Complex Bridge Inspection Procedure

LUC-00002-1862, SFN 4800303

Anthony Wayne Bridge over Maumee River

Toledo, Ohio

Bridge Type:

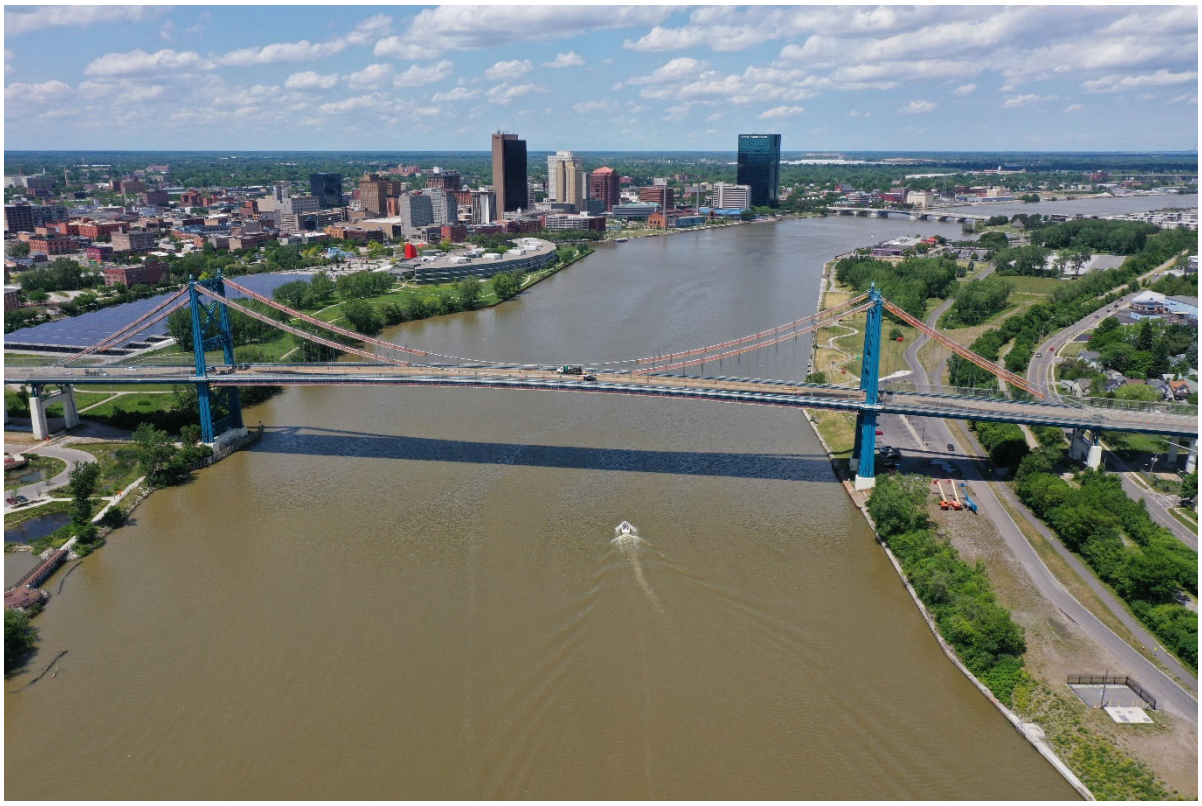
Main spans consist of three suspension spans with a light weight reinforced concrete deck supported with two built up steel towers and two reinforced concrete hold down piers. Approach spans consist of continuous steel plate girder spans, simple plate girder spans, and simple multi-beam spans. All approach spans have reinforced concrete deck supported on reinforced concrete substructures. Abutments, approach piers and hold down piers have foundations supported with precast cast concrete piles driven to rock or hard pan. Approach retaining walls are supported on spread footings. Towers are supported on deep concrete mass block foundations socketed into bedrock and anchorage piers are supported with deep concrete caissons embedded into rock.

