Ontario

Book 3

Ontario Traffic Manual

February 2022

Ground-mounted Sign Support and Installation

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Ontario Traffic Manual

Foreword

The purpose of the Ontario Traffic Manual (OTM) is to provide information and guidance for transportation practitioners and to promote uniformity of treatment in the design, application and operation of traffic control devices and systems across Ontario. The objective is to increase safe driving behaviour, achieved by a predictable roadway environment through the consistent, appropriate application of traffic control devices. Further purposes of the OTM are to provide a set of guidelines consistent with the intent of the Highway Traffic Act and to provide a basis for road authorities to generate or update their own guidelines and standards.

The OTM is made up of a number of Books, which are being generated over a period of time, and for which a process of continuous updating is planned. Through the updating process, it is proposed that the OTM will become more comprehensive and representative by including many traffic control devices and applications specific to municipal use. Some of the Books of the OTM are new, while others incorporate updated material from the Ontario Manual of Uniform Traffic Control Devices (MUTCD) and the King's Highway Guide Signing Policy Manual (KHGSPM).

The OTM is directed to its primary users, traffic practitioners. The OTM incorporates current best practices in the Province of Ontario. The interpretations, recommendations and guidelines in the OTM are intended to provide an understanding of traffic operations and they cover a broad range of traffic situations encountered in practice. They are based on many factors which may determine the specific design and operational effectiveness of traffic control systems. However, no manual can cover all contingencies or all cases encountered in the field. Therefore, the field experience and knowledge of traffic practitioners are essential in deciding what to do in the absence of specific direction from the Manual itself and in overriding any recommendations in this Manual.

The traffic practitioner's fundamental responsibility is to exercise engineering judgement and experience on technical matters in the best interests of the public and workers. Guidelines are provided in the OTM to assist in making those judgements, but they should not be used as a substitute for judgement.

Design, application and operational guidelines and procedures should be used with judicious care and proper consideration of the prevailing circumstances. In some designs, applications, or operational features, the traffic practitioner's judgement is to meet or exceed a guideline while in others a guideline might not be met for sound reasons, such as space availability, yet still produce a design or operation which may be judged to be safe. Every effort should be made to stay as close to the guidelines as possible in situations like these, to document reasons for departures from them, and to maintain consistency of design so as not to violate driver expectations.

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1. Introduction

OTM Book 3 (Ground-mounted Sign Support and Installation) is part of a series of volumes that makes up the Ontario Traffic Manual (OTM). Book 3 describes practical methods and guidelines for selecting materials and designing suitable support structures for ground-mounted signs and techniques for installing ground-mounted signs. OTM Book 3 does not address overhead signs or overhead sign structures. Overhead sign structures, including signs mounted on traffic signal mast arms and bridge spans, are addressed in the Ministry of Transportation's (MTO) Sign Support Manual (SSM). Book 3 is intended for those engaged in the actual practice of designing and fabricating ground-mounted sign support structures and installing ground-mounted signs.

OTM Book 3 does not provide detailed information for the design and fabrication of individual signs. For this purpose, reference should be made to Book 2 (Sign Design, Fabrication and Patterns). Book 2 addresses the design and fabrication of traffic signs. OTM Book 4 (Ground-mounted Sign and Support Inspection and Maintenance) addresses sign and sign support inspection and maintenance for ground-mounted signs.

Other Books in the OTM series provide practical guidance on a full range of traffic control devices and their application. A complete listing of the planned and currently available Books is found in OTM Book 1. Other documents, not in the OTM series, are also useful. The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads along with the MTO Design Supplement and the MTO Roadside Design Manual (RDM) 2017 also provide guidance. These, and other references, are listed in Appendix B (References).

1.1 Purpose and Scope

OTM Book 3 (Ground-mounted Sign Support and Installation) has been developed both to improve uniformity among agencies having experience and knowledge of sign support and installation and to provide direction and guidance on procedures for agencies having little experience in these areas. Book 3 is intended for use by the following agencies and organizations:

(1) The Provincial, Municipal, and private road authorities in Ontario and their contractors.

(2) Utilities, contractors, and others who may have approval to work on public roadways.

OTM Book 1B and OTM Book 8 (Guide and Information Signs) provide sign position guidance for the roadside including sign offsets and heights. They recommend that breakaway or yielding supports should be used, but do not provide detailed material specifications for signs and supports. OTM Book 3 provides design guidance and details for all ground-mounted signs requiring one or more non-breakaway or breakaway wooden posts or steel column supports, but does not address overhead or cantilevered signs. The MTO SSM (2019) provides design guidance and details for sign supports for overhead and cantilevered signs, including signs on traffic signal mast arms and on bridge spans. The MTO RDM (2017) recommends that breakaway sign supports be used when installed within the clear zone. The MTO Maintenance Manual (2003), Best Practice MBP-604, provides general guidance for the supply, installation, and repair of signs on wooden and steel posts, but does not provide detailed material specifications for the signs and supports.

Sign installation must be carried out in a safe environment and a safe manner. OTM Book 7 (Temporary Conditions - Office Edition) is the Ontario standard addressing work zone traffic control and safety, and its procedures are applicable to sign installation. Book 7 is referenced in Book 3 where appropriate.

OTM Book 3 addresses ground-mounted signs. For the purposes of Book 3, large signs are those which are greater than 7.2m² in area. (Sections 2.2, 2.3 and 2.4). Intermediate ground-mounted plywood signs are considered to be signs with areas between 3.6m² and 7.2m² (Section 2.4.1). Small signs are those which are less than or equal to 3.6 m² in area. (Sections 2.5).

1.2 Legal Authority – Signs

MTO, through the Highway Traffic Act (HTA), the Public Transportation and Highway Improvement Act, and various related statutes, has the legal authority and responsibility to regulate and control traffic on a provincial highway (see definition), and to regulate and control motor vehicles operating in the province. MTO has contracted the maintenance of provincial highways under a series of Maintenance Contracts, which include performance specifications for the maintenance of roadside features including regulatory, warning and information signing (PERF 4001 Roadside Features).

Municipalities, through the Municipal Act and various regional municipality acts, and as empowered to enact municipal by-laws through various provisions of the Highway Traffic Act and other provincial acts, have the legal authority and responsibility to regulate and control traffic on their highways. This authority and responsibility also applies to construction and maintenance activities on highways. The Ontario Municipal Act (Ontario Regulation 239/02 as amended), specifies minimum maintenance standards for municipal roads in Ontario. Traffic signs and other devices to regulate, warn or guide traffic are to be installed only under the authority of the road agency having jurisdiction.

When they have been delegated or designated authority, work zone contractors and utility companies may be permitted to install temporary conditions signs and devices, or to use traffic control persons to protect road users, the public, workers and equipment. This is subject to the guidelines of OTM Book 7, the Occupational Health and Safety Act and its regulations, and the requirements of the road authority.

Contractors may be authorized by the road authority to slow upstream traffic (e.g., rolling closures). The contractor may also implement short-term road closures, as authorized by the road authority. As the use of police to slow traffic or to implement road closures is not a legal requirement, it is the road authority's decision whether to use contractor staff or police for these operations.

Regulatory devices may need to be supported by applicable legislation, regulations, or by-laws. Effective traffic control requires both the appropriate application of traffic control devices and reasonable, effective enforcement.

Where the use of prescribed or official signs is required by the HTA or the Regulations under the HTA, such signs may be erected by the public authority having jurisdiction over the particular highway, or by its agent. However, in the cases set out more particularly in the HTA, where a municipal by-law is required, the prescribed or official sign indicated must not be erected without the authority of such a by-law.

Signs may not be placed on a public highway by private organizations without the approval of the road authority. All unauthorized signs should be removed by an authorized agent of the road authority, since they divert attention from authorized signs.

This, however, does not prohibit authorization for the erection of temporary conditions signs by public utility companies without obtaining specific permission in each case. Temporary conditions signs and devices required to protect workers and equipment engaged in maintenance or repair work on a public highway do not need specific permission, provided that they conform to the manual standards as to size, shape, and colour. Slight deviations are permissible if found more effective and if they are approved by the proper road authorities. Temporary conditions devices and the policies pertaining to their use and maintenance are found in OTM Book 7 (Temporary Conditions).

Traffic signs, or their supports, should not bear unauthorized commercial advertising.

1.3 Standardization

1.3.1 Standardization of Position

Signs must, in all cases, be placed in the most advantageous position and must be suitable to the roadway design and alignment. (See OTM Book 1B (Sign Design Principles) and OTM Book 3, Section 3 with respect to longitudinal, lateral, and vertical sign positioning).

1.3.2 Standardization of Application

Uniformity of application is important. Similar conditions should be treated in a similar manner, to accommodate driver expectation.

The OTM sets forth criteria for the application of most types of traffic control devices. It is impossible to set up specifications that apply to every case, or to cover every possible situation. The proper signing and signalization of roads depends, to a great extent, on the experience and good judgement of the engineer or other traffic official responsible for placement, installation and maintenance of traffic control devices.

Similar conditions in urban and rural areas, in general, should be treated in the same manner. It is recognized that urban conditions differ from rural conditions with respect to: speed; frequency of intersections; traffic congestion; parking; use of road space by other vehicles and pedestrians; and other lights and displays competing for the road user's attention. In such instances, traffic control devices must be appropriately applied and located. Where practical, the OTM sets out guidelines for both rural and urban areas.

Before any new highway, street, detour or temporary route is opened to traffic, all necessary traffic control devices must be in place.

Local traffic control device requirements should be reviewed on a regular basis, including when there are significant changes in the traffic characteristics of a roadway, and including those relating to construction and temporary conditions. Signs required by road conditions or traffic restrictions must be removed when those conditions cease to exist or the restrictions are removed. Guide signs directing traffic to and along temporary routes or detours must be immediately removed when no longer applicable.

Sign installation and sign support structures are addressed in the following construction specifications:

- Ontario Provincial Standard Specification OPSS. PROV 915 and/or OPSS.MUNI 915 – Sign Support Structures; and
- Standard Special Provision OPSS 703 – Permanent Small Signs and Support Systems.
- Standard Special Provision OPSS 709 - Permanent Intermediate Small Signs and Supoort Systems.

1.4 Decision Process Sequence

Two early and important decisions on sign support selection are:

(1) Breakaway or Non-breakaway Supports (Section 1.4.1)

(2) Steel or Timber Supports (Section 1.4.2)

The purpose of this section is to provide an overview of the types of sign support available and to guide the user through the process of selecting the appropriate sign support for their needs. Sign supports covered in OTM Book 3 are limited to roadside signs using ground-mounted support systems singly or in groups. Signs supported on this type of support range in size from the smallest signs up to those with a width of no more than 2.4m and a height of no more than 3.0m for a maximum area of 7.2m^2.

Types and configurations of sign supports include:

- Timber square or rectangular sections singly or in groups;

- Steel U sections singly or in groups;
- Steel square sections singly or in groups;
- Steel W sections normally in double or triple configurations.

The design of the vertical supports in Sections 2.2 and 2.3 may also be used for large plywood signs, Section 2.4, but the SSM mounting details are suitable only for extruded signs.

The MTO Roadside Design Manual 2017 (RDM). addresses small and intermediate signs (Sections 2.4.1 and 2.5). Small signs (Section 2.5) are considered to be signs with an area up to 3.6 m^2, including plywood signs. Intermediate ground-mounted plywood signs (Section 2.4.1) are considered to be signs with areas between 3.6m^2 and 7.2m^2.

To assist the user in understanding the decision process, several Master Flow Charts (MFCs) have been prepared. MFC-1 is the flow chart for large extruded aluminum signs with steel supports. MFC-2 is the flow chart for large extruded aluminum signs with timber supports. MFC-3 is the flow chart for large plywood signs. MFC-4 is the flow chart for small signs.

1.4.1 Breakaway or Non-breakaway Supports

In general, breakaway supports are required, except where they are beyond the clear zone or where they are separated from traffic lanes by a barrier.

In Ontario, all new small and intermediate sign support system installations on high speed roadways on provincial highway projects should be breakaway. All new ground mounted large sign support systems installed on the roadside not shielded by an existing barrier system with appropriate length of need should be breakaway. Breakaway sign supports are beneficial in reducing the severity of collisions and hence the number of fatalities and/or injuries.

When signs are located behind an appropriate length of barrier, or for low-speed urban installations located behind barrier curb, both breakaway or non-breakaway small sign support systems are acceptable.

Breakaway sign supports must meet the crash test acceptance requirements of American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (2016) (MASH-16) where products are available and recognized by MTO. When AASHTO's MASH-16 products are not available then products which fulfill the criteria of National Cooperative Highway Research Program (NCHRP) Report 350 should be installed.

The Roadside Design Manual provides design guidance and sign positioning for small, intermediate and large ground mounted signs.

1.4.2 Steel or Timber Supports

Sign supports may be of either steel or timber. The choice of support material is usually a matter of cost, except where only steel is feasible, for example, on large signs. More detail on designing steel and timber supports is provided in Section 2.

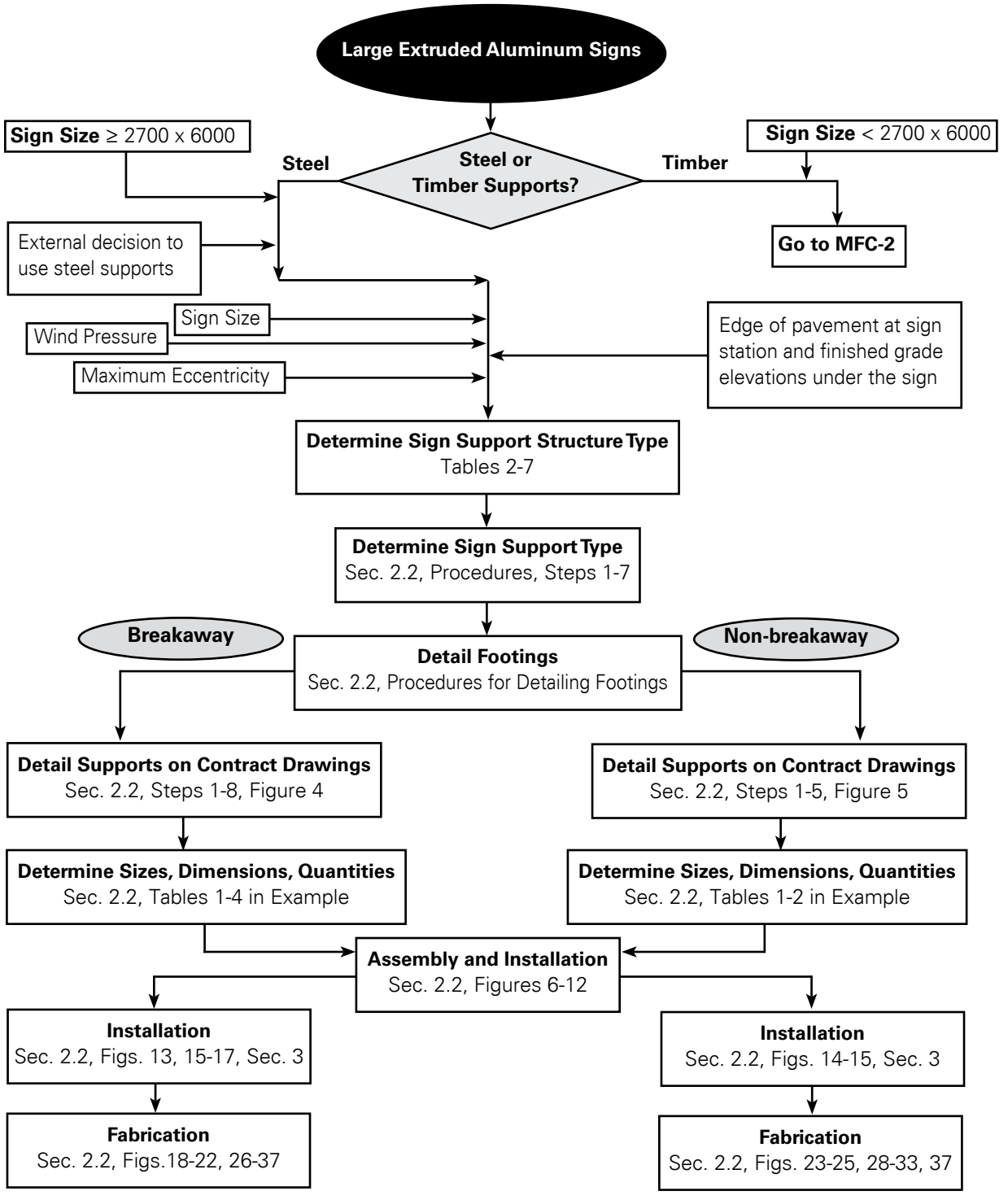
Timber sections are economical in material, but expensive in labour; they are frequently used in rural areas. Material is specified in standard sizes and species. Dressed sizes range from 89 mm x 89 mm up to 140 mm x 184 mm.

Auger equipment is normally used and lifting equipment will be required for larger sections.

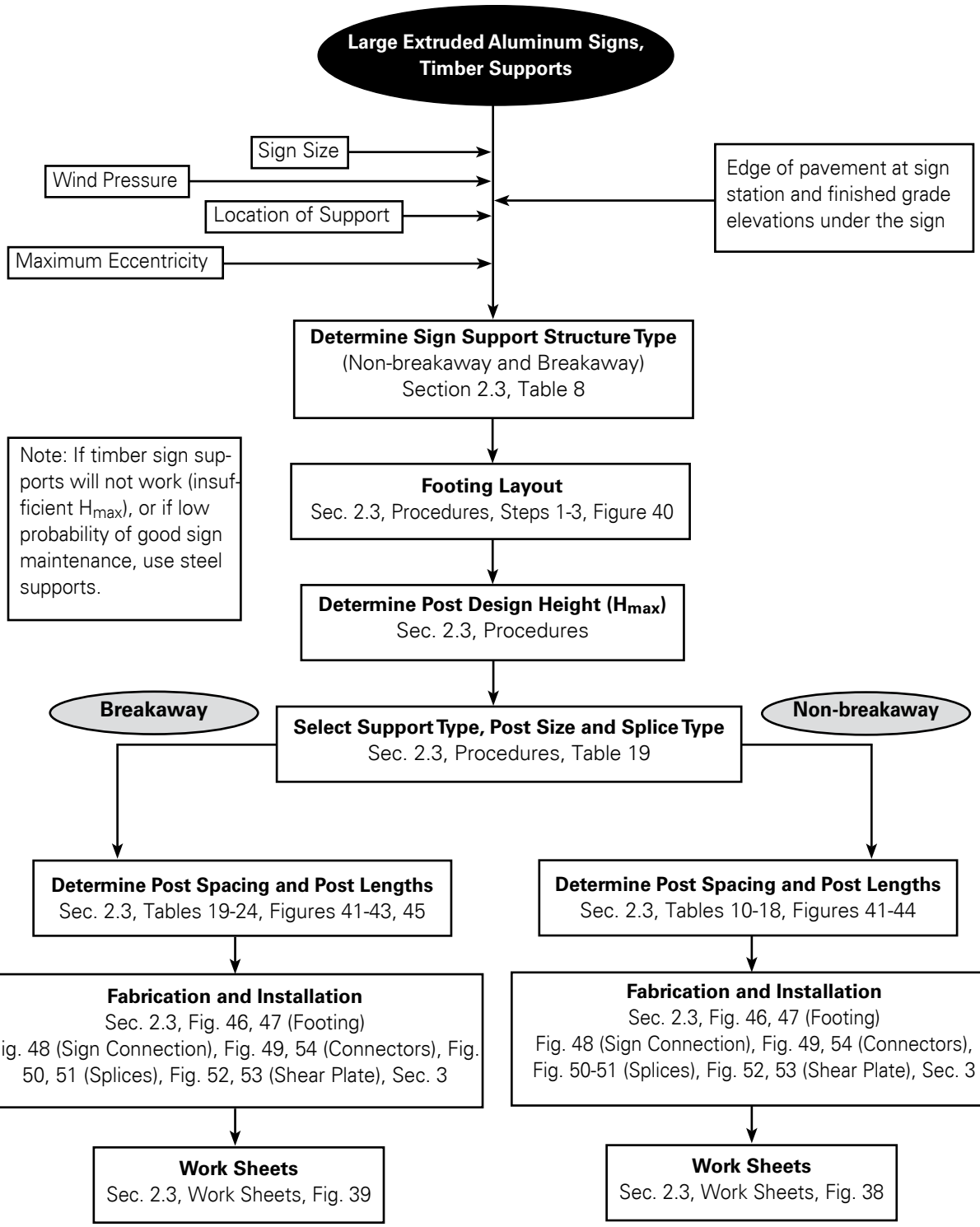
Timber sections can be designed as breakaway supports where required. A dressed 89 mm x 89 mm post is considered a breakaway post while larger sections can be modified to make a breakaway post by providing appropriately sized holes at certain locations across the section of the post.

Wood preservative shall be according to CAN/CSA O80 Series, Use Category UC 4.1". Designer should refer to OPSS for details about wood preservative and identification mark for wood species.

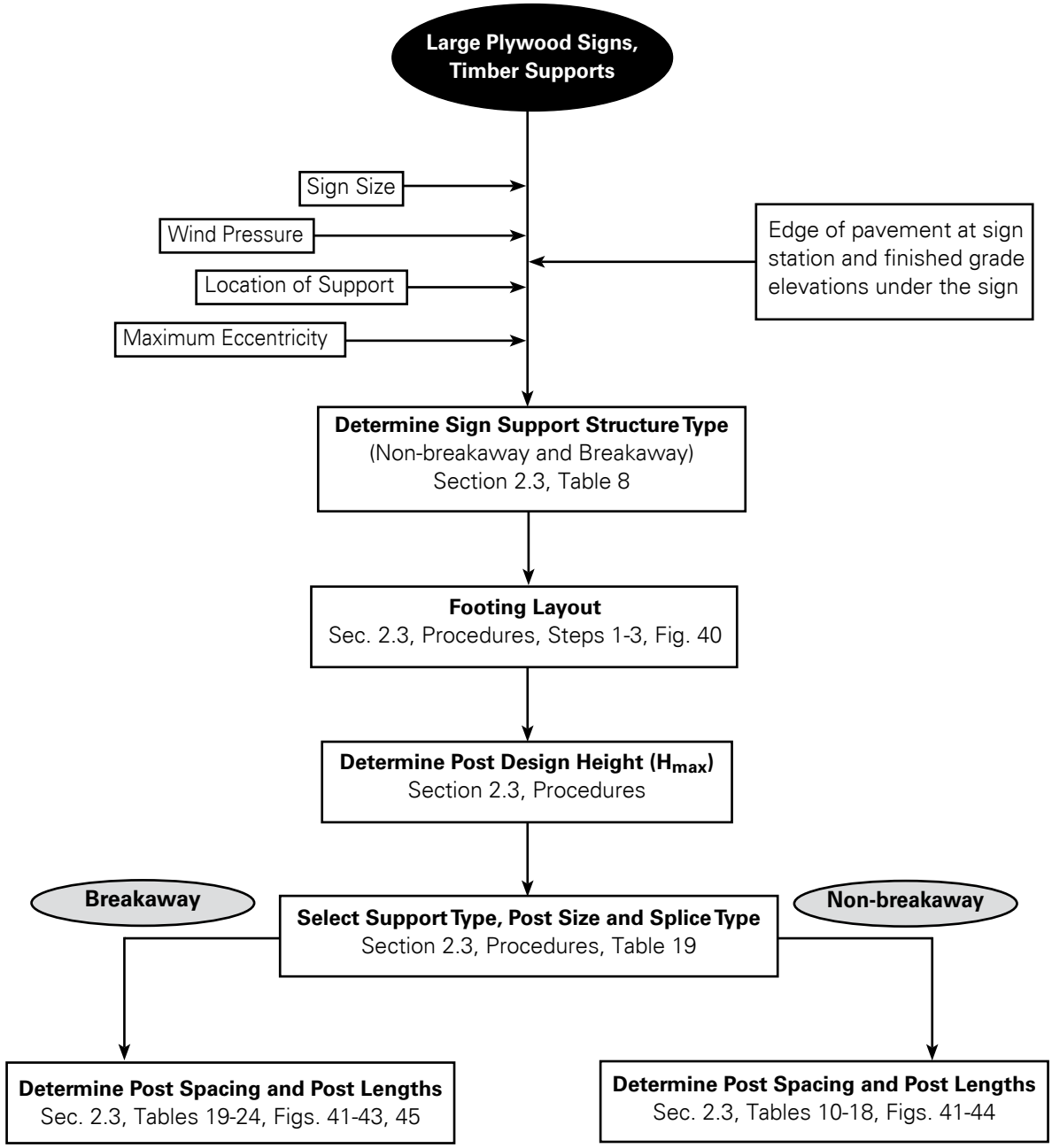
Master Flow Chart 1 (MFC-1) – Large Extruded Aluminum Signs with Steel Supports



Master Flow Chart 2 (MFC-2) – Large Extruded Aluminum Signs with Timber Supports

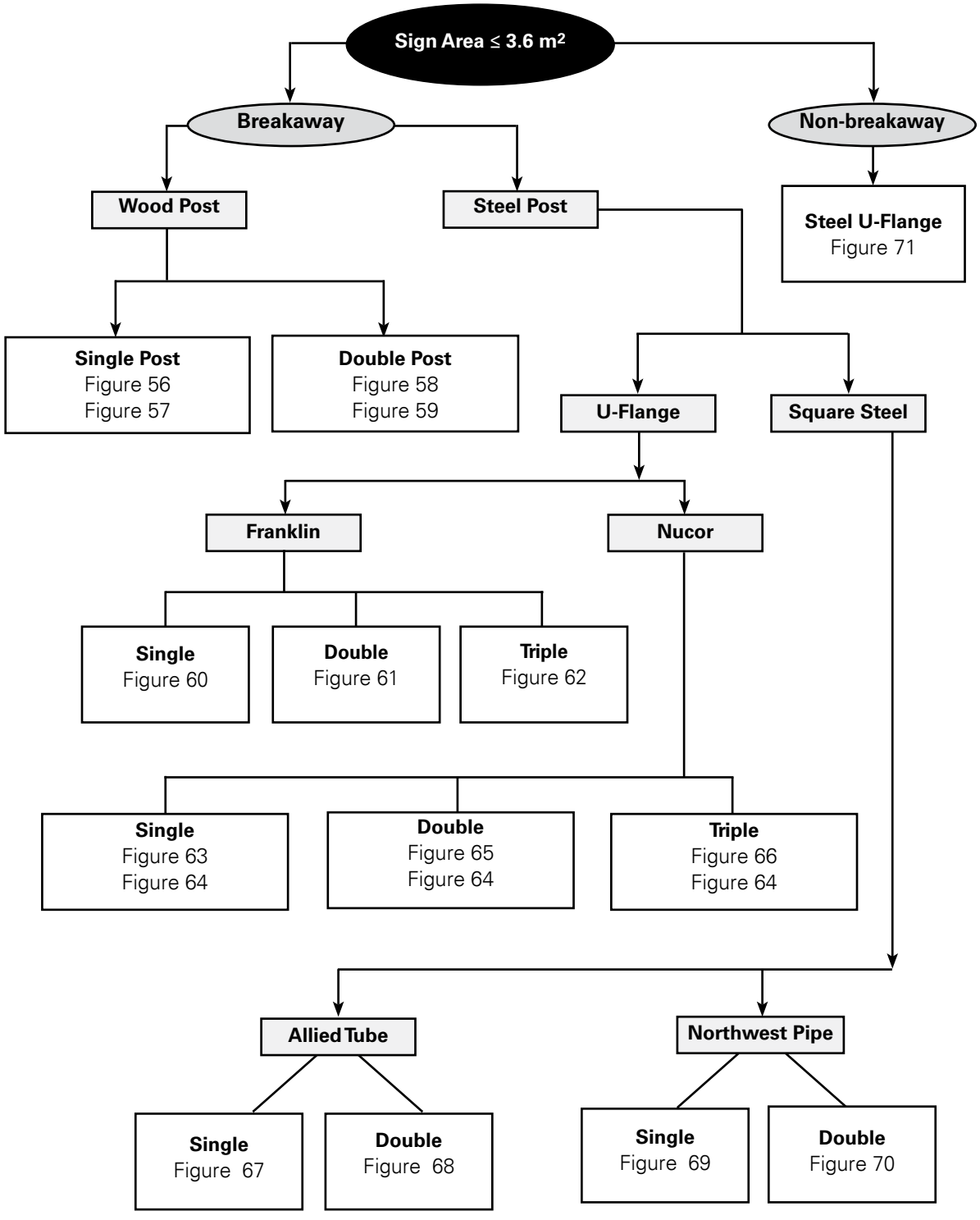


Master Flow Chart 3 (MFC-3) – Large Plywood Signs



Note: For fabrication and installation details for large plywood signs on timber supports, sign connection, and mounting details, contact MTO Traffic Office. Do not use those shown for small signs (Sections 2.5 and 2.6).

Master Flow Chart 4 (MFC-4) – Small Signs with Steel and Timber Supports



They can be installed singly or in groups of up to four posts for non-breakaway and up to three posts for breakaway supports. They can accommodate signs from the smallest size up to an area of 16.2 m^2.

Steel U sections are economical in labour, but expensive in material. They are readily available from several suppliers with an approved breakaway mechanism. Breakaway steel U flange sections are proprietary systems tested successfully according to the AASHTO MASH-16 or minimum NCHRP Report 350. They are used in sizes designated from 2.6 kg/m to 6 kg/m. They are easily installed by driving directly into the ground. They are light weight, easily handled and easily transported.

Breakaway systems are available through various proprietary systems.

They can be used singly or up to 3 posts to support larger signs up to a sign area of 2.52 m^2 for Rib-Bak, or up to a sign area of 2.88 m^2 for Franklin, utilizing three posts. The designer should refer to the latest MTODs and/or OPSDs.

Breakaway steel square sections are proprietary systems tested successfully according to the AASHTO MASH-16 or minimum NCHRP Report 350. They are normally available in a standard size of 51 mm x 51 mm with larger sections being used with an in-ground anchor and sleeve. They are normally installed within a sleeve and anchor which is placed in the ground so that the smaller post can be installed and removed later if damaged. They are light-weight, easily handled and easily transported. The designer should refer to the latest MTODs and/or OPSDs for details.

The sleeve and anchor system will work as a breakaway support. When installed in a concrete sidewalk or median, they can be removed easily and replaced, leaving the anchor system in place.

They can be used singly or two posts maximum to support larger signs up to a sign area of 3.15 m^2.

Steel W sections are readily available from several suppliers. They are used in sizes W200 x 42, W200 x 46 and W299 x 59. They are normally installed in a concrete caisson and normally require lifting equipment for installation.

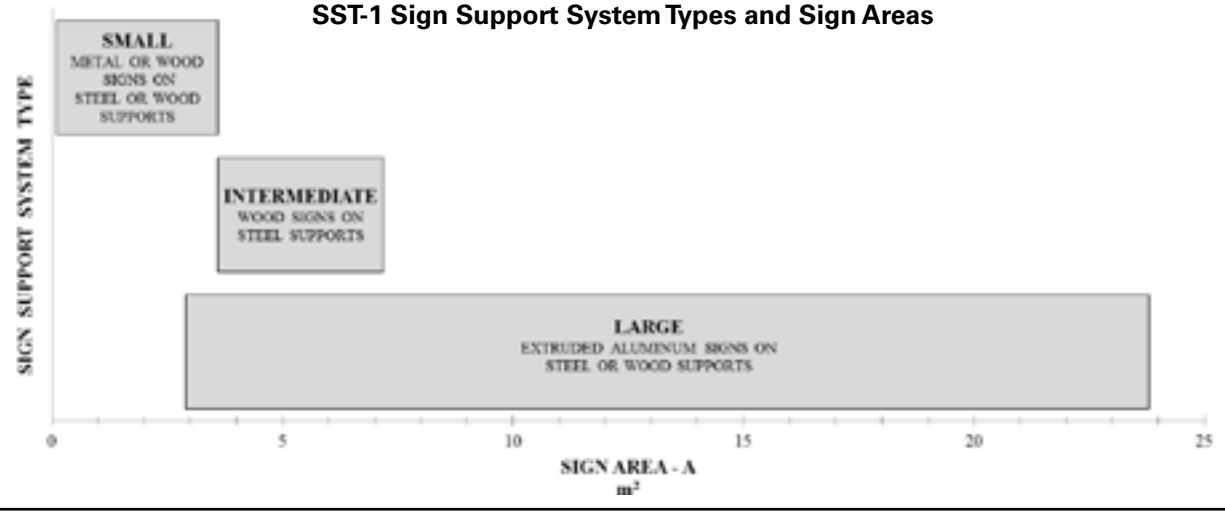
Breakaway systems are available through a standard friction plate and fuse plate arrangement.

They are normally used as double or triple post arrangements and support larger signs from 1200 mm x 3600 mm up to 3600 mm x 6600 mm.

1.5 Numbering System

Most of the material in OTM Book 3 has been taken from the MTO Sign Support Manual (2015)

SST-1 Sign Support System Types and Sign Areas



and the MTO Roadside Design Manual 2017 (RDM). Each of those documents had its own numbering system for drawings. A new numbering system has been created for OTM Book 3. The new drawing numbers also display the original drawing numbers for convenient cross-reference.

1.6 Terminology for Sign Dimensions

Most of the source material for OTM Book 3 comes from two MTO documents, the 2015 SSM (for large signs) and the 2017 RDM (for small signs). These two documents differ in their treatment of sign dimensions. Both documents use the term "width" (B) for the horizontal dimension of the sign. The difference is in their treatment of the vertical dimension of the sign. The SSM uses the term "depth" (D) for the vertical dimension of the sign, defining it as 'the height of the sign board.' The RDM uses the term "height" (H) for the vertical dimension of the sign. The SSM uses the term "Hi" for the vertical distance from the top of the footing to the horizontal centroidal axis of the sign board. This terminology usage is reflected in the drawings. This terminology has been retained in OTM Book 3. See also Appendix A, Definitions and Notation.

1.7 Revisions

When additions or revisions are necessary, they will be made available through ServiceOntario Publications or the online MTO Research Library, as detailed in Section 1.9.

1.8 Metrication

All dimensions are in millimetres unless otherwise stated. OTM Book 3 is based on metric sign sizes. When imperial signs are to be installed, the 'soft conversion' (multiply by 0.3) from imperial to metric should be used for design. For example, for a 9' x 24' sign, design for a 2700 mm x 7200 mm size.

1.9 Distribution

Electronic copies of OTM Book 3 and revisions may be downloaded from the MTO Technical Publications, Technical Manuals and Reference Materials at:

Online: https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/tmrmViews.aspx

Search: OTM or OTM Book #

1.10 Standard Drawings

Electronic CAD files containing standard drawings in AutoCAD may be obtained from the MTO Traffic Office or the Contract Preparation System (CPS).

2. Ground-mounted Sign Support

2.1 General Information

2.1.1 Scope

OTM Book 3 contains information needed to prepare Contract Drawings, Tender Quantities, Contract Design Estimating and Documentation (CDED), and Special Specification for ground-mounted sign installations. Steel column sign supports are addressed in Section 2.2 for large ground-mounted extruded aluminum signs requiring two or more supports. Timber sign supports are addressed in Section 2.3 for large ground-mounted extruded aluminum signs requiring two or more supports. Supports for large plywood signs are addressed in Section 2.4. Signs. Supports for intermediate plywood signs requiring two steel supports, are addressed in Section 2.4.1. Supports for small signs and plywood signs (requiring up to three supports), both steel and timber, are addressed in Section 2.5. Information on supports for small signs mounted on concrete median barriers and noise barriers is included in Section 2.6.

2.1.2 Standard Sign Supports

Only standard sign supports are described in OTM Book 3 and listed within their respective sections. All non-standard sign supports must be custom designed using appropriate design criteria and sealed and signed by an Engineer. This Engineer accepts full responsibility for the design.

2.1.3 Assumptions, Criteria and Limitations

Design code assumptions, criteria and limitations for each sign support type are described in the respective sections of OTM Book 3. Drawings and special provisions for steel and timber breakaway sign supports are sufficiently standardized so that MTO Regional Structural Section staff or equivalent municipal/regional staff may process them.

2.1.4 Standard Drawings

Information to be Added to Standard Drawings

Standard drawings shall be reviewed together with the corresponding text in OTM Book 3 to determine what information, if any, needs to be added to them. Where information in tables and dimensions is added to standard drawings for their completion, the drawings shall bear the seal, date and signature of an 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 Engineers. These Engineers accept full responsibility for the design that results from these changes.

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.

2.1.5 Processing of Documents

Preparation of Electrical Drawings

In general, supplementary illumination is not required for static ground-mounted signs because of the reflective ability of sign facing materials, and in some cases the effect of roadway lighting. The road authority determines which sites require illumination. The designer should contact the road authority regarding the preparation of electrical drawings, if required.

MTO Contract Preparation System (CPS)

Capital construction contract tender documents are produced for MTO by using the CPS application. This is an integrated system 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 Project Delivery Section 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 Tables 1A and 1B. The accompanying transmittal letter shall instruct the Project Delivery Section to complete the following items:

- Traffic Control;
- Supply and erect sign board, for static sign supports;
- Requirements in the tender documents for the design, supply, installation and testing of the ground-mounted, light-emitting variable message signs.

Distribution of Completed Drawings and Contract Documents

Copies of the completed drawings and applicable contract documents shall be distributed within the road authority, according to the road authority's policy and procedures, for example, as follows:

- Planning and Design Office (Manager);
- Estimating Office (Manager);
- Construction Staff (Engineer) to make provision for the supply and erection of the sign.

2.1.6 Traffic Protection

Non-breakaway sign supports shall either be located beyond the clear zone or they shall be protected from traffic travelling the adjacent roadways. Protection shall be provided with a barrier system or crash cushion. If a barrier system is used, the sign support shall be located sufficiently beyond the design deflection distance of the barrier, to ensue that the barrier will function as intended when struck by an errant vehicle (see MTO Roadside Design Manual and Standard Specifications).

Breakaway type sign supports are installed without protection and must meet the requirments of desirably AASHTO's MASH-16 or minimum NCHRP Report 350 to minimize the effect of vehicle/ support impact upon the occupants of the vehicle.

2.1.7 Soil Conditions

Footing proportions provided in this Book are intended to apply to normal soil conditions, that

Table 1A – CPS Tender Items for Permanent Ground-mounted Large Sign Support Systems

OPSS Spec No.	Item	Unit
OPSS.PROV 911	Coating New Structural Steel Sign Support Structures	Each
OPSS.PROV 915 OPSS.MUNI 915	Concrete in Steel Column Breakaway Sign Support Footings	Each
	Concrete in Steel Column Non-breakaway Sign Support Footings	Each
	Steel Column Breakaway Sign Support Structures	Each
	Steel Column Non-breakaway Sign Support Structures	Each
	Wood Column Breakaway Sign Support Structures	Each
	Wood Column Non-breakaway Sign Support Structures	Each
	Repair of Existing Structure	Each
	Attachment of Signboards	Each

Table 1B – CPS Tender Items for Permanent Small Signs and Support Systems

SSP Number	Item	Unit
OPSS 703	Ground-mounted Small Sign – New	Each
	Ground-mounted Small Sign – Relocation	Each
	Ground-mounted Small Sign - Removal	Each
	Concrete Median Barrier Mounted with Wooden Post - New	Each
	Concrete Meidan Barrier Mounted with Metal Post - New	Each

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; and
- soil is exceptionally soft or loose.

2.1.8 Reference Wind Pressure

The Canadian Highway Bridge Design Code (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 for overhead types of sign structures, including luminaires and traffic signals.

The CHBDC 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 criterion to be included for design.

In summary, OTM Book 3 considers a 10-year reference wind pressure, with no consideration for the 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.

Values for the local reference wind pressure can be obtained from Table C (Appendix C). The information shown in these tables was obtained from CAN/CSA S6-14.

2.1.9 Sign Boards

MTO static aluminum sign support designs are based on the aluminum snap-together Alcan Interlocking Sign Panel, Shape No. 72838, as shown in Figure 1. Alcan standard extrusion tolerances and finishes will apply unless otherwise specified. For other road authorities, bolt-together panels may be used as an alternative to the MTO snap-together panels.

2.1.10 Variable Message Systems

The requirements for the design, supply, installation and testing of ground-mounted, light-emitting Variable Message Signs (VMSs) are covered by the associated MTO Special Provisions. The major features of the variable 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.

See OTM Book 10 (Variable Message Signs), OTM Book 19 (Advanced Traffic Management Systems).

2.2 Steel Column Ground-mounted Sign Supports for Large Extruded Aluminum Signs

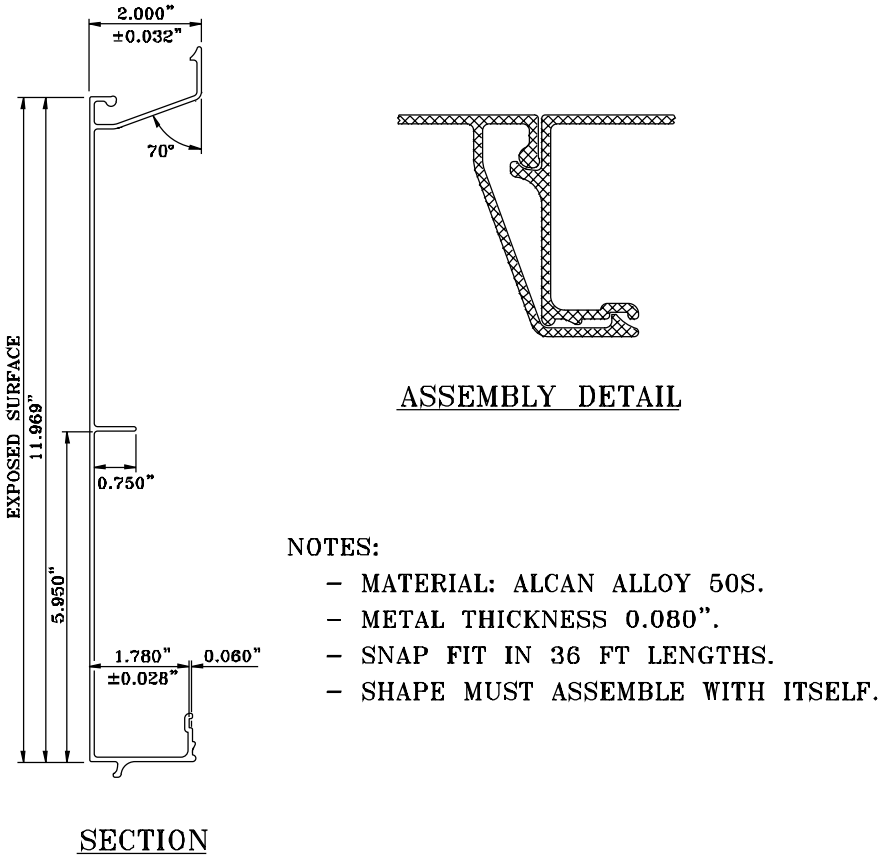
(Breakaway and Non-breakaway Types)

2.2.1 General

Steel Column Ground-mounted Sign Supports that previously were covered under the MTO Sign Support Manual are now covered in OTM Book 3. Section 2.2 covers steel column sign supports for ground-mounted signs for large extruded aluminum signs where two or more supports are required. See also Master Flow Chart 1 (MFC-1).

For terminology for sign dimensions, see Section 1.6.

Figure 1 – Alcan Interlocking Sign Panel – Shape No. 72838 (Snap-together Panels)



Standard Sign Supports

The galvanized steel supports have been designed to the requirements of the CHBDC CAN/CSA-S6-14, 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 mm to 3600 mm and in width from 3000 mm to 7800 mm as listed in Tables 2 to 7. For definitions and notations see Appendix A.

The design of the roadside sign supports given in OTM Book 3, while meeting the requirements of the CHBDC, is generally based on those of the Texas Transportation Institute (TTI). Previous crash testing carried out on the sign support detail had been analyzed by TTI according to NCHRP Report 230 and grandfathered under NCHRP Report 350 TL-3 with no further testing so far. There are great similarities in details between the TTI and MTO standards such as MTO standards no longer use slotted fuse plates but have adopted TTI details of perforated fuse plate connections. 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".

The CHBDC requires that breakaway supports shall be crash tested in accordance with the requirements of AASHTO's MASH-16 or minimum NCHRP Report 350. MTO has not done its own crash testing, but relies on results of tests conducted by the Texas Transportation Institute (TTI) for the Texas Department of Transportation (DOT). Previous crash testing carried out on the sign support detail had been analyzed by Texas Transportation Institute and was found to have met the requirements of

NCHRP Report 350 TL-3. No crash testing according to NCHRP Report 350 or MASH is currently planned however the system continues to perform adequately in the field. Until such time that a breakaway large sign support system is successfully crash tested according to NCHRP Report 350 or MASH, the current breakaway design will continue to be used on ministry contracts. Road authorities using breakaway supports other than those detailed in this manual have the responsibility of ensuring that those supports meet the requirements of NCHRP Report 350 or MASH.

OTM Book 3 follows the recommendations of the 2001 edition of OTM 1B, 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 does cause some reduced legibility. The benefits of reduced glare, however, are considered to outweigh the negative result of slightly decreased night legibility. For this reason the angling of ground-mounted signs slightly away from traffic has been adopted.

Description of Sign Supports

The supports consist of two or three vertical steel columns connected by two, three or four horizontal steel crossarms. The details are shown in Figure 2.

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 (friction plate and fuse plate), it is important that bolts be of the correct size and tightened to the correct torque. 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 of one support column by impact. A strong wind can destroy such a sign support, so repairs should be carried out quickly. Except for front and back fuse plates, the salvaged parts can generally be used again.

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 Section 2.3.

Steel non-breakaway type sign supports are only intended for use behind barriers, or beyond the clear zone, as discussed in Section 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)

Table 2 – Permissible Sign Sizes and Steel Support Structure Types

Two Columns / Wind Pressure = 465 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-2	1200	3000	W200x42	W200x42	W200x42
		3600			
		4800	W200x46		
		5100			
	1500	3000	W200x42	W200x42	W200x42
		3600			
		4200	W200x46		
		4500			
		4800			
		5100	W200x59		
		5400			
	1800	3300	W200x46	W200x42	W200x42
		3600			
		3900			
		4200			
		4500	W200x59		
		4800			
2-3	2100	2700	W200x46	W200x42	W200x42
		3000			
		3300	W200x59		
		3600			
		3900		W200x46	
		4200			
		4500			
		4800			
	2400	2400	W200x46	W200x42	W200x42
		2700			
		3000	W200x59		
		3300			
		3600		W200x46	
		3900			
		4200			
		4500			
		4800		W200x59	

Two Columns / Wind Pressure = 465 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-3	2700	2400	W200x46	W200x42	W200x42
		2700	W200x59		
		3000		W200x46	
		3300			
		3600			
		3900		W200x59	
		4200			
		4500			
		4800			
	3000	2400	W200x59	W200x42	W200x42
		4200		W200x59	W200x46
		4500			
		4800			
	3300	4200		W200x59	W200x46
		4500			
		4800			
	3600	4800		W200x59	W200x46

Table 3 – Permissible Sign Sizes and Steel Support Structure Types

Three Columns / Wind Pressure = 465 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
3-2	1500	5700	W200x46	W200x42	W200x42
		6000			
	1800	5100	W200x46	W200x42	W200x42
		5400			
		5700	W200x59		
		6000			
		6600		W200x46	
		7200			
		7800			
3-3	2100	5100	W200x59	W200x46	W200x42
		5400			
		5700			
		6000			
		6600		W200x59	
		7200			
		7800			
	2400	5400	W200x59	W200x46	W200x42
		6000		W200x59	
		6600			
		7800			W200x46
	2700	5100	W200x59	W200x59	W200x42
		5400			
		5700			W200x46
		7800			
	3000	5400		W200x59	W200x42
		7800			W200x59
	3300	5400		W200x59	W200x46
3-4	2400	7200		W200x59	W200x46
		7800			
	2700	6000		W200x59	W200x46
		6600			
		7200			
		7800			
	3000	6000		W200x59	W200x46
		6600			
		7200			W200x59
		7800			
	3300	6000		W200x59	W200x46
		6600			W200x59
		7200			
	3600	5400		W200x59	
		6000			
		6600			

Table 4 – Permissible Sign Sizes and Steel Support Structure Types

Two Columns / Wind Pressure = 390 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-2	1200	3000	W200x42	W200x42	W200x42
		3600			
		4800			
		5100	W200x46		
	1500	3000	W200x42	W200x42	W200x42
		3600			
		4200			
		4500			
		4800	W200x46		
		5100			
		5400			
	1800	3300	W200x42		
		3600			
		4200	W200x46		
		4500			
		4800			
2-3	2100	2700	W200x42	W200x42	W200x42
		3000	W200x46		
		3300			
		3600			
		3900	W200x59		
		4200			
		4500			
		4800		W200x46	
	2400	2400	W200x42	W200x42	W200x42
		2700	W200x46		
		3000			
		3300	W200x59		
		3600			
		3900		W200x46	
		4200			
		4500			
		4800			
	2700	2400	W200x46	W200x42	W200x42
		2700			
		3000	W200x59		
		3300		W200x46	
		3600			
		3900			
		4200			
		4500			
		4800		W200x59	

Table 4 (Continued) – Permissible Sign Sizes and Steel Support Structure Types

Two Columns / Wind Pressure = 390 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-3	3000	2400	W200x46	W200x42	W200x42
		4200	W200x59	W200x46	
		4500		W200x59	
		4800			
	3300	4200	W200x59	W200x59	W200x42
		4500			
		4800			W200x46
	3600	4800		W200x59	W200x46

Table 5 – Permissible Sign Sizes and Steel Support Structure Types

Three Columns / Wind Pressure = 390 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
3-2	1500	5700	W200x46	W200x46	W200x46
		6000			
	1800	5100	W200x46	W200x42	W200x42
		5400			
		5700			
		6000			
		6600	W200x59		
		7200			
		7800		W200x46	
3-3	2100	5100	W200x59	W200x42	W200x42
		5400			
		5700		W200x46	
		6000			
		6600			
		7200			
		7800		W200x59	
	2400	5400	W200x59	W200x46	W200x42
		6000			
		6600			
		7800		W200x59	
	2700	5100	W200x59	W200x46	W200x42
		5400			
		5700		W200x59	
		7800			W200x46
	3000	5400	W200x59	W200x59	W200x42
		7800			W200x46
	3300	5400	W200x59	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 6 – Permissible Sign Sizes and Steel Support Structure Types

Two Columns / Wind Pressure = 300 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-2	1200	3000	W200x42	W200x42	W200x42
		3600			
		4800			
		5100			
	1500	3000	W200x42	W200x42	W200x42
		3600			
		4200			
		4500			
		4800			
		5100			
		5400			
	1800	3300	W200x42	W200x42	W200x42
		3600			
		3900			
		4200			
		4500			
		4800			
2-3	2100	2700	W200x42	W200x42	W200x42
		3000			
		3300			
		3600			
		3800	W200x46		
		4200			
		4500			
		4800			
	2400	2400	W200x42	W200x42	W200x42
		2700			
		3000			
		3300	W200x46		
		3600			
		3900			
		4200			
		4500			
		4800	W200x59		
	2700	2400	W200x42	W200x42	W200x42
		2700			
		3000	W200x46		
		3300			
		3600			
		3900	W200x59		
		4200			
		4500			
		4800		W200x46	

Two Columns / Wind Pressure = 300 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
2-3	3000	2400	W200x42	W200x42	W200x42
		4200	W200x59	W200x46	
		4500			
		4800			
	3300	4200	W200x59	W200x46	W200x42
		4500			
		4800			
	3600	4800	W200x59	W200x59	W200x42

Table 7 – Permissible Sign Sizes and Steel Support Structure Types

Three Columns / Wind Pressure = 300 Pa					
Type	Sign Size (mm)		Maximum Eccentricity (mm)		
	Depth	Width	6900	5700	4500
3-2	1500	5700	W200x42	W200x42	W200x42
		6000			
	1800	5100	W200x42	W200x42	W200x42
		5400			
		5700			
		6000			
		6600	W200x46		
		7200			
		7800			
3-3	2100	5100	W200x46	W200x42	W200x42
		5400			
		5700			
		6000			
		6600			
		7200	W200x59		
		7800		W200x46	
	2400	5400	W200x46	W200x42	W200x42
		6000	W200x59		
		6600			
		7800		W200x46	
	2700	5100	W200x59	W200x42	W200x42
		5400			
		5700		W200x46	
		7800		W200x59	
	3000	5400	W200x59	W200x46	W200x42
		7800		W200x59	
	3300	5400	W200x59	W200x46	W200x42
3-4	2400	7200	W200x59	W200x46	W200x42
		7800			
	2700	6000	W200x59	W200x46	W200x42
		6600			
		7200			
		7800		W200x59	
	3000	6000	W200x59	W200x46	W200x42
		6600			
		7200		W200x59	
		7800			
	3300	6000	W200x59	W200x46	W200x42
		6600			
		7200		W200x59	
	3600	5400	W200x59	W200x46	W200x42
		6000			
		6600		W200x59	

- 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 2 for breakaway type and Figure 3 for non-breakaway type.

