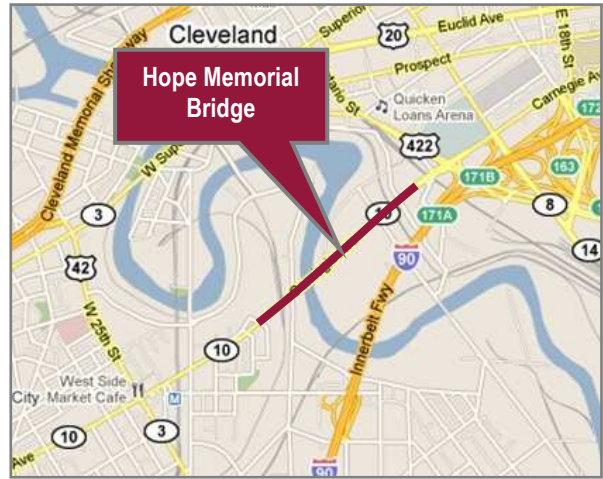






## BRIDGE DESCRIPTION

The CUY-10-1613 (Hope Memorial) Bridge carries four lanes of State Route 10 traffic, 3200 feet through downtown Cleveland, over numerous local streets, Norfolk Southern/CSX railroad tracks and the Cuyahoga River. Constructed in 1932, the bridge was originally intended to carry two rapid tracks on a lower deck as well as a utility deck for truck access. The main truss spans include a 13 span cantilevered Pratt deck truss consisting of 4 truss lines and a 3 truss line simply supported Pratt deck truss at the east end of the bridge (See Figures 1 and 2). Approach spans consist of a cellular unit at the east end of the bridge and steel beam simple spans at the west end, supported by both steel bents and concrete piers.



Location Map

The horizontal alignment of the Lorain-Carnegie Bridge does not vary over the length of the structure. The nomenclature for the bridge follows ODOT standards and is oriented from west to east. The four truss lines are labeled A through D with A being the northernmost truss. Gusset plate nomenclature is based on the shop drawings. The labels consist of truss letter (A through D), upper or lower (U or L), panel point number, and north or south plate (N or S). Site plans of the structure with the sections labeled can be found in Appendix A.

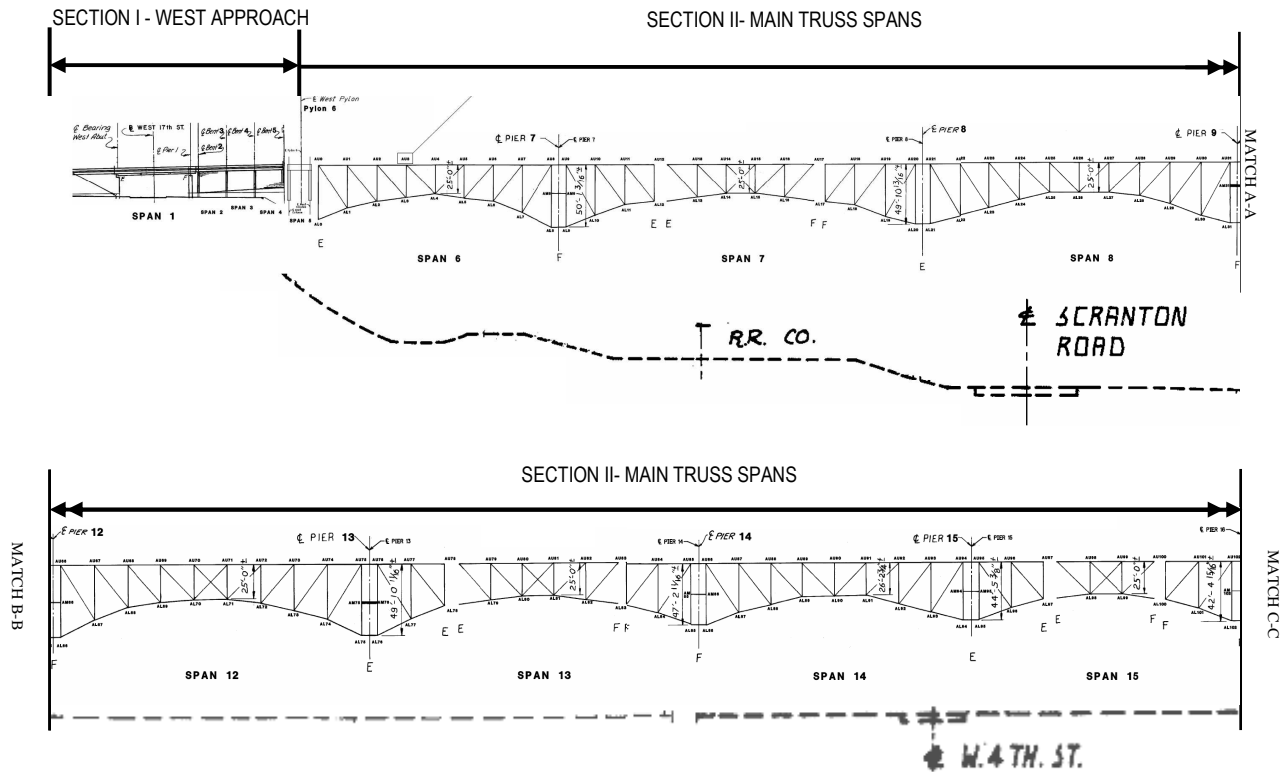


Figure 1 – Partial south elevation of the Lorain-Carnegie Bridge.

## INSPECTION PROCEDURE

An in-depth inspection of the structure was performed between September 21 and December 17, 2010. The inspection findings were recorded on bridge specific field inspection forms. Field sketches were prepared to detail specific conditions. Color digital photographs were taken to document areas of deterioration as well as typical details of the structure. In order to achieve the hands-on access required for this type of inspection, ladders, a 42' aerial bucket truck, a 35' towable boom lift, a UB-50 under bridge inspection unit, and modified technical climbing were utilized. An underwater inspection was performed by KCI Associates of Ohio.

