PHYSICAL CONDITION REPORT
FOR THE 2012 IN-DEPTH INSPECTION

VETERAN'S MEMORIAL (DETROIT-SUPERIOR) BRIDGE
BR#: CUY-6-1456
SFN: 1800930

OHIO DEPARTMENT OF TRANSPORTATION
DISTRICT 12
PID #91289

Inspected: September 17 through October 11, 2012
Report: February 22, 2013

TranSystems®

In-Depth
PHYSICAL CONDITION REPORT

of

DETROIT-SUPERIOR BRIDGE
BRIDGE NO. CUY-6-1456
SFN: 1800930

CUYAHOGA COUNTY, OHIO

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Inspected on:

September 17, 2012 through October 11, 2012

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DISTRICT 12

Report Submitted February 22, 2013

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TABLE OF CONTENTS

BRIDGE DESCRIPTION

The CUY-6-1456 (Detroit-Superior) Bridge carries four lanes of US Route 6 approximately 2,880 feet over numerous local streets including the Center Street Swing Bridge, surface parking lots, RTA railroad tracks, and the Cuyahoga River. The bridge was designed as a double-deck structure, carrying vehicular and pedestrian traffic on the upper deck and street railway traffic on the lower deck. Use of the lower deck for streetcars was abandoned in 1955, but now serves as a multi-functional space for the City of Cleveland.

Location Map

The Detroit-Superior Bridge has received several rehabilitations and modifications from original design during its service life, including major work in 1967 and 1994, as well as the widening of the north sidewalk in 2003. Key rehabilitation efforts include, but are not limited to, updating safety features, improving the drainage system, and strengthening or replacing deteriorated steel and concrete sections.

The Detroit-Superior Bridge consists of three distinct sections, including:

Section I	–	West Approach (Reinforced Concrete Spans) (See Figure 1)
Section II	–	Trussed, Three-Hinged Through-Arch Main Span (See Figures 1 and 2)
Section III	–	East Approach (Reinforced Concrete Spans) (See Figure 3)

<u>Section I – West Approach (West Tunnels, West Approach Spans, and Spans 1A through 3)</u>
The West Approach section consists of double-deck reinforced concrete open-spandrel arches, 2 cellular spans, and 2 tunnel sections. Typical approach sections consist of concrete arch ribs supporting open spandrel columns with jack arches and floorbeams at the both deck levels. The tunnel sections below Detroit Avenue and West 25th Street utilize similar column/jack arch constriction. The cellular construction spans are located in Spans 1A and 1B and consist of reinforced concrete walls supporting the upper deck columns above.

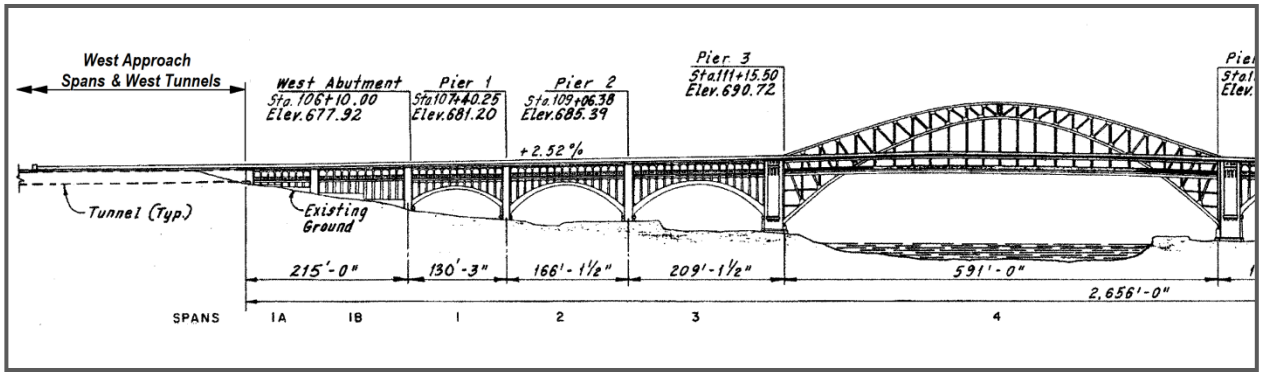


Figure 1 – Partial south elevation of CUY-6-1456 (Span 1A through Span 4 shown).

