Bridge Inspection Report

QUINSIPPI ISLAND BRIDGE

Quinsippi Island Road over Quincy Bay
Quincy, Illinois

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TABLE OF CONTENTS

APPENDIX

1. INTRODUCTION

The Quinsippi Island Bridge is located at the west edge of Quincy off of Bonansinga Drive. The structure carries Quinsippi Island Road over Quincy Bay to Quinsippi Island. The structure was inspected on June 23rd and 24th, 2009. Weather conditions were sunny with a temperature of 97 degrees. The site was revisited on August 6, 2009 in order to determine the condition of the abutments as they were not accessible during the June inspection due to high water. Weather conditions were sunny with a temperature of 80 degrees.

2. BRIDGE DESCRIPTION AND HISTORY

The Quinsippi Island Bridge is a one-lane, six span riveted steel plate girder bridge with a timber tie and concrete deck. There is a pedestrian lane on both sides of the bridge for pedestrian traffic. The back-to-back abutment length is 610.6 feet and there is no skew. Guardrail lines both sides of the vehicular traffic lane and there is pedestrian railing at the outside of the pedestrian lanes. The width of the traffic lane is 9'-9 ½" and the pedestrian lanes are 3'-10" wide. The total out-to-out deck width measures 19'-9 ½". There is a six inch concrete slab on top of twelve inch timber ties for a total deck thickness of 18". The original plans included five masonry piers and two masonry arch abutments. In the 1950's four timber lagging piers were added to the mid-span of the four outer spans. It is believed that the timber lagging piers were to be temporary even though they remain, however, most of them do not bear with the steel girders. There is no nameplate for the bridge since it was originally constructed by a railroad. Construction of the bridge was finished in 1868 and there is no information on the type of loading the bridge was designed for.

3. INSPECTION PROCEDURES

The field inspection was performed by a certified inspector and consisted of a complete visual inspection all bridge components above the surface of the water. The bridge dimensions were recorded and any deficiencies were noted.

The underwater inspection was performed by Mainstream Commercial Divers and consisted of a Level I underwater inspection by qualified diving inspectors. A separate report has been provided for the underwater inspection.

4. INSPECTION RESULTS

Approach Roadway:

The approach roadway is on a tangent alignment at the west end of the bridge and there is a slight curve to the north just past the east end of the deck. There is a level vertical profile across the bridge and approaches. The posted speed limit at the end of the bridge is 15 mph. The roadway consists of a bituminous surface and is in fair condition at the east end. There are many potholes and patches at this location. The west end approach roadway is in good condition with only minor surface cracking.

The approach roadway ramps for the pedestrian lanes at the west end of the bridge are not level. This condition can potentially create a hazard for pedestrians walking or riding a bicycle.

Superstructure:

The superstructure is in fair condition.

Deck: The concrete deck above the timber ties is in fair to poor condition. There are many longitudinal and transverse cracks across the entire surface of the deck. There is one area near the west end of the deck that has had full depth concrete replacement. Near the center of the bridge there is an approximately six inch diameter hole through the concrete. Drainage from the deck appears to run to the center of the traffic lane and then through any cracks in the concrete. Instead of a usual crown in a bridge deck at the center, it appears the center of the deck is the low point. After drainage makes its way through the deck, it saturates the timber ties and structural steel below. The timber ties are in fair condition and many of them are moldy from the constant presence of moisture. Approximately 10 – 15 % of the ties have hollowed out areas in the center which is visible from the ends. Since the ties are spaced so close together it does not severely affect the structural integrity.

The checkered plating used as a surface for the pedestrian lanes is in fair condition. The plating has been flame cut and welded in many locations along the south pedestrian lane. It appears that these sections have been cut in order to provide maintenance to the water line that runs directly below. Some of the welds connecting one plate to another have fractured.

Girders and Bearings: The steel is in overall fair condition. In each span there is minor surface rust and pitting. The additional ½" plate at the top flange of the girders is severely corroded and pack rusted. Nearly the entire depth of the plate along the length of the bridge is delaminated. This has been caused by the deck draining onto the ties and then onto the girders. Any strength that the plates may have provided has been ignored in the rating calculations. It appears the girders may have been painted some time ago, but there is essentially none left. The bridge is a two-girder, non-redundant structure which means that it is classified as fracture-critical. The additional deficiencies noted in each span are as described below. See the General Plan and Elevation sheet in the Appendix for the span arrangements.

Span 1: The steel bearings at the west abutment are in good condition with only minor surface rusting. The steel bearings at pier 1 have moderate surface rust and pack rusting. They are in overall fair condition.

Span 2: The steel bearings at pier 2 have very minor surface rust and no significant pack rusting. They are in overall satisfactory condition.