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

Footings

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

The indicated footing depths (see Section 2.2.4, Footing Details) and Figure 7 are the absolute minimum required for each support based on a passive earth pressure of 68 kPa (1400 psf) at serviceability limit state (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 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.

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

Clearance

- **Horizontal Clearance**
  For large highway signs on major highways, sign support columns must either be beyond the clear zone or, if in the clear zone, must either be protected or breakaway. For breakaway sign supports, the minimum clear distance between columns shall be 2100 mm. For other signs and/or highways, Figures 88 and 89 may be used. Figures 88 and 89 show nominal horizontal and vertical clearances; refer to the RDM for current clear zone

requirements. Vertical and horizontal clearances for STOP signs and Speed Limit signs are specified in the HTA Regulation 615, and must be observed.

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 RDM, in relation to the deflection characteristics of the barrier used.

- **Vertical Clearance**
  A minimum vertical distance of 1800 mm to 2500 mm from the edge of pavement elevation to the bottom edge of the sign shall be provided for both types of sign supports. For breakaway sign supports, the minimum distance from ground elevation to any part of the underside of the sign shall be 2100 mm. For non-breakaway sign supports, the minimum distance from ground elevation to any part of the underside of the sign shall be 1000 mm. This requirement is for summer and winter maintenance purposes.

For other signs and/or highways, Figures 88 and 89 may be used. Figures 88 and 89 show nominal horizontal and vertical clearances; the designer should check with RDM for current clear zone requirements.

These clearances are provided automatically when the procedures outlined later in Section 2.2.3, Procedures are adhered to.

Supply and Installation of Sign Supports (MTO)

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

The signboard and backing Ts are supplied and fully assembled by MTO, but are attached to the sign support by the contractor.

2.2.2 Preparation of Drawings

General

If the supply and erection of the support is to be part of a contract, Figure 2 and/or Figure 3 must be used, as described in Description of Sign Supports above. Up to five sign supports can be detailed on one drawing.

Data Required

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

(1) **The sign size**
This sign must be one of the combinations of sign depth (D), and sign width (B) shown in Tables 2 to 7 for three different values of reference wind pressure (465, 390 and 300 Pa) and maximum eccentricities (6900, 5700 and 4500 mm). See Figures 4 and 5. Only the combinations shown within shaded areas are permissible. See Types of Supports above for types of support.

Table A3.1.7 of the CHBDC, reproduced here as Table C (Appendix C), 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/stake.

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

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 highway, 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.

Footing Locations and Elevations

First, the type of support required must be determined. This is obtained from Tables 2 to 7 for the given sign size.

From Section 2.2.4, Typical Layout Plan and the appropriate figure from Assembly for the support type, the information can be readily extracted 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 Assembly apply for breakaway and also non-breakaway sign supports. Section 2.2.3, Procedure for Detailing Footings gives a step-by-step procedure for detailing footings.

The G-dimensions given in the tables of Figures 8 to 12 are a minimum, based on the minimum 6500 mm 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 mm to 600 mm, as required. In no case should the top of footing be allowed to extend above the top of grade (except by the 25 mm dome), in order to ensure that the 100 mm maximum allowable projection of the column stub of breakaway sign supports is not exceeded (see Figure 7). This is a safety requirement.

The angle of the sign to the roadway, as shown in Figure 6, is normally 3 degrees away from traffic. Angling the sign away from traffic is desirable to avoid glare, but it is turned away slightly because the reflective surface used on the signs is optimum for relatively small incident angles of reflection.

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 2.2.3, Procedure for Detailing Supports on Contract Drawing 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 or tabs, measured vertically regardless of fill or cut section of roadside, shall be a minimum of 2100 mm. For non-breakaway types this shall range from 1000 to 2100 mm based on cut or fill section of roadside. For both types, the minimum 1800 mm 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 2 to 7. 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 regraded. 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 7. (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 3.0 m, and have side slopes of 2:1. The Granular 'B' material shall be placed in maximum lifts of 300 mm, compacted to at least 95% standard Proctor maximum dry density. The compacted fill shall be placed around the already-constructed footing. If neither option is possible, the MTO Traffic Office or municipal traffic office should be contacted.

Completing Standard Drawings

If the supports are to be supplied and erected as part of a contract, Figure 2 or Figure 3 must be used. Due to space limitations, up to five sign supports can be detailed on one sheet.

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

On Figure 2 there are several tables to be completed on the drawing. Figure 3 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 2.2.4, Assembly 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 2.2.

The standard drawings shall be sealed, dated and signed according to the section on standard drawings in Section 2.1.

2.2.3 Procedures

General

This Section, Procedures, and the following two Sections, Assembly and Installation, and Fabrication, contain all data necessary to complete the Standard Drawing Figure 2 or Figure 3.

Procedure for Selection of Sign Support

Given: Sign Size
Sample = 2100 mm x 5400 mm
Type = Breakaway
Wind pressure = 465 Pa
See Figure 4.

Step 1: Determine Sign Support Type
From Table 3, a 2100 x 5400 mm sign requires a Type 3-3 support.

Step 2: Obtain
- Distance from Edge of Pavement (E.P.) to first Footing (G)
- Centre/Centre Distance between Footings (A)

Note: Layout dimensions A & G are obtained from Figure 11 for sample 2100 mm x 5400 mm sign.
- dimension A = 2300 mm
- dimension G = 6900 mm

Step 3: Establish Elevation P_1* (EL.P_1) 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 E.P. and Top of Footing Nearest E.P. (EL. P_1) This measured difference (above or below) need not be precise. A tolerance of 50 mm is acceptable.

Step 5: Establish EL.P_2 and EL.P_3 on Site

Note: Actual elevations need not be determined but difference in elevation relative to EL.P_1 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 Eccentricity
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 E.P. to bottom of sign board of 1800 mm.
E.g. For sample 2100 mm x 5400 mm sign, maximum eccentricity = 4010 mm.

Step 7: Determine if a Solution is Available
From Table 3 verify if a solution is available. This must be confirmed on Step 4 of the Section Procedure for Detailing Supports on Contract Drawing when checking boundary conditions.
E.g., For sample, there is a solution for a maximum eccentricity of 4500 mm with the column sizes as W200 x 42.

Procedure for Detailing Footings

Given: Sign Size
Sample = 2100 mm x 5400 mm
Type = 3-3
Wind pressure = 465 Pa
Maximum eccentricity = 4500 mm
Column size = W200 x 42
See Figure 4.

Figure 2 – Detail of Steel Breakaway Type SS 118-30

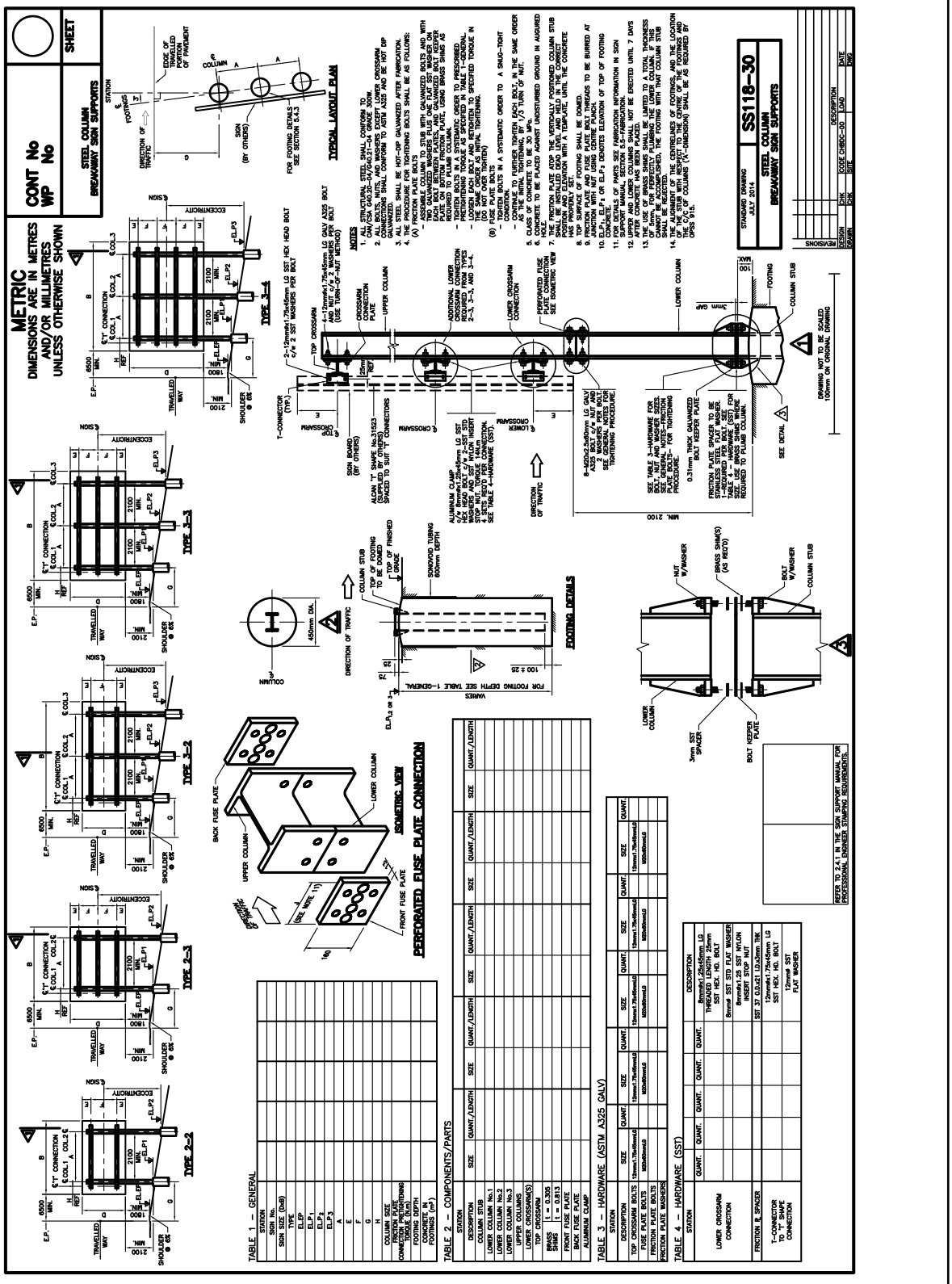
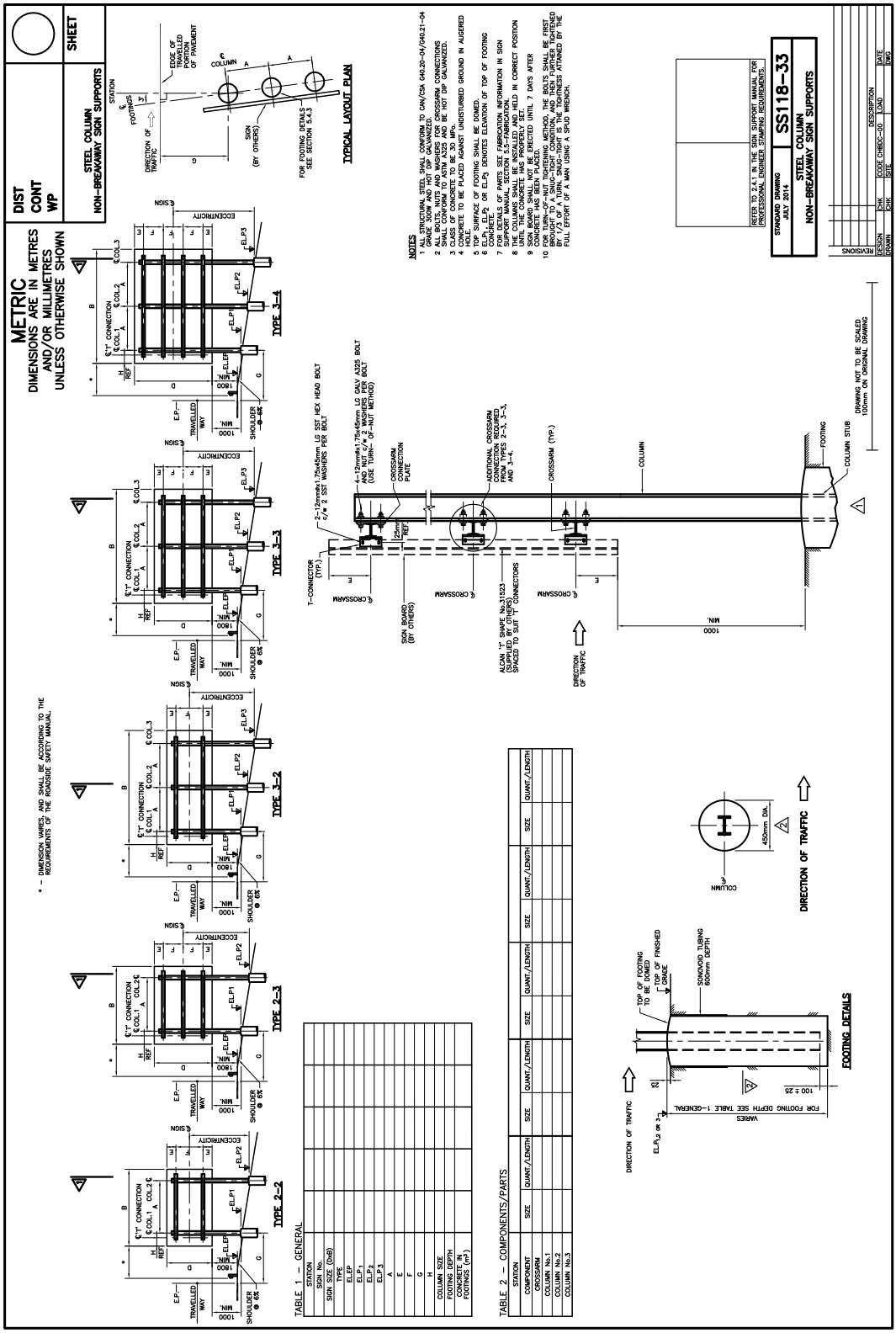


Figure 3 – Detail of Steel Non-breakaway Type SS 118-33



Step 1: Determine Column Stubs Required (For breakaway supports).
A 2100 mm x 5400 mm sign, Type 3-3 support with column size as W200 x 42 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 Figure 6. Footing depth and details are given on Figure 7. 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 W200 x 42, then both the lower and upper columns are W200 x 42.

Procedure for Detailing Supports on Contract Drawings

Case 1 – Breakaway Sign Support
See Figure 4

Given: Sign Size
Sample = 2100 mm x 5400 mm
Type = 3-3
Wind pressure = 465 Pa
Maximum eccentricity = 4500 mm

Step 1: Obtain Parts and Quantities Required.
For this example, Column size required is W200 x 42. E.g., 2100 mm x 5400 mm sign requires:
- 3 Column stubs
- 3 Lower Columns
- 3 Upper Columns
- 2 Lower Crossarms
- 1 Top Crossarm
- 12 Friction Plate Bolts (M16 x 70 mm long)
- 24 Fuse Plate Bolts (M20 x 60 mm long)
- 3 Concrete Footings (depth = 1700 mm) See Figure 7 (volume = 3(0.270) = 0.81 m^3)

Step 2: Obtain 3 Column Stubs
Column Stub size required = W200 x 42
Footing Depth = 1700 mm
Breakaway column stub length = 1700 mm
See Figure 7

Step 3: Obtain 3 Lower Columns
Lower Column size required = W200 x 42
E = 445 mm Mb = 1965
See Figure 11 (ref. Fig. 5.4.4(d))

Lengths of Lower Columns:
$L_1 = M_b + (EL.E.P. – ELP_1)$
$= 1.965 + (375.24 – 374.53) = 2.675$ m

$L_2 = M_b + (EL.E.P. – ELP2)$
$= 1.965 + (375.24 – 374.38)$
$= 2.825$ m

$L_3 = M_b + (EL.E.P. – ELP3)$
$= 1.965 + (375.24 – 374.08)$
$= 3.125$ m

Note: If top of footing elevations are higher than EP elevation, the "difference" becomes negative and the lower column lengths become shorter than M_b. If all footings are at the same elevation, then all lower column lengths are equal.

Step 4: Obtain 3 Upper Columns
Upper Column size required = W200 x 42
All 3 columns are equal length.

L = D – (E – 105) – (E – 205) (constants based on Figure 21)
= 2100 – 2E + 310
= 2410 – 2E
= 2410 – 2(445)
= 1520 mm
= 1.520 m

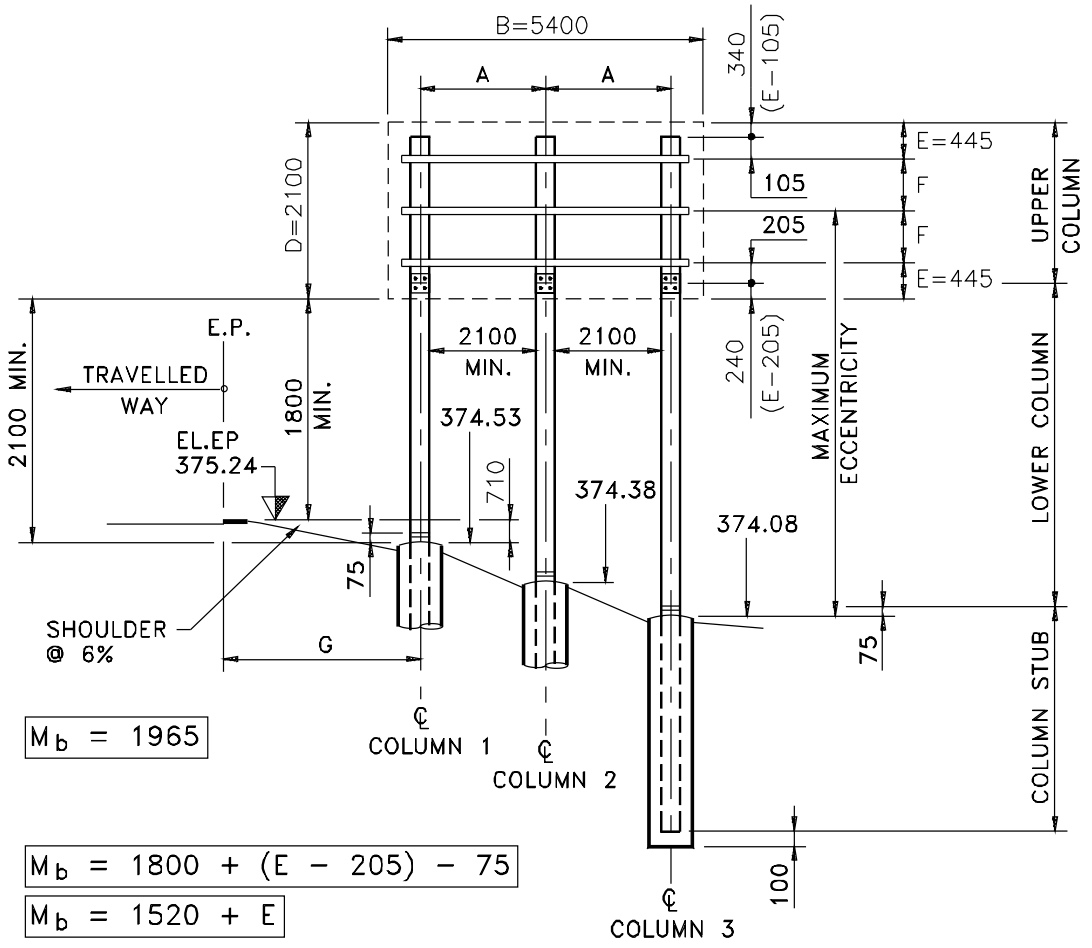
Step 5: Obtain 2 Lower Crossarms: (size S75 x 8)
Length = B – 2H + 115 (Figure 11, Figures 26 and 27)
= 5400 – 2(100) + 115
= 5315 mm
= 5.315 m

Note: Lower Crossarms do not have Connection Plates because they have Aluminum Clamps (for release).

T-Connector spacing = [1500 mm(typ)] or [equal end spac. + x@1500 mm]
T-Connector end dist. = 20 mm & 95 mm
Therefore [20 + 350 + (3 spac. @ 1500) + 350 + 95] = 5315 mm

Note: When 1500 mm spacing does not divide equally into (Length – 2 end distances), use Extended Lower Crossarms See Figure 27.
Otherwise use Regular Crossarms. See Figure 26.

Figure 4 – Steel Breakaway Supports



Step 6: Obtain 1 Top Crossarm (size S75 x 8)
Length = B – 2H + 115
= 5400 – 2(100) + 115
= 5315 mm
= 5.315 m

Note: Top crossarms have connection plates. See Figures 28 to 32.
T-Connector spacing = same as for lower crossarms

Step 7: Check Boundary Conditions
(a) If any lower column length is calculated to be less than 2100 mm, then all column lengths shall be increased by the same amount required to adjust the smallest (shortest) column length to 2100 mm (minimum)

E.g., If the 3 lower column lengths are calculated to be 1900 mm, 2200 mm, and 2500 mm, then all lengths should be increased by 200 mm, (i.e., 2100 mm – 1900 mm = 200 mm). Adjusted lengths would therefore be 2100 mm, 2400 mm, and 2700 mm.

(b) The dimension measured from top of lowest footing to centerline of signboard shall be less than or equal to the maximum eccentricity used in Tables 2 to 7 for the design.

Step 8: Insert all Resulting Sizes, Dimensions and Quantities Calculated Above, into Relevant Tables on Figure 2.

Note: Top Crossarm Bolts are 12 mm dia. x 1.75 x 45 mm 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 60 mm long, A325, complete with 2 flat washers per bolt. 8 sets required per connection. Therefore for Type 3-3, Quantity = 3(8) = 24.

Friction Plate Bolts for columns W200 x 42 and W200 x 46 shall be M16 x 70 mm long; For W200 x 59 they shall be M20 x 90 mm 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.)

Note: Lower Crossarm Connection uses 8 mm dia. bolts to connect the Aluminum Clamp to the upper column. The clamps secure the lower crossarm to the upper column. Four 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
= 5315 mm

Therefore the number of T-connectors required per crossarm:
Quantity = 6 (from Figures 26 and 27) (ref. 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

Case 2 – Non-breakaway Sign Support
See Figure 5 (ref. Fig. 5.3.3(b))

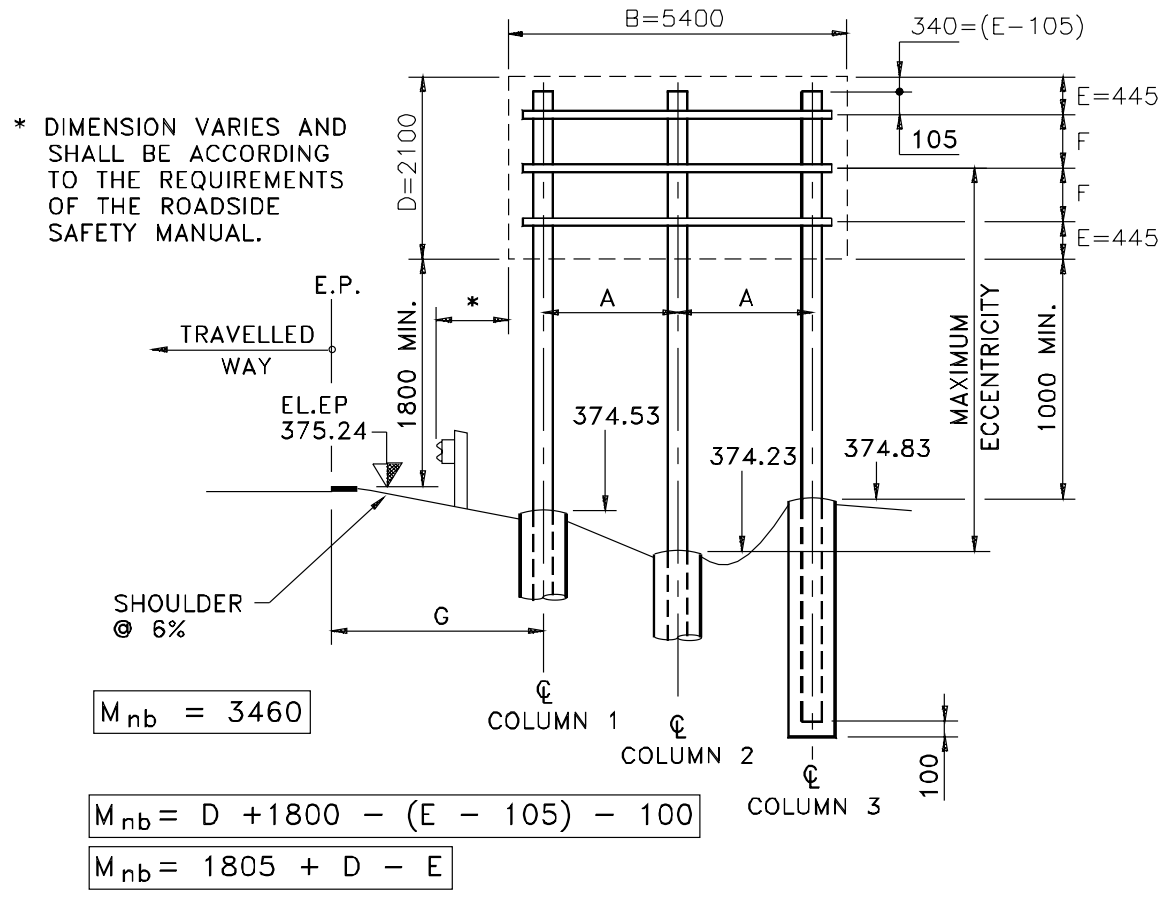
Given: Sign Size
Sample = 2100 mm x 5400 mm
Type = 3-3
Wind pressure = 465 Pa
Maximum eccentricity = 4500 mm

Step 1: Obtain Parts and Quantities Required
For this example, Column size required is W200 x 42:

E.g., 2100 mm x 5400 mm sign requires:
- 3 Columns
- 3 Crossarms
- 3 Concrete Footings (depth = 1700 mm), (volume = 3(0.270) = 0.81 m^3)

Step 2: Obtain Column Lengths for P_1, P_2 and P_3
For sample 2100 mm x 5400 mm sign, (Type 3-3)
M_{nb} = 3460 mm and E = 445 mm
From Figure 9 (ref. Fig. 5.4.4(b))

Figure 5 – Steel Non-breakaway Supports



Lengths of Columns:

L_1 = M_{nb} + Footing Depth + (EL E.P. – EL P_1)
= 3.460 + 1.700 + (375.24 – 374.53)
= 5.87 m

L_2 = M_{nb} + Footing Depth + (EL E.P. – EL P_2)
= 3.460 + 1.700 + (375.24 – 374.23)
= 6.17 m

L_3 = M_{nb} + Footing Depth + (EL E.P. – EL P_3)
= 3.460 + 1.700 + (375.24 – 374.83)
= 5.57 m

Note: If all footings are at the same elevation, then all column lengths are equal. If elevations for P_1, P_2 or P_3 are higher than for E.P., then the bracketed dimension in the column length formula becomes negative.

Step 3: Obtain 3 Crossarms: (size S75 x 8)
Length = B – 2H + 115. See Figures 11, Figures 30 to 31 = 5400 – 2(100) + 115
= 5315 mm

Obtain T-connector spacing same as for Lower Crossarm in Case 1.

T-Connector spacing = [1500 mm(typ)] or [equal end spac. + x@1500]
T-Connector end dist. = 20 mm & 95 mm
Therefore [20 + 350 + (3 spac. @ 1500) + 350 + 95] = 5315 mm

Note: When 1500 spacing doesn't divide equally into (Length – 2 end distances), use Extended Lower Crossarms. See Figure 27. Otherwise use Regular Crossarms. See Figure 26

Step 4: Check Boundary Conditions
- In severe cut situations, dimension (M_{nb})shall be increased to suit.
- The dimension measured from top of the lowest footing to centreline of sign board shall be less than or equal to the maximum eccentricity used in Tables 2 to 7 for the design.
- Ensure that minimum 1000 mm vertical clearance is provided from the underside of sign to the ground level.

Step 5: Insert all Resulting Sizes, Dimensions and Quantities Calculated Above, into Relevant Tables on Figure 3.

Note: 1) Table 1 – GENERAL is filled in similarly to that table for breakaway sign supports, with the only exception that non-breakaway sign supports don't have friction plate connections. 2) Table 2 – COMPONENTS/PARTS is given as follows:

Station	**0 + 00**	
Component	**Size**	**Qty / Length**
Column #1	W200 x 42	1 x 5870
Column #2		1 x 6170
Column #3		1 x 5570
Crossarm(s)	S75 x 8	3 x 5315

2.2.4 Assembly and Installation

General

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

(1) 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.

Note: The following tables (from Figure 2 – Breakaway Sign Supports are completed using the data from Case 1.

TABLE 1 - GENERAL

STATION	0+00				
SIGN No.	1				
SIGN SIZE (DxB)	2100x5400				
TYPE	3-3				
EL. P_1	374.53				
EL. P_2	374.38				
EL. P_3	374.08				
A	2300				
E	445				
F	605				
G	6900				
H	100				
COLUMN SIZE	W200x42				
FRICTION PLATE CONNECTION PRE-TIGHTENEING TORQUE (Nm)	67 (for M16 bolt)				
FOOTING DEPTH	1700				
CONCRETE IN FOOTINGS (m^3)	0.81				

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	t=0.305mm t=0.813mm	As req'd for plumbing lower column				
FRONT FUSE PLATE	t=13mm	3				
BACK FUSE PLATE	t=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				

(2) Concrete is to be placed against undisturbed ground in an augered hole.

(3) Class of concrete is to be 30 MPa.

(4) Top surface of footings shall be domed.

(5) For breakaway supports, components above ground level shall not be erected until seven days after concrete has been placed.

(6) 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 13.
- 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.

(7) Friction plate and fuse plate bolt threads to be burred at junction with nut, using centre punch.

Typical Layout Plan

Figure 6 is for use in installing steel column sign supports.

Footing Details

Figure 7 is for use in installing steel sign support footings.Assembly

Assembly

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

Type of Sign Support	Figure
2-2	Figure 8
2-3	Figure 9
3-2	Figure 10
2-3	Figure 11
3-4	Figure 12

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

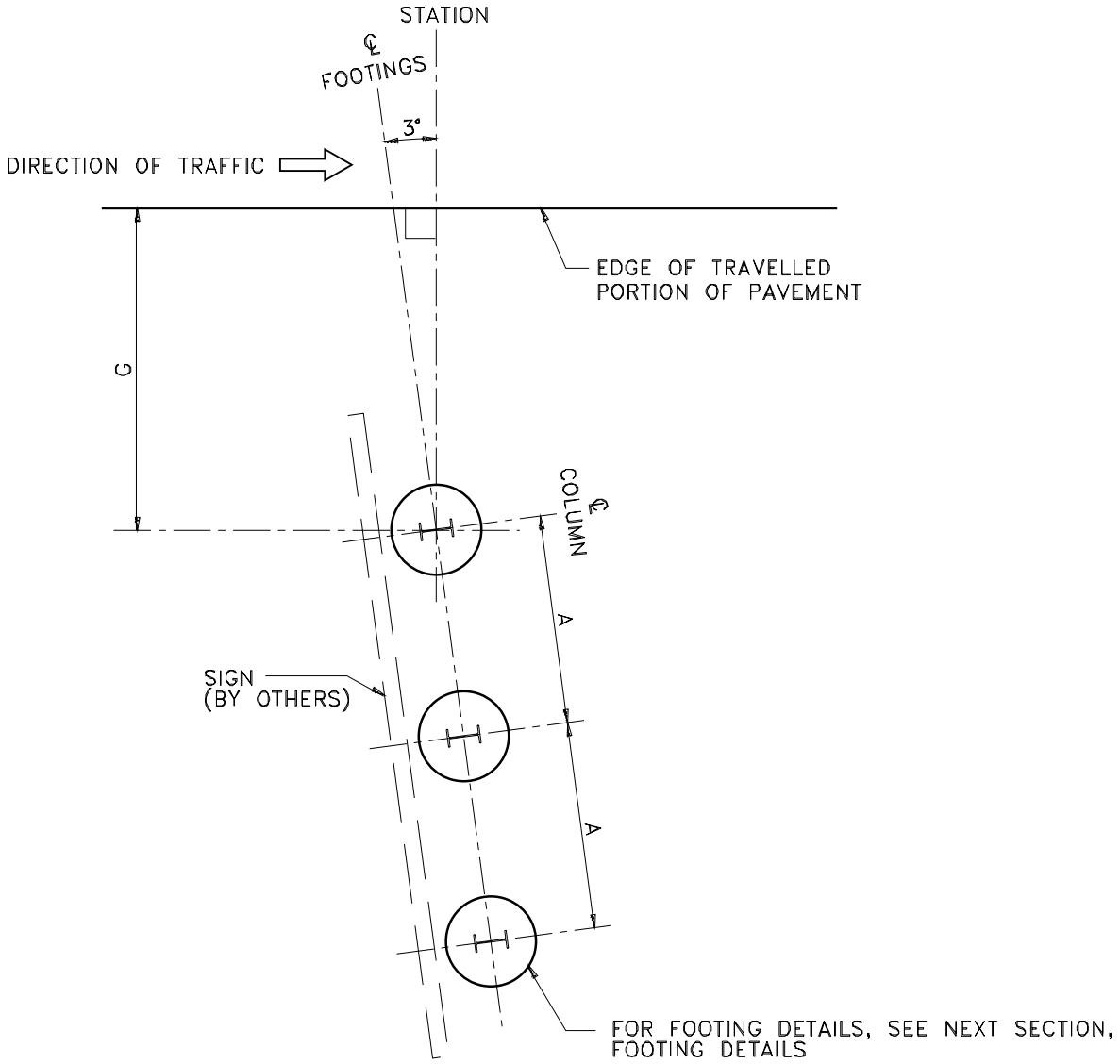
For clarity, traffic barrier for non-breakaway sign supports is not shown.

Installation

For more details on installation, see Section 3. Figures 13 to 15 provide information for the installation of steel column sign supports as follows:

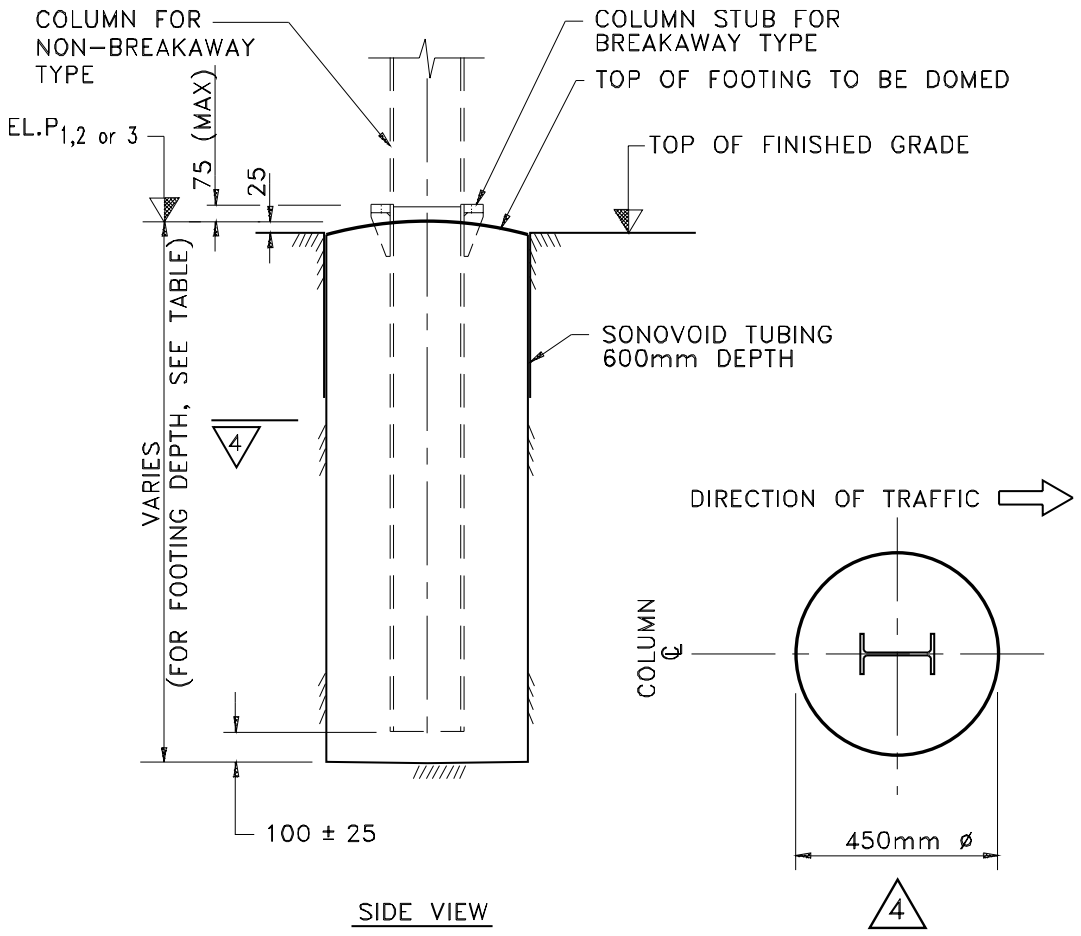
- Figure 13 – Breakaway Type Installation Details
- Figure 14 – Non-breakaway Type Installation Details
- Figure 15 – Installation Details

Figure 6 – Typical Layout Plan for Installing Steel Sign Supports



Note: For dimensions A and G, see Table in Section Assembly below.

Figure 7 – Footing Details for Steel Sign Support

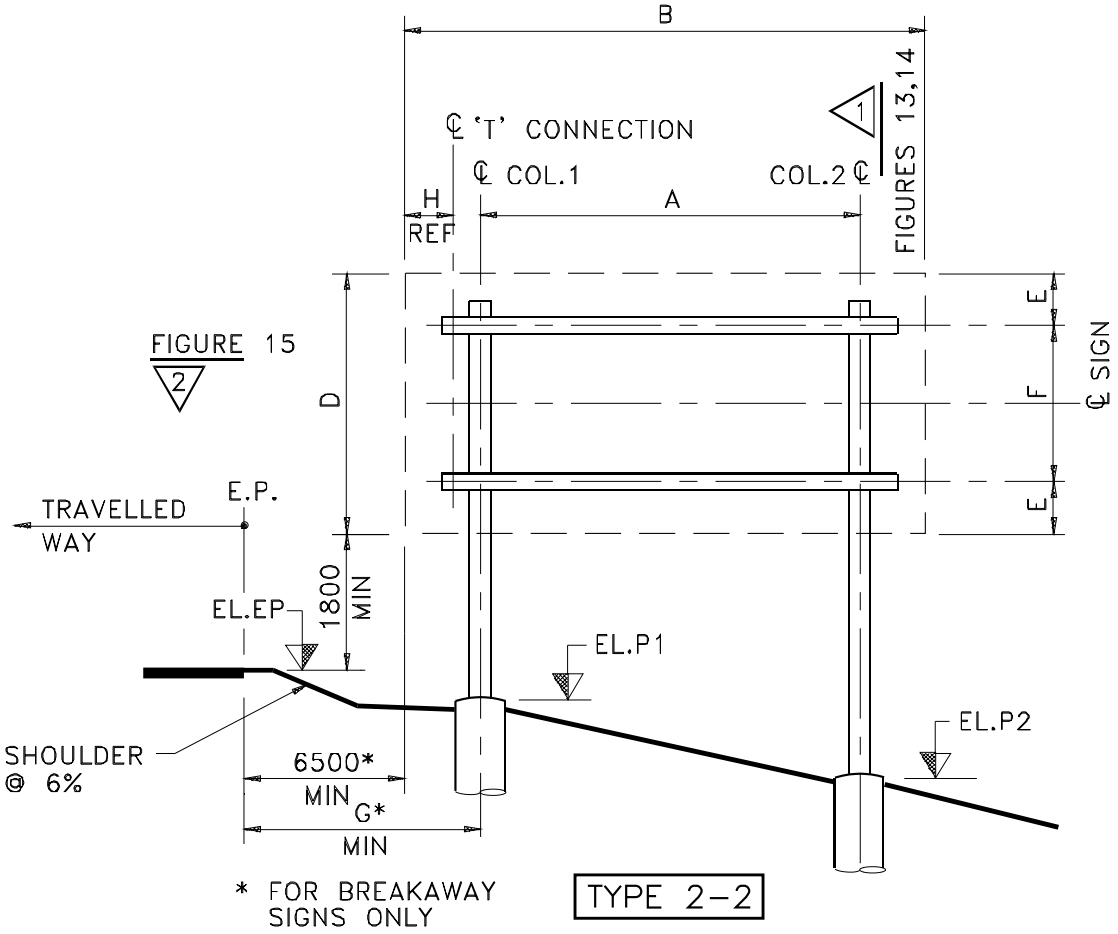


		Footing Depth* (mm)		
No. of Columns	**Sign Area (m²)**	**W200 x 42**	**W200 x 46**	**W200 x 59**
2	0 – 6.0	1600	1600	N/A
	6.1 – 12.0	2000	2200	2500
	12.1 – 18.0	2100	2500	2800
3	9.0 – 13.0	1700	1900	2000
	13.1 – 18.0	1900	2000	2200
	18.1 – 24.0	1900	2100	2400

* 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 (m³)	0.254	0.270	0.302	0.318	0.334	0.350	0.382	0.398	0.445

Figure 8 – Assembly and Installation Dimensions (Steel, Type 2-2)



Sign Size D x B (mm)	A	E	F	G min.	H	M_b	M_{nb}
1200 x 3000	2300	230	740	6850	100	1750	2775
1200 x 3600	2300	230	740	7150	300	1750	2775
1200 x 4800	3000	230	740	7400	150	1750	2775
1200 x 5100	3000	230	740	7550	300	1750	2775
1500 x 3000	2300	330	840	6850	100	1850	2975
1500 x 3600	2300	330	840	7150	300	1850	2975
1500 x 4200	2400	330	840	7400	200	1850	2975
1500 x 4500	2700	330	840	7400	350	1850	2975
1500 x 4800	3000	330	840	7400	150	1850	2975
1500 x 5100	3000	330	840	7550	300	1850	2975
1500 x 5400	3000	330	840	7700	450	1850	2975
1800 x 3300	2300	405	990	7000	150	1925	3200
1800 x 3600	2300	405	990	7150	300	1925	3200
1800 x 3900	2400	405	990	7250	450	1925	3200
1800 x 4200	2400	405	990	7400	200	1925	3200
1800 x 4500	2700	405	990	7400	350	1925	3200
1800 x 4800	3000	405	990	7400	150	1925	3200

Figure 9 – Assembly and Installation Dimensions (Steel, Type 2-3)

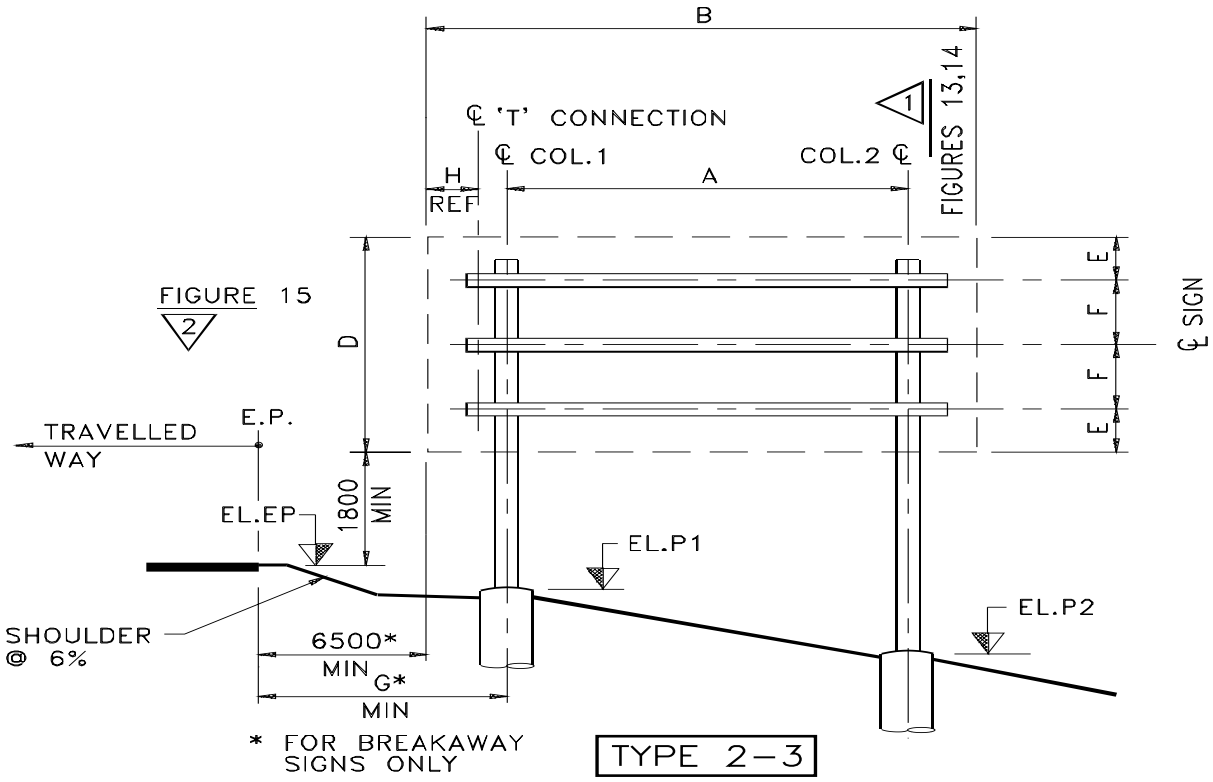
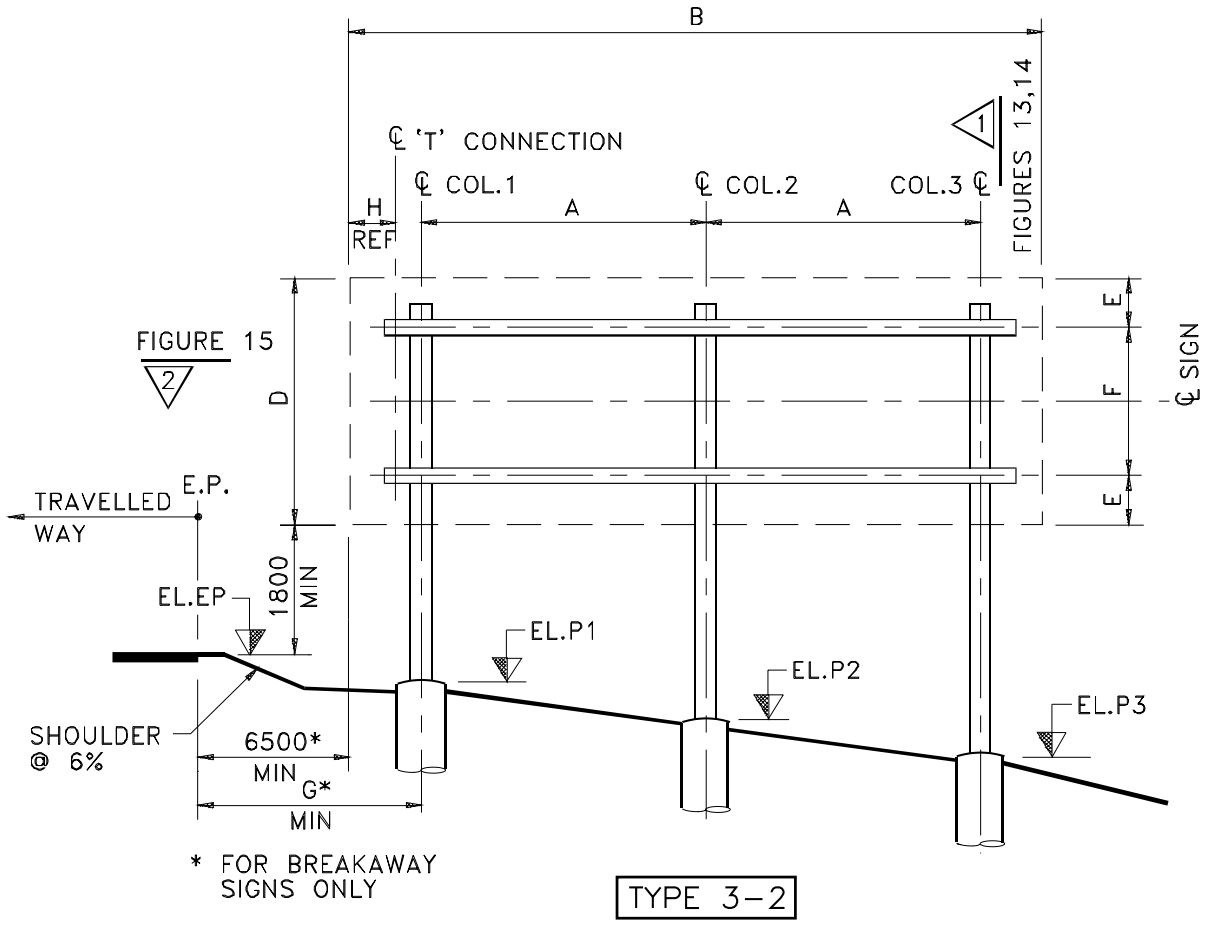


Figure 9 Continued – Assembly and Installation Dimensions (Steel, Type 2-3)

Sign Size D x B (mm)	A	E	F	G min.	H	M_b	M_{nb}
2100 x 2700	2300	445	605	6700	100	1965	3460
2100 x 3000	2300	445	605	6850	100	1965	3460
2100 x 3300	2300	445	605	7000	150	1965	3460
2100 x 3600	2300	445	605	7150	300	1965	3460
2100 x 3900	2400	445	605	7250	450	1965	3460
2100 x 4200	2400	445	605	7400	200	1965	3460
2100 x 4500	2700	445	605	7400	350	1965	3460
2100 x 4800	3000	445	605	7400	150	1965	3460
2400 x 2400	2300	480	720	6550	N.A.(*)	2000	3725
2400 x 2700	2300	480	720	6700	100	2000	3725
2400 x 3000	2300	480	720	6850	100	2000	3725
2400 x 3300	2300	480	720	7000	150	2000	3725
2400 x 3600	2300	480	720	7150	300	2000	3725
2400 x 3900	2400	480	720	7250	450	2000	3725
2400 x 4200	2400	480	720	7400	200	2000	3725
2400 x 4500	2700	480	720	7400	350	2000	3725
2400 x 4800	3000	480	720	7400	150	2000	3725
2700 x 2400	2300	580	770	6550	N.A.(*)	2100	3925
2700 x 2700	2300	580	770	6700	100	2100	3925
2700 x 3000	2300	580	770	6850	100	2100	3925
2700 x 3300	2300	580	770	7000	150	2100	3925
2700 x 3600	2300	580	770	7150	300	2100	3925
2700 x 3900	2400	580	770	7250	450	2100	3925
2700 x 4200	2400	580	770	7400	200	2100	3925
2700 x 4500	2700	580	770	7400	350	2100	3925
2700 x 4800	3000	580	770	7400	150	2100	3925
3000 x 2400	2300	635	865	6550	N.A.(*)	2155	4170
3000 x 4200	2400	635	865	7400	200	2155	4170
3000 x 4500	2700	635	865	7400	350	2155	4170
3000 x 4800	3000	635	865	7400	150	2155	4170
3300 x 4200	2400	675	975	7400	200	2195	4430
3300 x 4500	2700	675	975	7400	350	2195	4430
3300 x 4800	3000	675	975	7400	150	2195	4430
3600 x 4800	3000	730	1070	7400	150	2250	4675