Section II – Main Truss Span (Span 4)

Span 4 is a steel, 591 foot long three-hinged, trussed arch (Pratt design). The lower chord is pin connected to eyebar hangers from panel points 4 to 20 where the decks are below the arch. Members from Panels 0 to 3 and 21 to 24 are framed directly into the arch lower chord. Both deck levels consist of a stringer-floorbeam system with cantilevered brackets. The upper deck in Span 4 was replaced during the 1994 rehabilitation and consists of an 8" lightweight concrete slab. A wide sidewalk was added on the north side of the upper deck in 2003.

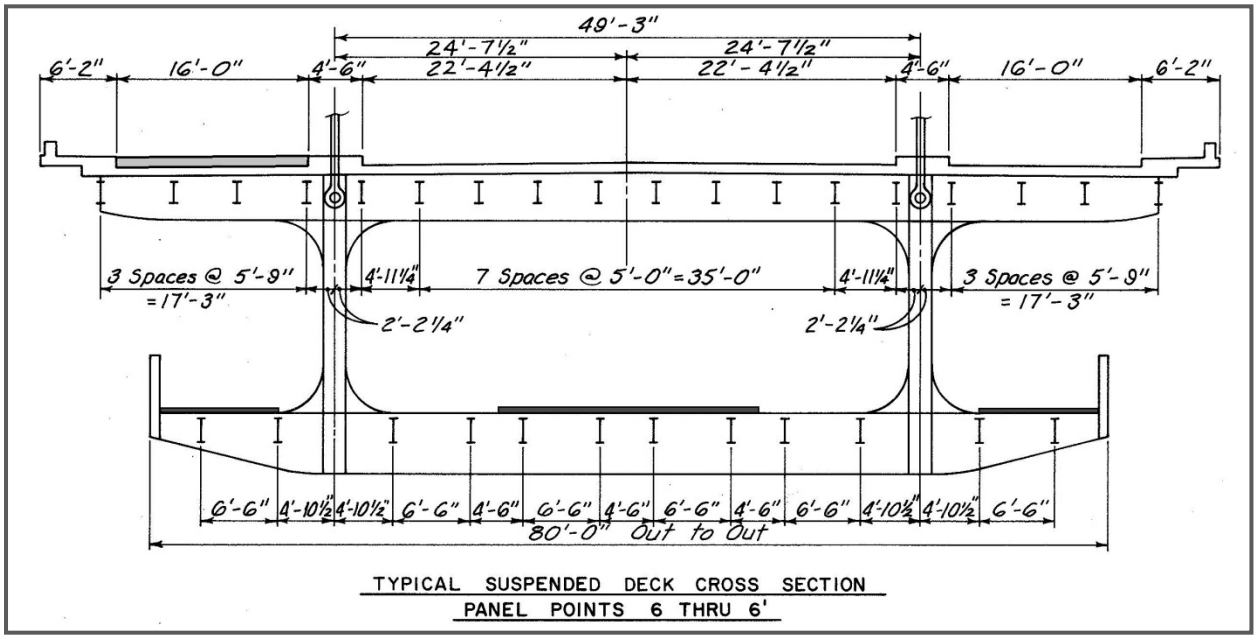


Figure 2 – Typical cross section in steel main span, looking east. Note additional top deck sidewalk added in 2003 (gray) and pedestrian walkway locations on lower deck (black).

Section III – East Approach (Spans 5 through 13)

The East Approach spans consist of double-deck reinforced concrete open-spandrel arches with jack arch and floorbeam framing similar to Spans 1 through 3 of the West Approach. Span 12 is unique in that the lower deck is supported by reinforced concrete hangers, thus making the span a through-arch system. The East Abutment is comprised of an open, framed system consisting of jack arches and floorbeams.