## INSPECTION TEAM

The inspection team members are as follows:

- Wesley R. Weir, PE – TranSystems
- Carolyn Guion, PE – TranSystems
- Anthony Koloze, EI – TranSystems
- Donald Cartwright, EI – TranSystems
- Nicholas Fisco, EI – TranSystems
- Jeff Hill, EI – TranSystems
- Kevin Williams – TranSystems
- Rich Spino, EI – Proudfoot
- Pat Luginbihl – Proudfoot

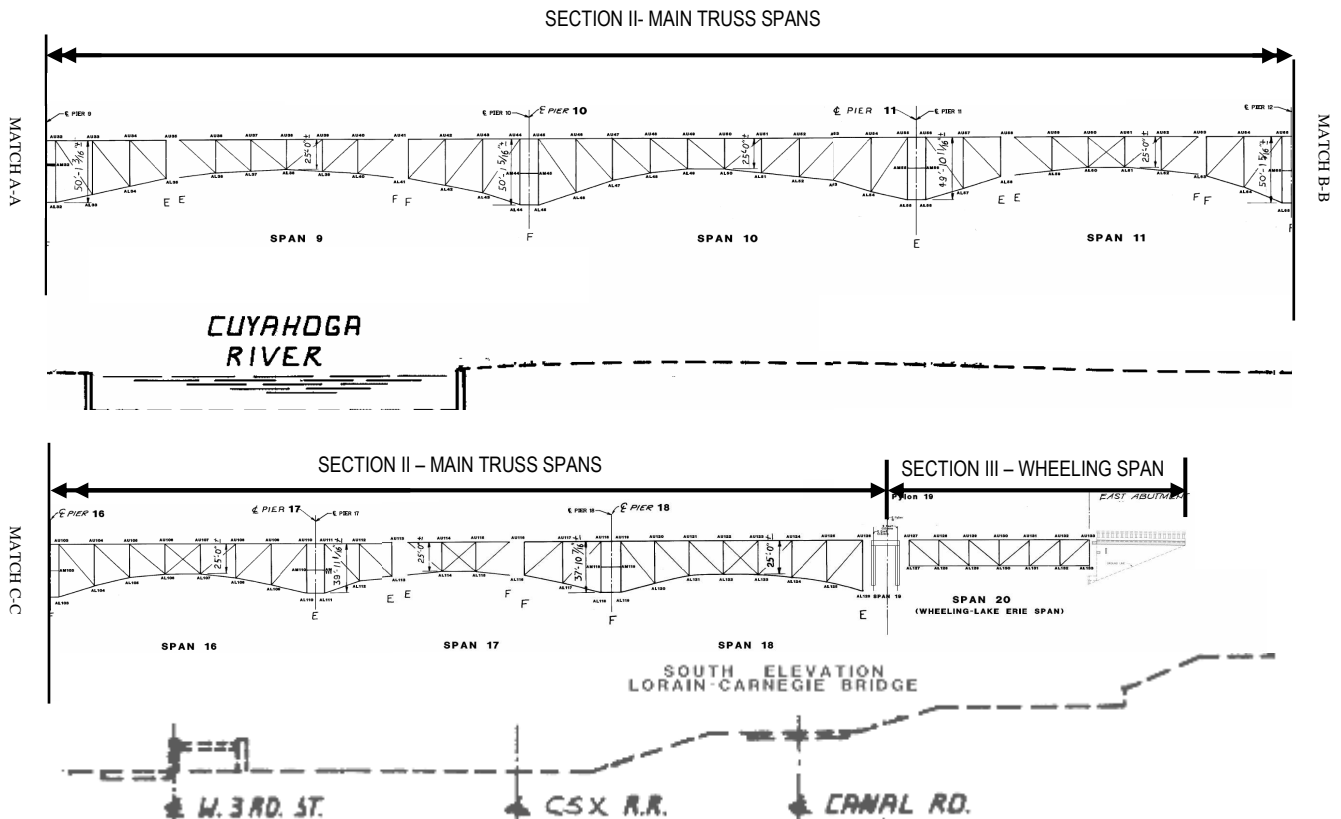


Figure 2 – Partial south elevation of the Lorain-Carnegie Bridge.

## CONDITION RATING

State and federal guidelines for evaluating the condition of bridges have been developed to promote uniformity in the inspections performed by different teams and at different times. Condition ratings are used to describe the existing, in-place bridge as compared to the as-built condition. The following table was used as a guide in evaluating the condition of the various fracture critical members of the bridge.

INDIVIDUAL ITEMS (ODOT)	SUMMARY ITEMS (NBIS)	CONDITION	DEFECTS
1 GOOD	9	Excellent	Excellent condition.
	8	Very Good	No problem noted.
	7	Good	Some minor problems.
2 FAIR	6	Satisfactory	Structural elements show some minor deterioration.
	5	Fair	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
3 POOR	4	Poor	Advanced section loss, deterioration, spalling or scour.
	3	Serious	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
4 CRITICAL	2	Critical	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action.
	1	"Imminent" Failure	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put it back in light service.
	0	Failed	Out of service - beyond corrective action.

The inspection of this bridge was performed in accordance with the following documents:

1. *Bridge Inspection Manual*, Ohio Department of Transportation (ODOT), 2006.
2. *Manual for Condition Evaluation of Bridges, 2<sup>nd</sup> Edition*, American Association of State Highway and Transportation Officials (AASHTO), 2000.
3. *Bridge Inspector's Reference Manual*, U. S. Department of Transportation, 2002 (rev 2006).
4. *Inspection of Fracture Critical Bridge Members*, U.S. Department of Transportation, 1986.
5. *National Bridge Inspection Standards*, U.S. Department of Transportation, 2004.
6. *Manual for Inspecting Bridges for Fatigue Damage Conditions*, Commonwealth of Pennsylvania Department of Transportation, 1990

## ITEM 8 - DECK SUMMARY

The deck is in SATISFACTORY CONDITION [6-NBIS] with spalls noted on the deck underside with exposed rebar. Typically these spalls have been sealed. Transverse cracks are present at ten foot spacing. Expansion joints are typically leaking with isolated torn glands.

### ITEM 1 - FLOOR

The bridge floor is in FAIR CONDITION [2] overall with spalls and exposed rebar noted on the roadway deck underside. The utility deck exhibits spalls adjacent to floor beam top flanges. Both decks exhibit hairline cracks with efflorescence spaced at approximately 10'.

#### Roadway Deck

Spalls with exposed reinforcing bars were noted over five percent of the roadway deck underside (**see photo 1**). The majority of spalls with exposed rebar have been patched or sealed. Isolated patches are starting to delaminate. Transverse hairline cracks with efflorescence were noted on the roadway deck underside at 10' spacing. Isolated locations exhibit stalactite formations above the exterior trusses (**see photo 2**).

#### Utility Deck

The utility deck underside exhibits haunch spalls, delaminations and cracks primarily located adjacent to floor beams. This condition is typical throughout and has increased since the last inspection. The majority of utility deck spalls are associated with 1" to 2" thick concrete that was poured below the underside of the top flange of the floor beam (**see photo 3**). Incipient spalls that were potential falling hazards were removed at the time of the inspection. A detailed layout of bays with full and partial haunch spalls can be found in **Appendix C**.

Transverse hairline cracks with efflorescence were noted at 10' spacing throughout the utility deck underside.



Photo 1 – Span 9 between FB 33 and FB34 roadway deck underside. Note several spalls have been sealed.



Photo 2 – Isolated location exhibiting a stalactite formation dripping onto Truss D at Panel Point DU47.



