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Guide developed by Debi Friedman, April 2010
Updated August 3, 2010

Florida Department of Transportation
Structures & Facilities
Ancillary Structures
Inspection Field Guide

Overhead Sign Structures
High Mast Light Poles
Traffic Signal Mast Arms

Notes

Notes

Table of Contents

Splice	a junction where two items have been joined
Stand-off distance	the distance between the bottom of the lock nut and the top of the foundation—should not be more than the diameter of the anchor bolt
Stiffener	a small vertical member (welded) attached to another member to transfer stress & prevent buckling on the base of the column
Swivel mount	used to attach the signal to the mast arm and allows the signal to be turned
TSMA	acronym for traffic signal mast arm
Vertical	the vertical member , pole or column
Vertical hanger	used on cable to hold signal
Weep Hole	a hole installed in a grout pad to allow moisture to escape
Wind beam	Horizontal sign panel support

Lock Nut	a nut that provides extra resistance to vibration loosening
Moment Connection	a joint capable of transferring moment to another member
Mounting bracket	a bracket used to attach the
Pal nut	a secondary nut installed above the primary nut to secure it
Plate washers	helps prevent the bolt head & nuts from loosening
Ponding	accumulation of water
Retro Fit	to install something on a previously constructed object
Screen guard	screen installed around perimeter of anchor bolts to discourage rodents nesting
Seated	fully engaged
Seized	frozen
Self-locking nut	a specially designed nut that locks into place when tightened
Short bolts	bolts that don't have at least two threads exposed after nuts are installed
Skew	turned or placed at an angle
Sleeve	used to create penetration
Soft concrete	crumbles easily due to improper curing process
Spall	circular or oval depression in concrete caused by a separation of a portion of the surface concrete, revealing a fracture parallel with or slightly inclined to the surface

Introduction

This guide was produced to assist in the identification and reduction of deficiencies and latent defects which are typically found in ancillary structures. It provides lists of typical deficiencies along with photos. **It is not intended to serve as a complete reference for ancillary structures.** The intent is to provide project managers a tool through which they can assist in creating a quality product prior to final acceptance and in reducing long term maintenance issues.

Traffic Signal Mast Arms (TSMA)

Direction of Inventory

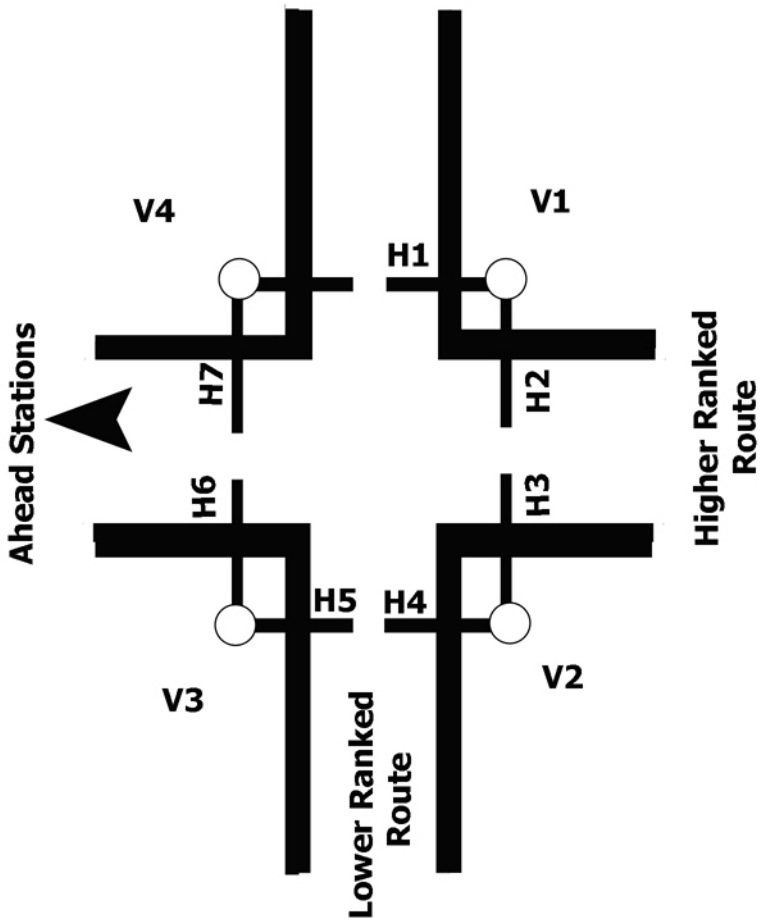
•Determined by hierarchy road

•North/South routes are inventoried South to North, East/West routes are inventoried West to East, then begin on right & go clockwise

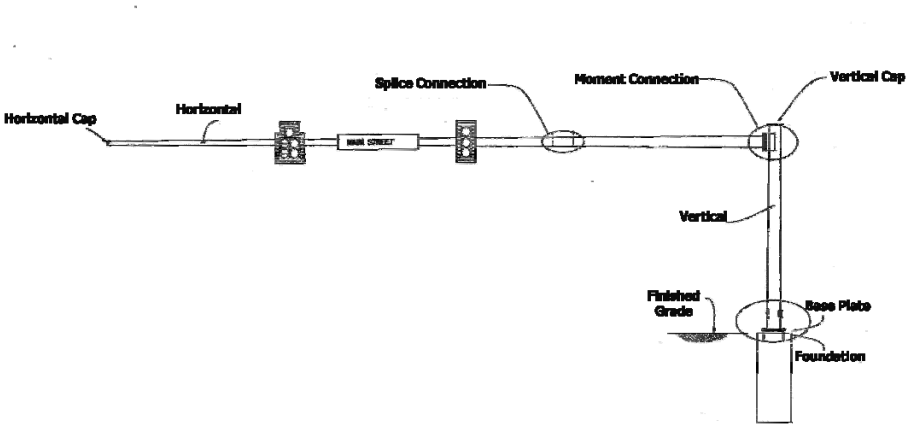
Diagonal	The diagonal members of the truss on an overhead sign
EOR	acronym for Engineer of Record
Flange	a rim or lip used to strengthen a member
Galvanize or Cold Galvanize	to coat with zinc
Grout	a mortar having a sufficient water content to render it a free-flowing mass, used for filling (grouting) the joints in masonry, for fixing anchor bolts and for filled cored spaces were water may accumulate
Grout pad	grout installed between foundation and base plate
Gusset plate	a rectangular or triangular steel plate that strengthens members
Hanger	vertical sign panel support
HMLP	acronym for high mast light pole
Honeycomb	an area in concrete with a lack of mortar to fill in the spaces between the coarse aggregate
Horizontal	the mast arm of a traffic signal
Jam Nut	a low profile type of nut typically half as tall as a standard nut
Leveling nuts	a self aligning nut