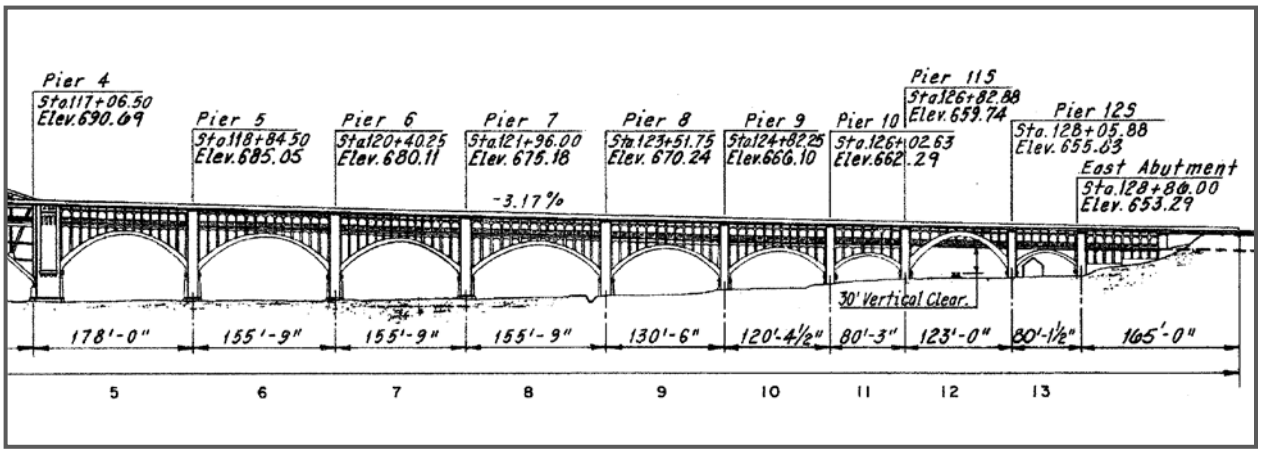


Figure 3 – Partial south elevation of CUY-6-1456 (Span 5 through Span 13 shown).

INSPECTION PROCEDURE

An in-depth inspection of the structure was performed between September 17, 2012 and October 11, 2012. The inspection findings were recorded on structure specific inspection forms, and 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 access required for this type of inspection, various techniques were utilized: a 42' telescoping boom lift, a 125' articulating boom lift, a Harcon Sidewalk Tracker Unit, ladders, and modified technical climbing.

INSPECTION TEAM

The inspection team members are as follows:

- Pete Anamasi, PE – TranSystems
- Carolyn Guion, PE – TranSystems
- Donald Cartwright, EI – TranSystems
- Doug Dickson, EI – TranSystems
- Jeff Hill, EI – TranSystems
- Kevin Williams, NICET III – TranSystems

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 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), 2010.
2. *Manual for Condition Evaluation of Bridges, 2nd Edition,* AASHTO, 2010 (rev 2011).
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] overall with the deck underside exhibiting transverse cracking, heavy efflorescence, and spalls with exposed reinforcing in the West Approach and west tunnel sections (see photo 1). Isolated spalls were noted throughout the top deck surface with minor spalls typical at joint headers, and heavy granular debris was typically noted in expansion joints. Minor problems were noted in sidewalk and drainage items. All deck components are functioning as intended with minimal additional deterioration since the last inspection.

Photo 1 – Deck underside spall and heavy efflorescence in West Side Station between column lines D and E.

ITEM 1 – FLOOR

The bridge floor is in FAIR CONDITION [2] overall due to localized concrete spalls and cracking with heavy efflorescence in the West Approach Spans and west tunnel sections of the bridge (see photo 2). Spalling in this area commonly exhibits exposed reinforcement with moderate section loss to the primary bars in isolated locations. Full depth repairs are present at each of the joint locations in the West Approach Spans and west tunnels. The remaining spans are without major floor deficiencies in the upper and lower concrete decks.

Photo 2 – Spall with exposed reinforcing in West Side Station deck underside adjacent to West 25th Street Tunnel.

The lower deck level in Span 4 consists of two different types of access walkways. A 5" open grid steel deck with plywood flooring is present between the two truss lines, supported by four rolled stringers. This deck is closed to main vehicular traffic but is occasionally used by maintenance or inspection vehicles and equipment. Two additional pedestrian walkways are located on the outside of each truss line, comprised of fiberglass reinforced grating. No significant deficiencies were noted in these lower deck elements.

ITEM 2 – WEARING SURFACE

The wearing surface is in GOOD CONDITION [1] with isolated distressed areas and moderate wear throughout the length of the structure. Numerous spalls or potholes were noted in the deck surface, most of which have been repaired with asphaltic patches. The largest patch is approximately 20' long by 10' wide (see photo 3), with the most severe deck spalls occurring in the right eastbound lane in Span 4.