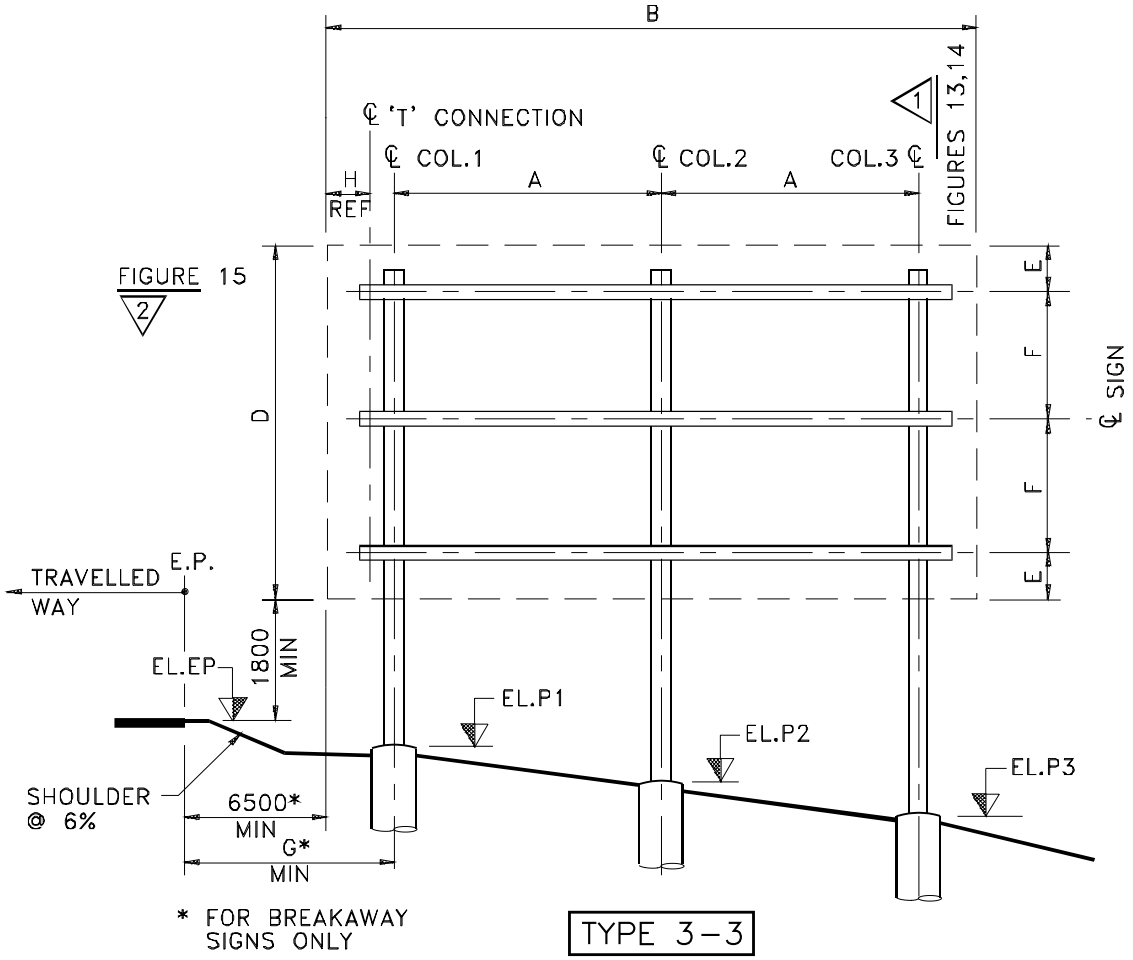
(*) - sign width is shorter than length of crossarm

Figure 10 – Assembly and Installation Dimensions (Steel, Type 3-2)



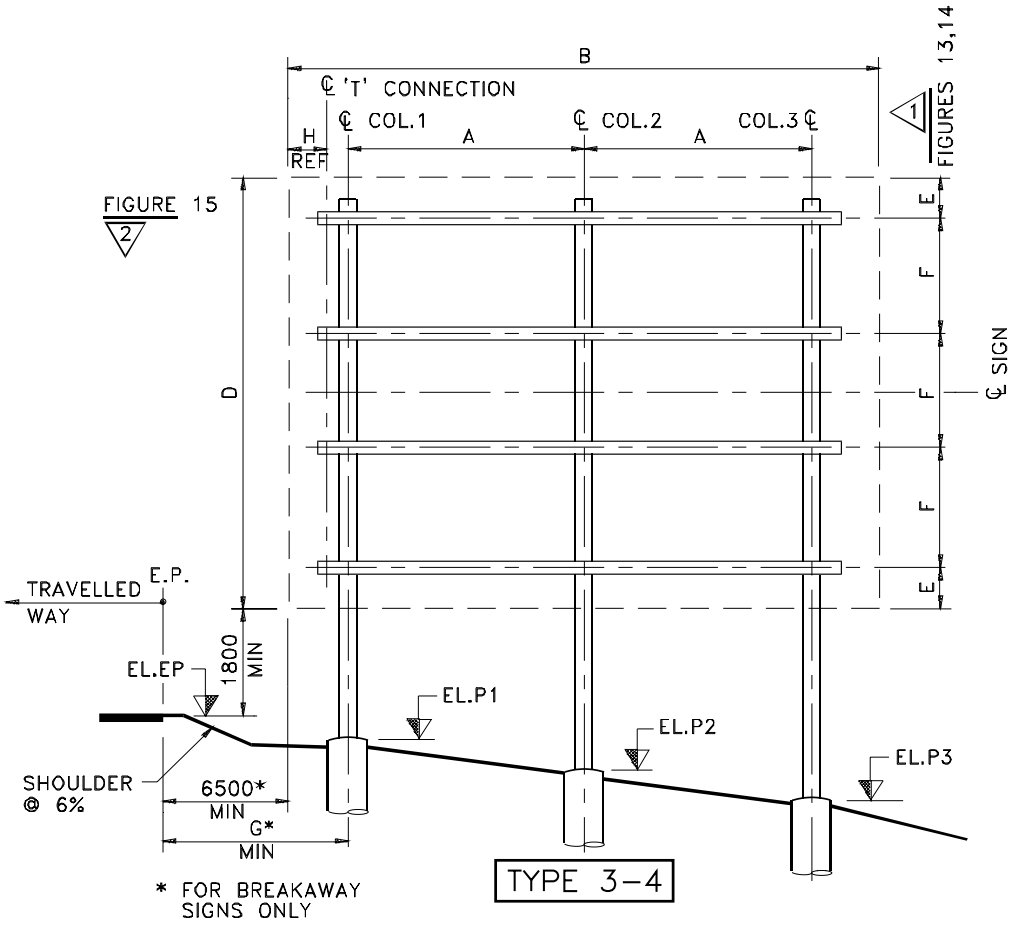
Sign Size D x B (mm)	A	E	F	G min.	H	M_b	M_{nb}
1500 x 5700	2300	330	840	7050	250	1850	2975
1500 x 6000	2300	330	840	7200	400	1850	2975
1800 x 5100	2300	405	990	6750	100	1925	3200
1800 x 5400	2300	405	990	6900	100	1925	3200
1800 x 5700	2300	405	990	7050	250	1925	3200
1800 x 6000	2300	405	990	7200	400	1925	3200
1800 x 6600	2700	405	990	7100	300	1925	3200
1800 x 7200	2900	405	990	7200	200	1925	3200
1800 x 7800	3000	405	990	7400	100	1925	3200

Figure 11 – Assembly and Installation Dimensions (Steel, Type 3-3)



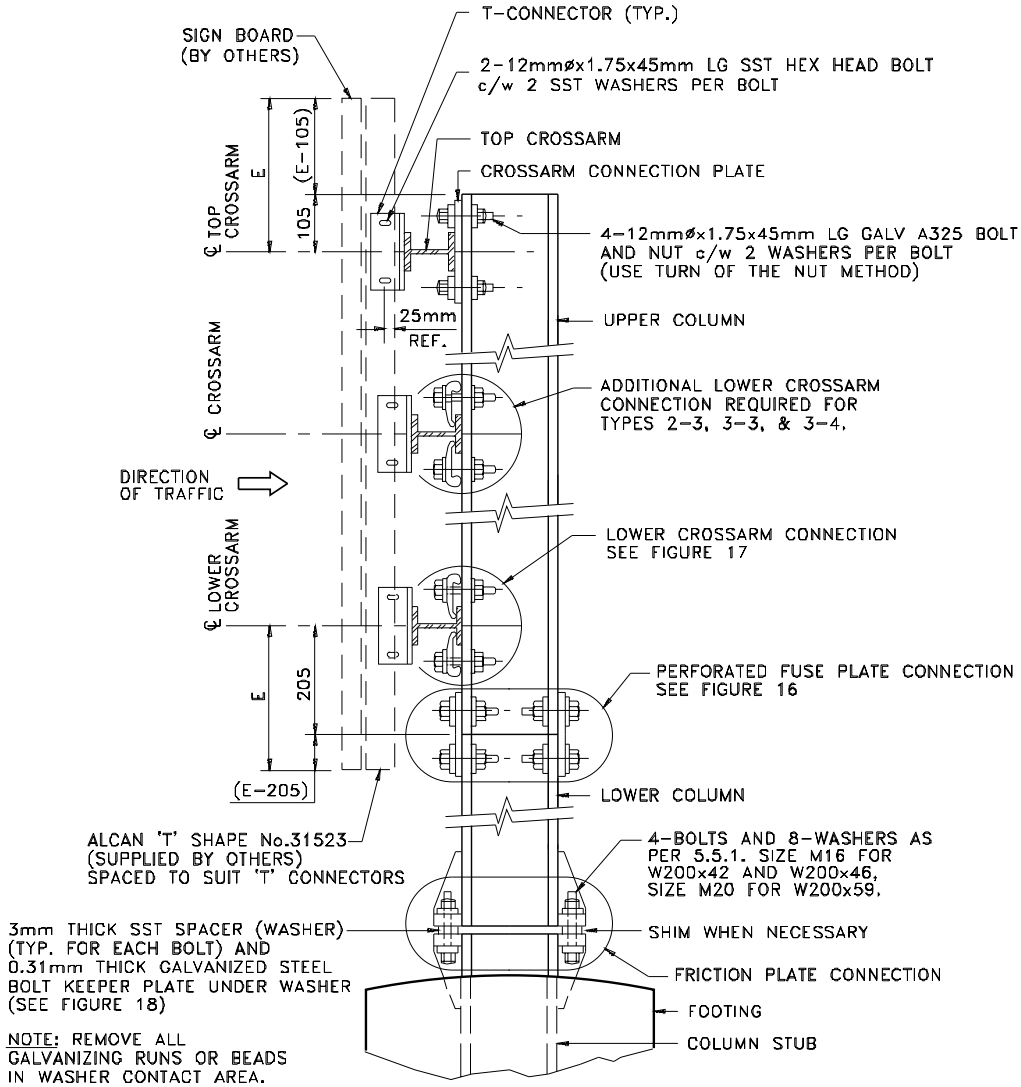
Sign Size D x B (mm)	A	E	F	G min.	H	M_b	M_{nb}
2100 x 5100	2300	445	605	6750	100	1965	3460n
2100 x 5400	2300	445	605	6900	100	1965	3460
2100 x 5700	2300	445	605	7050	250	1965	3460 c
2100 x 6000	2300	445	605	7200	400	1965	3460
2100 x 6600	2400	445	605	7400	300	1965	3460
2100 x 7200	2900	445	605	7200	200	1965	3460
2100 x 7800	3000	445	605	7400	100	1965	3460
2400 x 5400	2300	480	720	6900	100	2000	3725
2400 x 6000	2300	480	720	7200	400	2000	3725
2400 x 6600	2400	480	720	7400	300	2000	3725
2400 x 7800	3000	480	720	7400	100	2000	3725
2700 x 5100	2300	580	770	6750	100	2100	3925
2700 x 5400	2300	580	770	6900	100	2100	3925
2700 x 5700	2300	580	770	7050	250	2100	3925
2700 x 7800	3000	580	770	7400	100	2100	3925
3000 x 5400	2300	635	865	6900	100	2155	4170
3000 x 7800	3000	635	865	7400	100	2155	4170
3300 x 5400	2300	675	975	6900	100	2195	4430

Figure 12 – Assembly and Installation Dimensions (Steel, Type 3-4)



Sign Size D x B (mm)	A	E	F	G min.	H	M_b	M_{nb}
2400 x 7200	2900	300	600	7200	200	1820	3905
2400 x 7800	3000	300	600	7400	100	1820	3905
2700 x 6000	2300	375	650	7200	400	1895	4130
2700 x 6600	2700	375	650	7100	300	1895	4130
2700 x 7200	2900	375	650	7200	200	1895	4130
2700 x 7800	3000	375	650	7400	100	1895	4130
3000 x 6000	2300	450	700	7200	400	1970	4355
3000 x 6600	2700	450	700	7100	300	1970	4355
3000 x 7200	2900	450	700	7200	200	1970	4355
3000 x 7800	3000	450	700	7400	100	1970	4355
3300 x 6000	2300	525	750	7200	400	2045	4580
3300 x 6600	2700	525	750	7100	300	2045	4580
3300 x 7200	2900	525	750	7200	200	2045	4580
3600 x 5400	2300	600	800	6900	100	2120	4805
3600 x 6000	2300	600	800	7200	400	2120	4805
3600 x 6600	2700	600	800	7100	300	2120	4805

Figure 13 – Breakaway Type Installation Details (Steel)



Column Size	Friction Plate Bolt Size	Torque (Nm)
W200 x 42	M16 x 70 mm LG	67
W200 x 46	M16 x 70 mm LG	67
W200 x 59	M20 x 90 mm LG	85

Figure 14 – Non-breakaway Type Installation Details (Steel)

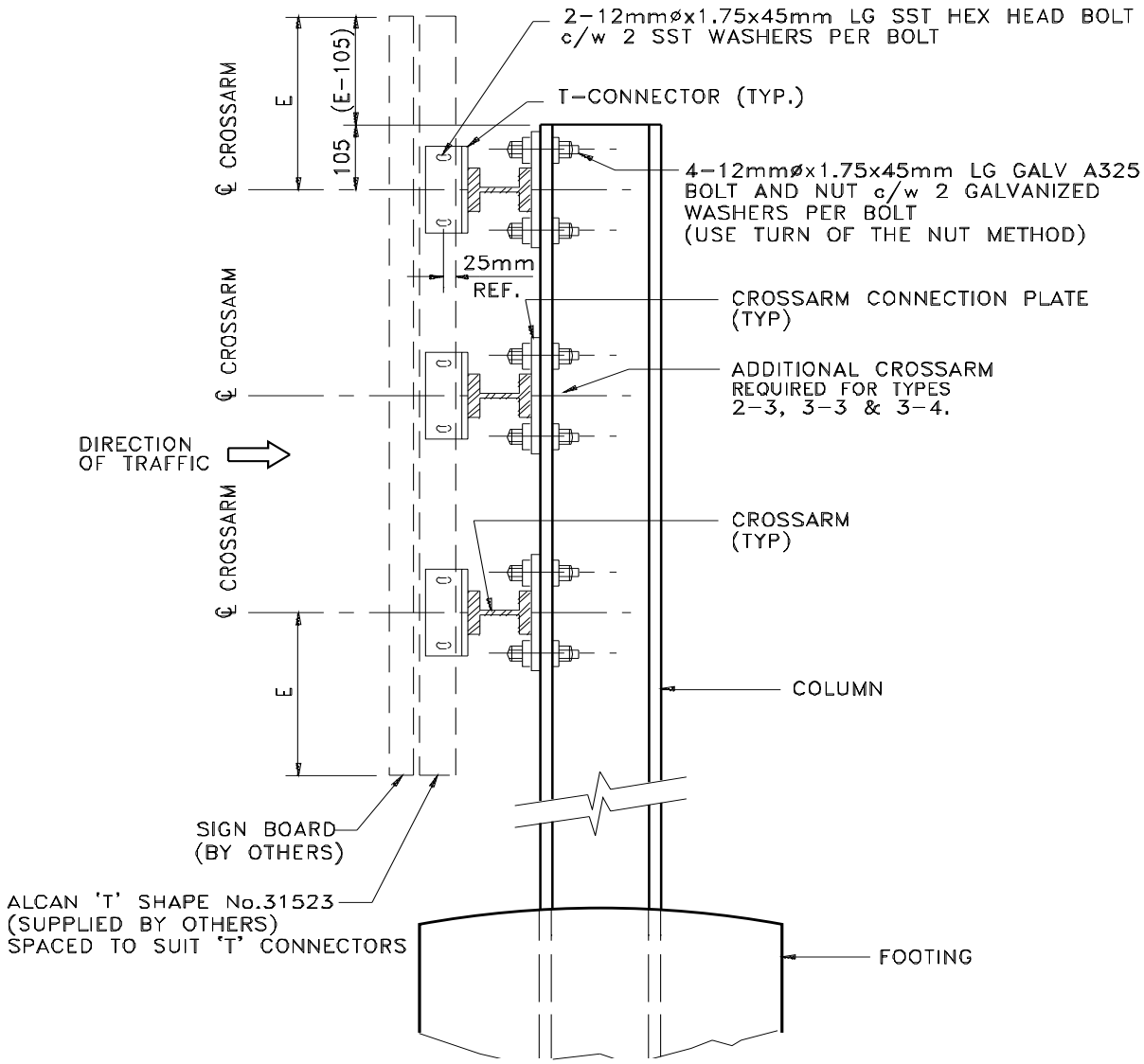
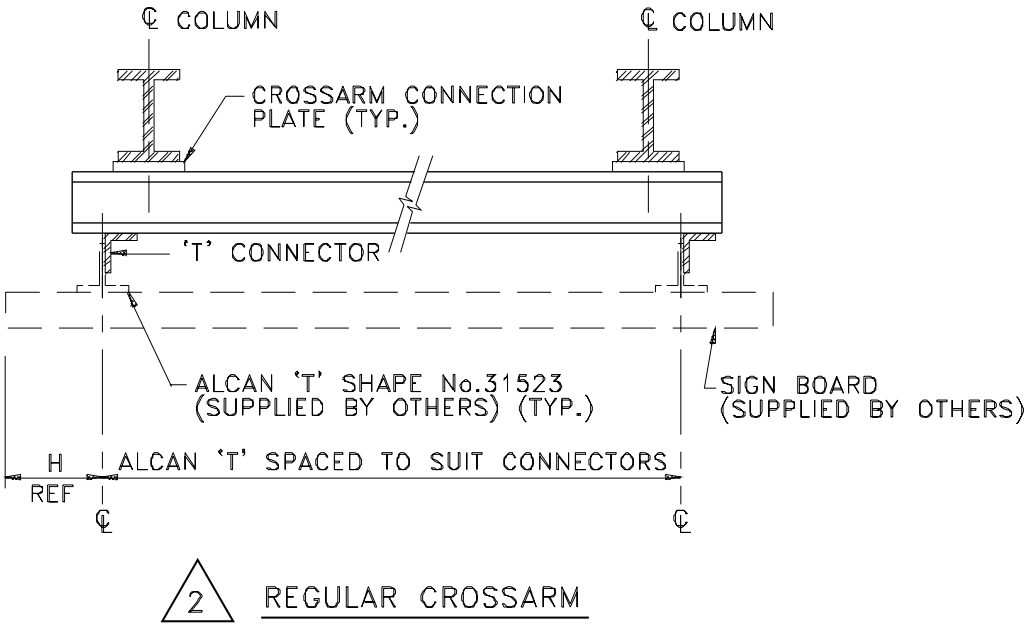
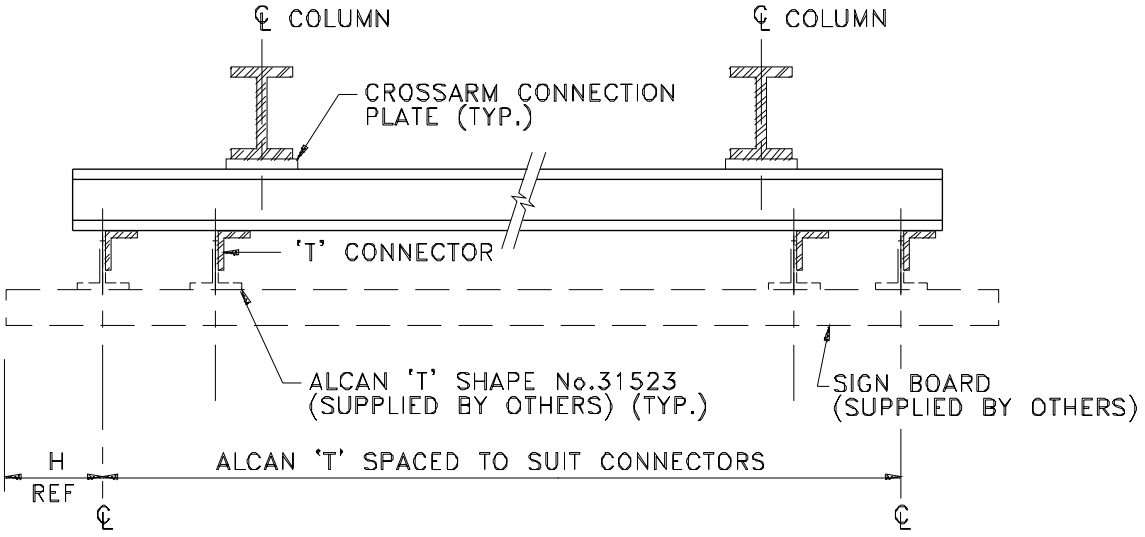


Figure 15 – Installation Details (Steel)



2 REGULAR CROSSARM



2 EXTENDED CROSSARM

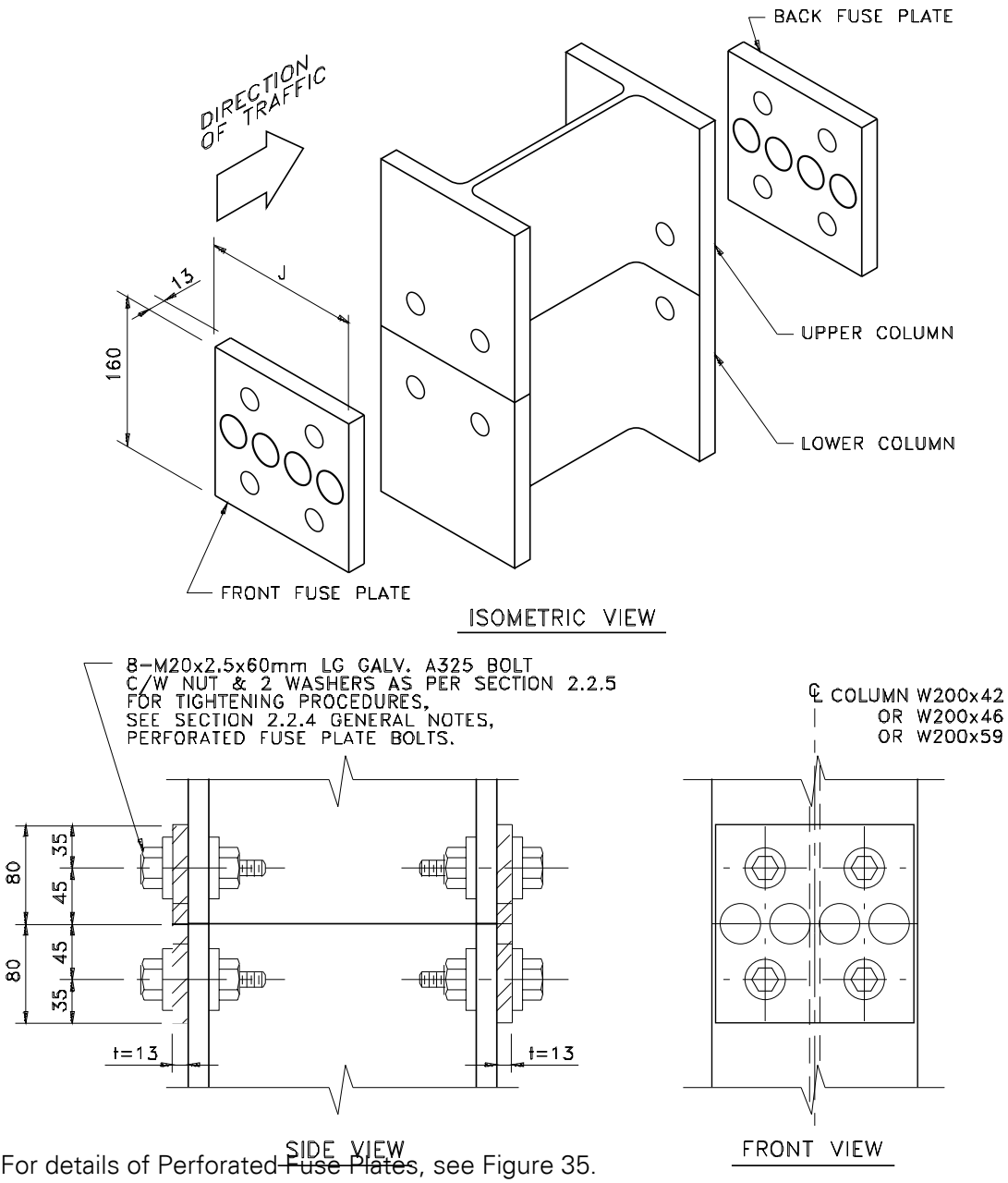
Notes:

- Regular crossarms are used when spacing of T-connectors is exactly 1500 mm.
- Extended crossarms are used when equal spacing of interior T-connectors of 1500 mm is not enough, but lengths of crossarm require additional smaller spacing of exterior T-connectors.

Perforated Fuse Plate Connection (Breakaway Type)

Figure 16 provides information for the assembly of the "Perforated Fuse Plates".

Figure 16 – Perforated Fuse Plate Details

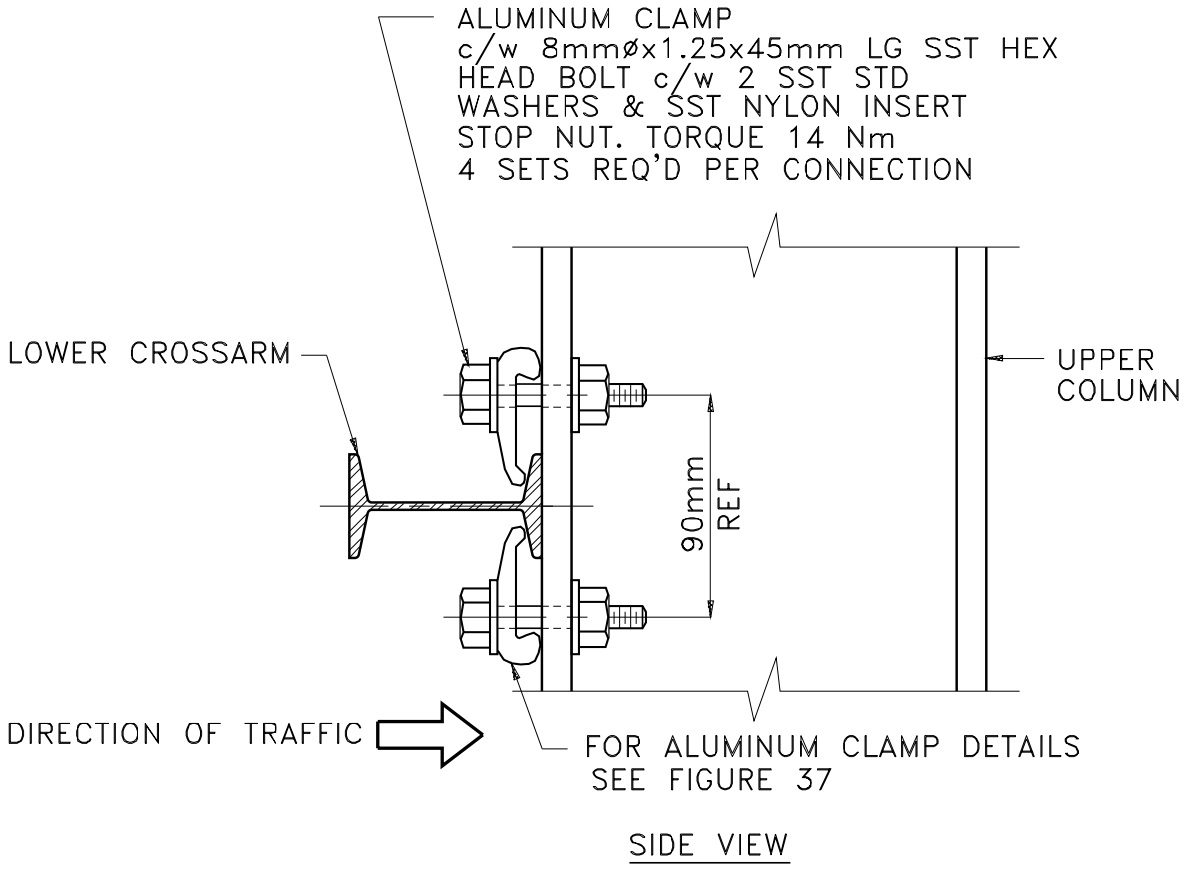


Note: For details of Perforated ~~Fuse Plates~~, see Figure 35.

Lower Crossarm Connection, Steel (Breakaway Type)

Figure 17 provides details for the assembly of the connection of the "Lower Crossarm" to the "Upper Column".

Figure 17 – Lower Crossarm Connection (Steel)



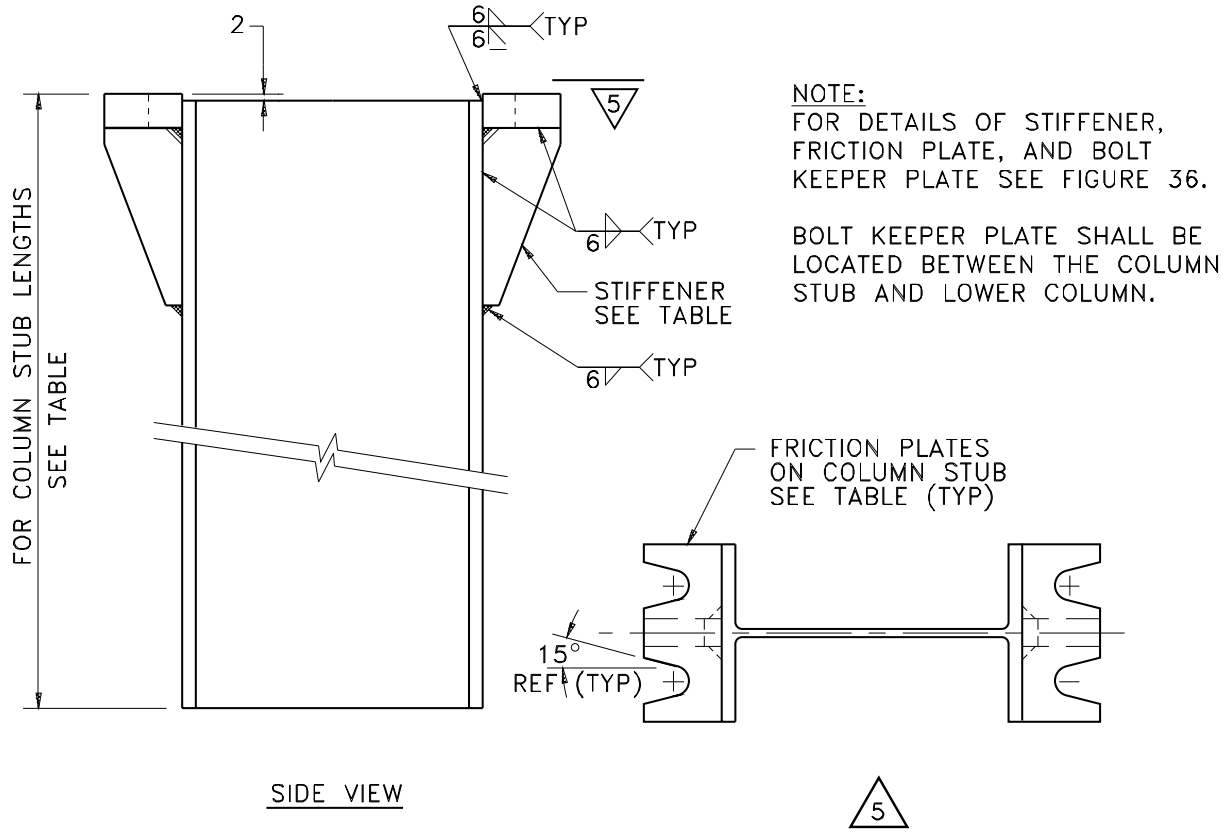
2.2.5 Sign Support Fabrication

General

Steel Support Column Stub (Breakaway Type)

Figure 18 provides all necessary information for the fabrication of the "Support Column Stubs".

Figure 18 – Steel Support Column Stub Details (Breakaway)

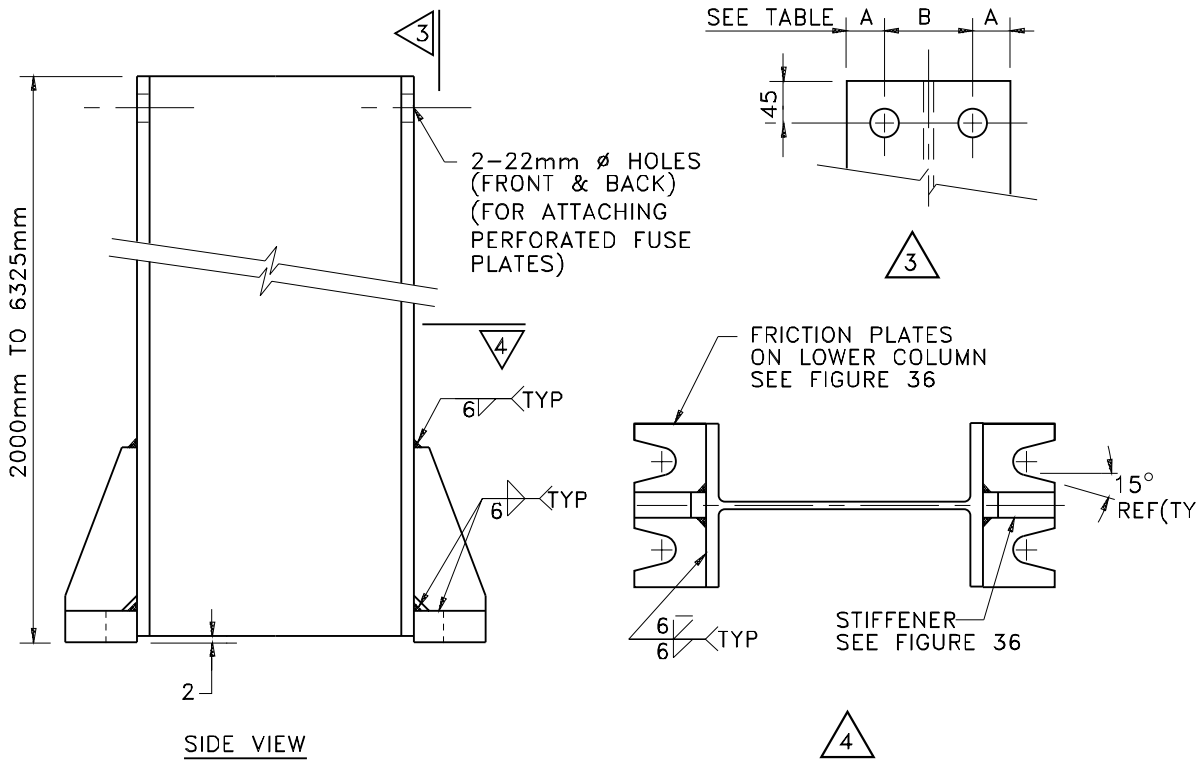


Column Size	Column Stub Length								
W200 x 42	1600	1700	1900	2000	2100	—	—	—	—
W200 x 46	1600	—	1900	2000	2100	2200	—	2500	—
W200 x 59	—	—	—	2000	—	2200	2400	2500	2800

Note: Friction plates shall be fabricated perpendicular to the longitudinal axis of the column.

Lower Steel Support Column (Breakaway Type)

Figure 19 – Lower Steel Support Column Details (Breakaway)



Column Size	A (mm)	B (mm)
W200 x 42	43	80
W200 x 46	52	100
W200 x 59	53	100

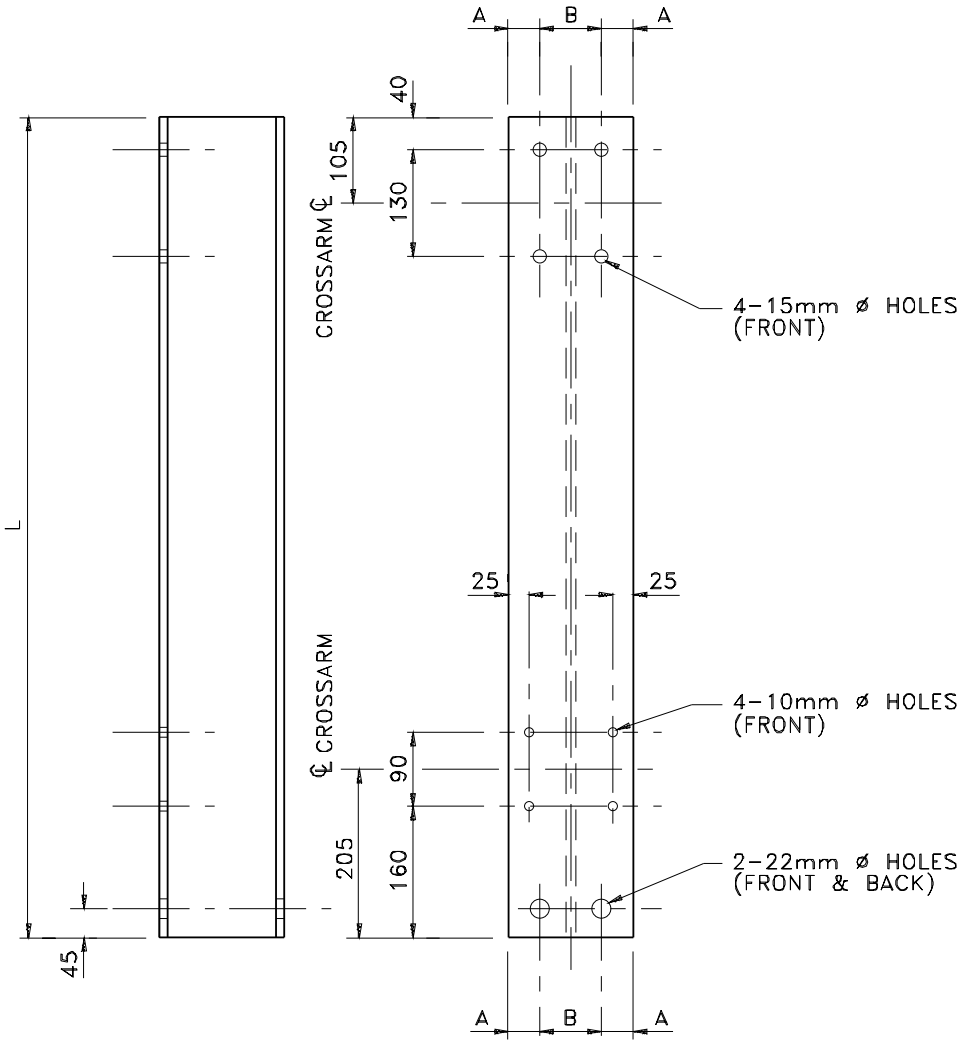
Notes:

- Friction plates shall be fabricated perpendicular to the longitudinal axis of the column.
- Obtain length from Figure 2.
- For details of stiffener, friction plate, and bolt keeper plate, see Figure 36
- Bolt keeper plate shall be located between the column stub and lower column.

Upper Steel Support Column (Breakaway Type)

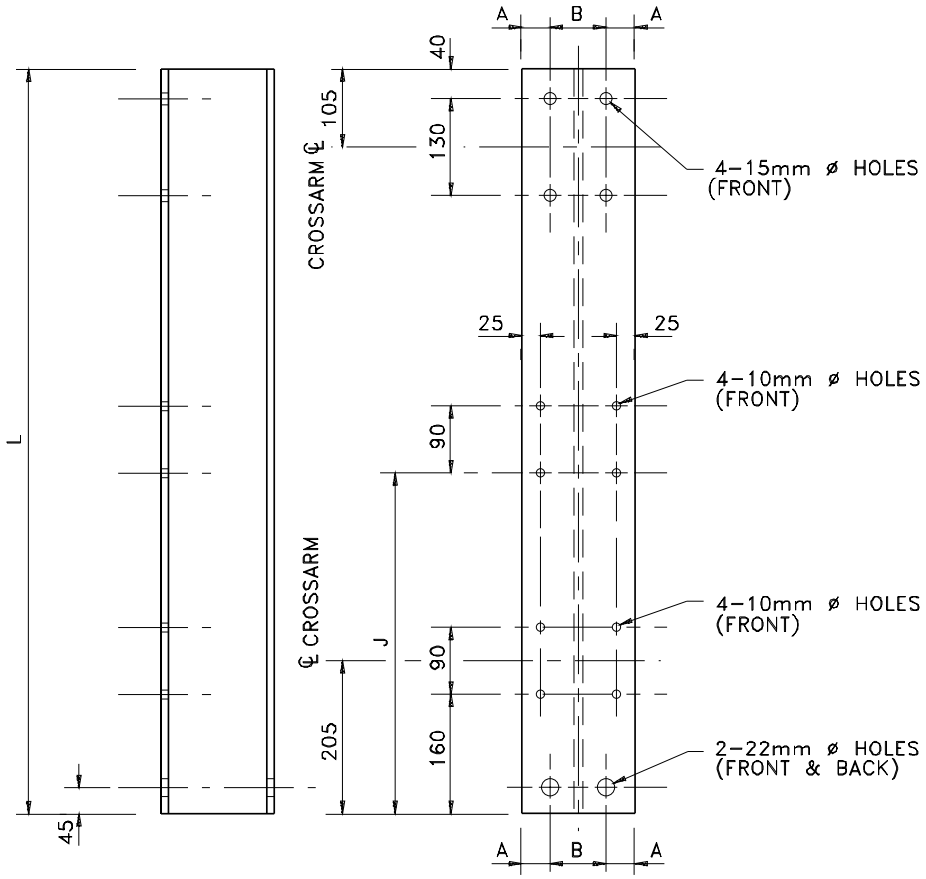
Figures 20 to 22 provide all information necessary for fabrication of the "Upper Steel Support Columns".

Figure 20 – Upper Steel Support Column Details (2 Crossarms – Breakaway)



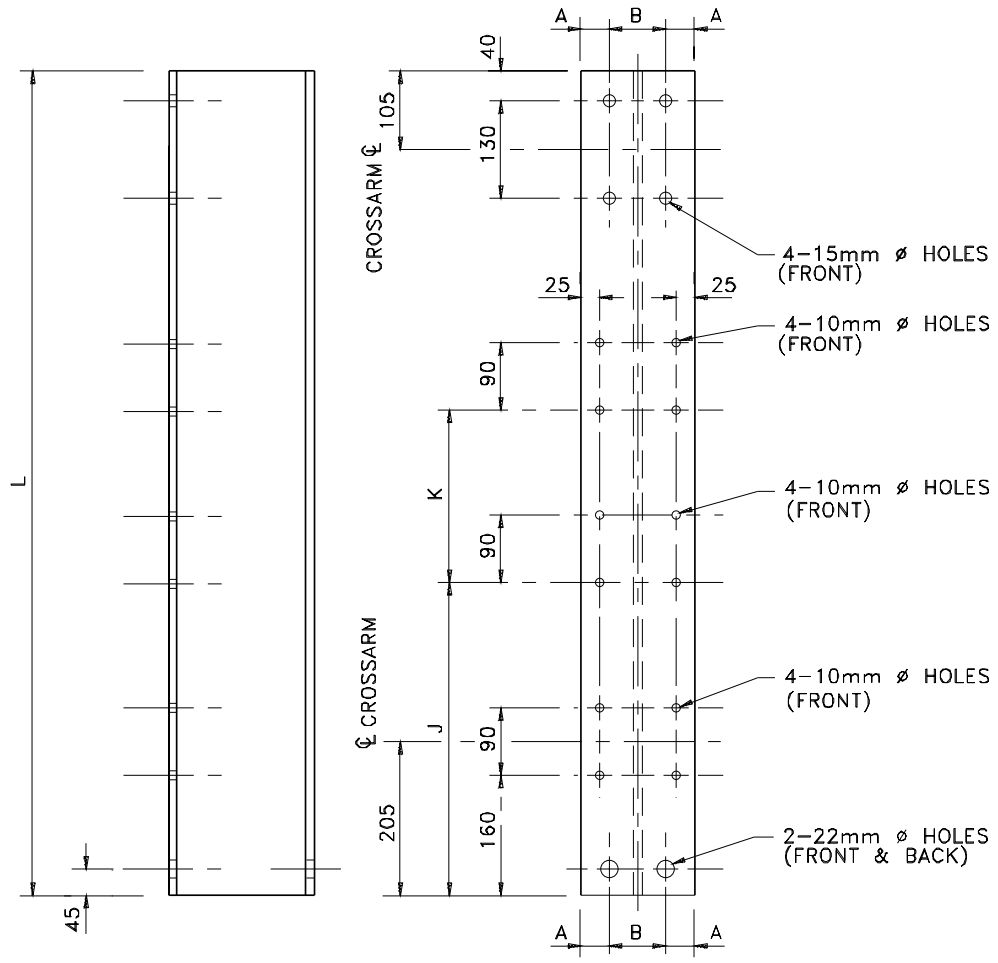
Column Size	L (mm)	A (mm)	B (mm)
W200 x 42	1050	43	80
	1150		
	1300		
W200 x 46	1150	52	100
	1300		
W200 x 59	1300	53	

Figure 21 – Upper Steel Support Column Details (3 Crossarms – Breakaway)



Column Size	L (mm)	J (mm)	A (mm)	B (mm)
W200 x 42	1520	765	43	80
	1750	880		
	1850	930		
	2040	1025		
	2260	1135		
	2450	1230		
W200 x 46	1520	765	52	100
	1750	880		
	1850	930		
	2040	1025		
	2260	1135		
	2450	1230		
W200 x 59	1520	765	53	100
	1750	880		
	1850	930		
	2040	1025		
	2260	1135		
	2450	1230		

Figure 22 – Upper Steel Support Column Details (4 Crossarms – Breakaway)

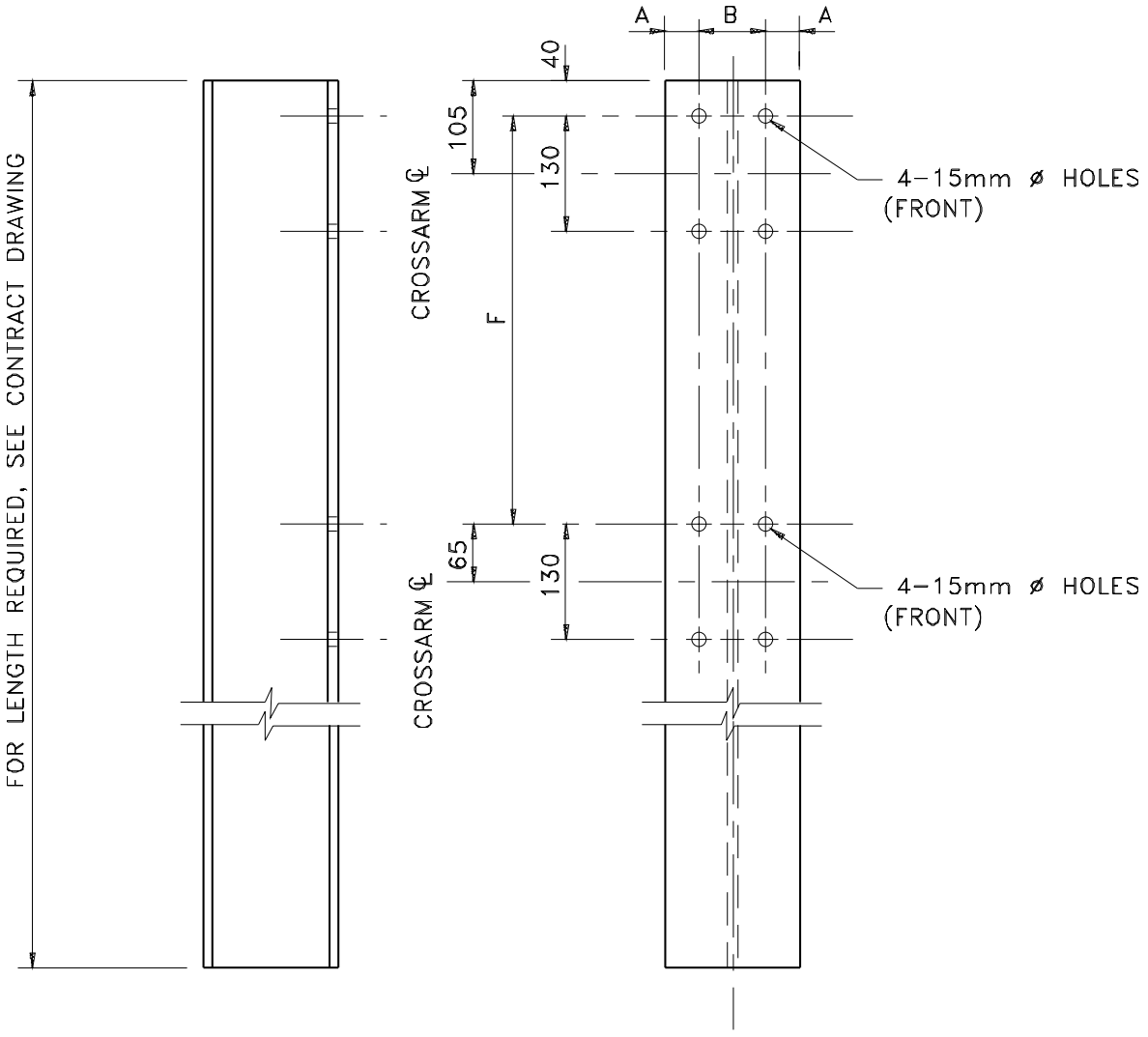


Column Size	L (mm)	J (mm)	K (mm)	A (mm)	B (mm)
W200 x 42	2110	760	600	43	80
	2260	810	650		
	2410	860	700		
	2560	910	750		
	2710	960	800		
W200 x 46	2110	760	600	52	100
	2260	810	650		
	2410	860	700		
	2560	910	750		
	2710	960	800		
W200 x 59	2110	760	600	53	100
	2260	810	650		
	2410	860	700		
	2560	910	750		
	2710	960	800		

Steel Support Column (Non-breakaway Type)

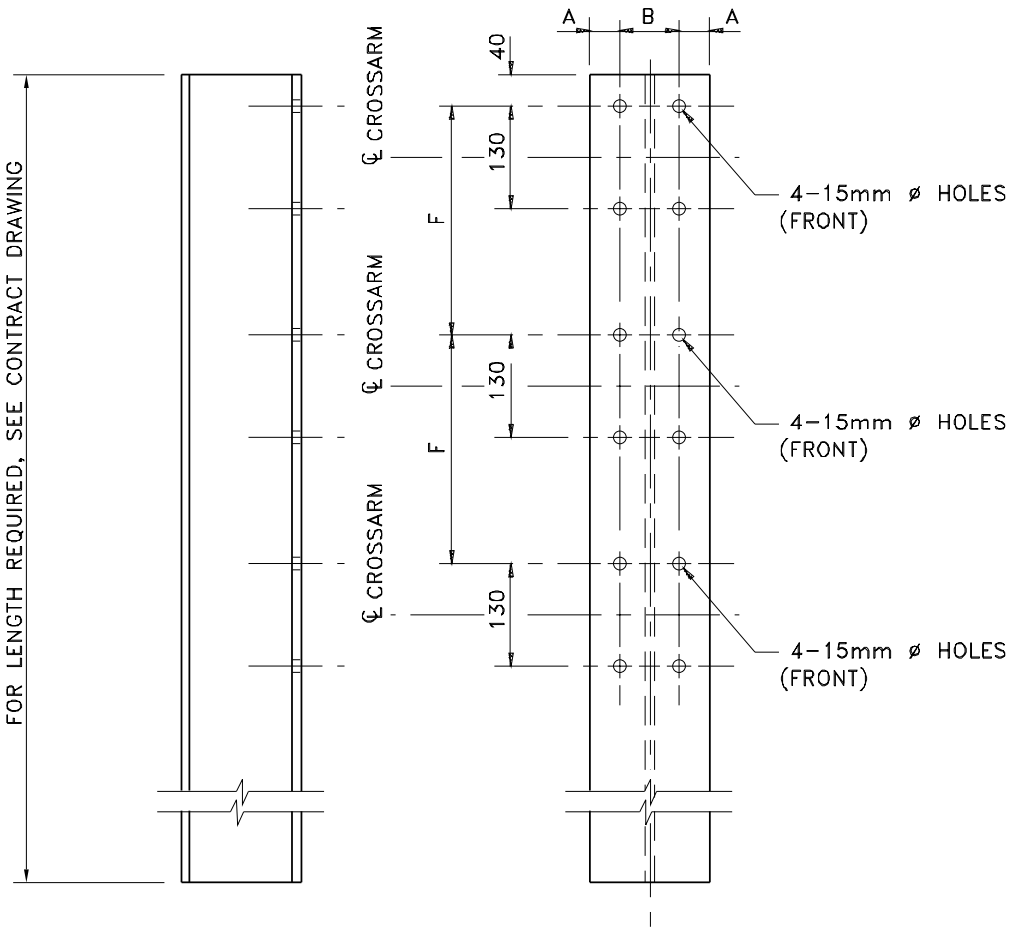
Figures 23 to 25 provide all information necessary to fabricate the columns for non-breakaway steel column sign supports.

