SIGN SUPPORT

INSPECTION

GUIDELINES

Ministry of Transportation
Bridge Office
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II. OVERVIEW OF GUIDELINES

A. INTRODUCTION

These guidelines describe the inventory, inspection and repair procedures for overhead sign support structures. The general philosophy of inspection, based on the "severity and extent" of defects, is the same as is used in the October 2000 Ontario Structure Inspection Manual (OSIM). Similar to bridges, sign support structures are divided in discrete elements for inspection. However, only defects in the poor and fair condition states will be recorded. This is due to the fact that a thorough deterioration model does not exist for sign support structures. The inspection procedure involves inspecting each element separately and a count of each element type in the fair and poor condition states is recorded.

The guidelines also give describe procedures for determining the need for maintenance work, repair work, and the urgency for this work. Most the existing types of sign supports are described in the guidelines. For sign supports that do not fit one of the standards listed, the philosophy of these guidelines should be adapted to suit the particular need of the inspection. These guidelines cover only those sign supports that extend over the roadway and it do not cover roadside signs, either breakaway or non-breakaway sign supports. The guidelines also do not cover electrical poles, camera poles or high-mast lighting poles.

B. INVENTORY

The information on the inventory data sheets provided in Appendix C is to be completed for each structure, as described in Part III. The information collected includes information to describe the location of the sign support, as well as sufficient information to describe the type and span of the structure, the type of footings, and sign sizes. Also collected is information such as the year of construction and other historical data. The quantities for each element must also be determined. Some procedures are provided to calculate quantities in cases where, due to the large number of members involved, counting would be too time consuming.

C. INSPECTION

An overview of the inspection requirements is provided in Part IV of these guidelines. Information on each element can be found in Part V. All elements should be inspected and the information recorded. The following should be noted for performing inspections:

1. Sign support inspection should be done on a regular basis. The MTO will use:
   - A two-year inspection cycle for the older aluminum sign supports {Aluminum Tapered Leg (ATL), Aluminum Circular Leg (ACL), Aluminum Rectangular Leg (ARL)}.
   - A four-year inspection cycle for the newer steel and aluminum hybrid sign supports {Changeable Message Sign (CMS)}, other steel designs {Trichord (TC), Cantilever (C)}, Monotube (MT)}, and also bridge mounted sign supports (BM).

   The frequency of inspections given above, applies to all structures in good repair. The maximum inspection interval and the level of inspection may however vary for certain structures. Some structures may have to be inspected more frequently as directed the Engineer. Such action can be justified based upon the type of structure, construction details, existing problems or restrictions, and material and performance condition history.

2. Appropriate safety and traffic control regulations and guidelines are to be followed during the inspections. These safety procedures and traffic control guidelines are not covered in these guidelines.
3. These guidelines should be followed to ensure uniform inspection procedures, and to ensure that useful information is obtained for the scheduling repairs of the sign supports.
4. The inspection is to be done by:
   - Professional Engineers with a background in inspection, design and construction of sign supports, or
   - Trained inspectors reporting to, or under the supervision of, a Professional Engineer.
5. The inspection is a detailed visual inspection, examining all the components from as close a distance as is necessary to determine the condition of the element. This is a hands-on inspection where all components such as bolts or clamps are tapped by a hammer or checked by hand and all welds are checked from a distance of about 30cm in order to be able to identify hairline cracks. If needed, the sign support can be flagged for a more specialized inspection, including Non-Destructive Testing (NDT) of the welds. The NDT methods of inspection are not covered in these guidelines.
6. The inspection should use the Condition State Tables 4 through 9 in Part IV, and the information provided in Part V, Section D, sub-section 1 through 6 of the guidelines. Table 3 provides a cross-reference for all elements, showing the units of measure and the applicable condition state tables.
7. The inspection information should be recorded on the forms provided in Appendix D.
8. The guidelines provide guidance for maintenance and repair requirements for sign supports. These recommendations should be made for each element using the information provided in Part VI.
9. The definitions of material defects are found in the Ontario Structure Inspection Manual.

D. MAINTENANCE AND REPAIR

During the inspection, the inspector shall make recommendations for maintenance and repair needs of each element. Guidelines for the required maintenance and repairs are given in Part VI. Guidelines for the actual maintenance and repair work are given in Appendices A and B. Safety and traffic control requirements during the maintenance or repair work are not covered in these appendices.

E. CONDITION OF SIGN SUPPORT STRUCTURE

A rating index will be calculated to obtain an overall rating for the sign support structure. The rating will give an indication as to the repair needs and the scheduling priority for each sign support structure. This rating will be determined as described in Part VII. The formula for determining the contribution of each component in determining the overall rating for the sign support structure will be modified based on some of the initial data. The structure rating is not required in any way to inspect the structures or to record the inspection information.

III. INVENTORY, HISTORICAL AND ELEMENT DATA REQUIREMENTS

The inventory and historical data must be collected for each sign support. This information should be obtained prior to the inspection, but should also be verified during the inspection. Field measurements and observations are required since a lot of the information may not be available from drawings, or the drawings may not exist. Most of the information is entered once, and does not change. Areas that are input by the inspector on an on-going basis, or areas that are calculated, are indicated. The inventory and historical data sheet is found in Appendix C. Also required is the initial setting up of the element groups, names and quantities. The following information is required:

A. INVENTORY DATA

MTO Site Number: The county and site number assigned to the structure, similar to that given to bridges. For counties with many sign supports, it may be preferable to begin the numbering with 5000. This will differentiate the sign structures from bridges.

Structure Name: The sign name, typically determined by the message on the sign and/or the location of the sign. Example, "Keele Street Advance Sign". The terms to be used are:

i) Exit Sign - The sign at the point of exit
ii) Advance Sign - The sign warning of the upcoming exit.
iii) Pre-Advance Sign - The first of two signs warning of the upcoming exit.

Location: A descriptive text telling where the structure is located.

Comment: A descriptive text for any additional information that is needed on the sign. This includes the configuration of the truss segments, the attachment locations for bridge mounted signs (i.e. barrier, fascia, or soffit), or other information that is of importance.

Direction: The direction of traffic under the sign and, if applicable, if the sign is at a core/collector location. The direction should correspond to that given by IHIS and is defined as the general direction of the highway. In determining the structure orientation, and describing the right and left-hand sides, the structure should be viewed facing the direction of traffic. For structures that span a two direction roadway, whether signs are present for both directions or not, the structure should be viewed looking in the North or Eastbound direction and recorded as such.

Region: The MTO region in which the sign is located.

District: The MTO district in which the sign is located.

County: The regional municipality or county in which the sign is located.

Old Site Number: The number given to the sign support structure under the previous inventory methods.

Owner: The owner of the sign support structure.

AADT: The AADT under the sign support structure.

Inspection Route Sequence: The route number on which the sign is located. (This is not used by all of the MTO Regions)

Manufacturer: If known, enter the name of the manufacturer.

Vertical Clearance: If known, enter the minimum vertical clearance to the lowest portion of the sign support structure or any attachment.

Latitude: The geodetic latitude obtained using a GPS unit and located at the centre of the right leg.

Longitude: The geodetic longitude obtained using a GPS unit and located at the centre of the right leg.

Sign Support Type: The type of sign support structure chosen from the list of standard types:

- Aluminum Tapered Leg (ATL) (formerly Type 1)
- Aluminum Circular Leg (ACL) (formerly old Type 2)
- Aluminum Rectangular Leg (ARL) (formerly LCMS Type or new Type 2)
- Changeable Message Signs (CMS) - electronic sign panel integral with structure

- TriChord (TC) - truss with 3 chords interlaced by diagonals and 2 legs
- Plane Truss (PT) - truss with 2 chords and 2 legs
- Cantilever (C) - truss with 2 chords and 1 leg
- Single Arm Cantilever (SAC)- single arm and single leg
- Butterfly (B) - single leg and 2 sets of arms in two directions
- Pole Mounted (PM) - sign located in front of single leg
- MonoTube (MT) - single arm with two legs
- Bridge Mounted (BM2) - 2 connection points
- Bridge Mounted (BM2S) - 2 connection points with Spacer truss
- Bridge Mounted (BM3) - 3 connection points
- Bridge Mounted (BM3S) - 3 connection points with Spacer truss
- Other Overhead Structure
- Other Bridge Mounted Structure
- Other

Sign Type: The type of signboard. Either
Aluminum
Plywood
Changeable Message, or
Other.

Left/Right Footing Type: The type of footing. Either
Ground Mounted
Bridge Mounted, or
Barrier Mounted (i.e. Median).

Sign A, B, C (Height, Length, Colour, Overlay, Contents):
Give the height, length and colour of the each sign on the structure. State (yes or no) whether an aluminum overlay has been placed on the sign. Give the information appearing on the sign in the contents field. There is space for three signs, starting from the left. This is used to determine the total sign area, and can easily be checked to see if any additional sign have been erected. Small signs, such as Hospital signs, Truck Restriction signs, Lane Marker Arrow Boards, should be included as attachments.

Total Sign Area: The area of all signs attached to the structure in square metres.

Maximum Sign Area: The maximum allowable sign area for the sign. Some newer sign support structures have the maximum sign area stamped onto the structure. For other structures, the maximum area can be obtained from the standard drawings. For the Aluminum Tapered Leg (ATL) sign supports, an evaluation of the original design found that the maximum area is 22.3 m^2 (240ft^2). Details of this can be found in the Memorandum issued by the Bridge Office on February 12, 1999 and reproduced in Appendix E.

Span: The span of the sign support structure. The span is measured from the centre of the left to right support. For cantilever type signs, the span is defined as the distance from the centre of the leg to the farthest edge of the arm. For bridge mounted sign supports, the span is defined as the length of the chord that is attached to the bridge. On older aluminum truss type sign supports, it may be helpful to estimate the span knowing that the typical panel size was 5 feet and trusses usually had span lengths in multiples of 5 feet. Generally, the span can be estimated by measuring a typical panel of the truss and counting the number of panels.

Attachments: List any other attachments that exist on the sign support structure. These include the following:

- Walkway arm
- Handrail
- Traffic light
- Damping plate
- Small sign
- Grating
- Illumination
- Camera
- Electrical Junction box
- Other

B. HISTORICAL DATA

Year Built:	If available, enter the year the structure was built.
Contract Number When Built:	The contact under which the sign support structure was built.
Latest Biennial Inspection:	The last time the structure was inspected. This value is carried forward from inspection to inspection.
Latest Specialized Inspection:	The last time the structure was inspected using NDT or other more detailed means.
Latest Structure Rating:	Based on the condition of the various components, an overall structure rating is determined. This gives an indication of the relative condition of various structures. This rating is calculated by the system.
Latest Structure Condition:	Based on the structure rating, the overall structure is placed into one of the four condition states – either excellent, good, fair, poor.
Rehab. History:	Enter the date and description of any rehab work that has been done to the structure.
Regional Priority Number:	Priority as determined by region.
Programmed Work Year:	Programmed work year as determined by region.
Nature of Program Work:	Brief description of required work as determined by region.

C. ELEMENT DATA

The complete list of element groups, element names, and quantities must be determined for each sign support. The table for completing the element inventory information is found in Appendix D. The first page in Appendix D contains overall information, with the Field Inspection Information completed before the inspection and the Additional Investigations Required being completed after the inspection. The Element Information on the second page (or the alternate form on the third page) must be completed for each structure. Each sign support does not necessarily contain all the elements. Table 1 lists the most common types of sign supports and lists whether the element exists or not. This can be used as a guide, however, it must be checked in the field as not all elements exist as listed in the table. Table 3 contains a complete list of all possible elements. The element table should be completed as described below:

Element Group: The description of the category in which the element belongs.

Element Name: The name of the element within the element group.

Location: If a certain location within the element is in significantly different condition that the remainder of the element, the inspection of the element can be separated by location. Typically when first obtaining the element information the location is not used. When the element is split into locations, usually as a result of the inspection, the quantity must be re-calculated for each location.

Type: A brief summary of the nature or material composition of the element. For example; concrete, aluminum or steel, or C-Clamp or U-bolt. The possible Element Types are given in Table 3.

Quantity: The calculated total quantity of the element. The method of estimating certain quantities, especially those with large quantities, is given in Table 2. Some of the elements may require field counting or field measuring.

TABLE 1: Possible Elements on Different Sign Support Types

	Element Group	Element Name	Aluminum Tapered Leg (ATL)	Aluminum Circular Leg (ACL)	Aluminum Rectangular Leg (ARL)	Changeable Message Sign (CMS)	Tri-Chord (TC)	Cantilever (C)	Mono-Tube (MT)	Bridge Mounted (BM)
1a.	Foundation	Concrete	Y	Y	Y	Y	Y	Y	Y	N
1b.		Steel Pedestal	P	P	P	N	N	N	N	N
1c.		Bearing Surface	Y	Y	Y	Y	Y	Y	Y	Y
2a.	Chord/Main Member	Base Plate	Y	Y	Y	Y	Y	Y	Y	Y
2b.		Leg	Y	Y	Y	Y	Y	Y	Y	N
2c.		Corner Arc	Y	N	N	N	N	N	N	N
2d.		Horizontal	Y	Y	Y	Y	Y	Y	Y	U
3a.	Diagonal	Leg	Y	Y	Y	Y	N	N	N	N
3b.		Corner Arc	Y	N	N	N	N	N	N	N
3c.		Truss	Y	Y	Y	Y	Y	Y	Y	N
4a.	Connection	Base	Y	Y	Y	Y	Y	Y	Y	Y
4b.		Leg	N	Y	Y	Y	Y	Y	Y	N
4c.		In Line Chord	Y	U	Y	Y	U	N	Y	N
4d.		Sign	Y	Y	Y	N	Y	Y	U	Y
4e.		Damping Assembly	N	N	N	N	N	U	N	N
4f.		Walkway Arm	U	U	U	N	N	N	N	N
4g.		Accessory	P	P	P	N	P	P	P	P
5a.	Attachment	Sign	Y	Y	Y	N	Y	Y	U	Y
5b.		Skin	N	N	N	Y	N	N	N	N
5c.		Damping Assembly	N	N	N	N	N	U	N	N
5d.		Walkway Arm	U	U	U	N	N	N	N	P
5e.		Walkway	U	U	U	Y	N	N	N	P
5f.		Handrail	U	U	U	Y	N	N	N	P
5g.		Other Accessory	P	P	P	P	P	P	P	P
6a.	Coating	Chords/Main Member	N	N	N	Y	Y	Y	N	N
6b.		Diagonals	N	N	N	N	Y	Y	Y	N
6c.		Connections	N	N	N	N	Y	Y	Y	N

Y = Yes, element must exist
N = No, element cannot exist
U = usually, element is usually associated with this type of Sign Support
P = possibly, element is possibly associated with this type of Sign Support

TABLE 2: Procedure for Determining Element Quantities

	Element Group	Element Name	ATL	ACL	ARL	CMS	TC	C	MT	BM
1a.	Foundation	Concrete	Count each foundation							
			2	2	2	2	2	1	2	0
1b.		Steel Pedestal	Count each							
			0-2	0-2	0-2	0	0	0	0	0
1c.		Bearing Surface	Count each surface connecting structure to foundation							
			4	4	4	4	2	1	2	count
	Chord/Main Member		Each segment of chord between field splices is counted as 1 chord element							
2a.		Base Plate	4	4	4	4	2	1	2	count
2b.		Leg	8	4	4	4	2	1	2	0
2c.		Corner Arc	8	0	0	0	0	0	0	0
2d.		Horizontal	4T	4T+8	4T+8	12	3T	2	2	0-2
	Diagonal		Each diagonal is counted. The approximations below can be used for large quantities in lieu of counting.							
3a.		Leg	23	20	20	20	0	0	0	0
3b.		Corner Arc	31	0	0	0	0	0	0	0
3c.		Truss	$\frac{s'-10}{5}*8+4$	$\frac{s'}{5}*8+4$	$\frac{s'}{5}*8+4$	$\frac{S}{3.2}*10$	62	$\frac{S}{2.8}*2$	0	0
	Connection		Count the connections							
4a.		Base	4*	4*	4*	4	2	1	2	count
4b.		Leg	0	8	8	4	4	2	2	0
4c.		In Line Chord	4T+12	4T+4	4T+4	8	4T-4	0	1	0
4d.		Sign	count	count	count	count	count	count	count	count
4e.		Damping Assembly	0	0	0	0	0	count	0	0
4f.		Walkway Arm#	count	count	count	0	0	0	0	0
4g.		Accessory	count	count	count	count	count	count	count	count
	Attachment		Count the attachments							
5a.		Sign	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3
5b.		Skin	0	0	0	5	0	0	0	0
5c.		Damping Assembly	0	0	0	0	0	1	0	0
5d.		Walkway Arm	count	count	count	0	0	0	0	0
5e.		Walkway##	count	count	count	count	0	0	0	count
5f.		Handrail###	count	count	count	count	0	0	0	count
5g.		Other Accessory	count	count	count	count	count	count	count	count
6a.	Coating	Chords/Main Member	Sum the quantities of chord/main member elements (2a to 2d)							
6b.		Diagonals	Sum of the quantities of diagonal elements (3a to 3c)							
6c.		Connections	Sum of the quantities of structural connections (4a-4c)							

* - If Steel Pedestals are present the quantity is double.
T - The number of truss segments.
s' - Span in feet.
S - Span in metres.
- Generally equal to twice the number of walkway arms.
- Each segment of grating is counted as a walkway element.
- Each handrail segment is counted as a handrail element.

