11 FRANGIBLE AND NON-FRANGIBLE POLE STRUCTURE

11.1 Definitions

The frangible pole structure is a steel or aluminum pole mounted onto a cast aluminum transformer base, which is mounted to a concrete foundation. The frangible transformer base is designed to break away at impact for safety of motorists. Due to the breakaway performance frangible pole structures may be used within the roadway clear zone. The non-frangible type is a steel or aluminum pole mounted directly on a concrete foundation with anchor bolts. Since non-frangible light poles are not considered breakaway structures, they are used outside of roadway clear zones or are shielded; shielding typically means the pole is protected by guardrail.

Other common terms which may be used when discussing frangible and non-frangible pole structures include:

- **Breakaway:** A design feature that allows a sign, luminaire, or pole top-mounted traffic signal support to yield, fracture, or separate near ground level on impact.
- **Clear zone:** The roadside border area, starting at the edge of the traveled way, available for unobstructed use by errant vehicles.
- **Frangible:** A component readily or easily broken on impact.
- **Frangible Transformer Base:** A base constructed of a brittle material and designed for breakaway performance, used to support a pole structure.
- **Luminaire:** A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the electric power supply.
- **Screw-in Helix:** Galvanized steel foundation installed by rotary equipment.

11.1.1 INVENTORY ITEMS

The inspector shall identify and record the type of base (i.e., Frangible or Non-Frangible base) and the number of arms and type of arm (i.e., single, davit, or truss bracket). The inspector shall also note the lengths of the arms and the mounting height of the structure. The inspector shall note the power source such as direct wire or solar. The inspector shall provide the Power Meter number. Take photos of the required inventory items listed in Section 11.2.2. A complete list of inventory items is provided in the Ancillary Structures Data Dictionary.

Figure 11-1: Pole structure arm types (numbering from left), single member (1), Davit member (2), single truss arm (3), double truss arm member (4)

11.1.2 ELEMENTS

Frangible and Non-Frangible Pole Structures are divided into three components: Foundation, Vertical Structure, and Horizontal Structure.

Foundation is further divided into elements: Concrete Foundation, Anchor Bolts, and Frangible Transformer Base.

Vertical Structure is further divided into elements: Base Plate, Frangible Base Connections, Vertical Support Column (Upright), and Vertical Structure Connections.

Horizontal Structure consists of one element: Luminaire and Luminaire Arm.

Table 11-1: Frangible and Non-Frangible Pole Structure Components and Elements

Component	Element	Element Code	Unit of Measure
Foundation	Concrete Foundation	21101	Each
Foundation	Anchor Bolts and Nuts	21102	Each bolt and nut unit
Foundation	Frangible Base	21201	Each
Vertical Structure	Base Plate	21202	Each
Vertical Structure	Frangible Base Connections	21203	Each bolt and nut unit
Vertical Structure	Vertical Support Column (Upright)	21204	Length, feet
Vertical Structure	Vertical Structure Connections	21205	Each
Horizontal Structure	Luminaire and Luminaire Arm	21301	Each

11.1.3 COMPONENTS

Frangible and non-frangible pole structures are divided into three main components: the foundation, the vertical structure, and the horizontal structure.

Component ratings for pole structures are based on the following:

- ***Foundation*** – Consider the structure's foundation effect on overall stability of the pole structure.
- ***Vertical Structure*** – Consider if the vertical structure may have damage that compromises the structural capacity such as fractures, significant twisting or kinking, corrosion, section loss, or stress cracks in the metal.
- ***Horizontal Structure*** – Consider fractures in welds or base metal, corrosion, section loss, or buckling of truss compression members as critical to the overall horizontal structure.

See Section 1.7 for the discussion on component rating, element rating, and condition states. A representation of the rating structure for frangible and non-frangible pole structures is provided in Figure 11-2.

Figure 11-2: Rating structure for Frangible and Non-Frangible Pole Structures

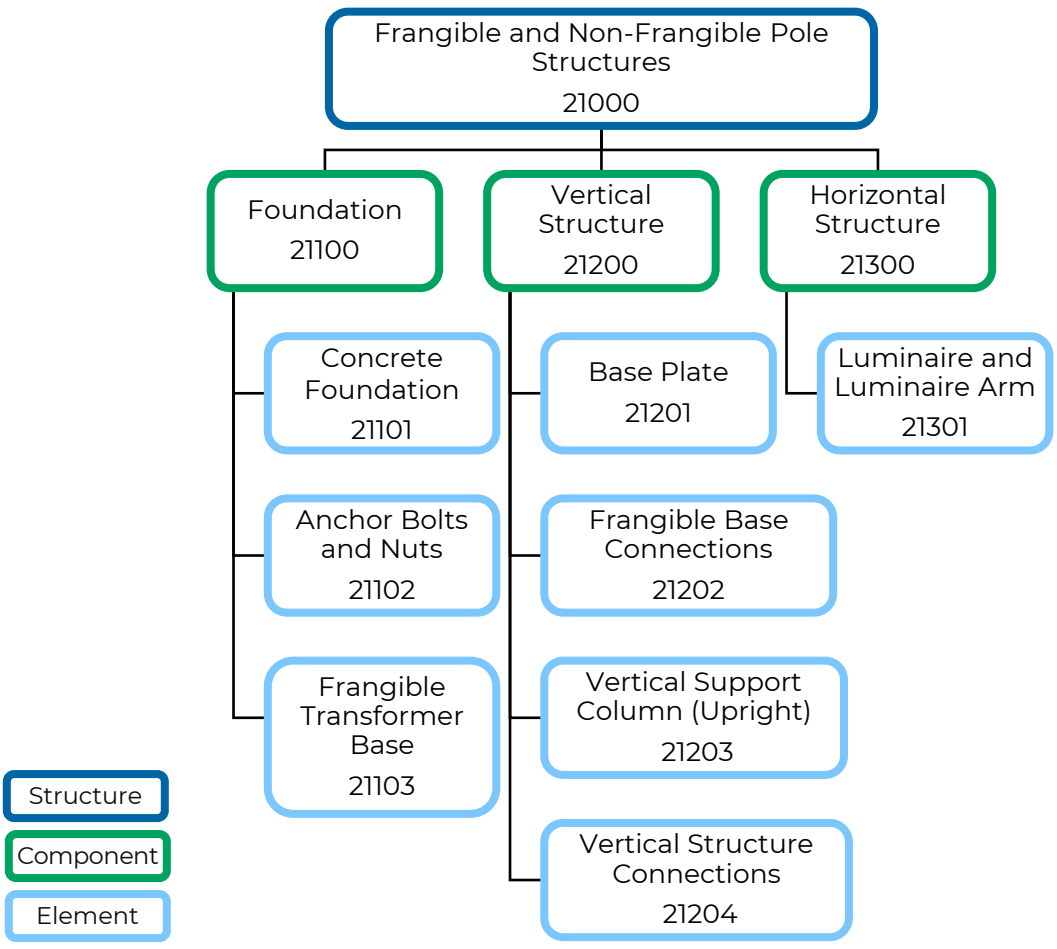


Figure 11-3: Component and elements on a Frangible Pole Structure (adapted from MDOT Detail SIG-061-A)