Glossary

Anchor Bolt	a threaded bolt fitted with a nut and washer used to secure in a fixed position upon the base of a column
Anti-rotation pin	used to prevent rotation of a nut
Base plate	plate used to connect the pole base to the foundation
Cap	
Chord	the main horizontal members of the truss on an overhead sign
Column	a general term applying to a vertical member
Corrosion	the general disintegration of surface metal through oxidation
Critter guard	screen installed around perimeter of anchor bolts to discourage rodents nesting
Delaminated	subsurface separation of concrete into layers



Traffic signals are assigned a unique number for the intersection only. As shown in the diagram above, the higher ranked road determines the direction of inventory, the order in which individual structures and mast arms are identified. Individual structures are identified as Verticals and are numbered V1, V2, etc. Mast arms are identified as Horizontals and are numbered H1, H2, etc.



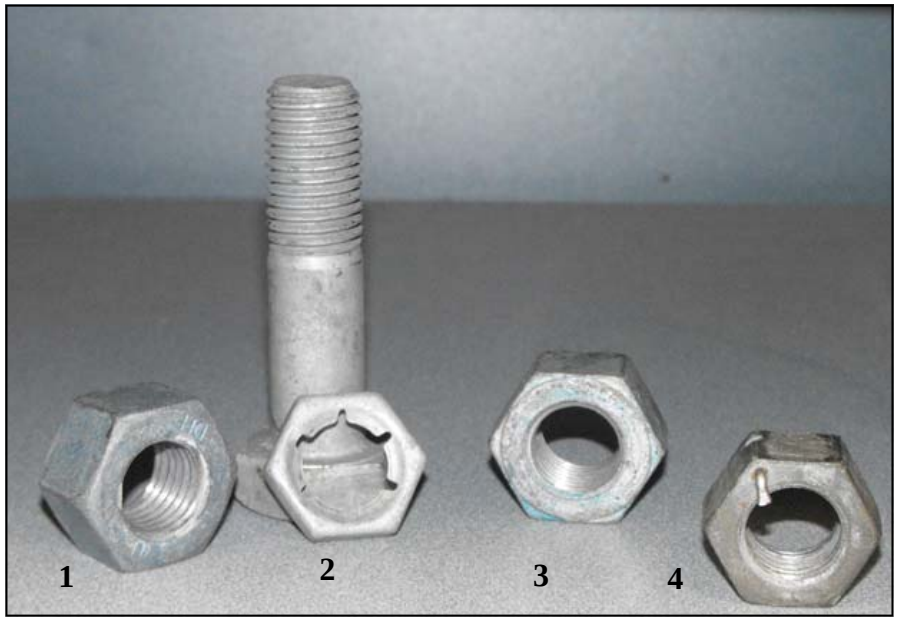
TSMA Terminology

Horizontal.....Mast Arm
Vertical ..... Column
Moment Connection....Mast Arm to Column

Maintenance Inspection

Upon receipt of the 90% Notification, an inquiry as to whether ancillary structures are ready for initial inspection is prompted. **There is a two-week lead time for the inspection/punch list process, so please plan accordingly for Final Acceptance.**

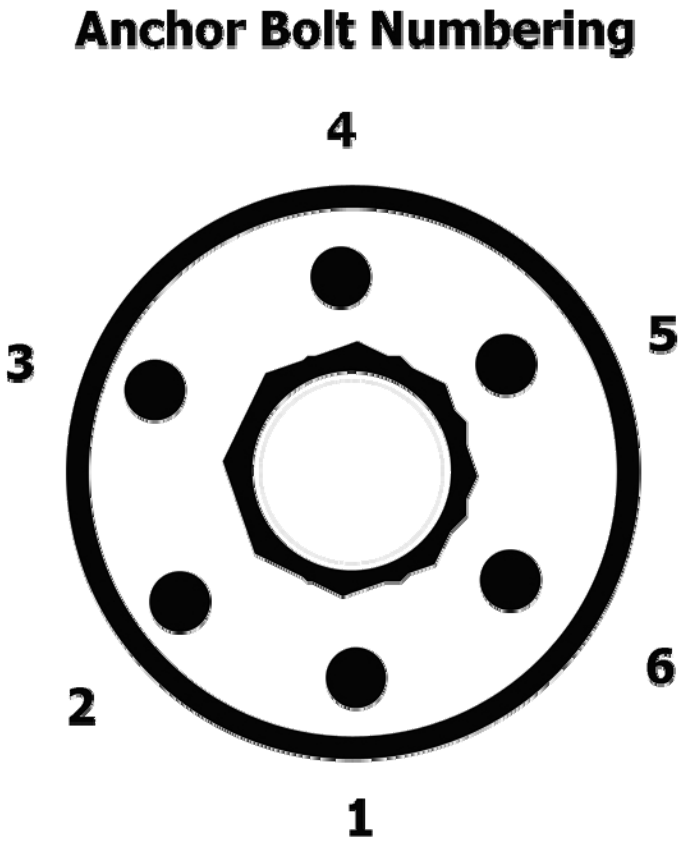
A consultant performs the necessary inspections and generates a punch list which is forwarded to the Structures & Facilities department along with deficiency photos and recommendations for repair/replacement. The punch lists are then forwarded to the FDOT Project Manager and/or the CEI Project Manager.



Typical Nuts & Bolts for Ancillary Structures

Above typical bolt and nuts found on ancillary structures.