IV. INSPECTION OVERVIEW

The inspection of sign supports shall be done using the “severity and extent” philosophy. The various sign supports are divided into elements, and each element is inspected and recorded separately. Not all elements exist on all sign supports. Table 3 is a cross-reference table that lists all elements, the materials involved, and the condition state tables to be used. For all elements, the quantity to be measured is "Each". Each element and each material has different potential defects. Condition state tables are provided for each type of material, which describes the potential defect, and categorizes the defects into four condition states – excellent, good, fair, and poor. Excellent and good condition states will be recorded together. Generally, the elements in Fair and Poor condition are noted and the remainder is noted in the Excellent/Good State. The definitions of material defects are found in the Ontario Structure Inspection Manual, although some have been repeated in the condition state tables. Some elements refer to several condition state tables. These are in cases where the element is composed of several materials, or if the list of defects could not be included in one table. The inspector records the number of elements in each condition state for each element type. If several defects of varying severity are found in an element, the condition state defining the worst defect is selected. If more than one table applies, the inspector uses several tables, and chooses the condition state that is the worst. The following are the condition state tables that apply to sign support structures:

Table 4:	Concrete
Table 5:	Metal (Steel and Aluminum)
Table 6:	Bolted Connections
Table 7:	Bearing Surfaces
Table 8:	Attachments
Table 9:	Coatings

During the inspection, the inspector should verify the inventory quantities, especially for elements that are easy to count. The sign areas and the number and type of attachments should be checked at each inspection since it is possible that these have been added or changed without notification. If the total sign area is greater than the maximum allowable sign area, the Regional Structural Section should be notified immediately.
Other information should also be reviewed to check the accuracy of the inventory information. The inspector shall also record the required maintenance item for the elements, as well as any repair items, including the urgency as described in Part VI. The number of occurrences should be noted along with the maintenance or repair code number. All urgent maintenance or repair items shall be brought to the attention of the Regional Structural Section immediately.

A complete inspection report shall include the following:

- The completed and verified Inspection Form for Inventory.
- The completed Inspection Form for General Inspection.
- The competed Inspection Forms for Elements. All elements shall be inspected according to the Condition State Tables, any performance deficiencies noted, maintenance and repair needs noted, along with the urgency and any comments made.
- Marking areas requiring repair with flagging tape or paint.
- A photograph of the overall structure, as well as photographs of all areas in fair or poor condition.

TABLE 3: Element/Condition State Cross-Reference Table

	Element Group	Element Name *	Type	Condition States
1a.	Foundation	Concrete	Concrete	Table 5 (concrete)
1b.		Steel Pedestal	Steel	Table 6 (metal)
1c.		Bearing Surface	Concrete, Grout, Bearing Pad	Table 8 (bearing surface)
2a.	Chord/Main Member	Base Plate	Steel, Aluminum, Casting-Aluminum	Table 6 (metal)
2b.		Leg	Steel, Aluminum	Table 6 (metal)
2c.		Corner Arc	Steel, Aluminum	Table 6 (metal)
2d.		Horizontal	Steel, Aluminum	Table 6 (metal)
3a.	Diagonal	Leg	Steel, Aluminum	Table 6 (metal)
3b.		Corner Arc	Steel, Aluminum	Table 6 (metal)
3c.		Truss	Steel, Aluminum	Table 6 (metal)
4a.	Connection	Base	Bolted Plate, Bolted Casting	Table 6 (metal), 7 (bolted connection)
4b.		Leg	Weld, Bearing Pad, Bracket, Bolted Plate	Table 6 (metal), 7 (bolted connection)
4c.		In Line Chord	Casting, Telescopic, Bolted Plate	Table 6 (metal), 7 (bolted connection)
4d.		Sign	C-Clamp, U-Bolt, Welded, Other	Table 6 (metal), 7 (bolted connection)
4e.		Damping Assembly	Bolted	Table 6 (metal), 7 (bolted connection)
4f.		Walkway Arm	C-Clamp	Table 6 (metal), 7 (bolted connection), Table 8 (bearing surface)
4g.		Accessory	Bolted, C-Clamp, Other	Table 6 (metal), 7 (bolted connection)
5a.	Attachment	Sign	Aluminum, Wood, Electronic	Table 9 (attachment)
5b.		Skin	Aluminum	Table 6 (metal)
5c.		Damping Assembly	Aluminum	Table 6 (metal), 7 (bolted connection)
5d.		Walkway Arm	Aluminum	Table 6 (metal)
5e.		Walkway	Steel, Aluminum	Table 9 (attachment)
5f.		Handrail	Steel, Aluminum	Table 9 (attachment)
5g.		Other Accessory	Steel, Aluminum, Wood, Other	Table 9 (attachment)
6a.	Coating	Chords/Main Members	Paint, Galvanizing, Dual, Various	Table 10 (coating)
6b.		Diagonals	Paint, Galvanizing, Dual, Various	Table 10 (coating)
6c.		Connections	Paint, Galvanizing, Dual, Various	Table 10 (coating)

* - See Sections V, Part D for a description of each element

CONDITION STATE TABLES

TABLE 4

Concrete Foundations			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
No observed material defects	Any areas with light scaling, honeycombing, pop-outs, alkali-aggregate reaction or with narrow cracks And, Total area less than 10% with medium scaling, honeycombing, pop-outs, alkali-aggregate reaction or with medium cracks.	Total area greater than 10% with medium scaling, honeycombing, pop-outs, alkali-aggregate reaction or with medium cracks And, Total area less than 40% with severe scaling, honeycombing, pop-outs, alkali-aggregate reaction or with medium cracks, or with spalling or delamination	Total area greater than 40% with severe to very severe scaling, erosion, and disintegration, honeycombing, pop-outs, alkali-aggregate reaction, or with spalling or delamination (02) or with wide cracks (01)

(The number in brackets indicates the required repair code number to correct the deficiency)

TABLE 5

Metal (Steel and Aluminum)			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
No observed material defects.	Light corrosion – no section loss.	Medium corrosion – up to 10% section loss.	Severe and very severe corrosion – more than 10% section loss (04 or 05).
			All cracks (03, 04, or 05)
		For only, Local notches or gouges in aluminum up to 3mm in depth, and, all notches in steel	Local notches or gouges in aluminum greater than 3mm in depth (06).
			Missing Members (05)
		Missing drain holes (susceptible to freezing) (07)	
		Local dents affecting less than 20% of the circumference or, member deformations (bends) where the displacement is less than 20% of the diameter.	Local dents affecting greater than 20% of the circumference or, member deformations (bends) where the displacement is greater than 20% of the diameter. (04, 05 or 08).

(The number in brackets indicates the required repair code number to correct the deficiency)

CONDITION STATE TABLES

TABLE 6

Bolted Connection			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
All bolts tight		Between 0 to 20% of fasteners in connection loose (12). Between 0 to 10% of fasteners in connection cracked, broken, or missing+ (13).	Greater than 20% of fasteners in connection loose (12). Greater than 10% of fasteners in connection cracked, broken, or missing+ (13).
All washers present	Misaligned but tight bolts* or bolts missing washers# (or small washers in oversize holes) in less than 30% of fasteners in connection.	Misaligned but tight bolts* (13) or bolts missing washers# (or small washers in oversize holes) in over 30% of fasteners in connection (14).	
Mating plates in Excellent condition.	Mating plates in Good condition (according to Table 5).	Mating plates in Fair condition (according to Table 5).	Mating plates in Poor condition (according to Table 5) (03, 04, 05).
Mating plates in contact with each other over entire surface	Mating plates without contact with each other over an area: - less than 10% of total area for single (bending) members. - less than 20% of total area for trussed (axial force) members.	Mating plates without contact with each other over an area: - between 10% and 30% of total area for single (bending) members. - between 20% and 60% of total area for trussed (axial force) members.	Mating plates without contact with each other over an area: - greater than 30% of total area for single (bending) members (11). - Greater than 60% of total area for trussed (axial force) members (11).
	Misaligned but tight clamp.	Loose clamp (15).	Cracked or broken clamp (16).

***** - Includes a bolt without proper thread engagement (the bolt is below the surface of the nut).
\+ - Includes Adhesive anchorage type bolts since the bond with the concrete has been broken.
\# - Only consider if missing washer appear to cause some bearing problems.

(The number in brackets indicates the required repair code number to correct the deficiency)

CONDITION STATE TABLES

TABLE 7

Bearing Surfaces			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
Plate in contact over entire surface	Plate without contact over an area: - less than 10% of total area for single chords (with bending). - less than 20% of total area for trussed chords (with only axial forces).	Plate without contact over an area: - between 10% and 30% of total area for single chords (with bending). - Between 20% and 60% of total area for trussed chords (with only axial forces).	Plate without contact over an area: - greater than 30% of total area for single chords (with bending) (10). - Greater than 60% of total area for trussed chords (with only axial forces) (10).
Grout pad fully intact	Grout pad intact with narrow intermittent cracks.	Grout pad intact with medium cracks or broken for length less than 60% of perimeter. (If grout does not extend under base plate, rate according to contact area).	Grout pad with severe cracks or broken for a length greater than 60% of the perimeter (10). (If grout does not extend under base plate, rate according to contact area).
Rubber* pad with no material defects	Rubber* pad with minor to medium bulging less than 40% of pad thickness.	Rubber* pad with bulging greater than 40% of pad thickness.	
	Rubber* pad with hairline, narrow or medium cracking.	Rubber* pad with wide to very wide cracking.	
	Rubber* pad misaligned under plate, less than 20% lack of contact.	Rubber* pad misaligned under plate, between 20% and 60% lack of contact.	Rubber* pad misaligned under plate, greater than 60% lack of contact (10).

* - Includes rubber, neoprene or laminated bearing pads.

(The number in brackets indicates the required repair code number to correct the deficiency)

CONDITION STATE TABLES

TABLE 8

Attachments			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
No observed material defects	Sign support bracket with light corrosion	Sign support bracket with medium corrosion.	Sign support bracket with cracks or severe corrosion (18).
	Sign support bracket firmly attached to sign. Attachment clips or screws in good condition.	Overall, sign support bracket firmly attached to sign, with a few loose or missing fasteners (17).	Sign support bracket loosely attached to sign – numerous loose or missing fasteners (17).
	Sign panel with light corrosion.	Sign panel with medium corrosion or slightly bent or cracked, but sign is still legible and no danger of any portion of sign panel coming off in high wind (17).	Sign panel with severe rust, severely bent or cracked with sign illegible and a possibility of a portion of sign panel coming off in high wind (17 or 18).
No observed material defects	Grating firmly attached to supports and with light corrosion,	Grating with moderate corrosion, loose, or with small part cracked or not bearing on the support arms, but no danger of grating dislodging (17).	Grating with severe corrosion, severely loose, or with larger portions cracked or not bearing on the support arms, with possibility of grating dislodging (17 or 18).
No observed material defects	Handrail , walkway arm or other attachment member firmly attached with light corrosion	Handrail, walkway arm or other attachment member with moderate corrosion, or slightly loose or bent, but no danger of coming off (17).	Handrail, walkway arm or other attachment member with severe corrosion, excessively loose or bent, with a possibility of coming off or not being able to support normal use (17 or 18).
No observed material defects	Minor accessory (luminaires, traffic signals, cameras, etc.) with light corrosion.	Minor accessory with moderate corrosion or moderate defects, but still appears to function adequately (17).	Minor accessory with severe corrosion, or damage and it appears the accessory may not function properly or may come off (17 or 18).
			Missing sign panels or other attachments (18)

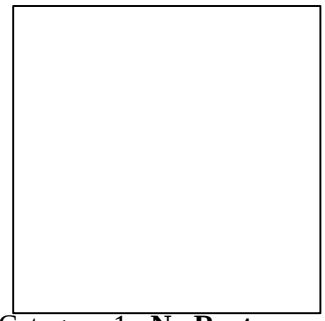
(The number in brackets indicates the required repair code number to correct the deficiency)

CONDITION STATE TABLES

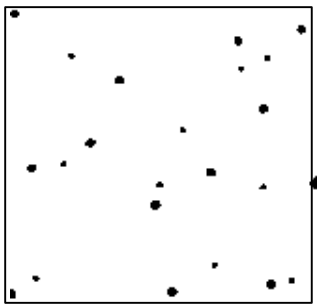
TABLE 9

Coating			
Excellent Condition	**Good Condition**	**Fair Condition**	**Poor Condition**
No observed material defect	Minor checking, cracking, alligatoring, chalking	Checking, cracking, alligatoring	Severe checking, cracking, alligatoring. (19 or 20).
		Intercoat delamination, peeling (top coat only)	Undercutting, blisters, peeling (prime coat), underfilm corrosion (19 or 20).
		Signs of chemical attack	
	Overspray, runs, sags, pinholing	Bridging, edge defects, shadows, pinpoint rusting	
RUST CONDITION* RATING CAT. 1	RUST CONDITION* RATING CAT. 2	RUST CONDITION* RATING CAT. 3	RUST CONDITION* RATING CAT. 4 or higher

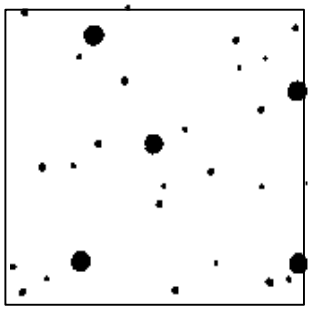
* - Rust Condition Ratings are defined in the Structural Steel Coating Manual (Figures showing the Rust Condition Rating Categories are shown below)



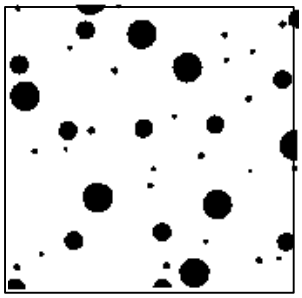
Category 1: **No Rust**
Condition State: **Excellent**



Category 2: **Light Surface Rust**
Condition State: **Good**



Category 3: **Medium Surface Rust**
Condition State: **Fair**



Category 4: **Severe Surface Rust**
Condition State: **Poor**

(The number in brackets indicates the required repair code number to correct the deficiency)

V. INSPECTION DETAILS

The inspection of the structures is to be a detailed visual inspection inspecting every area of every element in the truss. Table 3 provides a summary of all the elements, as well as the condition state table to use with each element. This part of the guidelines describe the inspection requirements in more detail. This includes:

i) What is included with which element.
ii) For which sign support structure the element exists.
iii) Some guidance in determining the quantity.
iv) What to look for during the inspection of the element.
v) Potential maintenance requirement for the element (also see Part VI).
vi) Potential performance deficiencies for the element (also see Part VI).

The inspector is to complete the forms in Appendix D. These are for any additional investigations required, field inspection information, as well as the severity and extent information for each element. The following information must be entered by the inspector:

A. FIELD INSPECTION INFORMATION

Date of Inspection:	The date the inspection is completed.
Inspector:	The party chief in the inspection.
Others in Party:	The other members of the inspection party.
Equipment used:	Any specialized equipment used.
Weather:	The weather conditions.
Temperature:	The temperature.

B. ELEMENT INFORMATION

The top part of the element information (or the left part of the alternate form) must be entered only once, at the inventory stage, and then the information is carried forward for future inspections. The inspector must enter the information on the lower part of the element sheet (or the right part of the alternate form) at each inspection. The number of elements in each condition state must be recorded with the excellent and good condition states recorded together. Generally, the number of elements in the Fair and Poor condition state are noted and the remainder are recorded in the Excellent/Good State. The inspector also must record the number of occurrences and code numbers for both the maintenance and repair items along with the urgency. All urgent maintenance or repair items shall be brought to the attention of the Regional Structural Section immediately.

C. ADDITIONAL INVESTIGATIONS

After completion of the inspection of an element, or the entire structure, the inspector can make recommendations for further investigations to be done. The inspection of the structures is to be a detailed visual inspection involving the inspection of every area of every element in the truss. Additional investigations should not be specified to avoid inspection of the entire structure. They should be used in cases where the extent of cracking or the effect of deformed members cannot be determined by the inspector. In these cases the inspector may indicate, by the use of a performance deficiency (02), that further additional investigations are to be done to certain elements. The inspector shall determine the needed investigation, as well as the urgency. Areas where Non Destructive Testing (NDT) may be beneficial include (but are not restricted to):

- Ultrasonic testing (UT) of the anchor bolts
- Liquid Penetrant Testing (LPT) of welds around base plates and possibly steel pedestals.
- LPT of diagonal to chord welds, especially for diagonals welded to aluminum cluster castings that are present on many aluminum sign supports.
- Areas and welds adjacent to impact damage.

If the inspectors feel that a defect may be significant enough to affect the immediate overall strength of the sign support, or a major component of the sign support, the suspected performance deficiency in structural capacity (05) should be indicated.

Also entered in this location are any special notes or general comments for the sign support structure. These should be general comments that apply to the overall sign support and not to specific elements. Recommendations related to the overall sign support can also be made in this location.

D. INSPECTION – ELEMENT DETAILS

The inspection of all elements is required. As described in the Repair Section (Part VI), defects that are to be repaired should be marked (with flagging tape or paint) to allow the defects to be found easily in the future when they are to be repaired. A photograph of all areas in fair or poor condition should be taken and included with the inspection report. The following sub-sections describe the details of each element in the sign support structure, including what to look for and what is included with each element:

1a. FOUNDATION – CONCRETE

All concrete portions of the foundation should be inspected under this item. Inspect the exposed portion of the concrete foundation. Determine the condition state of each foundation according to Table 4. As described in Table 4, a more serious defect over a relatively small area will not lead to as severe of a condition state since the concrete is very good at redistributing loads.

i) Typically, this element group includes the circular or rectangular projection of the foundation above the soil.
ii) For barrier mounted sign supports, a segment of barrier wall approximately 2 metres long centred about the leg shall be inspected as the pedestal. This corresponds approximately with the reinforced portion of the barrier wall. There are typically construction joints where the barrier ends and the foundation pedestal begins.
iii) For bridge-mounted legs of sign support structures, the projecting pedestal on which the leg is attached shall be inspected as the pedestal.

