DEPARTMENT OF TRANSPORTATION

Signs 101 Manual

Office of Traffic Engineering

February 2022

https://www.dot.state.mn.us/trafficeng/signing/docs/signs-101-manual.pdf

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1. INTRODUCTION

1.1 Background

This is a one-day introductory Traffic Signs 101 Course that is designed to enable participants to acquire a basic understanding of how and why the determination is made to place a traffic sign at a location. This course serves as an introduction for entry level traffic technicians and engineers, a refresher course for experienced staff, or an introduction to additional subjects related to traffic signs which may assist participants in responding to sign requests from the public.

1.2 Goals of Course

This is an introduction to traffic signs in Minnesota course. The main emphasis is to provide an overview of the life-cycle of a traffic sign from initiation, design, installation, and maintenance.

At the end of this course, you will be able to:

- ✓ List the principles of traffic control devices
- ✓ Name the different functional classifications of signs
- ✓ Navigate the appropriate laws and manuals related to signing
- ✓ Note the considerations for why signs are installed
- ✓ Define the difference between advertising and traffic signs
- ✓ Describe some types of agreements used in signing
- ✓ Recognize some of the typical components used in signing
- ✓ List the typical sheets in a signing plan set
- ✓ Describe some of the maintenance responsibilities related to signs
- ✓ List some of the new technologies in traffic signing

1.3 Disclaimer

This manual is disseminated under the sponsorship of the Minnesota Department of Transportation (MnDOT), Office of Traffic Engineering. MnDOT and Kimley-Horn and Associates, Inc. assume no liability for its contents or use thereof.

MnDOT does not endorse products or manufacturers. Trademarks of manufacturer's names appear herein only because they are considered essential to the objective of this manual.

1.4 Acknowledgments

The development of this Signing 101 Manual has been a result of the efforts of the MnDOT Office of Traffic Engineering (OTE) and Kimley-Horn and Associates, Inc. The contributions by Josie Tayse, Rick Sunstrom, Brian Barrett and Steven McBurney are gratefully acknowledged.

1.5 Written Communications Policy

To request this document in an alternative format, please contact the Affirmative Action Office at 651-366-4723 or 1-800-657-3774 (Greater Minnesota); 711 or 1-800-627-3529 (Minnesota Relay). You may also send an e-mail to ADArequest.dot@state.mn.us. (Please request at least one week in advance).

1.6 Contact Information

MnDOT's technical experts are listed below with contact information.

Exhibit 1-1 MnDOT Signing Technical Expert Contacts

Name	Email	Phone
Josephine Tayse	josie.tayse@state.mn.us	651-234-7371
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Rick Sunstrom	rick.sunstrom@state.mn.us	651-234-7381
Brian Barrett	brian.barrett@state.mn.us	651 234-7374

1.7 MnDOT OTE Website

The MnDOT Office of Traffic Engineering website includes a wide variety of traffic engineering information, including traffic signing. The website can be visited by going to:

http://www.dot.state.mn.us/trafficeng/

Click on the links to proceed to the appropriate Traffic Engineering Site.

1.8 Definitions

For definitions of important terms refer to Section 6-2.00 Glossary from Chapter 6 of the Traffic Engineering Manual (TEM), available at the following link:

https://www.dot.state.mn.us/trafficeng/publ/tem/2021/chapter6.pdf

2. SIGNING OVERVIEW

2.1 Purpose of Signs

Traffic signs regulate, warn, and guide motorists, pedestrians, and other traffic on all public roads. The traffic sign is the most used traffic control device, and it is the oldest device for controlling, safeguarding, and expediting traffic. Signs are not ordinarily needed to confirm the basic rules of the road, but they are essential to inform highway users of specific regulations, to warn users where hazards are not self-evident, and to furnish information and guidance.

The Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) provides legal standards, allowable limits, and alternatives for the design, use, and application of traffic signs. The purpose of this chapter is to describe typical applications and procedures related to placement of traffic signs on MnDOT streets and highways.

Since the basic principles of signing are set forth in the MN MUTCD and must be adhered to, the engineers, technicians, and maintenance personnel responsible for the design, selection, and placement of these devices should have ready access to and be familiar with the MN MUTCD. The MUTCD is discussed in more detail throughout this manual.

2.2 What is Retroreflectivity?

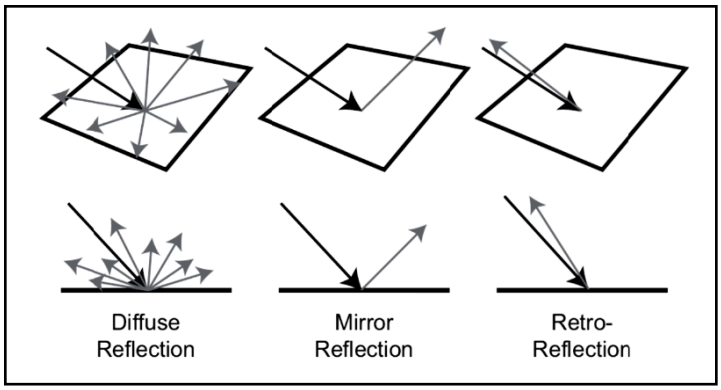
The MN MUTCD requires traffic signs to be either retroreflective or illuminated to show the same shape and color both day and night. Since it is more cost effective to make signs retroreflective than it is to illuminate them, retroreflective sheeting material is used on all signs.

Most objects reflect light. The most common type of reflection is “diffuse reflection” where light scatters after striking rough surfaces such as trees, clothing and carpet. Only a very small amount of the diffused light reflects back toward the light source.

Another type of reflection is “mirror reflection” that occurs when light strikes smooth or glossy surfaces, and the light reflects off the surface at an equal but opposite angle. Mirror reflection frequently occurs at night on wet roads when the headlights of approaching vehicles create extensive glare. Sign faces also produce some mirror reflection due to their glossy surfaces, and for this reason; it is a good practice to rotate signs away from the driver.

In contrast, “retroreflection” is the unique ability of a surface to reflect light back toward the light source, and “retroreflectivity” is the measurable property of a material’s ability to redirect light back to its source.

Exhibit 2-1 Types of Retroreflection



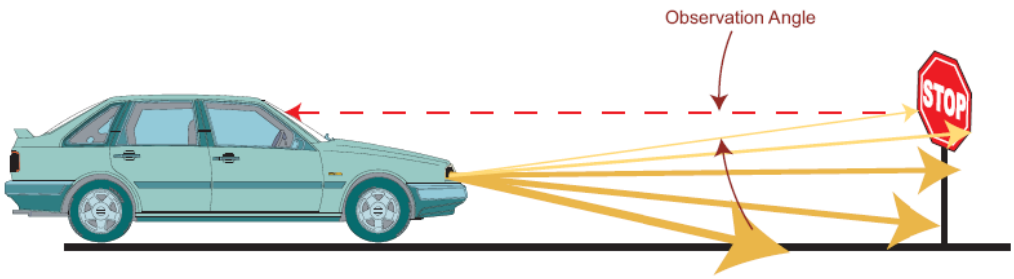
2.2.1 Retroreflective Sheeting Materials

To make signs retroreflective, sign manufacturers apply retroreflective sheeting, which contains either microscopic glass beads or cube corner reflectors, to the face of each sign. If the sheeting manufacturers could make all glass beads and cube corner reflectors perfectly shaped, all reflected light would return directly to the light source (headlights). Although retroreflective sheeting does not have perfectly shaped lenses, drivers do see more reflected light the closer their eyes are to the headlights. As illustrated in Exhibit 2-2, the angle formed between the headlights, the sign and the driver's eyes is the observation angle, and the smaller the angle the higher the retroreflectivity.

There are three different sign sheeting methods that are typically used for MnDOT signing applications: silk screen, ElectroCut Film, and digital print.

- ✓ Silk screen: a printing technique where a mesh is used to transfer ink onto a substrate, except in areas made impermeable to the ink by a blocking stencil. A blade or squeegee is moved across the screen to fill the open mesh apertures with ink, and a reverse stroke then causes the screen to touch the substrate momentarily along a line of contact. This causes the ink to wet the substrate and be pulled out of the mesh apertures as the screen springs back after the blade has passed. One color is printed at a time, so several screens can be used to produce a multi-colored image or design.
- ✓ Electrocut Film: a transparent, acrylic film with pressure sensitive adhesive for application over reflective sheeting.
- ✓ Digital printing: a printing technique which uses large ink jet printers to print directly onto a reflective film. This method is not typically used by MnDOT. It is used only for logos and images that cannot be created easily using the other methods, e.g. scenic byway signs.

Exhibit 2-2 Graphic Illustration of the Observation Angle



Retroreflective materials are also more efficient when the light source is approximately perpendicular to the sign face; therefore, it is important to have signs oriented to face approaching traffic.

The ability to see traffic signs at night is a function of the following:

- ✓ Driver's night vision capabilities.
- ✓ Intensity and light distribution of the headlights.
- ✓ Distance, mounting height, and orientation of the sign in relation to the vehicle's headlights.
- ✓ Location of driver's eyes with respect to the headlights.
- ✓ Type, color, and age of the retroreflective material.

2.2.2 Why is Retroreflectivity Important?

The nighttime visibility of signs and pavement markings is essential for highway safety. Some traffic signs may look almost new during the day but are completely ineffective at night. This nighttime visibility problem is usually a function of the type and age of the retroreflective material.

Exhibit 2-3 Stop Sign Retroreflectivity difference Day vs. Night

Stop Signs During the Day

Stop Sign During the Night

2.2.3 Minimum Retroreflectivity

In 1993, Congress directed the U.S. Secretary of Transportation to include minimum retroreflectivity values for traffic signs in the National MUTCD. Following extensive research and public input, FHWA adopted minimum retroreflectivity values for most traffic signs on December 21, 2007 and incorporated them into the National MUTCD (Revision 2 of the 2003 Edition). Specifically, Section 2A-09 and Table 2A-1 of the National MUTCD contain the new criteria.

2.3 Five Principles of Traffic Control Devices

As stated in the MN MUTCD Section 1A.2, for traffic signs to be effective, they should meet the following basic requirements:

1. Fulfill a need
2. Command attention
3. Convey a clear, simple meaning
4. Command respect from road users
5. Give adequate time for proper response

Design, placement, operation, maintenance, and uniformity are aspects that should be carefully considered to maximize the ability of a traffic control device to meet the five requirements listed in the previous paragraph. Vehicle speed should be carefully considered as an element that governs the design, operation, placement, and location of various traffic control devices.

Item 2, 3 and 4 in the list are mostly covered by how the sign is designed. That is, addressed by following the design rules and policies as set forth in the appropriate documents. Item 1 and 5 are the engineering behind signing. That is, the sign must fulfill a given need (be justified) and the placement should be such to give adequate time for the driver to respond.

2.4 Classification of Signs

As noted in Section 2A.5 of the MN MUTCD, there are three classifications of signs:

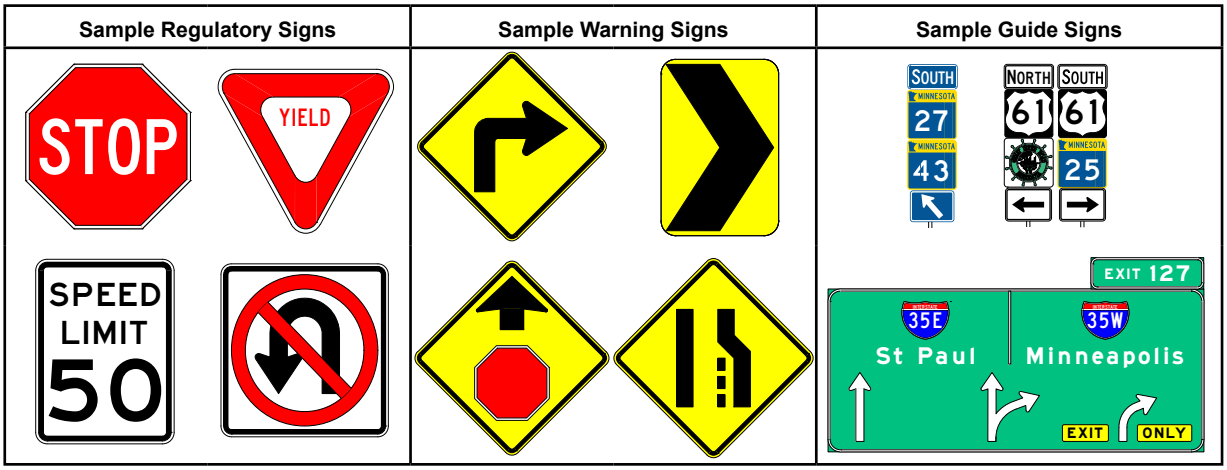
A. Regulatory signs give notice of traffic laws or restrictions (See Section 4.2 of this document)

B. Warning signs give notice of a situation that might not be clear (See Section 4.3 of this document).

C. Guide signs show route designations, destinations, directions, distances, services, points of interest and other geographical, recreational, or cultural information (See Section 4.4 of this document).

Exhibit 2-4 illustrates some examples of Regulatory, Warning, and Guide Signs.

Exhibit 2-4 Sample Regulatory, Warning, and Guide Signs Sample Regulatory Signs



2.5 Design of Signs

The primary purpose of the MN MUTCD is to improve safety and reduce driver frustration by promoting uniformity in the design and application of traffic control devices. Uniform designs and applications of traffic signs help everyone, because as drivers we can see and understand the sign messages, and the systematic advance placement of warning signs provide sufficient notice for us to take appropriate actions.

To that end, the MN MUTCD (see Section 2.7.2) establishes the basic framework for the design and application of signs, and the MnDOT Standard Signs and Markings Manual (see Section 2.7.4) provides detailed drawings of the standard signs and alphabets.

2.5.1 Sign Nomenclature

The MnDOT Standard Signs and Markings Summary (see Section 2.7.5) defines a unique nomenclature to all common types of traffic signs. The first letter in sign nomenclature conforms to the following:

- ✓ R Series: Regulatory
- ✓ W Series: Warning
- ✓ M Series: Route Markers and Auxiliaries
- ✓ G Series: Construction Information
- ✓ S Series: School Warning
- ✓ D Series: Guide Signs
- ✓ I Series: Informational
- ✓ E Series: Exit Signs
- ✓ OM Series: Object Marker
- ✓ X Series: Miscellaneous
- ✓ PM Series: Pavement Messages

Exhibit 2-5 shows examples of sign codes as listed in the MnDOT Standard Signs and Markings Summary (www.dot.state.mn.us/trafficeng/publ/index.html). The "Sign Code" in the left-hand column of the figure shows the sign code (nomenclature).

Modifications, Special Designs, Overlays, and Plaques

All Minnesota designs that are a modification of a federal design will be designed with an "M" at the end of the code. The rest of the code will mirror the federal code. If there is another modification of the same sign, an "a" will be added at the end of the code. If there are multiple codes, the last letter will be changed alphabetically. (Examples; **S3-2M** and **D-2Ma**)

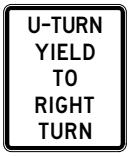
All Minnesota special designs start with the numbers associated with the sign design and after the dash an "X" will be placed, and numbering will start numerically. If there is another similar sign with a minor word change and it maintains the same basic meaning, an "a" will be placed after the code. If there are multiple codes, the last letter will be changed alphabetically. If a plaque is associated with that sign code, then a "P" will be added at the end. (Examples; **R5-X1, R12-X2a and R12-X1P**)

The legend "Overlay" found under the Sign Code means that the sign design is only intended as a panel overlay on a larger sign. The sign cannot be installed by itself.

The letter "P", which stands for Plaque, found at the end of a sign code refers to a sign mounted above or below a primary sign that provides additional information concerning the primary sign. A plaque cannot be installed by itself; it must accompany a primary sign.

Exhibit 2-5 Sample Sign Nomenclature

R Series

Sign Code	Old Sign Code	Sign Picture	Color	Use	Sign Size (inches)	MnDOT Stock #
R10-11c			Black on White	CR-SL, ML	30 x 42	57617
R10-12			Black and Green on White	CR-SL, ML	30 x 36	56990
				E	36 x 48	31358
R10-15M (R or L) MN Design	R10-15a		Black on Fluorescent Yellow, Black and Red on White	CR-SL, ML, E	30 x 30	55938 (R)
						58108 (L)
R10-16			Black on White	CR-SL, ML	30 x 36	51195

2.5.2 Elements of Traffic Sign Design

Elements of sign design include shape, color, size, legend, border, retroreflective properties, illumination, and uniformity. These elements are discussed in the MN MUTCD.