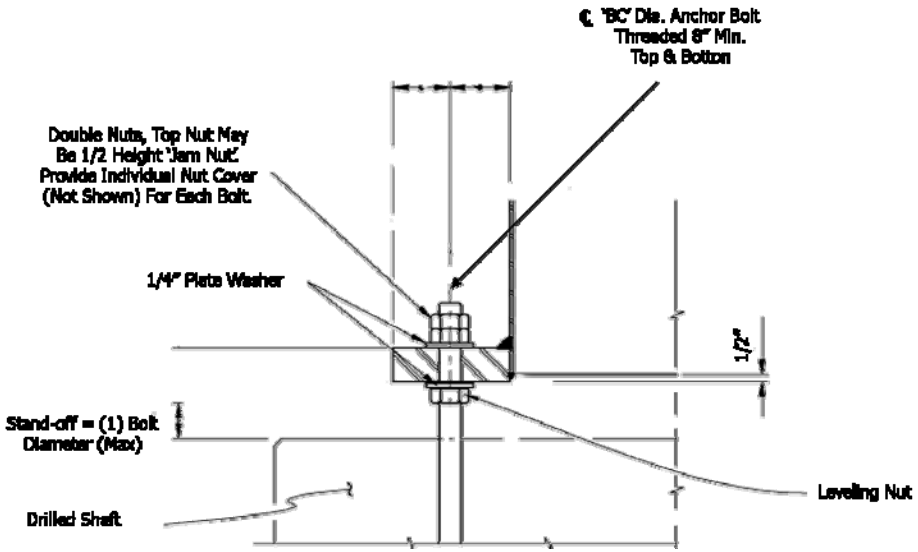
Nut 1 Self-locking tri-lock
Nut 2 Pal-nut
Nut 3 Typical structural nut
Nut 4 Self-locking with anti-rotation pin



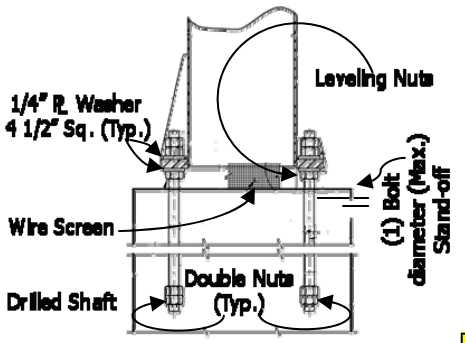
Anchor Bolt Numbering

Bolts are numbered in a clockwise direction; bolt 1 is located under the hand hole.

TSMA Foundation



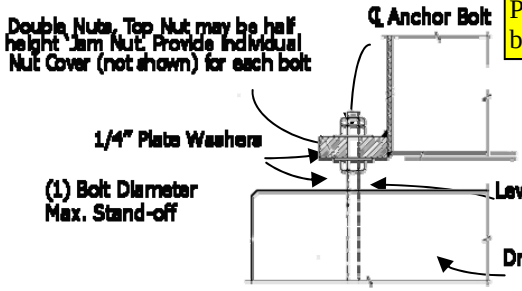
Note stand-off is measured from the top of the foundation to the bottom of the leveling nut. This distance cannot be greater than one bolt diameter.



Overhead Sign Structure

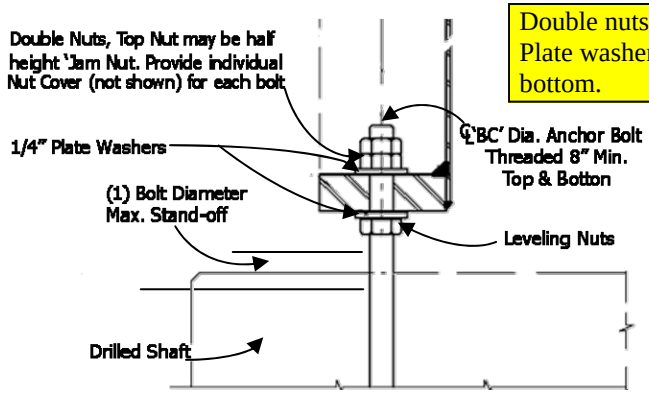
Double nuts on top only. Plate washers on top and bottom.

High Mast Light Pole



Double nuts on top only. Plate washers on top and bottom.

Traffic Signal Mast Arm



Double nuts on top only. Plate washers on top and bottom.

Stand-off

No matter which type of ancillary structure, the stand-off is measured the same, from the bottom of the leveling nut to the top of the foundation. **The distance cannot be more than one bolt diameter.**

Required Documentation

✓As-Built Plans
✓Shop Drawings
✓Signed Punch Lists
✓Final Acceptance Notice

And if applicable include the following
✓Repair Procedures
✓Engineer of Record (EOR) Documentation

Deficiencies

Some of the deficiencies typically found during TSMA inspections are:

•Missing washers
•Missing lock nuts
•Missing or broken anchor bolt covers
•Ground wires not connected
•Foundations below grade
•Excessive grout pads
•Short bolts
•Misaligned hardware
•Moment connection gaps
•Cracked mounting brackets
•Stand-off issues
•Coating deficiencies i.e. galvanizing and/or paint*
•Verticals not plumb

*Care should be taken on the construction site to protect the coating. ASTM 123 <1/2% defect. If verticals need to be stored, lay on wood blocks rather than concrete.

The following pages show of some of these deficiencies.

Short Anchor Bolts

A minimum of two threads should extend beyond the top nut

INITIAL HMLP INSPECTION REVIEW

INSPECTED BY: Roger Aker (Ayres Associates) **PROJECT LOCATION:** I-10 at Cecil Commerce Center Parkway

DATE: 9/11/2009 **FIN. PROJ. NO.** 213258-2-52-01

POLE NUMBER	DEFICIENCIES NOTED DURING 90% POLE INSPECTION	CORRECTION REVIEW REPAIRED YES / NO (NO REQUIRES COMMENT UNDER DEFICIENCY)
72P612	**Element 497**	
	None	
	Element 499	
	The anchor bolt stand off distance exceeds the anchor bolt diameter. Dia. = 1 3/4 in. Stand off = 3 1/4 in. (Refer to Photo 1) – Lower structure.	
	The perimeter of the foundation has several areas of honeycombing / spalling / soft concrete up to 30 in. x 1 ft in. x 3/4 in. on the vertical face. (Refer to Photos 2 and 3) – EOR review and make recommendation for repair.	

Please designate either FDOT or CEI.