Photo 3 – Typical utility deck haunch spall adjacent to floor beam 53 top flange in Bay 5.

## ITEM 2 - WEARING SURFACE

The wearing surface is in GOOD CONDITION [1] with isolated hairline map cracking and areas exhibiting minor wear throughout the length of the structure (see photo 4).



Photo 4 – Isolated area of worn wearing surface in bike lane.

## ITEM 3 – CURBS, SIDEWALKS AND WALKWAYS

The sidewalks are in GOOD CONDITION [1] with hairline cracking and isolated spalls less than 2" in depth (see photo 5).

## ITEM 5 - RAILING

The railing is in GOOD CONDITION [1] with isolated hairline cracks and rust staining present throughout. Cracks are located at most parapet construction joints (see photo 6).



Photo 5 – Isolated sidewalk spall in Span 19 on the north sidewalk.

## ITEM 6 - DRAINAGE

The drainage is in GOOD CONDITION [1] with isolated areas of pooling water along the sidewalk curbs. Isolated drains exhibited minor vegetation growth but all drains are functioning as originally intended (see photo 7).



Photo 6 – Typical parapet hairline cracks with rust staining.



Photo 7 – Typical roadway drain with minor water pooling around drain.

## ITEM 7 - EXPANSION JOINTS

The expansion joints are in FAIR CONDITION [2] overall, with typical leaking joints and isolated torn neoprene troughs (see photos 8 and 9). Most joints exhibit heavy granular debris buildup over the full length of the joints (see photo 10).



Photo 9 – Isolated torn neoprene trough with debris spilling onto roadway framing members adjacent to Panel Point DU35.



Photo 8 – Isolated torn gland with debris spilling onto roadway framing members adjacent to Panel Point DU35.



Photo 10 – Typical granular debris buildup in Joint 0 at West Abutment.

Expansion joint gaps were measured on October 11, 2010. Noted openings are within reasonable limits and are consistent along the length of each joint (see Table 1). Vertical misalignment at joints was negligible.

Joint Measurements (10/11/10 - 72° and Sunny)		
Joint	2010 Inspection	
	Westbound	Eastbound
West Abutment	1 7/8"	1 1/2"
Joint 1	1 9/16"	1 1/2"
Joint 2	1 3/4"	1 3/4"
Joint 3	1 3/4"	1 5/8"
Joint 4	8 3/4"	9 1/8"
Joint 5	2 3/16"	2 1/4"
Joint 6	5 1/4"	5 3/16"
Joint 7	2 3/16"	2 1/4"
Joint 8	5 7/8"	5 5/8"
Joint 9	2 1/4"	2 7/16"
Joint 10	5"	5 1/4"
Joint 11	2 1/8"	2 1/4"
Joint 12	5 1/4"	4 7/8"
Joint 13	2 1/4"	2 1/4"
Joint 14	4 3/4"	4 15/16"
Joint 15	2 1/4"	2 1/4"
Joint 16	1 5/8"	1 7/8"
East Abutment	1 5/8"	1 1/8"

Table 1 – Joint opening measurements. Note similarity of measurements along joints.



## ITEM 32 - SUPERSTRUCTURE SUMMARY

The superstructure is in FAIR CONDITION [5-NBIS] overall with isolated areas of advanced section loss noted on the truss lower chord members and gusset plates. Truss upper chord, diagonal and vertical members also exhibited minor to moderate losses. Throughout the approach sections, isolated minor losses were noted on the girders.

### ITEM 9 - ALIGNMENT

The structure alignment is in GOOD CONDITION [1] with no problems in the horizontal or vertical alignment noted.

### ITEM 10 - GIRDERS

The girders are in GOOD CONDITION [1] with isolated areas of minor section loss to the web and bottom flange with pitting less than 1/16" (cleaned and painted), primarily adjacent to the west abutment.

### ITEM 11 - DIAPHRAGMS AND CROSS FRAMES

The diaphragms and cross frames are in GOOD CONDITION [1] with no signs of deterioration noted.

### ITEM 12 - STRINGERS

The stringers are in SATISFACTORY CONDITION [2] overall with typical 1/16" pitting primarily on the web and bottom flange of the first interior stringers of the roadway deck. There are isolated locations of holed through sections up to 3" in diameter.

Stringers typically exhibit 1/16" pitting (cleaned and painted) along the bottom half of the web and bottom flange. There is 1/8" pitting with up to 1" holed-through sections along the first interior stringer webs (see photos 11 and 12). The first interior stringer adjacent to Panel Point AU118N exhibits a 3" diameter holed through section on the lower half of the web adjacent to the floor beam connection (see photo 13). The surrounding areas have 1/8" section losses.



Photo 11 – First interior stringer adjacent to Panel Point DU165 with holed-through sections up to 1" diameter.



Photo 12 – First interior stringer near DU16 with isolated holed through sections.

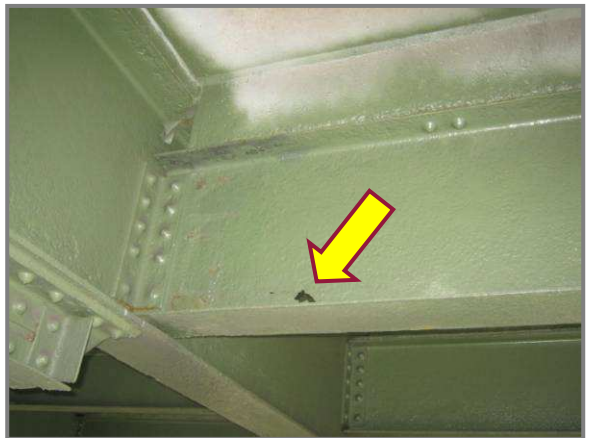


Photo 13 – 3" Diameter holed through section on the first interior stringer near AU118N.

## ITEM 13 – FLOOR BEAMS

The floor beams are in FAIR CONDITION [2] overall with section loss up to 1/4" deep and moderate rust, primarily adjacent to roadway joint locations. Several utility deck floor beams exhibit up to 3" long cracks in the web adjacent to floor beam connections. Cracks without arrest holes have been marked and dated to determine further crack propagation.

### Roadway Deck

Floor beams exhibit up to 1/8" pitting with moderate active rusting, primarily adjacent to joints. Isolated floor beams exhibit up to 1/4" pitting on the lower third of the web (see photo 14) and bottom flange.

### Utility Deck

Several utility deck floor beams exhibit up to 3" long cracks adjacent to connections due to a lack of radial coping (see Item 30 – Fatigue Prone Connections).



Photo 14 – Isolated 1/4" pitting over the lower fifth of the web of floor beam 78 adjacent to Panel Point CU78.