2.5.3 Shape

Sign shapes should be as designed as stated in the Mn MUTCD. MnDOT uses a white on brown rectangular sign for the Recreational and Cultural Interest Area signs as allowed in the MN MUTCD Section 2M.9 (see Exhibit 2-6).

Exhibit 2-6 Use of Sign Shapes (Source: MN MUTCD Table 2A-4)

Shape	Signs
Octagon	Stop *
Equilateral Triangle (1 point down)	Yield *
Circle	Grade Crossing Advance Warning *
Pennant Shape / Isosceles Triangle (longer axis horizontal)	No Passing *
Pentagon (pointed up)	School Advance Warning Sign (squared bottom corners) * County Route Sign (tapered bottom corners) *
Crossbuck (two rectangles in an "X" configuration	Grade Crossing *
Diamond	Warning Series
Rectangle (including square)	Regulatory Series Guide Series ** Warning Series
Trapezoid	Recreational and Cultural Interest Area Series National Forest Route Sign

* This sign shall be exclusively the shape shown.
** Guide series includes general service, specific service, tourist -oriented directional, general information, recreational and cultural interest area, and emergency management signs.

2.5.4 Color

General Provisions

Black: Used as legend color for signs with orange, white or yellow backgrounds. Black also is used as the background color for some regulatory signs.

Blue: Indicates services available to road users. It is used as the background color in motorist information signs, interstate, Minnesota, and county route markers, and auxiliary markers. Blue is not used as a legend color except on Adopt-a-Highway signing.

Brown: Indicates recreational and cultural facilities. It is used only as the background color in recreational and cultural interest signs. It is not used as a legend color.

Green: Indicates movement permitted or gives directional guidance. It is used as the background color in guide signs and as the legend color in permissive parking signs.

Orange: Warns of temporary traffic conditions with a higher than normal potential hazard level. It is used as the background color in temporary traffic control signs and is most commonly seen in construction zones. It is not used as a legend color.

Red: Indicates right-of-way control, prohibition or exclusion. It is used as the background color for STOP, DO NOT ENTER, WRONG WAY, and interstate route marker signs and as the legend color for YIELD, parking prohibition and prohibitory (circular with slash) signs.

White: White either indicates a law, regulation or legal requirement in effect at or near the sign or provides directional guidance. It is used as the background color for regulatory signs, route markers and route marker auxiliaries. It also is used as the legend color for signs with a black, blue, brown, green or red background.

Yellow: Warns of a potential hazard. It is used as the background color for warning signs and as the legend color for county route marker signs.

Fluorescent-Yellow Green: Designated for use as background color for warning signs and their supplemental plaques associated with pedestrians, bicyclists, playgrounds and schools. SCHOOL plaque is also included.

Fluorescent Pink: Incident Management

Purple: Electronic Toll Accounts (ETC) such as Minnesota's E-ZPASS lanes. More details on color usage can be found in the MN MUTCD Section 2F.3.

2.5.5 Size

In general, the following items control the size of the sign:

- ✓ Message on sign
- ✓ Font use for text
- ✓ Letter and object spacing
- ✓ Borders and margins

An accepted "rule-of-thumb" to follow for legibility for signs other than Interstate is to have 1 inch of letter height for every 30 feet of desired legibility. Whenever practicable, the overall dimensions of the sign panels should be in multiples of 6 inches.

Standard Signs

Both sign and letter size have been established for standard signs (regulatory, warning, etc.). The National MUTCD sets forth criteria establishing the series of letters to be used and the spacing between letters for these two classifications of signs. The resulting sign sizes are listed in the MnDOT Standard Signs and Markings Summary (see Section 2.7.5). The size of the sign selected is than based on the type of roadway and speed.

Speed Limit Sign Size Example

Consider the size of a speed limit sign for a conventional road with a single lane. In the MnDOT Standard Signs and Markings Summary this would be found in the "R" series signs on page 1 (see Exhibit 2-7). In this case, the sign would be 24" x 30". This is roughly the size of a full size (22" x 34") plan set.

Exhibit 2-7 Speed Limit Sign, R2-1 Sizing

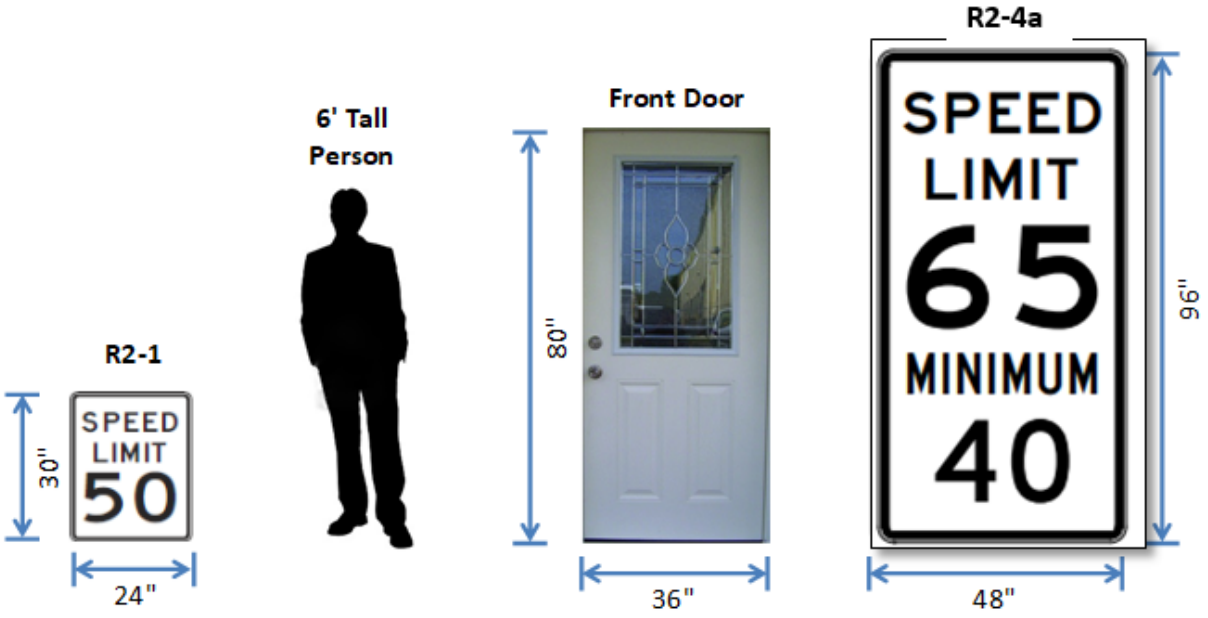
R2-1			Black on White	M	18 x 24	33273
				CR-SL	24 x 30	30859
				CR-ML, O	30 x 36	50084
				E	36 x 48	31102
				F	48 x 60	31111

Now consider a speed limit sign on a freeway. In this case, the sign also includes a "Minimum" speed sign. For this instance, the size of the sign is 48" x 96" (see Exhibit 2-8). This is larger than a standard front door to a house (typically 36" x 80"). See Exhibit 2-9 for a relative size comparison.

Exhibit 2-8 Speed Limit Sign, R2-4a Sizing

R2-4a	R2-4b		Black on White	CR-SL, ML	24 x 48	33269
				E, O	36 x 72	57575
				F	48 x 96	33270

Exhibit 2-9 Relative Size Comparison of Signs



Guide Signs

For guide signs, only minimum sizes have been established. The letter size needed to give motorists ample opportunity to read a sign easily at normal approach speed will, in general, determine the size of sign needed. Sign design is dependent upon many variables:

1. The sign reading behavior of drivers is a highly adaptive process - the manner in which a driver obtains information from a sign heavily depends on the following factors:
    a. Visual loads on the driver's visual information acquisition and processing functions
    b. Driver's informational need
        i. type of informational need
        ii. urgency associated in obtaining information
        iii. driver's familiarity with the route
    c. Size of letters displaying information on the sign
    d. Amount of message displayed on the signs and its relevance to driver's informational need
    e. Driver's visual capabilities
    f. Vehicle velocity
    g. Location of the sign with respect to the path of the driver

The SignCAD® program is currently used by MnDOT staff in designing guide signs. The software will assist in sizing the sign based on the legend and objects placed on the sign panel. On a two-way high-way, the font size is typically 6". However, on a freeway section, the font size is 16". See Exhibit 2-10 for a relative guide sign size comparison comparing an overhead freeway sign to a 6' tall person.

Exhibit 2-10 Relative Size Comparison for Guide Sign

2.5.6 Legend

MnDOT's preferred practice is to use symbol messages when the MN MUTCD allows the use of word messages as alternatives to symbols.

New warning or regulatory symbol signs not readily recognizable by road users should be accompanied by an educational plaque which is to remain in place for at least three years after initial installation.

It is MN MUTCD Standard to use upper/lower case lettering on all guide signs with proper name destinations. Contact MnDOT's Office of Traffic Engineering (OTE) for technical assistance in the design of guide signs and usage of this program.

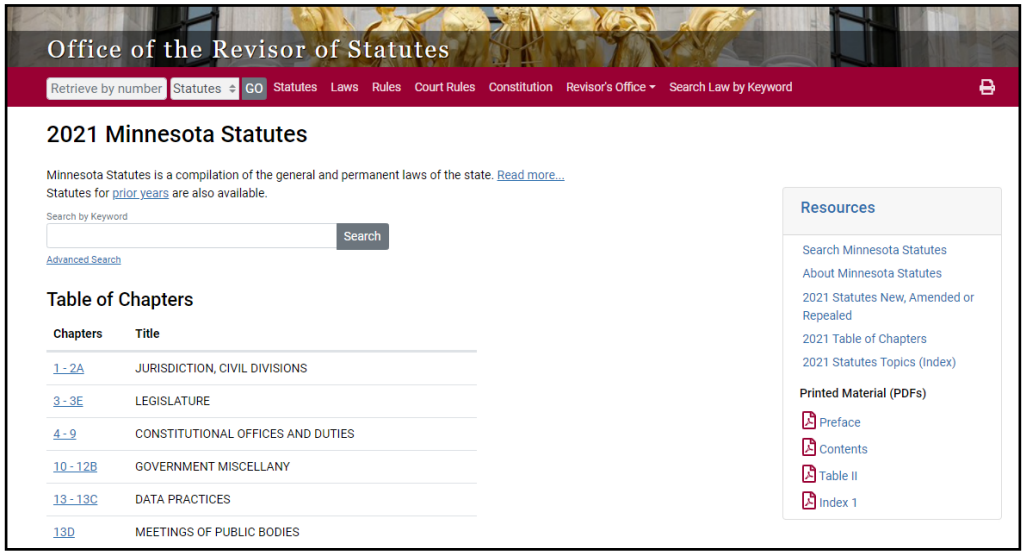
The MN MUTCD also states in Section 2A.06:

> "Except as provided in the option below and except for the Carpool Information (D12-2) sign (see Section 2I.11), Internet addresses and e-mail addresses, including domain names and uniform resource locators (URL), shall not be displayed on any sign, supplemental plaque, sign panel (including logo sign panels on Specific Service signs) or changeable message signs."

2.6 Legal Authority for Placement of Traffic Signs

Legal authority for the placement of signs is found in the Minnesota Statutes. Chapters 160 to 174A cover Transportation. The Statutes can be found at https://www.revisor.mn.gov/statutes/.

Exhibit 2-11 Minnesota Statutes Website



2.6.1 Traffic Signs Installed by MnDOT Maintenance Forces

Minnesota Statute (MS) 169.06, subd.2, provides that the Commissioner of Transportation (Commissioner) shall place and maintain traffic signs conforming to the MN MUTCD and the MnDOT Standard Specifications for Construction as deemed necessary to regulate, warn, or guide traffic on the Minnesota trunk highway system. MnDOT district traffic offices and maintenance forces act as agents of the Commissioner in this duty. Additional Statutes may also be applicable.

2.6.2 Traffic Signs Installed by Contract

Under the provisions of MS 161.32, subd.1, the Commissioner may elect to conduct sign installation work by construction contract rather than by maintenance forces. Additional statutes may also be applicable.

2.6.3 Traffic Signs Installed by Others by Maintenance Permit

Minnesota Statute (MS) 169.06, subd.2, the Commissioner may authorize others to install approved traffic signs by maintenance permit (MnDOT Form 1723). All signs shall conform to the MN MUTCD, Minnesota Standard Specifications for Construction, this Manual, and any specific conditions outlined in the permit. District traffic engineers should approve all sign installations to ensure that all applicable standards and practices are followed. Additional statutes may also be applicable.

2.6.4 Temporary Traffic Control Signs Installed by Construction Contracts and Public Utility Companies at Work Sites

The MN MUTCD, Part 6, Temporary Traffic Control provides standards and guidelines for placing traffic control signs at work sites to protect the public, workers, and equipment. Chapter 6A covers the legal responsibility of authorities having jurisdiction to comply with the requirements of Part 6.

2.7 Associated Manuals

A variety of manuals related to highway signs exist. This section covers some of the more common manuals used in Minnesota.

2.7.1 National Manual on Uniform Traffic Control Devices

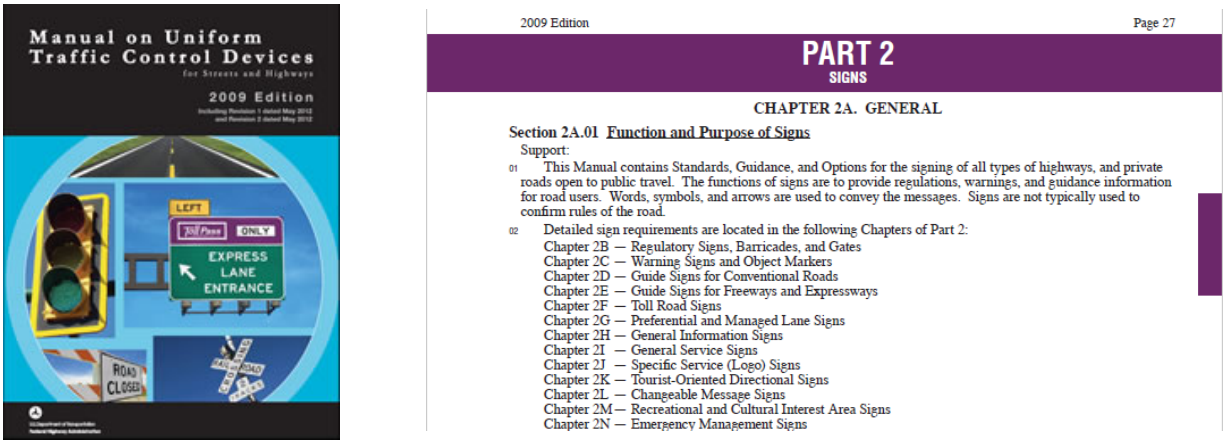
The National Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) establishes national standards for all traffic control devices (which includes signs, signals, and pavement markings) on all streets, highways, bikeways, and private roads open to public travel within the United States. It promotes safety and efficiency by creating uniformity in the meaning, use, and appearance of traffic control devices. The National MUTCD is published by the Federal Highway Administration (FHWA) under 23 Code of Federal Regulations (CFR), Part 655, Subpart F.

All States must officially adopt the National MUTCD or risk losing federal funds. When FHWA publishes a new or updated National MUTCD, States are given two years to officially adopt the National MUTCD either in its entirety, with supplemental provisions, or as a separate published document. Any supplemental provisions or separate published document must be in substantial conformance with the National MUTCD. Substantial conformance means that the supplements or the separate published document shall meet the minimum standards included in the National MUTCD.

Minnesota adopts the National MUTCD by publishing a separate document, the Minnesota MUTCD.

At the time of publication of this manual, the current version of the National MUTCD is the 2009 edition with Revisions 1 and 2 dated May of 2012. The National MUTCD website is located at: http://mutcd.fhwa.dot.gov/index.htm

Exhibit 2-12 National MUTCD



Chapter 2 of the National MUTCD focuses on Traffic Signs

2.7.2 Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD)

The Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways (MN MUTCD) provides a uniform system of traffic control devices on all streets, highways, bikeways, and private roads open to public travel within the State of Minnesota. In accordance with Minnesota Statutes, Section 169.06, subd. 1, the MN MUTCD is published by the Minnesota Department of Transportation.

Exhibit 2-13 Minnesota MUTCD

PART 2. SIGNS
Chapter 2B. REGULATORY SIGNS

2B.1 Application of Regulatory Signs

Standard

Regulatory signs shall be used to inform road users of selected traffic laws or regulations and indicate the applicability of the legal requirements.