Deficiencies corrected and approved by: _____ **(FDOT Project Engineer or CEI Project Engineer), on** _____ **(Date) indicates structure is ready for acceptance by Maintenance.**

Forms/90% Bridge Inspection.doc 05/28/08

INITIAL HMLP INSPECTION REVIEW

INSPECTED BY: Roger Aker (Ayres Associates) **PROJECT LOCATION:** I-10 at Cecil Commerce Center Parkway

DATE: 9/10/2009 **FIN. PROJ. NO.** 213258-2-52-01

POLE NUMBER	DEFICIENCIES NOTED DURING 90% POLE INSPECTION	CORRECTION REVIEW REPAIRED YES / NO (NO REQUIRES COMMENT UNDER DEFICIENCY)
72P598	**Element 497**	
	None	
	Element 499	
	2 of the 8 anchor bolts leveling nuts are loose. (Refer to Photo 1) – Tighten leveling nuts.	
	Vegetation is growing between the foundation and the surrounding slab. (Refer to Photo 2) Remove vegetation.	
	The NE face of the foundation has a 12 in. x 7 in. x ½ in. area of honeycombing / soft concrete. (Refer to Photo 3) Request EOR review and repair recommendation.	

Please designate either FDOT or CEI.

Anchor Bolts Missing Lock Nuts

Note, the crumbling grout pad.

Missing Washers

Standards for TSMA requires double top nuts, 1/4" plate washers **above and below** base plate. **Base plate should not be field modified - anchor bolt holes should not be greater than bolt diameter + 1/2".**

A Note About Punch Lists

- Punch list items shall be completed or addressed **prior** to Final Acceptance.

- Punch lists should be signed by the FDOT Project Manager or the CEI Project Manager verifying all deficiencies have been corrected.

- When punch list addresses excessive stand-off, please note if the structure was lowered.

- Completed punch lists should be sent, along with any backup documentation, repair procedures, Engineer of Record (EOR) support to the Structures & Facilities Office.

- Should you need any assistance or have any questions concerning the repair methods, please contact our office.

Anchor Bolt Deficiencies

•Skewed
•Too short
•No flat plate washers

View of Excessive Grout Pad/ Stand-off

Excessive grout pads generally indicate excessive stand -off. This will require removal of grout pad, EOR review and either lowering of the structure or EOR documentation of approval.

View of Moment Connection Gap

There should not be **any** gaps between moment connection plates. If gap cannot be closed, concurrence from EOR is needed.

Foundation Below Grade

The 2010 Design Standards state HMLP foundations are to be a **MINIMUM** of 2’ above the **FINISHED GRADE.**

View of Excessive Stand-off

Excessive stand-off will require either lowering the structure or EOR documentation of approval. Also, note missing critter guard.

View of Loose Nut

Moment connection and splice bolts need to have self-locking nuts. All nuts should be properly torqued.

View of Buried Foundation

Traffic signal mast arm foundations should be **FLUSH** with the finished grade and/or sidewalk. Care should be taken to have positive drainage away from the structure. When foundations are below grade it accelerates corrosion of anchor bolts and nuts.

View of Soft Concrete

Honeycombing on the face of the foundation and soft concrete. This type of deficiency will require EOR review and repair recommendation.

Deficiencies

Some of the deficiencies typically found during HMLP inspections are:

•Missing washers
•Missing lock nuts
•Missing or broken anchor bolt covers
•Ground wires not attached
•Foundations below grade
•Short bolts
•Misaligned hardware
•Moment connection gaps
•Stand-off issues
•Coating deficiencies i.e. galvanizing and/or paint*
•Verticals not plumb

*Care should be taken on the construction site to protect the coating. ASTM 123 <1/2% defect. If verticals need to be stored, lay on wood blocks rather than concrete.

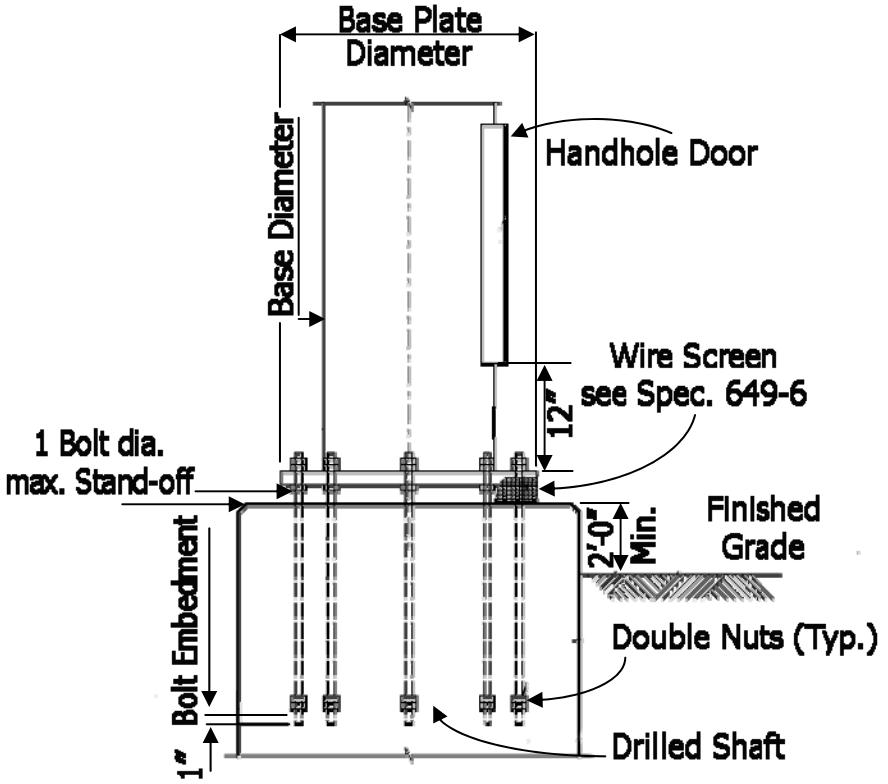
The following pages show of some of these deficiencies.

Anchor Bolt & Leveling Nut Corrosion

Note the accelerated corrosion of anchor bolts and leveling nuts. These are typical results of below grade foundations. Also note excessive stand-off.

