STATE OF RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

HIGHWAY ANCILLARY STRUCTURES INVENTORY & INSPECTION MANUAL









July 2026

ACKNOWLEDGMENTS

The 2024 edition of the Rhode Island Department of Transportation's Manual for Inventory & Inspection of Highway Ancillary Structures was developed by ATANE Engineers, P.C., with oversight and technical assistance provided by RIDOT Bridge Engineering.

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The Rhode Island Department of Transportation's Bridge Engineering and ATANE acknowledges the following organization and publication for information utilized in the development of this Ancillary Structures Inspection Manual:

Virginia Department of Transportation: *Traffic Ancillary Structures Inventory & Inspection Manual*; January 2021

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Special thanks to Kendal R. Walus, P.E., of VDOT for his help in acquiring permission to use the material from VDOT's Manual and to FHWA-RI Division Office for providing feedback for the development of this Manual.

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Chapter 1 Administrative

1.1 Purpose and Scope

The purpose of the Ancillary Structure Inspection program is to provide Rhode Island Department of Transportation (RIDOT) with inventory and physical condition information for the ancillary structures servicing public roadways within the State of Rhode Island. The data and information collected will be utilized for the purpose of managing, maintaining, repairing, and replacing ancillary structures.

The purpose of this Inspection Manual is to provide the most current policies and procedures of RIDOT as related to the Ancillary Inspection Program to ensure safety on the roadways and the collection of accurate and adequate information to manage the ancillary structure assets.

These provisions are not included for ancillary structures that are not related to public highways. The provisions of this manual may be applied to cover ancillary structures outside of the scope of this manual if supplemented with the additional required information and rating criteria.

This manual is not intended to supplant proper training or judgment by the owner, engineer, team leader or other field personnel. Instead, this manual serves to state only the minimum requirements necessary to provide for public safety. The owner, engineer, team leader and/or other field personnel may require inspection procedures or the testing of materials to be greater than the minimum requirements.

The information contained in this manual is to supplement the Federal Highway Administration's (FHWA) manuals NHI 20-999; Ancillary Structures Inspection Reference Manual (November 2021), and NHI 05-036; Guidelines for the Installation, Inspection, Maintenance and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals (March 2005) (hereby referred to as the FHWA Ancillary Manual), on the inspection of ancillary structures and is a guide to obtaining inventory data and performing structural condition inspections of ancillary structures within the State of Rhode Island. It explains the procedures required to properly document the inventory and inspection data in standard formats, supplemented by required sketches and photographs. This manual is not intended to be all inclusive. For information outside the scope of this manual, refer to the publications listed in Section 1.1.2 Applicable Standards and References.

1.1.1 Permissions and Acknowledgements

The State of Rhode Island has been granted permission for the use of the following copyrighted material in the development of this Inspection Manual:

- The Virginia Department of Transportation's Traffic Ancillary Structures Inventory & Inspection Manual is the intellectual property of the Virginia Department of Transportation (VDOT). The State of Rhode Island is using this work with the expressed permission of VDOT and acknowledges that it has no property interest in this Inspection Manual.

1.1.2 Applicable Standards and References

Applicable standards and references included in the development of this inspection manual and in the scope of work for Rhode Island ancillary structure inspections may include the following:

- *Bridge Inspection Manual*, State of Rhode Island Department of Transportation, October 2013 with July 2016 Addendum

- Rhode Island Department of Transportation *Traffic Design Manual*, Rhode Island Department of Transportation, Traffic Design Section, Latest Edition
- Rhode Island Department of Transportation Contact and Distribution Matrix
- The latest applicable Department to All Consultant and Design Policy Memorandums
- FHWA NHI 20-999; *Ancillary Structures Inspection Reference Manual,* November 2021
- FHWA NHI 05-036; *Guidelines for the Installation, Inspection, Maintenance and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, March 2005
- FHWA; *Manual on Uniform Traffic Control Devices* (MUTCD), December 2009 with Revisions 1 & 2 (May 2012)
- FHWA NHI 12-049; *Bridge Inspector's Reference Manual*, December 2012
- AASHTO; *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals,* 6th Edition, 2013 with 2015, 2019 & 2020 Interim Revisions.
- AASHTO; *Manual for Bridge Element Inspection,* 2nd Edition, 2019
- New York State Department of Transportation; *Overhead Sign Structures Inventory and Inspection Manual*, December 2013
- *Structure Inspection Manual* (Part 4 – Ancillary Structures, Chapter 2 - Overhead Sign Structures or Supports), Wisconsin Department of Transportation, 2017

1.1.3 FHWA Guidelines

FHWA Ancillary Manual (FHWA NHI 05-036, March 2005) provides guidance for the installation, inspection, maintenance, and repair of structural supports for highway signs, luminaires, and traffic signals.

Although inspection of ancillary structures is not required by Federal Regulations, RIDOT has initiated an ancillary structure inspection program to manage its inventory and to ensure the safe and satisfactory performance of its ancillary structures.

1.1.4 Scheduling Work to Consultants

In general, ancillary structures will be assigned to the Consultant approximately three to six months prior to their respective inspection due date. It is the responsibility of the Consultant to coordinate the necessary resources and equipment to complete the inspection no later than the due date listed on the assignment list. For all inspections, the Consultant shall coordinate and arrange access to the structures.

All inspections shall be completed by their due date - see Section 1.1.8 for time requirements.

For inspections due in the winter, the Department may require Consultants to advance inspections from the months of January and February into the previous calendar years. This practice may be considered to avoid possible adverse weather conditions that could potentially delay the inspection.

Schedules may have to be adjusted to avoid construction lane closures or other maintenance activities. The Consultant is required to check the Department's website (www.dot.ri.gov) for up-to-date construction and maintenance related traffic information that could impact the schedule for an inspection. It is the Consultant's responsibility to coordinate their field inspection to avoid delays to the schedule.

In general, the Consultant shall be designated for assignment(s) of ancillary structures based on location and schedule. The list of ancillary structures in each assignment shall be determined by the Department. The term Consultant in this manual refers to the consultant and its subconsultant(s). The consultant and its sub-consultant(s) shall conduct work in accordance with all State, local and Federal rules and regulations to preserve high ethical and moral standards, avoid conflicts of interest, and adhere to all legal requirements.

1.1.5 Preparation of Cost Proposals/PO Approval Process

The Consultant shall submit a detailed cost proposal and work order for each assignment to the Department for approval prior to performing the inspection. The Consultant shall visit the site prior to submitting the proposal to properly identify the estimated labor and direct expenses associated with a particular inspection. This proposal shall be submitted to the personnel listed in the Distribution and Contact List which will be provided to the Consultant at the start of the contract. The cost proposal and work order shall be submitted in electronic format. Cost proposal templates in electronic format can be obtained from the Department. For a sample cost proposal, see Figure 1.1-1 Example Cost Proposal

Below is a summary of the minimum required information to be included in the cost proposal:

- Estimated time (in hours) for each type of structure within the assignment for preparation, coordination, field inspection, data/reporting, sketches, and QA/QC for the project manager, team leader, staff inspector and technician;
- Master Price Agreement (MPA) hourly rates for each labor category;
- Direct expenses for each of the types of structures within the assignment to be inspected, along with an individual breakdown of dollar amounts; and
- Proposed inspection equipment and fees (usually listed under direct expenses).

Typically, once the proposal is approved by Bridge Engineering, the purchase order will generally be issued approximately one month after approval. The purchase order will be sent via electronic mail to the Consultant's project manager. However, the time for the issue of purchase orders varies and it is up to the Consultant to submit cost proposal/work order promptly to avoid any delays to the schedule. For scheduling purposes, it is recommended to forward the proposal to the Department as quickly as possible, but no later than one month after receiving the assignment or as required in the assignment instructions provided to the Consultant. The Consultant shall prepare the proposal at its own expense.

Rhode Island Department of Transportation
ANCILLARY INSPECTION COST PROPOSAL
MPA No. 359, AWARD No. XXXXXXX
Ancillary Structure Inspection - Assignment No. X
Consultant Name

Sign ID:	Various	**Cantilever**	X
City/Town:	Statewide	**Span**	X
Facility Carried:	I-95	**Bridge Mount**	X
Feature Intersected:	Various	**Ground Mount**	X
Structure Type:	Sign Structures	**Other**	X
Inspection Type:	Inventory	**Total**	**X**

Task	WORK HOURS / LABOR COSTS								
	PM	TL	Staff Inspector	Staff Engineer	Technician /Drafter	Load Rater	UW Inspector	Total Hours	Total Labor
HOURLY RATES	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		
Preparation/ Coordination								0	$ -
Field Inspection								0	$ -
Data/ Report								0	$ -
CADD Drawings								0	$ -
Traffic Management								0	$ -
QA / QC								0	$ -
TOTAL HOURS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
TOTAL COST	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**		**$ -**

Field Inspection	
Estimated Crew Size[1]	
Estimated Crew Days[2]	

1. Enter number of anticipated crew members to inspect XX Ancillary Structures
2. Enter anticipated duration (in days) for crew to inspect XX Ancillary Structures

Notes:

DIRECT EXPENSES	
Direct Expense - Item	**Cost**
Bucket Truck	$ -
Light Tower	$ -
Crash Truck	$ -
Arrow Board	$ -
Traffic Control	$ -
Testing	$ -
TOTAL DIRECT EXPENSES	$ -

TOTAL COST: **$0.00**

Figure 1.1-1 Example Cost Proposal

1.1.6 Submitting Invoices to RIDOT

The Consultant shall conform with the latest policies and procedures of RIDOT/Financial Management. Each invoice shall display the Purchase Order (PO) number and the Consultant contact information. Invoices for payment shall be submitted monthly and shall include, but not be limited to:

- Total hours billed that period for each classification for each type of structure inspected;
- Eligible reimbursable costs with receipts;
- Disadvantaged Business Enterprise (DBE) documentation if applicable; and
- A monthly progress report documenting the overall project status to date such as the total hours used, total dollars spent and the number of ancillary structure inspections completed.

Invoices shall be emailed to dot.accountspayable@dot.ri.gov. Hard copies of invoices, as required per the latest guidelines, should be submitted to:

Rhode Island Department of Transportation
Financial Management Room 245
ATTN: Accounts Payable
Two Capitol Hill
Providence, RI 02903

No work shall be permitted until a duly executed Purchase Order Release document has been issued for the specific work to be performed. All changes to the release document must be submitted to Financial Management, Central Purchasing prior to commencement of the work to carry out the necessary modifications.

1.1.7 Disadvantaged Business Enterprise (DBE)

Disadvantaged Business Enterprise (DBE) firm(s) and applicable documentation must be submitted through RIDOT's Contract Compliance System, PRISM, and coordinated through the following office:

RIDOT Office of Business and Community Resources
Two Capitol Hill
Providence, RI 02903
(401) 222-3260

1.1.8 Time Requirements

The State requires that all inspections be performed according to the requirements listed below (see Table 1.1-1).

It is important to note that changes to the established time requirements are not permitted unless unusual circumstances exist. Furthermore, all proposed changes must be met with Department approval.

Table 1.1-1 Time Requirements

Item	Time Requirements
Completion of Inspection	No later than the due date listed in the assignment list and no earlier than two months prior to the due date* unless directed otherwise by the Department.
Report Submittal	No later than sixty (60) days from the Completion of Inspection date. Subject to the approval of the Department, report submittal time may be extended. For damage inspections, the report shall be submitted within 5 days of the Completion of Inspection date.
*Due date: Last inspection date plus the frequency of the inspection	

1.1.9 Police Details

The following procedures are required for obtaining and scheduling police details, should they be necessary. It is noted that the State pays the applicable Police Department directly:

- For state police details on interstate highways, submit the Police Detail Request Form to the appropriate person listed on the form. This request shall be completed a minimum of one week prior to the week when police details are needed. The Police Detail Request Form can be obtained from RIDOT/Construction or Bridge Inspection Section. An example is included in A.23 Police Detail Request Form.

- For local police details on non-interstate routes, the Consultant shall contact the police with jurisdictional authority where the structure is located and schedule the police detail following the authority's approved procedure.

- The Consultant shall fill out the Police Detail form in the Smartform using the HeadLight website, https://Smartforms.headlight.com/, once the detail has been provided. The Police Department sends the invoice to RIDOT.

1.2 Personnel Policies

1.2.1 Staff Approvals

The consultant's key personnel, defined in Section 1.1, shall receive approval from RIDOT prior to their starting work. The consultant shall submit an approval request in BrM prior to assignment with their proposal during the Consultant Selection Process which shall include:

- The list of the proposed key personnel currently on the consultant staff;

- Resumes of proposed key personnel;

- Applicable documentation showing compliance with staff qualifications required by Section 1.1;

- Proof of certifications (PE license, training certifications, etc.); and

- Form BI-001: Bridge Inspection Qualifications Record.

Additions and/or replacements to the key personnel shall follow the above requirements for approval by RIDOT.

RIDOT Bridge Inspection Unit (BIU) shall track and maintain all inspection personnel in the RIDOT's Qualifications Database. Form AI-001 shall be updated due to:

- Changes to the training or certification.
- Request by RIDOT.
- An action resulting from a QA/QC review.

Key personnel are encouraged to participate in training sessions when made available. This provides awareness of any new and revised inspection techniques or data recording and coding methods.

RIDOT's Program Manager and the consultant's Project Manager and Team Leaders, are required to complete the NHI Course for Inspection and Maintenance of Ancillary Highway Structures (FHWA NHI # 130087).

1.2.2 Work Rules

The Consultant (and its Sub-consultants) shall conduct work in accordance with all State, local and Federal rules and regulations to preserve high ethical and moral standards, avoid conflicts of interest, and adhere to all legal requirements.

1.2.3 Safety

The Consultant shall conduct work in accordance with all State, local, and Federal governing safety rules and regulations. If there are questions regarding safety, reach out to RIDOT for advice.

1.2.4 Media/Public Relations

If the Consultant is approached by a member of the media while conducting an inspection, please direct all requests to the Department's Office of Communications:

Chief Public Affairs Officer
Charles St. Martin
401-563-4007
charles.stmartin@dot.ri.gov.

Chapter 2 Organization

The Bridge Engineering Section of the Rhode Island Department of Transportation is contained within the Infrastructure Development Division. Organizational charts can be found on the Department website (http://www.dot.ri.gov/).

See the current Contact and Distribution list for the Department's contact and distribution requirements.

The inspection of ancillary structures has many similarities to the inspection of bridges. The qualifications for ancillary structure inspection personnel are as summarized below with modifications for ancillary structures.

2.1 Program Manager (RIDOT)

2.1.1 Description

The program manager is the individual in charge of the ancillary structure inspection program, who provides overall leadership within the ancillary structure inspection program and provides guidance to bridge inspection team leaders when requested. At a minimum, one statewide program manager is required by the FHWA.

2.1.2 Qualifications

The minimum qualifications of a program manager are established in the Code of Federal Regulations, Title 23, Part 650, Subpart C, Section 650.309 (23 CFR 650.309) and are listed below. A program manager must, at a minimum:

1. Be a registered Professional Engineer, or have ten [10] years bridge inspection experience;

2. Complete an FHWA-approved comprehensive bridge inspection training course and score 70 percent or greater on an end-of-course assessment (completion of FHWA-approved comprehensive bridge inspection training under FHWA regulations in this subpart in effect before June 6, 2022, satisfies the intent of the requirement in this paragraph (a);

3. Complete a cumulative total of 18 hours of FHWA-approved bridge inspection refresher training over each 60 month period;

4. Maintain documentation supporting the satisfaction of paragraphs (a)(1) through (3) of this section; and

5. Satisfy the requirements of this paragraph (a) within 24 months from June 6, 2022, if serving as a program manager who was qualified under prior FHWA regulations in this subpart.

2.1.3 Responsibilities

The statewide program manager is assigned the duties and responsibilities for ancillary structure inspection, reporting and inventory. These duties and responsibilities may then be delegated by the statewide program manager to project managers (Consultants) and team leaders within the State. Although the statewide program manager may choose to delegate some or all functions to other ancillary

structure inspection personnel, the statewide program manager retains all responsibility for ancillary structure inspection operations for which he or she was assigned.

2.2 Project Manager (Consultant)

2.2.1 Description

The project manager serves as the link between the Consultant and the State and is therefore in charge of the organizational unit within the firm that has been delegated the responsibilities for all aspects of the inspection project.

2.2.2 Qualifications

State policy requires that, at a minimum, project managers have the following qualifications:

1. Have five (5) years of experience in bridge structures (inspection and/or design);

2. Complete a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course and score 70 percent or greater on an end-of-course assessment (completion of FHWA-approved comprehensive bridge inspection training under FHWA regulations satisfies the intent of the requirement); and

3. Complete a cumulative total of 18 hours of FHWA approved bridge inspection refresher training over each 60 month period.

No minimum Federal qualifications for Project Managers have been established within the NBIS (Code of Federal Regulations, Title 23, Part 650, Subpart C).

2.2.3 Responsibilities

The responsibilities of the project manager (Consultant) are defined within the scope of work for the project. Below is a summary of general responsibilities and inspection training responsibilities of the project manager (Consultant). State policy includes the following general responsibilities for project managers (Consultants):

- The Consultant shall be responsible for the timely inspection and reporting of ancillary structure inspections to the State in accordance with the guidelines contained in the scope of work.

- The Consultant shall submit a cost proposal and work order for approval detailing the work as described below prior to performing the inspection(s). Refer to Section 1.1.5 for more information.

- The Consultant shall follow specific procedures for reporting critical findings as defined in Section 5.2.8.

- The Consultant is required to keep the State updated on a regular basis by providing the following notifications: 2-WEEK Work Schedule; 2-DAY Inspection Notification; and Weekly Inspection Summary Reports. Refer to Section 5.2.3.1 for more information regarding these Notifications. When a Police Detail is required, the Consultant shall submit a 1-week notice: see Section 1.1.9

- The Consultant shall verify and document the ancillary elevation with vertical and horizontal clearances, main structural dimensions, and locations of ancillary structure devices, when applicable; see Section 6.3.6.

- The Consultant shall make timely submissions of all required documents to the Department: see Section 1.1.8. Any exception must be requested in writing by the Project Manager and approved by the Department.

- The Consultant shall conduct work in accordance with all governing rules and regulations: see Section 1.2.

- The Consultant shall be responsible to submit actual hours and cost data to the State upon completion of a work order assignment. This is in addition to and separate from invoicing. Refer to Section 1.1.6 for more information.

State policy includes the following responsibilities regarding inspection training:

- The Consultant's project manager(s) and team leaders are required to successfully complete a comprehensive training or refresher course based on the Bridge Inspector's Reference Manual (Report Nos. FHWA NHI 12-049 and FHWA NHI 12-050). Consultants are required to complete an approved bridge inspection refresher-training course once every 60 months.

- All personnel must receive the appropriate railway safety training prior to work on structures involving railways. It is the responsibility of the Consultant to arrange for and acquire the required Amtrak or appropriate railroad training.

- The Consultant's staff is encouraged to participate in additional training programs related to bridge inspection offered by FHWA. Please refer to http://www.nhi.fhwa.dot.gov for available course information.

State policy also includes responsibilities for program managers (Consultants) regarding quality control/quality assurance. Those responsibilities are discussed in Section 5.1.

Quality control/quality assurance responsibilities for Consultants as outlined in Chapter 7.

2.3 Team Leader

2.3.1 Description

The Team Leader is the individual who performs or provides direct supervision of the team member(s) during the field inspection of an individual ancillary structure. The team leader will have the assistance of one (1) staff inspector and/or one (1) technician for each inspection team. Refer to Section 2.4 for the description and qualifications of a staff inspector and Section 2.7 for the description and qualifications of a technician.

2.3.2 Qualifications

A Team Leader, at a minimum must:

1) Meet one of the four (4) qualifications listed in paragraphs (b)(1)(i) through (iv) of this section:

i. Have five (5) years bridge inspection experience;

ii. Have all of the following:

A. A bachelor's degree in engineering or engineering technology from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology; and

B. Successfully passed the National Council of Examiners for Engineering and Surveying Fundamentals of Engineering examination; and

C. Two [2] years of bridge inspection experience; or

iii. Have all of the following:

A. An associate's degree in engineering or engineering technology from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology; and

B. Four [4] years of bridge inspection experience;

2) Complete an FHWA-approved comprehensive bridge inspection training course and score 70 percent or greater on an end-of-course assessment (completion of FHWA-approved comprehensive bridge inspection training under FHWA regulations in this subpart in effect before June 6, 2022, satisfies the intent of the requirement in this paragraph);

3) Complete a cumulative total of 18 hours of FHWA approved bridge inspection refresher training over each 60 month period;

4) Provide documentation supporting the satisfaction of paragraphs 1) through 3) of this section to the program manager of each State transportation department, Federal agency, or Tribal government for which they are performing bridge inspections; and

5) Satisfy the requirements of this paragraph within 24 months from June 6, 2022, if serving team leader who was qualified under prior FHWA regulations in this subpart.

In addition to the minimum Federal qualifications, the State requires the following:

- At least fifty (50) percent of experience be from NBIS bridge safety inspections to qualify as a team leader in the State.

A Team Leader shall also meet the following qualifications:

- Successful completion of the Inspection and Maintenance of Ancillary Highway Structures (NHI-130087) course is required to qualify as a Team Leader for the inspection of ancillary structures.
- Successfully completed a FHWA approved comprehensive bridge inspection training course;
- Successfully complete a FHWA approved bridge inspection refresher training course once every 60 months;

2.3.3 Responsibilities

Prior to the ancillary structure inspection, the team leader is responsible for planning and preparing for the inspection, which includes reviewing the ancillary structure's past inspection files and evaluating any site conditions (such as any inspection obstructions, nondestructive evaluation and traffic control). While performing the field inspection, the team leader is responsible for all judgments made concerning an ancillary structures' condition, including recognizing and reporting any critical findings, as well as maintaining safe inspection practices throughout the entire inspection. Upon completion of the inspection, the team leader finalizes the ancillary structure inspection report and submits all required information within the specified timeframe.

2.4 Staff Inspector

2.4.1 Description

The Staff Inspector is an individual who assists the team leader during the ancillary structure inspection. The State requires that one (1) staff inspector and/or NDT Technician (see Section 2.7) assist the team leader for each inspection.

2.4.2 Qualifications

A Staff Inspector shall have any of the following:

- Minimum of three (3) years of experience in the inspection of structures (ancillary, bridges, tunnels); or
- Bachelor's degree in civil or structural engineering.

2.4.3 Responsibilities

The Staff Inspector assists the Team Leader during the field inspection and report writing. As with the Team Leader, the staff inspector is responsible for maintaining safe inspection practices throughout the entire field inspection.

2.5 Load Rater

2.5.1 Description

The load rater is a senior structural engineer who performs structural analysis and/or determines the Combined Stress Ratios (CSR) of existing ancillary structures using information contained in the existing ancillary structure plans (if available) supplemented by information gathered from the most recent ancillary structure inspection. The load rater is sometimes referred to as a load rating engineer.

2.5.2 Qualifications

The individual charged with the overall responsibility for structural analysis of ancillary structures must be a registered Professional Engineer in Rhode Island. Alternatively, the analysis may also be performed by an unlicensed staff engineer and then reviewed by a registered Professional Engineer in Rhode Island. The qualifications for an unlicensed engineer include having a bachelor's degree in civil or Structural Engineering and have worked under the supervision of a registered Professional Engineer.

2.5.3 Responsibilities

The Load Rater is responsible for performing ancillary structure highway structural analyses using an approved FEM software and manual calculations in accordance with the AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. The Load Rater will determine force effects due to dead loads, wind loads, and ice loads on ancillary structures and attached signage. Using that information, they will analyze the structure to determine Combined Stress Ratios (CSR) which are used to determine structural adequacy. The Load Rater may also recommend solutions for critical members or prepare repair details to address the deteriorated members to increase the in-service life of the structure.

2.6 Staff Engineer

2.6.1 Description

The staff engineer is an individual who assists with performing tasks such as, but not limited to, load rating and office engineering.

2.6.2 Qualifications

State policy requires that, at a minimum, staff engineers have the following:

- Bachelor's degree in civil or structural engineering.

2.6.3 Responsibilities

The primary responsibility of the staff engineer is to assist with performing duties such as, but not limited to, performing structural analysis, determining the combined stress ratios of ancillary structures and preparing repair details.

2.7 Non-Destructive Testing/Field Technician Qualifications

The State requires the inspection team conducting the NDT to be familiar with Liquid/Dye Penetrant Testing (PT) and Magnetic Particle (MT). ASNT Level I or Level II can perform UT testing of anchor rods (bolts). Any findings or indications should be verified by an ASNT Level II or Level III. Any other testing required (other than anchor rods) for any new findings or verification, shall be performed by an ASNT Level II and verified by an ASNT Level III.

2.8 Inspection Team Composition

An inspection team shall consist of a Team Leader and a Staff Inspector and/or an NDT Technician. Certain circumstances may require additional inspection staff, subject to the approval of the Department. The Department requires that a Team Leader shall be present during each field inspection including damage and special inspections. For each assignment, two inspection teams shall be available at all times. The Department may request additional inspection teams when needed.

All inspection personnel should be able to physically perform the field work. Although bucket trucks are typically used to access the structures, some climbing may be required.

Chapter 3 Terms and Ancillary Types

3.1 Glossary of Terms

Ancillary traffic structures carry devices that support the main use of the roadway by traffic and pedestrians. Terms commonly used in discussing ancillary structures and terms commonly used in this manual are defined below.

Anchor Rod/Bolt – Anchor rods (also referred to as anchor bolts) are threaded rods that are used to connect the ancillary structure to the foundation. The visible portion of the anchor rods above the foundation is generally referred to as "anchor bolts". The following are subcomponents of the anchor rod assembly:

- **Leveling Nut** – The nut immediately below the base plate and above the foundation.
- **Top/Turning Nut** - The nut immediately above the base plate.
- **Flat Washer** - Washers that are installed between the nut and the base plate, for both the top and leveling nut.
- **Jam Nut / Lock Nut** - This is an additional nut that may be installed above the top/turning nut that is used to lock the anchor rod assembly in.

Anchor Bolt Coupler – A type of breakaway system that connects the anchor rods to the post base plate. The coupler is made of frangible material or has been designed to be of a frangible configuration. A protective cover (skirt) is sometimes installed around the perimeter of the foundation to post base plate gap.

Barrier Mount – A non-footing mounted ancillary connected to a barrier; not to be confused with bridge mounted structures. Consists of anchor rods cast into a median or other roadway barrier, to which the vertical support component of the ancillary structure is attached.

Base Plate - The plate used to connect the post/post base to the foundation or to the transformer base.

Bracing Members – Vertical, horizontal, and diagonal secondary members located between truss chords or between posts of a support tower (end frame). Typically, tubular or angular shapes.

Catwalk - The walkway used by maintenance personnel to access VMS panels.

Chords - The main horizontal members of a truss.

Dampener - An attachment that helps dissipate excess vibrations. Note that the components are called dampeners, but the proprietary name may be damper.

Foundation - The portion of the structure below the base plate that transfers the load into the ground. Typically constructed of a concrete pedestal on pile, spread, or drilled shaft foundations.

Handhole - An opening in the post/post, arm, horizontal member or transformer base for access to the interior.

Horizontal Arm – Typically a tubular member attached at one end to a post that supports the sign panels.

Horizontal Member – Typically a tubular member supported at each end by a single post that supports the sign panels.

Log Direction - The Northbound or Eastbound direction of the inventoried roadway.

Luminaire Head – The head is attached to the end of an arm on a conventional lighting structure or to a ring on a High Mast Light structure. The head consists of a housing, a bulb, a lens cover, a light sensor, a hinge & latch and an attachment bracket.

Luminaire Ring – A circular structure with several luminaire heads that is mounted to a High Mast Light structure to provide high output illumination to a large area around the structure. The ring can typically be lowered for maintenance and inspection purposes.

Non-Destructive Testing (NDT) - Special testing on specific components, elements, or connections to determine quality or possible damage. NDT methods include:

- Magnetic particle testing equipment (welds)
- Ultrasonic testing equipment (Anchor Rods, vertical supports/posts, gusset plates)
- Ultrasonic (D-Meter) Thickness Testing to determine remaining thickness for structural members where thickness cannot be readily verified by other means, or where visible corrosion exists.
- Eddy current testing equipment (aluminum structure welds)
- Dye penetrant testing equipment (all material welds or members)

Panel Point – A point on a truss at which several members intersect.

Pedestal - The pedestal is a part of the foundation. It refers generally to the upper portion of a concrete foundation, which is above ground, near the area surrounding the post to foundation interface.

Post, Pole or Tower - The vertical supporting member(s) of an ancillary structure.

Reverse Log Direction - The Southbound or Westbound direction of the inventoried roadway.

Saddles - Bearings which support the chords of truss structures.

Shim Plates - Metal plates used to account for elevation differences in tower to truss supports.

Sign Clips – Aluminum clips with stainless steel hardware that are used to attach the extruded aluminum sign panels to the vertical support members.

Sign Panels - Sign panels are used to display messages on the side facing traffic. Panels may be rigid or may be a Variable Message Sign (VMS).

- Rigid panels use a reflective material and are typically extruded aluminum or sheet aluminum. Panels are attached on the backside to vertical support members with sign clips if extruded aluminum or are through bolted if sheet aluminum. Extruded aluminum sign panels are made up of sections bolted together.

- VMS panels typically have integrated structural components that make up the body of the panel and house the electrical components. These panels use light emitting elements arranged in rows and columns activated at variable times to display configurable messages. Panels are attached to the structure with a frame.

Slip Joint – A common method of splicing tubular sections together on traffic signal mast arms and on high mast light posts. Tubular sections are tapered to allow for the wider end to slip over the narrower end. One or more bolts are installed through the entire diameter of the overlapping portions of the tubular sections.

Span Wire – Typically a zinc coated high strength steel wire strand or cable, of a specific diameter ranging from 1/4" to 5/8" diameter, that is strung between two posts. The cable is tensioned as needed and then secured to itself through clamps, locking in the cable tension.

Splice - The connection between similar adjoining elements such as truss chords, long mast arms and high posts.

Spread Footing – The foundation type that is the most common for ancillary structures. It consists of a shaft made up of concrete and reinforcing steel. At the bottom of the shaft, a wider section of concrete extends outward. The foundation is covered with soil to almost the top of the shaft. An anchorage assembly is cast into the shaft.

Struts - The diagonal or horizontal bracing members of the truss arm or built-up vertical tower.

Sway Wire – Found on a span wire traffic signal structure, the sway wire is typically a zinc coated steel wire strand or cable of a specific diameter ranging from 1/4" to 5/8" diameter. The sway wire is strung between two posts and attaches to the bottom of the traffic signals and minimizes the amount of sway that may develop in the signals and any informational signs due to wind.

Traffic Signal Head - Typically consist of three housings in a vertical configuration. They may have anywhere from one to five or even more housings. Each signal head has visors and a backplate. The signals attach to the member or span wire via strap or clamp systems.

Traffic Signal Backplate – A flat black aluminum louvered or non-louvered plate border that provides a visual contrast between the signal head and the background enhancing signal visibility.

Traffic Signal Housing – A modular enclosure with a hinged door typically made of colored polycarbonate or painted/powder coated aluminum that houses the light and electronics.

Traffic Signal Visor – A colored polycarbonate or powered coated aluminum visor mounted to the front of each signal housing to increase signal visibility in sunlight.

Transformer Base - The most common type of breakaway base which consists of a box like enclosure that sits between the foundation and the post. The transformer base is considered to be part of the post and is connected to the post via a bolted connection. The base is also connected to the anchor rods that protrude from the foundation. The transformer base typically has a door or hatch that opens to allow maintenance and inspection of the interior of the base.

Truss Seat – A welded or bolted attachment to a post that supports the vertical load of a truss chord.

Truss - Superstructure that is composed of truss members. These can be tubular or angular.

U-bolts – "U" shaped bolts that are used to attach vertical support members to the sign truss or horizontal arm/member and are used between the sign truss and vertical support post or tower.

Vertical Support Members or Sign Hangers – Typically are T-beams, I-beams or angles and connect sign panels to the support structure.

3.2 Ancillary Types

Ancillary Structures are defined by their primary function – namely the main ancillary structure device that they carry (i.e., signs, traffic signals, lighting or ITS devices) and the structure that supports them (e.g., cantilevers, spans or mast arms.) For purposes of an all-encompassing inspection and inventory process, all ancillary structures will be categorized by these two main defining factors.

3.2.1 Sign Structures

A Sign Structure is a structure whose primary use is to support sign panels or other sign devices, such as variable message signs (VMS), and consists of its sign panels, its primary structure, its foundations (where applicable) and its auxiliary attachments.

3.2.1.1 Cantilever Signs

Cantilevered Sign Structures have arms that either overhang a portion of the roadway or are parallel to it and are supported on one side by a post or other vertical support. Depending on the structure's requirements and design, the cantilevered arm can have one of the configuration types outlined below in Sections 3.2.1.1.1 through 3.2.1.1.4.

3.2.1.1.1 Single Chord (Mono/Multitube) Cantilever

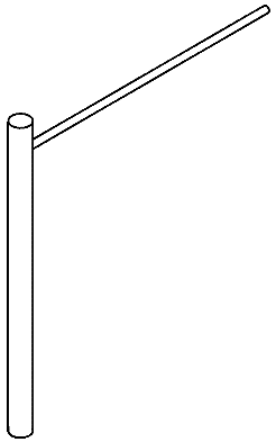


Figure 3.2-1 Cantilever, Single Chord



Figure 3.2-2 Cantilever Sign Structure; Typical Single Chord Cantilever

3.2.1.1.2 Dual-Chord (Trussed or Untrussed) Cantilever

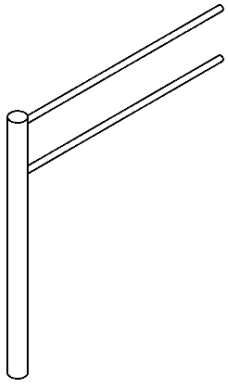


Figure 3.2-3 Cantilever, Dual-Chord, Untrussed



Figure 3.2-4 Cantilever Sign Structure; Typical Dual-Chord, Untrussed

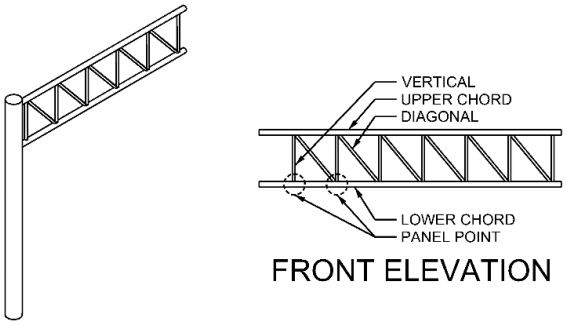


Figure 3.2-5 Cantilever, Dual-Chord Plane Truss



Figure 3.2-6 Cantilever Sign Structure; Typical Dual-Chord Plane Truss

3.2.1.1.3 Tri-Chord Truss Cantilever

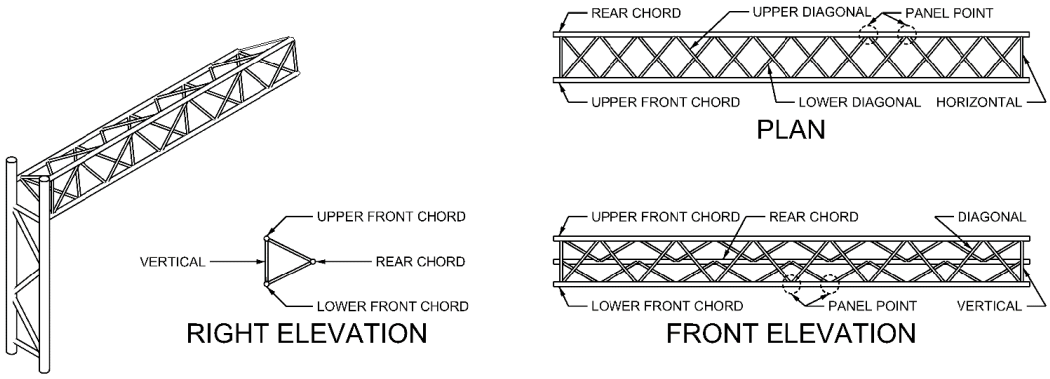


Figure 3.2-7 Cantilever, Tri-Chord Space Truss



Figure 3.2-8 Cantilever Sign Structure; Typical Tri-Chord

3.2.1.1.4 Quad-Chord Truss Cantilever

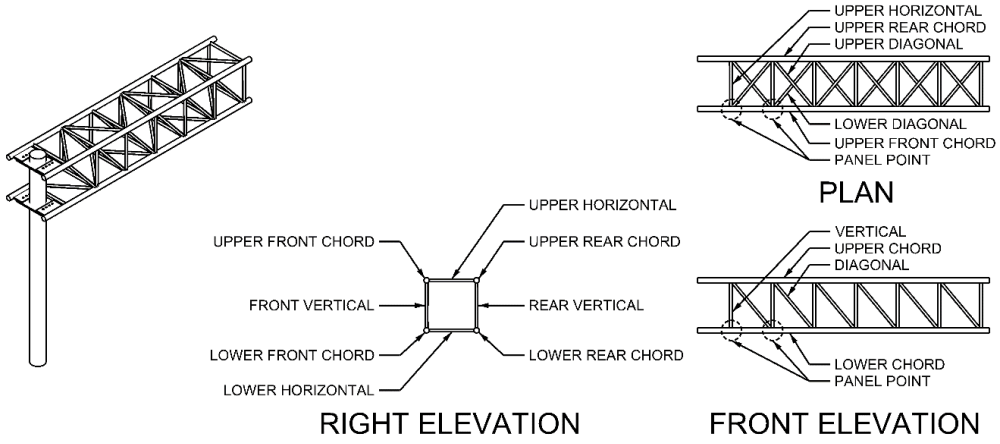


Figure 3.2-9 Cantilever, Quad-Chord Space Truss



Figure 3.2-10 Cantilever Sign Structure; Typical Quad-Chord

3.2.1.2 Span Signs

Span Structures span the roadway, with at least two supports on either end of the structure. They span the roadway in one or multiple directions with supports on the outside edges of the roadway. Depending on the structure's requirements and design, the cantilevered arm can have one of the configuration types outlined below in Sections 3.2.1.2.1 through 3.2.1.2.4.

3.2.1.2.1 Single Chord (Mono/Multitube) Span

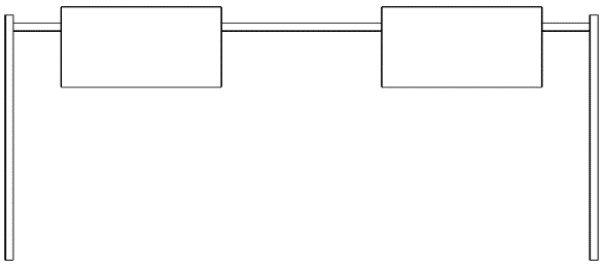


Figure 3.2-11 Span, Single Chord



Figure 3.2-12 Span Sign Structure; Typical Single-Chord

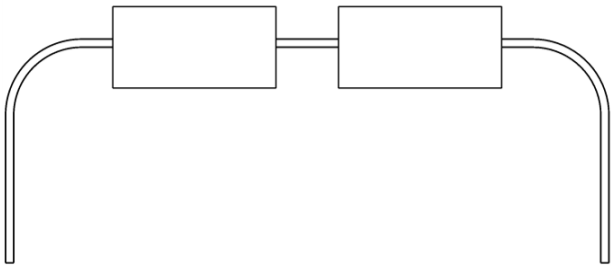


Figure 3.2-13 Span, Monotube

3.2.1.2.2 Dual-Chord (Trussed or Untrussed) Span

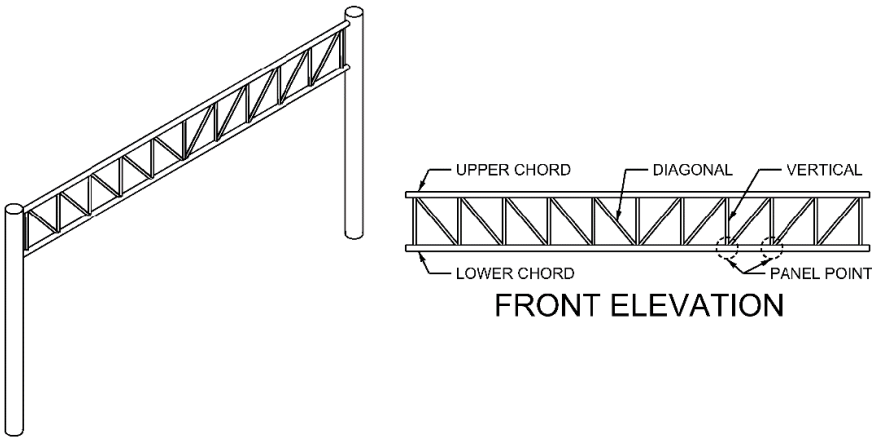


Figure 3.2-14 Span, Dual-Chord Plane Truss



Figure 3.2-15 Span Sign Structure; Typical Dual-Chord

3.2.1.2.3 Tri-Chord Truss Span

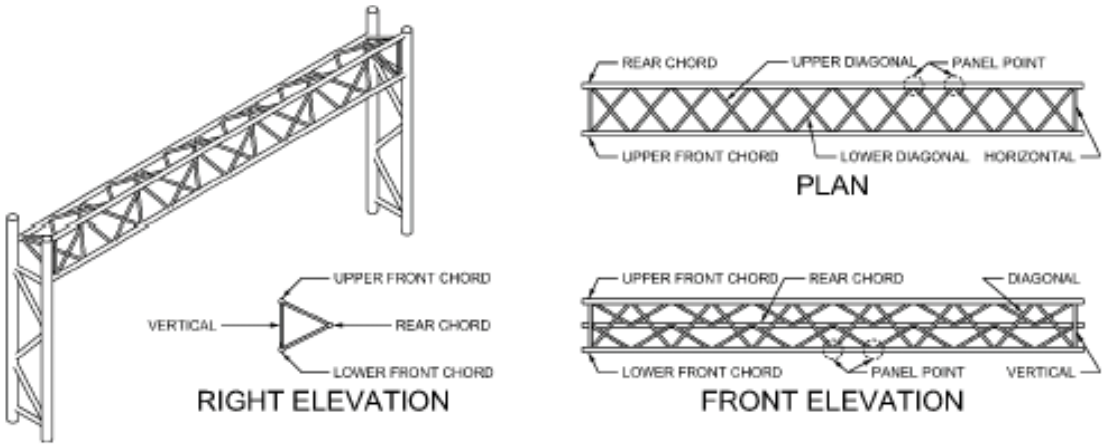


Figure 3.2-16 - Span, Tri-Chord Space Truss



Figure 3.2-17 Span Sign Structure; Typical Tri-Chord

3.2.1.2.4 Quad-Chord Truss Span

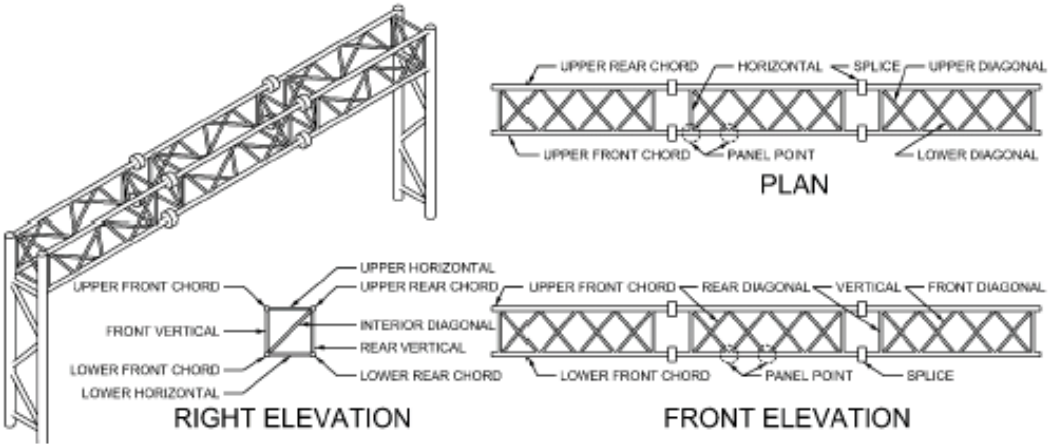


Figure 3.2-18 Span, Quad-Chord Space Truss



Figure 3.2-19 Span Sign Structure; Quad-Chord with VMS

3.2.1.3 Structure Mounted Signs

Structure mounted ancillary structures, typically signs, are mounted by a frame to structures such as bridge parapets/fasciae or retaining walls. The framing is made up of tubular shapes, angles, I-beams, or T-sections. The structure is typically attached via bolted or clamped connections.

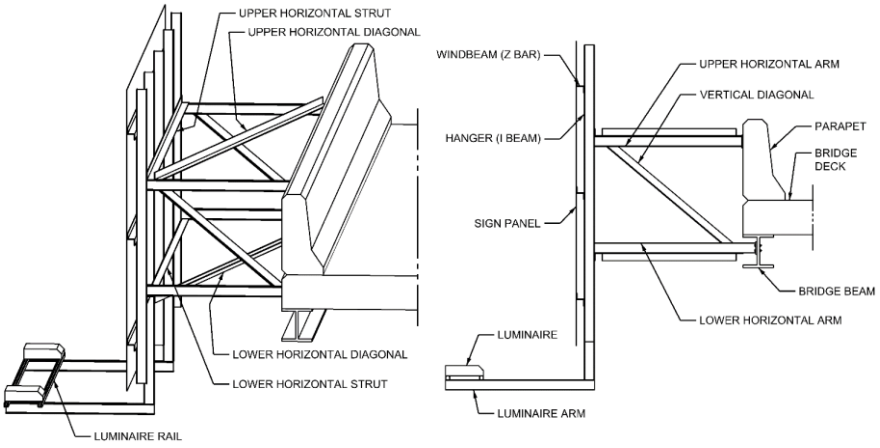


Figure 3.2-20 Structure Mounted Sign Structure, Bridge Mounted Frame



Figure 3.2-21 Bridge Mounted Sign Structure, Thru-bolted at parapet

3.2.1.4 Butterfly Signs

The butterfly structure shares many of its features with the cantilever structure type but has arms on each side of its vertical support. Depending on the structure's requirements and design, the cantilevered arm can have one of the configuration types outlined below in Sections 3.2.1.4.1 through 3.2.1.4.4.

3.2.1.4.1 Single Chord (Mono/Multitube) Butterfly

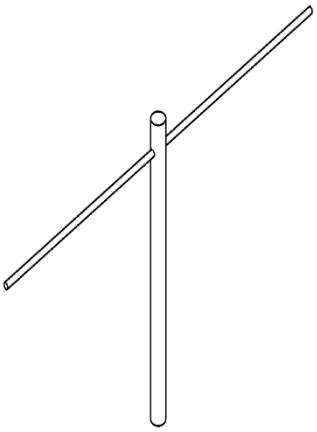


Figure 3.2-22 Butterfly, Single Chord

3.2.1.4.2 Dual-Chord (Trussed or Untrussed) Butterfly

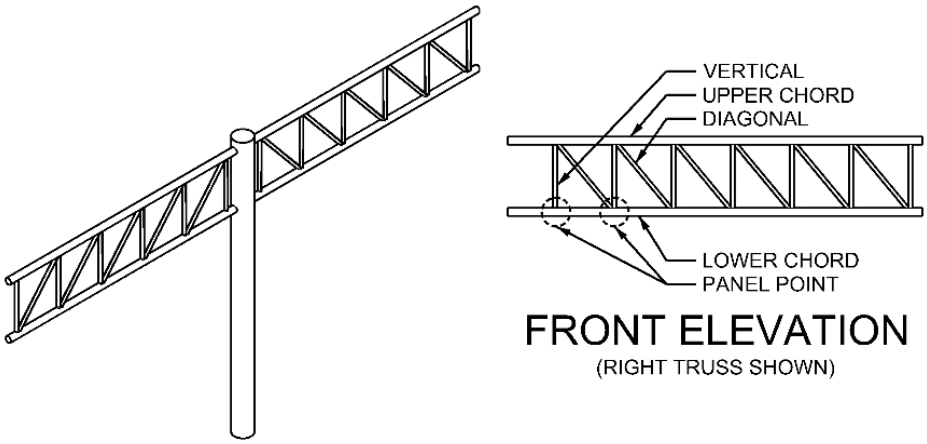


Figure 3.2-23 Butterfly, Dual-Chord Truss



Figure 3.2-24 Butterfly Sign Structure; Typical Dual-Chord

3.2.1.4.3 Tri-Chord Truss Butterfly

The tri-chord butterfly structure consists of three horizontal members (the chords), with bracing between the chords consisting of vertical, horizontal and diagonal members. The bracing members form a truss which is typically constructed of tubular or angular shapes. The truss is supported in the middle end by a vertical support.

3.2.1.4.4 Quad-Chord Truss Butterfly

The quad-chord butterfly sign structure consists of four horizontal members (the chords), which overhangs the roadway with bracing between the chords consisting of vertical, horizontal, and diagonal members. These members form a truss; since not all members are within a three-dimensional plane, this truss type is typically called a space truss. The truss is typically constructed of tubular or angular shapes and is supported in the middle by a vertical support.

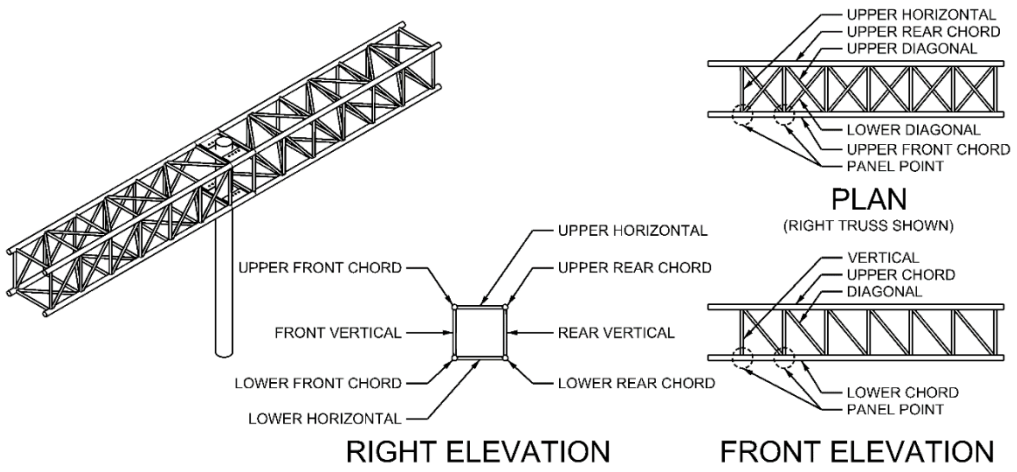


Figure 3.2-25 Butterfly, Quad-Chord Space Truss

3.2.1.4.5 Pedestal Mounted Signs

Pedestal mounted structures are vertical structures with no predominant arms or spanning sections over the roadway. The ancillary structure device is either mounted to the top of the vertical structure or is supported by the vertical member.

3.2.2 Traffic Signals

A Traffic Signal structure is primarily used to support traffic signals or other signaling devices, such as flashing or advanced warning signals, and consists of its signaling devices, its primary structure, its foundations (where applicable) and its auxiliary attachments.

3.2.2.1 Span Traffic Signals

Span Traffic Signal Structures span the roadway, with at least two supports on either end of the structure. They span the roadway in one or multiple directions with supports on the outside edges of the roadway. Unlike Sign Structures, Traffic Signal Structures typically use Single Chord or Span Wire structures to span the roadway due to the smaller dead loads that they carry and the cost saving measures that these types of structures demand.

3.2.2.1.1 Single Chord (Mono/Multitube) Span

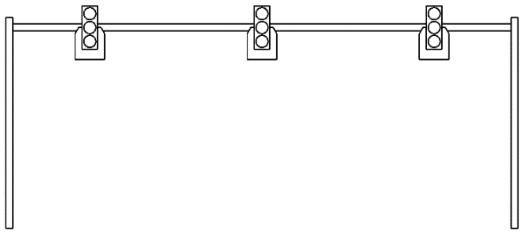


Figure 3.2-26 Span, Single Chord

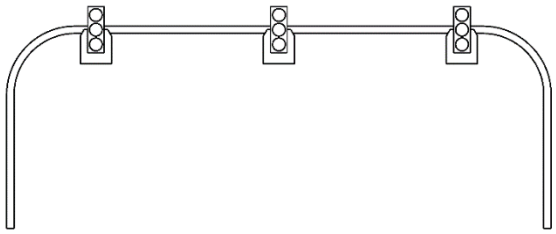


Figure 3.2-27 Span, Monotube

3.2.2.1.2 Span Wire

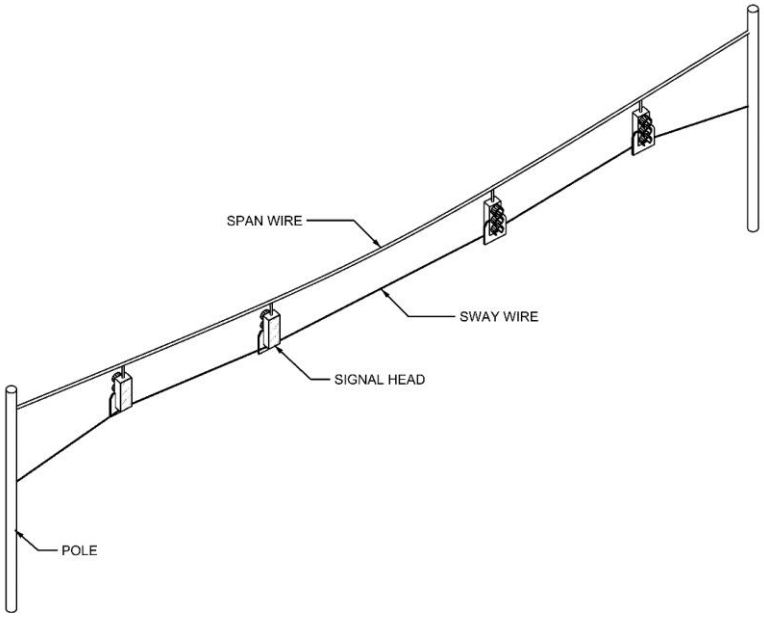


Figure 3.2-28 Span, Span Wire



Figure 3.2-29 Span Traffic Signal Structure; Typical Span Wire

3.2.2.2 Single Mast Arm Traffic Signals

Single mast arm structures consist of one cantilevered arm (mast arm) that either overhangs a portion of the roadway or is parallel to it. The arm extends out from a vertical support adjacent to the roadway. The arm may have one or more traffic signals attached and other auxiliary attachments (e.g., traffic sensors, cameras or traffic signs) can be found on the mast arms.

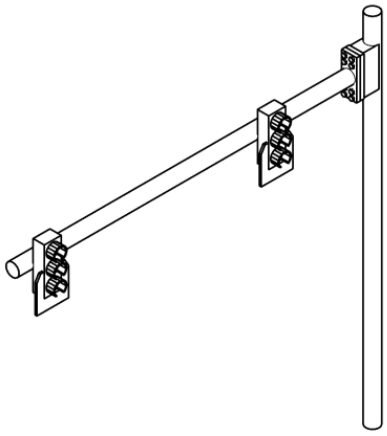


Figure 3.2-30: Mast Arm, Single Arm



Figure 3.2-31 Mast Arm Traffic Signal Structure; Typical Single Mast Arm

3.2.2.2 Double Mast Arm Traffic Signals

Double mast arm structures consist of two cantilevered arms (mast arms) in which the arms either overhang a portion of the roadway or are parallel to it. The arm extends out from a vertical support adjacent to the roadway. The arm may have one or more traffic signals attached and other auxiliary attachments (e.g., traffic sensors, cameras or traffic signs) can be found on the mast arms.

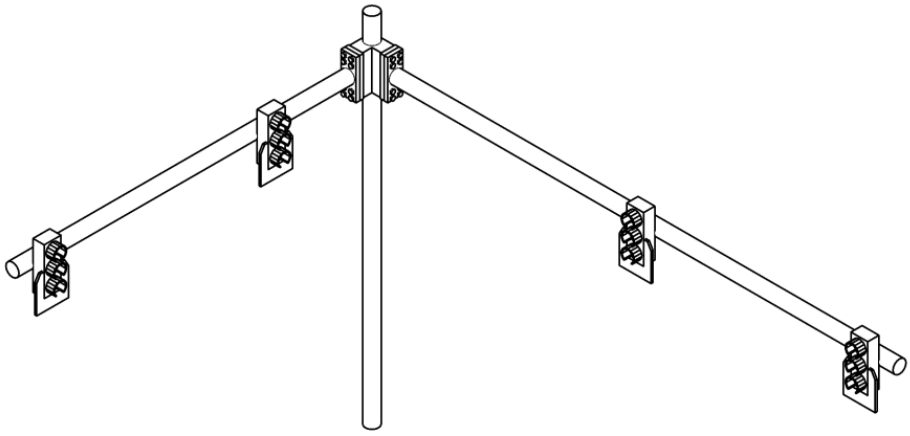


Figure 3.2-32 Mast Arm, Double Arm



Figure 3.2-33 Mast Arm Traffic Signal Structure; Typical Dual Arm

3.2.2.3 Pedestal Mounted Traffic Signals

Pedestal mounted structures are vertical structures with no predominant arms or spanning sections over the roadway. The traffic signal head is either mounted to the top of the vertical structure or is supported by the vertical member.

3.2.3 Lighting Structures

A Lighting Structure is a structure that's primary use is to support a luminaire. A luminaire distributes and directs the light, protects the lighting filament and connects the lamp to the power supply. The structure includes its luminaires, its primary structure, its foundations (where applicable) and its auxiliary attachments.

3.2.3.1 Pedestal Mounted

Pedestal mounted structures are vertical structures with no predominant arms or spanning sections over the roadway. These types of lighting structures are usually located in parking areas. The height of the vertical support for pedestal mounted structures is typically less than 55 feet.

Post mounted lighting can take on a wide variety of forms, but offset mounts are typical for this type of lighting. The light is either offset enough (i.e., less than 1 foot) to distribute the light directly below or is mounted in a monolithic housing, such as a shoebox light, to achieve the desired lighting. For the sake of simplicity and to avoid confusion with other structure and arm types: if the luminaire is mounted directly onto the post or mounted in a monolithic offset housing, the arm should be considered "None" (see Figure 3.2-34); if the luminaire is on a short offset bracket, the arm should be considered "Other" (see Figure 3.2-36).

3.2.3.1.1 None/Other Lighting Arms

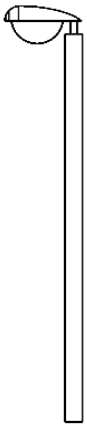


Figure 3.2-34 Mounted Lighting; Arm Type None

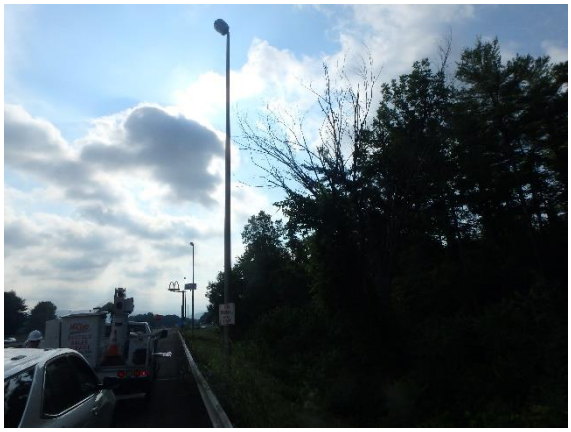


Figure 3.2-35 Mounted Lighting Structure; Typical Mount

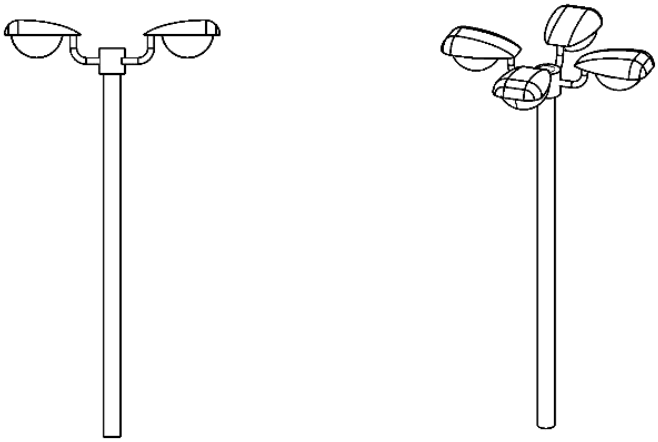


Figure 3.2-36 Mounted Offset Lighting; Double and Quad Mounts (Left to Right) – Other Arm Type



Figure 3.2-37 Mounted Offset Lighting Structure; Typical Offset Mounts

3.2.3.2 Single Mast Arm Lighting Structures

Single mast arm structures consist of one cantilevered arm (mast arm) that either overhangs a portion of the roadway or is parallel to it. The arm extends out from a vertical support adjacent to the roadway. The mast arm supports the luminaire at a lateral dimension from the post. Mast arm length is usually 6 feet, 9 feet or 12 feet. Conventional lighting units should have davit type mast arms (telescoped onto the top of the post) or bracket/tenon type mounting assembly unless a desire for decorative lighting dictates another type of arm, or unless the lights must match existing light posts with a different type of arm.

3.2.3.2.1 Single Bracket

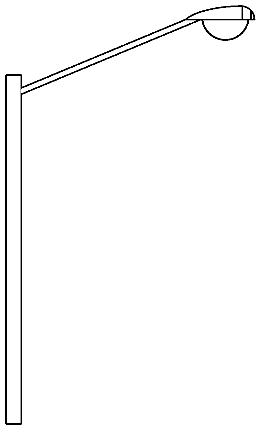


Figure 3.2-38 Single Mast Arm Light; Single Bracket



Figure 3.2-39 Mast Arm Lighting Structure; Typical Single Davit

3.2.3.2.2 Truss Bracket

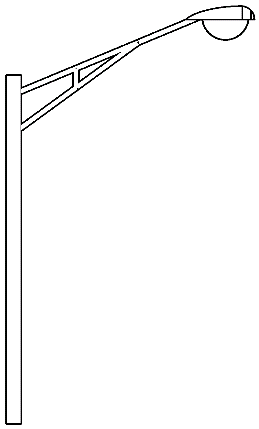


Figure 3.2-40 Single Mast Arm Light; Truss Bracket



Figure 3.2-41 Single Mast Arm Lighting Structure; Typical Truss Arm

3.2.3.2.3 Single Davit

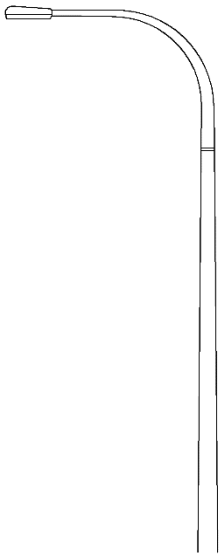


Figure 3.2-42 Single Mast Arm Light; Davit



Figure 3.2-43 Typical Single Mast Arm Lighting Structure; Single Davit

3.2.3.3 Dual Mast Arm Lighting Structure

Dual mast arm structures consist of two cantilevered arms (mast arms) that typically overhang two directions of roadway. The arms extend out from a vertical support towards the roadways; typically, from medians. Mast arm lengths are usually 6 feet, 9 feet or 12 feet. Conventional lighting units should have davit type mast arms (a telescoped arm slip-fit from the top of the post) or bracket/tenon type mounting assembly unless a desire for decorative lighting dictates another type of arm, or unless the lights must match existing light posts with a different type of arm.

3.2.3.3.1 Bracket

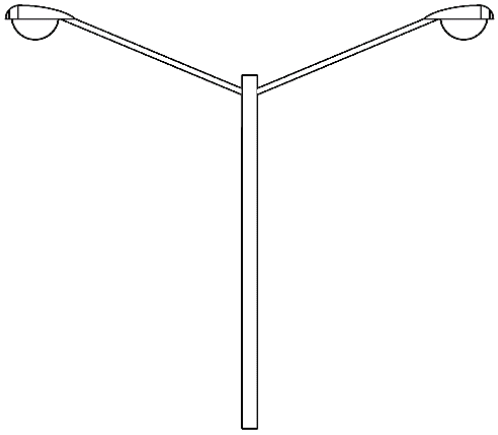


Figure 3.2-44 Dual Mast Arm Light; Double Bracket



Figure 3.2-45 Typical Double Bracket Light Structure

3.2.3.3.2 Truss Bracket

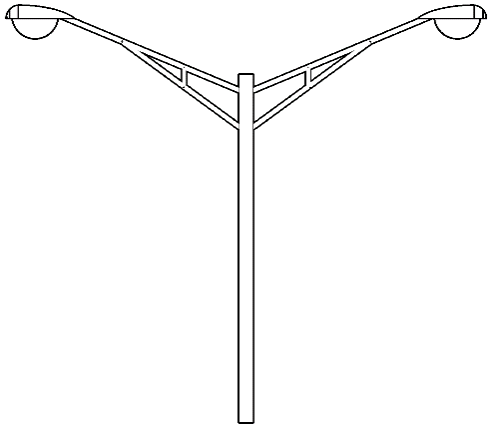


Figure 3.2-46 Dual Mast Arm Light; Double Truss Bracket



Figure 3.2-47 Truss Bracket Lighting Structure; Typical Dual Truss Bracket

3.2.3.3.3 Davit

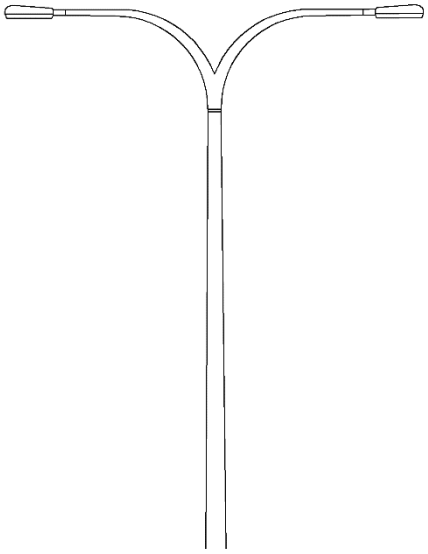


Figure 3.2-48 Double Mast Arm Light; Double Davit

3.2.3.4 High Mast Lighting

High mast lighting structures are pedestal mounted structures, typically exceeding a height of 55 feet and can surpass 100 feet. They typically carry a luminaire ring, a head of multiple luminaires, which provide high output illumination to a large area around the structure. The luminaire ring typically has a device to lower the ring from the ground. Due to the height of the structure, at least one slip joint is used in the post to achieve the height.

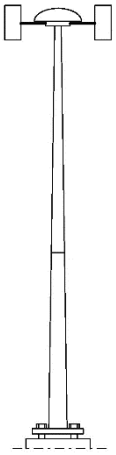


Figure 3.2-49 High Mast Lighting; Typical



Figure 3.2-50 Typical High Mast Lighting Structure

3.2.4 Intelligent Transportation System (ITS) Structure

An ITS Structure is a structure that's primary use is to support ITS devices (such as cameras, traffic monitoring devices; or EZ-Pass reading heads) and consists of ITS devices, the primary structure, the foundations (where applicable) and any auxiliary attachments.

3.2.4.1 Cantilevered ITS Structures

Cantilevered ITS structures have arms that either overhang part of the roadway or are parallel to it and are supported on one side by a post or other vertical support. Cantilever ITS structures share many structural and design aspects with Sign Structures – refer to Sections 3.2.1.1.1 through 3.2.1.1.4 for examples of these structures.

3.2.4.2 Span ITS Structures

Span ITS Structures span the roadway, with at least two supports on either side of the structure. They span the roadway in one or multiple directions with supports on the outside edges of the roadway. Span ITS structures share many structural and design aspects with Sign Structures – refer to Sections 3.2.1.2.1 through 3.2.1.2.4 for examples of these structures.

3.2.4.3 Pedestal Mounted ITS Structures

Pedestal mounted structures are vertical structures with no predominant arms or spanning sections over the roadway. The ITS device is either mounted to the top of the vertical structure or it is supported by the vertical member.

Pedestal Mounted ITS Structures can take on a wide variety of forms but offset mounts or direct mounts are typical. The ITS device is either offset enough (i.e., less than 1 foot) to position the camera or sensor to the desired line of sight. For the sake of simplicity and to avoid confusion with other structure and arm types: if the ITS device is mounted directly onto the post, the arm should be considered "None" (see similar Figure 3.2-34); if the luminaire is on a short offset bracket, the arm should be considered "Other" (see similar Figure 3.2-36).

Chapter 4 Inventory

4.1 Identification

Inventory items included under identification:

- **Structure ID**
- **District Structure ID**
- **Year Built**
- **Inspection Group**
- **Inspection Group Year**

4.1.1 Structure ID

The Structure ID uses a coding schema to assign a unique, descriptive code for any given ancillary structure. Traffic Signal structure types receive a different structure ID than the other ancillary structures. Note end of this section for details. The following is the ten-digit structure for the Structure ID grouped into four sections:

X - XXXX - XX - XXX
1 2 3 4

The numeric sections correspond to the following key identifiers:

1. Structure Type:
    - S = Sign Structure
    - L = Lighting Structure
    - I = ITS Structure
    - V = Variable Message Sign Structure

2. Highway Number:
    - A right aligned, zero padded, four-character alphanumeric name of the of highway. The Highway Number should not include any abbreviations. In the highly unlikely event of a conflict where there could be some ambiguity, the first letter of the descriptive roadway term can be prefixed to the roadway (e.g.: “I”, “R”, “U” for Interstate, Rhode Island Route and US Route respectively).
        - If not on a numbered highway, the first two digits will be “99” and the second two digits will refer to the indexed city/town in alphabetical order. For example: The Highway Number for this example in Barrington would be 9901 and Woonsocket would be 9939. Please refer to Table 4.1-1 for coded list of Rhode Island Cities/Towns

3. Mile Point
    - A right aligned, zero padded, two-digit truncated integer of the mile point for the roadway where the structure is located.

- If not on a numbered highway, the mile point will be “99”

4. Structure Number

   - Zero-padded, 3-digit integer of the structure within the log direction mile point. The first structure within the envelope of the log direction mile point will start with “001”

     - If not on numbered highway, log direction per given roadway will be used

As an example, a Sign Structure is on I-95 at Mile Point 34.21 and it is the first structure within the 34th mile point in the log direction (Northbound); its Structure Number would be S-0095-34-001. See Figure 4.1-1 and Figure 4.1-2 for sticker dimensions and formats.