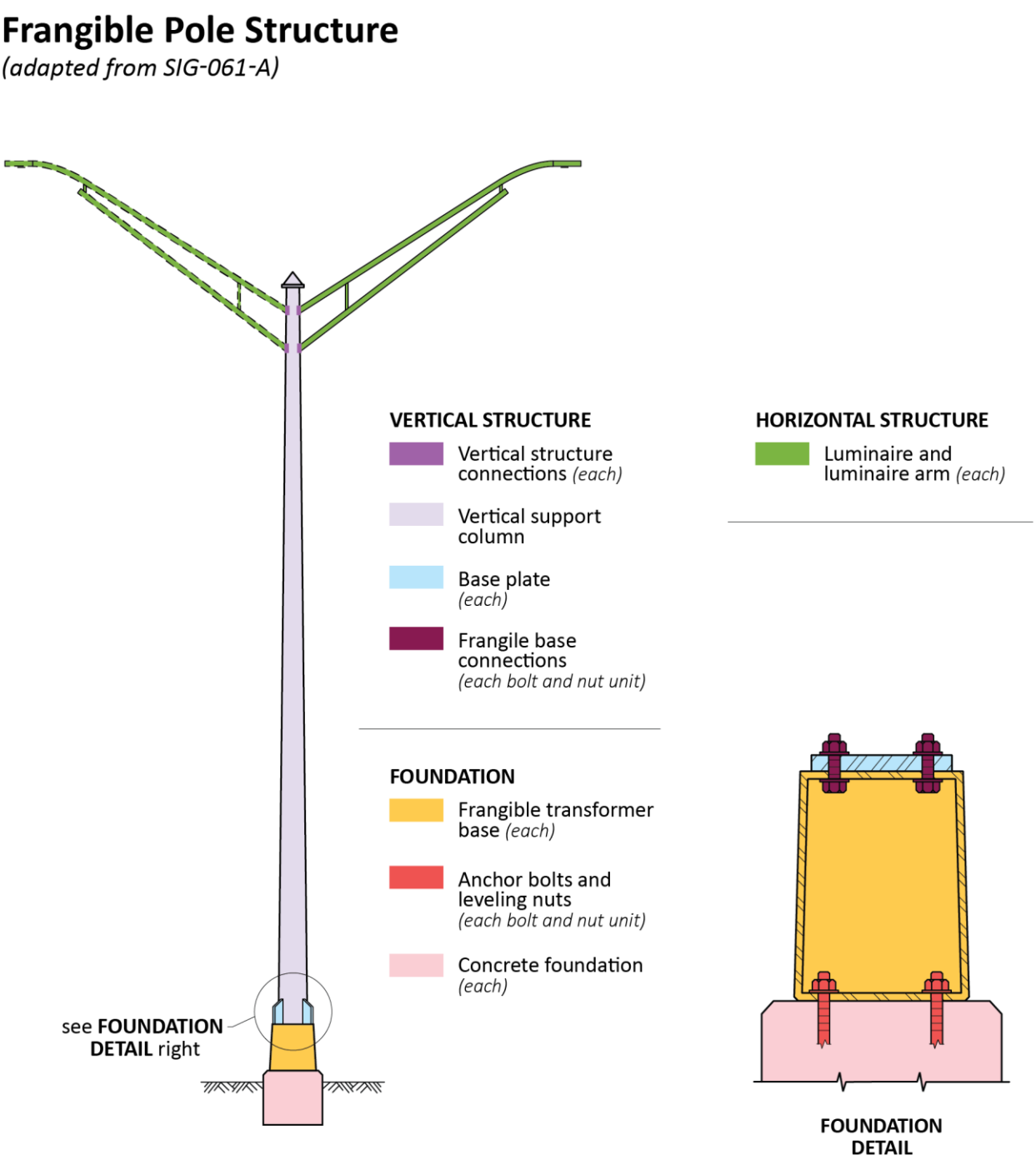
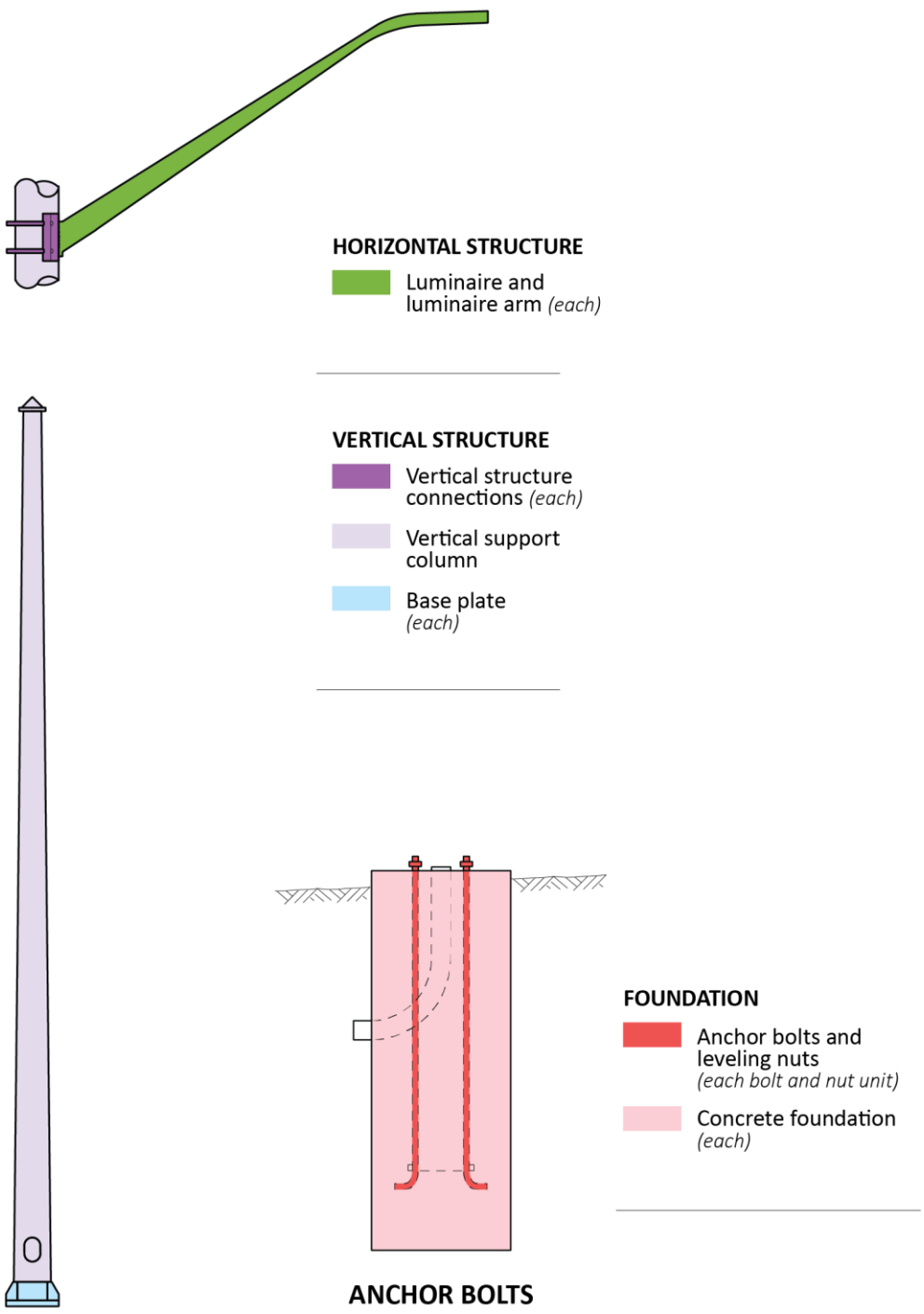


Figure 11-4: Components and elements on a Non-Frangible Pole Structure

Non-Frangible Pole Structure

(adapted from SIG-061-A)



11.2 Inventory Record Photographs

Inventory photos are captured during a routine inspection, saved as part of the inventory database, and follow the naming convention in *Table 11-2*.

Frangible Pole Structure and Non-Frangible Pole Structure Required Photos:

- General view of the entire structure
- Each foundation
- Structure number stenciled on support

Table 11-2: Frangible and Non-Frangible Pole Structures Photograph Naming Convention

Photo Name	Description
PS_Entire	Entire frangible or non-frangible pole structure
PS_Foundation	Foundation
PS_VH_Connection	Vertical to horizontal connection
PS_Lum	Luminaire and luminaire arm
PS_ID	Old ID and new structure number

11.3 Inspector Minimum Technical Qualifications

At least one member of the field inspection crew shall possess the following certifications and training:

- A minimum experience of two projects with a minimum of 10 structures total inspecting pole structures. Bolt inspection experience on cantilever or truss structures, or other ancillary structure type. Multiple structure types shall have been inspected as part of the total project experience.
- Ancillary structures inspection procedures training
- Working knowledge of inspection tools, their use, application, and limitations for the structure type being inspected
- MDOT structural bolting workshop for Non-Frangible Pole Structure initial field installation verification.
- Certified Welding Inspector – American Welding Society, Certified Welding Inspector (CWI) (Current)
- Ultrasound qualification for Non-Frangible Pole Structure – Current ASNT Level II (ASNT or per ASNT TC-1A guidelines) qualification in straight beam ultrasonic testing. In conditions where a weld needs ultrasonic testing (UT) then Level II in shear wave is required.

11.4 Routine Inspection

Pole structures may be categorized as either frangible or non-frangible types. The frangible type is a steel or aluminum pole mounted onto a cast aluminum transformer base, which is mounted to the concrete foundation. The frangible transformer base is designed to break away at impact to protect the safety of motorists. Due to the breakaway performance frangible pole structures may be used within the roadway clear zones. The non-frangible type is a steel or aluminum pole mounted directly on a concrete foundation with anchor bolts. Since non-frangible light poles are not considered breakaway structures, they are used outside of roadway clear zones or are shielded; shielding typically means the pole is protected by guardrail.

