
5 EMBEDDED POLE

5.1 Definitions

Embedded poles are used to support span wires, signals, lighting, cameras, or other appurtenances. They are constructed in a box span, diagonal span, or other type of configuration. Embedded poles may be constructed of round or multi-sided steel cross-sections, or timber. The poles are directly embedded in soil or cast in place concrete. The embedment material may be covered with concrete, bituminous, or masonry materials.

Other common terms which may be used when discussing Embedded Pole or other AS include:

- **Anchor Wires:** A tensioned cable designed to add stability to a free-standing structure. Often used for embedded poles to support unbalanced lateral loads. Embedded poles typically have a strain insulator near the top of the guy wire to mitigate voltage.
- **Camera:** A camera is a device that captures images or videos. A device that is both camera and sensor would classify as a camera (i.e., video detection).
- **Sensor:** A sensor is a device that detects and measures changes in traffic or environment. (e.g., atmospheric sensors).
- **Appurtenance:** An appurtenance is an attachment connected to the structure that does not constitute a rated element and is neither a camera nor a sensor (e.g., roadside unit, cell modem, antenna, radio antenna, signs, pedestrian signals, electrical utilities, etc.).

Figure 5-1: Embedded wood poles with box span configuration



Figure 5-2: Embedded steel poles with single span configuration



Figure 5-3: Embedded wood pole supporting ITS infrastructure



5.1.1 INVENTORY ITEMS

The inspector shall identify the pole and embedment material types. The pole may be constructed of timber or steel, and the latter may have a round cross-section or may be multi-sided. Embedded poles with round or multi-sided steel cross-sections are no longer being installed.

If the pole is steel, determine the type of coating – paint, galvanizing, or uncoated. The embedment material should be soil or concrete, although it may sometimes be covered by concrete sidewalk, masonry or pavers, or bituminous paving. Identify whether the pole is part of a configuration of poles and span wires such as a box span, if it is a single span between two poles, or if it is a single stand-alone pole. When a span wire is present, half of the span wire and whatever is attached to that half is assigned to each pole. The pole may support a variety of attachments, both directly and indirectly, including span wires, luminaires and luminaire arms, signs, signals, cameras, and other ITS infrastructure or power supply infrastructure. The quantity and type of these attachments and their connections to the structure should be noted. The types of connections may include direct bolting, bands, clamps, or brackets. Non-structural attachments such as signs, signals, and cameras receive ratings under Miscellaneous Arm, Bracket, and Attachment, and should

be reported appropriately if they pose a safety risk. Length and type of bracket arm should be recorded when applicable. The connections of these attachments to the structure are to be rated.

The inspector shall note and record the presence of any secondary support elements of the pole such as anchor wires, and also note and record the presence of any non-typical attachments that may not have been approved or been part of the original purpose or function of the pole.

Some embedded poles should not be included as inventory items as they are not under MDOT ownership. If there are two wood poles that only support a suspended luminaire, it is considered to be owned and operated by the power company, not part of the AS program.

Figure 5-4 Example of Excluded Embedded Poles as Inventory Items



If there are signals on a span wire and if there is a second span wire with luminaire above the signals, the presence of the suspended luminaire should be noted in the inventory.

Figure 5-5 Example of Second Span Wire with Luminaire



The inspector shall confirm any pre-populated inventory data while recording information that is not already documented. It may not be possible to record or verify all measurements exactly due to access limitations; estimate and use experience and best judgement to record data to the most accurate extent possible. Take photos of the required inventory items listed in Section 5.2.2. A complete list of inventory items is provided in the Ancillary Structures Data Dictionary.

5.1.2 ELEMENTS

Embedded poles (steel and wood) are divided into two components: Vertical Structure and Horizontal Structure.

Vertical Structure is further divided into elements: Pole and Embedment, Anchor Wire, and Vertical Structure Connections.

Horizontal Structure is further divided into elements: Span Wire, Span Wire Attachment Connections, Luminaire and Luminaire Arm, and Miscellaneous Arm, Bracket, and Attachment.

Elements are assigned a condition state described in Section 5.7 based on the distresses identified in each element.

The following guidelines for consistent location notation provide the framework for rating an embedded pole element in accordance with the condition rating tables:

- Vertical Structure Locations - Distress locations along the embedded vertical support are referenced by using offsets measured from the grade as measured in feet and prominent features (e.g., span wire connection).
- Horizontal Element Locations - Distress locations along the span wire or arm length are referenced by using offsets measured from the vertical support end. For span wires, half of the span wire length is assigned to each vertical support, along with any attachments along that length.
- Attachments on Span Wires or Arm Members - Attachments are identified in relationship to directionality (e.g., North/South, East/West, Right End/Left End looking at front of signal or sign, or Right/Left looking upstation or downstation).
- Other – When possible, identify other elements in relation to the defined elements above. Otherwise, photograph location and document distress. Annotate drawings and photos, as necessary.

Table 5-1: Embedded Pole Components and Elements

Component	Element	Element Code	Unit of Measure
Vertical Structure	Pole and Embedment	15101	Length, feet
Vertical Structure	Anchor Wire	15102	Each
Vertical Structure	Vertical Structure Connections	15103	Each
Horizontal Structure	Span Wire	15201	Each
Horizontal Structure	Span Wire Attachment Connections	15202	Each
Horizontal Structure	Luminaire and Luminaire Arm	15203	Each
Horizontal Structure	Miscellaneous Arm, Bracket, and Attachment	15204	Each