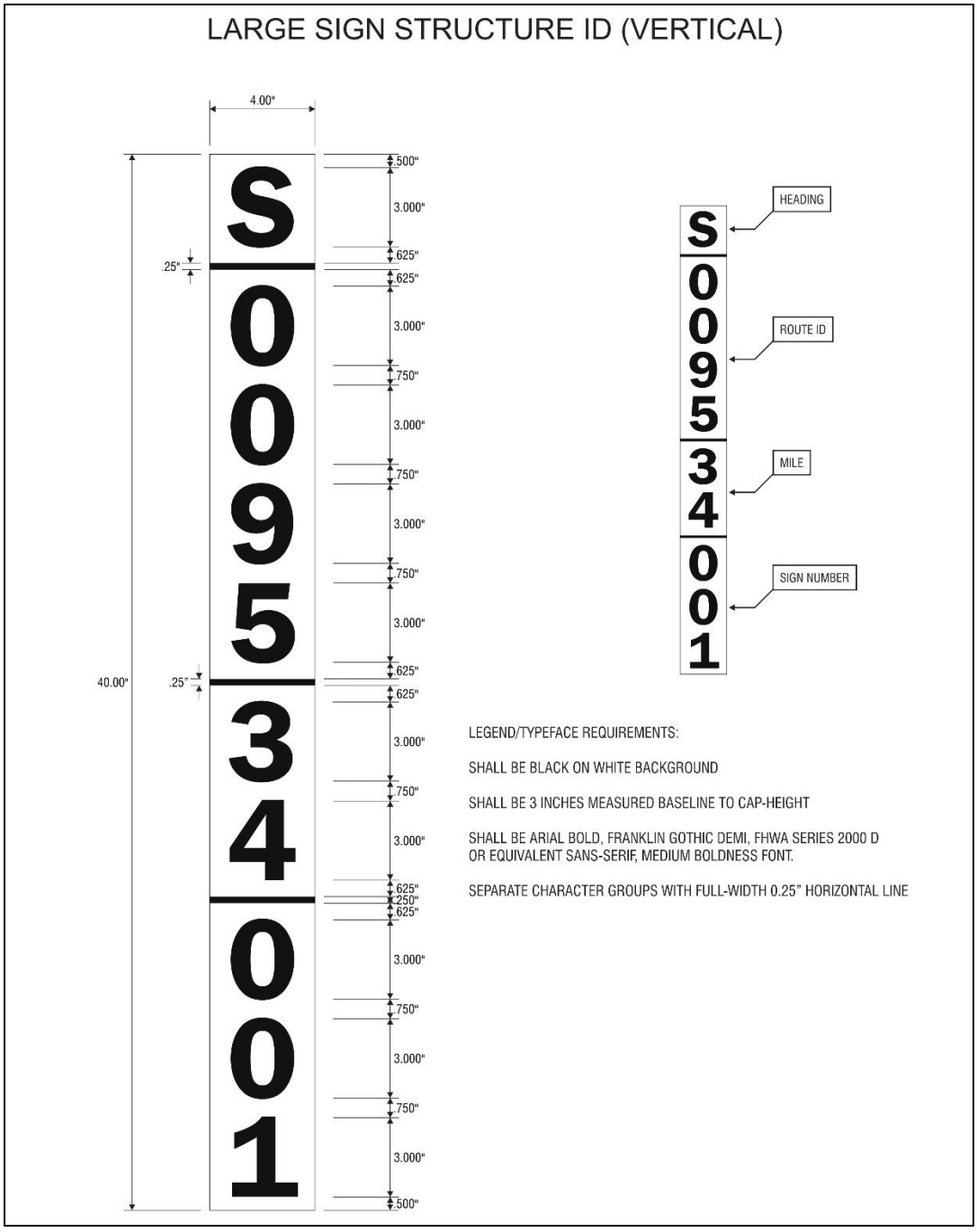


Figure 4.1-1 Vertical Structure ID sticker dimensions and format

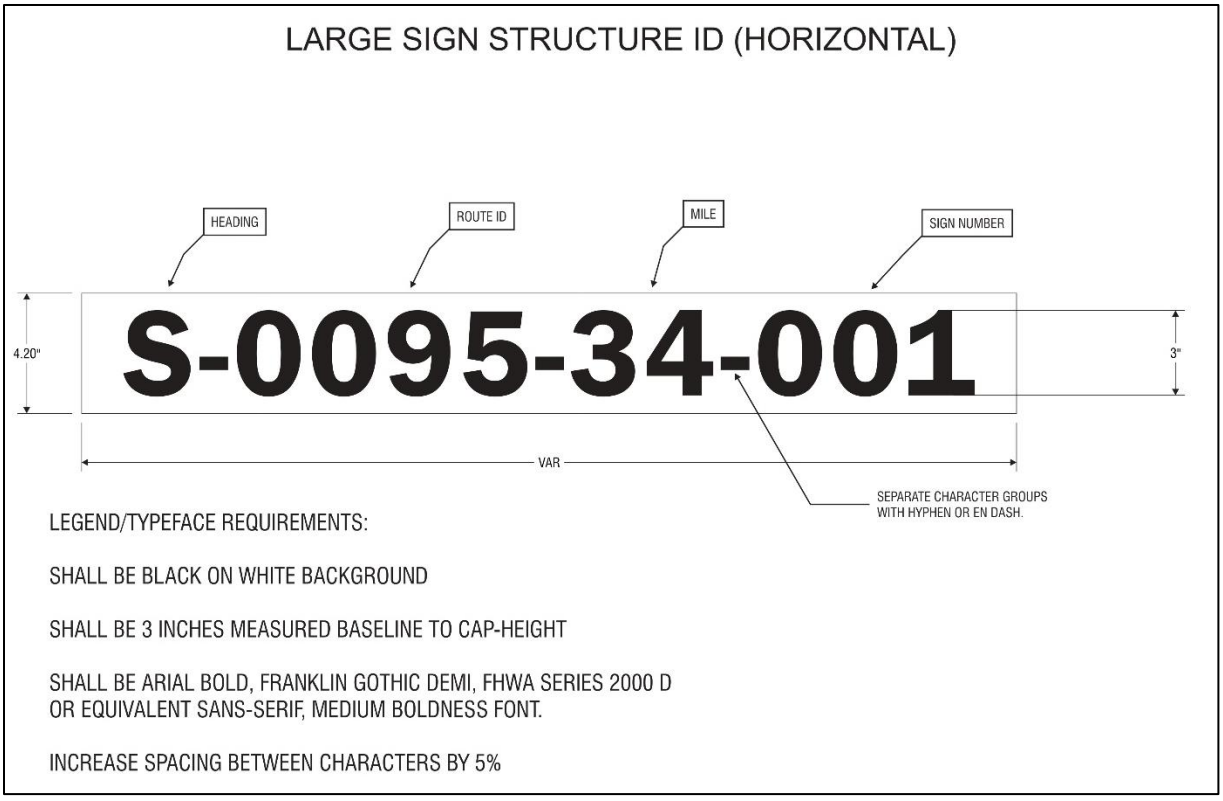


Figure 4.1-2 Horizontal Structure ID sticker dimensions and format

Table 4.1-1 City/Town Highway Number Coding

1 - Barrington	11 - Exeter	21 - Newport	31 - Smithfield
2 - Bristol	12 - Foster	22 - New Shoreham	32 - South Kingstown
3 - Burrillville	13 - Glocester	23 - North Kingstown	33 - Tiverton
4 - Central Falls	14 - Hopkinton	24 - North Providence	34 - Warren
5 - Charlestown	15 - Jamestown	25 - North Smithfield	35 - Warwick
6 - Coventry	16 - Johnston	26 - Pawtucket	36 - Westerly
7 - Cranston	17 - Lincoln	27 - Portsmouth	37 - West Greenwich
8 - Cumberland	18 - Little Compton	28 - Providence	38 - West Warwick
9 - East Greenwich	19 - Middletown	29 - Richmond	39 - Woonsocket
10 - East Providence	20 - Narragansett	30 - Scituate	99 – Unknown

The following is the seven-digit structure number for the Structure ID of Traffic Signals, which is grouped into three sections:

T -XXXX -XX

1 2 3

The numeric sections correspond to the following key identifiers:

1. Structure Type:

- T = Traffic Signal Structure

2. Traffic Signal Box Number:
    - A right aligned, zero padded, four-digit number that correlates to the number listed on the traffic cabinet/controller for the traffic signals at a given intersection. Traffic cabinet numbers are provided by RIDOT.
3. Traffic Signal Structure Identification
    - A right aligned, zero padded, two-digit number assigned to the traffic signal structure at a given intersection. During the initial inspection, the Traffic Signal Structure Identification will be assigned by inspectors and shall start at geographic north as “01” and increase moving in the clock-wise direction.

4.1.2 District Structure ID

The District Structure ID will refer to any previous naming conventions that the State or District has implemented in the past, namely if an ID decal is present which does not follow the coding conventions laid out in Section 4.1.1 or its ID as per as-built drawings. This should be recorded as it appears on the decal or as-built drawings to aid in any investigation.

4.1.3 Inspection Group

The Inspection Group record is for scheduling and contract purposes and will be set by the State. Unless directed to by the State, do not edit this record.

4.1.4 Inspection Group Year

The Inspection Group Year record is for scheduling and contract purposes and will be set by the State. Unless directed by the State, do not edit this record.

4.2 General Info

General information typically pertains to the location, the roadway and other outside factors surrounding the ancillary structure in general. The items included under General Info are broken down and listed as follows:

- Location
    - **District**
    - **County**
    - **Location**
    - **City**
    - **Location Notes**
- Coordinates
    - **Latitude**
    - **Longitude**
- Route
    - **Highway Type (Route Prefix)**
    - **Route**
    - **Route Direction**

- Mile Point
  - **Mile Point Prefix**
  - **Mile Point**
  - **Mile Point Suffix**
- ADT
  - **Bridge #**
  - **ADT**
  - **ADT Classification**
  - **ADT Year**
  - **Truck Percentage**
  - **Speed (MPH)**

4.2.1 Maintenance Facility

Record the maintenance facility responsible for the ancillary structure as listed in Table 4.2-1. The areas responsible for each maintenance facility are provided in the map in Figure 4.2-1. A GIS overlay of these areas is available from the State.

Table 4.2-1 Maintenance Facilities

Maintenance Facility
Unknown
Belleville
East Providence
Glocester
Hope Valley
Midstate
Portsmouth
Smithfield
Not Applicable

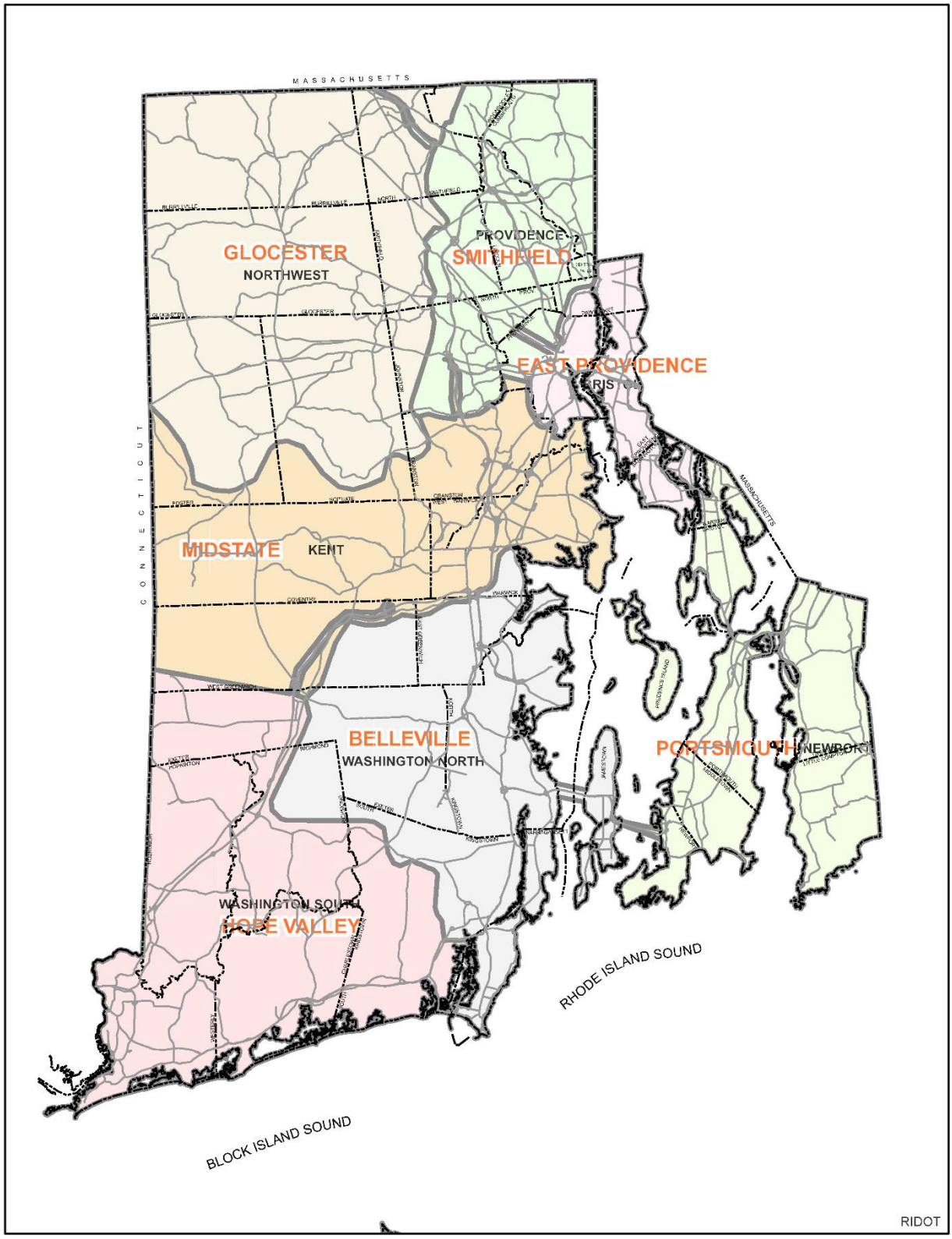


Figure 4.2-1 Maintenance Facility Area Map

4.2.2 County

Record the county where the ancillary structure is located. A list of Rhode Island cities\towns and their corresponding counties are provided below in Table 4.2-2. If the county is unknown, record as "Unknown".

4.2.3 City

Record the city or town where the ancillary structure is located. A list of Rhode Island cities\towns and their corresponding counties are provided below in Table 4.2-2. If the county is unknown, record as "Unknown".

Table 4.2-2 RI Cities/Towns and Corresponding Counties

City	County	City	County
Barrington	Bristol	Newport	Newport
Bristol	Bristol	New Shoreham	Washington
Burrillville	Providence	North Kingstown	Washington
Central Falls	Providence	North Providence	Providence
Charlestown	Washington	North Smithfield	Providence
Coventry	Kent	Pawtucket	Providence
Cranston	Providence	Portsmouth	Newport
Cumberland	Providence	Providence	Providence
East Greenwich	Kent	Richmond	Washington
East Providence	Providence	Scituate	Providence
Exeter	Washington	Smithfield	Providence
Foster	Providence	South Kingstown	Washington
Glocester	Providence	Tiverton	Newport
Hopkinton	Washington	Warren	Bristol
Jamestown	Newport	Warwick	Kent
Johnston	Providence	Westerly	Washington
Lincoln	Providence	West Greenwich	Kent
Little Compton	Newport	West Warwick	Kent
Middletown	Newport	Woonsocket	Providence
Narragansett	Washington		

4.2.4 Location

The Location record provides where the ancillary structure is, e.g.: on the route, ramp or how the ancillary structure is orientated in the intersection. Table 4.2-3, below is the list of coded options, where the Quadrant descriptor signifies where on the ramp or intersection the ancillary structure is:

Table 4.2-3 Location Inventory Coding

Location
N/A
1. On Route

Location
2. On Ramp
3. Off Ramp
4. Local Street
5. On Connector
6. On Route-NE Quadrant
7. On Route-SW Quadrant
8. On Route-SE Quadrant
9. On Route-NW Quadrant
10. Off Ramp-NE Quadrant
11. Off Ramp-SW Quadrant
12. Off Ramp-SE Quadrant
13. Off Ramp-NW Quadrant
14. On Ramp-NE Quadrant
15. On Ramp-SW Quadrant
16. On Ramp-SE Quadrant
17. On Ramp-NW Quadrant
18. On Route-MN Quadrant
19. On Route-MS Quadrant
20. On Route-MW Quadrant
21. On Route-ME Quadrant
22. Unknown

4.2.5 Location Notes

Location Notes provide a brief description of where the ancillary structure is, e.g.: the cross street of the intersection, the distance in miles or feet from an intersection or exit. Such examples could be: “0.8 miles north of I-95 NB Exit 4”; “At the intersection with Lincoln Ave.”; “Above I-95 NB on the Cowesett Rd. Overpass”.

4.2.6 Latitude

Record the latitude in decimal degrees (DD) to the nearest eighth decimal.

4.2.7 Longitude

Record the longitude in decimal degrees (DD) to the nearest eighth decimal.

4.2.8 Highway Type (Route Prefix)

The Highway Type is the route prefix that a roadway typically has such as Interstate, State Route or US Route. There are other Highway Types of roadways that signify things like level of service or funding. A complete list of the Highway Types is listed below in Table 4.2-4.

Table 4.2-4 Highway Types (Route Prefixes) Inventory Coding

Highway Type
Interstate Highway
U.S. Numbered Highway
State Highway
County Highway
City Street
Federal Lands Road
State Lands Road
Other (Including Toll Roads)

4.2.9 Route

Route is the name of the numbered roadway or street where the stability of the ancillary structure would be affected by or the roadway that the ancillary services, in that hierarchy of importance. The Route Inventory record should not include any prefixes or post fixes, just the numbered route or street, e.g.: 95, 1A, Oaklawn Ave.

4.2.10 Route Direction

The Route Direction is the log/antilog direction of the numbered roadway or street where the stability of the ancillary structure would be affected by or the direction of the roadway that the ancillary services, in that hierarchy of importance. If both directions of the inventoried route meet the above conditions, code accordingly. The coding options are NB, SB, EB, WB or N/A – using the typical abbreviations of Northbound, Southbound, Eastbound and Westbound.

4.2.11 Mile Point

Record the Mile Point, if applicable, of the numbered roadway to the nearest two decimal places, e.g.: 7.21, 8.02, 3.00. If the roadway is on a non-numbered route, record as 99.99

4.2.12 ADT Bridge

The State has ADT information for many bridges across the state. If the ancillary structure is close to and on the same roadway that a bridge services, providing the identification number for the bridge will provide all the ADT information as it exists in the bridge's inventory. This is only a method to get a near estimate if other means of providing an ADT are not available. Note if there are any major intersections or ramps between the bridge in question and the ancillary structure as it will skew the ADT information.

4.2.13 ADT

Average Daily Traffic (ADT) is the total vehicle count over the course of a day for the given route in the direction or directions it is inventoried under. If the ADT is unknown and a reasonable estimate cannot be made, leave blank.

4.2.14 ADT Year

The ADT Year is the year that the ADT was recorded. Code as four digits, e.g.: 2020. If the ADT is unknown and a reasonable estimate cannot be made, leave blank.

4.2.15 Truck Percentage

The Truck Percentage is the percent of the ADT that is truck traffic. Code to the nearest first decimal place, e.g., 2.3. If the ADT is unknown and a reasonable estimate cannot be made, leave blank.

4.2.16 Speed (MPH)

Speed is the recorded speed, in miles per hour (MPH), of the traffic during the sampling of the ADT. If not known, record posted speed limit.

4.3 Structural Information

The Structural Information pertains to defining the Ancillary Structure, its main and secondary components and its geometry. The items included under Structural Information are broken down and listed as follows:

- Ancillary
  - **Ancillary Type**
  - **Structure Type**
- Posts
  - **Type**
  - **Material**
  - **Coating**
- Arm
  - **Type**
  - **Material**
  - **Coating**
- Foundation
  - **Foundation Type**
  - **Bridge Number**
  - **Thru Bolted at Parapet**
- Geometry
  - **Min VC NB/EB**
  - **Min VC SB/WB**
  - **Span/Arm 1 Length**
  - **Span/Arm 2 Length**
- Other Attachments
- Other Details
- Inspection Details and Access Restrictions

4.3.1 Ancillary Type

The Ancillary Type is defined by the main ancillary structure device that the structure carries. If there are secondary ancillary structure devices attached, the main ancillary that services the roadway will be inventoried. Table 4.3-1 below provides a list of options to defining the type of ancillary.

Table 4.3-1 Ancillary Type Inventory Coding

Ancillary Type
Sign Structure

Ancillary Type
Traffic Signal
Lighting Structure
ITS Structure
Variable Message Sign Structure
Other

4.3.2 Structure Type

The Structure Type defines the main type of structure that supports the main ancillary structure device inventoried in Section 4.3.1. Refer to Section 3.2 Ancillary Types for detailed descriptions of the types of structures outlined in Table 4.3-2 below.

Table 4.3-2 Structure Type Inventory Coding

Structure Type
Cantilever
Span
Structure Mounted
Butterfly
Pedestal Mounted
Single Mast Arm
Double Mast Arm
High Mast
Other

4.3.3 Post Type

The Post Type defines the main vertical support of the ancillary structure, e.g.: posts, tubes/posts, or trussed posts. Table 4.3-3, below, outlines the main types of vertical supports one may encounter. If the ancillary structure is mounted to a bridge or retaining wall, code as “None”.

Table 4.3-3 Post/Support Type Inventory Coding

Post/Support Type
None
Round Tube
Multisided Tube
I-Beam
Truss Post
Timber
Other
N/A

4.3.4 Post Material

The Post Material is the main structural component of the vertical support. Table 4.3-4, below, provides a list of types of structural post materials. If there are multiple vertical post/support material types, code the main structural material used, otherwise code as "Hybrid". Note that different types of metal in contact with each other can accelerate corrosion and it should be noted in the inspection report. If the ancillary structure is mounted to a bridge or retaining wall, code "N/A".

Table 4.3-4 Post or Support Material Inventory Coding

Post/Support Material
Aluminum
Steel
Weathering Steel
Concrete
Timber
Hybrid
Other
N/A

4.3.5 Post Coating

The Post Coating is the main protective coating of the ancillary structure. If there are multiple coatings present code the main, base layer/coating or the most used coating that is on the structure, otherwise code as "Hybrid". Table 4.3-5, below, provides a list of types of structural post coating materials.

Table 4.3-5 Post/Support or Arm Coating Inventory Coding

Post/Arm Coating
None
Galvanized
Painted
Painted Galvanizing
Metalizing
Other
N/A

4.3.6 Arm Type

The Arm Type defines the main horizontal support, if applicable, of the ancillary structure, e.g.: tubes, trusses and brackets. Section 3.2 Ancillary Types discusses most of these arm types as the pertain to the different types of structures for each ancillary. Table 4.3-3, below, outlines the main arm types for horizontal supports one may encounter. If the ancillary structure is mounted to the top of a vertical support with no horizontal structure, code as "None".

Table 4.3-6 Arm Type Inventory Coding

Arm Type
None

Arm Type
Monotube
Multisided Tube
Single Bracket
Truss Bracket
Single Davit
Double Davit
Dual-Chord Truss
Tri-Chord Truss
Quad-Chord Truss
Span Wire
Structure Mounted Frame
Other

4.3.7 Arm Material

The Arm Material is the main structural component of the horizontal support. Table 4.3-7, below, provides a list of types of structural arm materials. If there are multiple horizontal support material types, code the main structural material used, otherwise code as “Hybrid”. Note that different types of metal in contact with each other can accelerate corrosion and it should be noted in the inspection report. If the ancillary structure is mounted on top of a vertical support with no structural arm, code as “N/A”.

Table 4.3-7 Arm Material Inventory Coding

Arm Material
Aluminum
Steel
Weathering Steel
Timber
Hybrid
Other
N/A

4.3.8 Arm Coating

The Arm Coating is the main protective coating for the horizontal support of the ancillary structure. If there are multiple coatings present on the arm, code the main, base layer/coating or the most used coating that is on the arm, otherwise code as “Hybrid”. Previous Table 4.3-5 provides a list of types of structural post materials.

4.3.9 Foundation Type

The foundation is the ground support or the mounting surface of the ancillary structure. If there is no foundation or mounting surface such as a bridge girder, concrete barrier or retaining wall, code as “N/A”. Table 4.3-8, below, provides a list of foundation types.

Table 4.3-8 Foundation Type Inventory Coding

Foundation Type
Spread Footing
Steel Helical Pipe
Single Caisson
Double Caisson
Bridge Mount
Concrete Barrier Mount
Wall Mount
Unknown
Other
N/A

4.3.10 Bridge Number

If the ancillary structure is mounted to a bridge, the Bridge Number that the structure is attached to should be coded here. If not applicable, code as “N/A”.

4.3.11 Thru Bolted at Parapet

If the ancillary structure is anchored by through bolts through a bridge parapet, mark the check box.

4.3.12 Min VC NB/EB

If applicable, record the minimum vertical clearance (in feet) from the lowest point of the structure or its attachments (e.g., chord, sign panel, hanger, luminaire/walkway support or traffic signal) to the highest point of the roadway in the log direction or NB/EB roadway to the nearest two decimal places. Each paved lane and each shoulder should be measured in the log direction. Clearances greater than 25’ or ancillary structures not over useable roadway should be recorded as 25’ without specific measurements taken at each location.

4.3.13 Min VC SB/WB

If applicable, record the minimum vertical clearance (in feet) from the lowest point of the structure or its attachments (e.g., chord, sign panel, hanger, luminaire/walkway support or traffic signal) to the highest point of the roadway in the antilog direction or SB/WB roadway to the nearest two decimal places. Each paved lane and each shoulder should be measured in the log direction. Clearances greater than 25’ or ancillary structures not over useable roadway should be recorded as 25’ without specific measurements taken at each location.

4.3.14 Span/Arm 1 Length

The length of the span or arm (in feet) of the first horizontal support should be recorded to the nearest two decimal places. For arms, the length should be taken from the centerline of the horizontal support or mount to the opposite end of the arm. For span structures, the length should be taken from centerline to centerline of the horizontal supports or mounts.

The designation of Span 1 or Arm 1 should be established during the initial inspection where the front elevation is established, or a logical method is laid out (e.g., log direction; left to right). The numbering system should be present in the ancillary/clearance sketch in the report. A one span/arm structure's span defaults to this record.

4.3.15 Span/Arm 2 Length

The length of the span or arm (in feet) of the second horizontal support should be recorded to the nearest two decimal places. For arms, the length should be taken from the centerline of the horizontal support or mount to the opposite end of the arm. For span structures, the length should be taken from centerline to centerline of the horizontal supports or mounts.

The designation of Span 2 or Arm 2 should be established during the initial inspection where the front elevation is established, or a logical method is laid out (e.g., log direction; left to right). The numbering system should be present in the ancillary/clearance sketch in the report.

4.3.16 Other Attachments

Other attachments include primary and secondary attachments (not including sign panels) to the ancillary structure such as traffic signals, sensors, street lighting and electric boxes. Table 4.3-9 lists the typical attachments that need to receive a numeric count in its record, except "Other Att. Notes" field which describes what the count of "Other Attachments" is for and "Auxiliary Sign Notes" which describes (e.g.: type and text) the auxiliary signs.

Table 4.3-9 Other Attachments Inventory List

Dampener	Pedestrian Signal
Electrical Cables	Traffic Signal
Flashing Signal	Camera
Antenna	Electrical Meter
Street Lighting	Utility Box
Auxiliary Lighting	Sensor
Other Attachments	Auxiliary Signs
Other Att. Notes	Auxiliary Signs Notes

4.3.17 Other Details

Other Details deals with traffic protection and the number of lanes over traffic. The traffic protection is referenced from left to right (see Table 4.3-10), which should follow the front elevation or ancillary structure drawing in the report as was defined during the initial inspection, and should only be included if the traffic protection is protecting the structure or foundation of the ancillary. An "Attenuator" checkbox is present to mark if an attenuator is serving as secondary protection to drivers. Table 4.3-11 lists the types of traffic protection to assign to the inventory fields laid out in Table 4.3-10.

Table 4.3-10 Traffic Protection Inventory Fields

Traffic Safety Protection Left
Traffic Safety Protection Mid-Left
Traffic Safety Protection Mid-Right

Traffic Safety Protection Right

Table 4.3-11 Types of Traffic Protection Inventory Records

Traffic Protection Types
None
W-Beam
Box Beam
Cable Guide Rail
Concrete Barrier
Timber Barrier
Other
N/A

4.4 Inspection Details and Access Restrictions

Obstructions that could hinder access to the ancillary structure or restrictions that would require lane closures to overcome need to be recorded. Table 4.4-1, below, lists typical items that should be known for scheduling and inspection purposes. Fields should be marked if the obstruction/restriction is present or if the item is required. The "Other" field should describe other hinderance that the inspection team should be aware of.

Table 4.4-1 Restrictions, Obstructions and Requirements Inventory Records

No Shoulder
Behind Guiderail/Barrier
Behind Sound Wall
Traffic Control
Median Area
Other

4.5 Sign Panels

The Sign Panels Table is for the inventory of each sign panel, if sign panels or VMSs are present. It provides fields relevant to distinguishing the panel and defining the panel's properties and geometry. The items included in the Sign Panels Table are listed as follows:

- Panel Number
- Panel Location
- Panel Text
- Panel Direction
- Panel Type
- Panel Width
- Panel Height
- Panel Depth
- Panel Lighting

- Panel Vertical Clearance
- Direction Under Panel
- Lanes Under Panel

4.5.1 Panel Number

The panel number should be established during the initial inspection and follow a methodical process of incremental numerals (e.g.: front elevation, left to right; facing log direction, left to right, top to bottom.) If panels are removed or added, the numbering should be changed to follow this same methodology.

4.5.2 Location

If the sign panels are stacked vertically, such as an exit number panel on top of the sign panel giving details about the exit's direction, the panel's location should be recorded using the drop-down options of "Top", "Middle" or "Bottom"; if the sign panel is not stacked vertically, code as "N/A".

4.5.3 Panel Text

The sign panel's text, emblems and symbols should be recorded here. A consistent methodology for recording emblems/symbols (e.g.: I-95 (Emblem); Roadway Exit Split (Emblem)) and using characters like "/" for line breaks in the text. If the sign panel is a VMS, record as such.

4.5.4 Direction

The Direction records the orientation of the panel, i.e. the roadway that the panel is visible to or services. The options include the log and anti-log directions of the roadway, i.e. NO, EO, SO and WO. If the orientation of the sign panel is not for the inventoried roadway or cannot be determined, record as "N/A".

4.5.5 Panel Type

The Panel Type records the type of the sign panel, e.g., the material/method used in its construction or if it is a VMS. Table 4.5-1 is a list of inventory options to classify sign panel type.

Table 4.5-1 Sign Panel Type Inventory Options

Panel Type
Aluminum Extruded
Sheet Aluminum
Aluminum Laminated
VMS
Other

4.5.6 Panel Width

Record the horizontal width, i.e. the horizontal projection, of the sign panel (in feet) to the nearest two decimal places.

4.5.7 Panel Height

Record the vertical height, i.e. the vertical projection, of the sign panel (in feet) to the nearest two decimal places.

4.5.8 Panel Depth

If the sign panel is a VMS, record the depth of the panel (in feet) to the nearest two decimal places. If the panel is not a VMS, record as 0.

4.5.9 Panel Lighting

Panel Lighting is a simple Yes/No option indicating if the sign panel is illuminated by auxiliary lighting.

4.5.10 Sign Panel Vertical Clearance

The Vertical Clearance is the most restrictive vertical measurement (in feet) between the sign panel or its attachments (e.g.: walkways, hangers and lighting) and any paved surface. Record from the highest part of the roadway to the lowest part of the panel or its attachments; record to the nearest two decimal places.

4.5.11 Direction Under Panel

The Direction Under Panel records the roadway direction/directions under the given panel in the log and/or anti-logs directions. If a log direction cannot be determined or the roadway it is over is not an inventoried route, code as “N/A”.

4.5.12 Lanes Under

The Lanes Under records the travel lanes of the inventoried route as recorded in Section 4.5.11. A methodical method, left to right, should follow the front orientation or clearance sketch as was laid out during the initial inspection. If the panel is over multiple directions of the roadway, the roadway order should follow left to right by the established front orientation and each lane should be designated by the orientation of each travel direction. The options for up to three lanes under the sign panel are laid out below in Table 4.5-2, with the Lane column being the inventory option and the Lane Description column defining the corresponding abbreviation.

Table 4.5-2 Lanes Under Inventory Options and Definitions

Lane	Lane Description
LS	Left Shoulder
LR-LL	Left Ramp - Left Lane
LR-CL	Left Ramp - Center Lane
LR-RL	Left Ramp - Right Lane
LM	Left Median/Gore Area
HOV	HOV Lane
LL	Left Lane
LCL	Left Center Lane
CL	Center Lane
RCL	Right Center Lane
RL	Right Lane
RM	Right Median/Gore Area
RR-LL	Right Ramp - Left Lane

Lane	Lane Description
RR-CL	Right Ramp - Center Lane
RR-RL	Right Ramp - Right Lane
RS	Right Shoulder
CM	Center Median/Gore Area

Chapter 5 Inspection

5.1 General Inspection Types and Requirements

Ancillary structures require several types of inspections, some of which are scheduled and some of which are required due to an event (high wind, impact damage, etc.). This chapter describes the various types of inspections and their requirements.

5.1.1 Inventory/Initial

The inventory or initial inspection is the first inspection of the structure and should take place shortly after the installation of a new ancillary structure or replacement of an existing structure. Inventory inspections are intended to facilitate entering the structure into the statewide inventory and will serve as the baseline for the as-built condition of the structure.

Refer to Sections 2.3, 2.4 and 2.7 for the description, qualifications, and responsibilities of a team leader, staff inspector and a technician, respectively. Refer to Section 6.2 for further details pertaining to inspection report requirements.

5.1.1.1 Scope

The scope of an inventory inspection includes:

- Pinpointing the ancillary's location (via GPS and descriptively), assigning a Structure Identification Number and collecting all general structure inventory data (see Chapter 4 for specific inventory items);
- Performing 100% hands-on inspection of the entire structure;
    - In the case of high mast lighting or ITS pole structures, a hybrid inspection can be performed with prior RIDOT approval. A 100% hands-on inspection shall be performed for the base and the structure that falls within a 45' lift envelope. The portion of the structure beyond the 45' lift envelope should preferably be inspected using a drone. RIDOT can approve a spotting scope if a drone is not feasible.
- Documentation of baseline as-built condition of the structure;
- Documentation of existing problems and their location;
- UT testing of the all anchor rods:
    - During the UT testing of the anchor rods, the length of the rods should be established/verified. If structure has J-bolts, refer to plans.
    - Transformer base anchor rods typically can't be UT tested because of the close proximity of wiring, even if the transformer base is powered down. Reder to F.3.1.3 Site Preparation for further information.
- A fully documented inspection report, complete with appropriate photographs and recommendations; and

- Preparation/review of a punch-list, identifying items that require completion or correction.

Documentation for an inventory inspection includes: photographs; a sketch outlining all relevant clearances, dimensions of main structural members and locations/dimensions of ancillary structure devices as necessary; Element Level quantities and condition states; base connection information (i.e., UT readings); and D-Meter readings of the post base. Construction records (i.e., shop drawings) may contain valuable information in the future and should be included if possible.

5.1.1.2 Frequency

An Initial or Inventory Inspection should only take place shortly after the structure is constructed or replaced. The owner (e.g., the State) may request an additional Initial or Inventory Inspection if the structure's configuration has changed (e.g., replacement, addition of ancillary structure devices, supplemental supports) or the structure has changed ownership. It is common for connection bolts, shortly after installation, to become loose and they should be rechecked within 60 days after construction is complete.

5.1.2 Routine

A routine inspection is a regularly scheduled inspection of an in-service ancillary structure. This inspection serves to evaluate the physical and functional conditions of the structure as compared to the initial or previously recorded conditions. This type of inspection is sometimes referred to as a *regular inspection.* Routine inspections help to confirm that all present service requirements are satisfied, and that the safety of the travelling public is ensured.

Refer to Sections 2.3, 2.4 and 2.7 for the description, qualifications, and responsibilities of a team leader, staff inspector and a technician, respectively. Refer to Section 6.2 for further details pertaining to inspection report requirements.

5.1.2.1 Scope

The scope of a routine inspection includes:

- Verifying all structural data recorded during the Inventory/Initial inspection;
- Update existing inventory data;
- 100% hands-on inspection of the entire structure;
    - In the case of high mast lighting or ITS pole structures, a hybrid inspection can be performed with prior RIDOT approval. A 100% hands-on inspection shall be performed for the base and the structure that falls within a 45’ lift envelope. The portion of the structure beyond the 45’ lift envelope should preferably be inspected using a drone. RIDOT can approve a spotting scope if a drone is not feasible.
- Evaluation of the physical and functional condition of the ancillary structure based on field observations and/or measurements;
- Inspection of the foundation, structure, ancillary structure devices, structural and ancillary connections, and anything that could become a potential safety hazard to the public.

- Inspection of ancillary structure components to identify changes from previously recorded conditions;

- UT testing of anchor rods should be conducted as noted in Section 5.1.1.1 and as per the frequency noted in Table 5.1-1 through Table 5.1-4. UT testing at an increased frequency may be needed for anchor bolts with indications noted during the previous inspection and structures with impact damage. All anchor rods should receive UT testing upon reinspection (not only the anchor rod(s) with an indication). See Section 5.1.4 for further information.

- Assessment of urgent maintenance needs and repair recommendations; and

- Fully documented inspection report, complete with appropriate photographs and recommendations.

The level of effort for a Routine Inspection is dependent on the ancillary type, its structure type, the number of ancillary structure devices and roadway access. Good engineering judgment is required for all inspections, including Routine Inspections, to make the proper differentiation between critical and non-critical areas. The above Scope is offered for determining the level of detail required to achieve a sufficient inspection of an ancillary structure. Note that these guidelines should be treated as such and do not relieve the Team Leader or other inspection personnel from the responsibility to perform the tasks required to ascertain the condition of the ancillary structure and assure the safety to the public.

5.1.2.2 Frequency

This manual provides the following guidelines regarding inspection frequency:

- Material Issues: Since it has been determined that aluminum span structures are problematic, it is recommended that a two-year frequency of Routine Inspections be conducted.

- Aluminum Structures: If the structure is aluminum, the inspection frequency required for a structure with over 30 years of in-service age is two years and for structures under 30 years of in-service age is four years.

- Redundancy Issues: For cantilever and other non-redundant structures, a four-year frequency is recommended.

- Typical Span Structures: A typical two tower, two or four post span structure with a steel superstructure need only be inspected hands-on every six years. Routine or ground inspections can be conducted more frequently to check corrosion of posts or connection problems.

Table 5.1-1 through Table 5.1-4 provide further guidance and clarifications to supplement the above guidelines.

Table 5.1-1 Routine Sign Inspection Frequency

Sign Structure Type	Inspection Frequency (Months)
Cantilever	48
Span	48
Structure Mounted	48
Butterfly	48
Ground Mounted	96

Table 5.1-2 Routine Traffic Signal Inspection Frequency

Traffic Signal Structure Type	Inspection Frequency (Months)
Mast Arm	48
Span & Span Wire	48
Pedestal Mounted	96

Table 5.1-3 Routine Lighting Inspection Frequency

Lighting Structure Type	Inspection Frequency (Months)
Pedestal Mount	96
Mast Arm	48
High Mast	48
Weathering Steel High Mast	24

Table 5.1-4 Routine ITS Structure Inspection Frequency

ITS Structure Type	Inspection Frequency (Months)
Cantilever	48
Span	48
High Mast	48
Weathering Steel High Mast	24

5.1.3 Damage

A damage inspection is an unscheduled inspection that evaluates structural damage to the ancillary structure that was caused by environmental effects and/or human actions. Damage inspections help ensure that the safety of motorists crossing under or adjacent to the ancillary structure is preserved following the incident, as well as verifying that all present service requirements are still met. The inspection reports for damage inspections shall be submitted no later than 5 days after inspection.

A Team Leader needs to be a part of the inspection team, accompanied by a staff inspector and/or technician. Refer to Sections 2.3, 2.4 and 2.7 for the description, qualifications, and responsibilities of a team leader, staff inspector and a technician, respectively. Refer to Section 5.2.8 for critical finding procedures. Refer to Section 6.2 for further details pertaining to inspection report requirements.

5.1.3.1 Scope

The scope of a damage inspection includes the following:

- Assessment of the damage to the ancillary structure and surrounding environment;
- In the case of impact damage, the assessment of secondary areas (e.g., post to arm connections or foundation elements) which could have been affected by the event;
- Determination of the need for immediate closing for vehicles or pedestrians passing under or adjacent to the structure;
- Evaluation of the effort required for the repair of the ancillary; and
- Non-Destructive Testing (NDT) including Ultrasonic Testing (UT) as warranted. In case of any impact damage to the structure, UT testing shall be performed.
- Written report documenting measurements (for calculations/analyses as needed), photographs, and all other findings.

In some cases, a damage inspection may be followed by a Miscellaneous Inspection (see Section 5.1.4 below.) This subsequent Miscellaneous Inspection may provide:

- Further evaluation of damaged conditions;
- Verification of field measurements and calculations performed during the damage inspection; or
- Advancement of the required follow-up procedures as mandated by the owner.

5.1.3.2 Frequency

The State assigns damage inspections on an as-needed basis. Follow-up inspections are dictated by the severity of the damage and resulting condition of the structure.

5.1.4 Interim, Special or Miscellaneous

An Interim Inspection may be used to evaluate an ancillary structure between the typical inspection intervals, a Special Inspection is used to monitor a suspected or known deficiency and a Miscellaneous Inspection assess the ancillary structure or its members following a manmade or natural event.

The State establishes guidance on what to observe and what to evaluate during an Interim, Special or Miscellaneous Inspection for each specific ancillary structure on the A.11 Special Inspection Requirements Form – Form AI-011.

5.1.4.1 Scope

The scope of an Interim, Special or Miscellaneous Inspection will vary greatly depending on the complexity of the deficiencies being inspected. At times, a Special Inspection can be used to investigate member deterioration that could not be properly evaluated through other inspection types and their procedures.

The Department determines the scope of an Interim, Special or Miscellaneous Inspection which may include the following:

- A visual 100% hands-on inspection of a specific area or condition that is noted in the previous inspection;
- Investigation of an ancillary structure with deteriorated members that clarifies the extent of deterioration on one or more ancillary's members and the overall impact of the deterioration on the performance and safety of the ancillary structure;
- A hands-on inspection of a repaired condition (Fiber Reinforced Polymer, etc.);
- Specialized inspection equipment (e.g., access vehicles);
- Specialized inspection personnel (e.g., Nondestructive Testing by an ASNT Level II or Level III);
- Written report complete with measurements, photographs, and findings resulting from the deteriorated condition. If the deteriorated condition worsens and the structural adequacy is compromised, it should be documented during the inspection.

5.1.4.2 Frequency

The frequency for an Interim, Special or Miscellaneous Inspection is determined by the Department. The Department reserves the right to waive the requirement for an Interim Inspection.

5.2 Policies

5.2.1 General

The policies contained within this section have been set forth by the Department. Note that this section is intended to provide a summary of the Department's policies (where applicable) and is not considered all-inclusive of State or Federal policy.

5.2.2 Planning and Scheduling

Planning and scheduling are essential for any ancillary structure inspection, regardless of size, location, or complexity. By addressing these two fundamental activities prior to going out into the field, the following outcomes can be obtained:

- The safest ancillary structure inspection. Inspection personnel (team leader, staff inspectors and/or technician) can minimize the rushed feeling during the inspection, which often leads to careless actions that may result in injury or damage to the equipment.

- The most efficient ancillary structure inspection. Inspection personnel can progress through the inspection in the most logical and organized manner, which often provides for the least number of setups during the inspection and the least number of (or possibly no) changes in the temporary traffic control.

- The most complete ancillary structure inspection. Inspection personnel can inspect the structure in the most complete manner, since an organized and well-planned inspection will minimize the chances of overlooking an ancillary element or deficiency.

- The most seamless ancillary structure inspection. Inspection personnel may need to coordinate with other parties during the inspection (e.g., police, equipment operators and traffic control personnel), which with the proper coordination between parties, can be made as seamless as possible.

Since ancillary structure inspections are not required by Federal Regulations, the FHWA Ancillary Manual and this manual only provide guidelines regarding frequency. However, in order to ensure and promote proper planning and scheduling, ancillary structures should be inspected in a consistent and timely manner as recommended in Section 5.1.2.2. Ancillaries should be inspected within a normal frequency interval. For example, if an ancillary structure is on a four-year routine inspection cycle and was last inspected in September 2021, it should be inspected by September 2025.

Key considerations when addressing planning and scheduling include document review, field review, inspection equipment, access to State land, coordination, and weather considerations. These considerations are listed in the next several sections.

5.2.2.1 Document Review

One of the first considerations when planning and scheduling for an ancillary structure inspection is to collect the appropriate information about the ancillary, which may be found in the ancillary structure file. This information may include, but is not limited to:

Plans, including construction plans, report clearance sketches, and as-built drawings (refer to Section 5.2.2.1.1 for more information);

Previous inspection reports, including any special or interim reports (refer to Section 5.2.2.1.2 for more information);

Ancillary maintenance and repair records/correspondence (refer to Section 5.2.2.1.3 for more information).

5.2.2.1.1 Plans

If available from the State, the as-built or design plans for a specific structure should be included in the ancillary structure file. These ancillary structure plans contain information that shows the materials used in the construction of the structure and how the ancillary structure was assembled. Member types and sizes, dimensions and connection details are all pieces of information that are useful to the inspector, all of which should be specified on the plans. The inspector should be able to recognize and question details in the field that do not agree with the information shown on the plans. Refer to Section 6.4.1for more information regarding ancillary structure plans.

5.2.2.1.2 Previous Inspection Reports

Previous inspection reports assist the inspector's awareness for any areas on the ancillary structure that may be of concern and might warrant special attention. Additionally, previous inspection reports also provide a standard with which to gage the progress of a previously noted deficiency. Special equipment or access requirements necessary to complete the inspection are also typically noted in previous reports. Overall, a thorough review of the last inspection report (and possible reviews of subsequent reports) not only gives the inspector a feel for the structure but helps to ensure completeness in the inspection and consistency in the evaluation ratings. Refer to Section 6.4.7 for more information regarding previous inspection reports.

5.2.2.1.3 Ancillary Maintenance and Repair Records/Correspondence

Maintenance and repair records provide the inspector with information of any repairs requested or repairs performed. While inspecting the ancillary structure, the team leader and staff inspector(s) should assess the repair(s) for completion and evaluate the quality of the repair work that was previously requested. Refer to Sections 6.4.2 and 6.4.5 for more information regarding correspondence and maintenance and repair records, respectively.

5.2.2.2 Field Review

All field reviews are the responsibility of the Consultant. Field reviews may be necessary for structures with changing conditions. Reasons to conduct field reviews include, but are not limited to, the following:

- Newly installed or recently replaced structures;
- Recent adjacent roadway or miscellaneous construction;
- Maintenance and protection of traffic; and
- Access equipment requirements.

5.2.2.3 Inspection Equipment

Document review and field review are important considerations in the planning and scheduling process, all of which are designed to help the inspector become familiar with the ancillary structure prior to arriving at the site. Another key consideration when planning and scheduling for an inspection is determining the inspection equipment and access requirements. In making this determination, the inspector must ask themself the following questions:

- Will temporary traffic control be required? If so, does the Department have a pre-approved Temporary Traffic Control (TTC) (sometimes referred to as Maintenance and Protection of Traffic (MPT)). Consultant should follow the requirements from the Traffic Management Plan (TMP).

- Does the ancillary structure inspection require additional personnel, such as police, equipment operators, traffic control personnel, or railroad officials? If so, have these persons been contacted with enough advance notice from the anticipated inspection date?

- Will access to any private property be required? Communication with the owner should be made prior to the inspection.

- Will a bucket truck or man lift be required for the inspection? If so, what size of bucket truck or man lift will be required? If not, what size step ladder should be used? Have the appropriate personnel been contacted for this request with sufficient advance notice from the anticipated inspection date?

By answering the above questions, the inspector can better determine the necessary inspection equipment that will be required to properly inspect the structure. Refer to Section 6.3.9 for a list of inspection equipment.

Note that it is Department policy that all inspection access equipment and traffic protection be the responsibility of the Consultant unless otherwise directed by the Department and shall be paid as a direct expense, where allowed. The Consultant and the Sub-consultant shall maintain daily records on equipment including but not limited to the mileage (odometer readings), hours, expenses, and daily activities and include this information as part of the monthly invoice submission to the Department. Expenses from misuse or neglect will not be reimbursed to the Consultant. The expense of rental equipment will be covered as a direct cost.

5.2.2.4 Access to State Land

Access to State-owned land may be required to perform preliminary engineering tasks. If access to State land is required through a secured gate, Property Management can assist in obtaining a key. When barriers and such fencing must be temporarily removed to access a site, it is the responsibility of the Consultant to ensure that the State's land is secured at the close of each workday. It is also the responsibility of the Consultant to verify that the barrier is restored to the same or better condition upon completion of the task work.

5.2.2.5 Coordination

Coordination efforts relating to the ancillary structure inspection are the responsibility of the Consultant, unless otherwise identified by the Department. In general, parties that require coordination from the Consultant may include, but are not limited to, the following:

- Ancillary owner/stakeholders;
- State and Local Police;
- Private property owners;
- Equipment operators;
- Traffic control personnel; and
- Park/facility directors and officials.

5.2.2.5.1 Active Construction Projects

For ancillary structure inspections that are scheduled to be performed during active construction, additional coordination efforts (beyond those listed in Section 5.2.2.5) may be required on behalf of the Consultant. The Consultant should verify construction projects on the RIDOT web site prior to performing any inspection. If there appears to be a conflict with a traffic control setup, the Consultant shall contact the Department.

5.2.2.5.2 Lane Restrictions

For ancillary structure inspections that require lane restrictions, the Consultant is required to complete the online Traffic Report Form, which identifies the nature of the restriction, dates and times of the restriction, and all other pertinent information related to the restriction. If the inspection work is cancelled or postponed due to weather, access issues etc., the Consultant is required to complete a cancellation request online as well. Links are below:

Lane Closure Request: https://ridot.wufoo.com/forms/ridot-lane-closure-report/

Lane Closure Cancel/Update: https://ridot.wufoo.com/forms/ridot-lane-closure-report-cancelation-request/

Refer to Section 5.2.7 for more information regarding maintenance and protection of traffic and lane closures.

5.2.2.6 Weather Restrictions

Proper planning and scheduling of ancillary structure inspections must also consider the weather. Inspections that are performed during adverse or uncomfortable weather conditions may lead to increased safety risks, reduced efficiency, increased field time during the inspection, a rushed or hastened inspection, or a less-detailed inspection in order to avoid the inclement weather conditions.

5.2.3 Pre and Post Inspection Requirements

Pre and post inspection requirements are discussed in the following sections. They include Weekly Work Schedules and Daily “Two-Day” Schedules (both pre-inspection requirements.)

5.2.3.1 E-mail Notifications

Consultants are required to submit inspection schedules and weekly summaries to the Department. The following sections outline the requirements set forth by the Department.

5.2.3.1.1 Weekly Work Schedule

The Consultant is required to complete a weekly (2-week) anticipated work schedule, detailing which structures will be inspected and when the inspections will occur. This notification serves to notify applicable staff of the confirmed start date of inspection and detailed traffic restrictions for the upcoming inspection. The weekly schedule should include, where applicable, the following information:

- Date of inspection
- Inspection time envelope
- Assignment No.
- Group No.
- Route
- Ancillary structures to be inspected
- Roadway or intersection details of the ancillary structures
- Lane closure details
- Inspection equipment needed
- Comments

5.2.3.1.2 Two Day Inspection Notification

The Consultant is required to notify the Department two days prior to the scheduled inspection date. This notification serves to confirm the inspection and details traffic restrictions for the inspection. The two day notification should include:

- Date of inspection
- Inspection time envelope
- Assignment No.
- Group No.
- Route
- Ancillary structures to be inspected
- Roadway and/or intersection details of the ancillary structures
- Lane closure details
- Inspection Team or Crew

- Vendors used for equipment and/or service
- Meetup time and location
- Comments

5.2.3.1.3 Weekly Inspection Summary Reports

The Consultant is required to submit weekly updates of the status of ancillary structure inspections and report submissions throughout the duration of the contract. The Consultant will forward the Weekly Inspection Summary Report (Form AI-007) every week (Monday) via e-mail to the Department. This form lists the ancillary structures inspected, primary inspection types, group numbers, inspection completion dates, and report submission dates. Refer to A.7 Weekly Inspection Summary Report – Form AI-007 for a blank version of the Report.

5.2.4 Ancillary Inspection Limits of Work

The following items listed below may represent potential limits of work during an ancillary structure inspection:

- Traffic safety features (up to 50 feet from the leading side of the vertical support and 20 feet on the trailing side).
- Sidewalks in the immediate area surrounding the foundation.
    - Cracks and settlement of the sidewalk may be a sign of structural conditions to the ancillary structure but can also lead to tripping hazards to the public.

5.2.5 Decreased Inspection Frequency

In specific situations, the inspection frequencies outlined in Section 5.1.2.2 may be too stringent for some structures, particularly newly constructed ancillary structures. Using good engineering judgment, the Consultant may recommend that the inspection interval be lengthened (decreased inspection frequency). This recommendation shall be submitted in writing to the Department and provide the reasoning for decreasing the inspection frequency.

5.2.6 Increased Inspection Frequency

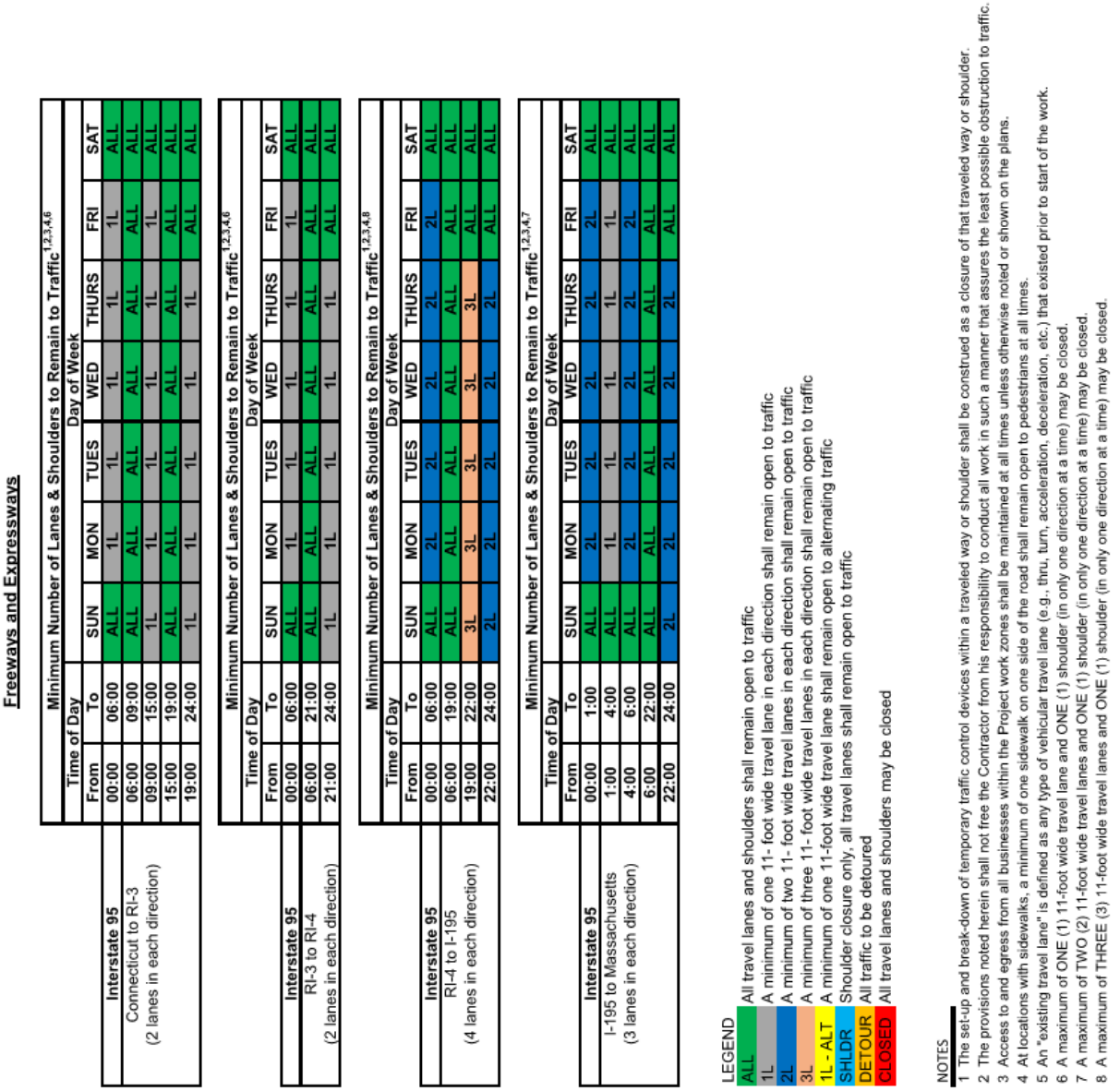
Although the Department establishes inspection frequencies and requirements, certain conditions or developing trends may necessitate shorter inspection intervals (increased inspection frequencies) to sufficiently monitor the condition of a structure. The Consultant shall use good engineering judgment while assessing the structural condition of the structure and, if deemed necessary, shall supply a recommendation to the Department to increase the inspection frequency. This recommendation shall be submitted in writing and provide the reasoning for increasing the inspection frequency (e.g., deteriorated conditions or other defects).

5.2.7 Temporary Traffic Control

In general, work zone restrictions shall be in accordance with the following guidelines adopted from the Department's *Traffic Management Plan (TMP) for Bridge Inspection.* These restrictions have been listed

below in Figure 5.2-1 through Figure 5.2-8, and Table 5.2-1. Additionally, all inspection activities involving lane closures shall be terminated if an extensive traffic back-up occurs, or as directed by the Department, or the Police with the jurisdictional authority. The Consultant shall report any extensive traffic back-ups to the Bridge Engineering Office. The Traffic Management Plan is subject to change and the latest version should be obtained from the Department.

Any deviations from these Temporary Traffic Control (TTC) guidelines must be approved by the Department.



Freeways and Expressways

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]

	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Interstate 95 Connecticut to RI-3 (2 lanes in each direction)	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	09:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	09:00	15:00	1L	1L	1L	1L	1L	1L	ALL
	15:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]

	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Interstate 95 RI-3 to RI-4 (2 lanes in each direction)	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	21:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	21:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,8]

	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Interstate 95 RI-4 to I-195 (4 lanes in each direction)	00:00	06:00	ALL	2L	2L	2L	2L	2L	ALL
	06:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	22:00	3L	3L	3L	3L	3L	ALL	ALL
	22:00	24:00	2L	2L	2L	2L	2L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,7]

	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Interstate 95 I-195 to Massachusetts (3 lanes in each direction)	00:00	1:00	ALL	2L	2L	2L	2L	2L	ALL
	1:00	4:00	ALL	1L	1L	1L	1L	1L	ALL
	4:00	6:00	ALL	2L	2L	2L	2L	2L	ALL
	6:00	22:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	22:00	24:00	2L	2L	2L	2L	2L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.
8 A maximum of THREE (3) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 5.2-1 Typical Work Zone Restrictions for Freeways and Expressways (1 of 7)

Freeways and Expressways

Interstate 195 (I-95 to Massachusetts, 3 lanes in each direction)	Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]								
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
	00:00	05:00	ALL	1L	1L	1L	1L	1L	ALL
	05:00	07:00	ALL	2L	2L	2L	2L	2L	ALL
	07:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	23:00	2L	2L	2L	2L	2L	ALL	ALL
	23:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Interstate 295 (I-95 to US-6, 2 lanes in each direction)	Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]								
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Interstate 295 (US-6 to Massachusetts, 3 lanes in each direction)	Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,7]								
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
	00:00	07:00	ALL	1L	1L	1L	1L	1L	ALL
	07:00	19:00	2L	2L	2L	2L	2L	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 5.2-2 Typical Work Zone Restrictions for Freeways and Expressways (2 of 7)

Freeways and Expressways

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-24	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
RI-114 to Massachusetts	06:00	20:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	20:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-114	00:00	16:00	ALL	1L	1L	1L	1L	1L	ALL
Federal Road to I-195	16:00	18:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	18:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-138	00:00	8:00	ALL	1L	1L	1L	1L	1L	ALL
US-1 to RI-1A	8:00	9:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	9:00	14:00	1L	1L	1L	1L	1L	1L	ALL
	14:00	18:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	18:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-403	00:00	5:00	ALL	1L	1L	1L	1L	1L	ALL
RI-4 to Commerce Park Road	5:00	6:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	6:00	14:00	1L	1L	1L	1L	1L	1L	ALL
	14:00	16:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	16:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 5.2-3 Typical Work Zone Restrictions for Freeways and Expressways (3 of 7)

Freeways and Expressways

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
US-1 RI-112 to RI-108 (2 lanes in each direction)	00:00	06:00	1L	1L	1L	1L	1L	1L	1L
	06:00	19:00	1L	1L	1L	1L	1L	1L	1L
	19:00	24:00	1L	1L	1L	1L	1L	1L	1L

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
US-1 RI-108 to RI-138 (2 lanes in each direction)	00:00	08:00	ALL	1L	1L	1L	1L	1L	ALL
	08:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-4 US-1 to RI-402 (2 lanes in each direction)	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,7]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-4 RI-402 to I-95 (3 lanes in each direction)	00:00	04:00	ALL	1L	1L	1L	1L	1L	ALL
	04:00	06:00	ALL	2L	2L	2L	2L	2L	ALL
	06:00	09:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	09:00	13:00	2L	2L	2L	2L	2L	2L	ALL
	13:00	18:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	18:00	21:00	2L	2L	2L	2L	2L	ALL	ALL
	21:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 5.2-4 Typical Work Zone Restrictions for Freeways and Expressways (4 of 7)

Freeways and Expressways

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]										
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-146	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
I-95 to I-295	06:00	22:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	22:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

RI-146	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
I-295 to Massachusetts	06:00	21:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	21:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-99	00:00	06:00	1L	1L	1L	1L	1L	1L	1L
RI-146 to RI-122	06:00	19:00	1L	1L	1L	1L	1L	1L	1L
(2 lanes in each direction)	19:00	24:00	1L	1L	1L	1L	1L	1L	1L

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-10	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
I-95 to RI-6	06:00	21:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	21:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 5.2-5 Typical Work Zone Restrictions for Freeways and Expressways (5 of 7)

Freeways and Expressways

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,7]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
US-6 I-295 to RI-10 (3 lanes in each direction)	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	19:00	2L	2L	2L	2L	2L	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Airport Connector Road I-95 to US-1 (2 lanes in each direction)	00:00	06:00	1L	1L	1L	1L	1L	1L	1L
	06:00	19:00	1L	1L	1L	1L	1L	1L	1L
	19:00	24:00	1L	1L	1L	1L	1L	1L	1L

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,8]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Freeway and Expressway Ramps (1 Travel Lane)	00:00	06:00	ALL	DETOUR	DETOUR	DETOUR	DETOUR	DETOUR	ALL
	06:00	09:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	09:00	21:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	21:00	24:00	DETOUR	DETOUR	DETOUR	DETOUR	DETOUR	ALL	ALL

Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]									
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
Freeway and Expressway Ramps (2 Travel Lanes)	00:00	06:00	ALL	1L	1L	1L	1L	1L	ALL
	06:00	09:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	09:00	15:00	1L	1L	1L	1L	1L	1L	ALL
	15:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.
8 A roadway or segment of roadways may be closed and alternative detour route shall be placed.

Figure 5.2-6 Typical Work Zone Restrictions for Freeways and Expressways (6 of 7)

Freeways and Expressways

	Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,6]									
	Time of Day		Day of Week							
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-37	00:00	07:00	ALL	1L	1L	1L	1L	1L	ALL
I-95 to I-295	07:00	19:00	ALL	ALL	ALL	ALL	ALL	ALL	ALL
(2 lanes in each direction)	19:00	24:00	1L	1L	1L	1L	1L	ALL	ALL

	Minimum Number of Lanes & Shoulders to Remain to Traffic[1,2,3,4,9]								
	Time of Day		Day of Week						
	From	To	SUN	MON	TUES	WED	THURS	FRI	SAT
RI-78	00:00	06:00	1L	1L	1L	1L	1L	1L	1L
US-1 to RI-2	06:00	19:00	1L	1L	1L	1L	1L	1L	1L
(1 lane in each direction)	19:00	24:00	1L	1L	1L	1L	1L	1L	1L

LEGEND

ALL	All travel lanes and shoulders shall remain open to traffic
1L	A minimum of one 11- foot wide travel lane in each direction shall remain open to traffic
2L	A minimum of two 11- foot wide travel lanes in each direction shall remain open to traffic
3L	A minimum of three 11- foot wide travel lanes in each direction shall remain open to traffic
1L - ALT	A minimum of one 11-foot wide travel lane shall remain open to alternating traffic
SHLDR	Shoulder closure only, all travel lanes shall remain open to traffic
DETOUR	All traffic to be detoured
CLOSED	All travel lanes and shoulders may be closed

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way or shoulder shall be construed as a closure of that traveled way or shoulder.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all businesses within the Project work zones shall be maintained at all times unless otherwise noted or shown on the plans.
4 At locations with sidewalks, a minimum of one sidewalk on one side of the road shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
6 A maximum of ONE (1) 11-foot wide travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) 11-foot wide travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.
8 A roadway or segment of roadways may be closed and alternative detour route shall be placed.
9 A minimum of ONE (1) 11-foot wide travel lane for each direction shall be opened at all time.

Figure 5.2-7 Typical Work Zone Restrictions for Freeways and Expressways (7 of 7)

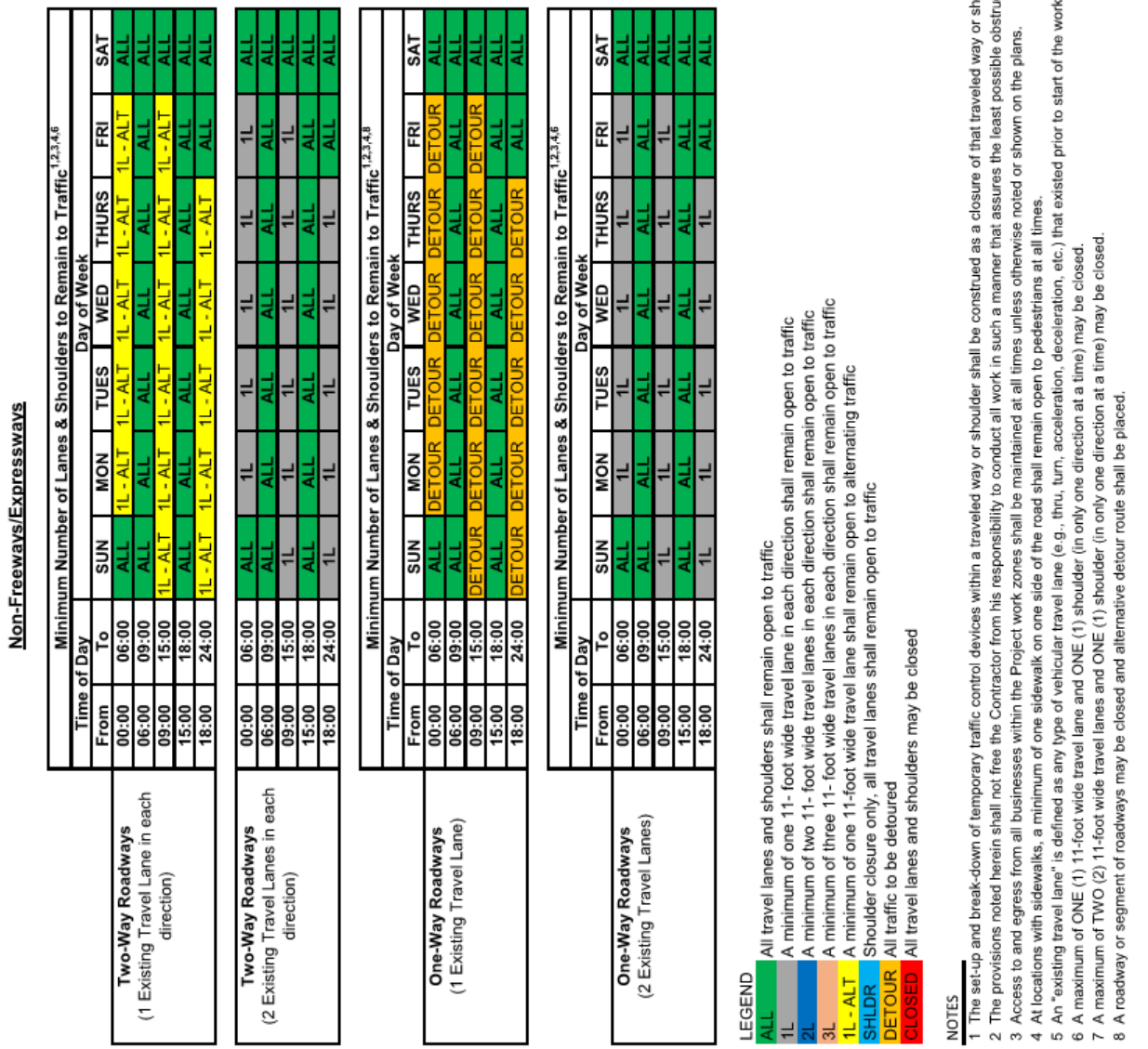


Figure 5.2-8 Typical Work Zone Restrictions for Non-Freeways/Expressways

Table 5.2-1 Typical Holiday Work Zone Restrictions

Holiday	Restriction
New Year's Day	No day or night work and no work the previous night after 1 PM.
Dr. Martin Luther King, Jr. Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday, with general restrictions that shall apply after 10 PM.
Easter Sunday	No Saturday or Sunday day or night work until 10 PM on Sunday, with general restrictions that shall apply after 10 PM.
Memorial Day	No Saturday, Sunday, or Monday day or night work.
June 19th (Juneteenth)	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday, with general restrictions that shall apply after 10 PM.