Spans:	North Approach Spans, 45’-3”, 68’-10”, 2@ 69’-7”, 81’-6”, 107’-10”, 91’-7”, 163’-8”, 105-7”, 98’-2” Suspension Span, 233’-6”, 784’-10”, 233’-6” South Approach Spans, 98’-2”, 105’-7”, 93’-9”, 5 @ 80’-0”, 79’-3”, 5 @ 40”-0”, 32’-6”, 32’-0”, 20”-0”
Roadway:	26’-0” f/f barrier each side with 5’ sidewalks each side.
Loading:	HS-20-44, Superstructure
Skew:	Varies
Wearing surface:	Monolithic concrete
Approach Slabs:	AS-1-81, 25’-0” long

Location Map:

The Anthony Wayne Bridge, also named the High Level Bridge, is located in Toledo, Ohio and carries Clayton Street on the west side of the bridge to Woodville Road on the east side, over Morris Street, the Maumee River, Boers-Boyer Way, Miami Street, Yondota Street, and Utah Street. State Routes on the bridge are SR-2, 51 & 65.

Elevation:



End View:

General Information:

Public Entity	Contact Name and Number
Bridge Inspection Responsibility	Ohio Department of Transportation
Bridge Maintenance, Major Bridge Maintenance, Minor	Ohio Department of Transportation City of Toledo

Complex Features on this Bridge:

Complex Feature	III. Frequency of Inspection
Main Towers	Routine Annual to spot-check known deficiencies, In-Depth Inspection every 60 months
Suspension cables, suspender cables & hanger brackets and saddles.	
Stiffening girders, floor beams & stringers	
Anchorage piers	
Dehumidification system on suspension cables (To be determined)	

Describe Risk Factors Unique to this Bridge:

Risk Factors	Description
Under Bridge Inspection from cat walks and by climbing methods	Access from man ladders, some in excess of 50' high and 15' to 20' above ground line.
Main Towers	Access doors at deck level. Inside towers man ladders in excess of 100' high.
Suspension cables, suspender cables & cable saddles by climbing methods.	Access from bridge deck or from main towers.
Anchorage piers	Access from doors and man ladders in excess of 50' below ground level.
Dehumidification system	To be determined

Detail the Inspection Methods and Equipment to be employed on this Bridge:

Inspection of the suspension spans will mostly be completed by climbing methods. Inspection of the approach spans can be competed with climbing methods and assisted with man lifts from ground level. Sounding of substructures will require man lifts. Inspection of the bridge deck, suspension cable hangers and stiffing girders may require traffic lane closures. Lane closures are to be coordinated with the City of Toledo.

Safety:

Inspectors shall refer to the procedures outlined by their own employer's health and safety policies for the minimum safety requirements. Local police should be notified prior to any personnel being on the suspension.

Contacts for this Bridge:

Agency	Contact Name and Number
ODOT District 2	ODOT District 2 Headquarters 317 E. Poe Rd. Bowling Green, OH 43402 Primary Phone: 419-353-8131
City of Toledo	Streets, Harbor and Bridges 1189 Central Ave. Toledo, OH 43610 419-936-2508
Toledo Police	525 N. Erie Str. Toledo, OH 43604 419-245-3340
Toledo Fire	Non-Emergency 419-939-3550

Additional Inspector Training, Experience, Licensing and Certification Required to Inspect Complex Features listed:

	Inspector Training, Experience, Licensing and Certification Required
Team Leader	• The inspection team shall be led by a Professional Engineer or supervised by a Professional Engineer who meets the minimum requirements for a Team Leader in the National Bridge Inventory. • Familiar with suspension span bridges, their construction, design and current inspection techniques. • Understanding of where and how defects occur. • Understanding and ability to perform testing or recommend advanced testing procedures at problem areas.