Regulatory signs shall be installed at or near where the regulations apply. The signs shall clearly indicate the requirements imposed by the regulations and shall be designed and installed to provide adequate visibility and legibility in order to obtain compliance.

Regulatory signs shall be retroreflective or illuminated (see Section 2A.7) to show the same shape and similar color by both day and night, unless specifically stated otherwise in the text discussion in this Manual for a particular sign or group of signs.

The requirements for sign illumination shall not be considered to be satisfied by street, highway, or strobe

Support

The use of educational plaques to supplement symbol signs is described in Section 2A.12.

Most regulatory signs are rectangular, with the longer dimension vertical. The shapes and colors of regulatory signs are listed in Tables 2A-4 and 2A-5, respectively. Exceptions are specifically noted in the following Sections.

The use of educational plaques to supplement symbol signs is described in Section 2A.13.

Guidance

Changeable message signs displaying a regulatory message incorporating a prohibitory message that includes a red circle and slash on a static sign should display a red symbol that approximates the same red circle and slash as closely as possible.

2B.3 Size of Regulatory Signs

Standard

Nov. 9

Chapter 2 of the MN MUTCD focuses on Traffic Signs

The MN MUTCD is in substantial conformance with the current edition of the National MUTCD. Most of the text, figures, and tables in the MN MUTCD are identical to those found in the National MUTCD. Some text, figures, and tables have been modified to meet State laws, or to reflect the conditions and policies of Minnesota more closely. Text in the MN MUTCD that was added or changed from the National MUTCD is shown in a sans-serif font. See Exhibit 2-14.

Part 2 of the MN MUTCD is dedicated to traffic signs. It contains Standards, Guidance, and Options for the signing on all streets, highways, bikeways, and site roadways open to public travel. Part 2 is further separated into the to the following chapters:

- ✓ Chapter 2A – General
- ✓ Chapter 2B — Regulatory Signs
- ✓ Chapter 2C — Warning Signs and Object Markers
- ✓ Chapter 2D — Guide Signs – Conventional Roads
- ✓ Chapter 2E — Guide Signs – Freeways and Expressways
- ✓ Chapter 2F — Toll Road Signs
- ✓ Chapter 2G — Preferential and Managed Lane Signs
- ✓ Chapter 2H — General Information Signs
- ✓ Chapter 2I — General Service Signs
- ✓ Chapter 2J — Specific Service (Logo) Signs
- ✓ Chapter 2K — Tourist-Oriented Directional Signs
- ✓ Chapter 2L — Changeable Message Signs
- ✓ Chapter 2M — Recreational and Cultural Interest Area Signs
- ✓ Chapter 2N — Emergency Management Signs

The MN MUTCD is in substantial conformance with the National MUTCD. When a supplement to the National MUTCD is needed, it is shown within the MN MUTCD by using an arial font . The example below illustrates the addition of a supplement. The text below the line is supplemental and shown using an arial font.

Exhibit 2-14 Example of Language Unique to MN MUTCD

1A.7 Responsibility for Traffic Control Devices

Standard

The responsibility for the design, placement, operation, maintenance, and uniformity of traffic control devices shall rest with the public agency or the official having jurisdiction, or, in the case of private roads open to public travel, with the private owner or private official having jurisdiction. 23 CFR 655.603 adopts the MUTCD as the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel (see definition in Section 1A.13). When a State or other Federal agency manual or supplement is required, that manual or supplement shall be in substantial conformance with the National MUTCD.

23 CFR 655.603 also states that traffic control devices on all streets, highways, bikeways, and private roads open to public travel in each State shall be in substantial conformance with standards issued or endorsed by the Federal Highway Administrator.

The following excerpts from Chapter 169, Minnesota Statutes, set forth the responsibilities for the establishment of standards and for the use of traffic control devices in the State of Minnesota.

169.06 Signs, Signals, Markings.

Subdivision 1. **Uniform System**. "The commissioner (of transportation) shall adopt a manual and specifications for a uniform system of traffic-control devices consistent with the provisions of this chapter (Chapter 169) for use upon highways within this state. Such uniform system shall correlate with and so far as possible conform to the system then current as approved by the American Association of State Highway Officials. ..."

At the time of publication of this manual, the most recent revision of the MN MUTCD was issued in September 2020. The MN MUTCD website is located at:

http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html

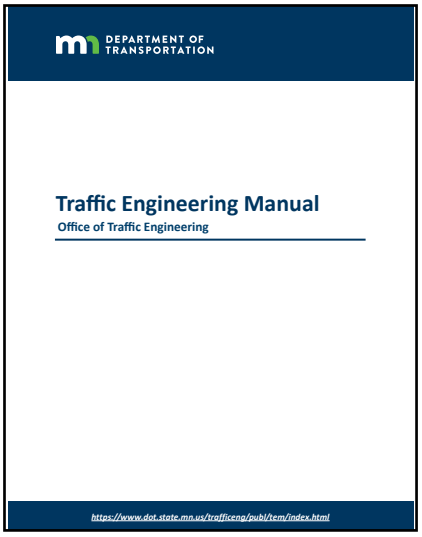
2.7.3 Traffic Engineering Manual

The Traffic Engineering Manual (TEM) is issued and updated by the MnDOT Office of Traffic Engineering (OTE). The purpose of the TEM is to establish uniform guidelines and procedures, primarily for use by personnel at MnDOT. Counties, cities, and local units of government will also find this manual useful when striving for uniformity in traffic engineering throughout the state of Minnesota. It is the intent of this Manual to set forth accepted practices, procedures, and guidelines, chiefly for the sake of uniformity of application, but there is no legal requirement for their use.

The TEM contains 14 chapters. Chapter 6 is related to Traffic Signs and Delineation (see Exhibit 2-15). The most current version of the TEM can be found at:

http://www.dot.state.mn.us/trafficeng/publ/tem/index.html

Exhibit 2-15 MnDOT Traffic Engineering Manual (TEM)



CHAPTER 6 - TRAFFIC SIGNS AND DELINEATION

Table of Contents

Chapter 6 of the TEM related to Traffic Signs

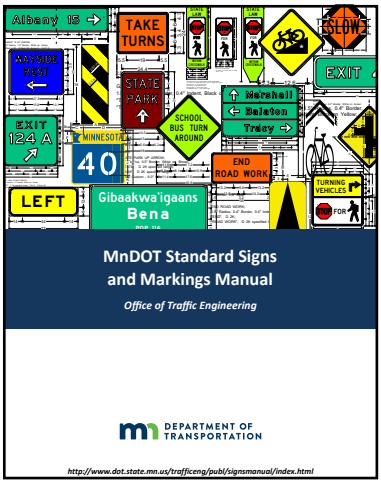
Chapter 6 of the TEM is broken into the following subsections:

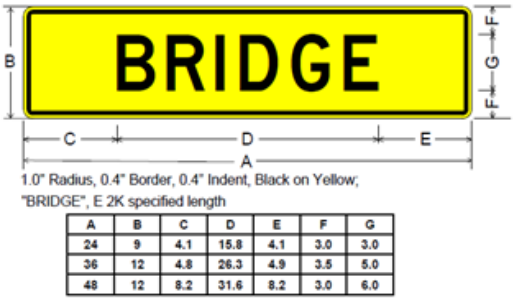
- ✓ 6-1.0 Introduction
- ✓ 6-2.0 Glossary
- ✓ 6-3.0 Legality - Legal Authority for Placement of Traffic Signs
- ✓ 6-4.0 General Principles of Traffic Signing
- ✓ 6-5.0 Application Guidelines - Regulatory Signs
- ✓ 6-6.0 Application Guidelines - Warning Signs
- ✓ 6-7.0 Application Guidelines - Guide Signing
- ✓ 6-8.0 Application Guidelines - Miscellaneous Signing
- ✓ 6-9.0 Object Markers
- ✓ 6-10.0 Delineators
- ✓ 6-11.0 References

2.7.4 MnDOT Standard Signs and Markings Manual

The MnDOT Standard Signs and Markings Manual is a supplement to the FHWA Standard Highway Signs and Markings book. The MnDOT manual includes sign and marking designs for Minnesota specific signs as well as designs not found in the FHWA book. It also includes punching codes for signs mounted on MnDOT sign structures. The MnDOT manual is based off of the two FHWA Standard Highway Signs and Markings books; the 2004 Edition and the 2012 Supplement to the 2004 Edition. The 2012 Supplement has standard signs not included in the 2004 Edition and also has some updated sign designs. The designs in the 2012 book take precedence over the 2004 book.

Exhibit 2-16 MnDOT Standard Signs and Markings Manual





A	B	C	D	E	F	G
24	9	4.1	15.8	4.1	3.0	3.0
36	12	4.8	26.3	4.9	3.5	5.0
48	12	8.2	31.6	8.2	3.0	6.0

Sample from MnDOT Standard Signs and Markings Manual

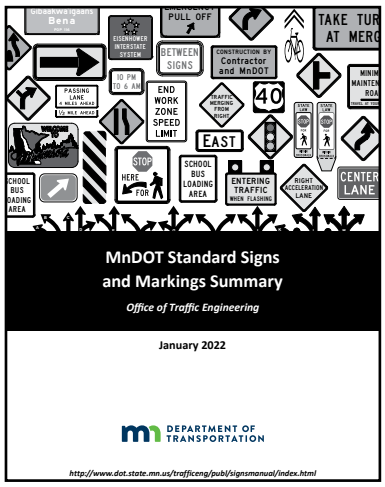
2.7.5 MnDOT Standard Signs and Markings Summary

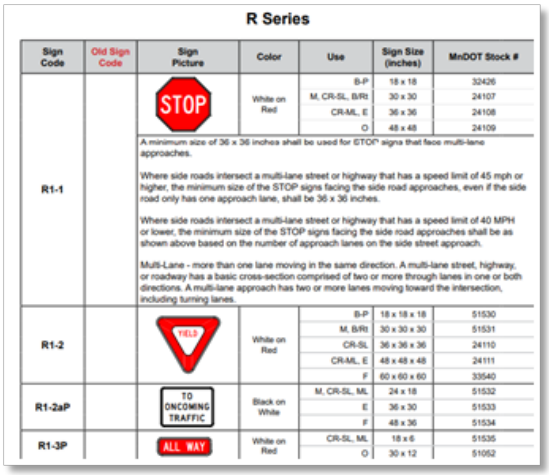
As the name implies, the MnDOT Standard Signs and Markings Summary is a summary of specific standard signs used in Minnesota (See Exhibit 2-17). It includes the sign number (nomenclature), a drawing of the sign, and the color of the sign and the sizes of the sign. Unlike the Standard Signs and Markings Manual, it does not contain the detailed layout details of the sign.

The Standard Signs and Markings Summary is available at the following link:

http://www.dot.state.mn.us/trafficeng/publ/signsmanual/index.html

Exhibit 2-17 MnDOT Standard Signs and Markings Summary





R Series

Sign Code	Old Sign Code	Sign Picture	Color	Use	Sign Size (inches)	MnDOT Stock #
R1-1		STOP	White on Red	B-P	18 x 18	32426
				M, CR-SL, B/Rt	30 x 30	24107
				CR-ML, E	36 x 36	24108
				O	48 x 48	24109
		A minimum size of 36 x 36 inches shall be used for STOP signs that face multi-lane approaches. Where side roads intersect a multi-lane street or highway that has a speed limit of 45 mph or higher, the minimum size of the STOP signs facing the side road approaches, even if the side road only has one approach lane, shall be 36 x 36 inches. Where side roads intersect a multi-lane street or highway that has a speed limit of 40 MPH or lower, the minimum size of the STOP signs facing the side road approaches shall be as shown above based on the number of approach lanes on the side street approach. Multi-Lane - more than one lane moving in the same direction. A multi-lane street, highway, or roadway has a basic cross-section comprised of two or more through lanes in one or both directions. A multi-lane approach has two or more lanes moving toward the intersection, including turning lanes.				
R1-2		YIELD	White on Red	B-P	18 x 18 x 18	51530
				M, B/Rt	30 x 30 x 30	51531
				CR-SL	36 x 36 x 36	24110
				CR-ML, E	48 x 48 x 48	24111
				F	60 x 60 x 60	33540
R1-2aP		TO ONCOMING TRAFFIC	Black on White	M, CR-SL, ML	24 x 18	51532
				E	36 x 30	51533
				F	48 x 36	51534
R1-3P		ALL WAY	White on Red	CR-SL, ML	18 x 6	51535
				O	30 x 12	51052

Sample R Series from MnDOT Standard Signs and Markings Summary

2.7.6 Guide Sign Design Manual

The Guide Sign Design Manual (see Exhibit 2-18) is designed to enable MnDOT and consultant engineering personnel to acquire basic design skills needed to design traffic guide signs using the SignCAD® software. The manual includes a series of examples on laying out guide signs. MnDOT published an online training in June 2020 which covered changes to 2K font and standard updates, and the training updated charts and project examples which supersede what is in the Guide Sign Design Manual. The training videos, PowerPoint presentation, and all associated documentation are available at the following link:

http://www.dot.state.mn.us/trafficeng/signing/guide-sign-design-training.html

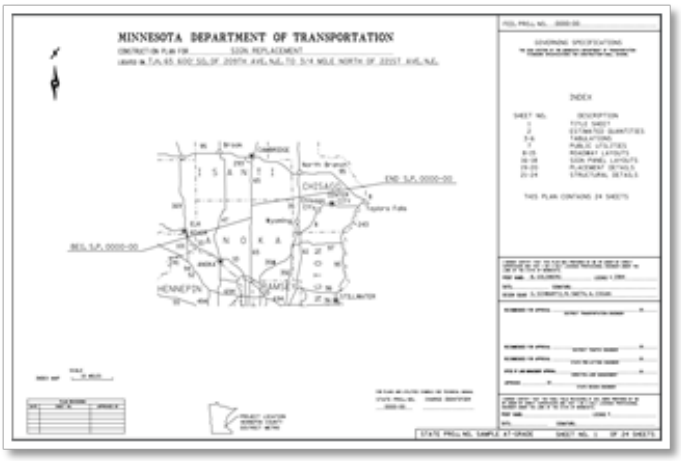
Exhibit 2-18 Guide Sign Design Manual

Sample Sign Panel Layout from Guide Sign Design Manual

2.7.7 Sign Plan Design - Conventional Roads Manual

The Sign Plan Design - Conventional Roads manual (see Exhibit 2-19) has been developed to provide training to traffic personnel to acquire basic design skills in assembling signing plans for conventional highways. The Sign Plan Design - Conventional Roads manual can be found at the following link: http://www.dot.state.mn.us/trafficeng/signing/publications.html.

Exhibit 2-19 Sign Plan Design - Conventional Roads Manual

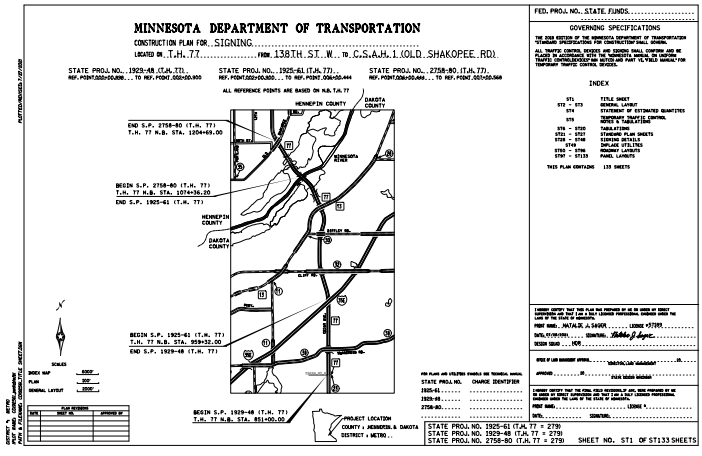


2.7.8 Freeway Signing Plan Design Manual

The Freeway Signing Plan Design Manual (see Exhibit 2-20) has been developed to provide training to traffic personnel to acquire basic design skills in assembling freeway signing plans. The Freeway Signing Plan Design Manual can be found at the following link:

http://www.dot.state.mn.us/trafficeng/signing/publications.html.

Exhibit 2-20 Freeway Signing Plan Design Manual



3. WHY SIGNS ARE INSTALLED

3.1 Introduction

A request for a traffic sign may be initiated in a variety of ways. A request for a sign may come from a developer, a city or county, a politician, the public or the state. The following sections provide information on why a sign is installed which is not simply due to a request for one.