## ITEM 30 – FATIGUE PRONE CONNECTIONS

The fatigue prone connections are in POOR CONDITION [3] with several utility deck floor beams and floor beam connections exhibiting fatigue cracks due to a lack of adequate radial coping.

Several utility deck floor beam webs exhibit cracks up to 3" long (see photo 15). There is a 2" crack in the web of Floor Beam 37 at Panel Point CL37 where the top flange has been torch cut tapered (see photo 16). The majority of these cracks have crack arrest holes. Isolated cracks in floor beams do not have arrest holes and have been marked and dated to determine further crack propagation.



Photo 16– Crack in web of FB37 at CL37.

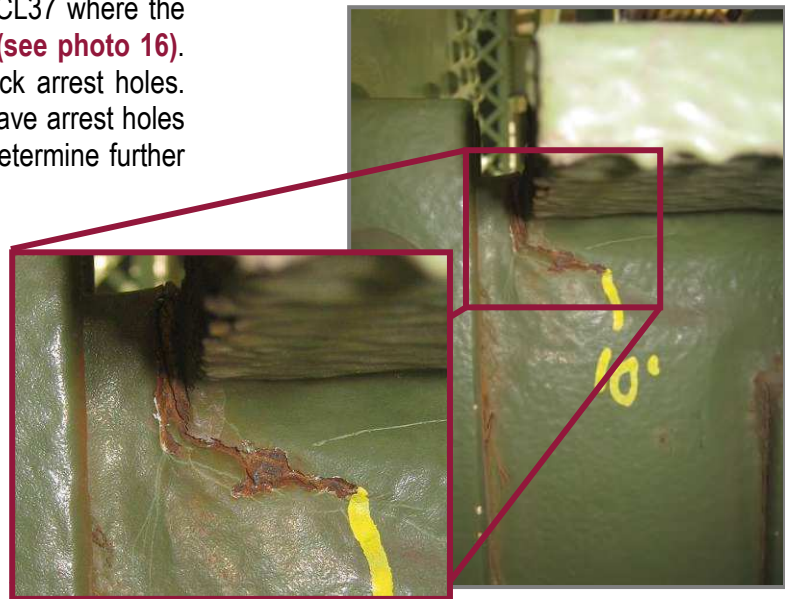


Photo 15 – Crack in utility deck floor beam at gusset plate CL36N connection.

## ITEM 14 – FLOOR BEAM CONNECTIONS

The floor beam connections are in GOOD CONDITION [1], with isolated locations of impacted rust between the girder web and connection angles. The utility deck floor beam connection angle to gusset plate BL15S exhibits a 3" long rolling flaw which has been marked to determine future propagation (see photo 17).

### TRUSS INSPECTION FINDINGS

The truss members are in FAIR CONDITION [2] overall with numerous areas of moderate section loss and isolated areas of advanced section loss on the lower chord members and gusset plates, vertical members, diagonal members, sway bracing and lateral bracing. The upper chord members and gusset plates exhibit moderate section loss at isolated locations. A detailed layout of truss member deficiencies can be found in Appendix D.

## ITEM 15 – VERTICAL TRUSS MEMBERS

The vertical members are in FAIR CONDITION [2] overall with isolated members exhibiting moderate to advanced pitting up to 1/4" section loss. This condition has not changed since the last inspection. There is impacted rust between flange angles and web plates up to 1/2" and is beginning to show signs of active corrosion.

The verticals consist of riveted built up box members. Vertical members at joints and pin locations typically exhibited the worst section losses up to 1/4" primarily on the web plates (see photo 18). Moderate pitting was also noted along the full width of the web plates along the gusset plates, and around sway bracing connections to the verticals (see photo 19).



Photo 17 – Utility deck floor beam connection angle to gusset plate BL15S exhibits 3" long rolling flaw.



Photo 18 – BL0-BU0 1/8" pitting with isolated 1/4" pitting over the lower half of the north web plate.



Photo 19 – Pitting up to 1/8" surrounding the sway bracing connection to the north web plate of member BL59-BU59.

Isolated pitting up to 1/4" was noted on flange angles adjacent to lacing bars (see photo 20). Isolated members exhibit up to 1" impacted rust, cleaned and painted, between the flange angles and cover plates (see photo 21).

### ITEM 16 - DIAGONAL TRUSS MEMBERS

The diagonal members are in FAIR CONDITION [2] overall with members typically exhibiting minor to moderate pitting and isolated areas of advanced section loss up to 1/4", primarily along the web plates. This condition has not changed since the last inspection.

There is up to 2" impacted rust between gusset plates and diagonal web members at several locations. Diagonal web plate section loss in this region is up to 1/4" deep over the full width of the web plate (see photos 22 and 23).



Photo 20 – Isolated pitting up to 1/4" on vertical DL21-DU21 adjacent to lacing bars.

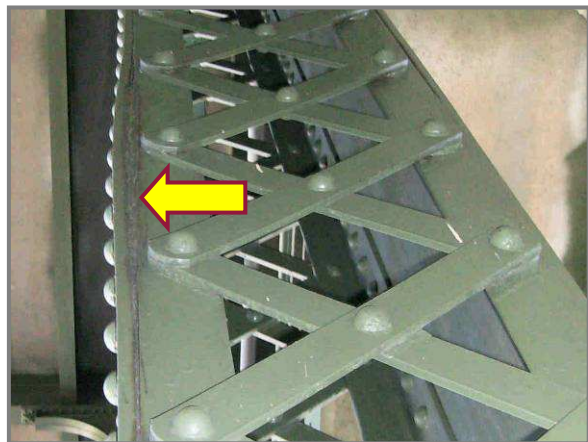


Photo 21 – Impacted rust between the web plate and flange angle of member BL76-BU76 up to 7/8" thick.



Photo 22 – Pitting up to 1/4" on the north web of member DL43-DU44 at interface with DL43 gusset plate. Note impacted rust present.



Photo 23 – Typical pitting up to 1/4" (circled in yellow) along interface with gusset plate.

Diagonal member DL36-DU35 exhibits 3/8" pitting on the interior of the south web plate between flange angles and 1/8" pitting over the exterior face at this same location (see photo 24).

Isolated pitting up to 1/4" deep was noted along the top flange angles at the interface with lacing bar connections (see photo 25).



Photo 24 – 3/8" pitting (cleaned and painted) on the interior face of the south web plate near the interface with gusset plate DL36 between flange angles.