Photo 3 – Large spall with asphaltic patch in Span 4 right eastbound traffic lane.

ITEM 3 – CURBS, SIDEWALKS & WALKWAYS

The curbs, sidewalks and walkways are in GOOD CONDITION [1] overall with isolated shallow voids and minor cracking in the sidewalk surface, as well as light rusting of curb plates. No deficiencies were noted which would inhibit the safe passage of pedestrians.

ITEM 5 – RAILING

The parapets are in GOOD CONDITION [1] overall with vertical hairline cracking noted in isolated areas throughout both bridge railings. The pedestrian protection fences exhibit several areas of minor to moderate impact damage, although none of these locations compromise the functionality of the fence (see photo 4). Minor impact damage is present on the guardrails protecting the south steel arch in Span 4, which separate the two eastbound traffic lanes.

Photo 4 – Pedestrian protection fence with impact damage in Span 7.

ITEM 6 – DRAINAGE

The drainage is in FAIR CONDITION [2] with standing water in the West Approach and East Approach cellular construction up to approximately 3 feet deep. In the West Side Station, the standing water is localized to the track bypass tunnels below the lower deck adjacent to the West 25th Street Tunnel. The standing water in the East Approach cellular unit covers the entire width of the lower deck, beginning midway through the span and increasing to maximum depth at the east end (see photo 5).

At the main deck level, numerous curb grates are partially clogged with vegetation growth. The joint membranes are typically filled with debris to impede proper drainage flow. Isolated drainage panels are missing or broken in the north sidewalk longitudinal trench drain, and vegetation has begun in some of these areas. Shallow ponded water was also noted on the north sidewalk in Span 4 at the crown of the vertical curve in the roadway profile (see photo 6).

Photo 5 – East approach cellular construction with standing water.

Photo 6 – Standing water on north sidewalk in Span 4, looking east.

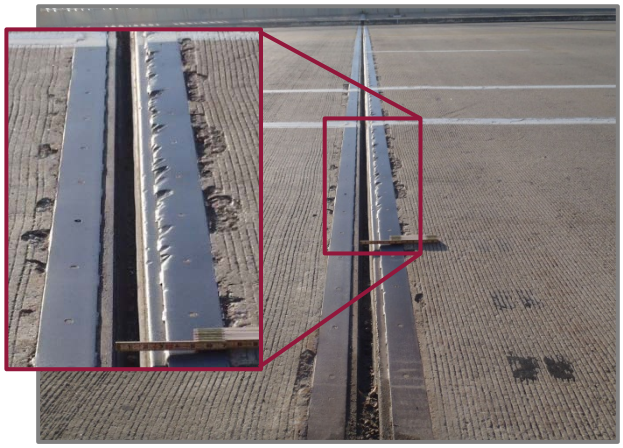


Photo 7 – Expansion joint between Spans 1A and 1B with gouges in west joint armor due to slight vertical misalignment.

ITEM 7 – EXPANSION JOINTS

The expansion joints are in FAIR CONDITION [2] overall due to heavy granular debris typical in the glands and isolated gouging of the joint armor (see photo 7). Alignment of the expansion joints was generally satisfactory with minor vertical misalignment at some locations, contributing to the armor gouging. Shallow spalling was typically documented in the joint headers throughout the structure. No leakage was observed in the deck joints at the time of the inspection.

ITEM 32 – SUPERSTRUCTURE SUMMARY

The superstructure is in POOR CONDITION [4-NBIS] overall with localized areas of advanced section loss noted on the truss lower chord gusset plates, floorbeams, and steel stringers, as well as deficiencies at various steel bearing elements. The reinforced concrete members in the West Approach Spans exhibit widespread moderate to advanced deterioration, with isolated moderate deficiencies present in the remaining concrete spans.

ITEM 9 – ALIGNMENT OF MEMBERS

The structure alignment is in GOOD CONDITION [1] with no significant alignment deficiencies noted.