3.2 Engineering Standards

3.2.1 MN MUTCD Text Heading

When used in the sections of the MN MUTCD, the text headings shall be defined as follows:

Standard

A statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. The verb “shall” is typically used. Standards are sometimes modified by Options.

Guidance

A statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. The verb “should” is typically used. Guidance statements are sometimes modified by Options.

Option

A statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. The verb “may” is typically used.

Support

An informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The verbs “shall”, “should”, and “may” are not used in Support statements.

Exhibit 3-1 is an example of the text headings used for Section 2C.2 from the MN MUTCD.

Exhibit 3-1 Text Heading Example from MN MUTCD

2C.2 Application of Warning Signs

Standard

The use of warning signs shall be based on an engineering study or on engineering judgment.

Guidance

The use of warning signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect for all signs. In situations where the condition or activity is seasonal or temporary, the warning sign should be removed or covered when the condition or activity does not exist.

Option

Consistent with the provisions of Chapter 2L, changeable message signs may be used to display a warning message.

Consistent with the provisions of Chapter 4L, a Warning Beacon may be used in combination with a standard warning sign.

Support

The categories of warning signs are shown in Table 2C-1.

Warning signs specified provided herein in this Manual cover most of the conditions that are likely to be encountered. Additional warning signs for low-volume roads (as defined in Section 5A.1), temporary traffic control zones, school areas, highway-rail grade crossings, and bicycle facilities, and highway-light rail transit grade crossings are discussed in Parts 5 through 9, respectively.

Section 1A.9 contains information regarding the assistance that is available to jurisdictions that do not have engineers on their staffs who are trained and/or experienced in traffic control devices.

3.2.2 Signing Standards

As previously presented, signs should:

1. Fulfill a need
2. Command attention
3. Convey a clear, simple meaning
4. Command respect from road users
5. Give adequate time for proper response

Engineering standards must be followed to fill these needs. Considering item number 1 and number 5, the average driver makes 400 observations, 40 decisions and 1 mistake for every 2 miles they drive.

Exhibit 3-2 Example Signing Decisions

Although conditions may exist where lesser sign spacing will be found to be necessary, freeway guide signs should be spaced at least 800 feet apart. A spacing of at least 400 feet should be provided between guide signs and all other types of signs on freeways.

Principle #1 of signing is to ensure the sign fulfills a need. The question to ask and adequately answer is, what is the "need"?

3.2.3 Engineering Judgment and Documentation

In many instances, engineering judgment is required when standards cannot be fully met. For instance, in the definition of Guidance above, it states, "deviations allowed if **engineering judgment** or engineering study indicates the deviation". The definition of engineering judgment from the MN MUTCD states:

"Engineering Judgment - the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required."

While "documentation of engineering judgment is not required", it is highly recommended. For liability purposes, it is important to document engineering judgment. Often, tort claims occur many months or years later. Documentation of decisions, including minutes of meetings, notes in a diary, notes on a plan, etc. become very important during depositions and trials.

Proper documentation of decision-making during design and proper review and implementation during construction results in not only a better design and safer work zone, but also reduces risk and liability.

3.3 Signing Priorities

According to the ITE Traffic Control Devices Handbook, when signs compete for the same physical space, there is a need to determine priorities based on the following order of precedence:

- ✓ Regulatory Signs (location specific)
- ✓ Warning Signs
- ✓ Regulatory Signs (non-location specific)
- ✓ Guide Signs
- ✓ Motorist Services
- ✓ Traffic generator signs
- ✓ General information signs

3.4 Functional Classifications of Traffic Signs

The MN MUTCD classifies signs by their functional usage as follows:

1. Regulatory signs inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.
2. Warning signs are used to call attention to unexpected conditions on or adjacent to a highway, street or private road open to public travel and to situations that would not be readily apparent to the motorist.
3. Guide signs are used to provide directions to motorists, informing them of intersecting routes, directing them to cities and other important destinations, and guiding them to available services, points of interest, and other geographic, recreational, or cultural sites.

Further, guide signs for highways have two (2) sub-classifications:

1. Primary guide signs consist of advance guide signing, exit directional signs, exit gore signs, destination, and distance signs. On freeways and expressways, exit numbers are included.
2. Supplemental guide signs further provide the driver geographic orientation and secondary destinations at certain interchanges. Destinations include cities, motorist services, or traffic generators.

3.5 Sign Effectiveness

Refer to the following links related to sign effectiveness. The first is “Effectiveness of Traffic Signs on Local Roads” and can be found at http://www.lrrb.org/media/reports/TRS1002.pdf. The second is Part F of the “Minnesota’s Best Practices for Traffic Sign Maintenance / Management Handbook” and can be found at www.mnltap.umn.edu/publications/handbooks/.

3.6 Excessive Use of Signs

The MN MUTCD Section 2A.4 states:

> "Regulatory and warning signs should be used conservatively because these signs, if used to excess, tend to lose their effectiveness. If used, route signs and directional guide signs should be used frequently because their use promotes efficient operations by keeping road users informed of their location."

3.6.1 Sign Clutter

Existing signs should be regularly reviewed to ensure that all of the signs are official and are necessary for regulatory, warning or guidance purposes. Unnecessary signs increase sign clutter and should be considered for removal as discussed in Section 3.5. See Exhibit 3-3 for examples of sign clutter.

Exhibit 3-3 Example of Sign Clutter

3.6.2 Sign Grouping

According to the the MN MUTCD 2A.16, Signs should be individually installed on separate posts or mounting except where:

A. One sign supplements another;
B. Route or directional signs are grouped to clarify information to motorists;
C. Regulatory signs that do not conflict with each other are grouped, such as turn prohibition signs posted with one way signs or a parking regulation sign posted with a speed limit sign; or
D. Street name signs are posted with a stop or yield sign.

3.7 Sign Justification

A traffic sign is not installed simply because of a request for it. As noted in Section 2.3, a traffic sign needs to fulfill a need, command attention, convey a clear, simple meaning, command respect from road users and give adequate time for proper response. If these principles cannot be met, the sign should not be installed. In addition, Section 1A.9 of the MN MUTCD states:

> "The decision to use a particular device at a particular location should be made on the basis of either an engineering study or the application of engineering judgment."

3.7.1 Politically Motivated Signs

In some cases, signs may be installed contrary to the engineering principles previously discussed. This may be due to political pressure or even state laws that contradict these principles. Engineers should work on educating the general public and appointed officials about the signing standards and why they are inplace to minimize the amount of politically motivated signs.

3.8 Advertising Signs vs. Traffic Control Signs

Exhibit 3-4 illustrates a logo sign and an advertising billboard. Logo Signs are located on Interstate highways and a few other freeways and are motorist service signs. Motorist services are defined by the Federal Highway Administration and include gas, food, lodging and camping (see Section 3.8.1). Billboards and other advertising are found off the public right of way (ROW).

Exhibit 3-4 Advertising vs. Highway Signs

You will notice that both signs have business and exit information and are visible from the highway. However, the billboard is an advertising device and the logo is a traffic control device.

Both types of signs are governed by federal and state law and policies and businesses pay for the signs.

Logo signs are NOT advertisements. They are motorist service signs.

3.8.1 Logo Signs

About

Logo signs (Exhibit 3-5) are guide signs that provide road users with business identification and directional information for services and eligible attractions. Eligible service categories are defined by the Federal Highway Administration as being limited to gas, food, lodging, camping, attractions and 24-hour pharmacies. Mainline logo signs are allowed on interstate and freeway highways within the State of Minnesota. Trailblazing signs are smaller signs located on freeway exit ramps and local roads to direct motorists from the freeway to the business.

Exhibit 3-5 Logo Signing

Program

The Minnesota Sign Franchise Program, which allows for the installation and maintenance of logo signs, was established by Minnesota Statute 160.80 in 1984. This program is in general conformance with the specific service signing guidelines in the National MUTCD. Eligibility criteria is contained in Minnesota Statute 160.80 and MnDOT's Sign Franchise Contract.

MnDOT's Logo Sign Franchise Contract is currently managed and operated by Minnesota Logos (http://www.minnesota.interstatelogos.com/state/). Information on business eligibility and participation fees can also be found on this website.

3.8.2 Bonus Law (1958)

In 1958, Congress passed the first outdoor advertising control legislation which is commonly known as the "Bonus Law", PL 85-381, formerly codified as 23 U.S.C., Section 231. However, since it has been replaced by the Beautification Act (see below), it can no longer be found in the United States Code. Its provisions still exist by reason of agreements.

The Bonus Act basically provided an incentive to states to control outdoor advertising within 660 feet of the Interstate system. States which complied with the Act would receive a bonus of one-half of one percent of the Federal Highway funds, which participated in the right-of-way acquisition and construction of the segment of Interstate on which outdoor advertising was controlled. Initially the bill that was introduced would have provided for a complete prohibition of standardized outdoor advertising on the Interstate system. Some signs were permitted, which will be explained later.

3.8.3 Highway Beautification Act (1965)

The Highway Beautification Act of 1965 called for control of outdoor advertising, including removal of certain types of signs, along the nation's growing Interstate Highway System and the existing federal-aid primary highway system. It also required certain junkyards along Interstate or primary highways to be removed or screened and encouraged scenic enhancement and roadside development.

Some highlights on the laws include:

- ✓ Signs allowed: directional or other official signs required or authorized by law. 87% of motorists prefer logo signs to billboards or high-rise signs. These provide information without creating an eyesore.
- ✓ Billboards detract from scenery and contribute to visual pollution.
- ✓ Traffic control devices shall not bear any advertising message or any other message that is not related to traffic control.
- ✓ Tourist-oriented directional signs and Specific Service signs are not considered advertising; rather they are classified as motorist service signs.

The Billboard Permits site (www.dot.state.mn.us/roadsides/billboards/) includes information regarding the Minnesota Outdoor Advertising Control Act and Fee Schedule for Advertising Devices.

4. TYPES OF SIGNS

4.1 Functional Classifications of Traffic Signs

The MN MUTCD classifies signs by their functional usage as follows:

1. Regulatory signs inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.
2. Warning signs are used to call attention to unexpected conditions on or adjacent to a highway, street or private road open to public travel and to situations that would not be readily apparent to the motorist.
3. Guide signs are used to provide directions to motorists, informing them of intersecting routes, directing them to cities and other important destinations, and guiding them to available services, points of interest, and other geographic, recreational, or cultural sites.

Further, guide signs for expressways and freeways have two (2) sub-classifications:

1. Primary guide signs consist of advance guide signing, exit directional signs, exit gore signs, destination signs, and distance signs. On freeways and expressways, exit numbers are included.
2. Supplemental guide signs further provide the driver geographic orientation and secondary destinations at certain interchanges. Destinations include cities, motorist services, or traffic generators.

4.1.1 Department Classification of Signs

While the previous sign classifications described general functions and “design” type, MnDOT has reclassified the sign classifications by mounting and panel characteristics.

Markers & Delineators include object markers, delineators, and miscellaneous signs. They are the smallest category, consisting of the OM Series and the X Series in the MnDOT Standard Signs and Markings Summary. They are typically installed on square tube posts.

Warning Sign

Signs include regulatory, warning, route marker assemblies, auxiliaries, and smaller guide, destination, or informational signs, as found in the MnDOT Standard Signs and Markings Manual. They are the most common sign type and are typically installed on square tube posts.

Guide Sign – Ground Mounted

Guide Sign – Bridge Mounted

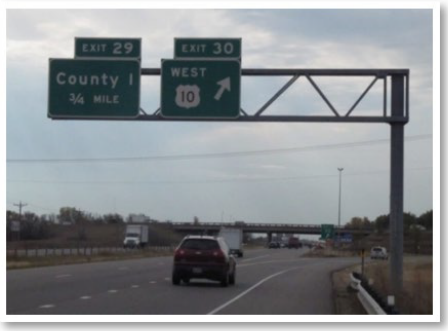
Guide Sign – Mast Arm Mounted

I-beam Sign
(with exit number panel)

I-beam signs are large breakaway guide, directional, or informational signs normally installed on mainline freeways, expressways, and occasionally on conventional roads. They are supported on wide-flange steel posts. Sign panels for I-beam signs are extruded aluminum.

Overhead signs are large guide, directional, or informational signs, either spanning a roadway, cantilevered over the roadway/shoulder, or bridge mounted. The requirements of the structural support system generally require installation or maintenance by contract. There are three kinds of overhead signs: monotubes which include no walkway or sign lighting, trusses which may or may not include walkway and sign lighting, and bridge-mounted structures which may or may not include walkway and sign lighting.

Cantilever (Design A) (no longer used)



Cantilever (Design B) (no longer used)

Sign Bridge (Design C) (no longer used)

Sign Bridge (Design D) (current design)

Overhead signs are necessary where ground-mounted signs are not deemed effective. Applications include, but are not limited to the following:

1. Freeway signing where space is not available for ground mounted signs or where there are three or more lanes of travel.
2. Guide and/or lane use control signing approaching major or complex intersections in urban areas.
3. Locations with restricted sight distance (may be coupled with other factors cited).

Monotube

Bridge Mounted

Exit number panels are attached with I-beam posts to I-beam and overhead sign panels.

4.2 Regulatory Signs

4.2.1 Application of Regulatory Signs

Regulatory signs shall be used to inform road users of selected traffic laws or regulations and indicate the applicability of the legal requirements. Regulatory signs shall be installed at or near where the regulations apply. The signs shall clearly indicate the requirements imposed by the regulations and shall be designed and installed to provide adequate visibility and legibility in order to obtain compliance.

Regulatory signs shall be retroreflective (see Section 2-1) or illuminated to show the same shape and similar color by both day and night, unless specifically stated otherwise in the text discussion in the MN MUTCD for a particular sign or group of signs.

The requirements for sign illumination shall not be considered to be satisfied by street, highway, or strobe lighting.

4.2.2 Establishment of Priorities

Signs should be used only where warranted by facts and field studies. Signs are essential where special regulations apply at specific places or at specific times only, or where hazards are not self-evident.

Regulatory signs are not necessary to confirm rules of the road.

4.3 Warning Signs

Warning signs call attention to unexpected conditions on or adjacent to a highway, street, or private roads open to public travel and to situations that might not be readily apparent to road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations.

Since the primary purpose of warning signs is to gain attention of the unfamiliar motorist, the placement of warning signs is important. The placement must allow these drivers sufficient time to see the warning sign, understand the intent, identify the potential hazard, decide what action must be taken, and then to perform any necessary maneuver.

4.4 Guide Signing

4.4.1 Purpose

Guide signs are necessary to inform motorists of intersecting routes; to direct them to cities, towns, villages, or other important destinations; to identify nearby rivers, streams, parks, forests, and historical sites; and generally, to give such information as will help them along their way in the most simple, direct manner possible.

Numbered traffic routes and directional signs facilitate travel by enabling motorists to reach their intended destination when using an accurate map. Proper directional signing consists of Route Markers and Route Marker auxiliaries; Destination signs; Distance signs; and, where necessary, Advance Street Name signs.

Install Route Markers and Route Marker auxiliaries in sign assemblies to identify the numbered traffic route and provide additional guidance (such as general direction of the route and other information required to follow a designated numbered traffic route). Destination and Distance signs provide directions and distances to communities and points of interest that may be reached by following certain roads. Advance Street Name signs provide advance notice of the names of intersecting major streets and highways.

4.5 Work Zone and Detour Signing

All traffic control devices used on MnDOT street and highway construction or maintenance work shall conform to the specifications of the latest edition of the MN MUTCD, the MnDOT Standard Specifications for Construction; and all other appropriate MnDOT technical manuals.

All devices shall be placed where they will convey their messages most effectively so the driver will have adequate time to react. All traffic control devices must be kept clean to ensure proper effectiveness and retroreflectivity. All devices shall conform to the quality standards of the MN MUTCD Field Manual.

Exhibit 4-1 Sample Signs for Work Zones (Temporary Traffic Control)

5. SUPPLEMENTAL GUIDE SIGNS

5.1 Overview

Supplemental guide signs are guide signs that provide additional guidance like geographical identification and secondary destinations. Supplemental guide signs may be considered once the primary guide signs are installed. Some examples of geographical identification are city boundary (population) signs and major rivers. Secondary destinations typically include cities, motor services and traffic generators. MnDOT has guidance in the TEM for each supplemental guide signing program. These program requirements must be met and there must be space available prior to installing supplemental guide signs.

