (b). Only the combinations shown within shaded areas are permissible. See Section 5.1.4 for types of support.

Table A3.1.7 of the CHBDC gives the 10 year return Reference Wind Pressures for all locations in the province of Ontario.

(2) The location of the support.

For a proposed highway or a highway under reconstruction, the location should be specified as a station. For an existing highway the location may be determined at the site and marked with a peg.

(3) The edge of pavement elevation at the sign station, and the final ground elevations under the sign.

For a proposed highway or highway reconstruction project this information may be obtained from profiles, cross sections or contour plans. In the case of an existing facility, elevations may be taken at the site. Since only approximate and relative elevations or differences in height are required they can be obtained with a string level or hand level.

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## STEEL COLUMN SIGN SUPPORTS

#### 5.2.3 FOOTING LOCATIONS AND ELEVATIONS

First the type of support required must be determined. This is obtained from Table 5.2.2(a) to (f) for the given sign size.

From Section 5.4.2 and the appropriate figure from Section 5.4.4 for the support type, the information can be readily extracted which is required for laying out the column footings on a cross section, a contour plan, or on the ground. Except for the exceptions noted, the figures in Section 5.4.4 apply for Breakaway and also Non-Breakaway sign supports. Section 5.3.3 gives step by step procedure for detailing footings.

The G-dimensions given in the tables of Figures 5.4.4 are a minimum, based on the minimum 6500mm horizontal offset (from edge of travelled portion of pavement to the edge of the signboard), and apply to the breakaway sign supports only. For both breakaway and non-breakaway sign supports, the footings should be located so that no footing is placed at the centreline of a ditch (drainage channel). Where the footings would fall at the ditch centreline based on tabulated G-dimensions, the designer should increase the G-dimension by 300 to 600mm, as required. In no case should the top of footing be allowed to extend above the top of grade (except by the 25mm dome), in order to ensure that the 100mm maximum allowable projection of the column stub of breakaway sign supports in not exceeded. (see Fig 5.4.3) This is a safety requirement.

The angle of the sign to the roadway, as shown in Figure 5.4.2, is normally 3 degrees away from traffic. This is desirable because the reflective surface used on the signs works only for small angles of reflection.

#### 5.2.4 COLUMN LENGTHS

For breakaway type sign supports, the lower column must be selected with lengths to suit the footing elevations and the edge of pavement elevation. Section 5.3.4 gives step by step procedures for obtaining this information.

This procedure ensures that for breakaway type supports, the column length from ground elevation to the underside of sign shall be minimum 2100mm, and for nonbreakaway type this shall be minimum 1000mm. For both types, the minimum 1800mm vertical distance requirement from the edge of pavement elevation to the bottom edge of the sign shall also be satisfied.

The permissible maximum eccentricities are 6900, 5700 and 4500 mm, as shown in Tables 5.2.2(a) to (f). If these eccentricities and/or the above column length requirements can not be met, then either the sign must be relocated locally, or the site must be regarded.

The preferred option would always be to relocate the sign, but if this is not possible, the designer should detail the necessary regrading as follows: Compacted Granular 'B' material should be used, and the thickness of the fill shall be limited to 1/3 of the required footing depth given in Figure 5.4.3. (At least 2/3 of the footing depth must be in the existing ground). The (minimum) lateral dimension of the fill (including the footing) shall be 3.0m, and have side slopes of 2:1. The Granular 'B' material shall be placed in maximum lifts of 300mm, compacted to 100% of the maximum dry density. The

compacted fill shall be placed around the already-constructed footing.

If neither option is possible, the Regional Traffic Office should be contacted.

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## STEEL COLUMN SIGN SUPPORTS

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			1					
WINE	D PRESSU			465				
TYPE	SIGN SI	ZE (mm)	MAXIMUM ECCENTRICITY, mm					
	DEPTH	WIDTH	6900	5700	4500			
2-2	1200	3000	W200X42	W200X42	W200X42			
		3600						
	1500	3000						
		3600						
		4200	W200X46	1				
		4500						
		4800						
		5400	W200X59					
	1800	3600	W200X46					
		4200						
	4500 W200X59		W200X59					
		4800						
2-3	2100	3600	W200X59	W200X42	W200X42			
		4200		W200X46				
		4500						
		4800						
	2400	4200						
		4500						
		4800		W200X59				
	2700	4200						
		4500						
		4800						
	3000	4200						
		4500			W200X46			
		4800						
	3300	4200						
		4500						
		4800						
	3600	4800						

# TABLE 5.2.2(a) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES(2 COLUMNS / WIND PRESSURE = 465 Pa)

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## STEEL COLUMN SIGN SUPPORTS

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r	\ <b>A/IN</b>	D PRESSUF		1	465	
	VVIIN					
ΤY	′PE	SIGN SIZ	ZE (mm) WIDTH	6900	/ ECCENTRI 5700	4500
2	-2	1800	5400	W200X46	W200X42	W200X42
5	-2	1000	6000	W200X40	VV200/42	VV200/42
			6600	VV200A09	W200X46	
			7200		VVZUUA40	
	2	2100	7800	W000X50	14/200X4C	W200X42
3	-3	2100	5400	W200X59	W200X46	W200X42
			6000		14/0002/50	
			6600		W200X59	
			7200			
	_		7800			
		2400	5400	W200X59	W200X46	
			6000		W200X59	
			6600			
			7800			W200X46
		2700	5400	W200X59		W200X42
			7800			W200X46
		3000	5400			W200X42
			7800			W200X59
		3300	5400		W200X59	W200X46
3	-4	2400	7200		W200X59	W200X46
			7800			
		2700	6000			
			6600			
			7200			
			7800			
		3000	6000			
			6600			
			7200			W200X59
			7800			
	-	3300	6000		W200X59	W200X46
			6600			W200x59
			7200			
	-	3600	5400		W200X59	
			6000			
			6600			
L				1		

# TABLE 5.2.2(b) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES (3 COLUMNS / WIND PRESSURE = 465 Pa)

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#### STEEL COLUMN SIGN SUPPORTS

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			n				
WIN	D PRESSU			390			
TYPE	SIGN SIZE (mm)		MAXIMUM ECCENTRICITY, mm				
	DEPTH	WIDTH	6900	5700	4500		
2-2	1200	3000	W200X42	W200X42	W200X42		
		3600					
	1500	3000					
		3600					
		4200					
		4500					
		4800	W200X46	1			
		5400					
	1800	3600	W200X42				
		4200	W200X46	1			
		4500					
		4800					
2-3	2100	3600	W200X46	W200X42	W200X42		
		4200	W200X59	1			
		4500					
		4800		W200X46			
	2400	4200					
		4500					
		4800					
	2700	4200					
		4500					
		4800		W200X59			
	3000	4200		W200X46			
		4500		W200X59			
		4800					
	3300	4200	W200X59				
		4500					
		4800			W200X46		
	3600	4800					

## TABLE 5.2.2(c) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES (2 COLUMNS / WIND PRESSURE = 390 Pa)

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#### STEEL COLUMN SIGN SUPPORTS

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WIND PRESSURE (Pa)				390			
TYPE	SIGN S	SIGN SIZE (mm)		MAXIMUM ECCENTRICITY, mm			
=	DEPTH	WIDTH	6900	5700	4500		
3-2	1800	5400	W200X46	W200X42	W200X42		
		6000					
		6600	W200X59				
		7200					
		7800		W200X46			
3-3	2100	5400	W200X59	W200X42	W200X42		
		6000		W200X46			
		6600					
		7200					
		7800		W200X59			
	2400	5400		W200X46			
		6000					
		6600					
		7800		W200X59			
	2700	5400	W200X59	W200X46			
		7800		W200X59	W200X46		
	3000	5400	W200X59		W200X42		
		7800			W200X46		
	3300	5400	W200X59		W200X42		
3-4	2400	7200	W200X59	W200X59	W200X42		
		7800					
	2700	6000	W200X59				
		6600					
		7200			W200X46		
		7800					
	3000	6000			W200X42		
		6600			W200X46		
		7200					
		7800					
	3300	6000					
		6600					
		7200					
	3600	5400					
		6000					
		6600					

## TABLE 5.2.2(d) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES (3 COLUMNS / WIND PRESSURE = 390 Pa)

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#### STEEL COLUMN SIGN SUPPORTS

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WIN	D PRESSUF	RE (Pa)		300		
TYPE	SIGN SI	ZE (mm)	MAXIMUM ECCENTRICITY, mm			
	DEPTH	WIDTH	6900	5700	4500	
2-2	1200	3000	W200X42	W200X42	W200X42	
		3600				
	1500	3000				
		3600				
		4200				
		4500				
		4800				
		5400				
	1800	3600				
		4200				
		4500				
		4800				
2-3	2100	3600	W200X42	W200X42	W200X42	
		4200	W200X46			
		4500				
		4800				
	2400	4200				
		4500				
		4800	W200x59			
	2700	4200				
		4500				
		4800		W200X46		
	3000	4200				
		4500				
		4800				
	3300	4200				
		4500				
		4800				
	3600	4800		W200x59		

## TABLE 5.2.2(e) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES (2 COLUMNS / WIND PRESSURE = 300 Pa)

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#### STEEL COLUMN SIGN SUPPORTS

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WIN	D PRESSUF	RE (Pa)		300	
T)/DE	SIGN SI	ZE (mm)	MAXIMU	MECCENTRIC	CITY, mm
TYPE	DEPTH	WIDTH	6900	5700	4500
3-2	1800	5400	W200X42	W200X42	W200X42
		6000			
		6600	W200x46		
		7200			
		7800			
3-3	2100	5400	W200X46	W200X42	W200X42
		6000			
		6600			
		7200	W200X59		
		7800		W200X46	
	2400	5400	W200X46	W200X42	
		6000	W200X59		
		6600			
		7800		W200X46	
	2700	5400		W200X42	
		7800		W200X59	
	3000	5400		W200X46	
		7800		W200X59	
	3300	5400		W200X46	
3-4	2400	7200	W200X59	W200X46	W200X42
		7800			
	2700	6000			
		6600			
		7200 7800		W200X59	
	3000	6000		W200X39 W200X46	
	5000	6600		VV200/40	
		7200		W200X59	
		7800		11200/00	
	3300	6000	W200X59	W200X46	
		6600		W200X59	
		7200			
	3600	5400	W200X59	W200X46	
		6000		W200X59	
	· ·	6600			

## TABLE 5.2.2(f) PERMISSIBLE SIGN SIZES & SUPPORT STRUCTURE TYPES (3 COLUMNS / WIND PRESSURE = 300 Pa)

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## **STEEL COLUMN SIGN SUPPORTS**

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#### 5.2.5 COMPLETE STANDARD DRAWING

If the supports are to be supplied and erected as part of a contract, SS118-30 or SS118-33 must be used. Due to space limitations, up to 5 sign supports can be detailed on one sheet.

The drawings indicate what information needs to be added. The Contract and W.P. numbers should be added to the title block. The sheet number is added when the drawings for the entire contract are assembled.

On SS118-30 there are several tables to be completed on the drawing. SS118-33 also has tables requiring completion. In each table one vertical column of data is used for each sign.

The data required to complete Table 1 on these standard drawings consists of the sign size, the footing elevations established earlier, as well as the values of A, E, F, G and H tabulated on whichever figure in Section 5.4.4 is appropriate to the type of sign support required.

The information required to complete the remaining tables on these drawings can be obtained from other sections of this Section 5.

The Standard Drawings shall be sealed, dated and signed according to Section 2.4.1.

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## **STEEL COLUMN SIGN SUPPORTS**

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#### 5.3 PROCEDURES

#### 5.3.1 GENERAL

Sections 5.3 to 5.5 contain all data necessary to complete the Standard Drawing SS118-30 or SS118-33.

#### 5.3.2 PROCEDURE FOR SELECTION OF SIGN SUPPORT

- GIVEN: SIGN SIZE (2100 mm x 5400 mm size, breakaway type with wind pressure of 465 Pa, is used as an example. See Figure 5.3.3 (a)).
- STEP 1: DETERMINE SIGN SUPPORT TYPE From Table 5.2.2(b), a 2100 x 5400 mm sign requires a Type 3-3 support.

#### STEP 2: OBTAIN

- DISTANCE FROM EP TO FIRST FOOTING (G)
- CENTRE/CENTRE DISTANCE BETWEEN FOOTINGS (A)
- NOTE: Layout Dimensions A & G are obtained from Figure 5.4.4 (d) for sample 2100 mm x 5400 mm sign. dimension A = 2300 mm
  - dimension G = 6900 mm
- STEP 3: ESTABLISH ELEVATION P1\* (EL.P1) AT GROUND LEVEL ON SITE AS DATUM (actual elevation need not be determined)

\*Elevation referred to is elevation at top of footing.

STEP 4: OBTAIN DIFFERENCE IN ELEVATION BETWEEN EP AND TOP OF FOOTING NEAREST EP (ELP1)

This measured difference (above or below) need not be precise. A tolerance of 50 mm is acceptable.

#### STEP 5: ESTABLISH EL.P2\* AND EL.P3\* ON SITE

NOTE: Actual elevations need not be determined but DIFFERENCE in elevation relative to EL.P1 should be established. If top of footing is more than 25 mm above or below ground, grade around footing with earth or by excavation.

#### STEP 6: DETERMINE MAXIMUM ECCENTRICTY

Determine the maximum dimension measured from top of footing to centreline of sign board using dimensions A and G, and values obtained in steps 3, 4 and 5. Specify a dimension from EP to bottom of sign board of 1800 mm.

E.g. For sample 2100 mm x 5400 mm sign, maximum eccentricity = 4010 mm.

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**STEEL COLUMN SIGN SUPPORTS** 

#### STEP 7: DETERMINE IF A SOLUTION IS AVAILABLE

From Table 5.2.2(b) verify if a solution is available. This must be confirmed on steps 4 of Section 5.3.4 when checking boundary conditions. e.g. For sample, there is a solution for a maximum eccentricity of 4500 mm with the column sizes as W200x42.

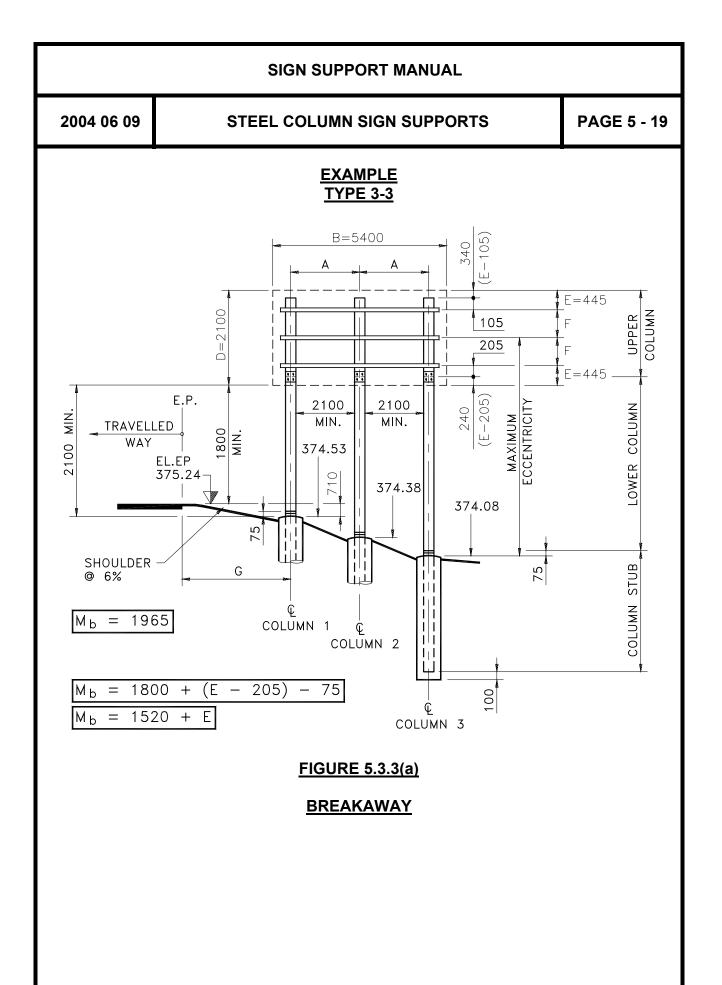
## 5.3.3 PROCEDURE FOR DETAILING FOOTINGS

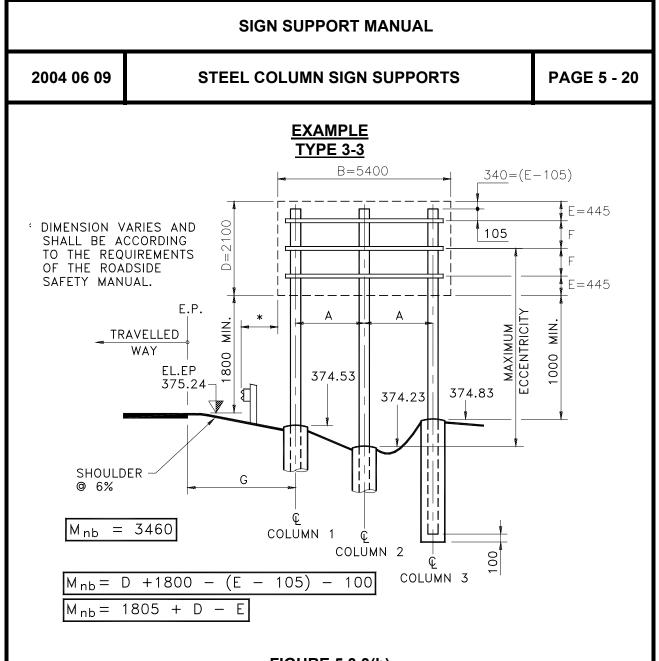
- GIVEN: SIGN SIZE (Sample 2100 mm x 5400 mm - Type 3-3 for a wind pressure of 465 Pa, maximum eccentricity of 4500 mm and column size as W200x42 - See Figure 5.3.3(a)).
- STEP 1: DETERMINE COLUMN STUBS REQUIRED (For breakaway supports). A 2100 x 5400 mm - sign, Type 3-3 support with column size as W200x42 requires 3 column stubs.
- STEP 2: ADD DIMENSIONS A AND G TO STANDARD DRAWING (Table 1).
- STEP 3: DETERMINE FOOTING DETAILS

Footing layout plan is given on Figures 5.4.2. Footing depth and details are given on Figure 5.4.3. These include column stub length (for breakaway supports), concrete dimensions and quantity per footing. e.g. For sample 2100 mm x 5400 mm sign, footing depth = 1700 mm Concrete in footings =  $3(0.27) = 0.81m^3$  (for 3 footings)

NOTE: Column stub length and concrete quantities are given here for the convenience of the footing installer. Footing depth and concrete quantities should be added to the drawing. Column stub length need not be added to the drawing.

In any given breakaway support the column stubs, lower columns and upper columns always have the same cross-section e.g. for the sample sign the column stub is made from W200x42. Thus both the lower and upper columns are W200x42 also.





# FIGURE 5.3.3(b)

**NON-BREAKAWAY** 

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5.3.4 PR	PROCEDURE FOR DETAILING SUPPORTS ON CONTRACT DRAWING								
CAS	<u>SE 1 - BF</u>	REAKA	AWAY SIGN SUPPORT (Se	ee Fig. 5.3.3(a))					
GIV	GIVEN: SIGN SIZE (Sample 2100 mm x 5400 mm; Type 3-3; Wind pressure = 465 Pa; Maximum eccentricity = 4500 mm.)								
STE	-	-	N PARTS AND QUANTITIE s example, Column size req						
	E	E.g. 21	00 mm x 5400 mm sign rec	juires:					
		•	3 Column stubs						
		•	3 Upper Columns						
		•	2 Lower Crossarms						
		• 1 Top Crossarm							
		•	12 Friction Plate Bolts	(M16 x 70 mm long)					
		•	24 Fuse Plate Bolts	(M20 x 60mm long)					
		•	3 Concrete Footings (see Fig 5.4.3)	(depth = 1700 mm) (volume = 3(0.270) =	= 0.81 m <sup>3</sup> )				
STE	EP 2: C	OBTAII	N 3 COLUMN STUBS						
	F	Columr Footing Breaka							
STE	EP 3: C	OBTAII	N 3 LOWER COLUMNS						
		Lower Column size required = $\frac{W200 \times 42}{E = 445mm}$ Mb = 1965 (Fig. 5.4.4(d))							
	Lengths of Lower Columns: $L_1 = M_b + (EL.EP - ELP_1) = 1.965 + (375.24 - 374.53) = 2.675 \text{ m}$ $L_2 = M_b + (EL.EP - ELP_2) = 1.965 + (375.24 - 374.38) = 2.825 \text{ m}$ $L_3 = M_b + (EL.EP - ELP_3) = 1.965 + (375.24 - 374.08) = 3.125 \text{ m}$								
	Ν	"(	top of footing elevations ar difference" becomes negati ecome shorter than M <sub>b</sub> .						
		f all foo equal.	otings are at the same eleva	ation, then all lower col	umn lengths are				

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STEP 4:	OBTA	AIN 3 UPPER COLUMNS:					
	All 3 c L = D = 2 <sup>2</sup> = 2 <sup>4</sup>	r Column size required = <u>W200 x 42</u> columns are equal length. – (E – 105) – (E – 205) (constants based on Fig. 5 100 – 2E + 310 410 – 2E 410 – 2(445) = 1520 mm = <u>1.520 m</u>	.5.4(b))				
STEP 5:	OBTA	AIN 2 LOWER CROSSARMS: (size S75 x 8)					
	Lengt	Length = B – 2H + 115 (Fig. 5.4.4(d) & Fig. 5.5.6 a&b) = 5400 – 2(100) + 115 = 5315mm = <u>5.315m</u> *					
	Note: Lower Crossarms don't have Connection Plates because they ha Aluminum Clamps (for release).						
	T-Connector spacing = [1500mm(typ)] or [equal end spac. + x@1500] T-Connector end dist. = 20mm & 95mm Therefore [20 + 350 + (3 spac. @ 1500) + 350 + 95] = <u>5315mm</u> *						
	Note: When 1500 spacing doesn't divide equally into (Length – 2 end distances), use Extended Lower Crossarms (Fig. 5.5.6(b)) Otherwise use Regular Crossarms (Fig. 5.5.6 (a))						
STEP 6:	OBTAIN 1 TOP CROSSARM ( size S75 x 8)						
	Length = B – 2H + 115 = 5400 – 2(100) + 115 = 5315mm = 5.315m						
	Note: Top Crossarms have Connection Plates (Fig.'s 5.5.7)						
	T-Connector spacing = same as for lower crossarms.						
STEP 7:	CHECK BOUNDARY CONDITIONS						
	(a)	If any lower column length is calculated to be less then <u>all</u> column lengths shall be increased by the adjust the smallest (shortest) column length to 210 (minimum) e.g. If the 3 lower column lengths are calculated to 2200 mm, and 2500 mm, then all lengths sho by 200 mm, (ie 2100 – 1900 = 200). Adjusted therefore be 2100 mm, 2400 mm, and 2700 m	same amount to 00 mm o be 1900mm, uld be increased I lengths would				
	(b)	The dimension measured from top of lowest footing of signboard shall be less than or equal to the man eccentricity used in Tables 5.2.2 for the design.					

## STEEL COLUMN SIGN SUPPORTS

STEP 8: INSERT ALL RESULTING SIZES, DIMENSIONS AND QUANTITIES CALCULATED ABOVE, INTO RELEVANT TABLES ON DWG. SS 118-30.

#### SS118-30 BREAKAWAY SIGN SUPPORTS

Note: All tables are completed for Example given in Section 5.3.

TABLE 1 - GENERAL

ADLE I - GENERAL						
STATION	0+00					
SIGN No.	1					
SIGN SIZE (DxB)	2100x5400					
TYPE	3-3					
EL. P <sub>1</sub>	374.53					
EL. P <sub>2</sub>	374.38					
EL. P <sub>3</sub>	374.08					
A	2300					
E	445					
F	605					
G	6900					
Н	100					
COLUMN SIZE	W200x42					
FRICTION PLATE CONNECTION PRE-TIGHTENEING TORQUE (Nm)	67 (for M16 bolt)					
FOOTING DEPTH	1700					
CONCRETE IN FOOTINGS (m <sup>3</sup> )	0.81					

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## **STEEL COLUMN SIGN SUPPORTS**

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#### TABLE 2 – COMPONENTS/PARTS

STATION	0.	+ 00		
COMPONENT	SIZE	QTY/LENGTH		
COLUMN STUBS	W200x42	3 x 1700		
LOWER COLUMN #1	W200x42	1 x 2675		
LOWER COLUMN #2	W200x42	1 x 2825		
LOWER COLUMN #3	W200x42	1 x 3125		
UPPER COLUMNS	W200x42	3 x 1520		
LOWER CROSSARM(S)	S75x8	2 x 5315		
TOP CROSSARM	S75x8	1 x 5315		
BRASS SHIMS	<i>t</i> =0.305mm <i>t</i> =0.813mm	As req'd for plumbing lower column		
FRONT FUSE PLATE	<i>t</i> =13mm	3		
BACK FUSE PLATE	<i>t</i> =13mm	3		
ALUMINUM CLAMP	SEE DETAILS	24		

#### TABLE 3 – HARDWARE (ASTM A325M GALV.)

STATION	0 + 00			
DESCRIPTION	SIZE	QUANTITY		
TOP CROSSARM BOLTS	12mmx1.75x 45mm LG.	12		
FUSE PLATE BOLTS	M20x60mm LG	24		
FRICTION PLATE BOLTS	M16x70mm LG	12		
FRICTION PLATE WASHERS	M16 FLAT	24		

Note: Top Crossarm Bolts are 12mm dia. x 1.75 x 45mm long, A325M bolts, c/w 2 washers per bolt.

4 sets required per connection.

Therefore for Type 3-3, Quantity = 3(4) = 12.

Fuse Plate Bolts for perforated fuse plate are M20 x 60mm long, A325, c/w 2 flat washers per bolt. 8 sets required per connection. Therefore for Type 3-3, Quantity = 3(8) = 24.

Friction Plate Bolts for columns W200x42 and W200x46 shall be M16 x 70mm long; For W200x59 they shall be M20 x 90mm long. The bolts shall be A325M, complete with 2 galvanized and one SST washer. Therefore for Type 3-3, Quantity = 3(4) = 12 bolts Quantity = 3(8) = 24 washers (galv.)

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### **STEEL COLUMN SIGN SUPPORTS**

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#### TABLE 4 – HARDWARE (SST)

STATION	0+00	/				DESCRIPTION
LOWER CROSSARM CONNECTION	QTY	QTY	QTY	QTY	QTY	8mm x 1.25 x 45mm LG.
	24					THREADED LENGTH 25mm SST HEX. HD. BOLT
	48					8mm SST STD FLAT WASHER
	24					8mm x 1.25 SST NYLON INSERT STOP NUT
FRICTION PLATE SPACER	12					SST 37 O.D. x 21 I.D. x 3mm THICK
T-CONNECTOR TO 'T' SHAPE CONNECTION	36					12mm x 1.75 x 45mm LG. SST HEX. HD. BOLT
	72					12mm SST FLAT WASHER

<u>Note</u>: Lower Crossarm Connection uses 8mm dia. bolts to connect the Aluminum Clamp to the upper column. The clamps secure the lower crossarm to the upper column.

4 sets required per connection.

Therefore for Type 3-3, Quantity = 6(4) = 24 bolts. Quantity = 6(8) = 48 washers.

Quantity = 6(4) = 24 nuts.

Friction Plate Spacers: 1 required per bolt in each friction plate connection.

Therefore for Type 3-3, Quantity = 3(4) = 12 spacers.

For 2100 x 5400 sign, (Type 3-3):

L = 5400 – 2H +115 = 5400 – 2(100) + 115

= 5315mm

Therefore the number of T-connectors required per crossarm: Quantity = 6 (from Fig. 5.5.6)

Therefore the number of SST bolts required for T-connector to T-shape connection:

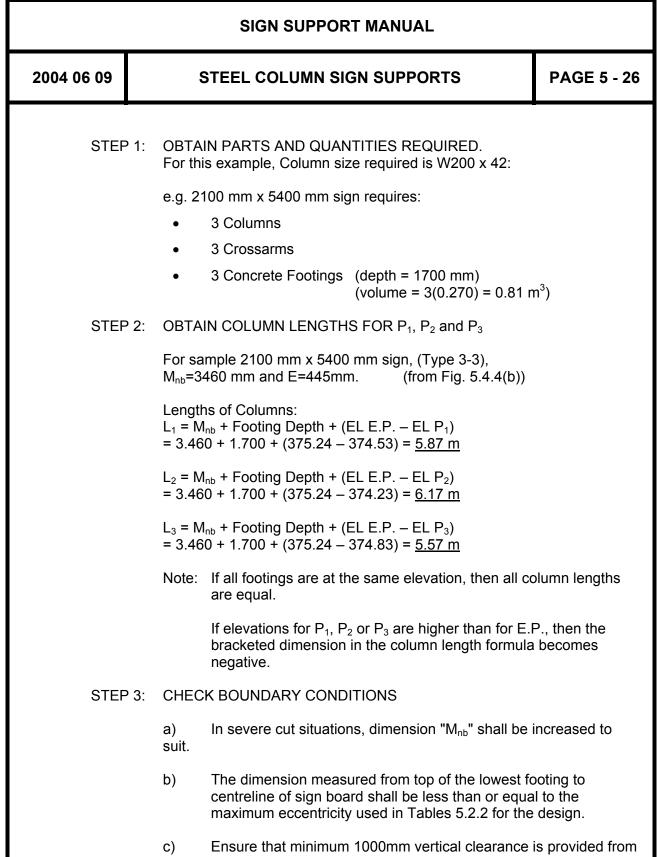
Quantity = 2(6x3) = 36 bolts

Therefore the number of SST washers required: Quantity = 2 (36) = 72 washers

The following components are Supplied by Others (MTO).

- sign board
- Alcan T-Shapes No. 31523

GIVEN: SIGN SIZE (Sample 2100 mm x 5400 mm; Type 3-3; Wind pressure = 465 Pa; Maximum eccentricity = 4500 mm.)



the underside of sign to the ground level.

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STEP	STEP 4: INSERT ALL RESULTING SIZES, DIN CALCULATED ABOVE, INTO RELEV Note:							
<ol> <li>Table 1 – GENERAL is filled in similar to that table for breakaway sign supports, with the only exception that non-breakaway sign supports don't have friction plate connections.</li> <li>Table 2 – COMPONENTS/PARTS is given as follows:</li> </ol>								
STATION	(	0 + 00						
COMPONENT	SIZE	QTY/LENGTH						
COLUMN #1	W200x42	1 x 5870						
COLUMN #2	W200x42	1 x 6170						
COLUMN #3	W200x42	1 x 5570						
CROSSARM(S)	S75 x 8	3 x 5315						

#### 5.4 ASSEMBLY AND INSTALLATION

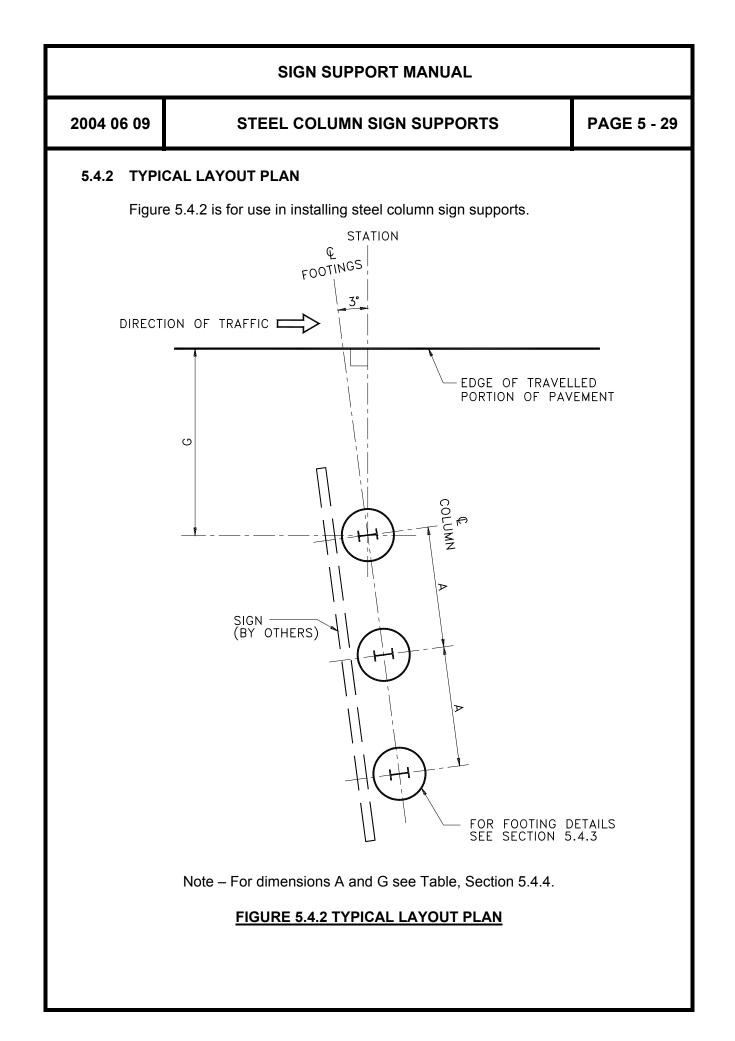
#### 5.4.1 GENERAL

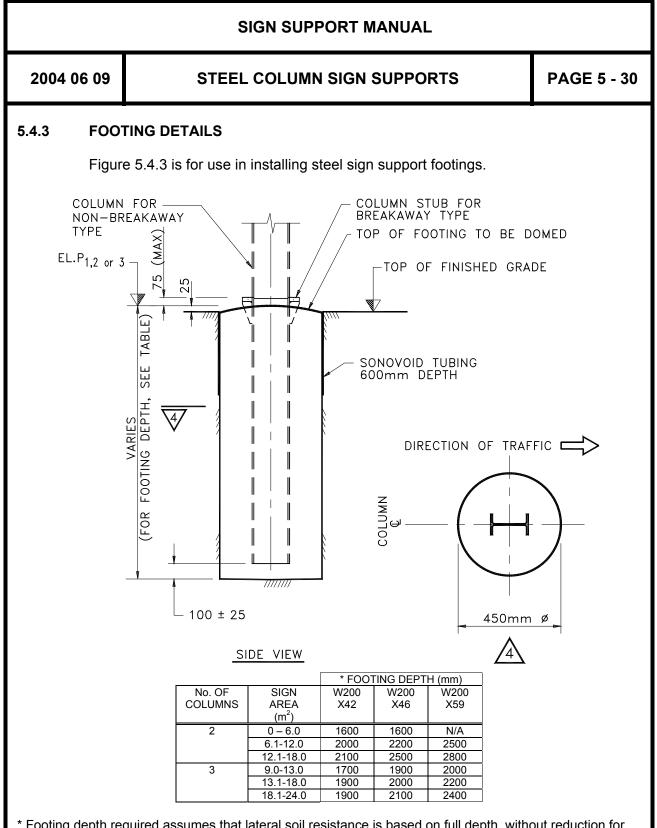
The following requirements must be met during the construction of steel sign supports.

(i) For breakaway supports, the friction plate atop the vertically positioned column stub shall be installed dead level and held in the correct position and elevation with a template, until the concrete has properly set.

For non-breakaway supports, install and hold column dead plumb until concrete has properly set.

- (ii) Concrete to be placed against undisturbed ground in augered hole.
- (iii) Class of concrete to be 30 MPa.
- (iv) Top surface of footings shall be domed.
- (v) For breakaway supports, components above ground level shall not be erected until 7 days after concrete has been placed.
- (vi) The procedure for tightening bolts of breakaway signs shall be as follows:
  - (a) FRICTION PLATE BOLTS (M16 or M20)
    - Assemble column to stub with galvanized bolts and with two galvanized washers plus one SST flat washer on each bolt between friction plates, and galvanized bolt keeper plate.
    - Use brass shims as required to plumb column.
    - Tighten bolts in a systematic order to a torque specified in Table of Figure 5.4.5(a).
    - Loosen each bolt and retighten to specified torque in the same order as initial tightening.
  - (b) PERFORATED FUSE PLATE BOLTS (M20)
    - Tighten bolts in a systematic order to a snug tight condition.
    - Continue to further tighten each bolt, in the same order as the initial tightening, by 1/3 of a turn.
- (vii) Friction plate and fuse plate bolt threads to be burred at junction with nut, using centre punch.





\* Footing depth required assumes that lateral soil resistance is based on full depth, without reduction for frost depth of soil.