ITEM 10 – BEAMS/GIRDERS/SLABS

The concrete jack arches (beams) are in FAIR CONDITION [2] due to heavy spalling in isolated locations within the West Approach Spans and west tunnel sections (see photo 8). Exposed reinforcing bars in these areas typically exhibit minor section losses. The most severe concrete deterioration occurs near the joint locations, although many of these areas have been repaired during the most recent major rehabilitation. These replacements included the end floorbeams and adjacent joints, as well as the top deck slab and isolated jack arches.

Photo 8 – Spall with exposed reinforcing in West Side Station jack arch between Columns B26 and B27.

The jack arches throughout the remaining concrete spans (Spans 1A thru 3 and Spans 5 thru 13) are typically in good condition with isolated minor deficiencies, including vertical hairline cracks and small areas of spalled or delaminated concrete. Much of the concrete elements east of the West Abutment have been repaired during the major structural rehabilitations.

ITEM 12 – JOISTS/STRINGERS

The stringers are in POOR CONDITION [3] overall with localized advanced section loss on upper and lower deck framing, typically occurring below expansion joints. Isolated upper deck stringer members exhibit heavy section losses up to 100% in webs and bottom flanges (see photo 9). This deterioration typically occurs in members adjacent to the truss lines, as these stringers experience accelerated corrosion from rainwater passing through the deck at truss or eyebar locations. Numerous modifications and replacements have been made to the upper deck framing members over the lifetime of the structure, including isolated locations where the original stringer was modified with a new, small roller section bolted to the top flange during the 1965 rehabilitation.

Photo 9 – Stringer P between Floorbeams 20 and 21 with 100% section loss in web and bottom flange.

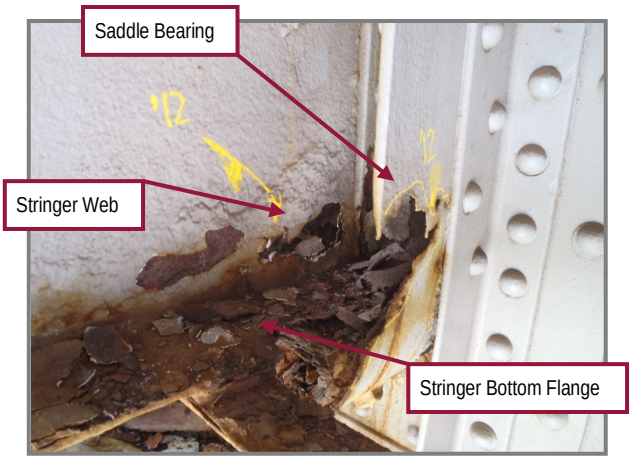


Photo 10 – Lower deck Stringer 10 at west face Floorbeam 21 saddle bearing. Note 100% section loss on the stringer web and bottom flange, as well as the saddle bearing.

The lower deck stringers consist of two unique sections: original Bethlehem 24" I-sections and new W24x68 rolled sections from the 1994 rehabilitation. The most severe deterioration in these elements occurs in the stringer ends at saddle bearing locations, where stringer bottom flanges and webs typically exhibit up to 100% loss (see photo 10). Active rusting was typically noted on the stringer bottom flanges within the saddle bearing devices. Many lower stringer top flanges exhibit isolated section losses up to 1/4" deep and are typically cleaned and painted with no active rusting. Most of the lower deck stringers with the worst deterioration are not subjected to live loading, as these members do not support a pedestrian walkway. Isolated upper and lower deck steel stringers exhibit sheared or missing rivet heads or bolts in connection angles to floorbeams (see photo 11). This condition appears to be a localized issue throughout the span with no evidence of distress noted in the connection angles at these locations.

ITEM 13 – FLOORBEAMS

The floorbeams are in POOR CONDITION [3] overall due to isolated advanced section losses throughout the structure. Holed through sections in the steel floorbeam webs and bottom flanges are locally common near truss and hanger connections, particularly at the lower deck floorbeams. Isolated cracks were noted in the weld material of various web retrofit plates on floorbeams in the main steel span.