Holiday	Restriction
Independence Day	No day or night work and no work the previous night after 1 PM.
Victory Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday, with general restrictions that shall apply after 10 PM.
Labor Day	No Saturday, Sunday, or Monday day or night work.
Columbus Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday, with general restrictions that shall apply after 10 PM.
Veteran's Day	No day or night work until 10 PM, with general restrictions that apply after 10 PM, and no work the previous night after 1 PM.
Thanksgiving Day	No Wednesday night work after 1 PM or Thursday day or night work. No work that impacts traffic shall be performed by the contractor on Wednesday through Sunday of Thanksgiving week in any calendar years. Impacting traffic is defined as inspection operations that reduce the number of travel lanes.
Christmas Day	No day or night work and no work the previous night after 1 PM.

Note: All Friday daytime work on any holiday weekend listed above must end by 1 PM.

5.2.8 Critical Findings Procedures

The procedures defined herein have been established by the Department and shall be followed to assure that all critical inspection conditions identified by the inspection teams that pose a clear and present danger or conditions that if left unattended, would likely become a clear and present danger are addressed in a timely manner. A critical finding determination shall be made during initial/inventory inspections, routine inspections, damage inspections, or any other type of inspection where such a finding may be encountered. These procedures are essential to assure that the necessary notifications, documentation, repair work, removal and other related activities are followed-up and accomplished in a timely manner.

5.2.8.1 General

If a structural or safety issue is identified during an inspection, the team leader shall immediately notify the Department via telephone (use the latest Emergency Contact List provided by RIDOT) and describe the critical finding and all relevant information collected. Within 24 hours of finding the critical finding, the inspection team shall document and forward the Critical Finding AI-006 Form to the inspection e-mail inbox (DOT.SAI@dot.ri.gov) unless an e-mail is forwarded to the inspection e-mail box that contains all the information that would otherwise be contained on the Form AI-006. The email should include a description of the issue, date, location, time, and photographs. The inspection mailbox automatically notifies the appropriate personnel of the issue encountered and initiates the process for documenting and following up on the critical finding(s) and other structural or safety-related issue(s) requiring attention. If an all-inclusive e-mail has been provided to the Department, the e-mail shall serve as the documentation for the critical finding reported within 24 hours of identification. Upon notification, the Department (through the Program Manager or Managing Engineer-Bridge Engineering (ME)) will decide if the issue is considered a critical finding as defined below. The form is found in the Appendix under A.6 Critical Finding Log – Form AI-006.

5.2.8.2 Determination of Critical Findings

A Critical Finding is a structural deficiency or safety-related deficiency that requires immediate follow-up action. The inspection team should use sound engineering judgment in determining if any other

deficiencies, or a combination of, exist that qualify as a critical or emergency condition as well as if other factors, such as structural redundancy or loading conditions, exist that should not raise the deficiency to a Critical Finding. In these cases, the inspection team needs to discuss with the Project Manager the reasoning behind their issuance or non-issuance of the Critical Finding. Critical Finding reporting procedure should be followed for reporting all Critical Findings.

If loose anchor bolt nuts or connection bolt nuts are found at the time inspection as defined in Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance, the inspection team should tighten all loose nuts (if possible) to bring them to a snug tight condition (see Section Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance). If all loose nuts are tightened to a snug tight condition, this condition may not be considered as a Critical Finding.

5.2.8.3 Reporting Process

The following list outlines the reporting process for a critical finding:

1. If a critical finding is identified during an inspection, the inspector shall immediately contact the Department via telephone (use the latest Emergency Contact List provided by RIDOT) based on the severity of the related concern. Describe the critical finding and all relevant information collected.

2. Within 24 hours, A.6 Critical Finding Log – Form AI-006 shall be completed and forwarded to the Department at the inspection e-mail box (DOT.SAI@dot.ri.gov) as formal documentation unless an e-mail is forwarded to the e-mail box, containing all the information otherwise on this form. The form is found in the Appendix under A.6 Critical Finding Log – Form AI-006.

3. The Managing Engineer will review the issue and enter the information into a database. The intent of this database is to track the critical finding, the plan of action, and the resolution of the issue. Numerous reports are generated from the database for planning and prioritizing the required work.

4. If the issue requires urgent attention, such as an imminent structural failure, an immediate phone call is required to one of the emergency contacts listed in the Contact and Distribution Matrix.

5.2.8.4 Plan of Action/Follow-Up

1. Based on the determination that the issue with a structure is critical, the Department will develop a plan of action. This plan of action may result in the assignment of staff to further investigate and develop the necessary corrective action. Also, the plan of action may be a mitigation measure such as removing the panel or removing the arm, etc.

2. Based on the severity of the problem, the Department will produce formal plans to make corrective action.

3. The Department will determine if the critical finding repairs/actions are to be designed by: 1) a Consultant firm; 2) an in-house bridge engineering staff; or 3) a simple maintenance repair operation. Upon this decision, the plan of action and documentation will be completed for use by the Department.

4. In the case that a critical finding may require the removal of a structure from service, the determination to remove the structure will be the responsibility of at least one and preferably two members listed in the Contact and Distribution Matrix with concurrence of the Chief Engineer, if available.

5. If significant repairs are performed as a result of a critical finding, a follow-up special inspection may be completed.

6. The Bridge Engineer or other designated Engineer will "close" the issue in the database once repair(s) or mitigation measure(s) are successfully completed.

5.2.9 High Priority Maintenance Findings Procedures

The procedures defined herein have not been strictly defined by the Department but are borrowed from the general practices from their Bridge Inspection program. These guidelines shall be followed to build a framework for all High Priority Maintenance Finding (HPMF) inspection conditions identified by the inspection teams.

5.2.9.1 General

HPMFs are structural or safety related findings that do not meet the criteria defined under Critical Finding Procedures in Section 5.2.8 but require corrective action by the State in a timely manner, i.e., within a 6 month time window.

If a HPMF issue is identified during an inspection, the team leader shall notify the Department via e-mail (DOT.SAI@dot.ri.gov) within 24 hours of discovery, describing the HPMF and all relevant information collected. The email should include: a description of the issue, date, location, time, and photographs. The inspection mailbox automatically notifies the appropriate personnel of the issue encountered and initiates the process for documenting and following up on the HPMF(s) and other structural or safety-related issue(s) requiring attention. If an all-inclusive e-mail has been provided to the Department, the e-mail shall serve as the documentation for the HPMF(s) reported within 24 hours of identification. Upon notification, the Department (through the Program Manager or individual appointed by the State) will determine if the issue is considered a HPMF as defined below.

5.2.9.2 Determination of High Priority Maintenance Findings (HPMFs)

Conditions that do not quite meet the threshold of a Critical Finding as laid out in Section 5.2.8.2 Determination of Critical Findings, (i.e., using engineering judgement, the issue does not require immediate action but needs to be addressed within a 6-month window) should be the baseline judgement used by the Team Leader in issuing a HPMF.

If loose anchor bolt nuts or connection bolt nuts are found at the time inspection, the inspection team should tighten all loose nuts (if possible) to bring them to a snug tight condition (see Section Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance). If all loose nuts are tightened to a snug tight condition, this condition may not be considered as a Critical Finding. The determination of HPMF severity is as follows:

- Lvl. 3 = Extreme Severity – needs to be addressed, repaired, or removed within 10 days. For failure rates of over 50% shall be a 3-day limit. These are findings that don't meet the critical finding criteria but should be addressed as soon as possible.

- Lvl. 2 = Moderate Severity – needs to be addressed, adjusted/repaired or scheduled for replacement within 180 days.

5.2.9.3 Reporting Process of HPMFs

The following list outlines the reporting process for a HPMF:

1. If a HPMF is identified during an inspection, the inspector shall contact the Department within 24 hours at the inspection e-mail box (DOT.SAI@dot.ri.gov) as formal documentation unless an e-mail is forwarded to the e-mail box.

2. When reporting HPMFs in BrM, select the appropriate box under maintenance and repair. Next, select Sign Requests for Action and create in BrM.

5.2.10 Routine Maintenance Findings Procedure

Conditions that do not require immediate action but belong on a maintenance schedule are documented under a Routine Maintenance Finding.

5.2.10.1 Reporting Routine Maintenance Findings

Documentation is needed to clearly identify what maintenance is needed. These are findings that should be addressed next time a crew is scheduled to be at the structure. The only reporting process is through the maintenance finding under Maintenance and Repair in BrM and is coded as Lvl. 1 (mild severity).

Chapter 6 Documentation

6.1 Electronic File Organization

This section describes the Department's data filing structure and naming conventions for electronic data. The organization and labeling structure are vital to the inspection data framework for consistency within the State's inventory of ancillary structures. At the time of this Manual's writing, files are uploaded to RIDOT's SharePoint folder of the BrM multi-media tab. Consultants should follow RIDOT's latest directive on file management.

6.1.1 Ancillary Inspection Data Folder Organization and Naming Conventions

The terms and definitions for describing the layout of the ancillary structure inspection data file folder should be labeled as the ten-digit (10-digit) Structure ID and include both a General Info folder and Inspection Folder as described below and illustrated in Figure 6.1-1. Note that the Appendix C Electronic Folder Quick Reference Guide also shows the organization between these three folders:

Ancillary Inspection Folder: The parent folder for all ancillary structure inspection data pertaining to a particular ancillary structure. This folder includes the General Info folder, Inspection Date Folder, and Critical Findings folder (if applicable).

For example, an Ancillary Inspection Folder for Structure ID S-004-05-001 would be labeled as:



General Info Folder: An ancillary structure inspection subfolder containing general information such as contract drawings, clearance sketches, TTC Folder, Plans Folder, special inspection requirements, correspondence, etc.

For example, a General Info folder for Structure ID S-004-05-001 would be labeled as:



Inspection Date Folder: An ancillary structure inspection subfolder containing inspection data specific to the inspection itself, such as inspection photos, Clearance Sketches, inspection sketches, field notes, etc.

To provide consistency within the electronic filing system, the Department requires that the Inspection Folder be named using the following format:

MM.DD.YYT

Where:

MM =	Month of inspection (zero padded 2-digit)
DD =	Day of inspection (zero padded 2-digit)
YY =	Year of inspection (2-digit)
T =	Type of inspection (D = damage, S = interim (special) and miscellaneous, all other types - leave blank)

For example, an Inspection Folder for Structure ID S-004-05-001 for an inventory/initial or routine ancillary structure inspection that was performed on 10-18-2021 would be labeled as:



Alternatively, an Inspection Folder for Structure ID S-004-05-001 for a damage inspection that was performed on 10-18-2021 would be labeled as:



The General Info folder is established for all ancillary structures by the Department. When submitting an inspection report to the Department, the Consultant shall only include this folder in the submittal package if any documents located inside the original folder have changed. This includes any Computer-Aided Design and Drafting (or CADD) drawings for use in the ancillary structure inspection, including the CADD reference files. Otherwise, the Consultant should not include a General Info folder in the submittal if it is not necessary. It is noted that only documents with changes shall be included in this folder. Therefore, it is not necessary to place this folder back in the submittal package if there are no changes to the documents within this folder. The only reason for submitting this folder to the Department is to alert the Inspection staff to update the General Info folder in the Main Database.

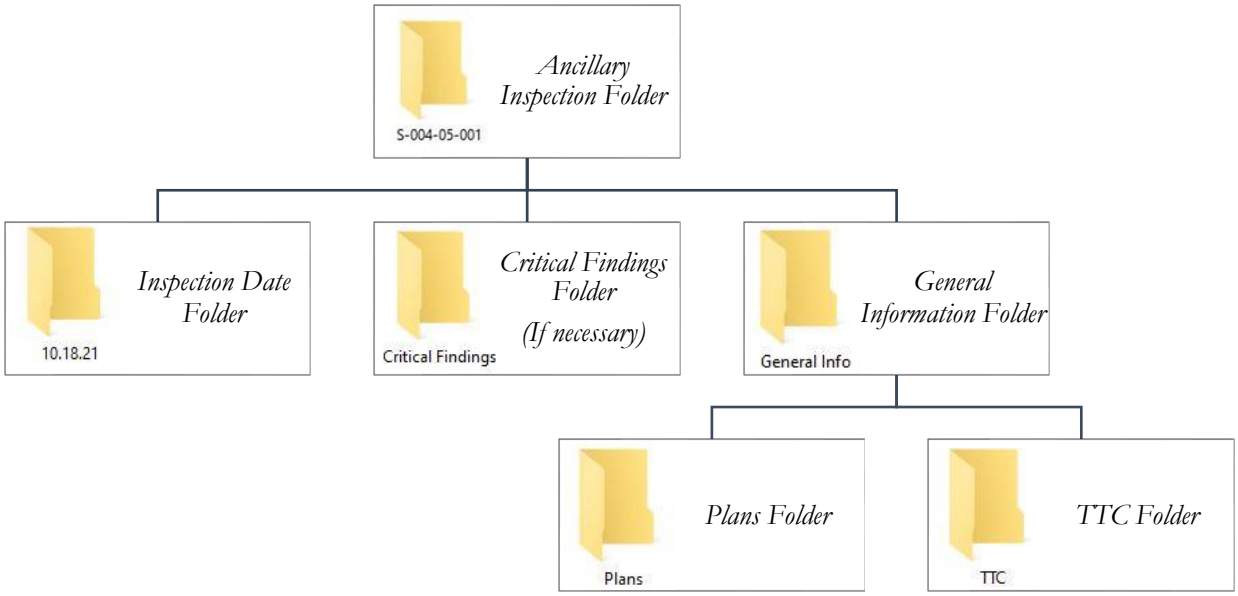


Figure 6.1-1 Ancillary Inspection Folder Layout

6.1.2 Photographic Data Organization and Naming Convention

In addition to the labeled photographs that are to be included within the Inspection Date Folder and within the inspection report (refer to Section 6.3.7 and Section 6.4.3 for more information), the Department also requires that four (4) raw digital photographs be included in the General Info folder if not already included.

Raw digital photographs are defined as digital images that do not contain any labeling or markups. The four (4) photographs should contain a general view of the ancillary structure from the leading (front) and trailing (rear) direction as well as foundation and post/arm connection. These raw digital photographs shall be no greater than 4,000 by 3,000 pixels and be in the *.JPG format. The purpose of the raw digital photographs is for use in future inspection reports and presentations by the Department.

To provide consistency within the electronic filing system, the Department requires that the raw photographs be named using the following format:

X-XXX-XX-XXX_ZZZZ

where:

X-XXX-XX-XXX = Ten-digit (10-digit) Ancillary Structure ID (see Section 4.1.1)

ZZZZ = Abbreviated description (e.g., FrontElevation, RearElevation, Foundation, PostArmConn)

6.1.3 Field Inspection Forms

The following forms are available in Appendix A Blank Forms:

- A.2 Inspection Team Report Evaluation – Form AI-002 (for State use only)
- A.3 Inspection Team Field Performance Evaluation – Form AI-003 (for State use only)
- A.4 Ancillary File Review – Form AI-004 (for State use only)
- A.5 Ancillary Structural Review Recommendation - Form AI-005
- A.6 Critical Finding Log – Form AI-006
- A.8 Ancillary Inspection Report Submittal Checklist – Form AI-008
- A.11 Special Inspection Requirements Form – Form AI-011

6.2 Inspection Reporting Requirements

Given the type of ancillary structure inspection performed, different levels of effort are required regarding reporting and documentation. The following are minimums for reporting and documentation given a type of inspection.

6.2.1 Inventory/Initial Inspection Reports

The inventory/initial ancillary structure inspection report documents all signs of distress and deterioration with sufficient precision such that future inspection teams can make comparisons between the structure's past and current condition. Refer to Section 5.1.1.1 for further information concerning the scope of the inspection. The following represents the State's minimum requirements for a sufficient inventory/initial inspection report.

6.2.1.1 Inventory

After an inventory/initial inspection, the entirety of the inventory needs be populated in BrM. Refer to Chapter 4 for an outline of all inventory items.

6.2.1.2 Inspection Report

For inventory/initial inspection reports, the following is a checklist of required items to be populated in BrM:

- Inspection:
    - Inspection Details – Information regarding the inspection date, type of inspection and a tentative inspection cycle.
    - Inspectors – Information regarding the inspection firm and team.
    - Inspection Tracking – Inspection Group assigned.
    - Access Information – Details of access equipment and lane closures required to complete the inspection.

  - Overall Condition Rating – An overall condition rating for the ancillary structure.
  - Maintenance and Repair – List of maintenance efforts required from report findings.

- Commentary:
  - Scope – Defines the scope of work undertaken during the inspection.
  - Inspector Comments – Describes the ancillary structure's location, a description of the structure and the ancillary structure items it supports, the use of police, the Overall condition rating and the reasoning of the rating if the Overall condition rating is anything but "Good".
  - Inspection – Any extra effort needed for the inspection or details of events that transpired during the inspection, e.g., increase traffic volumes and adequacy of equipment to access all areas of the structure.

- Ancillary Elements:
  - Element table – Populate the table with all relevant elements, quantities, Condition States and appropriate remarks and comments as outlined in 0. For each element, where it's applicable, add the protective coating and any deficiency coding for the element.

- Multimedia, i.e., required files and documents needed:
  - Cover Letter – See Section 6.3.2
  - Post Thickness/D-Meter Readings - See Section 6.3.4
  - Ultrasonic Testing – See Section 6.3.5
  - Clearance Diagram Sketch – See Section 6.3.6
  - Photos – See Section 6.3.7
  - Field Sketches – needed for structural and other critical deficiencies. See Section 6.3.8

- Work Request Items
  - As needed, add any work request items. See Section 6.3.13

6.2.2 Routine Inspection Reports

The routine ancillary structure inspection report monitors all previously documented deficiencies and documents any new signs of distress and deterioration; all with sufficient precision such that future inspection teams can make comparisons between the structure's past and current condition. Refer to Section 5.1.2 for further information concerning the scope of the inspection. The following represents the State's minimum requirements for a sufficient routine inspection report.

6.2.2.1 Inventory

All inventory items need to be confirmed in the field and updated, where necessary, in BrM. Refer to Chapter 4 for an outline of all inventory items.

6.2.2.2 Inspection Report

For routine inspection reports, the following is a checklist of required items to be populated in BrM:

- Inspection:
    - Inspection Details – Information regarding the inspection date, type of inspection and a tentative inspection cycle.
    - Inspectors – Information regarding the inspection firm and team.
    - Inspection Tracking – Inspection Group assigned.
    - Access Information – Details of access equipment and lane closures required to complete the inspection.
    - Overall Condition Rating – An overall condition rating for the ancillary structure.
    - Maintenance and Repair – List of maintenance efforts required from report findings.
- Commentary:
    - Scope – Defines the scope of work undertaken during the inspection.
    - Inspector Comments – Describes the ancillary structure's location, a description of the structure and the ancillary structure items it supports, the use of police, the Overall condition rating and the reasoning of the rating if the Overall condition rating is anything but "Good".
    - Inspection – Any extra effort needed for the inspection or details of events that transpired during the inspection, e.g., increase traffic volumes and adequacy of equipment to access all areas of the structure.
- Ancillary Elements:
    - Element table – Confirm and update with all relevant elements, quantities, Condition States and appropriate remarks and comments as outlined in 0. For each element, where it's applicable, confirm the protective coating and update the deficiency coding for the element.
- Multimedia, i.e., required files and documents needed:
    - Cover Letter – See Section 6.3.2

  - Data Changes Document – needed if new elements are added or an element's total quantity changed since the last inspection. See Section 6.3.3
  - Post Thickness/D-Meter Readings - See Section 6.3.4
  - Ultrasonic Testing – See Section 6.3.5
  - Clearance Diagram Sketch – See Section 6.3.6
  - Photos – See Section 6.3.7
  - Field Sketches – needed for structural and other critical deficiencies. See Section 6.3.8

- Work Request Items
  - As needed, add or update any work request items. See Section 6.3.13

6.2.3 Damage Inspection Reports

A damage inspection report documents structural deficiencies that occurred due to an environmental event or human action. The elements assessed in the report are limited to the damaged elements and any secondary areas that could have been affected by the damage (e.g., post/tower to arm/chord/wire connections, base plates and anchor rods). Refer to Section 5.1.3 for further information concerning the scope of the inspection. The following represents the State's minimum requirements for a sufficient damage inspection report.

6.2.3.1 Inventory

The scope of a damage inspection does not require inventory verification.

6.2.3.2 Inspection Report

For damage inspection reports, the following is a checklist of required items to be populated in BrM:

- Inspection:
  - Inspection Details – Information regarding the inspection date, type of inspection and a tentative inspection cycle.
  - Inspectors – Information regarding the inspection firm and team.
  - Inspection Tracking – Inspection Group assigned.
  - Access Information – As this section deals with access needed for an inventory/initial or routine inspection, do not update.
  - Overall Condition Rating – An overall condition rating for the ancillary structure.
  - Maintenance and Repair – List of maintenance efforts required from report findings.

- Commentary:
    - Scope – Defines the scope of work undertaken during the inspection.
    - Inspector Comments – Describes the ancillary structure's location, a description of the structure and the ancillary structure items it supports, the use of police, the Overall Condition Rating and the reasoning of the rating if the Overall Condition Rating is anything but "Good".
    - Inspection – Any extra efforts needed for the inspection or details of events that transpired during the inspection, e.g., increase traffic volumes and adequacy of equipment to access all areas of the structure.
- Ancillary Elements:
    - Element table – Update the comments/remarks, Condition States (as outlined in 0) and any defect coding for any elements inspected as per the scope and any secondary elements that could be affected by the damage event. The documentation comments should be prefixed to any comments made during the previous inspection and must include within the statement that any observations are being made during a damage inspection. For all other elements that do not fall under this scope, a statement (prefixed to previous documentation, if any) for each of these elements should state that this element was not inspected during this damage inspection and any of the following documentation (if any) corresponds to the previous inspection.
- Multimedia, i.e., required files and documents needed:
    - Cover Letter – See Section 6.3.2
    - Ultrasonic Testing – Needed if there is any impact damage to the structure. See Section 6.3.5
    - Clearance Diagram Sketch – See Section 6.3.6
    - Photos – See Section 6.3.7
    - Field Sketches – needed for structural and other critical deficiencies. See Section 6.3.8
- Work Request Items
    - As needed, add or update any work request items. See Section 6.3.13

6.2.4 Interim (Special) and Miscellaneous Inspection Reports

An interim (special) or miscellaneous inspection report documents elements between inspections or elements not addressed during a previous inspection. Refer to Section 5.1.4 for further information concerning the scope of the inspection. The following represents the State's minimum requirements for a sufficient interim (special) or miscellaneous inspection report.

6.2.4.1 Inventory

Unless any updates/improvements have been made to the structure or there is an obvious error, an interim (special) or miscellaneous inspection does not require an inventory update.

6.2.4.2 Inspection Report

For interim (special) or miscellaneous inspection reports, the following is a checklist of required items to be populated in BrM:

- Inspection:
    - Inspection Details – Information regarding the inspection date, type of inspection and a tentative inspection cycle.
    - Inspectors – Information regarding the inspection firm and team.
    - Inspection Tracking – Inspection Group assigned.
    - Access Information – As this section deals with access needed for an inventory/initial or routine inspection, do not update.
    - Overall Condition Rating – An overall condition rating for the ancillary structure.
    - Maintenance and Repair – List of maintenance efforts required from report findings.
- Commentary:
    - Scope – Defines the scope of work undertaken during the inspection.
    - Inspector Comments – Describes the ancillary structure's location, a description of the structure and the ancillary structure items it supports, the use of police, the Overall condition rating and the reasoning of the rating if the Overall condition rating is anything but "Good".
    - Inspection – Any extra effort needed for the inspection or details of events that transpired during the inspection, e.g., increase traffic volumes and adequacy of equipment to access all areas of the structure.
    - Previous Notes – document any previous documentation from "Inspection" (above) from the most recent inspection report.
- Ancillary Elements:
    - Element table – Update the comments/remarks, Condition States (as outlined in 0) and any defect coding for any elements inspected as per the scope. The documentation comments should be prefixed to any comments made during the previous inspection and must include within the statement that any observations are being made during an interim (special) or miscellaneous inspection. For all other elements that do not fall under this scope, a statement (prefixed to previous documentation, if any) for each of these

elements should state that this element was not inspected during this interim (special) or miscellaneous inspection and any of the following documentation (if any) corresponds to the previous inspection.

- Multimedia, i.e., required files and documents needed:
    - Cover Letter – See Section 6.3.2
    - Ultrasonic Testing – Needed if there is any impact damage to the structure. See Section 6.3.5
    - Clearance Diagram Sketch – See Section 6.3.6
    - Photos – See Section 6.3.7
    - Field Sketches – needed for structural and other critical deficiencies. See Section 6.3.8
- Work Request Items
    - As needed, add or update any work request items. See Section 6.3.13

6.3 Inspection Report Documentation

6.3.1 Terminology and Standard Abbreviations

Acceptable ancillary terminology and abbreviations shall be used in all inspection reports submitted to the State. Use terminology consistent with the information within this document. Refer to Section 3.1. for common terminology and Appendix D Glossary for inspection terminology.

Note that abbreviations are not permitted for any text located on photographs or within photo documentation.

6.3.2 Report Cover Letter

The report cover letter is typically the first page of the final delivered ancillary structure inspection report. The file shall be uploaded in BrM in document format (i.e., *.pdf). The purpose of the report cover letter is to summarize the following (see Figure 6.3-1):

- Recipient(s) of the finalized ancillary structure inspection report;
- Task or project from which the inspection was assigned;
- Type of ancillary structure inspection performed (e.g., initial, routine, damage, etc.);
- Ancillary Structure Identification Number;
- Date of previous inspection and inspection type (if Inventory Inspection, note “N/A – Inventory Inspection”)’
- Submission date of the report;

- Date when the ancillary structure inspection was completed; and
- Stamp of a Rhode Island registered Professional Engineer certifying the ancillary structure inspection.

February 28, 20XX
XXXXXX
Managing Engineer
Bridge Engineering Section
RIDOT Headquarters
2 Capitol Hill
Providence, Rhode Island, 02903

RE: Statewide Ancillary Inspection
MPA No. XXX, AWARD No. 1234567

Dear XXXXX:

Engineering Firm is pleased to submit the Inventory Inspection report for the following ancillary structure:

Ancillary Structure No. S-0095-00-001: Full Span VMS over I-95 NB & SB at Milepoint 0, Ashaway
Date Inspection Completed: 2/4/20XX (Inventory)
Date Submitted: XX/XX/20XX

If you have any questions and/or concerns regarding this correspondence or any other issue, please feel free to contact us at your convenience.

Sincerely,

XXXXXX
Engineering Firm

cc: XXXXXX

Figure 6.3-1 Example Report Cover Letter

6.3.3 Data Changes Document

The data changes document provides a list of changes or corrections that were made to the ancillary structure data from the previous inspection report. The file shall be uploaded in BrM in PDF format and with the source file (i.e., *.doc, *.docx). This document identifies elements as well as the reasoning behind the change or correction (see Figure 6.3-2).

For elements, the element number and name/description is noted, along with any changes to the total quantity and the appropriate reason for the change.

ELEMENT AND INVENTORY CHANGES
Structure ID 934307: No. S-0095-00-001: Full Span VMS over I-95 NB & SB at Milepoint 0, Ashaway
Inspection Date: April 24, 20XX

The following is a list of changes made to elements and the reasoning behind the changes.

Element Quantities:

- Element 241 - Single Arm Cantilever, Steel
  - From: 28 ft.
  - To: 30 ft.
  - Reason: Field verification

- Element 401 - Sign Frame, Steel
  - From: 3 (Each)
  - To: 6 (Each)
  - Reason: Addition of new sign panels

- Element 411 - Sign Panel, Aluminum
  - From: 2 (Each)
  - To: 4 (Each)
  - Reason: Addition of new sign panels

Inventory:

- Structural Information > Geometry > Min. VC NB/EB
  - From: 17.42 ft.
  - To: 17.20 ft.
  - Reason: New sign panel controls for vertical clearance

- Structural Information > Geometry > Span/Arm 1 Length
  - From: 27.82 ft.
  - To: 30.12 ft.
  - Reason: Field verification

- Signs Panels
  - From: Inventory descriptions of Panel Num. 1 and 2
  - To: Inventory descriptions of Panel Num. 1 through 4
  - Reason: New sign panels installed

Figure 6.3-2 Example Data Changes Document

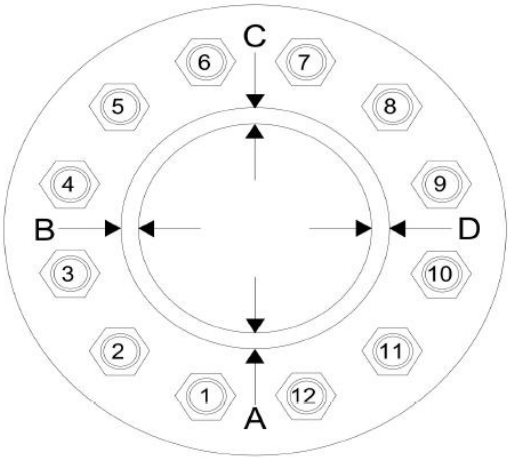
6.3.4 Post Thickness Readings

During Inventory Inspections, or if visual/past inspections deem it necessary, post thickness readings need to be taken at the base of post-type structures. The methodology for this process, traditionally carried out with a D-Meter, is laid out in Section 8.8.1. The findings need be documented in a tabular format with a cross-section plan view showing the locations of the measurements so section loss can be tracked (see

Figure 6.3-3). The file shall be uploaded in BrM in PDF format and with the source file (e.g., *.xls, *.xlsx). The PDF document and source file will also be kept in the Ancillary Files.

POST D-METER THICKNESS READINGS

Structure Number:			
Inspection Date:			
Consultant:			
Route:		Town:	



Direction of Travel

NTS

CANTILEVER, TWELVE (12) BOLT

ANCHOR BOLT DIAMETER:
NUT SIZE:
BASE PLATE THICKNESS:
BASE PLATE SIZE:

AB-AB CENTERLINE:
POST CIRCUMFIRENCE/DIAMETER:
FOUNDATION SIZE:
BASE PLATE TO FOUNDATION:

NOTES:
1) D-METER MEASUREMENTS TAKEN ON FOUR SIDES OF EACH POST WITH THE 'A' SIDE OF THE POST ALWAYS LOCATED ON THE ROADWAY SIDE OF THE POST AND ALL OTHER MEASUREMENTS TAKEN IN THE CLOCKWISE DIRECTION AROUND THE POST.

2) D-METER MEASUREMENTS TAKEN JUST ABOVE THE BASE PLATE WELD.

3) REFERENCE MEASUREMENT TAKEN ON EACH POST AT ±2' ABOVE THE TOP OF THE BASE PLATE ON THE 'A' SIDE OF THE POST.

Date	Location	A	B	C	D	Reference

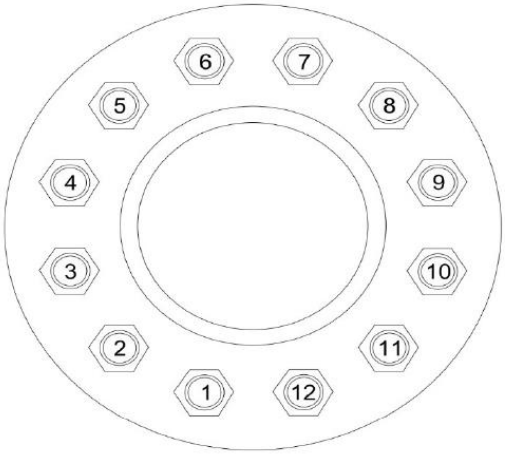
Figure 6.3-3 Post D-Meter Thickness Reading Example

6.3.5 Ultrasonic Testing

Ultrasonic Testing (UT) is performed to detect the presence and location of indications in anchor rods. UT frequencies vary by the type of structure, see Section 5.1.2.2. The UT needs to be documented with the necessary technical specifications of the test and equipment used with the findings presented in a tabular format and a cross-section plan view showing the anchor rod numbering (see Figure 6.3-4). The file shall be uploaded in BrM in PDF format and with the source file (e.g., *.xls, *.xlsx). The PDF document and source file will also be kept in the Ancillary Files.

	ULTRASONIC TESTING OF ANCHOR BOLTS			
	Structure Number:			
	Inspection Date:			
	Consultant:			
	Route:		Town:	

Technician	Type of Machine & Serial No.:	Epoch 600/160958109
Name:	Search Unit Under Zone (L=D2/4λ):	1.347"
ASNT Level:	Smallest Detectable Defect (0.5λ):	0.023"
Anchor Rod Dimensions	Search Unit Beam Spread (sinθ-1.22λ/d):	1.366"
Diameter:	Search Unit Manufacturer:	Olympus
Length:	Search Unit Diameter & Frequency:	Gamma / 0.50" / 5Mhz
Structure Type	Couplant Manufacturer & Grade:	Sonotech Ultragel



Direction of Travel

NTS

Cantilever, 12 Bolt

Post Bolt No.:	Indication & Location	Location of Post	Accept	Reject	Remarks
1		Right Post	X		
2		Right Post	X		
3		Right Post	X		
4		Right Post	X		
5		Right Post	X		
6		Right Post	X		
7		Right Post	X		
8		Right Post	X		
9		Right Post	X		
10		Right Post	X		
11		Right Post	X		
12		Right Post	X		

Figure 6.3-4 UT Documentation Example

6.3.6 Clearance Sketches

In general, clearance sketches are included with each inspection report. If the structure orientation has yet to be established, a sketch must be provided and must contain the following information:

- Elevation: Elevation in the orientation of the inventoried roadway direction or from an orientation that makes the most sense for the inspection (see Figure 6.3-5, Figure 6.3-6 and Figure 6.3-7). These elevation sketches must include, at a minimum:
    - Vertical clearance of all ancillary structure devices over the roadway and shoulders (most restrictive). If any structural elements are lower than the ancillary structures over the roadway, document the most restrictive vertical clearance over the roadway;
    - Horizontal clearance from the roadside shoulder to the bottom of the vertical support and the horizontal dimensions of any adjacent shoulders, sidewalks and barriers when applicable;
    - The roadway and direction underneath (e.g., I-95 SB);
    - Diameters of vertical and horizontal supports; and
    - Linear dimensions/locations of vertical supports, horizontal support, sign panels, splices, and post/tower to arm/chord connections.
- Completed drafts using a minimum of AutoCAD 2000 software, with one file for each ancillary structure, having the file name [Structure ID]_Clearance.DWG and stored in the folder of the ancillary; and
- The clearance should using the following name convention: [Ancillary Structure ID]_Clearance.PDF.
    - The file shall be uploaded in BrM in PDF format and with the source file and accompanying files (i.e., *.DWG, *.LOG, *.BAK). The PDF document and source file will also be kept in the Ancillary Files.

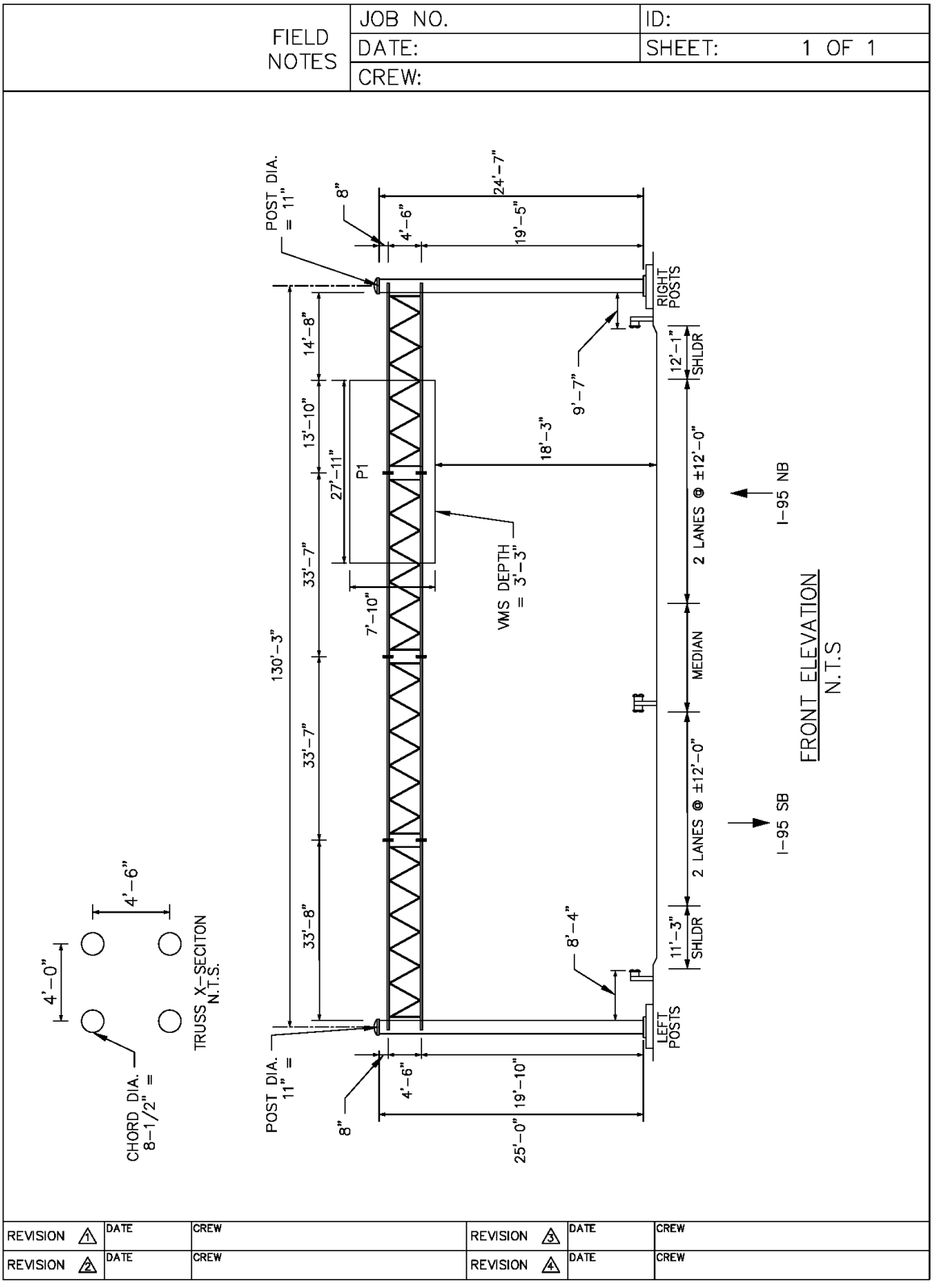


Figure 6.3-5 Sign Structure Clearance Sketch Example

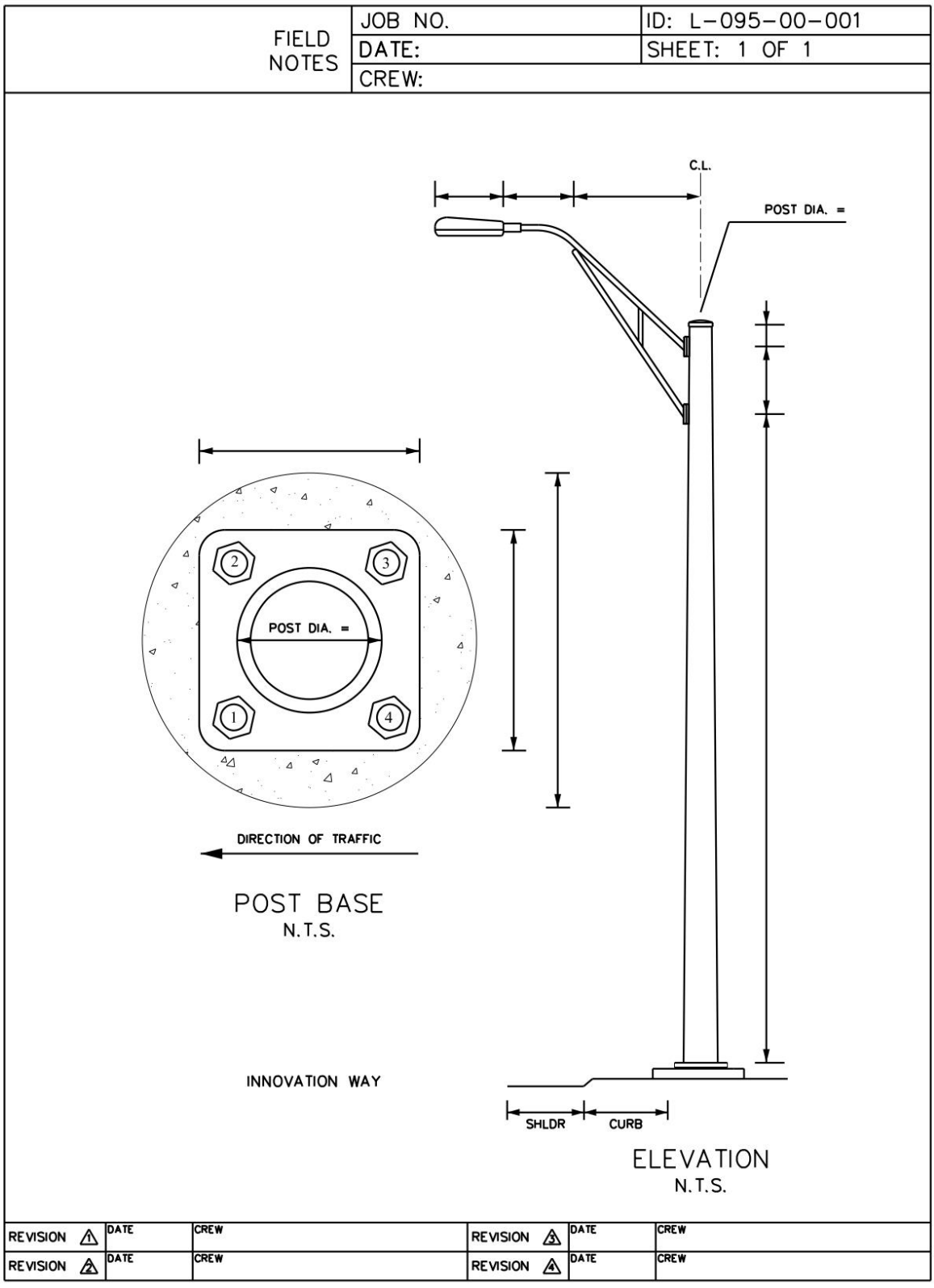


Figure 6.3-6 Lighting Structure Clearance Sketch Example

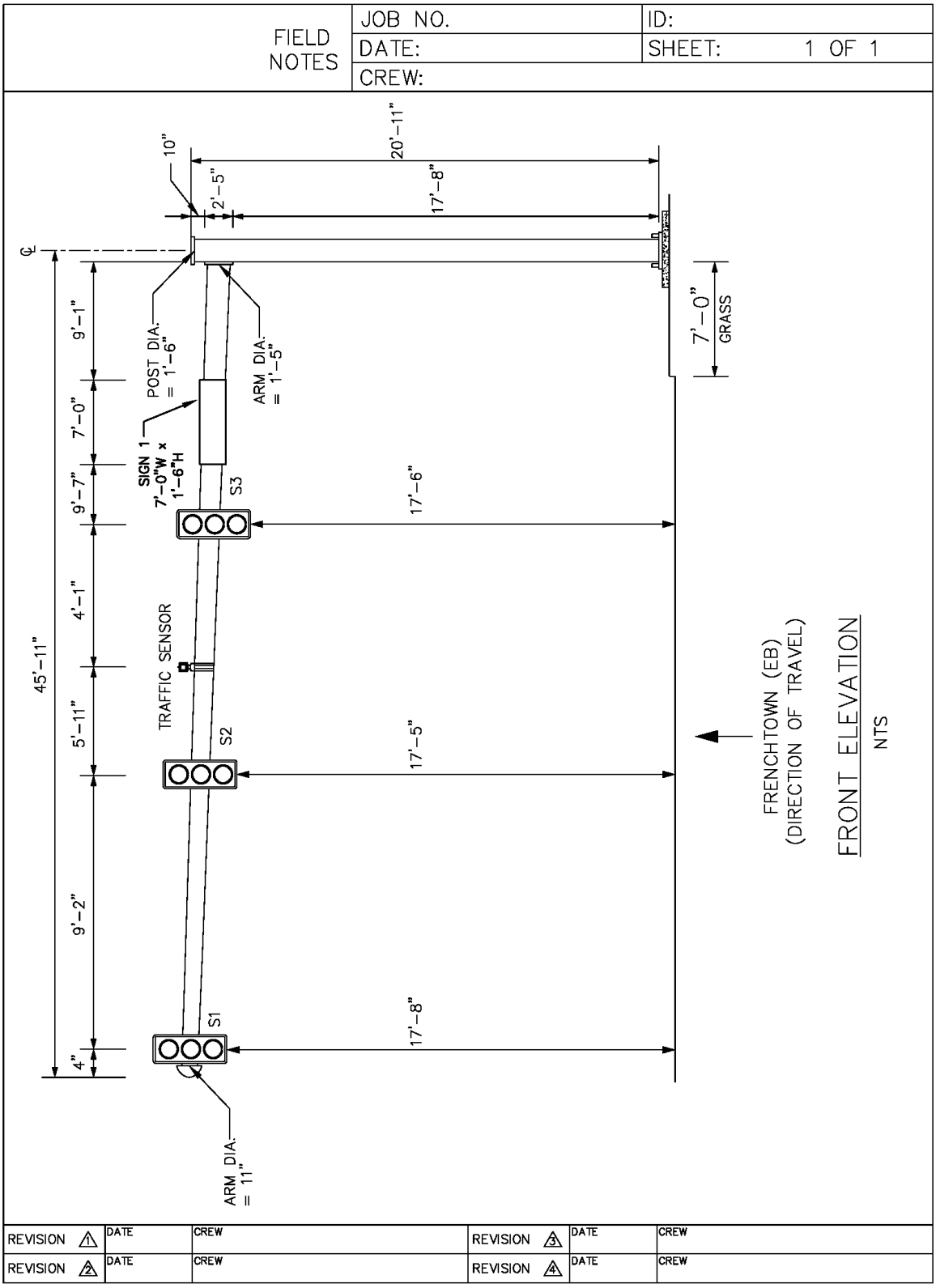


Figure 6.3-7 Traffic Signal Structure Clearance Sketch Example

6.3.7 Photo Documentation

Photographs are essential for a good inspection report. The State requires that every photograph include the photo number, annotation of the ancillary structure, comment(s) regarding the structure and location on the structure, Ancillary Structure No., photo orientation (viewing angle of the picture relative to the orientation or traffic direction), photo taken date, and any other pertinent information. Abbreviations are not allowed for text entered on the photograph.

A minimum of four (4) photographs are required for the inspection report: leading elevation (see Figure 6.3-8); trailing elevation (see Figure 6.3-9); foundation, bottom vertical support connection, or connection to bridge (see Figure 6.3-10); and post/tower to arm/chord/wire connection or mount (see Figure 6.3-11). It is recommended that pictures also be taken of any problem areas, even if the deficiency can be explained solely in writing.



Figure 6.3-8 Example Leading Elevation Photo



Figure 6.3-9 Example Trailing Elevation Photo

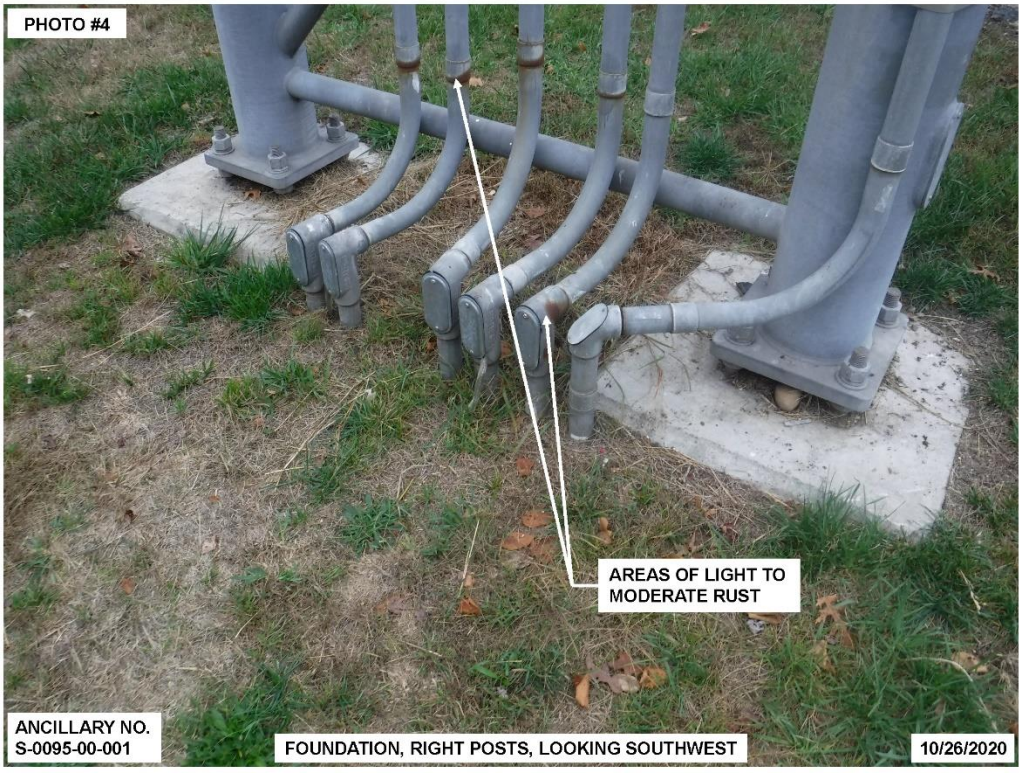


Figure 6.3-10 Example Base Photo

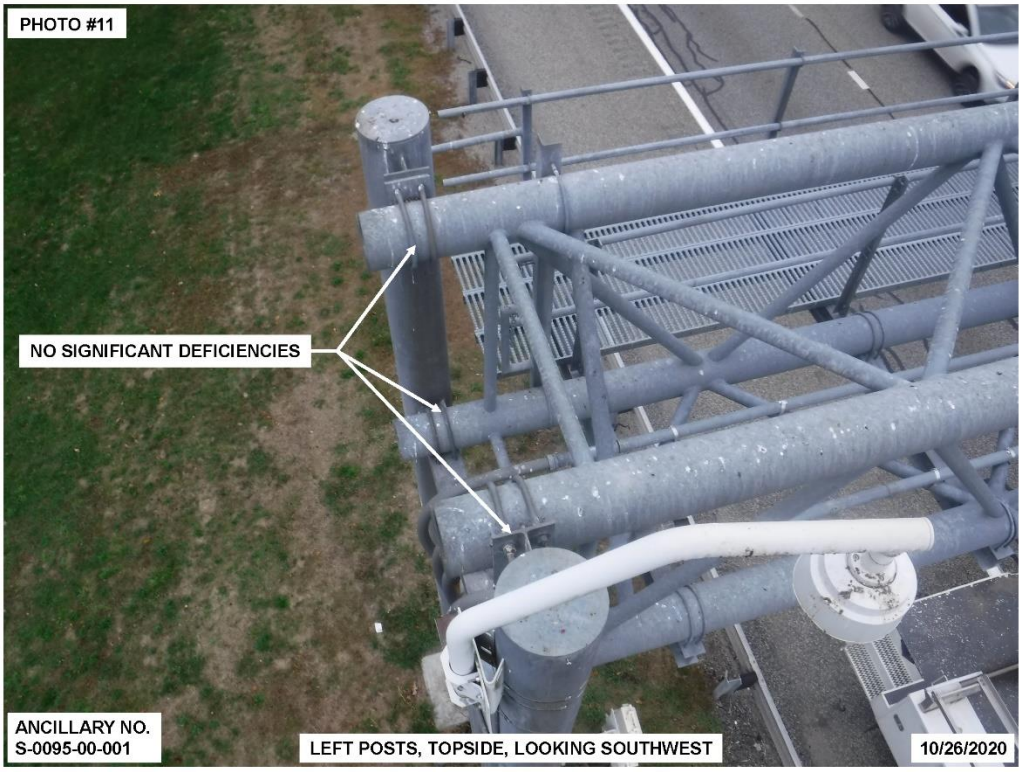


Figure 6.3-11 Example Tower to Chord Connection Photo

The photos shall be uploaded in BrM in PDF format which will also be kept in the Ancillary Files.

6.3.8 Field Sketches

Field sketches are often needed to clarify conditions of structural elements and locations of any deficiencies. The field sketch should include, at a minimum: the ancillary structure number; inspection date; sheet number; crew; brief description; roadway and its directions; identification of ancillary components/elements; general notes (if applicable); noteworthy deficiencies complete with field measurements and accompanying notes; legend or key; revision box; scale or Not to Scale note; and any other pertinent information (see Figure 6.3-12).

As an alternative, previously recorded sketches may also be modified in the revisions box to account for changes in the ancillary's condition. This will save time and effort in the field, as the inspector will only need to note the changes to the previous sketch and not re-record the same deficiencies. The revised field sketch should clearly indicate the revisions made to the original sketch, all information for an otherwise original sketch, and all other pertinent information.

In addition to satisfying the above requirements, sketches shall also be:

- 8.5 inch by 11 inch;
- Legible
- In Adobe *.PDF format; and
- Stored electronically (source CADD and supporting files) in the inspection folder.

Any field sketch (whether newly established or revised sketches) should be complete and detailed enough such that structural analysis can be performed based on the information provided on the sketches.

SIGN CLIPS TABLE

Structure Number:	S-0295-11-007		
Inspection Date:	11/07/2023		
Consultant:			
Route:	I-295 NB	Town:	Johnston

Panel	# Clips Per Plan	# Clips Loose	# Clips Missing	# Clips Replaced	# Clips Alum. Bolts	# Clips Steel Bolts	# Bolts Broken While Torquing	# Nuts Broken While Torquing
1	N/A	0	0	0	0	12	0	0
2	N/A	0	4	0	0	66	0	0
3	N/A	0	0	0	0	12	0	0
4	N/A	0	0	0	0	72	0	0
TOTALS	N/A	0	4	0	0	162	0	0

Notes:
- All clips noted as loose were tightened at time of inspection.
-The four (4) missing friction clips for Panel 2 are missing due to impact damage. RIDOT was notified of the impact damage via email 11/13/2023.

Figure 6.3-12 Example of an Ancillary Field Sketch

6.3.9 List of Specialized Tools and Equipment

Specialized tools and equipment that were required during the ancillary structure inspection should be noted in the inspection report (see Figure 6.3-13).

Examples of specialized tools and equipment include, but are not limited to, the following:

- Dye penetrant and or magnetic particle equipment;
- Zinc rich primer to coat any exposed metal from grinding;
- D-Meters;
- Ultrasonic Testing (UT) equipment;
- Electronic distance measurement (EDM) device;
- 4’ level, torpedo level, tilt meters/angle finder, and/or plumb bob;
- Torque wrench and/or multiplier;
- Ladders, which should be positioned according to the proper 1H to 4V ratio;
- Manlifts;
- Scissor lifts;
- Bucket trucks; and
- Inspection vehicles.

Refer to Section 5.2.2.3 for more information regarding inspection equipment.

Ancillary Notes:
Traffic Signal No. T-0004-03-001, supporting two (2) traffic signals over RI-2 northbound and southbound, was inspected on 11/10/20XX. Note that the left and right posts are shared with two (2) adjacent span wire structures at the intersection. Orientation: The structure is oriented with respect to RI 4 Northbound, having a south leading elevation and north trailing elevation. Weather: 11/10 – 74 degrees Fahrenheit, clear. Overall Rating: 'Fair' due to one (1) loose anchor rod nut. Traffic Control and Equipment Used: Daytime lane closures were utilized and the equipment consisted of a 40' bucket truck, traffic control and state police assistance. Specialty Tools: D-Meter; Ultrasonic Testing (UT) equipment, 8' folding ladder. Utilities: Adjacent to the right post, there is a manhole cover that has a partial collapsed catch basin. The manhole cover is unstable and there is a gap around the cover which is a potential tripping/falling hazard (See Photo 24). Vegetation: There is light to moderate vegetation growth around the left foundation (See Photo 7). Debris: There was light debris accumulation along the right foundation that was removed prior to inspection.

Figure 6.3-13 Example Ancillary Inspection Notes

6.3.10 Utility Documentation

Utilities are often exclusively documented within the inspection notes (see Figure 6.3-13). Utility locations, configuration, material/size should be documented. If deficiencies are present on the utilities, photographs may also be incorporated within the ancillary structure inspection report for added clarification (see Figure 6.3-14).



Figure 6.3-14 Example of Utility Documentation (Supplemental Photograph)

6.3.11 Minimum Vertical Clearance

During a routine inspection, if an ancillary structure is over the roadway, the minimum vertical clearance shall be verified with the previous inspection report and inventory. If the minimum clearance has changed, it should be indicated on the Clearance Sketch (see Figure 6.3-5, Figure 6.3-6 and Figure 6.3-7 for examples), in the inspection report under the element that is affected, and in the respective vertical clearance sections of the inventory.

The minimum vertical clearance should take into consideration the entire structure, e.g.: sign panels, lighting, traffic signals, utilities, and any other appurtenance that is attached to the structure over the roadway; including paved shoulders. Critical points that may determine the minimum vertical clearance include the edge of the roadway, outside edge of the shoulder, and the center of the roadway (e.g., at the roadway's crown).

As per the 2007 Rhode Island LRFD Bridge Design Manual (Section 2.1.2.1 Vertical and Horizontal Clearance - Highway Structures):

> *"In general, the minimum design vertical clearance will be 14'-3" over all lanes and shoulders. Structures on the National Highway System and major interstate highway truck routes shall have a 16'-3" minimum vertical clearance. The above-specified clearances include the provision for an additional 3-inch future wearing surface. The vertical clearance shall not be less than 13'-6" for*

the special cases when an exception to the above minimum clearances is warranted and approved by the Department.'

The most restrictive vertical clearance shall be entered into the Inventory of BrM. The minimum clearance for each direction of travel shall be provided.

6.3.12 Element Level Documentation

Identification of elements and their total quantities shall be done prior to inspections, if possible from plans. Proper identification of ancillary elements includes:

- Reviewing the original plans, rehabilitation plans, previous inspection reports and photographs;
- Identifying all elements and their element numbers per 0 of this document and as supplemented by the Department;
- Calculating total quantities for the identified elements; and
- Including the elements, element numbers and their total quantities in the permanent record, including plan drawings and/or calculations.

6.3.13 Work Requests

For deficiencies noted during the inspection, work recommendations or actions that should be taken need to be listed. Relevant information that needs to be included, but is not limited to:

- Action or work requested
- What type of work is needed, e.g., electrical or contractor
- Estimate of materials needed
- Priority of the work
- Notes describing the deficiency and description of the work needed

6.3.14 Video Documentation

Although not required by the Department, video documentation may be a very appropriate and efficient way of documenting a deficiency for certain situations. Examples of video documentation may include documenting excessive vibration or movement of structural components.

The video should contain adequate lighting and should be focused adequately to capture the deficiency. If provided to the State, the video should be submitted via email in a common video format. In the case of a critical finding, a short video should be e-mailed to the State at the time of the finding.

6.4 Ancillary Files

6.4.1 Ancillary As-Builts/Plans

Existing plans (if available) for the ancillary structure are stored electronically and can be accessed from the Plan Room of the Rhode Island Department of Transportation.

6.4.2 Correspondence

Ancillary files shall contain a copy of any applicable correspondence. Types of correspondence include letters, memos, etc. Correspondence is stored electronically in the General Info folder. Refer to Section 6.1.1 for more information regarding data folder organization.

6.4.3 Photographs

Photographs for ancillary structures are stored electronically on the State server.

The State requires that all photographs be taken using a digital camera. Digital photographs shall be saved into a *.JPG file format, have a minimum resolution of 1024 x 768 pixels and a maximum resolution of 4000 x 3000 pixels, be appropriately labeled as shown in Figure 6.3-8, Figure 6.3-9, Figure 6.3-10, and Figure 6.3-11 and shall fulfill all the requirements as outlined in Section 6.3.6. All the photographs for a particular ancillary structure are to be within the same file, with the file size not exceeding 100MB. Should this limit be exceeded, additional files are to be created as needed.

Each photograph shall be named Photo N-XXX.XXX where N is the specific photograph number and XXX is the number of photographs contained in the file. The photograph files will be stored in the Inspection Folder subfolder of the Ancillary Inspection Folder.

6.4.4 Specifications

Department files shall include a complete copy of the specifications used to design and build the ancillary structure. The edition and date of the general specifications are noted on the Plans.

6.4.5 Maintenance and Repair History

Ancillary Structure files shall include information regarding repairs and rehabilitation activities. This information includes details such as the date, project description, contractor, cost, contract number, and any other related data.

Refer to Section 5.2.2.1.3 for more information regarding maintenance and repair history.

6.4.6 Traffic Data

The average daily traffic (ADT) data is taken from the most adjacent relevant bridge on the same route. Traffic signals do not require count data; only the structures located on the state highways, i.e., signs, toll gantries and highway lighting.

6.4.7 Inspection History

Previous inspection reports are often very useful in determining specific locations that require special attention during the inspection. Furthermore, information from previous inspections can be compared against current conditions to estimate rates of deterioration, help judge the seriousness of the problems

detected, and anticipate the remaining life of the structure. Refer to Section 5.2.2.1.2 for more information regarding previous inspection reports.

The inspection history contained in the ancillary structures file includes a chronological record of inspections performed on the ancillary structure, including the dates and types of inspections beginning with the inventory inspection.

6.4.8 Inspection Requirements

Inspections are planned and prepared for by considering methods of access, inspection tools and equipment, structural details, inspection types, and the required qualifications of inspection personnel.

- Identify special access needs or equipment necessary to gain the access required to inspect the ancillary structure, such as inspection vehicles, manlifts, ladders, etc.
- Describe the inspection method(s) and frequency to be used for the elements. An example of possible language: "Visually inspect all structural members at arm's length for cracks, deterioration, missing bolts, loose connections, broken welds, etc. Use dye penetrant testing to verify the existence of suspected cracks."
- Address the required proximity to details (e.g., arm's length) during the inspection.
- Identify the special qualifications required of the inspection personnel as designated by the State's program manager.
- Prepare an appropriate traffic management plan as required.

In addition, other potential items to be addressed (depending on each unique situation) may include:

- Important contacts and special contacting procedures prior to inspection (e.g., local municipalities, security, operations personnel);
- Safety concerns (e.g., poison ivy, barbed wire); and
- Seasonal scheduling considerations (e.g., seasonal traffic conditions, snow, or ice).

6.4.9 Inventory Sheets

Ancillary structure files shall contain a chronological record of updated inventories for the ancillary structure.

6.4.10 Inventories and Inspections

Inspection reports are part of the ancillary structure. This information includes the results of all inventories and ancillary structure inspections. Construction or repair activities may also be included. Refer to Section 6.4.7 for more information.

6.4.11 Use of Ancillary Structure Files

All ancillary structure files are vital to the planning, scheduling, inspection, maintenance, and history of each ancillary structure. Therefore, storing of the files on the State server must be carefully monitored. If

any hard copy of a document (e.g., plans) is removed from State storage, a reference sheet should be inserted in the place of the removed document noting the date, item removed, person responsible, firm, contact information, etc. (see Appendix C Electronic Folder Quick Reference Guide).

Chapter 7 Quality Assurance/Quality Control

7.1 Purpose and Scope

RIDOTs Quality Assurance and Quality Control Plan (QA/QC Plan) establishes a detailed process which ensures conformance with this manual and related RIDOT requirements. This includes a comprehensive examination of all parts of ancillary structure inspection: staff qualifications, field procedures, technical/engineering accuracy, documentation and inventory.

Quality Control is a careful examination of field procedures and documentation to ensure consistency and compliance with this manual.

Quality Assurance is an assessment of the ancillary structure inspection program to determine that all policies, procedures and guidelines established in this manual, are being accomplished.

Ancillary inspections within the State are performed by consultants who are retained and managed by RIDOT. The consultant's QC/QA Plan shall complement RIDOT's QA/QC Plan to maintain/improve the quality of RIDOT's ancillary structure inspection program and its deliverables.

7.2 Quality Control

Quality control shall be performed by the consultant. The consultant shall apply the provisions of quality control to the subconsultant(s) and/or subcontractor(s).

RIDOT expects the consultant management to perform quality assurance of its staff to promote excellence in its service and in its deliverables.

At the start of the project, the consultant Project Manager shall:

- Provide RIDOT with the QC/QA Plan.
- Provide RIDOT with a written *Quality Assurance Statement*.

The consultant's Quality Control Plan shall consist of:

- Staff qualifications and performance.
- Field procedures.
- Data.
- Documents.
- Rectification.

7.2.1 Staff Qualification and Performance

The consultant's Project Manager is responsible for ensuring that the qualifications of the inspection staff remain current and compliant with this manual.

Routine performance evaluations of the inspection staff shall assess:

- Adherence to the consultant and RIDOT policies.
- Conformance to this manual.
- Competency in technical/engineering assessment.
- Completeness of inspection and inventory data.
- Completeness of documents such as notes, photos, sketches and plan updates.
- Field procedures including equipment use and safety.
- Report preparation and data submission.
- Meeting scheduled dates for inspection and submission.
- Professionalism of conduct.

7.2.2 Scheduling

The consultant's Project Manager is responsible for the completion of ancillary structure inspection by their due dates, as follows:

Assignment: The consultant is assigned a Group of ancillary structures by the RIDOT Bridge Inspection Unit (BIU), including the type of inspection to be performed. The consultant is provided all previous ancillary structure inspection information by BIU, if available.

Scheduling: Ancillary structures in these Groups, usually by Route, are assigned to the consultant approximately 3 to 6 months in advance of their collective due date by the Bridge Inspection Unit (BIU). This allows the consultant to develop, submit and obtain approval of cost proposals, to procure appropriate resources including WZTC and access equipment in a timely manner.

Tracking: As per Chapter 5, the consultant shall demonstrate commitment to timely inspections by submitting schedules for Weekly Work Schedule, Daily Inspection Notification, and the Weekly Inspection Summary Reports.

7.2.3 Field Procedures

7.2.3.1 Pre-Inspection: Scheduling, planning, and preparation.

Prior to starting any work in the field, the consultant's Project Manager and the team leader should consider the following:

1) Ensure that inspection meets the scheduling requirements: see Chapter 5.
2) Maximize efficient use of labor, Work Zone Traffic Control (WZTC) and special access equipment.
3) Minimize travel distance between ancillary structures.
4) Minimize traffic disruptions.
5) Successive inspections performed by the same inspector should be avoided if scheduling allows it.

6) Job Hazard Analysis: although an on-going process, all potential hazards must be identified, evaluated and mitigated. This may affect:
    - The quantity and qualification of inspection teams.
    - The access equipment being used.
    - The inspection methodology including coordination with other involved entities.
    - The Personal Protective Equipment (PPE) being used.
    - The inspection tools being used.
    - Appropriate WZTC.

1. Before scheduling an interim/miscellaneous inspection, contact the RIDOT Program Manager to verify if the concerned conditions have been repaired/mitigated and if the inspection is still necessary. A concerned condition may be due to deficiency or a natural/manmade event. Verify if flags are still active and inspection is still necessary.

7.2.3.2 Inspection: Site scope, WZTC, Safety, Inspection and Inventory.

Under the consultant's Project Manager's oversight, the Team Leader is responsible for the following:

To satisfactorily complete an inspection the listed factors are influenced by the time of inspection: day/night, limited time window.

Site scope: Upon arrival at the work site, the inspection team should scope the site to ensure that access equipment, inspection methodology and available tools, are appropriate for a successful inspection. The team leader should verify the location of the ancillary structure via GPS coordinates and other pertinent information relating to the inventory.

WZTC: The team leader should ensure that the WZTC is appropriate for the protection of the public as well as the inspection team including the staff of the WZTC subcontractor.

Safety: The team leader should ensure that best safety practices are implemented by all personnel on site and by any authorized visitors to the site, for the duration of the inspection. This includes the usage of appropriate Personal Protective Equipment (PPE).

Inspection: The team leader should determine a well-planned sequence to ensure a systematic and thorough inspection. The inspection team should perform a "hands-on" inspection of all the structural elements as required by this manual.

Inventory: The inspection team shall identify and provide the relevant measurements for all structure inventory components including changes to the listed inventory.

7.2.4 Post-Inspection Procedures (office)

An inspection report is an electronic stand-alone document compiled from information collected during the field inspection of structures. Depending on the type of inspection and the condition of the structure, the consultant's Project Manager should assess the following for completeness, accuracy, and timeliness: Report Contents, Element Assessment, Submissions, Critical Findings, Related Documents, Resolutions.

Report Contents: Information for items should be appropriately completed. All notes and sketches (D-Meter and UT reports if applicable) should be sufficiently descriptive for both the current reader and for the future Team Leader. Photographs should provide an adequate perspective and detail. There should be no discrepancy in the various aspects correlating with each other.

Element Assessment: Elements and any defects should be correctly identified and quantified. Element quantities should be a fair estimate of the Condition State.

Submissions including notifications: the consultant's Project Manager and the Team Leader should submit before the due date.

Critical Findings: The Team Leader shall determine the urgency of a defect and validate the critical finding with the Project Manager. Critical Finding shall be promptly reported to RIDOT BIU as per Chapter 5.

Related Documents: Information for all items should be appropriately completed.

Resolutions: Discrepancies shall be addressed with training as appropriate.

7.2.5 Field Reviews

The consultant's Project Manager shall visit each inspection team in the field twice a year or more when necessary. This field review of an ancillary structure inspection in-progress, should assess:

- The inspection team's understanding of the policies and procedures governing ancillary structure inspections.
- The inspection team's technical/engineering understanding of ancillary structures.
- The inspection team's understanding of timeliness, efficiency and safe conduct.

Field reviews should be primarily unscheduled. Field Reviews shall be documented and submitted to RIDOT BIU.

7.3 Quality Assurance (QA) Procedures

Quality assurance shall be performed by RIDOT Bridge Inspection Unit (BIU).

7.3.1 Staff Qualification

RIDOT's Program Manager is responsible for tracking ancillary structure inspection staff qualifications and maintaining these in the Qualifications Database which will include supporting documentation.

7.3.2 Scheduling

Assignment: The BIU assigns each ancillary structure to a Group and identifies the type of inspection to be performed. The BIU provides all previous bridge inspection information to the Consultant for use in the upcoming inspection, if available.

Scheduling: The BIU assigns the ancillary structures in these Group(s), usually by Route, to the project manager approximately 3 to 6 months in advance of their collective due date. This allows the consultant sufficient time to procure the necessary resources to address RIDOT proposal requirements and establish work mobilization.

