URS

November 6, 2009

William Dittrich
Indiana Department of Transporation
100 N. Senate Avenue, N808
Indianapolis, IN 46204

Subject: Load Rating Analysis – Report of Findings
Cline Avenue Bridge
S.R. 912 over the Indiana Harbor Canal
East Chicago, Indiana
Lake County

Dear Mr. Dittrich:

The purpose of this letter is to alert the Indiana Department of Transportation that immediate action should be taken to address structural deficiencies with the Cline Avenue Bridge. Specifically, URS strongly recommends that INDOT:

- Not allow any permit loads on the mainline bridge or ramps;
- Post the mainline bridge and ramps for reduced live loads not to exceed 18 tons;
- Restrict traffic to striped lanes and use prudent maintenance of traffic schemes to restrict traffic from the bridge shoulders;
- Immediately begin retrofit and/or replacement evaluation and strengthening implementation to correct structural deficiencies related to service level longitudinal bending stresses, factored web shear, and factored transverse bending in the top deck slab; and
- Continually monitor the bridge and ramps with a six month cycle inspection process.

Please note that the recommendations presented above are based on a preliminary analysis that assumes the structure is in pristine condition. The structure is not in pristine condition. As such, URS' preliminary analysis and recommendations do not reflect actual reductions in load carrying capacity caused by existing degradation of the structure. Further inspection and testing is required to gather the data needed to develop a more refined analysis of the structure's current (and likely reduced) load carrying capacity.

URS recognizes the significance of its recommendations and encourages the Department to conduct any due diligence it deems prudent to review URS' recommendations.

Summaries of the rating factors for HL-93 loading for AASHTO design lanes and striped lanes accompany this letter as Tables 1 and 2.

As requested by INDOT in our meeting on October 22, 2009, attached please find Figures 1a, 1b, 2a, 2b, and 3. These figures, and the accompanying discussions, are intended to provide INDOT with a brief overview of the various structural deficiencies identified by URS' load rating evaluations.

URS will provide early next week, for your review and use, ten copies of URS' Cline Avenue Bridge, "Load Rating Analysis – Report of Findings" and one hard copy of the seven volumes of structural calculations supporting URS' load rating evaluations. Please do not hesitate to contact me if you have any questions regarding this information.

Please immediately forward this letter, the Load Rating Analysis – Report of Findings, and all accompanying calculations to the appropriate INDOT officials who possess the authority to implement URS' remedial recommendations without delay. Failure to reduce loads on the bridge in accordance with URS' recommendations could result in a structural failure.

Sincerely,

Robert B. Anderson, PE
Senior Structural Engineer

Attachments: Table 1 and 2
Figures 1a and 1b
Figures 2
Figures 3a and 3b

cc: Joe Gustin, INDOT Central Office
John Pangallo thru Gary Mrozcka, INDOT Central Office
Michael McPhillips, INDOT LaPorte District
Wayne Skinner, INDOT LaPorte District