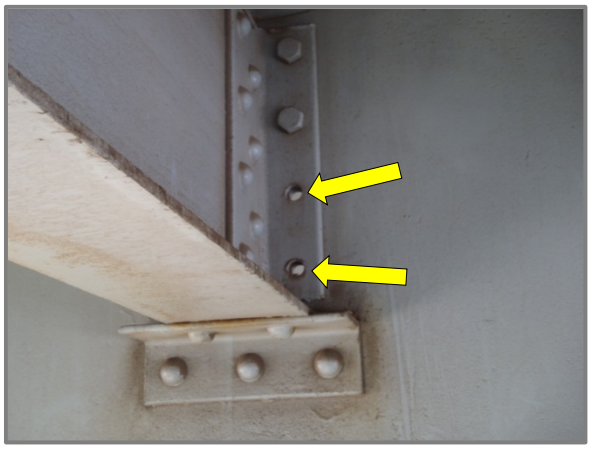


Photo 11 – Stringer F connection angle to west face of Floorbeam 18 with 2 of 4 bolts missing.

Minor to moderate spalling with exposed reinforcement was noted in isolated locations throughout all concrete approach spans, including large spalls in floorbeam corbels. Transverse hairline cracking was noted throughout the concrete floorbeams.

Photo 12 – Span 7 Column 10 corbel outside northernmost concrete arch with front face spall and exposed reinforcing.

Photo 13 – Span 9 Floorbeam 6 west face with epoxy injection crack repairs between interior column lines.

Spans 1A-3 and Spans 5-13 (Reinforced Concrete)

The reinforced concrete floorbeams in the East and West Approach Spans exhibit isolated minor deficiencies throughout. Minor to moderate spalls with exposed reinforcing bars are commonly present in areas that were not repaired during the last major rehabiliation. In addition, numerous exterior floorbeam corbels exhibit large spalls with exposed reinforcement, including isolated locations where the entire front face of the corbel has spalled off (see photo 12).

Transverse hairline cracks were commonly present across the bottom face of upper concrete floorbeams, and some of these cracks extend through the vertical faces of the members. Many of the reinforced concrete floorbeams in the East Approach have received epoxy injection repairs at these locations (see photo 13). Lower deck floorbeams exhibit isolated spalls with exposed reinforcement, delaminiations and hairline cracking (see photo 14).

Many of the floorbeams in the structure have been either partially or fully replaced during the two major rehabiliations of the structure. The end floorbeams in each span adjacent to joint locations were typically replaced during both the 1965 and 1994 rehabiliation projects. Numerous floorbeams were also strengthed with the addition of concrete top and bottom flange widening retrofits. These locations commonly exhibit hairline map cracking with light efflorescence.

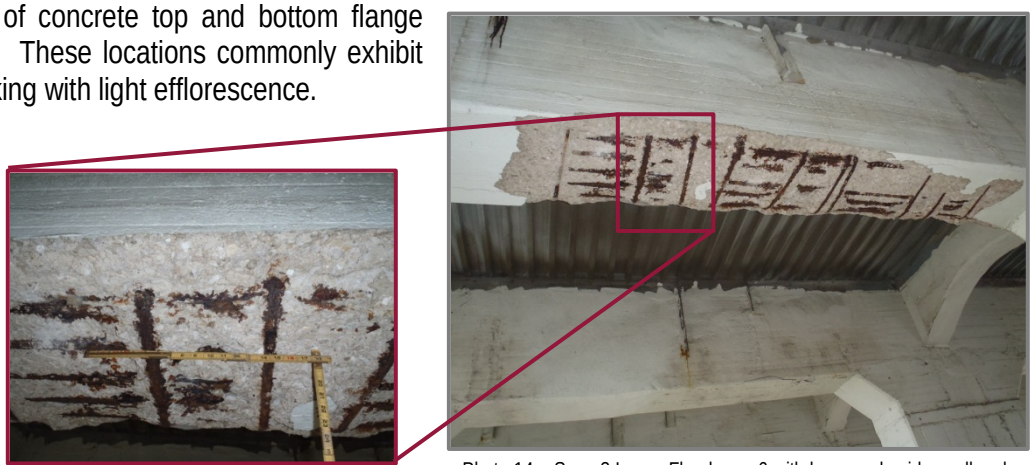


Photo 14 – Span 3 Lower Floorbeam 6 with large underside spall and exposed reinforcement with minor section loss.