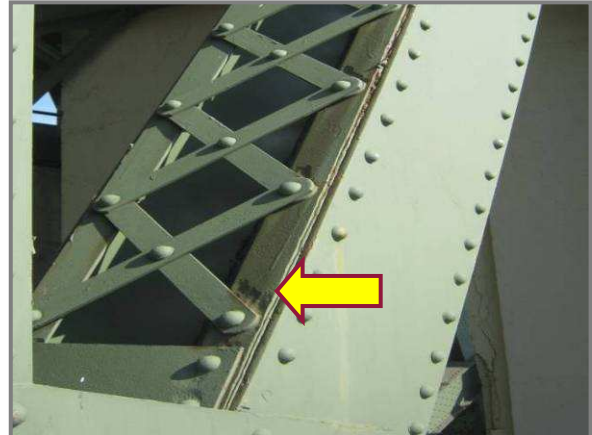


Photo 25 – Pitting up to 1/4" on top flange angle adjacent to lacing bar (DL7-DU8 shown).

## ITEM 18 - TOP CHORD TRUSS MEMBERS

The top chord members are in GOOD CONDITION [1] overall with only one area of moderate section loss and isolated areas of active rusting.

The top chord consists of riveted built up box sections. Chord members below deck leaks exhibited areas of active minor to moderate surface corrosion (see photo 26).

Chord member AU120-AU121 exhibits 2" diameter holed through sections to the batten plate and full section loss to the end upper lacing bar and to the horizontal leg of the top and bottom flange angles for the first 12" of the member within the bounds of gusset plate AU120 (see photo 27).



Photo 26 – Active surface corrosion to lacing bars and batten plate beneath area of leaking deck at AU120.



Photo 27 – AU120-AU121 exhibits 100% section loss to lacing bars and horizontal leg of flange angles over a 1' length within the bounds of gusset plate AU120.

Isolated locations along Truss A and Truss D exhibit steel attachments which have been field welded to the chord web plates. Several of these welds are poor quality but showed no signs of cracking at the time of the inspection (see photo 28).

**ITEM 19 - BOTTOM CHORD TRUSS MEMBERS**

The bottom chord members are in FAIR CONDITION [2] with isolated areas of advanced section loss in the web plate and flange angles, typical minor pitting along the top batten plates, and typical isolated areas of minor pitting along the web plates and lacing bars. All losses have been cleaned and painted. Impacted rust was noted between flange angles and lacing bars or batten plates. A detailed layout of lower chord member deficiencies can be found in Appendix D.



Photo 28 – Abandoned platform connection to the top chord member AU120-AU121 with typical field welds.

The bottom chord members consist of riveted built up box sections. Exterior section loss up to 1/4" was primarily found on the lower 3" of exposed web plates at the interface with the bottom flange angles (see photo 29). There are isolated areas of advanced section loss with holed through sections along the web plate at the interface with the bottom flange angle. Member DL0-DL1 exhibits a 2' long by 2" high hole near gusset plate DL0 on the north web plate (see photo 30).

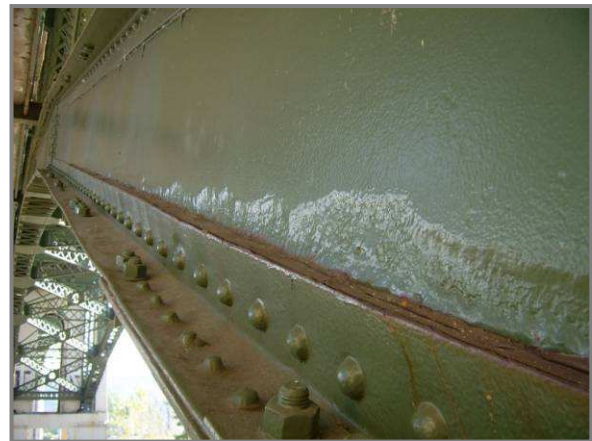


Photo 29 – North web plate of CL0-CL1 with 1/4" pitting up to 3" tall along the interface with the bottom flange angle.

Section loss on the interior surfaces of chord members is typical along the interface with the gusset plate. Member DL7-DL8 exhibits 1/4" pitting over the full height of the north web plate (see photo 31).



Photo 30 – Holed-through section of north web plate 2'Lx2"H of member DL0-DL1 adjacent to gusset plate DL0N.



Photo 31 – DL7-DL8 1/4" pitting over full height of south web at DL8.

Throughout the truss spans, previously cleaned and sealed impacted rust of up to 2" is beginning to reactive. This reactivating impacted rust is predominantly found at the interface between the chord web plates and the top or bottom flange angles (see photo 32).

At chord member DL15-DL16 near gusset plate DL15, the north top flange angle exhibits a longitudinal crack 24" long with rust staining (see photo 33). A similar crack 30" long was noted at the north bottom flange angle of member BL13-BL14 near gusset plate BL13 (see photo 34). Both locations are within the bounds of the top and bottom flange batten plates, which exhibit heavy impacted rust between the leg of the flange angle and the batten plates. The crack to member BL13-BL14 has not propagated since the last inspection, and the crack on member DL15-DL16 has been marked to determine future crack propagation.

Truss C, member CL12-CL13, at the CL12 pin plate location exhibits a 2-1/2" lateral misalignment of the north and south web plates and pin plates with respect to the gusset plates. This misalignment is due to extensive impacted rust between the free web plates and gusset plates (see photo 35).



Photo 32 – Typical evidence of sealed impacted rust reactivating.



Photo 33 – Crack in top flange angle of DL15-DL16 near DL15 within Bounds of top batten plate.



Photo 34 – Crack in bottom flange angle of BL13-BL14 near BL13 within the bounds of the bottom flange batten plate.



Photo 35 – Impacted rust up to 2 1/2" between the south web plate of CL12-CL13 and gusset plate CL12S.

## GUSSET PLATES

The gusset plates are in poor condition overall, with typical 1/16" – 1/8" losses (cleaned and painted), 3"-6" high along the top of the lower chord flange angles (see photo 36). Isolated gusset plates exhibit advanced pitting up to 1/4" deep between 30-50% of the surface area on the exterior and interior faces. The gusset plates with advanced deterioration were typically noted at the deck joints and pins. Gusset plate nomenclature is based on shop drawings. The labels consist of truss letter (A through D with A being the northernmost truss), upper or lower, panel point number, and north or south plate.



Photo 36 – Typical section loss along the chord member. Exterior of gusset plate DL2N shown.

Gusset plates were inspected utilizing a Pocket UT device for a detailed inspection of the plate losses. Typical measurements were taken along the intersection of the truss members and the gusset plate, particularly a horizontal scan along the top of the bottom chord and a vertical scan below the vertical member.

Gusset plates located at pin panel points exhibited typical 1/8" pitting for a 12" diameter area around the pin (see photo 37). Additional losses were noted between rivets and at the interface between pin plates and gusset plates (see photo 38).



Photo 37 – Typical pitting at a lower pin gusset plate (AL100N). Note pitting around pin and chord members as well as isolated peeling top coat.

Isolated gusset plate locations exhibit up to 1-1/4" of impacted rust between the gusset plate and the lower chord web plate, causing a concave bow along the gusset plate free edge within the bounds of the lower chord web plate (see photo 39).



