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Daniel E. Kent, Jr., P.E.
Senior Structural Engineer/Bridge Practice Inspection Lead
Gannett Fleming Engineers and Architects, P.C.
2500 Corporate Exchange Drive, Suite 230,
Columbus, OH 43231

Re: Letter report summarizing findings and recommendations related to diaphragm cracking in the steel cross girder at pier #6 on HAM-562-0147.

Dear Dan
As you know, I visited the above referenced steel cross girder on 1/19/2024 to examine the crack observed at the weld attaching the interior diaphragm to the web of the box girder. I was able to access the interior of the box through the man-door at the end of the box girder with the assistance of a man-lift provided by others. Mr. Michael Seal with Collins Engineers was present and was very helpful in getting us into the box girder and navigating to the cracked location on this very cold January day.

The crack of interest in shown in Figure 1. The crack is present on both fillet welds (i.e., on both sides of the diaphragm). It is also apparent that the diaphragm appears to have been distorted out-of-plane as evidenced by the paint damage where the diaphragm is fit tight to the top flange. As seen in Figure 1, there is no weld between the diaphragm and the top flange. Based on my review of the design drawings, it would seem that the longitudinal girders which frame into the box girder would apply tension forces to this diaphragm due to the negative moments that are generated. However, it is also true that the box girder is flexible in the vertical direction and as such, if one assumed the cross deflected downward, then positive moment would be generated in the longitudinal girders and hence, compression in the diaphragm. However, in the absence of installing strain gages and conduction long-term field measurements, it is not entirely clear if tension or compression from live load is carried through the diaphragm. Similarly, dead load forces could also be in tension or compression depending on fit up and other tolerances that affect locked in forces.

Nevertheless, the cracking is very isolated and I am not convinced that the crack has not actually been present for a number of years. What I could see inside of the crack surface was corroded and I did not see evidence of recent, active movement from live load. Such evidence would be the production of iron oxide that is often observed at displacement induced cracks due to the

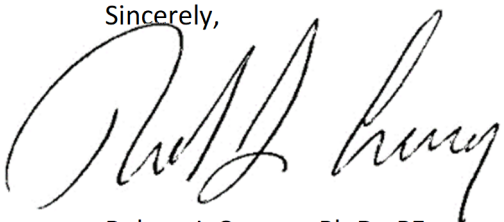
rubbing of the crack surfaces. **I think it is impressive that the crack was detected to some degree as these are large box girders and it is an isolated small crack. Thus, it could be that the crack was smaller and has finally reached a size that is more easily detectable, or it was present for many years and the coating has finally failed and hence, it is more detectable.**

Since it is an isolated crack that is not in the main member and located in a compression region of the box girder I don't see this to be a very serious matter. As such I would recommend the crack be ground and fillet out for a length of 3 inches to remove it entirely (See Figure 2). I would further recommend MT to ensure the crack was completely removed.

In terms of long-term inspection needs, I would subsequently inspect the repaired detail during normal NSTM inspections and I don't see a need to conduct more frequent inspections of this specific detail. At most, you may wish to examine this detail at 6 or 12 months after the repair is made to make sure no further crack extension is observed. Assuming no changes are observed, simply continue with normal NSTM inspections and note that this is a special detail to be examined by inspectors. Should additional crack growth be detected at this location we can consider the need to conduct a more detailed evaluation as to the cause with the objective of developing a more robust retrofit. Should cracks be detected at other locations (i.e., other interior diaphragms) or become more widespread in the future, the same retrofit could be introduced. However, I would request you reach out to me so that we can make sure the type of cracking is the same.

I appreciate the opportunity to continue to work with you on this interesting project and look forward to discussing these points in the near future. If you have any questions or comments on this report, please don't hesitate to contact me at rconnor@purdue.edu or 765-414-3992.

Sincerely,



Robert J. Connor, Ph.D., PE

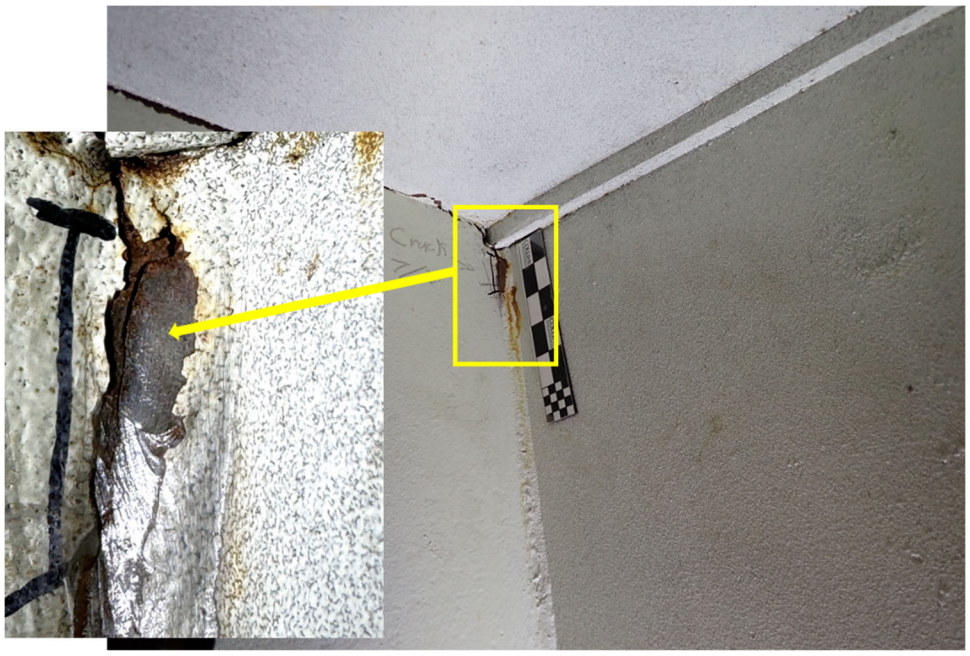


Figure 1 – Photograph of crack observed at interior diaphragm of pier 6 cross girder

Figure 2 – Photograph of the observed crack illustrating recommended limits of grinding to remove the cracked portion of the fillet weld as well as a portion of the uncracked weld