5.1.3 COMPONENTS

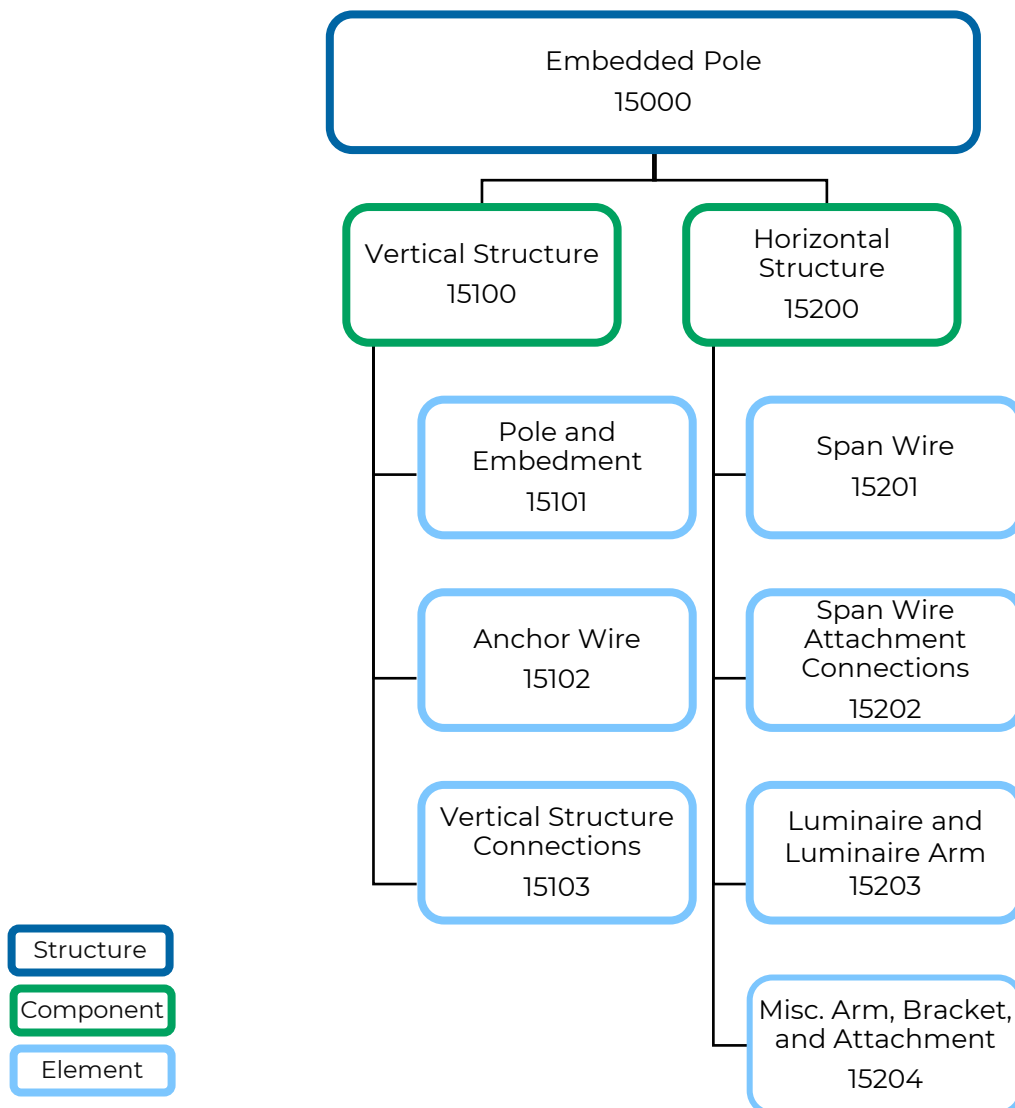
Embedded Poles are divided into two main components: Vertical Structure and Horizontal Structure. Component ratings for embedded poles are based on the following:


- **Vertical Structure** - Consider if the vertical structure may have damage that compromises the structural capacity such as cracking, fractured welds or base metal, deformation, corrosion, section loss, lack of embedment support, or fraying/damaged anchor wires.
- **Horizontal Structure** - Consider fractures in welds or base metal, corrosion, section loss, vertical clearance, fraying of wires, or advanced deterioration as critical to the overall horizontal structure.

A representation of the rating structure for embedded poles is provided in

Figure 5-6. A graphic indicating components and elements is in Figure 5-7 and Figure 5-8 for wood and steel embedded poles, respectively.

Figure 5-6: Rating structure for Embedded Poles





**Figure 5-7: Elements and components for Embedded Pole, Wood Pole material
(adapted from MDOT Standards SIG-010A, SIG-050A, SIG-060A, SIG-061A)**