5.1.1 General Motor Service Signs

General motor service signs include the following services: gas, food, lodging, camping, and hospitals. The legend on General Motor Service signs includes the generic type of service. This signing program is covered in the Chapter 2I (General Service Signs) of the MN MUTCD.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- These signs may be installed at rural freeway and expressway interchanges.
- Each facility must meet certain criteria related to hours of operation, licensing, distance from the interchange, etc.
- The cost of fabrication, installation and maintenance are paid by MnDOT

Exhibit 5-1 Sample General Motorist Service Sign

5.1.2 Logo (Specific Service Signs)

Logo signs include the following services: gas, food, lodging, camping, 24-hour pharmacies and attractions. The legend on the Logo signs includes business identification and directional information.

The Minnesota Sign Franchise Program, which allows for the installation and maintenance of Logo Signs as established by Minnesota Statute 160.80 in 1984. This sign franchise is in general conformance with the Specific Service Signing guidelines in the National MUTCD. Eligible criteria for gas, food, lodging, camping and 24-hour pharmacies is contained in Minnesota Statute 160.80 and MnDOT's Sign Franchise Contract. They are covered in Chapter 2J (Specific Service (Logo) Signs) of the Mn MUTCD.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- Logo signs may be installed at freeway interchanges.
- Each facility must meet certain criteria related to hours of operation, licensing, distance from interchange, etc.
- Cost of fabrication, installation, and maintenance are paid by the business.
- The program is managed by Minnesota Logos, Inc. under an agreement with MnDOT.

Exhibit 5-2 Sample Logo (Specific Service) Sign

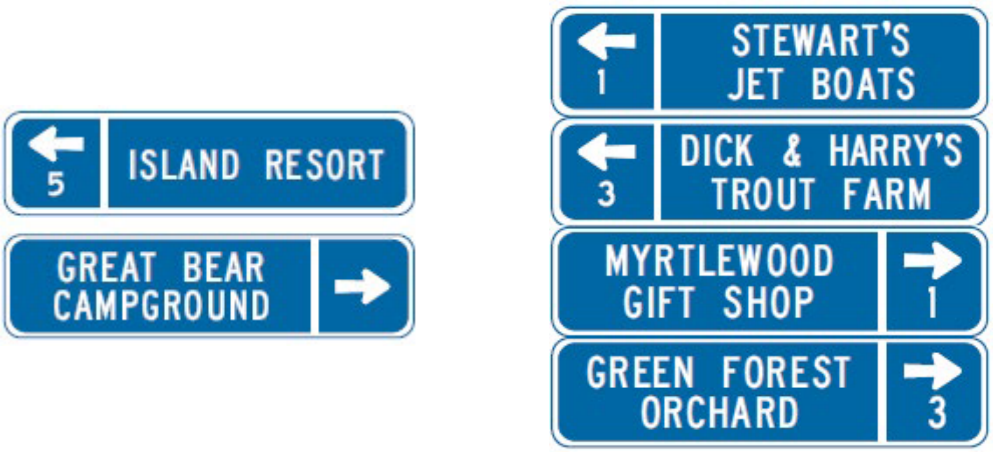
5.1.3 Specific Service Signs

Specific service signs include the following services: gas, food, lodging, places of worship, rural agricultural business, and tourist-oriented business. These signs are covered in Chapter 2K (Tourist-Oriented Directional Signs) of the Mn MUTCD and are also included in Minnesota Statutes 160.292-160.296.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- The criteria for installation of these signs (hours, types of business, etc.) are primarily defined in Minnesota Statues 160.292-160.296. MnDOT further clarifies some in the TEM.
- These signs can only be installed in rural areas at conventional road intersections or at rural bypasses that have interchanges on expressways.
- The cost of fabrication, installation, and maintenance of these signs are paid for by the facility. Trailblazing must be provided by the facility or local road authority.

Exhibit 5-3 Sample Specific Service Signs



5.1.4 Major Traffic Generator

Major traffic generators include major regional attractions, events, or facilities which attract persons or groups from beyond a local community, city, or metropolitan area. They are significant because of their unique educational, cultural, historical, or recreational experience and public appeal. Predominately retail, business, or manufacturing centers are not normally eligible for guide signing.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- Major regional attractions that attract persons or groups beyond the local area.
- Facilities must have a minimum of 10 events per year with an average event attendance of at least 5,000 persons.
- Signs may be installed on any trunk highway.
- The cost of fabrication, installation, and maintenance of these signs are paid by the traffic generator. Trailblazing must be provided by the facility or local road authority.

Exhibit 5-4 Sample Major Traffic Generator Sign

5.1.5 Minor Traffic Generators

Minor traffic generators are facilities which generally attract non-local persons or groups unfamiliar with the location of the generator, but which do not qualify as major traffic generators.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- Facilities have a broad motorist appeal, service non-familiar motorists, and are the type of facility for which a motorist normally expects highway signing.
- Facilities are typically cultural, recreational, or historic attractions.
- Facilities must meet certain criteria related to hours of operation, distance from intersection, etc.
- Signs may be installed at conventional road intersections and some expressway interchanges.
- The cost of fabrication, installation and maintenance of these signs are paid by the traffic generator. Trailblazing must be provided by the facility or local road authority.

Exhibit 5-5 Sample Minor Traffic Generator Sign

5.1.6 Other Traffic Generators

Other traffic generators are facilities which generally attract non-local persons or groups unfamiliar with the location of the generator, but do not qualify as major or minor traffic generators. These facilities include airports, casinos, educational institutions, national parks, regional shopping centers, and state parks. Criteria vary for each type.

MnDOT's TEM Chapter 6 has program requirements for each facility. Some considerations include:

- Signs may be installed on any trunk highway.
- The cost of fabrication, installation and maintenance of these signs are paid by the traffic generator. Trailblazing must be provided by the facility or local road authority.

5.2 Requester Pay Tech Memo

MnDOT established a standard sign cost based on sign size, type of structure and all associated labor costs for a typical sign installation. These costs are found in the Technical Memorandum No 17-06-T-01 Requester Pay Signing Costs.

5.3 External Sign Variance Committee

At the discretion of the District Traffic Engineer, signing requests denied based on MnDOT guidance may be appealed to the External Sign Variance Committee (ESVC). MnDOT retains the authority to deny requests for signing where acceptable standards cannot be met, including locations where other supplemental guide signs are already in place. Requests denied based on Minnesota statutes or engineering standards (i.e., insufficient space and design standards) may not be appealed.

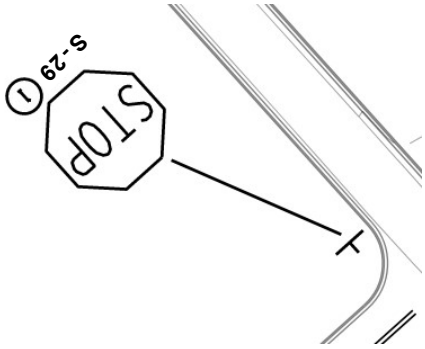
The ESVC is composed of persons outside of MnDOT who meet periodically to consider various requests for signing. The group serves as a variance committee making recommendations to the Commissioner's Office on signing requests that have been denied by the district office. The Commissioner has the ultimate authority to approve or deny variance requests.

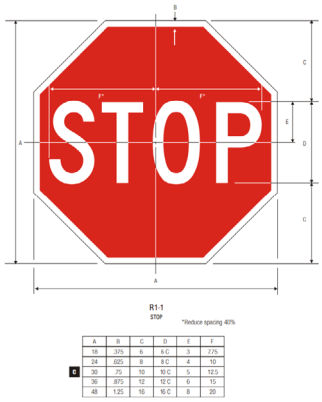
6. SIGN COMPONENTS

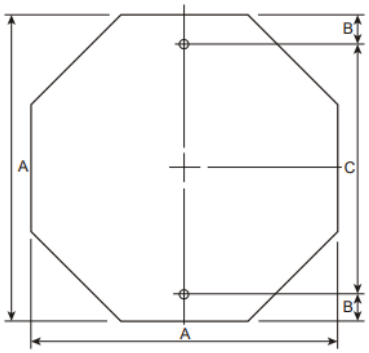
In this chapter, you will be introduced to some common pictures of traffic signs and sign components. In addition, refer to the next chapter for a discussion on signing plans and the Appendix for a copy of a sample plan.

6.1 Common Signs

Exhibit 6-1 Stop Signs



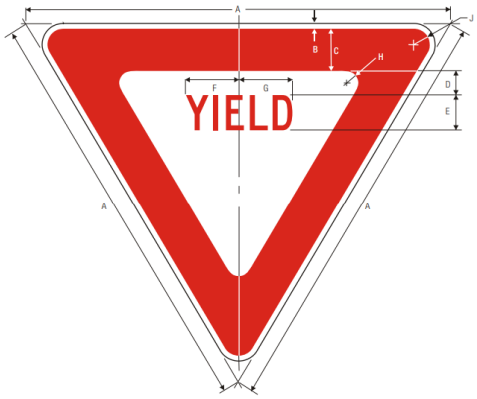




1 Post		
A	B	C
18	3	12
30	3	24

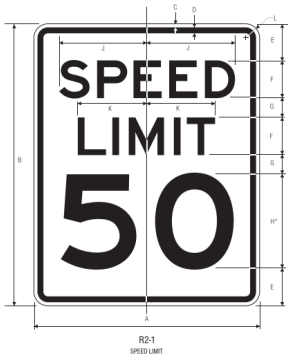
The picture on the upper left is a stop sign (R1-1) on a conventional road. The image in the upper right is the same sign on a signing plan set. The lower left is the layout of a stop sign in the Standard Signs and Markings Manual. The image in the lower right is the punching code layout for a stop sign on one post.

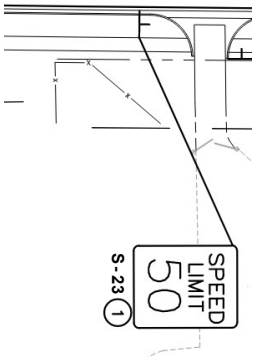
Exhibit 6-2 Yield Signs



The image on the left is a picture of a yield sign and the image on the right is from the Standard Signs and Markings Manual.

Exhibit 6-3 Speed Limit Sign



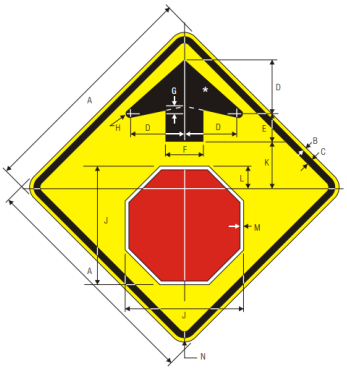


The picture in the upper left is a Speed Limit sign mounted on a square tube post. The image in the middle is from the Standard Signs and Markings Manual. The image on the right is a speed limit sign on a signing plan.

Exhibit 6-4 Lane Use Signs

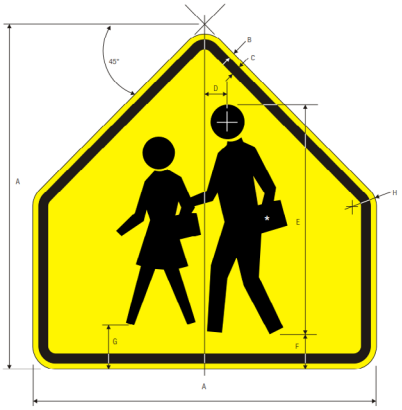
Images of a Lane Use Sign in advance of an intersection and associated information from the Standard Signs and Markings Summary.

Exhibit 6-5 Stop Ahead Signs



Images are of a stop ahead warning sign and the layout per the Standard Signs and Markings Manual.

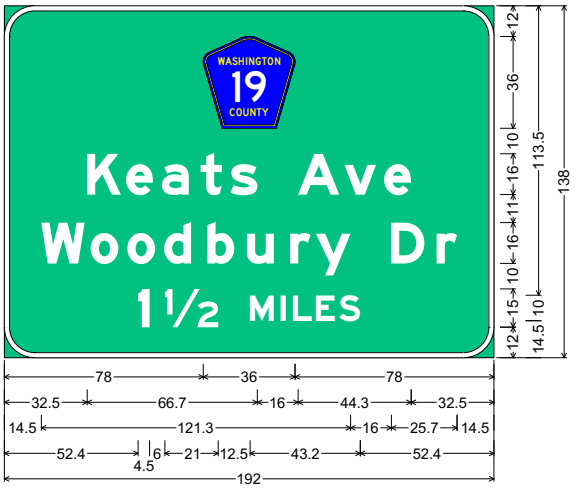
Exhibit 6-6 School Crossing Signs



Images of a school crossing sign and the layout from the Standard Signs and Markings Manual.

Exhibit 6-7 Guide Signs

The image above is a series of guide signs on an overhead structure. The images below are of the advance guide sign panel and the a screenshot of that panel from the SignCad® software which MnDOT uses to design Guide Signs.



COUNTY 19 Keats Ave Woodbury Dr 1 1/2 MILES; 12.0" Radius, 2.0" Border, White on, Green; Pentagonal County 19 M1-6M; "Keats Ave", E Mod 2K; "Woodbury Dr", E Mod 2K; "1 ½ MILES", E Mod 2K;

6.2 Sign Structures

Exhibit 6-8 Sign on Square Tube Post

The image on the left is a picture of square tube nested in the ground (fin base or three wall base). The image in the middle is a picture of a shear base and the image on the right is a picture of a slip base.

The square tube sign post when hit can react either by bending over and the vehicle runs it over (left installation) or having the bolts break and the sign will go up and over the vehicle (middle and right installations).

Exhibit 6-9 Monotube Guide Sign Mounting

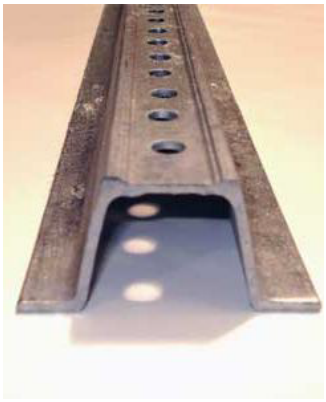
The above picture shows a monotube overhead sign structure.

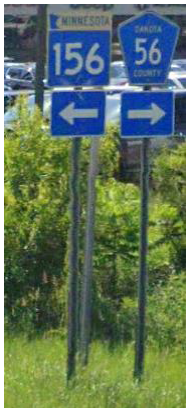
Exhibit 6-10 Truss Structure Guide Sign Mounting

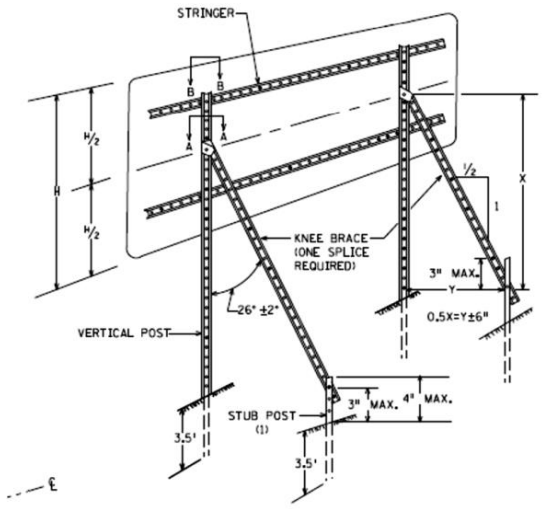
Above are pictures of a sign truss structure for guide signing.

Exhibit 6-11 U-Post Mounted Signs with Knee Braces







The images above show a variety of signs mounted with U-posts and knee braces. In this instance, the sign requires two knee braces. This is MnDOT's former standard and is no longer installed on MnDOT roadways.

The use of U-post and knee braces was the past (prior to 2020) standard. Current designs will no longer utilize this structure, and will instead use square tube, or other approved mounting methods.