Photo 38 – Up to 1/4" pitting (highlighted in yellow) at gusset plate (BL12N). Note pitting around pin and chord members.

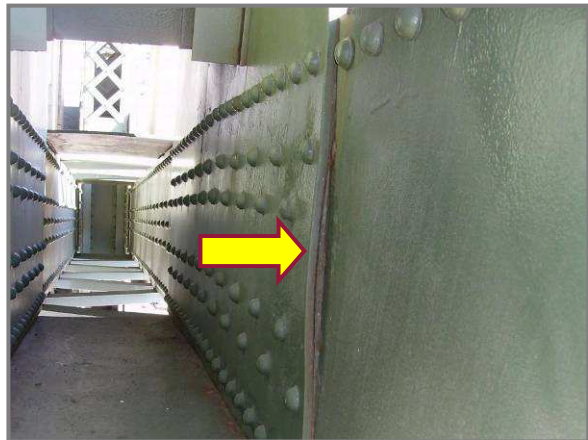


Photo 39 – 3/4" bow between gusset plate DL43S and DL42-DL43 web.



Gusset plate CL70S exhibits a lamellar tear under the west diagonal, reducing the gusset plate thickness to 1/4" remaining over a 2' length (see photos 40 and 41).



Photo 40 – Bounds (marked by yellow paint stick) of lamellar tear at CL70S (west end of plate).



Photo 41 – Laminar split of gusset plate CL70S.

Gusset plates at lower sliding pin locations exhibit advanced section loss up to 1/2" remaining along the free edge. This section loss is primarily the result of the lower chord web rubbing against the gusset plate at the sliding pin location (see photo 42). Gusset plate DL12S exhibits 1/4" pitting along the full length of the interior diaphragm in line with the lower chord. Along this line there is a 1" diameter hole (see photo 43).

## ITEM 20 – LOWER LATERAL BRACING

The lower lateral bracing is in GOOD CONDITION [1] overall with isolated areas of minor to moderate section loss and rust staining.

Wind lock assemblies are in good condition with room for lock to deflect. Isolated areas exhibit minor surface corrosion (see photo 44).



Photo 42 – Typical gusset plate loss measurable along the free edge at sliding pin locations.



Photo 44– Typical wind lock with minor surface corrosion at strut.



Photo 43 – 1" diameter hole in DL12S along interface with interior diaphragm.

## ITEM 22 – SWAY BRACING

The sway bracing is in GOOD CONDITION [1] overall with minor surface corrosion and pitting at isolated locations.

## ITEM 24 – BEARING DEVICES

The bearings are in FAIR CONDITION [2] overall with isolated areas of moderate pitting to bearing pins and impacted rust between bearing gusset plates and bearing castings. Utility deck bearings exhibit isolated gaps between rockers and bearing plates and excessively rotated rockers.

Several bearing pins exhibited isolated pitting up to 1/4" cleaned and painted (see photo 45). Impacted rust was noted between gusset plates and casting plates at the majority of bearing locations, preventing the gusset plates from rotating freely (see photo 46). Roller nest assemblies exhibited minor laminate rusting at isolated locations and active minor surface corrosion (see photo 47).

Isolated rocker bearings for the utility deck stringers are not in contact with the bearing plates (see photo 48).



Photo 45– Bearing pin at AL119 with up to 1/4" pitting (cleaned and painted) around the bearing casting.



Photo 46– CL119 impacted rust between bearing casting and gusset plate seizing panel point from free rotation.



Photo 47– Roller nest assembly at AL21 with active surface corrosion present.

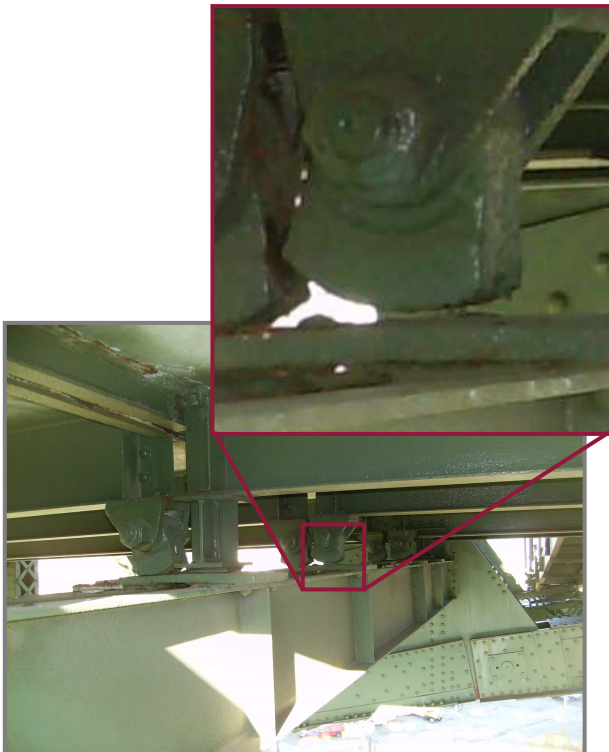


Photo 48 – Gap between Stringer 3 rocker bearing and bearing plate at FB 35.

The utility deck rocker bearings for Stringers 3 and 4 at Floor Beam 78 exhibit excessive rotation (see photo 49).

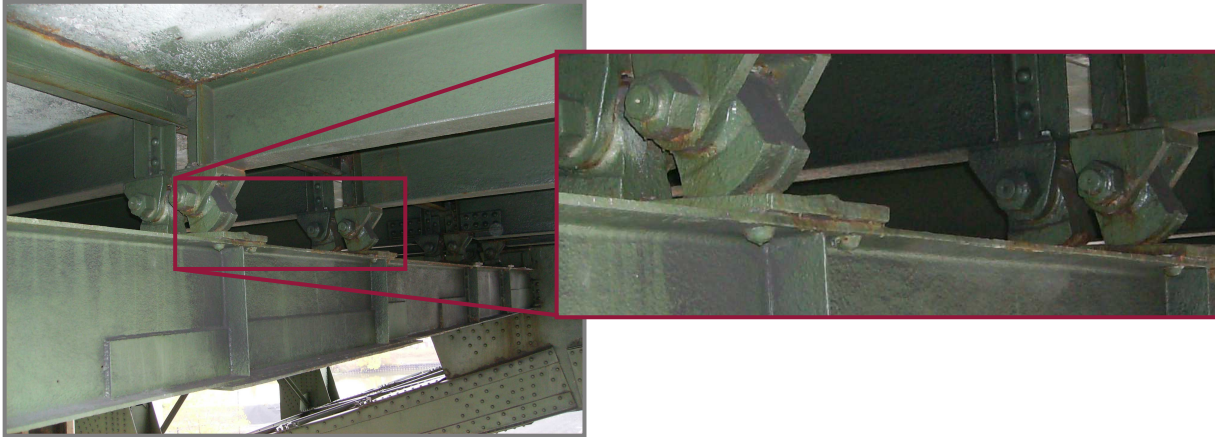


Photo 49– Excessive rotation of bearings at utility deck FB 78 for Stringers 3 and 4.