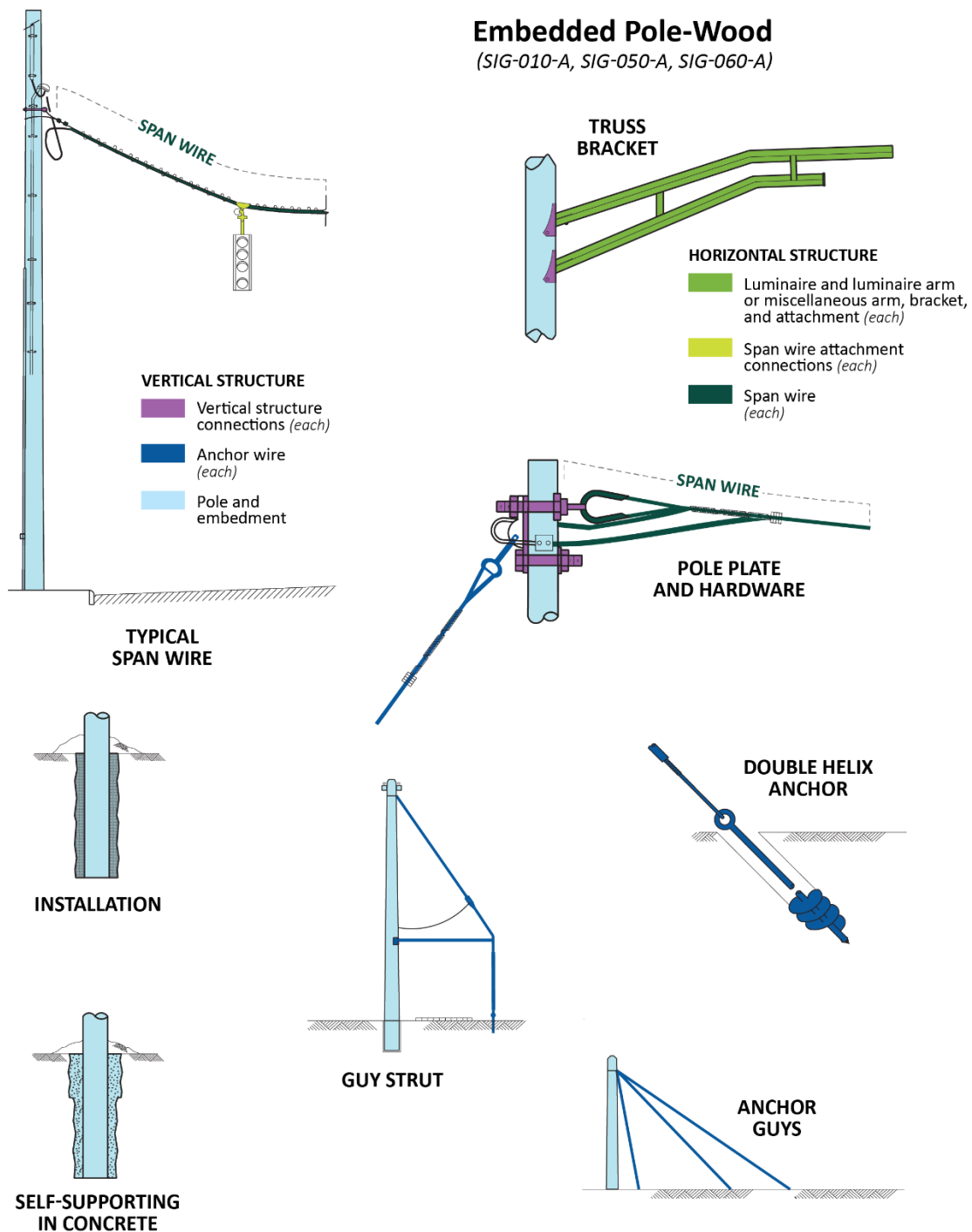
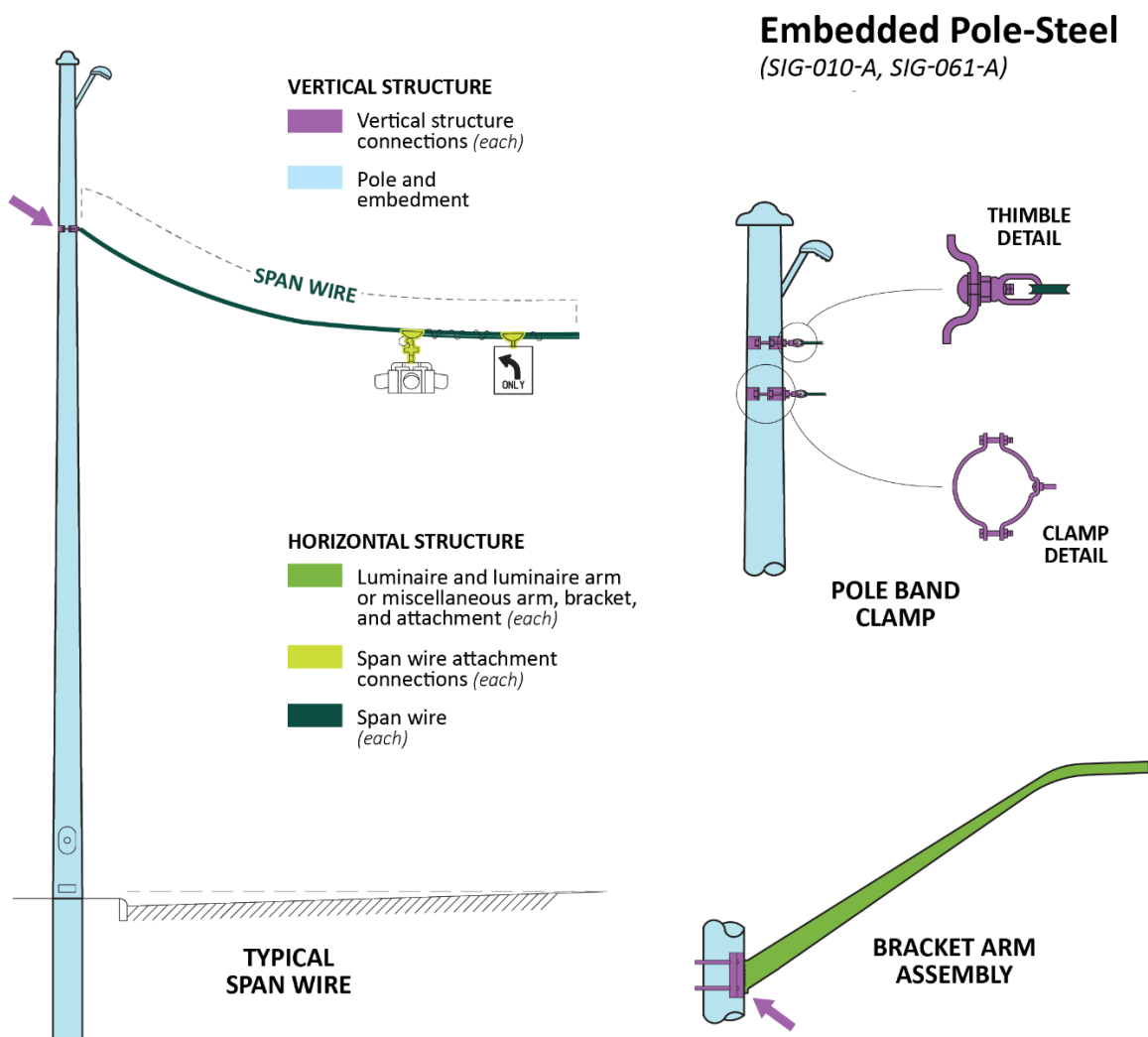


Figure 5-8: Elements and components for Embedded Pole, Steel Pole material (adapted from MDOT Standards SIG-010A, SIG-060A, SIG-061A)



5.2 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 5-2*.

Embedded Pole Required Photos:

- General view of the entire pole
- Each foundation (if applicable)
- General view of guy wires (if applicable)
- Structure number stenciled on support
- Manufacturer plate (if applicable)

Table 5-2: Embedded Pole Photograph Naming Convention

Photo Name	Description
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EmbPole_Entire	Entire embedded pole
EmbPole_VH#*_Connection	Vertical to horizontal connection
EmbPole_Lum	Luminaire and luminaire arm
EmbPole_ID	Old ID and new structure number
EmbPole_Attachment Name	Replace "Attachment Name" with attachment or appurtenance (e.g. sensor, camera, etc.)