Table 1: Rating Table—HL-93 Inventory Rating Factors—AASHTO Lanes

Segment	Design AASHTO Lanes							
	Longitudinal Analysis				Transverse Analysis			
	Strength		Service		Strength			
	Flexure	Shear	Flexure	Principal Stresses	Top Slab Centerline	Top Slab Thickness Change	Top Slab Webs & Cantilever	Transverse Web Bending
Segment 1 Girder 1	1.52	**0.82**	**0.46**	1.31	**0.98**	**0.56**	1.85	**0.71**
Segment 1 Girder 2	1.61	1.59	**0.88**	2.33	**0.98**	**0.56**	1.85	**0.71**
Segment 1 Girder 3	1.58	1.47	**0.92**	2.13	**0.98**	**0.56**	1.85	**0.71**
Segment 2 EB	1.81	2.24	**0.70**	3.13	1.69	1.78	1.85	**0.49**
Segment 2 WB	1.40	1.77	**0.45**	2.64	1.65	1.71	1.85	**0.49**
Segment 3 EB	1.07	**0.69**	**0.57**	1.30	1.65	1.71	1.85	**0.49**
Segment 3 WB	**0.82**	**0.52**	**0.53**	**0.86**	**0.86**	1.35	1.85	**0.49**
Segment 4 EB	1.54	1.40	1.24	1.49	**0.86**	1.35	1.85	**0.49**
Segment 4 WB	1.80	**0.93**	1.24	1.30	1.69	1.78	1.85	**0.49**
Segment 5 EB	1.99	1.26	1.04	1.13	1.69	1.78	1.85	**0.49**
Segment 5 WB	1.67	1.33	**0.88**	1.15	1.69	1.78	1.85	**0.49**
Segment 6 EB	1.72	**0.94**	1.44	1.04	1.05	1.60	1.85	**0.49**
Segment 6 WB	1.38	**0.90**	1.27	1.65	1.05	1.60	1.85	**0.49**
Ramp A	1.08	1.01	1.28	2.31	**0.76**	**0.96**	1.16	2.28
Ramp A Mainline Segment 2	1.04	1.92	**0.51**	2.64	1.65	1.71	1.92	**0.75**
Ramp A Mainline Segment 3	**0.88**	1.18	**0.28**	1.10	**0.86**	1.35	1.92	**0.75**
Ramp C Units 2-5	1.39	1.95	1.37	3.57	1.07	1.41	2.60	14.15
Ramp C Units 1, 6-8	1.07	1.47	**0.64**	3.17	1.07	1.41	2.60	14.15
Ramp C Mainline Segment 3	1.30	1.08	**0.83**	2.81	1.65	1.71	1.92	**0.75**
Ramp C Mainline Segment 4	2.17	1.60	1.55	**0.73**	**0.86**	1.35	1.92	**0.75**
Ramp B	2.08	2.52	1.37	4.26	1.07	1.41	2.60	14.15
Ramp B Mainline Segment 6	2.41	2.29	1.85	2.10	1.53	1.60	4.64	1.07
Ramp D	1.35	1.98	1.06	3.80	1.07	1.41	2.60	14.15
Ramp D Mainline Segment 6	1.41	1.00	**0.34**	1.11	1.53	1.60	4.64	1.07
Global Summary	**0.82**	**0.52**	**0.28**	**0.73**	**0.76**	**0.56**	1.16	**0.49**

0.28 -- Rating Factor Less than 1.00

1.00 -- Rating Factor Greater than or equal to 1.00

Table 2: Rating Table—HL-93 Inventory Rating Factors—Striped Lanes

Segment	Striped Lanes							
	Longitudinal Analysis				Transverse Analysis			
	Strength		Service		Strength			
	Flexure	Shear	Flexure	Principal Stresses	Top Slab Centerline	Top Slab Thickness Change	Top Slab Webs & Cantilever	Transverse Web Bending
Segment 1 Girder 1	2.00	1.29	**0.54**	1.84	**0.98**	**0.56**	2.36	1.41
Segment 1 Girder 2	2.06	1.59	1.05	2.33	**0.98**	**0.56**	2.36	1.41
Segment 1 Girder 3	2.10	2.11	1.16	2.99	**0.98**	**0.56**	2.36	1.41
Segment 2 EB	1.81	2.43	**0.71**	3.30	1.69	2.23	3.02	2.59
Segment 2 WB	1.49	1.87	**0.51**	3.22	1.65	1.71	2.43	2.59
Segment 3 EB	1.09	**0.85**	**0.57**	1.65	1.65	1.71	2.43	2.59
Segment 3 WB	1.09	**0.72**	**0.66**	1.01	**0.86**	1.35	1.89	**0.54**
Segment 4 EB	1.95	1.54	1.47	1.56	**0.86**	1.35	1.89	**0.54**
Segment 4 WB	1.84	1.00	1.26	1.44	1.69	2.23	3.02	2.59
Segment 5 EB	2.03	1.52	1.06	1.22	1.69	2.23	3.02	2.59
Segment 5 WB	1.70	1.64	**0.89**	1.35	1.69	2.23	3.02	2.59
Segment 6 EB	1.77	1.11	1.47	1.19	1.05	1.60	1.89	**0.54**
Segment 6 WB	1.43	1.04	1.41	1.77	1.05	1.60	1.89	**0.54**
Ramp A	1.38	1.24	2.00	2.80	**0.76**	**0.96**	1.16	2.28
Ramp A Mainline Segment 2	1.26	2.54	**0.60**	4.02	1.65	1.71	2.43	2.73
Ramp A Mainline Segment 3	1.48	1.54	**0.34**	1.66	**0.86**	1.35	2.15	1.35
Ramp C Units 2-5	3.36	2.65	2.14	4.86	1.07	1.46	3.15	101.04
Ramp C Units 1, 6-8	1.78	1.77	**0.94**	4.18	1.07	1.46	3.15	101.04
Ramp C Mainline Segment 3	1.57	1.83	**0.94**	4.07	1.65	1.71	2.43	2.73
Ramp C Mainline Segment 4	2.93	2.49	2.05	**0.73**	**0.86**	1.35	2.15	1.35
Ramp B	3.46	3.14	2.15	5.93	1.07	1.46	3.15	101.04
Ramp B Mainline Segment 6	4.81	3.60	3.20	4.05	1.55	1.60	4.64	1.37
Ramp D	2.24	2.61	1.63	5.19	1.07	1.46	3.15	101.04
Ramp D Mainline Segment 6	1.97	1.54	**0.43**	1.49	1.55	1.60	4.64	1.37
Global Summary	1.09	**0.72**	**0.34**	**0.73**	**0.76**	**0.56**	1.16	**0.54**