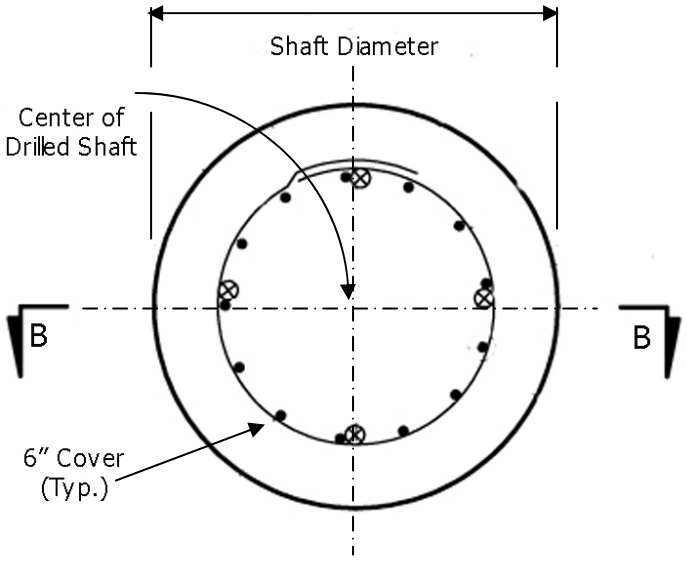
Excessive stand-off

The distance between the top of the foundation and the bottom of the leveling nut should be no more than one (1) anchor bolt diameter.

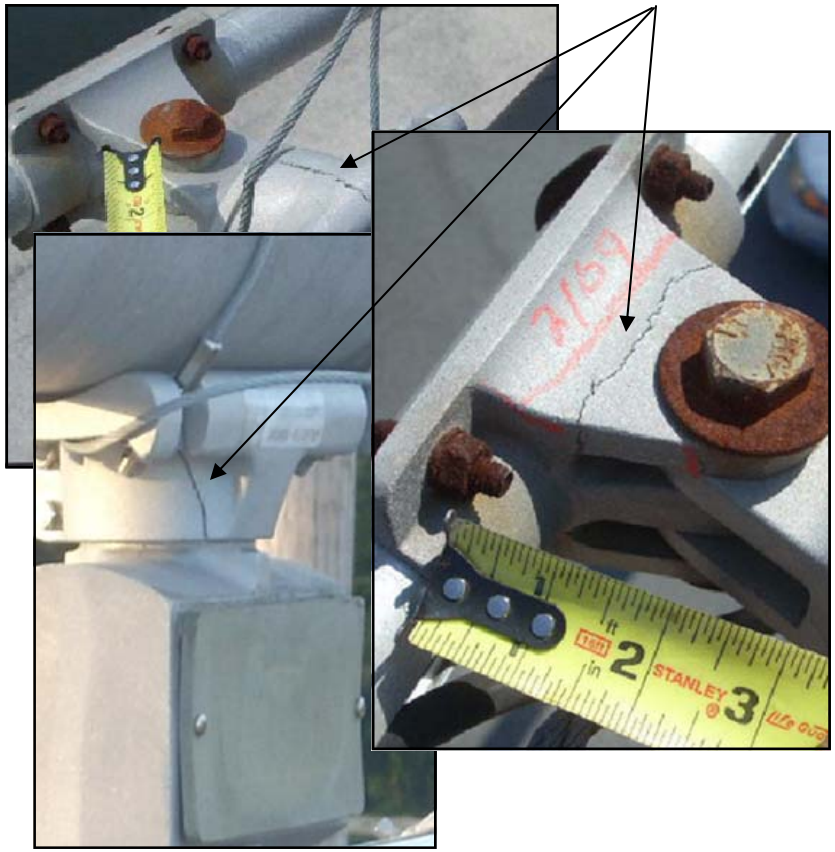


Base Plate & Anchorage Elevation
(Conduits Not Shown)

This diagram, found in Index 17502 sheet five of seven, does not show plate washers on the anchor bolts at the base plate. However, **1/4" Plate Washers are required top and bottom.**



Foundation Plan
(Anchor Bolts & Conduits Not Shown)

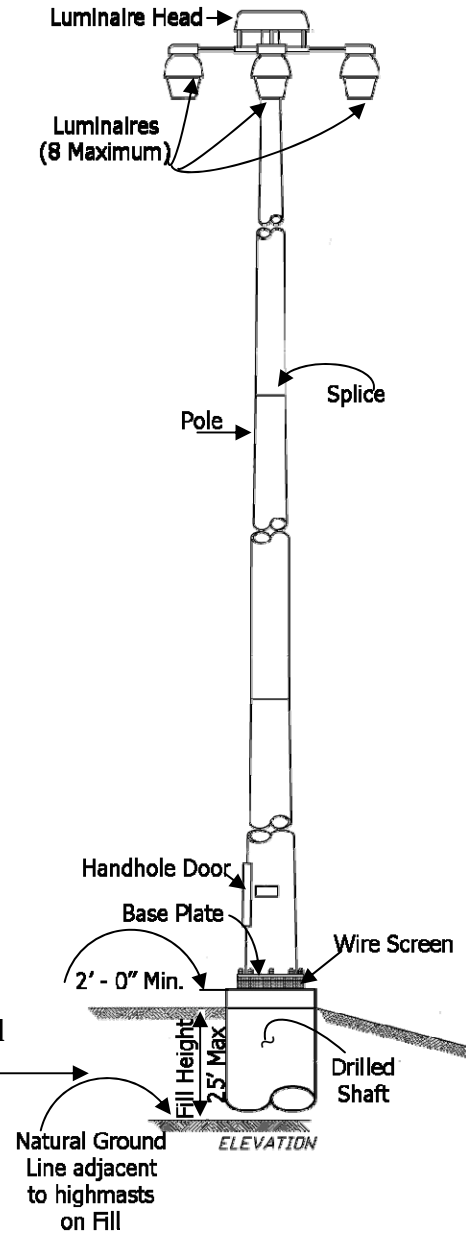


Cracked Signal Mounts

Cracked signal head mounts have been prevalent in initial inspections.

Ground Wire Not Attached

High Mast Light Pole



Note top of foundation minimum above finished grade is two feet.

High Mast Light Poles (HMLP)

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- Completed punch lists should be sent, along with any backup documentation, repair procedures, Engineer of Record (EOR) support to the Structures & Facilities Office.

- Should you need any assistance or have any questions concerning the repair methods, please contact our office.