***The # in photo naming convention should reflect the sequential number ranging from 1-x. One image is acceptable if all connections can be captured in a single image that provides enough detail to determine connection type and bolts/nuts. If this level of detail cannot be obtained in a single image, multiple photos are necessary to provide required level of visibility.**

5.3 Inspector Minimum Technical Qualifications

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

- Ancillary structures inspection procedures training
- Working knowledge of inspection tools, their use, application, and limitations for the structure type being inspected.
- Experience with anticipated material types such as wood, concrete, or steel. Internal training will address inspection procedures for all anticipated material types.

5.4 Routine Inspection

These inspections should assess embedded pole structures. Embedded poles are used to support signs, signals, and other appurtenances, most commonly on non-freeway routes. Damage or deterioration of embedded pole structures may impact function or safety.

In many cases, embedded poles are installed at intersections, where they comprise a box span or other geometric configuration. Embedded poles are distinguished from steel strain poles in that they do not have a concrete foundation to support the pole structure, they are embedded directly in the soil, with either soil or concrete filling the space between the edge of the drilled hole and the pole. As such, the interaction between the pole structure and adjacent soil plays a key role in assessing the overall condition of the asset.

Embedded pole standard inspection frequency is once every 4 years for wood poles, and once every 2 years for steel 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.

Figure 5-9: Embedded wood pole (left) and embedded steel pole (right)



5.4.1 VERTICAL STRUCTURE ROUTINE INSPECTION

Routine inspection of the vertical structure is conducted from the ground. Binoculars should be used as a visual aid for inspecting the top of the pole and connections.

- Inspect the general site conditions and assess the global stability of the structure and its operational function.

- Check around the base of the pole for erosion or soil displacement. If the pole is embedded in concrete inspect the concrete for deficiencies such as cracks and spalls, and for any voids between concrete and soil or between the pole and the soil/concrete.
- 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.
- If sidewalk or other material covers the embedment material check for signs of separation, settlement, or cracking at the surface.
- 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.
- For steel poles: inspect the protective coating – galvanizing and/or paint and note any corrosion or section loss. The base of embedded poles is especially prone to corrosion and should be checked carefully. An ultrasonic testing device or thickness gauge should be used to verify the wall thickness when signs of corrosion are present.
- Check for any cracks or deformations in the steel noting the size of deficiencies.
- For wood poles: inspect the timber for signs of deterioration such as cracking, splitting, or section loss noting the size or extent of deficiencies. Perform sounding of cracked areas to determine extent of delamination. Photograph the depth of decay measurement.
- Check for signs of vehicle damage noting that impact in one location may affect the structure in other locations as well.
- Inspect any secondary support of the pole such as anchor wires, guy struts, etc. Check for any corrosion and section loss, looseness or deterioration of connections, and anchorage condition.
- Inspect the connection to the pole of the horizontal structure – span wires and arms. This includes band clamps, brackets, and other bolted assemblies. Check for connections that are loose, missing, deteriorated or otherwise deficient.
- Review welds for signs of cracking.
- Check the base for signs of damage from maintenance equipment.
- Check for pole dents and buckling (refer to pole dents & buckling calculations).
- Provide photographs for all Poor or Severe condition state defects and submit the applicable Work Recs or RFAs.

5.4.1.1 Vertical Structure Component Ratings

The embedded pole's vertical structure overall characteristics are rated on its structural condition, ability to support the horizontal structure, and possible negative impact to the entire structure, its operation, or the adjacent roadway. The pole embedment, pole structure, and connections to the pole are all considered as part of the component rating. When evaluating distresses consider that different distresses and the location on the structure at which they occur are not of equal importance to the pole's function. The predominant characteristics determining overall condition are stability and resiliency.

Consider if the pole has stable support in the embedment material, a robust and consistent pole cross-section, and the horizontal structure is securely fastened.

Table 5-3: Component Rating Guidelines for Embedded 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.
		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.
		All	All components retain full section properties and function as designed.
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.
		Concrete	Insignificant cracks or moderate cracks that are sealed.
		Soil	Insignificant displacement or erosion of soil.
7	GOOD	Steel	Protective coating failure in very small and scattered locations.
		All	All components retain full section properties and function as designed.
		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	Protective coating failures is limited to less than 10% of the surface area with no loss of section.
5	FAIR	All	Minor deterioration affecting structural components. Minor misalignment.
		Concrete	Moderate delamination or spalling.
		Soil	Moderate displacement or erosion of soil. Minor gaps may be present between pole and embedment material.
4	POOR	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.
		Concrete	Considerable cracking and spalling.
4	POOR	Soil	Considerable displacement or erosion of soil.
		Steel	Protective coating failure and less than 25% loss of section. Cracks may be present. Fasteners may be considerably deteriorated. Considerable impact damage.
		All	Considerable deterioration or misalignment affecting structural members. Structural review may be warranted.

Component Rating	Condition	Material	Description
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 or broken fasteners or extensive cracking in pole.
		Timber	Extensive decay, section loss, checks, shakes, or splits.
		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 condition. Notify Region and the Bureau of Bridges and Structures.

5.4.1.2 Pole and Embedment Element Condition States

Start by inspecting the condition of pole embedment material around the base of the pole. Identify whether the pole is embedded directly into the soil or has cast in place concrete around it. The concrete may be below the soil surface and a soil probe may be necessary. Signs of soil erosion, soil that has been displaced, or settlement are conditions that could impact the support of the pole. A gap between the pole and adjacent soil may also indicated that the pole has moved. If the embedment soil is covered by bituminous paving, concrete sidewalk, or masonry pavers look for signs of settlement, cracking, or other distress at the surface which may indicate issues below.

If the pole is wood, inspect the timber for the various types of deterioration such and splits, checks, shakes, decay, etc. Check for misalignment or crooks or sweep in the pole and note if pole is out of plumb. Pay close attention to the timber at the soil surface and slightly below as it may be more deteriorated. Note the quantity or extent of the deterioration and its location on the structure. Check for signs of impact damage. If the pole has a handhole, the handhole should be free from excess moisture and debris. The handhole cover should be securely fastened, and the hand hole frame should be inspected for any crack in the welds or base metal, along with any other welded components.

