



Wiss, Janney, Elstner Associates, Inc.
8606 Allisonville Road, Suite 205
Indianapolis, Indiana 46250
317.510.3940 tel
www.wje.com

October 20, 2021

Dr. Ryan Glaze
Tipton Community School Corporation
1051 South Main Street
Tipton, IN 46072

Tipton High School Light Pole Assessment

WJE No. 2021.6711

Dear Dr. Glaze:

As requested, Wiss, Janney, Elstner Associates, Inc. (WJE) performed an assessment of six athletic field lighting poles surrounding the track and football field at Tipton High School located at 619 S Main Street in Tipton, Indiana. This letter outlines WJE's assessment, findings and recommendations.

Background & Description

We understand the existing lighting fixtures will be replaced with new LED light fixtures. In conjunction with replacement of the lighting fixtures, Tipton Community School Corporation (TCSC) has asked WJE to perform a visual assessment of accessible portions of the light poles. The assessment objectives were to 1) identify conditions that may have compromised the abilities of the poles to perform as intended, and 2) recommend actions to address any such conditions. Figure 1 shows an aerial view of the track and football field with each of six the poles identified.

Original fabrication drawings for the poles were not available for our review and therefore the following descriptions of the poles are based solely on observations made during the assessment. The poles were manufactured by Union Metal Manufacturing Co. (as determined based on the manufacturer identification tag applied to the base plate), are of steel construction and circular in cross section. The height of the poles is unknown, but they appeared to be approximately 70-80 feet tall. Figure 2 shows a view of the southwest pole. The poles taper over their height with a maximum diameter at their base of approximately 16 1/2 inches. Each pole consists of two sections which are connected via a slip-fit joint in which the bottom of the upper tapered pole section slides over the top of the lower tapered pole section (Figure 3). The tapered geometry of the upper and lower pole sections results in the connection tightening under gravity loads. The slip-fit joint is located at approximately mid-height of the pole.

Each pole is welded to a base plate that has a hole centered under the pole. The base plate is 24 inches square with rounded corners and a thickness of 2 1/2 inches (Figure 4). Soil covered the supporting foundation and base plate at many of the poles, but it is believed each pole is connected to a concrete foundation although the construction details on the concrete foundation are unknown. The poles are attached to their foundations via four, two-inch diameter anchor bolts. A hand hole exists near the base of each pole to allow access to the interior. Figure 5 shows a typical hand hole with its cover removed at the base of a pole. Although obscured by soil at many of the poles, it appears the space between the

foundation and base plate is filled with grout. Also, based on observations at the interior of some poles, we believe that the baseplate is bearing on leveling nuts at all of the poles.

We understand the weight and effective projected area (EPA) of each replacement light fixture will be less than those of the existing fixture being replaced, although the magnitude of this difference is unknown at this time. Assuming the original design was adequate, and the capacity of the existing poles has not been significantly compromised, there does not appear to be a need to perform a structural analysis of the poles at this time.