## ITEM 28 – PROTECTIVE COATING SYSTEM

The protective coating system is in GOOD CONDITION [7] with isolated paint failures and light surface corrosion at isolated locations. The condition has not deteriorated significantly since the last inspection. The paint date is March 4, 2004.

Truss members located at pin and joint locations exhibit severe surface corrosion with rust staining (see photo 50). Members at other locations exhibit isolated top coat paint failures over less than one percent of the truss area with no active corrosion present (see photo 51).



Photo 50– Active minor surface corrosion at DU12.



Photo 51– Isolated peeling paint in Span 21.

## ITEM 29 – PINS AND HANGERS

The pins are in FAIR CONDITION [2] overall with isolated moderate section loss and impacted rust. Pins appear to be functioning as designed.

Pin sleeves exhibited moderate section loss, cleaned and painted. As previously mentioned, the chord web plates at gusset plate CL12S are bent due to impacted rust between the gusset plate and the web plate. Due to this misalignment the sliding pins for member CL12-CL13 are not bearing on the outermost chord pin plate (1 of 3 plates) (see photo 52). Other sliding pin gusset plates which are not fully bearing by up to 1/4" on the outermost pin plate include BL97, DL83, and CL100.

Where pins were free to rotate, several pins exhibit advanced wear up to 1/4" along a third of the pin circumference (see photo 53).

Lower chord sliding pins at panel points AL17 and BL41 appear to be seized due to impacted rust (see photos 54 and 55).



Photo 52 – Sliding pin at CL12S not fully bearing on the outermost pin plate due to impacted rust between the web plate and gusset plate.



Photo 53– Wear along vertical pin at AL12 up to 5/16" loss over the lower half of the pin circumference.



Photo 54– Sliding pin at AL17 seized due to impacted rust which has been painted over.



Photo 55– Sliding pin at BL41 seized due to impacted rust.

## ITEM 42 – SUBSTRUCTURE SUMMARY

The substructure is in SATISFACTORY CONDITION [6-NBIS] with typical large spalls with exposed rebar throughout the pier towers above the truss bearings. Concrete pier walls exhibit hairline cracks and isolated corner spalls.

## ITEM 33 – ABUTMENTS

The abutments are in GOOD CONDITION [1] with minor hairline cracks present.

## ITEM 34 – ABUTMENT SEATS

The abutment seats are in GOOD CONDITION [1] with typical hairline cracks at isolated locations.

## ITEM 35 –PIERS

The piers are in FAIR CONDITION [2], with the concrete architectural pier towers exhibiting large spalls with exposed rebar throughout (see photos 56 and 57). Several of the spalls with exposed rebar have been sealed and painted. Pier faces below the truss bearings exhibit hairline map cracking with rust staining (see photo 58). The Pier 13 tower exhibits a 1" vertical crack extending through the top section of the pier tower above Truss A and Truss B bearings (see photo 59).



Photo 56– Typical spall with exposed rebar pier tower.



Photo 57– Advanced spall with exposed rebar on roof of Pier 12 tower above bearings. Note hanging exposed rebar.



Photo 58– Isolated patch of map cracking on pier wall with rust staining.



Photo 59– Vertical crack in Pier 13 north tower section.

Bent 1 columns exhibit vertical hairline cracks extending from the base, spaced at 12" (see photo 60).

**ITEM 36 –PIER SEATS**

The pier seats are in GOOD CONDITION [1], with typical hairline cracks at isolated locations.

**ITEM 37 – BACKWALLS**

The backwalls are in GOOD CONDITION [1], with isolated hairline cracks and minor map cracking present.

**ITEM 38 – WINGWALLS**

The wingwalls are in GOOD CONDITION [1], with a minor 6" diameter animal hole along the northwest wingwall.

**ITEM 39 – FENDERS AND DOLPHINS**

The fenders are in CRITICAL CONDITION [4] exhibiting severe rot and collision damage. The fender system has failed and no longer functions as intended. This condition does not appear to have changed since the last inspection.

The east fender has collapsed towards the centerline of the Cuyahoga River (see photos 61 and 62). The west fender exhibits severe collision damage adjacent to the southernmost pier column (see photo 63).



Photo 60– Vertical hairline cracks in Bent 1 columns.



Photo 61– South half of the east bank fender system collapsed towards river centerline.



Photo 62– East fender system collapsed towards river centerline (looking south).



Photo 63– West bank fender system with collision damage at the southernmost pier column.

**ITEM 40 – SCOUR**

The scour condition of the structure is in SATISFACTORY CONDITION [2], with a portion of the southernmost pier column footing at Pier 10 exposed. Large rip rap which was held back by rotting timber has since fallen towards the waterway. For a detailed report on the scour condition, see the Underwater Inspection in **Appendix E**.

**ITEM 54 – CHANNEL SUMMARY**

The channel is in SATISFACTORY CONDITION [6-NBIS] due to a sharp curve directly upstream (south) of the bridge as well as an area of sheet piling along the west bank which has washed out just downstream (north) of the bridge.

**ITEM 51 – ALIGNMENT**

The alignment is in SATISFACTORY CONDITION [2], with the Cuyahoga River exhibiting a sharp bend just upstream (south) of the bridge crossing (**see photo 64**). A slightly more gradual bend exists downstream (north) from the bridge crossing (**see photo 65**). This engineered alignment did not exhibit any signs of migrating from the designed path.

**ITEM 52 – PROTECTION**

The protection is in SATISFACTORY CONDITION [2] with an area of west bank sheet piling washed out just upstream (north) of the bridge crossing.

**ITEM 53 – WATERWAY ADEQUACY**

The waterway adequacy is in GOOD CONDITION [1] with adequate freeboard to allow channel vessels to pass under the bridge (**see photo 66**).

**ITEM 60 – APPROACHES SUMMARY**

The approaches are in VERY GOOD CONDITION [8-NBIS] with minor map cracking and previously patched areas noted.



Photo 64– Bend upstream (south) of the bridge crossing.



Photo 65– Bend downstream (north) of the bridge crossing.



Photo 66– Vertical clearance between truss and top of vessel under Truss D.

**ITEM 55 – PAVEMENT**

The pavement is in GOOD CONDITION [1] with minor map cracking and previously patched potholes (see photo 67).



Photo 67– Map cracking around patched pothole in approach pavement.

**ITEM 56 – APPROACH SLABS**

The approach slabs are in GOOD CONDITION [1] with only minor map cracking present.