Exhibit 6-12 Traffic Signal Mounted Signs

6.3 Other Signs

Exhibit 6-13 Scenic Byway Signing

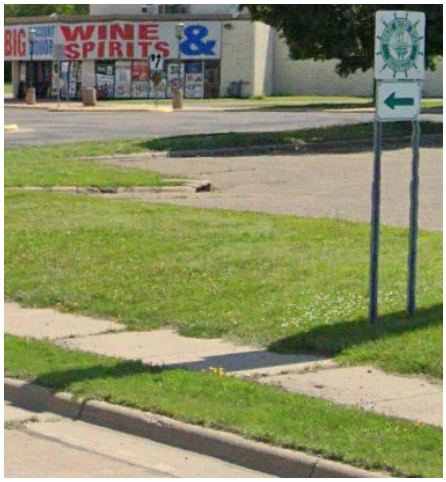
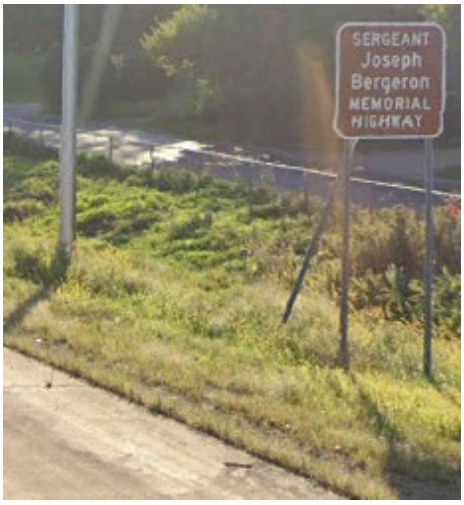


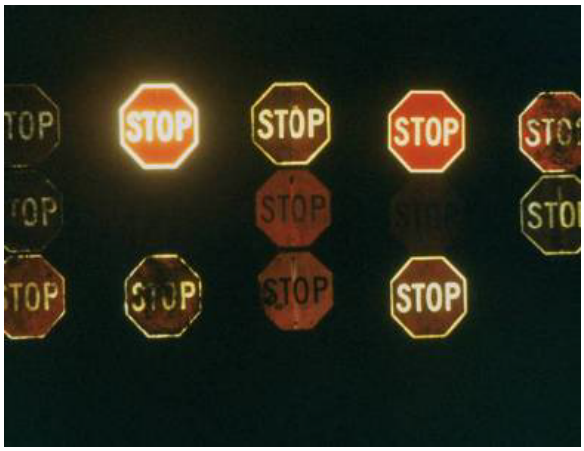
Exhibit 6-14 Six Panel Logo Signs

Exhibit 6-15 Memorial Signing



6.4 Sign Degradation

Exhibit 6-16 Faded Signs



6.5 Sign Installations and Maintenance

Exhibit 6-17 Sign Removal

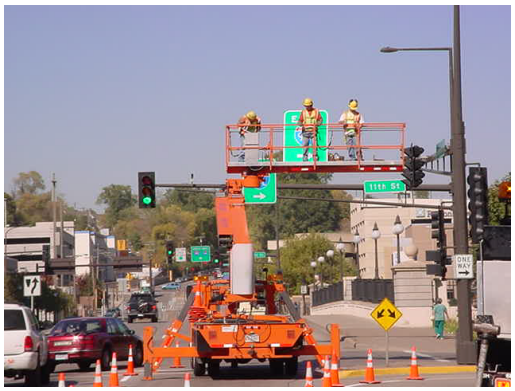
Exhibit 6-18 Repairing Signs

Images of maintenance crews repairing guide signs.

Exhibit 6-19 Flashing Stop Sign Installation

Installation of a stop sign with a flashing border.

Exhibit 6-20 Installing Mast Arm Signing



Various images of sign crews installing signs on traffic signal mast arms. Notice the size of the sign and the equipment required for this operation.

Exhibit 6-21 Images of Sign Hit by Contractor Equipment

Exhibit 6-22 Images of Sign Hit by Vehicle

7. SIGNING PLAN SETS

7.1 Design

Standard detail sheets for signing plans can be found on the OTE website:

http://www.dot.state.mn.us/trafficeng/signing/plans.html. The plan format and sequence of details is as follows:

1. Title sheet.
2. Statement of estimated quantities.
3. Sign data sheets.
4. Standard plans.
5. Standard details.
6. Utility sheet.
7. Traffic barrier data sheets.
8. Roadway signing layouts.
9. Sign panel drawings for all non-standard signs.
10. Structure elevations for I-beam and overhead signs.

Final signal plans should be prepared on 11” x 17” plan sheets.

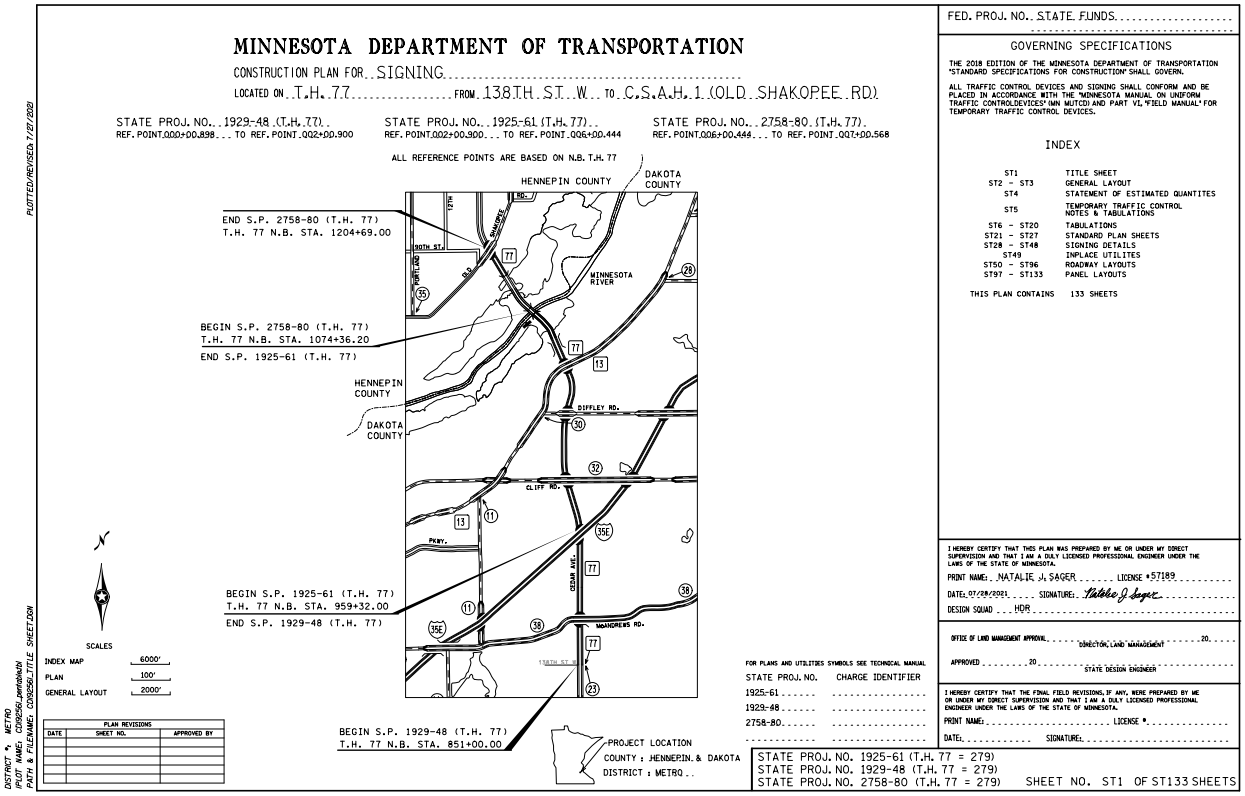
The licensed professional engineer responsible for or under whose supervision the work is performed shall sign the title sheet.

For the current sample plan sets available online, refer to the following link: http://www.dot.state.mn.us/trafficeng/signing/plans.html

Future training courses are planned for three signing plan design areas: conventional roads, expressways and complex intersections, and freeways.

7.2 Title Sheet

The Title Sheet includes information such as the title block, project location, governing specifications, etc. A sample title sheet is shown below from the sample plan.



MINNESOTA DEPARTMENT OF TRANSPORTATION

CONSTRUCTION PLAN FOR SIGNING

LOCATED ON T.H. 77 FROM 138TH ST. W. TO C.S.A.H. 1 (OLD SHAKOPEE RD)

STATE PROJ. NO. 1929-48 (T.H. 77)
REF. POINT 000+00.898 TO REF. POINT 002+00.900

STATE PROJ. NO. 1925-61 (T.H. 77)
REF. POINT 002+00.900 TO REF. POINT 006+00.444

STATE PROJ. NO. 2758-80 (T.H. 77)
REF. POINT 006+00.444 TO REF. POINT 007+00.568

ALL REFERENCE POINTS ARE BASED ON N.B. T.H. 77

END S.P. 2758-80 (T.H. 77)
T.H. 77 N.B. STA. 1204+69.00

BEGIN S.P. 2758-80 (T.H. 77)
T.H. 77 N.B. STA. 1074+36.20
END S.P. 1925-61 (T.H. 77)

BEGIN S.P. 1925-61 (T.H. 77)
T.H. 77 N.B. STA. 959+32.00
END S.P. 1929-48 (T.H. 77)

BEGIN S.P. 1929-48 (T.H. 77)
T.H. 77 N.B. STA. 851+00.00

HENNEPIN COUNTY
DAKOTA COUNTY
MINNESOTA RIVER
DIFFLEY RD.
CLIFF RD.
PKWY.
CEDAR AVE.
MCANDREWS RD.
138TH ST.
PORTLAND AVE.
90TH ST.

SCALES
INDEX MAP 6000'
PLAN 100'
GENERAL LAYOUT 2000'

PLAN REVISIONS

DATE	SHEET NO.	APPROVED BY

PROJECT LOCATION
COUNTY : HENNEPIN & DAKOTA
DISTRICT : METRO

FOR PLANS AND UTILITIES SYMBOLS SEE TECHNICAL MANUAL

STATE PROJ. NO.	CHARGE IDENTIFIER
1925-61	
1929-48	
2758-80	

FED. PROJ. NO. STATE FUNDS

GOVERNING SPECIFICATIONS

THE 2018 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

ALL TRAFFIC CONTROL DEVICES AND SIGNING SHALL CONFORM AND BE PLACED IN ACCORDANCE WITH THE "MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROLDEVICES" (MN MUTCD) AND PART VI, "FIELD MANUAL" FOR TEMPORARY TRAFFIC CONTROL DEVICES.

INDEX

THIS PLAN CONTAINS 133 SHEETS

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: NATALIE J. SAGER LICENSE #57189

DATE: 07/28/2021 SIGNATURE: Natalie J Sager

DESIGN SQUAD HDR

OFFICE OF LAND MANAGEMENT APPROVAL DIRECTOR, LAND MANAGEMENT 20

APPROVED 20 STATE DESIGN ENGINEER

I HEREBY CERTIFY THAT THE FINAL FIELD REVISIONS, IF ANY, WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: LICENSE #

DATE: SIGNATURE:

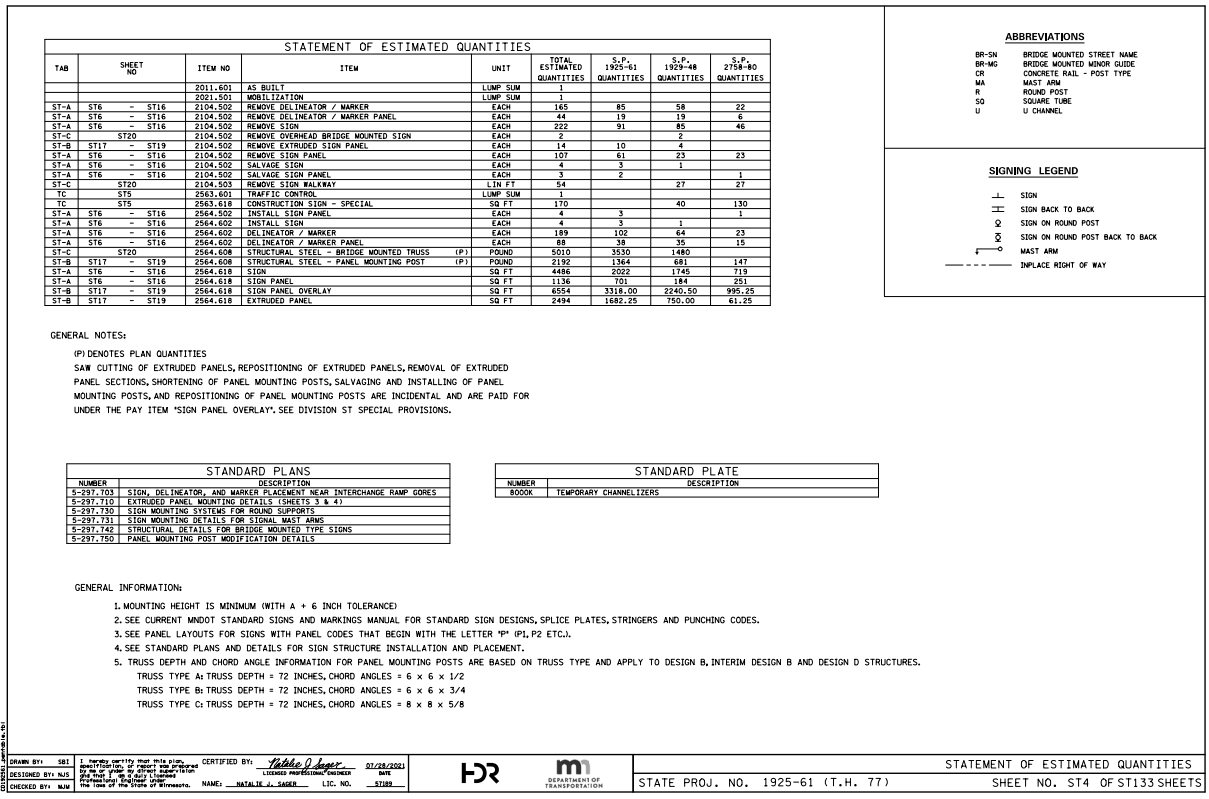
STATE PROJ. NO. 1925-61 (T.H. 77 = 279)
STATE PROJ. NO. 1929-48 (T.H. 77 = 279)
STATE PROJ. NO. 2758-80 (T.H. 77 = 279) SHEET NO. ST1 OF ST133 SHEETS

PLOTTED/REVISED 7/27/2020

DISTRICT METRO
PLOT NAME: C20250_PRINTMAP
PATH & FILENAME: C20250_TITLE SHEET.DGN

7.3 Estimated Quantities

The Estimated Quantities sheet includes the statement of estimated quantities, and any notes that are required to clarify information included in the statement of estimated quantities. A sample estimated quantities sheet is shown below from the sample plan.



STATEMENT OF ESTIMATED QUANTITIES

TAB	SHEET NO	ITEM NO	ITEM	UNIT	TOTAL ESTIMATED QUANTITIES	S.P. 1925-61 QUANTITIES	S.P. 1929-48 QUANTITIES	S.P. 2758-80 QUANTITIES
		2011.601	AS BUILT	LUMP SUM	1			
		2021.501	MOBILIZATION	LUMP SUM	1			
ST-A	ST6 - ST16	2104.502	REMOVE DELINEATOR / MARKER	EACH	165	85	58	22
ST-A	ST6 - ST16	2104.502	REMOVE DELINEATOR / MARKER PANEL	EACH	44	19	19	6
ST-A	ST6 - ST16	2104.502	REMOVE SIGN	EACH	222	91	85	46
ST-C	ST20	2104.502	REMOVE OVERHEAD BRIDGE MOUNTED SIGN	EACH	2		2	
ST-B	ST17 - ST19	2104.502	REMOVE EXTRUDED SIGN PANEL	EACH	14	10	4	
ST-A	ST6 - ST16	2104.502	REMOVE SIGN PANEL	EACH	107	61	23	23
ST-A	ST6 - ST16	2104.502	SALVAGE SIGN	EACH	4	3	1	
ST-A	ST6 - ST16	2104.502	SALVAGE SIGN PANEL	EACH	3	2		1
ST-C	ST20	2104.503	REMOVE SIGN WALKWAY	LIN FT	54		27	27
TC	ST5	2563.601	TRAFFIC CONTROL	LUMP SUM	1			
TC	ST5	2563.618	CONSTRUCTION SIGN - SPECIAL	SQ FT	170		40	130
ST-A	ST6 - ST16	2564.502	INSTALL SIGN PANEL	EACH	4	3		1
ST-A	ST6 - ST16	2564.602	INSTALL SIGN	EACH	4	3	1	
ST-A	ST6 - ST16	2564.602	DELINEATOR / MARKER	EACH	189	102	64	23
ST-A	ST6 - ST16	2564.602	DELINEATOR / MARKER PANEL	EACH	88	38	35	15
ST-C	ST20	2564.608	STRUCTURAL STEEL - BRIDGE MOUNTED TRUSS (P)	POUND	5010	3530	1480	
ST-B	ST17 - ST19	2564.608	STRUCTURAL STEEL - PANEL MOUNTING POST (P)	POUND	2192	1364	681	147
ST-A	ST6 - ST16	2564.618	SIGN	SQ FT	4486	2022	1745	719
ST-A	ST6 - ST16	2564.618	SIGN PANEL	SQ FT	1136	701	184	251
ST-B	ST17 - ST19	2564.618	SIGN PANEL OVERLAY	SQ FT	6554	3318.00	2240.50	995.25
ST-B	ST17 - ST19	2564.618	EXTRUDED PANEL	SQ FT	2494	1682.25	750.00	61.25

ABBREVIATIONS

BR-SN	BRIDGE MOUNTED STREET NAME
BR-MG	BRIDGE MOUNTED MINOR GUIDE
CR	CONCRETE RAIL - POST TYPE
MA	MAST ARM
R	ROUND POST
SQ	SQUARE TUBE
U	U CHANNEL

SIGNING LEGEND

- SIGN
- SIGN BACK TO BACK
- SIGN ON ROUND POST
- SIGN ON ROUND POST BACK TO BACK
- MAST ARM
- INPLACE RIGHT OF WAY

GENERAL NOTES:

(P) DENOTES PLAN QUANTITIES

SAW CUTTING OF EXTRUDED PANELS, REPOSITIONING OF EXTRUDED PANELS, REMOVAL OF EXTRUDED PANEL SECTIONS, SHORTENING OF PANEL MOUNTING POSTS, SALVAGING AND INSTALLING OF PANEL MOUNTING POSTS, AND REPOSITIONING OF PANEL MOUNTING POSTS ARE INCIDENTAL AND ARE PAID FOR UNDER THE PAY ITEM "SIGN PANEL OVERLAY". SEE DIVISION ST SPECIAL PROVISIONS.