INITIAL TSMA INSPECTION REVIEW

INSPECTED BY: James Revier/Robert Bridges **PROJECT LOCATION:** Construction Blvd. to Bridge Ave.

DATE: 12/10/09 **FIN. PROJ. NO.** 211112-5-52-01

TSMA NUMBER	DEFICIENCIES NOTED DURING 90% SIGN INSPECTION	CORRECTION REVIEW REPAIRED YES/NO; NO REQUIRES COMMENT UNDER DEFICIENCY)
264001	Element 480	
	Vertical 2 Anchor bolt stand-off distance exceeds the bolt diameter.	
	Dia. = 1 1/2 in, Stand-off = 2 1/2 in. (Refer to Photo 1)	
	Lower Structure.	Lowered
	Vertical 3 Replace missing lock nuts	Yes
	Element 481	
	Vertical 1 Repaint the columns	Yes
	Element 484	
	Horizontals 2 and 3 Eliminate the gap at the moment connection	Yes
	Horizontal 4 Properly tighten moment connection nuts	Yes

Please designate either FDOT or CEI.

Deficiencies corrected and approved by: Steve Rogerman (FDOT Project Engineer or CEI Project Engineer), on 1/10/10 (Date)

indicates structure is ready for acceptance by Maintenance.

Form 990-Bridge Inspection.doc 05/2008

Required Documentation

- ✓As-Built Plans
- ✓Shop Drawings
- ✓Signed Punch Lists
- ✓Final Acceptance Notice

And if applicable include the following

- ✓Repair Procedures
- ✓Engineer of Record (EOR) Documentation

90% SIGN INSPECTION REVIEW

INSPECTED BY: Ken Renfro (Ayres Associates) **PROJECT LOCATION:** SR-9A(I-295)NB 0.5mi. N/O SR-208(Wilson Blvd)

DATE: 02-26-08 **FIN. PROJ. NO.** 213238-6-52-01

SIGN NUMBER	DEFICIENCIES NOTED DURING 90% SIGN INSPECTION	CORRECTION REVIEW REPAIRED YES/NO (NO REQUIRES COMMENT UNDER DEFICIENCY)
728725	**Element 487**	
	The handrail safety chain is missing. (Refer to Photo 1)	Y
	1 of the 2 U-bolts at Vertical Hanger 2 and the bottom chord is loose. (Refer to Photo 2)	Y
	The electrical conduit clips are not tight behind Vertical Hangers 6 and 7.	Y
	The Alternate design at Vertical Hanger 5 and the chord connections have up to a 1/4 in. gap between the plates and chord. (Refer to Photo 3) This design needs the Engineer of record approval and a copy submitted to FDOT	Y SEE ATTACHED LETTER
	The lighting rods on the top of the structure are missing. (Refer to Photo 4) This omission in the design of the FDOT Standards of the DMS sign needs the Engineer of record approval and a copy submitted to FDOT.	N SEE ATTACHED LETTER
	The bolt heads and truss members throughout the truss have chipped galvanizing during the construction process.	Y
	Element 488	
	The column is out-of-plumb ½ in. on 4ft level. (Refer to Photo 5)	Y
	Element 489	
	5 of the 12 anchor bolt nuts were loose. The contractor tightened all loose nuts during the inspection.	Y
	The foundation has areas of soft and spalling concrete throughout. (Refer to Photos 6) This condition is currently under the engineer review to determine the structural strength of the foundation and the Engineer of record needs to submit findings to FDOT	Y SEE ATTACHED EAR REPORTS

Deficiencies corrected and approved by: _[signature]_ **(FDOT Project Engineer or CEI Project Engineer), indicates structure is ready for acceptance by Maintenance.**

Form/90% Bridge Inspection.doc 07/20/05

1 of 1

Required Documentation

✓As-Built Plans
✓Shop Drawings
✓Signed Punch Lists
✓Final Acceptance Notice

And if applicable include the following
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Overhead Signs