Both frangible and non-frangible pole structures may support a variety of luminaires and different types of pole attachments and connections.

Frangible and non-frangible pole structure standard inspection frequency is once every 4 years for steel poles and once every 2 years for aluminum poles, unless otherwise identified for more frequent inspection.

The acceptable tolerance for intervals of less than 24 months for the next inspection is up to two (2) months after the month in which the inspection was due. The acceptable tolerance for intervals of 24 months or greater for the next inspection is up to three (3) months after the month in which the inspection was due. Exceptions to the inspection interval tolerance due to rare and unusual circumstances should be approved by MDOT's Ancillary Structures Program Manager in advance of the inspection due date plus the above tolerances.

It is recognized that severe weather, inspector safety, inspection quality, resource optimization, technological difficulties, or other unique situations may be a reason to adjust the scheduled inspection date. In these situations, the adjusted inspection date should not extend more than two (2) months after the month the inspection was due for any inspection interval less than 24 months and not extend more than three (3) months after the month the inspection was due for any inspection interval 24 months or greater. Inspection interval tolerances are intended to provide some flexibility. When tolerances are applied, the longest time period prescribed between inspections is the applicable interval plus the prescribed tolerance. For example, a routine inspection on a 12-month interval could be performed during the 14th month if the tolerance is applied. Repeatedly applying the tolerance to the next inspection will create inspection date creep and may impact an owner's ability to perform future inspections in a timely manner due to other limitations (e.g. available resources, inspection workload, schedule, seasonal weather conditions, technological difficulties, etc.). Exceptions to inspection interval tolerances due to rare and unusual circumstances should be approved by MDOT's Ancillary Structures Program Manager in advance of the inspection due date, plus the tolerance. For example, if an inspection with an interval of 24 months is due on June 17, an exception request should be approved by MDOT's Ancillary Structures Program Manager before the end of the 3-month tolerance (i.e. September 30). However, a request for exception should be made when the potential for not meeting the tolerance becomes known to provide MDOT's Ancillary Structures Program Manager with adequate time for review and approval.

Table 11-3 provides guidance for inspecting reinforced and prestressed concrete cracking.

The acceptable tolerance for intervals of less than 24 months for the next inspection is up to two (2) months after the month in which the inspection was due. The acceptable tolerance for intervals of 24 months or greater for the next inspection is up to three (3) months after the month in which the inspection was due. Exceptions to the inspection interval tolerance due to rare and unusual circumstances should be approved by MDOT's Ancillary Structures Program Manager in advance of the inspection due date plus the above tolerances.

It is recognized that severe weather, inspector safety, inspection quality, resource optimization, technological difficulties, or other unique situations may be a reason to adjust the scheduled inspection date. In these situations, the adjusted inspection date should not extend more than two (2) months after the month the inspection was due for any inspection interval less than 24 months and not extend more than three (3) months after the month the inspection was due for any inspection interval 24 months or greater. Inspection interval tolerances are intended to provide some flexibility. When tolerances are applied, the longest time period prescribed between inspections is the applicable interval plus the prescribed tolerance. For example, a routine inspection on a 12-month interval could be performed during the 14th month if the tolerance is applied. Repeatedly applying the tolerance to the next inspection will create inspection date creep and may impact an owner's ability to perform future inspections in a timely manner due to other limitations (e.g. available resources, inspection workload, schedule, seasonal weather conditions, technological difficulties, etc.). Exceptions to inspection interval tolerances due to rare and unusual circumstances should be approved by MDOT's Ancillary Structures Program Manager in advance of the inspection due date, plus the tolerance. For example, if an inspection with an interval of 24 months is due on June 17, an exception request should be approved by MDOT's Ancillary Structures Program Manager before the end of the 3-month tolerance (i.e. September 30). However, a request for exception should be made when the potential for not meeting the tolerance becomes known to provide MDOT's Ancillary Structures Program Manager with adequate time for review and approval.

Table 11-3: Standard Cracking Widths

Description	Reinforced Concrete	Prestressed Concrete
Hairline (HL)	<1/16" (0.0625")	< (0.004")
Narrow (N)	1/16" to 1/8" (0.0625" to 0.125")	(0" to 0.009")
Medium (M)	1/8" to 3/16" (0.125" to 0.1875")	(0.010" to 0.030")
Wide (W)	>3/16" > (0.1875")	> (0.03")

Source: FHWA Bridge Inspector's Reference Manual (Publication No. FHWA NHI 03-001, October 2002)

11.4.1 FOUNDATION ROUTINE INSPECTION

The routine inspection assesses the foundation's ability to safely support the structure and transfer all loads to the surrounding soil or subsurface materials. If safety concerns such as significant erosion, settlement, or lateral displacement, are noted, initiate an RFA. The routine inspection is performed on a regularly scheduled basis, with frequency determined by AS type, and includes the foundation component rating as determined by the element condition ratings of the concrete foundation and steel anchor bolts and nuts. It consists of observations and measurements needed to determine the physical and functional condition of the foundation, to identify any changes from initial or previously recorded conditions, and to ensure that the foundation continues to satisfy present service requirements. Visually inspect all elements of the component at a distance close enough to determine the overall condition and to detect deficiencies.

A sample foundation routine inspection would consist of:

- Note vegetation growth impeding access to the structure.
- Inspect ground line for any material washing out around foundation.
- Examine the foundation visually and by sounding with a standard inspection hammer.
- Verify anchor bolt diameter and length, then scan for defects.
- Examine anchor bolts for tightness and embedment using a standard inspection hammer. Inspect visually for corrosion, section loss, and plumbness.
- Examine anchor bolts for any eccentricity. Note any noticeable eccentricity measurements.
- On Non-Frangible pole structures, perform ultrasonic testing of anchor bolts to note any breaks and verify lengths.
- Provide photographs for all Poor or Severe condition state defects and submit the applicable Work Recs or RFAs.

11.4.1.1 Foundation Component Ratings

The component rating for the foundation depends on the condition of the foundation concrete and surrounding soil, and the anchor bolts and nuts that connect the structure to the foundation. Assessing these factors with respect to the overall ability of the foundation to safely support the structure, along with the element condition ratings, provides the appropriate component rating. Note that the base plate is considered as part of the vertical structure component.

Table 11-4: Component Rating Guidelines for Frangible and Non-Frangible Pole Structure Foundation

Component Rating	Condition	Material	Description
9	**NEW**	All	No deficiencies in any of the structural components that will affect long term performance.
8	**VERY GOOD**	All	All structural components are sound and functioning as designed. There may be superficial cracking or weathering of protective

Component Rating	Condition	Material	Description
			components and/or dirt contamination of structural components.
7	GOOD	Concrete	Insignificant cracks or moderate cracks that are sealed.
		Soil	Insignificant displacement or erosion of soil.
		Steel	Protective coating failure in very small and scattered locations.
		All	All components retain full section properties and function as designed.
6	SATISFACTORY	Concrete	Unsealed moderate-width or map cracks. Minor delamination or spalling.
		Soil	Minor displacement or erosion of soil.
		Steel	Minor damage or worn galvanizing of anchor bolt connections.
		All	Minor deterioration affecting structural components. Minor misalignment.
5	FAIR	Concrete	Moderate delamination or spalling.
		Soil	Moderate displacement or erosion of soil. Minor gaps may be present between pole and embedment material.
		Steel	Minor loss of section. Loose fasteners may be present, but the connection is in place and functioning as intended.
		All	Moderate deterioration affecting structural components including minor settlement, or impact damage. Moderate misalignment. All members continue to function as designed.
4	POOR	Concrete	Considerable cracking and spalling.
		Soil	Considerable displacement or erosion of soil.
		Steel	Less than 25% loss of section. Fasteners may be considerably deteriorated.
		All	Considerable deterioration or misalignment affecting structural members. Considerable impact damage. Structural review may be warranted.
3	SERIOUS	Concrete	Extensive cracking and spalling.
		Soil	Extensive displacement or erosion of soil. Large gaps may be present between pole and embedment material.
		Steel	Measurable loss of section in excess of 25%. Missing, cracked, or broken fasteners.