Relevant Operating Manuals, Guides and Supporting Documents Necessary for the Successful Inspection of the Complex Features on this Bridge:

Document Name, Agency and Year	Location of Document
Previous Inspection Reports	ODOT Bridge Database
Previous Inspection Photographs	ODOT Bridge Database, ODOT District 2 local server

History:

The most recent In-Depth and Routine Inspection Reports need to be reviewed prior to performing the inspection in order to determine specific risk factors on the bridge.

- 1931 – The Anthony Wayne Bridge, designed by Waddell and Hardesty, was opened to traffic. The McClintic Marshall Company was the contractor for the erection of the superstructure and HP Converse and the Holmes Construction Company were the substructure contractors.
- 1960-61 – Improvements to the structure included concrete deck replacement, lighting improvements, structural steel repair, expansion joint replacement, new scuppers, and downspouts.
- 1978 – Concrete barrier built on centerline.
- 1981 – Fences constructed on east approach spans.
- 1984-85 – Structural steel was painted using ODOT System A (inorganic zinc silicate primer and a vinyl finish coat).
- 1987 – Decorative lighting added in the suspension spans.
- 1988 – City of Toledo, Division of Streets, Bridges, and Harbors started to replace sidewalk in the suspension spans.
- 1989 – Plans and specifications were developed to repair the substructure concrete, rehabilitate the link bearing members, including pin replacement at the towers, install new strip seal expansion joints, drainage troughs and downspouts, pavement relief joints, and curb railing on the bridge approach spans. In addition, Physical Condition Report was prepared by SSOE, Incorporated.

- 1991 – Burgess & Niple, Limited (B&N) performed the first annual inspection of the bridge. Modjeski & Masters was hired as a sub consultant to inspect the suspension components with B&N. A night field survey was performed to provide geometric data for a structural and geometric behavior analysis of the suspension spans. Improvements included substructure concrete repair, rehabilitation of the link bearing members at the towers, new strip seal expansion joints, new drainage troughs and downspouts, and installation of curb railing on bridge approach spans.
- 1992 – B&N performed the second annual inspection of the bridge. Modjeski & Masters was hired as a consultant to inspect the suspension components with B&N.
- 1993 – B&N performed the third annual inspection of the bridge. Modjeski & Masters was hired as a sub consultant to inspect the suspension components with B&N. Commercial Diving Service, Inc. was hired as a sub consultant to perform a subaqueous inspection.
- 1995 – B&N prepared rehabilitation plans for various improvements, including a superplasticized dense concrete overlay, sidewalk replacement, finger joint replacement, new deck joints, structural steel repairs, new suspender ropes, new cable wrap, painting the entire structure, etc.
- 1997-98 – American Bridge Company performed 1995 plan rehabilitation.
- 2003 –Gannett Fleming inspected the structure. Modjeski & Masters was hired as a sub consultant to inspect the suspension components. Mannik & Smith was hired as a sub consultant to inspect the east and west approach span components.
- 2012- Cable opening inspection-Plasecki Steel Const. Corp.
- 2014-15 - E.S. Wagner Const. Co. performed plan rehabilitation which replaced bridge deck, made structural steel repairs, replaced approach truss spans with continuous steel girders, and patched concrete substructures. The suspension span deck was replaced with lightweight concrete. Consulting engineers were Arcadis, Gannett Fleming & Modjeski & Masters.
- 2016-17- UCL Inc. preformed plan work to replace the bridge paint system.
- 2018-2020- Future planned work- Replace cable wrap and installation of cable dehumidification system, install dynamic lighting system.
- 2020 – Gannett Fleming performed in-depth, element level and fracture critical inspection. Modjeski & Masters was hired as a sub consultant to inspect the suspension components.

General:

This document is not comprehensive and is intended to supplement the current Ohio Department of Transportation Bridge Maintenance Manual. All inspections are to be conducted in compliance with the Ohio Department of Transportation Manual of Bridge Inspection. Maintenance procedures and repair materials should conform to the standard procedures where possible.