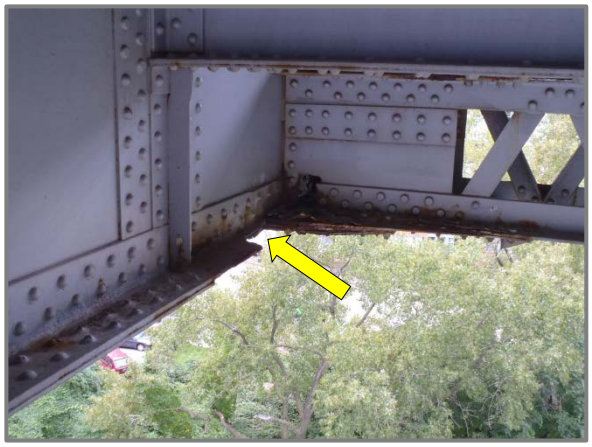


Photo 15 – Floorbeam 9 east face at North Truss with 100% section loss on bottom flange outstanding leg (west face similar).

The lower deck floorbeams exhibit numerous locations of up to 100% section loss on the webs and flanges near the built-up hanger connections. The outstanding legs of the bottom flanges were commonly noted to be either flame cut or corroded through below the lower longitudinal strut connections (see photo 15). These areas appear to have been previously cleaned and painted but now exhibit paint failures with active rusting. Isolated floorbeams webs were perforated on the interior of the hanger pin connections where water runs down the hanger and collects at the interface between the web and bottom flange. Heavy active corrosion with pitting up 1/4" deep was documented on the top flanges between the built-up hanger knee braces.

Photo 17 – West face of Floorbeam 0 with heavy losses to the web plate, web stiffeners and bottom cover plates.

Span 4 (Steel)

The steel floobeams in the main span exhibit localized heavy pitting and advanced section losses with active corrosion, particularly at locations near the built-up hanger connections and in the floorbeams. These areas are experiencing more accelerated deterioration from exposure to collecting rainwater, a result of the complex built-up configurations at these member connections. In addition, the leaking joints have caused the floorbeams below joint locations to experience more signficant corrosive conditions.

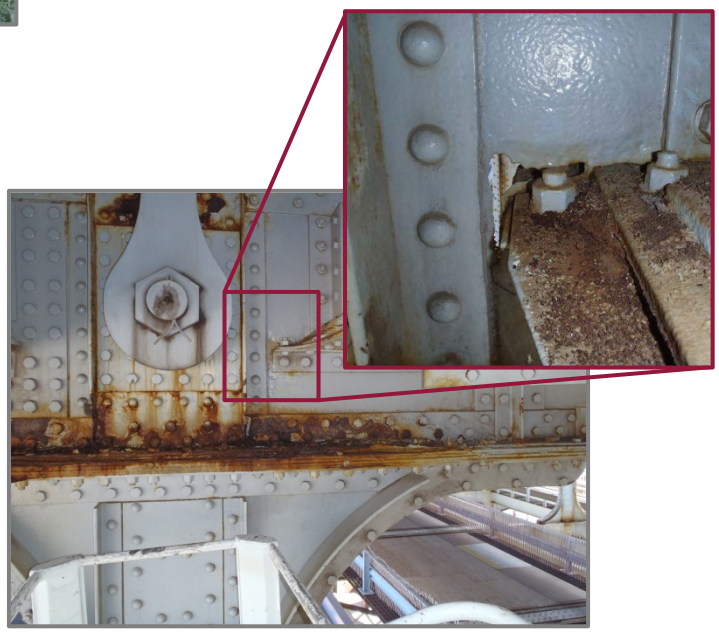


Photo 16 – Floorbeam 12 west face with perforation in web along lateral brace connection plate.

The upper deck steel floorbeams also exhibit heavy section losses adjacent to the truss lines where hangers pass through the concrete deck. Numerous floorbeam webs exhibit 100% section loss up to to 3" high long the top of lateral bracing connection plates (see photo 16). The upper and lower end floorbeams exhibit advanced pitting throughout the members and up to 100% section loss of the transverse stiffeners (see photo 17).