BREAKAWAY COLUMN STUB LENGTH (mm)	1600	1700	1900	2000	2100	2200	2400	2500	2800
FOOTING DEPTH (mm)	1600	1700	1900	2000	2100	2200	2400	2500	2800
CONCRETE QUANTITY (m <sup>3</sup> )	0.254	0.270	0.302	0.318	0.334	0.350	0.382	0.398	0.445

#### FIGURE 5.4.3 FOOTING DETAILS

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# **STEEL COLUMN SIGN SUPPORTS**

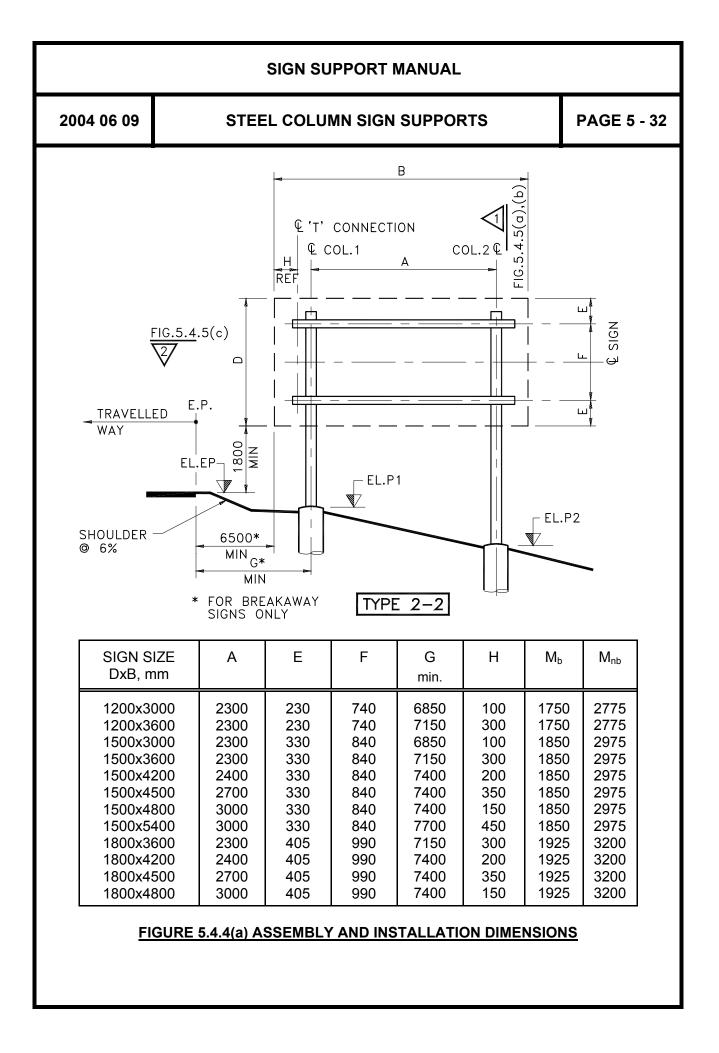
## 5.4.4 ASSEMBLY

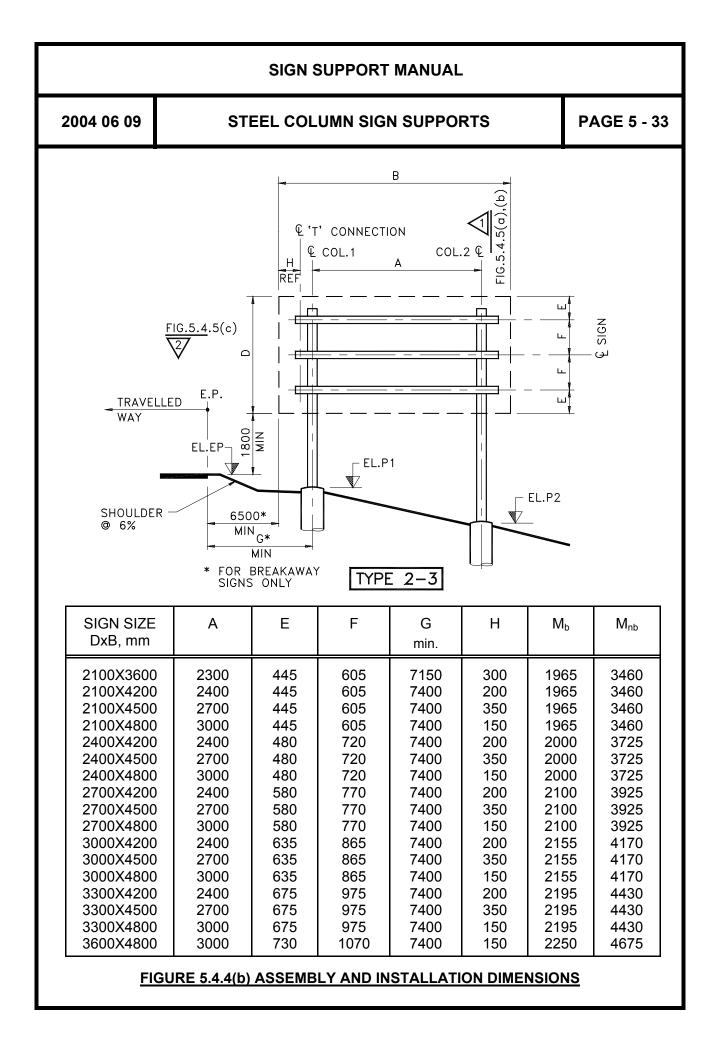
The following illustrations provide dimensions for assembly and installation of sign supports.

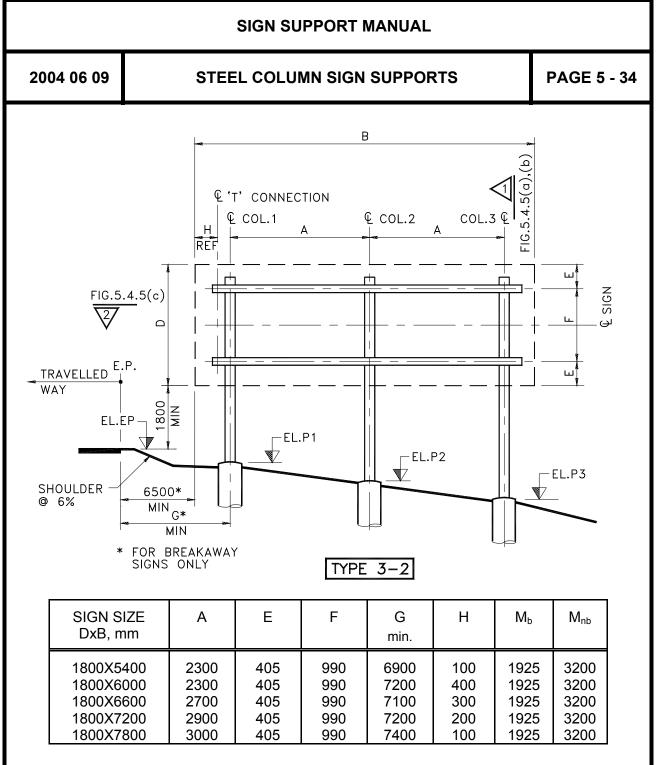
<u>TYPE OF SIGN</u> <u>SUPPORT</u>	<b>FIGURE</b>
2-2	5.4.4(a)
2-3	5.4.4(b)
3-2	5.4.4(c)
2-3	5.4.4(d)
3-4	5.4.4(e)

These figures are applicable to both breakaway and non-breakaway sign supports, with the exceptions as noted.

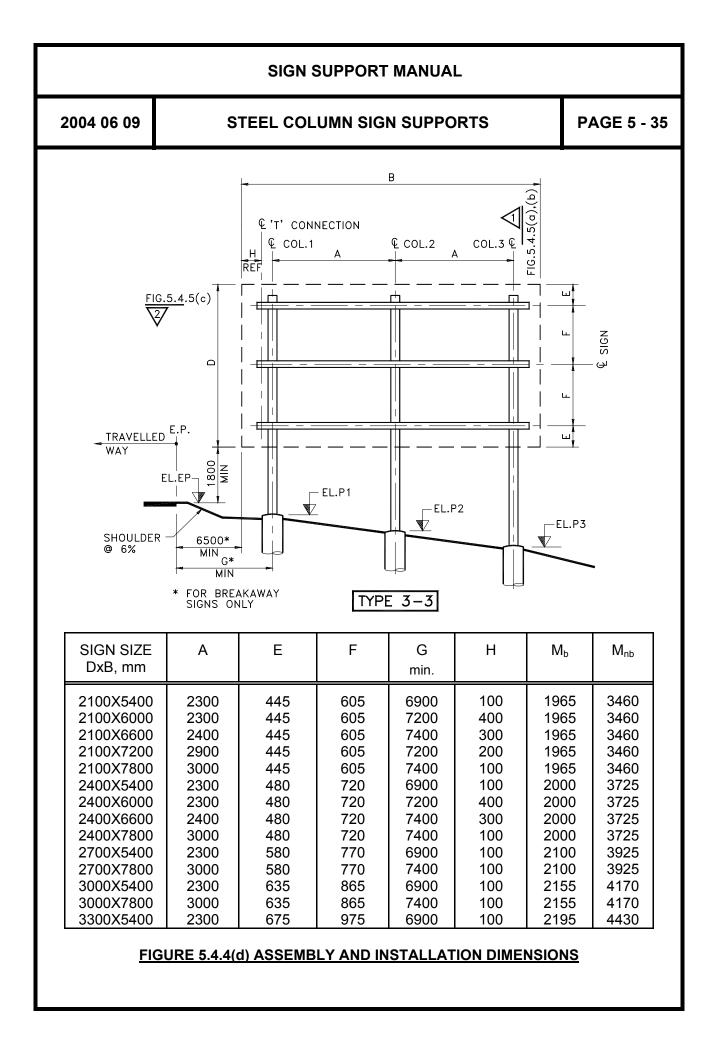
For clarity, traffic barrier for non-breakaway sign supports in not shown.

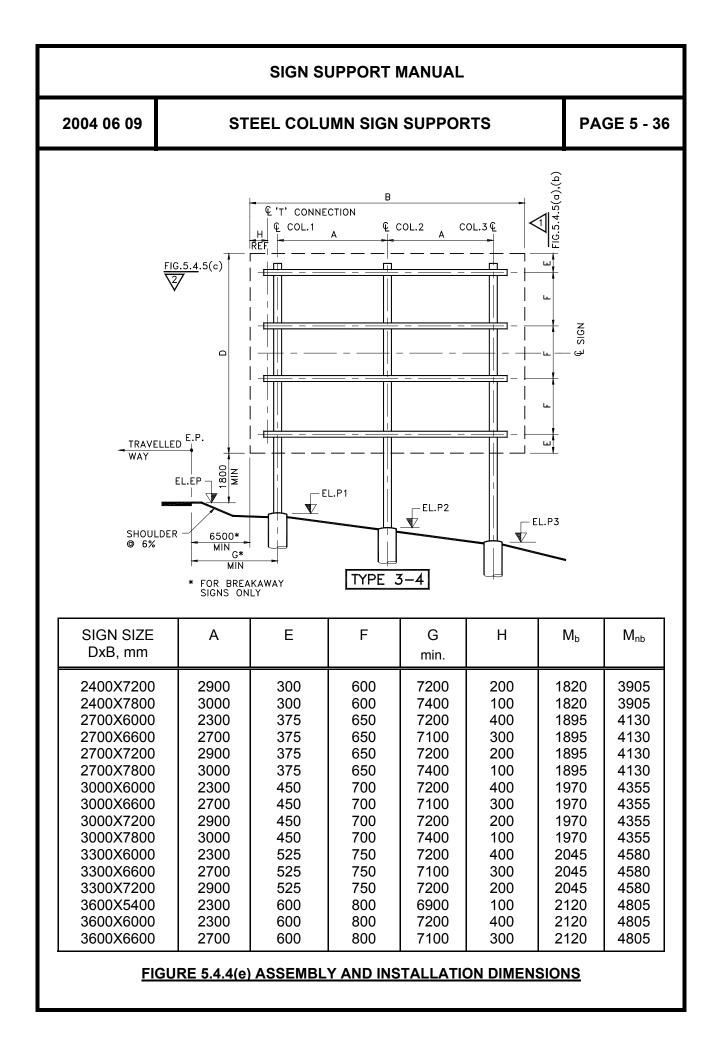






#### FIGURE 5.4.4(c) ASSEMBLY AND INSTALLATION DIMENSIONS





# STEEL COLUMN SIGN SUPPORTS

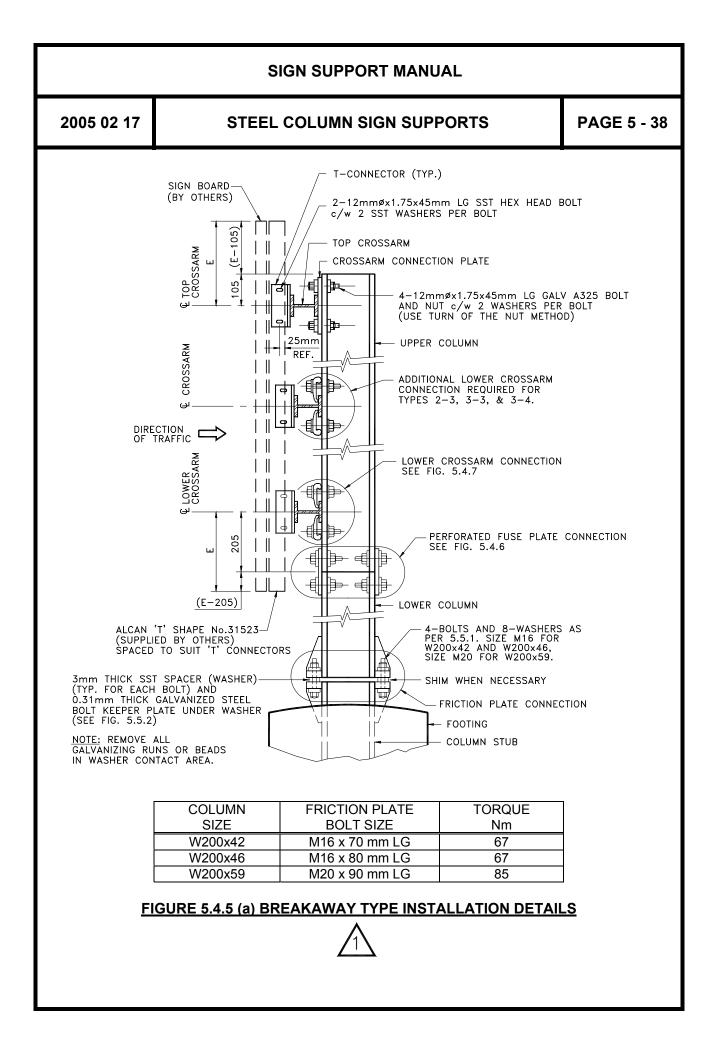
#### 5.4.5 INSTALLATION

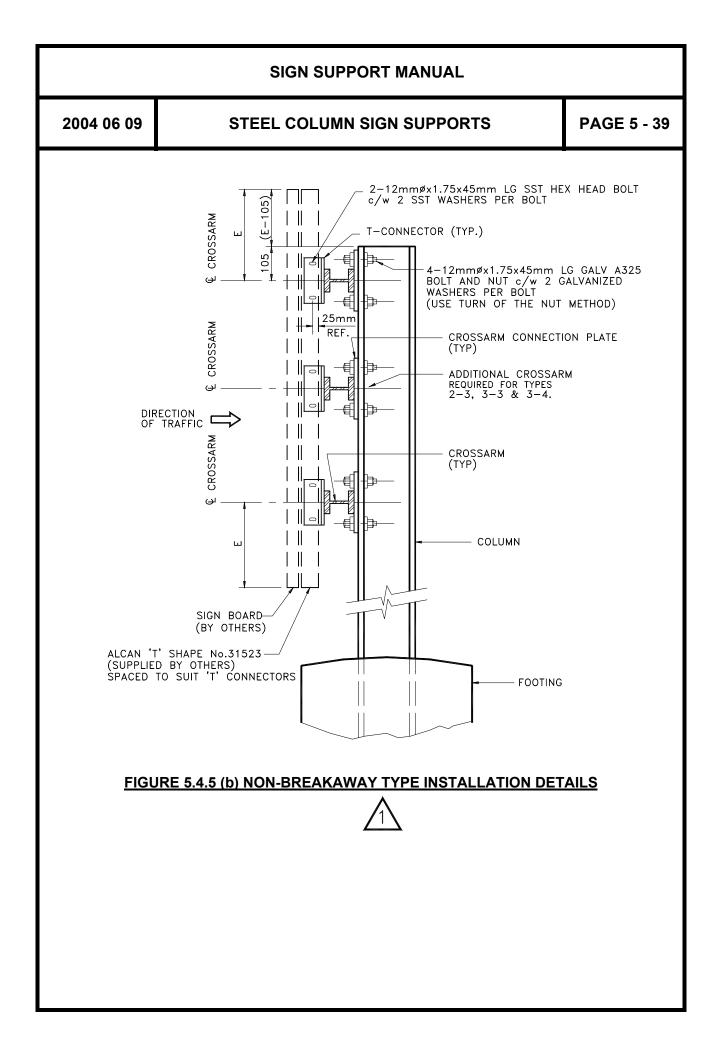
Figure 5.4.5(a), 5.4.5(b) and 5.4.5(c) provide information for the installation of steel column sign supports.

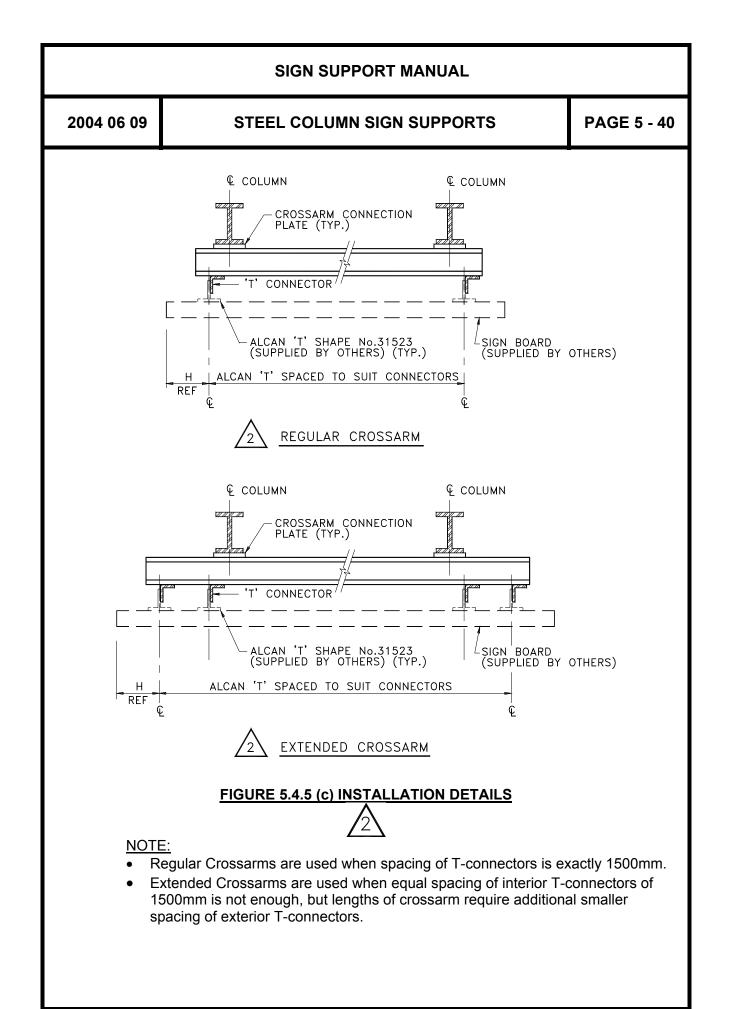
Figure 5.4.5 (a) – Breakaway Type Installation Details

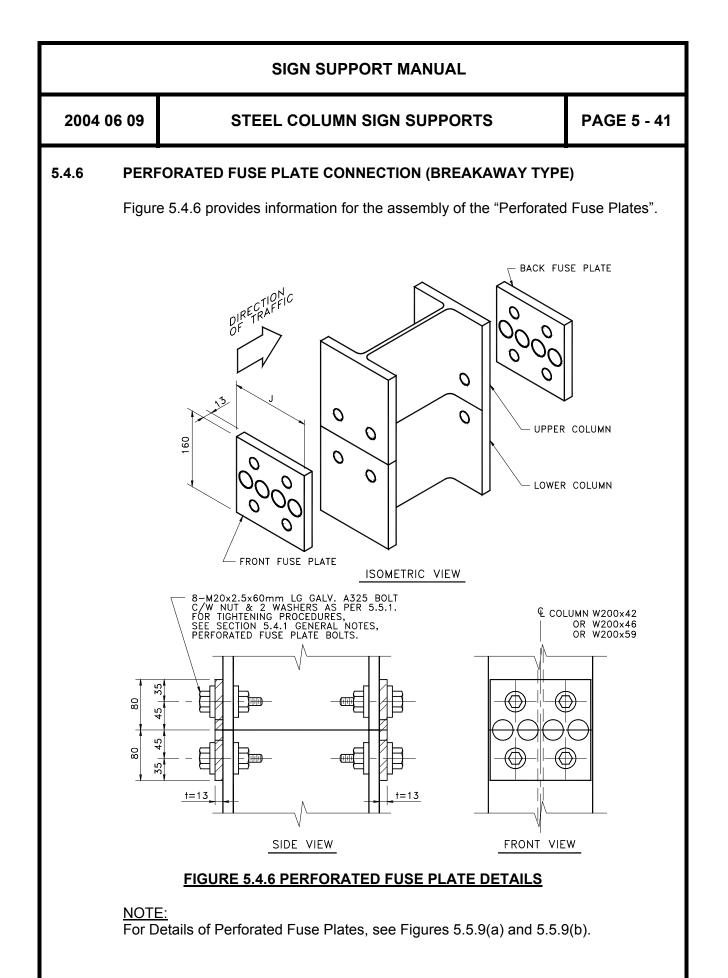
Figure 5.4.5 (b) – Non-Breakaway Type Installation Details

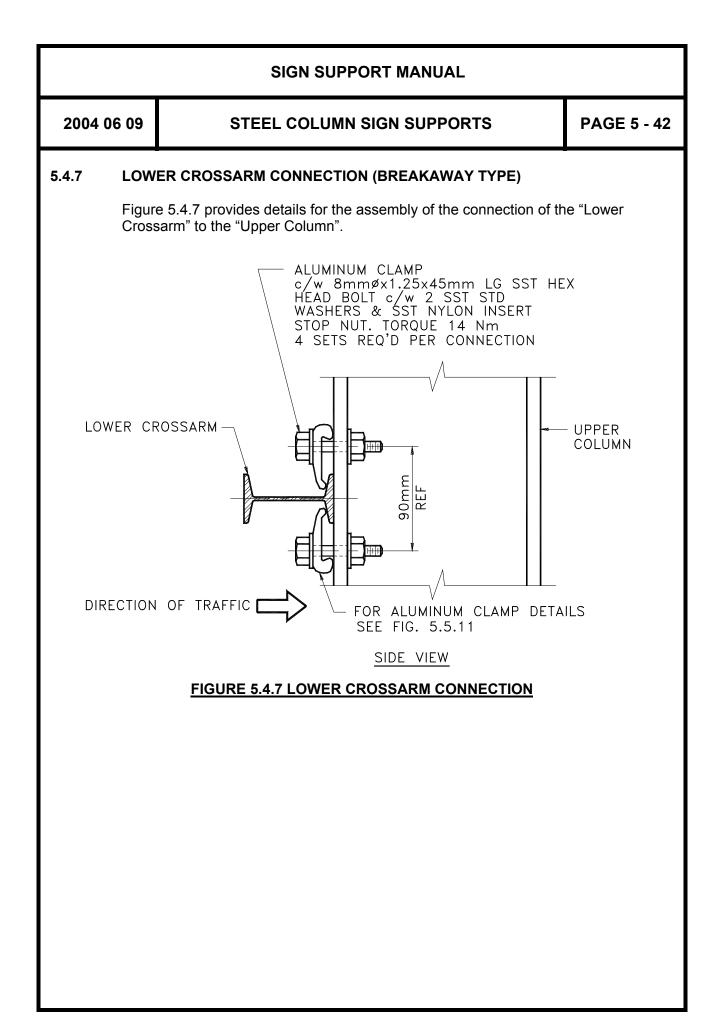
Figure 5.4.5 (c) – Installation Details











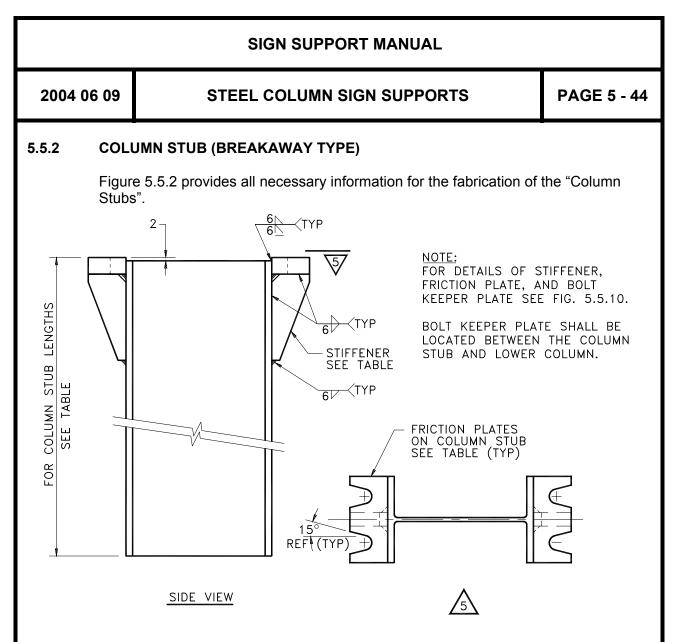
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**STEEL COLUMN SIGN SUPPORTS** 

#### 5.5 FABRICATION

#### 5.5.1 GENERAL

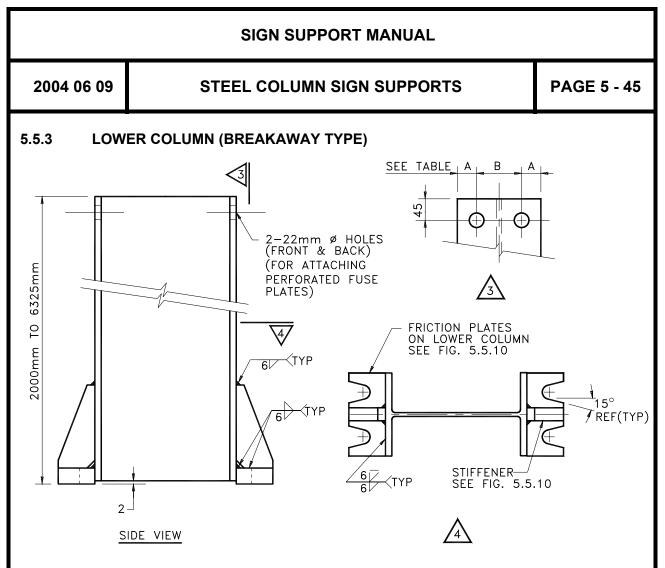
- (i) All structural steel shall conform to CSA Standard CAN3-G40.21 M92 Grade 300W.
- (ii) All bolts, nuts and washers, except lower crossarm connections (which are SST) shall conform to ASTM A325 and be galvanized in accordance with CSA Specification G164-M92.
- (iii) All contact areas of friction plates, perforated fuse plates and column flanges shall be free of galvanizing beads or runs.
- (iv) All steel shall be galvanized after fabrication in accordance with CSA Specification G164-M92.
- (v) All welding shall be in accordance with CSA Standard W59.
- (vi) Electrodes shall be to a low hydrogen specification. Electrodes for manual welding shall be E7015, E7106 or E7018.
- (vii) For inspection and delivery, assemble all bolts, nuts and washers in place as required.



Note that friction plates shall be fabricated perpendicular to the longitudinal axis of the column.

COLUMN SIZE	COLUMN STUB LENGTH								
W200x42	1600	1700	1900	2000	2100	-	-	-	-
W200x46	1600	-	1900	2000	2100	2200	-	2500	-
W200x59	-	-	-	2000	-	2200	2400	2500	2800

# FIGURE 5.5.2 COLUMN STUB DETAILS



- Note that friction plates shall be fabricated perpendicular to the longitudinal axis of the column.
- Obtain length from Standard Drawing SS118-30 in contract.

COLUMN	A	В
SIZE	(mm)	(mm)
W200x42	43	80
W200x46	52	100
W200x59	53	100

## FIGURE 5.5.3 LOWER COLUMN DETAILS

#### NOTE:

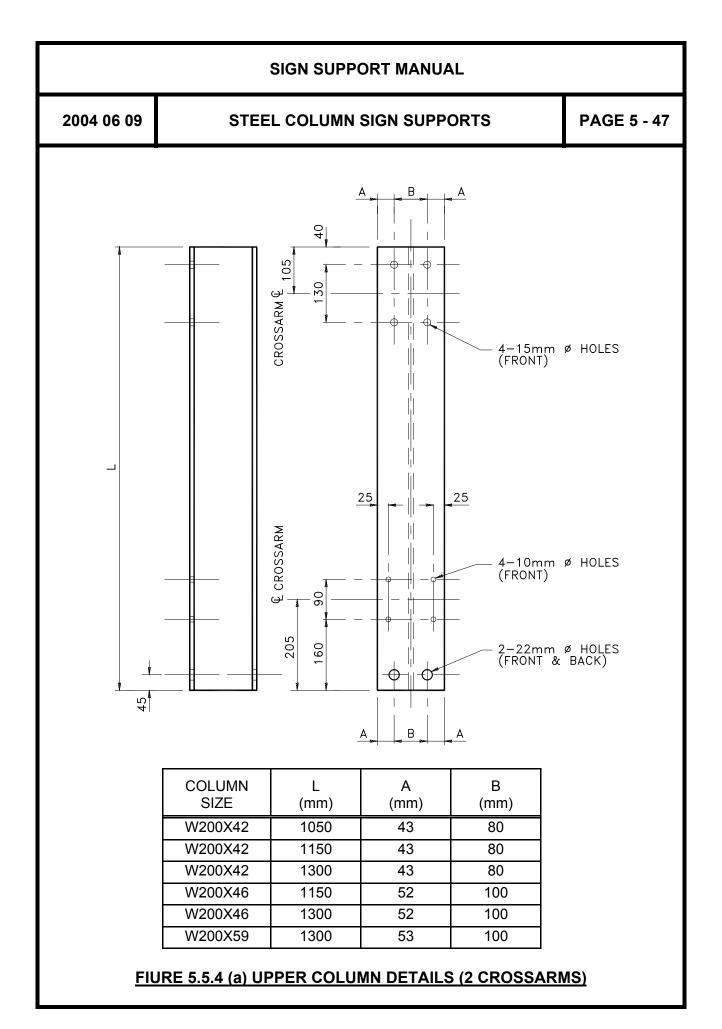
- For Details of Stiffener, Friction Plate, and Bolt Keeper Plate, see Figure 5.510.
- Bolt Keeper Plate shall be located between the Column Stub and Lower Column.

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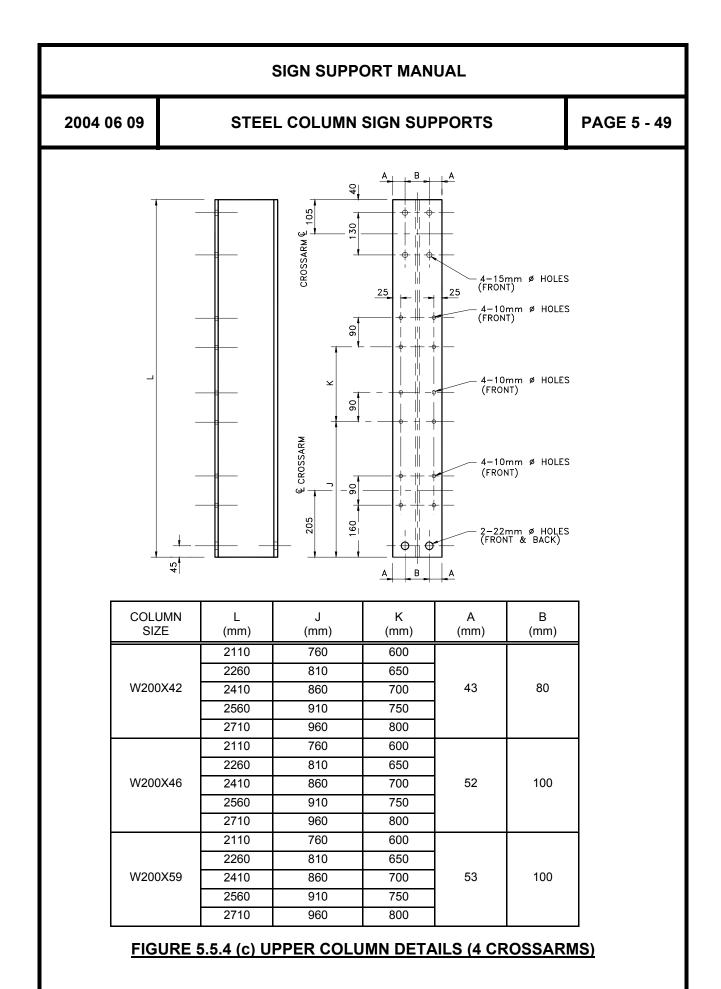
# STEEL COLUMN SIGN SUPPORTS

# 5.5.4 UPPER COLUMN (BREAKAWAY TYPE)

Figures 5.5.4(a) to 5.5.4(c) provide all information necessary for fabrication of the "Upper Columns".



	SIGN SUPPORT MANUAL						
2004 06 09	STEEL C	PAGE 5 - 48					
	205 E CROSSARM E 105		4-15mm Ø H (FRONT) 4-10mm Ø H 4-10mm Ø H (FRONT) 4-10mm Ø H (FRONT) 4-10mm Ø H 0 0 0 0 0 0 0 0 0 0 0 0 0	OLES			
COLUM		A B	A A	В			
SIZE	(mm)	(mm)	(mm)	(mm)			
	1520	765					
	1750	880					
W200X4	1850	930	43	80			
	2040	1025					
	2260	1135					
	2450	1230	<b>├</b> ────				
	1520 1750	765	4				
	1750	880	4				
W200X4	6 2040	930 1025	52	100			
	2040	1135	4				
	2260	1135	4				
		765	├				
	1600	100					
	1520	880					
	1750	880					
W200X5	1750 1850	930	53	100			
W200X5	1750 1850		53	100			

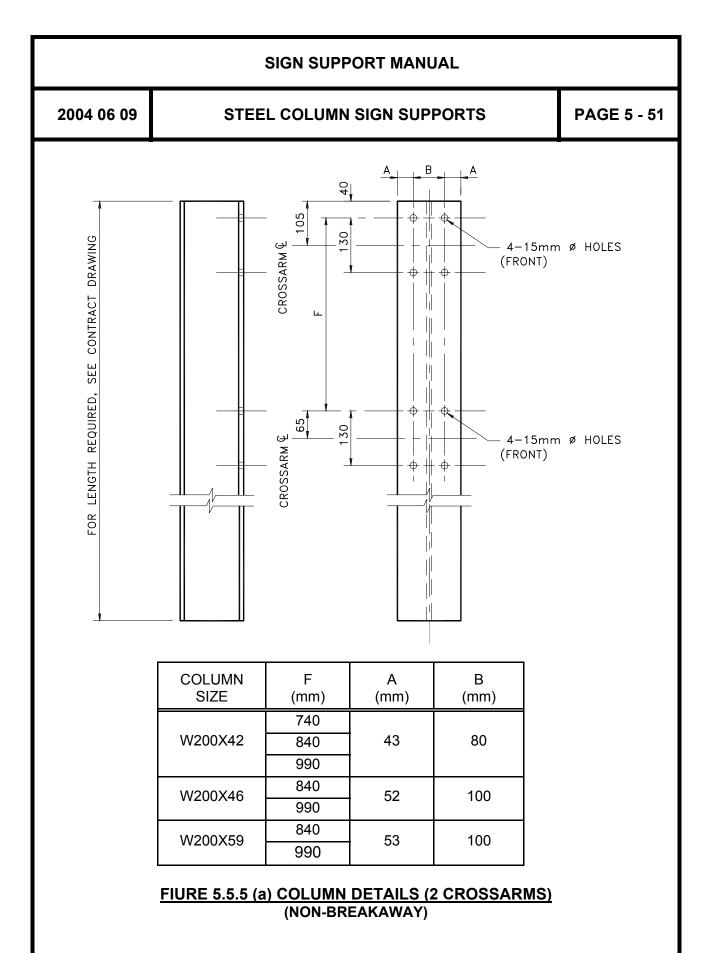


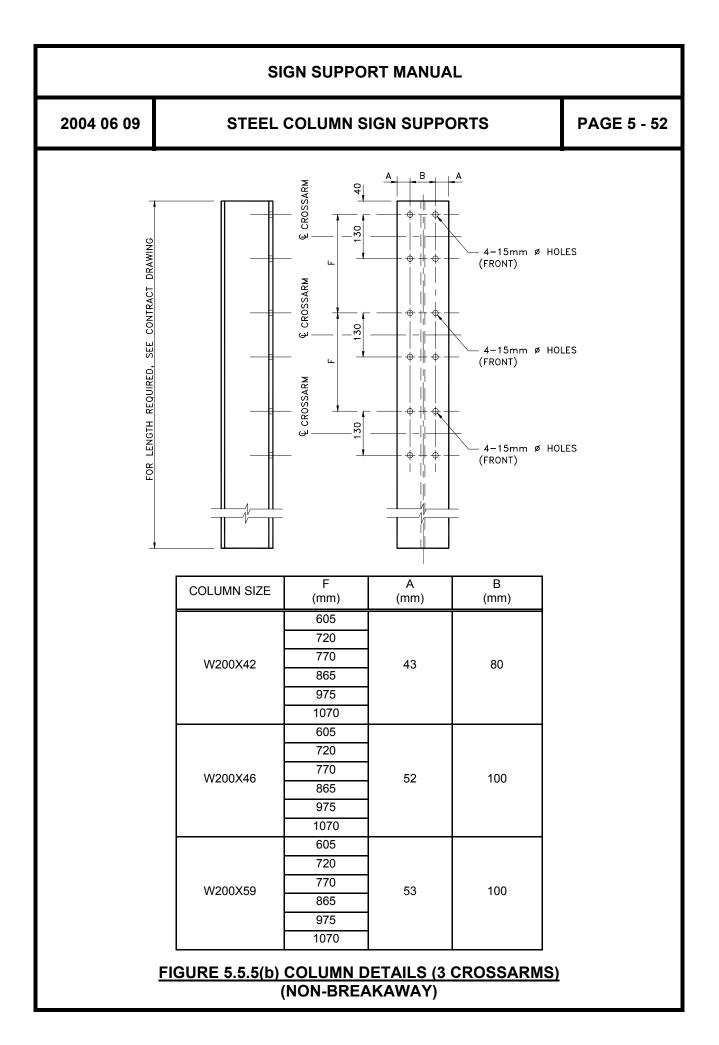
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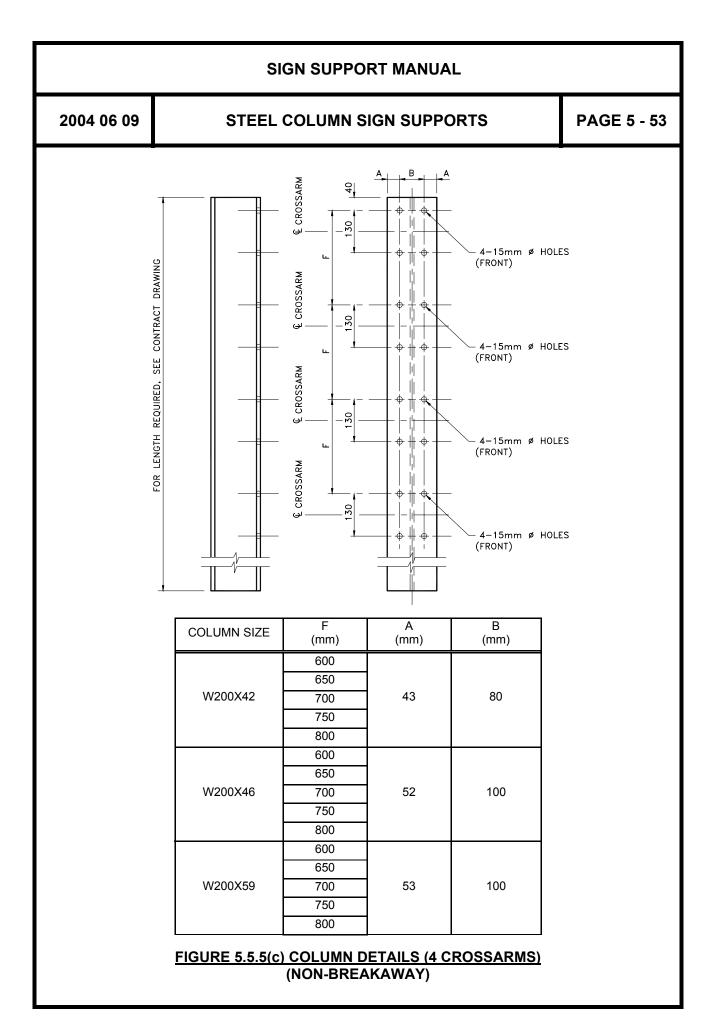
# STEEL COLUMN SIGN SUPPORTS

## 5.5.5 COLUMN (NON-BREAKAWAY TYPE)

Figures 5.5.5(a), (b) and (c) provide all information necessary to fabricate the columns for non-breakaway steel column sign supports.