· Cantilever

· Span

· Butterfly

· DMS Cantilever

Direction of Inventory

•North/South routes are inventoried South to North and then left to right

•East/West routes are inventoried West to East and then left to right

A Note About Punch Lists

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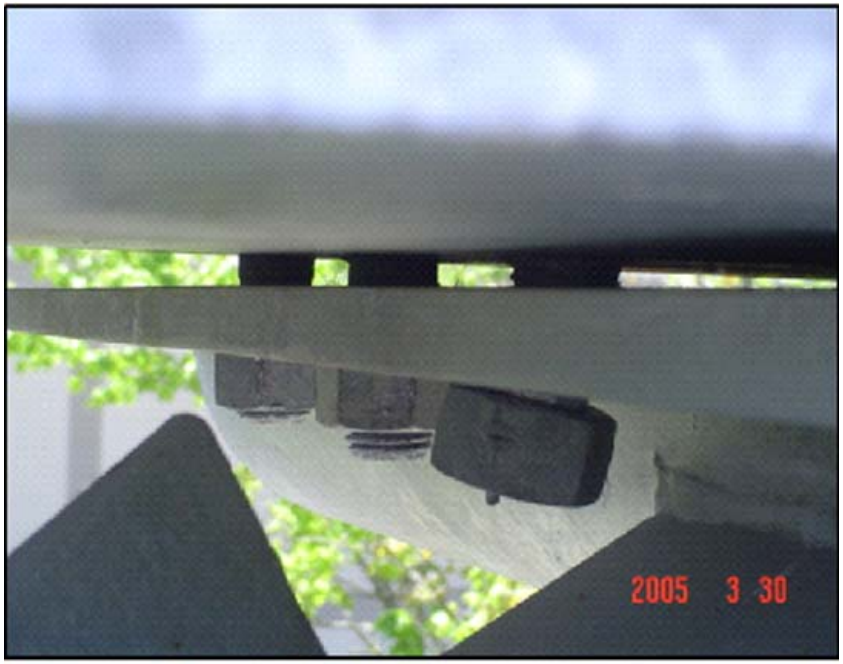
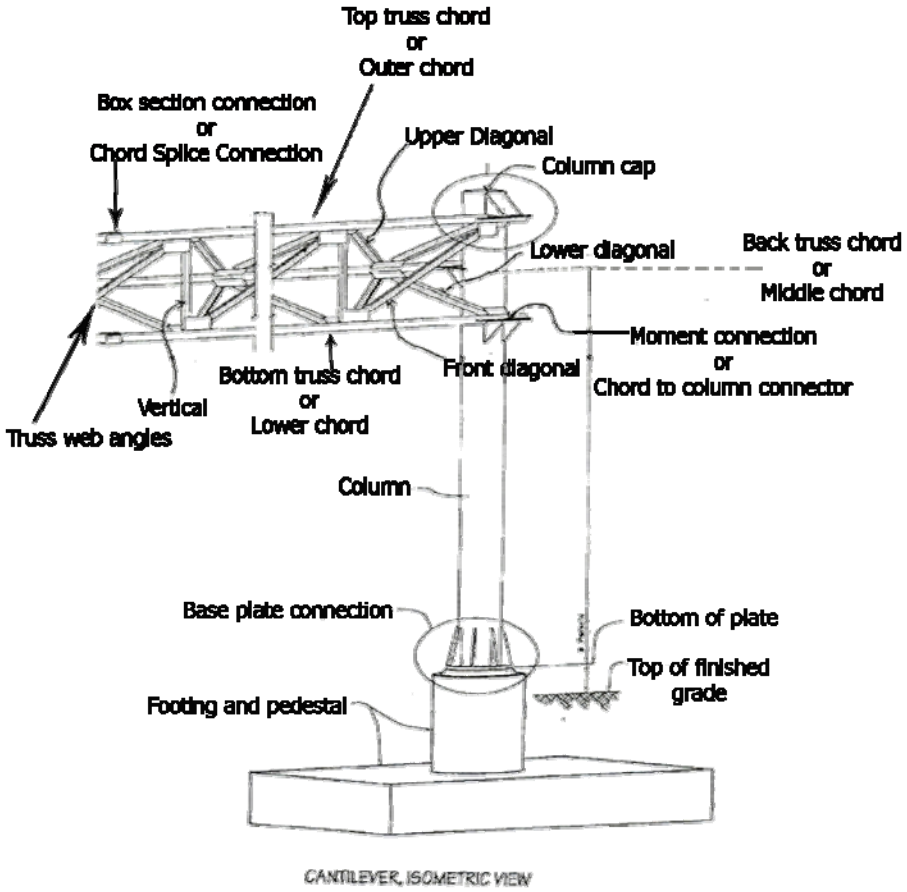
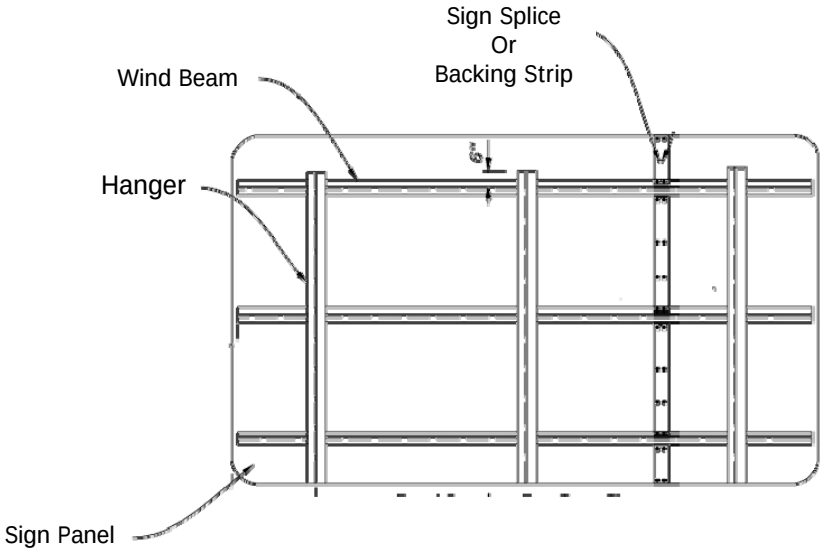


View of Excessive Moment Connection Gap

Loose nuts, misalignment and bent bolt causing excessive gap at moment connection



The top of the foundation should be a minimum of 2’ above finished grade.



Sign Panel Elevation

View of Foundation Below Grade

Foundations should have positive drainage away from structure.

Deficiencies

Some of the deficiencies typically found during overhead sign inspections are:

•Missing ground rods
•Missing washers
•Missing lock nuts
•Missing or broken anchor bolt covers
•Foundations below grade
•Short bolts
•Misaligned hardware
•Moment connection gaps
•Stand-off issues
•Coating deficiencies i.e. galvanizing and/or paint*
•Verticals not plumb

*Care should be taken on the construction site to protect the coating. ASTM 123 <1/2% defect. If verticals need to be stored, lay on wood blocks rather than concrete.