Tracking: All inspections must be completed by the established due dates (the inspection date). The subsequent reports shall be submitted within 60 days from the inspection date.

RIDOT BIU shall:

- Track the inspection completion and report submittal dates based on the Ancillary Inspection Weekly Summary Report (AI-007) (see A.7 Weekly Inspection Summary Report – Form AI-007).
- Prepare upcoming inspection lists (3-to-6-month future outlook).
- Submit quarterly status reports to the RIDOT Program Manager. The report will list the number of ancillary structures that were scheduled to be inspected, the number of ancillary structures inspected, and a plan of action proposed to get back on schedule if needed for the previous quarter. The report will also list the number of inspection reports that should have been submitted, the number of inspection reports that were submitted, and a plan of action proposed to get back on schedule if needed for the previous quarter.

7.3.3 Review and Validation of Inspection Reports and Data

RIDOT BIU shall review all inspection reports with a Condition State of CS-3 or CS-4 of all major elements. BIU may review additional reports as needed. The general review procedures are:

1. Review of the inspection report to check that all applicable fields have been recorded.
2. Review the elements, quantities, and condition states as per 0.
3. Check that all inventory information is recorded in accordance with the Inventory guidance in Chapter 4.
4. Check to make sure that any critical findings were promptly reported to RIDOT.
5. Check to make sure proper documentation (i.e., cover letter with PE Stamp, list of changes made in Bridge Management Software, etc.) has been submitted. A single cover letter can be used for multiple ancillary structures within the same Group.
6. Check that all photos are properly labeled and referenced in the inspection report.
7. Check for consistency between the previous inspection report and the current inspection report.
8. Check that the Condition Rating for the ancillary structure is consistent with the condition states of the individual major elements.
9. For Inventory Inspections, check the inventory data with the construction plans. If construction plans do not exist, check the inventory to data collected in the field.
10. Verification of the inspection team qualifications.
11. Validation of data entered in the Bridge Management System (BMS).

7.3.4 Field Review

RIDOT BIU shall periodically perform a field performance review (a site visit during actual inspection) of the inspection team as well as a QA field review of the report submitted by the consultant. See Section 7.3.5.1 for parameters and frequencies.

7.3.4.1 QA Field Review/Site Visit

RIDOT BIU shall perform a field review (site visit) of an ancillary structure in-progress inspection based on intervals defined in Section 7.3.5.1 to assess:

- The inspection team's understanding of the policies and procedures governing ancillary structure inspections.
- The inspection team's technical/engineering understanding of ancillary structure.
- The inspection team's understanding of timeliness, efficiency and safe conduct.
- Using the Daily Notification, RIDOT will select ancillary structures to perform an unannounced visit. Refer to the Inspection Team Report Evaluation (see A.2 Inspection Team Report Evaluation – Form AI-002).

7.3.4.2 QA Field Review of a report

RIDOT BIU shall perform a field review of a consultant report based on intervals defined in Section 7.3.5.1. Actual field conditions will be compared with those stated in the consultant report to determine the integrity of the written findings such as size and location of deficiencies. BIU will also check that all requirements were satisfied including proper notification. BIU should perform a QC Field Review within three months of an inspection that has been performed. Refer to the Inspection Team Report Evaluation (Form AI-002) (see Appendix A.2).

7.3.4.3 Corrective Action for QA Control

RIDOT BIU will implement the following procedures to address the omissions and errors identified by the field reviews:

Minor omissions and/or errors: BIU will notify the consultant Project Manager and request resolution. Corrected report shall be submitted within 30 days of notification. Non-compliance may result in implementation of disqualification procedures.

Significant omissions and/or errors: BIU will inform the consultant Project Manager in writing and may begin disqualification procedures.

Safety violations, unprofessional conduct and/or presence of a hazard: BIU will notify the consultant Project Manager and will expect an immediate rectification. Depending on the severity of violation, BIU may close the inspection at no cost to RIDOT. For significant violations, BIU may begin disqualification procedures.

Refer to Section 7.3.8 for disqualification procedures.

7.3.5 Quality Assurance (QA) Procedures

Quality Assurance is defined as the use of sampling and other measures to assure the adequacy of quality control procedures to verify or measure the quality level of the entire ancillary structure inspection program.

7.3.5.1 Sampling of Ancillary Structures for Review

When choosing a sampling selection of an ancillary structure inspection or an ancillary report for review, BIU must consider the impact on traffic control and the travelling public, with the following guidelines:

- Ancillaries with poor to critical deficiencies, i.e., structural elements with Conditions States of CS-3 or CS-4.
- Ancillaries in need of rehabilitation/replacement.
- Ancillaries with improper inventory data collection.

See Figure 7.3-1 for minimum frequencies.

Sampling Parameters	Frequency
Inspection Reports for: • CS-2 or worse Rating in any Structural Element Group • CS-2 or worse Rating for Foundation Elements except Element 151- Grout Pad.	100%
Field Review (Inspection Report Field Verification)	1 per prime Consultant per calendar year
Inspection Team Field Performance (Site Visit)	2 per prime Consultant per calendar year

Figure 7.3-1 Quality Assurance Sampling Parameters and Frequencies

7.3.6 Selection of QA Review Team

RIDOT QA Review Teams will consist of, but is not limited to, the following:

1. Bridge Inspection Program Manager (PM)
2. Team Leader
3. Bridge Engineering Design Unit (BEU) (Minimum 1 person)

This QA Team will conduct and document an independent inspection/field verification of the ancillary structure and the results of this inspection will be compared with the inspection report under review using Inspection Team Report Evaluation (Form AI-002) (see Appendix A.2). Differences between this inspection and the Consultant inspection will be discussed with the Consultant and the review process will be documented. The RIDOT Team Leader will discuss any discrepancies with the PM and CCE and prepare the necessary documentation. All members of the review team will sign the Form AI-002 and forward to the Consultant. This form contains a section for notable practices and corrective action. Any corrective action requires a written response from the Consultant.

In addition, the QA Review Team will review the ancillary structure file(s) for the selected structure. The goal of this file review is to ensure that a complete and accurate current record is maintained. The ancillary structure files are maintained by RIDOT personnel, but a comprehensive review of the ancillary structure file will also be performed at the same time of the Consultant ancillary structure inspection report review (field verification).

The QA Review Team will complete the following Forms as part of the QA review process:

1. Inspection Team Report Evaluation (Form AI-002)

2. Inspection Team Field Performance Evaluation (Form AI-003)

3. Ancillary Structure File Review (Form AI-004)

7.3.7 Corrective Actions

Corrective actions for Consultants with significant errors/omissions or hazardous situations include the disqualification and re-qualification procedures for Consultants, with periodic meetings.

7.3.8 Disqualification Procedures for Consultants

The following are potential reasons for disqualifying a Consultant from performing ancillary structure inspections in Rhode Island:

1. Not completing a field inspection on time.
2. Not submitting an inspection report within 60 days of completion of field inspection (unless extension was approved by the Department in writing).
3. Lack of follow-up/reporting of critical findings encountered in the field.
4. Miscoded critical elements (i.e., Foundation and Structural Elements).
5. Recurrence of miscoding of elements.
6. Lack of proper traffic control measures during a field inspection.
7. Recurrence of errors/omissions in report.
8. Failure to attend required continuing education sessions.
9. Failure to address corrective action from previous review.
10. Improper safety during inspection.
11. Recurrence of failure to submit weekly reports/notifications.

The Department reserves the right to implement these disqualification procedures at any time (not just during QA review) or extend disqualification for other reasons based on the judgment of the Managing Engineer (ME)/Program Manager.

For disqualification RIDOT will forward a letter to the Consultant explaining the reason(s) for disqualification and request an action plan outlining how the Consultant will prevent the issue(s) from re-occurring. However, RIDOT may also issue a warning letter instead of formal disqualification if the Consultant's past performance has been satisfactory and the action plan appears to adequately address the issue. This will be based on the severity and frequency of the issue as determined by the ME/Program Manager.

7.3.9 Re-qualification Procedures for Disqualified Consultants

If the Consultant is disqualified for the reasons listed in Section 7.3.8, the State may choose to implement the following:

1. The Consultant will be placed on probation for a period of three months after the disqualification. The Consultant shall submit an action plan to the Department detailing the methods to be implemented by the Consultant based on the required corrective action from the Department. No additional work is to be assigned to the Consultant during this probation period. A review of the action plan will be conducted by the ME, PM, and original reviewer. This action plan must be approved by the Department.

2. If the Consultant is disqualified for a 2nd time, the Consultant will be required to formally meet with the Department. The Consultant must again provide a detailed action plan on how the reason for disqualification will be corrected and what measures will be taken to ensure this will not occur again. The Consultant will be placed on a 2nd probation period for another three months. A review of the action plan will be conducted by the ME, PM, and original reviewer. The Department reserves the right to extend the disqualification time if necessary.

3. After the Consultant is disqualified for a 3rd time, the Consultant will be suspended indefinitely. Reinstatement must be approved by the Director of the Department of Transportation. At a minimum, the Consultant will be required to demonstrate that their work plan, staff, and program management has been modified to address the previously reported deficiencies.

7.3.10 Periodic Meetings

Periodic meetings are held with inspection staff and RIDOT Management to address quality issues. The objective of these meetings is to obtain feedback from staff, facilitate knowledge transfer, provide peer collaboration, identify problem areas, and implement corrective action(s) to continuously improve policies and procedures and the inspection process.

Chapter 8 Element and Rating Guidelines

Like element level bridge inspection, the purpose of element level ancillary structure inspection is to establish a systematic process that provides, analyzes, and summarizes ancillary structure information for use in selecting and implementing cost-effective rehabilitation and maintenance programs. Condition ratings provide a quantitative assessment of the current condition of the ancillary structure and the data provides more accurate ratings that can be used to make informed decisions regarding trigger values and budgeting as it relates to ancillary structures.

The FHWA Manuals "Guidelines for the Installation, Inspection, Maintenance and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals" (FHWA NHI 05-036, March 2005) and "Ancillary Structures Inspection Reference Manual" (FHWA-NHI-20-999) are the basis for the following Component Rating Guidelines. The Team Leader must assign a Condition State to all Elements of the structure, even if the Element is not visible or hidden. Engineering judgement and all available field observations should be utilized in assigning a Condition Rating. The Element Condition States and associated typical feasible corrective actions are as follows:

Table 8.0-1 Element Condition Ratings

Condition State	Description	Feasible Action
CS-1	Good: Element performs intended function with high degree of reliability.	None or routine maintenance.
CS-2	Fair: Element performs intended function with small reduction in reliability.	Repair/replace element, continue monitoring or no action.
CS-3	Poor: Element performs intended function with significant reduction in reliability.	Repair/replace element within specified time frame or increase inspection frequency.
CS-4	Critical: Element does not perform intended function with any degree of reliability.	Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.

It needs to be noted that while the example deficiencies summarized in the tables, herein this Chapter, aim to capture a wide array of deficiencies, there will be deficiencies encountered by Inspectors where engineering judgement will need to be used to assign a Condition State. Additionally, any assigned Condition States by the inspector which are more or less conservative than those suggested within this Chapter should be discussed with QC, QA and/or the Program Manager.

The following outline will be used to describe the Elements used for the State's ancillary structure inspection program:

1. Define the Element.

2. List inspection methods for the Element.

3. Give Element level guidance to define the scope of the defined element and how to quantify it.

4. Reporting and rating examples.

8.1 Foundations (Elements 101 – 109)

The foundation is the portion of the structure below the base plate that transmits the structure's loads to the earth or substructure. Typical foundation types are listed and illustrated below:

- Pedestal: The pedestal is the upper part of the foundation. It generally refers to the top portion of the concrete foundation, which is above ground, near the area surrounding the post to foundation interface.

- Spread Footing: Consists of a shaft made up of concrete and reinforcing steel. At the bottom of the shaft, a wider section of concrete extends outward. The foundation is covered with soil to almost the top of the shaft. An anchorage assembly is cast into the shaft

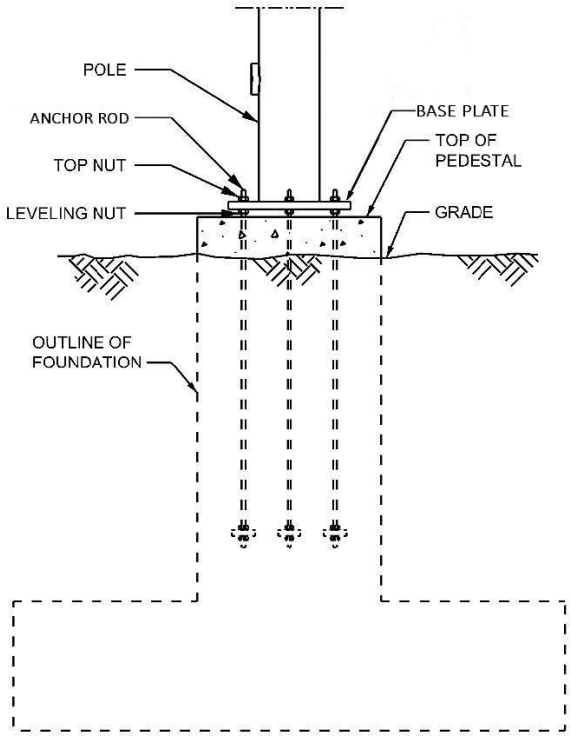


Figure 8.1-1 Spread Footing

- Drilled Shaft/Caisson: One of the common foundation types for ancillary structures. This foundation type consists of a shaft made up of concrete and reinforcing steel. The upper portion has a large diameter over a short depth compared to the bottom deep shaft portion with a small diameter. The shaft extends deeper into the ground as compared to a spread footing. The foundation is covered with soil to almost the top of the shaft. An anchorage assembly is cast into the shaft.

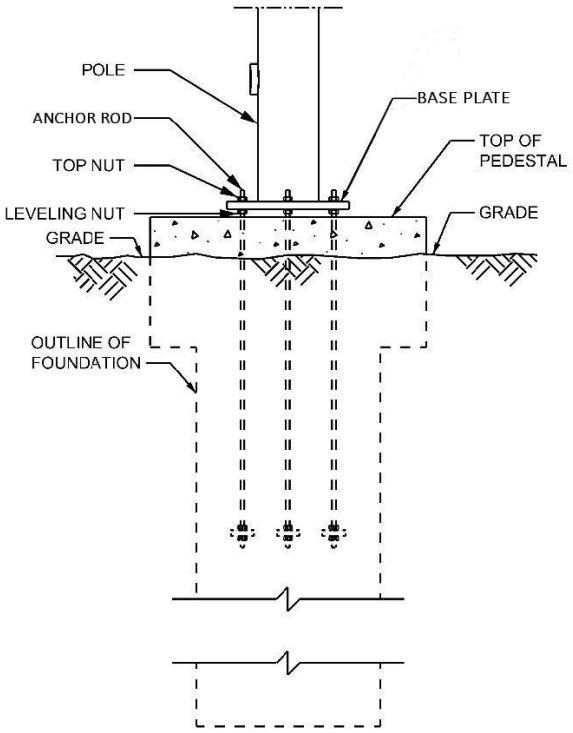


Figure 8.1-2 Caisson

- Helical Pile or Screw Pile: This foundation type consists of a hollow metal shaft with one or more helical plates (acting as augers) along the length, and a bolting plate capping the top of the pile. The helical plates pull the shaft into the soil when the shaft is rotated. The shaft is in the ground to almost the top of the shaft. An anchorage assembly is attached between the post's base plate and the helical pile's cap plate.

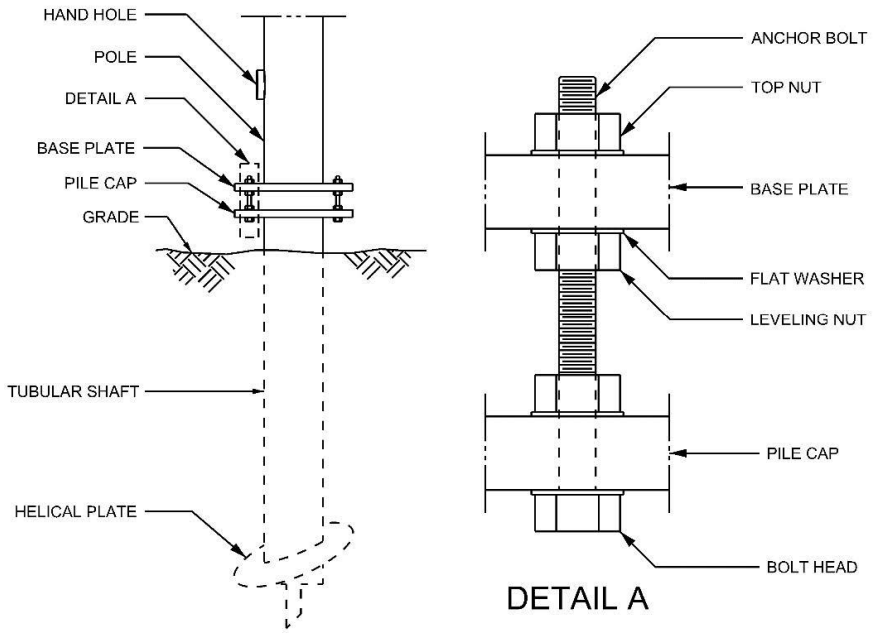


Figure 8.1-3 Helical Pile

- Steel stub post / sign post with connection bolts: For highway sign structures located next to the roadway. The steel foundation is typically embedded in a concrete pedestal. Note that the connection bolts are rated under the Anchor Rod Element (see Figure 8.1-8 for an example of Element breakdown). There are two different configurations of these anchorages:
    - S-Shaped and W-Shaped Stub Post: Used for two or three post roadside ancillary structures.

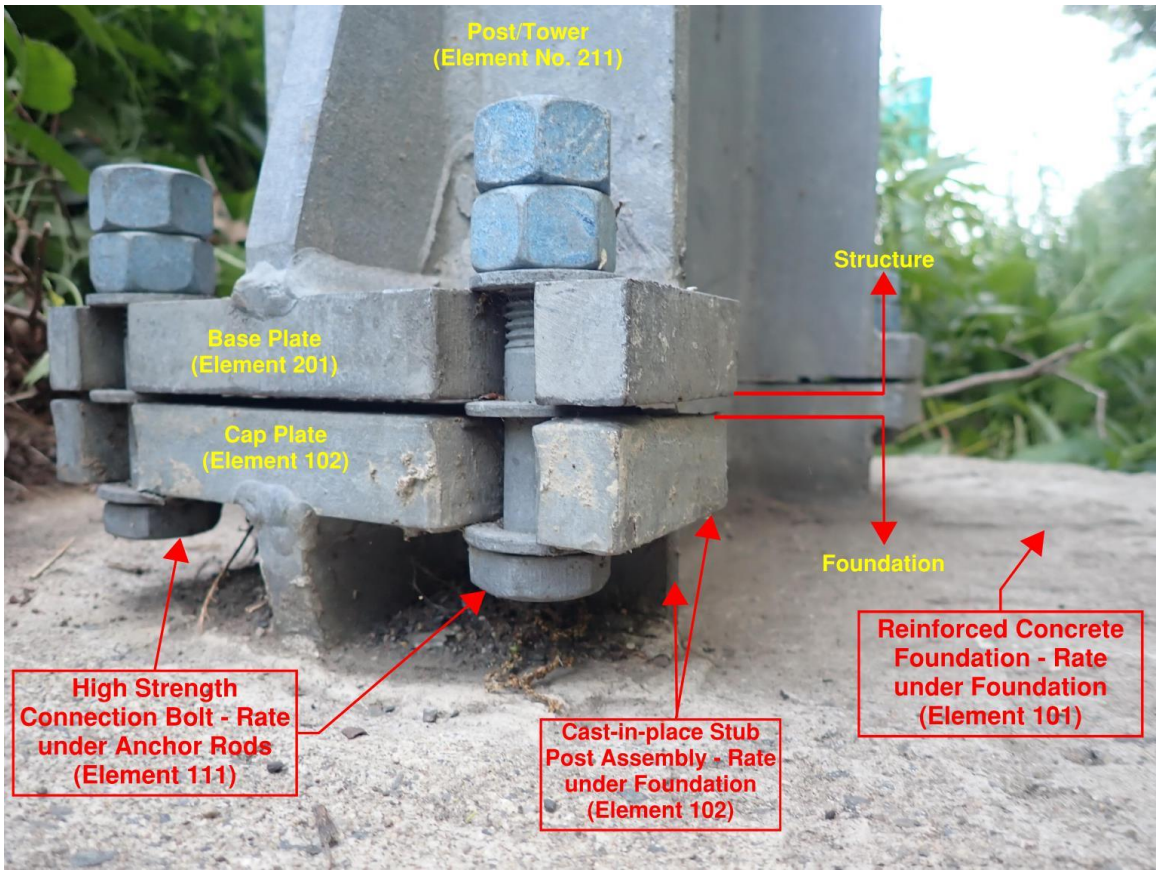


Figure 8.1-4 W-Shaped Steel Stub Post Element differentiation



Figure 8.1-5 S-Shaped Stub Post Anchorage example



Figure 8.1-6 W-Shaped Stub Post Anchorage example

- Single Pipe Stub Post (referred to as D6). See Figure 8.1-8 and Figure 8.1-9.

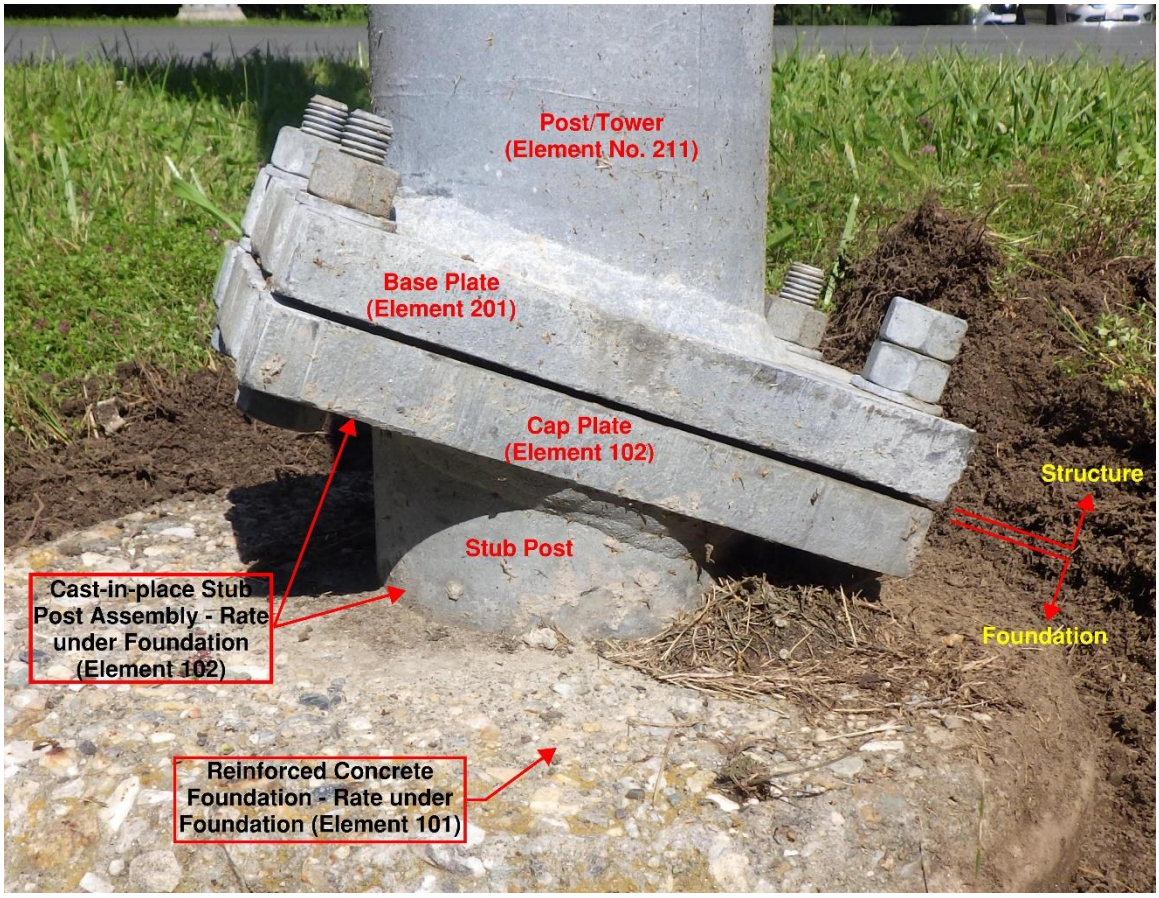


Figure 8.1-7 Single Pipe Stub Post Element differentiation

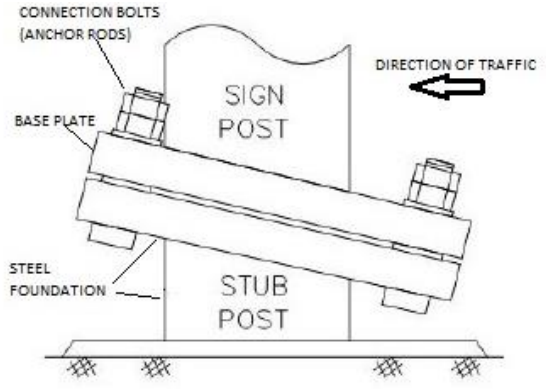


Figure 8.1-8 Single Pipe Post (D6) Assembly



Figure 8.1-9 Single Pipe Post Anchorage example

8.1.1 Inspection Methods

The visible portion of the concrete foundation should be visually and tactilely inspected. The top of the foundation should be at or above the surrounding grade to prevent the surrounding water retentive materials from accelerating deterioration of the mounted structure. All loose debris and vegetation should be removed prior to the inspection. An attempt should be made to clear any surrounding debris encroaching on the top of the foundation. If it is not possible and the debris cannot be excavated by a reasonable effort within 15 minutes, the Program Manager should be notified.



Figure 8.1-10 Foundation and anchor rods are hidden under sidewalk



Figure 8.1-11 Foundation and anchor rods are buried



Figure 8.1-12 Buried transformer base before excavation



Figure 8.1-13 Transformer base and foundation after excavation

All deficiencies shall be recorded by describing the type of deficiency (spall, crack, etc.), location, size (length, width, and depth), orientation, and severity of the defect. The inspector should inspect and document the following conditions:

- Cracking: All cracking should be documented with special attention given to cracks radiating from anchor rods. Any rust staining present along the cracks should be documented. The cracking could indicate overloading of the anchor rods or appreciable corrosion on the embedded portions of the anchor rods.



Figure 8.1-14 Extensive map cracking throughout foundation



Figure 8.1-15 Wide cracks for full height of the exposed foundation.

- Delamination: Sound the concrete with a hammer to detect locations of delamination. The delaminated areas will give a hollow sound when tapped with a hammer.



Figure 8.1-16 Delaminated concrete removed from foundation.

- Spalling, Honeycombing, Scaling and punky concrete: All spalling, honeycombing, scaling and punky concrete should be documented. Exposed steel reinforcement should be noted, as well as the severity of corrosion. If corrosion has caused section loss, then the remaining section should be measured and noted.



Figure 8.1-17 Spalled foundation exposing rebar with section loss



Figure 8.1-18 Heavy scale exposing rebar

- Impact damage: Document if impact damage exists and any deficiencies associated with it, which may include any of the above.

- Location of the foundation relative to its surroundings.

    - If the top of the foundation is buried and can be uncovered with less than 15 minutes of reasonable effort, remove the dirt/fill until the top is exposed, inspect and document that the foundation was buried and uncovered for inspection.

    - If the top of the foundation is located under a walkway or sidewalk, or buried such that it cannot be exposed with 15 minutes of reasonable effort, document the condition. The buried condition is to be reported for excavation by RIDOT maintenance crews. Notice shall be provided to the Program Manager. However, if conditions warrant immediate

excavation, the condition should be reported immediately. An inspection should be performed as soon as possible following excavation. Conditions that would warrant immediate excavation include observable corrosion and/or section loss.

- Erosion or undermining around the foundation faces. Any areas of undermining should be probed and documented to determine depth and extent. Any erosion should be documented under Embankment (Element 141).



Figure 8.1-19 Erosion gully around the foundation.

- Any indications of movement or rotation of the foundation should be measured and documented. Movement or rotation of a foundation could be indicative of an underlying foundation or soil issue. If movement is visible at the foundation due to loading at the time of inspection and there is a risk of the structure being displaced the Program Manager should be notified immediately.

- For steel stub post foundations:

  - Coating loss (paint or galvanized coating), corrosion, section loss, etc.

  - If an area of corrosion is observed on the steel stub post in an area that would pose an issue for the structural integrity of the steel element, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented.

  - If corrosion is present to the steel stub post, the component should be sounded with a hammer to detect “thin” areas. D-Meter thickness testing shall be performed to determine the amount and extent of section loss. Note Section F.3 Ultrasonic Testing for information regarding D-Meter testing.



Figure 8.1-20 W-Shaped Stub post has corrosion



Figure 8.1-21 S-Single Pipe (D6) stub post with corrosion

- Localized areas of distressed painted or coated surfaces: Cracks or splits in painted surfaces could be indicative of an overstressed section warranting additional investigation and NDT (see Appendix F Nondestructive Evaluation) for more information) at these areas. This condition could also be a result of weathering or chemical contamination. The inspector will need to use sound engineering judgment to determine the necessary level of investigation.

- Corrosion and cracking around any buried or rough-cut holes: Burned or rough-cut holes are stress risers and special attention should be given to these areas.

- Projection of steel stub from top of foundation or finished grade: Measure the projection of the steel stub post and note the thresholds below in Table 8.1-1.

Table 8.1-1 Steel Stub Post Standard Projections

Stub Projection from Top of Foundation & Finished Grade	**Stub Projection from Top of Foundation & Finished Grade**		
Seamless Steel Pipe - D6 Type (4", 5" & 6" diameters)	W-Shaped (W6x12, W6x15, W8x18 & W8x21)	W-Shaped (W10x22, W10x26, W12x26, W12x30 & W12x40)	S-Shaped (S4 x 7.7 & S5x10.0)
Max. 3-1/2"	Max. 3"	Max. 2-1/2"	Max. 3-1/2"
Note: Measurement taken to top of stub post base plate at the centerline of post(s) on the side			

MassDOT Standard Drawings for Signs and Supports (English, 1990)

8.1.2 Element Level Guidance

Each foundation of an independently connected vertical support should be quantified as each. Note that grout pads should be assessed under Grout Pad (Element 151).

The following elements are used to document the condition of the foundation:

Table 8.1-2 Foundation Elements

Element No.	Element Name	Element Group	Unit
101	Foundation, Reinforced Concrete	Foundations	Each
102	Foundation, Steel		
109	Foundation, Other		

8.1.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., scale, spalling, cracking), the foundation location if multiple are present (e.g., left-leading post, example in Figure 8.8-18 and Figure 8.8-19), location of deficiency (e.g., relative to anchor rods, anchor rod sector or post location) and severity of the defect (e.g., width and length of crack, size and depth of spall). The most severe condition will govern the rating.

The table below outlines some typical conditions for foundations. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.1-3 Foundation Condition State examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Foundation is new or has some minor deficiencies which does not affect its strength and/or serviceability.	None or routine maintenance.	CS-1
Hairline cracking of concrete (< 1/16”) w/o rust staining and with or w/o efflorescence.	None	
Superficial delaminations and/or spalling in the concrete w/o exposed reinforcement or no evidence of active corrosion and w/o bearing loss.		
Erosion of depth around foundation ≤ 1'.		
For steel, superficial corrosion with no section loss or damage.		
Foundation is covered in dense vegetation and vegetation was removed prior to inspection.		
Foundation is obstructed or covered and not able to be inspected. Using engineering judgement, there are no issues suspected.	If hidden elements are suspected of section loss of other deficiencies, recommend analysis which could include removal.	

Description of Deterioration or Defect	Work Action	Condition State
Fair Condition – The foundation is sound but has issues that slightly affect its strength and/or serviceability.	Repair/replace element or continue monitoring.	CS-2
Minor to moderate cracking of the concrete foundation (≥ 1/16” to < 1/8" wide) with or w/o rust staining and with or w/o efflorescence OR cracks that radiate from an anchor rod < 1/8”.	Seal cracks at affected components.	
Spalling or delamination up to 2” deep of concrete foundation with exposed reinforcing. Spalling does not significantly affect bearing area or anchor rods. Exposed rebar may have minor corrosion and minor section loss.	Remove unsound concrete; clean and paint exposed rebar and repair the foundation with solid concrete.	
< 15% section loss to steel.	Clean and paint affected components. If corrosion is due to dissimilar metals, replace with non-reactive metal.	
Foundation has notable level/plumb defect or grade is slightly different with a small reduction in strength and/or serviceability.	Monitor during future inspections to determine if active.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Moderate to advanced deterioration of foundation. The strength and/or serviceability of the foundation is moderately affected but it does not warrant immediate replacement.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Concrete cracks ≥ 1/8" to ≤ 3/8" wide, especially if radial from anchor rods, with or w/o rust staining. Map cracking with significant delamination.	Repair cracks; remove unsound concrete; or repair/ replace affected areas.	
Major spalling of concrete foundation with exposed reinforcing with moderate corrosion and significant section loss. Section loss to rebar is < 25% and there is no significant debonding. Spalling/deterioration exposes anchor rods (but does not increase unbraced length); bearing area of the baseplate is not significantly reduced.	Remove unsound concrete; clean and paint exposed rebar and repair the foundation with solid concrete.	
Section loss to steel ≥ 15% AND < 25%	Clean affected area or consider replacing foundation.	
Foundation has advanced level/plumb defects with active/nonactive settlement and with a significant reduction in reliability.	Plan remedial action; monitor or schedule remedial action	
Critical Condition – Major deterioration of foundation. The strength and/or serviceability of the foundation is significant enough to conduct structural analysis or warrant immediate replacement.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Concrete cracks > 3/8" wide, especially if radial from the anchor rods.	Repair or replace foundation; or increase inspection frequency.	
Major spalling with exposed rebar. Rebar has section loss > 25% or is deboned. Base plate is affected with > 25% loss to its bearing area. Spalling and/or deterioration exposes anchor rods (increasing unbraced length)		
Notable movement or rotation of the foundation.	Repair or replace affected element(s). Notification to the Program Manager may be warranted.	
For steel, section loss ≥ 25%.		
For steel, any cracks in the base metal.		
For steel, crack in weld at stub post.	Repair or replace the affected element(s)	
Steel stub post projection exceeds max projection.	Protect, regrade or reset.	

8.2 Anchor Rods (Element 111)

Anchor rods are partially or fully threaded rods that are embedded several feet into the reinforced concrete foundation, affixing the base plate or transformer base of the ancillary structure. This element includes not only the anchor rod but any main anchoring mechanism that connects the ancillary structure to a foundation, bridge, or mounted roadway barrier. With regards to inspection, the term "anchor bolts" generally refers to the visible portion of the anchor rod above the foundation.

This element includes the following components of the anchor rod assembly:

- Anchor rod: The partially or fully threaded rod(s) that are embedded several feet into the reinforced concrete foundation, affixing the base plate or transformer base of the ancillary structure.

- Leveling Nut: The nut immediately above the foundation and below the base plate.

- Top/Turning Nut: Upper most anchor rod nut adjacent to the base plate which excludes any secondary or 'lock' nut.

- Flat Washer: Washers that are installed between the nut and the base plate, for both the top and leveling nuts.

- Jam/Lock Nut: This is an additional nut that may be installed above the top nut, used to lock the anchor rod assembly in place.

- Lock Washer: Washers that are installed between the top nut and flat washer at some structures to help reduce loosening due to structure vibration and load fluctuation.

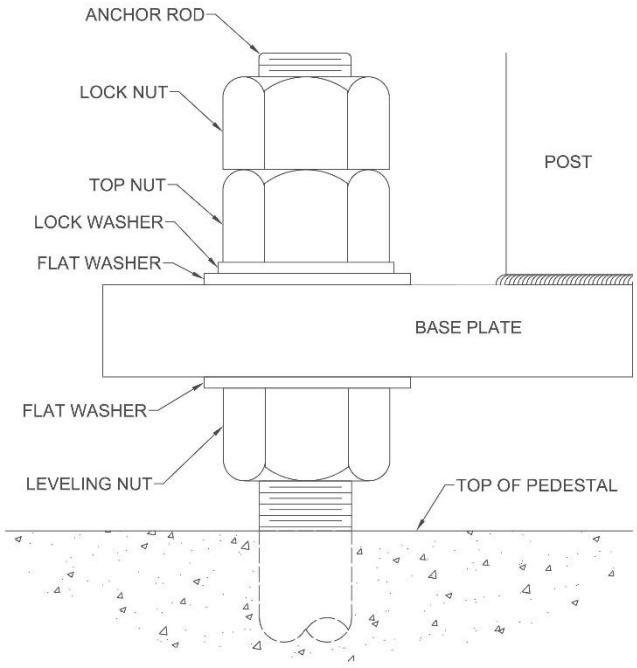


Figure 8.2-1 Anchor Rod and subcomponents

- Transformer base anchor rod and connection bolts: The anchor rods and the post to transformer base connection are rated under the Anchor Rod Element. For transformer base configurations, reference Figure 8.7-7.

- Breakaway Sign Supports: For ancillary structures located within roadside clear zones, a breakaway system is used to lessen the impact to a vehicle if struck and thereby minimizes injury to vehicular occupants and damage to vehicles. The following are types of breakaway systems in use by RIDOT:

- Double-neck couplers.

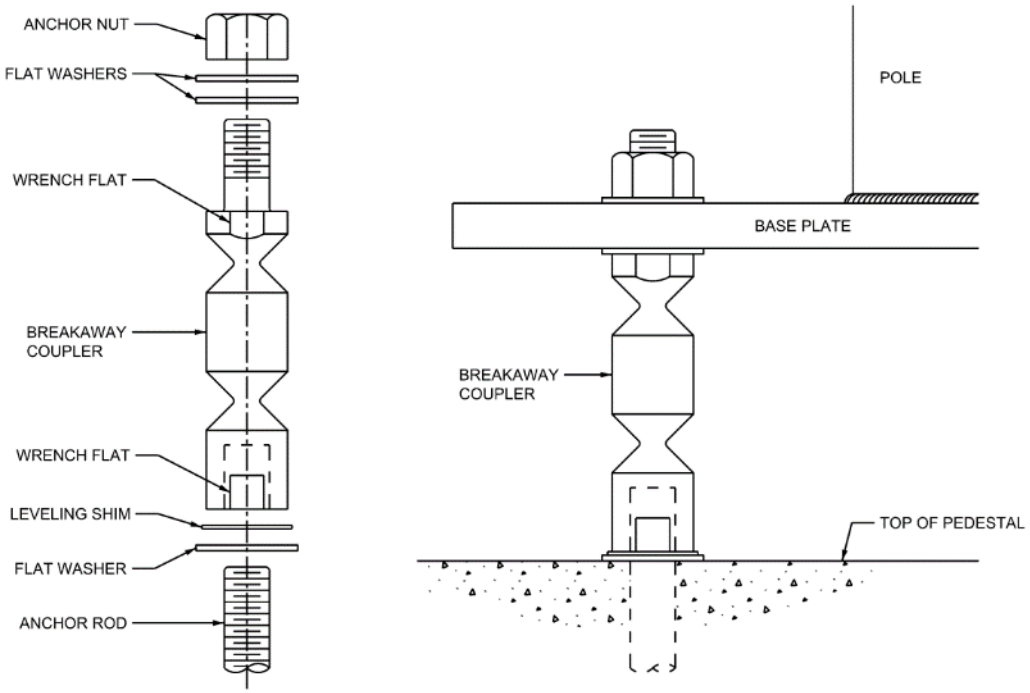


Figure 8.2-2 Steel Breakaway Double Neck Coupler Assembly



Figure 8.2-3 Typical Breakaway Double Neck Coupler Anchorage

- Pole-Safe Die Cast Couplers (see Figure 8.2-4and Figure 8.2-5). These come in two varieties, Model 301 and Model 201. The former is threaded into the Transpo Female Anchor (see Figure 8.2-6) and the latter screws into concrete base (see Figure 8.2-7).

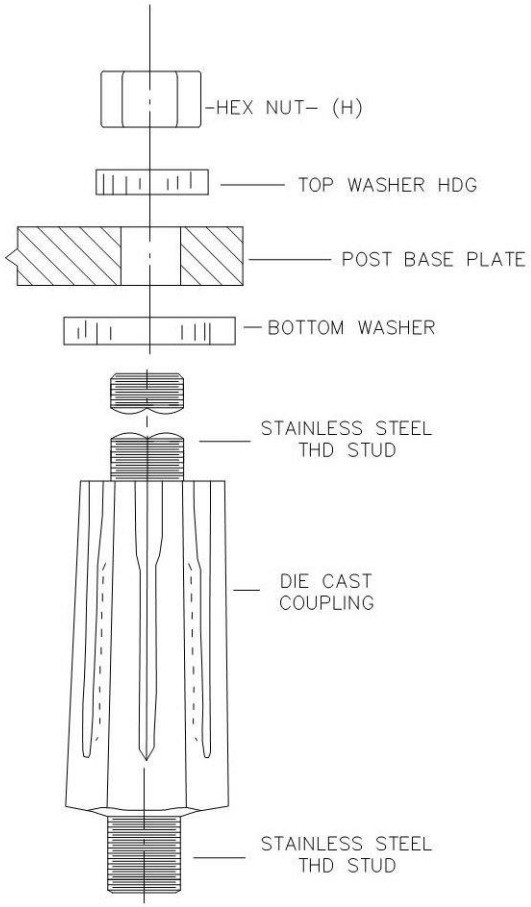


Figure 8.2-4 Pole-Safe Breakaway Coupler Assembly



Figure 8.2-5 Typical Pole-Safe Breakaway Coupler Anchorage

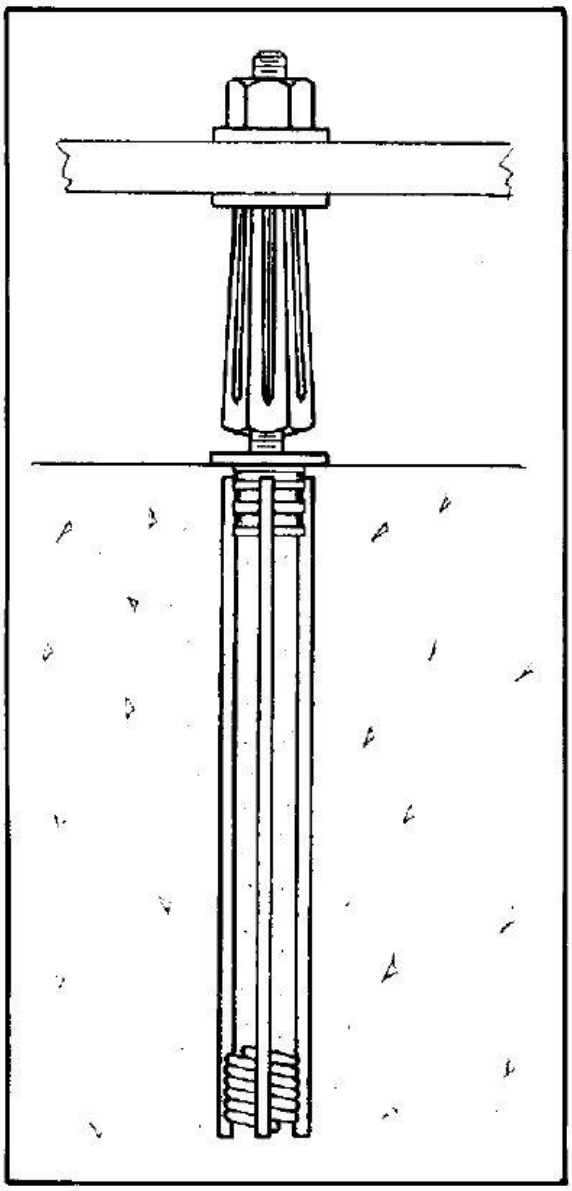


Figure 8.2-6 Model 301 Coupling - Transpo Female Anchor

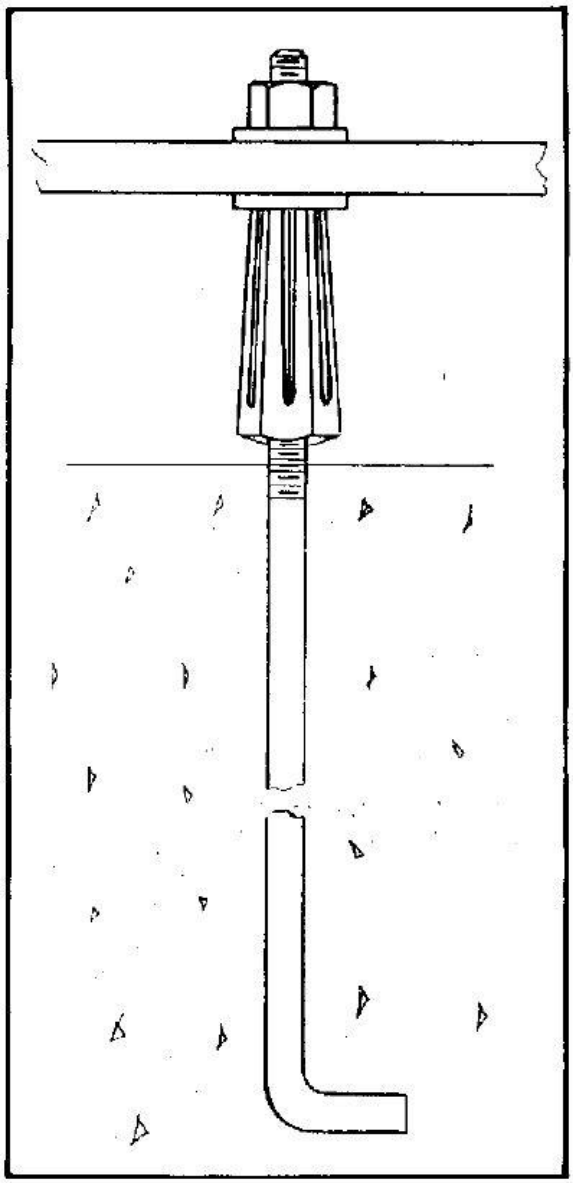


Figure 8.2-7 Model 201 Coupling - Standard HDG anchor bolt

- Break-Safe Breakaway Sign Support System: W-Shaped post structure found on ancillary structures next to the roadway, on the roadside. See Figure 8.2-8 and Figure 8.2-9.

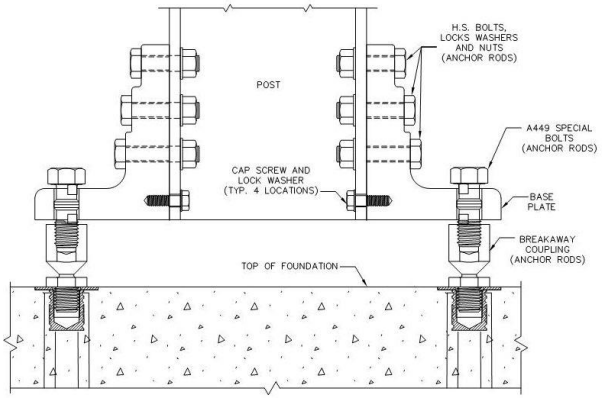


Figure 8.2-8 Break-Safe breakaway assembly



Figure 8.2-9 Typical Break-Safe Breakaway Anchorage

- Steel stub post / sign post with connection bolts: See Section 8.1 Foundations (Elements 101 – 109) for stub post examples.

8.2.1 Inspection Methods

All loose debris and vegetation should be removed. Anchor rods, washers, and nuts should be visually and tactilely inspected if accessible (not obscured by a grout pad). The inspector should inspect and document the following conditions:

- Anchor rod measurements: For Initial/Inventory inspections, document the field measured anchor rod diameter and length. The length of the rod can be gathered during UT inspection; for furth information, refer to F.3.1 Straight Beam Ultrasonic Testing.

- The top of the rods should be tapped and sounded with a 16-ounce ball-peen hammer for any hollow sounds that could indicate the presence of a crack, which would otherwise be hidden or unobserved within the anchor rods. If the anchor rod is continuous, it should produce a ringing sound when struck. Cracks, regardless of size, decrease the load capacity of the rods and could increase stresses in the surrounding rods. If a dull thud sound is present, a straight beam ultrasonic test (UT) will confirm the presence and location of a crack. UT of all anchor rods is required at each Initial and Routine Inspection and/or if anchor rods are a special member. See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance



Figure 8.2-10 Anchor rod fracture at foundation interface



Figure 8.2-11 Sheared anchor rod



Figure 8.2-12 Breakaway die cast coupler failed



Figure 8.2-13 Double-neck breakaway fractured

- Using a 16-ounce ball-peen hammer sound each anchor rod nut by striking the side of the anchor rod nut and the respective washers. This is done to check for loose nuts (leveling and top). If the nuts are tight, the top washers and/or top nuts will not move. If they are loose, or if a gap is visible, they should be made snug tight by the inspection team. See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance



Figure 8.2-14 Not fully tightened top anchor rod nuts with gap

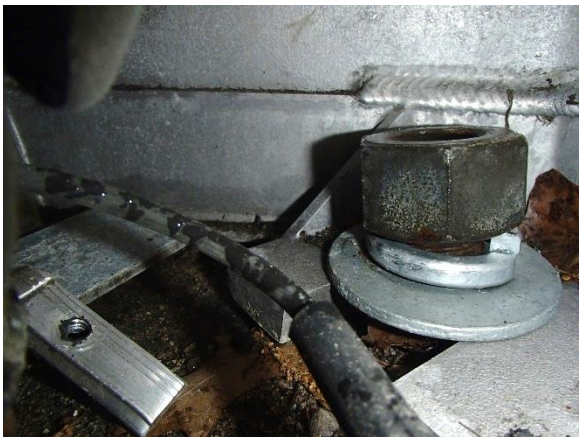


Figure 8.2-15 Loose anchor rod nut in transformer base.



Figure 8.2-16 Anchor nuts after tightening

- A loose leveling nut can also be the cause of the dull thud sound while performing hammer blows. If exposed, visually check for gaps between the leveling nut and the base plate. Tap one side of each washer above the leveling nut, placing one hand on the washer opposite the side being tapped. If the washer moves, the nut is not properly tightened. See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance



Figure 8.2-17 Leveling nut not tightened with gap

- Anchor rod nuts should be checked to see if they are frozen onto the anchor rod. This is particularly important when the nut is not at least snug tight. Frozen nuts can occur for various reasons however many are accelerated by the structure having a missing, broken, or damaged grounding; the use of non-galvanized components; and/or using dissimilar metals. Any of the aforementioned conditions that are observed should be noted within the inspection report.

- Document any deviation, excess or missing components from the construction plans or shop drawings. Some assemblies may include material other than mild steel (i.e. stainless steel or aluminum), the presence of lock washers, beveled washers, lock nuts, extra washers, and missing nuts and washers.



Figure 8.2-18 Anchor rod assembly missing top and bottom washers with debris between foundation and base plate



Figure 8.2-19 Missing anchor rod nut and washer

- Presence of any tack welds or other welds on anchor rod assemblies. Welding to rods can change the material characteristics and result in a loss in rod strength.

- Corrosion, loss of galvanized coating, section loss, etc. of the anchor rods, washers, nuts and breakaway couplings. If heavy rust is present on the anchor rods, washers and/or nuts, rust should

be removed to the base metal to measure the remaining diameter of the anchor rods, estimated percent section loss of the washer and/or flat-to-flat distance on the nuts.



Figure 8.2-20 Post base, anchor rod assembly and base plate with corrosion and section loss



Figure 8.2-21 Breakaway die cast coupler corrosion with section loss

- Inadequately sized flat washers or lack of flat or plate washers for enlarged holes in base plates should be noted as enlarged holes reduce the amount of bearing area of the top nut and/or leveling nut on the base plate.



Figure 8.2-22 Oversized hole in base plate and inadequately sized flat washer



Figure 8.2-23 Undersized washer and embedded nut at transformer base anchorage

- Adequate engagement of the nuts: Less than 100% engagement of the top nut reduces the ability of the anchor rod to develop its full load carrying capacity. Document percent engagement if less than 100%.



Figure 8.2-24 Anchor rod is short and has negative thread. Nut not fully engaged

- For transformer bases:
    - Condition of the transformer base to base plate bolted connections: Bolted connections should be inspected for loose or missing components, under engaged nuts, improperly sized washers, beveled washers, or extra washers. Document percent engagement if less than 100%. The connection bolts, washers and nuts should be checked to ensure tightness by hammer tapping. Document any hardware that was observed to be loose and try to bring to snug tight. This may however be ineffective as the bottom of the connection bolt will likely need to be secured in order to be tightened. This cannot be done unless the power has been turned off at the structure.



Figure 8.2-25 Missing transformer anchor rod



Figure 8.2-26 Base plate to transformer base connection bolt misaligned, with undersized washer and bolt with rust.

    - Torque control nuts. Some transformer bases have top nuts that have a necked section in the middle. The upper portion will separate from the lower portion at the neck when proper torque is applied to the torque control nut, leaving only the lower portion in place. In some cases, the upper and lower portions may not have separated.

- Plumbness of the anchor rods. Out of plumb anchor rods could result in increased bending stresses in the anchor rods. If one or more anchor rods are visually out of plumb, measure the

slopes of the affected rods (see Figure 8.2-27 and Figure 8.2-28). The measurements are to be taken and documented as follows:

- Measure the plumb vertical distance or height, V, of the bolt above the top of concrete.
- Measure the horizontal distance, H, from the centerline of the bolt at the top of concrete to the centerline of the bolt at the top of the bolt.
- The slope of H/V < 0.04 is within most design specifications unless noted otherwise.

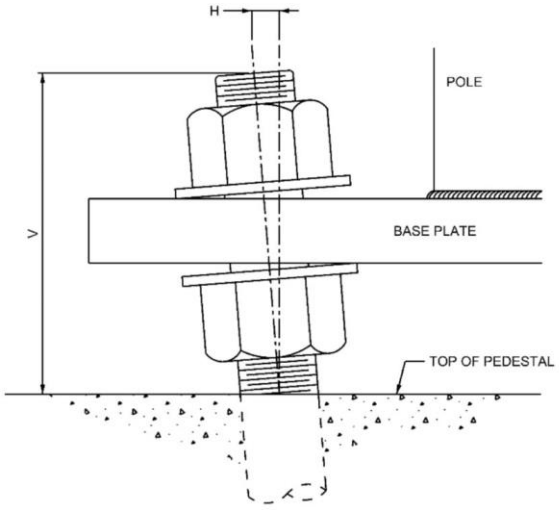


Figure 8.2-27 Out of plumb anchor rod



Figure 8.2-28 Out of plumb anchor rods

- Improperly seated top nuts on the base plate. Improper seating of top nuts can reduce the bearing area of the nut on the base plate and can consequently reduce the load capacity of the bolts. If the top nuts are not in full contact with the base plate and a gap exists between the bottom of the nut and the top of the base plate at one or more locations (see Figure 8.2-29 and Figure 8.2-30), the largest gap for each nut is to be measured and documented as follows:
  - The measurement, D, is to be taken from the top of the washer, or base plate if no washer exists, to the highest point above the base plate along the bottom of the nut. These measurements should be taken using a feeler or taper gauge.
  - The slope of the measurement D relative to the anchor rod diameter, d, (D/d) < 0.04 is within most design specifications unless noted otherwise.

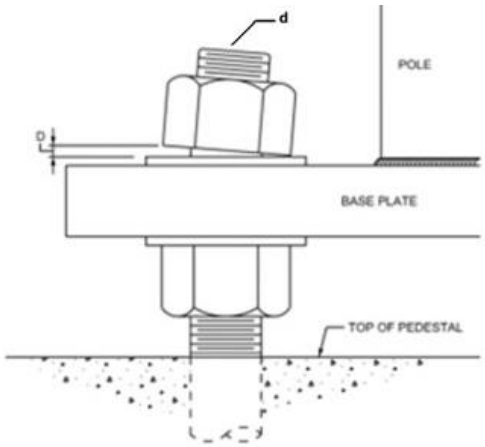


Figure 8.2-29 Measurement methodology for improperly seated anchor rod nuts



Figure 8.2-30 Improperly seated anchor nut

- Loose nuts increase the stresses in the adjacent rods and allow additional stress on the rod(s) having the loose nut(s). See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance

- Perform a "Shake Test" for all single post structures: While performing the Shake Test, the inspection team should observe the foundation, anchor rod assemblies, and base plate for movement. Any movement of the anchor rod assembly is indicative of issues with the foundation, anchor rods or base plate.

    - Shake tests are only performed on cantilever, structure mounted, butterfly, ground mounted and single post ancillary structures. The Team Leader pushes horizontally from to the top of the structure, above the foundation, with the Staff Inspector observing any movement of the foundation and its elements. The test should be done with caution and some trepidation as the structures are not designed to undergo this loading. Based on structure type and other variables, or possible deficiencies, it is difficult to know how the structure will react to the test. Start with a small push and increase up to a firm push as needed.

- Distance between the bottom of the base plate and the top of the pedestal, H. Base plates that exceed a clear height above the pedestal of two bolt diameters induce stresses that were not accounted for during design and could reduce the load capacity and fatigue life of the anchor rods. The maximum measured distance between the bottom of the base plate and the top of the pedestal should be documented for each base plate of a structure as differing heights could impact any recommendations pertaining to lowering of the structure.

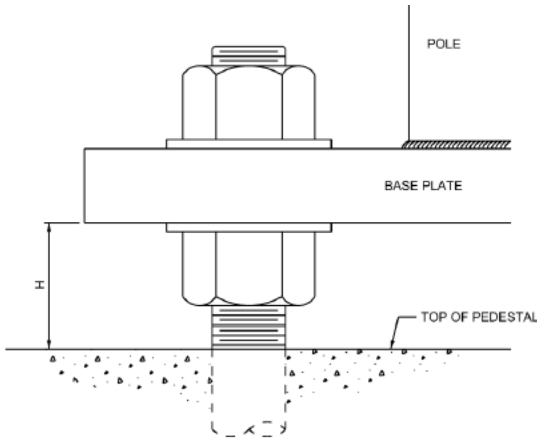


Figure 8.2-31 Clear height measurement methodology



Figure 8.2-32 Measuring clear height

- Base plates or transformer bases installed flush to the foundation should have anchor rod nuts snug tight.

- Ultrasonic testing (UT) straight beam should be performed on all accessible anchor rods, especially for cantilever structures. Due to the excessive galloping of the structure from natural and induced wind loading, fatigue and overstressing is more prevalent in anchor rods for these structures. If all anchor rods can't be tested, it should be noted in the inspection report the reason the testing could not occur. Note F.3 Ultrasonic Testing for further information.



Figure 8.2-33 UT being performed on anchor rod.

8.2.2 Element Level Guidance

Each individual anchor rod for all reinforced concrete foundations or anchor bolts for steel foundations should be quantified as each. For structures with transformer bases, the bolts connecting the post to the transformer base should also be included in the total quantities. The subcomponents of the anchor rod or bolts are addressed within this element.

The following element is used to document the condition of the anchor rods:

Table 8.2-1 Anchor Rods Element

Element No.	Element Name	Element Group	Unit
111	Anchor Rods	Anchor Rods	Each

8.2.3 Reporting and Rating Guidance

Anchor rod numbering is necessary to accurately locate the various defects and deficiencies encountered during the inspection, as well as indications detected through ultrasonic testing. The numbering is established by facing the foundation from the roadway (if the foundation is between multiple roadway directions, the log direction roadway controls) start numbering counterclockwise just past 6 o'clock and continue in a clock-wise manner until all anchor rods are numbered. For the anchor rod numbering system for various base plates, refer to Figure 8.2-34 below.

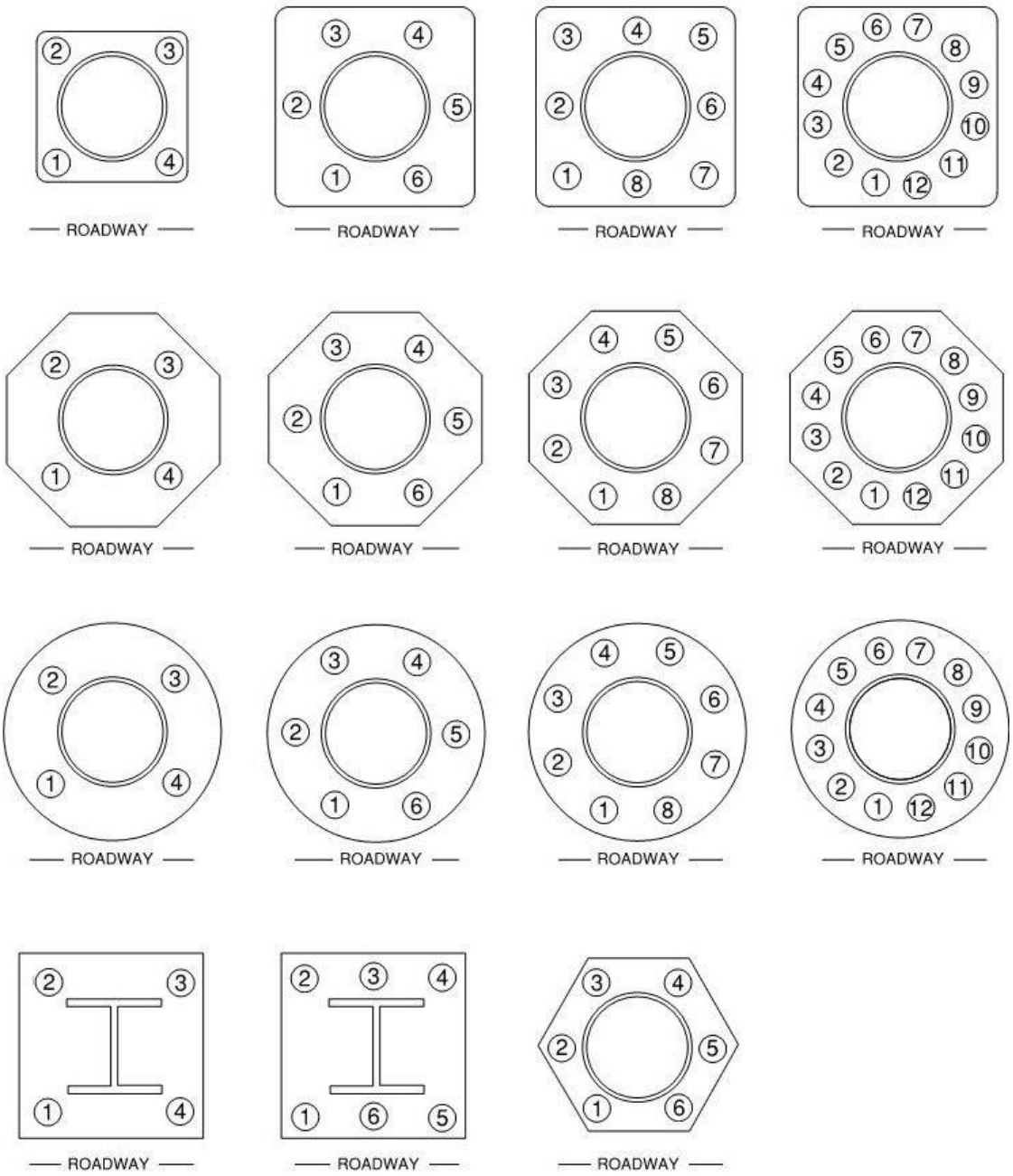


Figure 8.2-34 Anchor Rod numbering methodology

All deficiencies should be recorded by describing the type of deficiency (rust with section loss, loose nuts, etc.), anchor rod number, and severity of the defect (e.g., percent section loss). Each anchor rod should be assigned a Condition State independently, with the most severe condition governing the rating.

The table below outlines some typical conditions for anchor rods. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.2-2 Anchor Rod Condition State examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Anchor rods are new or have some minor deficiencies which do not affect its strength or serviceability.	None or routine maintenance.	CS-1
Discoloration or surface rust with no section loss to the anchor rods or its component parts.	Schedule to clean and paint.	
Base plate to foundation gap: H ≤ 2D, where the clear distance between the bottom of the base plate to the top of the foundation is H and the anchor rod diameter is D.	None.	
There is no deterioration or misalignment. The components are tight and in new or like-new condition.		
Ratio of anchor nut gap, D, between washer or baseplate (if no washer present) and anchor rod diameter, d, is < 0.04.	Monitor	
Anchor breakaway couplings have superficial corrosion		
Anchor rods are obstructed or covered and not able to be inspected. Using engineering judgement, there are no issues suspected.	If hidden elements are suspected of section loss of other deficiencies, recommend analysis which could lead to removal of obstruction.	

Description of Deterioration or Defect	Work Action	Condition State
Fair Condition – Minor corrosion of the elements may be present. Most of the elements are intact, engaged, and plumb. The defects only slightly affect the strength and/or serviceability of the structure.	Clean and paint affected components; Repair/replace element or monitor.	CS-2
Section loss to anchor rod nuts is < 15%.	Clean and paint affected components.	
Section loss to anchor rods is < 10%.		
> 0 AND < 15% of the top/leveling nut is missing or is inadequately tightened.	Replace or tighten affected components.	
> 0 AND < 15% of top flat washer missing or undersized in a slotted/oversized hole.	Replace affected components.	
< 30% of the anchor rods are out of plumb or the anchor rod nuts are improperly seated: Anchor rods are out of plumb such that the ratio of H/V is ≥ 0.04 AND < 0.08. OR Anchor rod nuts are not seated such that D/d is ≥ 0.04 AND < 0.08.	Correct the condition, install beveled washer or monitor.	
< 30% of anchor rods have negative thread such that ≤ 75% of the top nut is engaged.	Analyze to see if low profile nuts can be used. If not, lower structure or retrofit short anchor rod assembly to restore full capacity or monitor the structure.	
Multiple top/leveling washers are present.	Monitor.	
Lock washers are present.		
Anchor Rods/nuts/washers are dissimilar materials.	Replace dissimilar components or install isolation pad.	
Base plate to foundation gap: 2D < H ≤ 2D + 1”, where the clear distance between the bottom of the base plate to the top of the foundation is H and the anchor rod diameter is D.	Analyze to determine if gap is acceptable; if not or monitor the condition.	
Pole-Safe breakaway couplings have < 15% section loss.	Replace affected components.	
Double neck break-away with gap at foundation up to 1/4" high.		
For steel stub post with more than 1 post, ≤ 2 bolts are missing washer/shim between plates or 1 missing bolt on one post.	Replace missing hardware.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Moderate corrosion of the elements may be present. Some anchor nuts are not fully engaged, or rods are misaligned. Washers are missing (if specified on design plans). The affected elements do not significantly affect the strength and/or serviceability of either the element or the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss to anchor rods are ≥ 10% AND < 30%.	Replace or tighten affected components.	
Section loss to anchor rod nuts are ≥ 15% AND < 50%.		
≥ 15 AND < 25% of the top/leveling nut is missing or is inadequately tightened.	Replace or tighten affected components.	
≥ 15 AND < 25% of top flat washer missing or undersized in a slotted/oversized hole.	Replace affected components.	
> 0% AND < 25% of the anchor rods are broken, sheared or have relevant indication detected by UT testing.		
≥ 30% AND < 50% of the anchor rods are out of plumb or the anchor rod nuts are improperly seated: Anchor rods are out of plumb such that the ratio of H/V is ≥ 0.04 AND< 0.08. OR Anchor rod nuts are not seated such that D/d is ≥ 0.04 AND < 0.08.	Correct the condition, install beveled washer or monitor.	
≥ 30% AND < 50% of anchor rods have negative thread such that ≤ 75% of the top nut is engaged.	Analyze to see if low profile nuts can be used. If not, lower structure or retrofit short anchor rod assembly to restore full capacity or monitor the structure.	
Base plate to foundation gap: H > 2D + 1”, where the clear distance between the bottom of the base plate to the top of the foundation is H and the anchor rod diameter is D.	Analyze to determine if gap is acceptable; if not, lower base plate, increase the height of foundation or install structural grout below the base plate.	
Pole-Safe breakaway couplings have ≥ 15% AND < 35% section loss.	Replace affected components	
> 0% AND < 25% of Pole Safe breakaway couplers are broken, sheared, or cracked		
Double neck break-away with gap at foundation ≥ 1/4"		
For steel stub post with more than 1 post, > 2 bolts are missing washer/shim between plates or 2 missing bolts on one post.	Replace missing hardware.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Heavy corrosion of the element is present. Rods may be cracked/sheared, or many anchor nuts are loose/missing. Element does not perform intended function with any degree of reliability.	Notify Program Manager. Warrants a structural review to determine strength or serviceability of the structure. As per review: immediate repair; replacement or removal of structure; or increase inspection frequency.	CS-4
≥ 25% or the anchor rods have section loss ≥ 30%.	Replace affected components or remove structure. Notification to the Program Manager may be warranted.	
≥ 25% of top flat washer missing or undersized in a slotted/oversized hole.		
≥ 25% of Pole Safe breakaway couplers are broken, sheared, or cracked		
Section loss to anchor rods is ≥ 30%.	Replace affected components or remove structure.	
Section loss to anchor rod nuts is ≥ 50%.		
≥ 25% of the top or leveling nuts are loose or frozen without visible gaps.	Replace or tighten affected components.	
≥ 25% of the top or leveling nuts are loose or frozen with visible gaps.	Replace or tighten affected components. Notification to the Program Manager may be warranted.	
≥ 25% of the top/leveling nuts are missing.	Replace affected components.	
Top flat washer missing with nut not bearing on base plate, i.e., is embedded.		
≥ 50% of the anchor rods are out of plumb or the anchor rod nuts are improperly seated: Anchor rods are out of plumb such that the ratio of H/V is ≥ 0.04 AND< 0.08. OR Anchor rod nuts are not seated such that D/d is ≥ 0.04 AND < 0.08.	Correct the condition, install beveled washer or monitor.	
≥ 50% of the anchor rods are out of plumb or the anchor rod nuts are improperly seated: Anchor rods are out of plumb such that the ratio of H/V is ≥ 0.08. OR Anchor rod nuts are not seated such that D/d is ≥ 0.08.	Repair or replace affected components or remove structure. Notification to the Program Manager may be warranted.	
≥ 25% of the anchor rods are broken, sheared or have relevant indication detected by UT testing.		
≥ 50% of anchor rods have negative thread such that ≤ 75% of the top nut is engaged.	Analyze to see if low profile nuts can be used. If not, lower structure or retrofit short anchor rod assembly to restore full capacity or monitor the structure. Notification to the Program Manager may be warranted.	
≥ 50% of the top or leveling nuts are loose or frozen, with or without visible gaps.	Tighten affected components or remove structure.	
≥ 25% top/leveling nuts are missing or nuts are ineffective.	Replace affected components or remove structure.	
Any broken, sheared, or cracked anchor rod.		