If the foundation is tilted or has appeared to move, a performance deficiency for tilted/shifted foundation (01) shall be noted. This can either be noticed at the foundation itself or it may be evidenced by a sag in the span of the structure resulting from the foundation movement. If the foundation is entirely covered in soil, the maintenance action to regrade soil (02) shall be noted.

1b. FOUNDATION – STEEL PEDESTAL

In some cases, a steel pedestal has been placed under the standard height leg to account for original elevation differences. This is typically seen only on ATL Type sign supports. Each such pedestal should be inspected according to Table 5. **The condition of the pedestal is determined from the condition of the worst member within the pedestal**. The connections of the leg to the steel pedestal

and the steel pedestal to the concrete shall be included as a Connections at the Base while only the contact of the concrete to the pedestal should be included with the Foundation - Bearing Surface. If the base connection is covered in soil or debris, the maintenance action of cleaning the base (01) shall be recorded.

1c. FOUNDATION – BEARING SURFACE

Inspect the surface between the structure and the concrete foundation pedestal. The structure is either bearing directly (or through a steel pedestal) on the concrete foundation pedestal, bearing on a grout pad on top of the concrete foundation pedestal, or bearing on a rubber bearing pad. Each surface with bearing on the concrete shall be inspected; thus, each trussed leg accounts for 2 bearing surfaces. The bearing surface should be inspected according to Table 7. This surface is inspected since defects in this area can cause overload of the anchorage, base connection and possibly the legs.

i) For some older structures and most newer structures, where the base plate of the structure (or the steel pedestal) sits directly on the concrete surface, the bearing surface is inspected for proper bearing on the foundation.

ii) For the many older structures, the base plate of the structure (or the steel pedestal) is supported on a grout pad. The bearing surface is affected by the condition of the grout pad. Poor grouting practices have been a common problem. On many sign supports, the base should have been placed on levelling nuts or washers, with the space under the base plate filled or injected with grout. Often, this was not the case as the grout was simply placed in a fillet around the perimeter of the base plate with a trowel, providing no benefit to the bearing area. On structures that exhibit breaking up of the grout, it shall be determined if the grout extends under the base plate. The inspection should rate not only the grout, but also the degree of bearing.

iii) For bridge mounted sign supports, inspect the surface at each connection to the bridge. This is normally a steel plate bearing against a concrete surface.

iv) Some structures have a rubber bearing pad under the base plate to absorb small irregularities in the concrete surface and to provide damping to the structure. The condition of the bearing pad material should be inspected for cracking, bulging or tearing. The bearing pad is very thin and can only compensate for small irregularities. If gaps appear between the base plate and the bearing pad, the inspection should also include the effect on the degree of bearing contact.

2a. CHORDS/MAIN MEMBER – BASE PLATE

Inspect the base plate or base castings. Chords/Main Members refer to members that are connected by diagonals as well as longer single members such as single legs or single arms. Inspection should be according to Table 5 for steel and aluminum. Each chord rating should be based on the worst defects that are present.

i) For tapered leg structures, there are 2 aluminum casting base plates per leg.

ii) For most other sign supports with trussed legs, there are 2 welded base plates, with stiffeners, per leg.

iii) For mono-tube and many newer sign supports where a single vertical column exists, there is one base plate per leg.

If the base plate is covered in soil or debris, the maintenance action of cleaning the base (01) shall be recorded. The inspector should look for corrosion or cracks in the base plate or castings and any stiffener plates.

2b. CHORDS/MAIN MEMBER – LEG

Inspect the leg chords of the sign support structure. Inspection should be according to Table 5 for steel and aluminum. Each chord rating should be based on the worst defects in the length of the chord.

iv) For tapered leg structures, there are 4 chords per leg. The leg does not include the corner arc portion, but only the straight tapered portion of the leg.
v) For other sign supports where two columns are trussed together, there are 2 chords per leg.
vi) For mono-tube and many newer sign supports, a single vertical column exists and the inspection should be for each leg (main member).

Missing hand hole covers or chord caps should be replaced as a maintenance item (04), as a missing cover will allow corrosive salts to enter the legs. The inspector should look for cracks in the chord. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic corrosion should be marked as a performance deficiency (03) and marked with a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. Bent members due to erection damage or vehicle collision are also possible. Shop splice areas should also be inspected for this element.

2c. CHORDS/MAIN MEMBER – CORNER ARC

Inspect the chords of the corner arc portion of the structure. Inspection should be according to Table 5 for steel and aluminum. Each entire chord segment should be inspected, with the rating based on the worst defects in each chord.

i) This element only exists for tapered leg structures where there are 4 chords per corner arc.

Missing hand hole covers or chord caps should be replaced as a maintenance item (04), as a missing cover will allow corrosive salts to enter the legs. The inspector should look for cracks in the chord. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic corrosion should be marked as a performance deficiency (03) and marked with a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. Bent members due to erection damage or vehicle collision are also possible. Shop splice areas should also be inspected for this element.

2d. CHORDS/MAIN MEMBER – HORIZONTAL

Inspect the truss chords or arms of the structure. Inspection should be according to Table 5 for steel and aluminum. Each chord rating should be based on the worst defects in the length of the chord in a segment between field splices.

i) For ATL sign supports, there are 4 chord elements per truss segment (the top-front, top-back, bottom-front and bottom back). The truss is taken to begin at the end of the corner arc.

ii) For ACL and ARL sign supports, there are 4 chord elements per truss segment plus an additional 4 chords at each end (from the connection to the leg until the first in-line (cluster) connection).

iii) For the CMS type sign supports there are 4 truss segments in the centre portion as well as at each end. For the end segments, the truss is bent or angled with a shop weld being present. For the centre portion, much of the inspection must be done from the inside since the structure is covered with a sheet aluminum skin.

iv) For tri-chord sign supports, there are 3 chord segments per truss segment (the top, bottom, and middle).

v) For Plane truss structures and cantilever sign supports, there are typically 2 chords.

vi) For mono-tube signs, or other horizontal arms that do not contain truss-work, each chord segment between field splice should be inspected as an element.

Missing end caps should be replaced as a maintenance item (04), as a missing cover will allow corrosive salts to enter the chords. The inspector should look for cracks in the chord. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic corrosion should be marked as a performance deficiency (03) and marked as a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. Bent members due to erection damage or vehicle collision are also possible. Shop splice areas should also be inspected for this element.

3a. DIAGONALS - LEG

Inspect the diagonals in the legs of the sign support. Inspection should be according to Table 5 for steel and aluminum. Each diagonal should be inspected, including diagonals in all planes of orientation. This quantity was chosen since, it is convenient for both inspection and when repair is required. The welds at the member ends are included with this element. If cracks or other defects occur in the weld, the rating of the diagonal should be reflected by this defect. If it appears that the crack may propagate into the chord or the connection, the condition that element should also reflect that condition of this defect. The quantities of diagonals are quite large and Table 2 can be used as an approximation.

i) For tapered leg structures, there are diagonals between all 4 chords in the tapered portion of the leg.

ii) For other sign supports with two columns are trussed together, there are diagonals between the 2 chords in the leg. There are about 10 diagonals per leg.

iii) For mono-tube and many of the newer sign supports with a single vertical column, there are no diagonals and this element does not exist.

The inspector should look for cracks in the diagonals. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic corrosion should be marked as a performance deficiency (03) and marked as a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. Bent members due to erection damage or vehicle collision, and cracking of members due to water filling the tubes and freezing, are also possible.

Diagonals susceptible to filling with water should be marked for the repair need of drilling a drain hole (07). This applies only for members that have the possibility of filling with water. This includes only those members that are closed ended at the bottom with no drain holes, and either open-ended or closed ended with drain (or vent) holes at the top. If no drain (or vent) holes are visible it is possible that there is internal venting and filling with water is not possible. It may also be possible to tap the member to determine if it is filled with water.

3b. DIAGONALS – CORNER ARC

Inspect the diagonals in the corner arc portion of the sign support. Note that this element only exists for tapered leg structures. Inspection should be according to Table 5 for aluminum. Each diagonal should be inspected, including the diagonals in all planes of orientation. This quantity was chosen since, it is convenient for both inspection and when repair is required. The welds at the member ends are included with this element. If cracks or other defects occur in the weld, the rating of the diagonal should be reflected by this defect. If it appears that the crack may propagate into the chord or the connection, the condition that element should also reflect that condition of this defect.

The inspector should look for cracks in the diagonals. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic corrosion should be marked as a performance deficiency (03) and marked as a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. Bent members due to erection damage or vehicle collision, and cracking of members due to water filling the tubes and freezing, are also possible.

Diagonals susceptible to filling with water should be marked for the repair need of drilling a drain hole (07). This applies only for members that have the possibility of filling with water. This includes only those members that are closed ended at the bottom with no drain holes, and either open-ended or closed ended with drain (or vent) holes at the top. If no drain (or vent) holes are visible it is possible that there is internal venting and filling with water is not possible. It may also be possible to tap the member to determine if it is filled with water.

3c. DIAGONALS - TRUSS

Inspect the diagonals in the legs of the sign support. Inspection should be according to Table 5 for steel and aluminum. Each diagonal should be inspected, including the diagonals in all planes of orientation. This quantity was chosen since it is convenient for both inspection and when repair is required. The welds at the member ends are included with this element. If cracks or other defects occur in the weld, the rating of the diagonal should be reflected by this defect. If it appears that the crack may propagate into the chord or the connection, the condition that element should also reflect that condition of this defect.

i) For most aluminum structures, there are 4 chords with diagonals between all chords, including the gravity diagonals (visible on elevation), the wind diagonals (visible in plan) and the inside diagonals. This amounts to several dozen, up to about a hundred, diagonals per truss. The truss is taken to begin at the end of the corner arc. A common defect is cracking of the diagonal where it is welded to the cluster connection. Trapped water leads to corrosion of the aluminum cluster casting, which leads to cracking of the welds that connect the diagonal to the cluster. An example of this is shown in Figure 4c.1.

ii) For the CMS type sign supports, much of the inspection must be done from the inside since the structure is covered with a sheet aluminum skin.

iii) For tri-chord sign supports, there are 3 chords with several dozen diagonals between them.

iv) For Plane truss structures and cantilever sign supports, there are 2 arms with only a few diagonals between them, only in one plane. There are thus only 6 or 8 diagonals per truss, up to about 20 for plane truss structures.

v) For mono-tube signs, or other horizontal arms that do no contain truss-work, there are no diagonals and this element does not exist.

The inspector should look for cracks in the diagonals. Special attention should be given to attached clamps, which often lead to significant section loss due to galvanic corrosion. Areas of galvanic

corrosion should be marked as a performance deficiency (03) and marked as a maintenance item to remove the clamps (03) that are the cause of galvanic corrosion. The inspection should also concentrate on cracked welds in the areas around welded attachments. Bent members due to erection damage or vehicle collision, and cracking of members due to water filling the tubes and freezing, are also possible.

Diagonals susceptible to filling with water should be marked for the repair need of drilling a drain hole (07). This applies only for members that have the possibility of filling with water. This includes only those members that are closed ended at the bottom with no drain holes, and either open-ended or closed ended with drain (or vent) holes at the top. If no drain (or vent) holes are visible it is possible that there is internal venting and filling with water is not possible. It may also be possible to tap the member to determine if it is filled with water.

4a. CONNECTION - BASE

Inspect the connection at the base of the structure. The inspection should be according to Table 5 for a material of steel or aluminum and Table 6 for the bolts. The connection condition is based on the worst component within each connection.

i) For most situations, the base connection includes the base plates and stiffeners, as well as the anchor bolts.

ii) For many aluminum legged sign supports, the base connection includes the base casting, and the anchor bolts.

iii) Each connection at the base of the column should be inspected. Thus, single column legs have 1 connection per leg, trussed legs have 2 connections per leg, and structures with steel pedestals have connections of the base plate to the pedestal as well as the pedestal to the concrete anchorage.

iv) For bridge mounted sign supports, inspect the plates and bolts used to attach the structure to the fascia and soffit of the bridge. Each connection point should be inspected. Several bridge mounted structures have shown problems with the connection to the bridge. Current standards call for ¾ inch (19mm) bolts to be used for the connection. If smaller diameter bolts or studs exist, especially if the sign is not up against the bridge fascia, a suspected performance deficiency (04) should be noted. If the projection of the stud beyond brackets appears excessive, the suspected performance deficiency of improper embedment (06) of the studs should be noted.

If the base connection is covered in soil or debris, the maintenance action of cleaning the base (01) shall be recorded. The inspector should look for loose nuts or bolts and corroded or cracked bolts. Loose bolts may be determined by tapping each bolt with a hammer. For stud type anchorages, if the projection of the stud beyond base plate appears excessive, the suspected performance deficiency of improper embedment of the studs (06) should be noted.

4b. CONNECTION – LEG

Inspect the connection of the truss chords to the leg chord. Inspection should be according to Table 5 for steel and aluminum, and Table 6 for the bolts, and Table 7 for the connection surfaces. Each connection of a truss chord to the leg chord should be inspected. The connection includes all bolts, end plates and stiffeners, brackets and castings.

i) For tapered leg sign supports, this type of connection does not exist. All connections are considered in-line chord connections.

ii) For ACL and ARL aluminum sign supports, the connection of the 4 truss chords to the 2 leg columns should be included for this element. It should include all plates, and welds in the chord to leg area. This is a welded shop connection and not a field splice.

iii) For the CMS sign supports, the element includes the cap plates, saddles, bolts, and the bearing pad between the steel leg and the aluminum truss.

iv) For tri-chord sign supports, the connection of the front chord to the single leg should be included in this element. It includes the chord surface, steel brackets, the locking, hold-down and clamping plates, bolts, and the rubber gasket. Since the chord and steel brackets are significantly more important in the connection area, the condition of each connection shall only be deemed to be poor if it is due to the condition of the chord and steel brackets. If the governing component within the element is the locking, hold-down and clamping plates, bolts, or the rubber gasket, the condition of the connection should be recorded as no worse than fair, unless the inspector feels there is an effect on the load carrying capacity.

v) For the cantilever sign support, the connection of the two arms to the single leg is included in this element. It includes the end plates, stiffener plates, and the bolts.

The inspector should look for cracks in any of the plates or castings. The inspector should also concentrate on loose bolts, which can have a serious effect on the strength of the connection. Also, bolts in connections with poor connection surfaces may be exposed to a more severe environment and these areas should be inspected carefully for corrosion. If there is debris at the location of the connection, the maintenance item to clean the debris (01) should be noted.

4c. CONNECTION – IN LINE CHORD

Inspect the field splice connections of the truss chords. Inspection should be according to Table 5 for steel and aluminum, and Table 6 for the bolts and Table 7 for the connection surfaces. Each connection of a truss chord should be inspected. The connection includes all bolts, end plates and stiffeners, and castings.

i) For most aluminum sign supports, the field connection of the chords includes the aluminum castings and the long bolts. All connections should be inspected. For ATL Type sign supports, this includes the connections on the leg, at either end of the corner arc portion, as well as on the truss. For the ACL and ARL Type, there are only connections on the truss portions. A common defect is a loose bolt in the cluster connection, as shown in Figure 4c.2.

ii) For CMS signs, the connection is a telescopic one, with one chord segment inside of the other. The bolts through the chords must be tightened since this is a slip resistant connection. There is typically one connection on each chord at each end of the sign component.

iii) For tri-chord sign supports, the connection includes the end plates, stiffener plates, and bolts.

iv) For the cantilever sign support, typically, there are no chord to chord connections.

The inspection should look for cracks in any of the plates or castings. The inspection should also concentrate also on loose bolts, which can have a serious effect on the strength of the connection. Also, bolts in connections with uneven mating of plates may be exposed to a more severe environment and these areas should be inspected carefully for corrosion.

4d. CONNECTION – SIGN

Inspect the clamps used to attach the sign to the structure. Inspect the clamps according to Table 5, 6 and 7. This item includes the C clamp casting as well as the bolts or U bolts. Each clamp should be inspected.

i) In older and aluminum signs, these connections are C clamps.
ii) In newer steel sign supports, these connections are U-bolts.
iii) The Changeable Message Sign has the sign component built integral with the structural members. No real attachment points are definable and thus, this element does not exist.
iv) Other attachment methods may be possible. For example, on mono-tube sign supports, brackets are welded to the chord. These brackets shall be inspected under this element.
v) For bridge mounted signs, connection of the sign to the chord should be inspected in this element. These are typically C clamps.

4e. CONNECTIONS – DAMPING ASSEMBLY

Inspect the attachment of the damping assembly brackets to the sign. The damping assembly connection exists only on Cantilever Sign Supports, and this element does not exist for the other types of sign supports. Typically, there are two aluminum angle members connected to the aluminum "Z" shape of the sign. The connection is by means of smaller structural bolts. The attachment of each pair of angle brackets should be inspected in accordance with to Tables 4 and 5. Typically, there are about 3 to 5 pairs of such brackets per sign with 3 bolts per connection.

4f. CONNECTIONS – WALKWAY ARM

Inspect the clamps used to attach the walkway support arms to the structure. In older signs, the connections are by means of C-clamps. This item includes the C clamp casting as well as the bolts. Inspect the clamps, or other means of connection, according to Table 5 and 6. The unit of inspection for this element shall be each clamp.

i) For most sign supports, the connection is to the truss chord.
ii) For bridge mounted sign supports, these connections connect the walkway to the horizontal chords. Actually, in bridge mounted sign supports, the chords are supported by the arms through these connections. The actual connection of the walkway to the bridge is covered under another element.