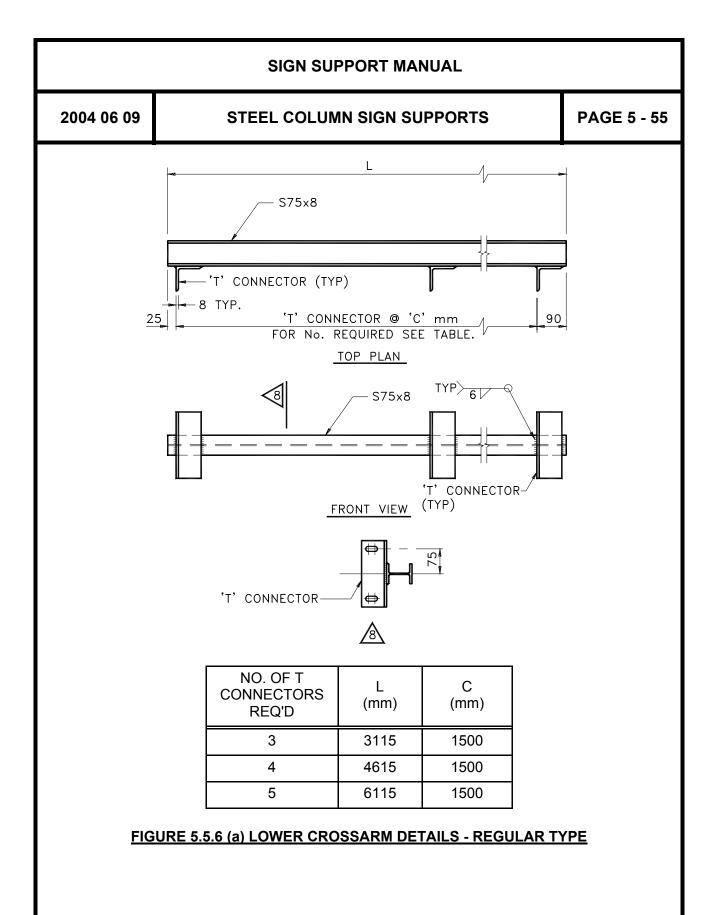


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# STEEL COLUMN SIGN SUPPORTS

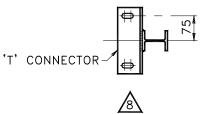
# 5.5.6 LOWER CROSSARM (BREAKAWAY TYPE)

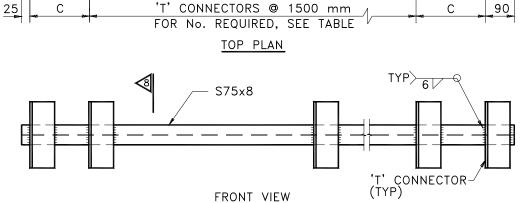
Figures 5.5.6(a) and 5.5.6(b) provide all information necessary for the fabrication of the "Lower Crossarms".

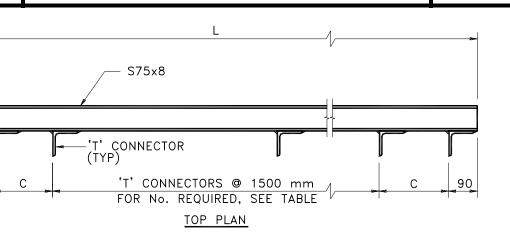


### FIGURE 5.5.6 (b) LOWER CROSSARM DETAILS - EXTENDED TYPE

NO. OF T CONNECTORS REQ'D	L (mm)	C (mm)
4	2915	650
5	3915	400
6	5315	350
7	6915	400
8	7715	800







## SIGN SUPPORT MANUAL

**STEEL COLUMN SIGN SUPPORTS** 

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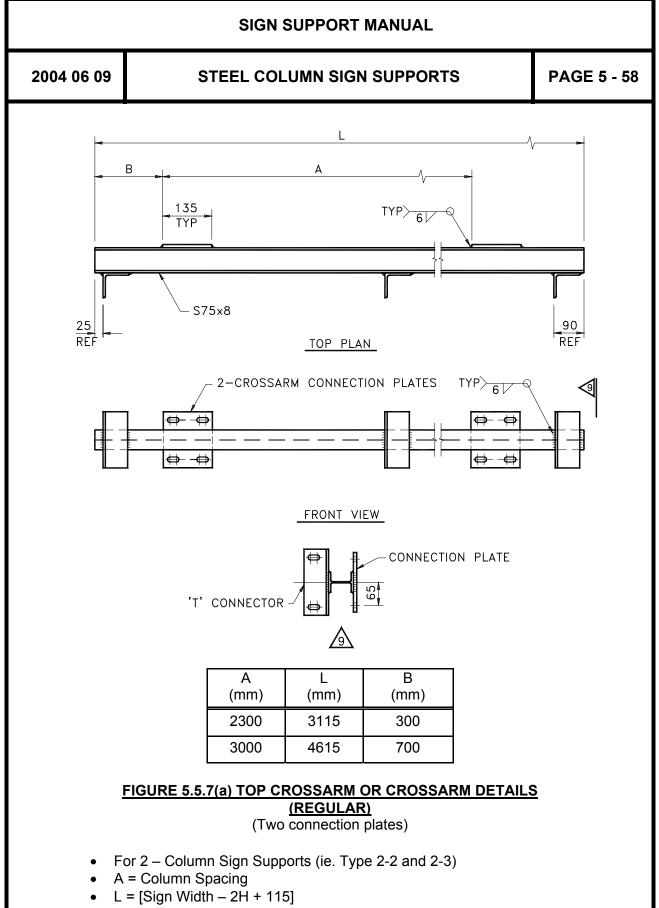
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## STEEL COLUMN SIGN SUPPORTS

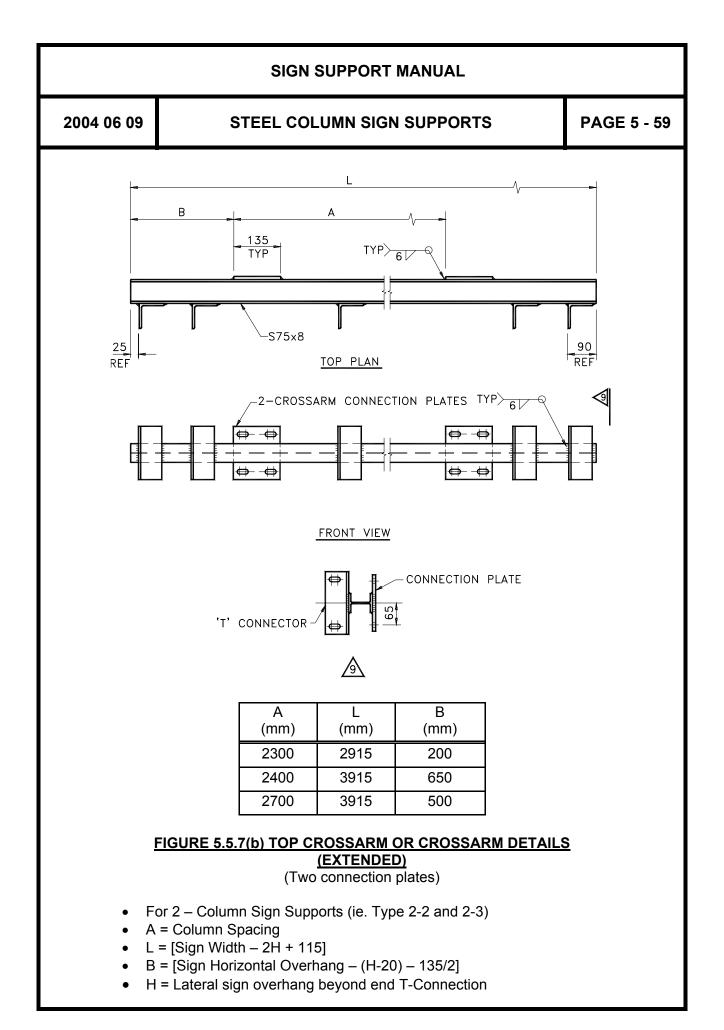
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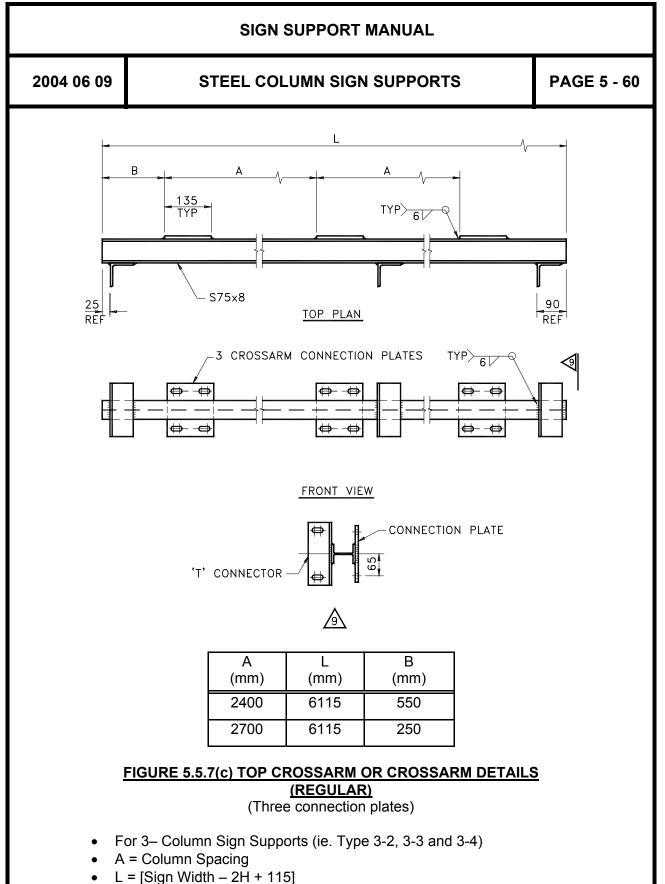
## 5.5.7 TOP CROSSARM OR CROSSARM

Figures 5.5.7(a) to 5.5.7(e) provide all information necessary for the fabrication of the "Top Crossarm" for breakaway type or "Crossarm" for non-breakaway type.

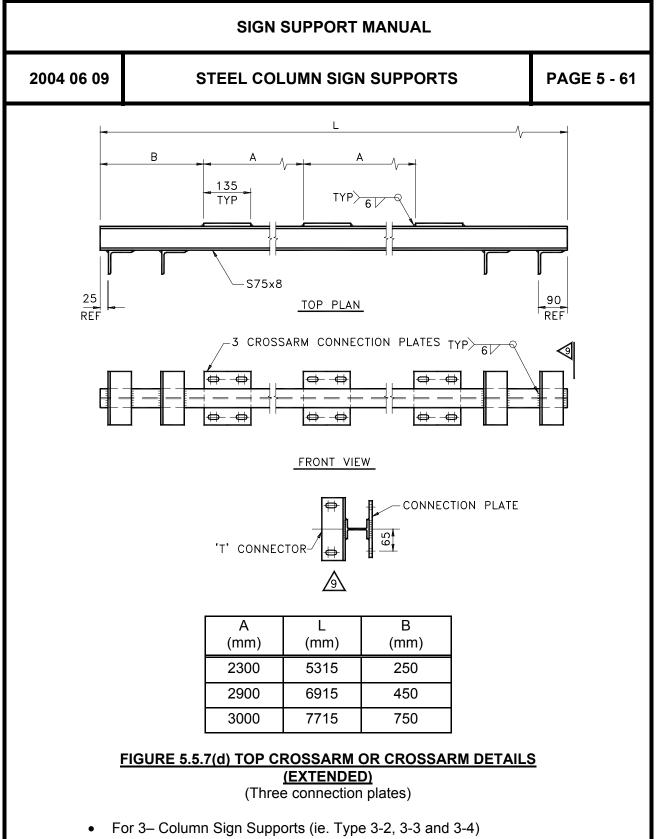


- B = [Sign Horizontal Overhang (H-20) 135/2]
- H = Lateral sign overhang beyond end T-Connection

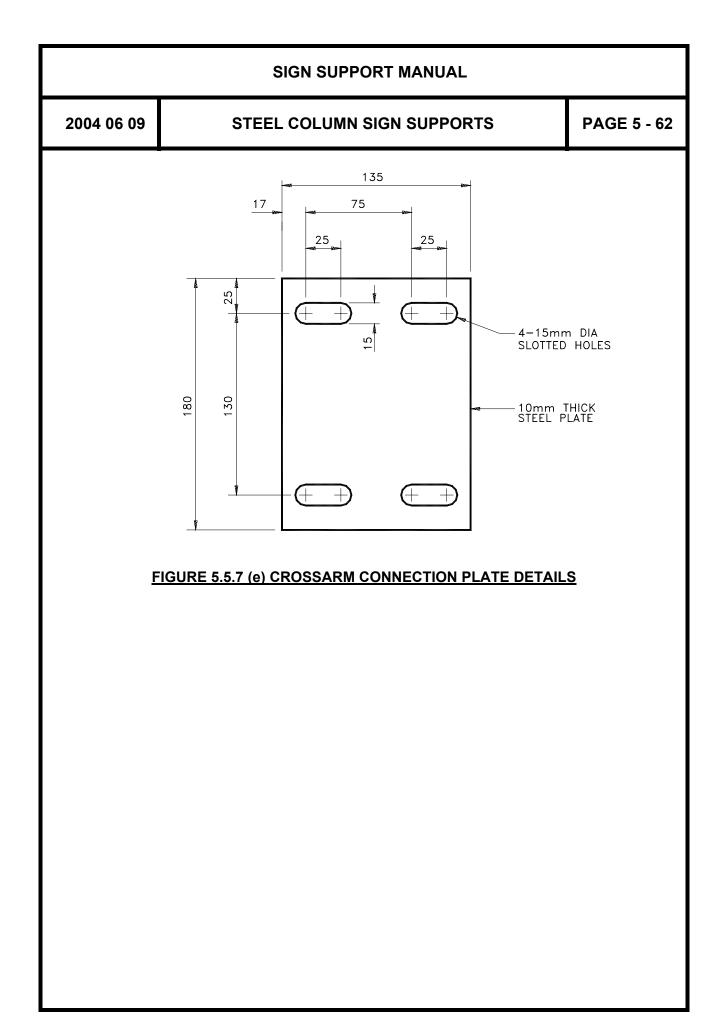




- B = [Sign Horizontal Overhang (H-20) 135/2]
- H = Lateral sign overhang beyond end T-Connection



- A = Column Spacing
- L = [Sign Width 2H + 115]
- B = [Sign Horizontal Overhang (H-20) 135/2]
- H = Lateral sign overhang beyond end T-Connection



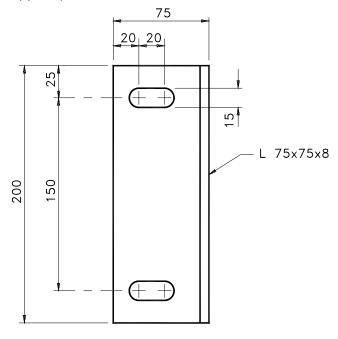
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# **STEEL COLUMN SIGN SUPPORTS**

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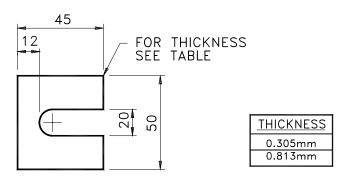
### 5.5.8 "T" CONNECTOR AND BRASS SHIM

Figure 5.5.8(a) provides all information necessary for fabrication of the "T" connectors used for the upper and lower crossarms (for Breakaway and Non-Breakaway sign supports).



#### FIGURE 5.5.8(a) T-CONNECTOR

Figure 5.5.8(b) details the "Brass Shims" used to shim the friction plates (for Breakaway sign supports).



MATERIAL BRASS SHIM STOCK

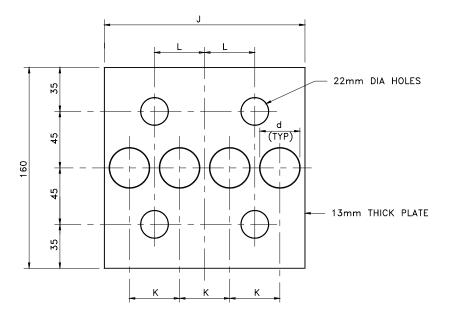
FIGURE 5.5.8(b) SHIM

# **STEEL COLUMN SIGN SUPPORTS**

## 5.5.9 FUSE PLATES (BREAKAWAY TYPE)

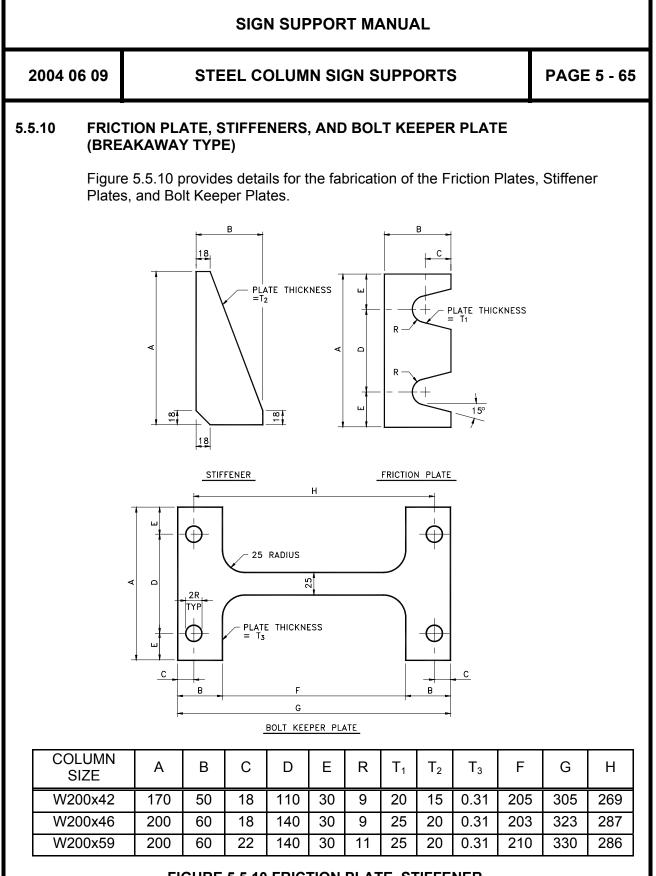
Figure 5.5.9 provides the information necessary to fabricate the Front and Back Fuse Plates.

Note: Front and back fuse plates are identical.

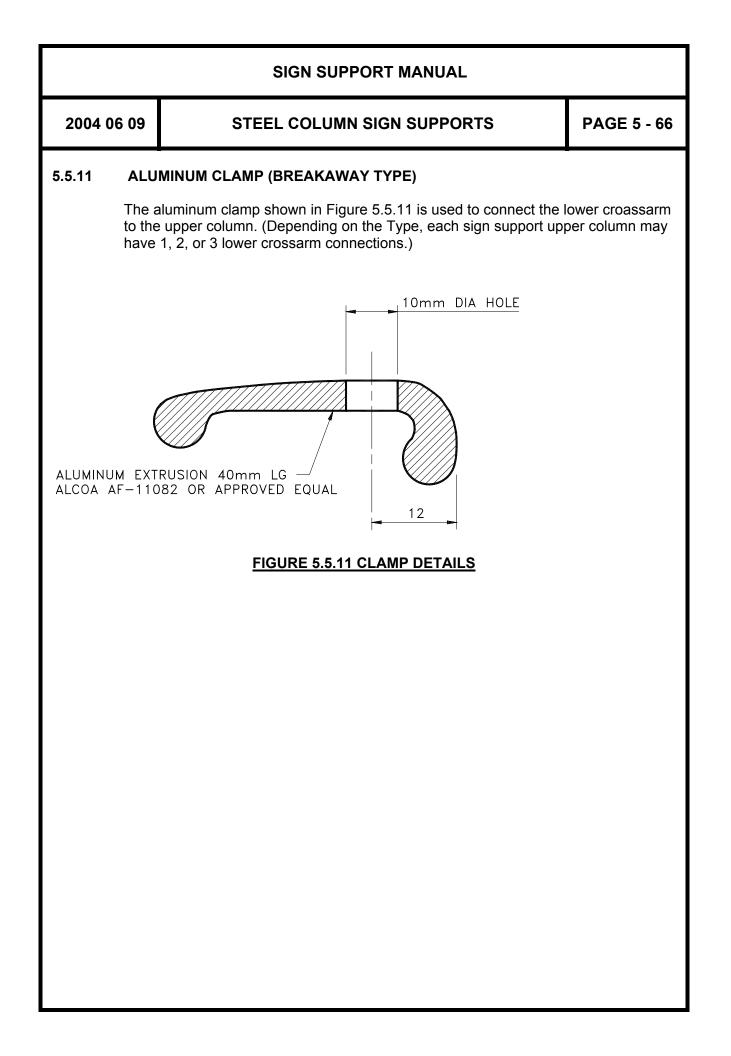


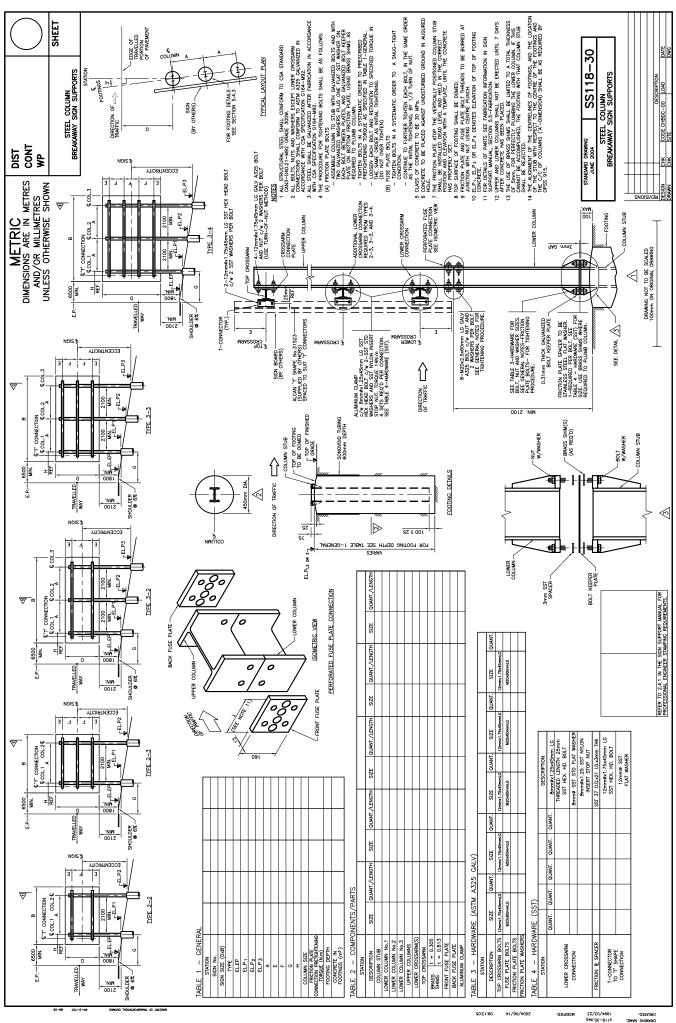
	J	K	L	d
W200x42	160	40	40	32
W200x46	200	50	50	40
W200x59	200	50	50	42

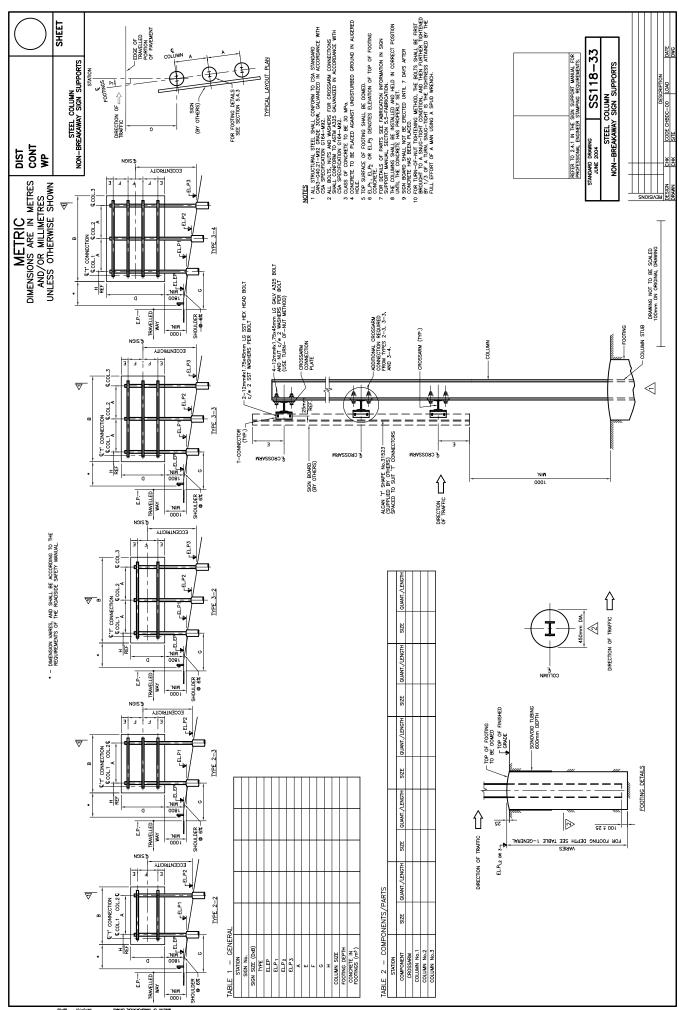
#### FIGURE 5.5.9 FRONT AND BACK FUSE PLATE DETAILS



#### FIGURE 5.5.10 FRICTION PLATE, STIFFENER, AND BOLT KEEPER PLATE DETAILS







**DIVISION 6 - TIMBER SIGN SUPPORTS** 

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TIMBER POST SIGN SUPPORTS

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#### 6 <u>TIMBER POST SIGN SUPPORTS</u>

#### 6.1 GENERAL

#### 6.1.1 STANDARD SIGN SUPPORTS

The design tables in this division cover sign sizes from 1200 mm x 2400 mm to 2700 mm x 6000 mm ( $2.88m^2$  to  $16.2m^2$ ). For small ground mounted signs, design information may be found in the Highway Design Office Bulletin 2006 – "Small Ground Mounted Signs and Support Systems". The design information in this bulletin covers sign sizes of 1220 mm x 2440 mm ( $2.98m^2$ ) and smaller.

The wood species specified in this manual are Douglas Fir and Jack Pine, which are the species suitable for preservative pressure treatment. Other species under the same species identification category as shown in Table 5.2.1.2 of CSA Standard 086 may be considered as an equivalent.

The design data is based on the requirements of the Canadian Highway Bridge Design Code (CAN/CSA-S6-00).

Timber posts not larger than 140 mm x 184 mm will meet the requirements of breakaway supports, if they have been provided with planes of weakness close to the ground line and near the lower edge of the sign, to facilitate failure by shearing and flexure respectively under impact loading. They are much less expensive than steel breakaway supports and should be seriously considered for the smaller sign sizes.

The design tables are intended to serve as a guide for the preparation of standard drawings SS118-34 (Timber Post Non-Breakaway Sign Supports) and SS118-35 (Timber Post Breakaway Sign Supports), which are shown on Figures 6.1.2(a) and 6.1.2(b). This division is intended for use in the preparation of contract drawings.

#### 6.1.2 DESCRIPTION OF SIGN SUPPORTS

The supports consist of two, three or four timber posts embedded in augered holes, to which signs are connected by steel connector plates (2 per post). Layout and details are given on Figure 6.1.2(a) and 6.1.2(b).

In each post two horizontal holes are drilled along the centreline of post parallel to the sign board. These holes, which are located 100 mm and 450 mm above finished grade, are intended to reduce the resistance of the posts to shear at the location where the impact of an errant vehicle is likely to occur, without substantially reducing the resistance of the posts to the high bending moments induced at this location by wind forces.

A horizontal sawcut is provided on the front face of each post just below the lower connector plate. This sawcut is intended to reduce the resistance of the post to bending at that location, thus permitting the portion of the post below the sawcut to rotate about the sawcut after impact.

## TIMBER POST SIGN SUPPORTS

If splices are required for the posts due to available timber length limitations, they shall be provided just below the lower edge of sign panel.

Nominal post sizes used are 6x6 (140x140) and 6x8 (140x184) inches. In these sizes, availability is very limited for lengths over 16 feet (4880 mm). Since the posts are embedded in the ground and the required clearance under the sign is 1800 mm from edge of pavement elevation, most posts will require a splice due to length availability limitations. The type of splice shown is designed for relatively small bending moments near the lower edge of the sign and is therefore much weaker than the post which is designed for much larger bending moments at ground level.

It is imperative that the splices be located directly (100 mm) below the lower edge of the sign as shown on Figure 6.5.4(a) because:

- (i) The splice is not strong enough to be used in a lower location.
- (ii) The low bending resistance of the splice might tend to initiate the breakaway action of the post after impact.
- (iii) The portion of the splice protruding below the sign must be minimized.

The connection of the posts to the signs is rigid in design and does not contribute to the breakaway function.

Due to the simplicity of timber support details and the ease with which members can be cut to required length, a parts-number system is not required.

#### 6.1.3 LIMITATIONS

The lower strength of timber makes it a suitable material for support structures for a limited range of sign sizes. Supports for sign sizes larger than those listed in Table 6.2.2 should be designed in steel.

#### 6.1.4 TYPES OF SUPPORTS

The two types of supports covered in this section are:

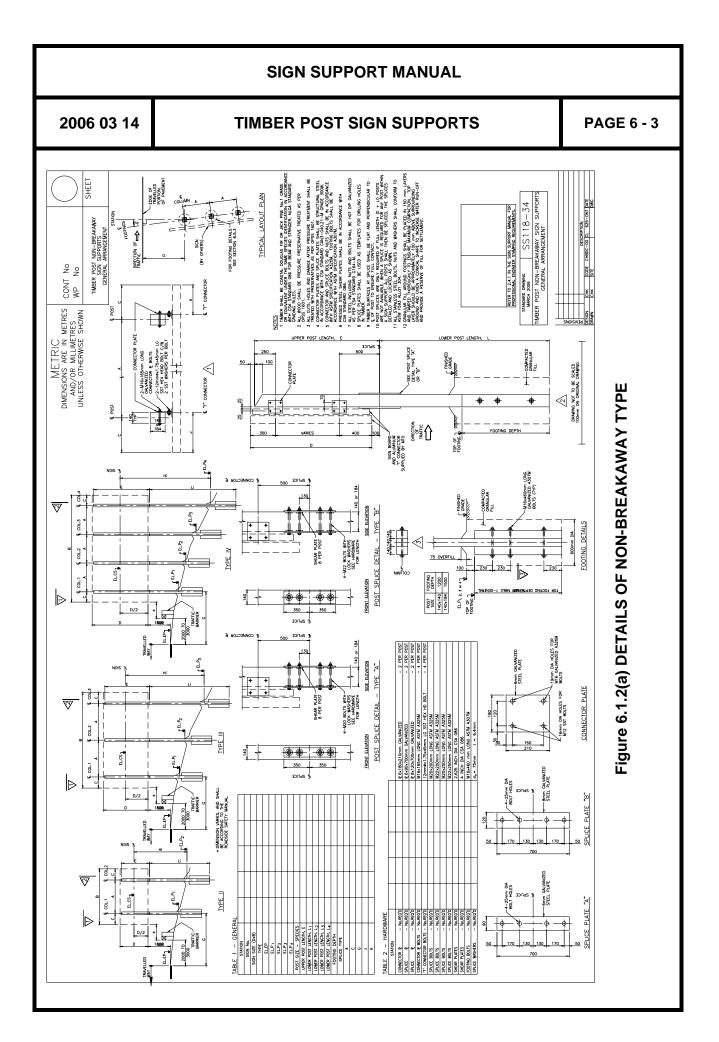
- (a) Timber Post Breakaway Sign Supports (not protected from traffic).
- (b) Timber Post Non-Breakaway Sign Supports (protected by traffic barrier).

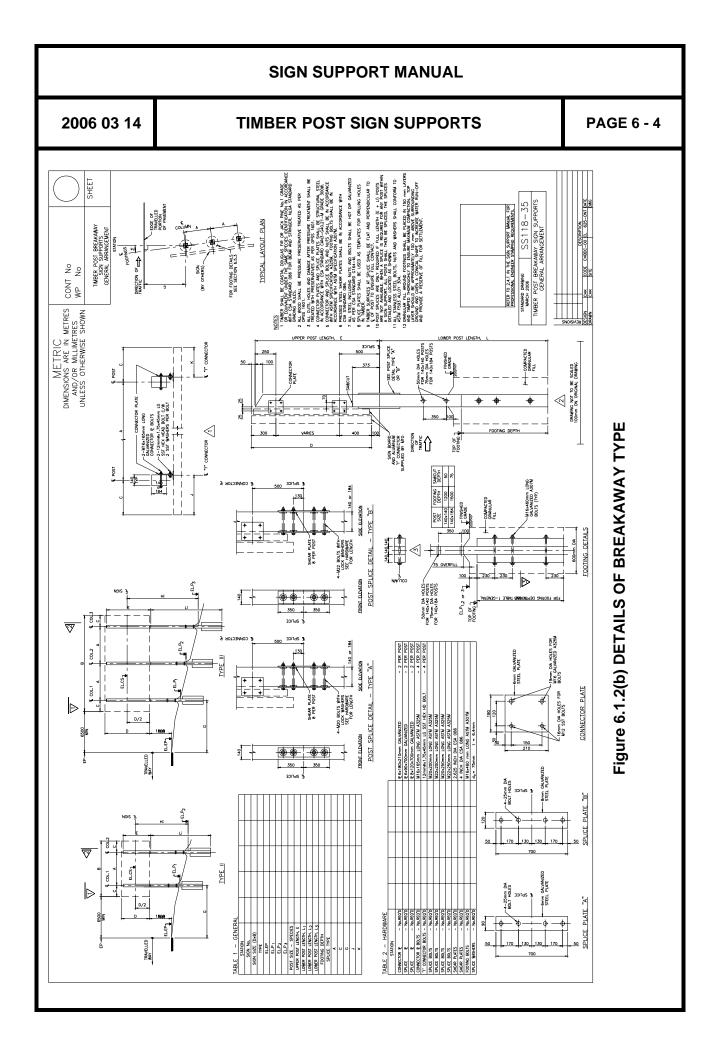
The supports are divided into types according to the number of posts as follows:

Type II - 2 posts Type III - 3 posts Type IV - 4 posts

The type of support is determined by the size of the sign to be supported and by the permissible post height  $H_{max}$  as described in Section 6.3.3.