Description of Deterioration or Defect	Work Action	Condition State
Greater than 25% of Pole-Safe couplings have ≥ 50% section loss.	Replace affected components or remove structure.	
Pole-Safe coupling has ≥ 35% section loss.		
For steel stub post with more than 1 post, ≤ 3 missing bolts on one post.	Replace missing hardware.	

8.3 Median/Barrier (Elements 121 – 129)

This element defines the median and other roadway barriers of which the vertical support of the ancillary structure is mounted on. If the median or barrier is not transferring the load of the ancillary, e.g., the base of a vertical support is shielded by barrier plates, the median or barrier should be documented under Traffic Protection (Element 561).

Note that for bridge mounted ancillary structures of which the ancillary structure is supported by a bridge girder and/or parapet the connection should be documented under Bridge Mounted Connection (Elements 131 – 139).

8.3.1 Inspection Methods

This element is inspected to ensure that the median or barrier can sufficiently transfer the load from the vertical support to the ground. Due to the similar purpose of the median/barrier to that of the foundation, reference the inspection methods for foundations outlined in Section 8.1.1.



Figure 8.3-1 Barrier mounted structure

8.3.2 Element Level Guidance

Each line of median or barrier that supports a vertical support will be counted individually (Each) with the most severe condition governing the rating.

The following elements are used to document the condition of the medians/barriers:

Table 8.3-1 Median/Barrier Elements

Element No.	Element Name	Element Group	Unit
121	Median/Barrier, Reinforced Concrete	Median/Barrier	Each

122	Median/Barrier, Steel		
129	Median/Barrier, Other		

8.3.3 Reporting and Rating Guidance

Due to the similarities of the median/barriers to that of the foundation, reference the reporting and rating guidance for foundations outlined in Section 8.1.3.

8.4 Bridge Mounted Connection (Elements 131 – 139)

Overhead ancillary structures can be attached to a bridge's superstructure (i.e. – girders, via bolted or clamp connections) and/or its parapets (via a bolted connection).

Typical bridge girder connection types are listed and illustrated below:

- Bolted: This type of connection consists of bolts that are inserted through predrilled holes in the bridge girder and through the end plate of the sign framing. Nuts are placed on the bolts and the through bolted assembly is tightened, thereby securing the anchorage in place.

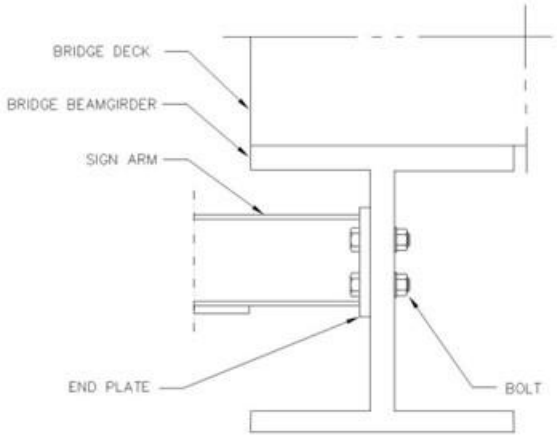


Figure 8.4-1 Attachment to Bridge Girder, Through Bolt



Figure 8.4-2 Bridge mounted connections to girder and parapet



Figure 8.4-3 Bridge bolted connection to girder

- Saddle Clamp: This type of connection consists of several plates. The two main plates are shaped to fit the contour of the bridge girder. One of the two main plates is welded to the sign frame, functioning as an end plate, and attaching to the front side of the girder; this plate is the front clamp. The other main plate wraps around the back of the girder; this is the rear clamp. The two main plates, once positioned correctly on the girder, are bolted together, thereby securing the clamp in place.

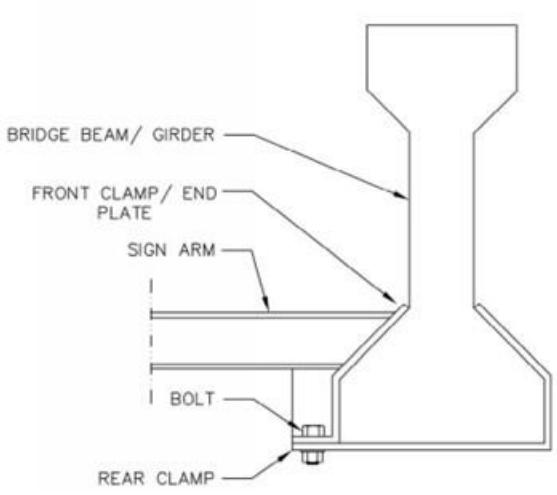


Figure 8.4-4 Attachment to Bridge Girder, Saddle Clamp

- Welded: This type of connection consists of the sign arm end plate or arm welded directly to the bridge girder. It should be noted this connection is typically field welded and results in an AASHTO Fatigue Category E' classification for the bridge girder and should be made note of in the inspection report.



Figure 8.4-5 Bridge girder welded connection

Typical bridge parapet connection types are listed and illustrated below:

- Adhesive Anchorage: This type of anchorage consists of fastener components (usually threaded rods) that are inserted through the end plate of the sign framing and into predrilled holes in the parapet. The fasteners are attached to the parapet, typically using an epoxy adhesive that bonds with the fastener components and the concrete, thereby securing the anchorage in place.

- Expansion Anchorage: This type of anchorage consists of expansion fasteners that are inserted through the end plate of the sign framing and driven into predrilled holes in the parapet. As the fasteners (usually anchor rods) are tightened, the expandable portion of the anchorage spreads outward, thereby securing the anchorage in place.

- Through Bolt: This type of anchorage consists of bolts that are inserted through a metal clamp plate, predrilled holes in the parapet, and through the end plate of the sign framing. Nuts are placed on the end plate side of the bolts and the through bolted assembly is tightened, thereby securing the anchorage in place.

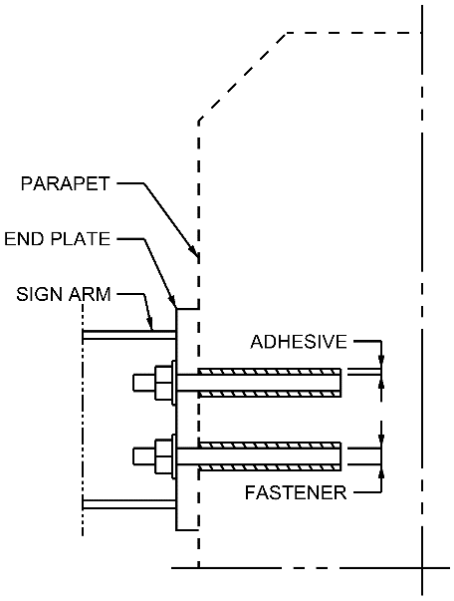


Figure 8.4-6 Adhesive Anchorage

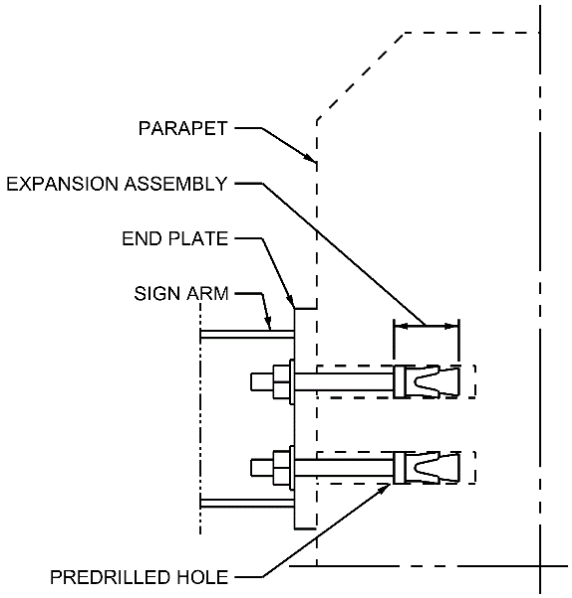


Figure 8.4-7 Expansion Anchorage

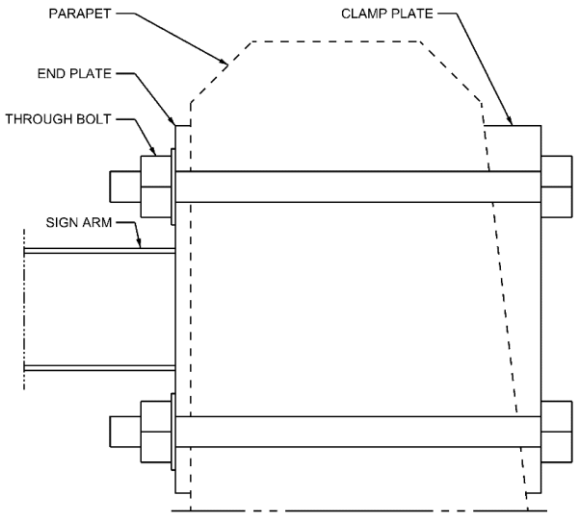


Figure 8.4-8 Parapet Through Bolt

8.4.1 Inspection Methods

The bridge girder and/or parapet mount connections should be visually and tactilely inspected from an aerial lift (bucket or platform) like the inspection of the overhead span, cantilever and butterfly structures. For overlapping inspection methods for anchor bolt connections to the bridge, reference Anchor Rods (Element 111)The inspector should check for:

- Condition of the parapet at the attachment. The parapet should be inspected for:
    - Cracking: All cracking should be documented, and special attention should be given to cracks propagating from the anchorages or through bolts. Cracking can be indicative of

overloading, corrosion of through bolts, or the beginning of expansion or adhesive anchor failure.

- Delamination: Sound the parapet with a hammer to detect locations of delamination at and around the connections.
- Spalling: All spalling should be documented at and around the connection and if there is exposed reinforcing, that should be noted along with any section loss associated with it.
- Impact damage. Document any observable impact damage that exists, and any deficiencies associated with it, which may include any of the above. Special attention should be given to the through bolt connections.

- Condition of the horizontal arm attachment to the parapet. The attachment should be inspected for corrosion, looseness, and pullout (anchorages). Looseness could be indicative of overloading of the connection hardware or failing of the mechanical or adhesive anchor(s). Often, the connection is installed without leaving proper edge distance and subsequent spalling may occur at the connection. Any spalling should be documented. Inspect the through bolts for signs of overstress, such as deformed washers under the nuts or embedment of the washer and/or nut within the hole (holes through the parapet may be oversized for the bolt assembly). See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance



Figure 8.4-9 Arm to parapet connection bolt nut is loose



Figure 8.4-10 Parapet back plate anchor bolts sheared off

- Adequate engagement of the nuts: Less than 100% engagement of the top nut reduces the ability of the anchor rod to develop its full load carrying capacity. Document percent engagement if less than 100%.



Figure 8.4-11 Rear girder connection bolt nuts are short and not fully engaged

- Condition of the bridge girder connections. These connections are typically bolted and should be inspected for corrosion, looseness, and any missing bolt assembly hardware. These connections should not normally be welded to steel girders, but this is sometimes encountered. The welds and the area of the girder immediately around the weld should be inspected as previously discussed for cracking. It should be noted these are welds are carried out in the field and result in an AASHTO Fatigue Category E' classification for the bridge girder.



Figure 8.4-12 Bridge girder connection plate and weld has rust

8.4.2 Element Level Guidance

Each arm connected to the bridge or parapet, i.e., each connection assembly, should be quantified as Each and assessed independently.

The following elements are used to document the condition of the bridge mounted connections:

Table 8.4-1 Bridge Mounted Connection Elements

Element No.	Element Name	Element Group	Unit
131	Bridge Girder Mount	Bridge Mounted Connection	Each
132	Bridge Parapet Mount		

8.4.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., spalling; gaps; pull outs), the arm and connection locations (e.g., top-right parapet steel plate), and severity of the defect (e.g.: number of anchor rods affected; size and depth of spall).

The table below outlines some typical conditions for bridge mounted connections. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.4-2 Bridge Girder Condition State Example

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Steel: Superficial corrosion to girder, connection bolts, plates or clamps.	None	
Concrete: < 1/16" crack in parapet radiating from connection or adjacent to connection.		
Concrete: Superficial delaminations and/or spalling in the concrete w/o exposed reinforcement or no evidence of active corrosion and w/o bearing loss.		
Fair Condition – Minor corrosion with minor section loss. Minor damage or missing hardware present.	Repair/replace element or continue monitoring.	CS-2
> 0% AND < 25% section loss to connection hardware.	Clean and paint affected components. If corrosion is due to dissimilar metals, replace with non-reactive metal	
Parapets: Arm end plates, or parapet end/back plates: < 15% section loss.		
For bridge girders: < 30% connection hardware loose or missing (with top-most connection being a parapet).	Replace affected components.	
Parapets: < 15% of hardware is loose/missing.	Replace or tighten affected components.	
Flat washers loose or missing.		
For bridge girders: Gap at connection (with top-most connection being a parapet).	Tighten hardware or shim gap.	
Concrete: > 1/16" and < 1/8" wide crack radiating from connection or adjacent to connection.	Seal cracks at affected components.	
Concrete: Spall or delamination with or without exposed rebar not affecting anchorage.	Remove unsound concrete and repair affected components.	
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
≥ 25% section loss to connection hardware.	Replace affected components.	
Parapets: Arm end plates/parapet end/back plates: ≥ 15% AND < 25% section loss.		
Girders: ≥ 30% connection hardware loose or missing (with top-most connection being a parapet).		
Concrete: ≥ 1/8" wide crack radiating from connection or adjacent to connection.		
Parapets: ≥ 15% AND < 30% of hardware is loose/missing.	Replace or tighten affected components.	
Concrete: Spall or delamination affecting bolts or anchorage.	Remove unsound concrete and repair affected components.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Hardware is missing/damaged, corrosion is advanced and/or section loss is enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the sign structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Any anchorage bolts, plates or clamps cracked, broken or missing.	Contact Program Manager. Replace affected components	
Parapets: ≥ 30% of hardware is loose/missing.		
Parapets: Arm end plates/parapet end/back plates: ≥ 25% section loss.		

8.5 Embankment (Element 141)

The embankment refers to the earthen material area around the ancillary structure and foundation. The inspector should determine if there is any erosion at or near the foundation that could lead to instability (such as undermining). If there is aggradation or the in-filling of materials over the foundation elements, determine if the water is properly channeling away from foundation elements.

8.5.1 Inspection Methods

The condition of the embankment should be visually assessed and documented for the following conditions:

- Aggradation: If the top of the foundation is buried and can be uncovered with less than 15 minutes of reasonable effort, remove the dirt/fill until the top of the foundation is exposed and document that the foundation was buried and uncovered for inspection. If excavation time exceeds 15 minutes, report for excavation by maintenance crews.



Figure 8.5-1 Foundation and anchor rod assembly buried

- If the top of the foundation is buried and cannot be uncovered by 15 minutes of reasonable effort, document the condition. The buried condition is to be reported to the Project Manager. However, if conditions warrant concern, i.e., the need for excavation, the condition should be reported

immediately by phone and/or email to the Project Manager. An inspection should be performed as soon as possible following the notification of excavation by the Project Manager. Conditions that would warrant immediate excavation include evidence of corrosion and/or section loss in areas above the dirt line, from localized excavation or deficiencies previously noted.

- Erosion or undermining around the foundation: Any areas of undermining or adjacent erosion should be probed and documented to determine depth and extent.



Figure 8.5-2 Embankment erosion exposing concrete foundation

- Standing water or indications of poor drainage should be noted and depth of water measured. If the foundation is in a swale or drainage ditch, it could periodically be submerged resulting in corrosion, debris accumulation, or damage of the submerged areas. Submerged areas for any structures that carry electric components should be assumed to be electrified and the Project Manager should be notified prior to inspection of the area.



Figure 8.5-3 Standing water above foundation

8.5.2 Element Level Guidance

The embankment for each foundation should be rated as a system (Each).

The following element is used to document the condition of the embankment:

Table 8.5-1 Embankment Elements

Element No.	Element Name	Element Group	Unit
141	Embankment	Embankment	Each

8.5.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., erosion or aggradation), the location of the deficiency (e.g., northeast quadrant, leading face), and severity of the defect (e.g.: dimensions of erosion and undermining).

The table below outlines some typical conditions for embankments. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.5-2 Embankment Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good – No substantial erosion degradation or standing water.	None.	CS-1
Fair Condition – Some notable erosion and/or standing water.	Regrade, excavate, or relocate structure.	CS-2
Covered in debris that could not be removed during the inspection.	Contact the Program Manager and reinspect after removal. Regrade or provide remedial action.	
Foundation is partially submerged in water.	Regrade around foundation or provide remedial action.	
Erosion occurs in adjacent area, but it does not expose the foundation.		
Erosion occurs at the foundation with a depth of less than 1’.		
Poor Condition – Erosion at the foundation and there is the possibility of undermining. Breakaway anchorage is < 3 1/2” above grade.	Regrade around foundation and / or provide remedial action within specified time frame or increase inspection frequency.	CS-3
Top of foundation and anchorage is submerged in water, the ancillary structure is electrified.	Border off area to the public regrade or provide remedial action.	
Top of foundation and anchorage is submerged in water with no electrical components affected.	Regrade around the foundation; or provide remedial action.	
Erosion occurs at the foundation with a depth greater than 1’ but does not affect structural integrity. Erosion is active.		
Erosion occurs at the foundation with a depth greater than 1’ but does not affect structural integrity. Erosion is not active.		
Critical Condition – Embankment or surrounding fill is not adequately supporting foundation.	Notify Program Manager. Perform corrective actions.	CS-4
Breakaway anchorage with erosion at foundation ≥ 3 1/2”.	Regrade around the foundation and provide immediate remedial action.	
Erosion occurs at the foundation with a depth greater than 1’ that affects the structural integrity.		

8.6 Grout Pad (Element 151)

This item refers to the cementitious material found between the ancillary structure foundation and base plate or transformer base. Agencies are phasing out the use of non-structural grout pads as they can retain moisture and accelerate corrosion of the base and anchor rods. However, some older structures may still have grout pads in place.

8.6.1 Inspection Methods

All loose debris and vegetation should be removed. The grout pad should be visually and tactilely inspected. The inspector should inspect and document the following conditions:

- Partial (minor cracking and/or section loss) or full (section loss, heavy cracking, punky gout, etc.) deterioration of the existing grout pad: Deterioration results in water/moisture retention within the grout pad and possible corrosion of the partially or unexposed anchor rods. Note the level of deterioration. If the grout pad is deteriorated to the extent that it can be removed easily with hand tools, first verify the existence of leveling nuts and then remove the grout pad and note that it was removed by the inspector.



Figure 8.6-1 Grout pad is 100% deteriorated



Figure 8.6-2 Deteriorated and missing sections of grout pad

- Moisture leaking from the grout pad indicates possible moisture/water retention and possible corrosion of the anchor rods.



Figure 8.6-3 Grout pad with cracks and moisture stains

- Document the maximum thickness of each grout pad. The height is representative of the height from bottom of the base plate to the top of the foundation.

8.6.2 Element Level Guidance

The grout pad for each post or tower should be quantified (Each). If a grout pad has been removed, it should no longer be quantified.

The following element is used to document the condition of the grout pad:

Table 8.6-1 Grout Pad Elements

Element No.	Element Name	Element Group	Unit
151	Grout Pad	Grout Pad	Each

8.6.3 Reporting and Rating Guidance

Since most grout pads are non-structural and are being phased out the primary concern is the retention of water and or salt creating a corrosive environment for the enveloped components.

All deficiencies should be recorded by describing the type of deficiency (e.g., cracking, deteriorated grout), the grout pad location (e.g., the left leading post), location of deficiency (e.g., at anchor rod #4) and severity of the defect (e.g., 10% of the grout pad is deteriorated).

Each grout pad should be assigned a Condition State independently with the most severe condition governing the rating. Below is an outline of some typical conditions, deficiencies, and possible work requests to remedy them.

Table 8.6-2 Grout Pad Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – The grout pad is in like-new condition.	Nothing.	CS-1
Fair Condition – Grout pad is deteriorated and there is no evidence of water retention.	Remove grout pad or monitor.	CS-2
Poor Condition – Grout pad is deteriorated with evidence of water retention.	Remove grout pad.	CS-3
Rust staining to grout pad	Remove grout pad.	

8.7 Base Plate/Transformer Base (Elements 201 – 209)

This element includes the base plate, flanges, casting clamps, gusset plates, and associated welds. In the case of transformer bases, this element includes the transformer base, its mounting tabs and base the plate and its connection bolts (see Figure 8.7-7).

The vertical support for ancillary structures will typically be inserted into and/or welded to a base plate or, in the case of a transformer base, attached to the transformer base with connection bolts or a weld. The base plate/transformer base (mounting tab) is connected to the foundation via the anchor rods. It is common for base plates to have stiffeners welded between the anchor rod locations to add rigidity and reduce the impact of fatigue on the connection.



Figure 8.7-1 Typical base plate for a post



Figure 8.7-2 Base plate with stiffeners



Figure 8.7-3 Typical transformer base with bolted post base



Figure 8.7-4 Typical interior of transformer base



Figure 8.7-5 Interior of transformer base at the base plate/post connection.



Figure 8.7-6Transformer base with threaded post

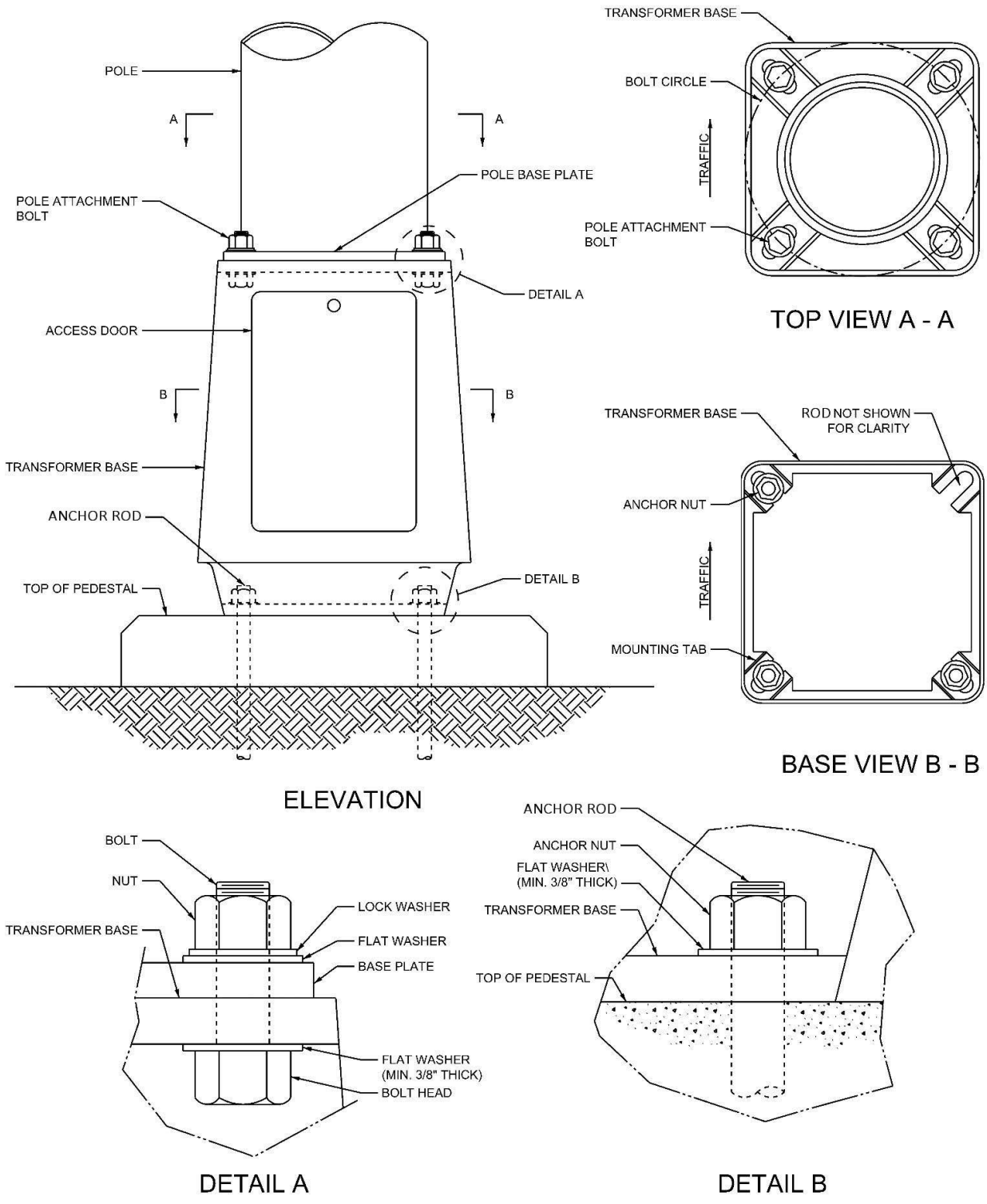


Figure 8.7-7 Typical Transformer Base

8.7.1 Inspection Methods

All loose debris and vegetation should be removed from under and around the base plate/transformer base. Base plates/transformer bases should be visually and tactilely inspected. The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanized coating), corrosion, section loss, etc.: If an area of corrosion is observed or suspected, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented. Aluminum base plates resting on a concrete foundation without an isolation pad can cause a reaction that induces section loss; this and other dissimilar metals being used should also be documented.



Figure 8.7-8 Section loss to base plate



Figure 8.7-9 Corroded base plate induced by dissimilar material

- Distress around enlarged holes for the anchor rods: Holes are sometimes enlarged to facilitate installation of the base plate/transformer base, due to improper installation/setting of anchor rods during construction. Note if enlarged holes are drilled or torch-cut. The often jagged nature of the in-field torch-cut enlargement can create inherent stress risers.

- Cracks or distortion of the base plate/transformer base: Distortion could be indicative of overloading, damage during erection or improper welding procedures during fabrication.



Figure 8.7-10 Dye penetrant confirming cracks in aluminum base plate

- Impact damage: Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.



Figure 8.7-11 Impact damage to base plate with cracks

- The welds of the post-to-base plate connection and stiffener welds (vertical to post and horizontal to base plate) shall be inspected. If castings are present, they shall be inspected for cracking and bolt tightness shall be verified. If necessary, additional testing may be required to determine the extent of weld cracking if visually present or suspected during routine inspections. Reference Appendix F Nondestructive Evaluation for further information.



Figure 8.7-12 Crack at post to base weld

- Structures with decorative bases or protective covers/skirts should be noted and flagged during the proposal phase. The Consultant should coordinate with RIDOT for their removal prior to the inspection date. Any decorative bases or protective covers/skirts that cannot be opened/removed shall be documented. However, if conditions warrant immediate removal, the condition should be reported immediately. An inspection should be performed as soon as possible.



Figure 8.7-13 Raising of decorative base lighting standard



Figure 8.7-14 Section loss at base plate and post after removal of decorative base

The following pertains specifically to transformer bases:

- Coating loss (paint, galvanized coating, or weathering steel), corrosion, section loss, etc.: If an area of corrosion is observed or suspected, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented. Aluminum base plates resting on a concrete foundation without an isolation pad can cause a reaction that induces section loss; this and other dissimilar metals being used should also be documented.



Figure 8.7-15 Corroded and cracked transformer base



Figure 8.7-16 Steel mast arm transformer base with section loss

- Condition of the transformer base to base plate bolted connections: Post attachment bolt connections should be inspected for loose or missing components, under engaged nuts, improperly sized washers, beveled washers, or extra washers (see Figure 8.7-17). Document percent engagement if less than 100%.

- The post attachment bolts, washers and nuts should be checked to ensure tightness by hammer tapping (see Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance) with the power turned off. Document any hardware that was observed to be loose. The connection nuts should be verified for snug tight. If the transformer base is not electrified, the connection bolt nuts should be verified by hand / hammer blows. If the base is electrified, bolt nuts can be verified by the following means:
    - Visual observation
    - Shake test with visual observation (note shake test explanation in Section 8.2.1)
    - Hammer blows to the connection bolt head with visual observation.



Figure 8.7-17 Post attachment bolt misaligned, with undersized washer and bolt with rust



Figure 8.7-18 Post attachment bolt is missing its washer and is under threaded



Figure 8.7-19 Post attachment bolt is backed off and loose

- Torque control nuts. Some transformer bases have top nuts that have a necked section in the middle. The upper portion will separate from the lower portion at the neck when proper torque is applied to the torque control nut, leaving only the lower portion in place. In some cases, the upper and lower portions may not have separated.

- Document any deviation, excess or missing components, from the typical configuration: The typical configuration of the transformer base varies depending on the manufacturer. The transformer base assembly may include shims, flat washers, thick washers, nuts, mounting tabs and connection bolts making up the transformer to post base plate connection. These components in the various possible configurations will be referred to collectively as the "transformer base assembly" or just "transformer base". Some examples of deviations from the typical configuration may include the presence of lock washers, beveled washers, lock or jam nuts, wedge shims, extra washers, and missing nuts and washers.

- Any access door that cannot be opened shall be documented: The condition is to be reported to the Program Manager on a maintenance list. If needed, inspectors can break access door fasteners, ensuring that the cover itself is not damaged, and report condition of fasteners to be replace. However, if conditions warrant immediate removal of the access door, the condition should be reported immediately to the Program Manager by phone and/or email. An inspection should be performed as soon as possible following removal of the access door. After removal of the access door, a visual inspection of the interior of the transformer base is required. The inspector shall treat all interior wiring as if energized and recognize the potential electrical hazard. If tactile inspection is necessary, the consultant will need to coordinate powering down the structure for safe and detailed investigation.

- Distress around the anchor rods: Special attention should be given to the transformer base in the immediate vicinity of the anchor rods, as this is a location of high stress. The area should be checked for cracking, section loss or other signs of distress. Specifically, the mounting tabs/flanges of transformer bases commonly have cracks due to over tightening of the anchor rod nuts. This condition is even more likely with a foundation that is not level.

- Impact damage: Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.



Figure 8.7-20 Impacted steel mast arm transformer base

- Debris or animal/insect infestation inside the transformer base: Any debris that can hinder the inspection or accelerate any deterioration of the transformer base or electrical system needs to be removed. If the transformer base is electrified, the power needs to be turned off prior to

removal. If the debris cannot safely be removed by the inspector the condition should be added to a maintenance list and provided to the Program Manager. Once the debris has been removed the inspection should take place.



Figure 8.7-21 Animal nest and debris inside transformer base

8.7.2 Element Level Guidance

Each individual base plate or transformer base is quantified (Each). If there is a post base plate connection to a transformer base, the assembly should still be treated as one system (Each). The subcomponents of the base plate or transformer base are addressed within this element.

The following elements are used to document the condition of the base plate or transformer base:

Table 8.7-1 Base Plate/Transformer Base Elements

Element No.	Element Name	Element Group	Unit
201	Base Plate, Steel	Base Plate/Transformer Base	Each
202	Base Plate, Aluminum		
203	Transformer Base, Steel		
204	Transformer Base, Aluminum		
209	Base Plate, Other		

8.7.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., corrosion, impact, cracks), the base plate location if multiple are present (e.g., left-leading base plate), location of deficiency (e.g., relative to anchor rods, anchor rod sector or post location) and severity of the defect (e.g., width and length of crack, size and depth of impact).

Each base plate or transformer base should be assigned a Condition State independently with the most severe condition governing the rating. Below is an outline of some typical conditions, deficiencies and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.7-2 Base Plate Condition State examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Superficial corrosion with no section loss.	None.	
Transformer base is covered in permanent/immovable material. No deficiencies suspected.		
Anchor rod skirt/covers are missing hardware.	Replace hardware.	
Transformer base has minor debris build-up, or there is debris below the base plate.	Remove water/debris and correct drainage/accumulation deficiency.	
Base plate or transformer base is buried and is inaccessible. Using engineering judgement, there are no issues suspected.	Excavate and inspect. Regrade, install retaining wall or relocate structure.	
Transformer base access cover is unable to be removed. Using engineering judgement, there are no issues suspected.	Remove cover, inspect, then replace cover.	
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss > 0% AND < 15% to base plate or transformer base.	Clean, prepare, and coat affected components.	
Section loss > 0% AND < 25% to mounting tabs.	Replace affected components.	
Transformer base access door has broken hardware but the anchorage was able to be inspected.	Replace hardware.	
Transformer base access door is missing or can't be temporarily secured and poses an electrical hazard.	Notify Program Manager and replace.	
Transformer base access cover is not permanently secured (can be temporarily secured in field).	Replace or repair affected components.	
Poor Condition – Light to moderate corrosion and section loss. Damage is present but the strength and/or serviceability is only moderately affected, and it does not warrant immediate replacement	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Dissimilar materials and/or aluminum base plate on concrete with no isolation pad.	Replace dissimilar components or install isolation pad.	
Section loss ≥ 15% AND < 25% to base plate or transformer base.	Clean, prepare, and coat affected components.	
Section loss ≥ 25% AND < 50% to mounting tabs.	Replace affected components.	
A crack is present but is arrested with no signs of distress.		
Impact damage that does not significantly affects the serviceability of the structure.		
Transformer base access door is missing or can't be temporarily secured and poses an electrical hazard.	Notify Project Manager and replace.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Cracks may be present on the base plate to column support connection weld. Corrosion is advanced and section loss is enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the ancillary structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Section loss ≥ 25% to base plate or transformer base.	Replace affected components.	
Section loss ≥ 50% to mounting tabs.		
A crack is present with possibility of propagation.	Replace transformer base/base plate or arrest crack. Program Manager may be warranted.	
Impact damage significantly affects the serviceability of the structure.	Remove structure or replace/repair affected components. Notification to the Program Manager may be warranted.	
Excessive movement of the transformer base or ≥ 50% post to transformer base connection bolts are seen moving when the pole is rocked.		
≥ 50% transformer base to anchor rod connections are not fully engaged, are misaligned, or are undersized.		
Vertical stiffeners of base plate are damaged/buckled.		

8.8 Post/Tower (Elements 211 – 229)

This item includes the vertical post / tower / high mast hand hole covers and caps.

Multi-chord full-span structures may be supported at each end by either a two-column trussed frame (tower) or by a single post. Dual-chord and monotube sign structures will typically be supported at each end by a single post. For cantilevered or mast arm structures, typical design includes a slight angle from vertical between the post/tower and base plate during fabrication. Once the arm and ancillary structure devices are installed, the intent is the loading will deflect the column to plumb. The inspector shall note whether the post/tower is out of plumb (factoring that the post may be tapered).

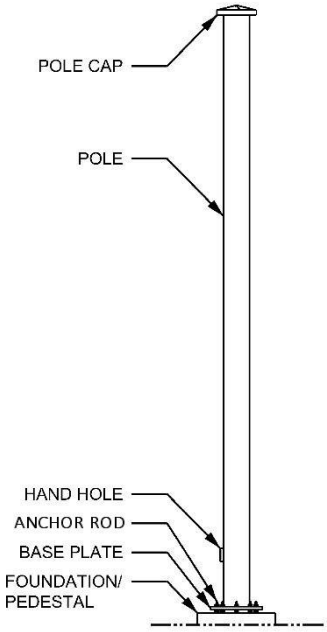


Figure 8.8-1 Single Post, Elevation

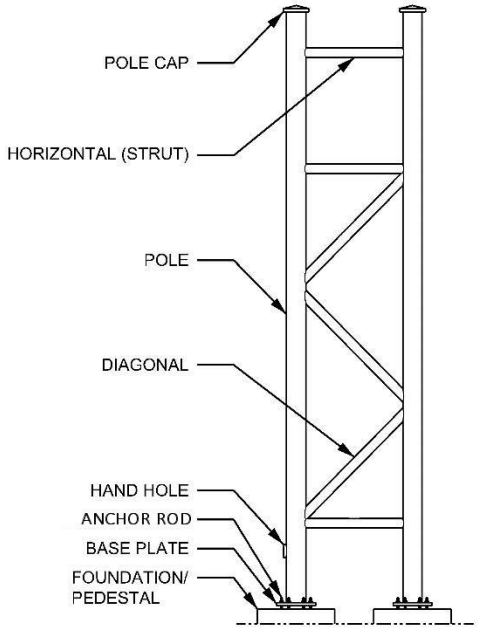


Figure 8.8-2 Tower - Two Post Truss (End Frame), Elevation

8.8.1 Inspection Methods

The post/towers should be visually and tactilely inspected. Hand hole covers, if present on the post, shall be removed to the extent possible without damaging the cover and attachment screws. The upper portions of the post/towers are to be inspected from an aerial lift (bucket or platform), or in the instance of a high mast structure with a combination of lift, drone and spotting scope. The inspector should inspect and document the following conditions:

- Coating loss (paint, weathering steel patina or galvanized coating), corrosion, section loss, etc.
- If an area of corrosion is observed on the outside of the post, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented.
- The outside of the post should be sounded with a hammer to detect areas of corrosion or “thin” areas in the post that may not be externally visible. An electrically insulated borescope may be used to visually inspect the inside of the post. The use of a borescope is to be documented. D-Meter thickness testing shall be performed to determine the amount and extent of section loss. Standard readings should be taken just above the post-to-base plate connection and 2” above the base plate , at each quadrant, with a single reference reading taken at 24" above the base plate. On structures that do not have a base plate, the readings shall be at and 2” above the post base. If section loss is indicated and more readings are required, a layout of readings shall be generated to accurately record the section loss and each reading line shall be mapped out and measured from the top of the base plate and recorded. Note Appendix F Nondestructive Evaluation for further information on D-Meter readings.



Figure 8.8-3 Severe section loss to base of post



Figure 8.8-4 Technician using a D-Meter to measure post thickness

- For weathering steel, mostly associated with high mast light (HML) poles, section loss at the base and slip joints, historically, experience more problems relative to other poles. Two weathering steel materials were mainly used for HMLs: ASTM A588 and ASTM A595 Grade C. Due to issues with using different materials and fabrication, recommendations based on section loss are more conservative than other poles.

- Localized areas of distressed painted or coated surfaces such as at connections, attachments, post bases, etc. Cracks or splits in painted surfaces may be indicative of an overstressed condition warranting additional investigation and NDT (see Appendix F Nondestructive Evaluation) at these areas. This condition could also be a result of weathering or chemical contamination (i.e., deicing salts).

- Perform a "Shake Test" for all single post structures: While performing the shake test, the inspection team should observe the foundation, anchor rod assemblies, and base plate for movement. Any movement of the post may indicate issues with the anchorage or base plate. See shake test explanation in Section 8.2.1

- Dents and ruptures in the round vertical posts reduce the load carrying capacity of the post or posts/towers as they could may significantly reduce the cross-section of the post or posts. A dent less than twice the thickness of the post is not considered to affect the strength of the post. The depth of the dent should be measured with a ruler; however, getting more complete or accurate information on the depth of the dent could require specialized equipment that is impractical. Nevertheless, the depth of any dent or rupture, as measured with the ruler, along with descriptions of any tears or punctures within the dent or rupture, should be recorded during the inspection. This may require the use of a 4-foot level to determine extent of the damaged area. The following measurements (refer to Figure 8.8-5) are to be taken and documented.

    - H: Horizontal measurement of the dent or rupture.

    - V: Vertical measurement of the dent or rupture.

    - d: Depth of the dent or rupture at the deepest point of the dent.

- C1: Circumference of the support, immediately above or below the affected area.
- C2: Circumference of the undamaged post at the location of maximum distortion.
- D: Distance from top of the base plate to the center/middle of the dent.

- L: Maximum dimension of dent or rupture.

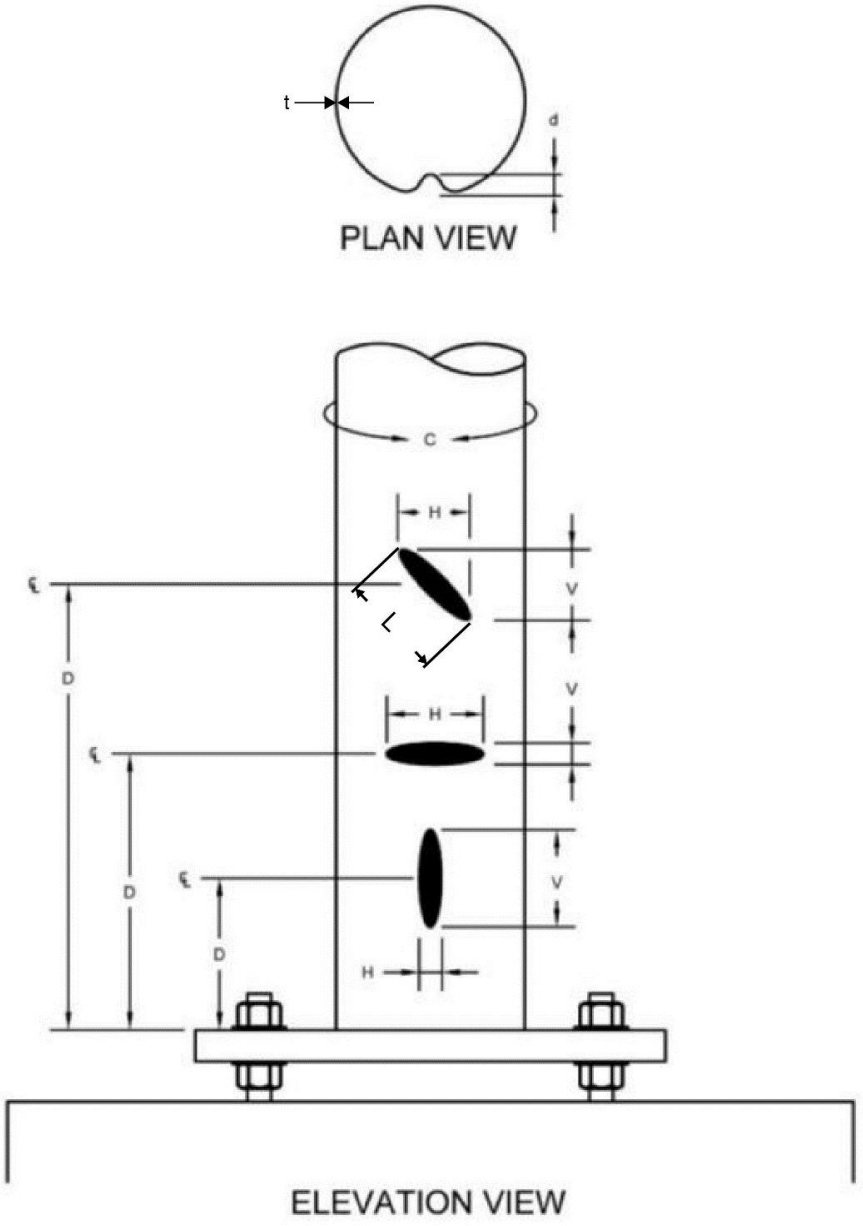


Figure 8.8-5 Measurement methodology for dents and ruptures in round or faceted posts



Figure 8.8-6 Impact damage to post with crack at hand hole



Figure 8.8-7 Measuring impact damage to post

- Distortion to post: These conditions can occur from vehicular impact or during the erection of the structure; these conditions need to be measured and documented.



Figure 8.8-8 Truss post diagonal is bent

- Corrosion or loose rust around weep holes: Corrosion and rust may be indicative of corrosion on the inside of the post and should be investigated as described previously in this section.

- Corrosion and cracking around any burned or rough-cut holes: Burned or rough-cut holes create stress risers and special attention should be given to these areas.

- Condition of the welded connections: The welds should be closely inspected for cracking, especially at the start and stop points of the intersecting welds and incomplete or excessively ground welds, as they create stress risers. Special attention should be given to the post-to-base plate weld due to the high stresses at this location. The location and size of any weld crack will be documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation). The start and the end of the crack should be marked with a line and dated.

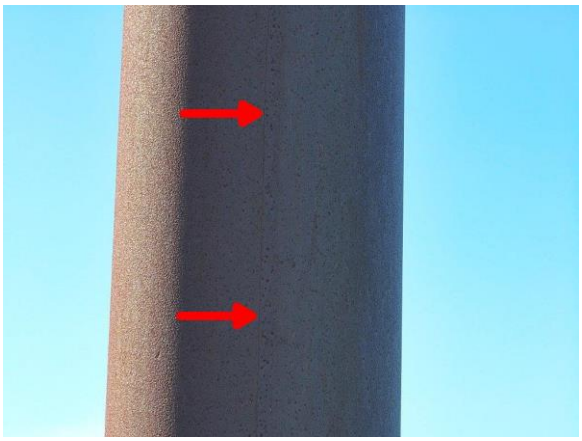


Figure 8.8-9 Vertical seam weld on HML



Figure 8.8-10 Crack to seam weld at HML slip joint

- Condition of the splices: Post structures are not typically spliced. However, if splices are present (as found in high mast light (HML) poles and Intelligent Transportation Structures (ITS) they should be inspected for pack rust, section loss, rust bleeding, loose or missing components, cracked welds, and under-engaged nuts. Document percent of engagement if less than 100%. Suspected cracks should be verified by NDT methods. The start and the end of the crack should be marked with a line and dated. Refer to Appendix F Nondestructive Evaluation for further information..

- Conditions of, in, and around the hand holes and covers: The hand hole covers should be removed to the extent possible and inspected for looseness of the cover and missing or sheared bolts securing the cover. Any cover that cannot be removed shall be documented. Missing or loose hand hole covers allow for water and debris infiltration; and animal infestation. Any debris present within the hand hole/post is not to be removed by the inspector if electrical power is present; the condition is to be reported for removal by RIDOT maintenance crews. Notice shall be provided to the Project Manager. However, if conditions warrant immediate removal of the debris, the condition should be reported by phone and/or email. Conditions that would warrant immediate debris removal include observable corrosion, damage, and/or section loss of the post and around the hand hole. An inspection should be performed as soon as possible following the removal of the debris.

- Cracks or breaks in the hand hole opening and opening weld, and cracks in the post around the hand hole. Special attention shall be given to the weld in the hand hole reinforcing ring. Cracks or breaks in the hand hole opening and welds can potentially serve as a means for crack propagation into the base metal of the post. Suspected cracks should be verified by NDT methods (see Appendix F Nondestructive Evaluation).



Figure 8.8-11 Crack from impact damage to post hand hole access

- Condition of post caps: Loose or missing caps allow water intrusion and animal infestation and should be documented. Loose caps should be tightened in the field if possible, with attention paid to not breaking fasteners.

- Condition of electrical ports: Damage to the ports and missing, loose, or damaged port caps or grommets allow for water infiltration and animal infestation and should be documented.

- Bowing or deflection: Typically observed for timber posts (see below) but can be observed on other types of posts. Excessive bowing or deflection can be indicative of other issues with the structure or the result of overstressing or impact. Any observable bowing or deflection should be quantified and documented.

- Timber posts:

    - Decay, checking, splitting, shakes, knots, fire damage, or insect damage: Timber posts should be checked for decay caused by insects, fungus, or other means. Decay often occurs below the ground line, so the timber post shall be excavated at least 6” to allow adequate inspection. The timber post should also be inspected for checking, splitting, or shakes. Any indication of fire damage should also be documented. All dimensions and extent of deficiencies should be documented.

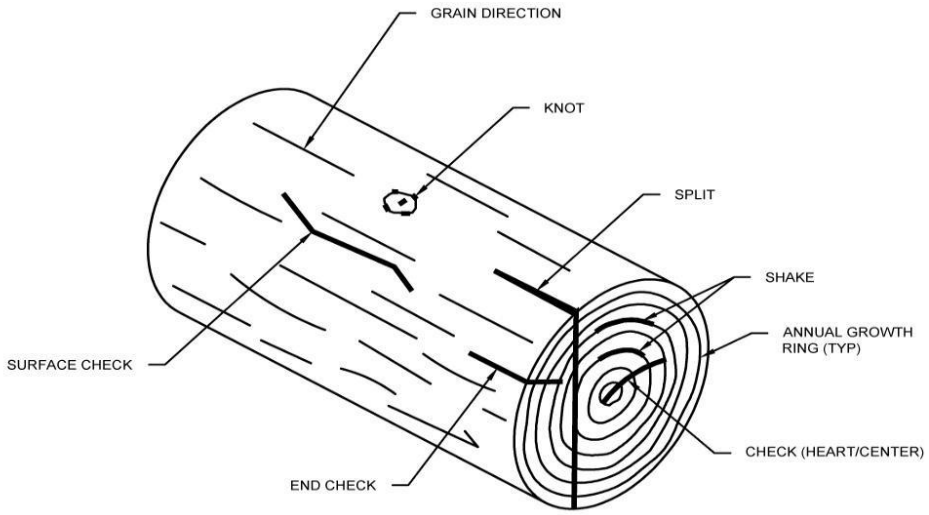


Figure 8.8-12 Typical Timber Defects

- Bowing or deflection of the post: Any deflection or bowing of the post should be documented.

- Impact damage: Impact to timber posts can result in crushing of fibers or breaking-off of material. Any loss of section should be quantified.

- High mast light post winching system at hand hole: High mast lights may have a winching system that is used to raise or lower the luminaire ring. This winching system is typically accessed at the hand hole. The inspector should check for any signs of corrosion, deterioration, or damage. Coordinate with RIDOT to conduct a test to verify that the system is operational.



Figure 8.8-13 High mast light post winching system accessed through hand hole

- High mast light posts may have hinges at the base which allow the post to be lowered horizontally to access the luminaire. The hinges and fasteners should be visually inspected for rust, deterioration or deficiencies which may prevent intended function.

- Impact damage. Document any observable impact damage that exists, and any deficiencies associated with it, which may include any of the above.

The ancillary structure should be tactilely inspected for leaning/plumbness and bowing or bending of posts, level/sag of arms, wires or chords and alignment of any structural connections with respect to each other and their original/design location. Various levels (e.g., from a plumb bob and a torpedo level or up to a 4' level), lasers and measuring tapes should be used to measure horizontal and vertical tilt and sagging. The upper portions of the posts and arms are to be inspected from an aerial lift (bucket or platform), or in the instance of a high mast structure with a combination of lift, drone, and spotting scope. The inspector should inspect and document the following conditions:

- Out of plumb or leaning vertical posts (not related to foundation movement): Posts/towers that are out of plumb or leaning can be indicative of damage or adjustments made during erection and can increase bending stresses in the posts. Any observable leaning of the vertical supports should be measured and the direction of the lean documented. The measurement can be obtained with a digital level/tilt meter or with a 4' level and tape by measuring the amount of lean of the post over the known vertical height, V, factoring in for any taper. Alternatively, the lean can be measured by lowering a plumb bob from the top of the support within a few inches of the base plate and taking a horizontal measurement, H, from the base of the support to the plumb bob line. For the method for measuring leaning posts, refer to Figure 8.8-14 and Figure 8.8-15.

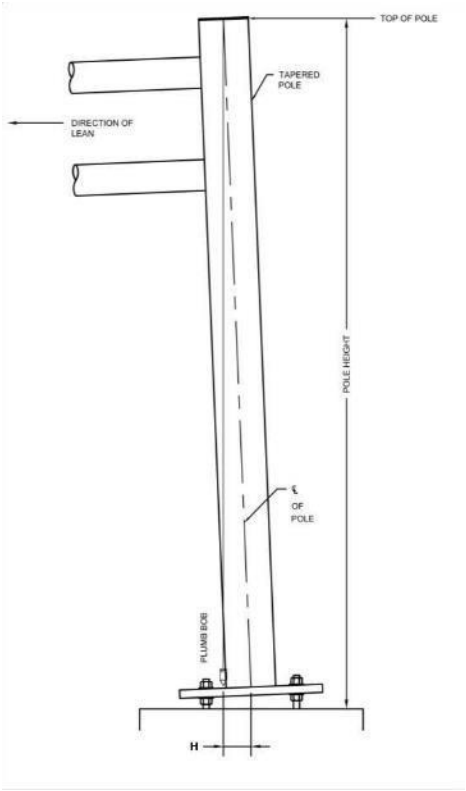


Figure 8.8-14 Measurement methodology for leaning or out of plumb tapered posts

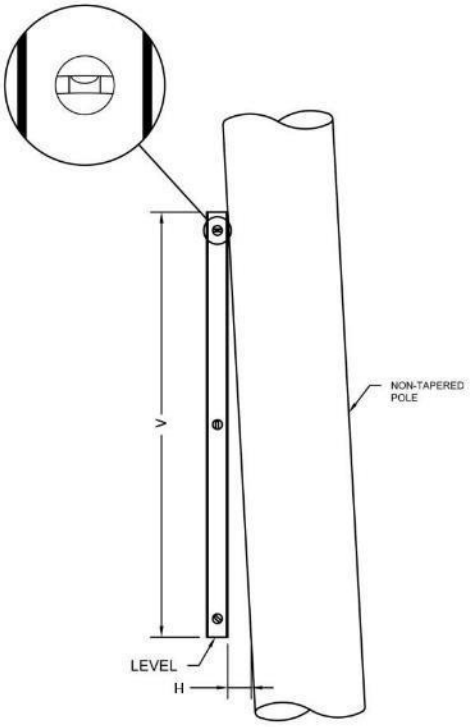


Figure 8.8-15 Methodology for manual measurement for leaning or out of plumb non-tapered post



Figure 8.8-16 Measuring plumbness of post with a level

- Bowing of the posts: An observable bowing of the vertical supports could be indicative of an overstress condition, inadequate support size or section, improper fabrication, or damage incurred by vehicle impact, and should be measured and the direction of the bow documented. The measurements should be performed by stretching a line from the top of the support to the face of post above the base plate and measuring the maximum bow. In the case of a localized area of bowing due to impact, the line or straight edge should be stretched across the area and rested against the plumb or vertical portions of the support on both sides of the area. For the method for measuring bowed posts, refer to Figure 8.8-17.

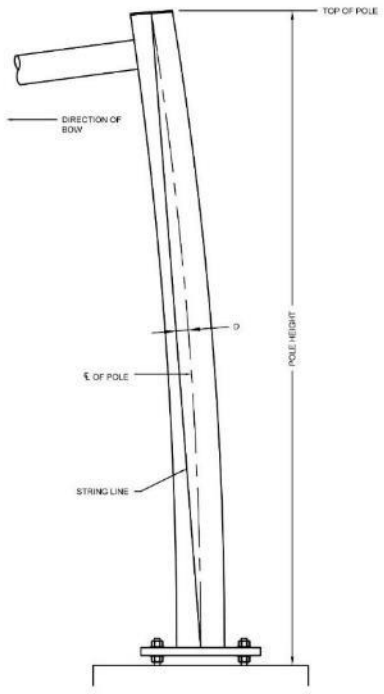


Figure 8.8-17 Measurement methodology for bowed posts

8.8.2 Element Level Guidance

Table 8.8-1 Post/Tower Elements

Element No.	Element Name	Element Group	Unit
211	Post, Steel	Post/Tower	Each
212	Post, Aluminum		
213	Tower, Steel		
214	Tower, Aluminum		
221	High Mast Post, Steel		
222	High Mast Post, Other		
229	Post/Tower, Other		

Each post, trussed tower or high mast will be counted separately under this element (Each). The subcomponents of the post (e.g., hand hole cover and post cap) or tower (e.g.: struts and diagonals) are assessed under this element.

8.8.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., corrosion, impact, cracks), the post location if multiple are present (e.g., left-front post, examples in Figure 8.8-18 and Figure 8.8-19), location of deficiency (e.g., relative to anchor rods, connection bolts or post location) and severity of the defect (e.g., width and length of crack, size and depth of impact).

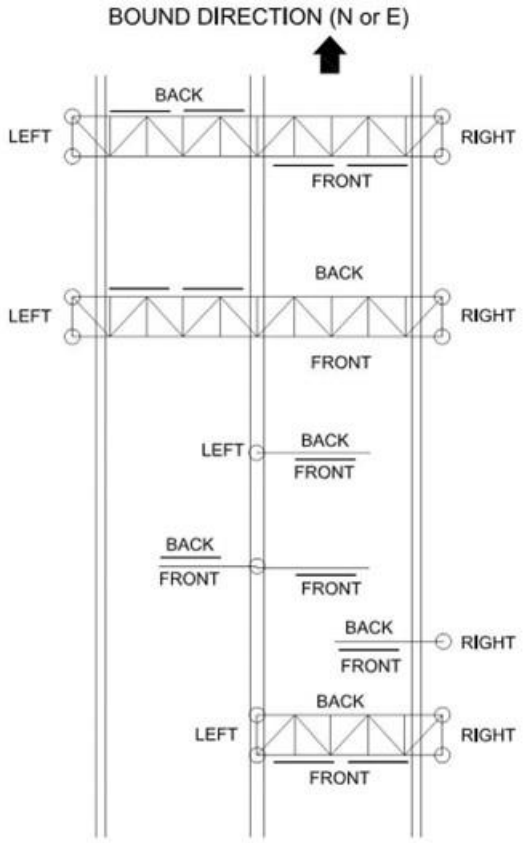


Figure 8.8-18 Post and Sign Orientation Bound Direction

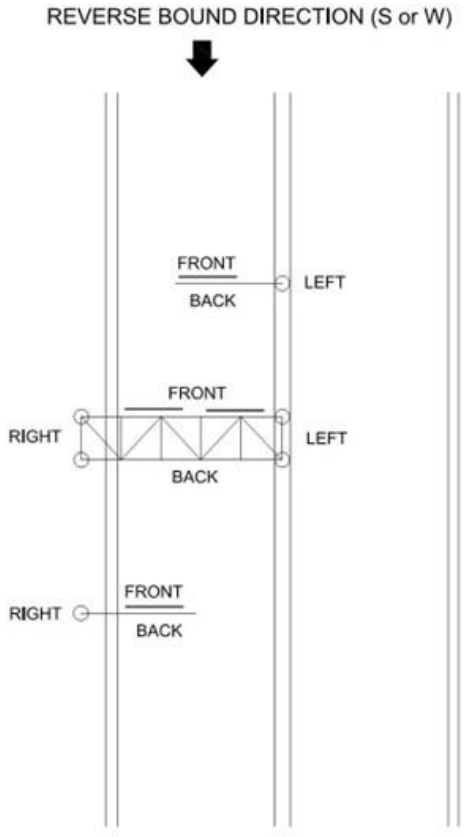


Figure 8.8-19 Post and Sign Orientation Reverse Bound

Regarding the Condition Rating for dents or ruptures to round or multi-sided tubular members, the criteria for "compactness" and "slenderness" needs to be defined:

As per AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (2015, 1st Edition) – Section 5.7, structural elements can be classified as compact, noncompact, or slender based upon their slenderness ratio.

- A compact section refers to a structural member with a slenderness ratio that is small enough to reach its full plastic moment capacity without experiencing local buckling.
- A non-compact section refers to a structural member with a slenderness ratio between the compact limit and the slender limit, meaning local buckling will occur after yielding starts.
- A slender section refers to a structural member with a high slenderness ratio where local buckling happens before yielding, significantly reducing the member's capacity.

In general, compact sections are the strongest, followed by non-compact sections, with slender sections having the least capacity. Note that slender and non-compact sections may show distress before failure such as bending, dimpling, or denting, which are not caused by secondary forces such as impact, before reaching failure, while compact sections may fail with little or no outward sign of overstress.

Structural elements can be classified as:

- Compact, the width-thickness ratio (λ) must not exceed the width-thickness ratio at the compact limit (λ_p).
- Non-compact, the width-thickness ratio (λ) must exceed the width-thickness ratio at the compact limit (λ_p) but less than the width-thickness ratio at the non-compact limit (λ_r)
- Slender, the width-thickness ratio must exceed the non-compact limit (λ_r).

The width-thickness ratios for round and multi-sided tubular compression elements and respective limits are as follows:

λ: width-thickness ratio of element = **D/t or b/t**

λ_p: width-thickness ratio at the compact limit

λ_r: width-thickness ratio at the non-compact limit

D: diameter of round post

b: inside distance between insertion points on the flat sides on a multi-sided tubular post

t: thickness of post wall

Compact: **$\lambda \leq \lambda_p$**

Non-compact: $\lambda_p < \lambda \leq \lambda_r$

Slender: $\lambda > \lambda_r$

Each post or tower should be assigned a Condition State independently with the most severe condition governing the rating. Below is an outline of some typical conditions, deficiencies, and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.8-2 Post/Tower Condition State examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss, damage, or misalignment.	None or routine maintenance.	CS-1
Minor/random superficial scrapes.	None.	
Post cap is loose or missing hardware.		
Vertical support is out of plumb such that H/V < 2.5%, where the post/tower leans a horizontal distance H per vertical distance V.	None or monitor.	

Description of Deterioration or Defect	Work Action	Condition State
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Post/tower corrosion with section loss > 0% AND < 15%	Clean, prepare, and coat affected components or increase inspection frequency to 24 months.	
For HMLs, section loss > 1% AND < 15%		
Tower bracing member has corrosion with section loss > 0% AND < 15%.	Clean, prepare, and coat replace affected components.	
Within 5' to 6' from the base plate, weathering steel for an HML has < 10% section loss.		
Tower bracing connections have section loss > 0% AND < 25%.	Straighten/brace or replace affected member; increase inspection frequency.	
Tower bracing member is bent.	Straighten/brace or replace affected member.	
Hand hole cover is missing or can't be temporarily secured and poses an electrical hazard.	Notify Project Manager and replace.	
Hand hole cover is not permanently secured (can be temporarily secured in field).	Replace or repair affected components.	
Vertical support is out of plumb such that ≥ 2.5% H/V < 5%, where the post/tower leans a horizontal distance H over a vertical distance V.	None or monitor.	
Horizontal support is out of level such that V/H ≥ 2.5% V/H < 5%, where the arm leans a vertical distance V over a horizontal distance H.		
Dents to compact and slender members (assume compact/non-compact section if unknown): Dent(s) with no cracking or sharply folded kinks in dent. AND The dent is located away from other considerations such as holes and welded-on plates. AND Under typical dead loads, neither out-of-plumb nor out-of-straightness exceeds 2.5% of post length. AND Dent where d ≤ 2t, where d is the depth of the dent and t is the thickness of the tube wall. AND Dent where W ≤ 0.1C (compact/non-compact) and W ≤ 0.5C (slender), where W is the width of the dent measured along the circumference and C is the post circumference. AND Dent where L < 0.2C (compact/non-compact) and L < 0.1C (slender), where L is the maximum dimension of the dent measured straight across the largest dimension of the dent and C is the post circumference.	Monitor.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Moderate section loss. Damage is present but the strength and/or serviceability is only moderately affected, and it does not warrant immediate replacement	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
For HMLs, section loss ≥ 15% AND < 20%	Remove pole from service in in 3 months.	
Corrosion with section loss ≥ 15% AND < 25%.	Clean, prepare, and coat or repair/replace affected components.	
Tower bracing connections have section loss ≥ 25%.		
Within 5' to 6' from the base plate, weathering steel for an HML has ≥ 10% AND < 15% section loss.		
A crack is present but is arrested with no signs distress.	Replace or repair affected components; increase inspection frequency.	
Vertical support is out of plumb such that H/V ≥ 5%, where the post/tower leans a horizontal distance H over a vertical distance V and does not enter or have the potential to enter the traffic envelope.	Monitor or reset.	
Horizontal support is out of level such V/H ≥ 5%, where the arm leans a vertical distance V over a horizontal distance H and does not enter or have the potential to enter the traffic envelope.		
Dent to tubular post exceeds any criteria listed above under CS-2.	Increase inspection frequency, analyze for engineered solution or replace depending on the severity of the dent.	
Critical Condition – Deterioration or damage is so severe that structural integrity is in doubt. Failure may be imminent.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
For HMLs, section loss ≥ 20%.	Remove pole from service immediately.	
Advanced level/plumbness defects and structure is within or has the potential to enter the traffic envelope.	Remove or stabilize.	
Level or plumbness is an active condition and is worst since the previous inspection to the point that there is concern future movement may impact the structural integrity or allow the structure to enter the traffic envelope.		
Section loss ≥ 25%.	Replace affected components or remove structure. Notification to the Program Manager may be warranted.	
Within 5' to 6' from the base plate, weathering steel for an HML has ≥ 15% section loss.		
A crack is present with possibility of propagation.		
Cracks around hand holes that propagate into base metal.		

8.9 Post/Tower to Arm/Chord/Wire Connection (Element 231)

This element defines the connection (e.g.: flange; gusset plates; saddles; thimble eye) and hardware (e.g.: bolts; clamps) that transfers the load from the horizontal to vertical support. Depending on the requirements of the structure, different types of horizontal to vertical support connections are used:

- **Seated** - A seated configuration involves the carried component bearing or sitting directly on the carrying component, e.g., a strut or post mounted saddle, such that most of the load is transferred directly to the carrying component rather than the load transferring through connection hardware. The two components are still secured with clamps or U-bolts, but this connection hardware carries a minor portion of the load. It is notable that seated type connections are more robust than unseated connections. This is due to the main structural members carrying the load directly and generally being heavier than any connection hardware that may be used in the unseated type connections.

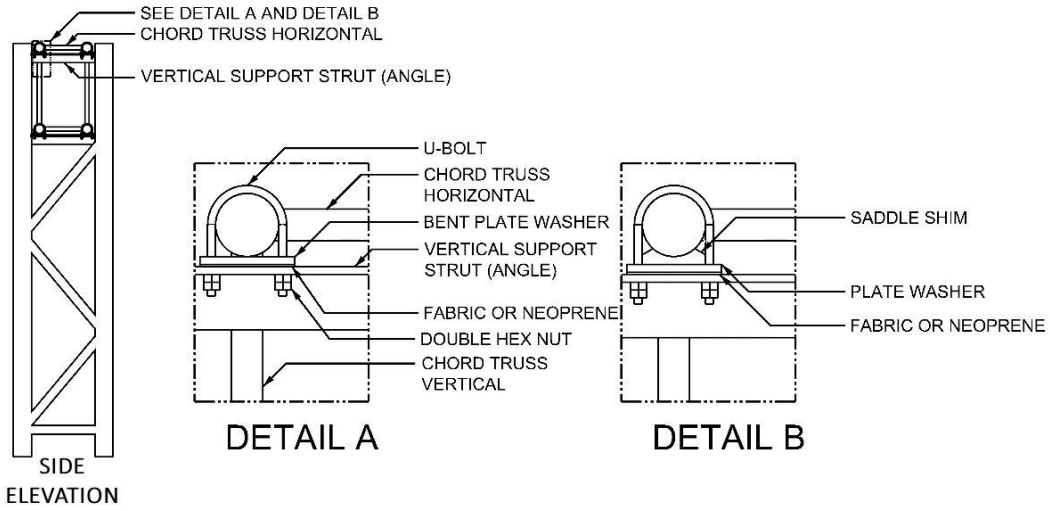


Figure 8.9-1 Truss Chord, Seated on Strut of Vertical Support



Figure 8.9-2 Typical seated chord assembly

- **Unseated** - An unseated configuration involves the carried component bolted or welded to the carrying component such that the load is fully transferred to the carrying component via the

connection hardware. Several common unseated type chord to vertical support connections are discussed in the list below:

- Flange Plate: This connection consists of a flange or box gusset that is shaped to fit the post and welded to the post. A flange plate is welded to the other side of the box gusset. A second flange plate is welded to the chord. The two flange plates are butted up and bolted together. This configuration exists at each chord or mast arm.

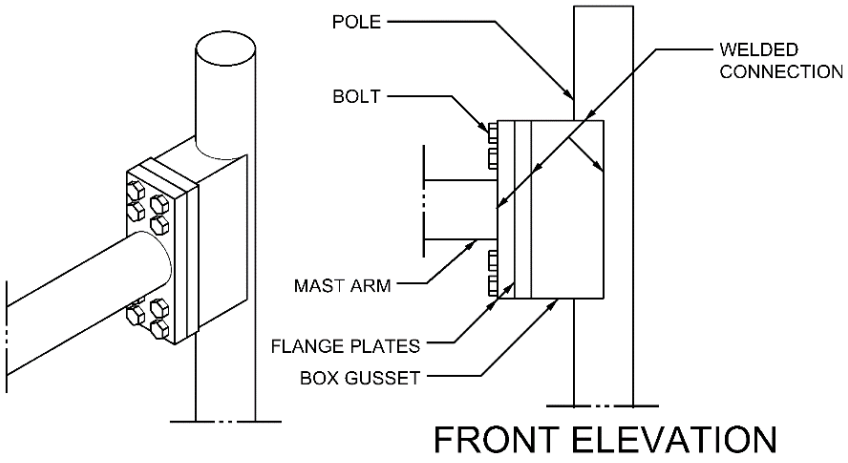


Figure 8.9-3 Cantilever Chord/Mast Arm to Post Connection, Gusseted Box Flange Plate



Figure 8.9-4 Post arm to chord connections, Gusseted box flanges

- Bolted Shape: This connection consists of one of several possible shapes (angle, T-shape) bolted to the post and the chord bolted to the shape. This type of connection is more common to vertical support posts/towers that are non-tubular.

- Thru-bolted: Typical for light structures where the arm or chords are welded to a clamp or bracket and bolted through the post or adjoining clamp.



Figure 8.9-5 Post arm to chord connection, thru-bolted bracket

- Collar Plate, Tubular Chords: This connection consists of a large horizontal plate welded to the post (one at the upper chords, one at the lower chords). The large plate is typically reinforced by ribs attached to the post and plate. The large plate extends out toward the chords. Alternately, the large plate may be two individual plates on each side of the post, which extend out to the chords. A smaller plate is welded to each chord, (two smaller plates at the upper chords and two at the lower chords), extending inward toward the post. The smaller collar plates are positioned to overlap the larger collar plate such that the structure is aligned properly. Once positioned correctly, the overlapping plates are bolted together.