Component Rating	Condition	Material	Description
		All	Considerable deterioration or damage affecting structural members. Structural evaluation, is necessary to determine if the structure can continue to function without repairs.
2	CRITICAL	All	Deterioration has progressed to the point where the structure will not support design loads and emergency repairs, or removal is required.
1	IMMINENT FAILURE	All	Road is closed to traffic due to imminent failure, but corrective action may put it back in service.
0	FAILED	All	Road is closed due to condition. Notify Region and the Bureau of Bridges and Structures.

11.4.1.2 Concrete Foundation Element Condition States

The foundation stabilizes and secures the entire structure. The purpose of inspection is to identify and record any minor to severe deficiencies throughout the lifespan of the foundations. Inspect the condition of the concrete foundation, noting any cracking, spalling, voids, and general deterioration. Typical issues include cracking throughout the foundation, spalling, chipping, delaminated or broken sections of the foundation, exposed aggregate and rebar, and soil erosion around the foundation.

Table 11-5: Frangible and Non-Frangible Pole Structure Concrete Foundations Element Distresses

Element Number	Element	Description	Associated Distresses
21101	Concrete Foundation	Frangible and non-Frangible pole structure foundations	Cracking
			Spalling, delamination, and patching
			Exposed rebar
			Embedment erosion
			Impact damage
Unit of Measure: Each foundation, note number of foundations within each condition state. Typically, a single foundation which will then be rated as a single condition state.			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

Cracking

Concrete cracking can be either nonstructural or structural and can be caused by different factors. Nonstructural cracking is most often related to volumetric changes in concrete caused by fluctuations in moisture content and/or temperature during curing or while in service. Structural related cracking is often related to loading on the concrete being

beyond its tensile capacity. Concrete can also crack if the embedded reinforcing bars are corroding. Inspect the foundation for cracking and investigate whether any observed cracking appears non-structural or structural in nature. Document the approximate location, orientation, width, and spacing of the cracking.

Spalling, Delamination, and Patching

Concrete spalling is a surface failure in which concrete breaks off from the underlying concrete substrate. Like cracking, spalling may occur when the steel reinforcing embedded within the concrete member undergoes corrosion. Inspect and document the extent and location of spalling and reinforcing bar corrosion. Estimate the extent of any section loss.

Concrete delamination can be identified as a thin layer of concrete separation from its substrate. Unlike spalling, delaminated concrete does not break away but remains attached to the structure.

Inspect the foundation for delamination by sounding areas that are exhibiting signs of distress to determine the limits of deterioration. Document the approximate location of delamination or spalling.

Figure 11-5: Non-frangible concrete foundation deterioration

Exposed Rebar or Anchor Bolt Thread

Indicate if reinforcement is exposed.

Figure 11-6: Concrete foundation, exposed anchor bolt in damaged foundation

Embedment Erosion

Soil erosion may cause instability of the foundation. Document the extent of erosion including the depth.

Impact Damage

Inspect the concrete foundation for vehicular damage. Document the location and degree of damage.

11.4.1.3 Anchor Bolt and Leveling Nuts Foundation Element Condition States

The anchor bolts transfer load from the structure into the foundation. For frangible bases, this element does not address the bolts and nuts connecting the base plate and the frangible base. It addresses the bolts in connection with the concrete foundation only. The bolts and nuts connecting the base plate and the frangible base are addressed in frangible base connection element.

The purpose of the anchor bolt inspection is to identify any degradation of the nuts, flat washers, leveling nuts, and anchor bolts connecting the frangible transformer base to the concrete foundation. Typical issues include corrosion, damaged threads, loose connections, missing or damaged anchor bolts and leveling nuts, soil or debris between the upright base and concrete foundation, ultrasound indications, excessive leveling nut to foundation standoff distance, bent or warped base plates, and bent or warped anchor bolts. All nuts should be tight and fully bear on connected surfaces. Loose nuts, nuts that don't fully bear on adjacent steel, nuts not fully engaged, or damaged or cracked anchor bolts can lead to connection movement, load redistribution, and ultimately failure.

Inspection of the anchor bolts includes a visual inspection, and a determination of the tightness of the bolts and nuts. For non-frangible bases, a sounding test, and a straight beam ultrasound scan (UT test) of 10 inches into the anchor bolts are required. Published procedures for the sounding and UT test are provided in references found in Section 11.4.4. Testing frangible bases may require appropriate PPE and insulated tools, recognizing the potential of electrical hazard. Panel doors may also be present and need to be opened to inspect the bolts and nuts.

For either frangible or non-frangible base, visually inspect the base looking for missing or damaged anchor bolts or nuts connected to the foundation. Note any damage or corrosion and any bolt that shows signs of bending. Check for any gaps between the nuts, washers, and base plate. Check for excessive standoff distance between the underside of the leveling nut and the top of the foundation (or the top of sound concrete in cases of foundation deterioration).

The standoff distance is an indication of whether or not the anchor bolts are subjected to bending moment stress. For double-nut connections, if the clearance between the bottom of the leveling nuts and the top of the concrete foundation is less than or equal to one bolt diameter, bending stresses in the anchor bolts can be disregarded (AASHTO LRFD Specifications for Structural Supports, Section 5.16.3.1). Any distance greater than one bolt diameter may be cause for concern.

Figure 11-7: Standoff measurement for a sound foundation (left) and standoff measurement with foundation concrete deterioration (right)

Table 11-6: Frangible and Non-Frangible Pole Structure Anchor Bolt and Leveling Nuts Element Distresses

Element Number	Element	Description	Associated Distresses
21102	Anchor Bolts and Leveling Nuts	Anchor bolts and leveling nuts	Corrosion or coating damage
			Loose or missing anchor nut
			Cracked bolt
			Standoff distance
			Impact damage
Unit of Measure: Each, note quantity of anchor bolt and nut units within each condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

Examples of common distresses associated with anchor bolts and leveling nuts are shown in *Figure 11-8*: Anchor bolt and leveling nuts foundation, severed anchor bolt and nut of non-frangible base through *Figure 11-12*: Anchor bolt and leveling nuts foundation, nut tack welded to washer (left), incorrect washer type – plate washers intended to cover slotted holes (right).

Figure 11-8: Anchor bolt and leveling nuts foundation, severed anchor bolt and nut of non-frangible base

Figure 11-9: Frangible pole structure anchor bolts and leveling nuts foundation, loose anchor bolt (left), anchor nut without fully engaged thread (right)

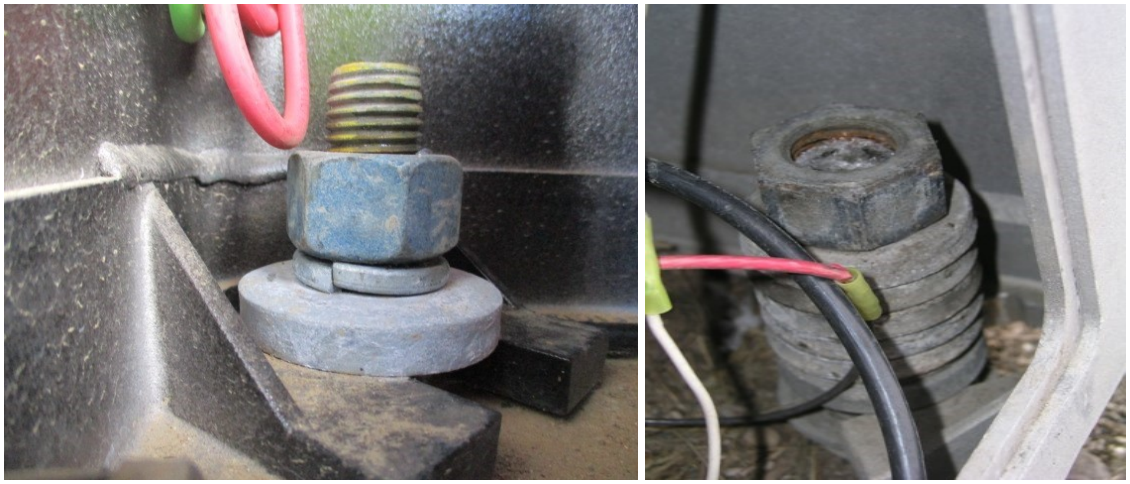


Figure 11-10: Anchor bolt and leveling nuts foundation, non-frangible base anchor bolt corrosion

Figure 11-11: Anchor bolt and leveling nut foundation, gap between anchor nut and washer in corroding base unit (left), gap between anchor nut and washer with bolt out of plumb and debris between upright base and concrete foundation (right)

Figure 11-12: Anchor bolt and leveling nuts foundation, nut tack welded to washer (left), incorrect washer type – plate washers intended to cover slotted holes (right)

11.4.1.4 Frangible Base Element Condition States

Inspectors shall visually inspect for any damage to the frangible base such as gouges, distortion, impact damage, or warping. Note galvanizing damage and the degree of corrosion present. Areas of galvanizing that appear to have been repaired are monitored closely throughout the lifespan of the structure. If that area was not thoroughly cleaned prior to repair, corrosion might not show through the repair immediately but could appear in later years.

