Applications 

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

Overhead Sign Structures
High Mast Light Poles
Traffic Signal Mast Arms
Notes

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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splice</td>
<td>a junction where two items have been joined</td>
</tr>
<tr>
<td>Stand-off distance</td>
<td>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</td>
</tr>
<tr>
<td>Stiffener</td>
<td>a small vertical member (welded) attached to another member to transfer stress &amp; prevent buckling on the base of the column</td>
</tr>
<tr>
<td>Swivel mount</td>
<td>used to attach the signal to the mast arm and allows the signal to be turned</td>
</tr>
<tr>
<td>TSMA</td>
<td>acronym for traffic signal mast arm</td>
</tr>
<tr>
<td>Vertical</td>
<td>the vertical member, pole or column</td>
</tr>
<tr>
<td>Vertical hanger</td>
<td>used on cable to hold signal</td>
</tr>
<tr>
<td>Weep Hole</td>
<td>a hole installed in a grout pad to allow moisture to escape</td>
</tr>
<tr>
<td>Wind beam</td>
<td>Horizontal sign panel support</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock Nut</td>
<td>a nut that provides extra resistance to vibration loosening</td>
</tr>
<tr>
<td>Moment Connection</td>
<td>a joint capable of transferring moment to another member</td>
</tr>
<tr>
<td>Mounting bracket</td>
<td>a bracket used to attach the</td>
</tr>
<tr>
<td>Pal nut</td>
<td>a secondary nut installed above the primary nut to secure it</td>
</tr>
<tr>
<td>Plate washers</td>
<td>helps prevent the bolt head &amp; nuts from loosening</td>
</tr>
<tr>
<td>Ponding</td>
<td>accumulation of water</td>
</tr>
<tr>
<td>Retro Fit</td>
<td>to install something on a previously constructed object</td>
</tr>
<tr>
<td>Screen guard</td>
<td>screen installed around perimeter of anchor bolts to discourage rodents nesting</td>
</tr>
<tr>
<td>Seated</td>
<td>fully engaged</td>
</tr>
<tr>
<td>Seized</td>
<td>frozen</td>
</tr>
<tr>
<td>Self-locking nut</td>
<td>a specially designed nut that locks into place when tightened</td>
</tr>
<tr>
<td>Short bolts</td>
<td>bolts that don’t have at least two threads exposed after nuts are installed</td>
</tr>
<tr>
<td>Skew</td>
<td>turned or placed at an angle</td>
</tr>
<tr>
<td>Sleeve</td>
<td>used to create penetration</td>
</tr>
<tr>
<td>Soft concrete</td>
<td>crumbles easily due to improper curing process</td>
</tr>
<tr>
<td>Spall</td>
<td>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</td>
</tr>
</tbody>
</table>
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 where 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

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
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.

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

TSMA Terminology

Horizontal..........................Mast Arm
Vertical...............................Column
Moment Connection..........Mast Arm to Column
Anchor Bolt Numbering

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

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
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.

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 some of these deficiencies.
Short Anchor Bolts

A minimum of two threads should extend beyond the top nut
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.
Moment connection and splice bolts need to have self-locking nuts. All nuts should be properly torqued.

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 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.

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.
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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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
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
Overhead Signs

• Cantilever
• Span
• Butterfly
• DMS Cantilever

A Note About Punch Lists

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

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

View of Excessive Moment Connection Gap

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

The following pages show some of these deficiencies.
**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.**