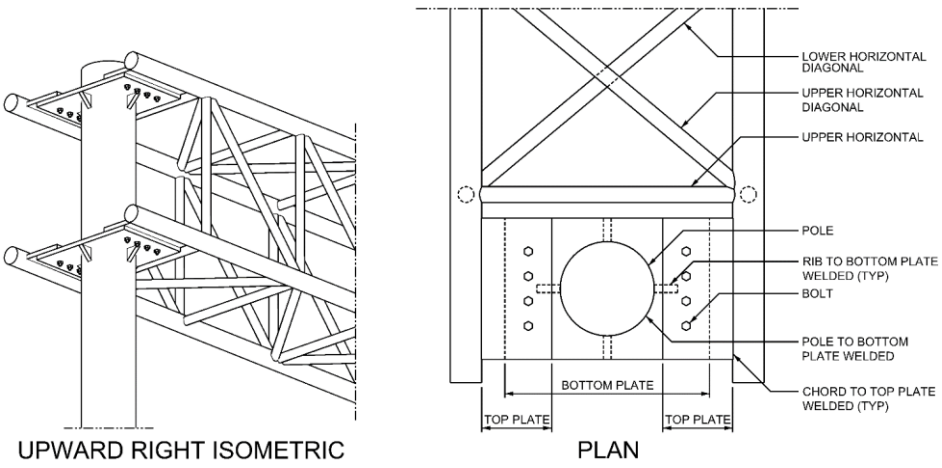


Figure 8.9-6 Chord to Post Connection, Collar Plate, Tubular Chords



Figure 8.9-7 Collar plate for post to quad-chord truss connection

- Collar Plate, Angle Chords: This connection consists of a large horizontal plate welded to the post (one at the upper chords, one at the lower chords). The large plate is typically reinforced by ribs attached to the post and plate. The large plate extends out toward the chords. Alternately, the large plate may be two individual plates on each side of the post, which extend out to the chords. The chords, which are angles, are oriented so that the horizontal leg of the angle can overlap the large collar plate. The chords are positioned to overlap the larger collar plate such that the structure is aligned properly. Once positioned correctly, the overlapping angles and plate are bolted together.

- Cantilever collared pass-through connection.



Figure 8.9-8 - Cantilever collared pass-through connection

- Span wire connection – Span wires will typically have a thimble-eye connection either thru-bolted or clamped around the post. The wire is looped through the eye, doubled back and clamped.



Figure 8.9-9 Span wire connections to post

- The sway/stay wire will have similar hardware, but not necessarily as much redundancy.

8.9.1 Inspection Methods

The arm/chord to post/tower connections should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanizing), corrosion, section loss, etc.
    - If corrosion is observed on the connection assembly, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented. If the section loss cannot be measured by conventional methods, then D-Meter thickness testing shall be performed to determine the amount and extent of section loss.
    - If corrosion is observed on the connection hardware, the amount and extent of section loss should be determined and documented. It should also be documented if the corrosion is caused by the presence of dissimilar metals.
- Loose or missing connection hardware and resulting gaps at respective connections should be quantified and documented. Refer to Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance for further information.



Figure 8.9-10 Loose connection bolts on truss arm to post connection clamp



Figure 8.9-11 Missing connection bolt on truss arm to post thru-bolt connection

- Localized areas of distressed painted or coated surfaces: Cracks or splits in painted surfaces could be indicative of an overstressed section warranting additional investigation and NDT (see Appendix F Nondestructive Evaluation) at these areas. This condition could also be a result of weathering or chemical contamination (i.e., deicing salts).

- Condition of the welded connections: The welds should be inspected for any deficiencies such as poor quality, porosity, undercutting and any cracking, especially at points of intersecting welds, and incomplete or excessively ground welds as they create stress risers. The location and size of the crack(s) is to be documented. The ends of the cracks should be marked and the date should be placed adjacent to the finding. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation)

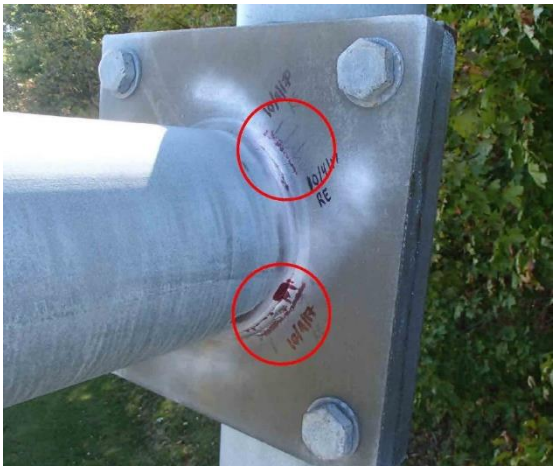


Figure 8.9-12 The post to arm connection plate weld has intermittent hairline cracks



Figure 8.9-13 Lower chord to post connection weld has a hairline crack

- Gaps in mounting plates or collar plates. Gaps could increase stresses in the connection bolts. Any gaps that are present should be measured and located.



Figure 8.9-14 Gap in arm to post connection plate

- Bent or distressed collar plate or collar plate ribs. This condition is typically due to construction or impact damage; however, if this condition occurs, it can be a warning sign of over stress.

- Impact damage. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.

- For span wire and sway wire at the post connection:

    - The wire should be inspected for section loss or broken strands that reduce the strength and capacity of the wire.

    - The span wire's pig tail, the amount of excess cable that protrudes from the friction clamp, should be documented to ensure adequate length of greater than 12”.



Figure 8.9-15 Short pigtail for span wire clamp

    - Friction clamp and post clamp assembly: Secures the span wire and sway wire at the post. The post clamp assembly or span wire clamps should be inspected for loose or missing components, under engaged nuts or cotter pins and signs of overstress, cracking or fracture, see Figure 8.9-16. Document percent engagement if less than 100% for nuts, see Figure 8.9-17.



Figure 8.9-16 Span wire post clamp assembly is fractured



Figure 8.9-17 Span wire post clamp assembly bolt nuts are loose

- Eye bolt (typically at "thimble" eye bolt) used to secure the span wire and sway wire to the post: The bolt should be inspected for evidence of overstress (cracking, bending, breaking) and the nut on the backside of the post should be inspected for tightness, engagement, cracks, etc. Washers should be present between the post and bolt connection, on the nut side and on the eye side (if required). The connections should be inspected for proper size and bearing.

- Timber should be inspected at the span wire and sway wire connection: The drilled holes in the timber should be inspected where visible for evidence of decay. If decay is present, the area should be probed with an awl or pick to determine the depth of the decay. The timber connection should also be inspected for signs of wear resulting from movement of the eye bolt. Movement and subsequent wear can increase the size of the bolt hole and loosen the connection.

8.9.2 Element Level Guidance

This element defines the flange, gusset plates, clamps, saddles, and hardware/fasteners connecting the horizontal support members to the vertical support members. Each independent connection per arm, chord or wire should be counted separately (Each).

For continuous monotubes and light post davits, the connections should be documented under Splice or Slip Joint (Elements 381 – 389), respectively.

Table 8.9-1 Post/Tower Elements

Element No.	Element Name	Element Group	Unit
231	Post/Tower to Arm/Chord/Wire Connection	Post/Tower to Arm/Chord/Wire Connection	Each

8.9.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., corrosion, impact, cracks), the connection location if multiple are present (e.g., left-leading post at bottom chord connection), location of deficiency (e.g., bottom leading connection bolt) and severity of the defect (e.g., width and length of crack, size and depth of impact).

Each individual arm/chord connection to the post/tower should be assigned a Condition State independently with the most severe condition governing the rating. Below is an outline of some typical conditions, deficiencies, and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.9-2 Post/Tower to Arm Condition State examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Superficial corrosion to connection plates, bolts, hardware or saddles with no section loss.	None.	
Alignment of components is good.		
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss to connection plate or connection bolt hardware is < 15%.	Clean and paint affected components.	
Section loss to connection bolts is < 10%		
For span wire connection hardware, > 0% AND < 10% section loss.		
Flat washers missing at connection (where required).	Replace.	
Portions of the span wire connection hardware are missing, with a small reduction in reliability.		
Lock washers present.	Remove lock washers.	
Misalignment or gap between connection plates or saddle ≤ 1/16”.	Monitor or repair.	
Minor distortion or misalignment of components.		
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss to connection plate or connection bolt washer or nut is ≥ 15% AND < 50%.	Replace affected components or, for corrosion due to dissimilar metals, replace with non-reactive metals.	
Section loss to connection bolts is ≥ 10% AND < 30%.		
For span wire connection hardware, ≥ 10% AND < 30% section loss.	Replace affected components.	
Portions of the span wire connection hardware missing, with a significant reduction in reliability.		
For a span wire, the pigtail is < 12”.		
≥ 10% AND < 25% connection bolts missing/compromised.		
Misalignment or gap between connection plates or saddle ≥ 1/16” AND < 1/8”.	Monitor or repair.	
Distortion or misalignment of components. To the extent that it may impact the serviceability of the components.		

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Cracks may be present post/tower to arm connection plate or saddle. Corrosion is advanced and section loss is enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the sign structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Section loss to connection plate or connection bolt washer or nut is ≥ 50%.	Replace affected components or, for corrosion due to dissimilar metals, replace with non-reactive metals.	
Section loss to connection bolts is ≥ 30%.	Replace affected components.	
For span wire connection hardware, ≥ 30% section loss.		
Critical portions of the span wire connection hardware are missing, cracked or fractured.		
≥ 25% connection bolts are missing/compromised.	Replace affected components. Notification to the Program Manager may be warranted.	
Distortion or misalignment of components. Severe enough to affect the ultimate strength or serviceability of the components.	Remove gap or increase inspection cycle.	
Misalignment or gap between connection plates ≥ 1/8”.		
Misalignment or gap in seated/saddle support.	Shim gap or replace affected components.	

8.10 Sign Arm/Chord Members (Elements 241 – 299)

These elements define the horizontal supports for sign structures. For examples of the various types of these supports, reference Section 3.2.1, which illustrates the various types of chords and arms. The Sign Arm/Chord Member elements described here-in are not mutually exclusive to sign structures and can be applicable to other types of ancillary structures - for example, it is possible to have traffic signal ancillary structures supported by a cantilever truss element.

Note that for trussed chords, the diagonals and struts are documented under Truss Arm Struts (Elements 371 & 372) in Section 8.13.

8.10.1 Inspection Methods

The arm/chord should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanized coating), corrosion, section loss, etc.
    - If an area of corrosion is observed on the outside of the chord, arm or wire components, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented.

- If corrosion is suspected on the inside of the arm/chord components, the outside of the component should be sounded with a hammer to detect “thin” areas. D-Meter thickness testing shall be performed to determine the amount and extent of section loss.

- Localized areas of distressed painted or coated surfaces such as at connections, attachments, etc. Cracks or splits in painted surfaces could be indicative of an overstressed section warranting additional investigation and NDT (see Appendix F Nondestructive Evaluation) at these areas. This condition could also be a result of weathering or chemical contamination. The inspector will need to use sound engineering judgment to determine the possible cause.

- Condition of the welded connections. The welds should be inspected for cracking, especially at points of intersecting welds, incomplete or excessively ground, or poor welds that can contribute to stress risers within the weld. The location and size of any weld crack is to be documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation).



Figure 8.10-1 Cracked truss weld



Figure 8.10-2 Overlapped truss weld for struts and undercutting to vertical strut weld

- Condition of the bolted connections. Bolted connections should be inspected for loose or missing components, under engaged nuts, and presence of lock washers, beveled washers, or extra washers. Document percent engagement if less than 100% for nuts.

- Corrosion or loose rust around weep/drain holes. Corrosion and rust may be indicative of corrosion of the inside of the arm/chords and should be investigated as described previously in this section.

- Corrosion and cracking around any burned or rough-cut holes. Burned or rough-cut holes are stress risers and special attention should be given to these areas.

- Bent or distressed collar plate or collar plate ribs.

- Dents, buckles, or ruptures in the chords. These conditions typically occur during erection of the structure but may also be caused by vehicular or debris impact and should be measured and documented.



Figure 8.10-3 Rupture/crack in chord arm member



Figure 8.10-4 Tear in arm at sign hanger to arm connection

- Impact damage. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above. See Figure 8.10-5



Figure 8.10-5 Impact damage to chord

- For span wires and sway wires:
    - Condition of splices (if applicable). If two or three bolt clamps are used to splice the wire, the clamps should be inspected for corrosion, loose or missing components, or under engaged nuts.
    - Condition of the span/sway/guy wire. The wires should be inspected for corrosion, breaks in the strands, kinks, etc.

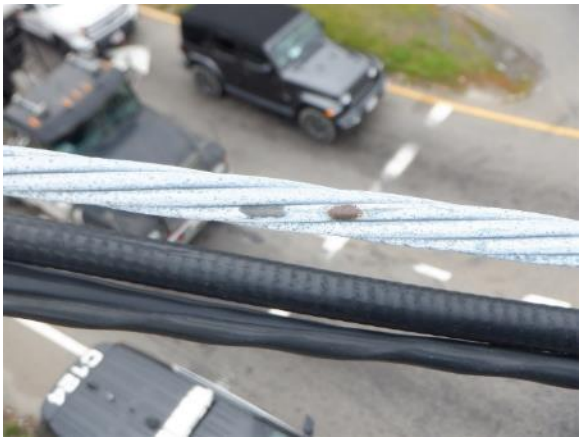


Figure 8.10-6 Loss of galvanized coating and surface rust to span wire

- Condition of end caps. Loose or missing caps allow water intrusion, birds, bees/insects and debris accumulation and should be documented.



Figure 8.10-7 Missing arm end caps

- Utility wires or electrified cables in contact with arms/chords: Document any utility wires or cables that are resting on, or in contact with the arm or truss members. Constant friction (rubbing) of the lines against the structure can cause coating failure and lead to corrosion or energizing of the structure. If utility wires or cables exist, the inspectors should maintain a minimum distance.

- Excessive sagging of a span structure: Excessive sagging could be the result of overstressing/overloading, inadequate member sizes, loose connections or damage resulting from vehicle impact, and should be documented when visually observed. If the horizontal alignment conflicts with the as-built plans or the sag allows the structure to encroach the traffic envelope, the misalignment shall be quantified. One method is to use a laser device such as an electronic distance measurement (EDM), and by stationing an inspector at the point of observable maximum sag, S, with a light-colored panel or board placed on the top of the top-most horizontal member. The other inspector place the laser at the end of the member at the support. The laser would then be pointed at the other support location providing a tangent to measure sag from. The inspector stationed at the board or panel would then mark the panel and the distance could

be discerned and compared to the as-builts. If the structure is found to be level, a level can be used to level the laser and the measurement can then be noted.

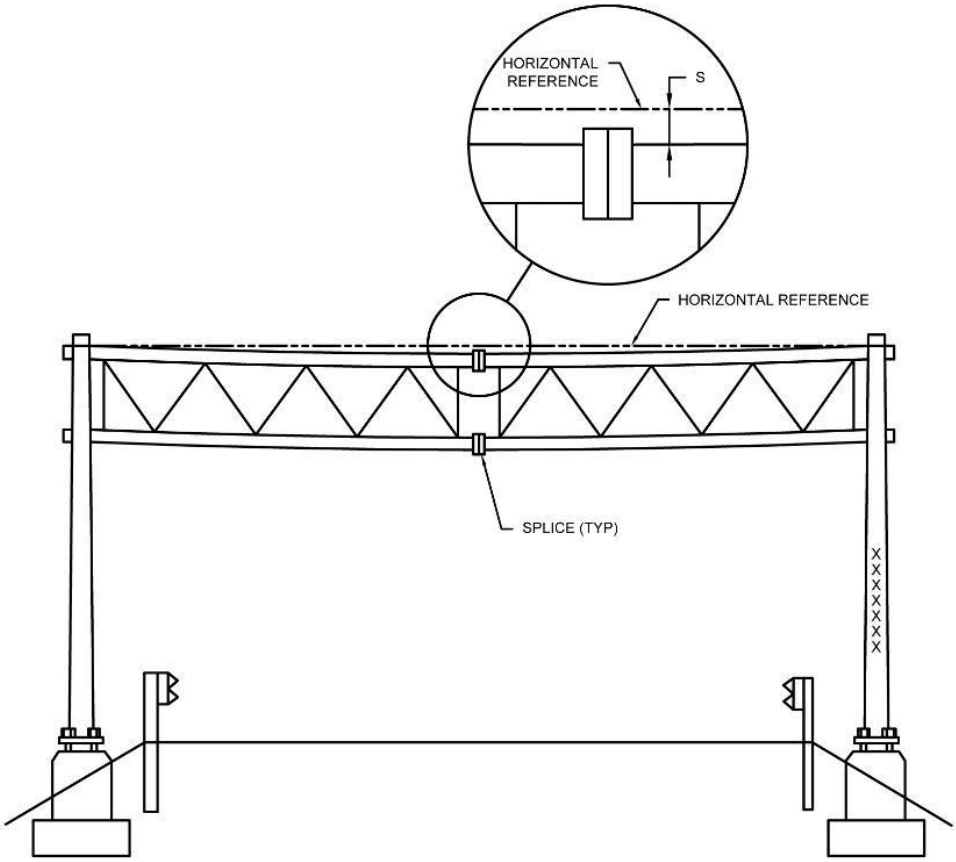


Figure 8.10-8 Measurement methodology for chord sag

- Excessive sagging of a cantilever structure: As with span structures, excessive sagging should be documented when visually observed for cantilevers. If the horizontal alignment conflicts with what is in the as-built plans or the sag encroaches the traffic envelope, the misalignment should be quantified. One method is to use a laser device by stationing an inspector at the free end of the cantilever with a light-colored panel and measuring the sag, S, by having the other inspector use a laser (90 degrees relative to the post) to mark the panel and the distance could be discerned and compared to the as-builts for any change.

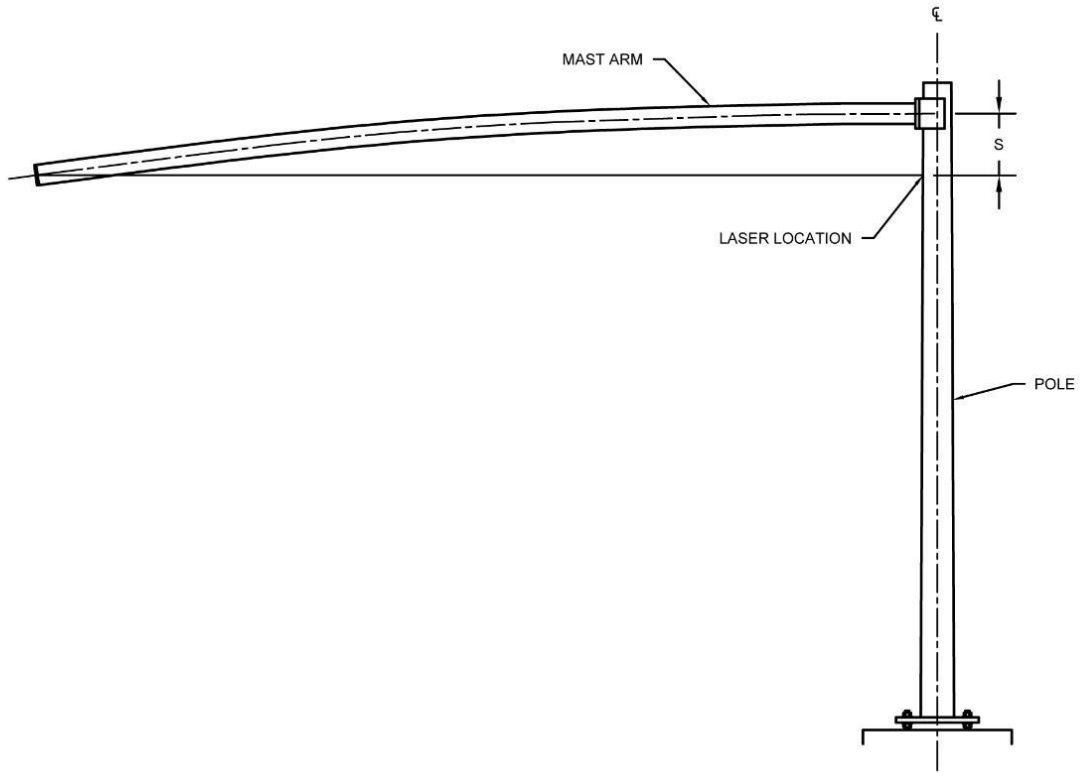


Figure 8.10-9 Measurement methodology for mast arm sag

8.10.2 Element Level Guidance

The arm/chord members will be quantified in linear feet, along their horizontal projection, from the centerline of the vertical support to either the extreme free end of the arm/chord or to centerline of the other vertical support. For bridge mounted frames, the width of the frame is used in linear feet.

The conditions of the diagonal members and struts integral to the truss are documented under Truss Arm Struts (Elements 371 & 372)

Table 8.10-1 Sign Arm/Chord Member Elements

Element No.	Element Name	Element Group	Unit
241	Single Arm Cantilever, Steel	Sign Arm/Chord Member	Length (ft.)
242	Single Arm Cantilever, Aluminum		
243	Double Arm Cantilever, Steel		
244	Double Arm Cantilever, Aluminum		
245	Cantilever Truss, Steel		
246	Cantilever Truss, Aluminum		
249	Cantilever, Other		
251	Single Arm Butterfly, Steel		
252	Single Arm Butterfly, Aluminum		
253	Double Arm Butterfly, Steel		
254	Double Arm Butterfly, Aluminum		
255	Butterfly Truss, Steel		
256	Butterfly Truss, Aluminum		
259	Butterfly, Other		
261	Single Chord Span, Steel		
262	Single Chord Span, Aluminum		
263	Truss Span, Steel		
264	Truss Span, Aluminum		
269	Span, Other		
271	Bridge Mounted Frame, Steel		
272	Bridge Mounted Frame, Aluminum		
299	Sign Arm/Chord Member, Other		

8.10.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., corrosion, impact, cracks), the location along the arm/chord (e.g., 10’ from the left support or), location of deficiency (e.g., lower front chord) and severity of the defect (e.g., width and length of crack, size and depth of impact).

Regarding the Condition Rating for dents or ruptures to round or multi-sided tubular members, the criteria for “compactness” and “slenderness” are defined within Section 8.8.3.

Each cross-sectional area (to the closest linear foot) of the truss/arm should be assigned a Condition State independently with the most severe condition governing the rating. Below is an outline of some typical conditions, deficiencies and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.10-2 Truss/Arm Condition States Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Coating loss with light rust – no notable section loss.	None.	
Minor/random superficial scrapes.		
End cap is missing or loose.	Tighten or replace affected components.	
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss < 10%	Clean, prepare and coat affected components.	
Areas of heavy rust throughout.		
Bent compression member not likely to buckle, where O/L < 20%, i.e., out of plane distance, O, over length between points of bending, L.	Monitor or brace/straighten affected member.	
Minor distortion that does not affect the structural adequacy of the member.	Monitor.	
Any bent chord member in tension.		
Dents to tubular post for compact/non-compact and slender members (assume compact/non-compact section if unknown): Dent(s) with no cracking or sharply folded kinks in dent. AND The dent is located away from other considerations such as holes and welded-on plates. AND Under typical dead loads, neither out-of-plumb nor out-of-straightness exceeds 2.5% of post length. AND Dent where d ≤ 2t, where d is the depth of the dent and t is the thickness of the tube wall. AND Dent where W ≤ 0.1C (compact/non-compact) and W ≤ 0.5C (slender), where W is the width of the dent measured along the circumference and C is the post circumference. AND Dent where L < 0.2C (compact/non-compact) and L < 0.1C (slender), where L is the maximum dimension of the dent measured straight across the largest dimension of the dent and C is the post circumference.		

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss ≥ 10% AND < 25%.	Clean, prepare, and coat; repair or replace affected components.	
Bent compression member, with potential to buckle, where O/L ≥ 20% - out of plane distance O over length between points of bending L.	Brace/straighten or replace affected components.	
Moderate distortion that does not significantly affect the structural adequacy of the member.	Monitor or repair.	
Span wire with < 10% of strands frayed/broken.	Repair or replace.	
Dent to tubular post exceeds any criteria listed above under CS-2.	Increase inspection frequency, analyze for engineered solution or replace depending on the severity of the dent.	
Critical Condition – Chord member is damaged or deteriorated enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the sign structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Section loss ≥ 25%.	Repair or replace affected components or remove structure. Notification to the Program Manager may be warranted.	
Crack or rupture present in arm or chord.		
Distortion that will affect the structural integrity of the member.	Repair or replace affected components or remove structure, if warranted.	
Span wire with ≥ 10% of strands frayed/broken.		

8.11 Traffic Signal Arm/Chord Members (Elements 301 - 329)

These elements define the horizontal supports for traffic signal structures. For examples of these supports, reference Section 3.2.2, which illustrates the various types of chords, arms, and span wires. The Traffic Signal Arm/Chord Member elements described here-in are not mutually exclusive to traffic signal structures and could be applicable to other types of ancillary structures - for example, it is possible to have sign panels supported by a mast arm.

8.11.1 Inspection Methods

The inspection methods for all horizontal supports for all ancillary structures is outlined in Section 8.10.1.

8.11.2 Element Level Guidance

The arm, chord and wire members will be quantified in linear feet, along their horizontal projection, from the centerline of the vertical support to either the extreme free end of the arm/chord or to centerline of the other vertical support.

The conditions of the diagonal members and struts integral to the truss are documented under Truss Arm Struts (Elements 371 & 372)

Table 8.11-1 Traffic Signal Arm/Chord Member Elements

Element No.	Element Name	Element Group	Unit
301	Mast Arm, Steel	Traffic Signal Arm/Chord Member	Length (ft.)
302	Mast Arm, Aluminum		
303	Dual Mast Arm, Steel		
304	Dual Mast Arm, Aluminum		
309	Mast Arm, Other		
311	Span Wire, Steel		
329	Traffic Signal Arm/Chord Member, Other		

8.11.3 Reporting and Rating Guidance

The reporting and rating guidance for all horizontal supports for all ancillary structures is outlined in Section 8.10.3.

8.12 Lighting Arm/Chord Members (Elements 331 - 369)

These elements define the horizontal supports for lighting structures. For examples of these supports, reference Section 3.2.3, which illustrates the various types of arms.

8.12.1 Inspection Methods

The inspection methods for all horizontal supports for all ancillary structures is outlined in Section 8.10.1.

8.12.2 Element Level Guidance

The arm members will be quantified in linear feet, along their horizontal projection, from the centerline of the vertical support to either the extreme free end of the arm/chord or to centerline of the other vertical support. Mounted/offset lighting structures will be given a minimum of 1 linear foot, per arm, where applicable.

The conditions of the diagonal members and struts integral to the truss are documented under Truss Arm Struts (Elements 371 & 372).

Table 8.12-1 Lighting Arm/Chord Member Elements

Element No.	Element Name	Element Group	Unit
331	Single Bracket, Steel	Lighting Arm/Chord Member	Length (ft.)
332	Single Bracket, Aluminum		
333	Double Bracket, Steel		
334	Double Bracket, Aluminum		
335	Single Truss Bracket, Steel		
336	Single Truss Bracket, Aluminum		
337	Double Truss Bracket, Steel		
338	Double Truss Bracket, Steel		
349	Bracket, Other		
351	Single Davit, Steel		
352	Single Davit, Aluminum		
353	Double Davit, Steel		
354	Double Davit, Aluminum		
369	Lighting Arm/Chord Member, Other		

8.12.3 Reporting and Rating Guidance

The reporting and rating guidance for all horizontal supports for all ancillary structures is outlined in Section 8.10.3.

8.13 Truss Arm Struts (Elements 371 & 372)

This element defines the secondary truss members of horizontal chords: the diagonals, horizontals, or vertical struts; the diagonals and the cross bracing. Reference Section 3.2, which illustrates the most common types of truss struts for trussed structures.

8.13.1 Inspection Methods

The truss struts should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanizing), corrosion, section loss, etc.
    - If an area of corrosion is observed on the outside of the struts, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented.
    - If corrosion is suspected on the inside of the strut components, the outside of the component should be sounded with a hammer to detect “thin” areas. D-Meter thickness testing shall be performed to determine the amount and extent of section loss.



Figure 8.13-1 Corrosion with through holes on struts

- Bent and distorted struts could be the result of overstressing/overloading, inadequate strut size, or damage resulting from vehicle impact, and should be measured and documented. A level or some other large straight edge should be used to determine the amount of distortion in the strut. This method would entail placing the level along the length of the strut, spanning from panel point to panel point, and measuring the maximum observable distortion in the member.



Figure 8.13-2 Distorted truss strut member

- Localized areas of distressed painted or coated surfaces such as at connections, attachments, etc. Cracks or splits in painted surfaces could be indicative of an overstressed section.

- Condition of the welded connections. The welds should be inspected for cracking, especially at points of intersecting welds, incomplete or excessively ground, or poor welds that can contribute

to stress risers within the weld. The location and size of any weld crack is to be documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation).

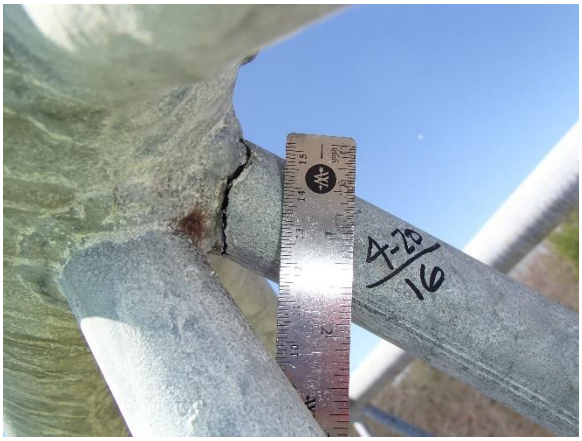


Figure 8.13-3 Diagonal bracing member is cracked along weld connection to chord

- Condition of the bolted connections. Bolted connections should be inspected for loose or missing components, under engaged nuts, and presence of lock washers, beveled washers, or extra washers. Document percent engagement if less than 100%. For chord assemblies, these conditions are typically encountered at the bolted trussing strut member connecting the chords.

- Dents, buckles, or ruptures in the struts. These conditions typically occur during erection of the structure but may also be caused by vehicular or debris impact and should be measured and documented.



Figure 8.13-4 Bent truss web member



Figure 8.13-5 Crack in truss web member

- Impact damage. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.

8.13.2 Element Level Guidance

Since the struts are components of the truss, the strut system should be measured along the horizontal projection of the truss, in linear feet, from the center of the vertical support, and should match the total quantity of the arm as discussed in Section 8.10.2

Table 8.13-1 Truss Arms Strut Elements

Element No.	Element Name	Element Group	Unit
371	Truss Arm Struts, Steel	Truss Arm Struts	Length (ft.)
372	Truss Arm Struts, Aluminum		

8.13.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., corrosion, impact, cracks), the location of the strut (e.g., using panel point references: UF0-UR0), location of deficiency (e.g., near panel point UF0) and severity of the defect (e.g., width and length of crack, size, and depth of impact).

Each cross-sectional area (to the closest linear foot) of the truss struts should be assigned a Condition State based on the most severe condition in the given vertical cross-section governing the rating. Below is an outline of some typical conditions, deficiencies and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.13-2 Truss Arm Struts Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Superficial corrosion affecting the truss struts with no section loss.	None.	
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss > 0% AND < 15% affecting the truss struts.	Clean, prepare and coat affected components.	
1 bracing member not functional	Brace or straighten affect component or monitor	
Connection hardware is loose, missing or broken for < 30% of the connection.	Replace affected components.	
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss ≥ 15% AND < 25% affecting the truss struts.	Clean, prepare, and coat or repair/replace affected components.	
Connection hardware is loose, missing or broken for ≥ 30% of the connection.	Replace affected components.	
> 1 AND ≤ 2 consecutive bracing members not functional	Replace or repair affected components.	
Weld at strut to truss chord connection or strut is cracked and not likely to propagate into the chord.		

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Truss struts are damaged/deteriorated enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the sign structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Section loss ≥ 25% to the truss strut.	Repair or replace affected components.	
Crack in bracing with probability of propagation.		
≥ 3 consecutive bracing members not functional.		
Weld at strut to truss chord connection or strut is cracked and is likely to propagate into the chord.		

8.14 Splices (Elements 381 – 389)

Splices are used to tie two members together to form a monolithic member. Splices can be used on vertical and horizontal supports depending on the requirements design and field fabrication. Some examples of common splices used for ancillary structures are as follows:

- **Splice Plates** - For round chords or towers, splice flanges are welded to the members at the end of each of the sections. The sections are field bolted together at the splice flanges. For angle chords, the splices are made by bolting or welding the chords to a short section of angle that overlaps each chord section.



Figure 8.14-1 Round chord splice connection

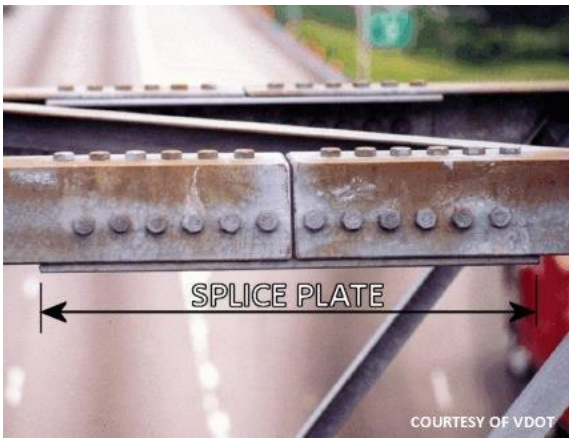


Figure 8.14-2 Angle chord splice connection

- **Slip Joints** - Slip joints consist of tapered sections overlapping each other, which may be mechanically fastened with through bolts along the overlapped sections. The friction that develops between the two sections keeps the post or tubular arm acting monolithically.



Figure 8.14-3 Post slip joint splice connection



Figure 8.14-4 Post slip joint splice bolted connection



Figure 8.14-5 Mast arm slip fit connection

- Posts, typically for high mast lights (HMLs), and arms, (typically for traffic light mast arms, may have welded splices.



Figure 8.14-6 Weathering steel HML welded splice

8.14.1 Inspection Methods

The splices should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanizing), corrosion, section loss, etc. If an area of corrosion is observed or suspected, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented. If only visual observation is possible, the inspector should document the approximate dimensions of the corrosion.

- For splice plates:



Figure 8.14-7 Corrosion with section loss to high mast light slip joint

  - Splices should be inspected for loose or missing components, cracked welds, and under engaged nuts. Document percent engagement if less than 100%. Misalignment and gaps between splice plates or flanges should also be measured and documented. Loose or missing components, dissimilar metals, or under engaged nuts increase the stresses in the splice components.



Figure 8.14-8 Splice plates misaligned

  - The splice flange shall be inspected in the same manner as a chord splice with the inspector verifying bolt snugness, weld condition and flushness of the flanges.

    - Cracks in welds are indicative of overloading or overstressing of the connection. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation).

- For slip joints:
    - Cracking at the slip joint: Any crack at the slip joint should be documented, see Figure 8.14-9. The extents of the crack should be marked.



Figure 8.14-9 Crack at slip joint

    - Pack rust: Any pack rust forming within the slip joint should be documented. Any deformations being caused to the slip joint by the pack rust should be documented.
        - The mast arms at the slip joints should be inspected for cracking, especially at the end of the members and at the drilled bolt hole (present at slip joint connection). The location and size of any weld crack is to be documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation). The slip joint bolt should be inspected for corrosion, loose or missing components, under sized bolt or under engaged nut.

8.14.2 Element Level Guidance

Each splice connection, and its associated hardware, will be documented separately per post and/or, arm/chord connection (Each).

Table 8.14-1 Splice Elements

Element No.	Element Name	Element Group	Unit
381	Splice - Horizontal	Splice	Each
382	Splice - Vertical		
383	Slip Joint - Horizontal		
384	Slip Joint - Vertical		
389	Splice, Other		

8.14.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., loose bolt, gaps), the location of the splice (e.g., 30 feet from left support), location of deficiency (e.g., top chord) and severity of the defect (e.g., size of crack, size of gaps).

Each splice should be assigned a Condition State based on the most severe condition of the splice connection. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.14-2 Chord Splice Connection Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Superficial corrosion affecting the splice or its hardware with no section loss.	None.	
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss > 0% AND < 25% affecting the splice plate.	Clean, prepare and coat affected components.	
Section loss < 15% affecting the slip joint.		
Slip joint with pack rust, < 1/16", without distortion (belling) or localized pitting, < 15% section loss.		
Slip joint bolt is loose.	Tighten affected components.	
Section loss > 0% AND < 15% affecting splice plate connection hardware/bolts, with or without dissimilar metals.	Replace affected components or, for dissimilar metals, replace with non-reactive metals.	
For a chord splice plate, < 10% of the connection hardware is missing/broken.	Replace affected components.	
For a chord splice plate, < 20% of the connection hardware is loose.		
Section loss < 20% affecting slip joint connection hardware/bolts.	Replace affected components.	
< 1/16” gap/misalignment in splice plates.	Tighten hardware or shim.	
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss ≥ 25% AND < 40% affecting the splice.	Replace affected components or, for dissimilar metals, replace with non-reactive metals.	
Section loss ≥ 15% AND < 25% affecting splice plate connection hardware/bolts.		
Section loss ≥ 20% AND < 30% affecting slip joint connection hardware/bolts.		
Section loss ≥ 15% AND < 25% affecting the slip joint.	Clean, prepare, and coat or replace affected components.	
Slip joint with pack rust, ≤ 1/16" AND < 1/8”, with distortion (belling).		
For a chord splice plate, ≥ 10% AND < 25% of the connection hardware is missing/broken.	Repair/replace affected components.	
For a chord splice plate, ≥ 20% AND < 30% of the connection hardware is loose.	Tighten hardware or shim.	
≥ 1/16” AND < 1/8” gap/misalignment in splice plates.		
Partial gap between splice plates.	Tighten hardware or shim.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Splices are damaged/deteriorated enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element and/or the sign structure.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.	CS-4
Slip joint with pack rust, ≤ 1/8", with distortion (belling).	Clean, prepare, and coat or replace affected components.	
Section loss ≥ 40% affecting the splice.	Repair or replace affected components.	
Section loss ≥ 25% to the slip joint.		
Section loss ≥ 25% affecting splice plate connection hardware/bolts.		
Section loss ≥ 30% affecting slip joint connection hardware/bolts.	Repair or replace affected components. Notification to the Program Manager may be warranted.	
For a chord splice plate, ≥ 25% of the connection hardware is missing/broken.		
For a chord splice plate, ≥ 30% of the connection hardware is loose.	Tighten hardware or shim.	
≥ 1/8" gap/misalignment in splice plates.		
Missing/broken bolt.	Remove and replace.	
Crack in slip joint.	Repair or replace affected components.	

8.15 Vibration Dampener (Element 391)

Ancillary structures can experience vibration under live load, namely wind. Vibration dampeners are attached internally or externally to structures to help dissipate excess vibrations under these loading conditions.

The most common type of dampener found on ancillary structures is the Stockbridge dampener, also called a dog bone dampener, see Figure 8.15-1 through Figure 8.15-3. This consists of two weights fastened at the end of a flexible cable that needs to be tuned based on the geometry and natural frequency of the structure.

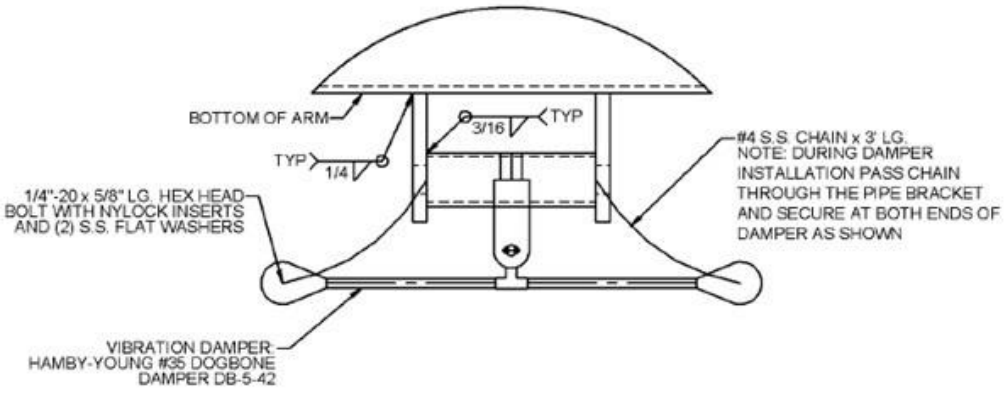


Figure 8.15-1 Typical vibration dampener detail



Figure 8.15-2 Vibration dampener attached to post



Figure 8.15-3 Vibration dampener attached to truss arm

Plate dampeners can be found on traffic signal mast arms. Internal vibration dampeners such as chains hanging from the top of the post cap within lighting structures are sometimes present. Various other configurations may be present. Regardless of the type, the attached dampener should be inspected to ensure it does not present a falling hazard.

8.15.1 Inspection Methods

The vibration dampener should be inspected to ensure that it is properly connected and functioning as designed. The dampener should move without obstruction. Any worn sections should be documented.



Figure 8.15-4 Frayed strands and broken safety chain

Safety chains should be attached to each weight and be threaded through the mounted bracket, see Figure 8.15-1. The chain should have enough slack to ensure free movement of the weights. Each weight should have a drain hole that is pointed in the down position, see Figure 8.15-6.

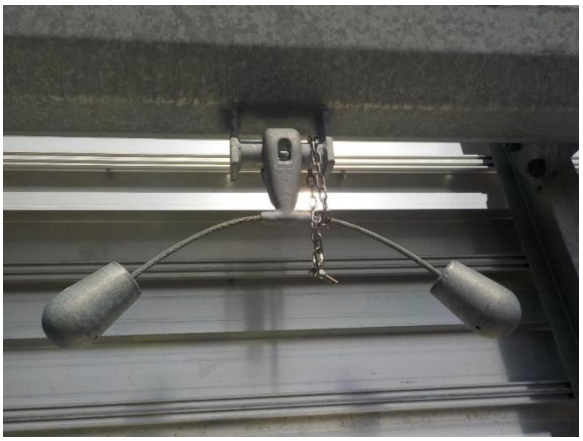


Figure 8.15-5 Improper safety chain installation



Figure 8.15-6 Water in weight of vibration dampener

It should be determined by review of design plans or as-built drawings if the structure being inspected requires a vibration dampener and if the installation is in the appropriate place.

8.15.2 Element Level Guidance

Each vibration dampener or dampening system should be counted separately (Each).

Table 8.15-1 Vibration Dampener Elements

Element No.	Element Name	Element Group	Unit
391	Vibration Dampener	Vibration Dampener	Each

8.15.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., loose connection, in contact with member), the location of the dampener (e.g., end of top chord) and severity of the defect (e.g., size of crack).

Each vibration dampener or dampener system should be assigned a Condition State based on the most severe condition. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.15-2 Vibration Dampener Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Vibration Dampener is like new and functioning as designed.	None or routine maintenance.	CS-1
Fair Condition – Moderate damage or deterioration of element, however the element remains functional.	Repair or replace element or continue monitoring.	CS-2
Light rust on mounting hardware with no appreciable loss.	Repair or replace affected components.	
Section loss > 0% AND < 25% affecting connection hardware or bolts.		
The vibration dampener is making minor contact with another element but is still able to function as designed.		

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Serious damage or deterioration to element is reducing the functional performance of the unit.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
≥ 25% of the connection hardware is loose, missing or broken.	Repair/replace affected components.	
Section loss ≥ 25% affecting connection hardware or bolts.		
Vibration dampener is missing.		
The vibration dampener is in contact with another element and/or is not able to function as designed.		
Critical Condition – Any collision damage or deterioration significant enough to threaten separation from the ancillary.	Notify Program Manager. Immediate replacement or corrective action must be taken.	CS-4
Any cracked connection or other deficiency that could lead to the dampener falling.	Inspection team to safely remove dampener.	
Any deficiency that could lead to a falling hazard prior to next scheduled inspection including: - Damage/wear on dampener or safety chain. - Safety chain is not attached to each dumbbell.		

8.16 Sign Frames (Elements 401 – 409)

This element defines the vertical attachment members (VAMs, e.g., hangers, I-beams, angles/L-shapes, T-beams and Z-shapes), horizontal attachment members (HAMs, e.g., windbeams), braces, arm connections and other structural members that mount the sign panels to the sign structure arm, chord, or mounted surface, see Figure 8.16-1 and Figure 8.16-2. Sign clips or other connections that mount the sign panel to the frame are discussed and rated under Sign Clips and Connections (Elements 421 & 422).

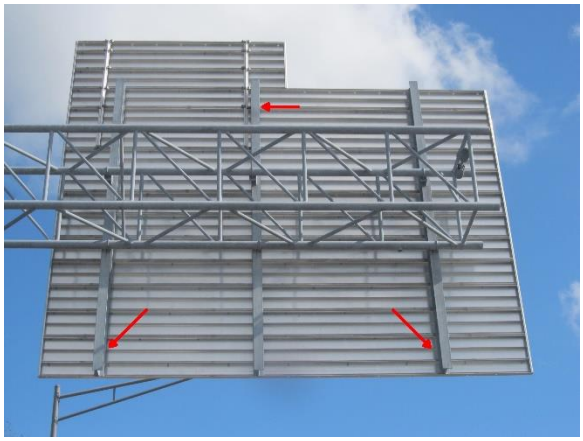


Figure 8.16-1 Sign connection frame - typical vertical hangers



Figure 8.16-2 Sign connection frame bracket

For roadside signs, typically those with steel stub and Break-Safe breakaway foundations: For 2+ post structures, the post above the hinge and fuse plate is considered a part of the sign frame (see Figure 8.16-3); for single post the post cap and mount is considered part of the sign frame (see Figure 8.16-5).

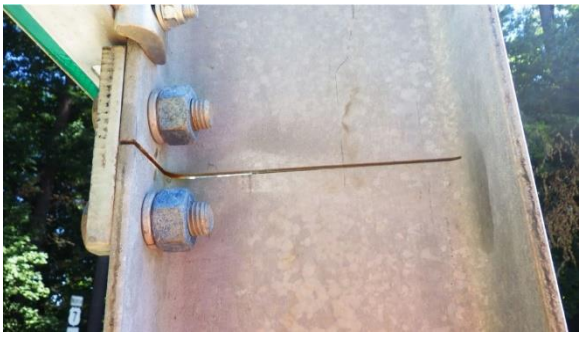


Figure 8.16-3 Post hinge and fuse plate of roadside stub post



Figure 8.16-4 Post cap and mount of roadside stub post

8.16.1 Inspection Methods

The sign frame and frame to arm connections should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanized coating), corrosion, section loss, etc.
    - If an area of corrosion is observed on the hangers, windbeams or other frame components, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented.

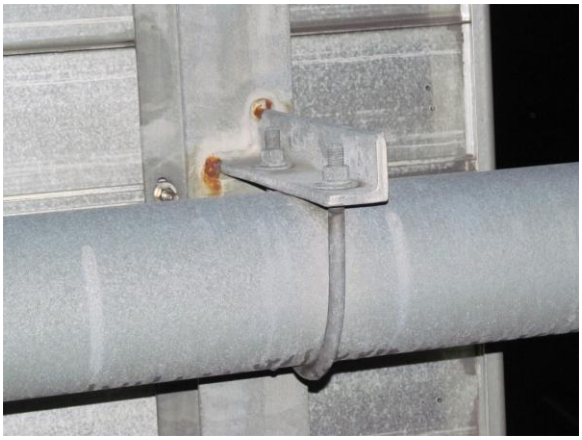


Figure 8.16-5 Connection Frame to arm connection weld has rust

- VAMs and HAMs and other members of the sign frame should be inspected for cracks in the members or at locations of previous weld repairs. Document location and size of the crack.

- Splices to the VAMs, HAMs and other members should be inspected for loose or missing components, cracked welds and under-engaged nuts. Document percent engagement if less than 100%. Gaps between frame members should also be measured and documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation).

- VAMs with misalignment, bowing or deformation should be measured and noted.

- VAMs should be in contact with the full height of the extruded sign panels. If there are no other vertical backing connections, note if the vertical hangers are short, see Figure 8.16-6.



Figure 8.16-6 Vertical Hangers are short

- Document any observable impact damage to the frame and any deficiencies associated with it, which may include any of the above. See Figure 8.16-7 and Figure 8.16-8.



Figure 8.16-7 Impact damage to vertical hanger



Figure 8.16-8 Impact with deformed hangers and windbeam

- Loose, missing, or deformed/misaligned bolted connections or components, missing washers, welds with undercutting/cracks and under-engaged nuts. Under-engaged nuts are to be recorded as percent engaged, see Figure 8.16-9 through Figure 8.16-11. See Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance

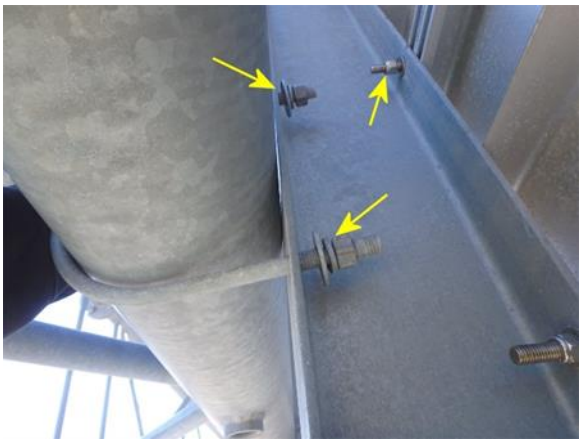


Figure 8.16-9 VAM U-bolt nuts and VAM Panel thru-bolt not fully tightened



Figure 8.16-10 Broken U-bolt at arm to hanger connection



Figure 8.16-11 Chord to hanger U-bolt has a gouge

- Document any observable impact damage that exists and any deficiencies associated with it.
- Document any cracks to sign connection frame welds.

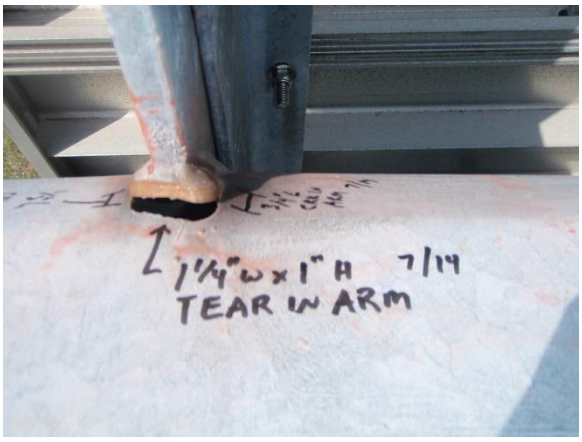


Figure 8.16-12 Crack at vertical hanger to arm connection weld

- VMS support structures are typically mounted to the frame with U-bolts. Due to the weight of the unit, numerous U-bolts are used, and all are essential for proper mounting. Care should be taken to ensure that all U-bolts are properly sized and are installed with the nuts fully engaged and tight.

8.16.2 Element Level Guidance

This element includes the L-brackets/vertical hangers, wind beams, horizontal braces, U-bolts, sign connection clamps and other structural members that mount the sign panels to the structure. Quantity is one each per L-bracket/vertical hanger. Deficiencies within the tributary area of a vertical hanger should be associated with its respective hanger and the most severe condition within this tributary area should control the rating.

Table 8.16-1 Sign Elements – Sign Frames

Element No.	Element Name	Element Group	Unit
401	Sign Frame, Steel	Signs	Each
402	Sign Frame, Aluminum		
409	Sign Frame, Other		

8.16.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., loose bolt, missing sign clip), the location of the member (e.g., third vertical hanger from the left (when facing inventoried orientation)), location of deficiency (e.g., top connection to vertical hanger) and severity of the defect (e.g., size of crack, number of connections affected).

Each L-bracket and vertical hanger should be assigned a Condition State based on the most severe condition of the hanger or the tributary area of the sign frame associated with it.

Table 8.16-2 Sign Frame and L-Brackets Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No evidence of section loss or damage.	None or routine maintenance.	CS-1
Superficial corrosion affecting the sign frame or main connection of the chord/arm to bracket/hanger with no section loss.	None	
The sign frame's most restrictive vertical clearance over the travel way is < 1' greater than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance	Notify Program Manager	
Missing washers.	Consider replacing washers.	
Fair Condition – Minor corrosion with minor section loss. Minor damage present.	Repair/replace element or continue monitoring.	CS-2
Section loss > 0% AND < 25% affecting the sign frame or main connections of the chord/arm to sign panel.	Clean, prepare and coat affected components.	
Minor misalignment or bowing of the VAM or HAM < 1/8" between sign frame and panel.	Repair or replace affected components.	
< 10% missing, loose, frozen or cracked sign frame connection to arm hardware. No falling hazard.	Replace affected components. Tighten loose nuts.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Major or multiple element defects or section loss that may significantly impact the serviceability or integrity of the structure. Connections are loose, missing or cracked.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss ≥ 25% AND < 50% affecting the sign frame or main connections of the chord/arm to bracket/hanger.	Clean, prepare, and coat or replace affected components.	
Moderate misalignment or bowing of the VAM or HAM ≥ 1/8" AND < 2" between sign frame and panel. Integrity of the member is slightly affected.	Monitor the condition with an increased inspection frequency or repair/replace affected components.	
Minor to moderate impact damage that slightly affects the integrity of the member or its connections.		
≥ 10% AND < 25% missing, loose, frozen or cracked sign frame connection to arm hardware. No falling hazard.	Replace affected components. Tighten loose nuts.	
Critical Condition – Sign frames are damaged/deteriorated enough to warrant structural analysis to ascertain the impact on the ultimate strength and/or serviceability of the element. Extensive number of connectors are loose/missing which could pose a safety hazard to the travelling public.	Notify Program Manager. Warrants a structural review to determine the effect on strength or serviceability of the element. As per review: immediate repair of element; or increase inspection frequency.	CS-4
Section loss ≥ 50% affecting the sign frame or main connections of the chord/arm to bracket/hanger.	Replace affected components.	
Severe impact damage with or without cracked welds that affects the integrity of the sign frame and/or its connections.	Repair or replace affected components.	
Section loss ≥ 50% to sign frame connection hardware or weld.	Repair/replace affected components.	
Cracked weld.		
≥ 25% missing, loose, frozen or cracked sign frame to arm connections.		
The sign frame's most restrictive vertical clearance over the travel way is less than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance	Correct clearance issue or remove/replace sign panel and frame.	

8.17 Sign Panels (Elements 411 – 413)

Reflective sign panels consist of the reflective messaging, the aluminum sheeting or extruded aluminum sections and the elements tying the aluminum sheeting together, e.g. – stitch bolts and backing strips.

Variable Message Sign (VMS) panels use light emitting elements activated at variable times to display configurable messages. These panels typically have integrated structural components that make up the body of the panel and house the electronic components. It is common for VMS panels to have internal enclosures that may be walked in to perform electrical component maintenance. These internal areas are typically locked and are not usually accessed for structural inspections. The electrical system of the VMS panels should be documented under Power and Sign Lighting (Element 441).



Figure 8.17-1 Typical reflective aluminum sign panel



Figure 8.17-2 VMS LED Panel

The following items are components of sign panels:

- Reflective Material: The sign panel displays information that is coated in a light reflective material.
- Aluminum Sheeting Sign Panel: The sign panel displays information that is applied to one or more thin aluminum sheets. These sheets can be combined to form larger signs, held together by backing strips.
- Extruded Aluminum Sign Panel: The sign panel displays information that is applied across several aluminum extruded sections that are bolted together with stitch bolts. This system eliminates the backing strips and windbeams found in aluminum sheeting sign panels.
- Backing Strip: Thin strip of aluminum that overlaps a portion of two sign panels, attaching them to one another. The backing strip is held in place by a backing strip stud (see Figure 8.18-1).
- Backing Strip Stud: The fastener connecting the backing strip to the sign panels. The backing strip studs are resistance welded to the panels (see Figure 8.18-2 and Figure 8.18-3).

For VMS panels, the type of light emitting element varies significantly and continues to become more advanced with evolving technology. Some of the various configurations are discussed in the list below.

- Light Emitting Diode (LED): The sign panel consists of LEDs arranged in rows and columns. Messages are displayed by altering the on and off state of the LEDs. This is very similar to a bulb matrix, but the LEDs are much smaller than the bulbs, allowing for greater resolution of the message. This greater resolution even allows for moving messages, such as an arrow pointing/expanding in one direction.
- Fiber Optic: The sign panel consists of fiber optic bundles arranged in rows and columns along with shutter devices that can block the light output. Messages are displayed by altering the shutter state, thereby controlling which light is visible.
- Bulb: Sometimes called Bulb Matrix, the sign panel consists of light bulbs arranged in rows and columns. Messages are displayed by altering the on and off state of the bulbs.

8.17.1 Inspection Methods

The sign panels should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Corrosion, section loss, etc.
    - If an area of corrosion is observed on any attachment components, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented.
- Loose or missing bolts connecting extruded sections, i.e., stitch bolts. Loose or missing connection bolts can increase the load in adjacent bolts.



Figure 8.17-3 Extruded aluminum panel has impact, disconnected sections and loose reflective lettering

- Bullet holes. Bullet holes per sign panel should be documented.

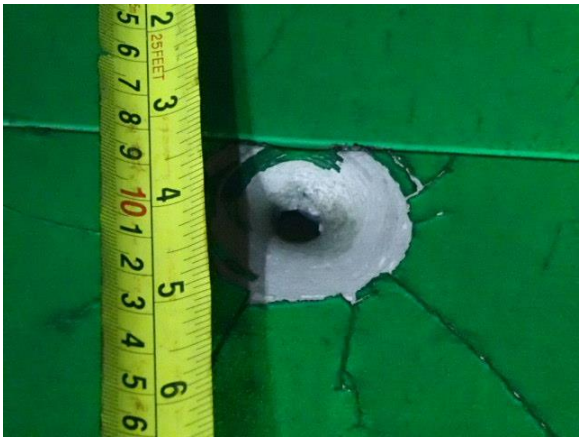


Figure 8.17-4 Bullet hole in reflective sign panel

- Cracking, damage, delaminating, peeling, or crazing (network of closely spaced, fine cracks) of the reflective material. Damaged or deteriorated reflective material can affect the legibility of the sign.

- Reflectivity: Method of assessing the reflectivity of a panel is done through the use of a reflectometer or a light source in non-bright lighting.

- Fading of lettering. Faded lettering can affect the legibility of the sign.



Figure 8.17-5 Faded and peeling emblems with bullet holes in the panel

- Impact damage. The affected sign, location on the affected sign, and dimensions of the impact damage are to be documented and the area photographed.



Figure 8.17-6 Impact damage to sign panel

- Loose or missing backing strip studs or nuts can reduce the stiffness in the edges of the sign panels and increase load in the adjacent studs within the connection. The number of loose and missing nuts and studs are to be quantified and documented for each backing strip.

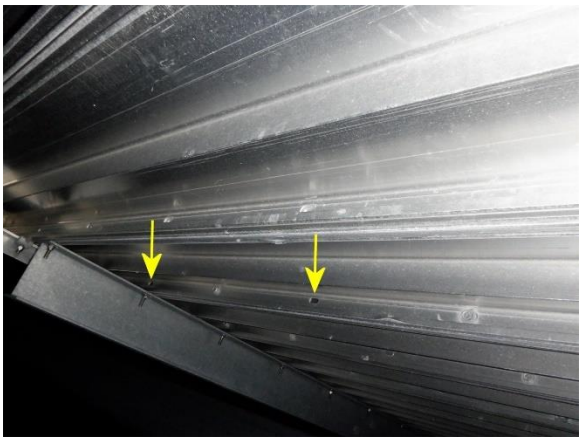


Figure 8.17-7 Missing sign panel backing strip studs

- Vertical and horizontal alignment of the sign panels. If the vertical clearance of sign panel or its components are less than 1’ greater than the State minimum, it should also be noted.
- Damaged or deteriorated reflective material can affect the legibility of the sign. Impact damage may also affect its legibility.
- Graffiti or vegetation can cover some or all of the sign lettering or symbols, see Figure 8.17-8.



Figure 8.17-8 Sign obstructed by vegetation

For VMS panels:

Missing or loose VMS panel hardware.

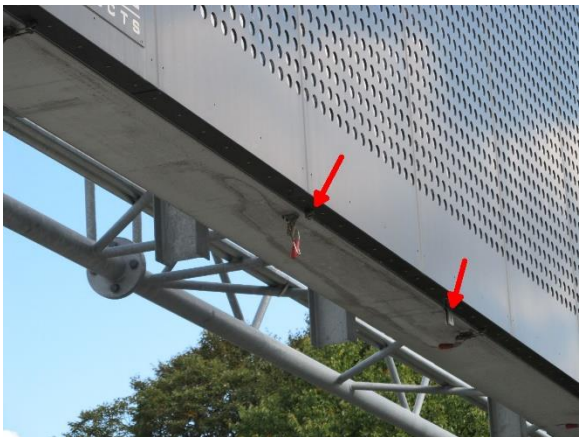


Figure 8.17-9 Missing latch clips at bottom of VMS panel

- VMS lights: any deficiency to the VMS bulbs/LEDs.
- Electrical hazard: Any exposed wiring from conduits or panels should be documented. Exposed wiring that is within the clearance of the traveling public should be reported to the Program Manager.
- If electrical conduit or wires are present, the base plate must be wrapped with a rodent screen or have a grout pad in place. The rodent screen should have no gaps between the base plate/screen interface. If the structure has electrical conduit or wires and the base is missing the metal screening, it should be reported in the inspection report under Grout Pad (Element 151).

8.17.2 Element Level Guidance

This element's assessment includes the sign/VMS panel, the elements that tie together the panel (e.g., panel strips) and the reflective message. Each Sign Panel is counted separately as each.

The lighting for reflective sign panels, the electrical components of VMS panels and catwalks are addressed under Power and Sign Lighting (Element 441).

Table 8.17-1 Sign Elements – Sign Frames

Element No.	Element Name	Element Group	Unit
411	Sign Panel, Aluminum	Signs	Each
412	Sign Panel, Other		
413	VMS Panel		

8.17.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., broken backing strip, peeling lettering, impact damage), the location of the member (e.g., third vertical hanger from the left), location of deficiency (e.g., top connection to top backing strip) and severity of the defect (e.g., percent of reflective material cracked, number of connections affected). Each Sign Panel should be assigned a Condition State based on the most severe condition of the Sign Panel.

The Sign Panels should be assigned designations during the Initial/Inventory Inspection using a standardized method such as left to right in the direction of orientation in a top to bottom manner.

Table 8.17-2 Sign Panel Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Sign is legible with no damage or corrosion.	None or routine maintenance.	CS-1
Minor/isolated graffiti, bullet holes or other punctures/cracks appear in the panel but do not affect the reflectivity of the panel or integrity of the structure.	None.	
Graffiti on back of sign panel.		
Minimal defects appear in the reflective material but do not affect its reflectivity.		
Reflective buttons or strips are not damaged or loose.		
< 5% of VMS lights are non-functioning; message is still clear and legible.		
Bullet holes or other punctures/cracks appear in the panel but do not affect its legibility.		
The sign panel's most restrictive vertical clearance over the travel way is < 1' greater than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance	Notify the Program Manager.	
Fair Condition – Graffiti, vandalism, or collision damage may be present, but not affecting element legibility. Moderate deterioration or impact damage to panels or connecting components.	Repair/replace element within specified time frame or increase inspection frequency.	CS-2
Minor impact damage with no underlying structural damage and the sign or any components are not in danger of falling.	Schedule replacement of affected components.	
Isolated area of section loss < 10% at sign panels.		
Section loss or loose/missing components affecting > 0% AND < 25% backing strips or studs. No falling hazard.		
Minor impact damage, bullet holes, cracking or other damage is present and affecting the reflective material.	Repair, remove obstruction or replace affected components.	
Reflective buttons or strips have minimal damage. No reflective material is in danger of falling.		
< 10% of VMS lights are non-functioning; message is still clear and legible.		
Minor impact damage, graffiti, bullet holes, vegetation or other damage is present, with minimal loss of legibility.		

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Signs are difficult to read for any reason. Significant deterioration or damage to the sign panel and/or connecting components.	Sign panel or its connections must undergo tentative corrective action or be replaced.	CS-3
Moderate impact damage with underlying structural damage and the sign or any components are not in danger of falling.	Schedule replacement of affected components.	
Section loss ≥ 10% AND < 25% at sign panels.		
Section loss or loose/missing components affecting ≥ 25% AND < 50% backing strips or studs. No falling hazard.		
≥ 10% AND < 20 % of VMS lights are non-functioning; message is mostly legible.	Repair/replace affected components.	
Moderate impact damage, significant cracking or other deterioration is present in the sign panel.	Replace affected components.	
≥ 25% AND < 50% of the reflective buttons or strips are loose or missing.		
≥ 25% AND < 50% of the panel lettering or symbols are not legible due to fading, damage or graffiti.		
Reflective components are slightly faded and do not perform as designed.		
Obstructions making the sign predominantly ineffective.	Remove obstruction.	
Residue is extensive and affecting legibility.	Clean panel.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Any collision damage or deterioration significant enough to threaten collapse or separation from the sign structure.	Immediate removal of sign panel or immediate corrective action must be taken. Increased inspection frequency may be used in the interim.	CS-4
Severe impact damage with underlying structural damage and the sign or any components are in danger of falling.	Remove sign panel or replace affected components.	
Any deterioration significant enough to pose a falling hazard		
Section loss ≥ 25% at sign panels.		
Section loss or loose/missing components affecting ≥ 50% to backing strips or studs.	Remove sign and frame; Immediately tighten or replace affected components.	
The most restrictive vertical clearance over the travel way is ≤ 1' greater than the State minimum vertical clearance for the respective obstruction.	Correct clearance issue.	
Reflective sheeting has severe impact damage or cracking.	Replace affected components.	
≥ 50% of the reflective buttons or strips are loose or missing.	Remove any loose sections of reflective material.	
Reflective material is in danger of falling.	Inspector to remove any loose sections of reflective material.	
Reflective components are faded and are no longer reflective.	Replace affected components.	
≥ 20 % of VMS lights are non-functioning; message is illegible.		
Impact damage, graffiti or other deterioration is significant and lettering and/or symbols are no longer legible.		
≥ 50% of the panel lettering or symbols are not legible due to fading, damage or graffiti.	Schedule for replacement.	
If sign is regulatory (e.g., “STOP” or “YIELD”), rather than way finding, and meets either of other critical conditions.		
The sign panel’s most restrictive vertical clearance over the travel way is less than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance	Correct clearance issue or remove/replace sign panel.	

8.18 Sign Clips and Connections (Elements 421 & 422)

Sign panels are connected to their frame, i.e. – vertical hanger or wind beam, by sign clips and/or other types of fasteners. Depending on the sign panel type, the connections may differ. The below figures illustrate typical sign panel connections for sheeted aluminum and extruded aluminum sign panel connections.

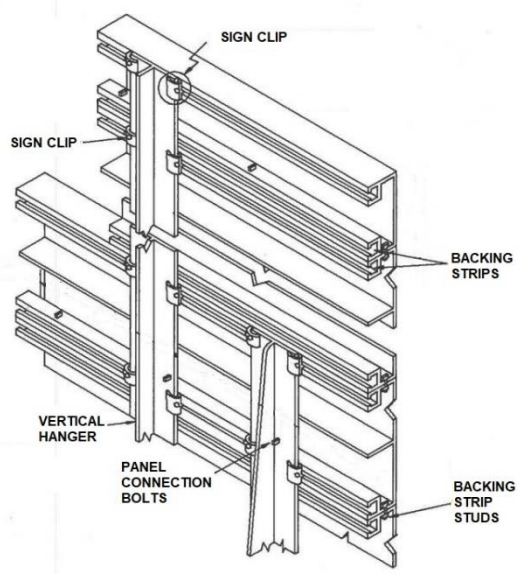


Figure 8.18-1 Typical Extruded Sign Panel with hanger and connectors

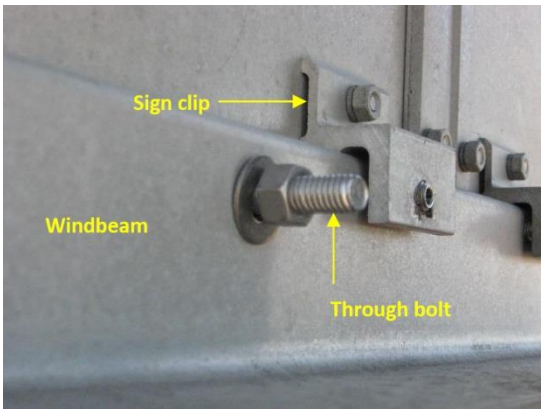


Figure 8.18-2 Sheeted aluminum panel sign clip connection



Figure 8.18-3 Extruded aluminum panel sign clip connections

8.18.1 Inspection Methods

The sign panel clips and/or connections should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Loose and missing backing strip nuts and studs in each backing strip for sheeted aluminum panels. Loose or missing backing strip studs or nuts can reduce the stiffness in the edges of the sign panels and increase load in the adjacent studs within the connection. The number of loose and missing nuts and studs are to be quantified and documented for each backing strip.

- RIDOT requires all sign clips to be torqued snug tight or to designed specifications. All missing sign clips need to be replaced.

- The sign clips should be inspected for sheared bolts on the sign panel as well as loose or missing nuts and washers. The number of missing bolts, washers or nuts should be documented.

- If through bolts are used to secure the sign panel to the frame, missing clips do not need to be documented but, if they are over the roadway, they should be tapped with a hammer to check that they are not loose and in no danger of falling, see Figure 8.18-4 through Figure 8.18-5.



Figure 8.18-4 Loose sign clip



Figure 8.18-5 Loose nut of panel through bolt

8.18.2 Element Level Guidance

This element's assessment includes the sign clips and/or other connections that connect the sign panel to the sign frame. Each clip/connector will be counted and assessed separately (Each).

If through bolts are used to secure the sign panel to the frame, the sign clips should not be quantified and should only be checked to ensure that they are not a falling hazard.

Table 8.18-1 Sign Elements – Sign Panel Connections

Element No.	Element Name	Element Group	Unit
421	Sign Clips	Signs	Each
422	Sign Panel Connection		

8.18.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., broken, frozen, or missing clip) and the location of the connection (e.g., third vertical hanger from the left). Each connection should be assigned a Condition State based on the most severe condition of the Sign Panel.

Table 8.18-2 Sign Panel Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – No significant defects	None or routine maintenance.	CS-1
Surface corrosion to connection with no section loss.	None	
Fair Condition – Minor section loss or missing/loose connections.	Repair/replace element or continue monitoring.	CS-2
Corrosion with section loss > 0% AND < 25% to sign panel connection hardware.	Replace hardware.	
< 10% missing, loose, frozen or cracked sign panel connection hardware. No falling hazard.	Tighten any loose fasteners; replace missing fasteners.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Connections are loose, missing or cracked.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Section loss ≥ 25% AND < 50% to sign panel connection hardware.	Tighten any loose fasteners; replace missing fasteners.	
≥ 10% AND < 25% missing, loose, frozen or cracked sign panel connection hardware. No falling hazard.	Replace hardware.	
Critical Condition – Extensive number of clips are loose/missing which could pose a safety hazard to the travelling public.	Notify Program Manager.	CS-4
Section loss ≥ 50% to sign panel connection hardware.	Tighten any loose fasteners; replace missing/broken fasteners.	
≥ 25% missing, loose, frozen or cracked sign panel connection hardware.		
Loose or cracked connection hardware that poses a safety hazard to the travelling public.	Remove and replace.	