Figure 5-10: Minor crook in wood pole



Figure 5-11: Wood pole embedment (left), steel pole embedment (right)



Figure 5-12: Measuring pole misalignment with a 4 ft. level



Figure 5-13: Measuring impact damage



If the pole is steel, check for the associated steel deterioration types and note the quantities and locations. Check for misalignment and note if pole is out of plumb. Also check for impact damage. For corrosion, pay special attention to the condition of the pole at the ground surface as corrosion tends to accelerate in that location. When corrosion is present at the base of the pole and section loss is suspected, use a thickness gauge or ultrasonic testing device to check the pole wall thickness close to the groundline at four locations equally spaced around the perimeter. Do the same at an elevation four feet above ground level to check the consistency of the pole wall thickness. Verify pole cap is in place.

Figure 5-14: Embedded Pole with heavy corrosion, concrete sidewalk covering embedment material



Table 5-4: Embedded Pole, Pole and Embedment Element Distresses

Element Number	Element	Description	Associated Distresses
15101	Pole and Embedment	Steel poles and wood poles embedded in soil or concrete	Misalignment or out of plumbness
			Embedment distress, erosion, or settlement
			Concrete cracking or spalling
			Corrosion and Cracking
			Timber decay/section loss/abrasion
			Timber checks/shakes
			Timber splitting/delamination/cracking
			Other Timber Defects
			Impact damage
			Handhole Defects

Unit of Measure: Length, feet along member which apply to each condition state

Details on the condition state rating schema are in Section 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.1.3 Anchor Wire Element Condition States

For the anchor wire condition states inspect any wires, struts, anchors, dead ends, and connections that comprise the element, which provides additional support to the pole structure. Any wires should be tensioned and free from corrosion and fraying. Connections at the pole and between portions of the element should be securely fastened and free of corrosion, cracks, wear, and deterioration. The soil anchorage should be fully embedded and the surrounding soil free of distress.

Table 5-5: Embedded Pole Anchor Wire Element Distresses

Element Number	Element	Description	Associated Distresses
15102	Anchor Wire	Anchor and guy wires, guy struts, preformed dead ends, thimbles, guy guards, and soil anchor bolts	Corrosion, section loss, or cracks Under tensioned or frayed wires Missing guy guard Worn or deteriorated assemblies Anchorage displacement

Unit of Measure: Each member which apply to each condition state

Details on the condition state rating schema are in Section 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.1.4 Vertical Structure Connections Element Condition States

For the vertical structure connections element consider all connections to the pole structure. There are several different types of connections that may be present. In general, any steel portions of a connection should be securely in place, and free of corrosion, wear, missing pieces, cracks, or other deterioration.

If the pole is wood, span wires and anchor wires are usually connected to the pole with a through bolt assembly. The bolting assembly should be tight to the pole and pass through the center of the cross-section. If the pole is steel, span wires and anchor wires are usually connected to the pole with band clamps. The two halves of the clamps are tightened against the pole with bolting assemblies on either side. Consider the typical steel deterioration types and inspect the band clamps for any distortion or cracking which may precede a failure. Luminaire arms or other arms used to connect attachments to the bolt may use brackets or other types of steel connections. Consider the typical steel and fastener deterioration modes for these connections. If miscellaneous arms, brackets, and attachments are failing or in some way pose a safety risk they should be noted in a Work Rec or RFA.

Table 5-6: Embedded Pole Vertical Structure Connections Element Distresses

Element Number	Element	Description	Associated Distresses
15103	Vertical Structure Connections	Bracket assemblies, pole band clamps, stainless steel straps, through bolts, or other connections to poles	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 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.2 HORIZONTAL STRUCTURE ROUTINE INSPECTION

Routine inspection of the horizontal structure is conducted from the ground, and binoculars should be used as a visual aid.

- Inspect the vertical clearance of the horizontal structure and its attachments, the alignment, and the operational function.
- Check for corrosion or section loss on the horizontal structure.
- Check the span wire for signs of fraying, corrosion, or broken strands.
- Inspect the luminaire and luminaire arm, and other miscellaneous arms or brackets, for any cracked welds, damage or deterioration, or loose and deficient connections.
- Inspect signals and other 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.

5.4.2.1 Horizontal Structure Component Ratings

The embedded pole's horizontal structure overall characteristics are rated on its structural condition, ability to support the connected attachments, and possible negative impact to the structure's operation and the roadway below. The span wire, arms, and the attachment connections to them are all considered as part of the component rating. When evaluating distresses, consider that different distresses and the location on the structure at which they occur are not of equal importance to the horizontal structure's function. The predominant characteristic determining overall condition is resiliency. Consider if the span wire and arms have a robust and consistent cross-section, and the attachments are securely connected.

Table 5-7: Component Rating Guidelines for Embedded Pole Horizontal Structure

Component Rating	Condition	Material	Description
9	NEW	All	No deficiencies in any of the structural components that will affect long term performance.
		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.
		Steel	Protective coating failure in very small and scattered locations.
8	VERY GOOD	All	All components retain full section properties and function as designed.
7	GOOD	Steel	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.
6	SATISFACTORY	All	Minor deterioration affecting structural components.
		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.
5	FAIR	Steel	

Component Rating	Condition	Material	Description
4	POOR	Steel	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.
3	SERIOUS	Steel	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 condition. Notify Region and the Bureau of Bridges and Structures.

5.4.2.2 Span Wire Element Condition States

For the span wire element condition consider the connection of the span wire to the pole connection – which includes the span wire, thimble, and dead end. Consider wear, deterioration and portions that may be loose, distorted, or otherwise exhibiting distress. For the length of the span wire, half of each wire is assigned to each supporting pole. The wire

should be inspected for corrosion, fraying, or any broken wires. Any attachment connected to the span wire should have a minimum vertical clearance to the top of pavement of 17 feet. Inspectors should rate the Span Wire element as severe for both poles if the clearance is less than 17 feet. While this may not be able to be measured, note report any vertical clearance that looks out of the ordinary.