Supports with single wooden posts (i.e. Type I) are not covered in this manual.





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#### TIMBER POST SIGN SUPPORTS

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#### 6.1.5 FOOTINGS

Posts are embedded in holes augered in earth. Lengths of timber are bolted to the sides of the embedded portion of the post to provide a greater contact area between timber and earth, to resist the overturning moments (caused by wind on the sign) through passive pressure against the adjacent earth.

The hole is then filled with tamped (compacted) Granular 'A' material and overfilled by approximately 75 mm to allow for settlement and to promote water runoff.

The indicated footing depths (given in Figure 6.5.3) are the absolute minimum for each post size based on a passive earth pressure of 68 kPa (1400 psf) at SLS. If the soil strength parameters for a particular site are not known, then a site specific soil investigation should be initiated. For soils not able to sustain the above noted pressure, a site specific footing design must be carried out.

Treated timber in these sizes is generally available in lengths of 12, 14 and 16 feet. If it happens that the calculated dimensions for lower post length necessitate cutting relatively short pieces from standard lengths of timber, it is preferable to increase the embedment depth to avoid cutting the treated timber; however care must be taken that the drilled holes in the lower posts will be installed at the proper elevation relative to ground level. Since the timber in the footing has been drilled (and possibly cut) after pressure treating, and will be buried at or near ground level, it is essential that the utmost care be taken to ensure that holes and sawcuts and any damaged areas be thoroughly treated as specified on Figures 6.1.2(a) and 6.1.2(b).

Footing hardware must be hot dip galvanized and the bolts or studs must be properly tightened to ensure an intimate connection between the faces of the footing timbers and the lower post.

#### 6.1.6 CLEARANCE

The supports should be located to result in the following minimum horizontal clearance from the edge of the travelled portion of pavement to the edge of the sign panel. For Breakaway sign supports, the required minimum horizontal clearance is 6500 mm. For Non-Breakaway sign supports, the required minimum horizontal clearance is as per the requirements of the Roadside Safety Manual. The minimum vertical distance shall be 1800 mm from the edge of pavement elevation to the bottom edge of the sign panel.

For breakaway sign supports, the minimum height of column from ground elevation to the underside of the sign shall be 2100 mm, and the minimum clear distance between columns should be 2100 mm.

For non-breakaway sign supports, if any portion of the sign is less than 1000 mm above the ground level immediately below the sign, the sign shall be raised to ensure this minimum 1000 mm clearance. This requirement is for summer and winter maintenance purposes.

Refer to Figures 6.4.1(d) and 6.4.1(e) for clarification of these clearance requirements.

#### 6.1.7 SUPPLY AND ERECTION

For timber column sign supports to be included as part of a contract, the relevant standard drawing(s) shall be completed by the designer and inserted into the contract documents.

All metal parts are standardized and timber parts are cut, drilled and touched-up to suit the individual support.

Timber post sign supports may be included in a contract provided standard drawing(s) SS118-34 and/or SS118-35 is completed and included in the contract documents.

Since the sign panels are necessary for the proper installation of the supports, contracts containing timber post sign supports should also include the erection of the sign panels and backing "T"s.

The sign panels are supplied fully assembled with backing "T"s by the MTO, but are attached to the sign support by the contractor.

The attachment of the signboard to the support shall be covered by a separate item in the contract documents.

#### 6.1.8 DESIGN CRITERIA

The Breakaway Timber Post Sign Supports given in this section, with post sizes 140x140 and 140x184, meet the requirements of NCHRP 350 crash testing. All timber posts are designed for wind load, according to the requirements of Section 3 of the CHBDC. Design tables have been prepared for Reference Wind Pressures (based on Return Periods of 10 years) of 465 Pa, 390 Pa, and 300 Pa, covering all possible wind pressures associated with the Ontario cities given in Appendix 3 of the code. Each design table (6.4.1(a) to 6.4.1(o)) gives the allowable Hmax for the two post cross-sections, using either Jack Pine or Douglas Fir, based on resisting moments calculated according to Section 9 of the CHBDC.

Post spacing (c/c) for Non-Breakaway Timber Post Sign Supports vary from 1200mm to 2400mm, with horizontal sign overhangs ranging from 300mm to 750mm.

Post spacing (c/c) for Breakaway Timber Post Sign Supports is a constant 2240mm (because of the clear horizontal spacing requirement of 2100mm), with horizontal sign overhangs ranging from 80mm to 1130mm.

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#### TIMBER POST SIGN SUPPORTS

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#### 6.2 DETAILING OF SUPPORTS

#### 6.2.1 GENERAL

Since the supply and erection of the support is always part of a contract, Standard Drawings SS118-34 and/or SS8118-35 shall be used.

#### 6.2.2 DATA REQUIRED

For each sign support, the following data is required:

1. <u>The sign size.</u>

This must be one of the combinations of sign depth (D), and sign width (B) shown in the design tables and in Table 6.2.2.

Sign depths shown in the tables are given in increments of 300 mm whereas actual sign depths are multiples of 304.8 mm (12 in). This difference may be disregarded when using the tables (i.e. a 2743 mm deep sign can be read as 2700 mm).

2. <u>The location of the support.</u>

For a new or proposed highway or a highway under reconstruction, the location should be specified as a station. For an existing highway, the location of the centreline of the sign may be determined at the site and marked with a peg.

3. <u>The edge of pavement elevation at the sign station and the finished grade</u> <u>elevations under the sign.</u>

For a proposed highway or highway reconstruction project, this information may, be obtained from profiles, cross sections or contour plans. In the case of an existing facility, elevations may be taken at the site. Since only approximate and relative elevations are required they can be obtained with a string level or hand level.

				SI	GN SI	UPPO	RT MA	ANUA	L				
2006 03	5 14		Т	IMBE	R PO	ST SI	GN SU	IPPOI	RTS			PAGE	E 6 - 8
					NON-	BREA	KAW	AY					
SIGN DEPTH, D		NON-BREAKAWAY SIGN WIDTH, B (mm)											
(mm)	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
1200													
1500													
1800		т	- Vno				Tun	~ III			Tvn		
2100		I	ype				Тур	em			тур	e IV	
2400													
2700													

					BR	EAK	WAY						
SIGN DEPTH, D					SI	GN W	IDTH,	<b>B</b> (m	m)				
(mm)	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
1200													
1500													
1800				Tur						т	when I		
2100				Тур	еп					1	ype l	11	
2400	]												
2700													

# TABLE 6.2.2 PERMISSIBLE SIGN SIZES AND SUPPORT STRUCTURE TYPES

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#### 6.2.3 FOOTING LOCATIONS AND ELEVATION

From Figure 6.1.2(a) and (b) and the appropriate Design Table for the support type, including spacing of posts and type of timber, information which is required for laying out the footings on a cross section, a contour plan, or on the ground can be readily extracted.

For orientation of the sign relative to the highway the present manual follows the recommendations of the 2001 edition of the Ontario Traffic Manual which states that ground-mounted signs should be angled horizontally slightly away from traffic, by about 3 degrees, so that glare is reduced. This layout, unfortunately, causes slightly reduced legibility. The benefits of reduced glare, however, seem to outweigh the negative result of slightly decreased night legibility. For this reason the angling of ground-mounted signs slightly away from traffic is adopted.

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## TIMBER POST SIGN SUPPORTS

#### 6.3 **PROCEDURES**

#### 6.3.1 FOOTING LAYOUT

- GIVEN: Example sign size (1500 x 3300 mm), Breakaway Type
- ASSUME: EL.EP = 10000 mm (DATUM)
- STEP 1: DETERMINE SUPPORT TYPE

From Table 6.2.2 for 1500 x 3300 mm Support is TYPE II

STEP II: DETERMINE DIMENSION C

For Type II, C = 530 mm (Table 6.4.1 (j))

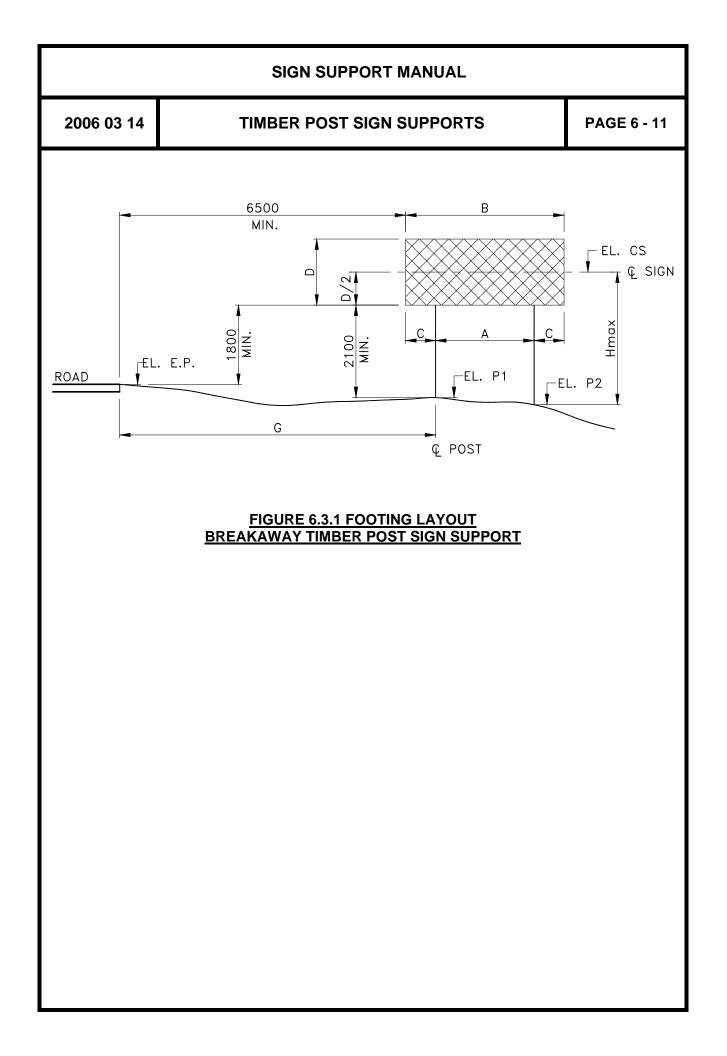
- NOTE: Dimension C is same whether Jack Pine or Douglas Fir is used, and whatever the wind pressure is. Spacing of posts (A) is available from the same tables as dimension (C) but is not required till support type has been established.
- STEP III: DETERMINE GROUND ELEV. AT LONGEST POST

Based on Type II support:

In the sign installation shown in Figure 6.3.1, the support is on a "FILL" slope and the longest post is the most remote from edge of pavement (EP).

DISTANCE FROM EP TO LONGEST POST = (6500 + SIGN WIDTH "B" - C):

i.e. 6500 + 3300 - 530 = 9270 mm from EP Ground Level (EL P2) = 9000 mm (SAY)



# TIMBER POST SIGN SUPPORTS

#### 6.3.2 DETERMINATION OF POST DESIGN HEIGHT (Hmax)

Determine elevation of centre line of sign (EL.CS).

EL.CS = EL.EP + 1800 + 0.5 x SIGN DEPTH

Post Design Height (Hmax) at longest post location "i" is:

H<sub>max</sub> = EL.CS -EL.Pi

but not less than 1800 + 0.5 D

For 1500 x 3300 Sign

Determine EL.CS:

EL.CS = 10000 + 1800 + 0.5 x 1500 = 12550 mm = 12.55 m

Determine Hmax:

Hmax = EL.CS - EL.P2 but not less than (1800 + 0.5 D) = 2550 mm Hmax = 12550 – 9000 = 3550 mm (greater than 2550 mm)

For Breakaway Sign Supports, if the minimum height of column from ground elevation to the underside of the sign is less than 2100 mm, then EL. CS and Hmax shall be increased to adjust that dimension to 2100 mm minimum.

For Non-Breakaway Sign Supports, if any portion of the sign is less than 1000 mm above the ground, then EL. CS and Hmax shall be increased to adjust that dimension to 1000 mm minimum.

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#### 6.3.3 SELECTION OF SUPPORT TYPE, POST SIZE AND SPLICE TYPE

For Breakaway supports, because of safety reasons, it is desirable to have the smallest post cross-section possible. Complete design tables have been provided for both Jack Pine and Douglas Fir in order that Regional Staff (or any designer) will have complete data from which to select the proper post size. Splice type is also given in the design table.

The following rules must be adhered to in selecting the support type and post size:

- RULE 1: The smaller of the two available post cross-sections shall be used when possible.
- RULE 2: The support type with the least number of posts shall be used provided that a decrease in the number of posts does not result in an increase in post cross-section.
- RULE 3: Where the smallest post cross-section can be of either species, Jack Pine shall be used.
- EXAMPLE 1 SIGN SIZE: 1500 x 3300 mm, Hmax = 3550 mm; Basic Wind Pressure = q = 300Pa

From the design tables the following post sizes are structurally adequate (Hmax refers to the maximum allowable value of design height which the post size will accommodate in the species and support type shown):

TABLE	TYPE	SPECIES	POST SIZE	H max	SPLICE
6.4.1(j)	П	J.P.	140 x 140	-	-
6.4.1(j)	II	J.P.	140 x 184	3840	А
6.4.1(j)	II	D.F.	140 x 140	3150	А
6.4.1(j)	II	D.F.	140 x 184	4130	А

- :. 140x184 Jack Pine and 140x184 Douglas Fir, for sign size as given, has sufficient resisting moment to permit an Hmax greater than 3550.
  - Select: Post Size 140x184 Type II Species – Jack Pine (Rule 3) Splice Type A

Note: For Hmax < 3550, the tabulated solution is inadequate.

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#### 6.3.4 SUPPORTS ON NON-LEVEL GROUND

Since the type of support is probably not known when elevations are established, the exact location of each post cannot be determined when the site is being examined.

It is recommended that a cross-section at the sign station be taken showing the EP as datum and the ground level under the full width(B) of the sign. If a Type III support is required where a Type II support was anticipated it will then be a simple matter to determine  $H_1$ ,  $H_2$  and  $H_3$ .

Regardless of the number of posts required, the post cross-section shall be designed for the largest H value for that support, consistent with reaction due to tributary area and continuity reaction.

For example:	If, H <sub>1</sub> = 2600, H <sub>2</sub> = 3200, H <sub>3</sub> = 3800
	Design all 3 post sizes for $H_3$ = 3800
	(see Section 6.4.2 for design philosophy)

It should be noted that on foreslopes, the ground line to centre line of sign dimension "Hmax" becomes very large for long signs and may rule out the use of timber breakaway supports.

	S	IGN SUPPORT MANUAL	
2006 03 14	ТІМВІ	ER POST SIGN SUPPORTS	PAGE 6 - 15
6.3.5 DETE	ERMINING POST S	PACING AND POST LENGTHS	
		and size of post is determined as described f A & C can be obtained from the appropriat	
E.g.	Example 1:	For Breakaway Sign 1500 x 3300 H <sub>1</sub> = 3550 mm q = 300 Pa Post size – 140 x 184 Type – II Species – Jack Pine	
	For 1500 x 33	esign table is 6.4.1(j) 800 sign: A = 2240, C = 530 n EP to 1st Post = 6500 + C = 7030 2nd Post = 6500 + C + A = 9270	
	EL.P1 and EL	P2 can be determined from cross-section.	
	highway, they purpose of ca however, A a	hough dimensions A & C are not actually y can be assumed to be so in determining alculating ground elevations. When laying and C must be measured at the proper any (a) & (b) (SS118-34 & SS118-35).	distances for the out the footings
	LOWER POS	T LENGTH (L):	
	L = [EL.CS - I	EL.P(1 or 2)] + [Footing Depth] - [0.5 x Sign Depth] - [100] + [?	100]
	UPPER POS <sup>-</sup> E = [Sign Dep	T LENGTH (E): oth + 50]	

#### 6.4 **DESIGN TABLES**

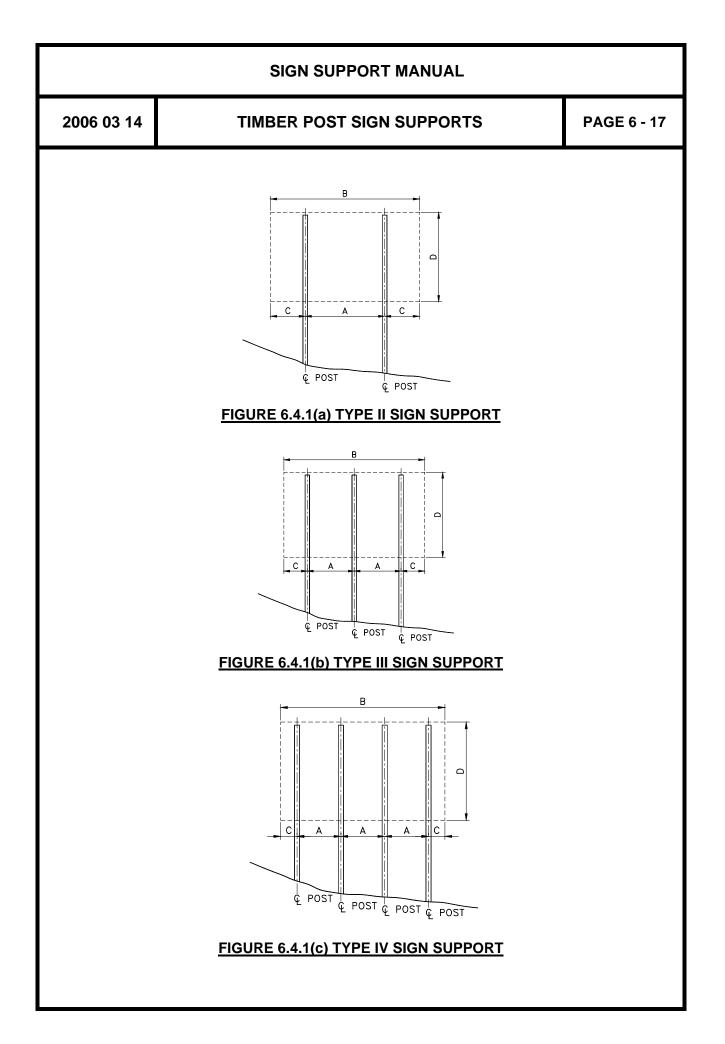
#### 6.4.1 GENERAL

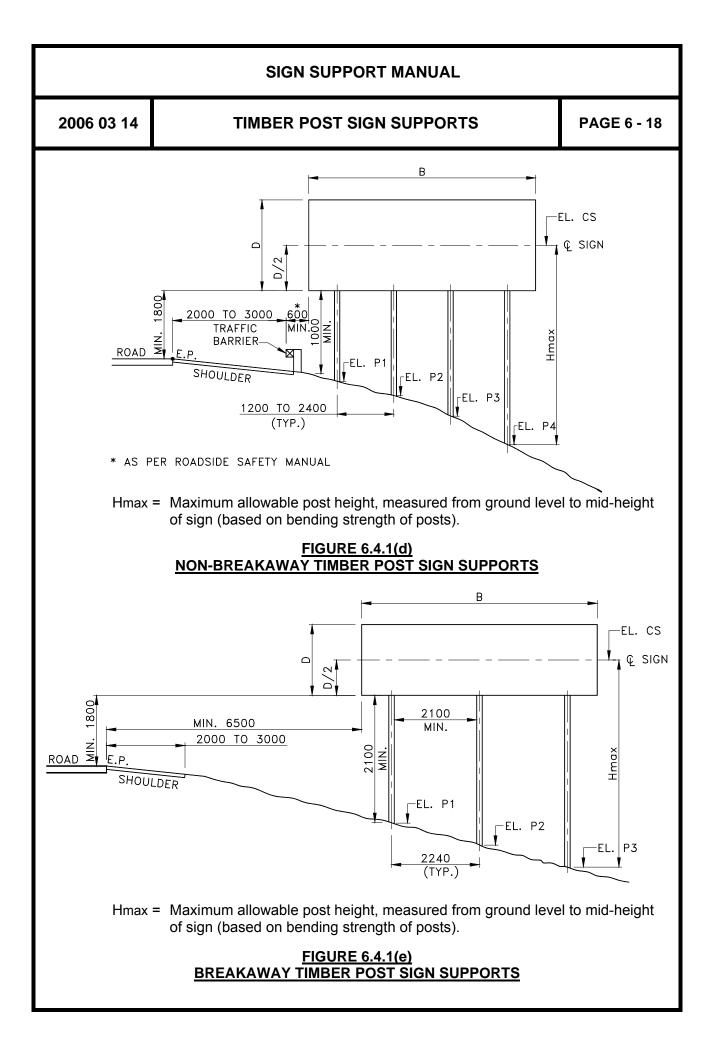
This section contains the following design tables:

				Jack	Pine	Douglas Fir		
Table	Structure	Type/ # of Posts	q (Pa)	Post	Size	Post	Size	
6.4.1 (a)	Non-Breakaway	II (2 posts)	300	140x140	140x184	140x140	140x184	
6.4.1 (b)	Non-Breakaway	II (2 posts)	390	140x140	140x184	140x140	140x184	
6.4.1 (c)	Non-Breakaway	II (2 posts)	465	140x140	140x184	140x140	140x184	
6.4.1 (d)	Non-Breakaway	III (3 posts)	300	140x140	140x184	140x140	140x184	
6.4.1 (e)	Non-Breakaway	III (3 posts)	390	140x140	140x184	140x140	140x184	
6.4.1 (f)	Non-Breakaway	III (3 posts)	465	140x140	140x184	140x140	140x184	
6.4.1 (g)	Non-Breakaway	IV (4 posts)	300	140x140	140x184	140x140	140x184	
6.4.1 (h)	Non-Breakaway	IV (4 posts)	390	140x140	140x184	140x140	140x184	
6.4.1 (i)	Non-Breakaway	IV (4 posts)	465	140x140	140x184	140x140	140x184	
6.4.1 (j)	Breakaway	II (2 posts)	300	140x140	140x184	140x140	140x184	
6.4.1 (k)	Breakaway	II (2 posts)	390	140x140	140x184	140x140	140x184	
6.4.1 (I)	Breakaway	II (2 posts)	465	140x140	140x184	140x140	140x184	
6.4.1 (m)	Breakaway	III (3 posts)	300	140x140	140x184	140x140	140x184	
6.4.1 (n)	Breakaway	III (3 posts)	390	140x140	140x184	140x140	140x184	
6.4.1 (o)	Breakaway	III (3 posts)	465	140x140	140x184	140x140	140x184	

In the design tables, a dash shown in the Hmax column indicates that the post size and species is not to be used for that sign size, because of inadequate flexural strength.

Figures 6.4.1 (a), (b) and (c) illustrate the various post arrangements.





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#### TIMBER POST SIGN SUPPORTS

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	WIND PRESSURE (q) = 300 Pa													
SIGN	Ρ				JACK	PINE			DOUGL	AS FIR				
SIZE	O S	Α	С		Hmax	: (mm)		Hmax (mm)						
DxB (mm x mm)	Т	(m)	(m)	POST S	IZE (mm)	) & SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE			
(111111 X 11111)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE			
1200x2400	2	1.2	0.6	3840	Α	3980	Α	4280	А	3980	Α			
1200x2700	2	1.5	0.6	3390	А	3980	А	4280	А	3980	А			
1200x3000	2	1.8	0.6	3030	А	3980	А	4280	А	3980	А			
1200x3300	2	2.1	0.6	2740	А	3980	А	3990	А	3980	А			
1200x3600	2	2.4	0.6	2490	А	3980	А	3640	А	3980	А			
1500x2400	2	1.2	0.6	3030	Α	4130	Α	4410	Α	4130	Α			
1500x2700	2	1.5	0.6	2670	А	4130	А	3890	А	4130	А			
1500x3000	2	1.8	0.6	2380	А	4130	А	3480	А	4130	А			
1500x3300	2	2.1	0.6	2150	А	3840	А	3150	А	4130	А			
1500x3600	2	2.4	0.6	1950	А	3500	А	2870	А	4130	А			
1800x2400	2	1.2	0.6	2490	Α	4280	Α	3640	Α	4280	Α			
1800x2700	2	1.5	0.6	2190	А	3920	А	3210	А	4280	А			
1800x3000	2	1.8	0.6	1950	А	3500	А	2870	А	4280	А			
1800x3300	2	2.1	0.6			3170	А	2590	А	4280	А			
1800x3600	2	2.4	0.6			2890	А	2360	А	4230	А			
2100x2400	2	1.2	0.6	2110	Α	3770	А	3090	А	4430	А			
2100x2700	2	1.5	0.6			3330	А	2720	А	4430	А			
2100x3000	2	1.8	0.6			2970	А	2430	А	4360	А			
2100x3300	2	2.1	0.6			2690	А	2190	В	3940	А			
2100x3600	2	2.4	0.6			2450	В			3600	А			
2400x2400	2	1.2	0.6			3270	А	2680	В	4580	А			
2400x2700	2	1.5	0.6			2890	В	2360	В	4230	А			
2400x3000	2	1.8	0.6			2580	В			3790	А			
2400x3300	2	2.1	0.6			2330	В			3430	В			
2400x3600	2	2.4	0.6							3120	В			
2700x2400	2	1.2	0.6			2890	В	2360	В	4230	Α			
2700x2700	2	1.5	0.6			2540	В			3740	В			
2700x3000	2	1.8	0.6							3350	В			
2700x3300	2	2.1	0.6							3020	В			
2700x3600	2	2.4	0.6							2750	В			

# TABLE 6.4.1(a) TYPE II

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#### TIMBER POST SIGN SUPPORTS

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				WIN	ID PRES	SURE (q) =	: 390 Pa				
SIGN	Ρ				JACK	PINE			DOUGL	AS FIR	
SIZE	O S	Α	С		Hmax	: (mm)	Hmax (mm)				
DxB	Т	(m)	(m)	POST S	IZE (mm)	) & SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x2400	2	1.2	0.6	2900	Α	3980	Α	4230	А	3980	Α
1200x2700	2	1.5	0.6	2560	А	3980	А	3740	А	3980	А
1200x3000	2	1.8	0.6	2280	А	3980	А	3340	А	3980	А
1200x3300	2	2.1	0.6	2060	А	3690	А	3020	А	3980	А
1200x3600	2	2.4	0.6	1870	А	3360	А	2750	А	3980	А
1500x2400	2	1.2	0.6	2280	Α	4070	Α	3340	А	4130	А
1500x2700	2	1.5	0.6	2010	А	3600	А	2950	А	4130	А
1500x3000	2	1.8	0.6	1790	А	3220	А	2630	А	4130	А
1500x3300	2	2.1	0.6			2910	А	2380	А	4130	А
1500x3600	2	2.4	0.6			2650	А	2160	А	3890	А
1800x2400	2	1.2	0.6			3360	A	2750	А	4280	А
1800x2700	2	1.5	0.6			2970	А	2420	А	4280	А
1800x3000	2	1.8	0.6			2650	А	2160	А	3890	А
1800x3300	2	2.1	0.6			2390	А	1950	В	3520	А
1800x3600	2	2.4	0.6			2170	В			3210	А
2100x2400	2	1.2	0.6			2850	А	2330	В	4180	А
2100x2700	2	1.5	0.6			2510	В			3700	А
2100x3000	2	1.8	0.6			2240	В			3310	А
2100x3300	2	2.1	0.6							2990	В
2100x3600	2	2.4	0.6							2720	В
2400x2400	2	1.2	0.6			2470	В			3640	А
2400x2700	2	1.5	0.6							3210	В
2400x3000	2	1.8	0.6							2870	В
2400x3300	2	2.1	0.6							2590	В
2400x3600	2	2.4	0.6							2360	В
2700x2400	2	1.2	0.6							3210	В
2700x2700	2	1.5	0.6							2830	В
2700x3000	2	1.8	0.6							2530	В
2700x3300	2	2.1	0.6								
2700x3600	2	2.4	0.6								

# TABLE 6.4.1(b) TYPE II

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#### TIMBER POST SIGN SUPPORTS

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	WIND PRESSURE (q) = 465 Pa													
SIGN	Ρ				JACK	PINE			DOUGL	AS FIR				
SIZE	O S	А	С		Hmax	(mm)		Hmax (mm)						
DxB (mm x mm)	Т	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE			
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE			
1200x2400	2	1.2	0.6	2400	Α	3980	Α	3510	Α	3980	А			
1200x2700	2	1.5	0.6	2110	А	3780	А	3100	А	3980	А			
1200x3000	2	1.8	0.6	1880	А	3380	А	2770	А	3980	А			
1200x3300	2	2.1	0.6	1690	А	3060	А	2500	А	3980	А			
1200x3600	2	2.4	0.6			2790	А	2280	А	3980	А			
1500x2400	2	1.2	0.6	1880	Α	3380	Α	2770	Α	4130	А			
1500x2700	2	1.5	0.6			2990	А	2440	А	4130	А			
1500x3000	2	1.8	0.6			2670	А	2180	А	3920	А			
1500x3300	2	2.1	0.6			2410	А	1960	А	3540	А			
1500x3600	2	2.4	0.6			2190	А	1780	А	3230	А			
1800x2400	2	1.2	0.6			2790	Α	2280	А	4090	А			
1800x2700	2	1.5	0.6			2450	А	2000	В	3610	А			
1800x3000	2	1.8	0.6			2190	А			3230	А			
1800x3300	2	2.1	0.6			1970	В			2920	А			
1800x3600	2	2.4	0.6							2660	В			
2100x2400	2	1.2	0.6			2360	В			3480	А			
2100x2700	2	1.5	0.6			2080	В			3070	В			
2100x3000	2	1.8	0.6							2740	В			
2100x3300	2	2.1	0.6							2470	В			
2100x3600	2	2.4	0.6							2250	В			
2400x2400	2	1.2	0.6							3020	В			
2400x2700	2	1.5	0.6							2660	В			
2400x3000	2	1.8	0.6							2370	В			
2400x3300	2	2.1	0.6											
2400x3600	2	2.4	0.6											
2700x2400	2	1.2	0.6							2660	В			
2700x2700	2	1.5	0.6											
2700x3000	2	1.8	0.6											
2700x3300	2	2.1	0.6											
2700x3600	2	2.4	0.6											

# TABLE 6.4.1(c) TYPE II

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#### TIMBER POST SIGN SUPPORTS

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				WIN	ID PRES	SURE (q) =	300 Pa				
SIGN	Ρ				JACK	PINE		DOUGLAS FIR			
SIZE	O S	Α	С	Hmax (mm)					Hmax	: (mm)	
DxB	T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x3900	3	1.5	0.45	2690	А	3980	А	3920	А	3980	А
1200x4200	3	1.5	0.6	2990	A	3980	А	4280	А	3980	Α
1200x4500	3	1.5	0.75	2850	Α	3980	А	4150	А	3980	Α
1200x4800	3	1.8	0.6	2300	Α	3980	А	3360	А	3980	Α
1500x3900	3	1.5	0.45	2110	А	3780	А	3100	А	4130	Α
1500x4200	3	1.5	0.6	2350	Α	4130	А	3440	А	4130	Α
1500x4500	3	1.5	0.75	2240	A	4000	А	3280	А	4130	А
1500x4800	3	1.8	0.6	1800	Α	3240	А	2650	А	4130	Α
1800x3900	3	1.5	0.45			3110	А	2550	А	4280	Α
1800x4200	3	1.5	0.6	1920	Α	3450	А	2830	А	4280	Α
1800x4500	3	1.5	0.75			3300	А	2700	А	4280	А
1800x4800	3	1.8	0.6			2660	А	2180	А	3910	А
2100x3900	3	1.5	0.45			2640	А	2150	В	3880	Α
2100x4200	3	1.5	0.6			2930	А	2400	А	4300	А
2100x4500	3	1.5	0.75			2800	А	2290	В	4100	Α
2100x4800	3	1.8	0.6			2260	В			3330	Α
2400x3900	3	1.5	0.45			2280	В			3370	В
2400x4200	3	1.5	0.6			2540	В			3740	Α
2400x4500	3	1.5	0.75			2420	В			3570	В
2400x4800	3	1.8	0.6							2890	В
2700x3900	3	1.5	0.45							2970	В
2700x4200	3	1.5	0.6							3300	В
2700x4500	3	1.5	0.75							3150	В
2700x4800	3	1.8	0.6							2540	В

## TABLE 6.4.1(d) TYPE III

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#### TIMBER POST SIGN SUPPORTS

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				WIN	ID PRES	SURE (q) =	390 Pa				
SIGN	Р				JACK	PINE		DOUGLAS FIR			
SIZE	O S	Α	С		Hmax	(mm)			Hmax	(mm)	
DxB	T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x3900	3	1.5	0.45	2020	Α	3620	А	2970	Α	3980	Α
1200x4200	3	1.5	0.6	2250	Α	3980	А	3300	Α	3980	А
1200x4500	3	1.5	0.75	2150	Α	3840	А	3150	Α	3980	Α
1200x4800	3	1.8	0.6	1720	Α	3110	А	2540	Α	3980	Α
1500x3900	3	1.5	0.45		Α	2860	А	2340	Α	4130	A
1500x4200	3	1.5	0.6	1760	Α	3170	А	2600	Α	4130	Α
1500x4500	3	1.5	0.75			3030	А	2480	Α	4130	Α
1500x4800	3	1.8	0.6			2440	А	1990	Α	3600	Α
1800x3900	3	1.5	0.45			2350	А	1910	В	3460	Α
1800x4200	3	1.5	0.6			2610	А	2130	Α	3840	Α
1800x4500	3	1.5	0.75			2490	А	2030	Α	3660	Α
1800x4800	3	1.8	0.6			2000	В			2960	Α
2100x3900	3	1.5	0.45							2940	В
2100x4200	3	1.5	0.6			2210	В			3260	Α
2100x4500	3	1.5	0.75			2110	В			3110	В
2100x4800	3	1.8	0.6							2510	В
2400x3900	3	1.5	0.45							2540	В
2400x4200	3	1.5	0.6							2830	В
2400x4500	3	1.5	0.75							2700	В
2400x4800	3	1.8	0.6								
2700x3900	3	1.5	0.45								
2700x4200	3	1.5	0.6							2490	В
2700x4500	3	1.5	0.75							2380	В
2700x4800	3	1.8	0.6								

## TABLE 6.4.1(e) TYPE III

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#### TIMBER POST SIGN SUPPORTS

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				WIN	ID PRES	SURE (q) =	465 Pa				
SIGN	Р				JACK	PINE			DOUGL	AS FIR	
SIZE	O S	Α	С		Hmax	(mm)		Hmax (mm)			
DxB	T	(m)	(m)	POST SIZE (mm) & SPLICE TYPE			POST S	IZE (mm)	) & SPLICE	TYPE	
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x3900	3	1.5	0.45	1660	А	3010	А	2460	Α	3980	A
1200x4200	3	1.5	0.6	1860	Α	3340	А	2730	Α	3980	Α
1200x4500	3	1.5	0.75	1770	Α	3180	А	2610	Α	3980	Α
1200x4800	3	1.8	0.6			2570	А	2100	Α	3780	А
1500x3900	3	1.5	0.45			2360	А	1930	Α	3480	Α
1500x4200	3	1.5	0.6			2630	А	2150	Α	3860	Α
1500x4500	3	1.5	0.75			2510	А	2040	Α	3690	Α
1500x4800	3	1.8	0.6			2020	А			2980	Α
1800x3900	3	1.5	0.45			1940	В			2870	Α
1800x4200	3	1.5	0.6			2160	В			3190	Α
1800x4500	3	1.5	0.75			2060	В			3040	Α
1800x4800	3	1.8	0.6							2450	В
2100x3900	3	1.5	0.45							2430	В
2100x4200	3	1.5	0.6							2700	В
2100x4500	3	1.5	0.75							2580	В
2100x4800	3	1.8	0.6							2070	В
2400x3900	3	1.5	0.45								
2400x4200	3	1.5	0.6							2340	В
2400x4500	3	1.5	0.75							2230	В
2400x4800	3	1.8	0.6								
2700x3900	3	1.5	0.45								
2700x4200	3	1.5	0.6								
2700x4500	3	1.5	0.75								
2700x4800	3	1.8	0.6								

#### TABLE 6.4.1(f) TYPE III

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#### TIMBER POST SIGN SUPPORTS