With appropriate PPE and insulated tools, recognizing the potential of electrical hazard, open access panel of the frangible base and conduct a visual inspection of the interior for damages such as corrosion and section loss. Inspect the interior anchor bolts, flash washer, lock washer and nuts, and document loose connections and lock washers not fully compressed. Note any damage such corrosion, or bolt misalignment. Debris and moisture aid damages such as corrosion and section loss. Document any debris and water within the frangible base access panel, and any loose, missing or unopenable access panel.

Figure 11-13: Frangible transformer base, panel door present (left), corrosion and debris in transformer base interior with missing panel door, and exposed wires (right)

Table 11-7: Frangible Pole Structure Frangible Base Element Distresses

Element Number	Element	Description	Associated Distresses
21103	Frangible Base	Base connecting the foundation to an upright designed to break away or yield when a vehicle impact occurs.	Corrosion or coating damage
			Loose or missing anchor nut
			Cracked bolt
			Impact damage

Unit of Measure: Each, note quantity of anchor bolt and nut units within each condition state

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

11.4.2 VERTICAL STRUCTURE ROUTINE INSPECTION

The uprights support the horizontal elements that directly support the luminaire arm. The routine inspection assesses the vertical structure's ability to safely support the horizontal structure and transfer all loads to the foundation. The routine inspection is performed on a regularly scheduled basis, with frequency determined by AS type, and includes the vertical structure component rating as determined by the frangible base connections, baseplate, vertical support column (upright), and vertical structure connections element condition ratings. It consists of observations and measurements needed to determine the physical and functional condition of the vertical structure and connections, to identify any changes from initial or previously recorded conditions, and to ensure that the vertical structure and connections continue to satisfy present service requirements. Visually inspect all elements of the component at a distance close enough to determine the overall condition and to

detect deficiencies. Binoculars are used as a visual aid if closer access with equipment or climbing is not available.

A sample routine inspection would consist of:

- Inspect the general site conditions and assess the global stability of the structure and its operational function.
- Inspect the vertical alignment of the pole with a 4 ft level or similar. Note that some poles may be tapered and checking at several points around the perimeter at the same elevation may be necessary to obtain the complete picture of any misalignment.
- Inspect the protective coating – galvanizing, powder coated, and/or paint and note any corrosion or section loss.
- Check the inventory label affixed to the pole facing approaching traffic for legibility. Install a new inventory number label if no label exists or the label is in poor condition.
- Check for pole dents and buckling (refer to pole dents & buckling calculations).
- Check for any cracks or deformations in the steel or aluminum noting the size of deficiencies.
- Check for signs of impact damage noting that impact in one location may affect the structure in other locations as well.
- Inspect the connection to the pole of the horizontal structure. This includes band clamps, brackets, and other bolted assemblies. Check for connections that are loose, missing, deteriorated or otherwise deficient.
- Provide photographs for all Poor or Severe condition state defects and submit the applicable Work Recs or RFAs.

11.4.2.1 Vertical Structure Component Ratings

The component rating for the vertical structure depends on the condition of the Frangible base connections, baseplate, vertical upright(s), and the connection(s) to the horizontal structures. Assessing these factors with respect to the overall ability of the vertical structure to safely support the horizontal structure and transfer loads to the foundation provides the appropriate component rating.

Table 11-8: Component Rating Guidelines for Frangible and Non-Frangible Pole Vertical Structure

Component Rating	Condition	Material	Description
9	**NEW**	All	No deficiencies in any of the structural components that will affect long term performance.
8	**VERY GOOD**	All	All structural components are sound and functioning as designed. There may be superficial cracking or weathering of protective components and/or dirt contamination of structural components.

Component Rating	Condition	Material	Description
7	GOOD	Concrete	Insignificant cracks or moderate cracks that are sealed.
		Soil	Insignificant displacement or erosion of soil.
		Steel/ Aluminum	Protective coating failure in very small and scattered locations.
		All	All components retain full section properties and function as designed.
6	SATISFACTORY	Concrete	Unsealed moderate-width or map cracks. Minor delamination or spalling.
		Soil	Minor displacement or erosion of soil.
		Steel/ Aluminum	Protective coating failures is limited to less than 10% of the surface area with no loss of section.
		All	Minor deterioration affecting structural components. Minor misalignment.
5	FAIR	Concrete	Moderate delamination or spalling.
		Soil	Moderate displacement or erosion of soil. Minor gaps may be present between pole and embedment material.
		Steel/ Aluminum	Minor loss of section. Loose fasteners may be present, but the connection is in place and functioning as intended.
		All	Moderate deterioration affecting structural components including minor settlement, or impact damage. Moderate misalignment. All members continue to function as designed.
4	POOR	Concrete	Considerable cracking and spalling.
		Soil	Considerable displacement or erosion of soil.
		Steel/ Aluminum	Protective coating failure and less than 25% loss of section. Cracks may be present. Fasteners may be loose, missing, or considerably deteriorated. Considerable impact damage.
		All	Considerable deterioration or misalignment affecting structural members. Structural review may be warranted.
3	SERIOUS	Concrete	Extensive cracking and spalling.
		Soil	Extensive displacement or erosion of soil. Large gaps may be present between pole and embedment material.

Component Rating	Condition	Material	Description
		Steel/ Aluminum	Measurable loss of section in excess of 25%. Missing or broken fasteners or extensive cracking in pole.
		All	Considerable deterioration or damage affecting structural members. Structural evaluation is necessary to determine if the structure can continue to function without repairs.
2	**CRITICAL**	All	Deterioration has progressed to the point where the structure will not support design loads and emergency repairs, or removal is required.
1	**IMMINENT FAILURE**	All	Road is closed to traffic due to imminent failure, but corrective action may put it back in service.
0	**FAILED**	All	Road is closed due to condition. Notify Region and the Bureau of Bridges and Structures.

11.4.2.2 Frangible Base Connections Element Condition States

Frangible base connections require extra attention because the connections are locations of high stresses. The purpose of inspection of the frangible base connections is to identify any degradation of the nuts, washers, and bolts above and below the vertical support (upright) base plate throughout the lifespan of the structure. Typical issues include loose, missing, corroded, or damaged bolting assemblies. All nuts should be tight and fully bear on connected surfaces. Inspection may require appropriate PPE and insulated tools, recognizing the potential of electrical hazard. Panel doors may also be present and need to be opened to inspect the interior washers and nuts. Loose nuts, nuts that don't fully bear on adjacent steel, nuts not fully engaged, or damaged or cracked bolts can lead to connection movement, load redistribution, and ultimately failure. Check the bolts and nuts to ensure they are fully tightened. Note any damage or corrosion and any bolt that shows signs of bending.

Figure 11-14: Frangible base connections, exposed bolt hole

Table 11-9: Frangible Pole Structure Frangible Base Connections Element Distresses

Element Number	Element	Description	Associated Distresses
21202	Frangible Base Connections	Connections connecting the upright to the frangible base.	Corrosion or coating damage
			Loose or missing anchor nut
			Cracked bolt
Unit of Measure: Each, note quantity of anchor bolt and nut units within each condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

11.4.2.3 Frangible and Non-Frangible Pole Structure Base Plate Element Condition States

Visually inspect for any damage to the base plate welds and gusset plates, such as gouges, distortion, impact damage, or warping. Note galvanizing damage and the degree of corrosion present. Areas of galvanizing that appear to have been repaired are monitored closely throughout the lifespan of the structure. If that area was not thoroughly cleaned prior to repair, corrosion might not show through the repair immediately but could appear in later years.

Perform a visual inspection of the gusset welds and base weld looking for cracks or other weld defects. Document questionable fillet or groove weld discontinuities. The base weld is a full-penetration weld and any crack identified in the toe or throat of the weld is considered as severe, and the appropriate procedure such as an RFA or Work Rec initiated.