Regular systematic inspections and maintenance is critical to the long-term operation of the bridge. Inspections should be carefully documented to be able to determine the progress of any deterioration to the bridge structure. This allows the timely scheduling of maintenance and repairs that will extend the life of the structure and reduce the maintenance costs.

In addition to the normal inspection process, department personnel should report any deficiencies noted during routine operations to the Bridge Engineer. This is particularly critical for any safety equipment such as damage to the barriers or attenuators.

When conditions or areas of concern are identified they should be monitored to determine the rate at which further deterioration is progressing. Areas where the conditions are stable and not changing significantly should be reviewed for their effects on the long-term maintenance or durability of the structure and the appropriate maintenance activities should be scheduled.

When the conditions are changing between inspections a more detailed review needs to occur to determine if the distress or deterioration is a symptom of a more critical condition that could impair the performance of the structure. It also needs to be determined if the continued deterioration will result in any significant damage to the structure or increased repair costs prior to the next maintenance or repair cycle.

When deterioration is continuing an appropriate inspection interval should be determined to monitor the deterioration and to provide for a proactive maintenance or repair program in a cost-effective manner.

Safety:

All inspections are to be conducted at a minimum in compliance with the NBIS and the Ohio Department of Transportation Manual of Bridge Inspection.

It may be necessary to set up traffic control or safety zones on the bridge or sidewalks to safely conduct inspection or maintenance operations. Any required traffic control for the inspection, repair or maintenance of the structure shall be in conformance with the requirements of the FHWA Manual for Uniform Traffic Control Devices and shall be coordinated with the City of Toledo and the ODOT district 2 office. Contacts are as provided above.

Entry of some bridge components may pose OSHA requirements regarding confined spaces. Locations that could require special concern are the inside of the tower bases, tower wind locks, and anchorage pits.
Therefore, entry of these items may include additional challenges with requirements for personal protective equipment following the protocols of the Ohio Department of Transportation Confined Space Entry Program and the Alternate Entry Procedures for bridge inspection as set forth in the Department's Manual of Bridge Inspection.

The bridge engineer is to be notified before the inspection starts so that he can advise local authorities.

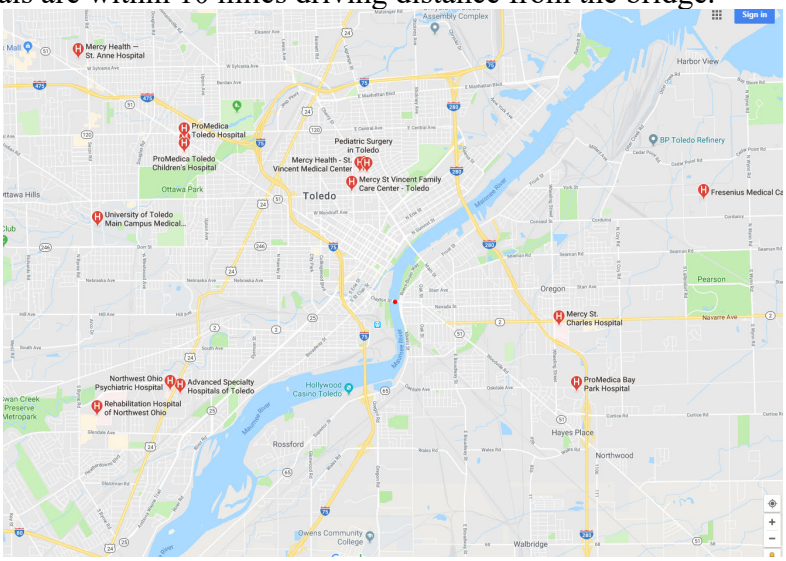
When accessing some components of the bridge proper safety procedures, clothing and personal protective equipment including a radio, flashlight, and possibly an air monitor are to be used. Note that cell phone and two-way radio service could be erratic at some locations on the structure.