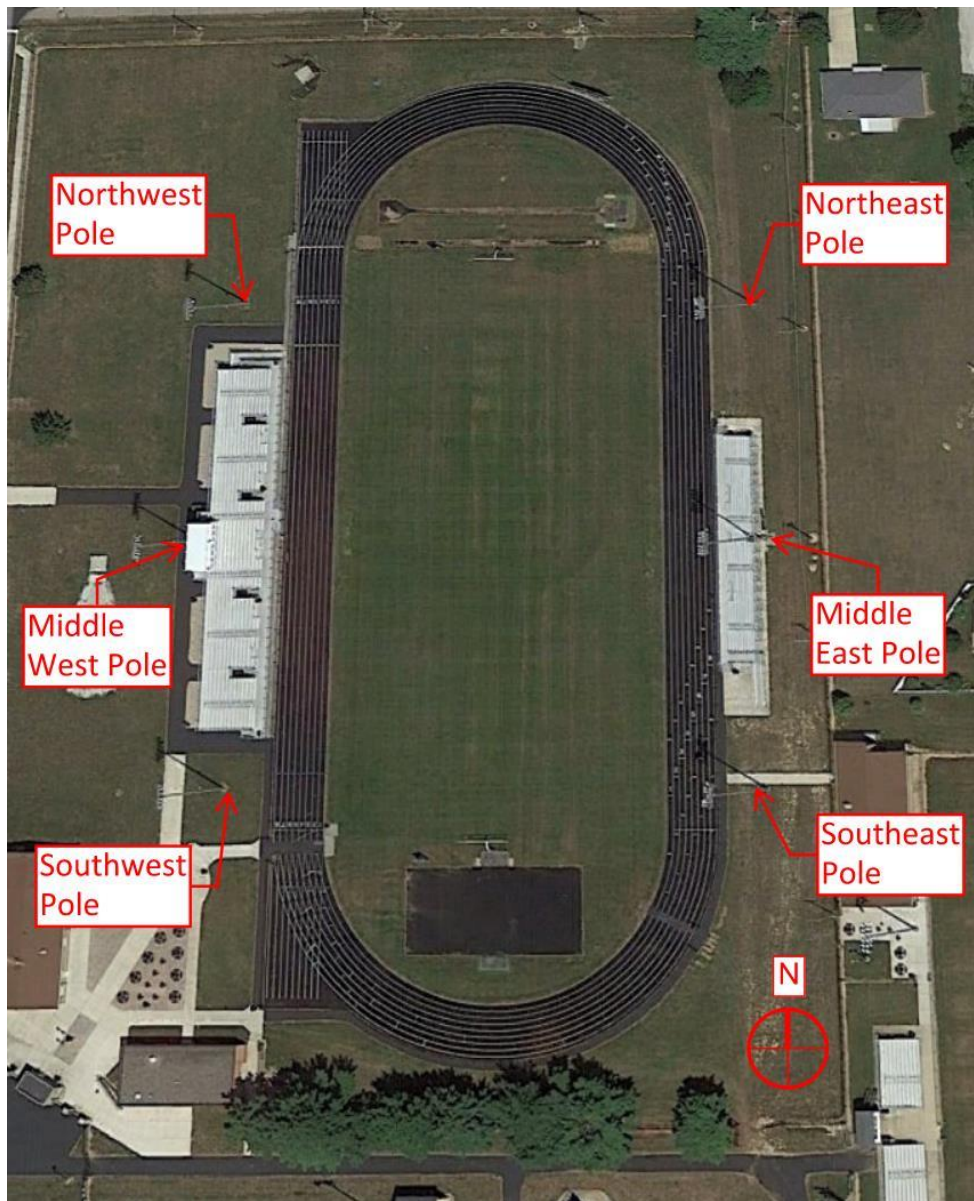


Figure 1. Aerial view of track and football field with each pole identified. Note, photo acquired from Google Earth, annotations added by WJE.



Figure 2. View of Southwest Pole looking west.