Figure 11-15: Non-frangible pole structure base plate crack

Figure 11-16: Non-frangible pole structure base plate, corrosion of base plate, anchor bolts, and nuts and inadequate bolt projection

Figure 11-17: Base plate, pole corrosion and section loss at base weld

Table 11-10: Frangible and Non-Frangible Pole Structure Base Plate Element Distresses

Element Number	Element	Description	Associated Distresses
21202	Base Plate	Base plate for Frangible and non-frangible pole structure	Corrosion or coating damage
			Weld defect or crack
Unit of Measure: Each, percentage of base plate within each condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

11.4.2.4 Frangible and Non-Frangible Pole Structure Vertical Support Column (Upright) Condition States

Verify that the structure number is stenciled on the front of the upright (facing traffic) and is still legible. If necessary, use black paint to stencil the number on the vertical support (upright). Note any galvanizing damage on the upright and the degree, if any, of corrosion on the base metal. Unless a mechanical lift or climbing or other means of working at heights (i.e., UAS) are utilized, binoculars are used as a visual aid to inspect the tops of vertical supports. If any type of impact damage is present (gouges, dents) clean the area and visually inspect for any cracks. An in-depth inspection may be needed to explore suspect visual indications by performing a magnetic particle inspection, liquid penetrant test or other appropriate non-destructive examination methods. Additional measures may be needed if the corrosion protection included painting over galvanizing. If nothing of note was found, spray "cold galvanizing" compound or zinc rich paint, after properly cleaning or preparing the surface, on any area where galvanizing was removed. Using a 4-ft level, check the plumbness of the upright in every direction and note any lean in the structure (e.g., "1/4 in 4ft away from traffic, towards traffic, with or against traffic). Also record any case of missing or loosely covered handhole.

Table 11-11: Frangible and Non-Frangible Pole Structure Vertical Support Column (Upright) Element Distresses

Element Number	Element	Description	Associated Distresses
21203	Vertical Support Column (Upright)	Vertical Support (Upright) for frangible and non-Frangible pole structure	Corrosion or coating damage
			Weld defect or crack
			Impact damage
			Out of plumb
			Missing handhole cover or post cap
Unit of Measure: Length, inch of vertical support within each condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

Figure 11-18: Non-frangible pole structure vertical support column (upright), coating system failure and corrosion in upright at base weld (left), corrosion inside column (right)

Figure 11-19: Non-frangible pole structure vertical support column (upright), dent

Figure 11-20: Non-frangible pole structure vertical support column (upright), loosely covered handhole

Figure 11-21: Non-frangible pole structure vertical support column (upright), visual identification of out of plumb pole (left), measurement of pole plumbness (right)

11.4.2.5 Frangible and Non-Frangible Pole Structure Vertical Structure Connections Condition States

Most connections are either bolted or welded. Stainless steel arm connection bolts require a flat washer and a lock washer on the nut end. Typical issues include loose bolts and nuts, weld discontinuities, galvanizing damage, flange connection gaps, missing washers, and missing end caps. Binoculars are used as a visual aid to inspect the connections of vertical supports when closer access through equipment or climbing is not possible. Note any gaps between steel in the bolted connections, cracked welds, and cracks at the ends of gusset plates. Record any bolting components that are missing, deteriorated, or damaged. Record any signs of corrosion.

Table 11-12: Frangible and Non-Frangible Pole Structure Vertical Structure Connections Element Distresses

Element Number	Element	Description	Associated Distresses
21204	Vertical Structure Connection	Bracket assemblies, pole band clamps, stainless steel straps, through bolts, or other connections to frangible and non-frangible pole structure	Weld defects or cracks
			Corrosion or coating damage
			Loose, missing, or failing hardware
Unit of Measure: Each connection quantity within the condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Frangible and Non-Frangible Pole Structure Condition State Tables

Figure 11-22: Frangible and non-frangible pole structure vertical structure connections, gap at arm flange (left), loose arm connection bolt (right)

11.4.3 HORIZONTAL STRUCTURE ROUTINE INSPECTION

The horizontal elements directly support the luminaire and other attachments. The routine inspection assesses the horizontal structure's ability to safely support all the attachments and transfer loads to the vertical support structures. The routine inspection is performed on a regularly scheduled basis, with frequency determined by AS type, and includes the horizontal structure component rating as determined by the element condition ratings. It consists of observations and measurements needed to determine the physical and functional condition of the horizontal structure, to identify any changes from initial or previously recorded conditions, and to ensure that the horizontal structure continues to satisfy present service requirements. Visually inspect all elements of the component at a distance close enough to determine the overall condition and to detect deficiencies. Unless a mechanical lift or climbing or other means of working at heights (i.e., UAS) are utilized, binoculars are used as a visual aid to inspect the horizontal structures.

A sample routine inspection would consist of:

- Inspect the vertical clearance of the horizontal structure and its attachments, the alignment, and the operational function.
- Inspect luminaires and luminaire arms or other arms for any cracked welds, or other deterioration.
- Check attachments to the horizontal structure for connections that are loose, missing, deteriorated or otherwise deficient.
- Provide photographs for all Poor or Severe condition state defects and submit the applicable Work Recs or RFAs.

11.4.3.1 Horizontal Structure Component Ratings

The component rating for the horizontal structure depends on the condition of the horizontal members, their internal connections, the attachments, and connections to the attachments. Assessing these factors with respect to the overall ability of the horizontal structure to safely support the attachments and transfer loads to the rest of the structure provides the appropriate component rating.

Table 11-13: Component Rating Guidelines for Frangible and Non-Frangible Pole Structure Horizontal Structure

Component Rating	Condition	Material	Description
9	NEW	All	No deficiencies in any of the structural components that will affect long term performance.
8	VERY GOOD	All	All structural components are sound and functioning as designed. There may be superficial cracking or weathering of protective components and/or dirt contamination of structural components.
7	GOOD	Concrete	Insignificant cracks or moderate cracks that are sealed.
		Steel/Aluminum	Protective coating failure in very small and scattered locations.
		All	All components retain full section properties and function as designed.
6	SATISFACTORY	Concrete	Unsealed moderate-width or map cracks. Minor delamination or spalling.
		Steel/Aluminum	Pole protective coating failures is limited to less than 10% of the surface area with no loss of section. Surface corrosion with no section loss of span wire or attachment connections.
		All	Minor deterioration affecting structural components.
5	FAIR	Concrete	Moderate delamination or spalling.
		Steel/Aluminum	Minor loss of section. Loose fasteners may be present but the connection is in place and functioning as intended.
		All	Moderate deterioration affecting structural components including minor settlement, or impact damage. Moderate misalignment. All members continue to function as designed.
4	POOR	Concrete	Considerable cracking and spalling.
		Steel/Aluminum	Up to 25% loss of section. Span wire may have minor fraying or attachments may have less than 17 ft of vertical clearance. Fasteners may be considerably deteriorated.
		All	Considerable deterioration affecting structural members. Structural review may be warranted.

Component Rating	Condition	Material	Description
3	SERIOUS	Concrete	Extensive cracking and spalling.
		Steel/Aluminum	Section loss in excess of 25%. Missing or broken fasteners or excess sagging of the span wire.
		All	Considerable deterioration or damage affecting structural members. Structural evaluation is necessary to determine if the structure can continue to function without repairs.
2	CRITICAL	All	Deterioration has progressed to the point where the structure will not support design loads and emergency repairs, or removal is required.
1	IMMINENT FAILURE	All	Road is closed to traffic due to imminent failure, but corrective action may put it back in service.
0	FAILED	All	Road is closed due to condition. Notify Region and the Bureau of Bridges and Structures.

11.4.3.2 Luminaire and Luminaire Arm Element Condition States

Inspectors shall visually inspect the luminaire and luminaire arm for any loose, missing, cracked, ruptured or broken arm or luminaire head. Check for loose or missing end cap and identify any danger of falling luminaire. Check for corrosion and peeling. Note any galvanizing damage and the degree, if any, of corrosion on the base metal. If nothing of note is found, spray “cold galvanizing” compound or zinc-rich paint on any area where galvanizing was removed. Use binoculars as a visual aid to inspect arms or truss members when closer access with equipment or climbing is not possible.