Span 3: Along with the ½" plate at the top flange, the splices at the top of the girder are severely pack rusted. All rivets are still intact and it appears the splices are still serving their intended function.

The bottom flange has been constructed with a channel section with the legs turned up. Even though a bituminous material has been placed to fill up the channel, water is still allowed to collect at the bottom flange, causing severe damage to the rivet heads. An approximately four-foot length near the east end of the north girder has no tar where the rivets can be observed. It is conservatively assumed that the unseen rivets in this span are also in poor condition. The rivets appear to be fully intact between connecting members, however, this poor detailing during the design and construction of the bridge needs to be addressed in order to halt any further damage.

The webs of the girders are in fair condition with minor pack rusting between the web and angles at the top and bottom flange. This condition does not appear to be affecting the strength of the member at this time.

Span 4: Along with the ½" plate at the top flange, the splices at the top of the girder are severely pack rusted. All rivets are still intact and it appears the splices are still serving their intended function.

The bottom flange has the same detail as span 3 with the channel legs turned up. There is no bituminous material in the channels, exposing the rivets. Almost all of the rivets at the bottom flange are deteriorated, and some of the rivet heads are nearly gone. All of the rivets remain intact between connecting members, but the detailing needs to be addressed.

The web of both girders near the first splice (west end) is in poor condition with severe pack rusting at the bottom flange. There is significant delamination of the web steel and several locations where the web has rusted all the way through, leaving small holes. The web is in fair condition for the remaining length of the beam.

The steel bearings at pier 4 are in good condition with only minor surface rusting.

Span 5: The steel roller bearings at pier 5 have moderate pack rusting and delamination. This may contribute to the structure not expanding properly, but does not appear to be causing any significant problems at this time.

Span 6: The steel bearings at the east abutment are in good condition with only minor surface rusting.

Substructure:

The substructure is in fair condition.

Abutments: The abutments are in fair condition. The faces of both abutments are in good condition. There is delamination of the masonry between the bearings, but everything under the bearings is solid. Vertical cracks are typical along the mortar joints of both abutments. There is a large vertical crack on the north and south sides of the east abutment that extends all the way down the sides. This crack is located in joints and through some of the stones as well. This has likely been caused by settlement over the long life of the structure and is does not appear to be a serious problem. There is no noticeable settlement at the west abutment. The concrete arches at both abutments are in satisfactory

condition with hairline cracks, leaching with efflorescence, and some minor spalls.

Piers: The piers are in fair condition. The original construction of the bridge included five masonry piers and rehabilitation in the 1950's included adding four timber lagging piers. The timber piers are believed to have been used for temporary shoring, but have been left in place. They are all in very poor condition and the one under span 1 has fire damage. Due to most of the timber lagging piers having no bearing, they are not considered part of the bridge. Even at the locations where there is bearing, it is not fully bearing and eliminating the timber piers from the bridge rating analysis will yield more conservative results.

At each pier there are vertical cracks in the mortar joints and delamination of the stone, particularly at the ends. Minor spalls are typical as well and could be the result of debris collision during high water events. The masonry below the bearings is in good condition. During the inspection, a depth finder was used to spot-check some of the water depths around the piers. The depth directly upstream of the piers was typically 6 – 12 feet while the depth directly downstream of the piers varied from 10 – 30 feet. It is to be noted that the water was approximately 4 – 5 feet above normal pool elevation during the inspection.

There is a heavy accumulation of debris around the piers and especially at the east abutment. There are existing pilings from a previous structure that extend above the water surface just south of the bridge downstream of span 6. These pilings hamper the ability of debris to flow downstream and contribute significantly to the build-up.

See the underwater inspection report provided by Mainstream for description of the pier conditions below the water surface.

Traffic Safety Features:

Steel plate beam guardrail (1'-9" to center of rail) serves as a bridge rail over the structure and is in good condition. There is surface rust on the guardrail posts and there are two locations that exhibit minor impact damage. The first guardrail post at the east end of the north rail is not attached and there are several locations along the bridge with loose connections, particularly along the north side. The guardrail does not continue beyond the ends of the deck and there are no terminals present.

Chain link fencing (3'-6" to top of rail) serves as pedestrian railing along the outer edges of the pedestrian lanes and is in satisfactory condition. There is surface rust on the posts and fencing, but no section loss was found on the posts. The pipe at the top of the pedestrian railing is loose at several locations along the bridge, especially at the west end of the north rail.

Channel:

Due to the depth of the water, the channel could not be evaluated from above the surface. The Level I underwater inspection was performed by Mainstream Commercial Divers. They have provided comments on the channel bottom both from diver probing and from soundings taken to evaluate possible scour locations.