Figure 23 – Steel Support Column Details (2 Crossarms – Non-breakaway)



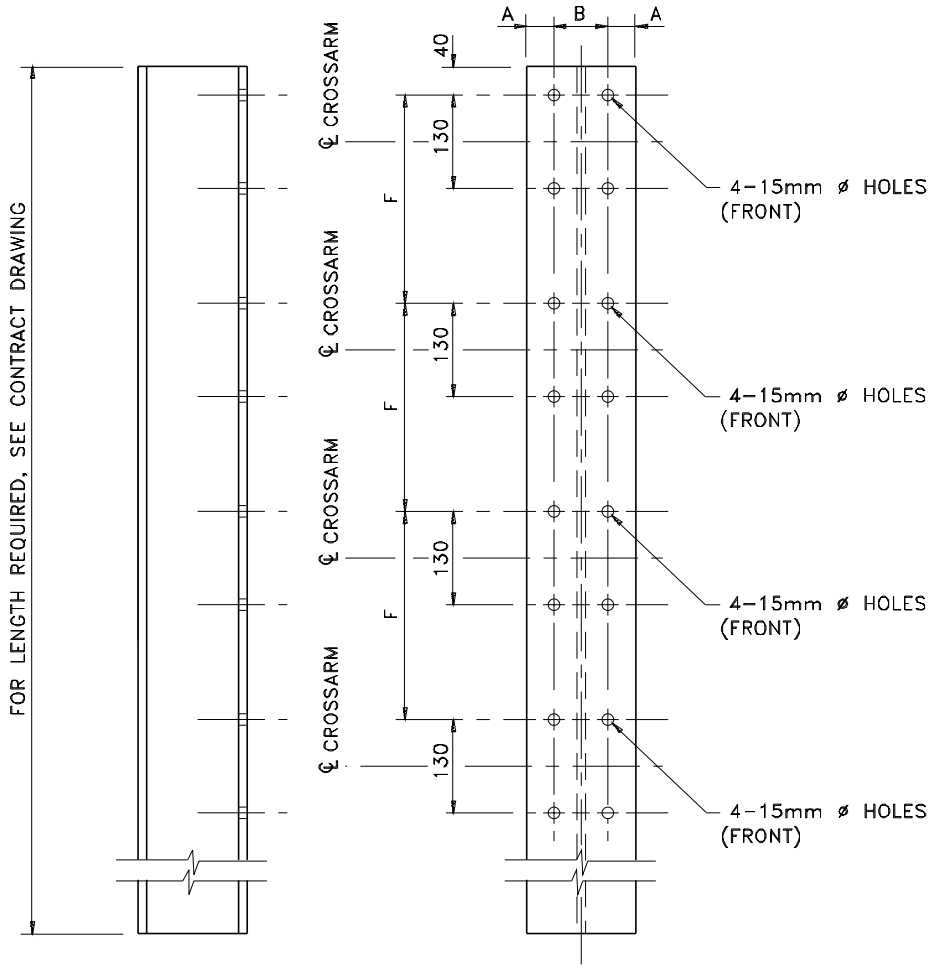
Column Size	F (mm)	A (mm)	B (mm)
W200 x 42	740	43	80
	840		
	990		
W200 x 46	840	52	100
	990		
W200 x 59	840	53	100
	990		

Figure 24 – Steel Support Column Details (3 Crossarms – Non-Breakaway)



Column Size	F (mm)	A (mm)	B (mm)
W200 x 42	605	43	80
	720		
	770		
	865		
	975		
	1070		
W200 x 46	605	52	100
	720		
	770		
	865		
	975		
	1070		
W200 x 59	605	53	100
	720		
	770		
	865		
	975		
	1070		

Figure 25 – Steel Support Column Details (4 Crossarms – Non-breakaway)

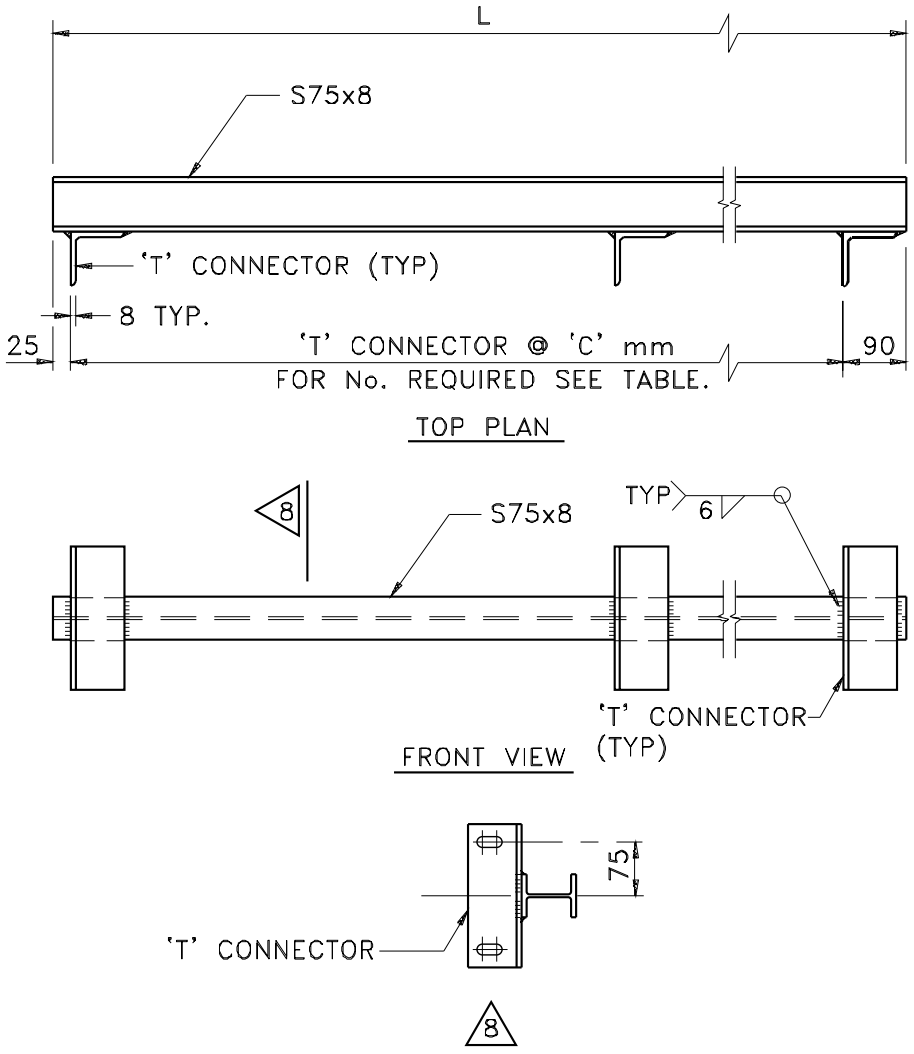


Column Size	F (mm)	A (mm)	B (mm)
W200 x 42	600	43	80
	650		
	700		
	750		
	800		
W200 x 46	600	52	100
	650		
	700		
	750		
	800		
W200 x 59	600	53	100
	650		
	700		
	750		
	800		

Lower Steel Crossarm (Breakaway Type)

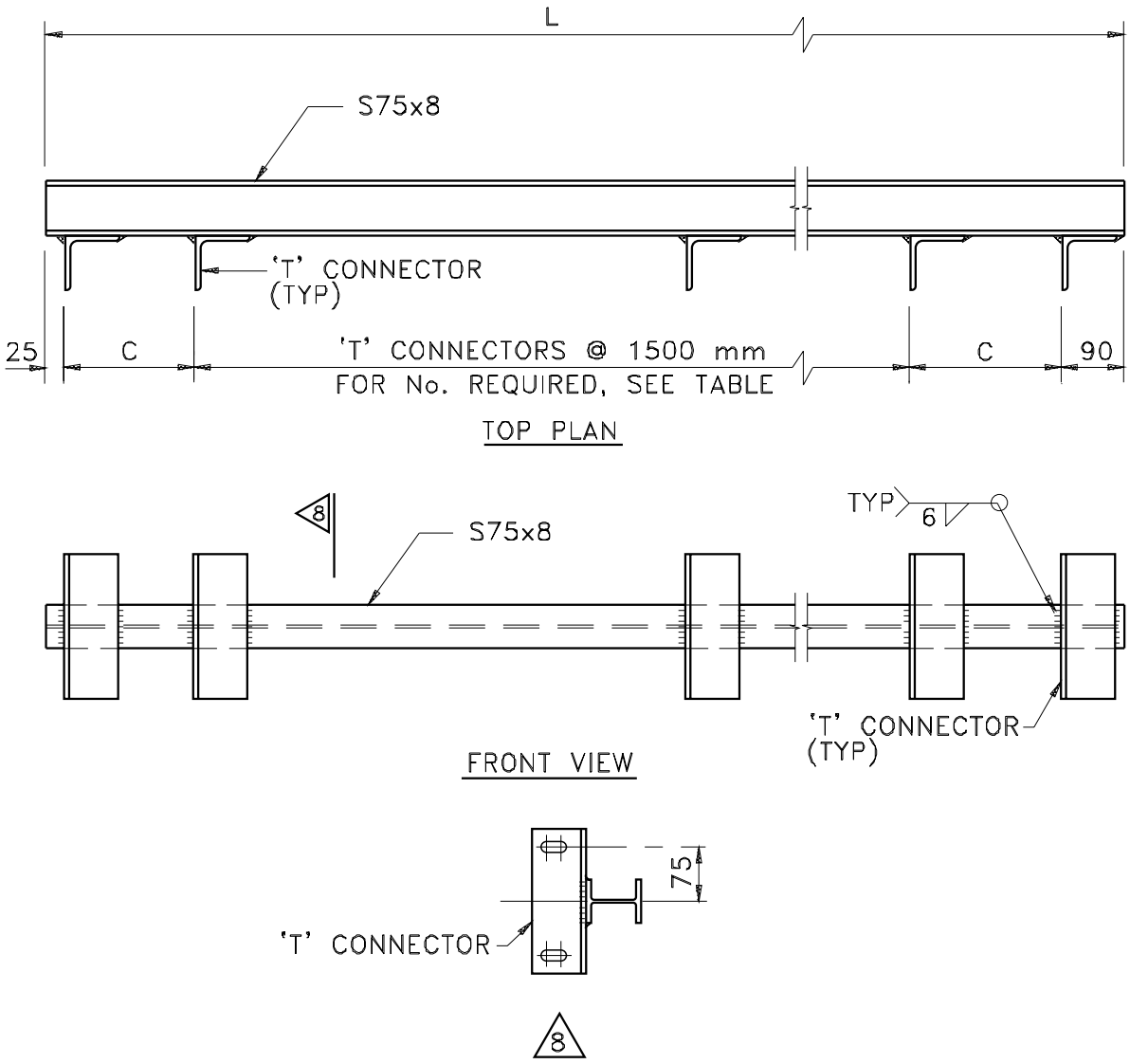
Figures 26 and 27 provide all information necessary for the fabrication of the "Lower Steel Crossarms".

Figure 26 – Lower Steel Crossarm Details (Regular Type)



No. of T-Connectors Req'd	L (mm)	C (mm)
3	3115	1500
4	4615	
5	6115	

Figure 27 – Lower Steel Crossarm Details (Extended Type)



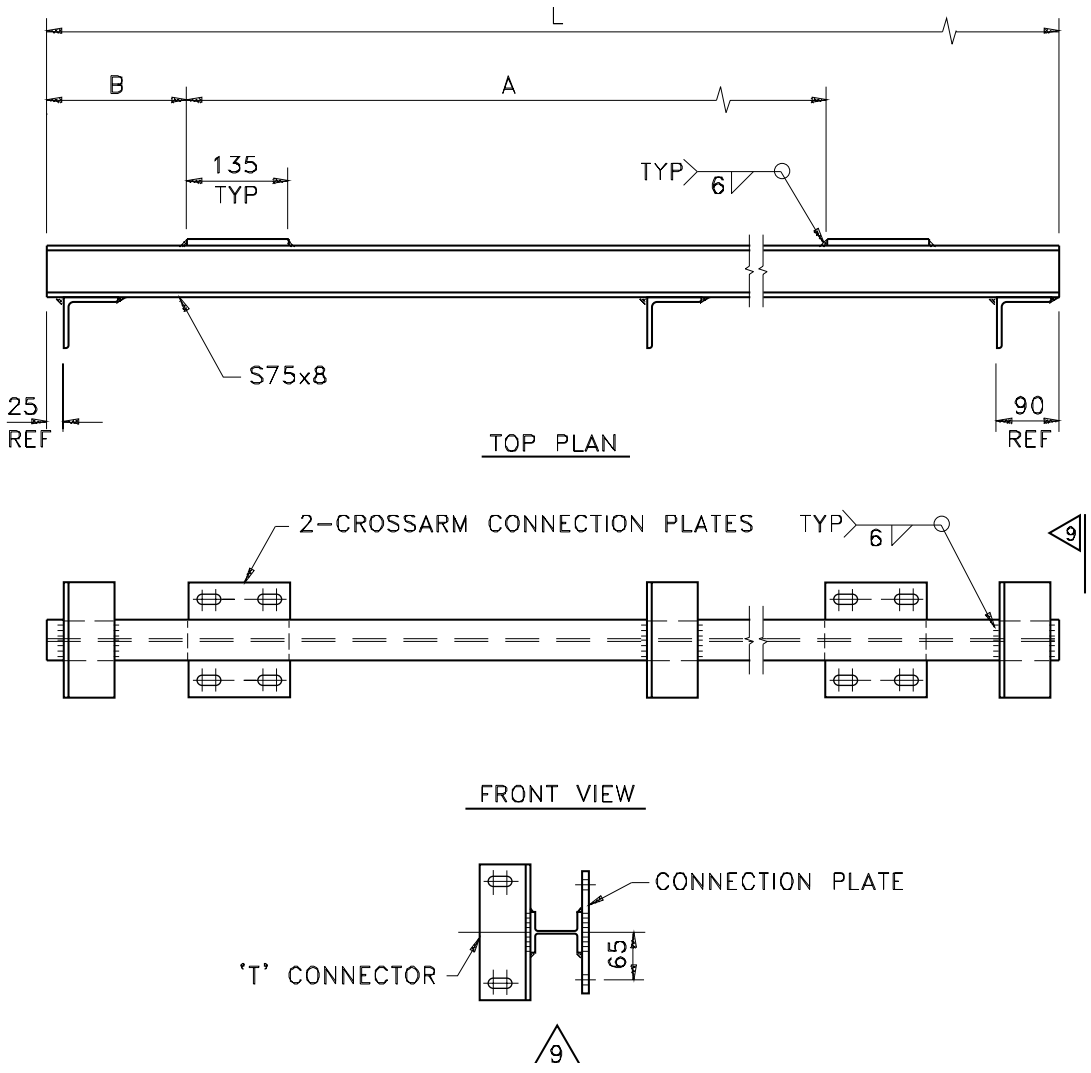
No. of T-Connectors Req'd	L (mm)	C (mm)
4	2466*	426
4	2503**	444
4	2615	500
4	2915	650
5	3915	400
6	5015	200
6	5315	350
7	6915	400
8	7715	800

(*) - for sign width of 2.4m with W200x42 post
(**) - for sign width of 2.4m with W200x456 post

Top Crossarm or Crossarm, Steel

Figures 28 to 32 provide all information necessary for the fabrication of the "Top Crossarm" for breakaway type or "Crossarm" for non-breakaway type.

Figure 28 – Top Crossarm or Crossarm Details (Steel, Regular, Two Connection Plates)

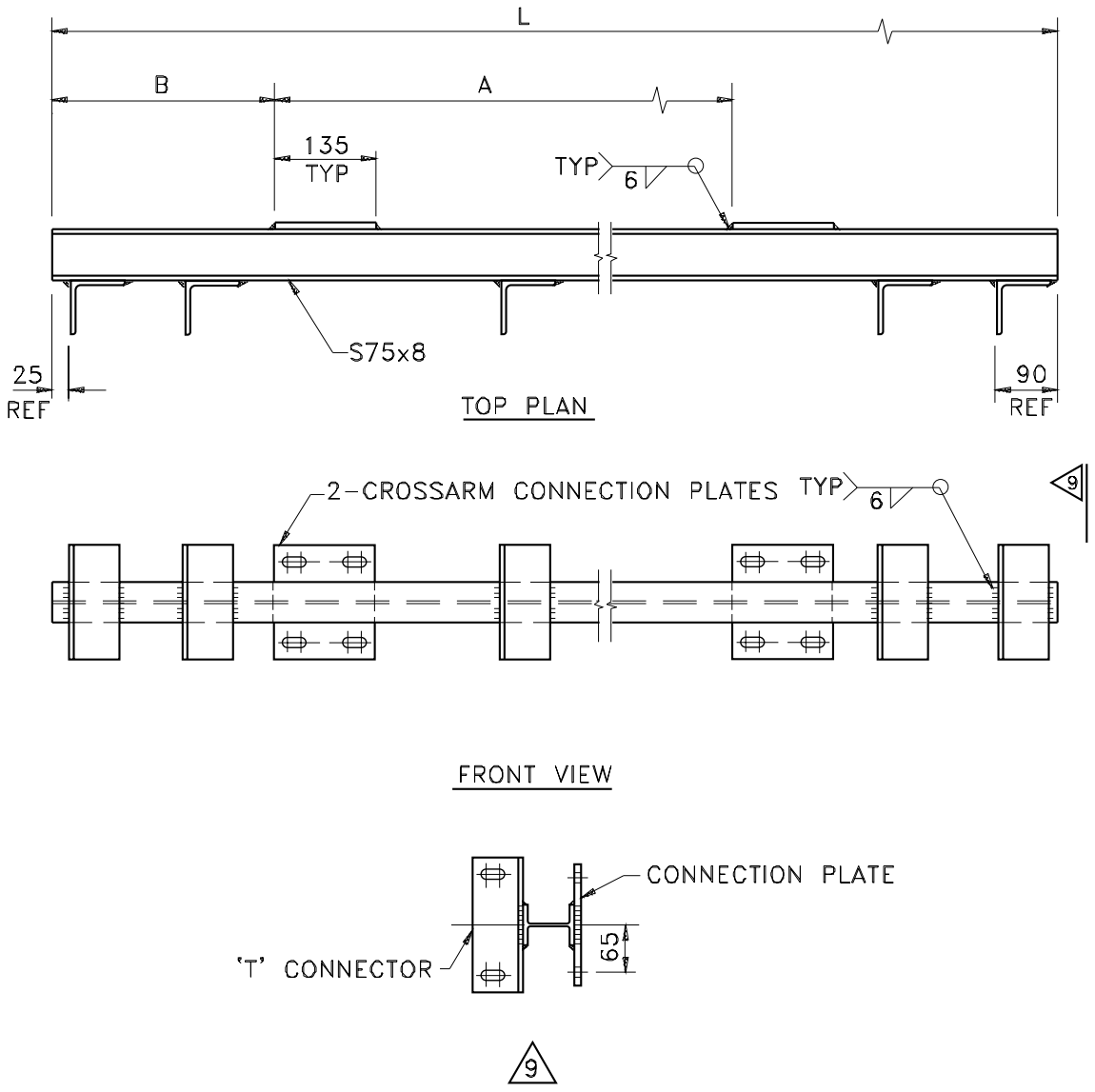


A (mm)	L (mm)	B (mm)
2300	3115	300
2400	3115	250
3000	4615	700

Notes:

- For two-column sign supports (i.e., Types 2-2 and 2-3)
- A = column spacing
- B = (Sign Horizontal Overhang – (H-20) – 135/2)
- L = (Sign Width – 2H + 115)
- H = Lateral sign overhang beyond end T-connection

Figure 29 – Top Crossarm or Crossarm Details (Steel, Extended, Two Connection Plates)



A (mm)	L (mm)	B (mm)
2300	2466*	16
2300	2503**	34
2300	2615	50
2300	2915	200
2400	3915	650
2700	3915	500

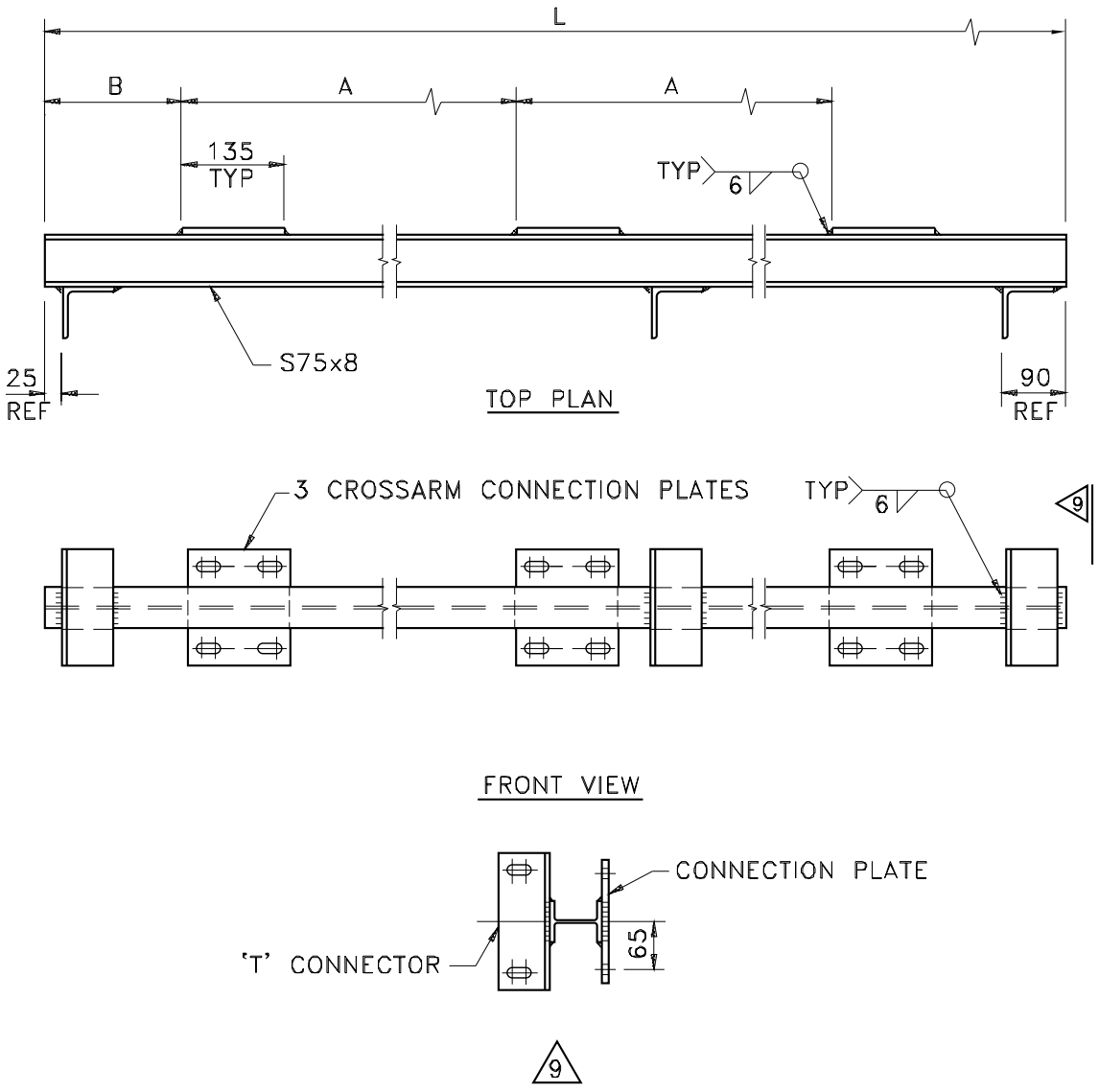
(*) - for sign width of 2.4m with W200x42 post

(**) - for sign width of 2.4m with W200x46 post

Notes:

- For two-column sign supports (i.e., Types 2-2 and 2-3)
- A = column spacing
- B = (Sign Horizontal Overhang – (H-20) – 135/2)
- L = (Sign Width – 2H + 115)
- H = Lateral sign overhang beyond end T-connection.

Figure 30 – Top Crossarm or Crossarm Details (Steel, Regular, Three Connection Plates)

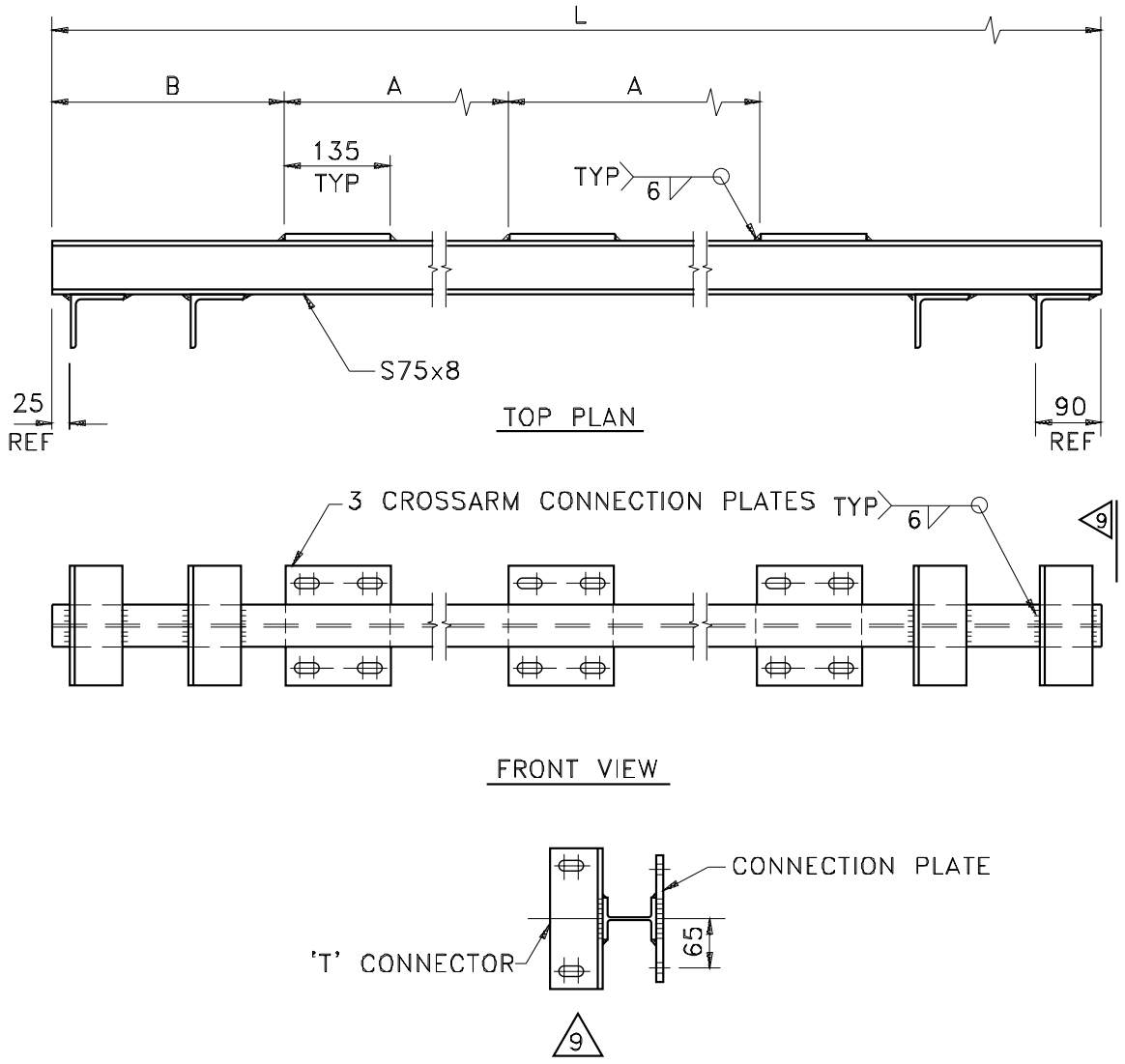


A (mm)	L (mm)	B (mm)
2400	6115	550
2700	6115	250

Notes:

- For three-column sign supports (i.e., Types 3-2, 3-3, and 3-4)
- A = column spacing
- B = (Sign Horizontal Overhang – (H-20) – 135/2)
- L = (Sign Width – 2H + 115)
- H = Lateral sign overhang beyond end T-connection.

Figure 31 – Top Crossarm or Crossarm Details (Steel, Extended, Three Connection Plates)

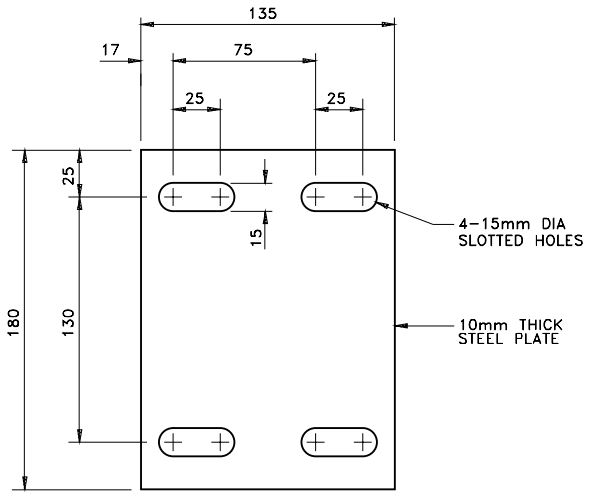


A (mm)	L (mm)	B (mm)
2300	5015	100
2300	5315	250
2900	6915	450
3000	7715	750

Notes:

- For three-column sign supports (i.e., Types 3-2, 3-3, and 3-4)
- A = column spacing
- B = (Sign Horizontal Overhang – (H-20) – 135/2)
- L = (Sign Width – 2H + 115)
- H = Lateral sign overhang beyond end T-connection.

Figure 32 – Crossarm Connection Plate Details (Steel)



T-Connector and Brass Shim, Steel

Figure 33 provides all information necessary for fabrication of the T-connectors used for the upper and lower crossarms (for breakaway and non-breakaway steel sign supports).

Figure 33 – T-Connector (Steel)

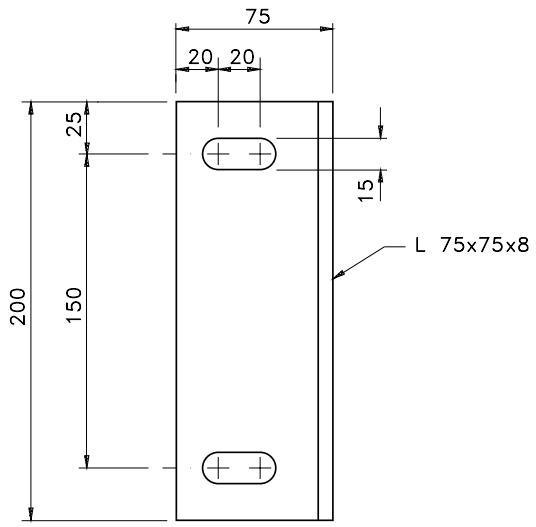
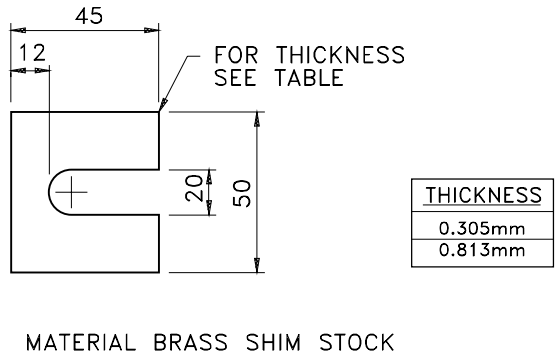


Figure 34 details the "Brass Shims" used to shim the friction plates (for breakaway steel sign supports).

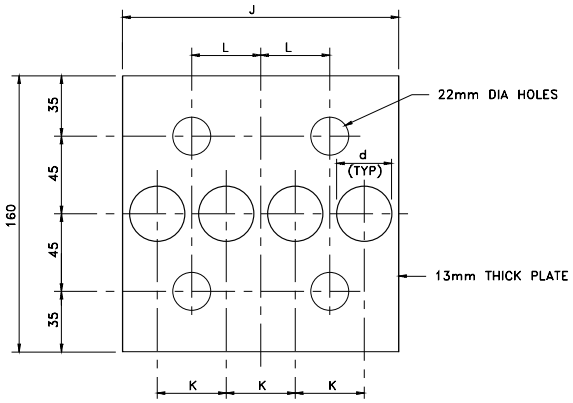
Figure 34 – Shim (Steel)



Fuse Plates, Steel (Breakaway Type)

Figure 35 provides the information necessary to fabricate the front and back fuse plates.

Figure 35 – Front and Back Fuse Plate Details (Steel)



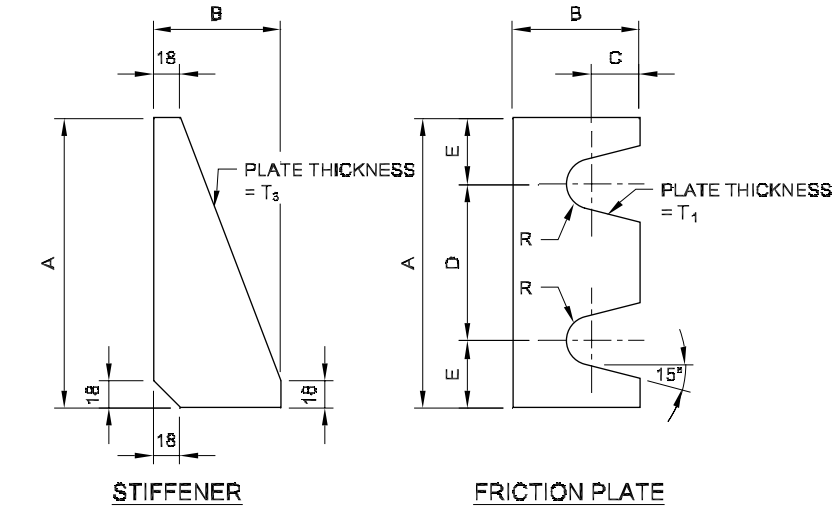
	J	K	L	d
W200 x 42	160	40	40	32
W200 x 46	200	50	50	42
W200 x 59				

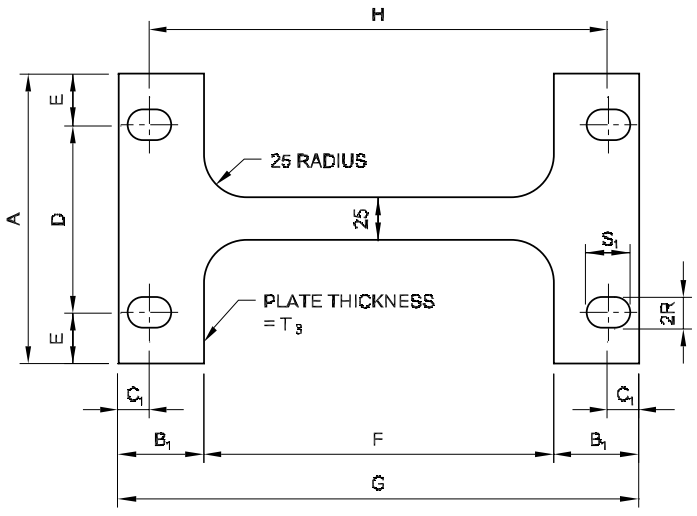
Note: Front and back fuse plates are identical.

Friction Plate, Stiffeners, and Bolt Keeper Plate, Steel (Breakaway Type)

Figure 36 provides details for the fabrication of the friction plate, stiffener plates, and bolt keeper plates for steel supports.

Figure 36 – Friction Plate, Stiffener, and Bolt Keeper Plates (Steel)



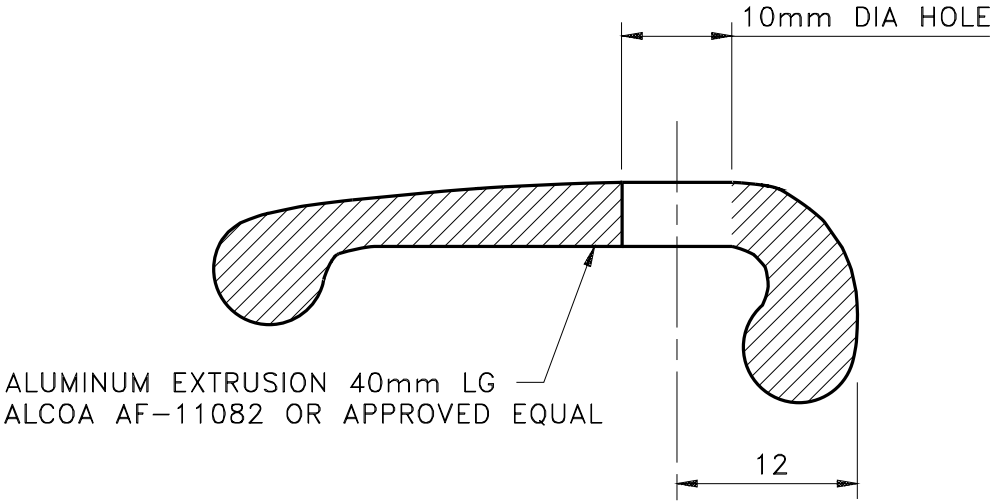


Column Size	A	B	B_1	C	C_1	D	E	F	G	H	R	S_1	T_1	T_2	T_3
W200 x 42	170	50	60	18	28	110	30	205	325	269	9	28	20	15	0.31
W200 x 46	200	60	70	18	28	140	30	203	343	287	9	28	25	20	0.31
W200 x 59	200	60	70	22	32	140	30	210	350	286	11	32	25	20	0.31

Aluminum Clamp, Steel Supports (Breakaway Type)

The aluminum clamp shown in Figure 37 is used to connect the lower crossarm to the upper column. (Depending on the type, each steel sign support upper column may have one, two, or three lower crossarm connections.)

Figure 37 – Clamp Details



2.3 Timber Post Ground-mounted Sign Supports for Large Extruded Aluminum Signs

(Breakaway and Non-breakaway Types)

2.3.1 General

Timber post ground-mounted sign supports that previously were covered under the MTO Sign Support Manual are now covered in OTM Book 3, the responsibility of the MTO Traffic Office. Section 2.3 covers timber post sign supports for ground-mounted signs for large extruded aluminum signs where two or more supports are required. See also Master Flow Chart 2 (MFC-2).

For terminology for sign dimensions, see Section 1.6.

Standard Timber Sign Supports

The design tables in this section cover sign sizes (depth x width) from, at the small end, 1200 mm x 3300 mm and 1500 mm x 2700 mm, up to 2700 mm x 6000 mm (3.6 m^2 to 16.2 m^2). For small ground-mounted signs, design information may be found in Section 2.5, Sign Supports for Small Ground-mounted Signs. The design information in Section 2.5 covers sign sizes of 1500 mm x 2400 mm (3.6 m^2) and smaller.

The wood species specified in this manual for large signs 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 O86 may be considered as an equivalent.

The design data is based on the requirements of the CHBDC (CAN/CSA-S6-14).

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 considered for the smaller sign sizes.

The design tables are intended to serve as a guide for the preparation of standard drawings, which are shown on Figure 38 (Details of Non-breakaway Timber Supports) and Figure 39 (Details of Breakaway Timber Supports). Section 2.3 is intended for use in the preparation of contract drawings.

Description of Timber Sign Supports

The timber supports consist of two, three or four timber posts embedded in augered holes, to which signs are connected by steel connector plates (two per post). Layout and details are given on Figures 38 and 39.

In each post two horizontal holes are drilled along the centreline of the 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 a 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.

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

Note: It is preferable to avoid splices if possible, either by using steel post supports, or by special order of longer timber posts. Splices are sometimes unavoidable, for example, if signs must be installed on short order, and there is insufficient time to order steel posts or long timber posts.

Dressed post sizes used are 6 inches x 6 inches (140 mm x 140 mm) and 6 inches x 8 inches (140 mm x 184 mm). 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 vertical clearance under the sign is 1800 mm from edge of travel lane elevation, and at least 2100 mm from ground elevation to the bottom of the sign or tab, some 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 100 mm below the lower edge of the sign as shown on Figure 48 because:

(1) The splice is not strong enough to be used in a lower location.

(2) The low bending resistance of the splice might tend to initiate the breakaway action of the post after impact.

(3) 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.

Limitations

The lower strength of timber makes it a suitable material for support structures for a limited range

Figure 38 – Details of Non-breakaway Timber Supports

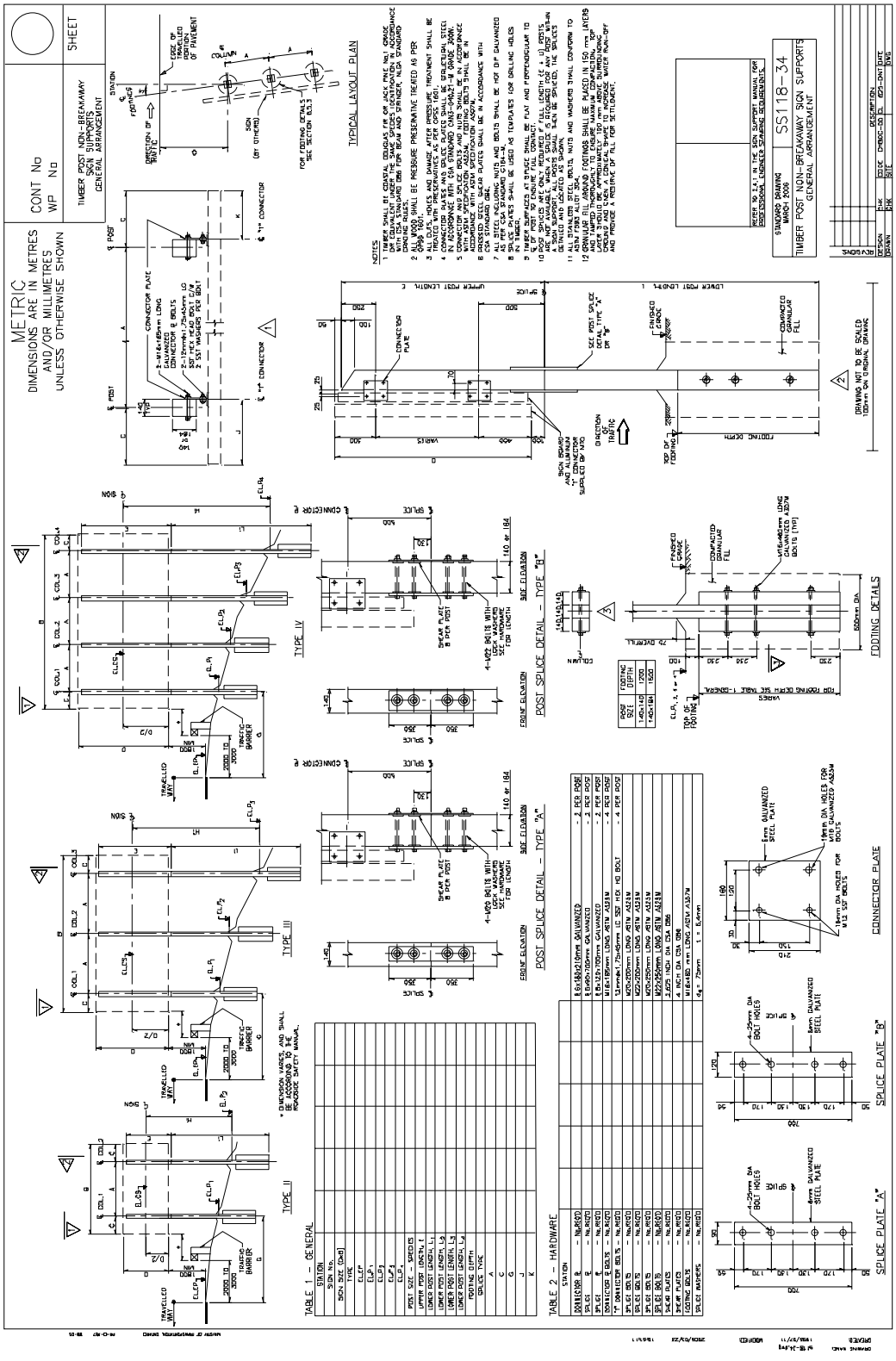


Figure 39 – Details of Breakaway Timber Supports

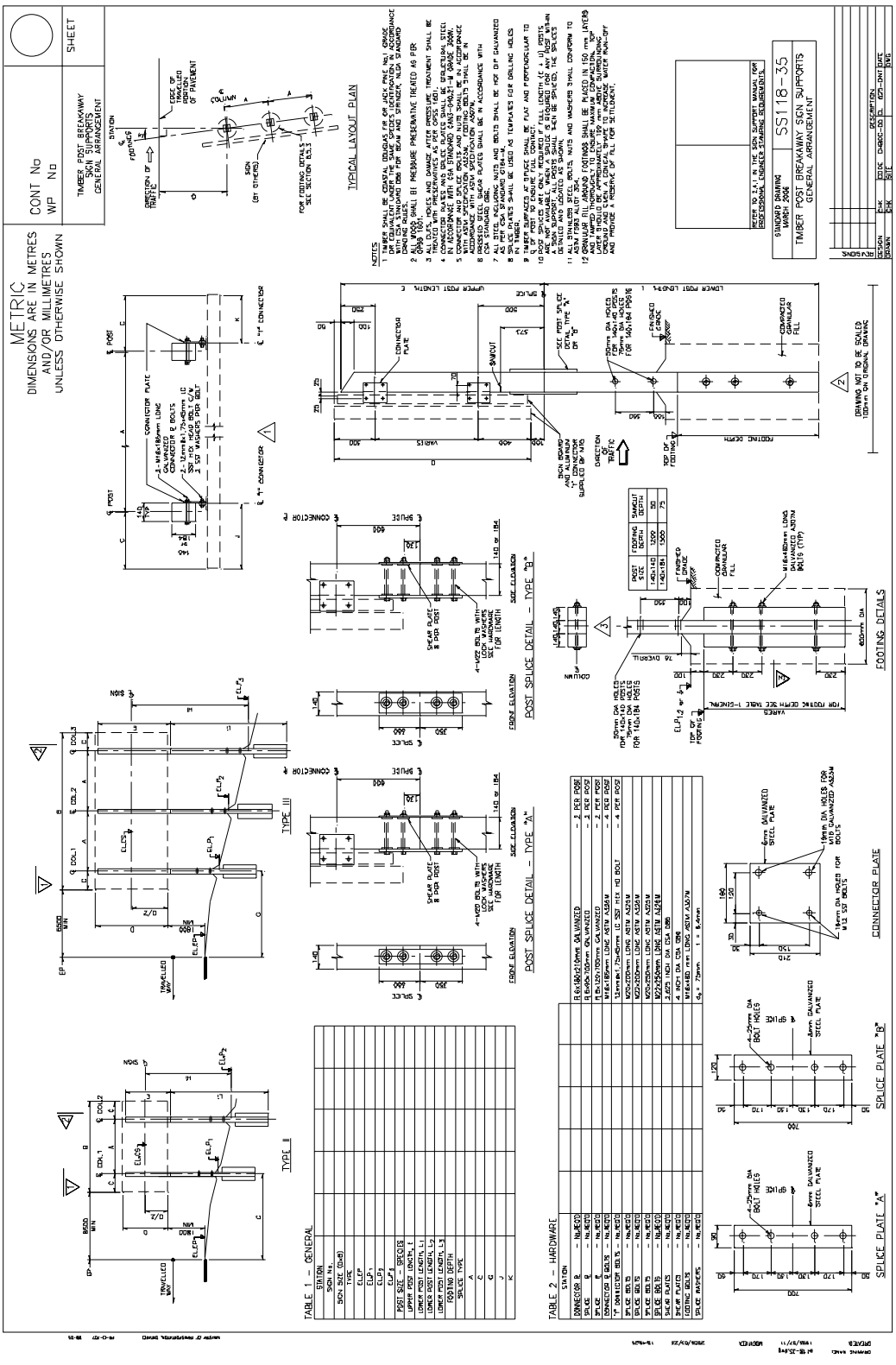


Table 8 – Permissible Sign Sizes and Timber Support Structure Types*

Non-breakaway

Sign Depth, D (mm)	Sign Width, B (mm)												
	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
1200	N/A	Type II				Type III				Type IV			
1500													
1800													
2100													
2400													
2700													

Breakaway

Sign Depth, D (mm)	Sign Width, B (mm)												
	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
1200	N/A	Type II							Type III				
1500													
1800													
2100													
2400													
2700													

* Do not use this table for small signs up to 3.6 m^2 in area (1200 x 2400 and 1500 x 2400).

of sign sizes. Supports for sign sizes larger than those listed in Table 8 should be designed in steel.

Types of Supports

The two types of supports covered in Section 2.3 are:

(1) Timber Post Breakaway Sign Supports (not protected from traffic).

(2) 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 I – 1 post (see Section 2.4)
- 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 2.3.3 Selection of Timber Support Type, Post Size and Splice Type.

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 47, are the absolute minimum for each post size based on a passive earth pressure of 68 kPa (1400 psf) at the Serviceability Limit State (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 38 and 39.

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.

Clearance

The supports should be located to result in the following minimum horizontal clearance from the edge of the travel lane to the edge of the sign panel. For breakaway sign supports, the required minimum horizontal clearance is 6500 mm. The minimum vertical distance shall be 1800 mm from the edge of travel lane elevation, and at least 2100 mm from ground elevation to the bottom of the sign or tab, and the minimum clear distance between columns shall be 2100 mm.

For non-breakaway sign supports, the required minimum horizontal clearance is as per the requirements of the RDM. 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 41 to 45, in particular Figures 44 and 45 for clarification of these clearance requirements.

Supply and Installation of Sign Supports

For timber post 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) Figures 38 and/or 39 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.

For MTO signs, 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.

Design Criteria

The breakaway timber post sign supports given in this section, with dressed post sizes 140 mm x 140 mm and 140 mm x 184 mm, successfully meet the crash testing requirements of NCHRP Report 350. However, in future if wood supports are not meeting the requirements of MASH-16, the use of wooden support may be abandoned. 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 from Tables 10 to 24 gives the allowable H_{max} 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 varies from 1200 mm to 2400 mm, with horizontal sign overhangs ranging from 300 mm to 750 mm.

Post spacing (c/c) for breakaway timber post sign supports is a constant 2240 mm (because of the clear horizontal spacing requirement of 2100 mm), with horizontal sign overhangs ranging from 80 mm to 1130 mm.

Design Philosophy – Timber Post Sign Supports

The design tables have been developed for the two structure types, namely non-breakaway and breakaway structures. The maximum allowable heights (H_{max}) 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 (4.88 m), because availability in these post sizes is limited for lengths over 16 feet. Particular cross-section ground profiles are not considered in the design. The general layout of the roadside sign supports shall be established according to the site ground profile and the required minimum horizontal and vertical clearances as shown in Figures 44 and 45.

Seventy-eight sign sizes are given (depth x width), ranging from the minimum of 1200 mm x 3300 mm and 1500 mm x 3300 mm at the small end, to the maximum size of 2700 mm x 6000 mm.

For non-breakaway structures, the number of posts used can be two, three or four. For breakaway structures (that are not protected by a traffic barrier), the number of posts used is two or three. Four posts cannot be used because of the minimum clear horizontal spacing requirements between posts of 2100 mm.