A common defect for the aluminum sign supports is shown in Figure 4f.1. The aluminum casting clamp is known to be susceptible to cracking on the flanges of the clamps if they were over tightened.

4g. CONNECTIONS – ACCESSORY

Inspect the clamps or other means used to attach any accessories to the structure. Inspect according to Table 5 and 6. Each clamp or attachment location should be inspected.

5a. ATTACHMENT – SIGN

Inspect the sign panel and sign brackets. The brackets, which attach the sign to the chord (at the sign connection), should be inspected according to Table 8. Similarly, the attachment of these brackets to the sign itself should be inspected. This is done by screws or clips, or other means. The sign panel should be inspected for impact damage and weathering. Each sign should be inspected as one unit since, in many cases, defects will result in the removal and replacement of the entire sign component.

5b. ATTACHMENT – SKIN

For Changeable Message Sign Supports, an aluminum skin covers the electronic portion of the sign, including the chords and diagonals. Typically, this thin sheet aluminum is welded continuously to the chords to provide a sealed enclosure. For convenience, each of the five surfaces of the skin are inspected (top, bottom, back, and sides). The inspection should be according to Table 5. The inspection should concentrate on cracks and corrosion of the areas adjacent to welds and locations of water leakage. A maintenance item should be indicated to seal a leak (05) if there is evidence that water is leaking into the enclosure.

5c. ATTACHMENT – DAMPING ASSEMBLY

Inspect all components of the damping assembly. The damping assembly exists only on Cantilever Sign Supports, and this element does not exist for other sign supports. The damping assembly is to provide for aerodynamic damping, to ensure that the sign support does not undergo galloping vibration in the wind. The damping assembly includes the aluminum angle brackets, the plate, and all bolts used to connect these parts. The inspection should be according to Table 5 for the aluminum members and Table 6 for the connections within the assembly. Each entire damping assembly should be inspected as one unit, with the condition of the overall assembly governed by the worst component.

5d. ATTACHMENT – WALKWAY ARM

Inspect the walkway arms. The walkway arms connect to the chords and support the grating. The inspection should be according to Table 5. This element only exists for most aluminum type sign supports and bridge mounted signs. For bridge mounted signs, this element includes all the arms and struts that connect the walkway and/or sign to the supports at the bridge. For CMS sign supports, the grating is supported directly on the diagonals and this element does not exist. For other sign supports, a grating is not supplied and this element does not exist.

5e. ATTACHMENT – WALKWAY

Inspect the walkway assembly, including the grating and grating attachment. The inspection should be according to Table 8. Each segment of the walkway should be inspected as one unit, including the connection of the segments to each other and to the structure. On the aluminum sign support structures and bridge mounted sign supports, the walkway segments are typically about 5 feet (1.5m) long.

5f. ATTACHMENT – HANDRAIL

Inspect the handrail and handrail attachments. The inspection should be according to Table 8. Each discrete portion of the handrail assembly should be inspected. For the aluminum sign supports and bridge mounted sign supports, there are typically about 5 to 10 handrail segments at a spacing of about 10 feet (3.0m). The handrail segments can fold down when not in use. On Changeable Message Signs there are typically two handrail segments (one on each side).

5g. ATTACHMENT – OTHER ACCESSORY

Inspect any attached traffic signals, luminaires, cameras, etc. The taper truss (or spacer truss) on bridge mounted sign supports would be inspected as this element. Also the door on CMS type sign supports, or other items that are deemed important, can be inspected under this element. The description of the element would go under the location of the element. Each of these attachments should be inspected for overall looseness or damage according to the descriptions in Table 8.

6a. COATING – CHORDS/MAIN MEMBERS

Inspect the coating of the truss chords and main single members of the sign support for both the legs and the horizontal portion. The coating can either be galvanizing, paint, or a dual system of galvanizing and coating. If chords/main members exist with different coating types (i.e. galvanized for the horizontal portion and dual for the legs) then the type can be classified as "various" or alternately, the element can be separated into several locations. Several locations can also be used if certain areas are in worse condition than others. Most aluminum members do not have a coating category, while most steel members have paint, galvanizing or a dual coating. The coating for each chord segment should be inspected according to Table 9. Only the chords that have a coating need be considered and thus this quantity only equals the sum of the quantities in elements 2b, 2c and 2d (the Chord/Main Member elements for the leg, corner arc and horizontal) when all are coated. Where a dual system exists, the condition should be based on the condition of the inner coating.

6b. COATING – DIAGONALS

Inspect the coating of the diagonals of trussed members of the sign support, including in the leg, corner arc and horizontal truss. The coating can either be paint or galvanizing or a dual system of galvanizing and coating. If diagonal members exist in with different coating types (i.e. galvanized for the truss portion and dual for the leg diagonals) then the type can be classified as "various" or alternately, the element can be separated into several locations. Several locations can also be used if certain areas are in worse condition than others. Most aluminum members do not have a coating category, while most steel members have paint, galvanizing or a dual coating. The coating for each diagonal should be inspected according to Table 9. Only the diagonals that have a coating need be considered and thus this quantity only equals the sum of the quantities in elements 3a, 3b and 3c (the diagonal elements for the leg, corner arc and horizontal) when all are coated. Where a dual system exists, the condition should be based on the condition of the inner coating.

6c. COATINGS – CONNECTIONS

Inspect the coating of the connections of the sign support. The coating can either be paint or galvanizing or a dual system of galvanizing and coating. If diagonal members exist in with different coating types (i.e. galvanized for the truss connections and dual for the base connection) then the type can be classified as "various" or alternately, the element can be separated into several locations. Several locations can also be used if certain areas are in worse condition than others. Most aluminum members do not have a coating category, while most steel members have paint, galvanizing or a dual coating. The coating for all structural connections should be inspected according to Table 9. Only the connections that have a coating need be considered and thus this quantity only equals the sum of the quantities in elements 4a, 4b and 4c (the base connections, the connections to the leg and connections for in line chords) when all are coated. Where a dual system exists, the condition should be based on the condition of the inner coating.

VI. MAINENTANCE AND REPAIR

After the inspection of the element, the inspector must decide on whether a repair is required, and the urgency of the repair. The need for repair and the urgency depend on the element and on the number of defects within that element. Generally, repairs are required only if the element is in poor condition. Some minor repairs such as tightening bolts or replacing clamps are sometimes required for a non-poor condition but the urgency would not be very high.

For the purposes of these guidelines, maintenance items are related only to the durability of the structures, and do not have an immediate effect on the strength of the structure. Repair includes items that are predominantly intended to increase the immediate strength or performance of the structure. Many repair items, such as repair of cracked members, are much more involved and typically require a contract to be completed. Some repair items are relatively simple to perform (such as tightening bolts, replacing clamps, or applying touch-up paint) but are included as repair items due to their relative importance in the strength of the structure. These items (items 07, 12, 13, 14, 15, 16, 17 and 19 in Appendix D) can probably be performed by a small crew and would not normally require a contract.

The 2-digit code for standard maintenance and repair items can be found on the Inspection Form in Appendix D. The required repair code is also found next to the defects in the Condition State Tables. Maintenance items do not appear in the Condition State Tables since these items are durability items and do not immediately affect the condition of the elements. Besides the Condition State Tables, Tables 10 and 11 list all the elements with the most common defects and repairs or maintenance that are required. Table 10 can be used for maintenance and Table 11 can be used for repair items. **The inspector can use judgement in recommending either alternate or additional maintenance or repair work or differing urgency**. A description of the actual procedures to be followed when doing the various types of maintenance actions and repair work are provided in Appendix A and B respectively.

The repairs listed in the following sections are intended to restore the structure to its original, or near original, condition. However, as stated in the 1999 Bridge Office memorandum, and reproduced in Appendix E, many aluminum sign support structures are not able to carry larger sign areas. For these cases, the repairs are considered temporary and replacement of the structure should still be planned in accordance with the timeframe given in that memorandum.

Safety procedures and traffic control guidelines are not covered in the Appendices.

The inspector shall inspect the element, determine whether either maintenance or repair actions are required, and determine the urgency in the case of repair work. The elements requiring work should be marked (e.g. with flagging tape or paint) to make the defective elements easier to find in the future. These actions and urgency are recorded on the inspection form under each element. More than one maintenance or repair action may be possible for any element. Figure VI can be used as a guide to the steps that must be followed.

After the inspector has completed the inspection of all the elements, the list of maintenance items can be prepared for the maintenance crew. Also, a list of the simpler repair items can also be compiled. This work may also be performed by a maintenance crew without the need for a contract. Feedback is required to ensure that the urgent items have been corrected. For sign support structures, the poor condition of the element (or even of the entire structure) is often the result of a defect that can be corrected by simple means. The list of urgent, more complex, repair items can be compiled so that a contractor can be retained to perform the needed work.

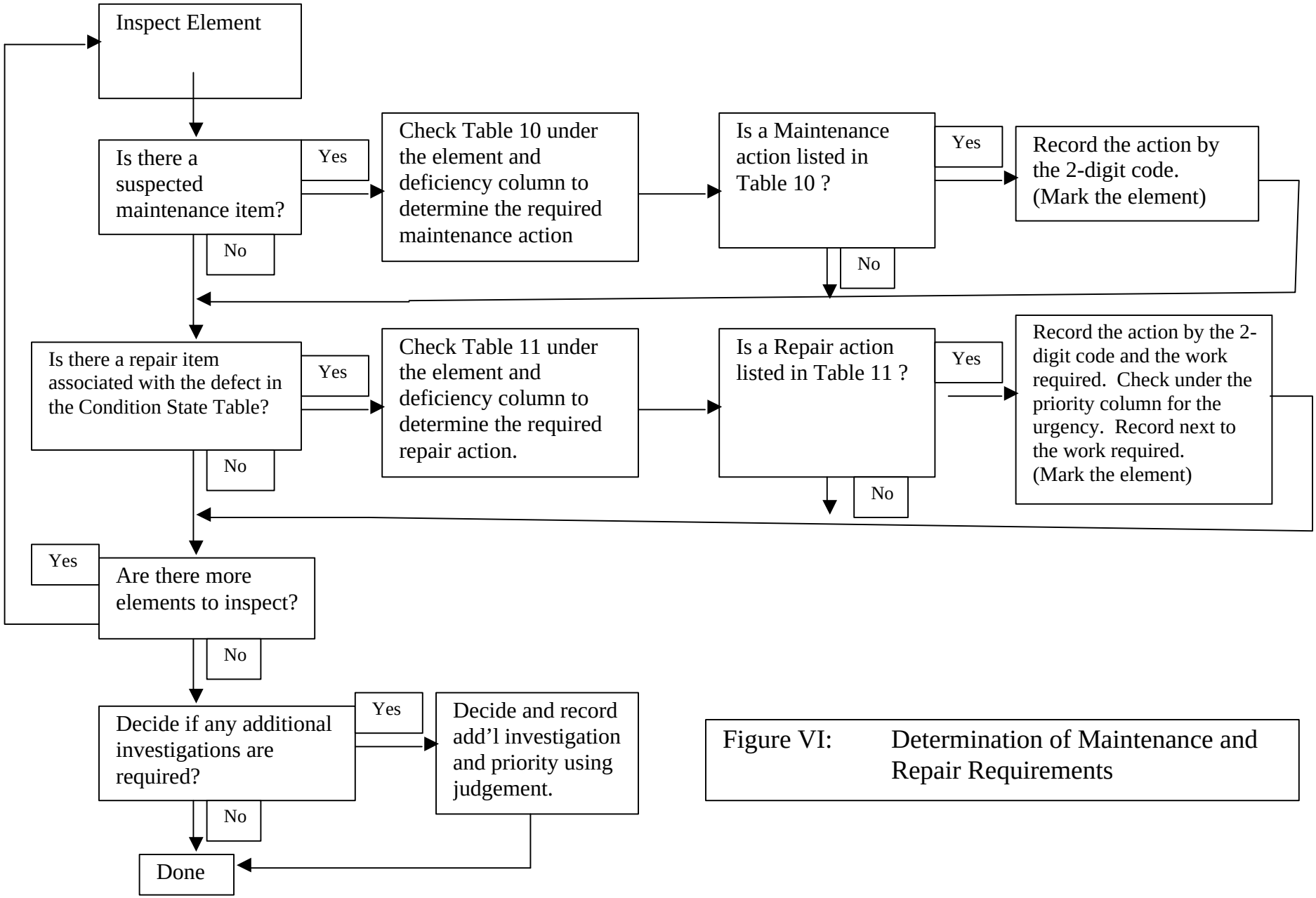


Figure VI: Determination of Maintenance and Repair Requirements

TABLE 10: Maintenance Items for Sign Support Structures

ELEMENT	DEFICIENCY	MAINTENANCE ACTION (code in brackets)
1a. Concrete Foundation	Covered entirely in soil.	Regrade soil. (02)
	Erosion.	Regrade soil. (02)
1b. Steel Foundation	Debris.	Clean. (01)
1c. Bearing Surface	Debris.	Clean. (01)
2a. Chord/Main Member -Base Plate	Debris.	Clean. (01)
2b. Chord/Main Member - Leg 2c. Chord/Main Member - Corner Arc	Missing hand hole cover or end cap.	Replace cover. (04)
2d. Chord/Main Member - Horizontal	Galvanic corrosion occurring at clamp.	Remove clamp and replace, if req'd, with same material as leg. (03)
3a. Diagonal - Leg 3b. Diagonal - Corner Arc 3c. Diagonal - Horizontal	Missing hand hole cover or end cap.	Replace cover. (04)
	Galvanic corrosion occurring at clamp.	Remove clamp and, if req'd, replace with corrosion resistant material. (03)
	Susceptible to filling with water.	Drill 10mm drain hole (05)
4a. Connection - Base 4b. Connection - Leg 4c. Connection - In Line Chord	Debris at connection.	Clean debris (01)
4d. Connection - Sign 4e. Connection - Damping Assembly 4f. Connection - Walkarm 4g. Connection - Accessory	Debris at connection.	Clean debris. (01)
5a. Attachment – Sign		
5b. Skin Attachment	Water leakage.	Seal with caulking. (10)
5c. Attachment – Damping Assembly 5d. Attachment – Walkway Arm 5e. Attachment – Walkway 5f. Attachment – Handrail 5g. Attachment – Other Accessory	Debris on attachment	Clean debris. (01)
6a. Coating – Chords/Main Members 6b. Coating – Diagonals 6c. Coating – Connections		

* - The inspector may use judgement to determine a different maintenance need, based on the observed conditions in the field.

(The maintenance code is given in brackets.)

TABLE 11: Repair Items for Sign Support Structures

ELEMENT	DEFICIENCY	REPAIR ACTION	PRIORITY*
1a. Foundation - Concrete	Cracking or spalling	Epoxy seal cracks (01) and patch spalls (02).	(U) if any in Poor and danger of collapse. (N) if any are Poor and no immediate danger of collapse.
1b. Foundation - Steel Pedestal	Cracks in steel	Repair cracks (03) or replace pedestal (05).	(U) if any in Poor and danger of collapse. (N) if any are Poor and no immediate danger of collapse.
	Corrosion	Repair corroded areas or replacement of the pedestal (04 or 05).	
	Distorted, Dented, or Bent	Repair or replace pedestal (04, 05, 06).	
1c. Bearing Surface	Uneven bearing, broken grout pad	Repair bearing surface (08).	(N) if any in Poor condition.
2a. Chords/Main Members - Base Plate	Corrosion	Repair areas of corrosion (04 or 05).	(U) if >10% Poor. (H) if 5-10% is Poor. (N) if 1-5% is Poor
	Cracked members	Repair cracks in the members (03, 04 or 05).	(U) if any Poor
2b. Chords/Main Members - Leg 2c. Chords/Main Members - Corner Arc 2d. Chords/Main Members - Horizontal	Notched or gouged aluminum member	Repair notch or gouge (06)	(N) if any Poor.
	Corrosion	Repair areas of corrosion (04 or 05).	(U) if >10% Poor. (H) if 5-10% is Poor. (N) if 1-5% is Poor.
	Bent or dented members	Repair distorted member, may require the removal of the structure (04, 05 or 19).	
	Cracked members	Repair cracks in the chords, may require the removal of the structure (03, 04 or 05).	(U) if any Poor.
3a. Diagonal - Leg 3b. Diagonal - Corner Arc 3c. Diagonal - Truss	Notched or gouged aluminum member	Repair notch or gouge (06)	(N) if any Poor
	Corrosion	Repair areas of corrosion (04 or 05).	(U) if 2 adjacent are Poor. (H) if 2 in any truss segment are Poor. (N) if at least one is Poor.
	Bent	Repair distorted member (04, 05 or 19).	
	Cracked members	Repair cracks or replace members (03, 04 or 05).	
	No drain hole and susceptible to filling with water	Drill 10mm drain hole (07)	(N) if any are Fair
4a. Connection - Base	Missing washers.	Install washer if req'd (12)	(N) if any in Fair. (For Bridge Mounted if >20% Fair).
	Loose or missing structural nuts. Or Loose, Missing or Cracked Adhesive anchorage bolts.	Tighten nuts (10). Install Adhesive anchorage (07).	(U) if any in Poor. (For Bridge Mounted if 2 adjacent Poor or >20% Poor). (H) if any in Fair. (For Bridge Mounted if 2 adjacent Fair, >20% Fair or Poor).
	Corrosion of plates or castings.	Repair corrosion (04 or 05).	(N) if any in Poor.
	Cracks of stiffener plates.	Repair cracks (03 or 05).	(H) if any in Poor.