**ITEM 57 – GUARDRAIL**

The guardrail is in GOOD CONDITION [1] and no noteworthy deficiencies to note.

**ITEM 59 – EMBANKMENT**

The embankment is in GOOD CONDITION [1] overall with no significant deficiencies noted.



Photo 68– Old mattress and trash piles at Pier 7.

**ITEM 66 – GENERAL APPRAISAL & OPERATIONAL STATUS**

The overall condition of the bridge is FAIR CONDITION [NBIS – 5], OPEN WITH NO RESTRICTIONS [ODOT - A], due to advanced section losses in the truss members and gusset plates of the Main Truss Spans.

**HABITATION**

No active habitation was noted on the structure. However, there is evidence of previous habitation at Pier 7 (see photo 68). There is also a buildup of aluminum cans in the northernmost column of Pier 11 where a 2' by 2' hole has been drilled into the west side of the column (see photo 69).

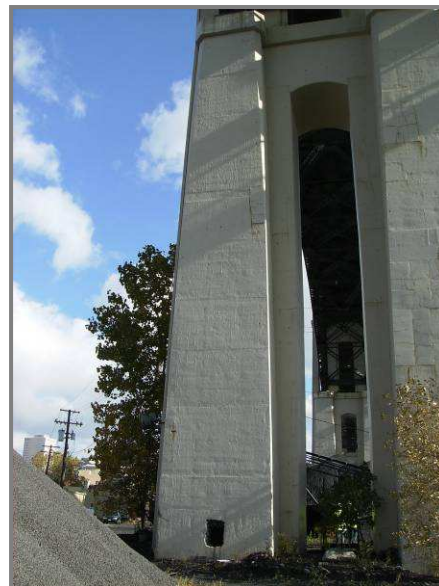


Photo 69 – 2'x2' drilled hole in the west face of the northernmost column at Pier 11.



## INSPECTION SAFETY ITEMS

The inspection walkways and ladders are in good condition with no significant deficiencies noted.

### ITEM 61 – NAVIGATION LIGHTS

The navigation lights are in GOOD CONDITION [1] and appear to be functioning as intended. No navigation lights were noted along the banks of the river or along the fender systems.

### ITEM 64 – UTILITIES

The utilities are in POOR CONDITION [3] with a misaligned gas main support, advanced deterioration to electrical conduit pipes, spalls in light poles and open electrical box covers.

Several precast concrete luminaire poles exhibit cracking and isolated spalls (see photo 70). Access covers for electrical boxes on light poles are missing.

Resting on the overhangs beyond the pedestrian railing, several electrical boxes have missing covers with exposed wires (see photo 71).

One support for the 40" gas main on the utility deck near Pier 15 is misaligned (see photo 72). Several utility conduits on the utility deck are broken as noted in previous inspections.

Void electrical conduit throughout the utility deck is breaking apart at isolated locations and falling onto the utility deck.



Photo 70– 5'x6" spall in light pole with exposed rebar located along the south sidewalk in Span 10.



Photo 71– Broken electrical box cover with exposed electrical wires in Span 14 of the north sidewalk overhang.



Photo 72– Misaligned support for 40" gas main on utility deck adjacent to Pier 15.

## CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of our in-depth inspection, the Hope Memorial Bridge CUY-10-1613 is in FAIR CONDITION [5-NBIS] overall. The main truss spans exhibit advanced section loss to lower chord members and gusset plates, primarily adjacent to pin or joint locations. Other truss members also exhibit moderate section loss adjacent to gusset plates.

Concrete falling from pier tower spalls and utility deck haunches pose a safety concern to public below the structure.

We present our recommendations for CUY-10-1613 in the following four categories:

- **Priority Work:**  
(Within 1 Year Period) Work which should be performed as soon as possible to address deficiencies which affect the capacity of the structure or public safety.
- **Rehabilitation/Evaluation:**  
(Within 5 Year Period) Recommendations for large-scale deficiencies which are extensive in nature and require engineering analysis.
- **Maintenance:**  
(Within 2-4 Month Period) Recommendations that are minor in nature and can be easily repaired.
- **Monitoring:**  
(As Recommended) Regular field observation of deficiencies which are not currently in need of repair, but will require corrective action if deterioration continues.

Additionally, we have prioritized these four recommendation categories into levels of corrective action required, as follows:

- [Minor Deficiency] – Deficiencies which are minor in nature and generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion to steel, Minor scouring, Clogged drainage, etc.
- [Major Deficiency] – Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroding reinforcing steel, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.
- [Safety Hazard Deficiency] – A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Loose concrete hanging down over traffic and pedestrians, a hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.

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**CUY-10-1613 RECOMMENDATIONS****Priority Work:**General

1. Repair light posts which exhibit spalls [**Minor Deficiency**].
2. Install navigation lights to fender system [**Safety Hazard Deficiency**].

Deck

3. Remove concrete from utility deck floor beam haunch areas. [**Safety Hazard Deficiency**].

Substructure

4. Remove and patch areas of loose concrete and spalls with exposed rebar from pier towers [**Safety Hazard Deficiency**].

**Rehabilitation/Evaluation:**General

5. Replace failed fender system [**Minor Deficiency**].

Deck

6. Repair spalls with exposed reinforcing bars on the deck underside [**Minor Deficiency**].
7. Remove and replace torn expansion joint neoprene troughs [**Minor Deficiency**].

Superstructure

8. Clean, caulk and paint lamellar tear in gusset plate CL70S [**Minor Deficiency**].
9. Perform load rating and gusset plate analysis for the main truss spans to include all section losses (Estimated to be completed in 2011).

**Maintenance:**General

10. Remove debris from and secure areas under Pier 7 [**Minor Deficiency**].
11. Re-align gas main utility pipe bearing which is misaligned [**Minor Deficiency**].

Top of Deck

12. Replace missing and broken covers to light post electrical boxes [**Minor Deficiency**].
  13. Clean debris from expansion joint glands [**Minor Deficiency**].
  14. Repair sidewalk spalls [**Minor Deficiency**].
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Superstructure

15. Drill arrest holes in utility deck floor beam cracks [**Major Deficiency**].

**Monitoring:**

Deck

16. Monitor utility deck floor beam haunch delaminations [**Minor Deficiency**].

Substructure

17. Monitor areas around pier tower spalls and delaminations [**Minor Deficiency**].

Superstructure

18. Monitor cracks in utility deck floor beam connections which have not been arrested [**Minor Deficiency**].

19. Monitor sliding pins which are not fully bearing on pin plates for further loss of bearing area [**Minor Deficiency**].

20. Monitor cracks in flange angles adjacent to batten plates at gusset plate locations [**Minor Deficiency**].

21. Continue to monitor pins & hangers in Main Truss Spans [**Minor Deficiency**].