Each sign is designed for the three possible 10-year return reference wind pressures (without any increase for funneling) 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 dressed size cross-sections are limited to140 mm x140 mm and 140 mm x184 mm, because larger sizes were not crash-tested (for use with breakaway sign supports).

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

Signs with two posts were designed using corresponding tributary sign area. For signs with three or four posts, the distribution of wind reactions on the posts were analysed using continuous beam theory. The governing limiting H_{max} is based on the maximum wind load acting on either the exterior or interior post.

Where $H_{max} > H_i$ (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", given in OTM Book 3. The post splice is designed according to CSA O86-01 (R2006).

2.3.2 Detailing of Timber Sign Supports

General

Since the supply and erection of the support is always part of a contract, Figures 38 and/or 39 shall be used.

Data Required

For each 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 the design tables and in Table 8. Sign depths shown in the tables are given in increments of 300 mm whereas actual sign depths are multiples of 304.8 mm (12 inches). This difference may be disregarded when using the tables (i.e., a 2743 mm deep sign can be read as 2700 mm).

(2) The location of the support.

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/stake.

(3) The edge of pavement elevation at the sign station and the finished grade 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 are required, they can be obtained with a string level or hand level.

Footing Locations and Elevation

From Figures 38 and 39 (ref. Fig. 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.

OTM Book 3 follows the recommendations of the 2001 Edition of OTM Book 1B (Sign Design Principles) 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 does cause some reduced legibility. The benefits of reduced glare, however, are considered to outweigh the negative result of slightly decreased night legibility. For this reason the angling of ground-mounted signs slightly away from traffic should be adopted.

2.3.3 Procedures

Footing Layout

Given: Sign Size
Sample = 1500 x 3300 mm
Type = Breakaway
Assume EL.E.P. = 10000 mm (DATUM)

Step 1: Determine Support Type
From Table 8 for 1500 mm x 3300 mm
Support is TYPE II

Step 2: Determine Dimension C
For Type II, C = 530 mm
See Table 19

Note: Dimension C is the 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 until the support type has been established.

Step 3: Determine Ground Elevation at Longest Post
Based on Type II support:
In the sign installation shown in Figure 40, the support is on a "FILL" slope and the longest post is farthest from the edge of pavement (E.P.).

Distance from E.P. to Longest Post
= 6500 + Sign Width (B) – C
i.e., 6500 + 3300 – 530
= 9270 mm from E.P.
Ground Level (EL. P2) = 9000 mm (SAY)

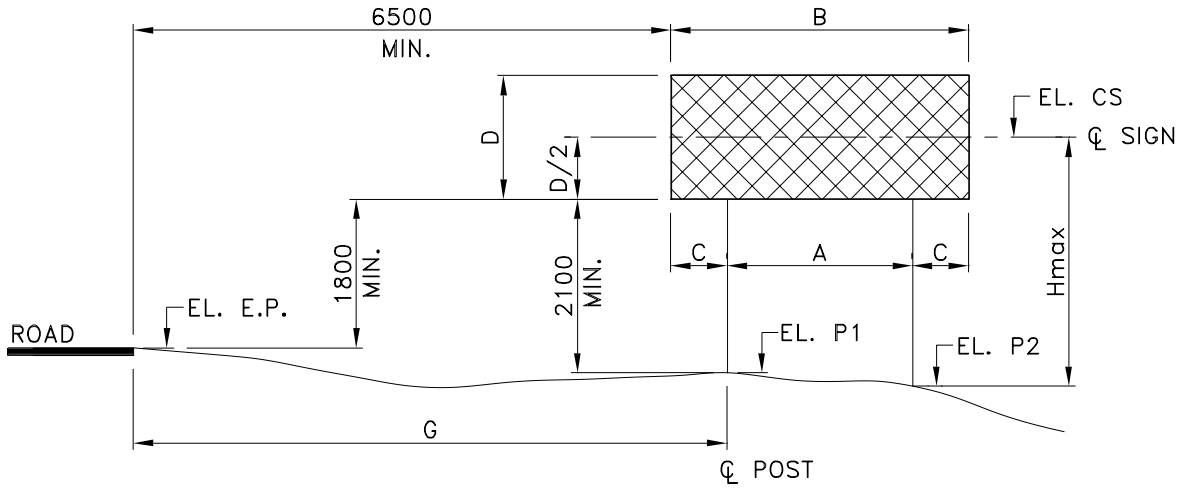
Determination of Timber Post Design Height (H_{max})

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

EL.CS = EL.E.P. + 1800 + 0.5 x Sign Depth

Post Design Height (H_{max}) at longest post location "i" is:

Figure 40 – Footing Layout (Breakaway Timber Post Sign Support*)



* Not applicable to plywood signs; for plywood signs, see Figure 61.

H_{max} = EL.CS – EL.P_i
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 H_{max}:
H_{max} = EL.CS – EL.P2 but not less than (1800 + 0.5 D) = 2550 mm

H_{max} = 12550 mm – 9000 mm
= 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 H_{max} 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 H_{max} shall be increased to adjust that dimension to 1000 mm minimum.

Selection of Timber 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, including splice types, have been provided for both Jack Pine and Douglas Fir (see Tables 9 to 24) to assist in the selection of proper post size.

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.

Therefore, 140 mm x 184 mm Jack Pine and 140 mm x 184 mm Douglas Fir, for the given sign size, have sufficient resisting moments to permit an H_{max} greater than 3550.

Example

Sign Size: 1500 mm x 3300 mm
H_{max} = 3550 mm
Basic Wind Pressure = q = 300Pa

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

Table	Type	Species	Post Size	H_{max}	Splice
Table 19 (ref. Tab. 6.4.1(j))	II	Jack Pine	140 x 140	—	—
			140 x 184	3840	A
		Douglas Fir	140 x 140	3150	A
			140 x 184	4130	A

Therefore, 140 mm x 184 mm Jack Pine and 140 mm x 184 mm Douglas Fir, for the given sign size, have sufficient resisting moments to permit an H_{max} greater than 3550.

Select: Post Size – 140 x 184; Type II
Species – Jack Pine (Rule 3)
Splice Type A

Note: For H_{max} < 3550, the tabulated solution is inadequate.

Select: Post Size – 140 x 184; Type II
Species – Jack Pine (Rule 3)
Splice Type A

Note: For H_{max} < 3550, the tabulated solution is inadequate.

Timber 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_1 = 2600, H_2 = 3200, H_3 = 3800
Design all 3 post sizes for H_3 = 3800
See Section 2.3.1 Design Philosophy

It should be noted that on ditch slopes, the ground line to centre line of sign dimension "H_{max}" becomes very large for long signs and may rule out the use of timber breakaway supports.

Determining Timber Post Spacing and Post Lengths

Once the type of support and size of post is determined as described in the section on Selection of Timber Support, Post Size and Splice Type above, the exact values of A and C can be obtained from the appropriate design table.

For example:

For Breakaway Sign 1500 mm x 3300 mm
H_1 = 3550 mm
q = 300 Pa

Post size = 140 mm x 184 mm
Type = II
Species = Jack Pine

Appropriate design table is Table 19.

For 1500 mm x 3300 mm sign:
A = 2240
C = 530
Distance from EP to:
1st Post = 6500 + C = 7030
2nd Post = 6500 + C + A = 9270

EL.P_1 and EL.P_2 can be determined from the cross-section.

Note that although dimensions A and C are not actually perpendicular to the highway, they can be assumed to be so in determining distances for the purpose of calculating ground elevations. When laying out the footings, however, A and C must be measured at the proper angle as shown on Figures 38 and 39.

Lower Post Length (L):
L = [EL.CS – EL.P(1 or 2)] + [Footing Depth] – [0.5 x Sign Depth] – [100] + [100]

Upper Post Length (E):
E = [Sign Depth + 50]

Figure 41 – Type II Timber Sign Support

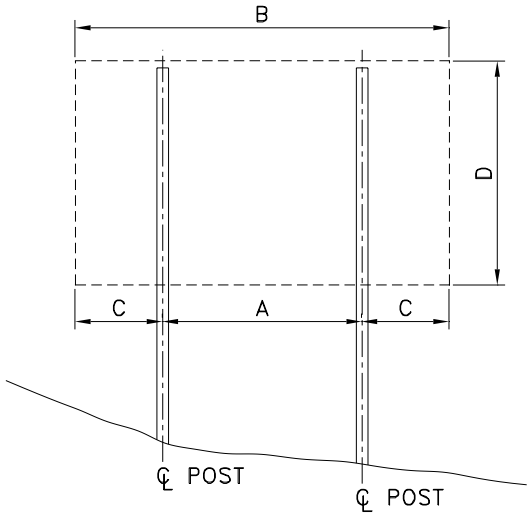


Figure 42 – Type III Timber Sign Support

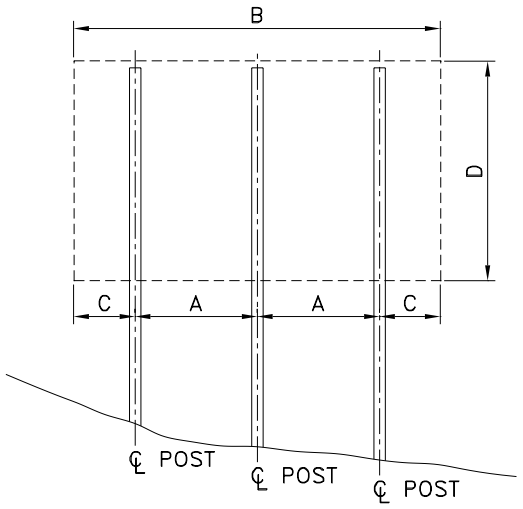


Figure 43 – Type IV Timber Sign Support

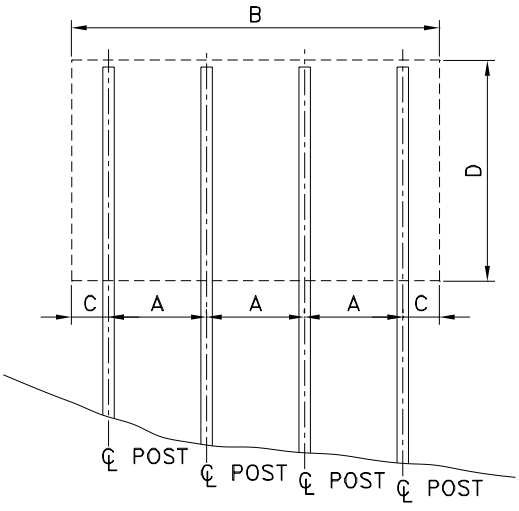
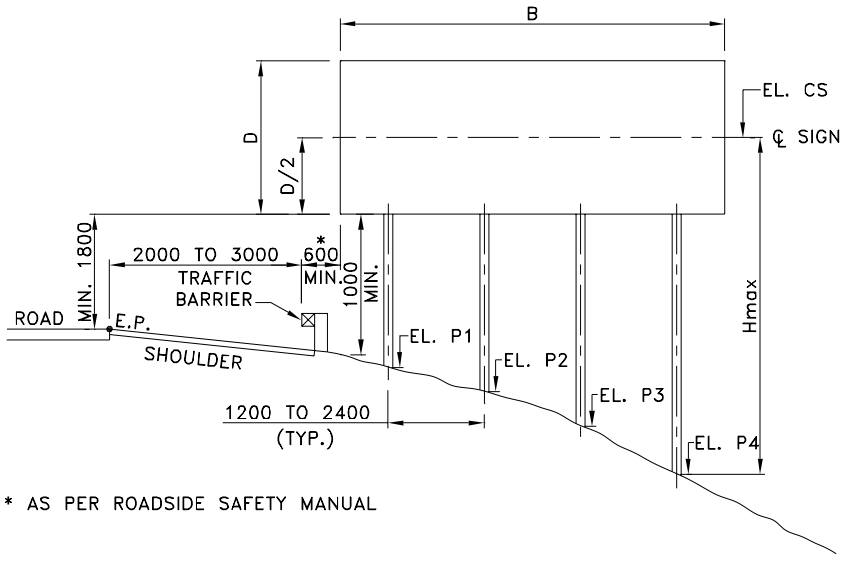
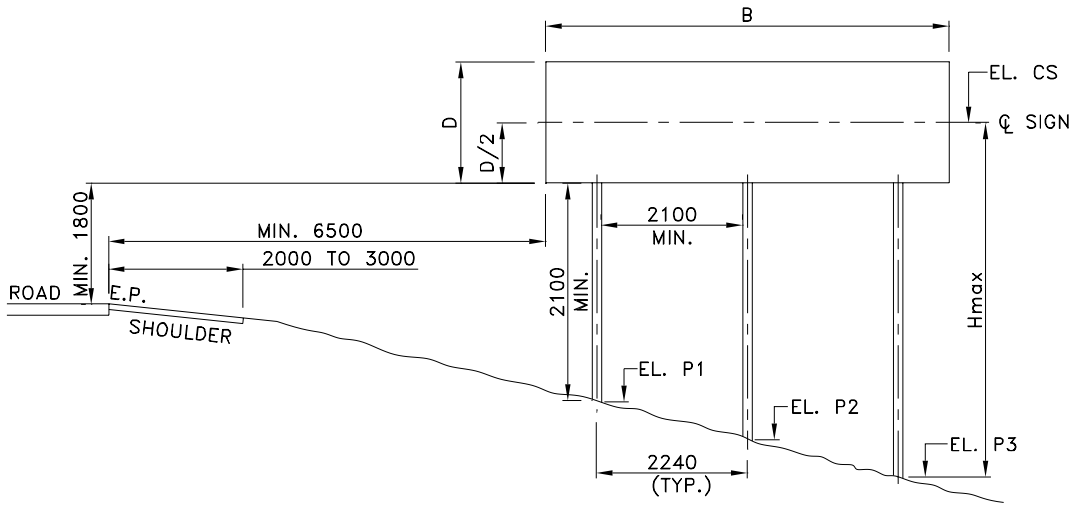


Figure 44 – Non-breakaway Timber Sign Supports



H_{max} = Maximum allowable post height, measured from ground level to mid-height of sign (based on bending strength of posts).

Figure 45 – Breakaway Timber Sign Supports



H_{max} = Maximum allowable post height, measured from ground level to mid-height of sign (based on bending strength of posts).

Note: In a cut section, the nearest vertical clearance must be achieved, and no portion of the sign may be buried.

2.3.4 Design Tables

General

This section contains the following design tables, as shown in Table 9.

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

Table 9 – Guide to Timber Support Design Tables

Table	Structure	Type/# of Posts	q (Pa)	Jack Pine Post Size		Douglas Fir Post Size	
10	Non-breakaway	**II** (2 posts)	300	140 x 140	140 x 184	140 x 140	140 x 184
11			390				
12			465				
13		**III** (3 posts)	300				
14			390				
15			465				
16		**IV** (4 posts)	300				
17			390				
18			465				
19	Breakaway	**II** (2 posts)	300	140 x 140	140 x 184	140 x 140	140 x 184
20			390				
21			465				
22		**III** (3 posts)	300				
23			390				
24			465				

Table 10 – Type II Timber Supports (Non-breakaway)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.1	0.6	2740	A	3980	A	3990	A	3980	A
1200 x 3600	2	2.4	0.6	2490	A	3980	A	3640	A	3980	A
1500 x 2700	2	1.5	0.6	2670	A	4130	A	3890	A	4130	A
1500 x 3000	2	1.8	0.6	2380	A	4130	A	3480	A	4130	A
1500 x 3300	2	2.1	0.6	2150	A	3840	A	3150	A	4130	A
1500 x 3600	2	2.4	0.6	1950	A	3500	A	2870	A	4130	A
1800 x 2400	2	1.2	0.6	2490	A	4280	A	3640	A	4280	A
1800 x 2700	2	1.5	0.6	2190	A	3920	A	3210	A	4280	A
1800 x 3000	2	1.8	0.6	1950	A	3500	A	2870	A	4280	A
1800 x 3300	2	2.1	0.6	—	—	3170	A	2590	A	4280	A
1800 x 3600	2	2.4	0.6	—	—	2890	A	2360	A	4230	A
2100 x 2400	2	1.2	0.6	2110	A	3770	A	3090	A	4430	A
2100 x 2700	2	1.5	0.6	—	—	3330	A	2720	A	4430	A
2100 x 3000	2	1.8	0.6	—	—	2970	A	2430	A	4360	A
2100 x 3300	2	2.1	0.6	—	—	2690	A	2190	B	3940	A
2100 x 3600	2	2.4	0.6	—	—	2450	B	—	—	3600	A
2400 x 2400	2	1.2	0.6	—	—	3270	A	2680	B	4580	A
2400 x 2700	2	1.5	0.6	—	—	2890	B	2360	B	4230	A
2400 x 3000	2	1.8	0.6	—	—	2580	B	—	—	3790	A
2400 x 3300	2	2.1	0.6	—	—	2330	B	—	—	3430	B
2400 x 3600	2	2.4	0.6	—	—	—	—	—	—	3120	B
2700 x 2400	2	1.2	0.6	—	—	2890	B	2360	B	4230	A
2700 x 2700	2	1.5	0.6	—	—	2540	B	—	—	3740	B
2700 x 3000	2	1.8	0.6	—	—	—	—	—	—	3350	B
2700 x 3300	2	2.1	0.6	—	—	—	—	—	—	3020	B
2700 x 3600	2	2.4	0.6	—	—	—	—	—	—	2750	B

Table 11 – Type II Timber Supports (Non-breakaway)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.1	0.6	2060	A	3690	A	3020	A	3980	A
1200 x 3600	2	2.4	0.6	1870	A	3360	A	2750	A	3980	A
1500 x 2700	2	1.5	0.6	2010	A	3600	A	2950	A	4130	A
1500 x 3000	2	1.8	0.6	1790	A	3220	A	2630	A	4130	A
1500 x 3300	2	2.1	0.6	—	—	2910	A	2380	A	4130	A
1500 x 3600	2	2.4	0.6	—	—	2650	A	2160	A	3890	A
1800 x 2400	2	1.2	0.6	—	—	3360	A	2750	A	4280	A
1800 x 2700	2	1.5	0.6	—	—	2970	A	2420	A	4280	A
1800 x 3000	2	1.8	0.6	—	—	2650	A	2160	A	3890	A
1800 x 3300	2	2.1	0.6	—	—	2390	A	1950	B	3520	A
1800 x 3600	2	2.4	0.6	—	—	2170	B	—	—	3210	A
2100 x 2400	2	1.2	0.6	—	—	2850	A	2330	B	4180	A
2100 x 2700	2	1.5	0.6	—	—	2510	B	—	—	3700	A
2100 x 3000	2	1.8	0.6	—	—	2240	B	—	—	3310	A
2100 x 3300	2	2.1	0.6	—	—	—	—	—	—	2990	B
2100 x 3600	2	2.4	0.6	—	—	—	—	—	—	2720	B
2400 x 2400	2	1.2	0.6	—	—	2470	B	—	—	3640	A
2400 x 2700	2	1.5	0.6	—	—	—	—	—	—	3210	B
2400 x 3000	2	1.8	0.6	—	—	—	—	—	—	2870	B
2400 x 3300	2	2.1	0.6	—	—	—	—	—	—	2590	B
2400 x 3600	2	2.4	0.6	—	—	—	—	—	—	2360	B
2700 x 2400	2	1.2	0.6	—	—	—	—	—	—	3210	B
2700 x 2700	2	1.5	0.6	—	—	—	—	—	—	2830	B
2700 x 3000	2	1.8	0.6	—	—	—	—	—	—	2530	B
2700 x 3300	2	2.1	0.6	—	—	—	—	—	—	—	—
2700 x 3600	2	2.4	0.6	—	—	—	—	—	—	—	—

Table 12 – Type II Timber Supports (Non-breakaway)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max}x (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.1	0.6	1690	A	3060	A	2500	A	3980	A
1200 x 3600	2	2.4	0.6	—	—	2790	A	2280	A	3980	A
1500 x 2700	2	1.5	0.6	—	—	2990	A	2440	A	4130	A
1500 x 3000	2	1.8	0.6	—	—	2670	A	2180	A	3920	A
1500 x 3300	2	2.1	0.6	—	—	2410	A	1960	A	3540	A
1500 x 3600	2	2.4	0.6	—	—	2190	A	1780	A	3230	A
1800 x 2400	2	1.2	0.6	—	—	2790	A	2280	A	4090	A
1800 x 2700	2	1.5	0.6	—	—	2450	A	2000	B	3610	A
1800 x 3000	2	1.8	0.6	—	—	2190	A	—	—	3230	A
1800 x 3300	2	2.1	0.6	—	—	1970	B	—	—	2920	A
1800 x 3600	2	2.4	0.6	—	—	—	—	—	—	2660	B
2100 x 2400	2	1.2	0.6	—	—	2360	B	—	—	3480	A
2100 x 2700	2	1.5	0.6	—	—	2080	B	—	—	3070	B
2100 x 3000	2	1.8	0.6	—	—	—	—	—	—	2740	B
2100 x 3300	2	2.1	0.6	—	—	—	—	—	—	2470	B
2100 x 3600	2	2.4	0.6	—	—	—	—	—	—	2250	B
2400 x 2400	2	1.2	0.6	—	—	—	—	—	—	3020	B
2400 x 2700	2	1.5	0.6	—	—	—	—	—	—	2660	B
2400 x 3000	2	1.8	0.6	—	—	—	—	—	—	2370	B
2400 x 3300	2	2.1	0.6	—	—	—	—	—	—	—	—
2400 x 3600	2	2.4	0.6	—	—	—	—	—	—	—	—
2700 x 2400	2	1.2	0.6	—	—	—	—	—	—	2660	B
2700 x 2700	2	1.5	0.6	—	—	—	—	—	—	—	—
2700 x 3000	2	1.8	0.6	—	—	—	—	—	—	—	—
2700 x 3300	2	2.1	0.6	—	—	—	—	—	—	—	—
2700 x 3600	2	2.4	0.6	—	—	—	—	—	—	—	—

Table 13 – Type III Timber Supports (Non-breakaway)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3900	3	1.5	0.45	2690	A	3980	A	3920	A	3980	A
1200 x 4200	3	1.5	0.60	2990	A	3980	A	4280	A	3980	A
1200 x 4500	3	1.5	0.75	2850	A	3980	A	4150	A	3980	A
1200 x 4800	3	1.8	0.60	2300	A	3980	A	3360	A	3980	A
1500 x 3900	3	1.5	0.45	2110	A	3780	A	3100	A	4130	A
1500 x 4200	3	1.5	0.60	2350	A	4130	A	3440	A	4130	A
1500 x 4500	3	1.5	0.75	2240	A	4000	A	3280	A	4130	A
1500 x 4800	3	1.8	0.60	1800	A	3240	A	2650	A	4130	A
1800 x 3900	3	1.5	0.45	—	—	3110	A	2550	A	4280	A
1800 x 4200	3	1.5	0.60	1920	A	3450	A	2830	A	4280	A
1800 x 4500	3	1.5	0.75	—	—	3300	A	2700	A	4280	A
1800 x 4800	3	1.8	0.60	—	—	2660	A	2180	A	3910	A
2100 x 3900	3	1.5	0.45	—	—	2640	A	2150	B	3880	A
2100 x 4200	3	1.5	0.60	—	—	2930	A	2400	A	4300	A
2100 x 4500	3	1.5	0.75	—	—	2800	A	2290	B	4100	A
2100 x 4800	3	1.8	0.60	—	—	2260	B	—	—	3330	A
2400 x 3900	3	1.5	0.45	—	—	2280	B	—	—	3370	B
2400 x 4200	3	1.5	0.60	—	—	2540	B	—	—	3740	A
2400 x 4500	3	1.5	0.75	—	—	2420	B	—	—	3570	B
2400 x 4800	3	1.8	0.60	—	—	—	—	—	—	2890	B
2700 x 3900	3	1.5	0.45	—	—	—	—	—	—	2970	B
2700 x 4200	3	1.5	0.60	—	—	—	—	—	—	3300	B
2700 x 4500	3	1.5	0.75	—	—	—	—	—	—	3150	B
2700 x 4800	3	1.8	0.60	—	—	—	—	—	—	2540	B

Table 14 – Type III Timber Supports (Non-breakaway)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3900	3	1.5	0.45	2020	A	3620	A	2970	A	3980	A
1200 x 4200	3	1.5	0.60	2250	A	3980	A	3300	A	3980	A
1200 x 4500	3	1.5	0.75	2150	A	3840	A	3150	A	3980	A
1200 x 4800	3	1.8	0.60	1720	A	3110	A	2540	A	3980	A
1500 x 3900	3	1.5	0.45	—	A	2860	A	2340	A	4130	A
1500 x 4200	3	1.5	0.60	1760	A	3170	A	2600	A	4130	A
1500 x 4500	3	1.5	0.75	—	—	3030	A	2480	A	4130	A
1500 x 4800	3	1.8	0.60	—	—	2440	A	1990	A	3600	A
1800 x 3900	3	1.5	0.45	—	—	2350	A	1910	B	3460	A
1800 x 4200	3	1.5	0.60	—	—	2610	A	2130	A	3840	A
1800 x 4500	3	1.5	0.75	—	—	2490	A	2030	A	3660	A
1800 x 4800	3	1.8	0.60	—	—	2000	B	—	—	2960	A
2100 x 3900	3	1.5	0.45	—	—	—	—	—	—	2940	B
2100 x 4200	3	1.5	0.60	—	—	2210	B	—	—	3260	A
2100 x 4500	3	1.5	0.75	—	—	2110	B	—	—	3110	B
2100 x 4800	3	1.8	0.60	—	—	—	—	—	—	2510	B
2400 x 3900	3	1.5	0.45	—	—	—	—	—	—	2540	B
2400 x 4200	3	1.5	0.60	—	—	—	—	—	—	2830	B
2400 x 4500	3	1.5	0.75	—	—	—	—	—	—	2700	B
2400 x 4800	3	1.8	0.60	—	—	—	—	—	—	—	—
2700 x 3900	3	1.5	0.45	—	—	—	—	—	—	—	—
2700 x 4200	3	1.5	0.60	—	—	—	—	—	—	2490	B
2700 x 4500	3	1.5	0.75	—	—	—	—	—	—	2380	B
2700 x 4800	3	1.8	0.60	—	—	—	—	—	—	—	—

Table 15 – Type III Timber Supports (Non-breakaway)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3900	3	1.5	0.45	1660	A	3010	A	2460	A	3980	A
1200 x 4200	3	1.5	0.60	1860	A	3340	A	2730	A	3980	A
1200 x 4500	3	1.5	0.75	1770	A	3180	A	2610	A	3980	A
1200 x 4800	3	1.8	0.60	—	—	2570	A	2100	A	3780	A
1500 x 3900	3	1.5	0.45	—	—	2360	A	1930	A	3480	A
1500 x 4200	3	1.5	0.60	—	—	2630	A	2150	A	3860	A
1500 x 4500	3	1.5	0.75	—	—	2510	A	2040	A	3690	A
1500 x 4800	3	1.8	0.60	—	—	2020	A	—	—	2980	A
1800 x 3900	3	1.5	0.45	—	—	1940	B	—	—	2870	A
1800 x 4200	3	1.5	0.60	—	—	2160	B	—	—	3190	A
1800 x 4500	3	1.5	0.75	—	—	2060	B	—	—	3040	A
1800 x 4800	3	1.8	0.60	—	—	—	—	—	—	2450	B
2100 x 3900	3	1.5	0.45	—	—	—	—	—	—	2430	B
2100 x 4200	3	1.5	0.60	—	—	—	—	—	—	2700	B
2100 x 4500	3	1.5	0.75	—	—	—	—	—	—	2580	B
2100 x 4800	3	1.8	0.60	—	—	—	—	—	—	2070	B
2400 x 3900	3	1.5	0.45	—	—	—	—	—	—	—	—
2400 x 4200	3	1.5	0.60	—	—	—	—	—	—	2340	B
2400 x 4500	3	1.5	0.75	—	—	—	—	—	—	2230	B
2400 x 4800	3	1.8	0.60	—	—	—	—	—	—	—	—
2700 x 3900	3	1.5	0.45	—	—	—	—	—	—	—	—
2700 x 4200	3	1.5	0.60	—	—	—	—	—	—	—	—
2700 x 4500	3	1.5	0.75	—	—	—	—	—	—	—	—
2700 x 4800	3	1.8	0.60	—	—	—	—	—	—	—	—

Table 16 – Type IV Timber Supports (Non-breakaway)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 5100	4	1.5	0.30	2810	A	3980	A	4090	A	3980	A
1200 x 5400	4	1.5	0.45	2880	A	3980	A	4200	A	3980	A
1200 x 5700	4	1.5	0.60	3010	A	3980	A	4280	A	3980	A
1200 x 6000	4	1.5	0.75	2870	A	3980	A	4180	A	3980	A
1500 x 5100	4	1.5	0.30	2200	A	3940	A	3230	A	4130	A
1500 x 5400	4	1.5	0.45	2270	A	4040	A	3320	A	4130	A
1500 x 5700	4	1.5	0.60	2370	A	4130	A	3460	A	4130	A
1500 x 6000	4	1.5	0.75	2260	A	4020	A	3300	A	4130	A
1800 x 5100	4	1.5	0.30	—	—	3250	A	2660	A	4280	A
1800 x 5400	4	1.5	0.45	—	—	3340	A	2730	A	4280	A
1800 x 5700	4	1.5	0.60	1940	A	3480	A	2850	A	4280	A
1800 x 6000	4	1.5	0.75	—	—	3320	A	2720	A	4280	A
2100 x 5100	4	1.5	0.30	—	—	2750	A	2250	B	4040	A
2100 x 5400	4	1.5	0.45	—	—	2830	A	2310	B	4150	A
2100 x 5700	4	1.5	0.60	—	—	2950	A	2410	A	4330	A
2100 x 6000	4	1.5	0.75	—	—	2820	A	2300	B	4130	A
2400 x 5100	4	1.5	0.30	—	—	2390	B	—	—	3510	B
2400 x 5400	4	1.5	0.45	—	—	2450	B	—	—	3610	A
2400 x 5700	4	1.5	0.60	—	—	2560	B	—	—	3760	A
2400 x 6000	4	1.5	0.75	—	—	2440	B	—	—	3590	B
2700 x 5100	4	1.5	0.30	—	—	—	—	—	—	3100	B
2700 x 5400	4	1.5	0.45	—	—	—	—	—	—	3180	B
2700 x 5700	4	1.5	0.60	—	—	—	—	—	—	3320	B
2700 x 6000	4	1.5	0.75	—	—	—	—	—	—	3170	B

Table 17 – Type IV Timber Supports (Non-breakaway)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 40	Type	140 x 184	Type
1200 x 5100	4	1.5	0.30	2110	A	3780	A	3100	A	3980	A
1200 x 5400	4	1.5	0.45	2170	A	3880	A	3180	A	3980	A
1200 x 5700	4	1.5	0.60	2270	A	3980	A	3320	A	3980	A
1200 x 6000	4	1.5	0.75	2160	A	3860	A	3170	A	3980	A
1500 x 5100	4	1.5	0.30	—	—	2980	A	2440	A	4130	A
1500 x 5400	4	1.5	0.45	—	—	3060	A	2510	A	4130	A
1500 x 5700	4	1.5	0.60	1770	A	3200	A	2610	A	4130	A
1500 x 6000	4	1.5	0.75	—	—	3050	A	2490	A	4130	A
1800 x 5100	4	1.5	0.30	—	—	2450	A	2000	B	3610	A
1800 x 5400	4	1.5	0.45	—	—	2520	A	2050	A	3700	A
1800 x 5700	4	1.5	0.60	—	—	2630	A	2150	A	3860	A
1800 x 6000	4	1.5	0.75	—	—	2510	A	2050	A	3690	A
2100 x 5100	4	1.5	0.30	—	—	2070	B	—	—	3060	B
2100 x 5400	4	1.5	0.45	—	—	2130	B	—	—	3150	B
2100 x 5700	4	1.5	0.60	—	—	2230	B	—	—	3280	A
2100 x 6000	4	1.5	0.75	—	—	2120	B	—	—	3130	B
2400 x 5100	4	1.5	0.30	—	—	—	—	—	—	2660	B
2400 x 5400	4	1.5	0.45	—	—	—	—	—	—	2730	B
2400 x 5700	4	1.5	0.60	—	—	—	—	—	—	2850	B
2400 x 6000	4	1.5	0.75	—	—	—	—	—	—	2720	B
2700 x 5100	4	1.5	0.30	—	—	—	—	—	—	—	—
2700 x 5400	4	1.5	0.45	—	—	—	—	—	—	2400	B
2700 x 5700	4	1.5	0.60	—	—	—	—	—	—	2510	B
2700 x 6000	4	1.5	0.75	—	—	—	—	—	—	2390	B

Table 18 – Type IV Timber Supports (Non-breakaway)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 5100	4	1.5	0.30	1740	A	3140	A	2570	A	3980	A
1200 x 5400	4	1.5	0.45	1790	A	3220	A	2640	A	3980	A
1200 x 5700	4	1.5	0.60	1870	A	3360	A	2750	A	3980	A
1200 x 6000	4	1.5	0.75	1780	A	3210	A	2620	A	3980	A
1500 x 5100	4	1.5	0.30	—	—	2470	A	2010	A	3630	A
1500 x 5400	4	1.5	0.45	—	—	2540	A	2070	A	3730	A
1500 x 5700	4	1.5	0.60	—	—	2650	A	2160	A	3890	A
1500 x 6000	4	1.5	0.75	—	—	2530	A	2060	A	3710	A
1800 x 5100	4	1.5	0.30	—	—	2020	B	—	—	2990	A
1800 x 5400	4	1.5	0.45	—	—	2080	B	—	—	3080	A
1800 x 5700	4	1.5	0.60	—	—	2170	B	—	—	3210	A
1800 x 6000	4	1.5	0.75	—	—	2070	B	—	—	3060	A
2100 x 5100	4	1.5	0.30	—	—	—	—	—	—	2540	B
2100 x 5400	4	1.5	0.45	—	—	—	—	—	—	2610	B
2100 x 5700	4	1.5	0.60	—	—	—	—	—	—	2720	B
2100 x 6000	4	1.5	0.75	—	—	—	—	—	—	2600	B
2400 x 5100	4	1.5	0.30	—	—	—	—	—	—	—	—
2400 x 5400	4	1.5	0.45	—	—	—	—	—	—	2260	B
2400 x 5700	4	1.5	0.60	—	—	—	—	—	—	2360	B
2400 x 6000	4	1.5	0.75	—	—	—	—	—	—	2250	B
2700 x 5100	4	1.5	0.30	—	—	—	—	—	—	—	—
2700 x 5400	4	1.5	0.45	—	—	—	—	—	—	—	—
2700 x 5700	4	1.5	0.60	—	—	—	—	—	—	—	—
2700 x 6000	4	1.5	0.75	—	—	—	—	—	—	—	—

Table 19 – Type II Timber Supports (Breakaway)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.24	0.53	2740	A	3980	A	3990	A	3980	A
1200 x 3600	2	2.24	0.68	—	—	3980	A	3640	A	3980	A
1200 x 3900	2	2.24	0.83	—	—	3980	A	3340	A	3980	A
1200 x 4200	2	2.24	0.98	—	—	3770	A	3090	A	3980	A
1200 x 4500	2	2.24	1.13	—	—	3500	A	2870	A	3980	A
1500 x 2700	2	2.24	0.23	—	—	4130	A	3890	A	4130	A
1500 x 3000	2	2.24	0.38	—	—	4130	A	3480	A	4130	A
1500 x 3300	2	2.24	0.53	—	—	3840	A	3150	A	4130	A
1500 x 3600	2	2.24	0.68	—	—	3500	A	2870	A	4130	A
1500 x 3900	2	2.24	0.83	—	—	3220	A	—	—	4130	A
1500 x 4200	2	2.24	0.98	—	—	2970	A	—	—	4130	A
1500 x 4500	2	2.24	1.13	—	—	—	—	—	—	4050	A
1800 x 2400	2	2.24	0.08	—	—	4280	A	3640	A	4280	A
1800 x 2700	2	2.24	0.23	—	—	3920	A	3210	A	4280	A
1800 x 3000	2	2.24	0.38	—	—	3500	A	—	—	4280	A
1800 x 3300	2	2.24	0.53	—	—	3170	A	—	—	4280	A
1800 x 3600	2	2.24	0.68	—	—	—	—	—	—	4230	A
1800 x 3900	2	2.24	0.83	—	—	—	—	—	—	3890	A
1800 x 4200	2	2.24	0.98	—	—	—	—	—	—	3600	A
1800 x 4500	2	2.24	1.13	—	—	—	—	—	—	3350	A
2100 x 2400	2	2.24	0.08	—	—	3770	A	—	—	4430	A
2100 x 2700	2	2.24	0.23	—	—	3330	A	—	—	4430	A
2100 x 3000	2	2.24	0.38	—	—	—	—	—	—	4360	A
2100 x 3300	2	2.24	0.53	—	—	—	—	—	—	3940	A
2100 x 3600	2	2.24	0.68	—	—	—	—	—	—	3600	A
2100 x 3900	2	2.24	0.83	—	—	—	—	—	—	3310	A
2100 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2100 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2400 x 2400	2	2.24	0.08	—	—	—	—	—	—	4580	A
2400 x 2700	2	2.24	0.23	—	—	—	—	—	—	4230	A

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Table 19 Continued – Type II Timber Supports (Breakaway) (cont'd)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
2400 x 3000	2	2.24	0.38	—	—	—	—	—	—	3790	A
2400 x 3300	2	2.24	0.53	—	—	—	—	—	—	3430	B
2400 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2400 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2400 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2400 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2700 x 2400	2	2.24	0.08	—	—	—	—	—	—	4230	A
2700 x 2700	2	2.24	0.23	—	—	—	—	—	—	3740	B
2700 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2700 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2700 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2700 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2700 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2700 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—

Table 20 – Type II Timber Supports (Breakaway)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.24	0.53	—	—	3690	A	3020	A	3980	A
1200 x 3600	2	2.24	0.68	—	—	3360	A	2750	A	3980	A
1200 x 3900	2	2.24	0.83	—	—	3090	A	—	—	3980	A
1200 x 4200	2	2.24	0.98	—	—	2850	A	—	—	3980	A
1200 x 4500	2	2.24	1.13	—	—	—	—	—	—	3890	A
1500 x 2700	2	2.24	0.23	—	—	3600	A	2950	A	4130	A
1500 x 3000	2	2.24	0.38	—	—	3220	A	—	—	4130	A
1500 x 3300	2	2.24	0.53	—	—	2910	A	—	—	4130	A
1500 x 3600	2	2.24	0.68	—	—	—	—	—	—	3890	A
1500 x 3900	2	2.24	0.83	—	—	—	—	—	—	3580	A
1500 x 4200	2	2.24	0.98	—	—	—	—	—	—	3310	A
1500 x 4500	2	2.24	1.13	—	—	—	—	—	—	3070	A
1800 x 2400	2	2.24	0.08	—	—	3360	A	—	—	4280	A
1800 x 2700	2	2.24	0.23	—	—	—	—	—	—	4280	A
1800 x 3000	2	2.24	0.38	—	—	—	—	—	—	3890	A
1800 x 3300	2	2.24	0.53	—	—	—	—	—	—	3520	A
1800 x 3600	2	2.24	0.68	—	—	—	—	—	—	3210	A
1800 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
1800 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
1800 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2100 x 2400	2	2.24	0.08	—	—	—	—	—	—	4180	A
2100 x 2700	2	2.24	0.23	—	—	—	—	—	—	3700	A
2100 x 3000	2	2.24	0.38	—	—	—	—	—	—	3310	A
2100 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2100 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2100 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2100 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2100 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2400 x 2400	2	2.24	0.08	—	—	—	—	—	—	3640	A
2400 x 2700	2	2.24	0.23	—	—	—	—	—	—	—	—

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Table 20 Continued – Type II Timber Supports (Breakaway) (cont'd)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
2400 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2400 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2400 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2400 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2400 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2400 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2700 x 2400	2	2.24	0.08	—	—	—	—	—	—	—	—
2700 x 2700	2	2.24	0.23	—	—	—	—	—	—	—	—
2700 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2700 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2700 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2700 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2700 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2700 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—

Table 21 – Type II Timber Supports (Breakaway)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 3300	2	2.24	0.53	—	—	3060	A	—	—	3980	A
1200 x 3600	2	2.24	0.68	—	—	2790	A	—	—	3980	A
1200 x 3900	2	2.24	0.83	—	—	—	—	—	—	3760	A
1200 x 4200	2	2.24	0.98	—	—	—	—	—	—	3480	A
1200 x 4500	2	2.24	1.13	—	—	—	—	—	—	3230	A
1500 x 2700	2	2.24	0.23	—	—	2990	A	—	—	4130	A
1500 x 3000	2	2.24	0.38	—	—	—	—	—	—	3920	A
1500 x 3300	2	2.24	0.53	—	—	—	—	—	—	3540	A
1500 x 3600	2	2.24	0.68	—	—	—	—	—	—	3230	A
1500 x 3900	2	2.24	0.83	—	—	—	—	—	—	2970	A
1500 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
1500 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
1800 x 2400	2	2.24	0.08	—	—	—	—	—	—	4090	A
1800 x 2700	2	2.24	0.23	—	—	—	—	—	—	3610	A
1800 x 3000	2	2.24	0.38	—	—	—	—	—	—	3230	A
1800 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
1800 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
1800 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
1800 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
1800 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2100 x 2400	2	2.24	0.08	—	—	—	—	—	—	3480	A
2100 x 2700	2	2.24	0.23	—	—	—	—	—	—	—	—
2100 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2100 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2100 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2100 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2100 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2100 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2400 x 2400	2	2.24	0.08	—	—	—	—	—	—	—	—

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Table 21 Continued – Type II Timber Supports (Breakaway) (cont'd)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
2400 x 2700	2	2.24	0.23	—	—	—	—	—	—	—	—
2400 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2400 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2400 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2400 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2400 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2400 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—
2700 x 2400	2	2.24	0.08	—	—	—	—	—	—	—	—
2700 x 2700	2	2.24	0.23	—	—	—	—	—	—	—	—
2700 x 3000	2	2.24	0.38	—	—	—	—	—	—	—	—
2700 x 3300	2	2.24	0.53	—	—	—	—	—	—	—	—
2700 x 3600	2	2.24	0.68	—	—	—	—	—	—	—	—
2700 x 3900	2	2.24	0.83	—	—	—	—	—	—	—	—
2700 x 4200	2	2.24	0.98	—	—	—	—	—	—	—	—
2700 x 4500	2	2.24	1.13	—	—	—	—	—	—	—	—

Table 22 – Type III Timber Supports (Breakaway)

Wind Pressure (q) = 300 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 4800	3	2.24	0.16	—	—	2790	A	—	—	3980	A
1200 x 5100	3	2.24	0.31	—	—	2840	A	—	—	3980	A
1200 x 5400	3	2.24	0.46	—	—	2940	A	—	—	3980	A
1200 x 5700	3	2.24	0.61	—	—	3050	A	—	—	3980	A
1200 x 6000	3	2.24	0.76	—	—	3240	A	—	—	3980	A
1500 x 4800	3	2.24	0.16	—	—	—	—	—	—	3240	A
1500 x 5100	3	2.24	0.31	—	—	—	—	—	—	3290	A
1500 x 5400	3	2.24	0.46	—	—	—	—	—	—	3400	A
1500 x 5700	3	2.24	0.61	—	—	—	—	—	—	3530	A
1500 x 6000	3	2.24	0.76	—	—	—	—	—	—	3750	A
1800 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1800 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1800 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
1800 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
1800 x 6000	3	2.24	0.76	—	—	—	—	—	—	3090	A
2100 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2100 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2100 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2100 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2100 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2400 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2400 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2400 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2400 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2400 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2700 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2700 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2700 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2700 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2700 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—

Table 23 – Type III Timber Supports (Breakaway)

Wind Pressure (q) = 390 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 4800	3	2.24	0.16	—	—	—	—	—	—	3110	A
1200 x 5100	3	2.24	0.31	—	—	—	—	—	—	3150	A
1200 x 5400	3	2.24	0.46	—	—	—	—	—	—	3260	A
1200 x 5700	3	2.24	0.61	—	—	—	—	—	—	3390	A
1200 x 6000	3	2.24	0.76	—	—	—	—	—	—	3600	A
1500 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1500 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1500 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
1500 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
1500 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
1800 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1800 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1800 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
1800 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
1800 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2100 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2100 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2100 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2100 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2100 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2400 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2400 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2400 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2400 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2400 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2700 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2700 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2700 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2700 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2700 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—

Table 24 – Type III Timber Supports (Breakaway)

Wind Pressure (q) = 465 Pa											
Sign Size D x B (mm x mm)	Posts	A (m)	C (m)	Jack Pine				Douglas Fir			
				H_{max} (mm)				H_{max} (mm)			
				Post Size (mm) & Splice Type				Post Size (mm) & Splice Type			
				140 x 140	Type	140 x 184	Type	140 x 140	Type	140 x 184	Type
1200 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1200 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1200 x 5400	3	2.24	0.46	—	—	—	—	—	—	2710	A
1200 x 5700	3	2.24	0.61	—	—	—	—	—	—	2810	A
1200 x 6000	3	2.24	0.76	—	—	—	—	—	—	2980	A
1500 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1500 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1500 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
1500 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
1500 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
1800 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
1800 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
1800 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
1800 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
1800 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2100 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2100 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2100 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2100 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2100 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2400 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2400 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2400 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2400 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2400 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—
2700 x 4800	3	2.24	0.16	—	—	—	—	—	—	—	—
2700 x 5100	3	2.24	0.31	—	—	—	—	—	—	—	—
2700 x 5400	3	2.24	0.46	—	—	—	—	—	—	—	—
2700 x 5700	3	2.24	0.61	—	—	—	—	—	—	—	—
2700 x 6000	3	2.24	0.76	—	—	—	—	—	—	—	—

2.3.5 Fabrication and Installation

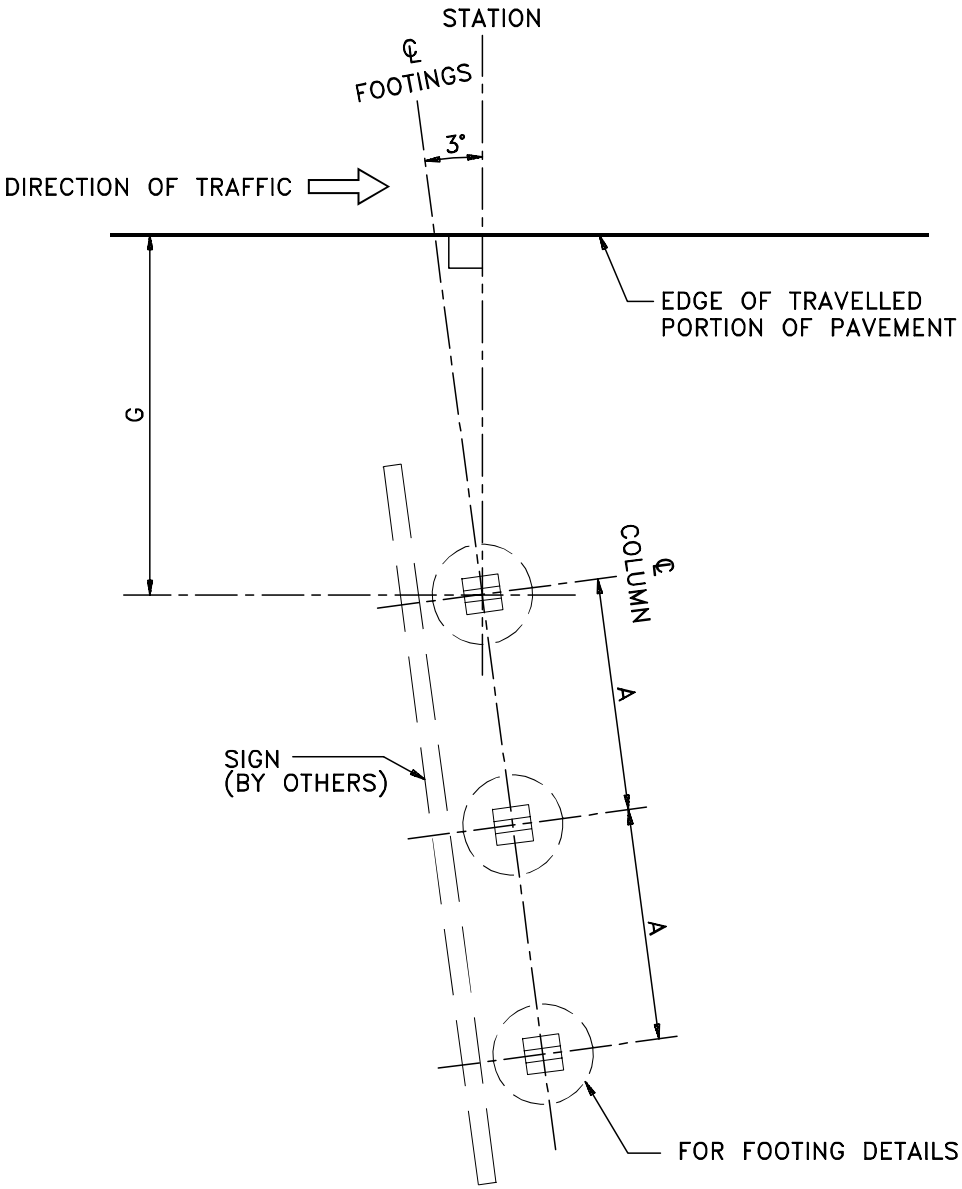
General

See MTO construction specifications for sign supports.

Typical Layout Plan (Timber Posts)

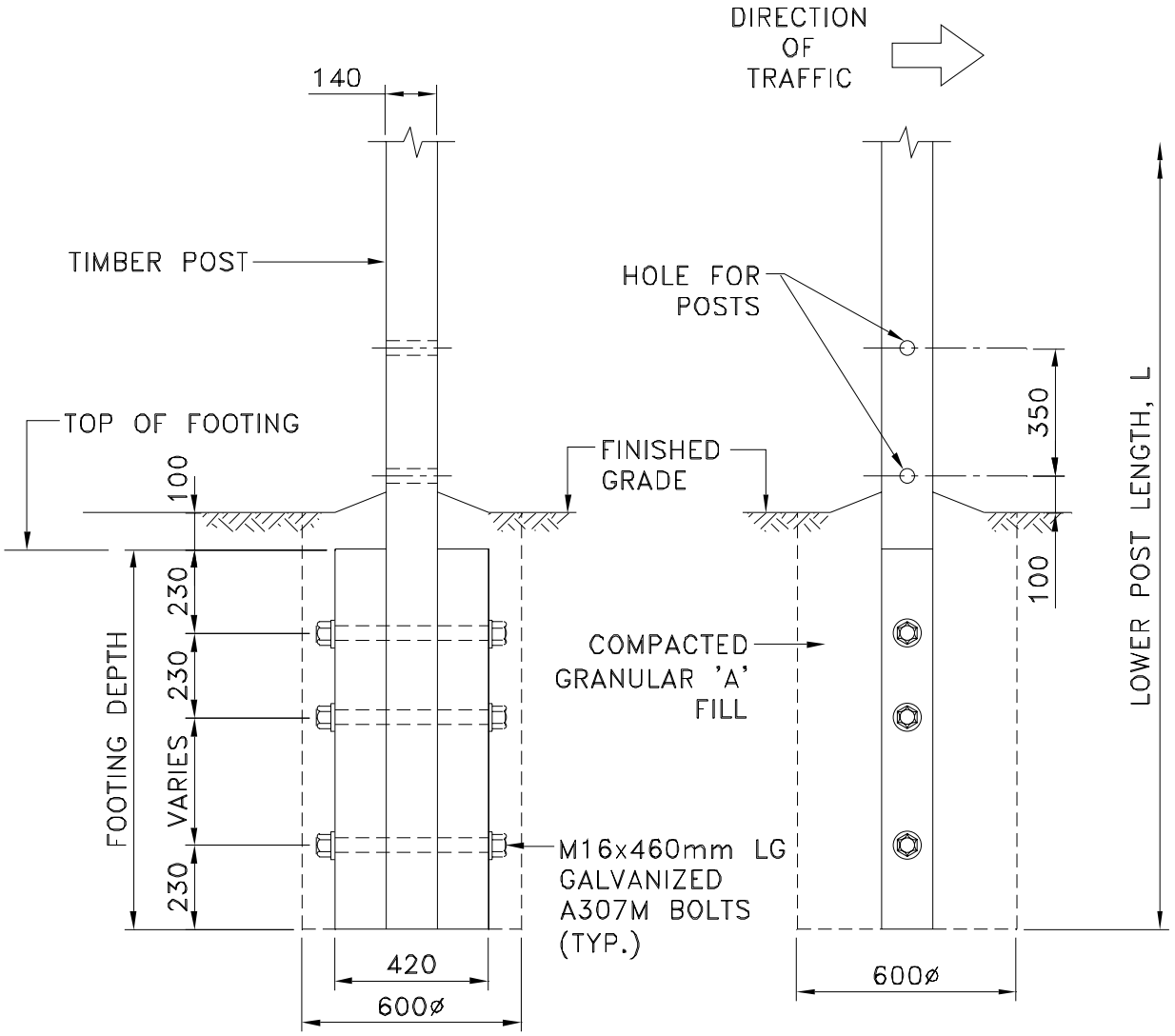
Figure 46 is for use in installing timber sign supports.