Table 11-14: Frangible and Non-Frangible Pole Structure Luminaire and Luminaire Arm Element Distresses

Element Number	Element	Description	Associated Distresses
21301	Luminaire and Luminaire Arm	Lighting sources, fixtures and assemblies, bracket arms, truss arms, tenon mounts, shepherds crooks, or other pole mounting devices	Broken lighting source or assembly
			Damaged or cracked housing, cover
			Corrosion or section loss
			Weld cracks/defects
			Deteriorated gasket/seal
Unit of Measure: Each luminaire and luminaire arm within the condition state			

Details on the condition state rating schema are in Section 11.7, linked below:

Figure 11-23: Luminaire and luminaire arm element, evidence of galvanizing damage

Figure 11-24: Luminaire and luminaire arm element, missing luminaire head

11.4.4 REFERENCES

***Light Standard Details are currently unpublished

MDOT Frangible Light Standard Installation Inspection Procedure

MDOT Non-Frangible Light Standard Installation Inspection Procedure, describing UT and Sounding Testing

Pole Dent & Buckling Calculations

AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 2015 (AASHTO Signs)

11.5 Work Recommendation Guidance

Frangible and Non-Frangible Structure Work Recs are recorded to initiate preventive maintenance actions. These Work Recs are presented on the Ancillary Structures (AS) Inspection Report Form. Loose bolts are frequently the cause of Work Recs. Typically, isolated or limited loose or missing bolts would qualify as a Work Rec but could increase to an RFA if bolt conditions worsened with time.

Additional Work Recs include repairing or monitoring foundation, replacing base cover or transformer base, repairing galvanizing or paint, and replacing luminaire, luminaire arm or luminaire arm connections.

Lighting support structures are not designed to have attachments other than the luminaire itself. Record and document any attachments to the vertical member and create a Work Rec to remove unauthorized attachments. Solar panels that power the lights are excluded from this as they are designed to be part of the structure.

The Work Recs are not meant to be all-inclusive and other Work Recs may be added to supplement those noted.

Photographs should include sufficient information to determine the relationship of the defect to the element or component or entire structure. Close-up photos of each defect with connection deficiencies marked on the photo should be provided.

Table 11-15: Frangible and Non-Frangible Pole Structure Work Recommendations

Code	Name	Material Involved	Quantity/Unit of Measure
1	Repair guardrail (protecting pole)	Galvanized Steel	Linear Feet
2	Correct erosion at foundation (prevent undermining)	Stone/Soil	Cubic Feet
3	Repair/monitor foundation	Concrete	Cubic Feet
4	Tighten leveling nut	Galvanized Steel	Each nut
5	Replace transformer base cover	Aluminum	Each cover
6	Address loose transformer base nuts	Galvanized Steel	Each nut
7	Replace transformer base	Aluminum	Each base
8	Replace baseplate to transformer base bolts	Galvanized Steel	Each bolt
9	Repair/replace handhole cover	Galvanized Steel	Each cover
10	Remove non-MDOT or unauthorized attachments to structures	Various	Each item
11	Remove graffiti	N/A	Square Foot
12	Repair galvanizing	Galvanic Paint	Square Inch
13	Repair paint	Metal Coating System	Square Foot
14	Address loose bolts	Galvanized Steel	Each bolt
15	Weld repair	Steel	Each weld
16	Replace pole cap	Galvanized Steel	Each cap
17	Replace pole cap bolt	Galvanized Steel	Each bolt
18	Replace luminaire	Various	Each luminaire
19	Replace luminaire arm/tenon	Steel or aluminum	Each arm/tenon
20	Replace arm/tenon connection	Steel or aluminum	Each connection
21	Replace bracket assembly	Galvanized Steel	Each assembly
22	Replace misc. attachment connecting appurtenance	Various	Each attachment
23	Permanently remove cap	Steel or aluminum	Each cap

11.6 Request for Action Guidance

Examples of applicable priority level items include, but are not limited to:

Priority 1 Level Items

a. Major foundation deterioration including concrete cracking/spalling/delamination, thread damage, steel reinforcement corrosion, anchor bolt corrosion, ultrasonic test failure, failure of anchor bolts, and significant section loss of steel reinforcement or anchor bolts

b. Major soil erosion or undermining of the foundation element(s) evidenced by lateral displacement or vertical out of plumbness

c. Major base plate distortion or section loss around anchor bolts

d. Frangible transformer base with broken tabs or tabs not engaged by anchor nuts (Frangible pole structures only)

e. Frangible base connections with broken or missing bolts, or bolts with less than 50% of nut engagement.

f. Standoff distance more than twice the bolt diameter, where bending of anchor bolts is evident (non-frangible pole structures only)

g. Multiple loose or missing bolts in a high strength bolted connection, anchor bolt connection, or luminaire arm connection

h. Multiple loose or missing bolts where connections do not have load-path redundancy and bolt tensioning is not possible

i. Loose or missing nut at 1 anchor bolt on a 4-bolt foundation

j. Major cracks present in the base metal or weld(s) on the base plate to column connection or for single column supports or the column to luminaire arm connection

k. Major section loss due to corrosion of a main element which impacts the capacity or short-term resiliency of the element or structure

l. Cracked or failing tenon/bracket assembly/luminaire mounting device

m. Presence of major cracks or active corrosion on main members (base metal) or connections (bolted or welded) where presence of new or recent cracking shows non-corroded, minimally corroded, or progressively corroded-cracked steel surfaces is observed as opposed to a heavily corroded-cracked surfaces which have been present for some time

n. Major structural damage to foundation, anchor bolts, transformer base, upright, or other elements, which impacts capacity and/or function, clearance, safety, and/or short-term resiliency of the structure

o. Pole is out of vertical alignment when the lean is greater than 4.75” over 4 feet (or about 10%)

Priority 2 Level Items

a. Significant foundation deterioration including concrete cracking/spalling/ delamination, steel reinforcement corrosion and section loss

b. Significant soil erosion or undermining of the foundation

c. Significant base plate distortion or section loss around anchor bolts when the lean is between 3.375” to 4.75” over 4 feet (or about 7% to 10%)
d. Pole is significantly out of vertical alignment
e. Significant corrosion of primary elements or connections is present
f. Standoff distance more than twice the bolt diameter where no bending of anchor bolts is evident (non-frangible pole structures only)
g. Frangible transformer base with tabs partially engaged by anchor nuts and/or bolts are misaligned (frangible pole structures only)
h. Loose bolts in a high strength bolted connection, anchor bolt connection, or luminaire arm connection where there is acceptable load-path redundancy, but significant impact to capacity or durability
    - When flat washers are present and the structure has six or fewer anchor bolts, two dull anchors are recorded as an RFA Priority Level 2
i. Frangible base connection bolts with 50% to 100% nut engagement.
j. Significantly loose or misaligned tenon/bracket assembly/luminaire mounting device
k. Significant weld deficiencies that have not initiated cracking but do not meet current code or will lead to Priority Level 1, but acceptable redundancy and/or resiliency is present
l. Structural cracks in secondary members that could potentially propagate through welded connections into main members
m. Incident resulting in significant structural dents above the actionable level according to the Pole Dent & Buckling Calculations guidance document

Priority 3 Level Items

a. Localized moderate foundation deterioration including concrete cracking/spalling/delamination, or exposed steel reinforcement, but section loss is negligible
b. Moderate erosion around the foundation
c. Moderate corrosion of the base plate, which includes moderate section loss
d. Moderate corrosion of the anchor bolt connections or high strength bolted connections
e. Pole is moderately out of vertical alignment when the lean is between 2.375” to 3.375” over 4 feet (or about 5% to 7%)
f. Standoff distance more than one bolt diameter but less than two bolt diameters where no bending of anchor bolts is evident (non-frangible pole structures only)
g. Moderate weld deficiencies, which do not meet code but do not impact function where significant redundancy is also present
h. Misaligned tenon/bracket assembly/luminaire mounting device
i. Loose or missing nuts or other elements of a bolted connection assembly where there is adequate redundancy and moderate impact to structural capacity or durability

- When lock washers are present, and the washer is compressed with the nut tightened, a dull anchor is not considered an RFA. However, if the nut is loose, it falls under the current RFA guidelines for loose nuts.
- When flat washers are present and the structure has six or fewer anchor bolts, one dull anchor is recorded as an RFA Priority Level 3.

j. Transformer base with tabs not fully engaged by anchor nuts (Frangible pole structures only)

