



DIXON

**ENGINEERING & INSPECTION SERVICES
FOR THE COATING INDUSTRY**

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November 2, 2020

Eric Wilson, Manager
City of Plainwell
211 N. Main St.
Plainwell, MI 49080

Re: Structural Inspection for the 100,000 Gallon Cone Roof Elevated Tank

Dear Mr. Wilson:

Dixon Engineering performed an inspection on September 30, 2020 on the 100,000 gallon cone roof water tower located in Plainwell, Michigan. The purpose of the inspection was to perform a general structural evaluation of the entire structure. The inspection was performed by James Rowley, PE and Paul Spitzley, PE.

Summary:

The water tank was constructed in 1946 by the Chicago Bridge & Iron Company with a height to high-water level of 120 feet. The tank is located on a large site that is currently being developed by the City. This tank has been removed from service and it is understood that there are no plans to place the tank back into service. For this reason, the inspection and recommendations have been limited to general structural integrity and safety items.

Site Inspection:

Foundation and Anchor Bolt Conditions:

The exposed concrete foundations are in good condition overall. The tops of the foundations are located at grade. The foundations are not coated.

There is one anchor bolt located on each leg. The anchor bolts are in fair condition overall with some steel loss on some of the nuts and bolts.

The grout between the baseplate and foundation is in fair condition on the legs and the riser. There is approximately 5 total lineal feet of grout missing on the legs.

Coating Conditions:

The exterior structure consists of the riser, legs, struts, sway rods, bowl, balcony, sidewall, and roof. The exterior coating is in poor condition overall with coating failures are throughout. The failures consist of delamination, spot coating failures with rust undercutting, erosion, and rust bleedthrough.

The wet interior structure had limited access due to the poor condition of the wet interior ladder. The visible portion of the wet interior coating appeared to be in poor condition with little coating remaining.

Information provided to Dixon Engineering indicates that the exterior coating contains lead. Special consideration will be needed during maintenance to avoid contamination of workers and prevent generation of hazardous waste.

Structural Conditions:

The exterior structure is in good condition overall. With the exception of the anchor bolts and the leg connection at the bowl, no steel loss or pitting was observed at any of the coating failures. The legs, riser, struts, and sway rods are in good condition with no steel loss or deformations. The sway rods appear to be in proper tension as designed. No steel loss or deformations were observed on the bowl, sidewall, or roof of the tank.

The wet interior structure consists of the bowl, sidewall, and roof plates. The wet interior structure is in good condition overall.

Access and Safety Conditions:

The exterior leg ladder starts approximately 5 feet above the ground and extends up to the balcony. The ladder is in good condition overall. The ladder is equipped with a cable-type fall prevention device that is undersized. The ladder is not equipped with a vandal guard.

There is a revolving ladder that extends from the outside of the balcony up to the center of the roof. The ladder is in good condition overall but is unstable. The only connection point of the ladder is at the center of the roof. The ladder is equipped with a cable-type fall prevention device that is undersized.

There is a wet interior ladder from the roof to the bowl that is in poor condition overall. The bolted connection is in poor condition and the ladder is not safe to climb. The ladder is not equipped with a fall prevention device.

All ladders do not meet current OSHA size requirements. The length and thickness of the rungs are undersized.

There is no grate or railing at the wet interior riser.

The exterior balcony is in fair condition overall. There is corrosion with some steel loss on the balcony floor plate. The balcony and railing do not conform to current OSHA requirements. The railing height is undersized and there is no midrail. The balcony does not contain enough drainage holes and water is ponding on the walkway. The tank does not have a roof handrail.

Recommendations:

There are no major structural deficiencies on this tank. The work recommended below is to increase the longevity of the structure as well as increase the safety for future inspections and maintenance activities. The recommended structural repairs and coating work should be completed within the next five years if the tank is to remain standing. The safety repairs and upgrades should be completed with the next paint project.

Disclaimer:

Unless DIXON feels the ladders and railings are unsafe, it is our opinion that if they were built to code at the time of construction, they do not require replacement. Codes can change regularly making compliance expensive and impractical. However, it is our responsibility to inform you of this possible deficiency.

1. Abrasive blast clean the exterior inside a dust tight containment system and repaint with a fluoropolymer system. Because of the nearby electrical transmission lines, a rigid containment system would be required. The estimated cost is \$230,000 plus \$350,000 for rigid containment.
2. Inspect the anchor bolts and nuts after abrasive blast cleaning to determine the amount of steel remaining and repair anchor bolts if necessary. The cost would be determined after the extent of repairs is known (if necessary).
3. Remove soil at the foundations to expose the top 4 inches. The work can be performed by in-house personnel.
4. Repair the leg to tank connections with welded patch plates. The estimated cost is \$40,000.
5. Modify the tank venting with engineered riser and roof openings to keep water out of the tank while maintaining airflow. This will minimize corrosion of the interior of the structure. The estimated cost is \$20,000.
6. Install a vandal guard on the leg ladder and each of the lattice legs. The estimated cost is \$10,000.
7. Weld the sidewall/roof ladder in place to keep it from rotating. The estimated cost is \$2,000.
8. Install a fall prevention device on the exterior ladders. The estimated cost is \$5,000.

9. Replace the wet interior ladder with a ladder that is equipped with a fall prevention device. The estimated cost is \$10,000.
10. Install a grated cover over the top of the riser. The estimated cost is \$4,000.
11. Install an opening in the balcony railing for access at the leg ladder. The estimated cost is \$5,000.
12. Repair the deteriorated balcony floor plates. The estimated cost is \$5,000.
13. Drill drainage holes in the balcony walkway. The cost would be incidental to exterior painting.
14. Enlarge the hasp opening on the wet interior roof hatch for installation of a standard sized lock. The estimated cost is \$500.
15. Maintain the coating over the next 75+ years. The exterior would be high pressure water cleaned and overcoated with a fluoropolymer system. The estimated cost would be \$100,000 at years 20-25, \$100,000 at years 40-45, and \$100,000 at years 60-65.

If you have any questions please call the project manager, Eric Binkowski at (616) 374-3221 ext. 309.

FOR DIXON ENGINEERING, INC.,



James Rowley, PE
Structural Engineer



100,000 gallon cone roof (Paper Tank) located in Plainwell, Michigan.



1) Typical leg is in good condition overall. The foundation concrete is in good condition.

2) Missing grout underneath a leg.



3) Active corrosion of leg anchor bolt and nut.



4) The riser foundation is in good condition.

5) Typical lattice leg is in good condition. The coating is in poor condition.



6) The riser is in good condition. The coating is in poor condition.



7) Coating failures on the riser.

8) The sway rods are in good condition. The coating is in poor condition.



9) The leg ladder is in good condition. The ladder is equipped with a cable-type fall prevention device that is undersized.



10) Typical strut is in good condition. The coating is in poor condition.



11) The bowl is in good condition. The coating is in poor condition.



12) The balcony is in fair condition. The coating is in poor condition.



13) There is evidence of water ponding on the balcony. There is active corrosion occurring on the floor plates.

14) The leg to bowl connection is in poor condition. There is active corrosion in the crevices.



15) Same.



16) The sidewall is in good condition overall. The coating is in poor condition.

17) There is graffiti on the sidewall.



18) The rotating sidewall ladder is in fair condition. The ladder is equipped with a cable-type fall prevention device that is undersized.