Figure 46 – Typical Layout Plan (Timber Supports)



Footing (Timber Supports)

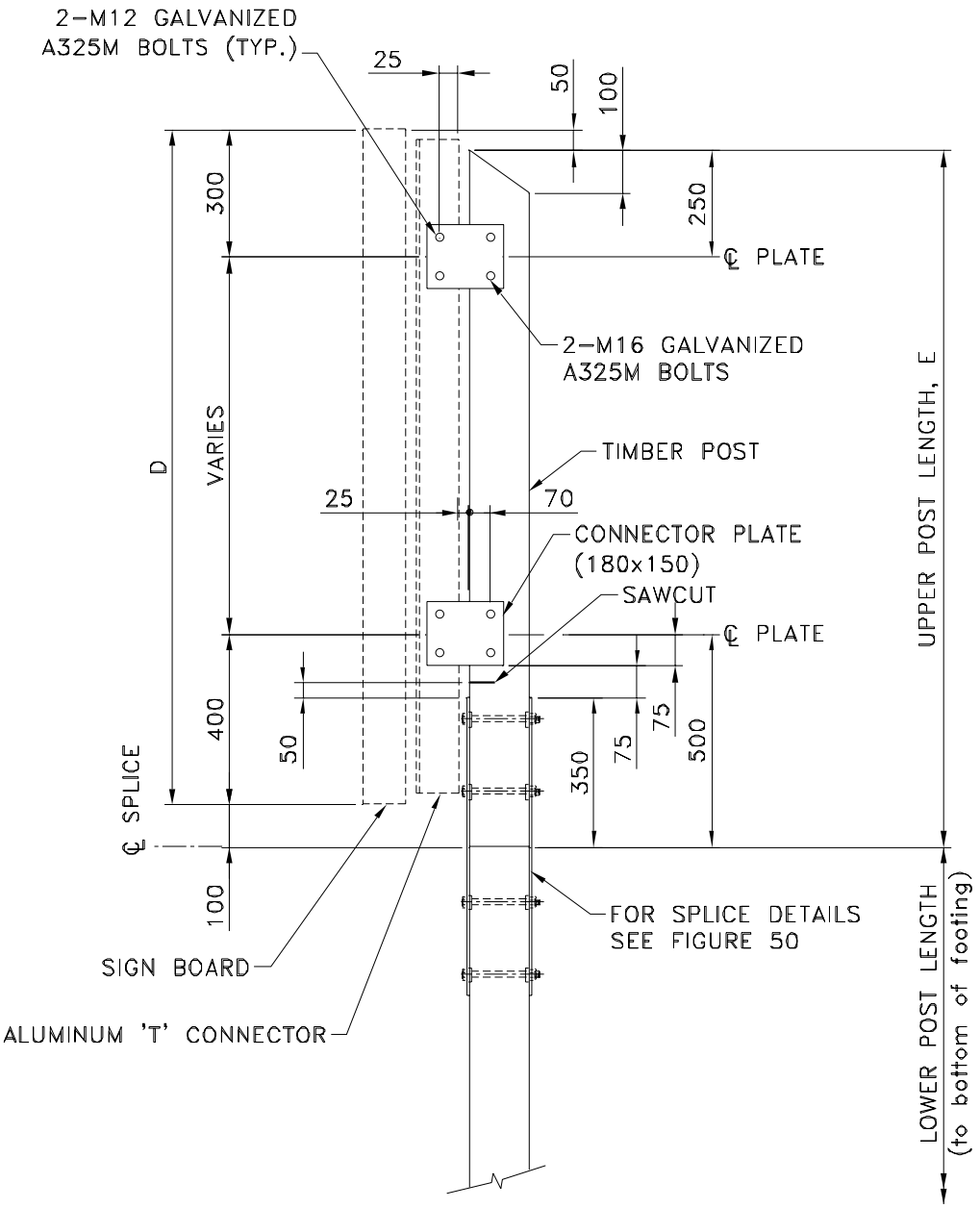
Figure 47 – Footing Details (Timber Supports)



Post Size (mm)	Footing Depth (mm)	Holes Dia. (mm)
140 x 140	1200	50
140 x 184	1500	75

Sign Details (Timber Supports)

Figure 48 – Sign Connection (Timber Supports)



Sawcut Depth (mm)	Post Size (mm)
50	140 x 140
75	140 x 184

Note: Plywood signs are attached to posts using lag bolts rather than connector plates.

Figure 49 – Typical Cross Section (Connectors, Timber Supports)

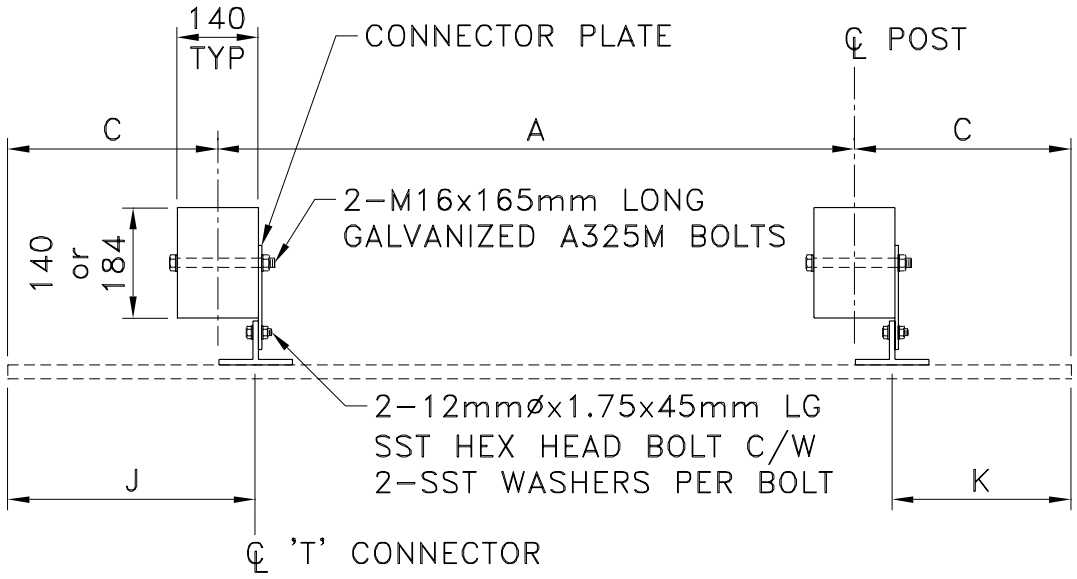
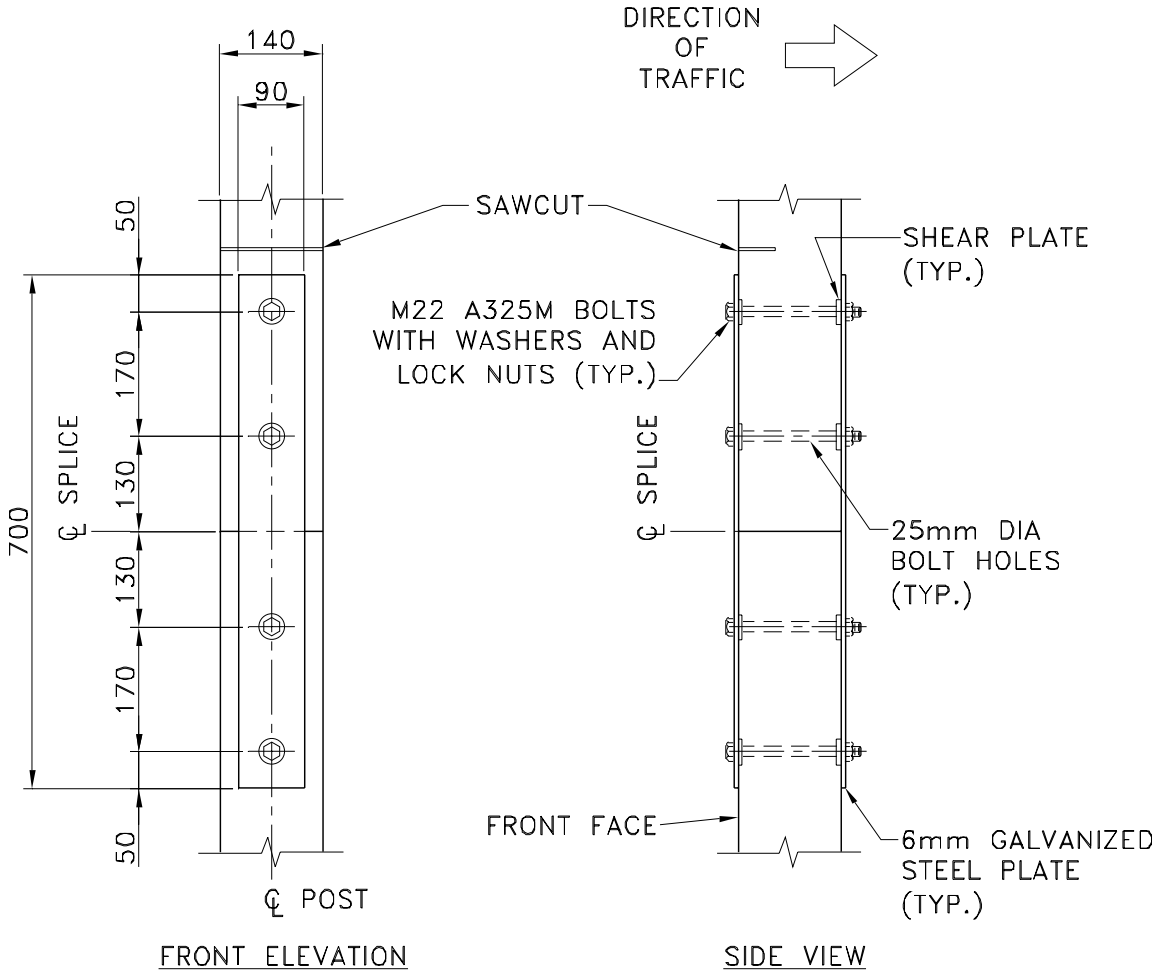


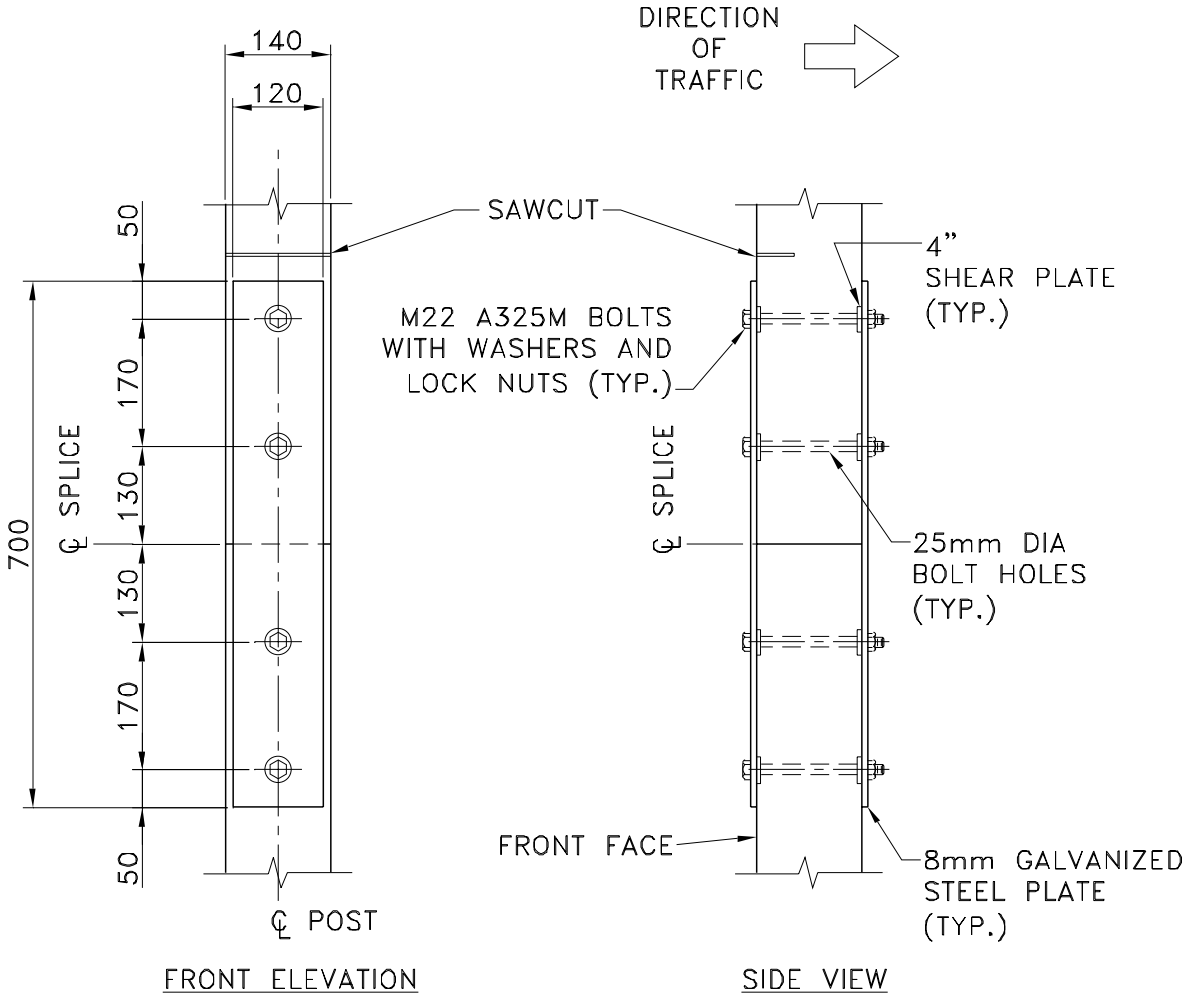
Figure 50 – Post Splice Detail (Type "A", Timber Supports)



Post Size (mm)	Bolt Size (mm)
140 x 140	M20 x 200 mm long
140 x 184	M20 x 250 mm long

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

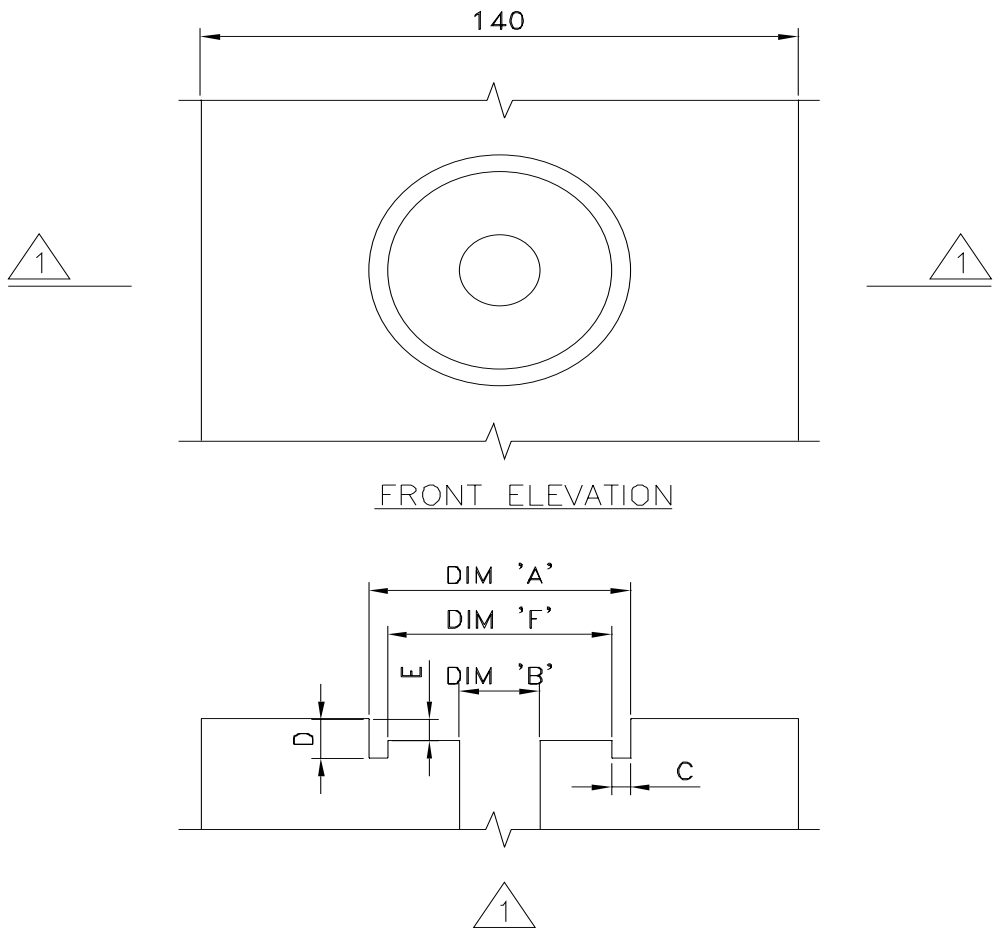
Figure 51 – Post Splice Detail (Type "B", Timber Supports)



Post Size (mm)	Bolt Size (mm)
140 x 140	M22 x 200 mm long
140 x 184	M22 x 250 mm long

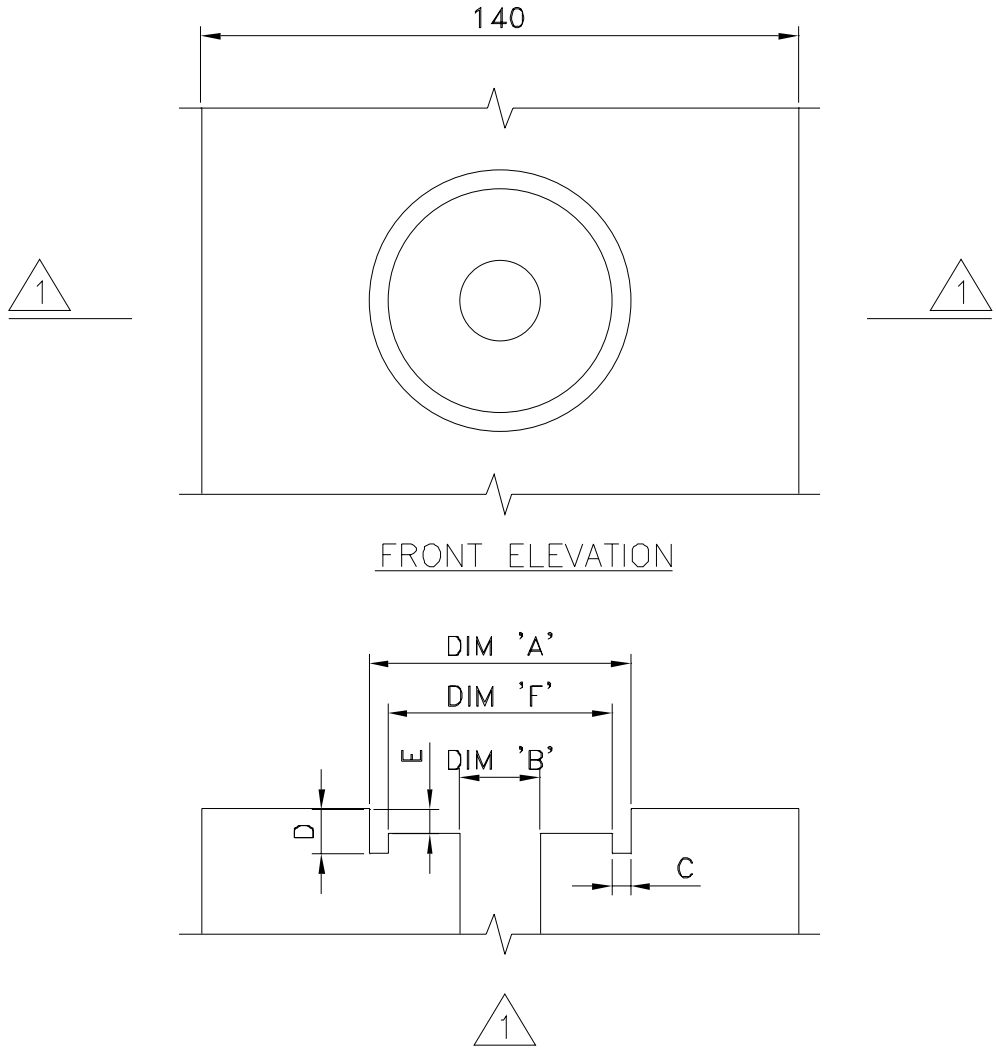
Note: Splice surfaces shall be flat and perpendicular to centre-line of the post to ensure full contact.

Figure 52 – 2.625 Inch (66.7 mm) Shear Plate Groove Detail (Timber Supports)



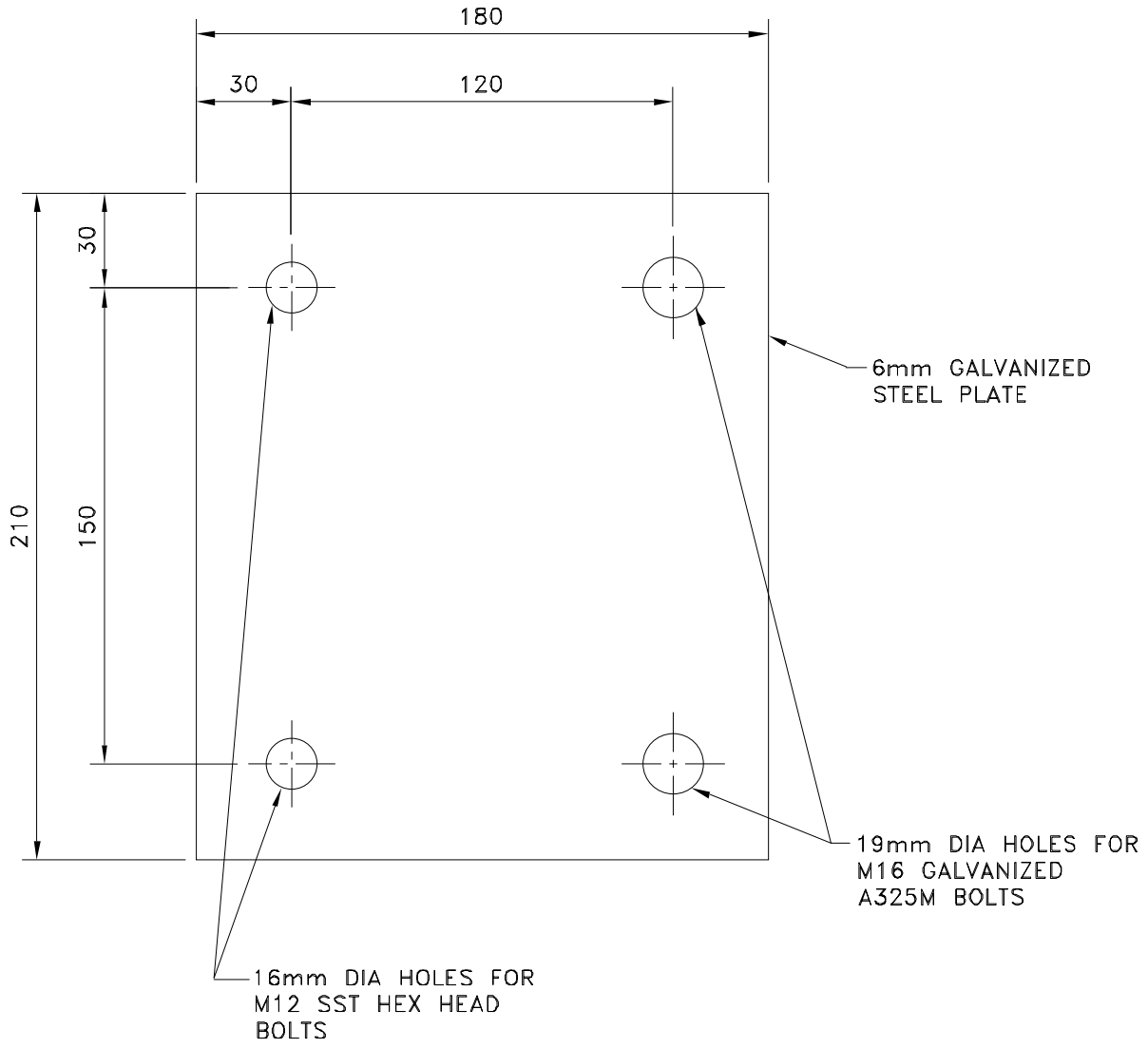
2.625 Inch Shear Plate Groove		
Dim	**Inches**	**mm**
A	2.63	66.8
B	0.81	20.6
C	0.19	4.5
D	0.45	11.4
E	0.25	6.4
F	2.25	57.2

Figure 53 – 4 Inch (101.6 mm) Shear Plate Groove Detail (Timber Supports)



4 Inch Shear Plate Groove		
Dim	**Inches**	**mm**
A	4.00	102.4
B	0.94	23.8
C	0.21	5.3
D	0.64	16.3
E	0.22	5.6
F	3.49	88.6

Figure 54 – Connector Plate Details (Timber Supports)



2.3.6 Work Sheet

Work Sheet (Blank)

The following "Work Sheet" is provided for designing timber sign supports. From Table 8, Figures 41 to 43; and Tables 10 to 24:

Timber Sign Supports

Sign Size (D x B) _____ x _____ WP No.: _____

Station: _____

Date: _____

Non-breakaway Sign Support Type	II	III	IV	Tables 10 to 18
Breakaway Sign Support Type	II	III		Tables 19 to 24
Dimension 'C' (overhang)				
Spacing of Posts 'A'				

Assume sign support type with the greater number of posts:

EL. EP (Datum) =	
Distance from EP to longest post	
$EP.P_i$ (at longest post i) =	

Elevation at centre line of sign: (EL.CS = EL.EP + 1800 + 0.5 D)

EL.CS =		+ 1800 +		=	

Post Design Height (H_{max}) at longest post location I: (H_{max} = EL.CS – $EI.P_i$)

H_{max} =		–		=			
			≥ 1800 + 0.5 D	=		H_{max} =	

If the sign is less than the minimum vertical clearance requirement above the ground level immediately below the sign then EL.CS and H_{max} shall be increased to suit. The minimum vertical clearance requirement for breakaway and non-breakaway sign support is 2100 mm and 1000 mm respectively.

_____

_____

_____

_____

_____

EL.CS	**H_{max}**

Work Sheet (Blank) Continued

	Table	Type	Species	Post Size	H_{max}	Splice
Breakaway	6.4.1( )			140 x		
	6.4.1( )			140 x		
	6.4.1( )			140 x		
	6.4.1( )			140 x		
	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:

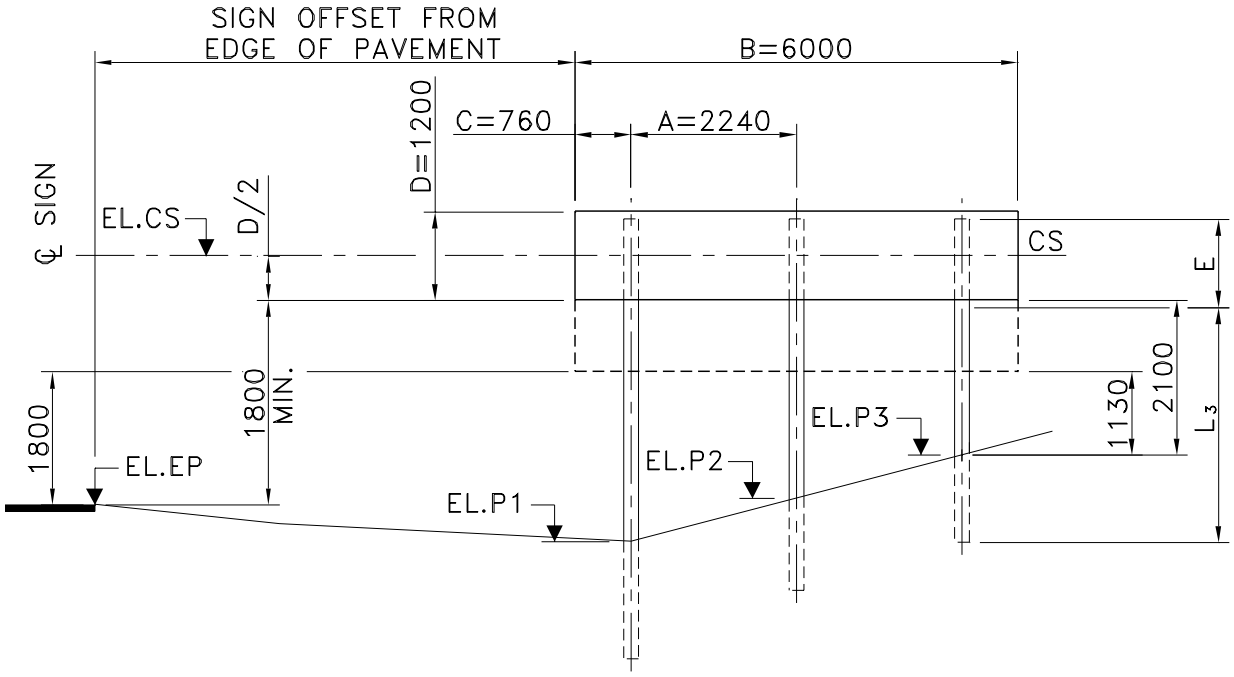
Post #	EL.P_i	Distance from EP to P_i	Lower Post Length L_i = EL.CS – EL.P_i – 0.5D + Footing Depth
1			
2			
3			
4			

Upper post length = **E** = D + 50 =	

All dimensions are in millimetres.

Figure 55 – Example (Breakaway Timber Sign Support)

Sign Size: 1200 mm x 6000 mm
q: 300 Pa
Given: EIEP = 10000 mm
EL.P_1 = 9500 mm
EL.P_2 = 10000 mm
EP.P_3 = 10500 mm



Work Sheet (Sample)

From Table 8, Figures 41 to 43, and Tables 10 to 24:

Timber Sign Supports

Sign Size (D x B) 1200 x 6000 WP No.: _____

Station: _____

Date: _____

Non-breakaway Sign Support Type	II	III	IV	Tables 10 to 18
Breakaway Sign Support Type	II	III	—	Tables 19 to 24
Dimension 'C' (overhang)	—	760	—	
Spacing of Posts 'A'	—	2240	—	

Assume sign support type with the greater number of posts:

EL. EP (Datum) =	10000
Distance from EP to longest post	7260
EP.P_i (at longest post i) =	9500

Elevation at centre line of sign: (EL.CS = EL.EP + 1800 + 0.5 D)

EL.CS =	10000	+ 1800 +	600	=	12400

Post Design Height (H_{max}) at longest post location I: (H_{max} = EL.CS – El.P_i)

H_{max} =	12400	–	9500	=	2900		
			≥ 1800 + 0.5 D	=	2400	H_{max} =	2900

If the sign is less than the minimum vertical clearance requirement above the ground level immediately below the sign then EL.CS and H_{max} shall be increased to suit. The minimum vertical clearance requirement for breakaway and non-breakaway sign support is 2100 mm and 1000 mm respectively.

At farthest post, sign is
1130 mm above the ground level,
then 2100 – 1130 = 970
New EL.CS = 12400 + 970 = 13370
New Hmax = 2900 + 970 = 3870

EL.CS	**H_{max}**
13370	3870

Work Sheet (Blank) Continued

	Table	Type	Species	Post Size	H_{max}	Splice
Breakaway	6.4.1( )	III	J.P.	140 x 184	3240	A
	6.4.1( )	III	D.F.	140 x 184	3980	A
	6.4.1( )	—	—	140 x	—	—
	6.4.1( )	—	—	140 x	—	—
	6.4.1( )	—	—	140 x	—	—
	6.4.1( )	—	—	140 x	—	—

No Type II Post Size structurally adequate available

C = 760

A = 2240

Post Size 140 x	184
Type	III
Species	D.F.
Splice Type	A
Footing Depth	1500

Determine post spacing and post lengths:

Post #	EL.P_i	Distance from EP to P_i	Lower Post Length L_i = EL.CS – EL.P_i – 0.5D + Footing Depth
1	9500	7260	4770
2	10000	9500	4270
3	10500	11740	3770
4	—	—	—

Upper post length = **E** = D + 50 =	1250

All dimensions are in millimetres.

2.4 Sign Supports for Large Ground-mounted Plywood Signs

The design of the vertical supports in Sections 2.2 and 2.3 may also be used for large plywood signs, Section 2.4, but the SSM mounting details are suitable only for extruded signs).

The RDM, which addresses small signs (Sections 2.4.1 and 2.5 in OTM Book 3), is concerned with signs with an area up to 3.6 m^2, including plywood signs. However, a gap is that the mounting details for the large plywood signs are not covered by Section 2.4. If mounting details for large plywood signs are needed, the reader should contact the MTO Traffic Office.

The mounting methods and details for small ground-mounted signs are not to be used for large ground-mounted plywood signs. Such details may be obtained from the MTO Traffic Office.

2.4.1 Sign Supports for Intermediate Ground-mounted Plywood Signs.

The RDM classified Intermediate ground-mounted plywood signs to be considered signs with areas between 3.6m^2 and 7.2m^2. The signs may only be installed on approved double sign supports.

The intermediate sign sizes most often utilized during sign design are 2400x1800, 2400x2100, and 2400x2400.

Multiple sign assemblies may also be installed on the same sign supports to make larger signs, such as 2400x2700 and 2400x3000 For example: Sign A 2400x1200 + Sign B 2400x1200 + Sign C 2400x600 = 2400x3000.

Sign supports for intermediate ground-mounted plywood signs is the Slip-Safe Supreme (TM) is a propriety system developed by Nucor Marion Steel, Inc. has been successfully crash tested according to MASH-16 and recognized by the MTO, please refer to the RDM. Other sign supports may be used, however they must meet the crash testing standards.

2.5 Sign Supports for Small Ground-mounted Signs

As noted in Section 1.4, small signs are considered to be signs with areas up to 3.6 m^2. They may be installed on single, double, or triple sign supports.

Although small signs are not always perceived as particularly hazardous, they can cause significant damage to impacting vehicles. Several types of breakaway small sign support systems are readily available for use in Ontario, which meet the crash test acceptance. The ministry intends to replace those sign supports which currently fulfill the crash test acceptance requirements of NCHRP Report 350 with products that successfully meet crash test requirements of MASH-16.

For terminology for sign dimensions, see Section 1.6.

For durability, different combinations and sizes of breakaway pressure treated wooden and galvanized steel sign support systems have been developed for various sign sizes typically used on provincial highways. Contractors will have the option to select appropriate wooden and/or steel sign support systems for each installation dependent upon sign size. Each sign support system has been designed for a 113 km/h (70 mph) wind speed and 400 MPa wind pressure with a 10-year return period in accordance with the CHBDC. Typical sign sizes, maximum sign/tab areas, and applicable post sizes and configurations are included in the selection tables below (Tables 25 and 26).

When selecting an appropriate breakaway small sign support system, the following should be considered:

- An economical sign support system should be selected.
- The sign dimensions may be up to the maximum depth (H) and maximum width (B) provided in Table 25.
- The total sign area shall be within the allowable maximum sign area (A) provided in Table 25.

- When multiple signs are mounted in one assembly, the sign area used to determine the sign support(s) is the aggregate of all the small sign areas.

For example, a speed limit sign of 600 mm width (B) and 900 mm depth (H), gives an area (A) of 0.54 m^2. If a timber support is selected, it may be installed on a 89 mm x 140 mm single support. This sign may not be installed on an 89 mm x 89 mm wood sign support system, because the sign area of 0.54 m^2 is larger than the allowable sign area of 0.41 m^2, although the width and depth dimensions of the sign are within the limits.

Note: Figures 56 to 73 are current at the time of publication. Designers must ensure that they are using the most current Ontario Provincail Standards (OPSS) and drawings.

2.5.1 Wooden Sign Support Systems

In future, wood supports are not meeting the requirements of MASH-16, the use of wooden support may be abandoned.

- Un-drilled 89 mm x 89 mm post (nominal 4 inches x 4 inches)
- Drilled 89 mm x 140 mm post (nominal 4 inches x 6 inches)
- Drilled 140 mm x 140 mm post (nominal 6 inches x 6 inches)
- Drilled 140 mm x 184 mm post (nominal 6 inches x 8 inches).

The wooden pressure treated posts are direct buried a minimum depth of 920 mm to 1200 mm into the ground, dependent on the size and configuration of the sign, and the bottom of the sign or tab must have a minimum height of 2.1 m above the ground, measured vertically at the post.

2.5.2 Steel Sign Support Systems

The following proprietary breakaway galvanized steel U-flange and galvanized perforated steel square tube systems with single, double, and triple post configurations meet the requirements of AASHTO's MASH-16 or minimum NCHRP Report 350 for various sign sizes to a maximum sign area of 3.24 m^2.

- Nucor Steel Marion Inc. U-Flange
- Franklin Industries Co. U-Flange
- Allied Tube and Conduit Square Tube
- Northwest Pipe Co. Square Tube

The breakaway steel post systems consist of two sections; with the bottom stub post buried a minimum depth of 965 mm to 1065 mm into the ground with the top of the stub post projecting no more than 100 mm above the ground. The top post is spliced and bolted to the lower stub post with the appropriate proprietary spacers, sleeves and bolts for each system. The height of the upper posts is selected to ensure that the bottom of the sign or tab has a minimum height of 2.1 m above the ground measured vertically at the post.

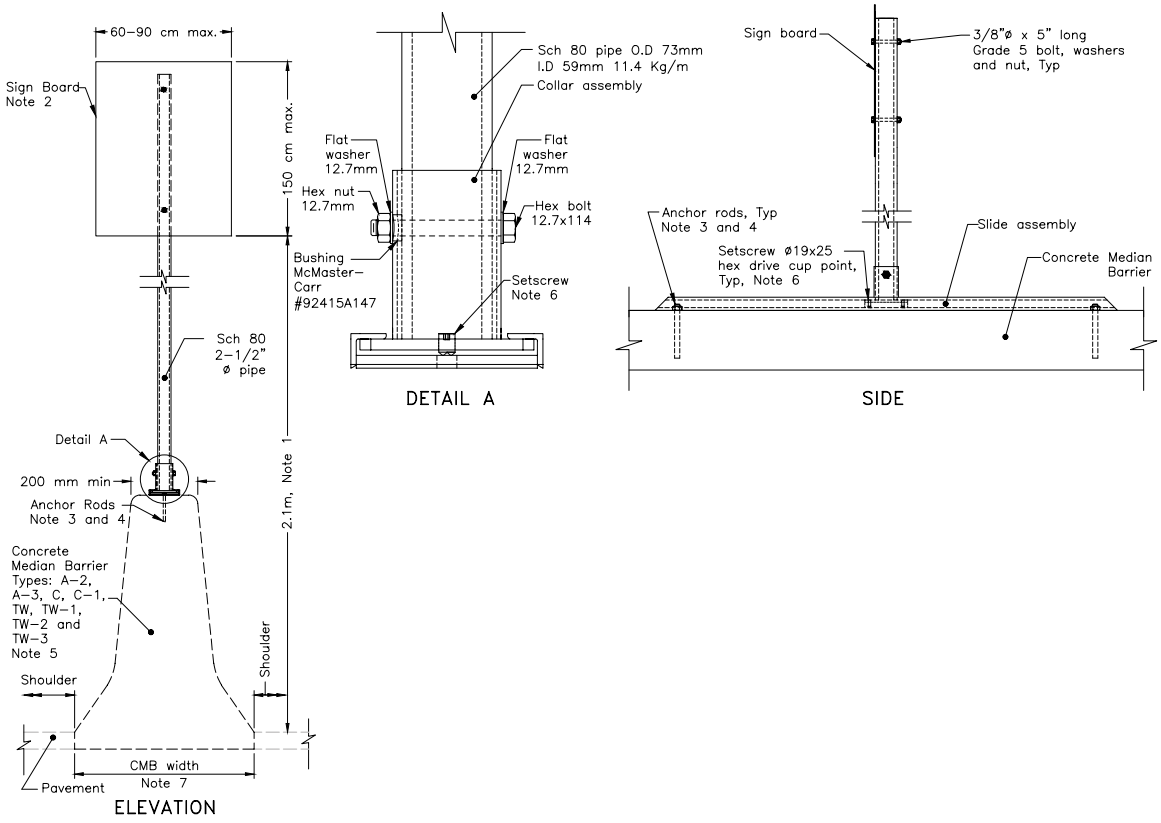
Breakaway sign supports should always be recommended, even if the sign location is outside the clear zone or on low speed roads, because the improved safety may be achieved at little or no additional cost.

2.5.3 Small Signs Mounted on Concrete Median Barriers

The metal and wooden single supports shown in Figures 56 and 57 are designed for small sign installation on top of concrete median barriers for signs up to 1.35 m2. The type of concrete barrier is specified in the Figures. The maximum width of sign should be between 600 to 900 mm so that the overhang of the sign onto the shoulder should not be struck by a parked vehicle in an emergency. The maximum height of the sign should not be greater than 1500 mm.

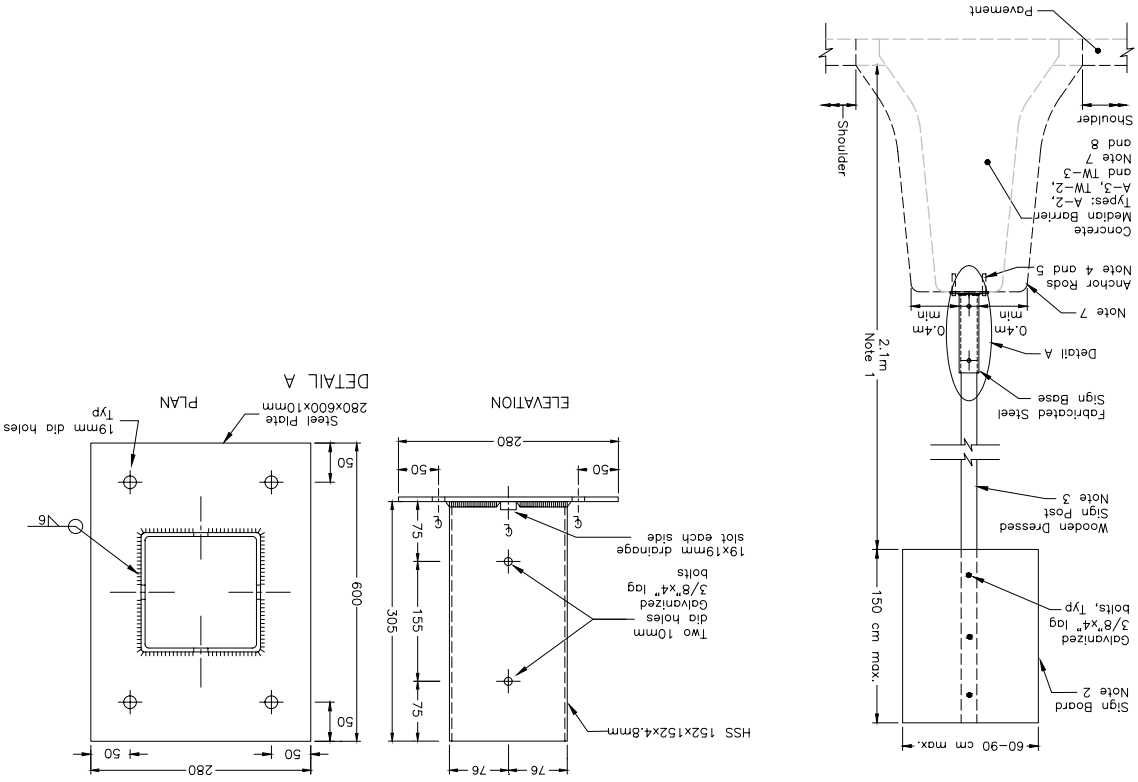
The metal sign support – Sliding Base and Chute (Fig A) is a proprietary sign support system and successfully passed crash test on the criteria of MASH. The steel post is attached to the steel collar assembly which could slide within steel base chute in the event of errant vehicle hit

Figure 56 – Small Sign Support System
(Metal Post, Sliding Base and Chute - Installation Concrete Median Barrier)



See applicable standards for other details and note references

Figure 57 – Small Sign Support System
(Wooden Post and Steel Base - Installation Concrete Median Barrier)



See applicable standards for other details and note references

Table 25 – Breakaway Small Sign Support Selection Table

Type	Posts	Size (mm)	Maximum Sign Area, A (m^2)	Maximum Width, B (mm)	Maximum Depth, H (mm)	Figure (ref. MTOD No.)
Timber	**1**	89 x 89	0.41	1200	900	Figure 56 (ref. 985.110)
		89 x 140	0.90	1200	1200	
		140 x 140	1.08	1200	1800	Figure 56 (ref. 985.110)
		140 x 184	1.80	1200	1800	
	2	89 x 89	0.90	2400	900	Figure 57 (ref. 985.210)
		89 x 140	1.89	2400	1200	
		140 x 140	2.16	2400	900	Figure 58 (ref. 985.220)
		140 x 184	3.60	2400	1500	
		Section (kg/m)				
Franklin Steel U-Flanges (this is a proprietary system)	**1**	3.0	0.34	900	900	Figure 59 (ref. 986.101) Figure 60 (ref. 986.105)
		3.7	0.45	900	900	
		4.5	0.56	900	1200	
		6.0	0.81	900	1500	
	2	3.0	0.90	1800	900	Figure 61 (ref. 986.201)
		3.7	1.08	1800	1200	
		4.5	1.44	1800	1500	
		6.0	2.16	1800	2100	
	3	3.0	1.44	2400	600	Figure 62 (ref. 986.301)
		3.7	1.89	2400	900	
		4.5	2.52	2400	1200	
		6.0	2.88	2400	1200	
Nucor Steel U-Flanges (this is a proprietary system)	**1**	2.61	0.27	900	900	Figure 63 (ref. 987.110) Figure 64 (ref. 987.101)
		2.98	0.30	900	900	
		3.72	0.36	900	900	
		4.46	0.41	900	900	
		5.95	0.56	900	900	
	2	2.98	0.81	1800	900	Figure 64 (ref. 987.101) Figure 65 (ref. 987.210)
		3.72	0.90	1800	900	
		4.46	1.08	1800	1200	
		5.95	1.44	1800	1500	
	3	2.98	1.62	2400	900	Figure 64 (ref. 987.101) Figure 66 (ref. 987.310)
		3.72	1.89	2400	1050	
		4.46	2.52	2400	1200	
Square Steel Post	(these are proprietary products)					
Northwest Pipe	**2**	51 x 51 x 12 gauge	3.15	2400	1500	Figure 67 (ref. 989.110) Figure 68 (ref. 989.210)

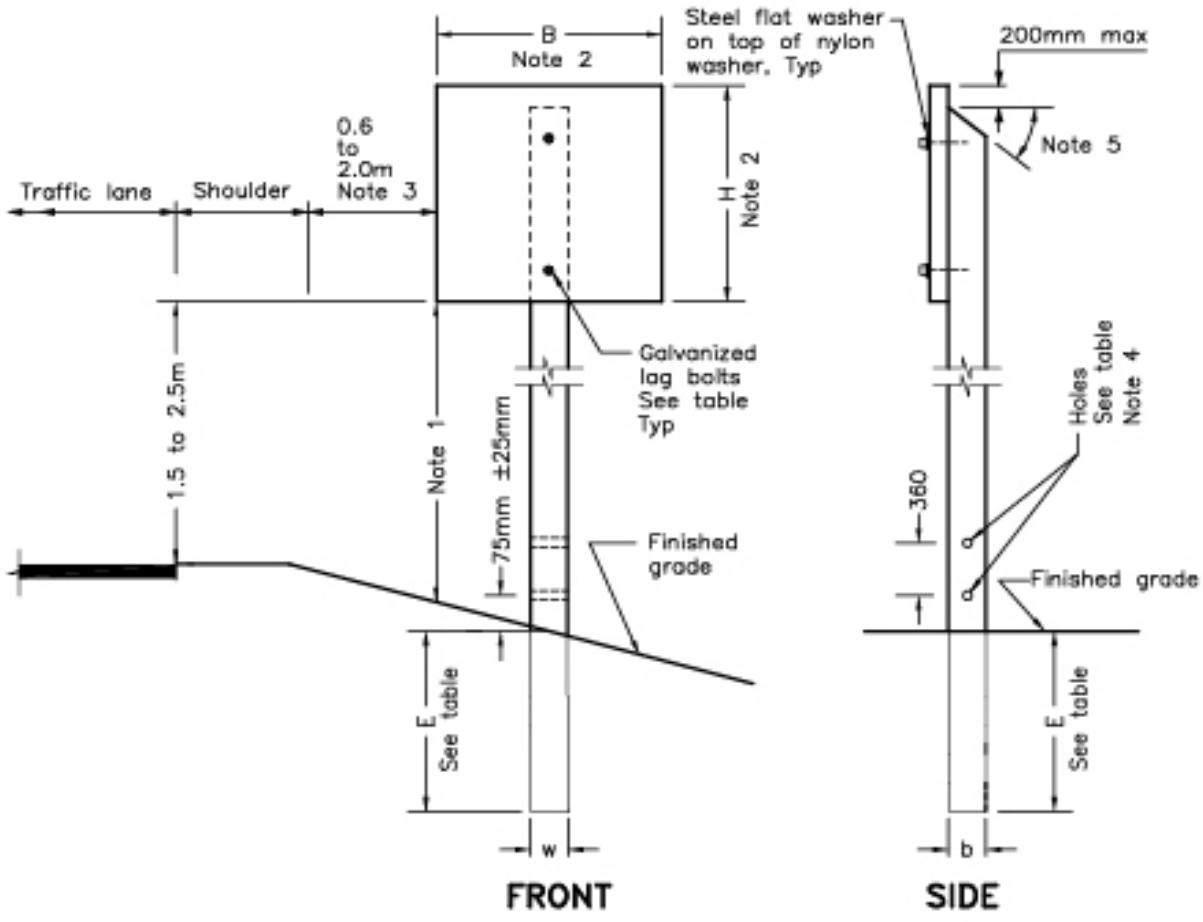
Table 26 – Non-breakaway Small Sign Support Selection Table

Type	Posts	Section	Maximum Sign Area, A (m^2)	Maximum Width, B (mm)	Maximum Depth, H (mm)	Figure (ref. MTOD No.)
Steel U-Flange	1	See Figure 71	0.56	900	900	Figure 69 (ref. 990.110)

Table 27 – Typical Small Sign Sizes and the Range of Applicable Supports

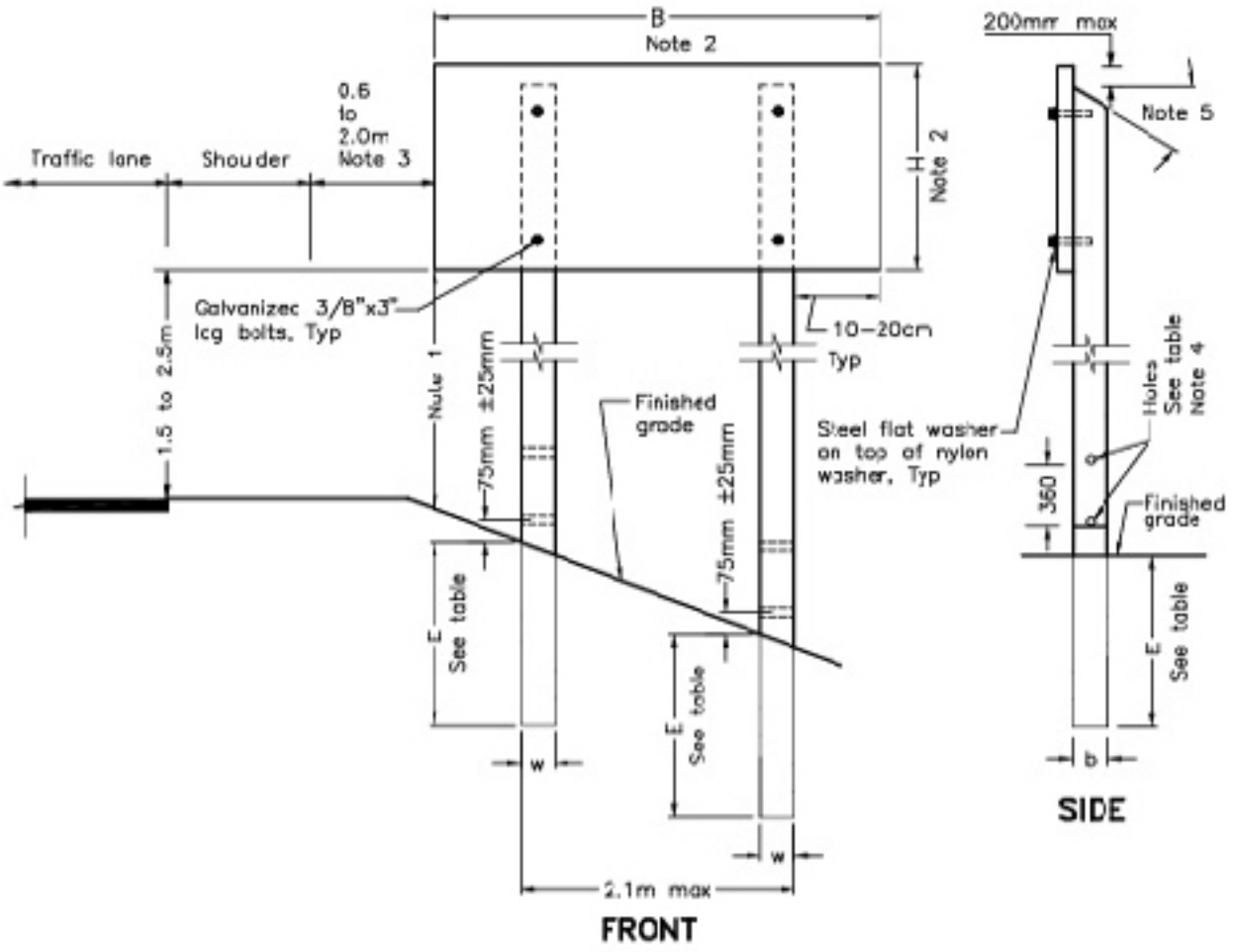
Typical Sign Sizes			Support Selection						
Area (m^2)	B (mm)	H (mm)	Timber		Franklin U-Flange		Nucor U-Flange		Square Posts
			Posts	(mm)	Posts	(kg/m)	Posts	(kg/m)	
0.14	300	450	1	89 x 89	1	3.7	1	4.46	1
0.20	450	450	1	89 x 89	1	3.7	1	4.46	1
0.27	300	900	1	89 x 89	1	3.7	1	4.46	1
0.27	450	600	1	89 x 89	1	3.7	1	4.46	1
0.36	600	600	1	89 x 89	1	6.0	1	4.46	1
0.36	1200	300	1	89 x 89	2	3.0			1
0.40	450	900	1	89 x 89	1	3.7	1	4.46	1
0.40	900	450	1	89 x 89	1	3.7	1	4.46	1
0.54	600	900	1	89 x 89	1	4.5	1	5.95	1
0.56	750	750	1	89 x 140	1	6.0	2	4.46	1
0.63	600	1050	1	89 x 140	1	6.0	1	4.46	1
0.72	600	1200	1	89 x 140	1	6.0	1	4.46	1
0.72	2400	300	2	89 x 85	3	3.0	3	2.98	2
0.79	750	1050	1	89 x 140	1	6.0	2	4.46	1
0.81	900	900	1	89 x 140	1	6.0	2	2.98	1
0.90	1200	750	1	89 x 140	2	3.0	2	3.72	1
0.90	1500	600	2	89 x 85	2	3.0	2	3.72	2
1.08	2400	450	2	89 x 140	3	3.0	3	2.98	2
1.10	600	1800	1	140 x 140	2	6.0	N/A	N/A	N/A
1.10	900	1200	1	140 x 140	2	3.7	2	4.46	1
1.10	1200	900	1	140 x 140	2	3.7	2	4.46	1
1.40	900	1500	1	140 x 184	2	4.5	2	5.95	1
1.40	2400	600	2	89 x 140	3	3.0	3	2.98	2
1.44	1200	1200	1	140 x 184	2	6.0	2	5.95	2
1.60	1800	900	2	89 x 140	2 or 3	6.0/3.7	3	2.98	2
1.80	1200	1500	1	140 x 184	2	6.0	N/A	N/A	2
1.80	1500	1200	2	89 x 140	2 or 3	6.0/3.7	3	3.72	2
1.90	2100	900	2	89 x 140	3	3.7	3	3.72	2
2.20	2400	900	2	140 x 140	3	4.5	3	4.46	2
2.88	2400	1200	2	140 x 140	N/A	N/A	N/A	N/A	N/A
3.60	2400	1500	2	140 x 184	N/A	N/A	N/A	N/A	N/A
Square posts may be either Allied Tube & Conduit Posts or Northwest Pipe Company Posts.									