Table 5-8: Embedded Pole Span Wire Element Distresses

Element Number	Element	Description	Associated Distresses
15201	Span Wire	Span wires, thimbles, preformed dead ends	Insufficient under clearance Corrosion or section loss, frayed wires Worn or deteriorated dead ends
Unit of Measure: Each member which apply to each condition state			

Details on the condition state rating schema are in Section 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.2.3 *Span Wire Attachment Connections Element Condition States*

Attachments connected to the span wire include signals and case signs. Typically, the signals and signs are connected using span wire hangers and suspension clamps. Consider the typical steel and fastener deterioration modes for these connections: loose connections, wear, corrosion, cracking, and deformation. The signals and signs themselves are not rated but if there is noticeable deterioration that could impact safety it should be reported.

Table 5-9: Embedded Pole Span Wire Attachment Connections

Element Number	Element	Description	Associated Distresses
15202	Span Wire Attachment Connections	Span wire hangers, lashing rods, armor rods, suspension clamps	Corrosion or section loss Loose, missing, or cracked hardware Deformed or worn parts
Unit of Measure: Each connection quantity within the condition state			

Details on the condition state rating schema are in Section 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.2.4 *Luminaire and Luminaire Arm Element Condition States*

luminaires are usually mounted on a luminaire arm but may also be mounted directly on the pole, on a tenon, or using some other pole mounting device. The arms may be a single member type or truss type. Note that the bracket assembly or other method of attaching

the luminaire arm to the pole is considered part of the vertical structure connections element. The arms should be inspected for steel condition and the condition of any welds. The condition of the luminaire connection to the arm or tenon should be inspected for material defects and connection type defects such as looseness and wear. The luminaire itself includes the light source, any fixtures or assemblies, and the housing. Note any visibly broken portions of the luminaire.

Table 5-10: Embedded Pole Luminaire and Luminaire Arm Element Distresses

Element Number	Element	Description	Associated Distresses
15203	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 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.2.5 *Miscellaneous Arm, Bracket, and Attachment Element Condition States*

Attachments or appurtenances may be mounted on a bracket or arm but may also be mounted directly on the pole, on a tenon, or using some other pole mounting device. The arms may be a single member type or truss type. Note that the bracket assembly or other method of attaching the miscellaneous bracket or arm to the pole is considered part of the vertical structure connections element. The miscellaneous arms, brackets, and attachments should be inspected for steel condition and the condition of any welds. The condition of the attachment connection to the bracket, arm, or tenon should be inspected for material defects and connection type defects such as looseness and wear.

Table 5-11. Embedded Pole Miscellaneous Arm, Bracket, and Attachment Element Distresses

Element Number	Element	Description	Associated Distresses
15204	Miscellaneous Arm, Bracket, and Attachment	Power sources, fixtures and assemblies, bracket arms, truss arms, tenon mounts, shepherds crooks, or other pole mounting devices	Broken power source or assembly Damaged or cracked housing, cover Corrosion or section loss Weld cracks/defects Deteriorated gasket/seal

Unit of Measure: Each miscellaneous arm, bracket, and attachment within the condition state

Details on the condition state rating schema are in Section 5.7, linked below:

[Embedded Pole Condition State Tables](#)

5.4.3 REFERENCES

[MDOT Traffic and Safety Standards and Special Details](#)

[SIG-010-series All Span Wire T.S. on Steel and Wood Poles](#)

[SIG-050-series Wood Pole Guys and Setting Depth](#)

[SIG-060-series Steel Truss Brackets](#)

[SIG-061-series Clamp on Bracket Arm Assembly \(Street Light\)](#)

[Pole Dent & Buckling Calculations](#)

5.5 Work Recommendation Guidance

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

Inspectors should create Work Recs to address span wires with less than 17 ft clearance. Half of the span of the wire is attributed to each pole. Inspectors should generate a single Work Rec to correct the wire tension. Inspectors should assign it to one of the poles and note the Work Rec in the other pole's inspection. 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 deficiencies marked on the photo should be provided.

Table 5-12: Embedded Pole Work Recommendations

Number	Description of Work Recommendation	Material involved	Quantity/Unit of Measure
1	Repair guardrail (protecting pole)	Galvanized Steel	Linear feet
2	Correct erosion	Stone/Soil	Cubic feet
3	Repair/monitor foundation	Concrete	Cubic foot
4	Repair/replace handhole cover	Galvanized Steel	Each cover
5	Remove non-MDOT or unauthorized attachments to structures	Various	Each item
6	Remove graffiti	n/a	Square foot
7	Repair galvanizing	Galvanic Paint	Square inch
8	Repair protective coatings system	Metal Coatings System	Square foot
9	Tighten leveling nut	Galvanized Steel Clamp	Each
10	Address loose bolts	Galvanized Steel	Each bolt
11	Weld repair	Steel	Each weld
12	Replace pole band clamps	Galvanized Steel	Each clamp
13	Replace through bolt assembly	Galvanized Steel	Each assembly
14	Tension anchor wire	Steel Strand	Each
15	Replace anchor wire	Steel Strand	Linear feet
16	Replace anchor	Galvanized Steel	Each anchor
17	Replace arm guy/pole guy/guy strut/ guy guard	Various	Each
18	Tension span wire	Steel Strand	Each
19	Replace span wire	Steel Strand	Linear feet

Number	Description of Work Recommendation	Material involved	Quantity/Unit of Measure
20	Replace span wire hanger	Galvanized Steel	Each
21	Replace pole cap	Galvanized Steel	Each cap
22	Replace pole cap bolt	Galvanized Steel	Each bolt
23	Replace preformed dead-end	Preformed Dead-end	Each preformed dead-end
24	Replace connectors	Galvanized Steel	Each connector
25	Replace service cap, PVC	PVC	Each cap
26	Replace service cap, metal	Galvanized Steel	Each cap
27	Replace Luminaire	Various	Each luminaire
28	Replace Luminaire arm	Galvanized Steel	Each arm
29	Replace luminaire arm clamp	Galvanized Steel	Each clamp
30	Replace bracket assembly	Galvanized Steel	Each assembly
31	Replace signal head	Various	Each signal head
32	Replace case sign	Various	Each sign
33	Replace misc. attachment	Various	Each attachment
34	Replace miscellaneous arm or bracket	Various	Each arm or bracket