Some local scour has occurred around the footings of the piers. See the underwater inspection report provided by Mainstream for an in-depth description of the scour.

5. GEOMETRIC REQUIREMENTS

The current daily traffic is unknown, but it is seasonal with more traffic using the bridge during warm months. It is assumed to be significantly less than 1,000 cars per day. Since the bridge is owned by a non-government entity (Quincy Park District) there are no specific requirements for bridge geometry. For bridge rehabilitation AASHTO and IDOT guidelines would be recommended.

6. BRIDGE LOAD RATING

A load rating has been determined from the condition of the bridge and guidelines set forth in AASHTO's "The Manual for Bridge Evaluation", First Edition, 2008. The ratings for the bridge are HS 33 and HS 44 for inventory and operating levels, respectively. These load ratings are controlled by the timber tie deck. Inventory rating refers to the amount of live load the bridge can sustain for an undetermined amount of time given the bridge stays in the same condition as it is now. Operating rating refers to the maximum permissible live that the structure can safely support. It is important to note that live loads at the operating rating level are "permanent" loads, i.e., they can reduce the life of the structure if allowed an unlimited number of times. No load posting is required for the structure at this time.

The structure rating was calculated assuming the timber lagging piers were not present. Most of the lagging does not bear at all and the ones that do are not fully bearing. The bridge was originally designed and constructed without the timber piers. Ignoring the timber lagging piers yields the most conservative results and most accurate behavior of the structure.

7. CONCLUSIONS

The structure is in overall fair condition. The existing deck safely supports all traffic, however the leaks that allow moisture to penetrate and reach the steel girders remains a cause for concern. Once water from the deck reaches the steel further corrosion can occur. The joints between the checkered plating on the pedestrian lanes also allow water to seep through to the steel below. Other problems on the deck such as loose guardrail connections and cracked welds in the checkered plating are minor. Maintenance repairs can be made to ensure proper function of these items.

The existing timber ties under the deck remain in fair condition. There are some that are visibly deteriorated, but due to the close proximity of each tie, there is good distribution from the deck to the girders below. Water from the deck saturates the ties and mold has grown on the bottom surface. This condition creates no immediate threat but will make the ties deteriorate at a quicker rate.

The steel girders are in fair condition. The surface rust and pitting is minor and common, especially for structures this old. The ½" thick steel plate along the top flange of the girders is severely deteriorated. Its strength was neglected for the rating calculations due to its condition. Water that drains through the deck reaches these plates before any of the other steel; therefore it is easy to understand why they are in such poor condition. If the deck were to be replaced we recommend removing these plates.

The angles and channels of the top and bottom flanges are in fair condition with no serious deterioration. In spans 3 and 4 the channel at the bottom flange is turned up, causing water to collect without any way to drain. The bituminous filler used in span 3 does not appear to be allowing water to drain fully, so further deterioration of the rivets continues. The condition of the rivets for span 4 is poor and it assumed that the unseen rivets in span 3 are of the same condition. The bituminous filler in span 3 should be removed and weep holes to allow water to drain should be drilled at the bottom flange of spans 3 and 4.

The webs in span 4 near the west end are in poor condition at the connection to the angles. The location of the deterioration is fortunate since this is not a high positive moment region, nor is located directly above a bearing. The reasoning for this deterioration is unknown, but it could be a result of more moisture getting through the deck at this location.

The substructure is in fair condition. Cracks in the mortar joints and stone delaminations are relatively minor but cracks and any loss of mortar should be filled or sealed to prevent moisture from penetrating, particularly the crack above the East Abutment arch. Freeze and thaw cycles can cause significant damage to the stone masonry in the future if the cracks remain open.

The timber lagging piers are in poor condition and were originally placed as a temporary support. A majority of the timber piers do not bear and none of them provide full bearing. For any major rehabilitation to the structure we recommend removing them since they restrict flow, create potential scour areas, and catch debris.

8. RECOMMENDATIONS

Maintenance Repairs:

- Re-weld areas of the checkered plating that have fractured.
- Post “One Lane Bridge” signs on both ends of the structure.
- Add bituminous material at the west approach ramps of both pedestrian lanes to provide smoother transition.
- Re-attach the top rail (pipe) at the west end of the north pedestrian rail.
- Tighten all loose guardrail connections and re-connect the guardrail to the first post at the northeast corner of the bridge.
- Remove tar and drill weep holes in the bottom flange in spans 3 and 4 to allow water to drain.

Programmed Repairs:

- Replace deteriorated rivets in spans 3 and 4 with high strength bolts.
- Replace deck.
- Mortar deteriorated masonry joints and epoxy seal cracks in the stones.