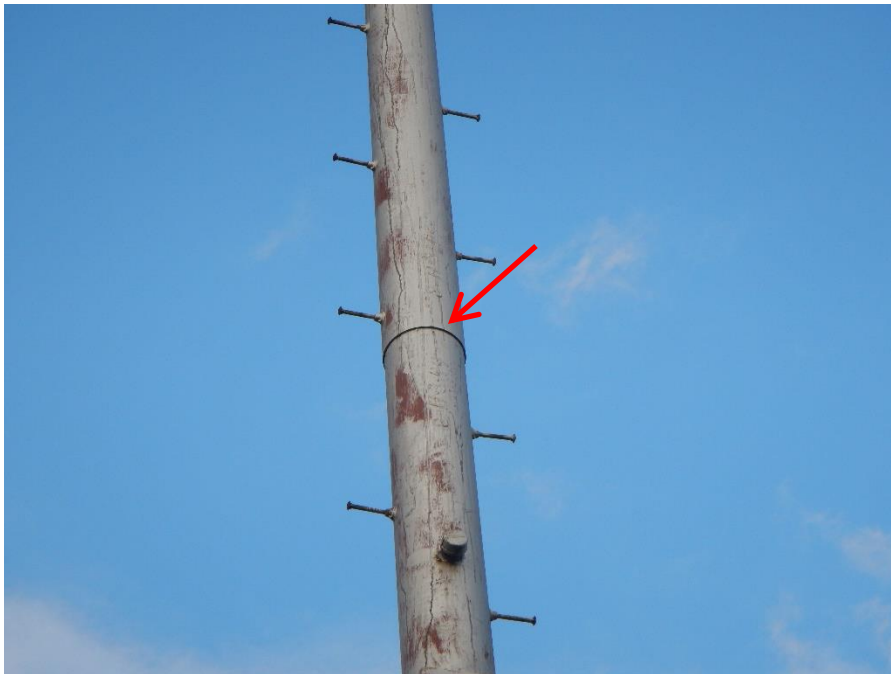


Figure 3. Slip-fit joint at mid-height of pole.



Figure 4. Base plate and anchor bolts at base of pole.



Figure 5. Typical hand hole at the base of a pole after removal of the cover. Note soil covering the top of the concrete foundation.

Scope of Assessment

The scope of the assessment included a brief, ground-level visual assessment of the full height of each light pole, as well as a more detailed, close-up inspection of the base of each light pole. The close-up assessment included visual observations of the exterior pole surface, the weld of the pole to the baseplate, the threaded anchor bolts, the concrete foundation (where exposed), and the interior surface of the pole (as possible based on the limited access through the hand hole). Other than hand hole covers removed by others, no elements of any installation were dismantled or otherwise disturbed. The assessment included ultrasonic thickness measurements of pole walls at selected locations just above the baseplate and hand hole.

For the reasons discussed above, structural analyses were not included in the assessment scope, and we are therefore unable to comment on the adequacy of the original design of the poles. It is assumed the poles were originally designed in accordance with all applicable building codes and standards. The recommendations include measures intended to prolong the useful life of the affected elements rather than address possible existing design deficiencies.

Observations

WJE visited the site on October 14, 2021 to perform an assessment of the six light poles. Relevant observations are described below.

- **Thickness Measurements:** Ultrasonic thickness measurements were made just above the base plate and compared to a thickness measurement made directly above the hand hole at a location where we observed no indication of section loss. The measurements were consistent and uniform, indicating no notable section loss of the pole directly above the base plate.
- **Loose and Partially Engaged Anchor Bolt Nuts:** All four nuts at the West Middle Pole were loose and could be loosened by hand. Figure 6 shows a nut with a gap between the nut and washer. Additionally, one of these loose nuts was only partially threaded onto the anchor bolt (Figure 7) and the top surface of the anchor bolt at two other nuts was slightly recessed below the top of the nut. The nuts at the West Middle Pole were taller than those at the other poles. Additionally, the nuts at the West Middle Pole were hot-dip galvanized instead of painted as was observed at all other poles.
- **Welded Nuts:** The nuts at all poles with the exception of the West Middle Pole were welded to the anchor bolt and base plate (Figure 8). Weld was installed around the full perimeter of the nut at the anchor bolt and base plate. Significant weld undercut was observed at the top toe of the fillet weld above the nut at several anchor bolts (Figure 9).
- **Weld Undercut:** At all poles, minor to moderate undercut was typically observed at the bottom toe of the exterior fillet weld connecting the base plate to the pole (Figure 10). The undercut was typically observed in the top surface of the base plate and not the pole.
- **Soil Surrounding Pole:** Soil covered the base plate and a portion of the nuts and anchor bolts at the Northeast and Southeast Poles (Figure 11). Soil covered the foundations and grout under the base plate at the Northwest and Southwest Poles (Figure 12). The foundation was exposed at the East Middle and West Middle Poles (Figure 13).