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				WIN	ID PRES	SURE (q) =	: 300 Pa				
SIGN	Р				JACK	PINE			DOUGL	AS FIR	
SIZE	O S	А	С		Hmax	(mm)		Hmax (mm)			
DxB	Т	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST SIZE (mm) & SPLICE TYPE			
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x5100	4	1.5	0.3	2810	А	3980	А	4090	А	3980	Α
1200x5400	4	1.5	0.45	2880	Α	3980	А	4200	А	3980	Α
1200x5700	4	1.5	0.6	3010	Α	3980	А	4280	А	3980	Α
1200x6000	4	1.5	0.75	2870	Α	3980	А	4180	А	3980	Α
1500x5100	4	1.5	0.3	2200	Α	3940	A	3230	А	4130	Α
1500x5400	4	1.5	0.45	2270	Α	4040	А	3320	А	4130	Α
1500x5700	4	1.5	0.6	2370	Α	4130	А	3460	А	4130	Α
1500x6000	4	1.5	0.75	2260	Α	4020	А	3300	А	4130	Α
1800x5100	4	1.5	0.3			3250	Α	2660	А	4280	Α
1800x5400	4	1.5	0.45			3340	А	2730	А	4280	Α
1800x5700	4	1.5	0.6	1940	Α	3480	А	2850	А	4280	А
1800x6000	4	1.5	0.75			3320	А	2720	А	4280	Α
2100x5100	4	1.5	0.3			2750	Α	2250	В	4040	Α
2100x5400	4	1.5	0.45			2830	А	2310	В	4150	Α
2100x5700	4	1.5	0.6			2950	А	2410	А	4330	А
2100x6000	4	1.5	0.75			2820	А	2300	В	4130	А
2400x5100	4	1.5	0.3			2390	В			3510	В
2400x5400	4	1.5	0.45			2450	В			3610	Α
2400x5700	4	1.5	0.6			2560	В			3760	Α
2400x6000	4	1.5	0.75			2440	В			3590	В
2700x5100	4	1.5	0.3							3100	В
2700x5400	4	1.5	0.45							3180	В
2700x5700	4	1.5	0.6							3320	В
2700x6000	4	1.5	0.75							3170	В

## TABLE 6.4.1(g) TYPE IV

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#### TIMBER POST SIGN SUPPORTS

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WIND PRESSURE (q) = 390 Pa											
SIGN	Ρ				JACK	PINE			DOUGL	AS FIR	
SIZE	O S	А	С		Hmax	(mm)			Hmax	: (mm)	
DxB	Т	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x5100	4	1.5	0.3	2110	А	3780	А	3100	А	3980	А
1200x5400	4	1.5	0.45	2170	Α	3880	А	3180	А	3980	Α
1200x5700	4	1.5	0.6	2270	Α	3980	А	3320	А	3980	А
1200x6000	4	1.5	0.75	2160	Α	3860	А	3170	А	3980	Α
1500x5100	4	1.5	0.3			2980	А	2440	А	4130	А
1500x5400	4	1.5	0.45			3060	А	2510	А	4130	А
1500x5700	4	1.5	0.6	1770	Α	3200	А	2610	А	4130	Α
1500x6000	4	1.5	0.75			3050	А	2490	Α	4130	А
1800x5100	4	1.5	0.3			2450	А	2000	В	3610	А
1800x5400	4	1.5	0.45			2520	А	2050	А	3700	Α
1800x5700	4	1.5	0.6			2630	А	2150	А	3860	А
1800x6000	4	1.5	0.75			2510	А	2050	А	3690	А
2100x5100	4	1.5	0.3			2070	В			3060	В
2100x5400	4	1.5	0.45			2130	В			3150	В
2100x5700	4	1.5	0.6			2230	В			3280	А
2100x6000	4	1.5	0.75			2120	В			3130	В
2400x5100	4	1.5	0.3							2660	В
2400x5400	4	1.5	0.45							2730	В
2400x5700	4	1.5	0.6							2850	В
2400x6000	4	1.5	0.75							2720	В
2700x5100	4	1.5	0.3								
2700x5400	4	1.5	0.45							2400	В
2700x5700	4	1.5	0.6							2510	В
2700x6000	4	1.5	0.75							2390	В

#### TABLE 6.4.1(h) TYPE IV

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#### TIMBER POST SIGN SUPPORTS

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WIND PRESSURE (q) = 465 Pa												
SIGN	Р				JACK	PINE			DOUGL	AS FIR		
SIZE	O S	А	С		Hmax	(mm)			Hmax (mm)			
DxB	T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE	
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE	
1200x5100	4	1.5	0.3	1740	А	3140	А	2570	А	3980	А	
1200x5400	4	1.5	0.45	1790	А	3220	А	2640	Α	3980	Α	
1200x5700	4	1.5	0.6	1870	А	3360	А	2750	Α	3980	Α	
1200x6000	4	1.5	0.75	1780	А	3210	А	2620	Α	3980	Α	
1500x5100	4	1.5	0.3			2470	Α	2010	Α	3630	Α	
1500x5400	4	1.5	0.45			2540	А	2070	Α	3730	Α	
1500x5700	4	1.5	0.6			2650	А	2160	Α	3890	Α	
1500x6000	4	1.5	0.75			2530	А	2060	Α	3710	Α	
1800x5100	4	1.5	0.3			2020	В			2990	Α	
1800x5400	4	1.5	0.45			2080	В			3080	Α	
1800x5700	4	1.5	0.6			2170	В			3210	Α	
1800x6000	4	1.5	0.75			2070	В			3060	Α	
2100x5100	4	1.5	0.3							2540	В	
2100x5400	4	1.5	0.45							2610	В	
2100x5700	4	1.5	0.6							2720	В	
2100x6000	4	1.5	0.75							2600	В	
2400x5100	4	1.5	0.3									
2400x5400	4	1.5	0.45							2260	В	
2400x5700	4	1.5	0.6							2360	В	
2400x6000	4	1.5	0.75							2250	В	
2700x5100	4	1.5	0.3									
2700x5400	4	1.5	0.45									
2700x5700	4	1.5	0.6									
2700x6000	4	1.5	0.75									

# TABLE 6.4.1(i) TYPE IV

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#### TIMBER POST SIGN SUPPORTS

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	Р				JACK	PINF			DOUGL	4S FIR	
SIGN SIZE	0	^	С		Hmax				Hmax		
DxB	S	A (m)	(m)			& SPLICE	TVDE			& SPLICE	
(mm x mm)	T S	(,	(,		· · ·				, ,		
1000 0400		0.04	0.00	140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x2400	2 2	2.24 2.24	0.08	3840 3390	A	3980 3980	A A	4280 4280	A	3980 3980	A
1200x2700	2	2.24	0.23 0.38	3030 3030	A		A	4280 4280	A A	3980 3980	A A
1200x3000 1200x3300		2.24	0.58	2740	A	3980 3980		4280 3990		3980 3980	
	2	2.24	0.53	2740	A		A A		A A	3980 3980	A
1200x3600	2					3980		3640			A
1200x3900	2	2.24	0.83			3980	A	3340	A	3980	A
1200x4200	2	2.24	0.98			3770	A	3090	A	3980	A
1200x4500	2	2.24	1.13			3500	A	2870	A	3980	A
1500x2400	2	2.24	0.08	3030	A	4130	A	4410	A	4130	A
1500x2700	2	2.24	0.23			4130	A	3890	A	4130	A
1500x3000	2	2.24	0.38			4130	A	3480	A	4130	A
1500x3300	2	2.24	0.53			3840	A	3150	A	4130	A
1500x3600	2	2.24	0.68			3500	A	2870	А	4130	Α
1500x3900	2	2.24	0.83			3220	А			4130	Α
1500x4200	2	2.24	0.98			2970	А			4130	А
1500x4500	2	2.24	1.13							4050	Α
1800x2400	2	2.24	0.08			4280	А	3640	А	4280	А
1800x2700	2	2.24	0.23			3920	А	3210	А	4280	A
1800x3000	2	2.24	0.38			3500	А			4280	A
1800x3300	2	2.24	0.53			3170	А			4280	А
1800x3600	2	2.24	0.68							4230	А
1800x3900	2	2.24	0.83							3890	А
1800x4200	2	2.24	0.98							3600	А
1800x4500	2	2.24	1.13							3350	А
2100x2400	2	2.24	0.08			3770	А			4430	Α
2100x2700	2	2.24	0.23			3330	А			4430	А
2100x3000	2	2.24	0.38							4360	А
2100x3300	2	2.24	0.53							3940	А
2100x3600	2	2.24	0.68							3600	А
2100x3900	2	2.24	0.83							3310	А
2100x4200	2	2.24	0.98								
2100x4500	2	2.24	1.13								
2400x2400	2	2.24	0.08							4580	А
2400x2700	2	2.24	0.23							4230	A
2400x3000	2	2.24	0.38							3790	A
2400x3300	2	2.24	0.53							3430	В
2400x3600	2	2.24	0.68								
2400x3900	2	2.24	0.83								
2400x4200	2	2.24	0.98								
2400x4200	2	2.24	1.13								
2700x2400	2	2.24	0.08							4230	A
2700x2400 2700x2700	2	2.24	0.00							3740	В
2700x2700 2700x3000	2	2.24	0.23								
2700x3000 2700x3300	2	2.24	0.58								
2700x3300 2700x3600	2	2.24	0.53								
2700x3900 2700x4200	2 2	2.24 2.24	0.83								
			0.98								
2700x4500	2	2.24	1.13								

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# TIMBER POST SIGN SUPPORTS

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	Р				JACK	PINE			DOUGL	AS FIR	
SIGN SIZE	0	^	с		Hmax				Hmax		
DxB	S	A (m)	(m)			& SPLICE	TVDE			) & SPLICE	TVDE
(mm x mm)	T S	( )	( )	140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x2400	2	2.24	0.08	2900	A	3980	A	4230	A	3980	A
1200x2400 1200x2700	2	2.24	0.08	2900		3980	A	4230 3740	A	3980	A
1200x3000	2	2.24	0.38			3980	A	3340	A	3980	A
1200x3300	2	2.24	0.53			3690	A	3020	A	3980	A
1200x3600	2	2.24	0.68			3360	A	2750	A	3980	A
1200x3900	2	2.24	0.83			3090	A	2750		3980	A
1200x4200	2	2.24	0.98			2850	A			3980	A
1200x4200	2	2.24	1.13							3890	A
1500x2400	2	2.24	0.08			4070	A	3340	A	4130	A
1500x2400 1500x2700	2	2.24	0.08			3600	A	2950	A	4130	A
1500x2700 1500x3000	2	2.24	0.23			3220	A	2000		4130	A
1500x3000	2	2.24	0.58			2910	A			4130	A
1500x3500 1500x3600	2	2.24	0.55			2010	~			3890	A
1500x3000	2	2.24	0.08							3580	A
1500x3900 1500x4200	2	2.24	0.83							3310	A
1500x4200 1500x4500	2	2.24	1.13							3310	
1500x4500 1800x2400	2	2.24	0.08			3360	 A			4280	A A
	2	2.24									
1800x2700			0.23							4280	A
1800x3000	2	2.24	0.38							3890	A
1800x3300	2	2.24	0.53							3520	A
1800x3600	2	2.24	0.68							3210	A
1800x3900	2	2.24	0.83								
1800x4200	2	2.24	0.98								
1800x4500	2	2.24	1.13								
2100x2400	2	2.24	0.08							4180	A
2100x2700	2	2.24	0.23							3700	A
2100x3000	2	2.24	0.38							3310	A
2100x3300	2	2.24	0.53								
2100x3600	2	2.24	0.68								
2100x3900	2	2.24	0.83								
2100x4200	2	2.24	0.98								
2100x4500	2	2.24	1.13								
2400x2400	2	2.24	0.08							3640	A
2400x2700	2	2.24	0.23								
2400x3000	2	2.24	0.38								
2400x3300	2	2.24	0.53								
2400x3600	2	2.24	0.68								
2400x3900	2	2.24	0.83								
2400x4200	2	2.24	0.98								
2400x4500	2	2.24	1.13								
2700x2400	2	2.24	0.08								
2700x2700	2	2.24	0.23								
2700x3000	2	2.24	0.38								
2700x3300	2	2.24	0.53								
2700x3600	2	2.24	0.68								
2700x3900	2	2.24	0.83								
2700x4200	2	2.24	0.98								
2700x4500	2	2.24	1.13								

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# TIMBER POST SIGN SUPPORTS

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					JACK	DINE			DOLLCI	AS FIR	
SIGN	P O		_								
SIZE	S	A (m)	C (m)		Hmax	· · ·			Hmax		
DxB (mm x mm)	Т	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST SI	ZE (mm)	& SPLICE	TYPE
	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x2400	2	2.24	0.08			3980	А	3510	А	3980	А
1200x2700	2	2.24	0.23			3780	А	3100	А	3980	Α
1200x3000	2	2.24	0.38			3380	А	2770	А	3980	А
1200x3300	2	2.24	0.53			3060	А			3980	А
1200x3600	2	2.24	0.68			2790	А			3980	А
1200x3900	2	2.24	0.83							3760	А
1200x4200	2	2.24	0.98							3480	А
1200x4500	2	2.24	1.13							3230	Α
1500x2400	2	2.24	0.08			3380	А			4130	А
1500x2700	2	2.24	0.23			2990	А			4130	А
1500x3000	2	2.24	0.38							3920	А
1500x3300	2	2.24	0.53							3540	А
1500x3600	2	2.24	0.68							3230	А
1500x3900	2	2.24	0.83							2970	А
1500x4200	2	2.24	0.98								
1500x4500	2	2.24	1.13								
1800x2400	2	2.24	0.08							4090	А
1800x2700	2	2.24	0.23							3610	А
1800x3000	2	2.24	0.38							3230	А
1800x3300	2	2.24	0.53								
1800x3600	2	2.24	0.68								
1800x3900	2	2.24	0.83								
1800x4200	2	2.24	0.98								
1800x4500	2	2.24	1.13								
2100x2400	2	2.24	0.08							3480	А
2100x2700	2	2.24	0.23								
2100x3000	2	2.24	0.38								
2100x3300	2	2.24	0.53								
2100x3600	2	2.24	0.68								
2100x3900	2	2.24	0.83								
2100x4200	2	2.24	0.98								
2100x4500	2	2.24	1.13								
2400x2400	2	2.24	0.08								
2400x2700	2	2.24	0.23								
2400x3000	2	2.24	0.38								
2400x3300	2	2.24	0.53								
2400x3600	2	2.24	0.68								
2400x3900	2	2.24	0.83								
2400x4200	2	2.24	0.98								
2400x4500	2	2.24	1.13								
2700x2400	2	2.24	0.08								
2700x2700	2	2.24	0.23								
2700x3000	2	2.24	0.38								
2700x3300	2	2.24	0.53								
2700x3600	2	2.24	0.68								
2700x3900	2	2.24	0.83								
2700x4200	2	2.24	0.98								
2700x4500	2	2.24	1.13								

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## TIMBER POST SIGN SUPPORTS

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WIND PRESSURE (q) = 300 Pa											
	_	1					- 500 T a				
SIGN	Р				JACK	PINE			DOUGL	AS FIR	
SIZE	O S	Α	С		Hmax	(mm)			Hmax	: (mm)	
DxB	T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	& SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x4800	3	2.24	0.16			2790	А			3980	Α
1200x5100	3	2.24	0.31			2840	А			3980	А
1200x5400	3	2.24	0.46			2940	А			3980	А
1200x5700	3	2.24	0.61			3050	А			3980	А
1200x6000	3	2.24	0.76			3240	А			3980	А
1500x4800	3	2.24	0.16							3240	Α
1500x5100	3	2.24	0.31							3290	А
1500x5400	3	2.24	0.46							3400	А
1500x5700	3	2.24	0.61							3530	А
1500x6000	3	2.24	0.76							3750	А
1800x4800	3	2.24	0.16								
1800x5100	3	2.24	0.31								
1800x5400	3	2.24	0.46								
1800x5700	3	2.24	0.61								
1800x6000	3	2.24	0.76							3090	А
2100x4800	3	2.24	0.16								
2100x5100	3	2.24	0.31								
2100x5400	3	2.24	0.46								
2100x5700	3	2.24	0.61								
2100x6000	3	2.24	0.76								
2400x4800	3	2.24	0.16								
2400x5100	3	2.24	0.31								
2400x5400	3	2.24	0.46								
2400x5700	3	2.24	0.61								
2400x6000	3	2.24	0.76								
2700x4800	3	2.24	0.16								
2700x5100	3	2.24	0.31								
2700x5400	3	2.24	0.46								
2700x5700	3	2.24	0.61								
2700x6000	3	2.24	0.76								

## TABLE 6.4.1(m) TYPE III

**BREAKAWAY** 

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## TIMBER POST SIGN SUPPORTS

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WIND PRESSURE (q) = 390 Pa											
SIGN	Р				JACK	PINE			DOUGL	AS FIR	
SIZE	0	А	С		Hmax	(mm)			Hmax	(mm)	
DxB	S T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x4800	3	2.24	0.16							3110	А
1200x5100	3	2.24	0.31							3150	А
1200x5400	3	2.24	0.46							3260	А
1200x5700	3	2.24	0.61							3390	Α
1200x6000	3	2.24	0.76							3600	А
1500x4800	3	2.24	0.16								
1500x5100	3	2.24	0.31								
1500x5400	3	2.24	0.46								
1500x5700	3	2.24	0.61								
1500x6000	3	2.24	0.76								
1800x4800	3	2.24	0.16								
1800x5100	3	2.24	0.31								
1800x5400	3	2.24	0.46								
1800x5700	3	2.24	0.61								
1800x6000	3	2.24	0.76								
2100x4800	3	2.24	0.16								
2100x5100	3	2.24	0.31								
2100x5400	3	2.24	0.46								
2100x5700	3	2.24	0.61								
2100x6000	3	2.24	0.76								
2400x4800	3	2.24	0.16								
2400x5100	3	2.24	0.31								
2400x5400	3	2.24	0.46								
2400x5700	3	2.24	0.61								
2400x6000	3	2.24	0.76								
2700x4800	3	2.24	0.16								
2700x5100	3	2.24	0.31								
2700x5400	3	2.24	0.46								
2700x5700	3	2.24	0.61								
2700x6000	3	2.24	0.76								

## TABLE 6.4.1(n) TYPE III

**BREAKAWAY** 

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#### TIMBER POST SIGN SUPPORTS

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WIND PRESSURE (q) = 465 Pa											
SIGN	Р				JACK	PINE			DOUGL	AS FIR	
SIZE	0	А	С		Hmax	(mm)			Hmax	(mm)	
DxB	S T	(m)	(m)	POST S	IZE (mm)	& SPLICE	TYPE	POST S	IZE (mm)	) & SPLICE	TYPE
(mm x mm)	S			140x140	TYPE	140x184	TYPE	140x140	TYPE	140x184	TYPE
1200x4800	3	2.24	0.16								
1200x5100	3	2.24	0.31								
1200x5400	3	2.24	0.46							2710	А
1200x5700	3	2.24	0.61							2810	А
1200x6000	3	2.24	0.76							2980	А
1500x4800	3	2.24	0.16								
1500x5100	3	2.24	0.31								
1500x5400	3	2.24	0.46								
1500x5700	3	2.24	0.61								
1500x6000	3	2.24	0.76								
1800x4800	3	2.24	0.16								
1800x5100	3	2.24	0.31								
1800x5400	3	2.24	0.46								
1800x5700	3	2.24	0.61								
1800x6000	3	2.24	0.76								
2100x4800	3	2.24	0.16								
2100x5100	3	2.24	0.31								
2100x5400	3	2.24	0.46								
2100x5700	3	2.24	0.61								
2100x6000	3	2.24	0.76								
2400x4800	3	2.24	0.16								
2400x5100	3	2.24	0.31								
2400x5400	3	2.24	0.46								
2400x5700	3	2.24	0.61								
2400x6000	3	2.24	0.76								
2700x4800	3	2.24	0.16								
2700x5100	3	2.24	0.31								
2700x5400	3	2.24	0.46								
2700x5700	3	2.24	0.61								
2700x6000	3	2.24	0.76								

TABLE 6.4.1(o) TYPE III

**BREAKAWAY** 

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#### TIMBER POST SIGN SUPPORTS

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#### 6.4.2 Design Philosophy

The design tables have been developed for the two structure types, namely Non-Breakaway and Breakaway structures. The maximum allowable heights (Hmax) provided in the tables are established based on two criteria. The bending strength of the timber post and the lower post length restricted to 16 feet (4.88m) because availability in these post sizes is limited for lengths over 16 feet. Particular cross section ground profile is not considered in the design. The general layout of the roadside sign supports shall be established according to the site ground profile and the design criteria specified in the Roadside Safety Manual for the required minimum horizontal and vertical clearances as shown in Figures 6.4.1(d) and 6.4.1(e).

Seventy-eight sign sizes are given, ranging from the minimum of 1200 x 2400 to maximum size of  $2700 \times 6000$ .

For Non-Breakaway structures, the number of posts used can be 2, 3 or 4. For Breakaway structures (that are not protected by a traffic barrier), the number of posts used is 2 or 3; 4 posts cannot be used because of the minimum clear horizontal spacing requirements between posts of 2100mm.

Each sign is designed for 3 possible 10-year return Reference Wind Pressures (without any increase for funnelling) of 300, 390, and 465 Pa, according to CHBDC. At any particular site, where the local wind pressure is greater than one of the above, the sign structure shall be designed for the next-higher wind pressure grouping.

Jack Pine and Douglas Fir are the two species used in establishing the design table.

Post size cross-sections are 140x140 and 140x184, limited to these because larger sizes were <u>not</u> crash-tested (for use with breakaway sign supports).

For design purposes, the post height used in flexure calculations, was 200mm below ground surface, to allow for post flexibility within the soil.

Signs with 2 posts were designed using corresponding tributary sign area. For signs with 3 or 4 posts, the distribution of wind reactions on the posts were analysed using continuous beam theory. The governing limiting Hmax is based on the maximum wind load acting on either the exterior or interior post.

Where Hmax > Hi (i = 1,2,3,4), the post size (based on structure type, wind load, and timber species) would be adequate.

There are two post splice details, namely "Type A" and "Type B", are given in this manual. The post splice is designed according to CSA 086-01 (2005).

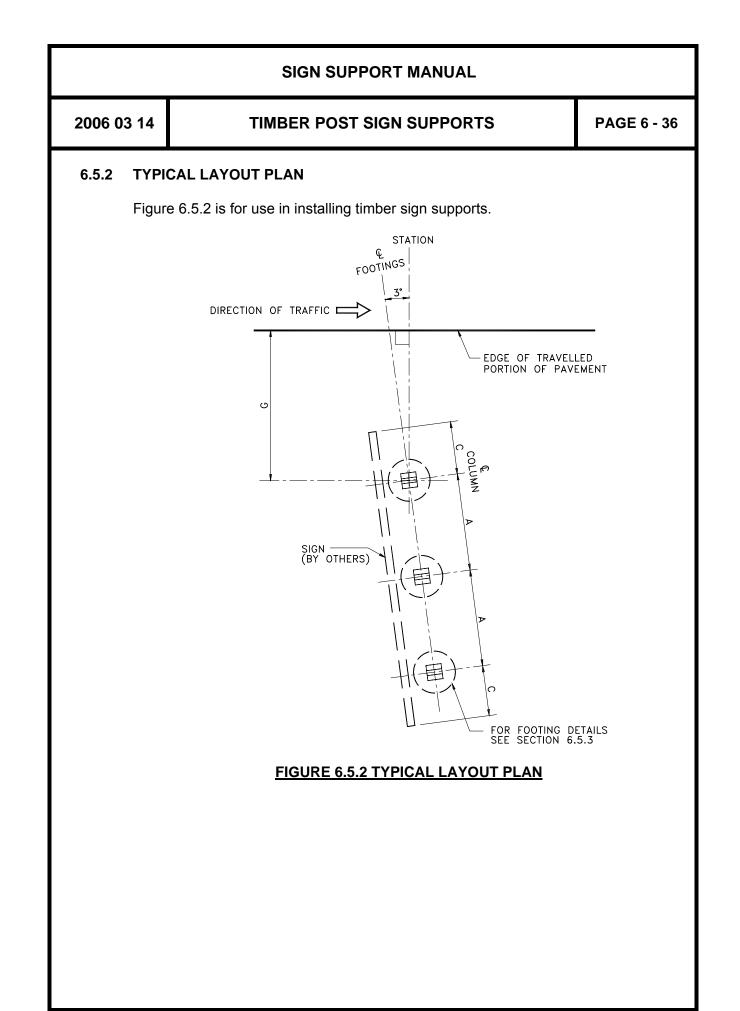
2006 03 14

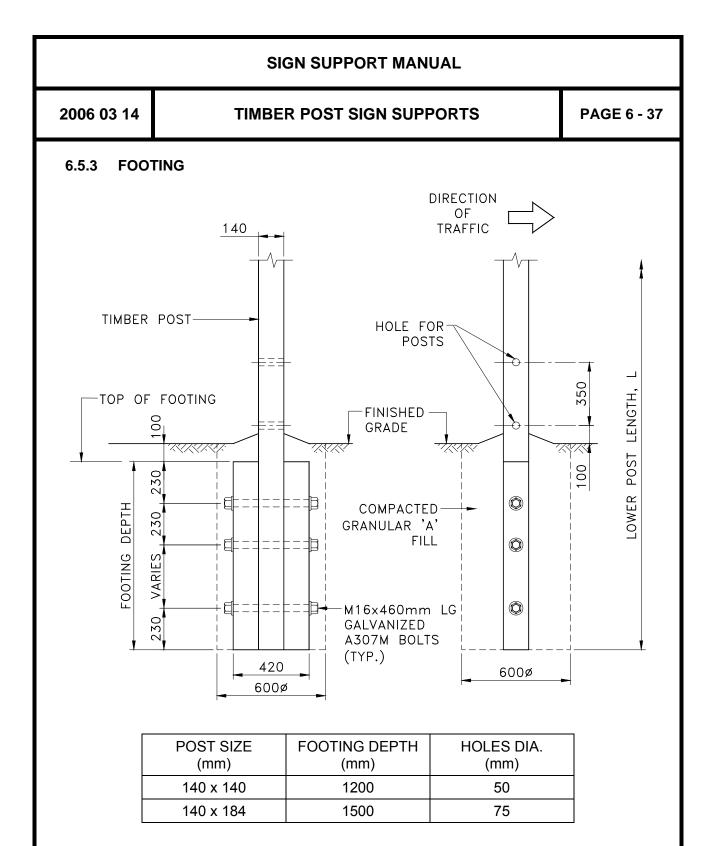
#### TIMBER POST SIGN SUPPORTS

#### 6.5 FABRICATION AND INSTALLATION

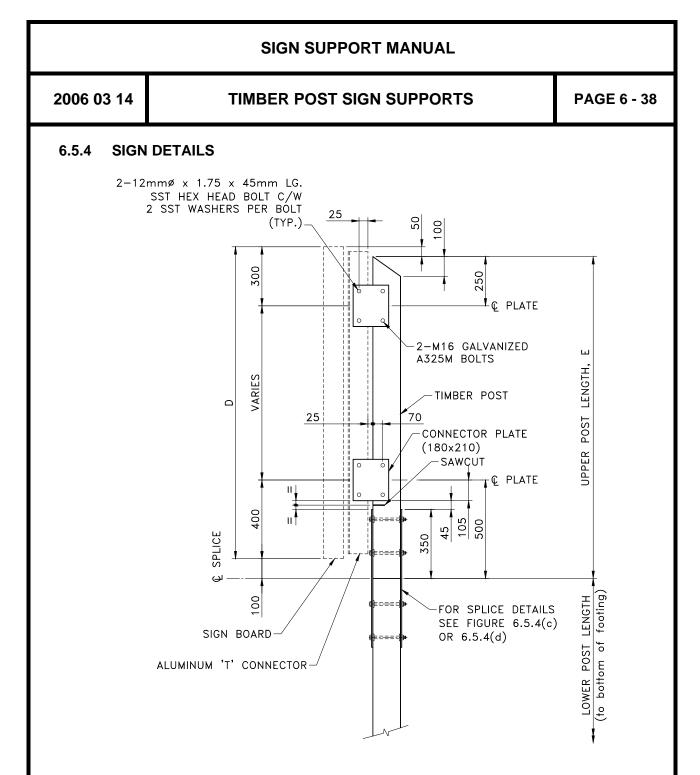
#### 6.5.1 GENERAL

- (i) Timber shall be Coastal Douglas Fir or Jack Pine No.1 Grade, S4S, in accordance with CSA Standard 086 for beams and stringers, NLGA grading rules.
- (ii) All wood shall be pressure preservative treated in accordance with OPSS 1601.
- (iii) All cuts, holes and damage after pressure treatment shall be treated with preservatives as per OPSS 1601.
- (iv) Connector plates and splice plates shall be structural steel in accordance with CSA Standard CAN3-G40.21-M Grade 300W.
- (v) Connector and splice bolts and nuts shall be in accordance with ASTM Specification A325M. Footing bolts shall be in accordance with ASTM Specification A307M.
- (vi) Pressed steel shear plates shall be in accordance with CSA Standard 086.
- (vii) All steel including nuts and bolts shall be hot dip galvanized in accordance with CSA Standard G164-M.
- (viii) Stainless steel bolts, nuts and washers shall conform to ASTM F593 Alloy 304.
- (ix) Splice plates shall be used as templates for drilling holes in timber.
- (x) Timber surfaces at splice shall be flat and perpendicular to centre line of post to ensure full contact.
- (xi) Earth fill around footings shall be placed in 150 mm lifts and tamped thoroughly to ensure maximum compaction. Top layer should be approximately 100 mm above surrounding ground and given a conical shape to facilitate water run-off and provide a reserve of fill for settlement.





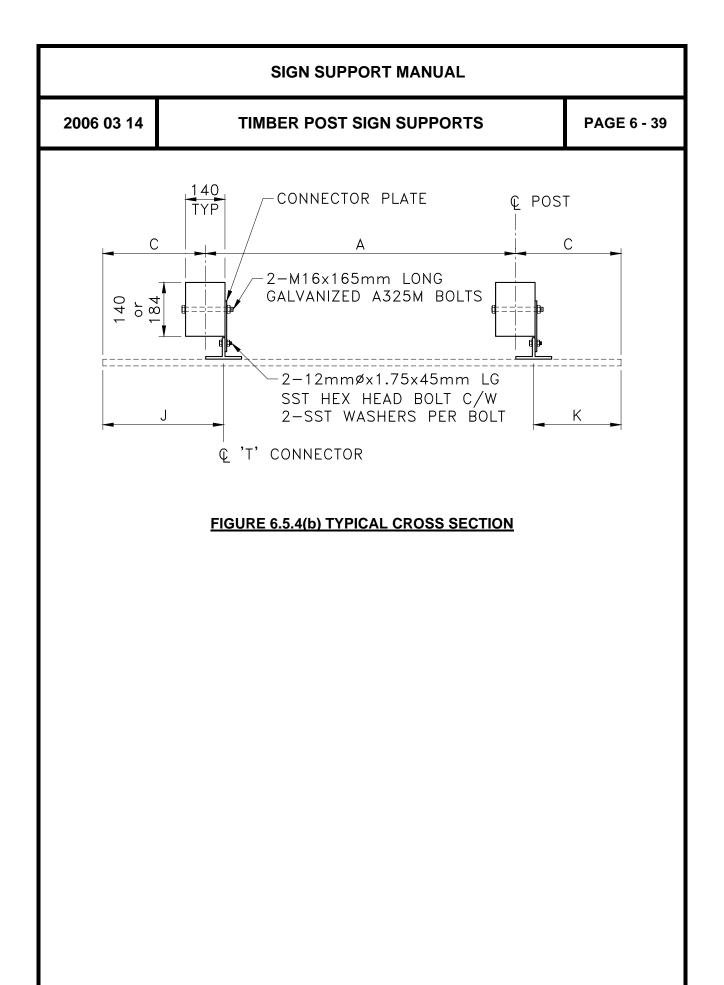
#### FIGURE 6.5.3 FOOTING DETAILS

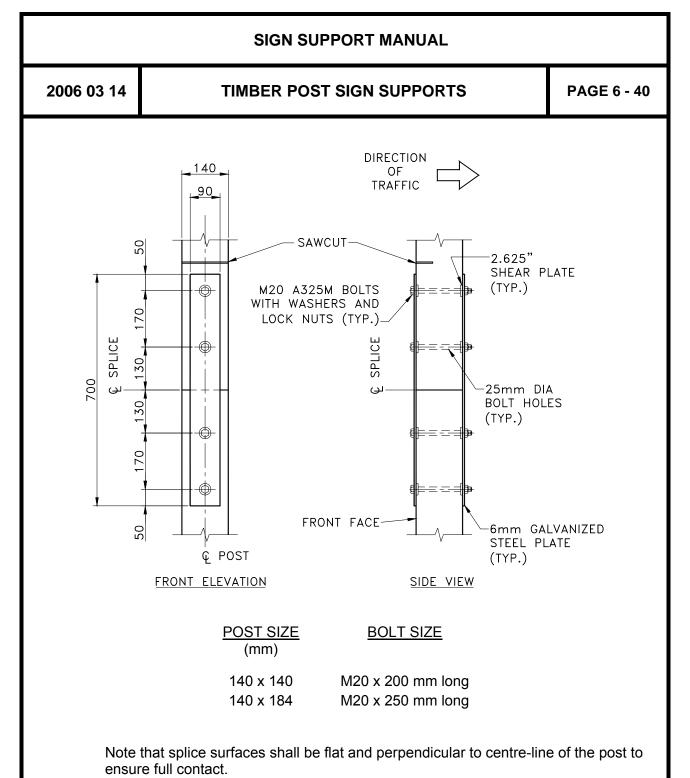


Note that sign board and aluminium 'T' connector are supplied by MTO.