STANDARD PLANS

NUMBER	DESCRIPTION
5-297.703	SIGN, DELINEATOR, AND MARKER PLACEMENT NEAR INTERCHANGE RAMP GORES
5-297.710	EXTRUDED PANEL MOUNTING DETAILS (SHEETS 3 & 4)
5-297.730	SIGN MOUNTING SYSTEMS FOR ROUND SUPPORTS
5-297.731	SIGN MOUNTING DETAILS FOR SIGNAL MAST ARMS
5-297.742	STRUCTURAL DETAILS FOR BRIDGE MOUNTED TYPE SIGNS
5-297.750	PANEL MOUNTING POST MODIFICATION DETAILS

STANDARD PLATE

NUMBER	DESCRIPTION
8000K	TEMPORARY CHANNELIZERS

GENERAL INFORMATION:

1. MOUNTING HEIGHT IS MINIMUM (WITH A + 6 INCH TOLERANCE)
2. SEE CURRENT MNDOT STANDARD SIGNS AND MARKINGS MANUAL FOR STANDARD SIGN DESIGNS, SPLICE PLATES, STRINGERS AND PUNCHING CODES.
3. SEE PANEL LAYOUTS FOR SIGNS WITH PANEL CODES THAT BEGIN WITH THE LETTER "P" (P1, P2 ETC.).
4. SEE STANDARD PLANS AND DETAILS FOR SIGN STRUCTURE INSTALLATION AND PLACEMENT.
5. TRUSS DEPTH AND CHORD ANGLE INFORMATION FOR PANEL MOUNTING POSTS ARE BASED ON TRUSS TYPE AND APPLY TO DESIGN B, INTERIM DESIGN B AND DESIGN D STRUCTURES.
   - TRUSS TYPE A: TRUSS DEPTH = 72 INCHES, CHORD ANGLES = 6 x 6 x 1/2
   - TRUSS TYPE B: TRUSS DEPTH = 72 INCHES, CHORD ANGLES = 6 x 6 x 3/4
   - TRUSS TYPE C: TRUSS DEPTH = 72 INCHES, CHORD ANGLES = 8 x 8 x 5/8

DRAWN BY: SBI
DESIGNED BY: NJS
CHECKED BY: NJW

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

CERTIFIED BY: Natalie J. Sager — LICENSED PROFESSIONAL ENGINEER — DATE 07/28/2021
NAME: NATALIE J. SAGER LIC. NO. 57189

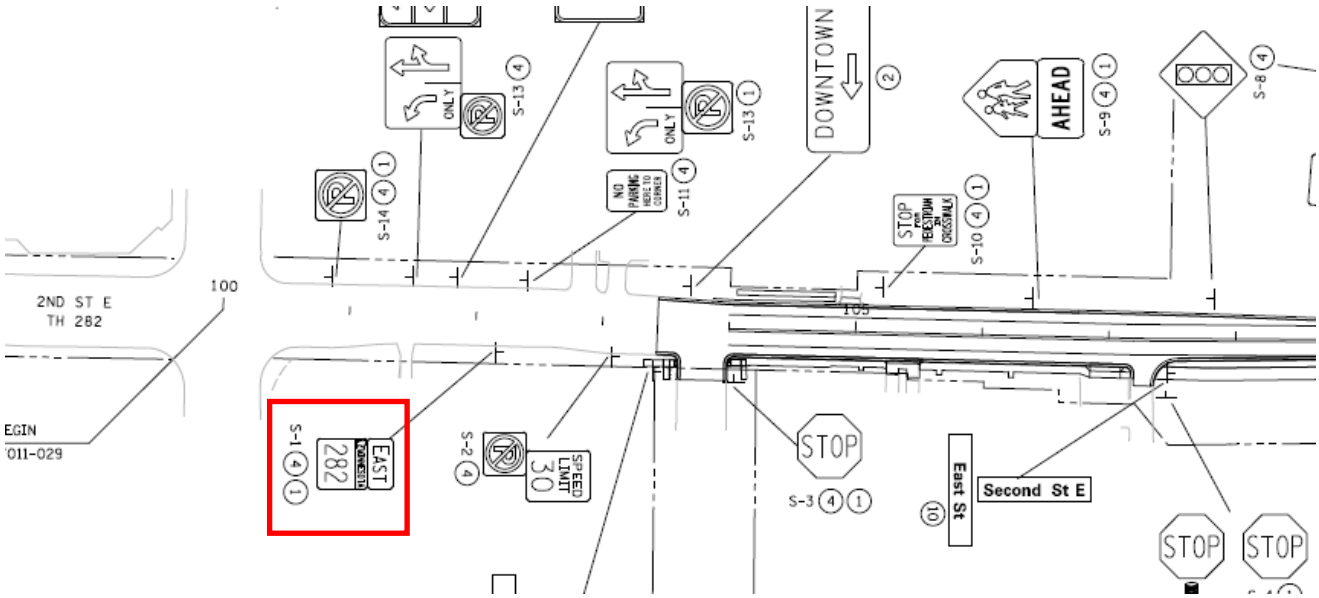
HDR — DEPARTMENT OF TRANSPORTATION

STATEMENT OF ESTIMATED QUANTITIES
STATE PROJ. NO. 1925-61 (T.H. 77) SHEET NO. ST4 OF ST133 SHEETS

7.4 Sign Data Sheets

The sign data sheets include a summary of data that is pertinent to the signs within the project area. Below is an example of a sign data sheet.

SIGN AND DELINEATOR / MARKER										
SIGN NUMBER	PANEL					SUPPORT			REMOVE SIGN	SIGN
	PANEL CODE	LEGEND	SIZE (W x H)	MOUNTING HEIGHT	A DISTANCE	TYPE	RISER POST SIZE	NUMBER OF POSTS		
			INCH	FEET	FEET		INCHES		EACH	SQ FT
S-1	M3-2	EAST (COLOR)	24 x 12	7		SQ-SOIL	2	1	1	2.00
	M1-5M	MINNESOTA HWY 282	24 x 24							4.00
S-2	R2-1	SPEED LIMIT 30	24 x 30			SQ-SOIL	2	1	1	
	R8-3	NO PARKING	24 x 24							
S-3	R1-1	STOP	30 x 30	7		SQ-SOIL	2	1	1	6.25
S-4	R1-1	STOP	30 x 30	7		SQ-SOIL	2	1	1	6.25

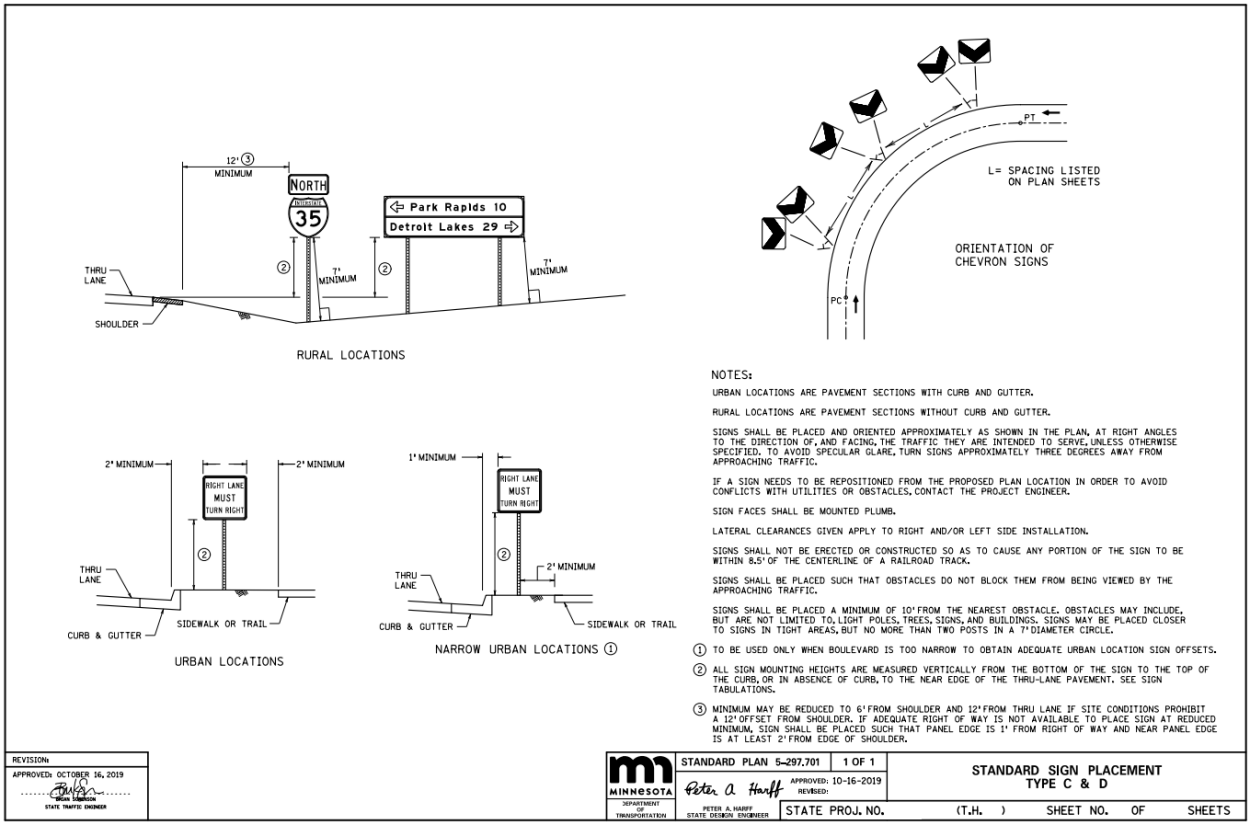


In the above image, the sign S-1 is boxed out on the Sign Panels Type C summary table and in an example from the layout sheet. In the table, the following headings are used:

- ✓ SIGN NUMBER: the number of the sign in the plan.
- ✓ PANEL CODE: the name of the sign based on MUTCD sign code.
- ✓ LEGEND: the message on the sign.
- ✓ SIZE: the size of the panel in inches, width by the height.
- ✓ MOUNTING HEIGHT: the height measured from the bottom of the lowest sign panel on the sign assembly to the road measured in feet.
- ✓ A DISTANCE: the distance measured from the sign panel to the end of a horizontal beam. This is only used on mast arms and monotube sign structures.
- ✓ TYPE: the type of structure the sign panel is installed on.
- ✓ RISER POST SIZE: the width in inches of the riser post. This is only used for square tube sign structure.
- ✓ NUMBER OF POSTS: the number of vertical riser posts.
- ✓ PAY ITEMS: the rest of the columns are specific pay items associated with each action the contractor needs to take for each sign.

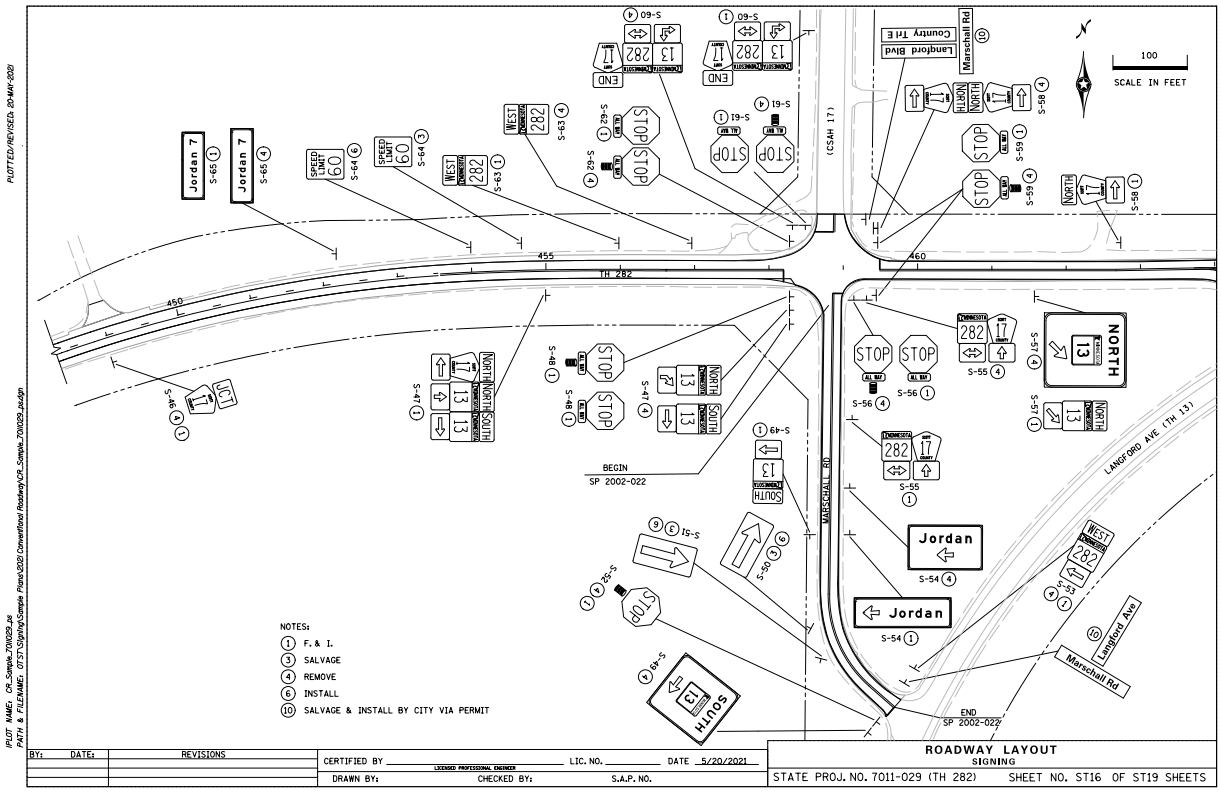
7.5 Standard Plans

The standard plans include all the MnDOT standard plan sheets that are relevant to the project.