8.19 Catwalk (Element 431)

Catwalks are typically found adjacent to VMS panels or on larger and older sign structures, see Figure 8.19-1. Current design practice is phasing out the use of catwalks on structures except on VMS panels where periodic service is needed. Catwalks consist of members that form a frame for grating to rest on, providing walkable access to the structure. Some catwalks have a railing that may be movable, pivoting into a deployed position as needed. Catwalks are primarily maintenance aids and can often be accessed from the supporting space frame. Some of the specific subcomponents of the catwalk system are detailed in the list below.

- Railing: A safety enclosure that protects personnel using the walkway from falling. It consists of a handrail, a mid-rail, posts, and a toeboard, each of which is detailed in the list below:
    - Handrail: The top horizontal member that runs parallel to the catwalk.
    - Mid-rail: The rail that is approximately midway between the handrail and the platform.
- Posts: The vertical members that support the rails.
- Toeboard: The plate that runs parallel to the catwalk, attached between the posts.
- Platform: The working space or walking surface. This typically consists of open-grid metal grating



Figure 8.19-1 Catwalk platform, posts, and handrail on a VMS sign structure

8.19.1 Inspection Methods

The walkway should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanized coating), corrosion, section loss, etc.
    - If an area of corrosion is observed on any components, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented.
- Condition of the safety railing. Safety railings should be inspected for damaged and misaligned members.
- Condition of the grating. The grating should be inspected for tripping hazards, uneven grating elevations, misaligned grating sections, or any condition that could pose a hazard to inspection and maintenance personnel.
- Loose, missing, or deformed/misaligned connection hardware.
- Condition of the welded connections. The welds should be inspected for cracking, especially at points of intersecting welds, incomplete or excessively ground, or poor welds that can contribute to stress risers within the weld. The location and size of any weld crack is to be documented. Suspected cracks should be verified by NDT (see Appendix F Nondestructive Evaluation).
- Impact damage. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above, or result in a reduced minimum vertical clearance for the structure.

8.19.2 Element Level Guidance

This element's assessment includes the catwalk gratings, handrails, posts, and connections on the structure in linear feet – the sum of the horizontal projection of the catwalk/walkway parallel to the sign structure.

Table 8.19-1 Sign Elements – Catwalk

Element No.	Element Name	Element Group	Unit
431	Catwalk	Signs	Each

8.19.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., disconnected post, impact damage), the location of the member (e.g., 10 feet from the right post), location of deficiency (e.g., post bottom connection) and severity of the defect (e.g., number of connections affected).

Each linear foot cross section should be assigned a Condition State based on the most severe condition of the catwalk system. Below is an outline of some typical conditions, deficiencies, and possible work requests to remedy them. Extra precautions and/or engineering judgement may be required depending on the redundancy of the structure or the behavior of the structure under its dead and live loading conditions.

Table 8.19-2 Catwalk Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – The connections are in new or like-new condition with no significant deficiencies or evidence of active corrosion.	None or routine maintenance.	CS-1
Fair Condition – Moderate deterioration of the connections may be present. Handrails and locking pins may be misaligned or inoperable. Safety chain(s) may be missing or deteriorated.	Repair/replace element or continue monitoring.	CS-2
Section loss > 0% AND < 25% affecting catwalk members.	Clean, prepare, and coat affected components.	
Section loss > 0% AND < 25% affecting connection hardware.		
The catwalk's most restrictive vertical clearance over the travel way is < 1' greater than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance	Notify the Program Manager.	
Catwalk members, railings, connections, or grating has loose, missing, broken connections or have impact damage – catwalk is not in danger of falling.	Replace, repair, or tighten affected components.	
Poor Condition – Sections of gratings or handrails may be misaligned, unstable, damaged, or missing. Heavy deterioration of the connections may be present.	The catwalk or its connections must undergo tentative corrective action; replace affected components; or increase inspection frequency. Some action must be taken.	CS-3
Section loss ≥ 25% AND < 50% affecting catwalk members.	Repair or replace affected components.	
Section loss ≥ 25% affecting connection hardware.		

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Any collision damage or deterioration significant enough to threaten collapse or separation from the sign structure.	Immediate removal of the catwalk; replacement of the affected component; or immediate corrective action must be taken.	CS-4
Section loss ≥ 50% affecting catwalk members.	Repair or replace affected components.	
The catwalk's most restrictive vertical clearance over the travel way is less than the State minimum vertical clearance for the respective obstruction. Reference 6.3.11 Minimum Vertical Clearance.	Correct clearance issue or remove/replace catwalk.	
Catwalk members, railings, connections, or grating has loose, missing, broken connections or have severe impact damage – catwalk is in danger of falling.	Replace, repair, or tighten affected components.	

8.20 Power and Sign Lighting (Element 441)

This element consists of VMS power, VMS control boxes, sign panel lighting, and the system supplying it power (e.g., electrical conduits, attached power boxes/meters). For power associated with traffic signal structures and lighting structures, reference Junction Box/Power Supply (Element 551).

Sign lighting illuminates the sign and typically extend from the bottom of the hangers, out beyond the front of the sign. Some of the specific subcomponents of the luminaire system are detailed in the list below.

- Luminaire: The lights that illuminate the sign. The luminaire sits at the end of the luminaire arm or on the luminaire rail, pointed toward the sign panel.
- Luminaire Arm: The arms carry the luminaire system, extending from the sign panel hangers, positioning the luminaires toward the front of the sign. The arms are typically the same material and beam type as the hangers. The luminaire arms may be connected to the hangers via a welded gusset plate, perimeter welded to one another or bolted together.
- Luminaire Rail: The luminaire rail spans across the luminaire arms, with the luminaires and conduit typically positioned on the luminaire rail.
- Lighting Panel Box: The lighting panel box is typically a junction box mounted to either the arm/chord or the post/tower.

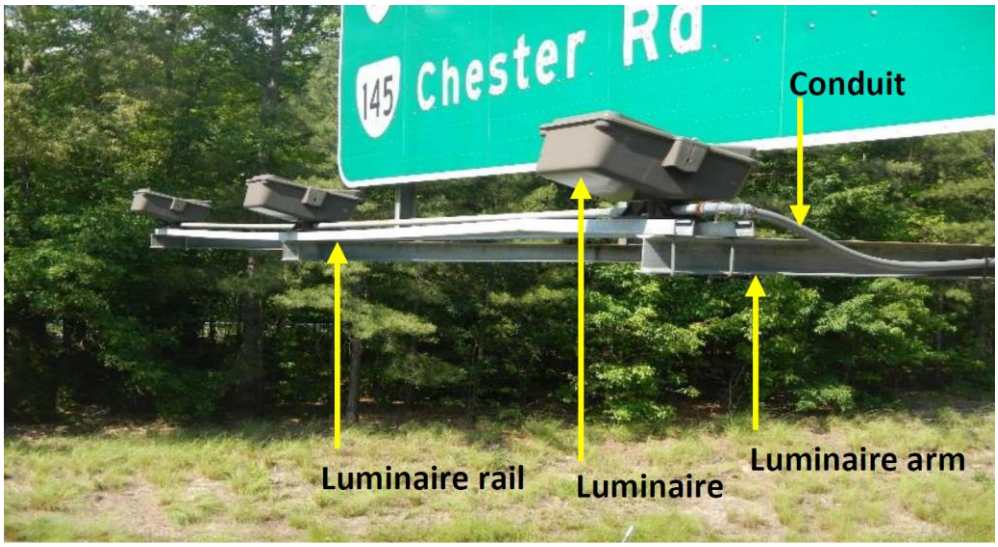


Figure 8.20-1 Reflective sign luminaire system and power

For VMS Panels, this element is associated with all power for the panel. The functionality of the VMS bulbs and legibility of the bulbs is covered under Sign Panels (Elements 411 – 413). All power sources and the control boxes for the VMS are also associated with this element.



Figure 8.20-2 VMS control box

8.20.1 Inspection Methods

The inspector shall consider all wiring, conduits, junction boxes, and all other components of the power system that are energized and operational unless specifically informed in writing by the Program Manager that the system is nonfunctional and not energized. The inspector shall follow all RIDOT and OSHA guidance for working around and near electrical hazards.

In general, ancillary structure inspections do not cover the operational functionality of the sign structure lighting system however, the inspector is required to note anything that may impact or pose a threat to the safety of the public, including motorists, pedestrians, or inspection personnel. In addition, any observed non-functioning component should be documented. The sign lighting system, including the

various attachments, should be visually inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Operation and burned-out bulbs of the lighting system.
- Cracked, broken or cloudy luminaire covers.
- Moisture accumulation or water in luminaire housings.
- Loose, missing, or deformed/misaligned bolted connections or components, and under-engaged nuts at the luminaire hanger connections. Under-engaged nuts are to be recorded as percent engaged if less than 100%.
- Section loss or impact damage at lighting support components (arm or rail) and/or its connection hardware should be quantified and noted.
- Condition of electrical conduit and/or electrical or panel boxes attached to the arm/chord or post/tower. The conduit should be visually inspected for missing components, breaks, exposed wiring, and corrosion and section loss of connector and attachments. In addition, the conduit and wiring entry and exit points in the arm/chord or posts/towers should be inspected for the presence of rubber grommets or seals. Electrical or panel boxes and their post attachments should be inspected for corrosion and section loss, including missing, broken or non-functioning doors. If any exposed wiring is present, inspectors are to take caution and avoid contact.
- Any exposed wiring should be brought to the attention of the Project Manager.
- Impact damage to any lighting components in which the components are in danger of falling.
- If electrical conduit or wires are present, the base plate must be wrapped with a rodent screen or have a grout pad in-place. The rodent screen should have no gaps between the base plate/screen interface, and the screen/concrete foundation interface. If the structure has electrical conduit or wires, and the base is missing the metal rodent screening, it should be noted in the inspection report under Grout Pad (Element 151).
- For VMS control boxes:
    - Corrosion and section loss: If an area of corrosion is observed on any control boxes, hinges or closure clips of the panel box, the area should be thoroughly cleaned of any rust and the amount and extent of section loss should be determined and documented. See Figure 8.20-3.



Figure 8.20-3 Heavy rusting along bottom of control box

- Missing or loose control box hardware: Control boxes should be locked from the general public. The hardware of the box, e.g., hinges and doors, should be able to keep weather, animals and the general public outside of the box's components.

- Electrical hazard: Any exposed wiring from conduits or panels should be documented. Exposed wiring that is within the clearance of the traveling public should be reported to the Project Manager.



Figure 8.20-4 Open control box with exposed wiring

- Impact: any damage to the control box or its connection to the structure should be inspected.



Figure 8.20-5 Control Box to post connection impact with broken components

8.20.2 Element Level Guidance

The power and auxiliary lighting system for the sign structure should be considered as a whole unit/system – the total quantity will always be 1 if there is sign lighting or a VMS panel present. The most severe condition will govern the rating.

Table 8.20-1 Sign Elements – Power and Sign Lighting

Element No.	Element Name	Element Group	Unit
441	Power and Sign Lighting	Signs	Each

8.20.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., exposed wiring), location of deficiency (e.g., 10 feet to the right of the VMS panel) and severity of the defect (e.g., number of connections affected).

Below is an outline of some typical conditions, deficiencies, and possible work requests to remedy them:

Table 8.20-2 Power and Sign Lighting Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – There are no exposed wiring and the lighting system is unaffected.	None or routine maintenance.	CS-1
Structural components and/or hardware with surface rust with no notable loss.	None.	
Conduits are weathered but are intact and secure.		
Lights with light moisture buildup under lens.		
Panel box or control /junction box with surface rust and no notable loss.		

Description of Deterioration or Defect	Work Action	Condition State
Fair Condition – Minor deterioration and deficiencies to conduit connections or elements of the power system and auxiliary lighting.	Work action request; or do nothing.	CS-2
Bulb/light broken or missing at sign lighting.	Replace affected components.	
Structural components and/or hardware with section loss < 25%.		
Conduits with section loss or abrasions but intact and secure.		
Panel box or control box with section loss but intact and secure.		
Gap between conduits and control box with wires nominally exposed.		
Moderate impact damage that affects the control/junction box door's function or limits the boxes functionality; no hazard present.		
< 10% of connection hardware for luminaires/conduits/lighting is loose/missing/broken but is in no danger of falling.	Replace, repair, or tighten affected components.	
Wiring conduit, clip or grommet is loose or is missing, broken with no exposed wiring or wiring exposed outside the clearance of the traveling public.		
Poor Condition – Moderate to advanced deterioration and deficiencies to conduit connections or elements of the power system and auxiliary lighting.	The electrical or auxiliary lighting should undergo tentative corrective action; or replace affected components. Some action must be taken.	CS-3
Bulb/light broken or missing at sign lighting.	Replace affected components.	
Structural components and/or hardware with section loss < 25%.		
Conduits with section loss but intact and secure.		
Panel box with section loss but intact and secure.		
Gap between conduits and control/junction box with wires nominally exposed.		
Moderate impact damage that affects the control/junction box door's function or limits the boxes functionality; no hazard present.		
Wiring conduit, clip or grommet is loose or is missing, broken with exposed wiring within reach of the traveling public.	Replace affected components.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Any collision damage or deterioration significant enough to threaten collapse or electrocution to the public, e.g., exposed wiring that is accessible to the public.	Notify Program Manager. Immediate removal of the lighting or replacement of the affected component; or immediate corrective action must be taken.	CS-4
Connection hardware for luminaires or conduits are loose/missing/broken and is in danger of falling.	Replace affected components.	
Impact damage to lighting or conduits and is in danger of falling.		
Gap between conduits and control box with wires nominally exposed.		
Moderate impact damage that affects the control/junction box door's function or limits the boxes functionality.		

8.21 Traffic Signal (Elements 451 & 452)

This element covers the traffic light (and all components of the signal) as well as its method of attachment to the structure and the safety chain. They appear in a variety of configurations from 1 to 5 lights per grouping. The lights and electronics of the signal are enclosed within a housing. Each signal typically has a signal visor and the overall signal group has a backplate. The signal attaches to the arm, post, or span wire via metal straps, hangers, or various other mounting systems.

8.21.1 Inspection Methods

In general, the traffic light structure inspections do not cover the operational functionality of the signals, however, the inspector is required to note anything that may impact or pose a threat to the safety of the public, including motorists, pedestrians, or inspection personnel. In addition, any observed non-functioning, partially functioning or mistimed component should be documented. The signals and their connections should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint), oxidation, section loss, etc.
    - If an area of coating loss and/or oxidation is observed on the signal housings, the area should be thoroughly cleaned and the amount and extent of section loss (if present) should be determined and documented. See Figure 8.21-1.
    - The universal mounting bracket attachment hardware is typically stainless steel; however, galvanized steel can also be found in the attachment hardware. If an area of corrosion is observed on the attachment hardware, the area should be thoroughly cleaned of all rust and the amount and extent of section loss should be determined and documented.
    - Corrosion of the pins connecting the stainless-steel band to the universal mounting bracket should be documented. If an area of corrosion is observed on the pin or pins, the exposed portion of the pin should be thoroughly cleaned of all rust and the amount and

extent of section loss should be determined and documented. The pins are typically zinc plated and, as such, are highly susceptible to galvanic corrosion (dissimilar metals).



Figure 8.21-1 Signal housing has holes and coating loss

- Housing: Any damage to the housing or cast shell should be documented. Cracks and any deterioration should be noted.



Figure 8.21-2 Signal shell is deteriorated and cracked.

- Signal lenses: The lenses should be inspected for functionality and any defects (bullet holes, cracked lenses, missing lenses, water/moisture, etc.) should be noted.

- Signal visors and backplate: These components should be inspected for missing, loose, or broken components. If a missing visor significantly reduces the visibility of the signal the inspector should report the condition immediately to the Project Manager.



Figure 8.21-3 Missing traffic light visors and backplate

- Wing nuts securing front panel of signal housing: The nuts should be inspected for missing, loose, or broken components.



Figure 8.21-4 Missing signal panel wing nut

- If a safety chain is not present on a mast arm or span wire signal over the roadway, it should be noted.

- Alignment of the components. The inspector should verify that all signals are mounted so that they are easily visible from the intended direction of travel.

- Connection hardware fastening the attachments to the arms.



Figure 8.21-5 Traffic light goose-neck connection worn away



Figure 8.21-6 Traffic light hanger has surface rust and has a missing bolt. Temporarily secured with a bungie chord

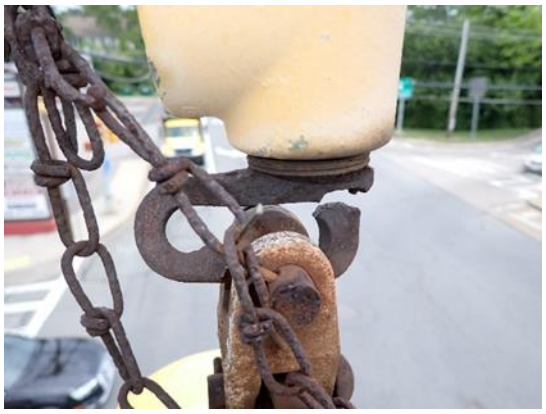


Figure 8.21-7 Traffic light hanger cracked

- Moisture accumulation or water inside the housing.

- Condition of universal mounting bracket (aluminum): The universal mounting bracket should be inspected for cracks or breaks. Cracks or breaks compromise the ability of the connection to support the intended component (signal head, sensor, camera, etc.). Document location and size of the crack or break.



Figure 8.21-8 Cracked traffic light universal mounting bracket



Figure 8.21-9 Broken universal mounting bracket strap to mast arm connection

- Condition of universal mounting bracket curved washer (aluminum). This washer connects the bolt on the stainless-steel band to universal mounting bracket. This should be inspected for cracks or breaks. Document location and size of the crack or break.

- Loose, missing, deformed/misaligned, or broken bolted connections or components, and under-engaged nuts on the universal mounting bracket assembly. Under-engaged nuts are to be recorded as percent engaged if less than 100%.

- Signal cycles should be observed to ensure all lights are functional and timed properly. This includes pedestrian signals, i.e., pedestrian walk signal should not contradict a green light for traffic in the same path.

- Impact damage. The affected signal head, location on the affected component, and dimensions of the impact damage are to be documented and the area photographed. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.

- Document any deviation, excess or missing components from the typical configuration. Some examples may include material other than stainless steel or aluminum, the presence of beveled washers, lock or jam nuts, extra washers, and missing nuts and washers.

- For span wires, traffic lights are typically attached using span wire saddle clamps: These clamps are then attached to a leveling assembly and a hanger, which is then mounted to the signal, see Figure 8.21-10. This mounting allows vertical adjustments as well as the ability to “plumb” and properly align the signals and signs. The inspector should inspect and document the following conditions associated with the span wire clamps:

    - Worn hardware. Due to the potential for motion of the assembly, connection hardware as well as bolt holes or slots can become worn. Document any section loss of the members due to wear.

- Loose, missing, deformed/misaligned, or broken bolted connections or components, and under-engaged nuts on the attachment assembly. Under-engaged nuts are to be recorded as percent engaged if less than 100%.



Figure 8.21-10 Span wire traffic light clamp has a crack

8.21.2 Element Level Guidance

Each traffic signal, i.e., each traffic lighting system contained within a housing system, should be counted individually (Each). The number of traffic signal connections should equal the number of traffic signals (Each).

Any utility or conduit associated with the traffic signal should be documented under Junction Box/Power Supply (Element 551).

Table 8.21-1 Traffic Signal Elements

Element No.	Element Name	Element Group	Unit
451	Traffic Signal	Traffic Signal	Each
452	Traffic Signal Connection		

8.21.3 Reporting and Rating Guidance

Traffic signals are numbered left to right, front to back, relative to the direction of orientation.

All deficiencies should be recorded by describing the type of deficiency (e.g., missing visor, cracked orbital bracket), the traffic signal designation (which should be established during the initial inspection and documented in the vertical clearance sketch), location of deficiency (e.g., red light, top right visor nut) and severity of the defect (e.g., percent paint loss, length of crack). Each traffic signal and connection should be assigned a Condition State based on the most severe condition.

Table 8.21-2 Traffic Signal and connection Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Minor damage or deterioration of element, however the element is functioning as designed.	None or routine maintenance.	CS-1
Damage not affecting function or safety. Some secondary signal components are loose or damaged, e.g., loose/missing screws for signal visors or cracked backing panels.	Tighten loose screws (caution against stripping bolts) or none.	
Surface corrosion to signal head connection hardware with no section loss.	None.	
Connection bracket or hardware with areas of light rust with no notable section loss.		
Minor weathering to housing, visor or backplate.		
Housing with areas of peeling coating, scattered signal visor or backplate screws are missing or not fully tight.	Clean, prepare and coat affected components or tighten loose components.	
Fair Condition – Moderate damage or deterioration of element, however the element remains operational.	Repair/replace element or continue monitoring.	CS-2
There is damage to the housing of the signal or its components, but the signal is still operational and in no danger of falling.	Replace affected components.	
Components are missing, e.g.: visor is missing; back plate is missing or severely damaged. The signal is functional. No components are in no danger of falling.		
> 0% AND < 25% of the connection hardware is loose, missing or broken.		
For span wire structures, the traffic light is not connected to the sway wire (if present).		
Housing with over 50% loss of coating, 25% or more of signal visor or backplate screws are missing or not fully tight.	Clean, prepare and coat affected components or tighten loose components.	
Moderate weathering housing, visor or backplate.		
Connection hardware with light to moderate flaky rust with ≤ 25% section loss.		
Connection bracket with hairline crack, < 50% of length with safety chain properly installed.	Replace affected components.	
Dissimilar metal corrosion at connection bracket and mounting straps or pins, rust staining and minor section loss.		
Set screw(s) loose or missing for post mounted traffic light or gusseted tube luminaire.		

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Serious damage or deterioration to element is reducing the functional performance.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Safety chain is not installed on signal over traffic lanes.	Install safety chain.	
Housing with coating loss, visible heavy signs of weathering on housing with possible UV deterioration.	Clean, prepare and coat affected components.	
Missing visor or missing backplate.	Replace affected components.	
Connection hardware with moderate to heavy rust with ≥ 5% AND < 20% section loss.	Clean, prepare and coat affected components	
Minor impact damage that does not significantly affect the traffic light; all connections and hardware are sound and no loose components are capable of falling.	Replace affected components.	
Redundant signal is not operational.		
Connection bracket with hairline < 1/16" wide crack, up to full length.		
Critical Condition – Any collision damage or deterioration significant enough to threaten separation from the ancillary structure.	Notify Program Manager. Immediate removal or corrective action must be taken. Increased inspection frequency may be used in the interim.	CS-4
Connection hardware with heavy rust with ≥ 20% section loss.	Replace affected components.	
Major impact damage that significantly affects the traffic light; traffic light can fall.		
Connection bracket with hairline crack, < 50% of length with no safety chain or chain is not properly installed.		
Nonredundant signal is not operational.		
Any deterioration that poses a potential falling hazard.		
Connection bracket with ≥ 1/16" wide crack.		

8.22 Light Fixture (Element 461)

Light fixtures, i.e., luminaires, provide light to luminate the roadway, pedestrian areas, and signage. They can be fixed to structures by brackets, trussed arms, davit arms, post mounts or under signs, among others. This element covers the lens, bulb and housing of the light fixture.

8.22.1 Inspection Methods

In general, light structure inspections do not cover the structure's lighting. However, the inspector is required to note anything that may impact or pose a threat to the safety of the public, including motorists, pedestrians, or inspection personnel. The luminaire lens bulb and housing should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Coating loss (paint or galvanizing), oxidation, corrosion, section loss, etc.
    - Coating loss (paint), oxidation, or section loss: If an area of oxidation or flaking is observed on the lighting housing, the area should be thoroughly cleaned and the amount and extent of section loss should be determined and documented.



Figure 8.22-1 Flaking coating and oxidation on luminaire housing

- Housing is open, missing or not secure. The housing should be inspected for its ability to keep moisture and debris out of the light. If the housing is not secured, zip ties or other methods should be used to temporarily secure it.



Figure 8.22-2 Missing traffic light visors

- The hinges and other mechanical components of the housing should be inspected noting any damage, missing components, rust or section loss.



Figure 8.22-3 Housing hinge keepers missing and door tab broken

- If the housing connection to arm or post is not visible, the inspector should use both hands to lightly try and move the housing to ensure its internal connection is secure. The housing should not be opened by the inspector.
- Connection hardware to the arm or post.
- Moisture accumulation or water presence.



Figure 8.22-4 Water accumulation and debris in luminaire lens

- Missing lens.
- Buildup of debris or moisture in the lens: This can lead to clouding or staining to the lens and could be indicative to the failure of the lens seal or gasket.
- Broken or cracked lenses, see Figure 8.22-5.



Figure 8.22-5 Broken and cracked lens

- Improper seating of the lens within the housing.
- Missing or broken bulbs or damaged LEDs.
- Non-functioning lighting: Most lights have a lighting sensor that can be covered by hand to test if the light is operational during daytime inspection, see Figure 8.22-6.



Figure 8.22-6 HML with non-functioning bulbs

8.22.2 Element Level Guidance

Each light fixture should be counted individually (Each). The number of light fixture connections should equal the number of light fixtures (Each).

Any utility or conduit associated with the light fixture should be documented under Junction Box/Power Supply (Element 551).

Table 8.22-1 Light Fixture Elements

Element No.	Element Name	Element Group	Unit
461	Light Fixture	Light Fixtures	Each

8.22.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., cracked housing, missing lens), the light fixture designation (which should be established during the initial inspection and documented in the vertical clearance sketch) and severity of the defect (e.g., percent paint loss, length of crack). Each light fixture should be assigned a Condition State based on the most severe condition.

Table 8.22-2 Light Fixture Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – Minor conditions affecting the function or appearance of the light fixture with no impact to its stability.	None or routine maintenance.	CS-1
Corrosion to housing with no section loss.	Clean, prepare, and coat affected components.	
Fair Condition – Minor corrosion/oxidation with minor section loss or loose/missing hardware.	Repair/replace element or continue monitoring.	CS-2
Housing has loose or missing hardware but the housing is still secured and weather tight.	Replace affected components.	
Housing hinges or other closure components have light rust with no appreciable section loss.		
Housing has visible light accumulation of debris or moisture.		
Housing seal is protruding from closure.		
Housing has moderate weathering and/or peeling coating over 25% of surface.		
Lens is cloudy or is cracked but operational.		
Lens is not seated properly within the housing but does not pose a falling hazard.		
Bulb or LED is above traveling public and is in danger of falling.		
Lens has minor debris or water accumulation.	Repair source of moisture or debris infiltration.	
The bulb or LED is dim but still operational.	Monitor.	

Description of Deterioration or Defect	Work Action	Condition State
Poor Condition – Major or multiple defects or section loss without the fixture being in danger of falling.	Light fixture should undergo tentative corrective action; replace affected components; or increase inspection frequency. Some action must be taken.	CS-3
Housing is broken or missing hardware; does not pose a falling hazard.	Replace affected components.	
Housing hinges or other closure components have moderate rust with up to 20% section loss.		
Housing has visible moderate accumulation of debris.		
Housing seal is missing.		
Housing has heavy weathering and/or peeling coating over 50% of surface		
Housing can be moved slightly by hand but is secure.		
Housing is cracked or damaged but not in danger of falling.		
Lens is missing.	Replace affected components.	
Lens is broken but does not pose a falling hazard.		
Lens has moderate debris or water accumulation affecting lamination.	Repair source of moisture or debris infiltration.	
Lens is stained or foggy which affects illumination.	Replace affected components.	
Bulb or LED is missing or not operational.	Replace.	
Critical Condition – The light fixture or one of its components could be in danger of falling or could pose some sort of danger to the public.	Notify Program Manager. Immediate removal of the light fixture or immediate corrective action must be taken.	CS-4
Housing hinges or other closure components are missing or have heavy section loss.	Replace affected components.	
Housing is missing.		
Housing has visible heavy accumulation of debris.	Repair source of debris or moisture infiltration.	
Housing has severe damage but is in danger of falling.	Replace affected components.	
Lens is broken and poses a falling hazard.	Replace affected components.	
Lens has severe debris or water accumulation affecting lamination.	Repair source of moisture or debris infiltration.	
Bulb or LED is above a the traveling public and is in danger of falling.	Replace affected component.	

8.23 Attachments (Elements 501 – 519)

The Elements define common ancillary structure attachments that serve a secondary/auxiliary purpose to the main ancillary structure attachments. These include, but are not limited to, ITS devices, cameras, traffic sensors, pedestrian signals, miscellaneous street/traffic signs, antennas, traffic control counters and other mounted devices to the structure.



Figure 8.23-1 HML winch system



Figure 8.23-2 Preemption confirmation strobe



Figure 8.23-3 Toll gantry with tag readers and other attachments



Figure 8.23-4 Antenna attached to arm

8.23.1 Inspection Methods

In general, ancillary structure inspections do not cover the operational functionality of sensors, cameras, antennas, etc.; however, the inspector is required to note anything that may impact or pose a threat to the safety of the public, including motorists, pedestrians, or inspection personnel. In addition, any observed non-functioning component should be documented. The miscellaneous items attached to the mast arm, span wire or vertical support should be visually and tactilely inspected from an aerial lift (bucket or platform). The inspector should inspect and document the following conditions:

- Alignment of the components: The inspector should verify that all cameras are mounted in a logical direction. If the camera angle is askew or clearly off target, the condition should be noted.

- Condition of universal mounting bracket (aluminum): The universal mounting bracket should be inspected for cracks or breaks. Cracks or breaks compromise the ability of the connection to support the intended component. Document location and size of the crack or break.



Figure 8.23-5 Cracked camera universal mounting bracket



Figure 8.23-6 Cracked universal mounting bracket temporarily secured with zip-tie

- Condition of universal mounting bracket curved washer (aluminum). This washer connects the bolt on the stainless-steel band to universal mounting bracket. This should be inspected for cracks or breaks. Document location and size of the crack or break.

- Sign mount: These components should be inspected for missing, loose, or broken components.



Figure 8.23-7 Signs with a missing strap at the mount

- Cracking, damage, delaminating, peeling, or crazing (network of closely spaced, fine cracks) of the reflective material. Damaged or deteriorated reflective material can affect the legibility of the sign.

- Fading of lettering: Faded lettering can affect the legibility of the sign.

- Alignment of the components: The inspector should verify that all signs are mounted so that they are easily visible from the intended direction of travel. This is even more critical if they are calling out directions to the public, such as “ONE WAY” or other warnings.

- Loose, missing, deformed/misaligned, or broken bolted connections or components, and under-engaged nuts on the universal mounting bracket assembly. Under-engaged nuts are to be recorded as percent engaged if less than 100%.

- Impact damage. The affected camera, location on the affected component, and dimensions of the impact damage are to be documented and the area photographed. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.



Figure 8.23-8 Sign is broken

- For Span Wires: The anti-sway connections to the span and sway wires.



Figure 8.23-9 Sign anti-sway teeth not engaged



Figure 8.23-10 Bottom connection to sway wire broken and temporarily secured with zip ties

- Connection hardware fastening the attachments to the arms/posts/wires. Bolted connections should be inspected for loose or missing components, corrosion, under engaged nuts, and presence of lock washers, beveled washers, or extra washers. Document percent engagement if less than 100%.



Figure 8.23-11 Pedestrian signal arm is corroded and connection bracket is cracked

- Loose, missing, deformed/misaligned, or broken bolted connections or components, and under engaged nuts on the universal mounting bracket assembly. Under engaged nuts are to be recorded as percent engaged.

- Impact damage. The affected camera, location on the affected component, and dimensions of the impact damage are to be documented and the area photographed. Document any observable impact damage that exists and any deficiencies associated with it, which may include any of the above.

- Document any deviation, excess or missing components from the typical configuration.

- Cracking, damage, delaminating, peeling, or crazing (network of closely spaced, fine cracks) of the reflective material of traffic/road signs. Damaged or deteriorated reflective material can affect the legibility of the sign.

- Fading of lettering. Faded lettering can affect the legibility of the traffic or road sign.

- Attachment operation and functionality.



Figure 8.23-12 Traffic sensor with adjacent broken and water-filled strobe light

- Cracked, broken, cloudy sensors.

- Moisture accumulation or water in attachment housings.
- Loose, missing, or deformed/misaligned bolted connections or components, and under engaged nuts. Under engaged nuts are to be recorded as percent engaged.
- Document any deviation, excess or missing components from the typical configuration. Some examples may include material other than stainless steel or aluminum, the presence of beveled washers, lock or jam nuts, extra washers, and missing nuts and washers.
- Exposed or damaged wiring: Given the attachment, if any electrical wiring is exposed, is frayed or the conduit is broken that could encounter the traveling public, it needs to be documented and the Project Management notified.



Figure 8.23-13 Strobe attachment is broken with exposed wiring.

- High mast lights (HML) winches should check for any signs of corrosion, deterioration, or damage.

8.23.2 Element Level Guidance

Each attachment worthy of note should be counted individually (Each).

Any utility or conduit associated with the attachment should be documented under Element 441, Power and Signal Lighting, discussed in Section 8.20.

Table 8.23-1 Attachment Elements

Element No.	Element Name	Element Group	Unit
501	ITS Device	Attachments	Each
502	Camera		
511	Luminaire Ring		
512	Winch Cable		
519	Other Attachment		

8.23.3 Reporting and Rating Guidance

All deficiencies should be recorded by describing the type of deficiency (e.g., missing clamps, broken housing), the attachment designation if multiples of the same type exist (which should be established during the initial inspection and documented in the vertical clearance sketch) and severity of the defect (e.g., percent paint loss, length of crack). Each attachment should be assigned a Condition State based on the most severe condition.

Table 8.23-2 Attachment Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – The attachment is properly connected and appears to be serving its function.	No work action required unless non-structural.	CS-1
Fair Condition – The attachment or its connection is minorly damaged without any threat to the public.	Work action request; or do nothing.	CS-2
Attachment is askew or not pointed in the intended direction.	Replace affected components.	
> 0% AND < 25% of the connection hardware is loose, missing or broken. No falling hazard.	Clean, prepare, and coat affected components.	
Connection hardware bracket with moderate to heavy rust with < 25% section loss.	Remove obstruction, realign, or move device.	
Sign lettering or symbols have light crazing, fading or has become faded; still legible.	Replace affected components.	
Solar panel shows signs of weathering, attachment hardware has areas of light rust with no appreciable loss.	Monitor.	
Poor Condition – Significant deterioration or damage to the attachment and/or connecting components	Attachment or its connections must undergo tentative corrective action; replace affected components; or increase inspection frequency. Some action must be taken.	CS-3
≥ 25% of the connection hardware is loose, missing or broken.	Repair, replace affected components.	
Connection bracket with hairline < 1/16" wide crack, up to full length.		
Connection hardware with moderate to heavy rust with ≥ 25% section loss.	Clean, prepare and coat affected components	
Anti-sway connection not in place.	Replace affected components.	
Sign lettering or symbols have moderate crazing, fading or legibility < 50%.		
≥ 25% AND < 50% of the connection hardware is loose, missing or broken.	Replace affected components.	
Connection hardware with moderate to heavy rust with ≥ 25% AND < 50% section loss.	Clean, prepare and coat affected components.	
Minor impact damage that does not significantly affect the sign; all connections and hardware are sound and no loose components are capable of falling.	Replace affected components.	
Connection bracket with hairline < 1/8" wide crack, up to full length. Not in danger of falling.		
Solar panel is obstructed from the sun.	Remove obstruction.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Any damage or deterioration significant enough to threaten falling in the path of the travelling public.	Immediate removal of attachment or immediate corrective action must be taken. Increased inspection frequency may be used in the interim.	CS-4
Any deterioration that poses a potential falling hazard.	Remove and replace the affected components.	
Sign related to the safe movement of the traveling public is missing or not legible.	Replace.	
≥ 50% of the connection hardware is loose, missing or broken.	Replace affected components.	
Connection bracket with crack ≥ 1/8" wide.		
Sign and/or connection has severe deterioration that poses a falling hazard.		
Connection hardware with moderate to heavy rust with ≥ 50% section loss.	Clean, prepare and coat affected components.	
The solar panel poses a falling hazard.	Replace.	
The solar panel poses an electrical hazard.		

8.24 Junction Box/Power Supply (Element 551)

This element consists of non-sign related power/electrical system such as electrical conduits, attached power boxes/meters that are used to power traffic signals and light standards exclusively.

Any electric system associated with the auxiliary lighting of signs or the power/lighting of VMS panels should be documented under Power and Sign Lighting (Element 441).



Figure 8.24-1 Transformer base interior electrical system



Figure 8.24-2 Traffic control box for traffic light

8.24.1 Inspection Methods

Due to the similar inspection methods used for Power and Sign Lighting (Element 441).

8.24.2 Element Level Guidance

The power system for the non-sign related ancillary should be considered as a whole unit/system – the total quantity will always be 1. The most severe condition will govern the rating.

Table 8.24-1 Miscellaneous Elements – Junction Box/Power Supply

Element No.	Element Name	Element Group	Unit
551	Junction Box/Power Supply	Miscellaneous	Each

8.24.3 Reporting and Rating Guidance

Due to the similar reporting and rating methods used for sign power systems, reference Section 8.20.3.

8.25 Traffic Protection (Element 561)

Ancillary structures located adjacent to heavily trafficked roadways have protective systems to guard vehicles against direct impacts. It is common for these structures' foundations and vertical supports to be protected from errant vehicle impacts with guide railings and other protective features. Some typical protective features include guide rails, barriers, and attenuators.

For ancillary structures that are mounted on traffic protection, reference Median/Barrier (Elements 121 – 129).

8.25.1 Inspection Methods

Inspect traffic safety features for signs of impact damage or deterioration. The inspector shall visually inspect the condition of all crash protection adjacent to and in advance of the structure 50 feet before and 20 feet after the structure. The inspector should inspect the protection's physical condition of the protection system and its ability to absorb impact and steer/guide the vehicle back onto the road.



Figure 8.25-1 Impact damage to leading side of guardrail with bent posts

- Assess any damage or displacement to the rail posts: multiple, consecutive loose or damaged/leaning posts can negatively affect the designed capacity of the rail system. Additionally, displaced rail sections can be snagging hazards and unsafe potential impact conditions, this is particularly hazardous if the displacement is on the leading side presenting a blunt end to traffic. Note any loss of tension to wire ropes, impact damage/displacement of any sections of the steel rails, and the extent of any loose or missing fasteners.

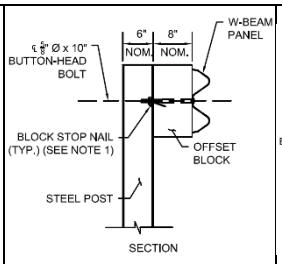
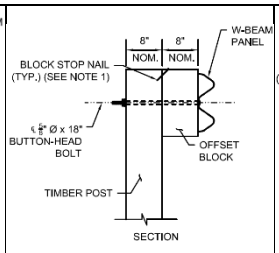
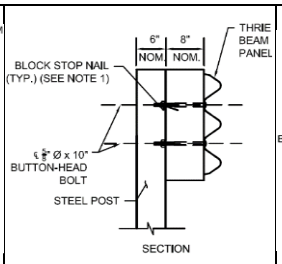
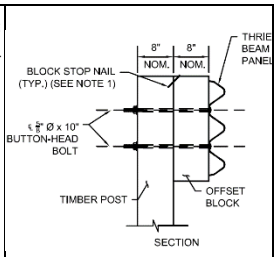
- Note if portions of the rail are non-continuous due to impact damage, if there are gaps in the rail large enough to permit vehicles to pass through or if any blunt ends or snagging hazards are present. These conditions need to be reported to the Project Manager for repair.

- The offset distance between the ancillary structure and guardrail should be checked to ensure that the structure is outside of the designed deflection zone, which will vary depending on the type of guardrail selected, speed of travel and the site conditions (such as steep slopes). Note Table 8.25-1 for minimum guardrail offsets to ancillary structures. Note if the structure has a breakaway base within the clear zone, it shall be noted but will not control the rating.



Figure 8.25-2 Ancillary structure is within the guiderail clear zone

Table 8.25-1 Guardrail Standard Drawings

Example Sections				
System Name	Steel Post W-Beam Guardrail	Timber Post W-Beam Guardrail	Steel Post Thrie-Beam Guardrail	Timber Post Thrie-Beam Guardrail
Standard Post Spacing	TL-2: 12'-6" TL-3: 6'-3"	TL-2: 12'-6" TL-3: 6'-3"	TL-2: 12'-6" TL-3: 6'-3"	TL-2: 12'-6" TL-3: 6'-3"
Minimum Offset to Fixed Object	TL-2: 48" TL-3: 60"	TL-2: 48" TL-3: 60"	TL-2: 48" TL-3: 60"	TL-2: 48" TL-3: 60"
Height of Panel Top	2'-7"	2'-7"	2'-7"	2'-7"
Post Type	W6x8.5 or W6x9	6"x8" nominal timber	W6x8.5 or W6x9	6"x8" nominal timber
Beam Type	W-Beam Panel	W-Beam Panel	Thrie-Beam Panel	Thrie-Beam Panel
Offset Bracket	6"x8" Timber or Plastic	6"x8" Timber	6"x8" Timber or Plastic	6"x8" Timber

Note: All values taken from the MassDOT Construction Standard Details, Drawing Numbers 400.1.0 to 402.22.0.

- If a guardrail termination is within the inspection limits, the end treatment type should be inspected for damage or blunt ends, see Figure 8.25-3.



Figure 8.25-3 Guardrail boxing glove end treatment is blunt in the leading direction and does not meet current standards

- For cable guide rail, the tensile forces in the cable strands supply most of the resistance to impact, so cables must be properly tensioned to provide designed protection.

- For sand barrels, any displaced, tipped or damaged barrels.



Figure 8.25-4 Sand barrels with knocked over barrel

- Assess any damage to or displacement of the attenuators; note the extent of the damaged attenuators. Note if damage is extensive enough to expose any blunt ends.



Figure 8.25-5 Impact attenuator with sharp leading edge

- For concrete barriers, document displacement, settlement, or deterioration. The concrete barriers should be inspected for conformance with current standards but this will not affect the component rating. The inspector shall visually inspect the condition of all crash protection adjacent to and in advance of the structure. The inspector should inspect the concrete barrier's ability to steer/guide the vehicle back onto the road.

8.25.2 Element Level Guidance

The protective countermeasures of the structure will be rated as a system – 1 Each.

Table 8.25-2 Miscellaneous Elements – Traffic Protection

Element No.	Element Name	Element Group	Unit
561	Traffic Protection	Miscellaneous	Each

8.25.3 Reporting and Rating Guidance

This element defines the state of the devices such as guide rails protecting the structure. Evaluate for no more than 50 feet in advance of the structure and 20 feet following the structure.

All deficiencies should be recorded by describing the type of deficiency (e.g., impact damage), location of deficiency (e.g., 10’ from the leading side of the vertical support) and severity of the defect (e.g., three guide rail posts are bent and disconnected).

Table 8.25-3 Traffic Protection Condition State Examples

Description of Deterioration or Defect	Work Action	Condition State
Good Condition – The element shows no deterioration.	None or routine maintenance.	CS-1
Superficial to light rust.	None.	
Fair Condition – Minor damage or deterioration is noted. Element is still performing its intended function and its ability to withstand impact is slightly affected.	Repair/replace element or continue monitoring.	CS-2
Any impact damage on the trailing side of the structure, 10’+ from the post/tower.	Schedule repair.	
Guardrail system with areas of light rust with no appreciable section loss on the leading side of the structure.		
Minor dents in the rail or twisted posts that are still connected to the rail.		
Cable guiderail systems with a loss of tension resulting in little to no visible sag. All connections to posts are present.		
Guardrail system on the leading side of the structure with minor impact damage, less than 2" of deflection.		
There is damage to the system such as cosmetic damage, minor dents, scrapes and gouges, or minor misalignment of components.	Monitor.	
Poor Condition – Moderate to heavy damage or deterioration is noted. Its ability to withstand impact is significantly affected.	Repair/replace element within specified time frame or increase inspection frequency.	CS-3
Guardrail system with areas of moderate rust with up to 20% section loss on the leading side of the structure.	Schedule repair or replace guardrail.	
Guardrail system on the leading side of the structure with moderate impact damage, 2" to 12" of deflection; Deflection is isolated between posts.		
Dents and tears in the guiderail that do not affect the serviceability. Posts are twisted or disconnected but the rail is not significantly affected.		
Cable guiderail systems with a loss of tension resulting in visible sag but cables can perform their function. There are missing cable to post connections but the cable is secure.		
There is damage to the system such as missing barrel covers that allow water to enter and freeze, holes or tears that allow barrel fill to escape, damage that affects the ability of the system to perform such as missing or frozen components.	Repair/replace or Monitor.	

Description of Deterioration or Defect	Work Action	Condition State
Critical Condition – Significant damage or deterioration is visible. There is sufficient concern about the barrier's ability to adequately absorb impact, there are gaps between sections or a blunt end is present.	Notify Program Manager. Immediate corrective action must be taken.	CS-4
Guardrail system with severe rust with ≥ 20% section loss on the leading side of the structure	Replace.	
Guardrail system on the leading side of the structure with severe impact damage, ≥ 12" of deflection.		
In the leading direction, the guiderail system is missing guiderail, is missing consecutive posts or has blunt/protruding ends.		
Ancillary structure is within deflection zone or below standard offset standard specifications for guardrail type.		
Dents, tears or breaks in the rail that affect the ability of the rail to provide protection. Damaged or missing posts.		
Cable guiderail systems with a loss of tension resulting in visible sag but cables can perform their function or there is missing cable.		
There is damage to the system such as missing or seriously damaged barrels, improperly or partially installed or removed systems, or systems that have received significant vehicular impacts		

8.26 Other (Element 571)

This element is used to list any pertinent element not covered under any available Agency Defined Elements (ADE). The use of this element should be done with prudence for items that need to be brought to the State's attention or the next inspector.

8.26.1 Inspection Methods

The item should be inspected with the safety of the travelling public in mind and the element's serviceability.



Figure 8.26-1 Man hole access adjacent to post is not properly covered

8.26.2 Element Level Guidance

Each element needing discussion should be assessed individually (Each).

Table 8.26-1 Miscellaneous Elements – Other

Element No.	Element Name	Element Group	Unit
571	Other	Miscellaneous	Each

8.26.3 Reporting and Rating Guidance

It should be clear in the report what is being discussed and the location of the element. Engineering judgement should be when rating these elements – refer to Table 8.0-1 for general rating information.

All deficiencies should be recorded by describing the type of deficiency (e.g., abandoned service pit), location of deficiency (e.g., 5’ from the leading side of the vertical support) and severity of the defect (e.g., service pit is not covered).

Appendix A Blank Forms

The following forms are sample forms from RIDOT. The most recent forms can be obtained by contacting RIDOT.

A.1 Bridge Inspection Qualifications Record – Form BI-001

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE INSPECTION QUALIFICATIONS RECORD
(Form BI-001)

PART I – GENERAL

Name:	Phone-Office:	
Employee:	Phone-Cell:	
Address:	Email:	
City	State:	Zip:

PART II – QUALIFICATIONS/RELEVANT EXPERIENCE

Education:

Bachelor's Degree in Civil Engineering:
Associate degree in Civil Engineering:

Registrations/Certifications:

Rhode Island Registered Professional Engineer:	
P.E. Registration Number:	[Attach certification]
NHI Two-Week Training Course:	[Attach certification]
NICET Level III or IV Bridge Safety Inspector:	[Attach certification]
Engineer-In-Training (EIT):	[Attach certification]

Experience:

Years of Bridge Inspection Experience[1]: [Attach resume/relevant experience]

Training:

Training Course[2]	Completion Date
Engineering Concepts for Bridge Safety Inspections (NHI 1-Week Course)	
Safety Inspection of In-Service Bridges (NHI 2-Week Course)	
Bridge Inspection Refresher Training (NHI)	
Fracture Critical Inspection Techniques for Steel Bridges (NHI)	
Inspection and Maintenance of Ancillary Highway Structures (NHI)[3]	
Other:	
Other:	
Other:	

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE INSPECTION QUALIFICATIONS RECORD
(Form BI-001)

Footnotes:

1. *Experience in NBIS bridge safety inspection, bridge design, bridge construction inspection, bridge maintenance, or bridge construction may be used to provide the required experience. However, to qualify as a Team Leader at least 50% of experience must be from NBIS bridge safety inspection experience. To qualify as Team Leader for ancillary safety inspection the individual should be an approved Team Leader for Bridge Inspection and should have one-year ancillary safety inspection experience (RIDOT, at their discretion, reserves the right to waive the one-year ancillary safety inspection experience or any other requirement).*
2. *Enter the most recent completion date for the courses above. Also, attach applicable documentation and/or certifications for the above courses. If necessary, attach additional sheet(s) as required to list all applicable training.*
3. *NHI-130087 Inspection and Maintenance of Ancillary Highway Structures course is required to qualify as a Team Leader for the inspection of ancillary structures.*

I, the undersigned, affirm that all information contained in Parts I & II is true and accurate.

(Applicant Signature) (Date)

COMMENTS:

A.2 Inspection Team Report Evaluation – Form AI-002

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

PART I – GENERAL

QA/QC Review Date:

Inspection Group:		**RIDOT QA/QC Review Team:**	
Consultant:		Team Member 1:	
Project Manager:		Team Member 2:	
Team Leader:		Team Member 3:	
Staff Inspector 1:		Team Member 4:	
Staff Inspector 2:		Team Member 5:	

Ancillary Information:

Ancillary Structure ID:		Ancillary Type:	
Inventoried Route:		Structure Type:	
Route Direction:		Structure Material:	
City/Town:			

Inspection:

Consultant Inspection Completion Date:	
Inspection Type:	
Previous Inspection Date:	
QA/QC Review Team Inspection Date:	

PART II – QA/QC FIELD INSPECTION INFORMATION

QA/QC Field Inspection Team:

Team Leader:	
Inspector:	
Inspector:	
Inspector:	

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

PART III – QA/QC REVIEW

Qualifications

Is the Project Manager qualified per the Qualifications Record?	
Is the Team Leader qualified per the Qualifications Record?	
Is the Staff Inspector (1) qualified per the Qualifications Record?	
Is the Staff Inspector (2) qualified per the Qualifications Record?	

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Inspection Process Evaluation:

1. Was report submitted within 60 days of field inspection? _____
    a. Date of Completed Ancillary Inspection _____
    b. Date Report Received _____
2. Was field inspection completed on time? _____
    a. Date Inspection Due _____
3. Were all items (fields) completed in the report? _____
4. Was the report stamped/signed by a Professional Engineer registered in the State of Rhode Island? _____
5. Were critical findings reported immediately via email, phone, or fax?
6. Did RIDOT receive the following required inspection notifications?
    a. Two Week Notification? _____
    b. Two-day notification? _____
    c. Weekly Summary Report? _____
7. Did the contents of the submittal (electronic) meet the current requirements of RIDOT? _____
8. Was a Ancillary Inspection Report Submittal Checklist submitted (AI-008)? _____
9. Did the contents of the submittal package meet the requirements of the Ancillary Inspection Report Submittal Checklist (AI-008)? _____

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Inspector & Inspection Notes

1. Did the notes include pertinent information such as: structure and route description; special access equipment; overall rating summary; weather conditions etc.? _____
   _____
   _____

Comments:

Miscellaneous

1. Did the consultant complete the inspection within the original budget? _____
2. Was the consultant responsive to requests from RIDOT? _____

Comments:

Foundation and Structure Condition Rating Review

The following tables document the condition of the subject ancillary structure as inspected by the QA Review Team for the overall condition rating for the foundation (Elements 101 through 151) and the structure (Elements 201 through 391).

The following definitions apply to these tables:

Photos: Is the condition of the subject ancillary structure adequately documented by the photos? This shall include adequate photos of deficient areas and proper labeling of photos.

Notes: Is the condition of the subject ancillary structure adequately documented by the notes provided in the report?

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Foundation Elements

Element No.	Element Name	Element Group	Condition State (CS)	Photos (Y/N/NA)	Notes (Y/N/NA)
101	Foundation, Reinforced Concrete	Foundations			
102	Foundation, Steel				
109	Foundation, Other				
111	Anchor Rods	Anchor Rods			
121	Median/Barrier, Reinforced Concrete	Median/Barrier			
122	Median/Barrier, Steel				
129	Median/Barrier, Other				
131	Bridge Girder Mount	Bridge Mounted Connection			
132	Bridge Parapet Mount				
141	Embankment	Embankment			
151	Grout Pad	Grout Pad			

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Structural Elements

Element No.	Element Name	Element Group	Condition State (CS)	Photos (Y/N/NA)	Notes (Y/N/NA)
201	Base Plate, Steel	Base Plate/Transformer Base			
202	Base Plate, Aluminum				
203	Transformer Base, Steel				
204	Transformer Base, Aluminum				
209	Base Plate, Other				
211	Post, Steel	Post/Tower			
212	Post, Aluminum				
213	Tower, Steel				
214	Tower, Aluminum				
221	Highmast Post, Steel				
222	Highmast Post, Other				
229	Post/Tower, Other				
231	Post/Tower to Arm/Chord/Wire Connection	Post/Tower to Arm/Chord/Wire Connection			

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Structural Elements (cont.)

Element No.	Element Name	Element Group	Condition State (CS)	Photos (Y/N/NA)	Notes (Y/N/NA)
241	Single Arm Cantilever, Steel	Sign Arm/Chord Member			
242	Single Arm Cantilever, Aluminum				
243	Double Arm Cantilever, Steel				
244	Double Arm Cantilever, Aluminum				
245	Cantilever Truss, Steel				
246	Cantilever Truss, Aluminum				
249	Cantilever, Other				
251	Single Arm Butterfly, Steel				
252	Single Arm Butterfly, Aluminum				
253	Double Arm Butterfly, Steel				
254	Double Arm Butterfly, Aluminum				
255	Butterfly Truss, Steel				
256	Butterfly Truss, Aluminum				
259	Butterfly, Other				
261	Single Chord Span, Steel				
262	Single Chord Span, Aluminum				
263	Truss Span, Steel				
264	Truss Span, Aluminum				
269	Span, Other				
271	Bridge Mounted Frame, Steel				
272	Bridge Mounted Frame, Aluminum				
299	Sign Arm/Chord Member, Other				
301	Mast Arm, Steel	Traffic Signal Arm/Chord Member			
302	Mast Arm, Aluminum				
303	Dual Mast Arm, Steel				
304	Dual Mast Arm, Aluminum				
309	Mast Arm, Other				
311	Span Wire, Steel				
329	Traffic Signal Arm/Chord Member, Other				

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

Structural Elements (cont.)

Element No.	Element Name	Element Group	Condition State (CS)	Photos (Y/N/NA)	Notes (Y/N/NA)
331	Single Bracket, Steel	Lighting Arm/Chord Member			
332	Single Bracket, Aluminum				
333	Double Bracket, Steel				
334	Double Bracket, Aluminum				
335	Single Truss Bracket, Steel				
336	Single Truss Bracket, Aluminum				
337	Double Truss Bracket, Steel				
338	Double Truss Bracket, Aluminum				
349	Bracket, Other				
351	Single Davit, Steel				
352	Single Davit, Aluminum				
353	Double Davit, Steel				
354	Double Davit, Aluminum				
369	Lighting Arm/Chord Member, Other				
371	Truss Arm Struts, Steel	Truss Arm Struts			
372	Truss Arm Struts, Aluminum				
381	Splice - Horizontal	Splice			
382	Splice - Vertical				
383	Slip Joint - Horizontal				
384	Slip Joint - Vertical				
389	Splice, Other				
391	Vibration Dampener	Vibration Dampener			

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form AI-002)

CONCLUSIONS

Recommendations for Corrective Action:

Overall Evaluation Report:

GOOD			SATISFACTORY (Minor Improvement Needed)			POOR (Needs Improvement)		
9	8	7	6	5	4	3	2	1

Notable Practices:

Signatures:

Team Member #1: _____ Date: _____

Team Member #2: _____ Date: _____

Team Member #3: _____ Date: _____

Team Member #4: _____ Date: _____

A.3 Inspection Team Field Performance Evaluation – Form AI-003

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM FIELD PERFORMANCE EVALUATION
(Form AI-003)

Inspection Team

Consultant:

Project Manager:

Team Leader:

Staff Inspector:

Staff Inspector:

Field Review Date:

Time of Visit:

Ancillary Information

Ancillary Structure ID:

Inventoried Route:

Route Direction:

City/Town:

Structure Type:

Ancillary Type:

Structure Material:

Review Team

Team Member 1:

Team Member 2:

Team Member 3:

Team Member 4:

Field Conditions

Temperature:

Weather Condition:

Inspection Team Field Review

For the following questions, if "No" is selected please provide explanation under the "Recommendations/Remarks" section.

1. Did consultant demonstrate sound judgment with traffic control setup and public safety? Yes No NA

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM FIELD PERFORMANCE EVALUATION
(Form AI-003)

2. Did inspectors have proper access equipment for inspection? Yes No NA
   - ☐ Aerial Lift ☐ Bucket Truck
   - ☐ Ladder ☐ Other

3. Did inspectors have proper personal safety equipment for inspection? Please indicate the personal safety equipment during site visit below. Yes No NA
   - ☐ Hard Hat ☐ Safety Harness
   - ☐ Safety Glasses ☐ Ear Protection
   - ☐ Safety Vest ☐ First Aid Kit
   - ☐ Safety Shoes ☐ Dust Mask

4. Was there a qualified Team Leader present during inspection? Yes No NA

5. Did inspection crew display professionalism? Yes No NA

6. Was the consultant responsive to requests from the Department? Yes No NA

7. Was inspection performed in a thorough and timely manner? Yes No NA

Conclusions
Recommendations/Remarks:

Overall Field Evaluation

- ☐ Satisfactory
- ☐ Fair - Minor improvement needed. Minor issues.
- ☐ Poor - Needs improvement. Discuss with Consultant.

A.4 Ancillary File Review – Form AI-004

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

ANCILLARY FILE REVIEW
(Form AI-004)

Review Date:

Ancillary Information

Ancillary Structure ID:
Inventoried Route:
City/Town:
Location Description:

Review Team

Team Member 1
Team Member 2
Team Member 3
Team Member 4

Ancillary File Review:

The following denotes abbreviations for common Ancillary File Locations:

AI: Ancillary Inspection File
ASR: Ancillary Structural Review File
PR: RIDOT Plan Room (Room 016)
AIL: Ancillary Inspection Incident Log and Maintenance Priority List (database)
BMS: Ancillary Management System
EL: Ancillary Electronic Files

Document:	Yes/No/NA	Document Location
Original Ancillary Plans		
Rehabilitation Plans		
Analysis		
Ancillary Correspondence		
Inventory/Initial Inspection Report		
Routine Inspection Report		
Damage Inspection Report		
Damage Inspection Report		
Interim (Special) and Miscellaneous Inspection Report		
Design Calculations		
Ancillary Inspection Photographs		
Ancillary Maintenance & Repair Record(s)		
Special Tools (for Inspection)		

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

ANCILLARY FILE REVIEW
(Form AI-004)

1. Does this structure warrant a structural review?
2. Is the ancillary scheduled for rehabilitation or replacement?
    a. If so, what is the anticipated construction start and completion dates (mm/yyyy) for the subject ancillary?

CONCLUSIONS

Recommendations for Corrective Action:

A.5 Ancillary Structural Review Recommendation - Form AI-005

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

ANCILLARY STRUCTURAL REVIEW RECOMMENDATION
(Form AI-005)

Bridge Information

Ancillary Structure ID:

Inventoried Route:

City/Town:

Location Description:

Inspection Date:

Date Notified:

Notified By:

General Recommendation

- ☐ Recommend structural analysis based on current condition (i.e., due to damage, deterioration or deficiency).
- ☐ Structural elements are not performing as designed (e.g., excessive vibration, alignment/tilt issues, buckling distortion of members.)
- ☐ Inventory has been updated (e.g., sign panels added) or modifications have been made to the structure that should warrant a structural review.
- ☐ Other (explain)_____
  _____
  _____

Notes:

1. This form shall be submitted electronically to the appropriate personnel in accordance with the latest Distribution & Contact List.

Remarks

A.6 Critical Finding Log – Form AI-006

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

Critical Finding Log
(Form AI-006)

Ancillary Structure ID:	**Date Reported:**
Ancillary Type:	**Time Reported:**
Inventoried Route:	**Reported By:**
City/Town:	**Firm/Agency:**

CRITICAL ISSUES SUMMARY

ACTIONS/COMMENTS

Notes:

1. Attach photos with proper labels showing the critical deficiency and any other support documentation

A.7 Weekly Inspection Summary Report – Form AI-007

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

WEEKLY INSPECTION SUMMARY REPORT
(Form AI-007)

Consultant:	**Week Beginning: (mm/dd/yy)[3]** **Week Ending: (mm/dd/yy)[4]**

Completed Ancillary Structures (This Period):

Please only list the ancillary structures that were completed during the time period noted above.

Structure ID	Ancillary Type	Inspection Type	Group No.	Completion Date

Reports Submitted (This Period):

Please only list the ancillary structures that were completed during the time period noted above.

Structure ID	Ancillary Type	Inspection Type	Group No.	Completion Date

Notes:

1. Reports are to be submitted within 60 days after completion of ancillary structure inspection. Exceptions must be requested in writing with reasons for an extension.

2. This report shall be submitted via email every Monday by 10:00am.

3. Week beginning and week ending dates shall coincide with Sunday through Saturday respectively .

Form AI-007 (May 2023) **Page 1 of 1**

A.8 Ancillary Inspection Report Submittal Checklist – Form AI-008

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

ANCILLARY INSPECTION REPORT SUBMITTAL CHECKLIST
(Form AI-008)

Structure ID:			**Date:**
Submitted by (Name/Company):			
PAPER SUBMITTAL			
Y	**NA**		
☐	☐	Report cover letter with date of inspection, type of inspection, and PE Stamp included.	
☐	☐	Data changes document included.	
☐	☐	Electronic version of report cover letter & data changes document included.	
Bridge Management (BrM) Platform			
Y	**NA**		
☐	☐	All inventory and element level data are complete and accurate and has been double-checked.	
☐	☐	All elements, condition states, and condition quantities have been verified.	
☐	☐	All notes have been double-checked with photos for correct references and notations.	
☐	☐	Minimum vertical clearance(s) fields correspond to the measured vertical clearances.	
☐	☐	Inspection report checked for consistency with previous report and any notable differences verified.	
☐	☐	List of special access equipment, specialized tools and equipment, noted within the bridge inspection notes.	
☐	☐	If special access is required to inspect the ancillary structure, coordination with certain person/entity, etc., is noted in inspection notes to aid the next inspector.	
☐	☐	Work requests for all items requiring attention.	
ELECTRONIC BACKUP DOCUMENTS & OTHER			
Y	**NA**		
Photos:			
☐	☐	All photos have been double-checked with inspection report for proper cross references and descriptions. The narrative in the report matches the descriptions on the photos.	
☐	☐	A minimum of four (4) photographs are required for the inspection report: leading elevation; trailing elevation; foundation, bottom vertical support connection, or connection to bridge; and post/tower to arm/chord/wire connection or mount. If these photos already exist in the electronic folder, it is not necessary to provide new photos unless any rehab/updates have been made to the structure or the photo on file is not clear.	
☐	☐	All photo descriptions/notations contain full text and no abbreviations.	
Forms/Sketches:			
☐	☐	Clearance sketch is included. The sketch documents the most restrictive vertical clearance of the ancillary structure over the roadway and the horizontal clearance from adjacent roadways to the post/tower.	
☐	☐	Maintenance & Protection of Traffic (MPT) Plan included, if required.	
☐	☐	Post Thickness Readings sketch is included.	
☐	☐	Ultrasonic Test of anchor rods is included.	
☐	☐	Ancillary Structural Review Recommendation form is included, when required.	
☐	☐	Field sketch of critical findings included, when required.	
Forms/Sketches:			
☐	☐	Electronic folder content, format, and naming structure satisfy RI requirements (see RIDOT's Manual for Inventory & Inspection of Highway Ancillary Structures)	
☐	☐	RIDOT's Manual for Inventory & Inspection of Highway Ancillary Structures has been reviewed and all applicable requirements have been satisfied for this inspection report.	

Form AI-008 (March 2023) **Page 1 of 1**

A.9 Place Holder Future Form AI-009

A.10 Use of Ancillary File Record Form – Form AI-010

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

USE OF ANCILLARY FILE RECORD FORM
(Form AI-010)

This Record shall be inserted into the space occupied by the file retrieved.

Date: _____
Ancillary No: _____
Person: _____
Firm: _____
Phone No.: _____
E-mail: _____

Item(s) Removed:

Date Returned: _____
Initial: _____

A.11 Special Inspection Requirements Form – Form AI-011

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

SPECIAL INSPECTION REQUIREMENTS FORM
(Form AI-011)

Ancillary No: _____
Ancillary Type: _____
Inventoried Route: _____
City/Town: _____

The following documents the primary reason for a special inspection pertaining to this ancillary structure. The inspector shall focus the primary efforts of this special inspection on the elements described below. If, in the opinion of the engineer, other areas not listed below are deemed critical in terms of structural capacity or public safety, then these particular areas shall be inspected as part of this special inspection.

Primary Reason for Special Inspection[1]:

Rehab/Repair (R)
Deteriorated Condition (DC)
Damage (D)
Settlement (S)
Other (O)

Specific Condition/Element Inspection Requirements[2]:

Date Filed:		**Completed By:**	

Notes:
1. In BrM, under the Inspection Details block, mark Inspection Type as either Damage or Interim/Special accordingly and explain the reason.
2. Document the specific component(s) of the ancillary to be inspected as part of the special inspection. For example, if deterioration of the "Left Post" requires close monitoring then briefly state "Left Post" as the specific element requiring this inspection.

Form AI-011 (March 2023) **Page 1 of 1**

A.12 Place Holder Future Form AI-012

A.13 Photo Log – Form AI-013

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

PHOTO LOG
(Form AI-013)

Structure ID: _____ **Photos By: _____**

Date: _____/_____/_____ **Page: _____ of _____**

Photo#	Description

Form AI-013 (July 2026)

A.14 Place Holder Future Form AI-014

A.15 Place Holder Future Form AI-015

A.16 Place Holder Future Form AI-016

A.17 Place Holder Future Form AI-017

A.18 Place Holder Future Form AI-018

A.19 Place Holder Future Form AI-019

A.20 Place Holder Future Form AI-020

A.21 Place Holder Future Form AI-021

A.22 Place Holder Future Form AI-022

A.23 Police Detail Request Form



RHODE ISLAND STATE POLICE
DETAIL SCHEDULING OFFICE



TRAFFIC MANAGEMENT CENTER
MONDAY – FRIDAY
6 AM – 8 PM
(401) 222-5826 EXT-4141
(401) 222-5640 (FAX)
scheduler@risp.dps.ri.gov

State Police Detail for Week Of _____ **To** _____

RIDOT Project #: _____

Project Name: _____

Project Location: _____

Project Description: _____

Meeting Location: _____

DATE:	SUN _____	MON _____	TUE _____	WED _____	THU _____	FRI _____	SAT _____
HOURS:	_____M To _____M	_____M To _____M	_____M To _____M	_____M To _____M	_____M To _____M	_____M To _____M	_____M To _____M
NUMBER OF TROOPERS							

Resident Engineer_____

Cell #_____**Office #**_____

******PLEASE SEND REQUEST BY 2 PM Each WEDNESDAY TO PLACE REQUEST FOR NEXT WEEK***

AFTER HOURS CANCELLATIONS MAY CALL RISP H.Q. (401) 444-1000

A.24 Traffic Report Form

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

ANCILLARY INSPECTION TRAFFIC REPORT

NOTE: Please be sure that all the information requested below is included in your e-mail to the appropriate staff on the Distribution and Contact List.

OPERATION: Briefly describe the activity taking place:

RESTRICTION REQUIRED:

Right Lane Closed		Right Exit Ramp Closed	
Left Lane Closed		Left Exit Ramp Closed	
Right Shoulder Closed		On-Ramp Closed	
Left Shoulder Closed		Center Lane Closed/Traffic Split	
Moving Operation			

ROUTE:

Interstate		Direction	
US Route		Direction	
State Route		Direction	
Road		Direction	

LOCATION:

Location Description	
Start Point	
End Point	

(Use exit numbers, mile points and road names when possible)

TIMES:

Start Date		Start Time	
End Date		End Time	

DAYS OR NIGHTS WORK OCCURS:

Monday		Saturday	
Tuesday		Sunday	
Wednesday			
Thursday			
Friday			

SENDER:		**PHONE #**	

- This form must be filled out and e-mailed a minimum of 48 hours in advance of proposed lane closure.
- Any cancellation must be reported as soon as possible, but no later than 2:00pm of business day before scheduled lane closure. Weekend closures and cancellation should be called in directly to TMC: (401) 222-5826 Nextel DC ID - 59

A.25 Field Sketch Templates

FIELD NOTES	STRUCTURE ID:	DATE:
	CREW:	SHEET: OF

REVISION 1	DATE	CREW	REVISION 3	DATE	CREW
REVISION 2	DATE	CREW	REVISION 4	DATE	CREW

Appendix B Temporary Traffic Control (TTC) Plans

The following TTC plans were approved by RIDOT as of October 2013.

