Black Covered Bridge Truss

Rehabilitation and Maintenance Report

City of Oxford, OH

45056



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Exhibit 1-Oxford Bridge Column Repair for Oxford Museum Assoc.

Schaefer Structural Engineers, dated 07/24/2017

Introduction

One of the few remaining covered bridges in southwestern Ohio and the only one in Butler County on its original site, the Black (Pugh's Mill) Covered Bridge was built in 1868 to give access to a saw and grist mill owned by James B. Pugh on Four Mile (Talawanda) Creek. Pugh's Mill ceased to operate after two decades, and the name of the span gradually changed to Black Bridge, likely because there was a white covered bridge located downstream.

The firm of Banden, Butin, and Bowman built this 223-foot bridge as a single span for $30.25 per lineal foot, and unusually steep price in the 1860's. The county commissioners decided to have the builders come back to erect a central pier and "remodel" the structures with new braces so it would bear on the new pier. The extra work cost $600, and the bridge was completed and accepted in January, 1869. The original design was probably a Long truss, but after the remodeling it combined both the long and Childs truss concepts. Some panels have the wooden counterbraces of the Long truss, and those towards the center have the iron counterbraces of the Childs truss. The bridge is on the National Register of Historic Places (Bridge No. 35-09-03)[1]. A State of Ohio Bicentennial Historic Marker has been placed at the site. (Photo 1 and 2)



Photo 1—Ohio Historical Marker

[1] Excerpt from Covered Bridges-Ohio-Kentucky-West Virginia text by Miriam F. Wood and David A. Simmons, and photography by B. Miller—2007 The Wooster Book Co.—pp 124-125.



Photo 2—Ohio Historical Marker

The areas of the structure evaluated were the structural integrity of the columns and piers, the different components of the trusses and the site conditions affecting the bridge.

Findings and Recommendations

Columns and Piers

Column A

Column A, as referenced by Mr. Jim Miller, with Schaefer Structural Engineers, is shown on a drawing by Mr. Miller (Exhibit 1) is located on the north end of the bridge the 2nd column south of the north abutment on the east side. The existing column is a wood column that recently has been repaired. (Photo 3)



Photo 3—Column A Recent Repair

The existing repair seems to be sound except the existing repair does not appear to have the structural capacity to adequately meet design standards. The repair for Column A, as outlined by Mr. Miller's drawing, appears to be an adequate repair. I would recommend a protective measure, such as bollards, be installed to protect the column from debris, such as large floating trees during flooding times.

Column B

Column B, as referenced by Mr. Jim Miller, with Schaefer Structural Engineers, is shown on a drawing by Mr. Miller (Exhibit 1) is located on the north end of the bridge the 2nd column south of the north abutment on the west side. (Photo 4, 5, and 6)



Photo 4—Deterioration on Column B



Photo 5—Deterioration on Column B



Photo 6—Close-up of Deterioration on Column B

The base of column B shows a large amount of section loss in the wood column. Also, extreme crushing of the column can be seen.

The repair for Column B appears to be an adequate repair. When this repair is made, a temporary shoring should be use to return the truss to its original height to get an accurate measurement on the length of the column. The use of a steel W16x31 column on the upstream side will aid it the protection of the existing wood column. I would also recommend a protective measure, such as bollards, be installed to protect the column from debris, such as large floating trees during flooding times. This section loss and crushing affects the structural integrity of the bridge; therefore, this repair should be made as quickly as possible in the Spring.

Currently, the remainder of the existing columns, pier and abutment appear to be in adequate structural integrity. I would recommend a more thorough inspection of the components be made as weather allows.

Trusses

General Appraisal

The bridge components appear to be in good physical condition due to a major rehabilitation of the bridge in 2000. (Photo 7 and 8)



Photo 7—View of Internal Bridge Components



Photo 8—View of External Bridge Components

The main issue is the trusses are “out of tune”, meaning the trusses are not operating as designed. There are loose members which do not aid in the load carrying capacity of the bridge, and in some cases, since they are not functioning as designed actually adversely affect the load carrying capacity of the bridge. There is excessive vertical deflection in all 4 of the trusses as seen by the deflection in the floor system, with the largest deflection in the North West truss. (Photo 9)



Photo 9—Vertical Deflection in North West Truss

There is also misalignment of the top of the truss (top chord) as a result of the ineffectiveness of the load carrying capacity of the structural members. There is horizontal deflection in all 4 of the trusses as seen by the deflection in the top chord, with the largest deflection in the North West truss. (Photo 10)



Photo 10—Horizontal Deflection in North West Truss



Photo 11—Steel Rods, Nuts and Washers, and Thrust Blocking

The structural members of this particular bridge can be adjusted to restore the bridge to near original load carrying capabilities with the adjustment of the diagonal steel rods, characteristic of the Childs truss design and possibly other structural members. The adjustment is made by tightening or loosening the nuts on the threaded rods. (Photo 11 and 12)



Photo 12—Diagonal Steel Rods with Threaded Ends

The adjustment of the structural members of the bridge must be made as quickly as possible due to the excessive vertical deflection. Delay in adjusting the bridge could result in possible serious damage to the bridge and, more importantly, human well-being.

Exterior Components

Siding

The existing siding is comprised of wooden vertically aligned boards with battens. The siding appears to be in relatively good condition except for a few loose boards. A more detailed inspection needs to be performed. The siding needs to be re-stained as soon as possible to stop the effects of wood rot and deterioration. (Photo 13 and 14)



Photo 13—Loose Boards and Battens on East Side of Bridge



Photo 14—Loose Boards and Battens on West Side of Bridge

Roof

The existing roof is comprised of wooden cut shingles. The roof appears to be in relatively good condition except for a few loose shingles. A more detailed inspection needs to be performed. A wood sealant and preservative needs to be applied as soon as possible to stop the effects of wood rot and deterioration. (Photo 15)



Photo 15—Loose Shingles

General Maintenance

Tree at Southwest Corner



Photo 16—Tree at Southwest Corner of Bridge

There is a tree located just west of the southwest corner of the bridge that appears to be either dead or dying. The tree's condition should be investigated further. The tree should be cut back or taken down should it pose a fall hazard to the bridge or pedestrians. (Photo 16)

Scrub Trees at Northwest Corner of Bridge

There are some scrub trees growing on the abutment at the northwest corner of the bridge. These need to be removed. Left unattended the root system on the trees will grow under the truss system and cause a horizontal and vertical displacement of the main structural load carrying capacity of the bridge.



Photo 17—Scrub Trees at Northwest Corner of Bridge, Growing on Abutment

Overview

The overall condition of the bridge is good. There is repair work that already has been identified on Columns A and B. The trusses are in good shape. They need to be tuned to maximize the load carrying capacity of the bridge. As stated earlier, this work needs to be completed as soon as possible. The deck is in great condition. The roof and siding needs to have some minor repairs. The re-staining of the siding will be time consuming but once complete and the re-staining but on a routine schedule the time element should be minimalized.

Something to consider is a load carrying capacity analysis be performed on the bridge once the major column repairs and tuning of the trusses are complete. This analysis will inform the City of how many pedestrians can be safely allowed on the bridge. The City may want to procure the Law Director's opinion.