5.6 Request for Action Guidance

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

Priority 1 Level Items

- Major soil erosion or undermining of the pole evidenced by pole lateral displacement and/or pole out of plumb/rotated
- Major corrosion or section loss of pole adjacent to the groundline, which impacts the capacity or short-term resiliency of the structure
- Pole vehicle impact damage resulting in major cracks and pole deformation
- Major vertical misalignment of the pole when the lean is greater than 4.75" over 4 feet (approximately 10%)
- Steel poles with major cracking in a weld or base metal
- Wood poles with major splitting/cracking/decay and/or major crooks/sweep
- Multiple loose, missing, or damaged parts, or major deterioration, in a connection assembly for signs, signals, miscellaneous attachments, or luminaires
- Major span wire corrosion and section loss, including fractured individual wires of the span wire strand

Priority 2 Level Items

- a. Significant soil erosion or undermining of the pole and embedment
- b. Corrosion or section loss at or near the groundline of the pole causing significant impact to capacity, stability, or durability
- c. Pole impact damage resulting in significant pole deformation and cracking
- d. Pole is significantly out of vertical alignment when the lean is between 3.375" to 4.75" over 4 feet (or about 7% to 10%)
- e. 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
- f. Wood poles with significant splitting/cracking/decay or significant crooks/sweep
- g. Significantly loose parts or significant deterioration or wear in a connection assembly for signs, signals, miscellaneous attachments, or luminaires over traffic where there is significant impact to capacity or durability
- h. Significant span wire corrosion and section loss

Priority 3 Level Items

- a. Localized moderate soil erosion or undermining of the pole and embedment
- b. Corrosion or section loss at or near the groundline of the pole causing moderate impact to capacity or durability
- c. Pole impact damage resulting in moderate pole deformation
- d. Moderate weld deficiencies, which do not meet code but do not impact function where significant redundancy is also present
- e. Pole is significantly out of vertical alignment when the lean is between 2.375" to 3.375" over 4 feet (or about 5% to 7%)
- f. Wood poles with moderate splitting/cracking/decay or moderate crooks/sweep
- g. Loose or misaligned parts or moderate deterioration or wear in a connection assembly for signs, signals, miscellaneous attachments, or luminaires over traffic where capacity or durability is moderately affected
- h. Moderate span wire corrosion and section loss

5.7 Element Condition States

Element Number	Element	Condition States Defects Note	Link to Discussion in Section 5
15101	Pole Embedment	Use the appropriate condition state table.	Pole and Embedment Element Condition States
15102	Anchor Wire	Use the appropriate condition state table.	Anchor Wire Element Condition States
15103	Vertical Structure Connections	Use the appropriate condition state table.	Vertical Structure Connections Element Condition States
15201	Span Wire	Use the appropriate condition state table.	Span Wire Element Condition States
15202	Span Wire Attachment Connections	Use the appropriate condition state table.	Span Wire Attachment Connections Element Condition States
15203	Luminaire and Luminaire Arm	Use the appropriate condition state table.	Luminaire and Luminaire Arm Element Condition States
15204	Miscellaneous Arm, Bracket, and Attachment	Use the appropriate condition state table.	Miscellaneous Arm, Bracket, and Attachment Element Condition States

Element 15101 (Pole and Embedment) – Metal

Description		This element defines the vertical pole included in installing an embedded pole, regardless of steel or metal material type.		
Quantity Calculation		Quantity measured in length in feet along pole which is exposed above ground.		
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Misalignment and Plumbness	Pole is plumb, no evidence of misalignment.	Pole may be slightly out of plumb, but serviceability and function are unaffected.	Pole may be moderately out of plumb. The condition does not significantly affect serviceability and/or function.	Pole is majorly out of plumb. The condition has affected the serviceability or integrity of the structure.
Embedment distress, erosion, or settlement	Embedment material is compact, well graded, and provides adequate pole support.	Any surface paving may have minor cracks or settlement. Minor erosion of the embedment material may be present at the groundline.	Any surface paving may have moderate to major cracks or pieces missing. Moderate embedment erosion is present, or embedment material is loose. The conditions do not significantly affect serviceability and/or function.	Major embedment erosion is present. The element conditions have majorly affected the serviceability or integrity of the structure.
Corrosion and Cracking	No evidence of active corrosion. Surface coating is sound and functioning as intended.	Minor corrosion may be present. Protective coating failure with no measurable section loss. Minor superficial damage to the component parts. Pole caps may be missing.	Moderate corrosion/pitting/ section loss may be present. Protective coatings are failing. Element welds have no evidence of defects and/or cracking.	Major corrosion/pitting/ section loss is present. Protective coatings are significantly failing. Element welds may have cracks/ defects.
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.

Description	This element defines the vertical pole included in installing an embedded pole, regardless of steel or metal material type.			
Quantity Calculation	Quantity measured in length in feet along pole which is exposed above ground.			
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Handhole Defects	Cover is securely fastened. No handhole or reinforcing frame weld defects are evident. The inside of the pole is free of excess moisture, debris, and corrosion.	Handhole cover is in place, but fastener is loose, minimally damaged or missing. No handhole or reinforcing frame weld defects are evident. The inside of the pole may contain minor moisture and debris.	Handhole cover is moderately damaged. No handhole or reinforcing frame weld defects are evident. 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 or reinforcing frame welds have defects. Moisture or debris inside the pole is creating major corrosion and/or section loss of material.

Element 15101 (Pole and Embedment) – Wood

Description		This element defines the vertical pole included in installing an embedded pole, regardless of steel or metal material type.			
Quantity Calculation		Quantity measured in length in feet along pole which is exposed above ground.			
Condition State Descriptions					
Defect Type	Good	Fair	Poor	Severe	
Misalignment and Plumbness	Pole is plumb– i.e. within 3/16 inch of plumb over 3 feet or ~0.5%, no evidence of misalignment.	Pole may be slightly out of plumb or have minor crooks or sweep.	Pole may be moderately out of plumb. The condition does not significantly affect serviceability and/or function.	Pole is majorly out of plumb. The condition has affected the serviceability or integrity of the structure.	
Embedment Distress, Erosion, or Settlement	Embedment material is compact, well graded, and provides adequate pole support.	Any surface paving may have minor cracks or settlement. Minor erosion of the embedment material may be present at the groundline.	Any surface paving may have moderate to major cracks or pieces missing. Moderate embedment erosion is present, or embedment material is loose. The conditions do not significantly affect serviceability and/or function.	Major embedment erosion is present. The element conditions have majorly affected the serviceability or integrity of the structure.	
Timber Decay/ Section Loss/ Abrasion	No indication of decay, section loss or abrasion	Minor decay, section loss or abrasion.	Moderate decay, section loss or abrasion	Major decay, section loss, or abrasion.	
Timber Checks/ Shakes	Checks and shakes affect less than 5% of the member thickness.	Checks and shakes affect 5% to 50% of the member thickness. Larger checks/shakes have been repaired.	Checks and shakes of timber affect more than 50% of member thickness.	The condition warrants a structural review to determine the effect on strength or serviceability of the element OR structural review has been completed and defects impact strength or serviceability of the element.	