Manlifts and other specialized equipment shall only be used by personnel trained for the use of that equipment.

Climbing to obtain access to areas on the structure shall only be done by trained experienced personnel using the appropriate climbing safety equipment and techniques.

Access to the suspension span catwalk, towers and anchorage pits is limited. Therefore, the inspection team needs to be aware of any physical limitations that might require them to return to the egress point.

More than five hospitals are within 10 miles driving distance from the bridge.



Suspension Span Catwalk:

When using the inspection walkway under the suspension spans care is to be taken to abide by all load restrictions. The walkway is designed to provide access for inspection personnel only. The spans are limited to three persons or 750 lbs. of persons and equipment per walkway span.

The catwalk system and railings are NOT designed to provide fall arrests. Do not use the railings or any part of the catwalk or its support framing as an anchor point for fall arrest equipment. The rails are purely to function as safety railings and are not to be loaded as part of any construction or maintenance activities.

All required fall protection for operations outside of the handrails is to be independent of the catwalk system and shall be designed by a qualified person, in accordance with OSHA, not to provide any loads to the catwalk or handrail system.

No additional loads are to be placed along the catwalks due to mechanical equipment, maintenance or repair operations. Any maintenance or construction scaffolding is to be supported independently of the catwalk system and railings.

The catwalk is to be visually inspected for any signs of corrosion or deterioration prior to being fully loaded.

Access:

A. Main Suspension Span Access:

Access to the main suspension span catwalk system located below the bridge deck is accessible from the hold down piers B and E, located each side of the river and opposite of the towers. Equipment required to access the top of the hold down pier caps or ladder cages are extension ladders or man lift. Even though the paint system has been replaced, inspectors should be cautioned that areas of lead paint may remain and to be cautious of bird droppings.

B. Tower Access:

Access to the inside of the four towers is through hinged man doors located at the sidewalk level. The doors are locked, keys may be obtained from the bridge engineer. Keys are not to be reproduced unless granted permission from the bridge engineer and are to be returned after the inspection is completed unless the inspector has authorization to keep the key. Each tower consist of five cells and each cell is accessible using installed man ladders. The height of the ladders inside the towers varies on the location of the internal bulkheads. Bulkhead manhole openings in the center cell are 16”x 18” and in other cells are 16”x13”. The only cell that exits to the top of the tower is the center cell. When exiting the towers, it is important that the upper doors are kept closed to keep birds out and the sidewalk doors are locked to prevent vandals from entering. The tower cells are unlighted, contain lead paint and bird droppings. Inspectors are cautioned to have the proper equipment.
Confined space entry techniques and equipment may be required for entry into these areas. Inspectors are advised to review the plans and site conditions before entering the towers.

C. Cable Access:

The cables are accessible from the sidewalks or from the towers. Locked gates on the cables have been installed to prevent vandals from climbing the bridge. Keys may be obtained from the bridge engineer and are not to be reproduced unless permission is grated and are to be returned after the inspection unless permission is granted for the key to remain with the inspector. The cables are equipped with safety cables. Inspectors must have proper climbing equipment when on the cable. When working on the cables the lead engineer or bridge engineer will be required to contact the local authorities at the contact information provided above.

D. Anchorage Pit Access:

Access to the four anchorage pits is by locked hinged doors located on the ground level of the anchorage piers. Keys can be obtained from the bridge engineer. Keys are not to be reproduced unless permission is grated and are to be returned

after the inspection unless permission is granted for the key to remain with the inspector. The pits are lighted and have ventilation systems. Inspectors should not enter these areas if these systems are found to not work. Also, if standing water is visualized inspectors should not enter. If any of the above is found it should be reported to the bridge engineer for repair. Located in these pits is electrical equipment, sump pumps and dehumidifiers. Even though this equipment is powered from ground fault circuits, to avoid electrical shock, inspectors should not enter until it is confirmed by a certified electrician that the equipment is de-energized or repaired. Access to the lower and upper levels of these pits is by uncaged man ladders, some in excess of 50' in length. Inspectors should have the proper equipment when accessing these ladders.