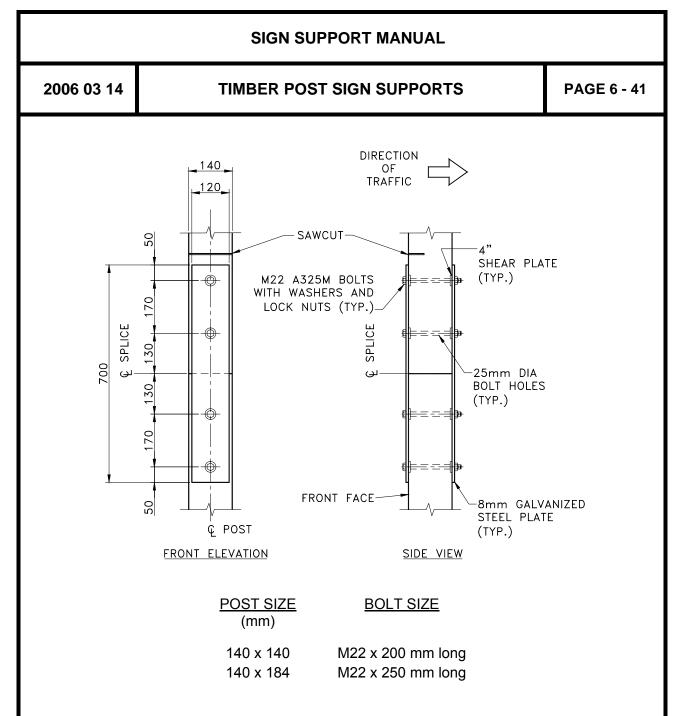
SAWCUT DEPTH (mm)	POST SIZE
50	140x140
75	140x184

#### FIGURE 6.5.4(a) SIGN CONNECTION



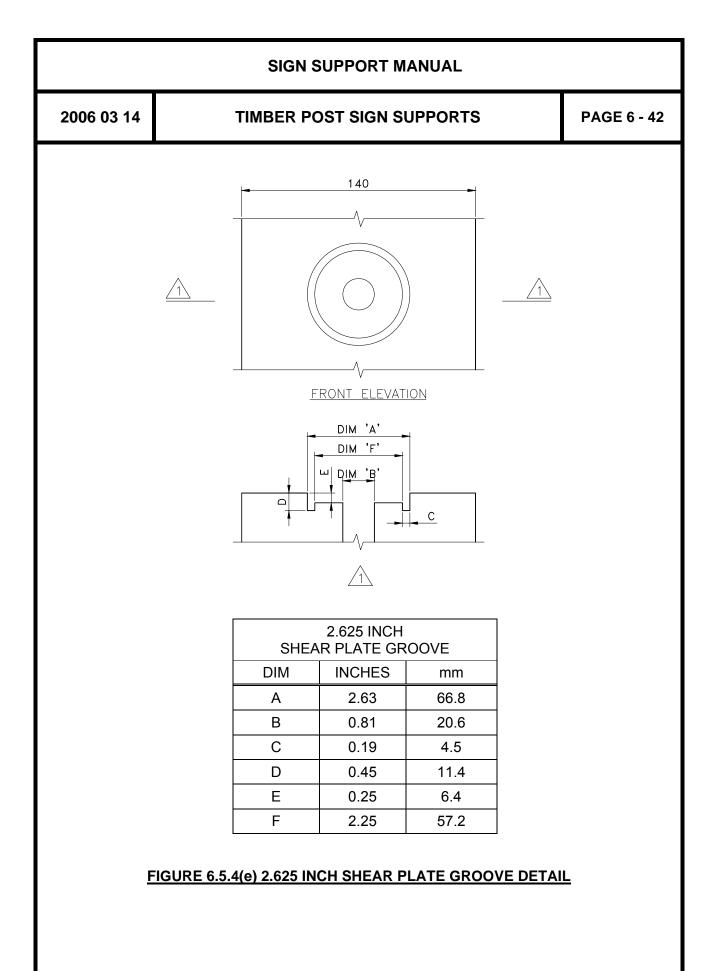


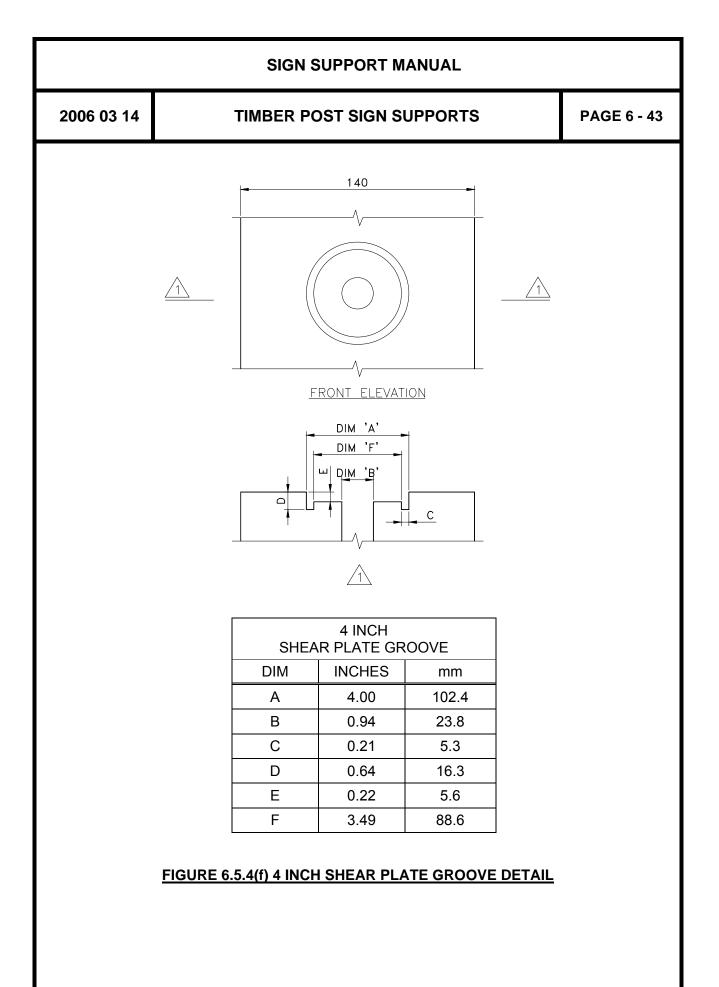
### FIGURE 6.5.4(c) POST SPLICE DETAIL – TYPE "A"

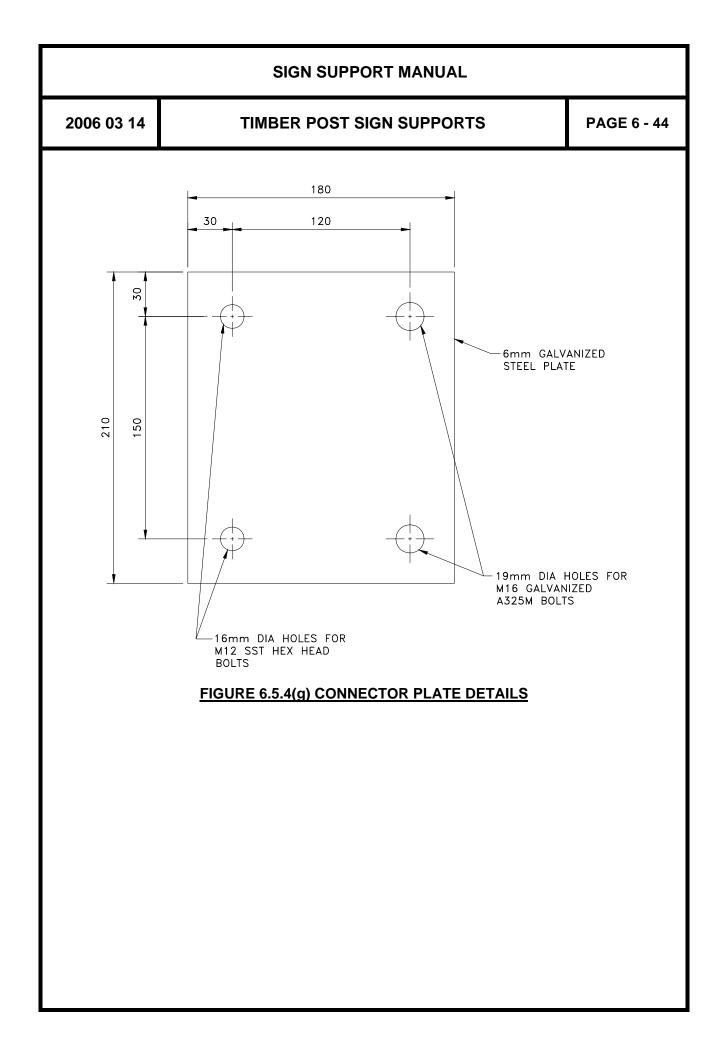


Note that splice surfaces shall be flat and perpendicular to centre-line of the post to ensure full contact.

#### FIGURE 6.5.4(d) POST SPLICE DETAIL – TYPE "B"







# TIMBER POST SIGN SUPPORTS

## 6.6 WORK SHEETS

The following "Work Sheets" are for your convenience when designing timber sign supports.

SIGN SUPPORT MANUAL						
2006 03 14	006 03 14     TIMBER POST SIGN SUPPORTS					
SIG	TIMBER SIGN SUPPORTS       WP No         STATION       STATION         SIGN SIZE (DxB) x       DATE			_		
NON-BRE	E 6.2.2, Figures 6 AKAWAY SIGN ORT TYPE	.4.1 (a) to (c);	and Tables 6.4	.1(a) to (o):	Tables 6.4.1(a) to (i)	
	AWAY SIGN ORT TYPE	Ш	ш		Tables 6.4.1(j) to (o)	
DIMENSIO	N 'C' (overhang)					
SPACING	OF POSTS 'A'					
ELEVATION	AT CENTRE LINI S=	E OF SIGN: (E + 180		+ 1800 + 0.5 D =	)	
POST DESIC (H <sub>max</sub> = EL.C	GN HEIGHT (H <sub>ma</sub> CS – El.P <sub>i</sub> )	<sub>X</sub> ) AT LONGE	ST POST LOC/	ATION I :		
H <sub>max</sub> =	_		=			
	≥ 1800 + 0.5 D =					
If the sign is less than the minimum vertical clearance requirement above the ground level immediately below the sign then EL.CS and Hmax shall be increased to suit. The minimum vertical clearance requirement for breakaway and non-breakaway sign support is 2100mm and 1000mm respectively.						

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## TIMBER POST SIGN SUPPORTS

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	TABLE	TYPE	SPECIES	POST SIZE	H <sub>max</sub>	SPLICE
	6.4.1( )			140 x		
AΥ	6.4.1( )			140 x		
BREAKAWAY	6.4.1( )			140 x		
EAK	6.4.1( )			140 x		
BR	6.4.1( )			140 x		
	6.4.1()			140 x		

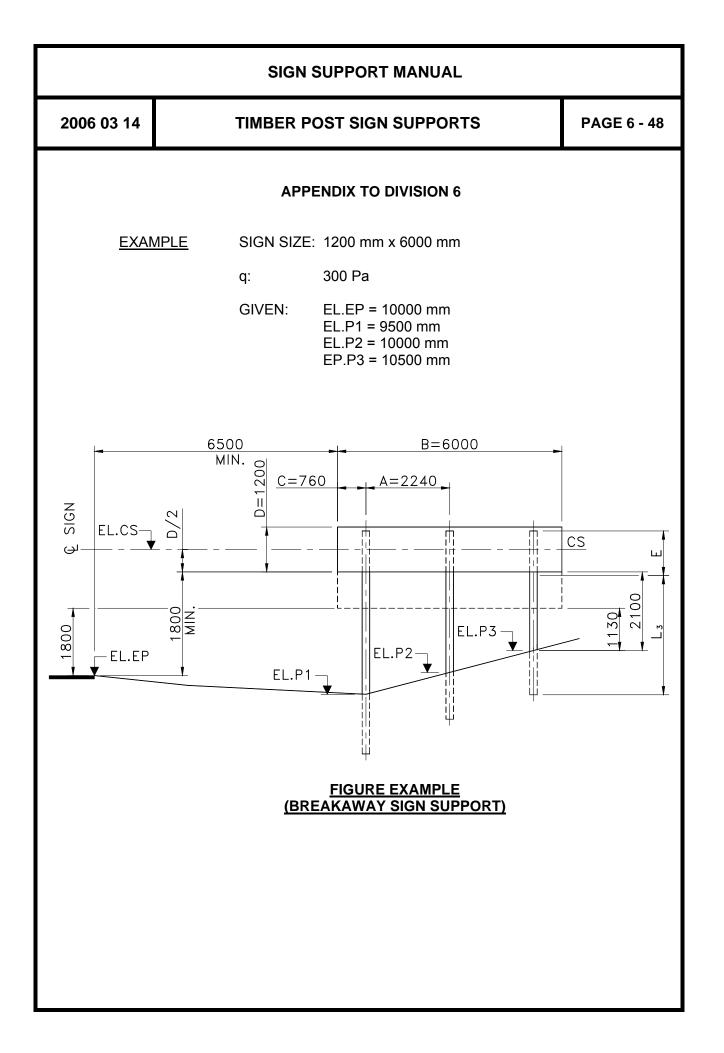
POST SIZE 140 x	
TYPE	
SPECIES	
SPLICE TYPE	
FOOTING DEPTH	

### DETERMINE POST SPACING AND POST LENGTHS:

POST #	EL.Pi	DISTANCE FROM EP TO PI	LOWER POST LENGTH <b>L</b> <sub>i</sub> = EL.CS – EL.P <sub>i</sub> – 0.5 D + FOOTING DEPTH
1			
2			
3			
4			

UPPER POST LENGTH = E = D + 50	=
--------------------------------	---

All dimensions are in millimetres.



	:	SIGN SUPPO	RT MANUAL				
2006 03 14 TIMBER POST SIGN SUPPORTS					PAGE 6 - 49		
TIMBER SIGN SUPPORTSWP No.STATIONSTATIONSIGN SIZE (DxB)1200x6000DATEDATE					  		
NON-BRE	E 6.2.2, Figures 6 AKAWAY SIGN ORT TYPE	.4.1 (a) to (c); a	and Tables 6.4.	1(a) to (o):	Tables 6.4.1(a) to (i)		
BREAK	AWAY SIGN ORT TYPE	II	III	_	Tables 6.4.1(j) to (o)		
DIMENSIO	N 'C' (overhang)	_	760	_	-		
SPACING	OF POSTS 'A'	—	2240				
	i (at longest post i	·	L.CS = EL.EP	+ 1800 + 0.5 D	9500		
EL.C	S= 1000	)() + 18	300 + <i>6</i> C	) =	2400		
POST DESIC (H <sub>max</sub> = EL. H <sub>max</sub> =	GN HEIGHT (H <sub>ma</sub> CS – EI.P <sub>i</sub> )  2400 –		ST POST LOCA = 2900	ATION I :	Haran		
	2	2 1800 + 0.5 D	= 2400	Γ	H <sub>max</sub> 2900		
If the sign is less than the minimum vertical clearance requirement above the ground level immediately below the sign then EL.CS and Hmax shall be increased to suit. The minimum vertical clearance requirement for breakaway and non-breakaway sign support is 2100mm and 1000mm respectively.         AT FARTHEST POST, SIGN IS       EL. CS       H <sub>max</sub> II3Omm ABOVE THE GOUND LEVEL,       I3370       3870							
$\frac{111200 - 1130 = 970}{1000 - 1130 = 970} = 13370$							
NEW Hmax=	NEW Hmax=2900 + 970 = $3870$						

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## TIMBER POST SIGN SUPPORTS

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	TABLE	TYPE	SPECIES	POST SIZE	H <sub>max</sub>	SPLICE
	6.4.1(m)		J.P.	140 x 184	3240	A
٩۲	6.4.1(m)	<b></b>	D.F.	140 x 184	3980	A
BREAKAWAY	6.4.1( )		_	140 x		_
REAK	6.4.1( )	_	_	140 x	_	—
BB	6.4.1( )		_	140 x		—
	6.4.1( )	_	_	140 x	_	—

NO TYPE II POST SIZE

STRUCTURALLY ADEQUATE

AVAILABLE,

POST SIZE 140 x	184
TYPE	
SPECIES	D.F.
SPLICE TYPE	A
FOOTING DEPTH	1500

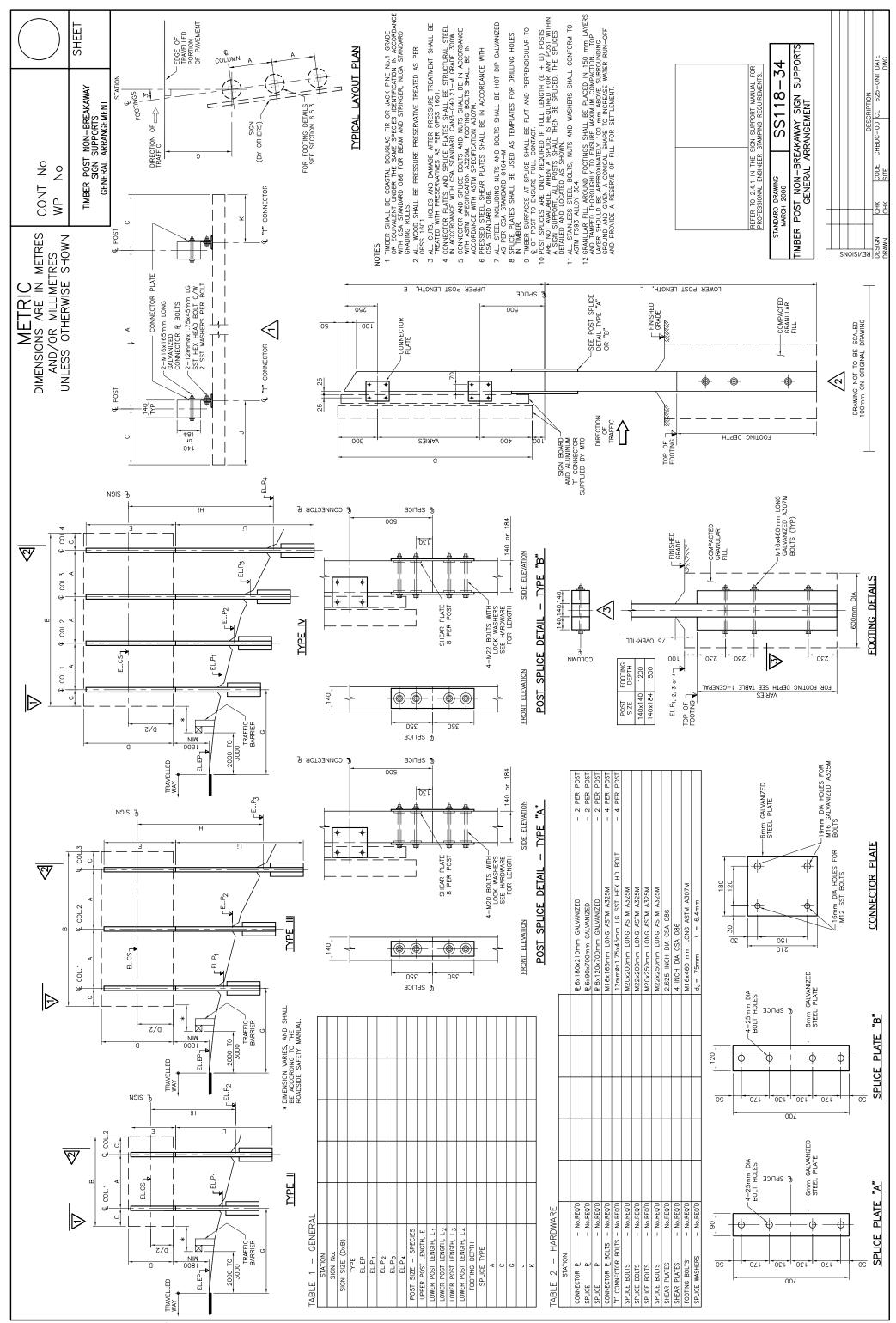
C = 760 A = 2240

DETERMINE POST SPACING AND POST LENGTHS:

POST #	EL.Pi	DISTANCE FROM EP TO PI	LOWER POST LENGTH <b>L</b> <sub>i</sub> = EL.CS – EL.P <sub>i</sub> – 0.5 D + FOOTING DEPTH
1	9500	7260	4770
2	10000	9500	4270
3	10500	11740	3770
4	_	_	_

UPPER POST LENGTH =  $\mathbf{E} = \mathbf{D} + 50 = 1250$ 

All dimensions are in millimetres



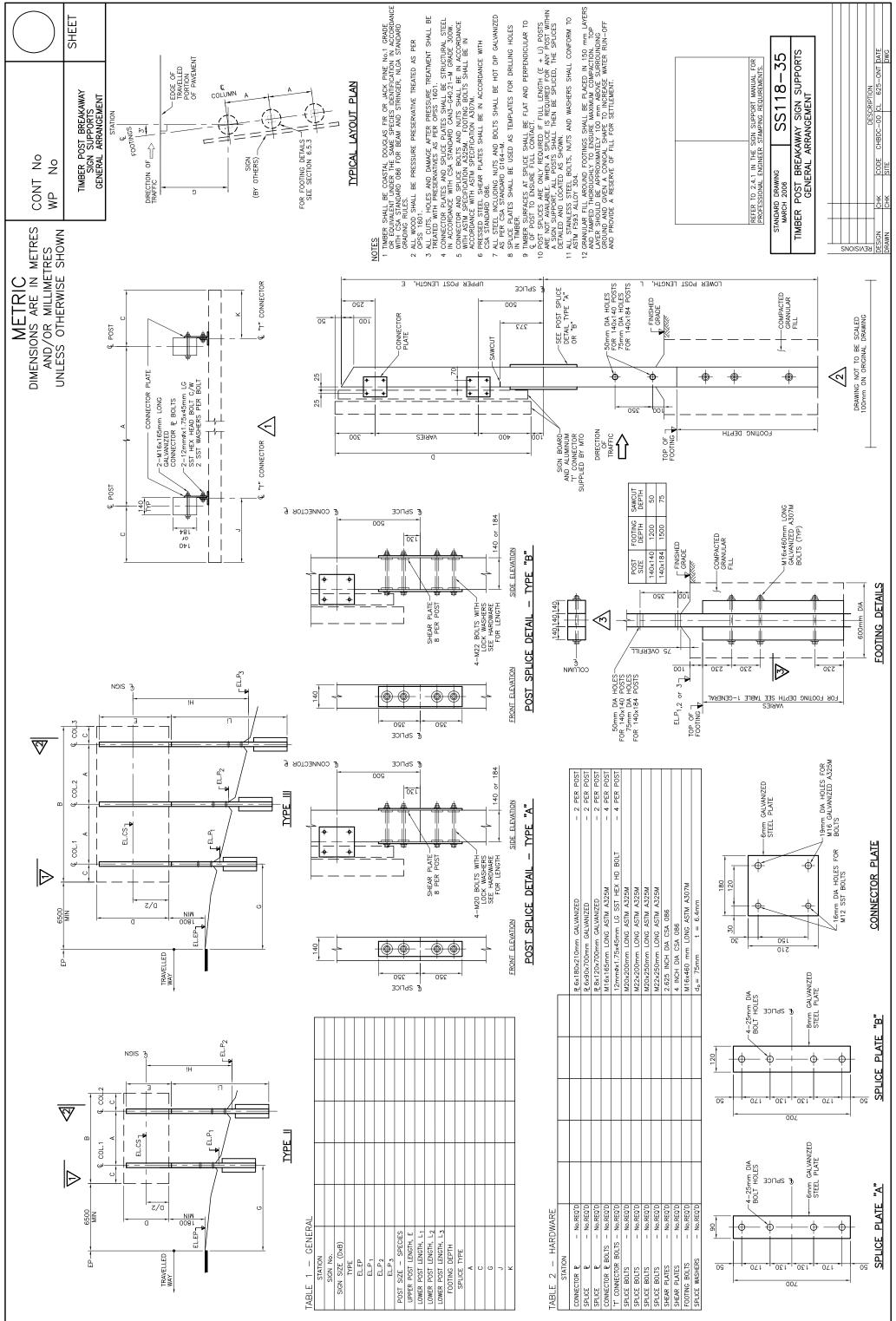
20-88 TOT-0-99 OISATNO, NOTATROGZNART TO YATZINI

11:12:01 22/20/9002

6mp.4δ-811e ::#MA

WODILIED:

DRAWING NAME: CREATED:



<u>90-88</u> PR-D-707 MINISTRY OF TRANSPORTATION, ONTARIO

32:64:01 5006/03/23

11/20/9661 ρwb.čč−8ftε

WODILIED:

CREATED: DRAWING NAME:

**DIVISION 7 - OVERHEAD MONOTUBE SIGN SUPPORTS** 

2007 04 02

OVERHEAD MONOTUBE SIGN SUPPORTS

## 7 OVERHEAD MONOTUBE SIGN SUPPORTS

## 7.1 <u>GENERAL</u>

## 7.1.1 STANDARD SIGN SUPPORTS

Standard overhead monotube sign supports are used to support static lanedesignation signs. The sign supports are fabricated in galvanized structural steel and designed to the requirements of the Canadian Highway Bridge Design Code CAN/CSA-S6-00 (CHBDC).

The sign supports contained in this Section are designed for sign boards and site conditions that meet the following criteria:

- (a) Maximum sign size to be 1.2m by 1.2m.
- (b) Supporting one under mounted sign or up to four evenly spaced front mounted signs.
- (c) Design span length ranging from 13.5m to and including 24.0m.
- (d) Maximum allowable column height to be 7.7m. Since members are custom fabricated for each installation, any span-height combination is allowed.
- (e) Reference wind pressure to be 595 Pa at a return period of 50 years. The effect of wind tunnelling as stated in CHBDC 3.10.1.1 is not considered.
- (f) Competent soil conditions excluding rock fill.

## 7.1.2 TYPES OF SIGN SUPPORTS

There are two types of steel monotube overhead sign supports:

- TYPE I Front Mounted Signs, SS118-40: For cases where the signs are to be viewed by traffic in one direction only. The signs are attached at their mid height to the horizontal support member.
- TYPE II Under Mounted Signs, SS118-41: For cases where the sign is to be viewed by traffic in both directions, such as a single sign designating a "centre lane for left turns only". This type of sign is suspended below the level of the horizontal support member.

Figures 7.1.2(a) and (b) illustrate these types of sign support structures.

Under mounted signs are more economically supported by cables suspended from guyed poles rather than by horizontal support members, as illustrated in Figure 7.1.2(c). Therefore, the suspended cable/guyed pole arrangement should be specified, unless:

(i) The standard monotube design is used for lane designation signs in the same vicinity.

**OVERHEAD MONOTUBE SIGN SUPPORTS** 

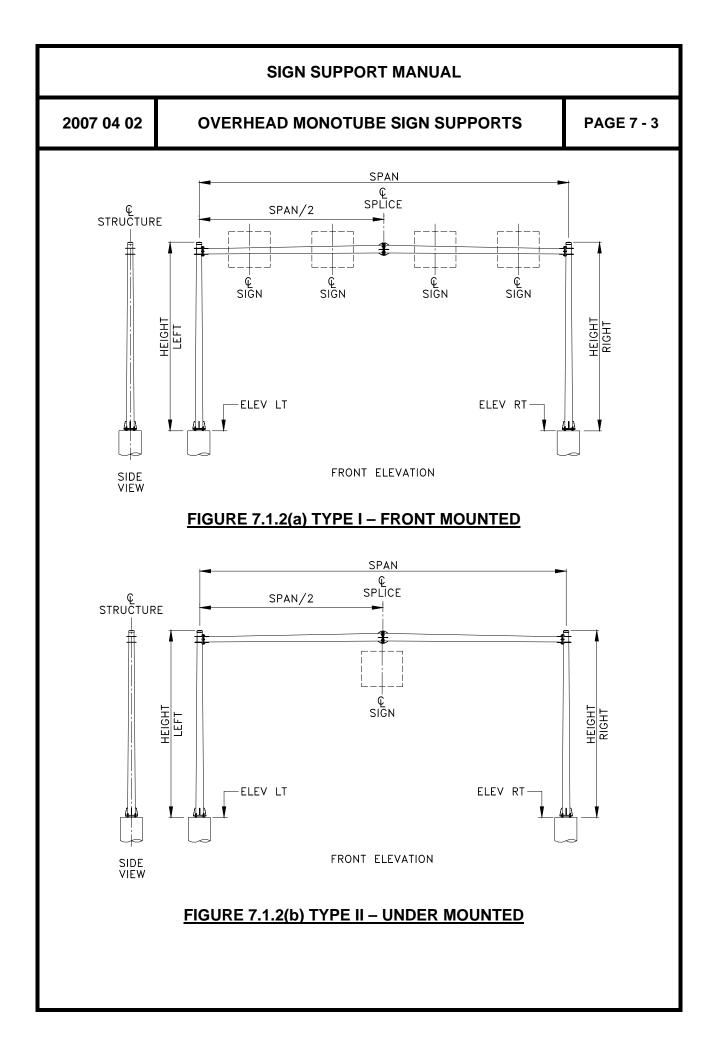
- (ii) Where the guying of poles is not practical.
- (iii) When the monotube support is preferable for aesthetic reasons and is approved by the Head, Regional Planning and Design.

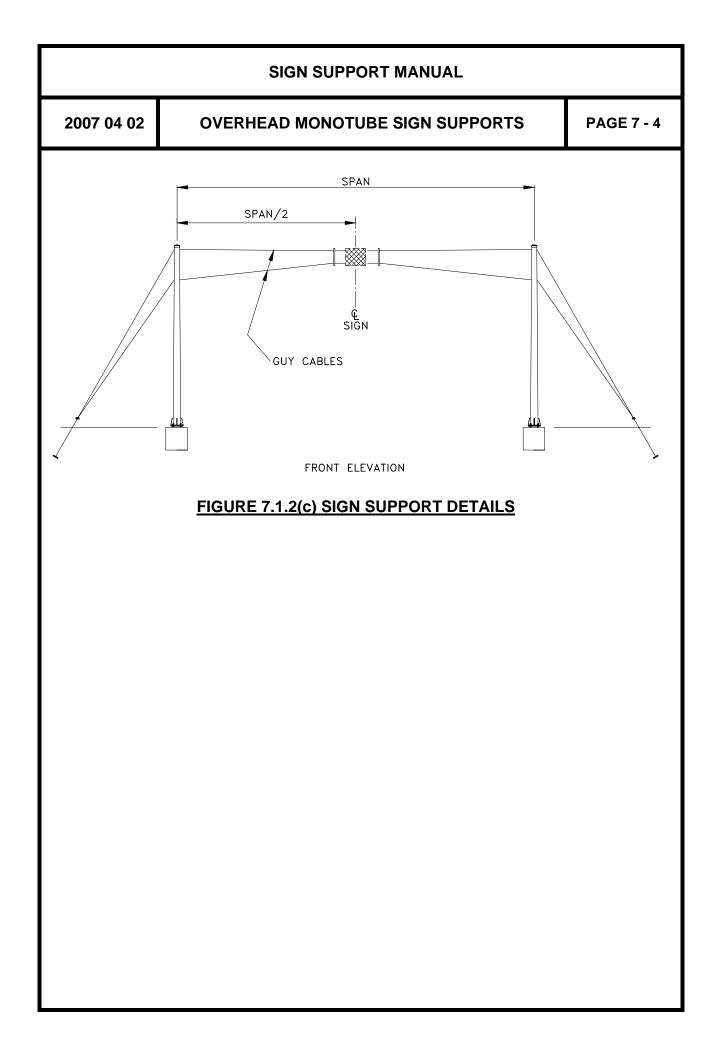
## 7.1.3 LIMITATIONS

For economic and practical reasons these supports should be placed as close as possible to the edge of the travelled portion of the roadway (see 7.1.6). For this reason these supports will probably be in the Clear Recovery Zone and should be protected as discussed in Section 2.6.

Under mounted signs should not be used in combination with front mounted signs. Each structure may support one under mounted sign or up to four front mounted signs.

Unless protected from traffic, overhead monotube sign supports are limited to use on highways where the posted speed does not exceed 70 km/h.





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## OVERHEAD MONOTUBE SIGN SUPPORTS

### 7.1.4 DESCRIPTION OF SIGN SUPPORTS

The supports are made up of four tapered, octagonal, galvanized steel members. Each member tapers uniformly 280 mm to 190 mm, outside face, across flats.

There are three types of connections between sign support members:

- (i) Base Plate Connection- connecting the leg to the concrete footing.
- (ii) Corner Connection- connecting the horizontal support member to the legs.
- (iii) Mid-span Connection- connecting the two components of the horizontal support member at or near midspan.

Each type of connection has been standardized for all spans in the allowable range and no selection or additional data is necessary.

Signs are attached to supports by means of brackets welded to the horizontal support member.

Horizontal support members are fabricated with lugs along the centre line of the top surface for attaching aerodynamic device to reduce the occurrences of wind induced vertical vibration.

### 7.1.5 FOOTINGS

Footings consist of reinforced concrete cast in augered holes. Details of footings are shown on the standard drawings.

The indicated footing depth is based on relatively competent soils of uniform composition. The soil types considered in the design were either cohesionless with a minimum angle of internal friction of 30° or cohesive with a minimum shear strength of 50 kPa. If the encountered soil condition is such that the minimum requirements specified above are not satisfied, a site specific footing design must be carried out.

### 7.1.6 CLEARANCE

The legs of the sign support structure should be located as close to the traffic barriers as possible but not closer than the minimum horizontal distance specified in the Roadside Safety Manual.

When the legs of sign support structures are not protected from traffic, they shall be located beyond the clear recovery zone as specified in the Roadside Safety Manual.

The minimum vertical clearance from the highest point on the highway, including shoulders, curbs and medians to the bottom of a signboard, shall

	SIGN SUPPORT MANUAL					
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mem	not be less than 5300mm and not less than 5600mm to the lowest structural member of the sign support structures as specified in the Geometric Design Standards for Ontario Highways.					

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OVERHEAD MONOTUBE SIGN SUPPORTS

#### 7.2 **PREPARATION OF DRAWINGS**

#### 7.2.1 GENERAL

If the supply and erection of the support is to be part of the contract, Standard Drawings SS118-40 and/or SS118-41 and SS118-42 must be used.

#### 7.2.2 DATA REQUIRED

Prior to design, a "Key Plan and Frame Dimension" drawing(s) must be prepared to enable the working drawings to be detailed. This drawing(s) will form part of the contract documents and must show, for one or more structures, the following information.

- (i) A key plan, indicating the approximate location of each support.
- (ii) The Structure I.D. number.
- (iii) The support span, measured from centreline to centreline of leg, should be rounded up to the nearest half metre unless there is a restriction on the leg location.
- (iv) The control line of the roadway and the offset of the leg from the control line.
- (v) The elevation of the highest point on the roadway surface under the support structure.
- (vi) The location, size and type of the signs with a clear indication as to whether front mounted signs or a single under mounted sign shall be installed. This information should be shown on a working print since it is not needed on the contract drawings. The vertical and horizontal dimensions of each sign must be shown together with the distance from the centreline of the signs to the centreline of the leg. If the signs are to carry directional arrows, these should be shown diagrammatically on the drawing.
- (vii) The vertical dimension measured from the highest point on the roadway surface to the lowest bottom edge of the signs. This is normally 5300mm but may be slightly more in order to allow for a future change in pavement elevation.
- (viii) The elevation of the ground line at each footing.

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(ix)	The top of footing elevation. The footings must neither be more than 200mm above finished grade for safety reasons nor less than 75mm to ensure drainage.		
(x)	The offset of the centreline of footing from the control line, either as note or as a dimension.		
(xi)	The station of the support structure on a designated highway centreline or control line.		
(xii)	A designation for each footing as a "Left footing" or "Right footing". Left and Right for this purpose are defined as if looking in the direction of the traffic that will finally be viewing the signs. All elevations of the support should be marked "FRONT VIEW" and must be drawn accordingly, with the right footing on the right, etc. When a sign or signs on the support are to be read from either side, that is, traffic travelling in both directions passes, under the support structure, the view should be drawn looking in the direction of increasing chainage and this should be noted under the title of "FRONT VIEW". In such cases, the footings should also be marked with reference to the north point as a check.		
(xiii)	Unusual requirements must be clearly noted; for ex- mounted" signs which are to be on the back of the s which are to be asymmetrically positioned in relation to to centreline.	upport, signs	

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### **OVERHEAD MONOTUBE SIGN SUPPORTS**

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### 7.2.3 STRUCTURE DRAWINGS

There are three standard drawings for these supports. The Appendix contains reduced size prints of these standard drawings, showing what information needs to be added. The Contract and W.P. numbers should be added to the title block. The sheet number is added when the drawings for the entire contract are assembled. Up to 6 sign supports can be detailed on one sheet.

Standard drawing SS118-40 is for supports carrying front mounted signs. All required data in the tables could generally be obtained directly from the key plan and frame dimension drawing described earlier. The "MESSAGE" column is to show diagrammatically the sign content such as direction arrows, for the information of the District staff because the signs are not included in the contracts. The column height is measured from the top of footing to the top of column.

Standard drawing SS118-41 is for supports carrying an under mounted sign to be seen from either traffic direction. The signboard and the splice joint are generally located at or very close to the middle of the span. There is only one table to be filled in the standard drawing to show all the design information of the sign support structure. The MESSAGE however contains two columns to show the content at the front and the rear of the signboard.

When the highway layout is simple, the location of the supports and their footings can be shown adequately on the standard drawing. In this case, it is not necessary to make the key plan and frame dimension drawing part of the contract documents. If this is not the case, add a note referring to that drawing and cross out the location sketch and the X and Y columns on the standard.

The Standard Drawings shall be sealed, dated and signed according to 2.4.1.

### 7.3 MAINTENANCE AND INSPECTION

All components shall be inspected and maintained according to the "Sign Supports Inspection Guideline".

Long-term durability of sign supports is dependent on routine maintenance and inspection. In order to prevent corrosion damage and fatigue problems to the anchorage assembly, the following shall be ensured:

(i) The base of the vertical support leg shall be kept free from dirt and debris

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- (ii) The base plate and arm connection welds shall be inspected regularly for fatigue cracking.
- (iii) The anchor bolts connection shall be checked periodically for tightening.

## 7.4 DESIGN INFORMATION

Design and detailing data contained in this Division conforms to the requirements of the Canadian Highway Bridge Design Code CAN/CSA-S6-00 unless otherwise stated.

Calculations are based on Standard CAN/CSA-G40.21-M Grade 300W for structural steel, 30 MPa for concrete and Grade 400 reinforcing steel for footings.

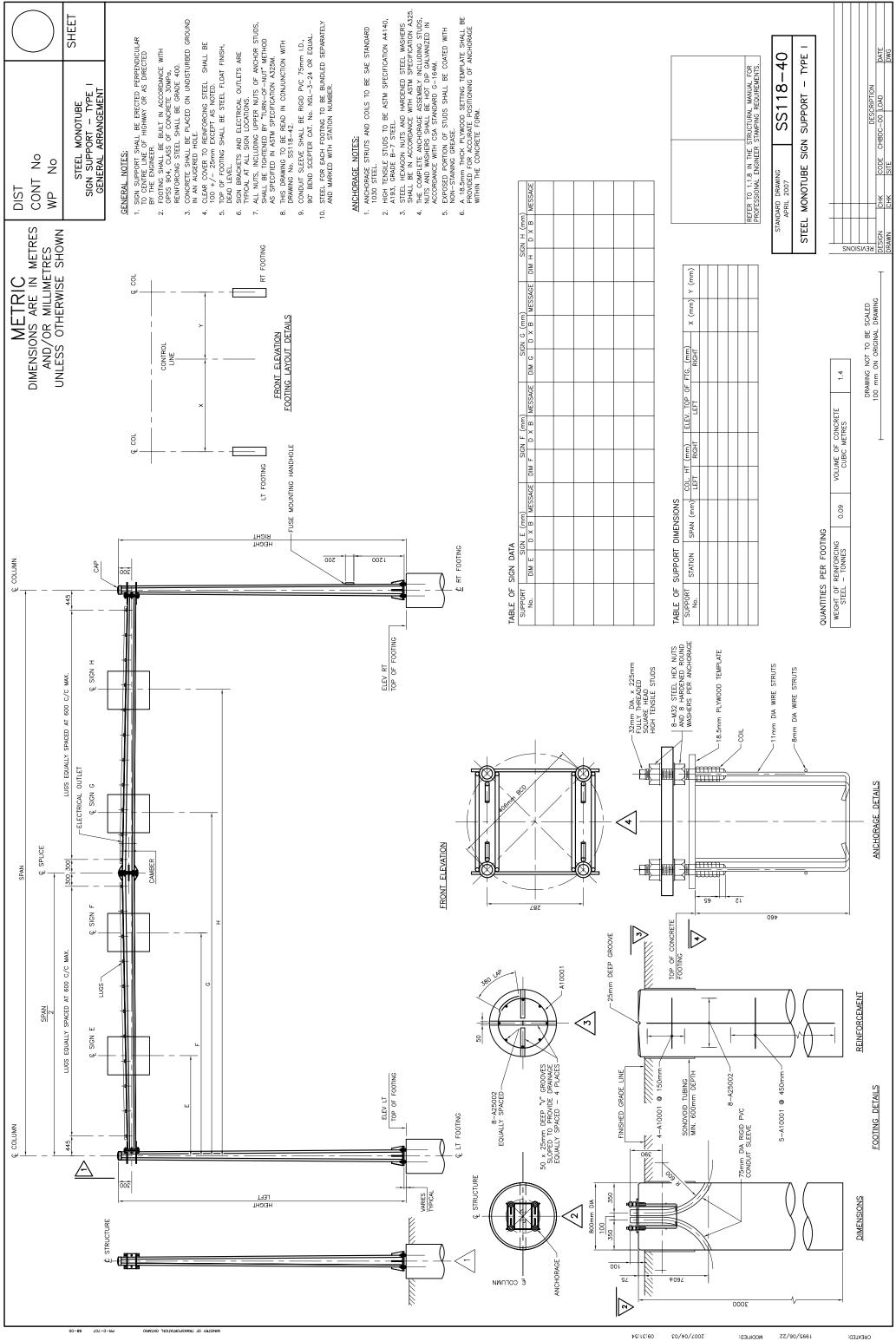
Dead load deflection is compensated by cambering the horizontal support as shown in the drawing.