	Cracks of base plates castings.	Repair cracks (03 or 04).	(U) if any in Poor.
4b. Connection - Leg 4c. Connection - In Line Chord	Missing washer	Install washer if req'd (12).	(N) if any in Fair.
	Loose, missing, cracked, or broken nuts or bolts.	Replace (11) or tighten (10) the nut or bolt.	(U) if any in Poor. (H) if any in Fair.
	End plates without proper contact	Repair connection plates (09).	(N) if any in Poor condition.
	Corrosion of end plates	Repair areas of corrosion (04 or 05).	(N) if any in Poor.
	Corrosion of stiffener plates	Repair areas of corrosion (04 or 05).	(H) if any in Poor.
	Cracks in base plate or castings.	Repair cracks in the connection, may require the removal of the structure (03, 04, 05).	(U) if any in Poor
4d. Connection - Sign 4e. Connection - Damping Assembly 4f. Connection - Walkarm 4g. Connection - Accessory	Missing washers.	Install washers if req'd (12).	(N) if >20% in Fair.
	Loose, missing, cracked or broken clamps.	Tighten (13) or replace (14) clamps.	(U) if >10% or 2 adjacent are Poor. (H) if 5-10% are Poor. (N) if 0-5% are Poor or any Fair.
	Embedded stud/bolt corroded, loose, or cracked.	Install new Adhesive Anchorage bolt (07).	(U) if >10% or 2 adjacent are Poor. (H) if 5-10% are Poor. (N) if 0-5% are Poor or any Fair.
5a. Attachment - Sign	Any loose, bent, or otherwise dangerous sign that is easy to repair.	Make minor repair to sign (15).	(N) if >20% in Fair or any in Poor.
	Any loose, severely bent, cracked or otherwise dangerous sign that is more complex to repair.	Make major repair to sign as required (16).	(U) if Poor and immediate danger of collapse. (N) if Poor and no danger of collapse.
5b. Attachment - Skin	Cracked welds	Repair cracked weld (03).	(N) if any Poor.
5c. Attachment – Damping Assembly 5d. Attachment – Walkway Arm 5e. Attachment – Walkway 5f. Attachment – Handrail 5g. Attachment - Other Accessory	Any loose, bent, or otherwise dangerous attachment that is easy to repair.	Make minor repair to the attachment (15).	(N) if >20% in Fair or any in Poor.
	Any loose, severely bent, cracked or otherwise dangerous attachment that is more complex to repair.	Make major repair to the attachment as required (16).	(U) if Poor and immediate danger of collapse. (N) if Poor and no danger of collapse.
6a. Coating – Chord/Main Member 6b. Coating – Diagonal	Peeling, flaking or cracking of coating.	Apply overall coating (18).	(N) if >75% Poor.
6c.Coating – Connections	Peeling, flaking or cracking of coating.	Apply localized coating (17).	(N) if >25% Poor.

* - For amounts less than shown in the Tables, or for elements in other Condition States, no repair is required. **The inspector may use judgement to determine a different priority, or to determine a need, based on the observed conditions in the field**.

(The repair code is given in brackets.)

(U) - Urgent repair is required within 1 month.
(H) - High priority repair is required within 1 year.
(N) - Normal priority repair is required within 3 years.

VII. STRUCTURE RATING (to be fully implemented at a later date)

The structure rating methods presented in this part of the guidelines are a means of categorizing the structures' overall condition. This part is not required in any way to perform an inspection of the structure or to record the inspection information.

Using the inspection information, some simple rules will be applied to obtain an overall structure rating number and an overall structure condition. The ratings and conditions can be used to rank the sign support structures in an approximate order reflecting the severity of the defects and the effect on the overall performance of the structure. When decisions are to be made on programming certain structures for repair, the structure ranking can be used as a guide. However, the region can create a program priority listing based on this and/or any other information that they deem significant.

In determining the importance of various elements on the performance of the structure, the overall effect of the element on the strength and stability of the structure has been estimated. Elements that primarily effect the durability of the structure are deemed less important when deriving the structure rating. Table 12 provides information on the assumed importance of the various elements in the overall sign support structure.

The actual structure rating is derived by combining the element conditions and applying weighting factors according to the importance of the element on the overall structure. The method of obtaining the rating is detailed in Table 13.

The structure rating and structure conditions have not been finalized at this time. As inspection data becomes available, the formulae for determining structure rating and structure condition will be improved.

TABLE 12: Structure Rating: Importance of Elements

The overall condition of the structure is effected by the elements as described below.

	Element Group	Element Name	Importance*	Comments
1a.	Foundation	Concrete	Somewhat Important	Deterioration of the Pedestal is not usually a common or severe problem.
1b.		Steel Pedestal	Important	The steel pedestal is somewhat over-designed compared to the rest of the structure, however, it is a single load path element.
1c.		Bearing Surface	Important	Deterioration of the bearing surface can place higher than expected load on the anchor bolts or legs. It has a large effect on fatigue loading and ultimate strength of the structure.
2a.	Chord/Main Member	Base Plate	Very Important (Somewhat Important for Bridge Mounted Signs)	The chords are the main load carrying members of the truss, although some minor load re-distribution is possible through the truss-work. (For bridge mounted signs, the chords carry little axial load but still are the main attachment points.
2b.		Leg		
2c.		Corner Arc		
2d.		Horizontal		
3a.	Diagonal	Leg	Important	The diagonal members are significant for resisting wind and truck gust loads. Load re-distribution is possible due to the great number of diagonals and through the chords in bending.
3b.		Corner Arc		
3c.		Truss		
4a.	Connection	Base	Very Important	This connection is responsible for supporting the entire structure.
4b.		Leg	Very Important	Connection of the chords is required to maintain the integrity of the main load carrying members.
4c.		In Line Chord		
4d.		Sign	Important	Any faults could lead to unexpected collapse of the element, with possible injury to traffic or maintenance staff.
4e.		Damping Assembly		
4f.		Walkway Arm		
4g.		Accessory		
5a.	Attachment	Sign	Somewhat Important	Any faults do not lead to a sudden collapse of the structure or of the element, and typically show evidence of distress prior to failure of the element.
5b.		Skin	Minor Importance	Any faults do not have a possibility of collapse of the structure or of the element
5c.		Damping Assembly	Somewhat Important	Any faults do not lead to a sudden collapse of the structure or of the element, and typically show evidence of distress prior to failure of the element.
5d.		Walkway Arm		
5e.		Walkway		
5f.		Handrail		
5g.		Other Accessory		
6a.	Coating	Chords/Main Member	Minor Importance	Any faults do not have a possibility of collapse of the structure or of the element
6b.		Diagonals		
6c.		Connections		

* - The importance is based on the expected behaviour of the structures. If the inspector determines that any component is in extremely poor condition, the urgent repair option can be chosen for the element.

TABLE 13: Structure Rating: Weighting of Elements

The overall rating of the structure is determined as described below.

Rating	$SSR = \frac{100 - \sum F_{IMP}\left[(0.5)(F) + (5.0)(P)\right]}{}$
Overall Condition	Excellent - if SSR >95 Good - if SSR >75 Fair - if SSR > 40 Poor - if SSR < 40

Where: SSR = Sign Structure Rating.

F_{IMP} = Importance Factor = 10.0 for Very Important
2.0 for Important
0.4 for Somewhat Important
0.1 for Minor Importance

F = Number of elements in Fair condition state

P = Number of elements in Poor condition state

VII. REFERENCES

The following references have been used in the preparation of these guidelines:

MTO - Ontario Structure Inspection Manual (OSIM).
MTO - Safety Practices for Structure Inspections.
Overhead Sign Structure Inventory and Inspection Manual – State of New York DOT.
Statewide Inspection of Traffic Structures – State of Virginia DOT.
MTO - Sign Support Manual.

APPENDIX A:

Maintenance Procedures for Sign Support Structures

(The number in brackets is the maintenance need number found on the inspection form)

Clean Debris (01).

1. Debris against the structure will trap water and promote corrosion.
2. The debris should be removed and the area washed of any corrosive salts.

Regrade (02).

1. If the soil is encroaching on the foundation base, this will trap water and lead to premature corrosion.
2. The soil should be removed and regrading shall be done to prevent the soil from falling back into this area.

Remove Clamps Causing Galvanic Corrosion (03).

1. Clamps of dissimilar metal to the structure will lead to galvanic corrosion and section loss.
2. Remove the clamps. If it is required to replace the clamps, they should be placed in a slightly different location so that the area with section loss can be easily viewed.

Replace covers on Members (04).

1. If a cover is missing, corrosive salts and water can enter the tubes and lead to premature corrosion.
2. A cover, made from the same material as the member, shall be attached to cover the hole.

Seal Leak (05)

1. If the enclosed CMS sign is leaking, some components may become damaged.
2. Seal the leak with caulking, silicone, or another appropriate sealant.

APPENDIX B

Repair Procedures for Sign Support Structures

(The number in brackets is the repair need number found on the inspection form)

The repair procedures listed below are general repair strategies that are applicable for most common situations. The engineer may consider a different repair depending on the specific conditions that are present.

Repair Procedure for Concrete Foundation: Crack (01) or Spall (02) repair

1. All loose and delaminated concrete shall be removed. If there is any danger of stability of the structure, the structure shall be removed during the repair material.
2. Concrete shall be patched with an approved repair.
3. Excessive cracks shall be repaired by epoxy injection.

Repair Procedure for Cracks in Members: Re-weld (03), Lap (04) or Replace (05) member

1. Where the termination of the cracks cannot be determined, the area should be tested, either by Liquid Penetrant Testing (LPT) or Ultrasonic Testing (UT), to identify the extent of the cracking.
2. In determining a repair strategy for the structure, the condition of the entire component, and of all the components, should be considered. If various defects occur and are widespread, it may be cost advantageous to replace the entire segment, or replace the entire sign support.
3. For transverse cracks in the parent material or in welds of diagonals;
   a) Where there is no or minimal separation of the crack (less than 1 or 2mm), the crack shall be removed (by grinding) and the area re-welded.
   b) Where there is a larger separation of the crack, the damaged member shall be removed and replaced.
4. For transverse cracks in the parent material or in welds of chords;
   a) Where there is no or minimal separation of the crack, the crack shall be removed and the area re-welded.
   b) Where there is a larger separation of the crack, or where the crack extends greater than 20% of the circumference, the damaged member shall be removed and replaced or covered with a lap splice plate.
5. For longitudinal cracks in parent material;
   a) Where there is no or minimal separation of the crack, the crack shall be removed and the area re-welded.
   b) Where there is a larger separation of the crack, the damaged member shall be removed and replaced or covered with a lap splice plate.
6. No or minimal separation is defined as a gap that can easily be closed by temporary clamping, or approximately 2 mm.
7. Crack removal, where required, shall be complete crack removal and be done by gouging, shipping, machining or grinding.
8. For all welding, the groove shall then be properly prepared to meet the joint and geometry requirement specified in the corresponding Welding Procedure Data Sheet (WPDS), specifically prepared by the welding engineer to meet by the Canadian Welding Bureau (CWB) standards for the repair of cracks in aluminum or steel sections.
9. For all field repairs, where the length of the crack is greater than 20% of the circumference, the area should be stabilized with temporary bracings and clamps to ensure satisfactory fit-up during possible in-service vibrations.

10. If satisfactory fit-up of a diagonal cannot be achieved during preparation, the member should be replaced. If satisfactory fit-up of a chord or, a plate or stiffener attached to the chord, cannot be achieved during preparation, the repair will require a suitable back up bar, as specified in the corresponding Welding Procedure Data Sheet (WPDS).
11. For all welding, the heat due to welding can have an effect on the load carrying capacity of the member. The heat shall be carefully controlled to ensure that there is no adverse stress redistribution.
12. Where members are to be replaced, the new member shall be of corresponding material and physical properties. Where lap plates are used for aluminum members, the ends of the plate shall be tapered to minimize the length of weld transverse to the member.
13. All groove welds shall be ground flush.
14. If the source of the cracking is due to the accumulation of water, drain holes should be drilled. This may occur on some diagonals and be evident by splitting of the tube. Also, cracking at the connection of an aluminum diagonal to an aluminum casting is often caused by water filling the casting, causing corrosion that pushes apart the tines of the casting, and initiates the cracking. In this case, a drain hole should be drilled in the casting.
15. After welding, the members shall be coated similar to the existing coating.

Repair Procedure for Bent, Dented or Distorted Members: Lap (04), Replace (05) or Heat Straighten member (08)

1. Minor dents, bends or distortions that fall into the fair condition state do not require repair.
2. In determining a repair strategy for the structure, the condition of the entire component, and of all the components, should be considered. If various defects occur and are widespread, it may be cost advantageous to replace the entire segment, or replace the entire sign support
3. For all sections;
   a) Bent or distorted aluminum members shall not be straightened by heat or mechanical means.
   b) Localized dents or bends on aluminum, not exceeding 50% of the circumference in width, the area shall be covered with a lap plate. Bends and dents without sharp kinks on steel shall be repaired by heating and straightening or by lap plate.
   c) All severely bent or distorted members, including those with sharp kinks, as well as larger dents, the damaged sections shall be removed completely, at the connecting fillet welds, and replaced.
4. Welding, if required, shall be as described in the notes 8-12 above.
5. Temporary bracing may be required if straightening members by heating.
6. After repair, the members shall be coated similar to the existing coating.

Repair of Notched or Gouged Members: Weld Gouge (06)

Notches or gouges can occur from impact, or from improper fabrication, transportation or erection of the sign support structure. These notches provide a location for stress raisers and thus are poor for the fatigue performance of the structure.

1. Notches in Fair Condition (less than 3mm in depth for aluminium and all notches in steel) typically do not require repair. Some grinding may be advisable if areas are very sharp.
2. All notches in aluminium requiring repair (the ones in Poor Condition) shall be repaired by grinding and welding. The notch or gouge shall be ground to a profile and welded as shown on the applicable WPDS. After welding, the weld shall be ground flush.
3. After repair, the members shall be coated similar to the existing coating.

Repair Procedure for Corroded Members: Lap (04) or Replace (05) member

1. Only areas of severe corrosion require repair. Minor or moderate corrosion should have the surface cleaned, to verify the degree of section loss, and re-coated with any further corrosion to be monitored.
2. All areas that are to be repaired shall be cleaned to determine the extent of the corrosion.
3. In determining a repair strategy for the structure, the condition of the entire component, and of all the components, should be considered. If various defects occur and are widespread, it may be cost advantageous to replace the entire segment, or replace the entire sign support
4. For all sections;
   a) For localized severe corrosion, extending less than 20% of the circumference for diagonals or 40% of the circumference for chords, the area shall be covered with a lap plate.
   b) For more general severe corrosion, the damaged member shall be removed completely, at the connecting fillet welds, and replaced.
5. Welding, if required, shall be as described in the notes 8-12 above.
6. After repair, the members shall be coated similar to the existing coating.

Repair procedure for lack of Drain Holes in Members susceptible to filling with water (07).

1. The crew should verify the safety of the walkway prior to using it. The repair work may need to be done by bucket truck for structures with unsafe or non-existent walkways.
2. Only those members that are closed ended at the bottom and either open-ended or closed ended with drain (or vent) holes at the top will require drain holes. If no drain (or vent) holes are visible at the top or bottom of the member, it is probable that internal venting exists, thus the addition of drain holes are not required.
3. Drain holes are to be 10mm in diameter and located on the lower face, at the bottom end of the member.

Repair Procedure for Connection of Bridge Mounted Signs to Structure: Install Adhesive Anchorage bolt (09).

1. Cut off or remove the bolt.
2. Either reuse existing hole, or drill new hole through plate and into bridge.
3. Ensuring full contact of plate, install new Adhesive Anchorage type bolt. Size of the new bolt should match the existing, but should not be less than 15mm.
4. Sign structure may have to be relocated.

Repair Procedure for Bearing Surface (10).

1. The leg of the sign support shall have a uniform bearing on the foundation.
2. All poor areas, as well as areas determined by the engineer, should be repaired.
3. If there is poor contact between the leg and the foundation, including deteriorating grout pads, the area shall be cleaned and an epoxy or cement grout pad (depending on the thickness) used to level the surface. If a rubber gasket is present, the grout shall not be placed on top of the gasket. Depending on the condition, it may be necessary to remove or temporarily support the structure while the repair is being done.

Repair Procedure for Misaligned Plate Connections (11).

1. All plate-to-plate connections should provide close to uniform bearing. This reduces fatigue loading and improved the performance of the bolts.
2. All repairs shall be as directed by the engineer, the following are some suggested options:
   a) The plates can be brought into contact by tightening the bolts. If the bolts are seized, they can be removed (one at a time) and replaced with a new bolt.
   b) A carefully measured and manufactured bevel plate can be placed in the connection to provide proper bearing. This would require the removal or temporary support of the structure.
   c) The stiffener plates can be cut, the plates can then be brought into contact by tightening the bolts, and the stiffeners then re-welded.
3. In all cases, the area between the plates should be cleaned to allow for proper bearing of the two surfaces after the repair is completed.

Replacing (13) or Tightening (12) Bolts for Chord, Leg or Base Connections

1. The crew should verify the safety of the walkway prior to using it. The repair work may need to be done by bucket truck for structures with unsafe or non-existent walkways. The weight of the crew, or the wind gusts from passing trucks, will not have an impact on the repair.
2. Each bolt in a connection should be removed and replaced prior to removal of subsequent bolts in the connection.
3. The bolts for connecting members should be tightened using the turn-of-nut method.

Adding Washer to Bolts (14).