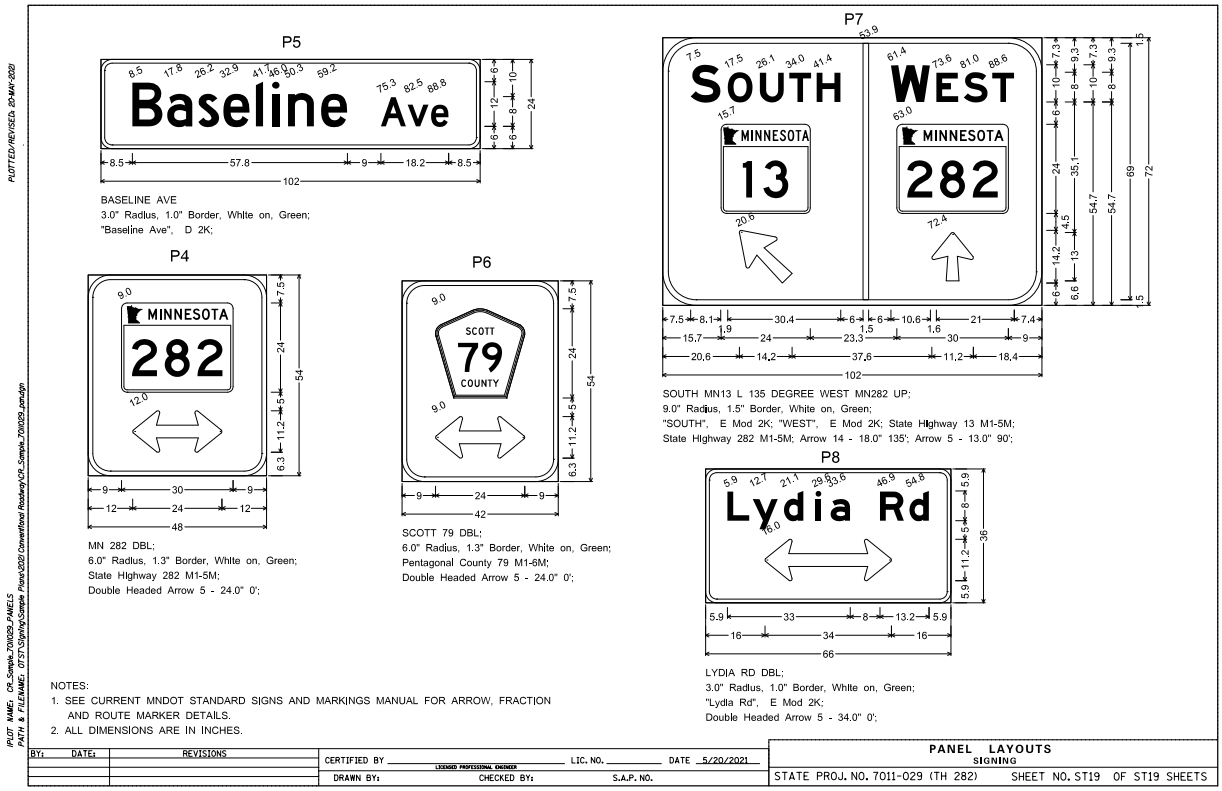
7.6 Roadway Signing Layouts

The roadway signing layouts show the detailed layout and location of the inplace and proposed signs within the project area, and the work to be completed for each sign.



7.7 Sign Panel Layout Sheet

When sign panels exist, the layout details will be shown on these sheets. MnDOT uses the software SignCAD® to layout guide signs.

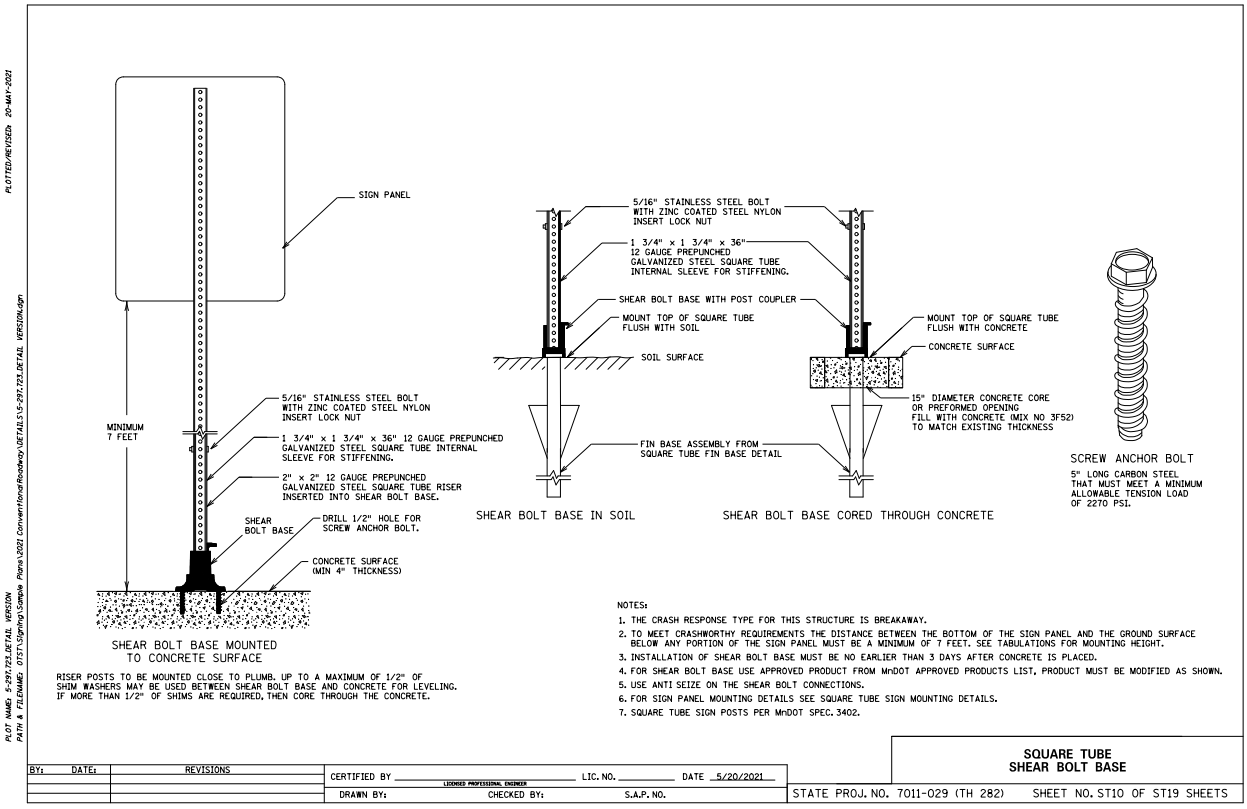


7.8 Structural Details

OTE Signing is in the process of converting all standard details into standard plan sheets. Most have already been converted and need to be included in a separate standard plan sheets section. The full list is found on the OTE website: http://www.dot.state.mn.us/trafficeng/signing/plans.html.

Sheet Number/PDF	DGN File	Standard Plan Name/Description
Placement		
5-297.701	DGN	Standard Sign Placement
5-297.702	DGN	Delineator and Marker Placement
5-297.703	DGN	Sign, Delineator, and Marker Placement near Interchange Ramp Gores
Square Tube Sign Structures		
PDF	DGN	Square Tube Mounting Details
PDF	DGN	Side By Side Square Tube Mounting Detail
PDF	DGN	No Passing Zone Panel Square Tube Mounting Detail
5-297.721	DGN	Three-Wall Base
PDF	DGN	Square Tube Fin Base
PDF	DGN	Square Tube Fin Base Cored Through Concrete Detail
PDF	DGN	Square Tube Shear Bolt Base
PDF	DGN	Square Tube Shear Bolt Base in Soil Detail
PDF	DGN	Square Tube Slip Base
PDF	DGN	Square Tube Slip Base Mounted to Concrete Surface
Signs Mounted on Other Structures		
5-297.726	DGN	Sign Mounted on Concrete Wall
5-297.730	DGN	Sign Mounting Systems for Round Supports
5-297.731	DGN	Sign Mounting Details for Signal Mast Arms
5-297.740	DGN	Concrete Rail Mounted Sign
5-297.741	DGN	Structural Details for Bridge Mounted Type D Signs - Street Name
5-297.742	DGN	Structural Details for Bridge Mounted Type D Signs - Minor Guide Signs
Extruded Panels and Panel Mounting Posts		
5-297.710	DGN	Extruded Panel Mounting Details
5-297.750	DGN	Panel Mounting Post Modification Details
I-Beam Sign Structures		
5-297.711	DGN	I-Beam Supported Sign Structural Details
5-297.713	DGN	I-Beam Supported Sign Structural Details - Shallow Spread Footing

Below is an example of a standard detail sheet that has not yet been converted to a standard plan sheet.



8. MAINTENANCE OF SIGNS

8.1 Signing Responsibilities

Effective sign maintenance is important from a customer satisfaction perspective and from a safety aspect in reducing crashes. Careful management of sign maintenance at all levels throughout the state is essential.

Altogether, many organizations within the state are involved in signing and each has their necessary function and area of responsibility. The flow line of information and direction starts with state regulations and policies and ends with the actual installation and maintenance of the signs.

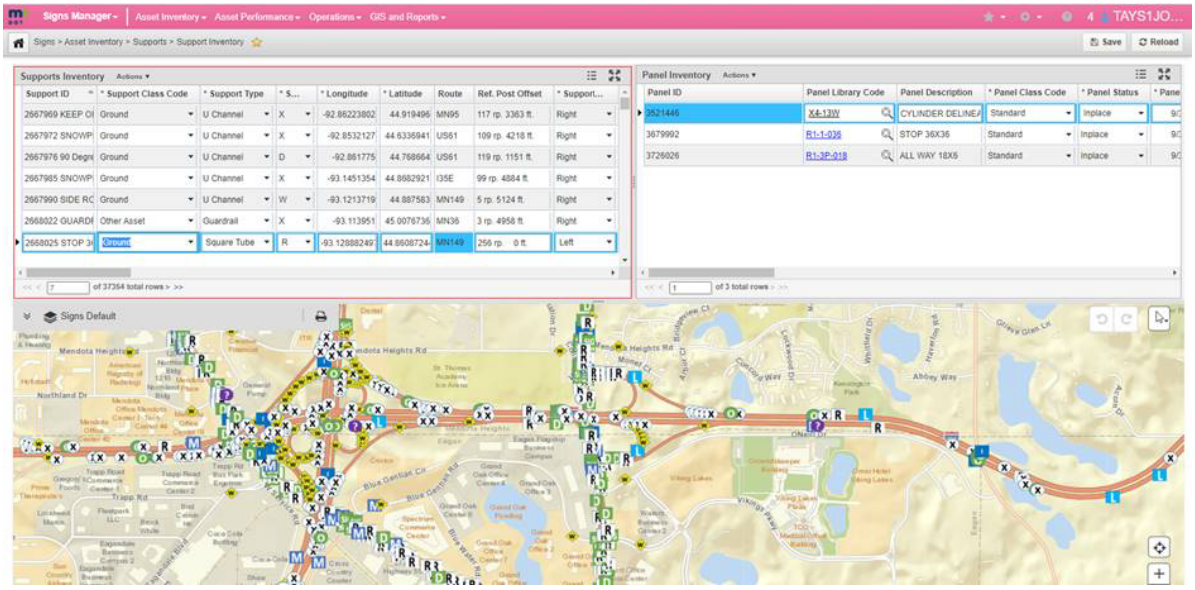
8.2 Maintenance Methods

MnDOT typically completes a blanket replacement of all signs every 15 years. For maintenance of larger sign structures, MnDOT inspects overhead sign bridges every 5 years and roadway bridge mounted sign structures every 2 years in conjunction with bridge inspections.

Local agencies may use the MN LTAP "Minnesota's Best Practices for Traffic Sign Maintenance/ Management Handbook", available at the following link: www.mnltap.umn.edu/publications/handbooks/

MnDOT uses their Transportation Asset Management System (TAMS) application to manage their full inventory of signs.

Exhibit 8-1 MnDOT Transportation Asset Management System



9. NEW TECHNOLOGIES

Below are summaries of several new or emerging technologies. Further details can be found on the MnDOT ITS website at the following link: http://www.dot.state.mn.us/its/

9.1 Truck Parking and Management System

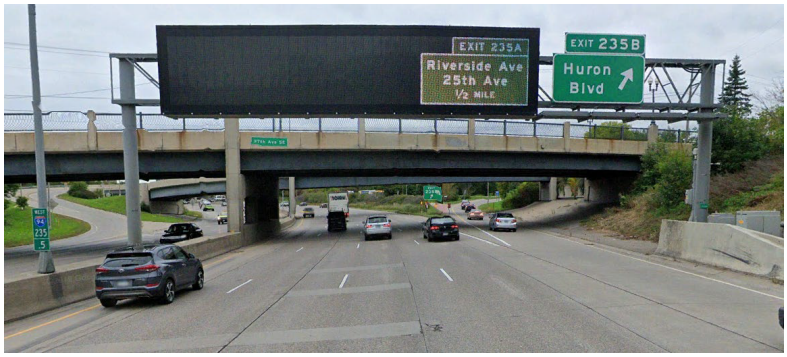
The goal of the Truck Parking and Management System (TPIMS) project is to reduce the time searching for parking and provide a safe truck parking alternative. The system monitors truck parking availability at selected sites and provides real-time information to truck drivers.

Exhibit 9-1 Truck Parking and Management System Signs

9.2 Variable Static Sign Panel Images on Dynamic Message Sign

At locations where wayfinding guidance needs to be flexible as traffic conditions change, a dynamic message sign (DMS) may be used to display a digital version of a static guide sign panel. On TH 94 westbound at the exit to Huron Blvd in Minneapolis, MnDOT installed a 45' x 10' DMS to provide flexibility to display different static guide sign panel images as conditions warrant.

Exhibit 9-2 DMS with Variable Static Guide Sign Panel Image



9.3 Driver Feedback Signs

A driver feedback sign (DFS) is a device that detects and display a vehicle's current speed back to the driver. Driver feedback signs have been shown to have a significant speed-reducing effect in temporary applications such as work zones or neighborhood speed watch programs.

Exhibit 9-3 Driver Feedback Sign

9.4 Curve Warning System

The Curve Warning System provides a programmable active warning based on the speed of the vehicle as it approaches the curve, and provides a warning message to the driver to reduce speed if it is excessive.

A dynamic curve warning sign (DCWS) is a low-cost technology that may help drivers select an appropriate speed when approaching a horizontal curve. A DCWS generally consists of a warning sign combined with a speed measuring device (e.g., radar) that activates a variable message (e.g., slow down) when vehicles are traveling above a set threshold. The technologies used to create a DCWS are currently available and the devices have been implemented at various locations.

Exhibit 9-4 Curve Warning System Signs

9.5 Truck Rollover Warning System (TROWS)

MnDOT's Truck Rollover Warning System (TROWS) uses a 3-beam sensor mounted over each lane to determine the vehicle speed and height and warn if a truck is potentially traveling too fast.

The system shown in Exhibit 9-5 is located at I-94 WB in Minneapolis prior to the Lowry Hill Tunnel west of I-35W. It includes three speed signs with LEDs in the border, one small DMS on the right-hand side and an intelligent lane control signal (ILCS) on the left.

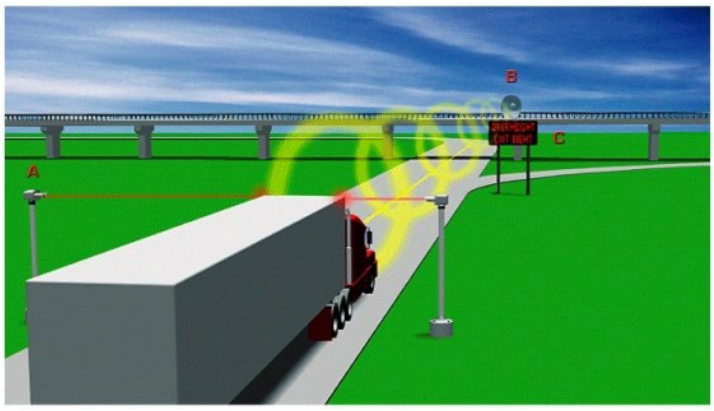
When a vehicle is exceeding the speed and height, the system turns on the appropriate lane signs, and activates the ILCS and DMS at the same time.

Exhibit 9-5 Truck Rollover Warning Systems (TROWS)

9.6 Overheight Warning System

This type of system detects overheight vehicles moving toward obstacles such as bridges, tunnels and other overhead structures and individually warns drivers. A sign is activated when an over height vehicle is detected by the system. The purpose of this system is to detect over-height vehicles and warn the drivers of the impending problem. This will enable them to exit the freeway and avoid the possibility of contact with the bridge. An infrared light beam and a remote lighted message sign will be included in the components of this system.

Exhibit 9-6 Overheight Warning System



9.7 Water on Road System

This type of system is a highway sensor that measures the presence of water on the roadway and is linked to traveler information systems. The purpose is to warn drivers of water on a roadway advising them not to pass.

Exhibit 9-7 Water on Road System

9.8 Fog Warning System

This type of system is a highway visibility sensor that measures the density of roadway fog and is linked to traveler information systems. The need for a highway fog warning system has long been internationally recognized. With such a system, motorists can avoid tragic pile-up accidents caused by dense or patchy fog, which are often fatal.

Exhibit 9-8 Fog Warning System

10. APPENDIX

10.1 Frequently Asked Questions

MnDOT Office of Traffic Engineering Signing frequently asked questions are available at the following link:

http://www.dot.state.mn.us/trafficeng/signing/faq.html