Figure 58 – Small Sign Support System
(Breakaway Wooden Post – Installation Single Post Assembly)



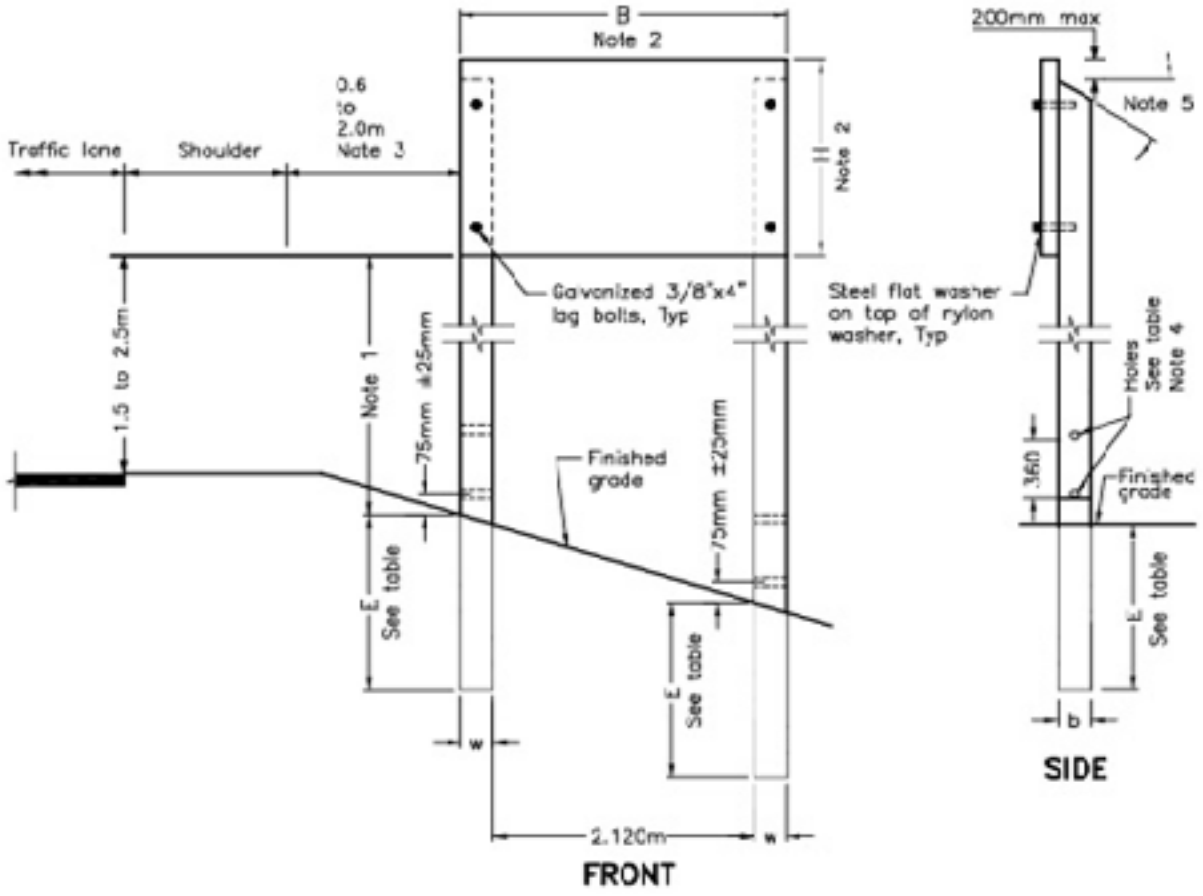
See applicable standards for other details and note references

Figure 59 – Small Sign Support System
(Breakaway Wooden Post 89x89mm & 89x140mm– Installation Double Post Assembly)



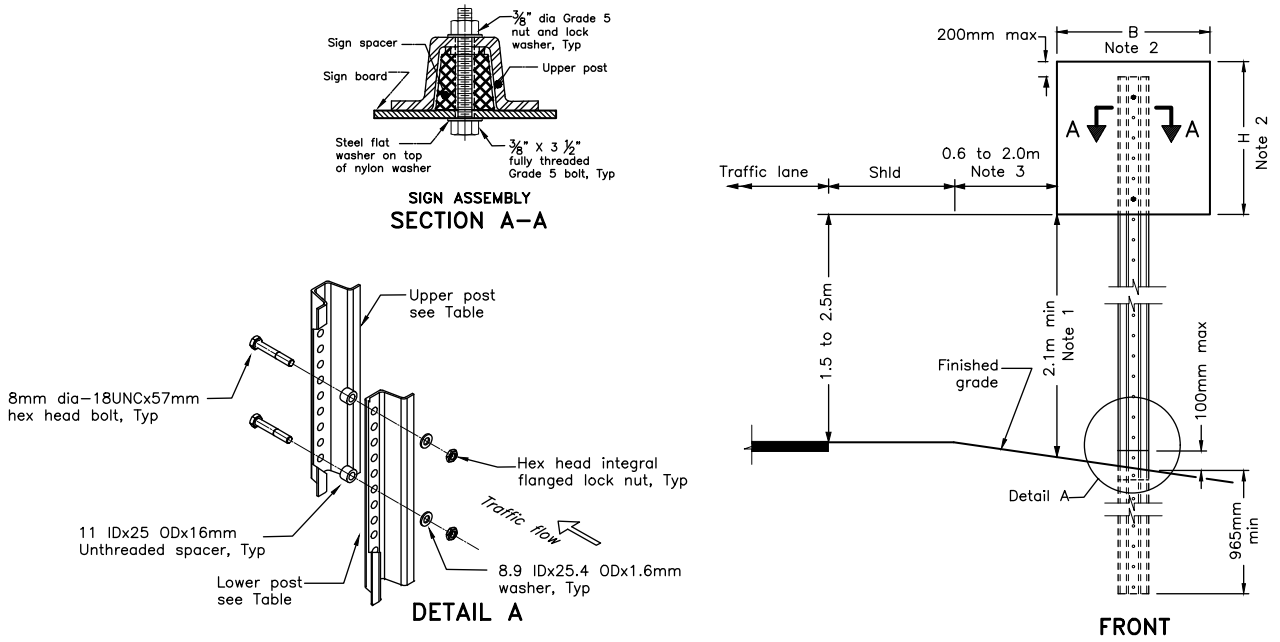
See applicable standards for other details and note references

Figure 60 – Small Sign Support System
(Breakaway Wooden Post – 140x140mm & 140x184mm Installation Double Post Assembly)



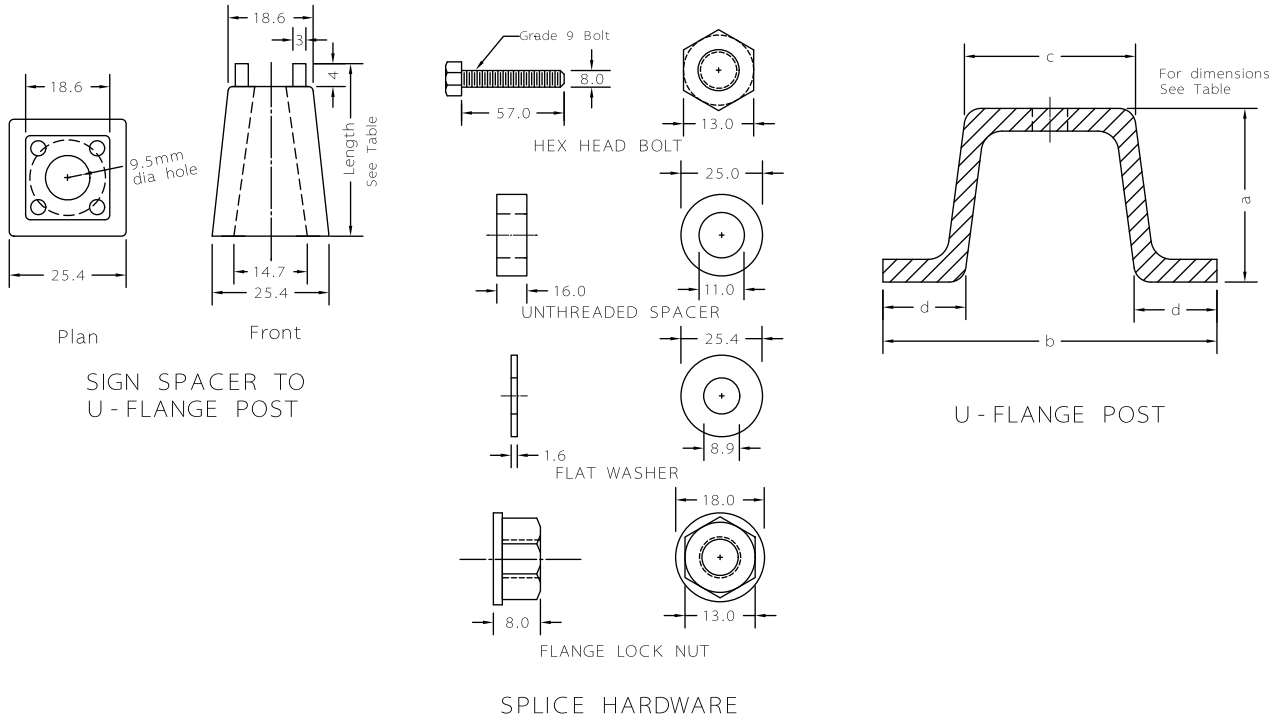
See applicable standards for other details and note references

Figure 61 – Small Sign Support System, Base-Bolted Breakaway System (U-Flange Post – Installation Single Post Assembly)



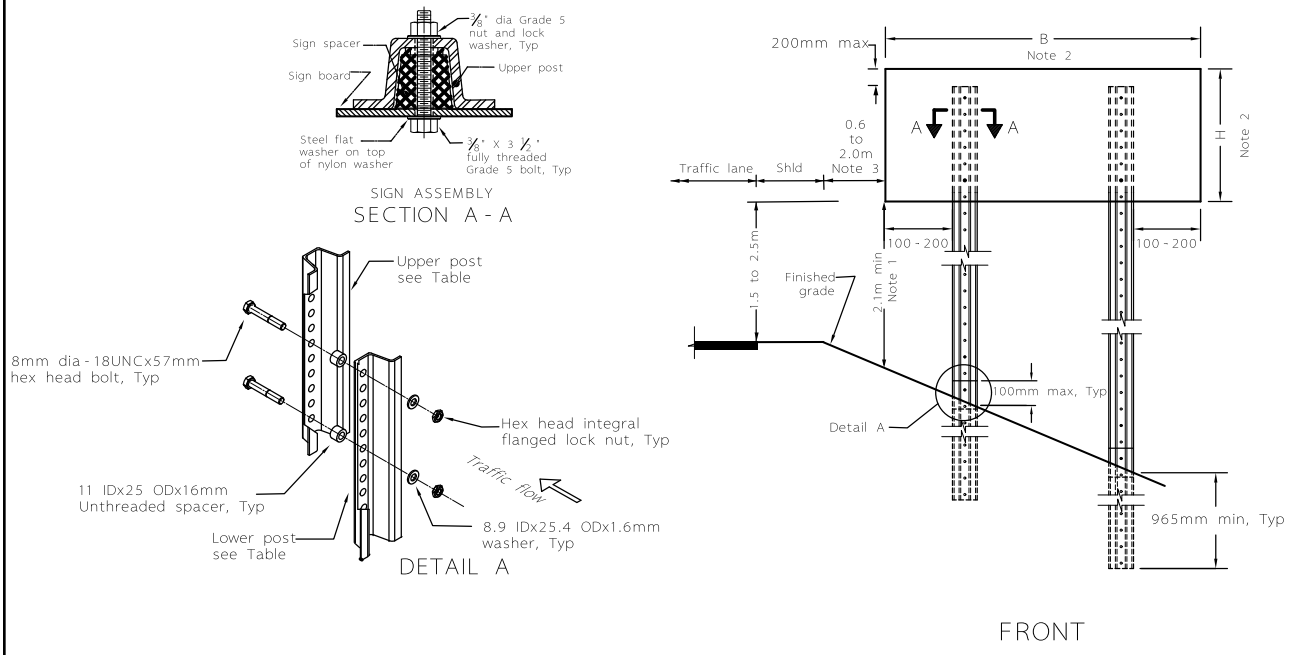
See applicable standards for other details and note references

Figure 62 – Small Sign Support System, Base-Bolted Breakaway System (Breakaway U-Flange Post – Components)



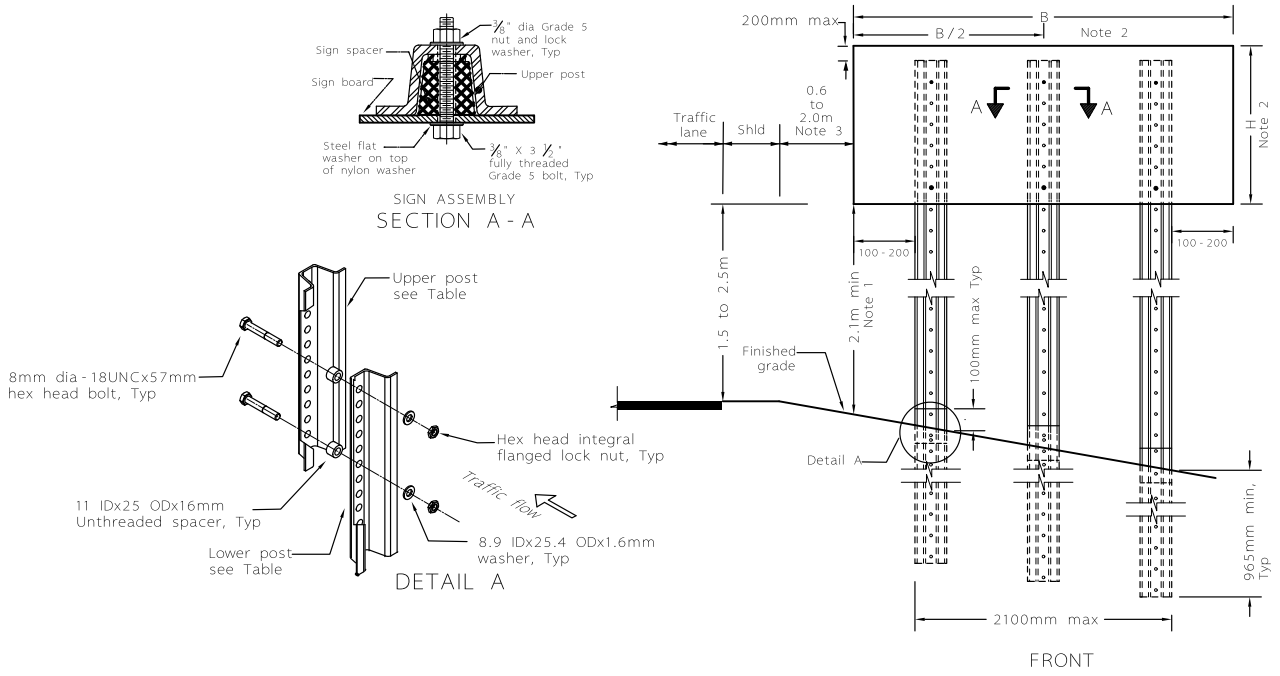
See applicable standards for other details and note references

Figure 63 – Small Sign Support System, Base-Bolted Breakaway System (Breakaway U-Flange Post – Installation Double Post Assembly)



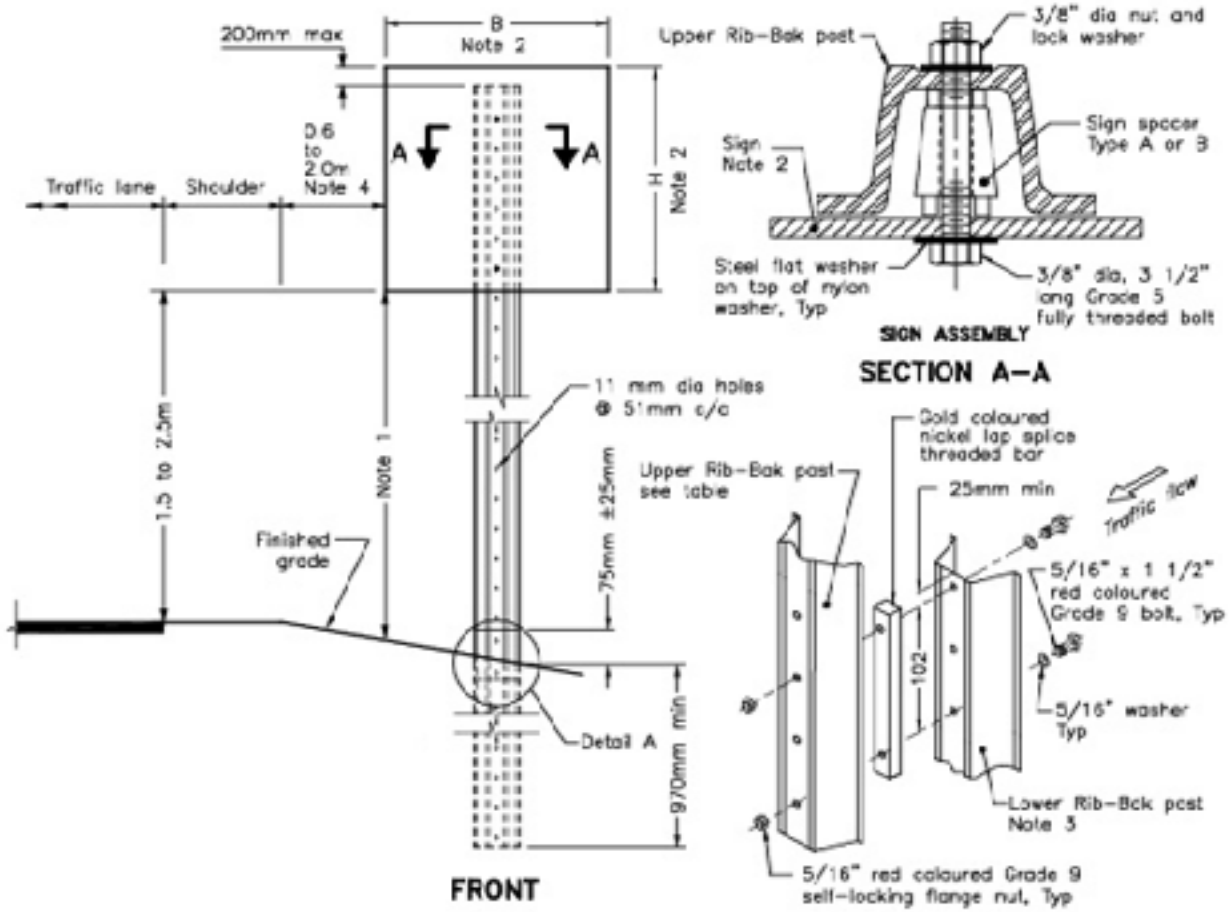
See applicable standards for other details and note references

Figure 64 – Small Sign Support System, Base-Bolted Breakaway System (Breakaway U-Flange Post – Installation Triple Post Assembly)



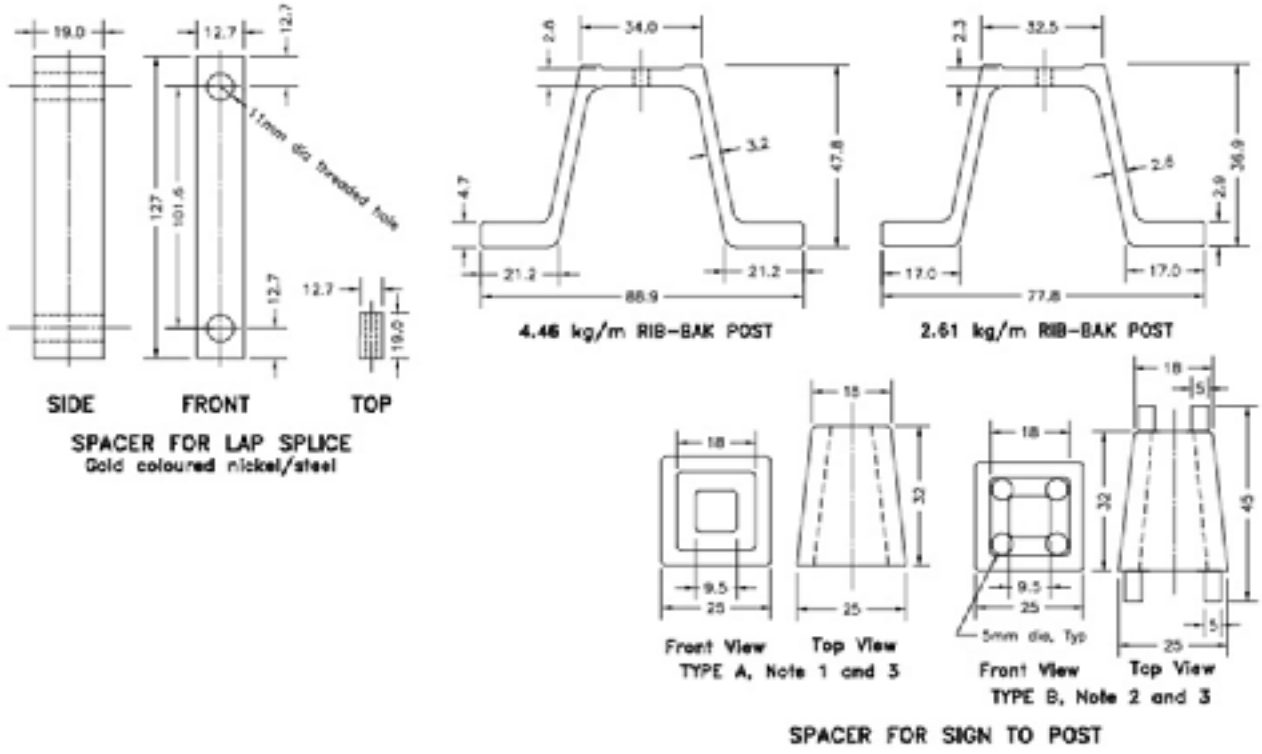
See applicable standards for other details and note references

Figure 65 – Small Sign Support System (Nucor Steel Marion Inc.)
(Breakaway U-Flange Post – Installation Single Post Assembly)



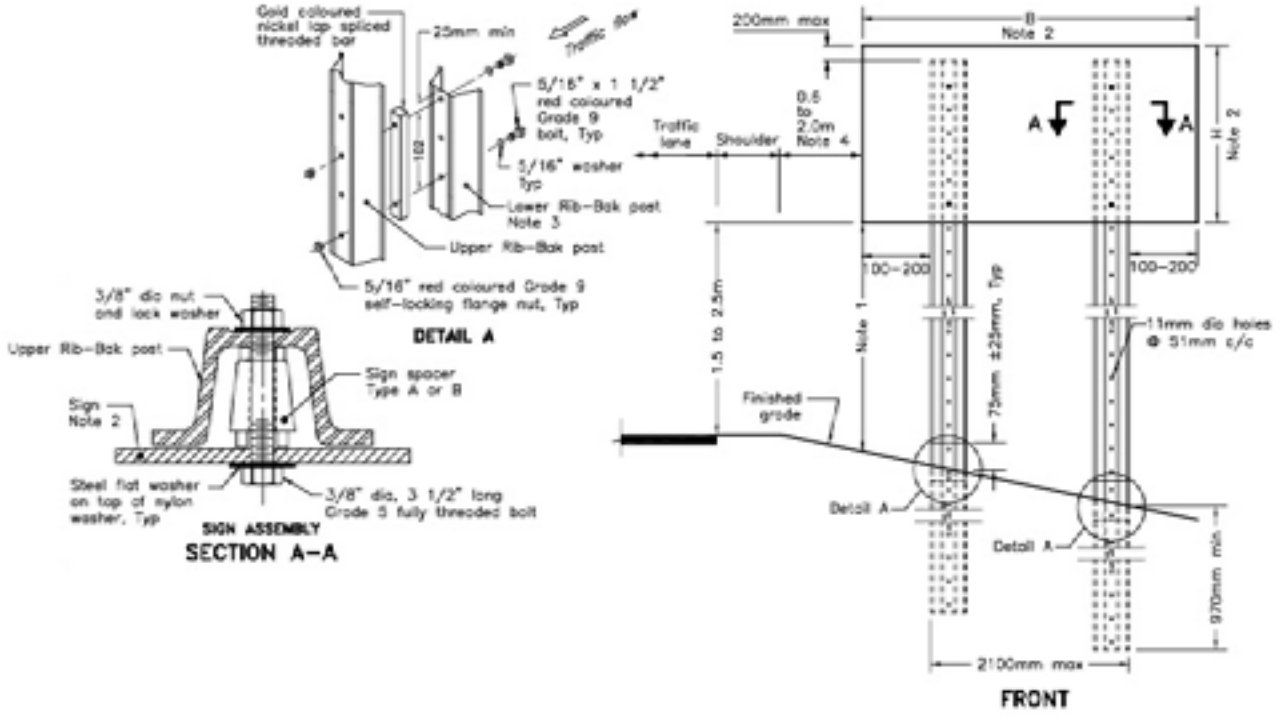
See applicable standards for other details and note references

Figure 66 – Small Sign Support System (Nucor Steel Marion Inc.)
(Breakaway U-Flange Post – Components)



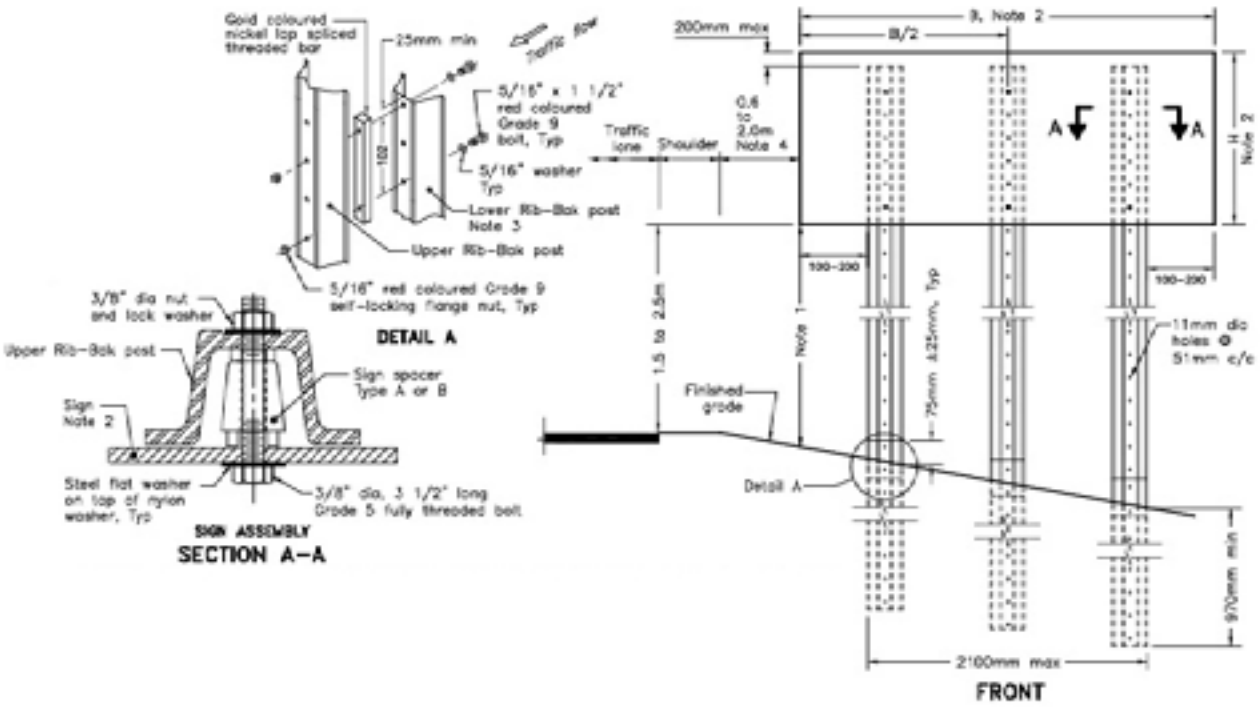
See applicable standard for other details and note references

**Figure 67 – Small Sign Support System (Nucor Steel Marion Inc.)
(Breakaway U-Flange Post – Installation Double Post Assembly)**



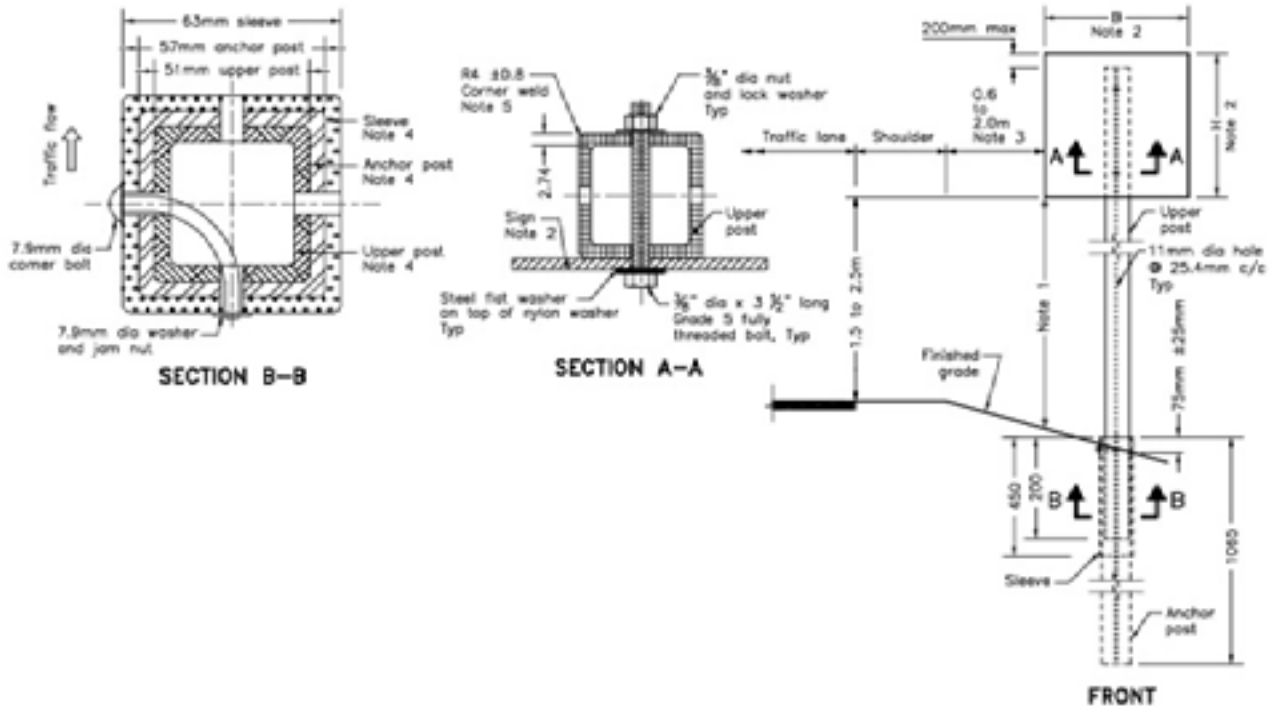
See applicable standard for other details and note references

**Figure 68 – Small Sign Support System (Nucor Steel Marion Inc.)
(Breakaway U-Flange Post – Installation Triple Post Assembly)**



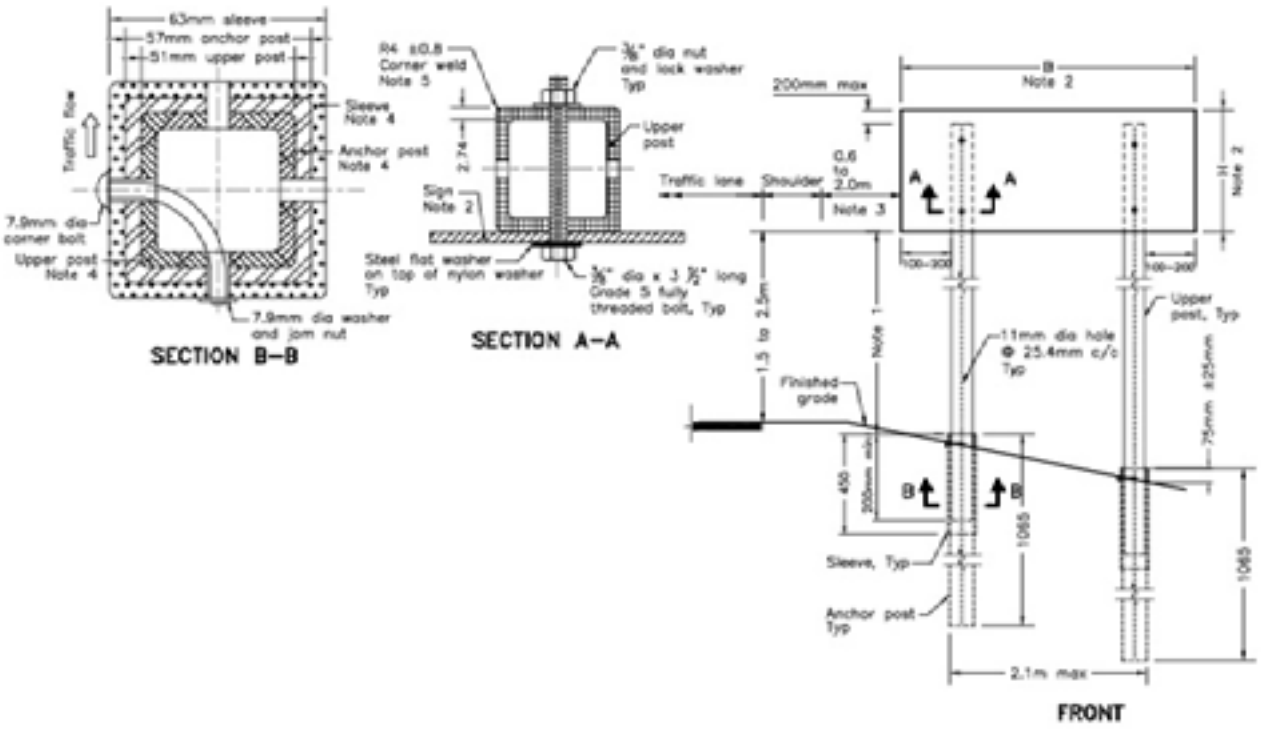
See applicable standard for other details and note references

Figure 69 – Small Sign Support System (Northwest Pipe Co.)
(Breakaway Square Tube Post – Installation Single Post Assembly)



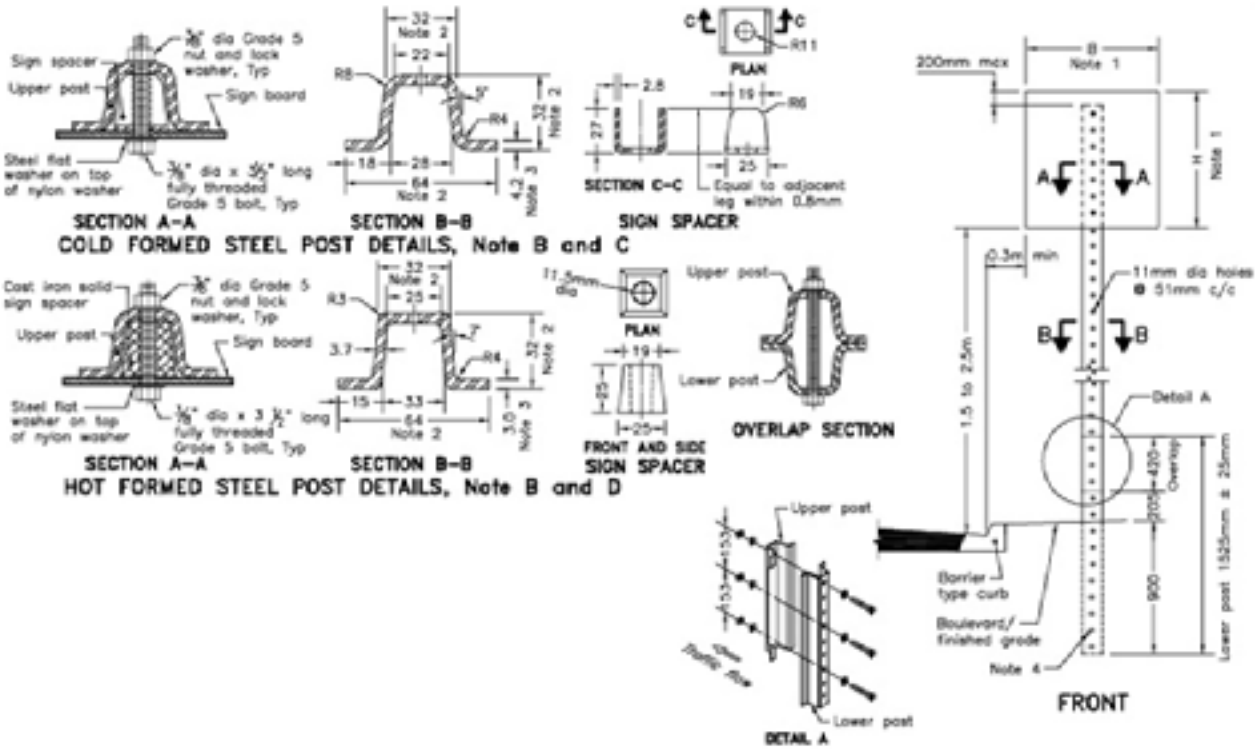
See applicable standard for other details and note references

Figure 70 – Small Sign Support System (Northwest Pipe Co.)
(Breakaway Square Tube Post – Installation Double Post Assembly)



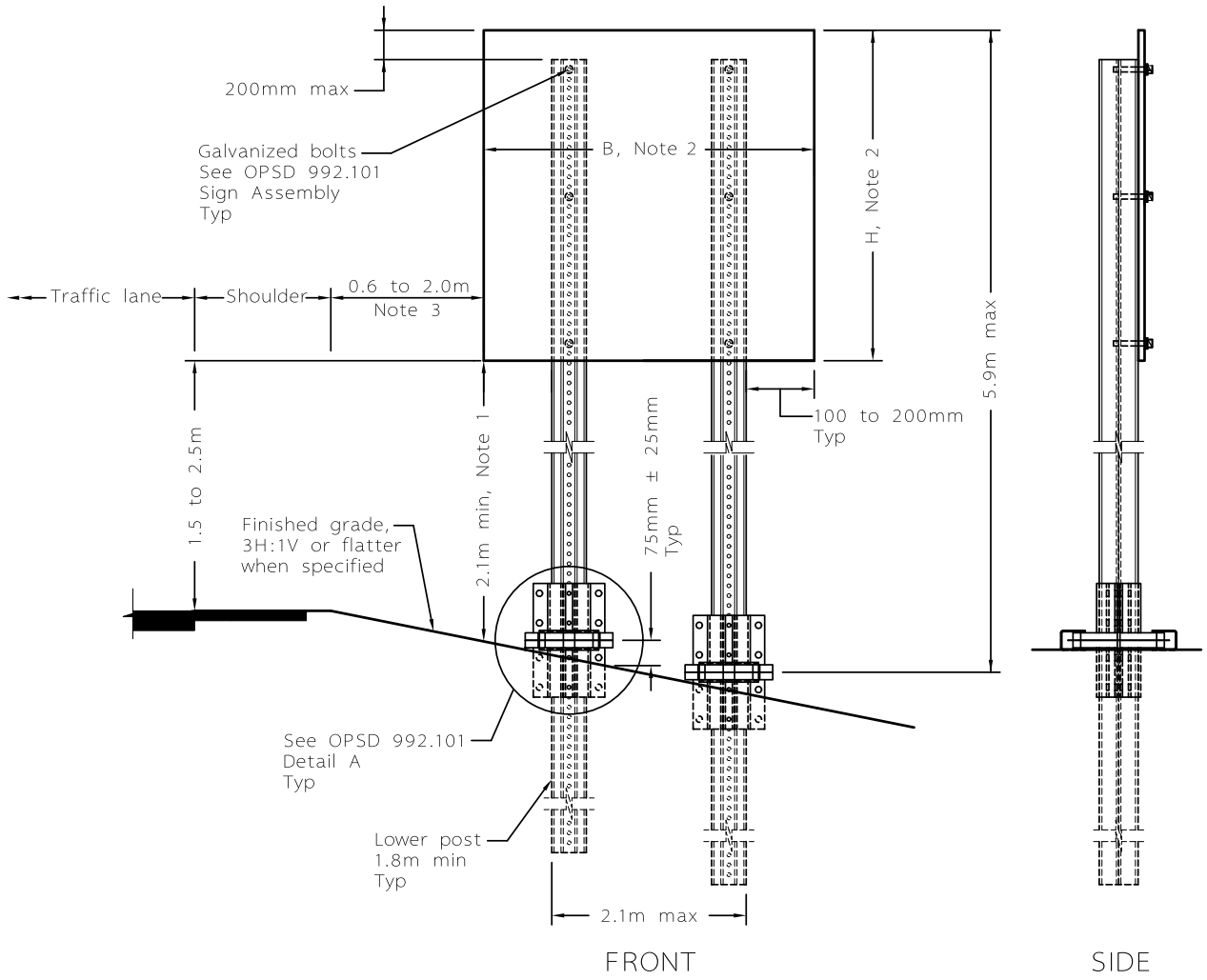
See applicable standard for other details and note references

Figure 71 – Small Sign Support System
(Non-breakaway U-Flange Post – Installation Single Post Assembly)



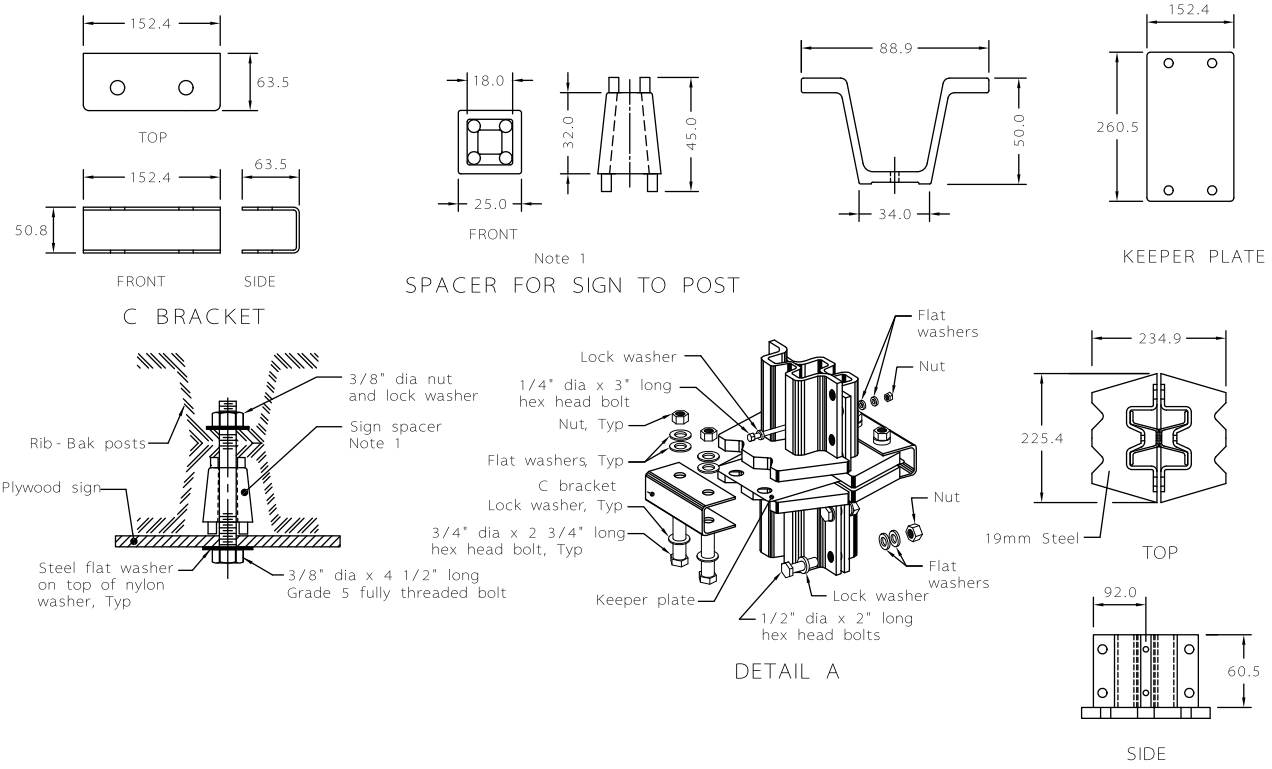
See applicable standard for other details and note references

Figure 72 – Intermediate Sign Support System
(Slip-Safe Supreme Rib-Bak Breakaway System – Installation Double Post Assembly)



See applicable standard for other details and note references

Figure 73 – Intermediate Sign Support System
(Slip-Safe Supreme Rib-Bak Breakaway System - Components)



See applicable standard for other details and note references

the post and sign. The sliding mechanism will dissipate kinetic energy of the collision and to minimize the damage. The base is anchored into the top of concrete barrier with specified hardware.

The size of wooden support is 140 mm x 140 mm (Fig B). The support is sleeved into a fabricated steel base which is anchored into the top of the concrete barrier with specified hardware. This system is not crash worthy and therefore shall be installed at locations where concrete median barrier is flared out where minimum top width of the barrier is 1.0 meter. If a fill is required between the two concrete median barriers for flaring, concrete shall be filled to the depth of the anchor steel rod.

2.6 New Technologies and Products

Technology and best practice are not static. New technologies and techniques continue to be developed for application in traffic engineering. Technology development is welcome, and it is important that new technologies and techniques are tested in real-life situations. It is also important, however, that new technologies and techniques be accepted into standard practice and guidelines through an orderly, controlled process.

For this purpose, MTO has established an arrangement with the Ontario Good Roads Association (OGRA) to support "The Road Authority" (TRA). The TRA is a web-based database application that provides an information resource on roadway products, services, and technologies used in the province. There are two types of evaluations that can be documented on the site, which include:

(1) The pre-qualification of a product or vendor which is then listed on the Designated Source for Materials (DSM) list for the participating jurisdiction; and

(2) Product classification through the Ontario Provincial Standards (OPS) Products Management Committee (PMC), which is responsible for the evaluation of products and technologies against applicable standards and specifications. Further information on the processes for these two scenarios is available from the TRA website.

2.6.1 Designated Sources for Materials

The MTO DSM is the official list of pre-qualified products and vendors for use on provincial highway construction and maintenance contracts. The DSM acceptance criteria for the product listing may include, but are not limited to, testing in the laboratory, evaluation of a product under field conditions, and inspection of the manufacturer's facilities.

The MTO does not warrant that the sources listed on their DSM will produce an acceptable or sufficient product for any contract. The MTO DSM listing only indicates that the listed manufacturer/ distributor is capable of producing a product that meets MTO requirements or that it has demonstrated the ability to meet them in the past.

Vendors are encouraged to register their product on the TRA for the benefit of all road authorities.