1. Washers should only be placed in locations where there is doubt concerning the bearing of the nut.
2. The nut shall be removed, and a proper washer placed. It should be noted that often the bolts are in a rusted or seized condition and that removal may lead to damage of the bolt. When removing nuts, a lubricant should be used and replacement bolts should always be on hand.
3. Extreme caution should be used when trying to add a washer under a stud or bolt that is anchored in concrete. In these cases, if the bolt is damaged during removal of the nut, the replacement bolt will be very difficult to install. Attempts to add washers in these circumstances should only be done when absolutely necessary.

Replacing (16) and Tightening (15) Clamps on Signs, Walkway Arms or Other Attachments

1. The crew should verify the safety of the walkway prior to using it. The repair work may need to be done by bucket truck for structures with unsafe or non-existent walkways.
2. Each clamp should be removed and replaced prior to removal of subsequent clamps.
3. The removal should begin with the clamps that are in the worst condition.
4. Caution should be exercised to not over-tighten the clamps.
5. When tightening clamps, additional clamps should be available in case the threads become damaged.

Minor Repair of Sign or Other Attachment (17)

1. The crew should verify the safety of the walkway prior to using it.
2. This item includes items that are easy to perform regardless of whether it has a large or small effect on the overall strength or stability of the component.
3. This includes tightening bolts or clips within the sign panel or other attachment or other defective areas that can easily be corrected.

Major Repair of Sign or Other Attachment (18).

1. The crew should verify the safety of the walkway prior to using it. The repair work may need to be done by bucket truck for structures with unsafe or non-existent walkways.
2. This item include larger repairs that are more complex, more time consuming and also for repairs that require the sign panel or other attachment to be removed and repaired in a shop environment.
3. If the sign or other attachment can be repaired in place, the necessary repairs shall be done as required.
4. If the repairs are deemed to be excessive, the sign or other attachment shall be removed and either fixed in a shop environment or replaced. The sign or other attachment shall be temporarily supported prior to removal of the clamps that hold it on.

Applying New Coating: Loacalized (19) or Overall (20)

1. The purpose of the coating is for aesthetics and for protection the members.
2. Applying a new coating the structure is quite expensive and usually involves removing the structure and performing the work in a shop environment. This should be considered before recommending that a new coating be applied.
3. The application of a new coating in localized areas is often a preferred option. Usually the poor areas are confined to the areas around the base plate, and possibly other connection areas.
4. The areas to receive a new coating should be cleaned by blast cleaning or wire brush. An approved coating should be applied.

APPENDIX C

Sign Support Inspection Guidelines **MTO Site Number:**

Inspection Form (Inventory)

Inventory Data:			
Structure Name			
Location:		Comments	
Direction:		Core/Collector/Ramp	
MTO Region		Main Highway	
MTO District		Owner	
Old County		AADT	
Old Site No.		Inspection Route Sequence	
Manufacturer		Vertical Clearance	(m)
Latitude		Longitude	
Sign Support Type		Sign Type	
Left Footing Type		Right Footing Type	

Sign	Height (m)	Length (m)	Colour	Overlay	Contents
A					
B					
C					

Total Sign Area (m^2) Maximum Allowable Area (m^2) Span (m)

Attachments

Historical Data:			
Year Built		Contract Number When Built	
Latest Biennial Inspection		Latest Specialized Inspection	
Latest Structure Rating:		Latest Structure Condition:	
Rehab. History: (Date/description)			
Regional Priority Number		Programmed Work Year	
Nature of Program Work:			

APPENDIX D

Sign Support Inspection Guidelines **MTO Site Number:**

Inspection Form (General Inspection)

Additional Investigations Required:	Priority		
	None	Normal	Urgent
Detailed Weld Inspection:			
Structure Evaluation:			
Other Evaluation:			
Special Notes/General Comments:			
Next Biennial Inspection:			

Field Inspection Information:	
Date of Inspection:	
Inspector:	
Others in Party:	
Equipment Used:	
Weather:	
Temperature:	

Suspected Performance Deficiencies

01	Tilted/Shifted Foundation	**04**	Suspected Deficient Size Of Anchorage	**07**	Other
02	Deficiency In Material of Indeterminate Magnitude, Do A NDT (Non Destructive Test)	**05**	Suspected Deficiency in Structural Capacity		
03	Galvanic Corrosion	**06**	Suspected Lack Of Stud Embedment		

Maintenance Needs

01	Clean Debris	**04**	Replace Cover	**07**	Other
02	Regrade Soil	**05**	Seal Leak		
03	Remove Clamps	**06**	Minor Maintenance of Sign or Other Attachment		

Repair Needs

01	Epoxy Seal Crack In Concrete	**08**	Heat Straighten member	**15**	Tighten Clamp
02	Patch Spalled Concrete	**09**	Repair Adhesive Anchorage Bolt	**16**	Replace Clamp
03	Re-weld member	**10**	Repair Bearing Surface	**17**	Minor Repair Sign Or Attachment
04	Add lap plate	**11**	Repair Misaligned Connection Plate	**18**	Larger Repair Sign Or Attachment
05	Replace member	**12**	Tighten Bolts	**19**	Apply Localized Coating
06	Repair gouge in member	**13**	Replace Bolts	**20**	Apply Overall Coating
07	Drill Drain Hole	**14**	Add Washer To Bolts	**21**	Other

MTO Site Number:

Inspection Form (Elements)

Group:			Name:			Tot. Quantity:				Not Insp'd		ÿ
Location:			Material			Maint.		Rehab.		Rehab.		Urgency
Condition Data:	Units	Exc/ Good	Fair	Poor	Perform Defic.	#	Code	#	Code	#	Code	None 3 year 1year Now
	each											

Comments:

Group:			Name:			Tot. Quantity:				Not Insp'd		ÿ
Location:			Material			Maint.		Rehab.		Rehab.		Urgency
Condition Data:	Units	Exc/ Good	Fair	Poor	Perform Defic.	#	Code	#	Code	#	Code	None 3 year 1year Now
	each											

Comments:

Group:			Name:			Tot. Quantity:				Not Insp'd		ÿ
Location:			Material			Maint.		Rehab.		Rehab.		Urgency
Condition Data:	Units	Exc/ Good	Fair	Poor	Perform Defic.	#	Code	#	Code	#	Code	None 3 year 1year Now
	each											

Comments:

Group:			Name:			Tot. Quantity:				Not Insp'd		ÿ
Location:			Material			Maint.		Rehab.		Rehab.		Urgency
Condition Data:	Units	Exc/ Good	Fair	Poor	Perform Defic.	#	Code	#	Code	#	Code	None 3 year 1year Now
	each											

Comments:

Group:			Name:			Tot. Quantity:				Not Insp'd		ÿ
Location:			Material			Maint.		Rehab.		Rehab.		Urgency
Condition Data:	Units	Exc/ Good	Fair	Poor	Perform Defic.	#	Code	#	Code	#	Code	None 3 year 1year Now
	each											

Comments:

MTO Site Number:

Inspection Form (Elements) [Alternate Form]

	Group	Name	Loc'n	Mat'l	Qty	Not Insp	Unit	Exc/ Good	Fair	Poor	Perform Defic.	Maintenance		Rehab.		Rehab.		Comments	Urgency
												#	Code	#	Code	#	Code		
1a	Foundation	Concrete					Each												
1b		Steel Pedestal					Each												
1c		Brg. Surface					Each												
1d		Anch. Bolts					Each												
2a	Chord/Main Members	Base Plate					Each												
2b		Leg					Each												
2c		Corner Arc					Each												
2d		Horizontal					Each												
3a	Diagonal	Leg					Each												
3b		Corner Arc					Each												
3c		Truss					Each												
4a	Connection	Base					Each												
4b		Leg					Each												
4c		In Line Chord					Each												
4d		Sign					Each												
4e		Damp Assemb					Each												
4f		Walkway Arm					Each												
4g		Accessory					Each												
5a	Attachment	Sign					Each												
5b		Skin					Each												
5c		Damp Assemb					Each												
5d		Walkway Arm					Each												
5e		Walkway					Each												
5f		Handrail					Each												
5g		Other Access.					Each												
6a	Coating	Chords					Each												
6b		Diagonals					Each												
6c		Connections					Each												

APPENDIX E: 1999 Bridge Office Memo for Aluminum Tapered Leg Sign Supports

MEMO

To: **Regional Managers of Engineering** **February 12, 1999**
Heads, Regional Structural Sections

Re: Type 1 Overhead Sign Support Structures

Please find attached the Evaluation Report on Structural Adequacy of Type 1 Overhead Sign Support Structures. The evaluation reveals that the Type 1 Sign Support Structures are structurally deficient if they carry more than 240 square feet of sign areas. There are also problems related to construction tolerance of the base anchorage, corrosion distress and fatigue cracking of welds. Many components are subjected to excessive fatigue stress ranges and may therefore be approaching their fatigue life.

The report has recommended the following immediate actions in order to ensure safety:

i. An inventory survey and a detailed one-time inspection of all Type 1 sign support structures should be performed immediately according to the following priority:
   - Structures carrying changeable message signs
   - Structures carrying sign area > 240 square feet
   - All other structures

   All structures should be identified by a reference site number with proper record of the signage areas. The detailed inspection should be carried out by qualified structural inspectors and should be sufficiently thorough to cover each structure in its entirety, with particular attention to the following critical areas:
   - Connection of diagonal members to splice of chords
   - Welding of legs to base casting
   - As-built distance between base supports
   - Other diagonal members welded connections to chords
   - Attachment of any dissimilar metal like grounding cables that may cause galvanic corrosion

ii. Carry out structural evaluations for structures carrying changeable message signs.

iii. For structures with observed defects, including support mis-alignment, the following actions can be taken:
   - Replace immediately; or
   - Carry out temporary repair (if economically feasible) and replace within 5 years if the sign area is < 240 square feet; otherwise, replace within 3 years.
   - If support mis-alignment is the only observed defect, rectify the defect if it is economically feasible, otherwise, replace within 3 years.

iv. Plan for replacement of any other structures carrying sign area > 240 square feet within 3 years.

v. Carry out biennial inspection on all Type 1 structures by qualified structural inspectors. District inspection currently carried out on an annual basis should continue.

Since there may be Type 1 sign support structures that have suffered critical distresses and are unsafe to the travelling public, prompt actions would have to be taken to either repair or replace them. Hence, the inventory survey and the detailed inspection should be expedited. We recommend that the survey and detailed inspection be completed in six months. The detailed inspection should be programmed and co-ordinated by the Regional Structural Sections; Bridge Office would provide technical support to the Regions to analyse the inspection data and to determine structures that would require temporary repairs. Bridge Office is currently developing a temporary repair scheme specifically for the diagonal connection to the chord splices; other repair schemes may have to be developed in due course for other defects. Bridge Office is also developing a set of inspection guidelines for the biennial inspection to be carried out by the Regional Structural Sections and for the regular annual inspection carried out by the Districts; some interim guidelines could also be provided for the initial detailed inspection if it is required by the Regions.

In view of the many defects and deficiencies of this type of sign support structure, and the potential high cost of repair and on-going maintenance, it would be prudent to program for their replacement with new standard types of sign support structures, particularly when there are major highway improvement works in the vicinity.

Original signed by:

Bala Tharmabala
Manager, Bridge Office

cc. Heads, Bridge Office

APPENDIX F: PHOTOGRAPHS

Included are pictures of the various types of sign supports, as well as pictures of the element types to show which components are included with which elements and to show some common material defects.

The figure number relates to the element number found in other areas of the guidelines. When the Figure number is 0, this relates to an overall photograph of the sign support structure. When the Figure number is from 1 to 6, this relates to the element numbers found in the guidelines. The digits after the decimal are simply the photograph numbers within each element number.

A detailed description of what components are included with each element is found in Part V, Section D, sub-section 1 to 6.

Figure 0.1 Aluminum Tapered Leg Sign Support (ATL)

Figure 0.2 Aluminum Circular Leg Sign Support (ACL): Note circular legs

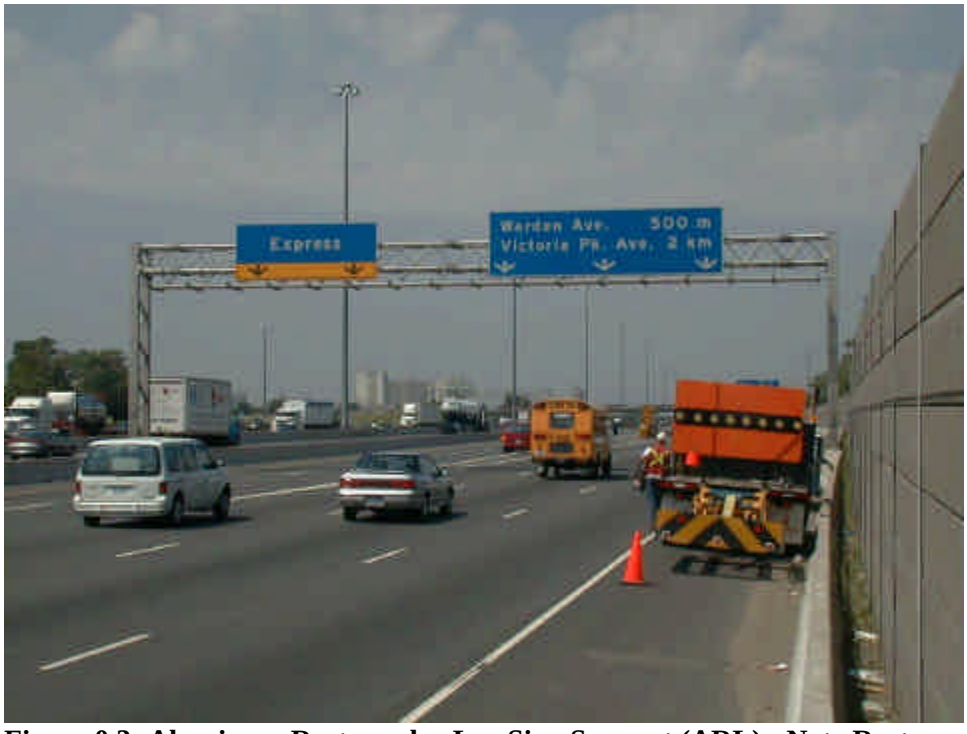


Figure 0.3 Aluminum Rectangular Leg Sign Support (ARL): Note Rectangular Legs.

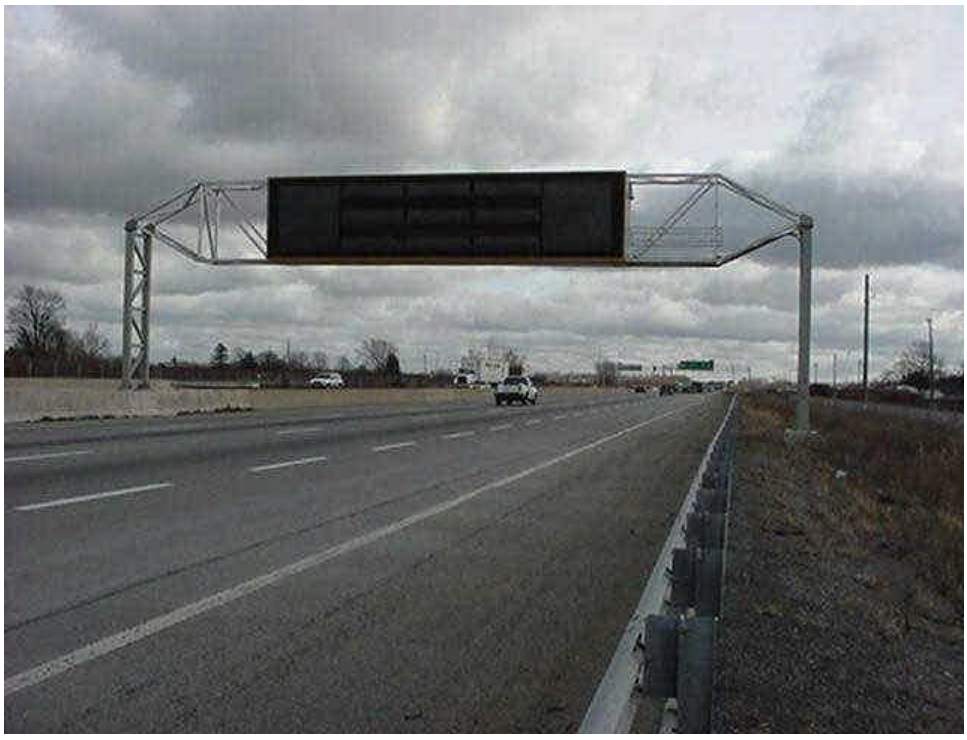


Figure 0.4 Changeable Message Sign Support (CMS)

Figure 0.5 Tri-Chord Sign Support (TC)

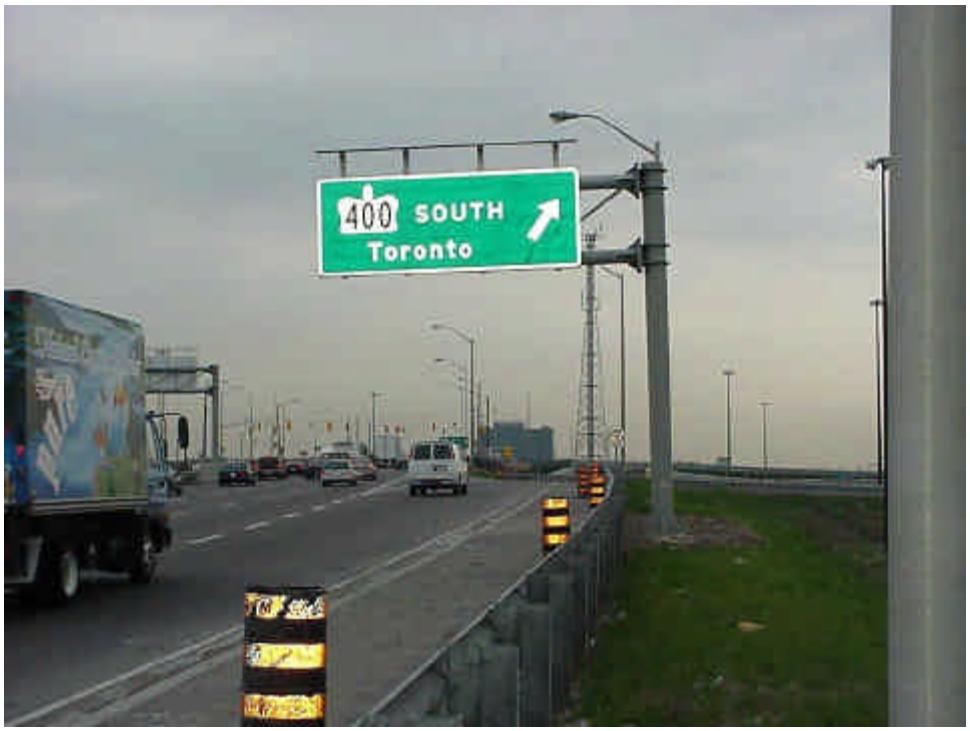


Figure 0.6 Cantilever (C) Sign Support

Figure 0.7 Mono-Tube Sign Support (MT)

Figure 0.8 **Bridge Mounted Sign Support, (BM2) (Connected at 2 points, no walkway)**

Figure 0.9 **Bridge Mounted Sign Support, (BM2) (Connected at 2 points – soffit and fascia, with walkway)**

Figure 0.10 **Bridge Mounted Sign Support, (BM2) (Connected at 2 points – both on fascia, with walkway)**

Figure 0.11 **Bridge Mounted Sign Support, (BM3) (Connected at 3 points – soffit, fascia and barrier, with walkway)**

Figure 0.12 **Bridge Mounted Sign Support, BM3) (Connected at 3 points – soffit, 2 on fascia, with walkway)**

Figure 0.13 **Bridge Mounted Sign Support, (BM2S) (Connected at 2 points – soffit and fascia, with walkway and spacer truss behind sign).**

Figure 1a.1 **Foundation - Concrete, Projection above ground.**
Condition State – Good: Minor scaling.
Maintenance Need – Clean debris (01)
Note: for leg element, cover is missing – maintenance item (04).