0.34 -- Rating Factor Less than 1.00

1.00 -- Rating Factor Greater than or Equal to 1.00

Figure 1a: Longitudinal Service Flexural Stress Summary Segment 3WB

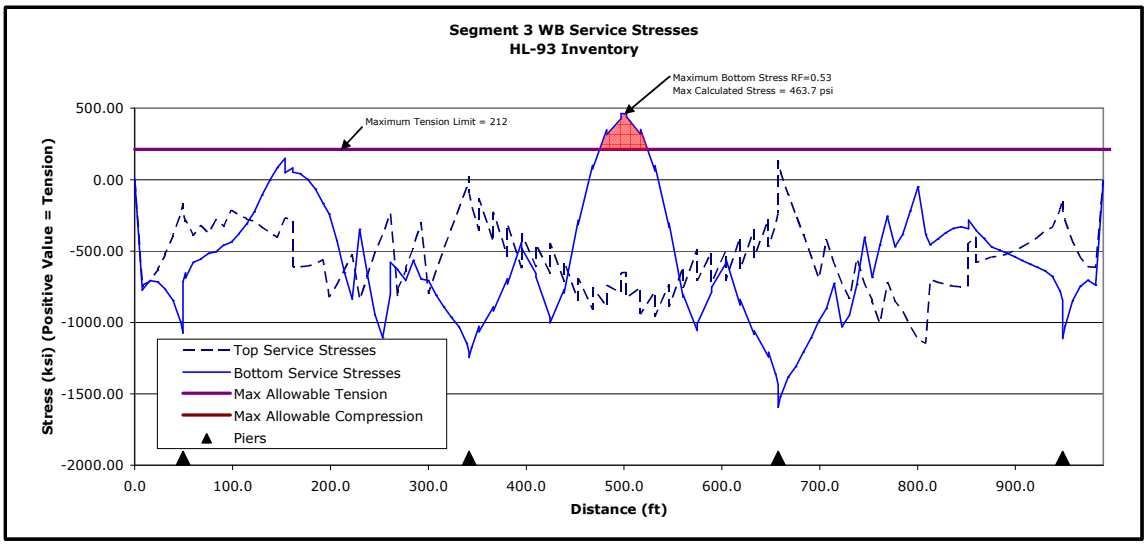
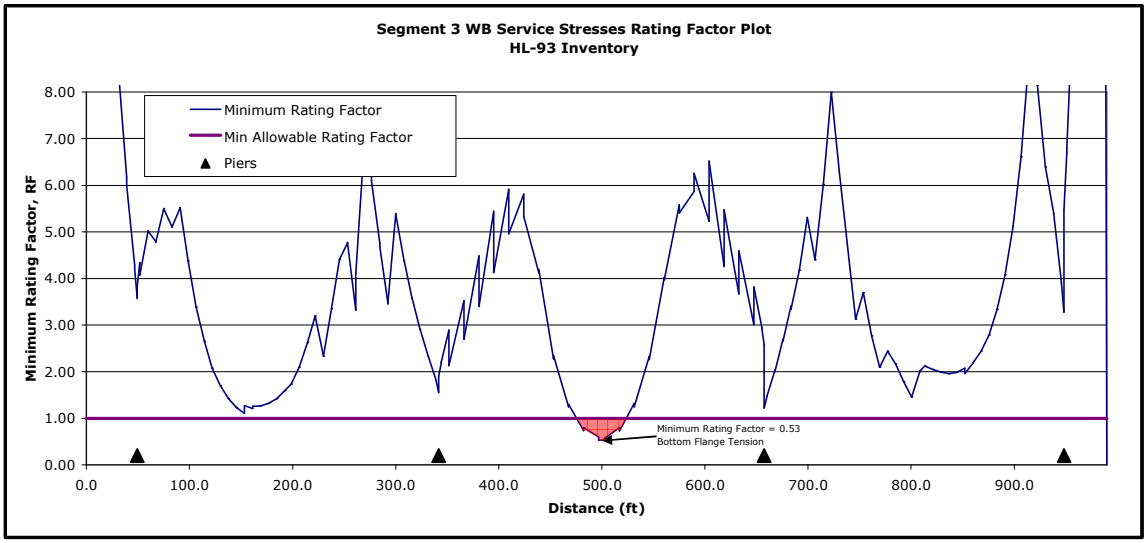


