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August 22, 2019

Eric Evanoo, E.I.
Ohio Department of Natural Resources
2045 Morse Road, Bldg. E-3
Columbus, OH 43229

RE: Evaluation Timber Sidewalk and Railing
On Bridge ASD-20SP-00.85
At Mohican State Park
(Structural File Number 0326437)

Dear Mr. Evanoo:

Per your request, the Ohio Department of Transportation (ODOT) – District 3 Bridge Department has conducted an inspection and evaluation of the wooden sidewalk and railings on the referenced bridge. Please review the findings given in the letter report below.

Summary

The ODOT District 3 Bridge Department inspected the wooden sidewalk and railings after concerns were raised by the Ohio Department of Natural Resources (ODNR). Of primary interest were the notable sag of the cantilevered wooden sidewalk away from the concrete slab superstructure; and the visible deterioration on multiple wooden components of the sidewalk and railings. Based on the visible condition of the sidewalk, with uneven and deteriorated planks, ODNR intended to replace the walkway, at minimum, at the close of the 2019 camping season. ODOT was asked to evaluate all of the wooden components to determine if it would be better to replace all of the wood on the bridge.

After an arms-length inspection of every wooden component of the sidewalk and railing, ODOT believes that all wooden components of the bridge should be replaced at the end of the camping season. The sidewalk and railing is currently safe for pedestrians, but essentially all wooden components display some level of deterioration. Multiple members have significant rotting or cracking; or have failed completely and no longer carry their intended loads.

It is known that the sidewalk planks should be replaced. Multiple members on the wooden cantilevers supporting the sidewalk and railing posts would also need to be replaced because of deterioration. Many of the railing posts and railing panels would also need to be replaced in the project. With deterioration starting on many members that could be salvaged, it would only be a matter of time before these would need replaced also. This would lead to annual repair projects to replace different members. Some members needing replacement would be supporting relatively new members that would need to be temporarily removed to access the deteriorated members, creating extra work for the annual repairs.

Also of concern would be the aesthetics of the wooden railing and sidewalk which would consist of a mix of new members and aged members.

The inspection determined the cause of the noticeable sagging of the sidewalk away from the concrete superstructure. There was a gap between the vertical face of the slab and the vertical wooden 6x6 of the cantilever. This allows the tops of the cantilevers to rotate away from the bridge, creating the sag. The original plans show a ¾"x10" steel plate was to be installed between the concrete and wood vertical, but this was missing at all post locations. Similar steel plates were to be installed between the upstream railing posts and the concrete slab. These are also missing, allowing this railing to give somewhat when pushed laterally. It is not known why these plates are not present.

The steel anchor rods connecting the wooden cantilevers on the downstream side of the bridge, and the wooden railing posts on the upstream side of the bridge are in good condition. They can be reused in the installation of new wooden components.

Full replacement of all wooden components of the sidewalk and railings is recommended. The connections to the concrete bridge are in good condition and should allow for a straightforward replacement of the wooden cantilever supports; sidewalk planking; railing posts and rails.

The replacement can be done per the original plans, except the holes in the new members should be field drilled as there are slight variations in the existing anchor rod locations on the bridge. The ¾" gap between the wooden cantilever vertical member on the downstream face of the bridge, and the gap between the railing post and the bridge on the upstream face needs to be filled with something to prevent the sidewalk from rotating and the to keep the posts tight against the bridge.

History

The bridge was built in 1967. Construction plans for the bridge are available. New posts, rails and sidewalk planking were installed in 2005. The report from that time is silent on whether the entire wooden cantilever support was replaced. Additional wooden planks were installed to completely cover the deteriorating 2005 sidewalk planking in 2017. The original plans detail a ¾"x10" steel plate installed between the downstream side of the concrete slab superstructure and each sidewalk cantilever support. The plans also detail 4"x4" steel spacer plates at each individual anchor rod between the upstream face of the concrete slab superstructure and each wooden railing posts. None of these steel plates is present and it is not known whether they were originally installed or removed at a later date.

The bridge concrete wearing surface received a microsilica modified overlay in 2010. As the bridge sides are curbed, this should not have affected the railing or sidewalk.

ODOT performs the annual inspection of the bridge. In 2018, the bridge was rated in satisfactory condition. The wooden railing and sidewalk were rated in fair condition, with notes that the sidewalk planks were warped and cracked; and some posts had rotted.

Inspection Findings

Downstream Sidewalk, Cantilever Brackets and Railings

The downstream wooden sidewalk consists of 2x12 (finished to 11"x1 ½"). A second layer of planks was laid atop the original planks to support pedestrians as some of the original planks exhibit significant deterioration. The railing consists of a 6x6 post and two 2 ¾" x 7 1/2" (3x8 nominal) railing panels. Each post and the sidewalk are supported by a wooden cantilever consisting of two 2x6 horizontal members, two 2x6 diagonal members, and a 6x6 vertical member adjacent to the side of the concrete slab superstructure. The sidewalk cantilevers are attached to the slab with two ¾" diameter steel anchor rods cast into the vertical face of the slab (See Picture # 1.) There are 22 cantilevers and railing posts spaced at 6'-0" across the bridge. For purposes

of this report, they are labeled 1-22 from the south or rear end of the bridge. The bays between the posts are labeled 1-21.

The downstream sidewalk and railing are overall in fair condition, although there are multiple individual wooden components that are in poor condition or have failed due to deterioration.

Picture # 1 – Typical downstream sidewalk cantilever support.

The sidewalk planking installed in 2005 is deteriorated throughout, with several holes where planks have completely rotted through. The planks installed over the 2005 planks are successfully carrying the pedestrian loads to the adjacent cantilevered supports. (See Picture # 2).

Picture # 2 - Hole in sidewalk plank in bay 4.

The cantilevered support members display varying levels of deterioration. Many of the members have splits emanating from the connection bolts, or rot. (See Picture # 3 and Picture # 4).

Picture # 3 - Split at connection bolts at cantilever 7.

Picture # 4 - Heavy deterioration on north diagonal on cantilever 13.

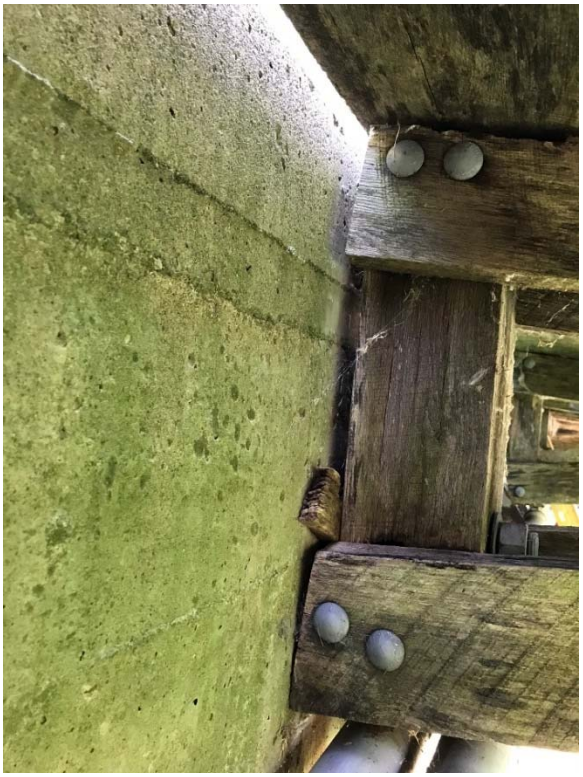
Two horizontal 2x6 boards on the cantilevers have broken away from the connection to the vertical 6x6. These are the south board at cantilever 1 (See Picture # 5) and the north board at cantilever 13 (See Picture # 6).

Picture # 5 - Failed south horizontal sidewalk support board at cantilever 1.

Picture # 6 - Failed north horizontal sidewalk support board at cantilever 13.

One of the primary concerns with the downstream railing and sidewalk was the noticeable sag away from the concrete slab. The fall of the 4'-0" wide sidewalk was estimated to be 6 3/8". Over time, the natural relaxation of the wood and minute enlargement of the connection bolt holes under repetitive load would contribute to some of this sag. The primary cause of the sag is that ¾"x10" steel filler plates shown in the plans to fill the gap between the wood cantilevers and the vertical face of the concrete slab are missing at all cantilever locations. With this gap, the cantilever is free to rotate away from the slab until the bottom of the cantilever makes contact with the slab. (See Picture # 7.) The photograph shows an ineffective wood

shim. Shims may have been used during construction, but most are now gone and those remaining do little to level the sidewalk.



Picture # 7 - Gap between sidewalk cantilever support and downstream side of concrete slab. (Cantilever 2 shown.)

Two 3 ½" diameter conduits hang directly below the sidewalk cantilever brackets. They can be seen in Picture # 7. They do not interfere with the brackets.

The downstream railing posts exhibit consistent deterioration. Most have large splits, some extending the full length of the vertical member. (See

Picture # 8 and Picture # 9). The posts support two 3x8 railing panels. The railing panels are in fair condition, although the lower rail in bay 20 from the south end of the bridge is cracked.

Picture # 8 - Split in top of post 2.

Picture # 9 - Large splits in bottom of post 7.

Upstream Railing

The upstream railing consists of 22 - 6x6 posts spaced at 6'0", supporting two 3x8 railing panels. The posts are connected to the slab superstructure by two steel anchor rods. The upstream railing has multiple deficiencies.

All of the post are not tight against the slab and can be rocked back and forth. The posts were detailed with a gap of ¾" similar to the downstream sidewalk cantilevers. The gaps were to be filled by two 4"x4" steel spacers, one placed at each anchor rod protruding from the concrete. These spacers are not present, allowing the posts to rock. A defunct 1/2" conduit runs between the anchor rods, providing a minimal amount of support to post. (See Picture # 10.) The conduit is severed at the rear abutment. The purpose and time of installation of this conduit is not known.

Picture # 10 - Typical gap between upstream railing post and slab. Note defunct conduit.

The tops of posts 12, 13, 15, 16, 19 and 22 from the south end of the bridge display rot. Post 16 has the worst deterioration. (See Picture # 11.)

Picture # 11 - Heavily rotted downstream post 16.

About half of the top and bottom railing panels display noticeable cracking. (See Picture # 12.)

Picture # 12 - Typical cracked panels on upstream railing.

Recommendations

It is our recommendation that all of the wood sidewalk, cantilever supports, and railing posts and panels be replaced at this time.

The original project intended to replace the warped and uneven sidewalk planks; but further evaluation indicates that the supporting members are also deteriorating, as well as the railing posts and panels on both sides of the bridge. A project performed this fall would need to replace a significant number of supporting cantilever members, railing posts and railing panels. The finished project would be functional, but unsightly with existing and replacement members side by side throughout the bridge. With all members continuing to deteriorate, this approach would lead to annual small repair projects to replace the worsening members. These projects would require tearing out new members to access the deficient pieces. A rehabilitation of the sidewalk and railings consisting of replacement of individual deteriorated component is not the preferred solution.

In its present condition, the sidewalk and railings lack the plan-specified steel spacers between the wood members and the superstructure slab. This gap has led to the sagging of the sidewalk and looseness of the upstream railing posts. This should also be addressed in a replacement project.

Other than the lack of spacers, the wooden sidewalk and railings appear to be constructed per the original plan. The existing anchor rods connecting the wood to the concrete slab are in good condition, with minor surface rust in places. It looks as if a new sidewalk and railing could be constructed using the original plan detail.

ODNR indicates they can have the wood for the new railings and sidewalk cut. Our inspection noted that the nominal wood sizes in the plans were consistent with random field measurements of the wood members. However, the plans were not specific on the amount of finishing performed on the wood. For example, the nominal 6x6 railing posts and cantilever vertical members measured 6”x6”, indicating no surface finishing. The horizontal and diagonal members of the sidewalk cantilevers also measured a full 2”x6”. The nominal 3x8 railing panels measured about 2 ¾” x 7 ½”, indicating they were surfaced on three sides. The nominal 2x12 sidewalk planks measured 11” x 1 ½”. These were surfaced on all four sides, with an additional ½” of material removed from the width. ODNR personnel should confirm the sizes prior to cutting.

Although no deficiencies were noted, we suggest replacing the galvanized steel connection hardware as part of the project.

The new railing and sidewalk need to have some type permanent material included to fill the ¾” gaps between the wood and the concrete slab. The plans specify galvanized steel plates and spacers. Another option may be to use ¾” elastomeric rubber pads to fill the gap. These are typically used as bearings to support bridge beams on the concrete abutments. We do not recommend using wood shims. This appears to have been tried before on the bridge. The relatively thin wood deteriorates faster than the remaining wood components and most of these have fallen out, leading to the sag in the sidewalk.

The defunct conduit on the upstream side of the bridge must be removed or relocated to accommodate proper shimming of the railing posts to the side of the concrete slab.

Inspection Procedure

The inspection was conducted on August 27, 2019 by Kent Kapustar, District Bridge Engineer; Steve Meggysey, Andrea Pasqualini, and Walt Keener, all Bridge Specialist 2s. The inspection utilized an extension ladder and small tools. The water level of the Clear Fork River appeared to be normal at the time of the inspection.

The relevant railing details from the 1967 plans are included with this letter. All bridge plan sheets are available upon request. A Liquidfiles invitation also accompanies with this letter allows the download of all of our inspection photos for your use. No hard copy of this report or photos will be mailed.

Please contact me at 419-207-7077 or kent.kapustar@dot.ohio.gov if you have any questions.

Respectfully,

Kent A. Kapustar

Kent A. Kapustar, P.E.
District 3 Bridge Engineer
Capital Programs Administration

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