Figure 1a.2 **Foundation - Concrete, on Barrier Wall**
Condition State – Fair: Medium scaling and pop-outs.

Figure 1a.3 **Foundation - Concrete, Bridge Mounted (ATL) Sign Support**
Condition State – Fair: Medium scaling.
Maintenance Need – clean debris (01).

Figure 1b.1 **Foundation - Steel Pedestal Under ATL Sign Support**
Condition State – Good: Light corrosion with no section loss.
Maintenance Need – clean debris (01).

Figure 1c.1 **Foundation -Bearing Surface, Leg on Concrete**
Condition State – Fair: Between 20% and 40% of area without contact for trussed leg.

Figure 1c.2 **Foundation - Bearing Surface, Leg with Grout under Base Plate**
Condition State – Fair: Grout pad broken and cracked for less than 20% of perimeter.

Figure 1c.3 **Foundation - Bearing Surface, Leg with Rubber Pad**
Condition State – Good: Rubber pad in contact over most of the area.

Figure 2a.1 **Chord - Base Plate , Aluminum Casting of ATL Sign Support**
Condition State – Fair: Local corrosion with less than 10% section loss.

Figure 2b.1 **Chords - Leg, ATL Type Sign Support**
Condition State – Poor: Local notch (gouge) in aluminum of depth greater than 3mm.
Rehablilitation Need – Repair notch or gouge (06).

Figure 2b.2 **Chords - Leg, ACL Sign Support**
Condition State – Good: Minor corrosion with no section loss.

Figure 2b.3 **Chords - Leg, ARL Sign Support**
Condition State – Excellent: No defects.
Note: check diagonals for drain holes, possible rehab. need (07)

Figure 2b.4 **Main Member - Leg, Single Column Leg of Sign Support (TC)**
Condition State – Excellent: No defects.

Figure 2c.1 **Chords of Corner Arc, ATL Sign Support**
Condition State – Excellent: No defects.

Figure 2d.1 **Chords – Horizontal, Aluminum Sign Support**
Condition State – Good: Note that shop splice is included with chord and not with connection. Minor corrosion with no section loss.
Note: replace cover on conduit – maintenance item (04).

Figure 2d.2 **Chords – Horizontal, CMS Type Sign Support**
Condition State – Excellent: No defects.

Figure 2d.3 **Chords – Horizontal, Tri-Chord Sign Support**
Condition State – Excellent: No corrosion (coating has runs).

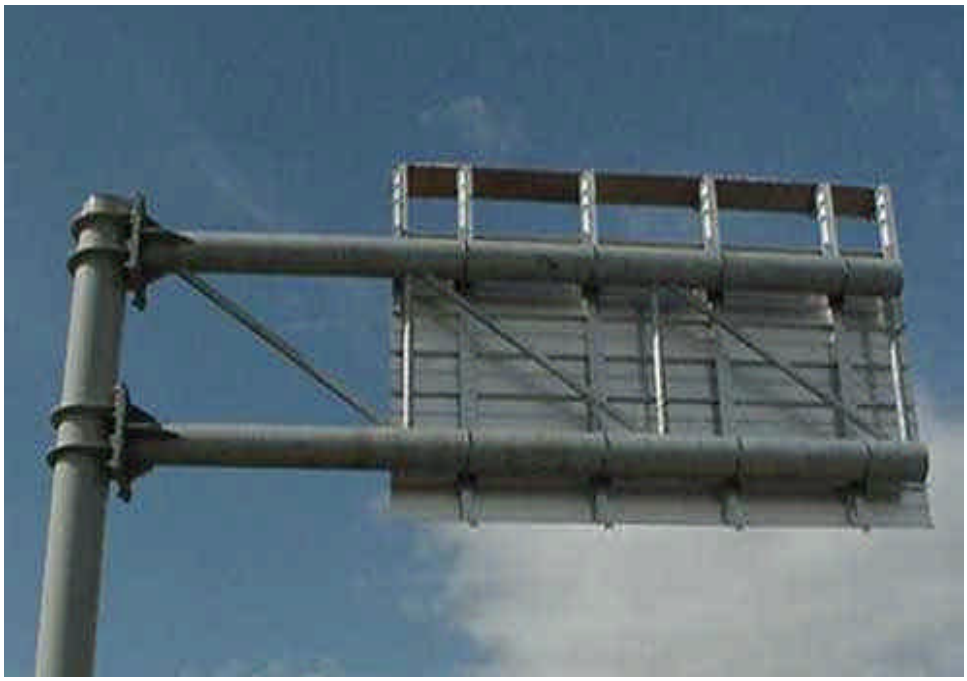


Figure 2d.4 **Chord - Horizontal, Cantilever Sign Support**
Condition State – Excellent: No defects.

Figure 3a.1 **Diagonals – Leg, ATL Sign Support**
Condition State – Fair: Notch (gouge) less than 3mm depth.
Repair Need – Repair not required according to guidelines (06).

Figure 3a.2 **Diagonals – Leg, ARL new Sign Support**
Condition State – Poor: Underside of diagonal member is cracked.
Repair Need – Repair crack in Diagonal (03).

Figure 3b.1 **Diagonals – Corner Arc, ATL Sign Support**
Condition State – Poor: Crack at weld.
Repair Need – Repair crack in diagonal at weld (03).

Figure 3c.1 **Diagonals –Truss, ATL Support**
Condition State – Poor: Diagonal member bent (dented) over half the circumference.
Repair Need – replace member (05).

Figure 3c.2 **Diagonals –Truss, CMS Type Sign Support**
Condition State – Excellent: (note that the sloping chord and the two diagonals are shown). No defects in the diagonals.

Figure 4a.1 **Connection - Base, Aluminum Base Plate of ARL**
Condition State – Good: All bolts tight, no corrosion of bolts.
Note: square washers are not present, ensure round washers provide adequate contact.

Figure 4a.2 **Connection - Base, Steel Base Plate of Single Column Leg**
Condition State – Excellent: All bolts tight, no corrosion.
Note: For Concrete Foundation element, remove debris (formwork) around base – maintenance item 01.

Figure 4a.3 **Connection - Base, Attachment of Bridge Mounted Sign Support to Fascia**
Condition State – Fair: Misaligned but tight bolts in 50% of bolts in connection. Also, medium corrosion of left side bolt.
Note: Ensure bolts are tight by tapping with a hammer (if loose, condition is Poor).

Figure 4b.1 **Connection –Leg, ACL Sign Support**
Condition State – Excellent: No defect in weld connection of chord to column.

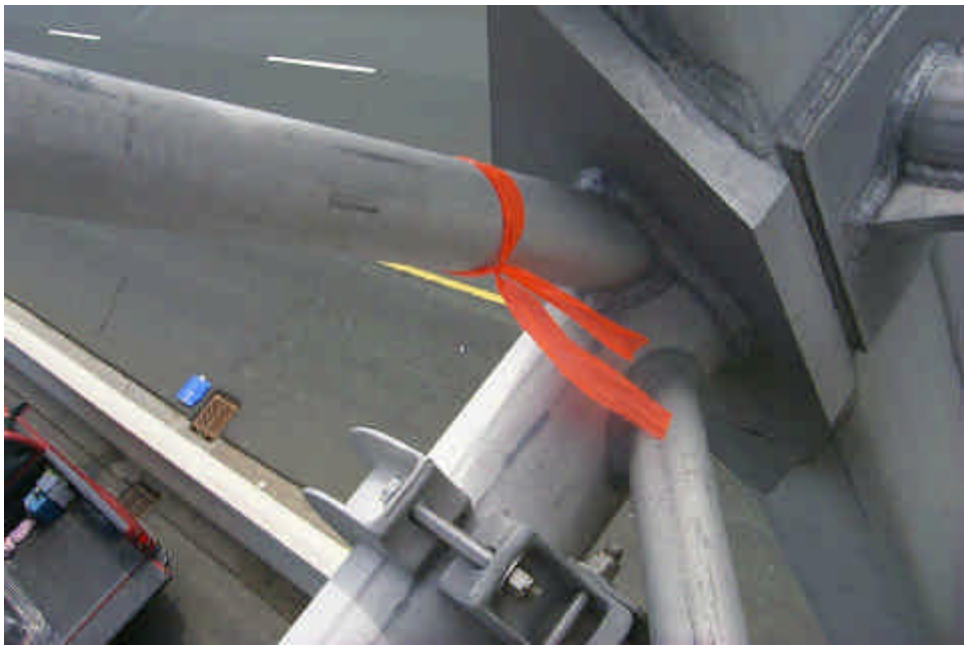


Figure 4b.2 **Connection – Leg, ARL Sign Support**
Condition State – Excellent: No defect in plate to column connection.

Figure 4b.3 **Connection – Leg, Changeable Message Sign**
Condition State – Excellent: All bolts tight, no defects in plates or rubber pad.

Figure 4b.4 **Connection – Leg, Tri-Chord Sign Support**
Condition State – Good: no corrosion, bolts are tight, and bearing surface (rubber gasket) slightly misaligned.

Figure 4b.5 **Connection – Leg, Cantilever Sign Support**
Condition State – Excellent. All bolts tight, full contact between connecting plates, no defects on plates.

Figure 4b.6 **Connection – Leg, Mono-Tube Sign Support**
Condition State – Good: bolts tight with full contact between plates, minor corrosion with no section loss.

Figure 4c.1 **Connection – In Line Chord, ATL Type Sign Support**
Condition State – Good: Minor corrosion of aluminum casting.
Note: Small cracks in the weld of diagonal will not affect chord strength; therefore the cracks are included only with the diagonal element condition rating.

Figure 4c.2 **Connection – In Line Chord, ATL Type Sign Support (Alternate)**
Condition State – Fair: 1 out of 8 (12.5%) bolts loose.

Figure 4c.3 **Connection – In Line Chord, CMS Type Sign Support**
Condition State – Excellent: All bolts in connection are tight.

Figure 4c.4 **Connection – In Line Chord, Tri-Chord Sign Support**
Condition State – Good. All bolts are tight with full contact between plates, minor corrosion with no section loss.

Figure 4c.5 **Connection – In Line Chord, Mono-Tube Sign Support**
Condition State – Good: All bolts tight, minor corrosion of plates with no section loss.

Figure 4d.1 **Connection – Sign, ATL Type Sign Support**
Condition State – Good: Cast aluminum clamp with minor corrosion and no section loss.

Figure 4d.2 **Connection – Sign, Changeable Message Sign on ATL Type**
Condition State – Good – Minor corrosion with no section loss.

Figure 4d.3 **Connection – Sign, Tri-Chord Sign Support**
Condition State – Fair: Stainless steel U-bolt with no material defects but improper thread projection.

Figure 4d.4 **Connection – Sign, Bridge Mounted Sign Support**
Condition State – Fair: Misaligned cast aluminum clamp.

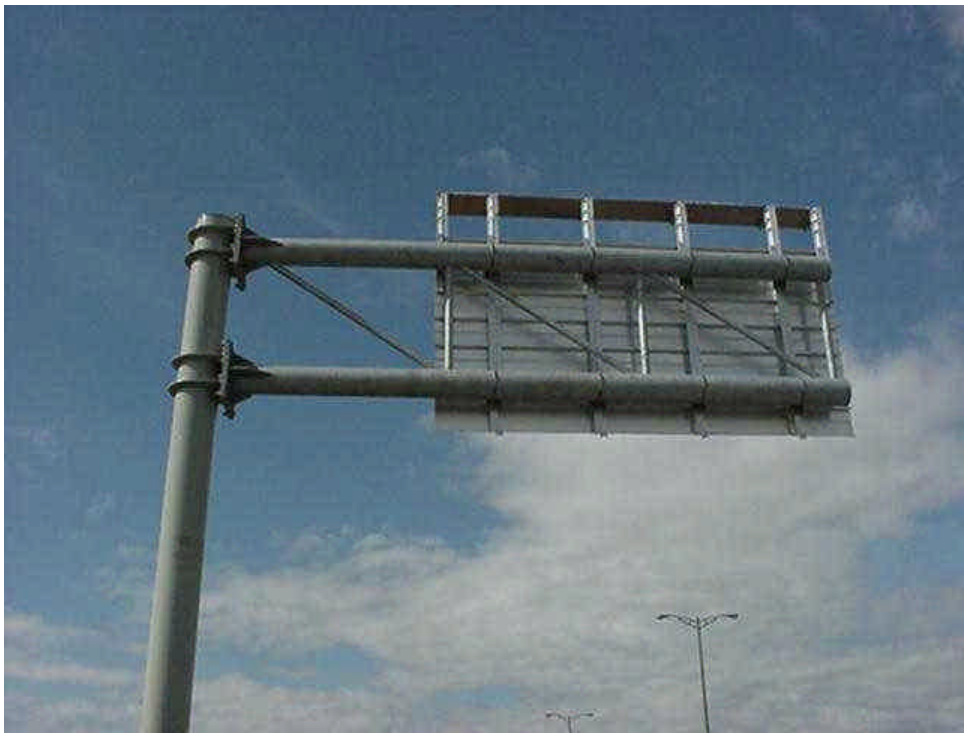


Figure 4e.1 **Connection – Damping Assembly, Cantilever Sign Support**
Condition State – Excellent: All bolts attaching support angles to brackets on sign support are tight and no material defects.

Figure 4f.1 **Connection – Walkway Arms, ATL Type Sign Support**
Condition State – Poor: Crack in aluminum casting.
Repair Need – Replace clamp (14).

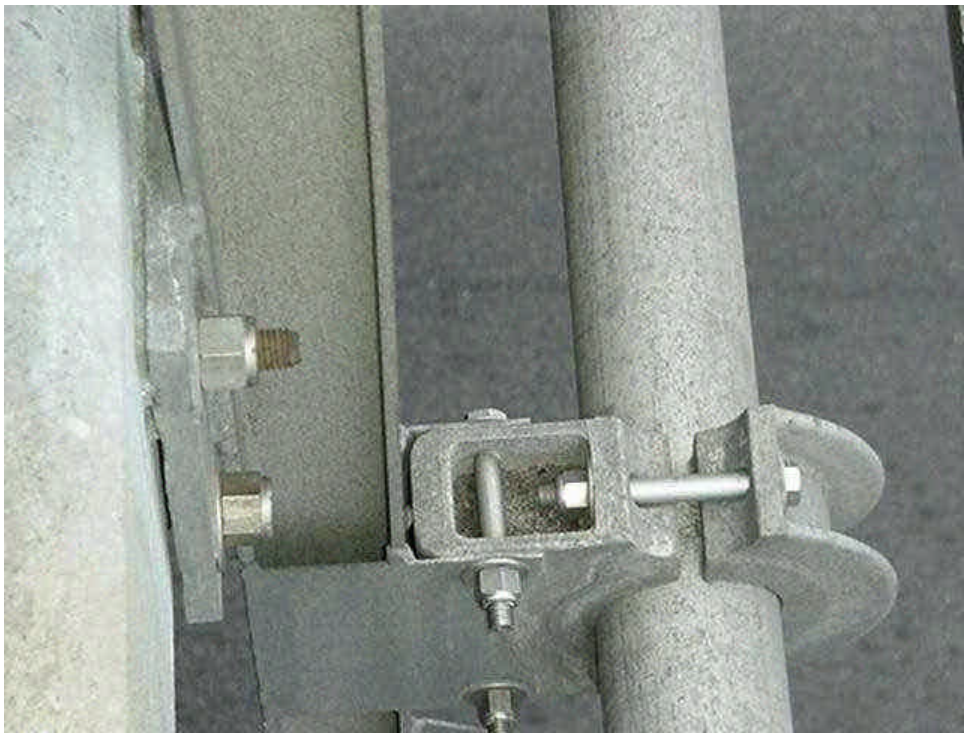


Figure 4f.2 **Connection – Walkway Arms, Bridge Mounted Sign Support**
Condition State – Good: Aluminum casting with minor corrosion, all bolts tight.