- Soil Inside Pole: Soil was typically observed inside the poles at their bases (Figure 14). The depth of soil varied and, in some locations, extended onto the base plate inside the pole.
- Coating: The painted coating which was applied to the pole, base plate, nuts and anchor bolts was compromised at all poles with missing, chipped and flaking paint (Figure 15). The coating on the upper portions of the poles was typically in better condition than the coating lower down but some compromised coating higher up was observed. Minor uniform surface corrosion was typically observed where the coating was missing and the steel surface of the pole was exposed (Figure 16). In all cases, corrosion-related section loss was insignificant. The interior surface of the poles was also painted. The condition of the coating on the interior pole surface was typically similar to or worse than that observed on the pole exterior (Figure 17).
- Grout: The gap between the base plate and foundation was grouted (Figure 18) but leveling nuts were observed at some of the poles through the hand hole opening (Figure 19). A portion of the grout under the base plate at the West Middle Pole was spalled and unsound (Figure 20).
- Speaker Attachment: Speakers were attached to the Southwest and Northwest Poles via wood blocking and light gauge steel straps (Figure 21).



Figure 6. Nut at West Middle Pole with a gap between the nut and washer.



Figure 7. Partially threaded nut at West Middle Pole.



Figure 8. Nut welded to anchor bolt and base plate.



Figure 9. Section loss of anchor bolt at weld installed between nut and anchor bolt.



Figure 10. Undercut and poor profile at weld between pole and base plate.



Figure 11. Soil covering base plates and part of anchor bolts and nuts.



Figure 12. Soil covering foundation and grout at Northwest Pole.



Figure 13. Concrete foundation at base of West Middle Pole.



Figure 14. Soil inside pole as seen through hand hole opening.



Figure 15. Failed coating on exterior surface of pole.



Figure 16. Uniform corrosion of pole at area of failed coating.



Figure 17. Failed coating on interior surface of pole.



Figure 18. Grout installed under base plate of East Middle Pole.



Figure 19. Leveling nut under base plate as seen through hand hole opening.



Figure 20. Spalled grout under West Middle Pole.



Figure 21. Speaker attached to Southwest Pole via wood blocking and steel straps.

Discussion

The significance of our noted observations is summarized below.

- **Loose Nuts:** Nuts can loosen over time if not properly tightened or otherwise restrained. Loose nuts like those observed at the West Middle Pole can have many adverse effects. When a nut is loose, the associated anchor bolt carries little or no load, which can result in overload of other bolts and/or the base plate. When all nuts are loose, the pole can move laterally and/or rotate. Such movements can deform anchor bolt threads, bend anchor bolts, distort base plates and lead to impact loading of the anchor bolts and base plates if the pole is allowed to rock about its base. Impact loading significantly increases the load applied to anchorage elements and can potentially exceed element capacities and/or cause the formation of fatigue cracks which develop due to repeated load cycles at stress levels well below the yield strength of affected materials. Rocking of the West Middle Pole was not observed during the assessment, but it is plausible rocking does occur under certain wind conditions based on the observed separation between the nut and base plate.
- **Recessed Nuts:** It appears the nuts at the West Middle Pole have been replaced as evidenced by their greater height and hot-dip galvanized coating as compared to the painted coating at other nuts. The greater height may account for why one of the nuts is only partially threaded and two other anchor bolts are slightly recessed below the nut. This is further exacerbated by the fact that the nuts are loose as discussed above. Although one of the nuts is not fully threaded, it likely engages a similar number of threads as the original nut and therefore provides a similar capacity to the original nut. The

recessed area above the anchor bolt can trap water leading to accelerated corrosion of the anchor bolt and nut.