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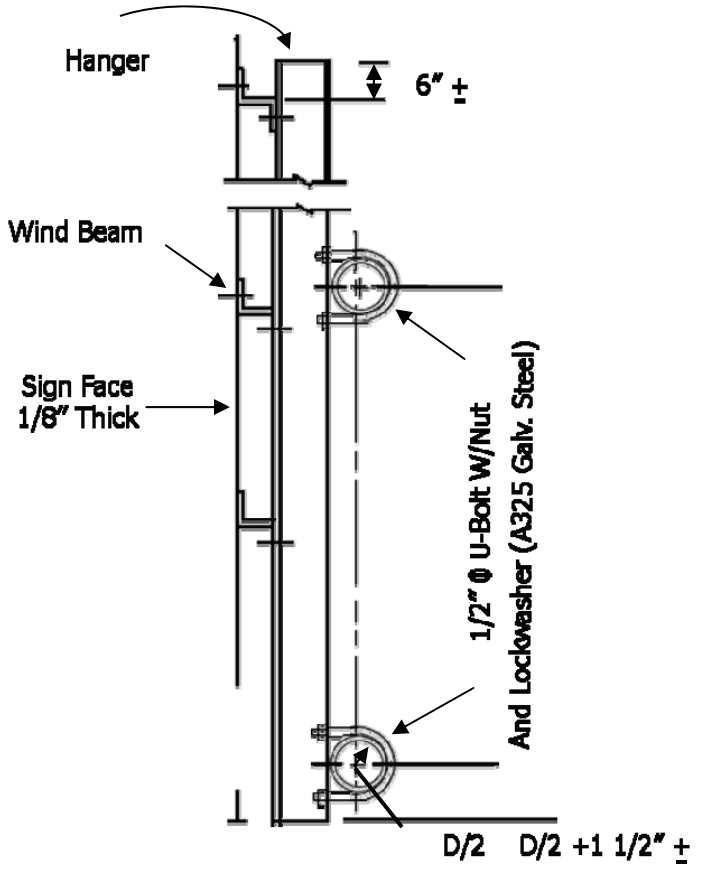
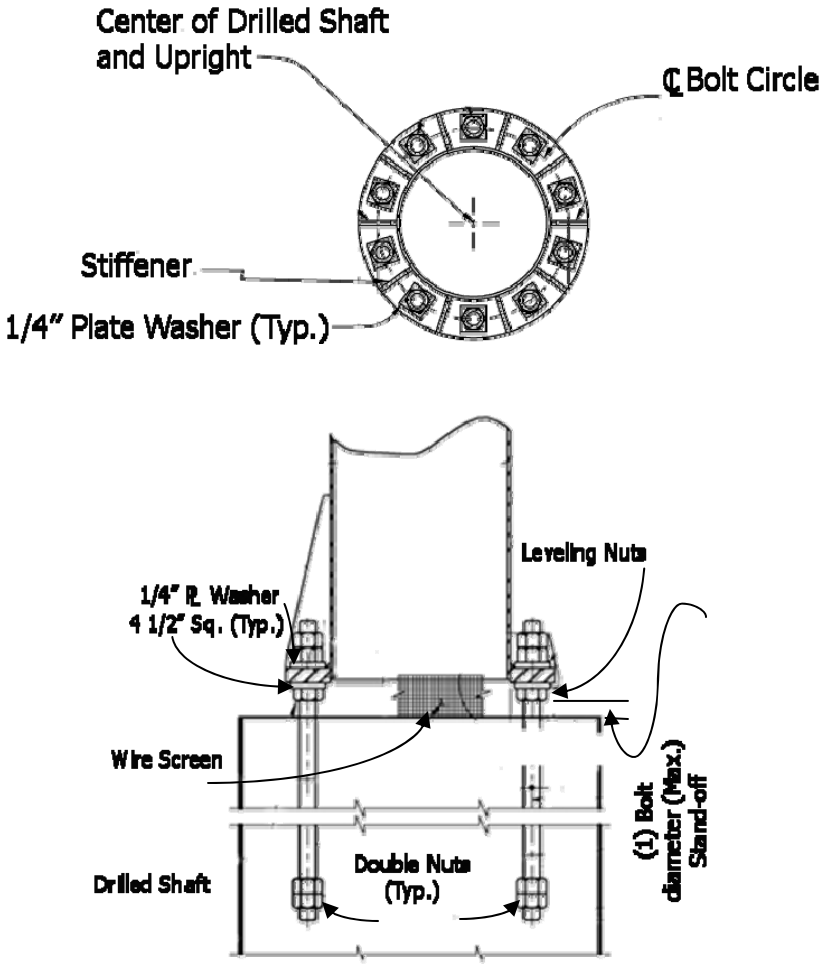
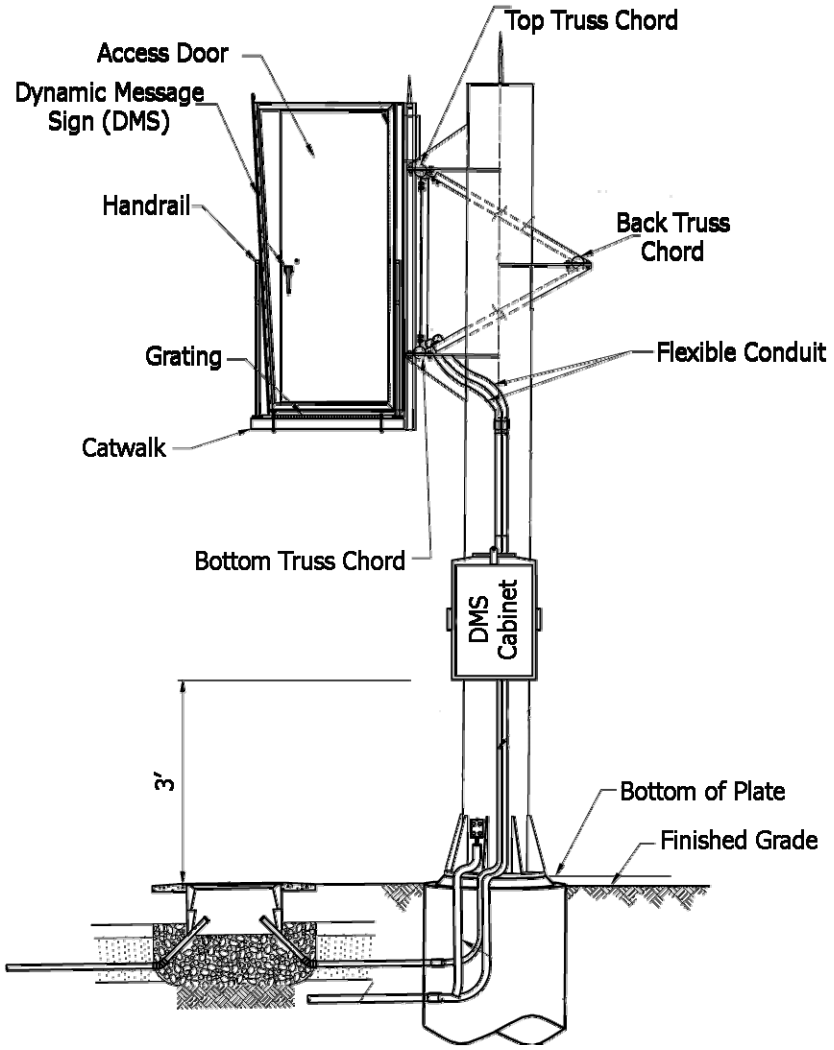


Sign & Truss Connection



Sign Base

Stand-off is measured from the bottom of the leveling nut to the top of the foundation and can be no more than the diameter of an anchor bolt.



Typical DMS Elevation

DMS structures are classified as overhead sign structures and must be inspected. **The top of the foundation should be a minimum of 2' above finished grade.**