Routine Inspection:

Routine inspections are to be performed annually. Throughout this time the bridge should be observed to ensure that it is functioning properly through the different seasons. Routine inspections shall include a general inspection of the following items:

ALL SPANS:

1. Approaches including pavement, curbs and sidewalks, median barriers and parapets and crash attenuators.
2. Approach slabs and bridge decks including sidewalks, median barriers and parapets, railings and vandal fencing.
3. Expansion joints, Modular and strip seal, Bearings
4. Superstructure- steel stringers, floor beams, and continuous built up girders.
5. Drainage system- scuppers, catch basins, leader pipes, and trash separators.
6. Substructures including approach retaining walls and three staircases.
7. Bridge lighting mast and supports.

SUSPENSION SPAN:

1. Suspender ropes and hanger brackets.
2. Hold down brackets, ropes and pier anchors.
3. Main cable –check for wrap tears and open seams, dehumidification system.
4. Anchorage pits-access system, cable anchors, mechanical equipment
5. Superstructure- access ladders, catwalk, floor beams & stringers, wind braces & gusset plates
6. Navigation lights upstream and downstream.
7. Channel- seawall and fender system.

Fracture Critical Inspection:

The bridge shall receive fracture critical inspection on all fracture critical members every 24 months at an arm's length distance. The stay cables, hangers, edge girders and floor beams are fracture critical. Inspectors shall consult the previous inspection for deficiencies and nomenclature.

In-Depth Inspection:

On a five-year plan, the bridge should receive an in-depth inspection requiring that all components of the bridge be inspected within arm's reach. This inspection should include all the above items in addition to the following:

1. Approach spans exceeding a vertical clearance of 25' need to be inspected with a man lift or by climbing.
2. On the suspension span:
    A. Cable saddles including spot checking bolt tensions, minimum one per saddle, 1 ¾" dia. @ 54,000 lbs., 120 locations.
    B. Suspender ropes.
    C. Tower wind struts, check gusset and batten plates.
    D. Tower airplane light anchor bolts.
    E. Main cable above and below the suspension span, checking wrap system, including the cable bands at the saddles.

Maintenance:

Routine maintenance is performed by the City of Toledo and includes the following:

1. Cleaning and sweeping sidewalks and gutters.
2. Cleaning suspension span hanger brackets.
3. Cleaning catch basins, scuppers, drain leaders and trash separators.
4. Cleaning expansion joints, bearings and abutment and pier bearing seats.
5. Making repairs to bridge sidewalks and bridge deck wearing surfaces.
6. Maintaining street, navigation and airplane lighting systems, including access systems.
7. Maintaining median barrier wall crash attenuator.

Major maintenance is by ODOT. Regardless of maintenance responsibility all deficiencies should be reported to the bridge engineer so that repairs can be scheduled.

Cable Dehumidification system:

When installed this system will be inspected and maintained with a yearly maintenance contract. The inspection of all mechanical and electrical equipment relating to this system will be per manufacturer's requirements and performed by a specialist, recommended by the manufacturer. Any potential air leaks noted in any of the piping systems or on the cable wrap system should be brought the bridge engineers attention. Air leaks that affect the performance of the system will be repaired with the maintenance contract.

11. Maintenance of Traffic:

Since the bridge has shared maintenance responsibility, both ODOT and the City of Toledo need to approve any maintenance of traffic plans. One lane can be closed with a merge temporary traffic control. When closing a lane and maintaining traffic (MT) Standard Construction Drawings (SCD) must be followed, (http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/SCD/Pages/CurrentMaintainingTraffic(MT)SCDs.aspx). If warranted for all lanes to be closed for short durations, detours may be approved and provided by the city of Toledo.

Detour Map: