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Title

Conrail - Madjeski and Masters Bridge Inspection Report

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December 20, 2012

Thomas Bilson, PE,
Assistant Chief Engineer MW & Structures
1000 Howard Boulevard
Mt. Laurel New Jersey 08054

ATTN: Paul DeSantis, PE, Project Manager

RE: PN3228
CONRAIL SHARED ASSETS
Conrail U.G. Bridge No. 13.70
Paulsboro Bridge over Mantua Creek
Post Derailment Structural Certification
Letter Report

Gentlemen:

As directed by Conrail Shared Assets (CSA) and in accordance with our Scope of Services Agreement, we provide this Letter Report in summary of our professional engineering services to CSA following the November 30, 2012 train derailment at the referenced Bridge.

Modjeski and Masters, Inc. (MM) visited the referenced bridge and performed a Visual Structural Inspection (VSI) of the five (5) span superstructure and all substructure elements above the stream bed and ground line. Following this VSI, MM provided CSA with additional structural repair recommendations along with a certification that the repaired bridge (once movable but made fixed) would perform with the same structural level of service as it had before the derailment incident. All bridge elements were inspected for damage due to the recent derailment as well as other relevant deterioration in structural conditions. Full access to the bridge superstructure and substructure elements was provided to MM by CSA, and MM worked with CSA's diver team to assess their underwater inspection findings of the in-water portions of the structure.

For the purposes of the summary that follows, the bridge railway is assumed to be oriented in a North-South direction, and the spans and piers are numbered from South to North.

Field Observations

Richard Jackson, PE (Team Leader), David Barrett, PE, Geoffrey Forrest, PE and Gregory Wisniewski, EIT visited the bridge site initially on Monday, December 10, 2012. The rail car removal process was on-going at that time and there was limited access to the structure. As such, limited portions of the superstructure near the abutments were accessible, and a VSI of the approach span superstructure was performed at that time. A visual inspection of the swing span superstructure's west elevation was also performed at that time from aboard the salvage crane barge.

At that time, the balance wheels were found to be in-place on the ring plate, and the swing span appeared to be seated on its pivot bearing. The toe end (north end) of the swing span (Span 4) was positioned off its bearing pedestals to the west. There appeared to be firm contact between a derailed tank car and the east side of the easterly swing span girder.

Richard Jackson, PE, visited the bridge site on Thursday, December 13, 2012. At that time, three rail cars remained in the water and removal operations were on-going. The south abutment was inspected, and the following deficiencies were observed. The southeast wingwall exhibited a large open spall at the top of the wall and a wide diagonal crack over the full exposed height of the wall. The end of crack was not visible, and Tom Bilson indicated the wingwall would be temporarily removed to facilitate railcar removal and would be repaired.

The Span 2 superstructure appeared to be shifted to the south with respect to the Bent I pier cap. The bolts connecting the girder bottom flange to the Bent 1 pier cap were found in contact with the north end of the slotted holes in the flange suggesting a Span 2 expansion mode, and bolt damage was expected. Suspecting connector damage, MM recommended the replacement of the bolts that connect the superstructure to the Bent 1 pier cap, and CSA work forces were on-site later to perform this repair and reported that the existing bolts had not been damaged. As such, MM withdrew this repair recommendation.

The previously noted off-set conditions at the toe end of the swing span remained.

Richard Jackson, PE, David Barrett, PE, and Gregory Wisniewski, EIT, visited the bridge site on Friday, December 14, 2012. At that time, one rail car remained in the water, and the swing span was repositioned onto its bearing pedestals. Access for the VSI to the underside of the superstructure was provided by boat. The following superstructure deficiencies were observed and discussed with CSA during this field visit:

- The end diaphragm at the north end of the swing span (Span 4) was damaged
- The stiffener at the northeast end of the swing span's east girder appeared to be buckled, but this condition did not seem to be related to the recent derailment.
- The lateral restraints at the toe end of the swing span were broken.

There was no visible damage to the swing span and approach span steel girders.

Richard Jackson, PE, visited the bridge site on Sunday, December 16, 2012. At that time, all railcars were removed from the waterway, and CSA's diver team performed an inspection of the underwater portions of all pile bents. All substructure piles were reported to be undamaged except for two piles as follows:

- The interior easterly vertical (plumb) pile of the 4-pile bent that supports the north end of Span 3 (note: this bent is immediately adjacent to, and just south of, the pivot pier bent) exhibited a slightly deflected shape. Relative measurements were taken by the diver to further assess this apparent pile misalignment, and the clearance between adjacent concrete pile jackets at the top of jacket was measured to be 6", while the clearance at the bottom of jacket was measured to be 3". The bottom of the pile was reported by the diver to be bent towards the west. It was not evident whether this damage was a result of the recent derailment, but a railcar axle was reported to have been found at the bottom of this pile bent. Tom Bilson suspected this damage to be pre-existing, but could not be certain of that.
- The easterly plumb pile in Bent #2 exhibited a damaged fiberglass jacket and some shallow concrete encasement spalls.

The stream bed at the base of all pile bents appeared to be stable with some minor local scour observed by the dive team.

At this time, it was also observed that the new swing span girder bearings (welded shim packs) had been installed beneath the girders on the pivot pier, but were installed in front of and behind the existing pivot centerline of bearing. Also, no damage was observed on the easterly swing span girder where a derailed railcar had made contact.

Document Reviews

The following documents have been provided by CSA and have been reviewed by MM as part of this priority work assignment:

- Shop Drawing of the swing span steel girder, dated September 1901
- Shop Drawing of the balance wheel ring support, dated September 9, 1940
- North Approach Reconstruction (one Drawing) dated December 21, 1963
- South Approach Reconstruction (Drawings 1 of 4 and 2 of 4), dated January 10, 1980
- Six (6) of the most recent 2-page structural inspection summary reports
- Pile Strengthening Plans, dated October, 6, 2009

Analyses

No engineering analyses were made as part of this priority work assignment for CSA.

Conclusions

A VSI was performed on the five (5) span superstructure, four (4) pile bents, and two (2) abutments. All structural elements located above the stream bed and ground line were inspected. We observed several damage-related deficiencies that were recommended for repair, and were repaired by CSA, prior to restoring railway traffic on the bridge.

- The end diaphragm at the toe end of the swing (draw) span (Span # 4 / Bent #4) was replaced in-kind
- Proper lateral restraints on each side of each swing span girders at the rest pier bearings (Bent #4) were provided
- New bearing shims were provided beneath the swing span girders at the pivot pier (Bent #3). The shims were initially installed in front of, and behind, the existing centerline of pivot bearing and were ultimately re-installed on the centerline of pivot bearing

The swing span temporary shims were initially installed on the pivot pier such that the swing span length is slightly shorter than the existing span length. This condition didn't warrant precluding railroad traffic on the bridge in the short term, however, CSA was notified that proper bearing shims need to be provided as soon as possible to restore a fixed bridge span length that is equal to that of original swing (draw) span length. On December 18, 2012, CSA informed MM that the bearing shims had been provided at their proper location. Since demands on the new shim bearings require the transfer of transverse and longitudinal load effects from the superstructure to the substructure, all the shim pack were welded together by CSA as a

contiguous bearing unit and were fixed by welding to their respective girder and bent caps members as the means of load transfer.

The existing end stiffener on the east side of the east swing span (Span #4) girder at the rest pier (Bent #4) appeared to be in a buckled state, and the condition was discussed in the field with CSA. It was agreed that a repair of this deficiency should be made as soon as possible, but this deficiency appears to have been in this condition state for quite some time, and that repair was viewed to be not be immediately consequential to this structural certification.

In addition, the possible damage-related pile deficiencies observed, were determined to not affect this certification.

- The interior easterly plumb pile of the 4-pile bent that supports the north end of Span 3 exhibited a slightly deflected shape. No apparent impact damage was observed. This deficiency was discussed with Tom Bilson, and it was concluded that the deficiency could not be specifically attributed to the 2012 derailment, but periodic monitoring of this deflected pile should be made for any changed conditions within the next month and it should also be monitored as part of the routine underwater inspection program.
- The easterly plumb pile in Bent #2 exhibited a damaged fiberglass jacket and some shallow concrete pile encasement spalls. While these concrete encased jacketing systems offer some incidental improvement to pile bent stiffness overall, they are not a structural component and are intended only to slow steel H-pile corrosion in the tidal zone. The damaged encasement system is expected to continue to protect the steel pile and its condition should be monitored as part of the routine underwater inspection program.

The recent derailment damaged the existing shear pole and tie rod stay system thereby leaving the bridge inoperable for navigational traffic, however, structural related damage to this bridge was found by MM to be relatively minor should this bridge remain in service temporarily as a non-movable (fixed) type structure. Therefore, it is our opinion that the reset bridge will perform with the same level of structural service as it did before the derailment incident.

Recommendations

The following recommendations are made moving forward:

- Repair the damaged and removed section of southeast wingwall (South Abutment)
- Supplement the existing bearing stiffener at the northeast end of the east swing span girder at the rest pier by installing a bolted repair stiffener.
- On a bi-weekly bases, monitor the structural performance of the temporary shim bearings and lateral restraints that have been provided to make the draw span (Span 4) structurally fixed to its substructure units
- Within the next month, monitor the interior easterly plumb pile of the 4-pile bent that supports the north end of Span 3 for lateral movement. Also, monitor this pile during routine underwater inspections.
- Monitor the jacket and encasement condition of the easterly plumb pile in Bent #2 during routine underwater inspections.
- Continue slow-speed (10 mph max) railway operations over the temporary fixed bridge

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Thomas Bilson
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December 20, 2012

We trust that you will find this report in order and responsive to your needs on this project. Please do not hesitate to contact us should you have any questions or require any further information or assistance in this regard.

Very truly yours,

ORIGINAL TO BE SIGNED

Richard E. Jackson, PE
Structural Project Engineer

Concurred,

PII

Richard A. Martino, PE
Structural Project Manager

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Limitations: This report is based upon examinations and studies at the times and in the manner herein discussed. The nature of the inspection does not permit assurance that there are not latent or hidden defects in the condition of the members, lack of uniformity in the quality of the materials used or detrimental occurrences subsequent to the inspection. Therefore, no responsibility can be assumed for lack of integrity of the structure from unpredictable causes or those beyond the scope of this inspection and report.

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