- **Welded Nuts:** It is unclear why the nuts were typically welded to the anchor bolt and base plate. It should be noted that welding anchor bolt nuts to the anchor bolts or baseplates is not a recommended or accepted practice. If done to prevent the nuts from loosening, a tack weld connecting the nut to the base plate or anchor bolt would have been sufficient. It is possible the welds were installed to compensate for an undersized nut during original installation but in the absence of additional documentation or analysis we cannot comment on the adequacy of the existing nuts. There was no deformation, cracking or other indications that the existing nuts were not performing as intended. The weld has reduced the section of the anchor bolt in some locations due to undercut at the anchor bolt during welding, but this only occurs above the nut where stresses in the anchor bolt are low.
- **Weld Undercut:** Weld undercut reduces the cross sectional thickness of the base metal and can reduce the capacity of the weld. Based on our observations made during the assessment, the pole passes through a hole in the base plate and is welded to both the top and bottom of the base plate. This type of connection is typically referred to as a socket connection. This socket connection is not solely reliant on the top or bottom weld. The undercut observed in the weld connecting the pole to base plate was typically minor and was primarily in the base plate which is much thicker than the pole. The extent of section loss in the base plate was insignificant as compared to the thickness of the base plate. Additionally, the undercut has been present since the time of original fabrication of the poles and has not resulted in any observed deformations or distress.
- **Soil:** The soil covering the base plates of the Northeast and Southeast Poles can trap moisture against the poles and anchorages leading to accelerated corrosion. The height of soil observed inside all the poles varied but was in direct contact with the base plate in some locations and the anchor bolts and leveling nuts below the base plate where they are not encapsulated by grout. Where soil is in direct contact with steel elements it can lead to accelerated corrosion.
- **Grout:** The grout observed between the foundation and base plate of the poles is likely not structural as evidenced by our observations of leveling nuts at accessible locations through the hand hole and was probably installed to prevent accumulation of debris under the poles.
- **Coating:** The extent of coating damage was relatively significant with large areas of failed coating on the pole exterior and interior, base plate, anchor bolts and nuts. The related corrosion where the steel was exposed is currently not significant. However, if not addressed, corrosion of unprotected areas will continue and could compromise the poles in the future.
- **Speaker Attachment:** The attachment of the speakers to the Southwest and Northwest Poles did not appear to be designed and may not have the necessary capacity to resist design level wind loads. Although not observed, if the wood blocking begins to decay, the connection could loosen compromising the support of the speaker. Also, since the speaker attachment does not appear to be designed, it is also possible that the original pole was not designed for the additional wind loads imposed by the speaker.

Recommendations

Recommendations for addressing items of concern are discussed below.

1. Loose Nuts: Due to the possibility of rocking and the associated increased potential for cracking of the anchor bolts due to fatigue loading, it is recommended that non-destructive testing (NDT) of the anchor bolts at the West Middle Pole be performed. The NDT should employ ultrasonic flaw detection equipment to inspect the interiors of the anchor bolts to identify flaws that may be present. This work may require temporary removal of the nut where it projects above the top of the anchor bolt to provide access to the anchor bolt. If flaws are observed, repairs should be developed as required to address the conditions observed.

If no flaws are detected during the NDT, we recommend that all nuts at the West Middle Pole be tightened. Although the light poles are not transportation structures, poles of this type are typically designed in accordance with The American Association of State Highway and Transportation Officials (AASHTO) *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (AASHTO Luminaires Specification). Therefore, we recommend tightening all nuts in accordance with Table C15.6.3-1 of the AASHTO Luminaires Specification which has been reproduced in Figure 22.

Table C15.6.3-1—Top-Nut Rotation for Turn-of-Nut Pretensioning of Double-Nut Moment Connections

Anchor Bolt	Nut Rotation beyond Snug-Tight ^{a,b,c}	
Diameter, in.	F1554 Grade 36	F1554 Grades 55 and 105, A449, A615, and A706 Grade 60
≤1 1/2	1/6 turn	1/3 turn
>1 1/2	1/12 turn	1/6 turn

^a. Nut rotation is relative to anchor bolt. The tolerance is plus 20 degrees (1/18 turn).

^b. Applicable only to double-nut moment connections.

^c. Use a beveled washer if the nut is not in firm contact with the base plate or if the outer face of the base plate is sloped more than 1:40.

Figure 22. Table C15.6.3-1 of AASHTO Luminaires Specification specifying nut tightening.