Figure 4g.1 **Connection – Accessory, Traffic Signal Mounted to Sign**
Condition State – Good: Accessory firmly attached, minor corrosion.

Figure 4g.1 **Connection – Accessory, Arrow Board to Truss**
Condition State – Poor: Accessory support is firmly attached, but sign board is missing

Figure 5a.1 **Attachment – Sign, Sign Panel on ATL Type Sign Support**
Condition State – Fair: Slight cracking and bending of one portion of sign panel, no danger of sign panel falling off.

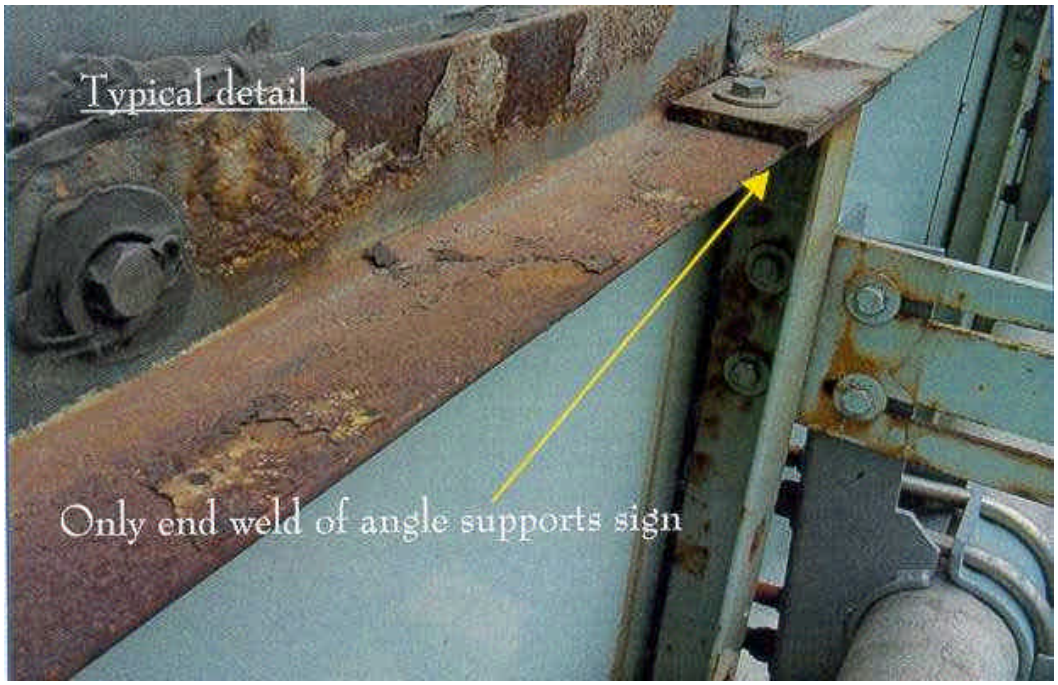


Figure 5a.2 **Attachment – Sign, old Changeable Message Sign Panel on Aluminum Support**
Condition State – Fair: Medium corrosion on components of sign panel.
Suspected Performance Deficiency: Although bracket is attached firmly to structure, the attachment of bracket to the remainder of sign is possibly deficient. Possible deficiency in Structural Capacity (05).

Figure 5a.3 **Attachment – Sign, Sign Panel on Tri-Chord Type Sign**
Condition State – Excellent: Sign panel and support brackets with no material defects.
Note: for connection of sign panel, it appears the U-bolt at the upper left is in fair condition – loose.

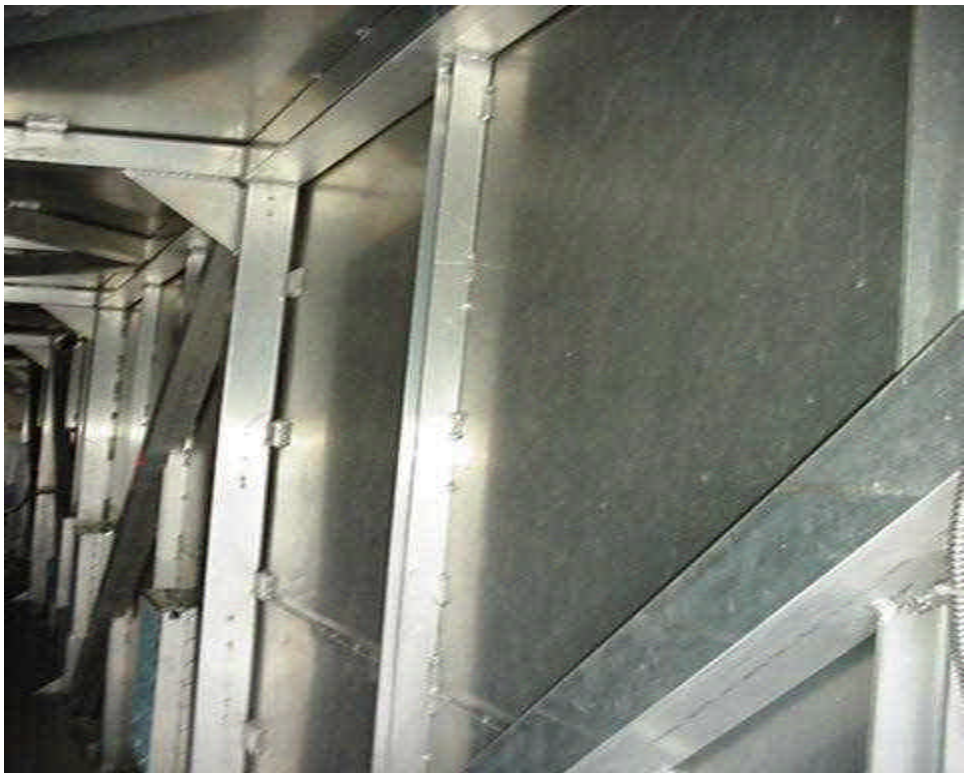


Figure 5b.1 **Attachment – Skin, Changeable Message Sign**
Condition State – Excellent: No cracks in any welds and no corrosion of aluminum skin.

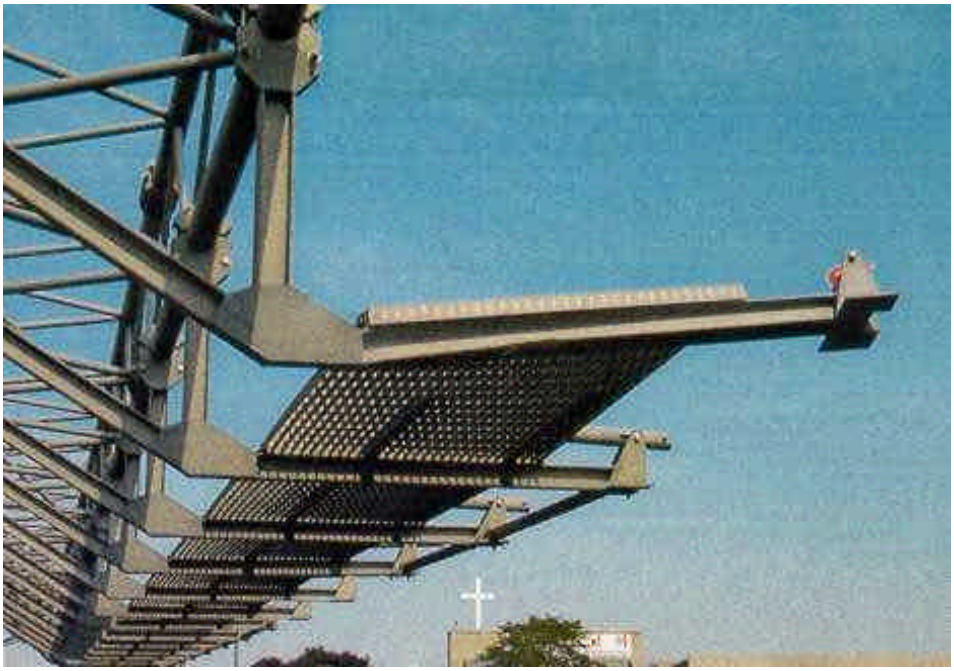


Figure 5d.1 **Attachment – Walkway Arms, Attached to ATL Type Sign Support**
Condition State – Fair: Walkway arm slightly bent with minor corrosion and no cracking at joint.
Note: If the arm is has cracks near the location of the bend then its ability to support load is suspect and it would be classified as Poor.

Figure 5d.2 **Attachment – Walkway Arms, Attached to Bridge Mounted Sign Support**
Condition State – Excellent: No defect in aluminum members.

Figure 5e.1 **Attachment – Walkway, Attached to Walkway Arms**
Condition State – Good: Grating firmly attached with minor corrosion and no section loss.

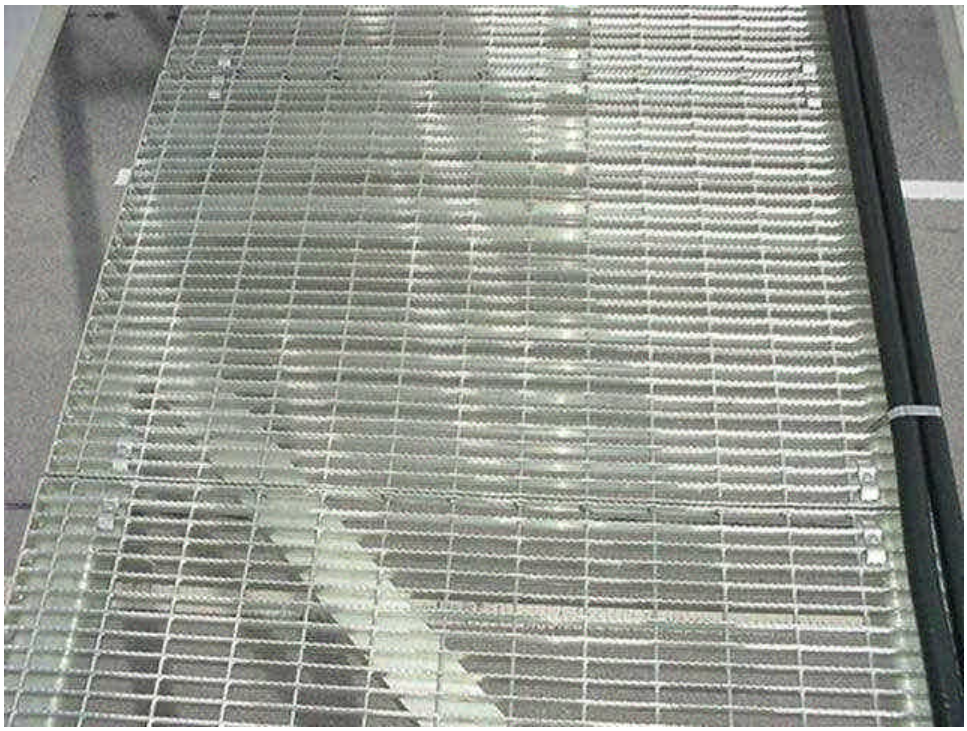


Figure 5e.2 **Attachment – Walkway, Attached to CMS Type Sign Support**
Condition State – Excellent: Grating firmly attached with no defects.

Figure 5f.1 **Attachment – Handrail, Attached to ATL Type Walkway**
Condition State – Good: Handrail firmly attached, all bolts tight and only minor localized surface corrosion.
Note: Lighting is no longer used, it should be removed – other maintenance need (07).

Figure 5f.2 **Attachment – Handrail, Attached to CMS-Type Sign Support**
Condition State – Excellent: Handrail firmly attached and no defects.

Figure 6a.1 **Coating – Chord, Trussed Leg of CMS Type Sign Support**
Condition State – Excellent: No defects in coating.

Figure 6a.2 **Coating – Chord, Horizontal Truss of Tri-Chord Sign Support**
Condition State – Fair: Galvanizing wearing off in areas, rust condition rating category 3.

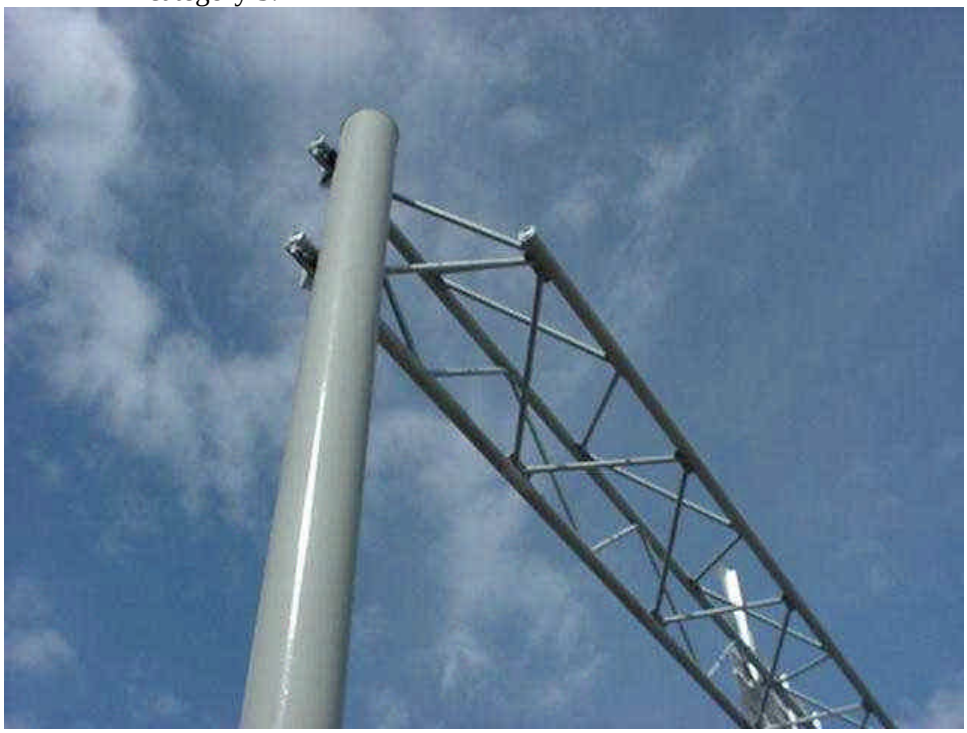


Figure 6a.3 **Coating – Chord, Single Leg of Tri-Chord Sign Support**
Condition State Excellent: No defects in coating.

Figure 6c.1 Coating – Connections, Connection at Base of Tri-Chord Sign Support

Condition State – Fair: Pinpoint rusting visible on coating, rust condition rating category 3.

Note: Bolt projection is not uniform, suspected lack of stud embedment (suspected performance deficiency 06), and anchorage is not centred.

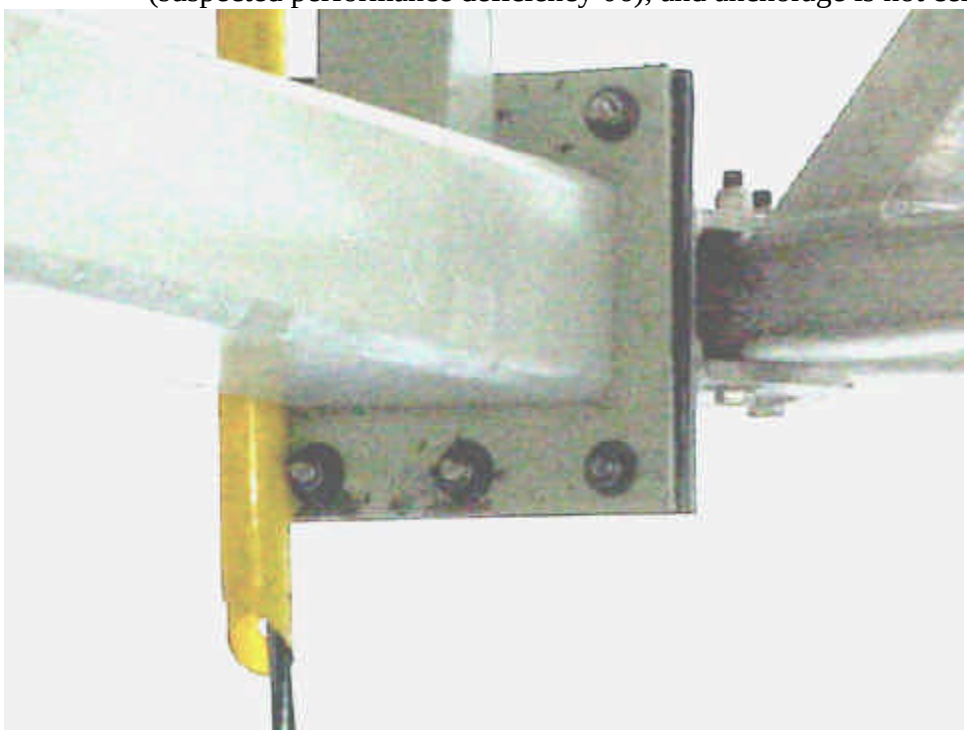


Figure 6c.2 Coating – Connections, Connection Leg of CMS Type Sign Support

Condition State – Fair: Localized rusting visible around bolts, rust condition rating category 3.