Figure 1b: Long. Service Flexural Stress – HL-93 Inventory Rating Summary Segment 3WB



Discussion: Figures 1a and 1b

Figures 1a and 1b show the under-strength for longitudinal service level flexural stresses in a limited area along the length of this portion of the bridge. Intense inspection activities and strengthening of a small portion of the bridge could be a cost effective solution to extend the service life of the bridge for this type of structural deficiency.

Figure 2a: Longitudinal Strength Shear – HL-93 Capacity vs. Demand Summary Segment 3WB

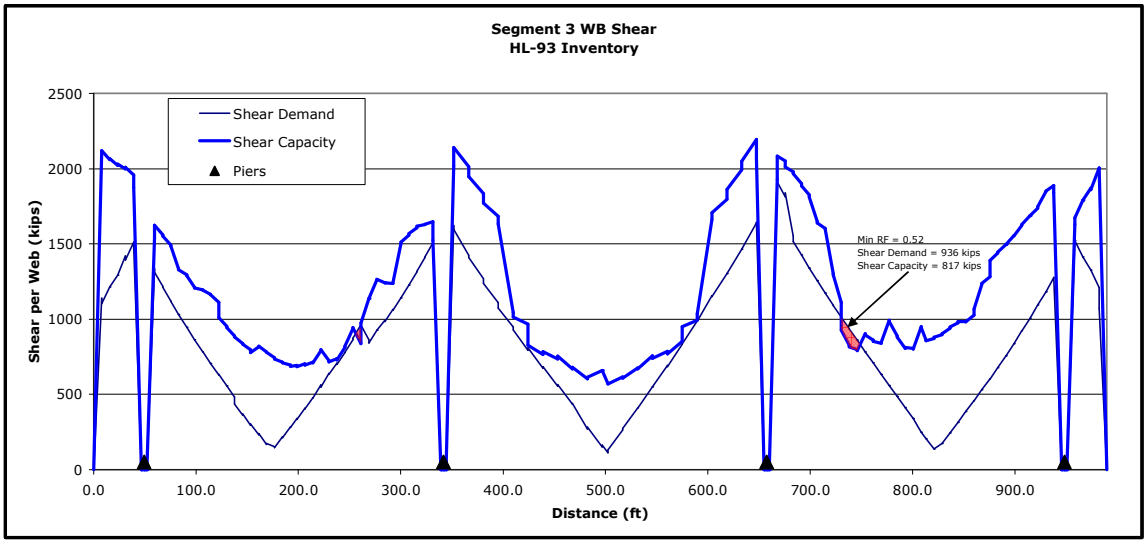
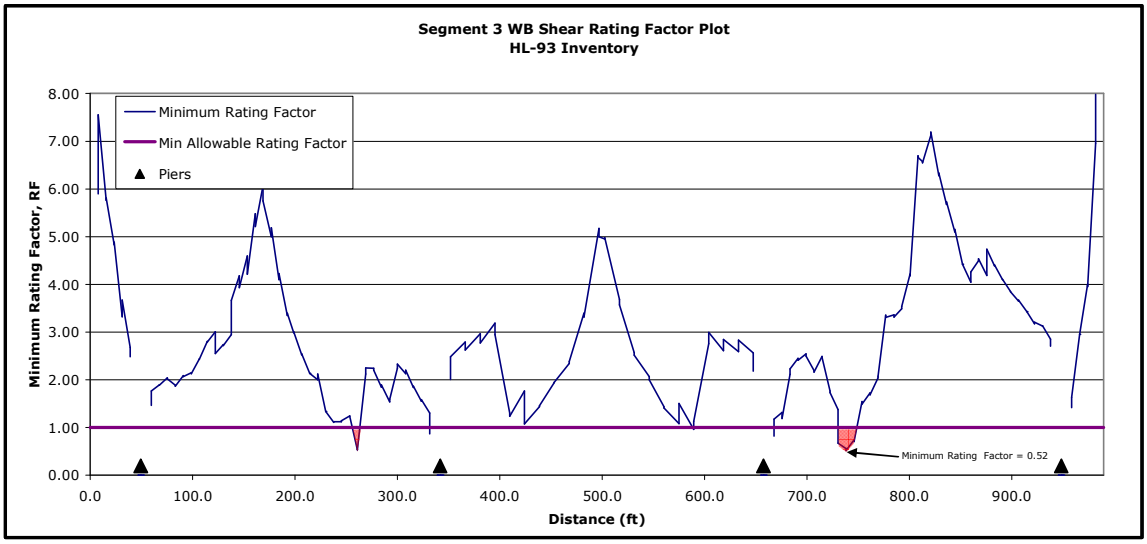