2.6.2 Product Classification

The OPS PMC is responsible for the evaluation of products and technologies against applicable standards and specifications. The TRA publishes the decisions made by the committee. Products that are designated as "Accepted for Use" have been reviewed by the committee, have met the established criteria, and have been recommended as acceptable products for use in Ontario. Large municipal governments may consider placing these products on their lists of acceptable products, while smaller municipalities may solely rely on the lists published by the MTO, other municipalities, or the TRA.

If a product is classified as "under evaluation", lab testing and field trials are in progress and it has not been evaluated yet as an accepted product for use (TRA).

In addition, the MTO or other road authorities may conduct field evaluations of new devices or products. Initially, new technologies may be accepted only as supplements to existing prescribed traffic control devices, not as replacements for them. As experience and satisfaction are gained with the new technologies, some of them may be accepted as part of the family of prescribed traffic control devices, while others may continue to be accepted, but only as supplemental devices. Their mandatory use will be at the discretion of the road authority.

Where a road authority is considering the trial of a new device, a change to an existing one, or the application of an existing device outside general policy or practice, an assessment of the need and evaluation of effectiveness should be conducted and documented. For trials on provincial highways, approval is required from the MTO Traffic Engineering Office, and the MTO Traffic Office should be consulted on the proposed process and provided with the results of the assessment for potential policy development.

The following information should be documented in a proposal for a field evaluation of a new technology:

- Detailed description and drawings of the traffic control device/application that is being proposed;
- Description of the problem that the proposal seeks to overcome;
- The location of the proposed trial and why this site is suitable;
- Involved time frames;
- How the problem can be addressed by non-standard treatment better than existing practices;
- Outcomes of any previous trials or investigations;
- Jurisdictional scan of relevant legislation, policies, or guidelines;
- Assessment of any new safety or other problems that may result;
- Rationale that the proposed trial will be easily understood by road users;
- List of all interested parties and the likely level of up-take;
- Information on consultation undertaken and/or proposed; and
- A plan for close monitoring of any field trial, especially in the early stages of implementation.

Prior to field testing, detail how the performance of the device will be assessed, including any computer or other technical analysis used.

The results of the assessment should show:

- How the proposal affects each class of road user with respect to the desired outcome;
- The level of understanding of the proposed device/application (obtained from road users through observation, interviews, or questionnaires);
- The reliability/performance of the device;
- That the information collected was well-defined and appropriate;
- That a sound scientific design was used with appropriate controls so that any conclusions reached are supported by robust statistical analysis.

3. Sign Installation

Signs are one of the primary means of conveying information to drivers. For signs to be effective, they need to fulfill a purpose, command attention, convey a clear and simple message, command the respect of road users, and give adequate time for response. They need to be at the right locations and be visible to the intended road users. They should not create unnecessary hazards to vehicles, cyclists or pedestrians. Hence, proper installation of signs is important.

Some of the material in this section is based on Chapter 10 of the ITE Traffic Signing Handbook (See References), adapted for Ontario conditions.

3.1 Sign Location

Signs generally must be located where drivers expect to see them, typically on the right side of the roadway. Supplementary signs may be located on the left side of the roadway where the median is wide enough to accommodate the signs. They should also be used on multi-lane, one-way roadways, and in situations where experience has shown that drivers fail to see the primary signs. Some signs may have to be placed on traffic islands or over the road.

Adjustments to the height and distance requirements may have to be made to allow placement of signs in constricted urban areas.

To minimize costs and roadside obstructions, it is often desirable to attach signs to existing supports. Examples of available supports include overhead bridge structures, traffic signal mast arms, and street light and utility poles. In many cases, this may require a special attachment system.

3.2 Sign Grouping

Signs usually should be installed individually, on separate supports. OTM Book 1B, Section 12.5, Other Position Criteria, states that "Signs should normally be placed individually on separate posts, except where one sign supplements the other, or where route or direction signs must be grouped. Enough space should be allowed between signs for the driver to read the entire message on each sign." Under some circumstances, grouping signs may be desirable when one sign supplements another or the installation does not confuse motorists. Sign grouping can be advantageous in reducing installation costs and the number of roadside obstacles, provided that it does not confuse motorists. When signs are grouped, it is important that basic shape coding of signs is not obscured, for example, mounting a rectangular sign on the reverse side of a STOP sign, which obscures the octagonal shape of the STOP sign. Also, too many signs on one sign post can result in sign clutter and confusion.

Some examples of sign groupings include:

- Street name signs installed above STOP signs on up to four sides (typically two sides) of the post;
- A divided highway crossing sign below a STOP sign;
- A DO NOT ENTER sign on the back of a STOP, YIELD, or MERGE sign at the end of an off-ramp, with ONE-WAY signs on both sides of the post above the other two sides (**Note:** OTM Book 5 (Regulatory Signs) states that the DO NOT ENTER sign must be mounted at the back of the YIELD or STOP sign at right-turn channelized ramps and one-way freeway exit ramps.);
- A supplemental street name sign below an intersection-related warning sign (e.g., side road, cross road, and signal ahead signs);
- Chevron signs mounted back-to-back at an angle to each other around the outside of curves;

- Parking/No Parking/No Stopping/No Standing signs combined on one post or in combination with other signs; and

- Supplementary or information sign tabs.

This section contains recommended guidelines for sign grouping. The most sensitive issues are related to STOP or YIELD signs and speed limit signs. Municipalities have adopted sign grouping to a greater degree than has MTO. Further, many municipalities mount signs on utility poles rather than on their own sign posts.

Figures 74 to 81 show examples of acceptable municipal sign grouping.

In some situations, sign grouping is recommended, or even a requirement. For example, where a supplementary advisory speed tab is affixed below a sharp curve or turn sign, or in Figure 9 in OTM Book 5 (Regulatory Signs) where an Rb-25 (KEEP RIGHT) sign is shown above a Wa-33L (OBJECT MARKER) sign, on the same post. This is also illustrated in Figure 80.

Figure 74 – Example of Municipal Sign Grouping (two regulatory signs)

Figure 75 – Example of Municipal Sign Grouping (one regulatory sign plus Hospital sign)

Figure 76 – Example of Municipal Sign Grouping (regulatory sign, and bicycle route sign)

Figure 77 – Example of Municipal Sign Grouping (one regulatory sign, plus transit sign and street name sign)

Figure 78 – Example of Municipal Sign Grouping (two regulatory signs mounted on a signal pole)

Figure 79 – Example of Municipal Sign Grouping (two regulatory signs and a warning sign)

Figure 80 – Example of Required Sign Grouping (one regulatory and one warning sign)

A related example is shown in Figure 81.

Other examples of sign grouping are those applying to parking/stopping/standing restrictions, where these restrictive signs are often mounted on the same post. OTM Book 5 recognizes this practice, stipulating that the more restrictive regulation should appear on top.

3.2.1 STOP Signs

Some jurisdictions favour mounting street name signs on the same post as STOP signs, while others do not. The Highway Traffic Act (HTA) is silent on using tabs or other signs on STOP sign posts, except for ALL WAY tab signs. (This does not mean that such use is legal or illegal, only that the HTA is silent.) The unique shape of a STOP sign assists in motorist recognition of the sign. Additional signing placed on the post, in proximity to the STOP sign, may detract from this recognition and could therefore be viewed as a bad idea in legal/court proceedings (should they arise). However, a significant improvement in street name signs was made when some municipalities mounted larger street name signs on signal mast arms, based on human factors study recommendations. Rather than such street name signs distracting drivers from the all-important signal indications, they actually permit drivers to concentrate more on the signal indications, because drivers can process the navigational information so much more readily and easily (see Figure 82). Mounting street name signs on STOP sign posts could have a similar benefit. Some municipalities note that this practice is quite common, and changes to this practice would have significant impacts on municipalities.

Figure 81 – Example of Municipal Sign Grouping (two regulatory signs and one warning sign)

Figure 82 – Large Street Name Sign on Signal Mast Arm

Another issue related to STOP signs arises where signs are placed on the reverse side of the STOP sign, possibly obscuring the octagonal shape of the sign or distracting a driver from recognizing the octagonal STOP sign. The unique octagonal shape of a STOP sign assists in motorist recognition of the sign and should not be compromised by the addition of other signs, either facing in the same direction or mounted on the back of the sign facing in the

Figure 83– STOP Sign with Sign on Reverse

**Figure 84 – Obscuring Sign,
Reverse of STOP Sign shown in Figure 85**

opposite direction. This is an important principle. One can see how it may be violated in the paired Figures 83 and 84, and the paired Figures 85 and 86. Such signing practice should be avoided.

Figure 85 – Stop Sign with Sign on Reverse

**Figure 86 – Obscuring Sign,
Reverse of Stop Sign shown in Figure 87**

3.2.2 Other Regulatory Signs

Regulatory signs are considered to be the most critical signs in terms of their importance to the driver. However, requiring regulatory signs to be mounted on their own posts, with no other signs on the same posts, would be unnecessarily restrictive. As many of the examples above illustrate, it often appears feasible and even desirable to combine regulatory signs on the same post/pole. This does not mean that sign grouping should be permitted without limitation, as this could result in distraction, failure to recognize or observe critical signs, and so much sign clutter that the driver cannot possibly absorb all of the information. It is recommended that sign grouping be permitted, but subject to the guidelines below.

3.2.3 Warning Signs

Warning signs are generally less critical than regulatory signs, yet may be of high importance in avoiding hazards. In temporary work zones, they may actually be critical, in that traffic movements are diverted from their normal paths. It is recommended that sign grouping be permitted with regular warning signs (black and yellow), subject to the guidelines below.

3.2.4 Information and Guide Signs

Generally speaking, large information/guide signs should stand alone on their own posts, without additional signs on those same posts. However, it is recommended that it is acceptable to group guide sign trailblazers or transit stop signs with other signs on the same posts/poles, as shown in Figure 87. The sign shown in Figure 87 is considered to be a single sign, not three signs.

3.2.5 Sign Grouping Guidelines

Sign grouping guidelines are as follows:

- In general, all educational tab signs or tab signs supplementary to (and supporting or enhancing the meaning of) the primary signs are acceptable.

Figure 87 – Single Sign Showing Multiple Destinations/Routes

- Street name signs on STOP or YIELD sign posts: MTO policy is that STOP and YIELD signs should be mounted on their own posts with no supplementary or additional signs (other than ALL WAY tabs). Municipal policy may permit placing street name signs on STOP or YIELD sign posts (provided they do not block or compromise the shape and visibility of the STOP or YIELD signs). No signs should be mounted on the back of STOP or YIELD signs if they may block or compromise the shape and visibility of the STOP or YIELD signs.

- STOP or YIELD sign posts should have no signs mounted on the same post, other than street name signs, or a small sign mounted on the back, which do/does not block or compromise the shape and visibility of the primary sign.

- Speed limit signs (with any associated tabs) should generally be mounted alone on their own posts.

- A maximum of three signs may be mounted on the same post/pole, which may be a combination of regulatory, warning and information signs.

- Large information/guide signs (more than one post) should stand alone on their own posts, without additional signs on those same posts.

- Parking and No Standing or No Stopping signs, generally small in size and at a different orientation, may be mounted in combination with most other signs (excluding STOP and YIELD signs and speed limit signs).

- Temporary conditions (work zone) (black and orange) signs should generally be mounted singly on their own post(s). An exception would be the PEDESTRIAN DIRECTION sign together with a supporting text sign directing pedestrians to the other side of the street.

3.3 Longitudinal Placement

The proper location of signs along the roadway depends on the type of sign message, roadway alignment, desired motorist response, and existence of other signs and their relative importance. Therefore, signs should be placed at the best locations available and within the field of vision of the intended road users. Also, signs should not block a driver's view of the road, other signs, or vehicles on an intersecting roadway.

When signs require different decisions, they should be spaced far enough apart so that drivers can respond and safely make any necessary manoeuvres. On conventional highways, a minimum of 60 m between signs should be maintained. On freeways a minimum of 250 m between all large guide signs should be maintained. Although greater sign spacings usually would be desirable, these recommended minimum values are not always attainable, especially in urban areas.

Spacing requirements are also subject to the limitations prescribed for the specific signs and normally should be addressed in the development of the signing plan or sign work order. Sign crews may need to make field adjustments to provide drivers with an unobstructed view without sacrificing the intent of the sign.

When two or more signs are needed at approximately the same location, priority should be used to determine the order of placement. Because regulatory signs typically should be at the location where the regulation applies, their placement takes precedence over warning and guide signs, for example. Guide signs usually are the least crucial, because their placement is more flexible. Within the regulatory sign group, the sign bearing the most important regulation supersedes the others.

The order of priority for sign types is:

(1) Regulatory Signs
For example, STOP and turn prohibition signs. Speed limit signs are regulatory signs, whose lateral and vertical offset from the edge of pavement and maximum longitudinal spacing are specified by Regulation 615 of the Highway Traffic Act. The application of various other regulatory signs is also specified by Regulation 615 of the Highway Traffic Act.

(2) Warning Signs
Curve, cross road, narrow bridge, one-lane bridge signs.

(3) Guide Signs
Trailblazers, destination signs.

(4) Emergency Service Signs
Hospital, police signs.

(5) Motorist Service Signs
Food, fuel, accommodation, camping, information signs.

(6) Public Transportation Signs
Bus or rail transit signs, park-and-ride signs.

(7) Traffic Generator Signs
Tourist attractions.

(8) General Information Signs
County line, city limits, rivers, lakes.

Because warning signs principally are for unfamiliar drivers who may not be acquainted

with the road, their placement is very important. Warning signs should provide adequate time for the driver to perceive, identify, decide, and perform any necessary manoeuvre. Warning signs are generally allocated into three groups:

- Condition A: Driver judgement required.
- Condition B: Potential or actual stop required.
- Condition C: Speed reduction required.

Advance warning sign placement may be determined from OTM Book 6 (Warning Signs).

The longitudinal placement of guide signs is similar to that of warning signs. The best location is found by making the necessary field adjustments to provide an unobstructed view of the sign. In some cases, it may be desirable to test the effectiveness of a sign location under both day and night conditions.

3.4 Lateral Clearance

Signs should have the maximum practical lateral clearance possible from the edge of the roadway to reduce the possibility of vehicles hitting the signs. Advantage should be taken of existing guide rail, barrier, or overpass structures to reduce the exposure of sign supports to traffic. If a proposed sign relocation does not appear practical or feasible, the sign crew should discuss the situation with the individual who prepared the work order.

Figure 88, taken from OTM Book 1B (Sign Design Principles), shows vertical and horizontal offsets of signs from the edge of pavement for typical installations. The vertical and horizontal offsets of speed limit signs and STOP signs are specified in Regulation 615 of the Highway Traffic Act.

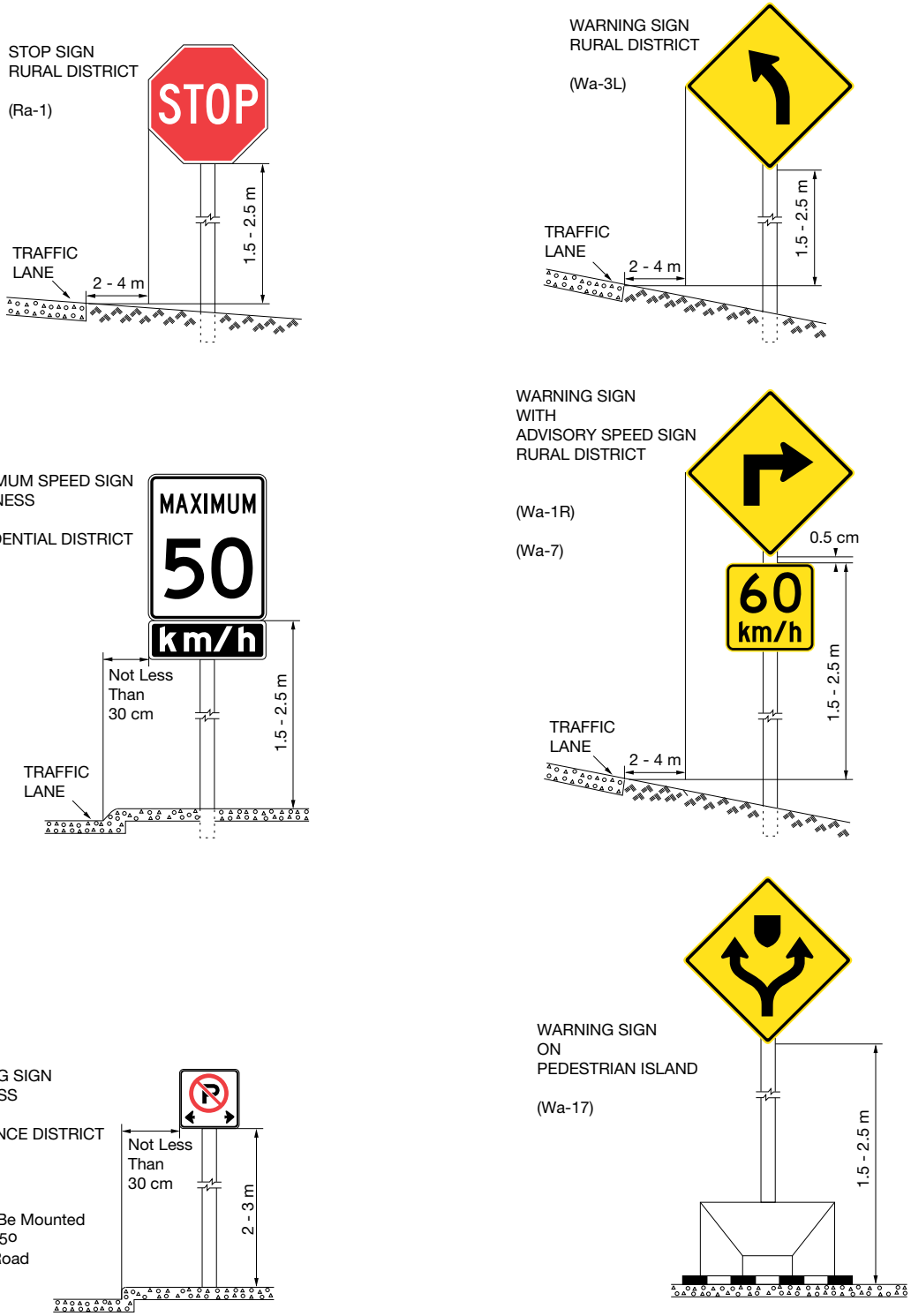
Figure 89, taken from OTM Book 1B, shows vertical and horizontal offset of markers from the edge of pavement, for typical installations.

Signs should either be located beyond the clear zone or, if in the clear zone, must either be protected or breakaway.

An effort should be made to place signs with the following minimal lateral clearances from the edge of the travel lane to the near edge of the sign:

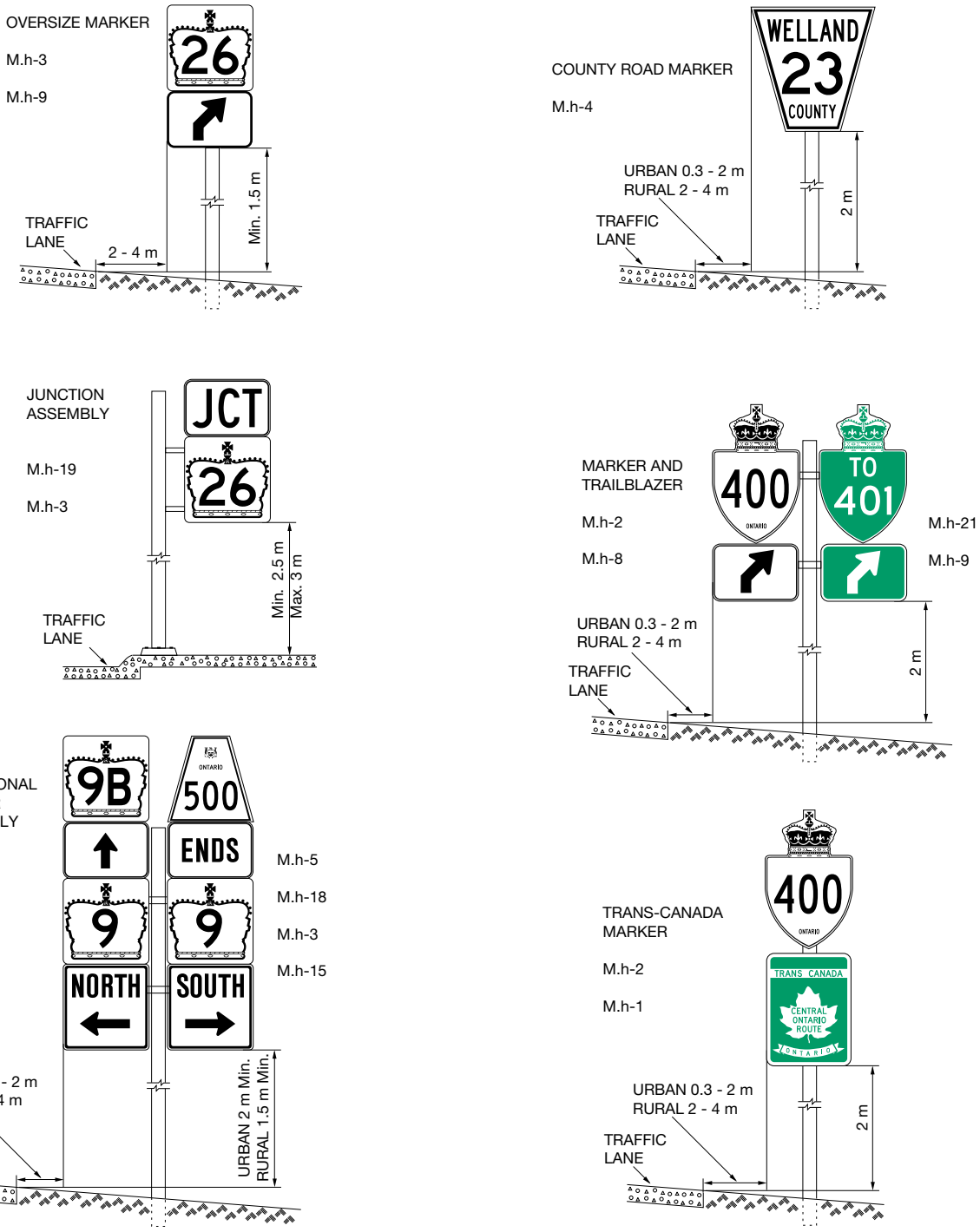
- Behind a barrier system, the nearest sign support should be located sufficiently beyond the design deflection distance for the barrier, to ensure that the barrier will function as intended when struck by an errant vehicle. Refer to the RDM for barrier system specifics.
- 2000 mm to 4000 mm for rural signs and 300 mm to 2000 mm for urban signs, as shown in Figures 88 and 89.
- Horizontal and vertical clearances for object/hazard markers may be taken from Figures 88 and 89.
- Horizontal clearances for signs on median barriers and noise barrier walls should be in accordance with Figures 56 to 57.
- All signs should be at least 600 mm outside the shoulder. Otherwise trucks and other large vehicles using the shoulder may hit them.
- In urban areas, signs should be located at least 600 mm behind the face of the curb when curb sections are used. This will help ensure that trucks and other large vehicles pulling up next to the curb will not hit the sign. A clearance of 300 mm is permissible if sidewalk width is limited. Where practicable, signs should be installed between the curb and the sidewalk or beyond a curb-attached sidewalk. In all cases, sign supports must not interfere with an adequate width sidewalk that is traversable by disabled persons.
- Crash tests show that breakaway supports installed on level terrain will perform as intended when struck head-on by a vehicle. However if these supports are installed on a slope or if there is a possibility that a vehicle may be spinning or sliding sideways on impact, the breakaway feature may not function as intended. In general, signs should be located to minimize their vulnerability to impact, and locations on steep roadside slopes should be avoided.

Figure 88 – Height and Lateral Location of Signs, Typical Installation



See applicable standard for specific installation details and note references.

Figure 89 – Height and Lateral Location of Markers, Typical Installation



NOTE: Where shoulder width is less than 3 m signs should be erected 60 cm from edge of shoulder

See applicable standard for specific installation details and note references.

- Avoid locations in the bottom of drainage ditches or other locations where the soil or ice may accumulate around the sign support base, possibly interfering with proper yielding upon impact.

3.5 Orientation of Signs

Generally, as noted in Section 2.2, signs should be installed at approximately right angles to the direction of the traffic they are intended to serve, but angled about 3 degrees away from the roadway instead of being exactly perpendicular to the edge of the roadway, in order to avoid specular glare that could reduce sign readability.

NO PARKING signs, however, are installed differently. These signs are set at an angle of 30 to 45 degrees to the direction of approaching traffic to reduce their conspicuity to through motorists. The flat angle also makes it easier for those parking to understand the meaning of any arrows on the NO PARKING signs.

Sign crews normally should install signs vertically; however, on steep grades, signs can be tilted forward or back from the vertical to improve the viewing angle. Signs normally should be installed with their horizontal axis level. However, road name signs can be installed on the outside of overpasses at the same grade as the overpass to avoid an awkward appearance.

3.6 Sign Height

To maximize safety and sign visibility, the following mounting heights for primary signs are recommended:

- The bottom of signs generally shall be at least 2100 mm above grade, and 1800 mm above the edge of pavement, to allow pedestrians and errant vehicles to pass beneath them.
- If the signs are outside the clear zone or otherwise protected by a crashworthy barrier and pedestrians do not walk in their vicinity, the bottom of the signs may be as low as 1500 mm above grade.

If a secondary sign is placed below the primary sign on the same support along a conventional street or road, the vertical clearance of 2100 mm should be maintained from ground elevation to the bottom of the lower sign. Maintaining a clearance of at least 2100 mm below secondary signs is recommended at locations within the clear zone or where pedestrians are apt to walk. Supplementary tabs on sign assemblies are considered when determining the minimum vertical clearance height requirements.

If a secondary sign is installed below the primary sign on a freeway or major multi-lane highway, the bottom of the sign including any tabs should be at least 1800 mm above the edge of pavement, and the bottom of the secondary sign should be at least 2100 mm above the ground elevation. Highway route marker assemblies are considered as a single sign when determining the minimum height requirements.

3.7 Special Sign Location Considerations

Adjacent property owners often maintain the highway right-of-way with the same care as they do for their land. Therefore, installing signs within a manicured lawn frequently upsets property owners. If possible, the sign should be moved back or ahead without losing its intended function, as every effort should be made to be sensitive to property owners' concerns. Because the exact placement of some signs is critical, the sign crew may need to contact traffic practitioners to determine if the sign can be relocated. Often, however, a sign crew can move a sign 10 m in either direction without affecting its usefulness. If possible, signs should be placed at the boundary lines between adjacent property owners.

Underground gas, water, sewer, electric and telephone lines are common. Utility companies often mark their underground utilities, but the plaques or markers eventually may deteriorate, be removed, or disappear. When markings are not present, other clues, such as service valves or subsided trenches, could suggest the presence of an underground utility. If possible, avoid these areas for sign installations. If a sign must be erected at such locations, care must be exercised before digging a hole or driving a post into the ground. Contact the utility company for the exact location of the utility. The contact number for www.on1call.com is 1-800-400-2255. Not all utilities are subscribers to on1call, so it may be necessary to contact other utilities.

Some municipalities try to put signs in line with utility poles (same lateral offset from edge of curb) for aesthetic reasons.

3.8 Improving the Safety of Sign Supports

To provide a safe roadside, the number of signs should be minimized. Therefore, the following options should be considered, in order of preference:

(1) eliminate the need for the sign;

(2) locate the sign where it is unlikely to get hit, such as behind an existing guide rail or barrier or outside the clear zone;

(3) use breakaway supports that will readily yield or break away when hit; and

(4) place a guide rail or barrier in front of the sign.

Generally, the second and third options are the most common, especially the third. To reduce the inventory of various types of sign supports and minimize roadside hazards, road authorities may wish to consider breakaway supports for all locations, even when the supports are protected by guide rail or barrier or signs are located outside of the clear zone.

3.9 Installation of Large Ground-mounted Signs

Installation of large ground-mounted signs is a more complex operation than installation of small signs, with respect to foundations, alignment, fabrication, and equipment required for heavier signs. The following are practical steps involved in the installation of these large signs.

- Visit the site to determine the equipment that will be required for the installation (typically an auger truck, an excavator or a vactor truck, crash truck, and traffic control crew).

- Note and record physical objects/assets in the area, such as utilities or other obstructions including overhead obstructions, and neighbouring properties' manicured lawns, which are generally good to protect and accommodate, if possible. The reality on the ground may not always match what is shown on a drawing.

- Sign locations should be staked and painted for the benefit of other parties, including locators. Coordinates may also be beneficial for locators, or other parties.

- Ditch depths and post bases should be measured and soil conditions noted.

- A Traffic Protection Plan (see Section 4) should be prepared so that the crew will know what is required for traffic control for the installation.

- The time of the year and issues with respect to water in ditches, snow banks, trees and brush or parking should be noted.

- During the installation of an extruded aluminum sign, typically the holes are dug first, disturbing no more soil than necessary. The sign is built on the ground face down to easily install connector plates and bolt timber on these plates and then boom the posts into the holes using a boom truck or an excavator. Backfill with compactable soil, compacting and insuring that the sign is level. To properly align the sign posts to the desired angle to the road, a string line is used

to locate each post. Before cutting posts to exact measurements, use a plumb line level to measure exact depths after tamping the bottom of holes.

- During the installation of a plywood sign, typically the holes are dug first making sure not to disturb more soil than necessary. The sign is built on the ground face up, equally measuring the posts on the plywood; they should be approximately 300 mm from edge of the sign to the centre of the post. The posts are boomed into the holes using a boom truck or an excavator. Back fill in compactable soil, compacting and insuring that the sign is level. To properly align the sign posts to the desired angle to the road, a string line is used to locate each post. Before cutting posts to exact measurements use a plumb line level to measure exact depths after tamping the bottom of holes.

3.10 Installation of Intermediate Ground-mounted Signs

Installation for intermediate signs uses a proprietary breakaway system consisting of two steel posts where concrete footings are not required and can accomidate multi-panel plywood sign assemblies. The following are factors to consider for installation;

- Sign panel(s) shall be plywood with a maximum width of 2.4m and height ranging from 1.5 m to 3.0 m maximum.
- Total sign(s) area including all tabs should be from 3.6m^2 to 7.2m^2.
- Intended for installation on traversable roadsides with sideslopes 3H:1V or flatter.
- Intended for installation in competent soils of uniform composition. Modification to the design or use of another sign support system is required for:
  - Rock cut
  - Rock fills
  - Soil is exceptionally soft or loose.
- Installations should not be installed within the 22 m x 6 m obstacle clear area behind guide rail terminal systems. Refer to RDM section 4.5.
- Not for use with Aluminum extruded signs, see OPSS 709.

3.11 Installation of Small Ground-mounted Signs

Posts for small signs generally are installed by driving the post into the soil, drilling and then backfilling after the post has been placed.

In urban areas, it is generally preferable, where possible, to install signs on already existing poles or posts, such as utility poles. In some locations, sign posts may need to be installed in sidewalks. Additional work can be avoided if careful thought is given to the sign post installation before placing the concrete. For example, steel square anchors can be positioned for square posts prior to placing the concrete. If concrete exists, a hole through the concrete can be drilled or cored to install the posts. After the holes are formed, posts can be driven into the ground.

Some factors to consider when selecting breakaway sign posts include:

- Wooden posts should be pressure treated to help prevent them from rotting, see OPSS 703.
- Wooden posts typically require that a pair of holes be drilled through the sides of the posts, perpendicular to the centreline of the highway, to satisfy breakaway criteria.
- Wooden posts are typically augered off the back end of a small tractor. Augers should be heavy enough to auger through frozen ground.

- Steel posts generally have pre-punched holes to facilitate mounting signs.

- Typically, maintenance staff will use a post pounder (steel tube with a capped end) to drive steel posts.

- Two-piece steel posts frequently allow sign crews to replace the top portion of a sign post, when damaged, without needing to replace the anchor.

- Posts designed to break away at or very near ground level (e.g., steel square posts, socket system anchors) save reinstallation time by allowing more frequent reuse of the anchors. Further, these "low-profile" anchors generally must be used when posts are installed on mountable medians or near the edge of small, raised islands, where vehicle undercarriages otherwise would destroy the anchors and snag the vehicles.

- Square or rectangular posts facilitate signs on more than one side.

- A variety of types of hardware is available for joining short sections of steel square posts to be used like pieces of an "erector set." This hardware is handy for multiple route marker assemblies and attaching sign tabs beneath other signs. Manufacturers' recommendations should be followed.

- Splices are not recommended for small ground-mounted signs. However, if they must be used, above-ground splices in channel bar posts used to lengthen the posts need to be strong enough to avoid separation upon impact. It is recommended that the splice lap be approximately 450 mm long, with the upper post section in back of the lower post section. The splice lap should be either completely above a 400 mm height or completely below a 500 mm height, but not below ground level. A minimum of four 8 mm galvanized A449 bolts (SAE J429 Grade 5) or galvanized A325 bolts should be used, two at each end of the splice, through the holes nearest the ends of the splice, with spacers between the channel bar sections. For splicing of non-breakaway U-flange posts, see Figure 62 and Figure 66.

- When installing signs with pre-punched holes on more than one sign post, if the sign posts also have pre-punched holes, the posts need to be accurately spaced, and the holes in the sign posts should be at the same elevation on all posts. A level is invaluable in this situation.

- If more than one post is required to support a sign, be sure that the number of posts allowable within a 2.1 m line is not exceeded.

- Signs may sometimes be attached to existing traffic signal poles, street light poles, utility poles, etc., if the supports are at the proper location and the proper authorization is obtained.

- Crossbracing will help stabilize multipost installations. Use of a single sign board to accommodate these types of installations is recommended. Other designs (crossbracing) may be used provided the jurisdiction has a detailed drawing which has been reviewed and approved by an engineer.

- It is preferable to combine multiple small signs in a single sign blank and to mount them as a small sign assembly according to the procedures outlined in this Book.

- The mounting procedures shown for small signs are not to be used for mounting large plywood signs.

3.12 Sign Crew Equipment

The number of people on a sign crew and the types of equipment needed to install signs depends on the mounting location, types of sign posts, sizes of signs, number of signs, and the like. Generally, a sign crew should consist of at least two or three workers.

The work vehicle should have a number of compartments for tools and equipment, a bucket

and outriggers. A utility cargo box is ideal for storing small signs, tools and sign hardware. Ideally, signs should be stored vertically in cabinets. An area is also required to accommodate sign posts and larger signs that will not fit into cabinets. The bucket and outriggers are helpful if working on large signs or on signs behind a guide rail or barrier. The following equipment is recommended for the sign trucks:

- drift pins for aligning sign and post holes;
- hand or power wrenches for tightening and loosening bolts;
- 600 mm level;
- 6 m tape measure and a measuring wheel and/or electronic distance measuring instrument;
- sledge hammer and manual driving caps for driving or realigning posts or anchors;
- hydraulic, electric pneumatic, or gasoline post driver and driving caps;
- hydraulic tamp;
- post puller;
- electric or a pneumatic drill, or cordless drill and rechargeable battery pack, and the required power source, electric cords, air lines, etc;
- banding tool for fastening signs to poles or wooden posts;
- pop rivet gun;
- power auger, dirt shovel, and rake;
- work area protection equipment and handbook (cones, TC-2, Rb-91, see OTM 7);
- posts and hardware.

4. Traffic Control During Sign Installation Operations

OTM Book 7 (Temporary Conditions) is the standard of practice for traffic control in Ontario work zones, providing basic uniform requirements for traffic control in work zones on or adjacent to public highways. Book 7 and other OTM Books are available from ServiceOntario Publications: www.publications.serviceontario.ca.

Besides its applicability to road construction, maintenance, and utility operations, OTM Book 7 is applicable for work activities related to sign installation, sign inspection, and sign maintenance.

Before going out in the field to install, inspect, or maintain ground-mounted signs, it is essential that the user become familiar with OTM Book 7 to help ensure that such activities are conducted in a safe manner. Field work normally needs to be done while traffic is on the roadway. Reference should also be made to the latest edition of the Ontario Ministry of Labour, Training and Skills Development's Occupational Health and Safety Act and Regulations for Construction Projects, for requirements regarding safety responsibilities, protective garments, and a Traffic Protection Plan.

OTM Book 7 contains a substantial number of typical layouts which illustrate the traffic control required for a variety of work situations on highways.

4.1 Types of Operations

Generally, the installation, inspection and maintenance of traffic control signs will be 'intermittent', 'short duration' or 'very short duration' work, as defined in OTM Book 7.

4.2 Traffic Control and Devices

Traffic control devices required for work on the road are described in OTM Book 7, and are shown on the various typical layouts.

5. Development of a Traffic Sign Inventory

The development, maintenance and use of a traffic sign inventory is addressed in Ontario Traffic Manual Book 4 - Ground-mounted Sign and Support Inspection and Maintenance.

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Appendix A • Definitions and Notation

A

A
- 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.

AASHTO
American Association of State Highway and Transportation Officials

ASTM
American Society for Testing and Materials

B

B
- 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.

Barrier
A device which provides a physical limitation through which a vehicle would not normally pass, It is intended to contain or redirect an errant design vehicle of a particular size range, at a given speed and angle of impact.

Breakaway Sign Support
A static sign support system designed to fail in a predetermined location and mode when impacted upon by a vehicle.

C

C
- 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.

Clear Zone
The unobstructed, traversable area provided beyond the edge of the through travelled way available for use by errant vehicles. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes. The clear zone also includes recoverable slopes, and non-recoverable slopes with a clear run-out area. The selected clear zone width is dependent upon traffic volumes and design speed, and roadside geometry.

CS
Horizontal centroidal axis of sign board.

CHBDC
Canadian Bridge Highway Design Code

D

D
- Height of sign board (large signs), or
- Depth of shear plate groove, or
- Spacing of bolt hole cutouts.

Dressed
Smooth (planed or sanded) wood; dressed wood has final standard dimensions somewhat smaller than nominal dimensions.

E

E
- 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 the centre of the sign board, or
- Horizontal distance from the centreline of the sign support leg to the centreline of the end vertical element of the sign component.

EL.CS
Elevation of CS.

EL.EP
Elevation of EP.

EL.HP
Elevation of the highest point on the highway under the sign, including shoulders, curbs, and medians.

EL.Pi
Elevation of top of footing P_i.

Engineer
A Professional Engineer licensed in the Province of Ontario.

EP
Edge of pavement of highway.

F

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 second leftmost sign board.

G

G
- Perpendicular distance from edge of pavement to first column, or
- Horizontal distance from left support to third leftmost sign board, or
- Horizontal distance from rear face of traffic barrier to the nearest face of support structure footing.

Guiderail
See Barrier.

H

H
- Lateral sign overhang beyond end T (large signs), or
- Horizontal distance from left support to fourth leftmost sign board.

H_i
Vertical distance from P_i to CS.

Highway
A general term denoting a public way for purposes of vehicular and pedestrian travel, including the area within the right-of-way. This includes King's Highways, tollways, parkways, regional and county roads, rural roads, and municipal roads and streets.

Highway Traffic Act (HTA)
The Ontario Highway Traffic Act.

H_{max}
Maximum H_i.

I

Installation
The process or act of placing, erecting, and/or connecting a traffic control device or system into its functional position and state of operational readiness.

J

J
- Edge distance of second 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.

K

K
- 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.

Kilometre (Km)
A measure of distance equal to 1000 m (0.622 miles).

King's Highway
A highway, including secondary and tertiary roads, designated under the Public Transportation and Highway Improvement Act.

km
Abbreviation for kilometre.

L

L
- Length of top crossarm, or
- Length of column, or length of upper column section, or
- Length of lower post.

M

m
Abbreviation for metre.

Maintenance
The upkeep of highways, traffic control devices, other transportation facilities, property and/or equipment.

MASH
Manual for Assessing Safety Hardware

Maximum Eccentricity
Height from the top of lowest footing to the centre of the sign board.

Mb
A parameter used to compute column length for breakaway sign supports.

Ministry
Unless otherwise specified, the Ministry of Transportation Ontario (MTO). Where so specified, the Ministry means the Ontario Ministry of Labour, Training and Skills Development (MLTSD).

MLTSD
The Ontario Ministry of Labour, Training and Skills Development.

mm
Abbreviation for millimetre (equals 0.001 m).

M_{nb}
A parameter used to compute column length for non-breakaway sign supports.

MTO
The Ministry of Transportation Ontario.

MUTCD
The Manual of Uniform Traffic Control Devices for Ontario, 1995, superseded over time by the Ontario Traffic Manual.

MUTCDC
The Manual of Uniform Traffic Control Devices for Canada.

N

NCHRP
National Cooperative Highway Research Program (U.S.)

NLGA
National Lumber Grades Authority

O

Occupational Health and Safety Act (OHSA)
The Ontario Occupational Health and Safety Act and Regulations for Construction Projects, of the Ontario Ministry of Labour, Training and Skills Development.

OHBDC
Ontario Highway Bridge Design Code

OHSA
Occupational Health and Safety Act

Order Forms
Preprinted forms containing all information needed to purchase components to assemble a sign support.

P

P_i
Top of footing.

Provincial Highway
Any public highway under the jurisdiction of the Ministry of Transportation of Ontario. See King's Highway.

S

Sign
A Traffic Control Device mounted on a fixed or portable support which conveys a specific message by means of symbols or words, and is officially installed for the purpose of regulating, warning, or guiding traffic.

Sign Assembly
Any Traffic Sign mounted and installed alone or in conjunction with any combination of associated Tab Signs.

Sign Blank Number
The number given to a given size of standard size blank (substrate), for purposes of identification, inventory, and fabrication.

Sign Pattern
The full-size hard copy drawings or electronic images of individual signs, showing sufficient detail and dimensional accuracy for sign fabrication.

Sign Sheeting
The Retroreflective Material used on the surface of a Sign to provide good daytime and nighttime visibility.

Sign Support
A structure to support static signs (sign boards) or variable message sign systems, and hold it in its intended position.

SLS
Service Limit States, as defined in the Canadian Highway Bridge Design Code.

Static Sign (or Sign Board)
A flat surface displaying visual information.

Structure I.D. Number
Number assigned to a sign support structure, to provide a unique identifier for each sign structure.

Standard Structural Drawing
A structural drawing as shown in this Manual. It is available as an electronic CAD file requiring the user to add site specific information.

Steel Column Sign Support
A static sign support structure consisting of two or more vertical steel columns, either Breakaway or non-breakaway.

T

Timber Post Sign Support
A static sign support structure consisting of one or more Breakaway or non-breakaway vertical timber posts.

Traffic Control Device
Any sign, signal, marking, or device placed upon, over or adjacent to a roadway by a public authority or official, or private road owner, having jurisdiction, for the purpose of regulating, warning, guiding or informing road users.

V

Variable Message Sign (VMS)
A light-emitting electronic display system to provide up-to-date information that changes periodically, to motorists of traffic conditions ahead.

VMS
Variable Message Sign.

X

X
Horizontal distance from left footing to control line.

Y

Y
Horizontal distance from right footing to control line.

Appendix B • References

AASHTO, Manual for Assessing Safety Hardware - 2016

AASHTO, Roadside Guide Manual, Software Version 5.0

ASTM, American Society of Testing Materials

CSA Standard Canadian Highway Bridge Design Code; Canadian Standards Association

CSA O80 CSA Standard for Wood Preservation

Geometric Design Manual; Ministry of Transportation Ontario

Roadside Design Manual 2017 (RDM) 2011-002, Permanent Ground-mounted Small Signs; Ministry of Transportation Ontario, July 8, 2011

Highway Traffic Act (HTA); Revised Statutes of Ontario, 1990, and the Regulations thereunder (as amended)

Maintenance Manual; Ministry of Transportation Ontario, 2003

Manual of Uniform Traffic Control Devices; Ministry of Transportation Ontario, 1985

Manual of Uniform Traffic Control Devices for Canada; Sixth Edition, Transportation Association of Canada, 20210

Municipal Act; Revised Statutes of Ontario, 1990

National Cooperative Highway Research Program (NCHRP); Standard 350; 1993

Occupational Health and Safety Act and Regulations for Construction Projects; Revised Statutes of Ontario, 1990, Revised Regulations of Ontario 213/91 as amended by 631/94 and 145/00

Ontario Highway Bridge Design Code (OHBDC); Ministry of Transportation Ontario

Ontario Municipal Act

Ontario Provincial Standard Specification (OPSS); Ministry of Transportation Ontario and Municipal Engineering Association

OPSS 703, Construction Specification for Permanent Small Signs and Support System

OPSS 709, Construction Specification for Permanent Intermediate Signs and Suport System

OPSS 915, Construction Specification for Sign Support Structures

Ontario Traffic Manual; Books 1, 1a, 1b, 1c, 2, 3, 4, 5, 6, 7, 10, 11, 12, 15, 19 (various years)

Public Transportation and Highway Improvement Act; Revised Statutes of Ontario, 1990

Roadside Design Manual; Ministry of Transportation Ontario

Sign Support Manual; Ministry of Transportation Ontario

Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; American Association of State Highway and Transportation Officials (AASHTO), 2001

Traffic Signing Handbook; Institute of Transportation Engineers, 1997

Ontario Good Roads Association (OGRA)

The Road Authority (TRA); a web-based database application that provides an information resource on roadway products, services, and technologies used in the province

Appendix C • Hourly Mean Wind Pressure for Ontario

Appendix C provides a reference to wind pressures for many locations in Ontario.
Source: CSA Standard Canadian Highway Bridge Design Code.Os experup tatisi nimodiatur alit pa nus ium fuga. Nam, im fuga. Itaepernatet aut versper itisimeni conet ipid erum quibus ab ium que

Table C – Hourly Mean Wind Pressure (Pascals) for Ontario

Ontario Location	For Return Periods of:			Ontario Location	For Return Periods of:		
	10 yr	25 yr	50 yr		10 yr	25 yr	50 yr
Ailsa Craig	395	480	550	Cannington	245	310	360
Ajax	430	510	570	Carleton Place	295	360	410
Alexandria	305	360	400	Cavan	310	380	435
Alliston	220	280	330	Centralia	375	455	525
Almonte	295	360	410	Chapleau	190	235	270
Ansonville	305	360	400	Chatham	320	380	430
Armstrong	205	240	260	Chelmsford	285	375	450
Arnprior	275	330	370	Chesley	330	410	475
Atikokan	200	235	260	Clinton	375	455	525
Aurora	305	380	440	Coboconk	260	315	350
Bancroft	230	280	320	Cobourg	465	535	595
Barrie	210	280	330	Cochrane	260	310	350
Barriefield	350	415	460	Colborne	440	510	565
Beaverton	240	305	360	Collingwood	255	325	385
Belleville	320	380	430	Cornwall	300	360	410
Belmont	350	435	500	Corunna	350	415	465
Bowmanville	460	535	590	Deep River	260	315	350
Bracebridge	260	315	350	Deseronto	320	380	430
Bradford	240	305	360	Dorchester	330	410	480
Brampton	315	380	430	Dorion	300	355	390
Brantford	310	365	400	Dresden	320	380	430
Brighton	415	485	540	Dryden	200	235	260
Brockville	315	380	430	Dunbarton	430	510	575
Brooklin	385	460	520	Dunnville	335	385	425
Burk's Falls	260	315	350	Durham	310	380	435
Burlington	360	415	460	Dutton	340	410	470
Caledonia	315	365	400	Earlton	315	390	450
Cambridge	265	310	350	Edison	230	275	310
Campbellford	290	360	415	Elmvale	235	305	365
Camp Borden	215	280	335	Embro	330	410	475

Table C – Hourly Mean Wind Pressure (Pascals) for Ontario (cont'd)

Ontario Location	For Return Periods of:		
	10 yr	25 yr	50 yr
Englehart	290	360	415
Espanola	280	360	420
Exeter	375	455	525
Fenelon Falls	250	310	355
Fergus	260	310	355
Fonthill	335	385	425
Forest	390	460	520
Fort Erie	365	415	460
Fort Frances	230	275	310
Gananoque	350	415	465
Georgetown	275	330	375
Geraldton	210	245	275
Glencoe	310	380	435
Goderich	395	480	550
Gore Bay	300	350	390
Graham	205	240	260
Gravenhurst	260	315	350
Grimsby	365	415	460
Guelph	250	295	325
Guthrie	215	280	335
Hagersville	335	385	425
Haileybury	315	380	435
Haliburton	260	315	350
Hamilton	365	415	460
Hanover	335	410	475
Hastings	290	360	415
Hawkesbury	310	365	405
Hearst	200	245	280
Honey Harbour	255	325	385
Hornepayne	190	235	270
Huntsville	260	315	350
Ingersoll	330	410	475
Iroquois Falls	300	360	405
Jarvis	330	380	425
Jellicoe	200	235	260
Kapuskasing	230	275	310
Kemptville	295	360	410
Kenora	230	275	310
Killaloe	260	315	350
Kincardine	400	480	545
Kingston	350	415	465
Kinmount	260	315	350
Kirkland Lake	295	360	410
Kitchener	275	330	370
Lakefield	265	325	380
Landsdowne House	240	285	315
Leamington	355	415	465
Lindsay	265	325	380
Lion's Head	330	410	475
Listowel	340	410	470
London	365	455	535
Lucan	395	480	555
Maitland	315	380	430
Markdale	285	360	415
Martin	205	240	260
Matheson	300	360	410
Mattawa	245	285	315
Midland	255	325	385
Milton	320	380	430
Milverton	310	380	435
Minden	260	315	350
Mississauga	370	435	495
Mitchell	350	435	505
Moosonee	260	315	350
Morrisburg	300	360	410
Mount Forest	290	360	410
Muskoka Airport	260	315	350
Nakina	210	245	275
Napanee	320	380	430
Newcastle	460	535	595
New Liskeard	315	380	435
Newmarket	260	325	385
Niagara Falls	330	380	425
North Bay	260	300	340
Norwood	290	360	415
Oakville	375	435	490
Orangeville	250	310	355
Orillia	260	315	350
Oshawa	430	510	575
Ottawa	295	360	410
Owen Sound	330	410	475

Table C – Hourly Mean Wind Pressure (Pascals) for Ontario (cont'd)

Ontario Location	For Return Periods of:		
	10 yr	25 yr	50 yr
Pagwa River	190	240	275
Paris	310	365	405
Parkhill	400	480	545
Parry Sound	245	325	395
Pembroke	260	315	350
Penetanguishene	255	325	385
Perth	295	360	410
Petawawa	260	315	350
Peterborough	290	360	415
Petrolia	350	415	465
Picton	375	435	490
Plattsville	295	360	410
Point Alexander	260	315	350
Porcupine	275	330	375
Port Burwell	345	415	470
Port Colborne	365	415	455
Port Credit	370	435	495
Port Dover	360	415	465
Port Elgin	395	480	550
Port Hope	465	535	595
Port Perry	310	380	435
Port Stanley	340	410	470
Prescott	315	380	430
Princeton	300	360	410
Raith	205	240	260
Red Lake	220	255	285
Renfrew	260	310	350
Ridgeway	365	415	455
Rockland	300	360	410
St. Catharines	365	415	460
St. Marys	350	435	505
St. Thomas	330	410	475
Sarnia	350	415	465
Sault Ste. Marie	320	365	400
Schreiber	300	355	390
Seaforth	375	455	525
Simcoe	330	380	425
Sioux Lookout	205	240	260
Smiths Falls	295	360	410
Smithville	335	385	425

Ontario Location	For Return Periods of:		
	10 yr	25 yr	50 yr
Smooth Rock Falls	235	285	320
	380	460	525
Southampton	275	330	375
South Porcupine	230	280	325
South River	280	345	400
Stirling			
Stratford	335	410	475
Strathroy	355	435	500
Streetsville	350	415	465
Sturgeon Falls	255	310	355
Sudbury	290	390	465
Sundridge	230	280	325
Tavistock	340	410	475
Temagami	275	330	375
Thamesford	330	410	475
Thedford	405	485	545
Thunder Bay	300	355	390
Tilsonburg	310	380	435
Timmins	255	310	355
Toronto	390	460	520
Trenton	350	415	465
Trout Creek	240	285	320
Trout Lake	335	385	425
Uxbridge	285	360	415
Vanier	295	360	410
Vittoria	355	415	465
Walkerton	355	435	500
Wallaceburg	320	380	430
Waterloo	275	330	370
Watford	340	410	470
Wawa	300	355	390
Welland	330	380	425
WestLorne	345	415	470
Whitby	430	510	575
White River	210	245	275
Wiarton	330	410	475
Windsor	360	420	470
Wingham	350	435	505
Woodstock	305	380	435
Wyoming	350	415	465