11.7 Element Condition States

21101	Concrete Foundation	Use the appropriate condition state table.	Concrete Foundation Element Condition States
21102	Anchor Bolts and Leveling Nuts	Use the appropriate condition state table. Use UT testing result to assist in the condition assessment.	Anchor Bolt and Leveling Nuts Foundation Element Condition States
21103	Frangible Base	Use the appropriate condition state table. Use for Frangible pole structures only.	Frangible Transformer Base Element Condition States
21201	Frangible Base Connections	Use the appropriate condition state table. Use for Frangible pole structures only.	Frangible Base Connections Element Condition States
21202	Base Plate	Use the appropriate condition state table.	Frangible and Non-Frangible Pole Structure Base Plate Element Condition States
21203	Vertical Support Column	Use the appropriate condition state table.	Frangible and Non-Frangible Pole Structure Vertical Support Column (Upright) Condition States
21204	Vertical Structure Connections	Use the appropriate condition state table.	Frangible and Non-Frangible Pole Structure Vertical Structure Connections Condition States
21301	Luminaire and Luminaire Arm Connections	Use the appropriate condition state table.	Luminaire and Luminaire Arm Element Condition States

Elements 21101 – Concrete Foundation

Description	This element defines a concrete foundation for a steel strain pole, regardless of foundation type such as drilled shaft or reinforced concrete pile.			
Quantity Calculation	The quantity is collected in each.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Concrete Foundation Defects	The concrete shows no deterioration. Superficial cracking, discoloration, or efflorescence may be present. No exposed reinforcing or impact damage.	Minor cracks and/or spalls may be present in the concrete. No exposed reinforcing or embedment erosion or impact damage.	Moderate cracks and/or spalls may be present. Some reinforcing may be exposed. Incidental loss of section or surface pitting of reinforcing may be present. Element may show evidence of some embedment erosion or impact damage.	Major cracks and/or spalls are present. Major corrosion of exposed reinforcing. Extensive steel and/or concrete loss or embedment erosion is present. Major impact damage may be present.

Elements 21102 – Anchor Bolts and Leveling Nuts

Description	Anchor bolts and leveling nuts attaching the upright to the foundation.			
Quantity Calculation	The quantity for this element is each anchor bolt and nut unit.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Anchor Bolt and Leveling Nut Defects	There is no deterioration. The elements are fully engaged. For non-frangible pole structures, the anchor bolt standoff distance is less than 1". The sounding test produces a sharp ringing sound. For frangible pole structures lock washers are fully compressed. No evidence of impact damage	Minor corrosion of the elements may be present. The elements are fully engaged and functioning as intended. For non-frangible pole structures, the anchor bolt standoff distance is less than 1". The sounding test produces a sharp ringing sound. For frangible pole structures lock washers are fully compressed. No evidence of impact damage.	Moderate corrosion/section loss of the elements may be present. Anchor nuts may not be fully tightened. For non-frangible pole structures, anchor bolt standoff distance is greater than 1" but less than two times the bolt diameter. The sounding test produces a dull sound. For frangible pole structures a lock washer may be missing or not fully compressed. A nut may not fully engage the frangible transformer base. Some evidence of impact damage may be present.	Severe corrosion/section loss of the elements may be present. Nuts or washers are loose/missing. For non-frangible pole structures, anchor bolt standoff distance is greater than two times the bolt diameter. The sounding test produces a dull sound. UT testing indicates cracks or breaks in bolts. For frangible pole structures multiple nuts may not fully engage the base. Major evidence of impact damage may be present.

Elements 21103 – Frangible Base

Description	Frangible base which connects the upright element to the foundation which is designed to break away or yield when a vehicle impact occurs to a frangible pole structure.			
Quantity Calculation	The quantity is collected in each.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Frangible Base Defects	New or like-new condition with no deficiencies. The inside of the base is free of excess moisture, debris, and corrosion.	Minor corrosion or superficial damage may be present. The inside of the base may contain minor moisture and debris. Minor gaps may be present between the base and foundation.	Moderate corrosion/section loss, wear or damage is present. Moisture and debris may be present inside the base creating moderate corrosion and/or section loss. Moderate gaps may be present between the base and the foundation.	Major corrosion/section loss or damage is present. Major debris and moisture present inside the base. Cracks are present in the base or base tabs. Major gaps may be present between the base and foundation.

Elements 21201 – Frangible Base Connections

Description	This element defines the connections connecting the upright to the frangible base for a frangible pole structure.			
Quantity Calculation	The quantity for this element is measured as “each.”			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Frangible Base Connections Defects	New or like-new condition with no deficiencies. Lock washers are fully compressed. Ends of bolts are at least flush with top surface of nuts.	Minor corrosion or superficial damage may be present. Lock washers are fully compressed. Ends of bolts are at least flush with top surface of nuts.	Moderate corrosion/section loss, wear or damage is present. A lock washer may be missing, or not fully compressed. The flat washer may be deformed or not fully cover the bolt hole. The end of a bolt may not be at least flush with the top surface of the nut, but at least 75% of the threads are engaged.	Major corrosion/section loss or damage is present. Nuts or bolts are broken or missing. Bolt engages less than 75% of the threads of the nut.

Elements 21202 – Base Plate

Description	Base plate which connects the upright element to the anchor bolt and leveling nut element.			
Quantity Calculation	The quantity for this element is each base plate.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Base Plate Defects	No evidence of active corrosion. Surface coating is sound.	Minor surface corrosion or superficial damage may be present. Protective coating failure with no section loss. Base element welds have no evidence of defects.	Moderate corrosion/ section loss may be present. Protective coatings are failing. Base element welds have no evidence of defects and/or cracking. Base plate may exhibit minor warping.	Major corrosion/section loss is present. Base element welds may have cracks/defects. Base plate has moderate to major warping.

Elements 21203 – Vertical Support Column (Upright)

Description	This element is defined by all upright supporting a frangible or non-frangible pole structure.			
Quantity Calculation	The quantity is collected in length in feet of vertical support.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Vertical Support Column (Upright) Defects	No evidence of active corrosion. Surface coating is sound.	Minor corrosion or superficial damage of the elements may be present. Protective coating failure with no section loss. No element weld defects or cracking are evident.	Moderate corrosion/ section loss may be present. Protective coatings are failing. Element welds have no evidence of defects and/or cracking. Support may be out moderately of plumb.	Major corrosion/section loss is present. Protective coatings are significantly failing. Element welds may have cracks/defects. Support may be majorly out of plumb.
Impact Damage	No damage caused by vehicular impact.	The element has minor damage caused by vehicular impact.	The element has moderate damage caused by vehicular impact.	Impact damage is major and affects the integrity of the structure.
Handhole Defects	Handhole cover and attachment to pole is securely fastened. The inside of the pole is free of excess moisture, and debris.	Handhole cover is in place but loosely fastened or minimally damaged. Handhole attachment to pole may have minor deficiencies. The inside of the pole may contain minor moisture and debris.	Handhole cover is moderately damaged or missing fasteners. Handhole attachment to pole may have moderate deficiencies. Moisture and debris may be present inside the pole creating moderate corrosion and/or section loss of material.	Handhole cover is missing or majorly damaged. Handhole attachment to pole is failing. Moisture or debris inside the pole is creating major corrosion and/or section loss of material.

Elements 21204 – Vertical Structure Connections

Description	This element consists of the connections along the upright for various attachments.			
Quantity Calculation	The quantity to be collected includes each connection location.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Vertical Structure Connection Defects	New or like-new condition with no deficiencies.	Minor surface corrosion, wear, or superficial damage may be present. The connection is functioning as intended. Hardware is fully engaged. No gaps are present.	Moderate corrosion/section loss or wear is present. Hardware is fully engaged. Gap may be present at bolted connection, but bolts are tight. The conditions do not significantly affect serviceability and/or function.	Major corrosion/section loss is present. Protective coatings are significantly failing. Members may have cracks/defects or major wear. Hardware is loose or missing. Connection is not functioning as intended.

Elements 21301 – Luminaire and Luminaire Arm

Description	This element consists of lighting sources, fixtures and assemblies, bracket arms, truss arms, tenon mounts, shepherds crooks, or other pole mounting devices.			
Quantity Calculation	The quantity is collected as each luminaire and luminaire arm unit.			
	Condition State Descriptions			
Defect Type	**Good**	**Fair**	**Poor**	**Severe**
Luminaire and Luminaire Arm	Lighting source, housing/cover, waterproofing-gasket/seal, and arm or mounting device do not have evident wear or corrosion and are functioning as intended.	Gasket/seal may have minor deterioration. Lighting source, housing/cover, arm, and connections may have minor wear or corrosion.	Gasket/seal may be moderately deteriorated. Lighting source, housing/cover, arm, and connections may have moderate wear or corrosion, but the conditions do not significantly affect serviceability and/or function.	Major deterioration of gasket/seal is present. Lighting assembly or hardware is broken or missing. Major failure of protective coatings or corrosion/pitting/section loss is present. Welds have cracks/defects. Element is not functioning as intended.