Description	This element defines the vertical pole included in installing an embedded pole, regardless of steel or metal material type.			
Quantity Calculation	Quantity measured in length in feet along pole which is exposed above ground.			
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Timber Splitting/ Delamination/ Cracking	No splitting or delamination present. Sealed cracks may exist.	Minor delamination or cracking is present.	Delamination or splitting length equal to or greater than the total member depth, but only present away from connections. Evidence of moderate cracking of the member thickness. Larger cracks have been repaired.	Delamination or splitting near connections; Severe deterioration due to cracking.
Other Timber Defects	Other timber defects are present and do not exhibit deterioration or distress.	Minor deterioration or distress of other timber defects.	Moderate deterioration or distress of other timber defects.	Major deterioration or distress of other timber defects.
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.

Element 15102 (Anchor Wire)

Description	This element defines the anchor and guy wires, guy struts, preformed dead ends, thimbles, guy guards, and soil anchor bolts associated with an embedded pole which extend to terminate at the ground level.			
Quantity Calculation	The quantity is collected as each anchor wire.			
	Condition State Descriptions			
Defect Type	Good	Fair	Poor	Severe
Anchor Wire	No evidence of active corrosion. Anchor wire, dead ends, guy strut, and anchorage are functioning as intended with no evident wear.	Minor surface corrosion or wear may be present. Minor wear of anchor wire, dead ends, guy strut, and anchorage may be present, but members are functioning as intended.	Moderate corrosion/section loss or wear is present. Safety guy guard may be missing. Wire may not be fully tensioned.	Major corrosion/section loss is present. Protective coatings or dead ends are significantly failing. Elements may have cracks/defects or major wear. Major ground displacement may be present at the anchorage. Anchor wire is not tensioned or is not functioning as intended.

Element 15103 (Vertical Structure Connections)

Description	This element consists of the connections along the embedded pole for various attachments. Connections may include bracket assemblies, pole band clamps, stainless steel straps, through bolts, or other connections to poles.			
Quantity Calculation	The quantity to be collected includes each connection location.			
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Vertical Structure Connections	Pole band clamps, bracket assemblies, and other connection hardware are functioning as intended with no evidence of wear or corrosion.	Minor surface corrosion or wear may be present.	Moderate corrosion/section loss or wear is present. U-bolts, band clamps, or lag bolts may be loose, but 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. U-bolts, band clamps, or lag bolts are loose or missing. Element is not functioning as intended.
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.

Element 15201 (Span Wire)

Description	This element defines the span wires, thimbles, preformed dead ends which extend to terminate at another vertical structure.			
Quantity Calculation	The quantity is collected as each span wire.			
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Span Wire Defects	Span wire, preformed dead end, and thimble have no evidence of corrosion or wear and minimum clearance is 17 ft from roadway to bottom of any signal/sign.	Minor surface corrosion or wear may be present. Minimum clearance is 17 ft from roadway to bottom of any signal/sign.	Moderate corrosion/section loss or wear is present. Minimum clearance is 17 ft from roadway to bottom of any signal/sign.	Minimum clearance is less than 17 ft from roadway to bottom of a signal/sign. Major corrosion/pitting/section loss is present. Protective coatings are failing. Members may have cracks/defects or major wear.

Element 15202 (Span Wire Attachment Connections)

Description	This element defines the span wires hangers, lashing rods, armor rods, and suspension clamps.			
Quantity Calculation	The quantity is collected as each connection.			
Condition State Descriptions				
Defect Type	Good	Fair	Poor	Severe
Span Wire Attachment Connection Defects	Span wire hangers, preformed lashing rods and armor rods, and other connection hardware have no evidence of wear or corrosion.	Minor surface corrosion or wear may be present. Hardware is fully engaged, and no gap is present.	Moderate corrosion/section loss or wear is present. Hardware is fully engaged but gaps may be present	Major corrosion/pitting/section loss is present. Protective coatings are failing. Members may have cracks/defects or major wear. Gaps are present and hardware is loose or missing.

Element 15203 (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 do not have evident wear or corrosion.	Gasket/seal may have minor deterioration. Lighting source, housing/cover, or arm may have minor wear or corrosion.	Gasket/seal may be moderately deteriorated. Lighting source, housing/cover, or arm 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 with corrosion/pitting/section loss is present. Welds have cracks/defects.

Element 15204 (Miscellaneous Arm, Bracket, and Attachment)

Description	This element consists of power 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 miscellaneous arm, bracket, and attachment unit.			
	Condition State Descriptions			
Defect Type	Good	Fair	Poor	Severe
Miscellaneous Arm, Bracket, and Attachment	Power source, housing/cover, waterproofing-gasket/seal, and arm do not have evident wear or corrosion.	Gasket/seal may have minor deterioration. Power source, housing/cover, or arm may have minor wear or corrosion. Arm, bracket, and attachment have	Gasket/seal may be moderately deteriorated. Power source, housing/cover, or arm have moderate wear or corrosion, but the conditions do not significantly affect serviceability and/or function.	Major deterioration of gasket/seal is present. Assembly or hardware is broken or missing. Major failure of protective coatings with corrosion/pitting/section loss is present. Welds have cracks/defects.

Description		This element consists of power 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 miscellaneous arm, bracket, and attachment unit.			
Condition State Descriptions					
Defect Type	Good	Fair	Poor	Severe	
		minor deterioration. Bracket arm & fixture has minor wear or corrosion but does not impact serviceability and/or function.			