Fatigue wind loads are obtained from AASHTO – "Standard Specifications for Structural Supports for Highways Signs, Luminaires and Traffic Signals, 4<sup>th</sup> Edition 2001". It is based on NCHRP Report 412, "Fatigue Resistance Design of Cantilever Signal, Sign and Light Supports".

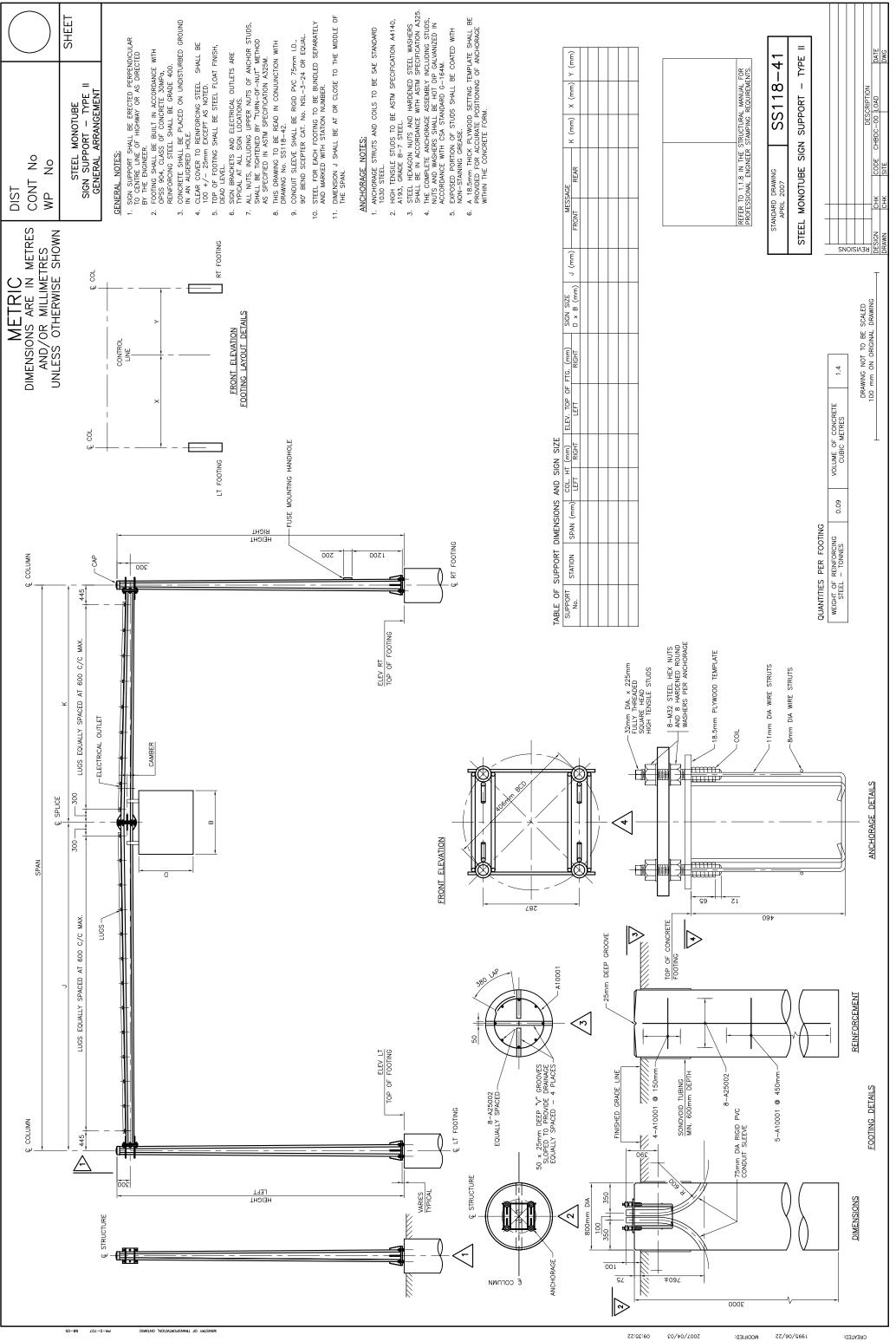
A baffle plate is mounted on top of the centreline of the Monotube sign support in order to minimize the dynamic effects of across-wind loads induced by vortex shedding excitation.

SIGN SUPPORT MANUAL			
2007 04 02	OVERHEAD MONOTUBE SIGN SUPPORTS	PAGE 7 - 11	
	APPENDIX TO DIVISION 7 STEEL MONOTUBE SIGN SUPPORTS		

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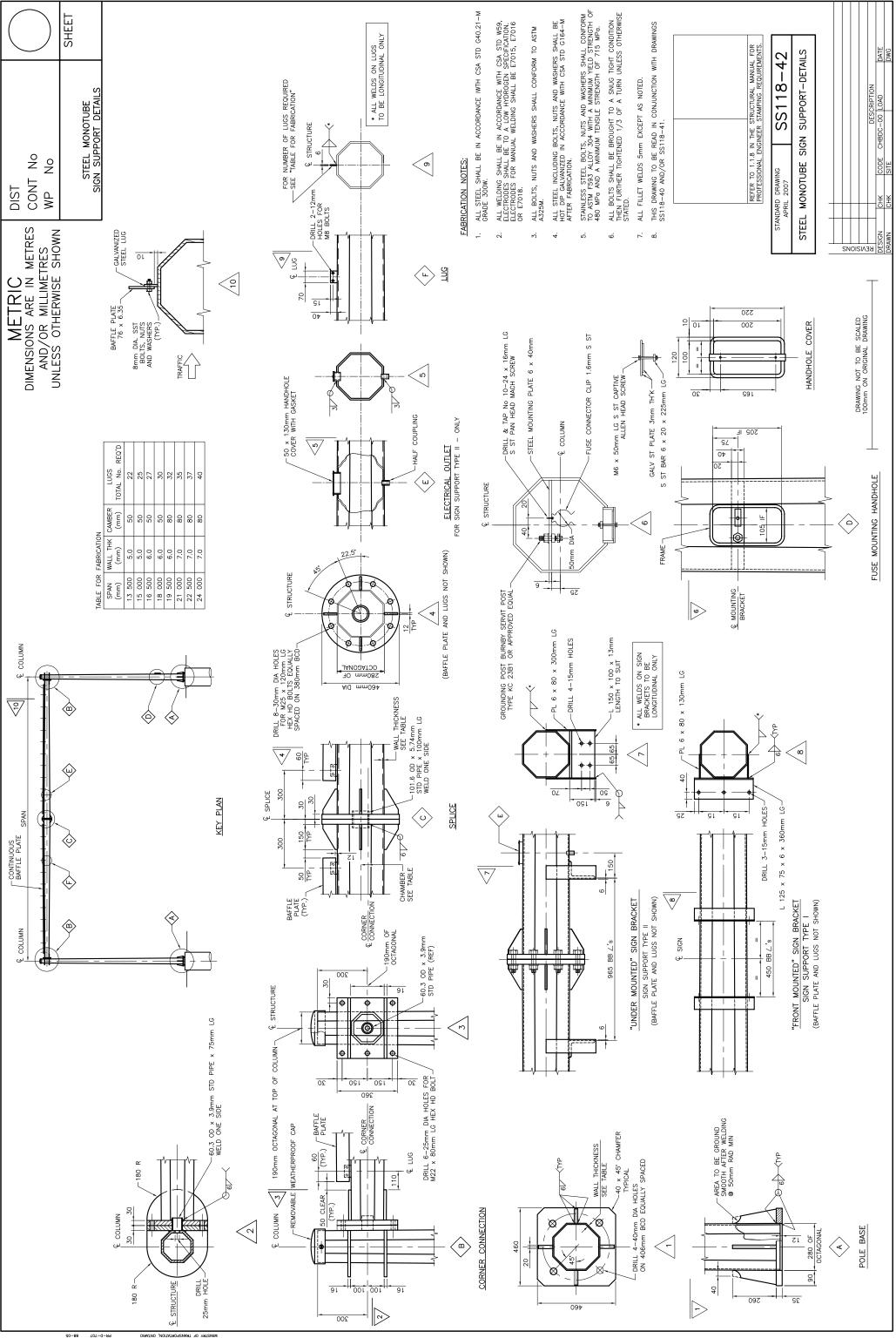


DRAWING NAME: s118-40.dwg



pwb.f4-8ffe :3MAN 3

DRAWING NAME:



55:9<u>5</u>:60 2001/04/03 22/90/9661 CREATED: pwb.24-811a DRAWING NAME:

WODILIED:

DIVISION 8 - CHANGEABLE MESSAGE SIGN SUPPORTS

May 2000

2000 05 15

CHANGEABLE MESSAGE SIGN SUPPORTS

## 8 <u>CHANGEABLE MESSAGE SIGN SUPPORT (CMS)</u>

#### 8.1 <u>GENERAL</u>

#### 8.1.1 STANDARD SIGN SUPPORTS

Standard CMS overhead truss sign supports are used to support changeable message sign systems. The overhead truss is fabricated in aluminum, and the vertical support legs, in galvanized structural steel. They are designed to the requirements of the Ontario Highway Bridge Design Code.

The sign supports contained in this Section are designed for changeable message sign components and site conditions that meet the following criteria:

- (a) Spans from 17592 to 34000mm.
- (b) Maximum total sign area of 40 square metres for a reference wind pressure of 600 Pa at a return period of 50 years.
- (c) Overall depth of sign component of 3043 mm.
- (d) Overall width of sign component of 13220 mm.
- (e) Competent soil conditions excluding rock fill.

### 8.1.2 LIMITATIONS

For economic and practical reasons these supports should be placed as close as possible to the edge of the travelled portion of the highway. Therefore, the supports will probably be in the clear recovery zone and should be protected as discussed in Section 2.6. They could also be located on median barriers.

For ground mounted footings, the top of footing elevation shall be a minimum of 300 mm above the finished grade. This could be increased up to 1000 mm in order to limit the leg height. The dimension from the top of the footing to the centreline of the CMS overhead truss shall not exceed 7500 mm.

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CHANGEABLE MESSAGE SIGN SUPPORTS

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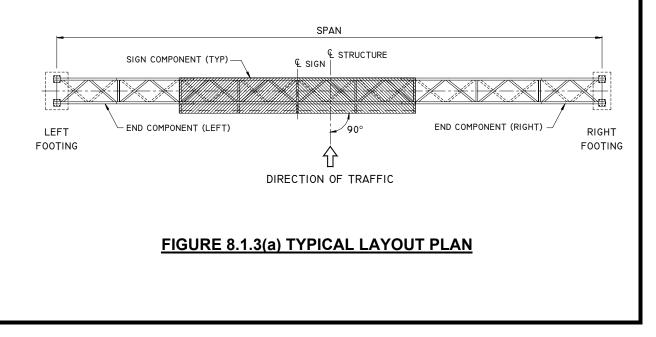
### 8.1.3 DESCRIPTION OF SIGN SUPPORTS

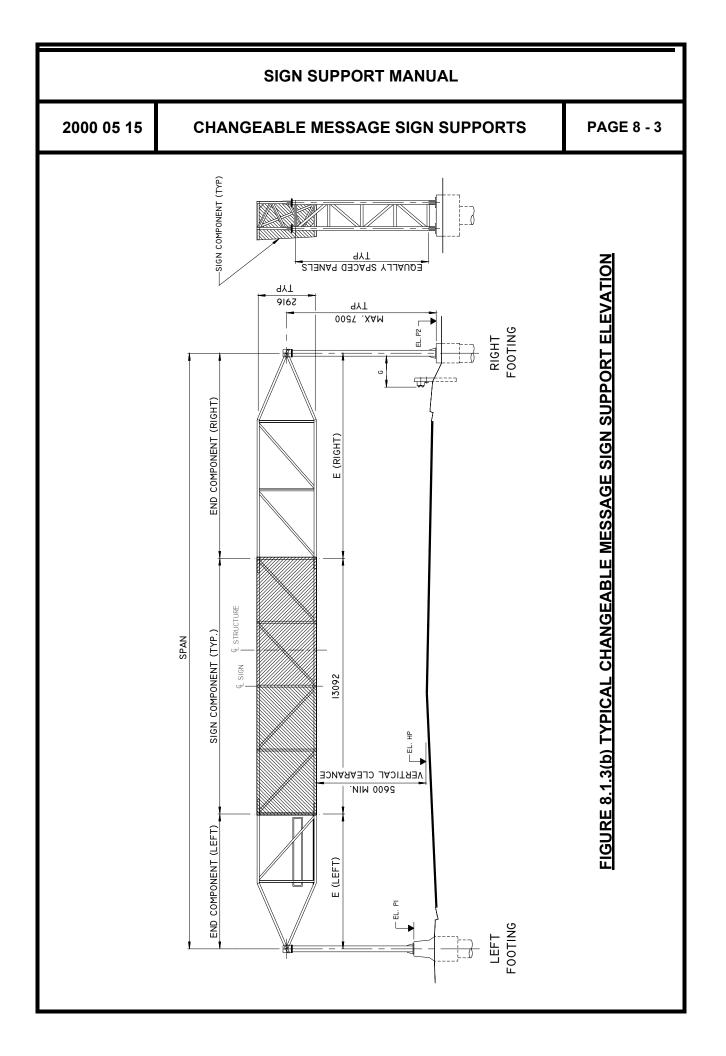
The CMS sign support system is comprised of two vertical support legs, and a rectangular overhead space truss. The vertical support legs are fabricated from structural steel, and the overhead truss from aluminum. The overhead truss is comprised of two end components (left and right) and one sign component. The system is fabricated based on specific site requirements. These supports are designed for ground mounting or supported on concrete median barriers. The typical layout plan and elevation are shown in Figures 8.1.3 (a) and (b), respectively.

The vertical support legs are made of rectangular HSS sections (column shafts) and from square HSS sections (bracing and struts). All components are interconnected by moment and shear welded connections. The column shafts are connected at the base to concrete footings by a bolted anchorage. The column lengths of the supports are not standard. At a particular location the legs may be of different heights to ensure the truss is installed horizontal.

The overhead truss in the span is made of aluminum square tubes. All components are interconnected by moment and shear welded connections. The changeable message sign structure (sign component) is built-into the overhead truss (walk-in CMS). The aluminum overhead truss ends are connected to the structural steel legs by a hinge type connection with a neoprene pad and stainless steel bolts.

All structural steel components, other than stainless steel bolts, nuts and washers, are galvanized after fabrication. The support legs and base plates are subsequently coated with an approved paint system.





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CHANGEABLE MESSAGE SIGN SUPPORTS

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# 8.1.4 FOOTINGS

Sign support footings consist of a single reinforced concrete caisson. Details differ according to their location, and generally are of two types, as shown on the drawings: ground mounted and median mounted. (See Standard Drawings SS118-6, SS118-7 and SS118-8).

The indicated footing depths are the minimum required for each support. Footing proportions apply to competent soil conditions of uniform composition. Parameters upon which the design is based are given in Section 8.5.3.

Encountered soil conditions such as rock fill, land fill, and soft material require the footing to be redesigned by an Engineer.

# 8.1.5 CLEARANCE

For ground mounted footings, all members of the sign structure and the footing within the horizontal projection of the barrier, should be located a minimum horizontal distance 'G' from the traffic protection barrier as specified in the Roadside Safety Manual.

The minimum vertical clearance from the bottom of the sign component to the highest point on the highway, including shoulders, curbs and medians, shall not be less than 5600 mm.

# 8.1.6 SUPPLY AND ERECTION

For a temporary installation, a Tri-Chord overhead truss (Division 4) with the same span as a prospective CMS truss structure, could be mounted on the CMS support legs. A connection detail for this assemblage is shown on SS118-36.

Construction shall meet the requirements of OPSS 915, Construction Specification for Sign Support Structures, and associated Special Provisions.

Each sign support shall have a corrosion-protected identification plate showing the structure ID number, the manufacturer's name or the rademark, and the date of manufacture.

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CHANGEABLE MESSAGE SIGN SUPPORTS

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# 8.2 PROCEDURES

# 8.2.1 GENERAL

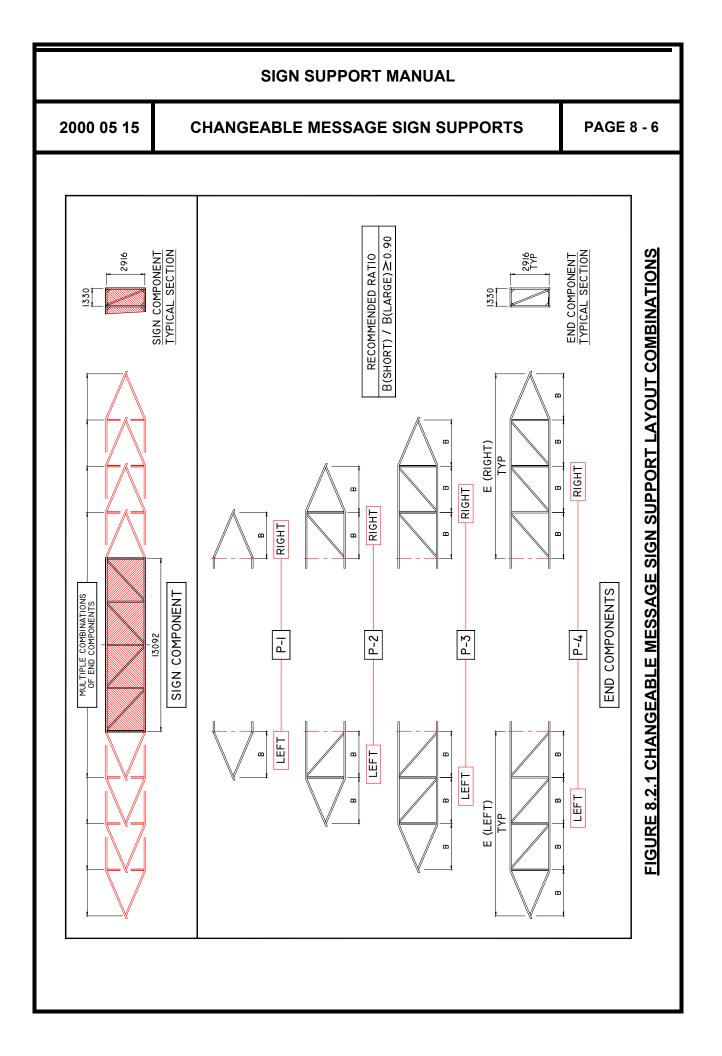
The sign supports structures are fabricated from shop drawings based on the standard drawings on a site-specific basis.

The design of the changeable message sign supports (CMS) is based on a reference wind pressure of 600 Pa. The geometric layout of the overhead truss shall depend on the location of the sign component along the span of the structure, in relation to the travelled portion of the highway. (See Standard Drawing SS118-36). Multiple combinations of end components (left/right) and sign component can be obtained, as shown in Figure 8.2.1. The length of panel for the end components will vary, within certain limits, in every structure. The length of panel for the sign component is fixed. Design dimensions (structural sections) for end and sign components are fixed, and are given on the Standard Drawings SS118-37 and SS118-38.

# 8.2.2 DATA REQUIRED

For each CMS sign support, the following data is required:

- (1) The span.
- (2) The site location of the structure. For a proposed highway or a highway under reconstruction, the location should be specified as a station.
- (3) The location of the sign component along the longitudinal centreline of the structure.
- (4) The elevation of the highest point on the highway under the sign component, and the final ground elevations under the sign structure.



SIGN SUPPORT MANUAL			
2000 05 15	CHAI	NGEABLE MESSAGE SIGN SUPPORTS	PAGE 8 - 7
8.2.3 PRO	8.2.3 PROCEDURE FOR DESIGN OF SIGN SUPPORT		
GIVE	<u>Exa</u> the	AN AND LOCATION OF SIGN COMPONENT <u>imple</u> : a span of 27990 mm, and a distance of centreline of the left leg to the centrelin ponent.	
STEP	E.g. com 121 cen com Bas	TAIN THE LENGTH OF THE END COMPONEN , The distance between centreline of end verti- nponent is <u>13092</u> mm. The sign component 38 mm from the left leg. Therefore, the dime treline of the left leg to the left end vertic nponent, E (LEFT), is equal to 12138-13092/ sed on the given span, E (RIGHT) is equal to 2 2 = 9306 mm.	cals of the sign is centered at ension from the cal of the sign $2^{2} = 5592$ mm.
STEF	The a m sha ≤ 3 E.g.	TAIN THE LENGTH OF PANELS e number of panels for each end component sh inimum. The length of the panel, b, for a given Il be a constant value, and within the following I 600 mm. ., B (LEFT) = 5592/2 = <u>2796</u> mm, and B (RIG <u>2</u> mm.	end component limits: $2250 \le b$
STE	93: CHI	ECK BOUNDARY CONDITIONS	
	(a)	The maximum length of the vertical support I of the footing to the centreline of the overhea 7500 mm.	• ·
	(b)	The dimension measured from the highes highway, EL.HP, to the bottom of the sign c be equal to or greater than 5600 mm.	-
	(c)	For statics and aesthetics reasons the ratillength of panel in both end components should be close to 1 as possible. The minimum recommon 0.9. A minor relocation of the sign component required. E.g., 2796/3102 = 0.9	ould be kept as nended value is
STE	94: CO	MPLETE THE STANDARD DRAWINGS	

Refer to 8.3 for Preparation of Drawings.

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CHANGEABLE MESSAGE SIGN SUPPORTS

# 8.3 **PREPARATION OF DRAWINGS**

#### 8.3.1 DATA REQUIRED

Prior to design, a "Key Plan and Frame Dimension" drawing(s) must be prepared to enable the working drawings to be detailed. This drawing(s) will form part of the contract document and must show for one or more structures, the following information:

- (1) A key plan, indicating the approximate location of each support.
- (2) The Structure ID number.
- (3) The support span measured from centreline to centreline of leg.
- (4) The control line or the centreline of the roadway, and the offset of the left leg from the control line.
- (5) The elevation of the highest point on the roadway surface under the support structure.
- (6) The dimension measured from the highest point on the roadway surface to the bottom of the sign component. This height shall not be less than 5600 mm.
- (7) The dimension measured from the top of footing to the centreline of the overhead truss. This dimension shall not exceed 7500 mm.
- (8) The top of footing elevation. This elevation can differ for each leg, if required. The elevation shall be a minimum of 300 mm above the ground line. This could be increased up to 500 mm in order to limit the column leg height as stated in (7).
- (9) The elevation of the ground line at each footing.
- (10) The offset of the centreline of each footing from the control line, either as a note or as a dimension.
- (11) The station of the support structure on a designated highway centreline or control line.
- (12) A designation for each footing as a "Left Footing" or "Right Footing". Left and Right for this purpose are defined as if looking in the direction of the traffic, as shown in Figure 8.1.3(a).

SIGN SUPPORT MANUAL				
2000 05 15	CHANGEABLE MESSAGE SIGN SUPPORTS	PAGE 8 - 9		
(13)	The footing type for each sign support footing (See 8.1 mounted footings, the dimension 'G' from the front fac protection barrier to the leg or the footing, whichever 8.1.5).	ce of the traffic		
(14)	<ul> <li>For the sign component, the following additional required:</li> <li>An outline in dashed line showing the sign component.</li> <li>The requested location of the sign component with centreline of the left column.</li> </ul>	nt,		
8.3.2 SIGN	I SUPPORT DRAWINGS			
follov SS11	If the supports are to be supplied and erected as part of a contract, the following Standard Drawings must be used: SS118-36, SS118-37 and SS118-38, for the structure; and SS118-6 and/or SS118-7 and/or SS118-8 for the footings. Up to 10 sign supports can be detailed on one sheet.			
inforr adde	The Appendix contains reduced prints of these drawings, showing what information needs to be added. The Contract and W.P. numbers should be added to the title block. The sheet number is added when the drawings for the entire contract are assembled.			
	ne SS118-36 there is a table to be completed on the draw vertical column of data is used for each sign.	ing. In the table		
The S	Standard Drawings shall be sealed, dated and signed acco	ording to 2.4.1.		
The	data required to complete Table 1 – <u>General</u> consists of th	e following:		
(i) (ii) (iii) (iv) (v)	Station Structure ID Number The support span measured from centrelines of support Truss Diagram. The electronic file of the standard draw contains schematic sign and end components drawn or that shall be used to fill this box. End Component (Left):	ving SS118-36,		
(v) (vi)	Type of Panel (P-1, P-2, P-3 or P-4) E (Left): dimension from centreline of left column to le of sign component. B (Left): length of panel End Component (Right): Type of Panel (P-1, P-2, P-3 or P-4)	eft end vertical		

SIGN SUPPORT MANUAL			
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	(vii) (viii) (ix) (x) (xi) (xi) (xii)	E (Right): dimension from centreline of right column vertical of sign component. B (Right): length of panel Elevation of the highest point on the highway under the shoulders, curbs and median, EL.HP Elevation at top of the left support footing, EL.P <sub>1</sub> Elevation at top of the right support footing, EL.P <sub>2</sub> Door Side (Left/Right). Left Footing Type (See 8.1.4) Right Footing Type (See 8.1.4)	Ū
8.4	MAIN	ITENANCE AND INSPECTION	
	requi	components must be inspected and maintained acc rements of OPSS 915, Construction Specification for tures.	
	and in the	term durability of sign supports is dependent on routinnspection. In order to prevent corrosion damage and fationase plate and the anchorage assembly, and to all ction of the assembly, the following shall be ensured:	gue problems to
	(i)	The base of the vertical support leg shall be kept fre debris	e from dirt and
	(ii)	The surrounding ground level shall be a minimum of 30 top of the footing	0 mm below the

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CHANGEABLE MESSAGE SIGN SUPPORTS

# 8.5 **DESIGN INFORMATION**

#### 8.5.1 GENERAL

Design and detailing data contained in this Division conforms to the requirements of the 1991 edition of the Ontario Highway Bridge Design Code unless otherwise stated.

Calculations are based on Standard CAN/CSA-G40.21-M92 Grade 350W structural steel, Alloy 6061-T6 aluminum extruded tube and plates, 30MPa concrete, and Grade 400 reinforcing steel for footings.

The maximum weight of the sign component, which includes the self-weight of the aluminum truss, shall not exceed 4500 kg.

All bolts, nuts and washers shall be stainless steel and conform to ASTM F593 Alloy 304 with a minimum yield of 480 MPa and a minimum tensile strength of 715 MPa.

Wind loads for fatigue design were obtained from a revision to AASHTO – 1994 Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals. These amendments were based on a number of reports including "Fatigue Resistant Design of Cantilevered Signal, Sign and Light Supports." National Cooperative Highway Research Program. Final Report – NCHRP Project 10-38.

#### 8.5.2 DESIGN DIMENSIONS

The design dimensions for the CMS sign supports found in the Standard Drawings were developed by determining the member responses under various design spans and wind loads. Member responses were checked for ultimate, serviceability and fatigue limit states. The analysis was then confirmed with the use of a three-dimensional finite element model.

#### 8.5.3 DEFLECTIONS

The deflections for both vertical and horizontal members are limited for clearance concerns as well as for aesthetic purposes. Vertical members are restricted to 1% (L/100), and horizontal members are restricted to 2% (L/50) lateral movement. Both limitations are well within the suggested limits provided in AASHTO's "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", 1994, which allows 2.5% lateral movement or 1°40' angular rotation from the centreline at the top of the structure in relation to the centreline at its base.

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CHANGEABLE MESSAGE SIGN SUPPORTS

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# 8.5.4 FOUNDATIONS

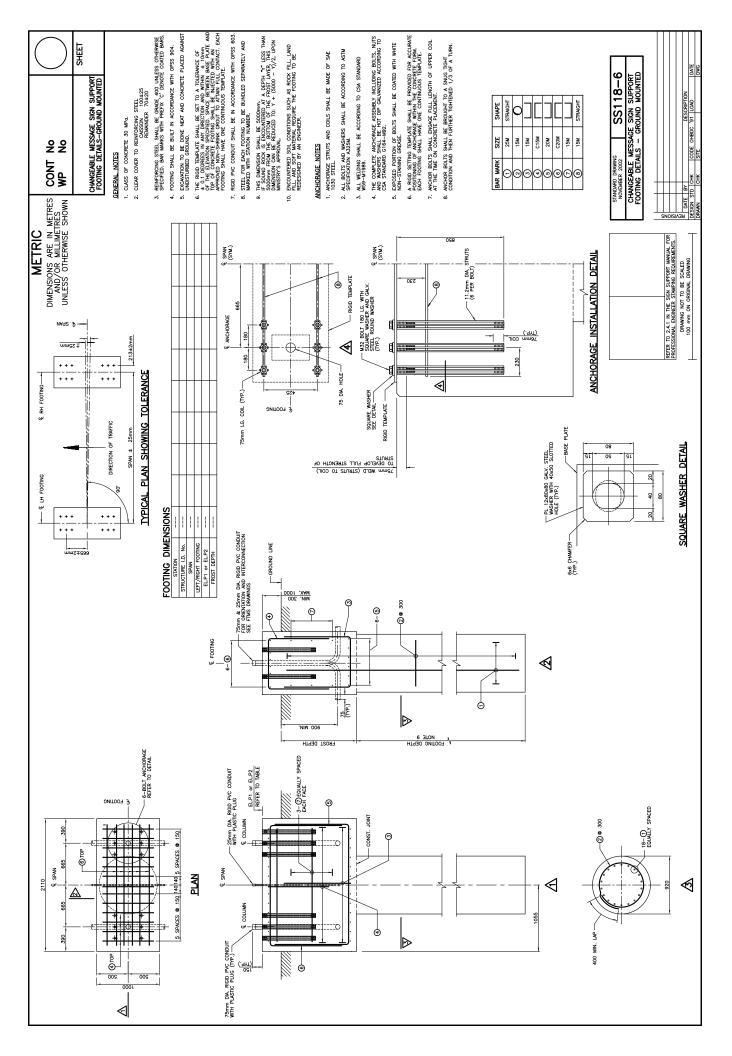
The caisson foundations were modelled in S-Frame as beam elements with spring constants representing earth pressure. Springs constants in the dead load direction (for sustained load) were assumed to be 1/3 the value of those in the live load direction (for instantaneous load). Any resisting earth pressure in the frost depth layer was discounted.

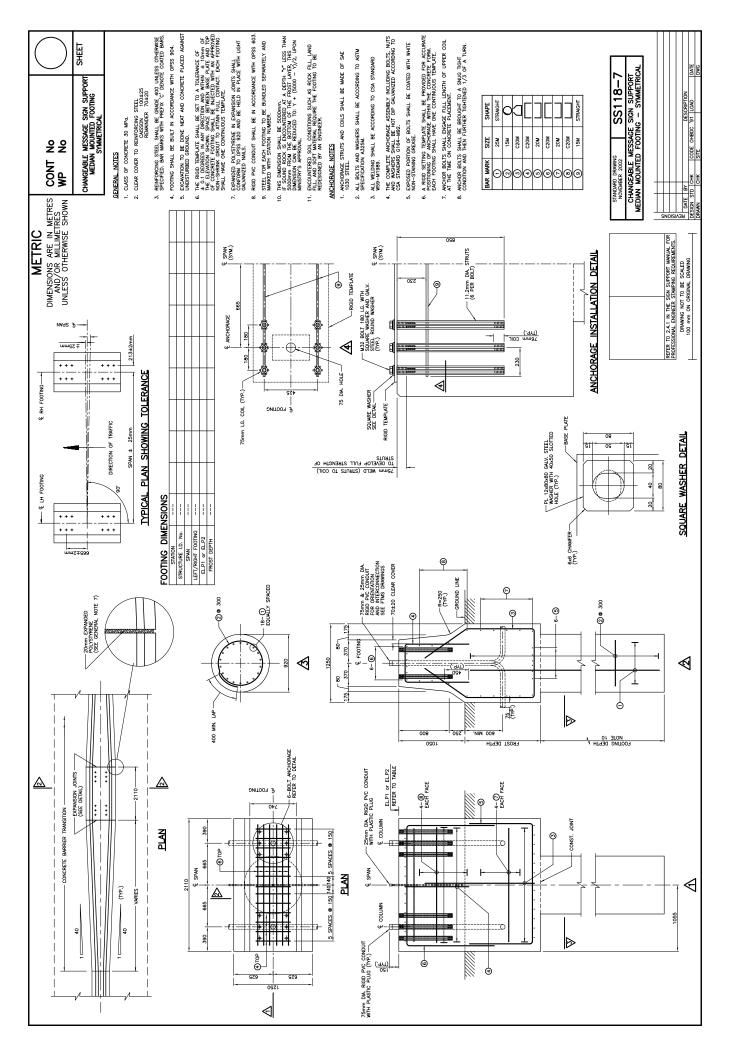
Assumed soil parameters below the frost layer are as follows:

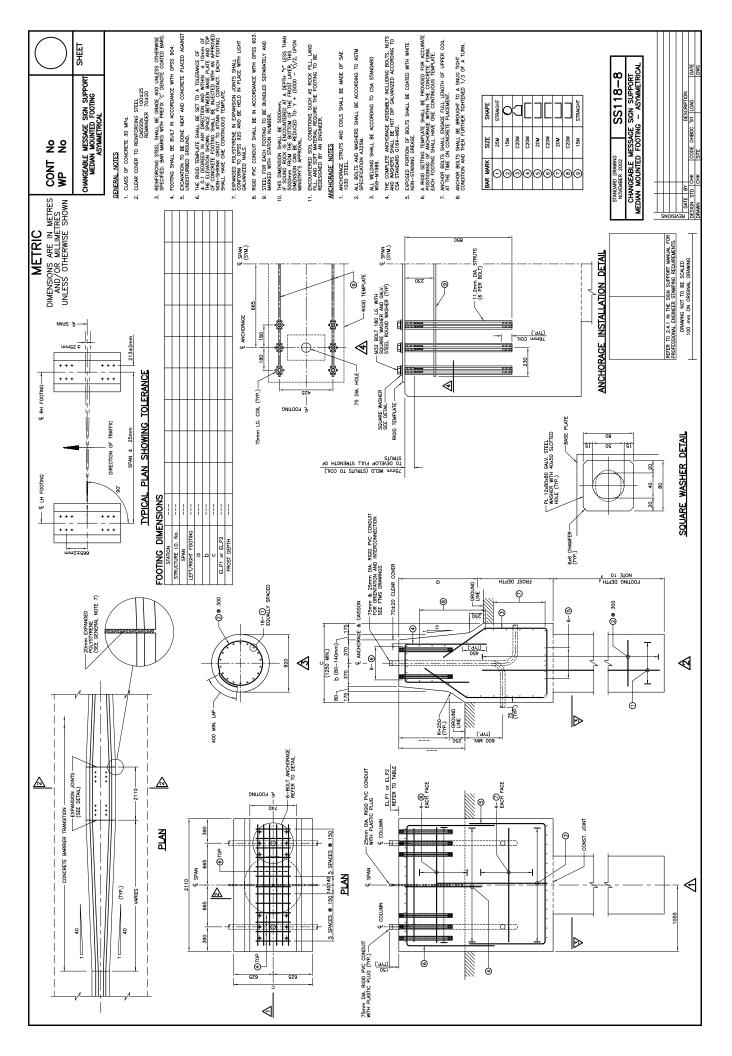
		CASE 1 (Sand)	CASE 2 (Soft clay)
LENGTH OF CAISSON BELOW FROST LAYER	Upper 2/3	M = 28 °	C <sub>u</sub> = 25 kPa
LENG: BELOV	Lower 1/3	M = 30 °	C <sub>u</sub> = 50 kPa