2. Recessed Nuts: After tightening of the nuts as recommended in Item 1, the recessed areas above the anchor bolts created by the projecting nut will be reduced but will likely not be eliminated. Where the recessed areas remain, we recommend they be filled with silicone sealant to prevent the accumulation of water and debris and reduce the potential for accelerated corrosion.
3. Soil: We recommend the soil covering the base plates, anchor bolts, nuts, grout and foundations at the Northeast, Southeast, Northwest and Southeast Poles be removed to expose the top of the foundation and prevent accelerated corrosion of these components. The soil should be lowered several inches below the top of the foundations and graded away from the pole foundation to drain surface water away from the pole. Depending on the soil elevation beyond the area immediately around the pole, additional drainage modifications may be required to allow water to drain away from the foundation.
4. Grout: Leveling nuts were visible from inside the pole at some locations, but it shall be confirmed that leveling nuts exist at all locations and that they are in full contact with the base plate. Verification can be done by means of a borescope or other visual means from inside the poles. If the presence of

leveling nuts cannot be confirmed from inside the poles, local removal of small areas of grout at the remaining anchor bolts should be performed to confirm their presence. Assuming leveling nuts are present at all anchor bolts and properly installed, we recommend the grout be removed in order to remove the soil that has accumulated inside poles and inspect the anchor bolts and leveling nuts. If any significant corrosion induced section loss or other deleterious conditions are observed at the leveling nuts or anchor bolts, the conditions should be further evaluated to determine if additional remedial measures are required. After the anchor bolts and leveling nuts have been inspected and assuming they are deemed acceptable for reuse, these elements should be coated in accordance with the recommendations of Item 5. We recommend that protective stainless steel screens be installed or the grout under the base plate be reinstalled to prevent the accumulation of debris under and inside the pole.

5. Coating: We recommend that all exterior surfaces of the poles and their anchorages be recoated with an appropriate coating system applied in accordance with the manufacturer's specifications. All poorly bonded existing coating should be removed. Where the existing coating is well bonded, it may remain assuming the new coating system is compatible with overcoating of the existing. The surface of the steel pole where exposed and the existing coating to remain should be prepared in accordance with the coating manufacturer's recommendations. The interior surface of the pole is not accessible for recoating. As noted, the observed corrosion has not compromised the capacity of the pole at this time. It is recommended the poles be inspected on a regular basis to identify areas of corrosion which could potentially compromise the poles. Refer to Item 7 for details.
6. Speaker Attachment: We recommend the existing connection of the speakers to the Northwest and Southwest poles be replaced with a new connection designed to resist the code prescribed wind loads. We recommend the connection use hot-dip galvanized or stainless steel components to prolong the life of the connection.
7. Monitoring: In order to provide for efficient maintenance of the poles, we recommend periodic monitoring, including the nuts and anchor bolts, weld between the pole to the base plate, and the interior surface of the pole, as well as ultrasonic thickness measurements in selected areas. Based on the conditions we observed and the ages of the poles, we recommend the next assessment be performed in two years. It may be possible to increase the interval between assessments based on the observations made during the initial follow-up assessment.

As noted previously, we understand the existing lighting fixtures will be replaced by new LED lighting fixtures which have a reduced weight and smaller effective projected area than the existing fixtures thereby reducing the loads on the existing poles, anchor bolts and foundations. Consequently, lacking any indication that the original designs were inadequate, the existing light poles can be used to support the new lighting fixtures assuming Recommendations 1, 3 and 4 noted above are completed prior to installation of the new lighting fixtures. The remaining recommendations are not structurally critical. Implementation of these repairs in a timely manner will help to prolong the life of the poles but the timing of the implementation is at the discretion of TCSC.



Closing

It has been a pleasure to assist TCSC with this project. Should you have any questions please feel free to contact me at NFehrenbacher@wje.com.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

A handwritten signature in black ink that reads "Noah Fehrenbacher". The signature is written in a cursive, flowing style.

Noah J. Fehrenbacher
Project Manager & Senior Associate