B.1 Typical Lane Closure on Freeway or Expressway

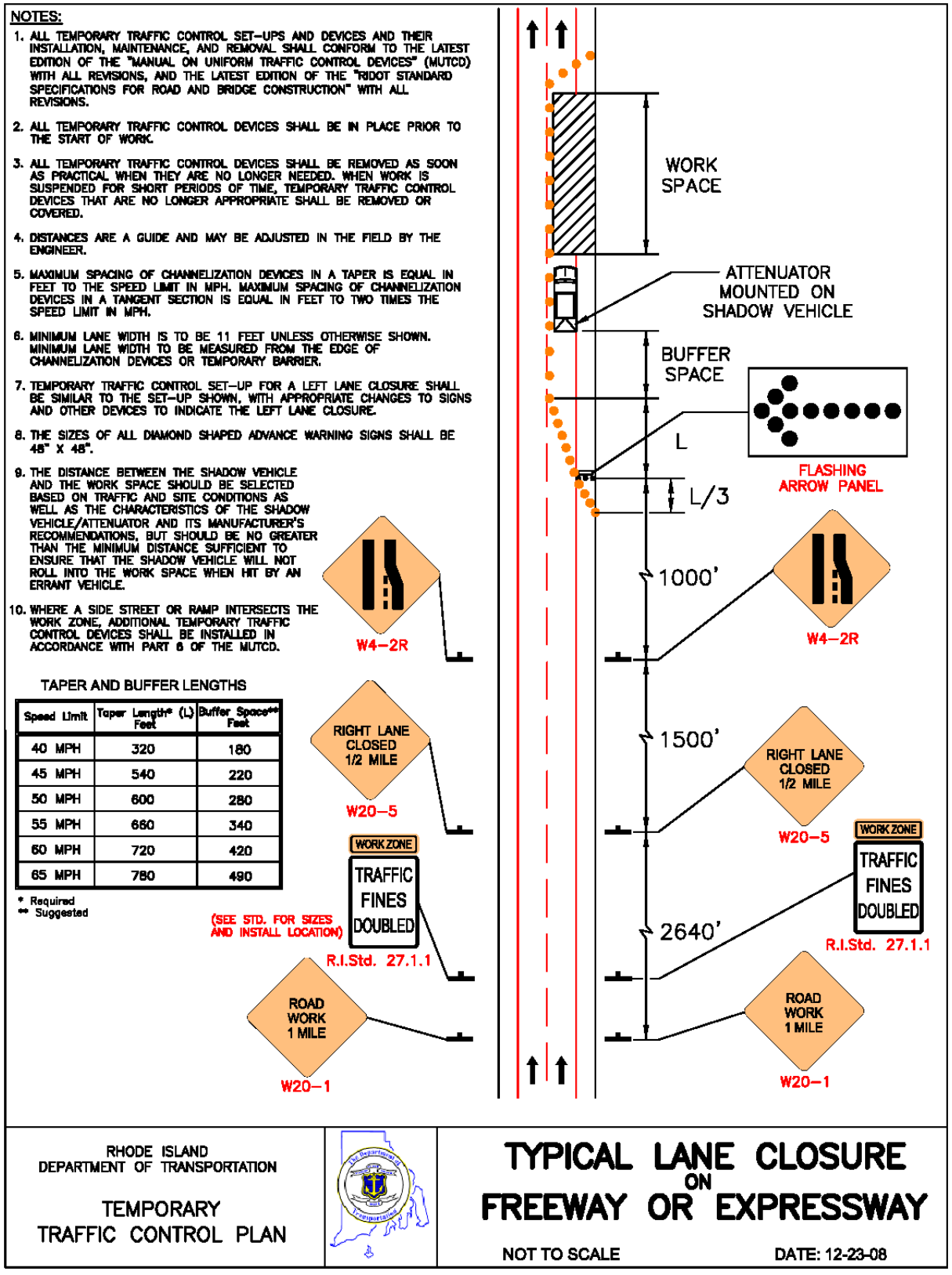
NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET-UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
6. MINIMUM LANE WIDTH IS TO BE 11 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
7. TEMPORARY TRAFFIC CONTROL SET-UP FOR A LEFT LANE CLOSURE SHALL BE SIMILAR TO THE SET-UP SHOWN, WITH APPROPRIATE CHANGES TO SIGNS AND OTHER DEVICES TO INDICATE THE LEFT LANE CLOSURE.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 48" X 48".
9. THE DISTANCE BETWEEN THE SHADOW VEHICLE AND THE WORK SPACE SHOULD BE SELECTED BASED ON TRAFFIC AND SITE CONDITIONS AS WELL AS THE CHARACTERISTICS OF THE SHADOW VEHICLE/ATTENUATOR AND ITS MANUFACTURER'S RECOMMENDATIONS, BUT SHOULD BE NO GREATER THAN THE MINIMUM DISTANCE SUFFICIENT TO ENSURE THAT THE SHADOW VEHICLE WILL NOT ROLL INTO THE WORK SPACE WHEN HIT BY AN ERRANT VEHICLE.
10. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** Feet
40 MPH	320	180
45 MPH	540	220
50 MPH	600	280
55 MPH	660	340
60 MPH	720	420
65 MPH	780	490

* Required
** Suggested



RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

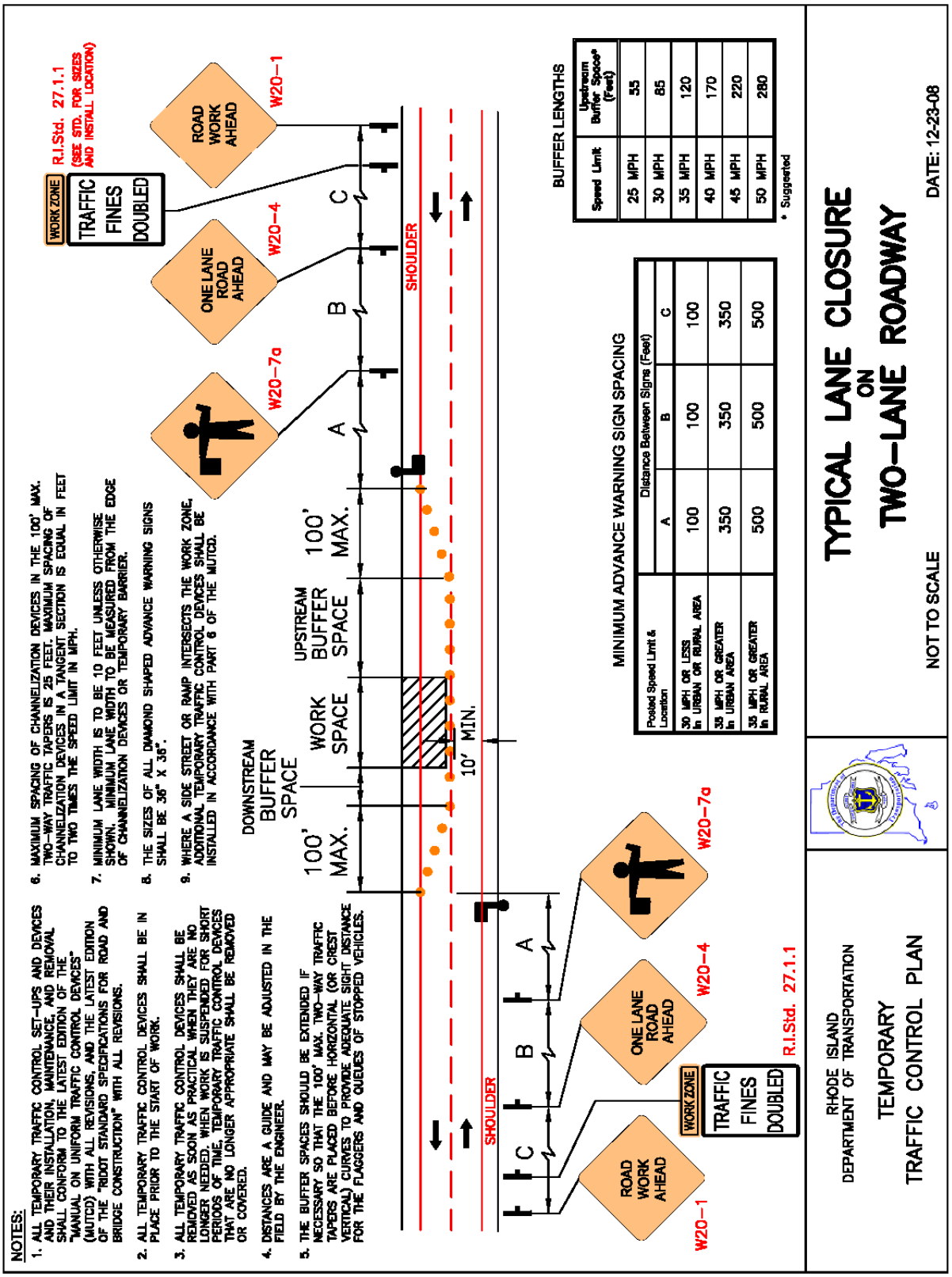
TEMPORARY
TRAFFIC CONTROL PLAN

TYPICAL LANE CLOSURE ON FREEWAY OR EXPRESSWAY

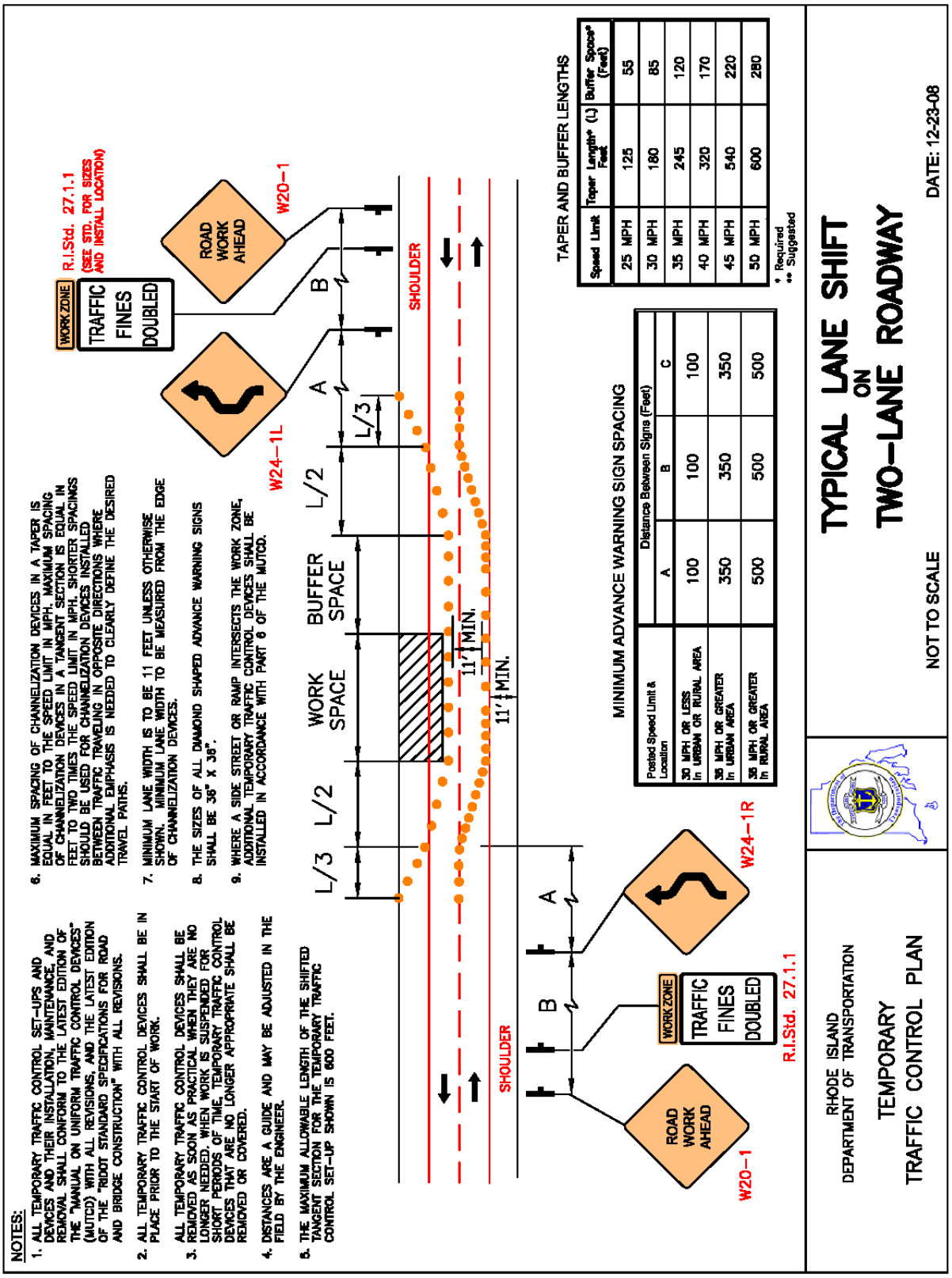
NOT TO SCALE

DATE: 12-23-08

B.2 Typical Lane Closure on Two-Lane Roadway



B.3 Typical Lane Shift on Two-Lane Roadway



B.4 Typical Shoulder Closure on Freeway or Expressway

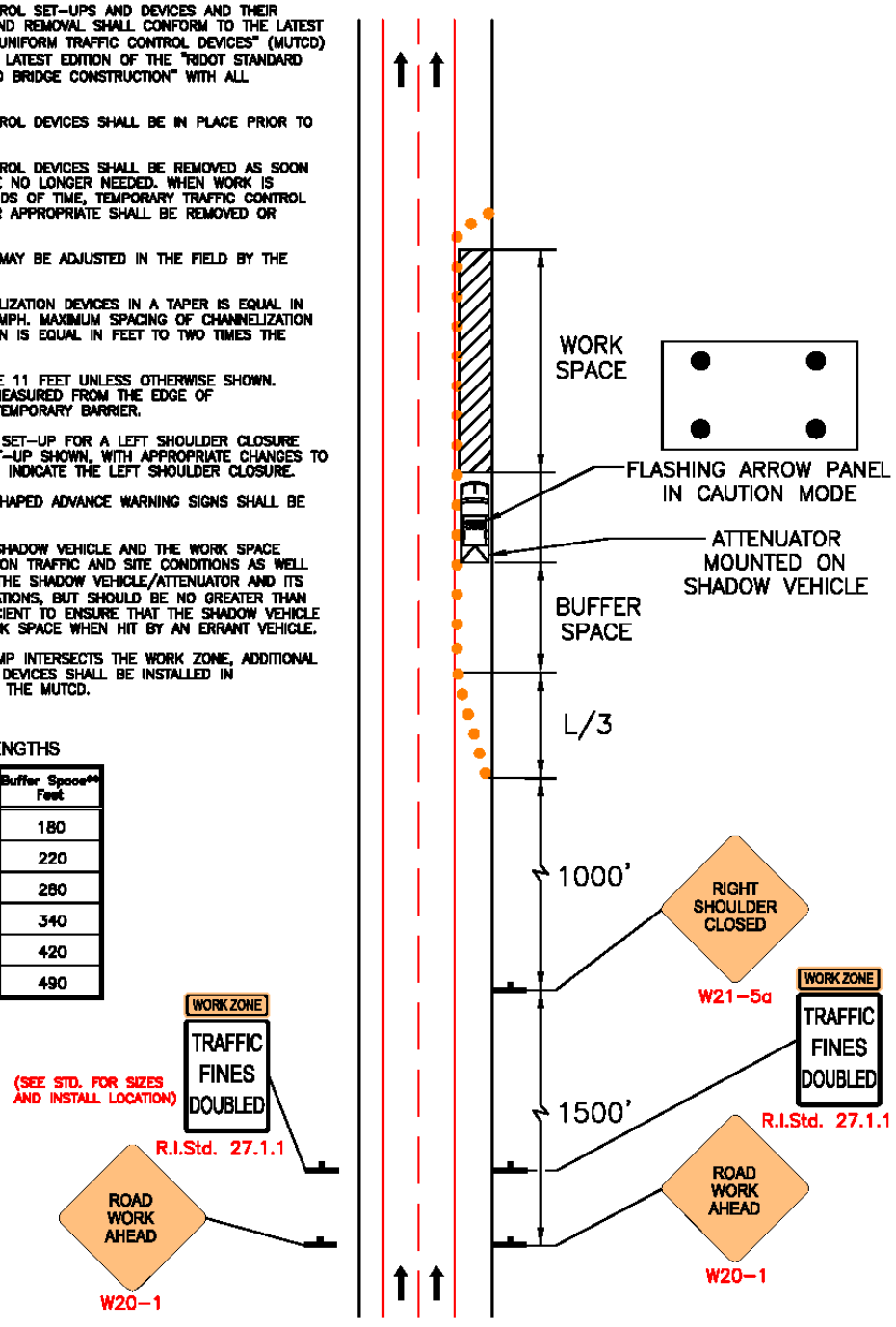
NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET-UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
6. MINIMUM LANE WIDTH IS TO BE 11 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
7. TEMPORARY TRAFFIC CONTROL SET-UP FOR A LEFT SHOULDER CLOSURE SHALL BE SIMILAR TO THE SET-UP SHOWN, WITH APPROPRIATE CHANGES TO SIGNS AND OTHER DEVICES TO INDICATE THE LEFT SHOULDER CLOSURE.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 48" X 48".
9. THE DISTANCE BETWEEN THE SHADOW VEHICLE AND THE WORK SPACE SHOULD BE SELECTED BASED ON TRAFFIC AND SITE CONDITIONS AS WELL AS THE CHARACTERISTICS OF THE SHADOW VEHICLE/ATTENUATOR AND ITS MANUFACTURER'S RECOMMENDATIONS, BUT SHOULD BE NO GREATER THAN THE MINIMUM DISTANCE SUFFICIENT TO ENSURE THAT THE SHADOW VEHICLE WILL NOT ROLL INTO THE WORK SPACE WHEN HIT BY AN ERRANT VEHICLE.
10. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** Feet
40 MPH	320	180
45 MPH	540	220
50 MPH	600	280
55 MPH	660	340
60 MPH	720	420
65 MPH	780	490

* Required
** Suggested



RHODE ISLAND DEPARTMENT OF TRANSPORTATION

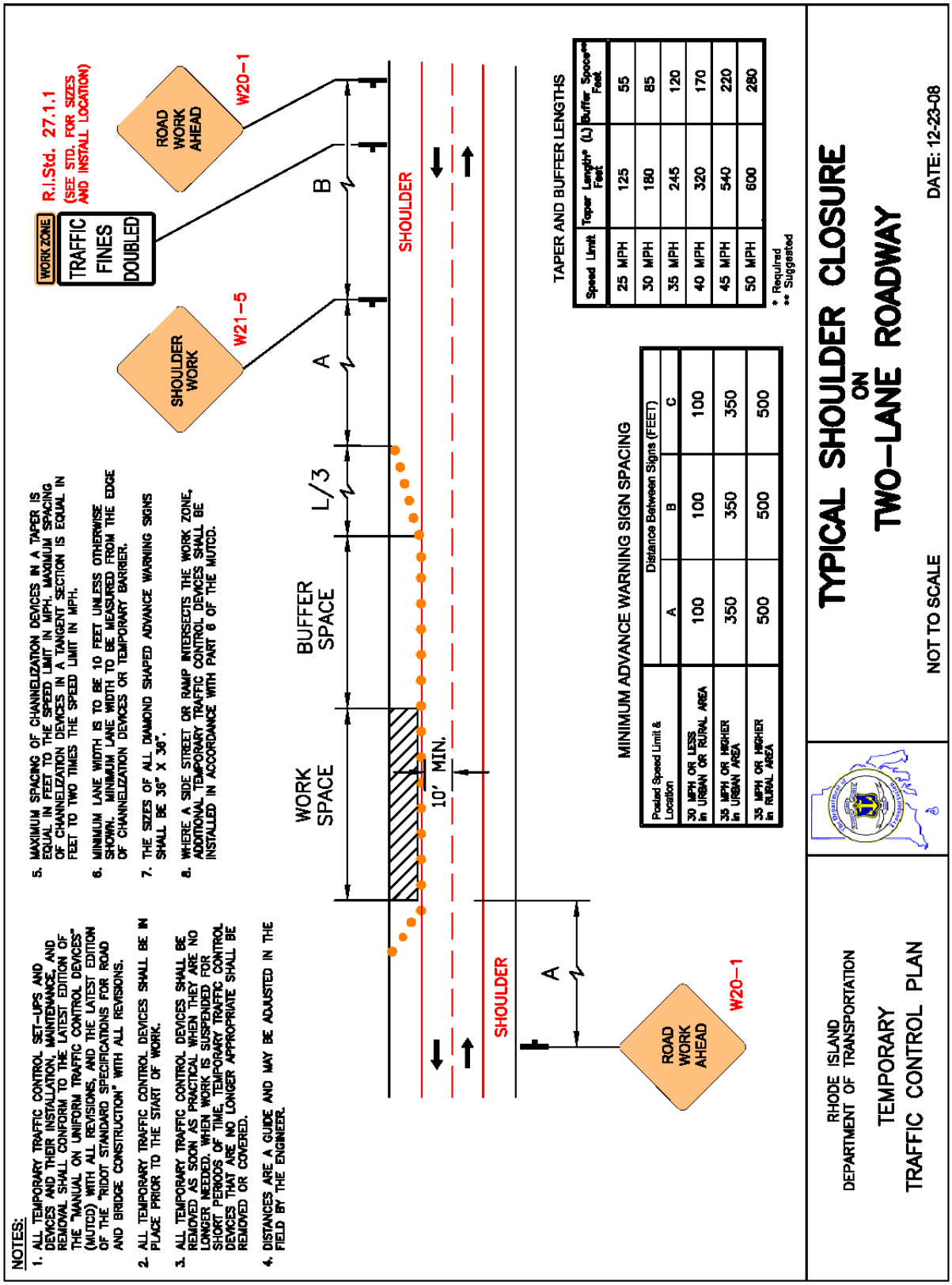
TEMPORARY TRAFFIC CONTROL PLAN

TYPICAL SHOULDER CLOSURE ON FREEWAY OR EXPRESSWAY

NOT TO SCALE

DATE: 12-23-08

B.5 Typical Shoulder Closure on Two-Lane Roadway



Appendix C Electronic Folder Quick Reference Guide

Folder	Naming Convention	Contents	Comments
Ancillary Inspection Folder  	Ten-digit Structure ID Format = X-XXX-XX-XXX	General Info folder Inspection Date folder Critical Findings folder	Parent folder of General Info and Inspection Date folder.
General Info Folder  	General Info	Plans folder TTC folder Clearance Sketch Correspondence Special Inspection Requirements Raw Photographs CADD Drawings	This folder includes ancillary structure information related to all inspections.
Inspection Date Folder  	MM.DD.YYT MM = Month of inspection DD = Day of inspection YY = Year of inspection T = Type of inspection (D, S, or leave blank)	Digital photos Post Thickness Reading Sketch UT Sketch Inspection sketches Field notes Data changes document	This folder includes inspection information that pertains specifically to the current inspection being performed.
Critical Findings Folder  	Critical Findings	Critical Findings Form Applicable Correspondence	This folder stores all critical finding logs and applicable follow-up correspondence.
TTC Folder  	TTC	TTC Forms	Plans and documents relating to Temporary Traffic Control (TTC)

Folder	Naming Convention	Contents	Comments
Plans Folder  Plans	Plans	Design/As-Built Plans Rehab Plans	This folder stores Design Plans in PDF and CAD, if available.

Appendix D Glossary

For a list of ancillary related terms, refer to the glossary in Section 3.1. What follows are terms and abbreviations related to both bridge and ancillary structure inspections.

AASHTO: American Association of State Highway Transportation Officials.

Abrasion: The wearing or grinding away of material by water that contains sand, gravel, or stones.

ADT: Average Daily Traffic.

ADTT: Average Daily Truck Traffic.

Assignment list: A group of bridges or ancillary structures assigned to the Consultant for inspection.

Bridge Management (BrM): AASHTO–supported software (AASHTOWare) that is used for the Rhode Island Department of Transportation (RIDOT) for entering, checking, storing, processing, and submitting inspection and inventory information for bridges and ancillary structures.

Ancillary element: Elements that are commonly used in ancillary structures and are encountered on ancillary safety inspections.

Ancillary Inspection Folder: Part of the RIDOT Ancillary Inspection Data Folder Organization. Refer to Section 6.1.1.

CCE: Chief Civil Engineer-Bridge Engineering (RIDOT).

CFR: Code of Federal Regulations.

Checks: Separations of the wood fibers, normally occurring across or through the annual growth rings, and generally parallel to the grain direction.

Chloride contamination: The presence of recrystallized soluble salts, which causes accelerated corrosion of the steel reinforcement.

Creep: A gradual, continuing, irreversible deformation due to a constant stress level below the yield strength.

Critical finding: A structural deficiency or safety deficiency that requires immediate follow-up inspection and action.

Debris: A collection of tree branches, leaves, litter, and other non-indigenous materials within the stream that have been transported by streamflow, often collecting near bridge substructure units, culvert openings, or shallow water areas.

Decay: The result of fungi feeding on the cell walls of the wood.

Deflection: The vertical or horizontal movement of a structure or structural member when subjected to a load.

Deformation: The local distortion or change in shape of a material due to applied force.

Delamination: The subsurface separation of concrete into layers.

Deterioration (reinforced concrete): Areas exhibiting cracks, spalls, scaling, impact damage, map cracking, efflorescence, exposed reinforcing bars with or without corrosion and section loss, delaminations (hollow

areas), abrasion or any other defect that reduces the ability of the structural component to function in its design capacity.

Deterioration (steel): Areas exhibiting corrosion, pitting, impacted rust, section loss, cracks, dings, gouges, impact or construction damage, fire damage, loose fasteners or any other defect that detracts from the As-Built condition of the member.

Deterioration (timber): Areas exhibiting fungus growth, decay, parasite infestation, fire damage, collision or impact damage, section loss, weathering or warping, splitting, cracking, checking, chemical damage, or signs of overstress that detracts from the As-Built condition of the member.

Displacement: Sliding, tilting, heaving, rotating or settling of the foundation. Displacements may be caused by but are not limited to such things as collision, deterioration, water infiltration and freeze/thaw action, and settlement of the substructure.

Efflorescence: The leaching out of calcium carbonate and other recrystallized carbonate and chloride compounds.

Fatigue: The tendency of a member to fail at a stress below the yield stress when subjected to cyclical loading.

FHWA: Federal Highway Administration.

Field welds: Welds that are used to repair corroded areas, add strengthening components or to correct fabrication errors.

Force: The action that one body exerts on another body.

Fracture: The separation of a member into two (2) parts.

General Info: Part of the RIDOT Ancillary Inspection Data Folder Organization. Refer to Section 6.1.1.

Honeycombs: Voids in concrete that are caused by the failure of mortar to fill in the spaces between aggregate.

Horizontal shear splits: Separations of the wood fibers parallel to the grain due to excessive loading.

Inspection Date Folder: Part of the RIDOT Ancillary Inspection Data Folder Organization. Refer to Section 6.1.1.

Inspection due date: The last inspection date plus the frequency of the inspection.

Knots: Separations of the wood fibers due to the trunk growing around an embedded limb.

ME: Managing Engineer-Bridge Engineering (RIDOT).

Mechanical fasteners: Bolts or rivets.

MPT plan: Maintenance and Protection of Traffic plan (also referred to as temporary traffic control (TTC)).

MUTCD: Manual on Uniform Traffic Control Devices.

NBIS: National Bridge Inspection Standards.

NCHRP: National Cooperative Highway Research Program.

NDE: Nondestructive evaluation.

NDT: Nondestructive testing.

NHI: National Highway Institute.

NICET: National Certification in Engineering Technologies.

Non-structural cracks (conventionally reinforced): Cracks caused by temperature changes or shrinkage and other cracks that do not pose an immediate threat to the structural integrity of the member but allow penetration of water, corrosion producing agents and other contaminants that may cause further deterioration of the concrete, reinforcing steel, anchor rods, etc., and negatively affect the structure over the long term. Spalling, due to freeze/thaw action and bleeding efflorescence may be noted around these cracks.

Out-of-plane bending: Occurs when a member is loaded causing it to twist about its longitudinal axis.

Overload: Occurs when the elastic limit of the member is exceeded.

PE: Professional Engineer.

Plan of Action (POA): A report consisting of the process, schedule, and cost estimate to implement corrective action. A plan of action may consist of verbal communication followed by written confirmation in emergency situations.

Post-tensioned: A method of prestressing concrete in which the tendons are stressed after the concrete has been cast and hardens. The concrete is cast with ducts and the reinforcement is then threaded through the ducts, stressed (stretched) after the concrete cures.

Prestressed: Applying forces to a structure to deform it in such a way that it will withstand its working loads more effectively. The reinforcement is stressed in concrete prior to the application of the live load.

Pretensioned: A method of prestressing concrete in which the strands are stressed before the concrete is placed. Strands are released after the concrete has hardened, inducing internal compression into the concrete.

Program Manager (PM): The individual in charge of the program that has been assigned or delegated the duties and responsibilities for bridge and ancillary structure inspection, reporting, and inventory. Refer to Section 2.1.

Purchase order (PO): A commercial document used to request one to supply something in return for payment and providing specifications and quantities.

Quality Assurance (QA): The required procedures to sample and measure the adequacy of quality control procedures.

Quality Control (QC): The systematic procedures that RIDOT and inspection Consultant follow to maintain the overall quality of a ancillary structure inspection at or above a specified level. These procedures include, but are not limited to, the qualifications of staff, quality of field inspections, staff training, validation of data collected and entered into the Bridge Management (BrM) platform and identification/resolution of data errors.

Redundancy: The capability of a structural system to carry loads after damage to or the failure of one or more of its members.

Reinforcing bar: Mild steel (non-prestressed) reinforcing steel, also known as reinforcement bars. Most commonly placed transverse to the longitudinal centerline of the prestressed member for use as shear reinforcement or parallel to the longitudinal centerline for use as temperature and shrinkage reinforcement.

RIDOT: Rhode Island Department of Transportation. (Referred to as the State or the Department.)

Safety Deficiency: A deficiency in a component or element of a bridge or ancillary structure that poses an extreme hazard or unsafe condition to the public but does not impair the structural integrity of the bridge or ancillary structure.

Scaling: The gradual and continuing loss of mortar and aggregate over an area due to the chemical breakdown of the cement bond.

Shakes: Separations of the wood fibers parallel to the grain between the annual growth rings.

Slope protection: The placement of geotextiles, wire mesh, paving, revetment, plantings, or other materials on the existing channel embankments.

Spall: A depression in concrete caused by a separation of a portion of the surface concrete.

Splits: Advanced checks that extend completely through the piece of wood.

Strain: The measure of deformation and denotes the amount an object deforms with respect to its original dimension.

Strand: Fabricated by twisting wires together, the seven-wire strand is the most common type of prestressing steel in the United States.

Stress: The force per unit area; denotes the intensity of an internal force.

Structural cracks (reinforced): Cracks, other than temperature and shrinkage cracks, that depending on their location, length, width and orientation to the member being rated, indicate the possibility of one or more of the following: an over stressed condition of the concrete and/or reinforcing steel, a reduction in the structural integrity of the member, or an immediate need for further investigation. These cracks may allow water and contaminant infiltration with subsequent corrosion of the reinforcing steel and delamination of the concrete possibly reducing the capacity of the member. The width of the cracks may indicate the progressive level of the over stress condition. Cracks that form in member compression zones or at bearing interfaces, indicating excessive compressive stresses, may be accompanied by crushing of the concrete around the cracks and may lead to non-ductile failure of the member. Cracks in tension zones, indicating excessive tensile stresses, may visibly open and close during a shake test (note shake test explanation in Section 8.2.1). Cracks that are diagonal in orientation to the member indicate over stress in shear.

Structural Deficiency: A deficiency in a structural element of a bridge or ancillary structure that poses an extreme unsafe condition due to the failure or imminent failure of the element, which affects the structural integrity of the bridge or ancillary structure determined as substantially endangering the load-carrying capacity of the bridge or the stability of the ancillary structure.

Surface breakdown: See scaling.

Tack weld: Small welds commonly used to temporarily hold pieces in position during fabrication or construction.

Team leader: The individual responsible for planning, preparing, and performing the inspections of individual bridges or ancillary structures. Refer to Section 2.3.

TRB: Transportation Research Board.

TTC: Temporary traffic control (also referred to as Maintenance and Protection of Traffic (MPT)).

Undermining: The scouring away material supporting foundation material from beneath the substructure footing.

Wear: Gradual removal of surface mortar due to friction.

Yield strength: The stress level at which plastic deformation begins.

Appendix E Element List

Element Condition States		
Condition State	**Description**	**Feasible Action**
CS-1	Good: Element performs intended function with high degree of reliability	None or routine maintenance.
CS-2	Fair: Element performs intended function with small reduction in reliability	Repair/replace element or continue monitoring.
CS-3	Poor: Element performs intended function with significant reduction in reliability	Repair/replace element within specified time frame or increase inspection frequency.
CS-4	Critical: Element does not perform intended function with any degree of reliability	Warrants a structural review to determine the effect on strength or serviceability of the structure. As per review: immediate repair of element; replacement of structure or increase inspection frequency.

Foundation			
El. No.	**Element Name**	**Element Group**	**Unit**
101	Foundation, Reinforced Concrete	Foundations	Each
102	Foundation, Steel		Each
109	Foundation, Other		Each
111	Anchor Rods	Anchor Rods	Each
121	Median/Barrier, Reinforced Concrete	Median/Barrier	Each
122	Median/Barrier, Steel		Each
129	Median/Barrier, Other		Each
131	Bridge Girder Mount	Bridge Mounted Connection	Each
132	Bridge Parapet Mount		Each
141	Embankment	Embankment	Each
151	Grout Pad	Grout Pad	Each
Structure (General)			
El. No.	**Element Name**	**Element Group**	**Unit**
201	Base Plate, Steel	Base Plate/Transformer Base	Each
202	Base Plate, Aluminum		Each
203	Transformer Base, Steel		Each
204	Transformer Base, Aluminum		Each
209	Base Plate, Other		Each
211	Post, Steel	Post/Tower	Each
212	Post, Aluminum		Each
213	Tower, Steel		Each
214	Tower, Aluminum		Each
221	Highmast Post, Steel		Each
222	Highmast Post, Other		Each
229	Post/Tower, Other		Each
231	Post/Tower to Arm/Chord/Wire Connection	Post/Tower to Arm/Chord/Wire Connection	Each

Structure (Ancillary Specific)			
El. No.	**Element Name**	**Element Group**	**Unit**
241	Single Arm Cantilever, Steel	Sign Arm/Chord Member	Length (ft.)
242	Single Arm Cantilever, Aluminum		Length (ft.)
243	Double Arm Cantilever, Steel		Length (ft.)
244	Double Arm Cantilever, Aluminum		Length (ft.)
245	Cantilever Truss, Steel		Length (ft.)
246	Cantilever Truss, Aluminum		Length (ft.)
249	Cantilever, Other		Length (ft.)
251	Single Arm Butterfly, Steel		Length (ft.)
252	Single Arm Butterfly, Aluminum		Length (ft.)
253	Double Arm Butterfly, Steel		Length (ft.)
254	Double Arm Butterfly, Aluminum		Length (ft.)
255	Butterfly Truss, Steel		Length (ft.)
256	Butterfly Truss, Aluminum		Length (ft.)
259	Butterfly, Other		Length (ft.)
261	Single Chord Span, Steel		Length (ft.)
262	Single Chord Span, Aluminum		Length (ft.)
263	Truss Span, Steel		Length (ft.)
264	Truss Span, Aluminum		Length (ft.)
269	Span, Other		Length (ft.)
271	Bridge Mounted Frame, Steel		Length (ft.)
272	Bridge Mounted Frame, Aluminum		Length (ft.)
299	Sign Arm/Chord Member, Other		Length (ft.)
301	Mast Arm, Steel	Traffic Signal Arm/Chord Member	Length (ft.)
302	Mast Arm, Aluminum		Length (ft.)
303	Dual Mast Arm, Steel		Length (ft.)
304	Dual Mast Arm, Aluminum		Length (ft.)
309	Mast Arm, Other		Length (ft.)
311	Span Wire, Steel		Length (ft.)
329	Traffic Signal Arm/Chord Member, Other		Length (ft.)
331	Single Bracket, Steel	Lighting Arm/Chord Member	Length (ft.)
332	Single Bracket, Aluminum		Length (ft.)
333	Double Bracket, Steel		Length (ft.)
334	Double Bracket, Aluminum		Length (ft.)
335	Single Truss Bracket, Steel		Length (ft.)
336	Single Truss Bracket, Aluminum		Length (ft.)
337	Double Truss Bracket, Steel		Length (ft.)
338	Double Truss Bracket, Aluminum		Length (ft.)
349	Bracket, Other		Length (ft.)
351	Single Davit, Steel		Length (ft.)
352	Single Davit, Aluminum		Length (ft.)
353	Double Davit, Steel		Length (ft.)
354	Double Davit, Aluminum		Length (ft.)
369	Lighting Arm/Chord Member, Other		Length (ft.)

Structure (Miscellaneous)			
El. No.	**Element Name**	**Element Group**	**Unit**
371	Truss Arm Struts, Steel	Truss Arm Struts	Length (ft.)
372	Truss Arm Struts, Aluminum		Length (ft.)
381	Splice - Horizontal	Splice	Each
382	Splice - Vertical		Each
383	Slip Joint - Horizontal		Each
384	Slip Joint - Vertical		Each
389	Splice, Other		Each
391	Vibration Dampener	Vibration Dampener	Each

Ancillary Devices, Attachments & Misc.			
El. No.	**Element Name**	**Element Group**	**Unit**
401	Sign Frame, Steel	Signs	Each
402	Sign Frame, Aluminum		Each
409	Sign Frame, Other		Each
411	Sign Panel, Aluminum		Each
412	Sign Panel, Other		Each
413	VMS Panel		Each
421	Sign Clips		Each
422	Sign Panel Connection		Each
431	Catwalk		Length (ft.)
441	Power and Sign Lighting		Each
451	Traffic Signal	Traffic Signal	Each
452	Traffic Signal Connection		Each
461	Light Fixture	Light Fixtures	Each
501	IT Device	Attachments	Each
502	Camera		Each
511	Luminaire Ring		Each
512	Winch Cable		Each
519	Other Attachment		Each
551	Junction Box/Power Supply	Miscellaneous	Each
561	Traffic Protection		Each
571	Other		Each

Appendix F Nondestructive Evaluation

F.1 Introduction

Non-destructive testing (NDT) is typically used to determine if materials and/or components have internal or inaccessible defects or fine defects that are not visible to the human eye that compromise the structure's integrity or safety. While visual inspection is the primary inspection method, some structural defects such as small cracks, subsurface inclusions, and remaining section of an element cannot always be fully detected using this method. NDT methods provide inspectors the ability to further investigate and determine possible defects and can also be used to determine the extent of a visible defect as well as a structure's material or geometric properties. As the name suggests, these tests are performed without inflicting damage or additional stress to the structure.

The three most common non-destructive tests performed on ancillary structures are Dye Penetrant Testing, Ultrasonic Testing (UT), and Magnetic Particle (MT) testing. The following sections describe these three NDT methods and their applications in more detail.

F.2 Dye Penetrant

F.2.1 Introduction

The Dye Penetrant test is used to provide visual confirmation and dimensions to surface discontinuities in non-porous materials such as steel or aluminum. It is the most readily available and economical way to test suspected defects after visual inspection.

The test consists of applying three types of liquids to the desired area in a particular order where a discontinuity is suspected. Manufacturers may have proprietary labeling, but the three general components are cleaner, penetrant, and developer. The system is available in aerosol form for easy application. The cleaner is a solvent used to remove surface contaminants prior to investigation. The dye is a low surface tension liquid of a contrasting color (typically deep red) used to penetrate the surface of the material by capillary action. The developer contains a chalk-like substance that draws dye from the defect to show the affected area.

F.2.2 Applications

The Dye-Penetrant test can be used to check for cracks, porosity, underfill, and other surface discontinuities within non-porous materials such as metals, plastics, and ceramics.

F.2.3 Procedures

1) General Considerations

   For personal protection, always wear latex gloves, eye protection, and a respirator if working in a poorly ventilated area while working with chemicals. The dye will irreparably stain clothing and may take days to come off exposed skin.

   All required liquid components are highly volatile and flammable. They will readily evaporate during the application process but there must be no open flames in the vicinity of the work area.

Because the chemical formulation of the three components may vary, always familiarize yourself with and follow the manufacturer's recommendations.

Lint-free cotton rags should be readily available for cleaning. Paper towels are not recommended as they leave fibrous debris behind during use. Highly absorbent synthetic materials are not recommended as they may spread dye quickly through the weave and become soiled.

2) Cleaning and Preparing the Surface

Prior to applying the cleaner, the surface surrounding the defect shall be mechanically cleaned. It is important to remove all rust and coating (galvanization, paint, etc.) in the vicinity of the defect to avoid excessive dye bleeding from surrounding areas. It is recommended to remove the coating with a wire brush. A stiff nylon-bristle brush can then be used to remove loose pieces. Similarly, if vigorous brushing with a steel brush is performed, the base metal can smear and close the crack disallowing the dye to penetrate.

After mechanical cleaning, the cleaner shall be applied to the surface. The cleaner shall be used sparsely and just enough to clean, otherwise it may penetrate the defect and it will take time to evaporate and block dye from entering. This may also affect the accuracy of the test. It is suggested that a cotton rag is sprayed with cleaner and used to swab the surface. Please note, multiple cleaning passes may be required.

3) Applying and Removing the Penetrant

Once the surface is clean and dry, the dye shall be sprayed directly over the defect trying to minimize bleeds. Several light passes may be necessary. The dye must fully coat the desired area. Horizontal surfaces facing up are easier to work on as the dye puddles and is slowly drawn into the defect by capillary action. Most of the defects are very fine and don't require a large volume of dye to be applied. It is necessary to wait for the dye to be drawn into the defect, which time will vary based on factors such as crack size and temperature. Depending on the temperature of the material, the required time may vary between 5-15 minutes.

Once the dye has been allowed to penetrate the defect, the area must be cleaned again. Initially, any excess dye must be wiped off with a dry absorbent rag followed by a wipe with a cleaner moistened rag. It is important to not spray the area with cleaner as the spray may physically force the dye out of the defect or dilute it. All dye surrounding the defect must be removed prior to applying the developer.

4) Applying the Developer

Once the area is dry after the second cleaning, spray the developer in several light sweeps. It may initially look watery but will swiftly evaporate leaving a white chalky residue. The white residue must completely cover the defect and any visible base metal in a thin film without excessive buildup. The developer dries rapidly within a few seconds. Inspection shall begin immediately after spraying developer and shall continue until area is fully developed. It is suggested to practice on a nearby area to obtain uniform results, if necessary.

Once the developer is dry, the dye will start to bleed out over white developer residue if a defect is present.

5) Interpreting the Results

Once the dye is extracted onto the developer, the results can be interpreted. Typical dye behaviors are as follows:

- Cracks: When a crack is present, it will first show as a red hairline that will slowly, over the course of several minutes, get paler and wider as the dye spreads in the developer. At this point it is necessary to mark the limits of the crack on the adjacent surface; it is recommended to write the length and date of inspection as well. Markings may need to be reapplied following the clean-up. Permanent paint markers of a contrasting color shall be used.

- Underfill: When a shallow large linear void is present, the dye will quickly bleed out and form a wide line (usually within a minute). A similar condition will be observed where dye penetrated at the edge of chipped-off paint.

- Porosity: The dye will show as spots and the size of voids will be dictated by how much dye bleeds out.

- Inconclusive: If the entire area is red, the dye is not fully removed from the surface and the test must be redone.

The results may not be uniform along the defect. There may be overlapping defects within the same area shown by the dye. If the test was performed incorrectly, the structure must be thoroughly cleaned off and allowed to air-dry for at least 5 minutes before reperforming the test.

6) Cleanup of the structure

After performing the test, recording the findings, and taking photographs, thoroughly clean the area with a rag and the cleaner. Once the area is dry, apply cold galvanizing spray or a zinc-rich primer on the testing area to prevent further corrosion. Following cleanup, the defect limits may need to be redrawn on the component.

F.2.4 Limitations

Dye penetrant is only effective when investigating surface defects. Internal defects such as internal porosity, inclusions, internal cracks, and incomplete fusion/penetration cannot be detected using this method.

It is recommended to complete this test when the surface temperature is above 40°F due to extended drying and penetration times. In this case, waiting for favorable weather or pre-warming of the base material is necessary.

Depending on the cleaning effort, it should generally take between 20 to 30 minutes to perform one dye penetrant test. Therefore, time limitations for lane closure should be considered when planning to use this testing method.

F.2.5 Training & Certification Requirements

There is no formal requirement for certification currently. However, an ASNT limited certification is available, and an overview of the dye penetrant test is part of the NHI-130078 Bridge Inspection

Techniques for Nonredundant Steel Tension Members (NSTM) Course. ASTM E1417 establishes minimum requirements for conducting liquid penetrant testing.

F.3 Ultrasonic Testing

Ultrasonic Testing (UT) is a method of non-destructive testing which uses reflected sound waves to measure thickness/depth and identify discontinuities in the internal structure of a material. Ultrasonic pulses reflect from discontinuities, such as laminations, inclusions or cracks, enabling detection of the presence and location of the deficiencies.

There are two major uses of ultrasonic testing used in ancillary structure inspections. These include straight beam ultrasonic testing (UT) of anchor rods and ultrasonic thickness testing (D-Meter) of structural elements.

Angle beam testing can be used for weld evaluation however it is infrequently utilized for RIDOT ancillary structures as visual inspection or dye penetrant are readily available and typically provide the necessary information.

F.3.1 Straight Beam Ultrasonic Testing

Commonly referred to as UT, Straight Beam Ultrasonic Testing is used determine anchor rod lengths and locate discontinuities within the anchor rods (see Figure F.3-1). A crack in the anchor rod, regardless of size, decreases the load capacity which could increase stresses in the surrounding anchor rods. UT testing of all anchor rods is required during an Initial Inspection and each successive Routine Inspection, or as directed by the State.



Figure F.3-1 UT being performed on anchor rod

F.3.1.1 Introduction

For ancillary structure inspection, UT testing is used to evaluate the internal condition of anchor rods, to determine soundness or to verify the existence and extent of cracks or inclusions.

UT testing of anchor rods will be performed during all Initial and Routine inspections, as needed for a Special Inspection or as directed by the State. Prior to performing any inspection work, the consultant (or their subconsultant) shall submit their Straight Beam UT procedure to the Program Manager for review. All staff performing Straight Beam UT must meet current RIDOT qualification requirements.

F.3.1.2 Calibration

Prior to starting the ultrasonic testing, all equipment should be inspected for flaws or defects and the UT unit shall be calibrated by the manufacturer's recommended methods (see Figure F.3-2).



Figure F.3-2 Typical Straight Beam UT kit

Equipment and materials used to implement UT Stright Beam Testing must be calibrated and certified in accordance with ASTM E 317 "System Performance Evaluation". Search units will be single element transducers between 2.5MHz and 5MHz. Transducers should be between ¼ inch to 1 inch in diameter.

Below is a high-level typical calibration procedure (not to be substituted for specific manufacturer directions):

- A 10-inch screen with a straight beam transducer/probe is used.
- The transducer is placed on a steel stepped calibration block and the indications on the screen are adjusted so that a reflection is positioned at each inch mark.

- The probe is next placed on a 10-inch-long test rod that has a 1/8-inch-deep saw cut at a set distance (preferably at 2” and 6” from the end of the rod) in the threaded portion of the rod.
- Adjust the back reflection from the saw cut until the indication is at 60 or 80 percent of the screen height. The dB (decibel) reading is recorded to establish the Reference Level.
- The Scanning Level is set by adding 14 to 30 dB over the Reference Level.
- Calibration should be checked at each location before inspecting any anchor rod.

F.3.1.3 Site Preparation

The following is a recommended process for site preparation:

1. Before starting any UT test, the surface to be tested shall be cleaned and made free of any debris.
2. The anchor rod ends must be made smooth and horizontal, roughness, surface imperfections or an angled testing surface can affect the UT results (see Figure F.3-3). The certified Team Leader, or Technician, must grind all anchor rod ends horizontal (flat) using a hand-held grinder (perpendicular to the shank of the bolt). The testing surface must be thoroughly cleaned to remove all galvanized coating, paint, dirt, or debris. Any rod ends that cannot be ground (e.g. due to extreme slant or recessed rod ends) shall be noted in the inspection form.
    a. If the anchor rods are in an electrified area, e.g., a transformer base, the structure needs to be powered down by maintenance prior to any grinding. However, if the structure is powered by solar panels, the wiring is less intrusive and there is less power relative to non-solar powered structures. Using precautions and avoiding any electrified components, a battery powered angle grinder can be used in these locations. See Figure F.3-4. UT testing of non-solar powered transformer bases is done as per the discretion of RIDOT but are not typically performed.



Figure F.3-3 Grinding bolt ends before UT



Figure F.3-4 Grinding bolt ends with a battery powered grinder on a solar powered structure

3. A couplant gel (such as glycerin, cellulose gel, oil, or grease) is applied to the ends of the rods to be tested. It is recommended to utilize the couplant specified by the unit manufacturer. See Figure F.3-5.



Figure F.3-5 Anchor rod with couplant gel applied

4. Once all anchor rods have been tested, the couplant gel must be wiped off and the surface should be allowed to dry completely. If any original coating was removed for the testing, the rod ends should be sprayed with a cold galvanized coating or zinc-rich paint.

F.3.1.4 Performing the Ultrasonic Testing

F.3.1.4.1 Straight Beam - Anchor Rods

Consult RIDOT's current SOP and the manufacturer's manual prior to testing: Current and typical straight beam UT procedures are as follows:

1. Anchor rods are scanned with the straight beam probe using a circular motion pattern, and the results recorded. See Figure F.3-6 for example CRT display.

2. The entire surface of the rod should be scanned at 12dB over reference. When scanning the anchor rods, there should be no indications on the CRT screen between the Main Bang (zero depth) and the end of the screen (10-inch depth).

3. Any indication that is displayed after the Main Bang is a possible flaw. The depth of the discontinuity observed will be recorded along with the amount of dB adjustment required to bring the indication to the Reference Level on the screen (see Figure F.3-6). This is recorded as the Indication Level.

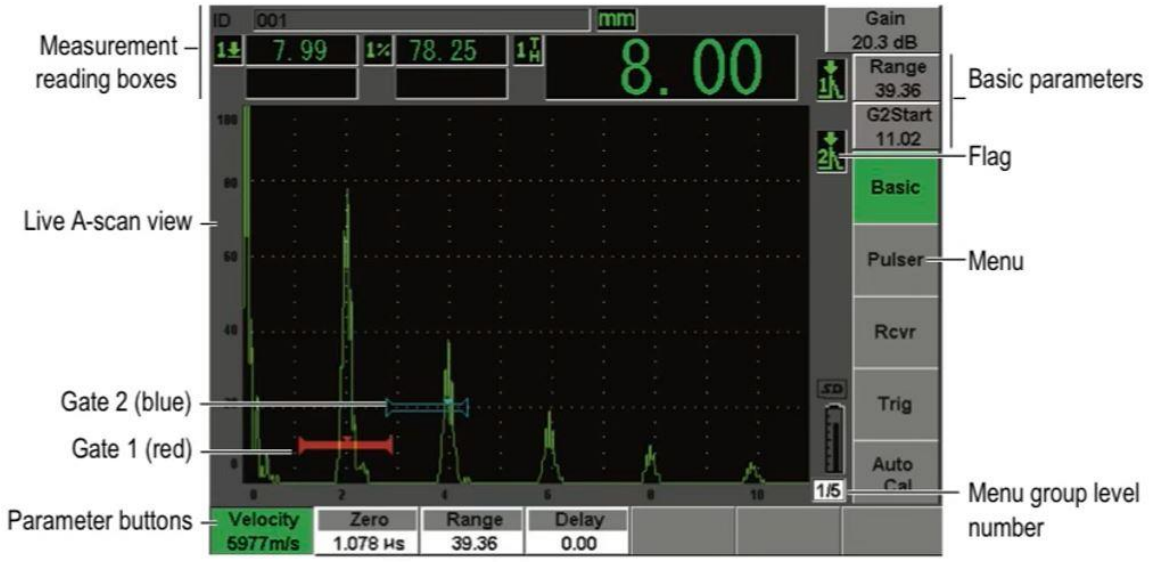


Figure F.3-6 Example of CRT screen

4. If the testing reveals rods that have an indication of defects these shall be reported as notable findings. If the condition affects the overall safety of the structure the Team Leader will notify the Program Manager from the field.

F.3.1.4.2 Angle Beam - Welds

If during a visual inspection, a post-to-base plate weld is found to have a crack, and it is known that the weld has a backing bar installed, angle-beam testing could be used to verify the crack size and location. The following is the procedure for angle beam UT:

1. The angle-beam configuration will consist of a 2.25MHz transducer fixed with a 70-degree wedge. Testing and acceptance criteria will be as per AWS D1.1 structural steel.

2. The scanning area will be cleaned with a bristled brush, material such as brass or stiff nylon is recommended as not to gouge or distress the material around the crack, potentially covering it prior to testing.

    a. If a backing bar is not present at the weld, dye penetrant or magnetic particle testing will be used – see F.2 Dye Penetrant and F.4 Magnetic Particle, respectively.

F.3.1.5 Reporting

The Straight Beam Ultrasonic Testing readings / results for anchor rods will be recorded as follows:

- The date of the readings
- Details of the equipment used:
    - Serial number

  - Frequency used
  - Couplant specifications

- Name of the Team Leader or Technician performing the testing
- Information about the type of structure tested including anchor rod pattern (with a sketch)
- Anchor rod dimensions (diameter and, if determined, length)
- Any other relevant information.

F.3.1.6 Limitations

Refer to the manufacturer's user manual for limitations of the UT equipment, e.g., operating temperature, surface requirements, couplant recommendations, and calibration methods.

F.3.1.7 Training & Certification Requirements

Ultrasonic testing of anchor rods currently requires the UT Technician to be qualified in accordance with the current edition of the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A.

The State requires the inspection team conducting the NDT to be familiar with UT testing. An ASNT Level I or Level II can perform UT testing of anchor rods (bolts). Any findings or indications should be verified by an ASNT Level II or Level III. Any other testing required (other than anchor rods) for any new findings or verification, shall be performed by an ASNT Level II and verified by an ASNT Level III.

F.3.2 Ultrasonic Thickness Measurements (D-Meter)

An ultrasonic thickness gage or "D-Meter" is used primarily to measure wall thickness of various members when the other side of the member is inaccessible. This information is used to determine the presence and amount of section loss in the member as well as to determine full section thickness when no section loss is present (if shop drawings are unavailable). Numerous ancillary structure failures have been attributed to corrosion and deterioration on the interior of the post, in many instances with minimal or no visual indication on the outside surface (see Figure F.3-6).



Figure F.3-6 Technician using a D-meter to measure post thickness

F.3.2.1 Introduction

For ancillary structure inspection, UT testing is used to determine the thickness of a material. D-meter testing of structural components is used to determine remaining thickness and indicate section loss

D-meter testing of the post, above the post to base plate weld, will be performed during all Initial/Inventory inspections or as specified by a Special Inspection or requested by RIDOT.

F.3.2.2 Calibration

For calibration of D-Meter unit refer to the specific equipment owner's manual. Equipment shall be inspected for flaws or defects and calibrated each day prior to starting work with the type of material that will be tested (steel or aluminum). It is recommended that a stepped steel or aluminum calibration block be utilized during calibration. (see Figure F.3-7).



Figure F.3-7 Typical D-Meter kit

F.3.2.3 Site Preparation

Before starting any D-Meter testing:

- Surface areas to be tested should be clean and free of any debris. Hammer-tapping along the base will help to remove any possible corrosion on the interior of the post.

- Apply a couplant gel (such as glycerin, cellulose gel, oil or grease) to the D-meter test locations or directly to the probe. It is recommended to utilize the couplant specified by the unit manufacturer.

F.3.2.4 Performing the Ultrasonic Testing

For the D-meter test:

- Readings are taken at the top of the post-to-base plate weld, which is identified as 0”, in all four quadrants.

    - For High-Mast Lighting structures, the readings should be taken on the post at 0”, 3” and 6” above the post-to-base plate weld in eight equally spaced locations.

- A reference location reading is taken at 24” above the post-to-base weld to field verify original thickness.
- If readings are inconsistent or section loss is found additional locations should be investigated until the limits of the section loss is determined.

F.3.2.5 Reporting

For D-meter reporting:

- Thickness readings are recorded in decimal inches to the nearest thousandth.
- The readings should include a section view of the post indicating where the measurements were taken so any advancement in section loss can be tracked.
- Depending on findings, additional section loss sketches may be required.

F.3.2.6 Limitations

Refer to the manufacturer’s user manuals for limitations of the D-Meter equipment, e.g., operating temperature, surface requirements, couplant recommendations, and calibration methods.

F.3.2.7 Training & Certification Requirements

For any non-destructive testing, the team members conducting the testing and the staff interpreting the test data should possess an understanding of the theory behind the testing as well as knowledge in the practical application of the testing. This shall be obtained by in-house training or as specified by RIDOT.

F.4 Magnetic Particle

F.4.1 Introduction

Magnetic Particle Testing (MT) is a non-destructive testing method which uses magnetism to find surface or near-surface discontinuities in ferromagnetic materials.

MT involves placing opposite charges on a ferromagnetic surface, which creates a closed loop within the magnetic fields. Fine, dry particles of a ferromagnetic material, commonly known as "iron filings", are then applied to the testing surface. A discontinuity in the testing surfaces has a weaker magnetic pull, creating a leakage field, which will attract the ferromagnetic particles to fill in the voids, indicating where an internal discontinuity is located.

Common equipment used during Portable MT includes an AC/DC yoke. The AC/DC yoke is a portable tool that requires a power source to use and has articulated legs to position around the testing area. The iron filings used to identify the discontinuity are stored in a "puffer" container that allows the inspector to apply the filings as needed.

F.4.2 Applications

Steel is the most common ferromagnetic material used to construct ancillary structures. Discontinuities that can be tested using this method include surface-types including gouges, lack of fusion, porosity, and

cracks, and subsurface-types very near to the surface such as inclusions, voids within the material, internal cracks, and lack of material fusion. Some advantages of MT include the following:

- Inexpensive cost of materials.
- Quick testing times.
- Sensitivity to small and shallow surface defects.
- Ability to detect discontinuities near the surface that may be filled with either paint or debris.
- Not limited by the size or shape of the piece being inspected.
- No elaborate preparation.
- MT is also effective when analyzing the condition of welds.

F.4.3 Procedures

MT requires surface preparation to achieve good results. Therefore, proper surface cleaning shall be performed prior to testing. Acceptable cleaning measures may include wire brushing, solvent cleaning, and coating removal. Cracked coatings should be removed prior to testing as the filings can become trapped within the cracks and give a false positive result.

Once the testing surface has been properly cleaned, the AC/DC yoke is placed on the testing surface with the area under investigation oriented perpendicular to the induced magnetic field between the two poles. The ferromagnetic particles are then lightly and slowly applied to the surface in a "dusting" fashion. The applied particles will mostly congregate towards the yoke or magnets. If there is a discontinuity in the testing material, the particles will congregate around that area. Once sufficient metal filings have been applied to the testing area, a powder application bulb or blower is used to remove excess filings from the testing area and further define a potential defect. The yoke or magnets should then be rotated 90 degrees with respect to the initial placement to ensure the entire surface has been covered. Multiple iterations of testing with different orientations of the yoke or magnets may be required to fully test an area of a structure. Following testing, the post shall be cleaned of all adhered particles. Leaving residue has the potential to cause further surface corrosion of the material; any removed protective coating shall be replaced by the inspector.

Results are interpreted by the inspector; therefore, it is the responsibility of the inspector to determine whether potential indications are true, false, or non-relevant.

A true surface discontinuity generally produces distinct particle patterns on the surface, with a distinct gathering of metal filings at the indication. The MT particles will also tightly hold to the material at the true surface indication.

At a true subsurface discontinuity, the fine ferromagnetic material will congregate around the indication, but will not be as distinct, and may congregate on a wider area on the testing subject. The material will also not hold as tightly to the testing surface, and the material will not build up as much.

False indications can occur if the particles are held to the surface of the testing subject by either mechanical elements or gravity. This can be caused by surface irregularities which are not an indication, including surface roughness or sharp contours, or outside chemicals on the testing surface. The particles

will also not hold tight to the surface at a false indication. It is recommended the testing surface be recleaned and the test process redone if the inspector suspects that a false indication has been identified. Indications can be considered non-relevant if there appears to be minor flux leakage with no true discontinuity. These locations should be monitored during future inspections.

F.4.4 Limitations

MT comes with an array of limitations while implementing this technique in the field. MT can be limited by the following:

- Limited to ONLY ferromagnetic materials, it will not work on aluminum or timber materials.
- Testing surface must be dry, clean, and free of contaminants which could catch the ferromagnetic particles applied to the surface.
- Limited to dry weather conditions.
- Will not disclose fine porosity.
- Dependent on defect orientation.
- Only large subsurface defects provide a readable indication.
- Dirt and paint can reduce sensitivity.
- Per The American Society for Testing and Materials (ASTM) standard E-709, MT is recommended to be performed on painted surfaces with a paint thickness of up to 2 mils (two-thousandths of an inch).
- Can leave some residual magnetism in the member being tested.
- True MT results are limited to mostly surface discontinuities, and any potential subsurface indications shall be noted and monitored during future inspections.

F.4.5 Training & Certification Requirements

Inspectors performing MT shall be certified to Level II per the American Society of Nondestructive Testing (ASNT) recommended practice SNT-TC-1A.

Appendix G Anchor Rod Nut Tightening & Structural Bolt Guidance

G.1 Introduction

Ancillary structures experience cyclic loadings such as resonant vibrations due to variable frequency wind loading, which is believed to be a primary cause of loose anchor rod nuts. Over time, nuts subjected to cyclic loads become loose which can contribute to full or partial failure of the structure. Improperly installed nuts can accelerate loosening and/or prevent adequate connection form being established. Loose nuts can lead to the redistribution of loads to the individual anchor rods which could result in the overstress of the adjacent anchor rod(s) or structural connection bolt(s). This uneven distribution of stress also may cause base plate distortion and uneven loading of the base plate to post weld.

Commonly used terminology regarding anchor rods and structural bolts:

- Not fully engaged/negative thread/under threaded – The anchor rod or connection bolt does not fully extend through the nut and the nut cannot be tightened any further due to physical restriction.
- Not properly seated: - Partial contact of the anchor nut with washer or base plate (if washer is missing). This could be caused by cross threading or misaligned anchor rods.
- Backed off – Visible gap between bottom of nut and washer/baseplate; nut can be tightened with normal effort.
- Frozen – Nut does not move when attempted to be tightened or loosened.
- Backed off and frozen – Visible gap between bottom of nut and washer/baseplate; nut cannot be tightened with normal effort.
- Loose – Nuts and or washers which can be moved by hand or with hammer blows. Loose nuts on anchor rods should create a dull sound when struck with a hammer.
- Tight - Washers and/or nuts will not move when struck with a hammer. There should be a sharp ringing sound if tight. It is unknown if proper torque has been applied.
    - When a Shake Test is performed for a single post structure, there should be no visible movement of the washers or nuts.
- Snug Tight - Maximum nut rotation resulting from the full effort of one person using a wrench which meets or exceeds 20%-30% of verification torque as outlined in Table G.2-1. Pull on the handle of wrench with both arms in one smooth motion with normal effort until the anchor rod nut no longer turns.

Inspectors should be mindful to identify loose nuts; a brief description of inspection methods is provided herein.

Using a 1.5-lb ball-peen hammer, sound each anchor rod by striking the side of the top anchor rod nut to check for loose nuts (leveling and top). This action will result in a sharp ringing sound and no movement of washers/nuts when sufficiently tight. Loose nuts will result in a dull sound.

Where loose nuts are suspected, do not immediately tighten the top nut. A loose leveling nut can also be the cause of the dull sound; Visually check for gaps between the leveling nut and the base plate. Tap one side of each washer above the leveling nut, placing one hand on the washer opposite the side being tapped. If the washer moves, the nut is not properly tightened. Physically grasp the washer and try to move it to determine the leveling nut tightness. For inspection purposes the difference between snug tight and fully tight will be difficult to differentiate without specialty equipment (see below for the definition of snug tight). If the leveling nut appears to be tight, proceed to tighten the top nut. Inspection of the leveling nut is not always possible due to grout pads. If this is the case, try to tighten the top nut as noted below. If the top nut cannot be tightened further, a more in-depth investigation is needed outside of this procedure.

Anchor rod nuts should be checked to see if they are frozen onto the anchor rod. This is particularly important when the nut is not at least snug tight. Frozen nuts can occur for various reasons however many are accelerated by the structure having a missing, broken, or damaged grounding; the use of non-galvanized components; and/or using dissimilar metals. If any of the above conditions are noted, a more in-depth investigation is needed outside of this procedure.

Anchor rod nuts may also be immoveable due to anchor rod damage or plumbness. Any anchor rod that is damaged or out of plumb (slope > 1:40) should be noted in the inspection report (where appropriate).

High strength bolts and similar fasteners are checked by striking the bolt head nut, or washer with hammer blows. As mentioned above, the inspector should sound each connection to verify tightness. Loose or missing bolts should be replaced in-kind and tightened to at least a snug tight condition. Care should be taken not to warp or deflect any attachment bracket or plate while tightening bolts and fasteners. Excessive gaps should be noted and a work item should be generated. Any bolts or fasteners snug tightened during the inspection should have a work item for the affected hardware to be properly torqued per RIDOT specifications.

G.2 Procedure

Anchor rod nuts should only be tightened with an appropriately sized socket, fixed or adjustable box style (crescent) wrench. While tightening, broken anchor rods can be identified as both the nut and the rod will turn with applied torque. If only the nut rotates under the applied torque, complete the tightening procedure noted below and again sound the side of the top nut and the top of the anchor rod with a hammer. Nuts should never be checked or tightened with a pipe wrench as these are not designed to handle torque loading and can damage the nut. Note all nuts that required tightening in the inspection report (where appropriate).

Field inspectors should bring loose anchor rod nuts to a snug tight condition using Table G.2-1 to determine the wrench length and pull force. Snug tight is defined here as the maximum nut rotation resulting from the full effort of one person using a wrench which will meet or exceed 20% of verification torque without overtightening. The target torque range to tighten all loose nuts is between 20% and 50% of verification torque. Care should be taken not to exceed the upper 100% torque limit as this could damage the anchor rod and will not appreciably add strength or service life to the connection.

The following procedure will be used by field inspectors to bring accessible anchor rod nuts to at least a snug tight condition.

1. Clean and lubricate the exposed threads of the anchor rods.

2. If present and accessible, turn leveling nuts to bear on the bottom of the post base plate or the bottom of the base. Note if structural washers are in place and if the base plate or transformer base has either a standard circular hole, a slotted hole, or a tab. If there are slotted holes or tabs, flat washers (one washer corresponding to each anchor rod) are required per AASHTO. If a flat washer is not present, it should be noted as a deficiency.

3. Note if the top nuts have washers or bearing plates and if they are properly positioned. If not present, nuts should only be tightened to engage the base plate or transformer base and a maintenance recommendation should be generated. At no time should a nut that is engaged be removed without the pole and arm (if present) being supported by a secondary method.

4. Verify that the nuts can be turned onto the rods by the effort of one person using the wrench length prescribed in Table G.2-1 (i.e., without employing a pipe extension on the wrench handle). If any nut is frozen, apply RIDOT approved liquid penetrant, e.g., PB B'laster penetrant, prior to leaving the site.

5. Tighten top nuts to a snug tight condition. If more than one nut is loose, tighten each nut in a star pattern. A star tightening pattern is one in which the nuts on opposite or near-opposite sides of the anchor bolt circle are successively tightened in a pattern resembling a star (e.g., for an 8-bolt circle with anchor rods sequentially numbered 1 to 8, tighten nuts in the following bolt order: I, 5, 7, 3, 8, 4, 6, 2).

6. If present and accessible, tighten leveling nuts to a snug tight condition in a star pattern.

Table G.2-1 was borrowed from a 2018 study undertaken by MNDOT; it was altered to be simplified for field personnel. The approximate torque values given in Table G.2-1 below represent 20% of the design torque. This is the minimum torque that must be achieved to ensure a snug tight condition as defined above. The intent of Table G.2-1 is not to be exact but to achieve a target torque of 20% to 50% while not exceeding 100%.

Table G.2-1 Approximate Minimum “Snug Tight” Torque Values

Anchor Rod Diameter (in.)	**Anchor Rod Grade (Yield Stress)**					
	36		**55**		**105**	
	Wrench Length[1] (in.)	Approximate Torque lb.-ft	Wrench Length[1] (in.)	Approximate Torque lb.-ft	Wrench Length[1] (in.)	Approximate Torque lb.-ft
3/4	12[1]	9	12[1]	14	12[1]	26
1	12[1]	22	12[1]	33	12[2]	64
1-1/4	12[1]	44	12[2]	67	12[2]	128
1-1/2	12[2]	76	12[2]	116	21[2]	221
1-3/4	12[2]	120	18[2]	183	34[2]	349

Anchor Rod Diameter (in.)	Anchor Rod Grade (Yield Stress)					
	36		55		105	
	Wrench Length[1] (in.)	Approximate Torque lb.-ft	Wrench Length[1] (in.)	Approximate Torque lb.-ft	Wrench Length[1] (in.)	Approximate Torque lb.-ft
2	17[2]	180	26[2]	275	60[2]	525
2-1/4	25[2]	261	39[2]	402	74[2]	768
2-1/2	35[2]	360	53[2]	550	101[2]	1050

[1] Use a 12" long wrench to snug tighten nuts by pulling on the handle with only one arm in a smooth motion until the anchor rod nut no longer turns.

[2] Use the wrench length specified in the table to snug tighten the nuts. Pull on the handle with both arms in one smooth motion, exerting the full effort of one person, until the anchor rod nut no longer turns.

Notes:

1. *If the wrench length used does not match the length specified in the table, adjust the grip distance from the anchor rod to replicate the effect of the specified wrench length*
2. *If anchor rod grade is unknown use Anchor Rod Grade 36 Column.*

G.3 Documentation

In addition to the typical inspection and condition documentation required for anchor rods, the following should be noted in the inspection report as well:

- Anchor rod measurements: For Initial/Inventory inspections, document the field measured anchor rod diameter and length. The length of the rod can be gathered during UT inspection; for furth information, refer to F.3.1 Straight Beam Ultrasonic Testing.

- Accessible nuts that have been snug tightened in the field should be physically marked for Maintenance replacement. The nut number should be documented; also specify if it is a top or leveling nut. This should be included in a High Priority Maintenance Finding – refer to Section 5.2.9.

- Any nuts that are frozen and cannot be moved or tightened with snug tight effort. Also document that lubricant was applied.

- Any nuts that cannot be accessed due to either live wires, grout pad or any other obstruction.

    - Any accessibility issues should be provided to the Program Manager.

- Any missing or undersized washers, either under the turning (top/tightening/leveling) nut or for any slotted holes or tabs.

- Any missing anchor rod bearing plates, plates that are out of alignment and if they are not fully bearing on the transformer base.

- Any deteriorated nuts that cannot be tightened due to section loss or rounding.

When loose bolts are tightened during the inspection, the initial condition found shall be noted and the condition rating shall reflect the condition after tightening. Note any instances where snug tight

conditions could not be achieved due to frozen nuts, unsafe access (such as for live electrical wires) or insufficient clearance.