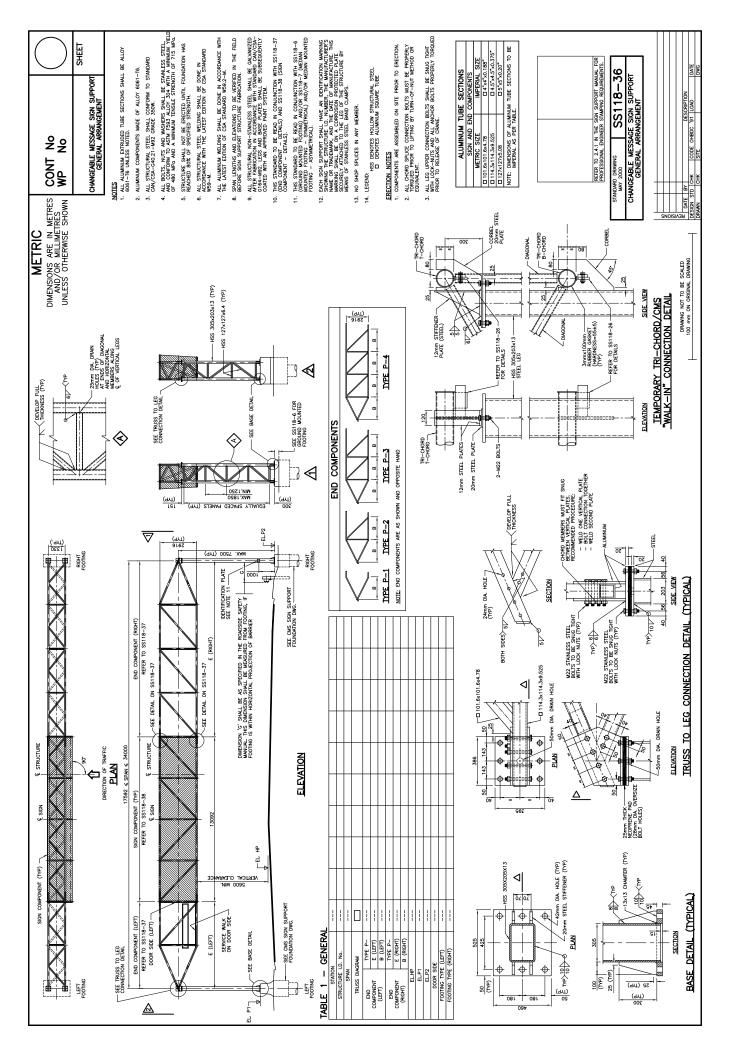
SIGN SUPPORT MANUAL					
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	APPENDIX TO DIVISION 8				
	CHA	NGEABLE MESSAGE SIGN SUPPORTS			
s	SS118-6 CHANGEABLE MESSAGE SIGN SUPPORT FOOTING DETAILS - GROUND MOUNTED				
S	S118-7	CHANGEABLE MESSAGE SIGN SUPPORT MEDIAN MOUNTED FOOTING - SYMMETRI	CAL		
S	S118-8	CHANGEABLE MESSAGE SIGN SUPPORT MEDIAN MOUNTED FOOTING - ASYMMET	RICAL		
S	S118-36	CHANGEABLE MESSAGE SIGN SUPPORT GENERAL ARRANGEMENT			
		CHANGEABLE MESSAGE SIGN SUPPORT END COMPONENT - DETAILS			
<b>SS118-38</b> CHANGEABLE MESSAGE SIGN SUPPORT SIGN COMPONENT - DETAILS					

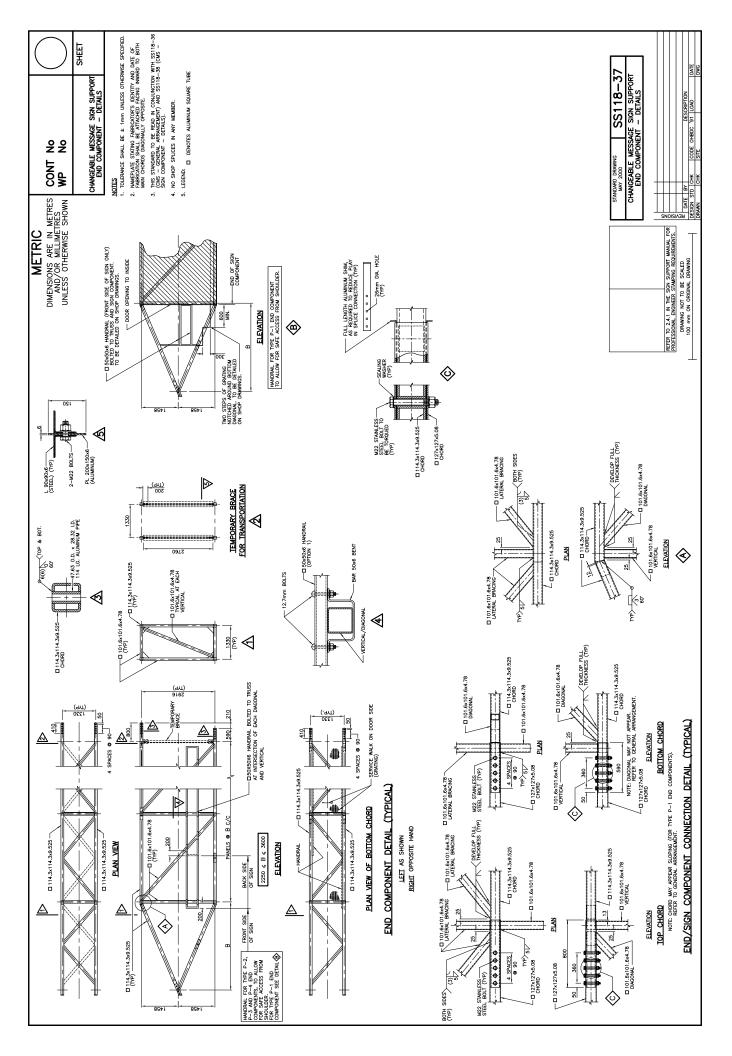
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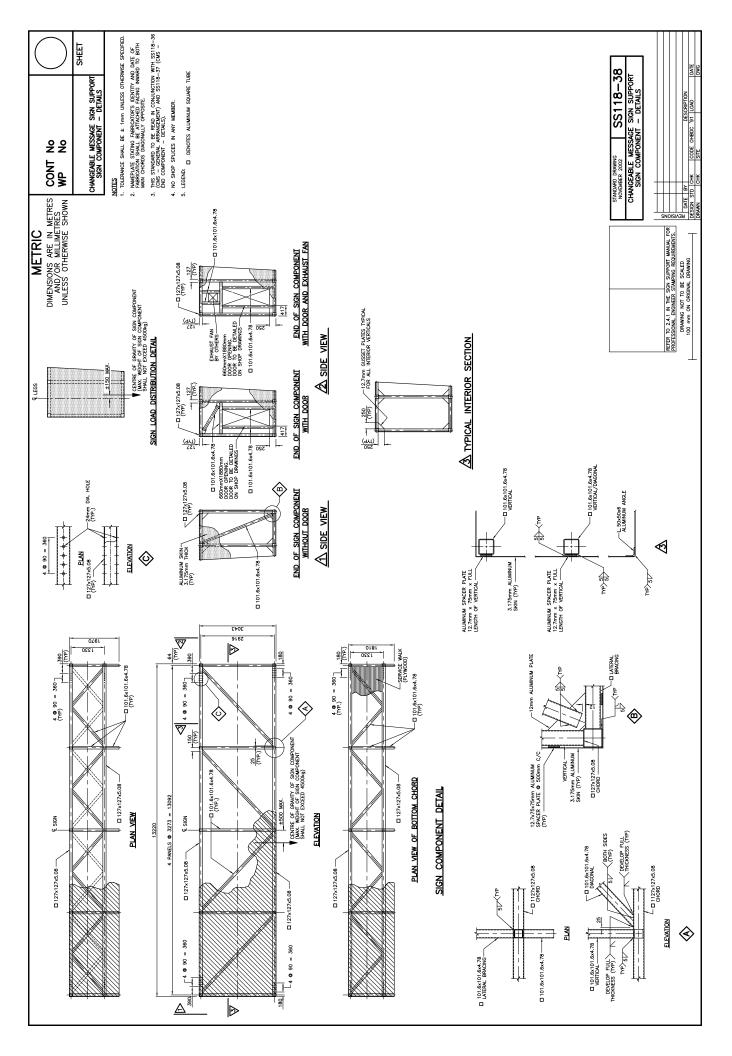












**DIVISION 9 - BRIDGE MOUNTED SIGN SUPPORTS** 

September 2004

2004 09 13

**BRIDGE MOUNTED SIGN SUPPORTS** 

#### 9 BRIDGE MOUNTED SIGN SUPPORTS

#### 9.1 <u>GENERAL</u>

#### 9.1.1 STANDARD SIGN SUPPORT

Bridge mounted sign supports are used when it is convenient and economical to mount overhead signs on bridges.

For bridges skewed more than 15 degrees, the signs shall be cantilevered from the bridge on a skewed sign support structure to ensure that the sign remains nearly perpendicular to oncoming traffic (Type IV sign support). Generally signboards are kept to within 15 degrees of normal to the direction of oncoming traffic.

#### 9.1.2 DESCRIPTION OF SIGN SUPPORTS

The sign supports main components, the top and bottom chords, the walk arm assembly, the grating and the hinge support pipe are all made of aluminum. To prevent a chemical reaction from occurring between the concrete of the bridge and adjoining aluminum components, neoprene spacers are used. Sign supports are fastened to the bridge using stainless steel anchors.

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**BRIDGE MOUNTED SIGN SUPPORTS** 

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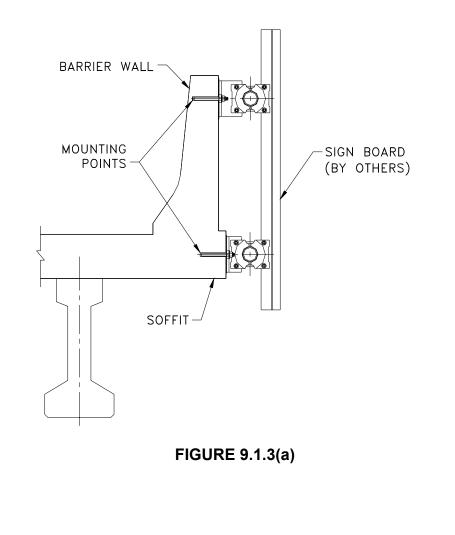
# 9.1.3 TYPES OF SIGN SUPPORTS

Four types of bridge mounted sign supports are used:

TYPE I – Standard Drawings SS118-12 and SS118-13

This type of sign support requires 3 mounting points and is shown in Figure 9.1.3(a). This support type is generally used when a barrier wall is available and when a walkway is not required. The top chord is mounted directly to the barrier wall. The bottom chord is mounted directly to the curb face. A third connection point is located on the deck soffit.

Note that this arrangement has a minimal clearance of approximately 330 mm between the sign and the bridge face, therefore resulting in a very difficult installation, often requiring lane closures, traffic detours and special equipment.



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**BRIDGE MOUNTED SIGN SUPPORTS** 

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#### TYPE II- Standard Drawing SS118-14 and SS118-15

This sign support structure requires two mounting points, as shown in Figure 9.1.3(b). This support type is generally used when a barrier wall is not available and when a walkway is required. The top and bottom chords are mounted to a vertical strut, which in turn is anchored to the curb face. The second mounting point is located on the deck soffit.

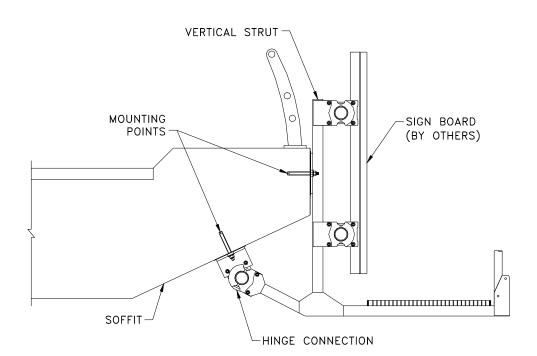


FIGURE 9.1.3(b)

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**BRIDGE MOUNTED SIGN SUPPORTS** 

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#### TYPE III -Standard Drawing SS118-16 and SS118-17

Type III bridge mounted sign support structures require three mounting points, as detailed in Figure 9.1.3(c). This support type is generally used when a barrier wall is available and when a walkway is required. The top and bottom chords are fastened to a vertical strut which in turn is attached to the bridge at two mounting points, on the barrier wall and at the level of the curb face. A third mounting point is located on the deck soffit.

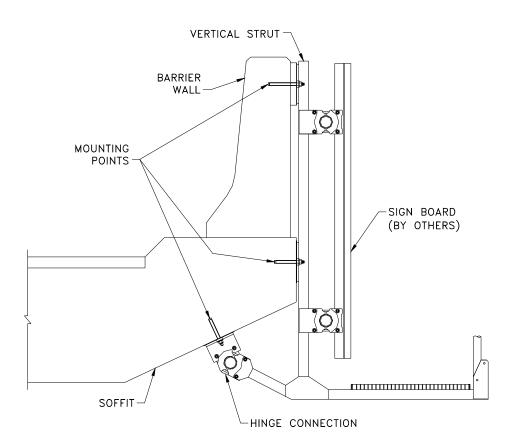


FIGURE 9.1.3(c)

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**BRIDGE MOUNTED SIGN SUPPORTS** 

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#### TYPE IV -Standard Drawing SS118-18 and SS118-19

This type of "tapered" support is used when there is a significant skew angle (bridge skew greater than 15°). The approximate distance between the back of the sign board and the face of the bridge deck may vary up to 1800 mm as shown in Figure 9.1.3(d). Walkways form part of the structure. The tapered truss is fastened to a vertical strut at two points, which itself is anchored to the barrier wall, curb face and deck soffit.

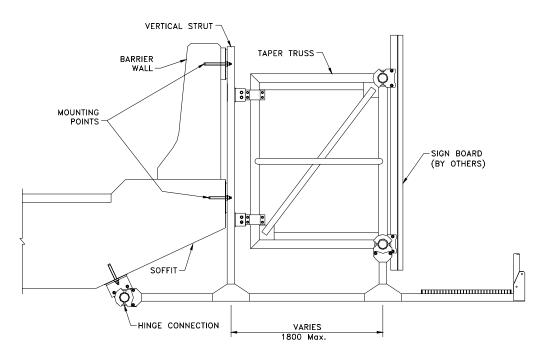


FIGURE 9.1.3(d)

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# **BRIDGE MOUNTED SIGN SUPPORTS**

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# 9.1.4 CLEARANCE

The clearance provided to bridge mounted sign supports must exceed the clearance to the supporting bridge. The roadway clearance to the small lane designation signs (915 mm wide by 610 mm high) attached to the bottom of sign support structures is 4650 mm.

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# **BRIDGE MOUNTED SIGN SUPPORTS**

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#### 9.2 **PREPARATION OF DRAWINGS**

#### 9.2.1 DATA REQUIRED

Before sign supports can be detailed a full cross-section and plan of the bridge is required to show the following data:

- (i) The station of the bridge.
- (ii) The bridge clearance.
- (iii) The bridge drawings.
- (iv) The skew of the bridge.
- (v) Direction of traffic; for sign board(s) to be mounted on the bridge (i.e. North Bound, South Bound, etc.).
- (vi) Dimension from centre line of sign board(s) to fixed point(s) on the bridge or highway (e.g. pier, abutment, painted lane markings, etc.).
- (vii) Dimension of sign board(s).

#### 9.2.2 SUPPORT DRAWINGS

The standard drawings for Types I, II and III sign supports are to be used when the skew of the bridge is less than 15 degrees. Each of these drawings contains one elevation and one detail drawing.

The standard drawings for Type IV sign supports are to be used when the skew of bridge exceeds 15 degrees. These drawings consist of two detail drawings each. An elevation of the structure must be added by the user.

The elevation must show the relationships between the bridge, the sign and the roadway. A site plan, typical cross-section and an enlarged front elevation showing all components is normally included, as illustrated in Figure 9.2.2(a).

Mylar copies of the standard drawings are to be completed in accordance with the following procedure:

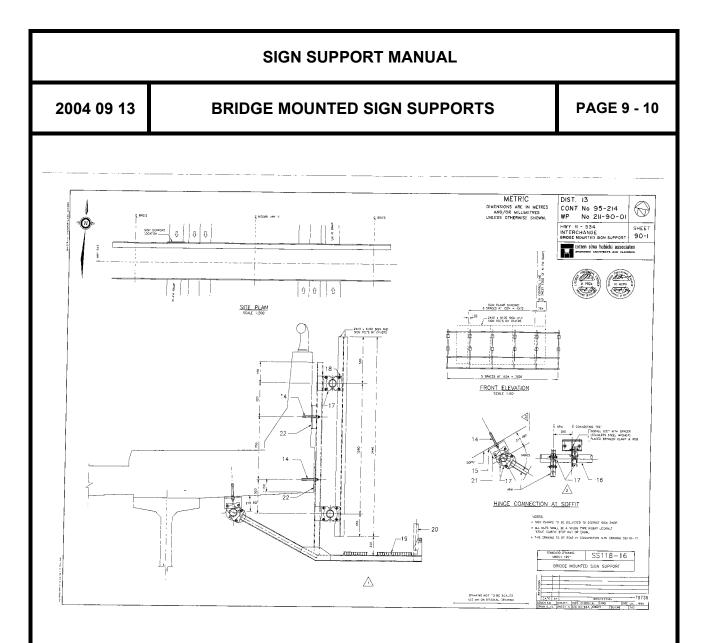
(i) Add the bridge name and/or the intersection, contract number and W. P. number in the title block.

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(ii)	Show on the front elevation, the outline and dimensions of each sign board. Use broken lines since the signs are not part of the contract. The position of the sign should be dimensioned from the vertical centreline of the sign board to a fixed point, and from the centreline of the lower chord to the bottom of the sign board according to the following table.			
	SIGN DEPTH (mm)	DIMENSION (mm)		
	1525	300		
	1830	350		
	2130	400		
	2440	450		
	2740	500		
(iii)	Indicate the size of each sign and that they are not part of the contract (1830 x 6400 -SIGN BY OTHERS). Draw the service walkway on the front elevation. Service walkways; allow maintenance staff access; to luminaries and sign boards; without interference to traffic. The service walkway must extend from the shoulder area (usually the right shoulder) to the remote edge of the sign board. The service walkways are composed of 1524 mm (5 foot) long grating units supported by walk arms. The walk arm is part of the "Service Walk Arm Assembly"; other parts of this assembly include the vertical strut and the brace. This assembly is mounted to the face of the bridge deck, soffit and barrier wall, as; detailed in Section 9.1.3. Walkways should be extended by at least 750 mm beyond the ends of the sign board for safety and future considerations.			
(iv)	The railing should be drawn Railings are available in two 8A) and 3810 mm (3 posts extends over one 1524 mm	) lengths, 3050 mm (2 s, BD-221-045-10A). T i (5 foot) grating unit a	posts BD-221-045- he two post railing and halfway across	

8A) and 3810 mm (3 posts, BD-221-045-10A). The two post railing extends over one 1524 mm (5 foot) grating unit and halfway across each of the two adjacent units (do not use this two post railing to end a walkway). The three post railing extends over two 1524 mm (5 foot) grating units and halfway across the right-hand adjacent unit. The three post railing is used only on the left hand end of a service walkway when the service walkway has an even number of grating units. When an uneven number of grating units are used, either add one more 1524 mm (5 foot) grating unit or modify a three post unit into a two post end railing.

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(v)	Draw the vertical centre lines of the sign clamps on the front elevation. Print along a dimension line above each sign the number, size and spacing. The spacing is normally 1524 mm (5 feet) to coincide with the spacing of the vertical strut clamps which are normally offset by 762 mm (vary to suit individual situation, minimum 250 mm). The following table gives the limits for overhangs, measured from the centre line of the sign clamp to the edge of the sign board.			
	SIGN SIZE/TYPE	<u>MAXIMUM</u> (mm)	MINIMUN (mm)	Δ
	2740 mm deep	750	150	
1524 to 2440 mm deep 915 150				
	2740 mm deep, and bevelled end 150 150			
	150			

- (vi) To assist the user in the completion of these standard drawings, instructions have been added to the reduced copies included in this Manual. Explanatory notes with arrows indicating the specific area of the drawing to which they apply are provided. These instructions do not appear on the production versions of the standard drawings, and must not appear in the contract.
- (vii) Assign a Figure number from the "Part List" on the "Service Walk Arm Assembly" drawing to all items not already numbered. Show the Figure numbers against the item in an appropriate location with an arrow from the number to the item.



# FIGURE 9.2.2(a) GENERAL LAYOUT DRAWING

**BRIDGE MOUNTED SIGN SUPPORTS** 

#### 9.3 PROCESSING

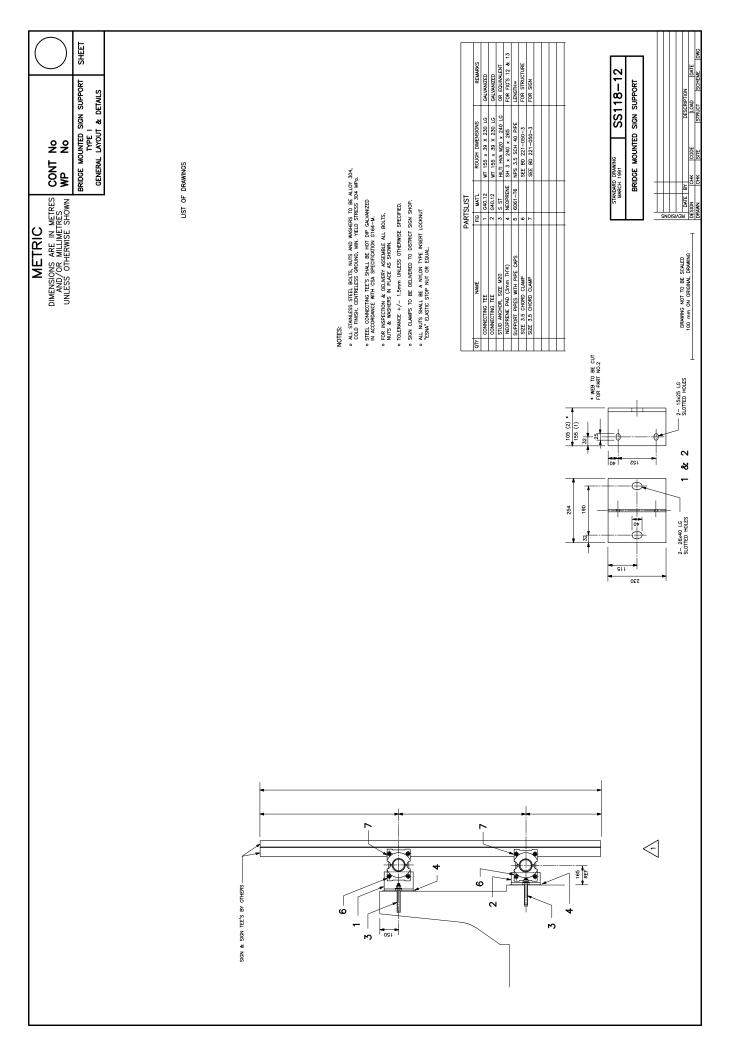
# 9.3.1 PREPARATION OF ELECTRICAL DRAWINGS

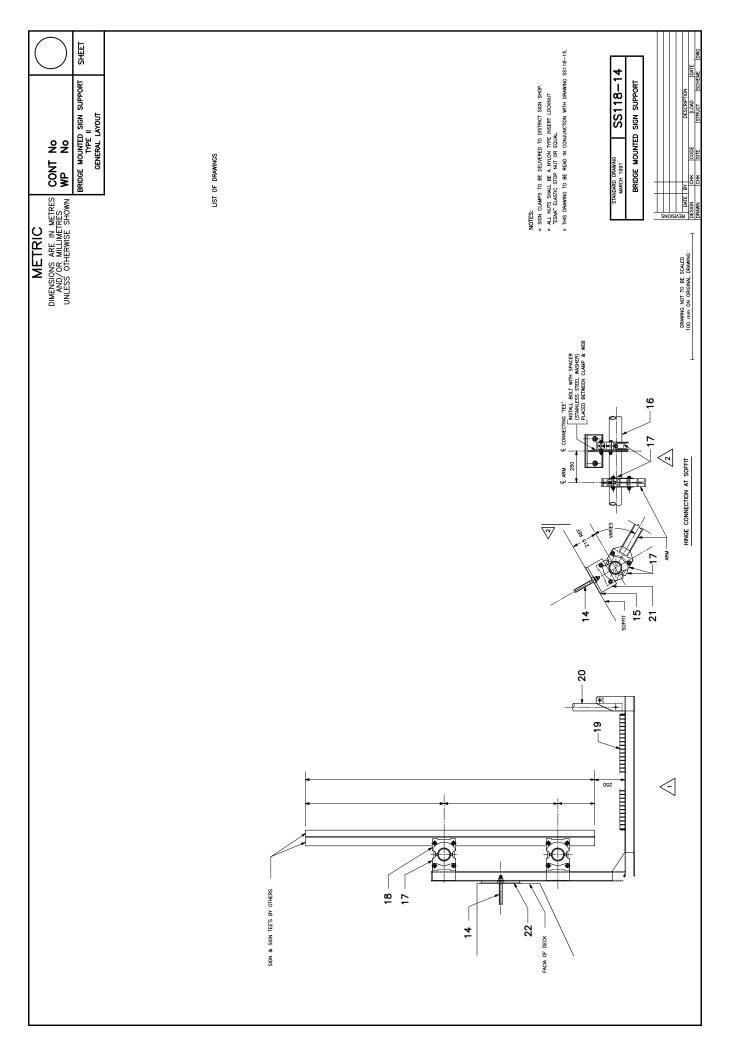
When illumination is required as described in Section 2.5.1, the electrical wiring for the bridge mounted signs is to be supported by the bridge.

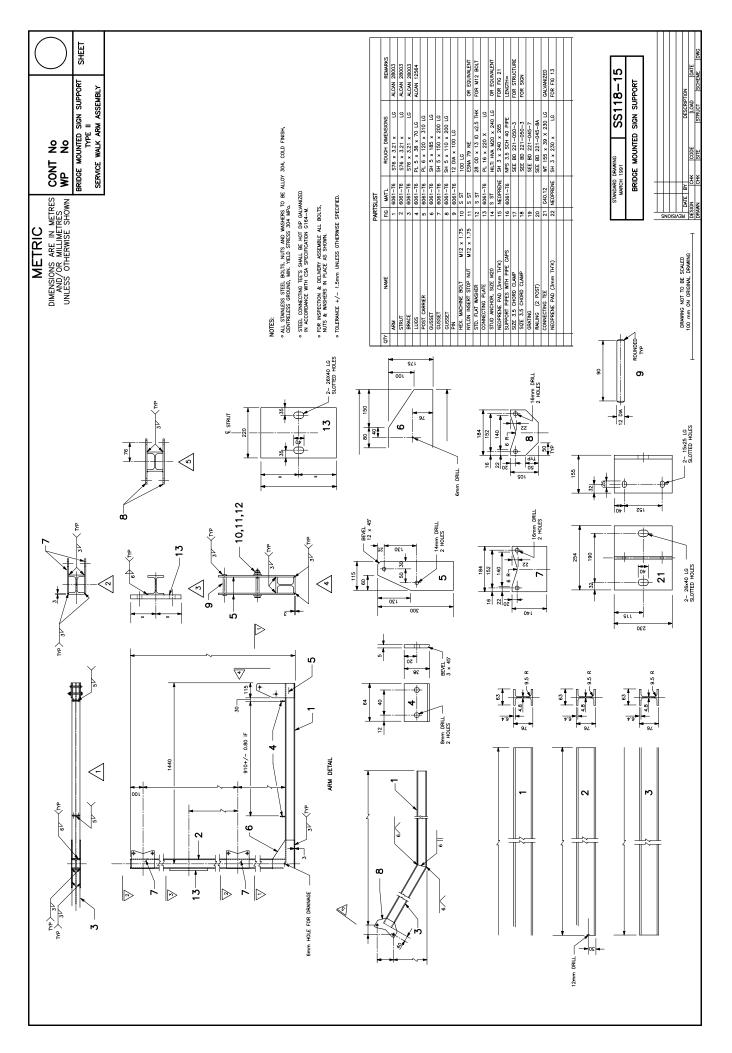
For new bridges, it is desirable to have the electrical work embedded in concrete. Therefore it is important that the type and location of the sign support be decided upon in time for inclusion of electrical work in the structural design process.

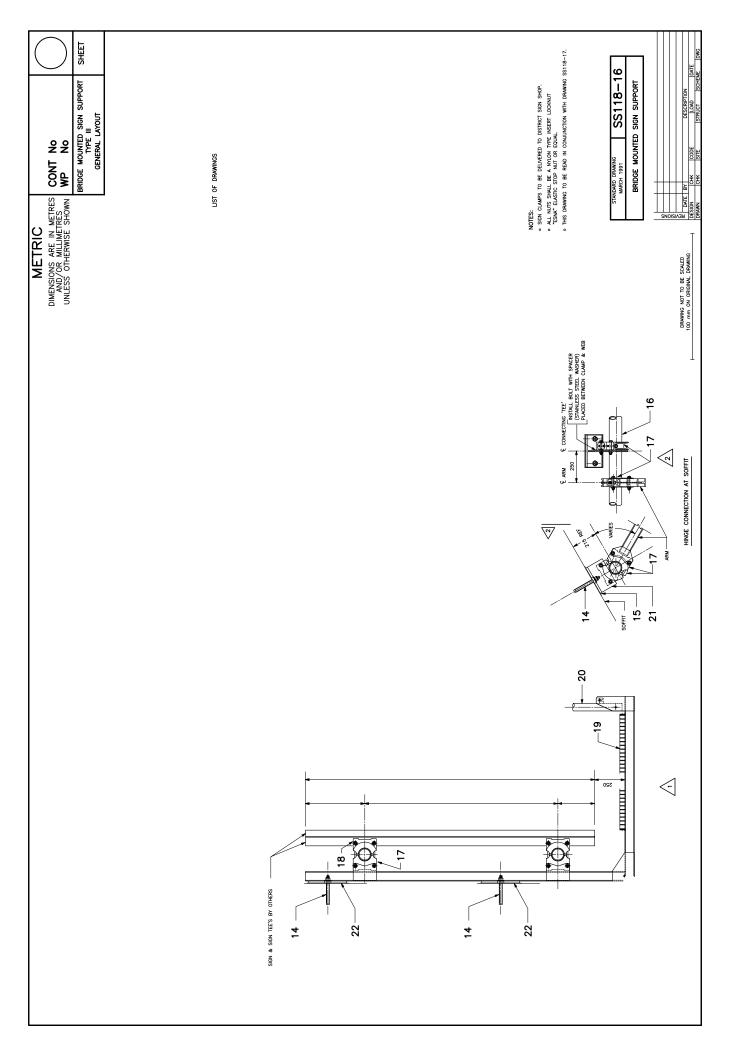
2004 09 13

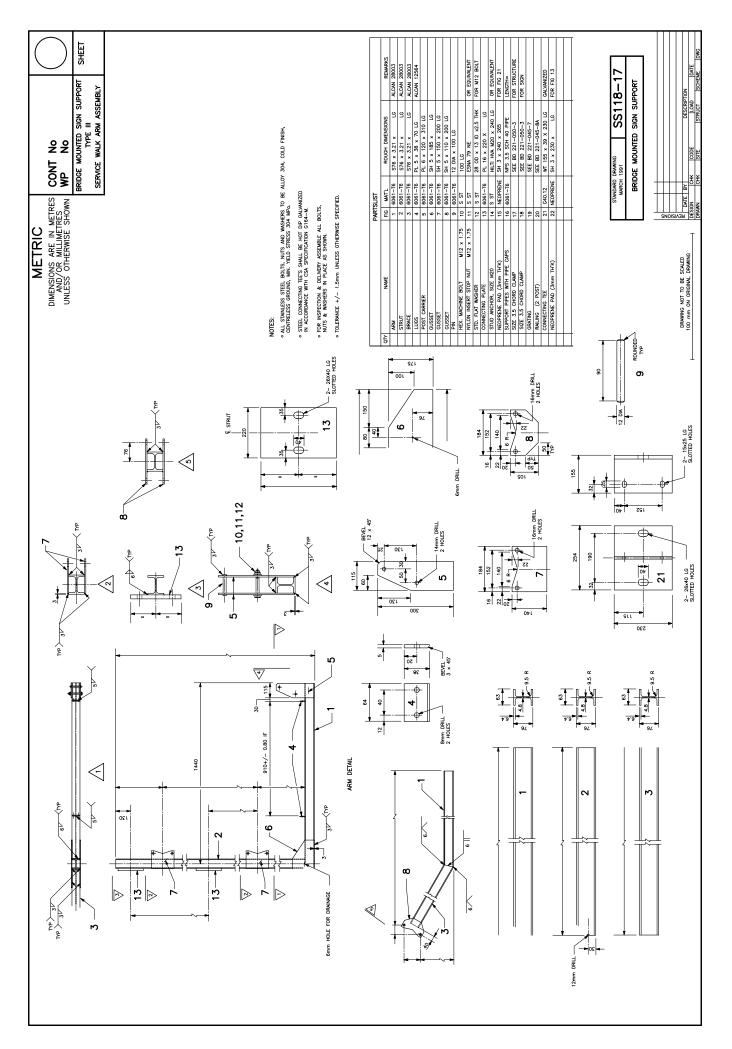
SIGN SUPPORT MANUAL			
2004 09 13	BRIDGE MOUNTED SIGN SUPPORTS	PAGE 9 - 12	
	APPENDIX TO DIVISION 9		
	BRIDGE MOUNTED SIGN SUPPORTS		

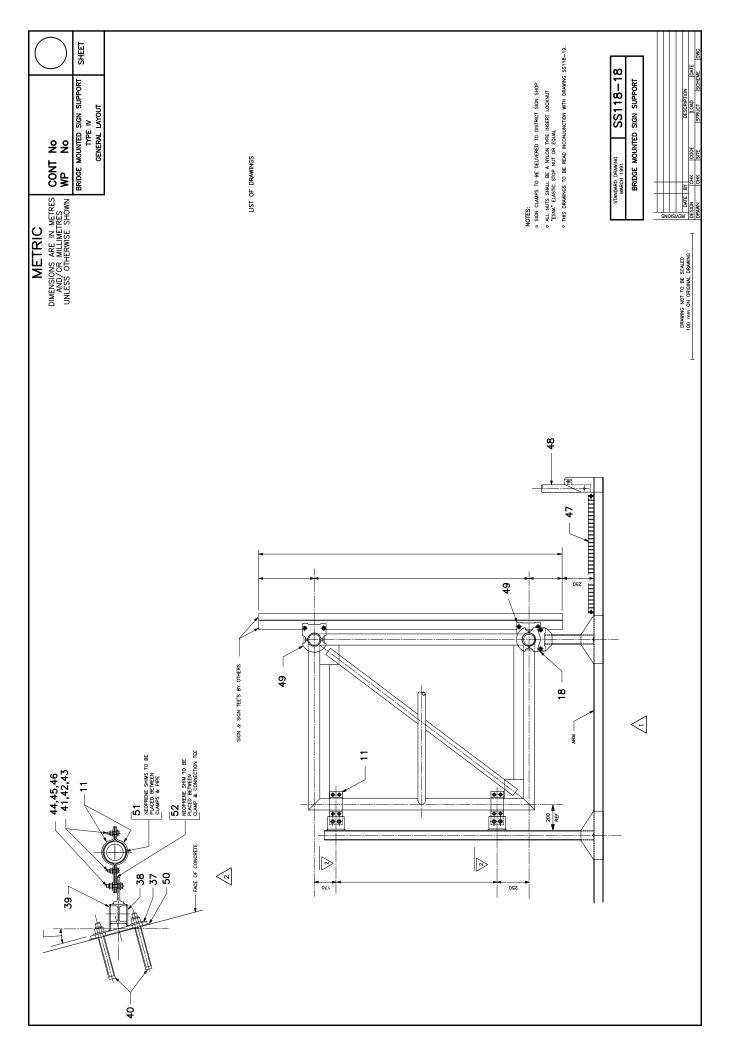


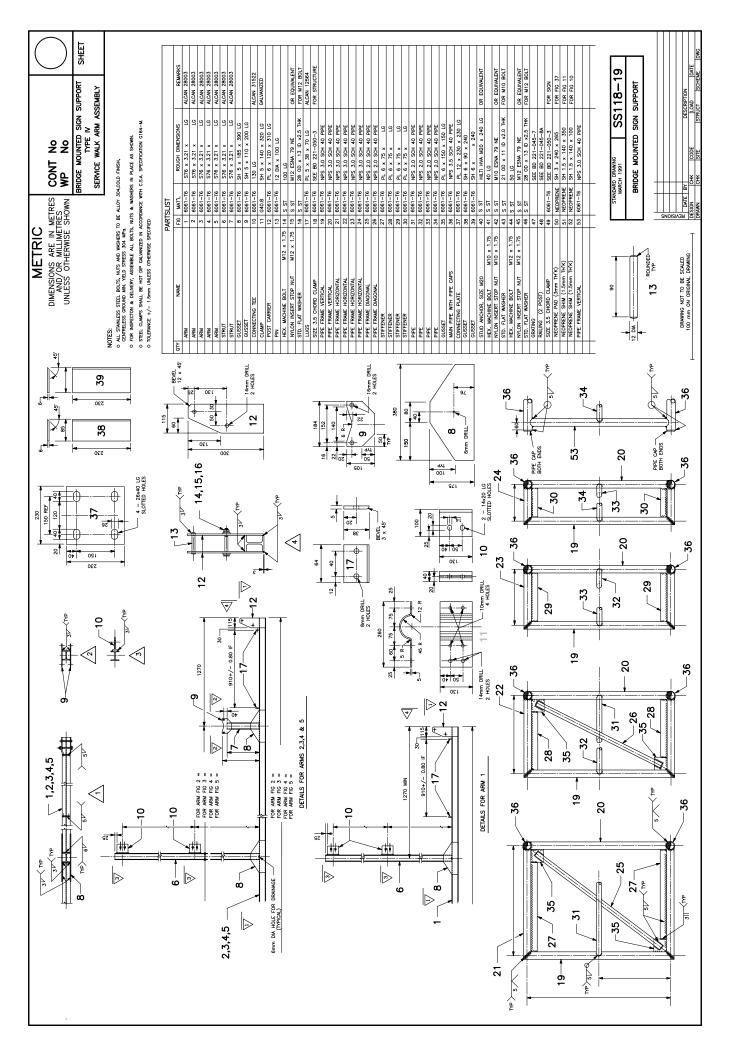












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