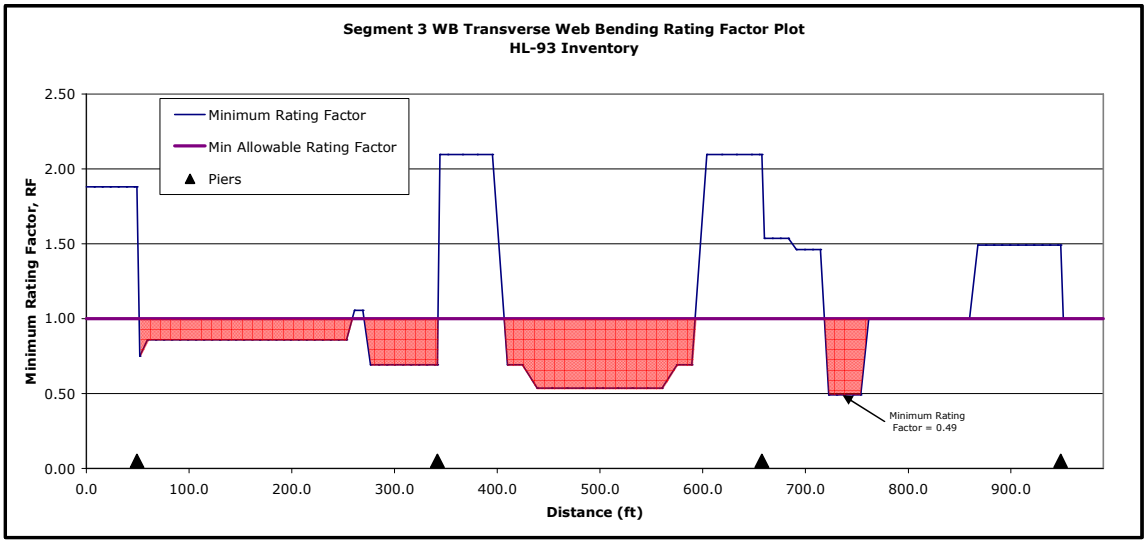
Figure 2b: Longitudinal Strength Shear – HL-93 Inventory Rating Summary Segment 3WB



Discussion: Figures 2a and 2b

Figures 2a and 2B show the under-strength for longitudinal shear in a limited area along the length of this portion of the bridge. Intense inspection activities and strengthening of a small portion of the bridge could be a cost effective solution to extend the service life of the bridge for this type of structural deficiency.

Figure 3: Transverse Web Bending – Inventory Rating Summary Segment 3WB



Discussion: Figure 3

Compared to the previous evaluations for service level longitudinal flexural stresses and strength level for longitudinal shear, the structural deficiencies shown for the calculated rating factors for transverse web bending are much more wide spread. This is illustrated by the large areas in red noted in Figure 3. The main under-strength areas are at the mid-depth of the webs where web steel extending downward from the top deck is terminated. The structural redundancy of the box transversely will offer a degree of warning by indication of large cracks and redistribution of forces internally should the bending capacity of the webs be exceeded.