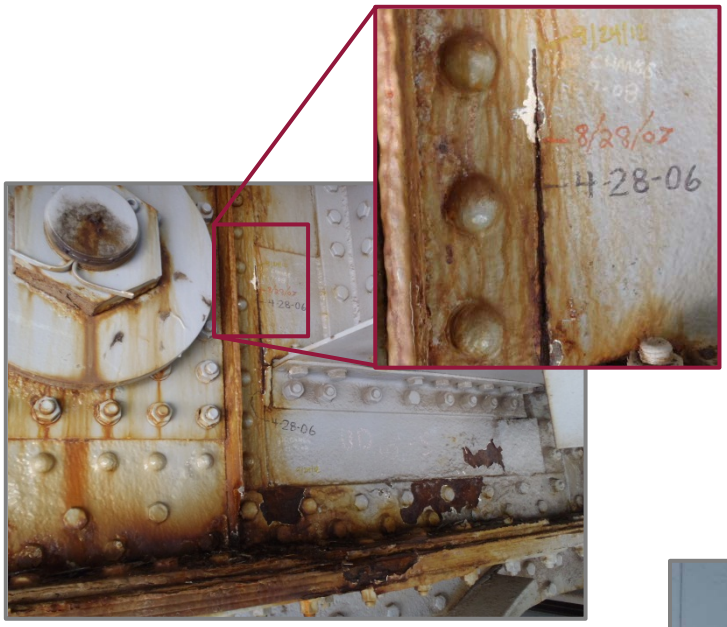


Photo 18 – Floorbeam 14 east face adjacent to South Truss hanger with crack in web retrofit plate weld.

Isolated steel floorbeams throughout the structure have several retrofit plates welded to the web below and adjacent to steel hanger connections. Some of the retrofit welds are cracked or broken due to the presence of pack rust between the original floorbeam web and retrofit plates. One such crack, on the east face of Floorbeam 14 adjacent to the South Truss, has propogated approximately 2" since last marked during the 2008 inspection (see photo 18). In all cases, the cracks were confined to the weld material with no indications of distress in the base metal.

Multiple circular, welded web retrofits are present at upper deck Floorbeams 1, 22 and 23 near the truss connections. Welds at each of these floorbeams had previously cracked and were documented during the prior inspections. The cracked location at Floorbeam 22 has propagated 1/4" on the east face and nearly 1/8" on the west face since last documented during the 2010 inspection (see photo 19).

Photo 19 – Floorbeam 23 east face near North Truss with circular retrofit exhibiting a broken weld which has propagated a total of 3/8" since the 2010 inspection.

ITEM 14 – FLOORBEAM CONNECTIONS

The floorbeam connections are in FAIR CONDITION [2] overall due to reactivating rust typical at lower floorbeam connections. The areas adjacent to truss hanger connections commonly exhibit previously noted section losses that had been cleaned and painted; however, rust has reactivated in many locations, including some which exhibit significant levels of new deterioration. The upper steel floorbeams typically exhibit reactivating corrosion in similar locations, although these losses are generally less severe. In addition, impacted rust has accumulated between the built-up steel framing members in isolated locations throughout the main steel span.

TRUSS INSPECTION FINDINGS

The truss members are in POOR CONDITION [4-NBIS] with locations of advanced section loss with and active corrosion, particularly in the gusset plates and members below the upper deck, as well as isolated lacing members. The main truss bearings exhibit advanced section loss in bolster components and isolated pin retaining washers with radial cracks.

Photo 20 – South Truss vertical member U3-L3 with heavy active corrosion and section loss to interior faces of box section (west web plate shown).

ITEM 15 – VERTICAL TRUSS MEMBERS

The vertical members are in FAIR CONDITION [2] overall with isolated heavy pitting and active corrosion adjacent to lower chord panel points. Section losses up to 1/4" deep were noted along web plates and throughout the angles of built-up vertical members at lower gusset plate and floorbeam interfaces (see photo 20). This level of deterioration was only documented in members at or below the upper deck level, which occurs at panel points from L0 to L4 and L20 to L24 (see photo 21).

Photo 21 – North Truss U3-L3 north face with 100% section loss in batten plate at longitudinal strut connection.

The truss vertical members extending above the upper deck level exhibit isolated paint failures, light surface rusting, and minor section losses on the interiors of built-up box members. These members pass through the deck immediately adjacent to the vehicular travel lanes, subjecting them to increased water and corrosive elements. The traffic spray zone appears to impact the vertical members for up to five feet above the roadway. The vertical members above this splash zone are typically free of any significant deficiencies.

Photo 22 – Holed through portion of underside batten plate of North Truss U1-L2 at lower chord gusset plate.

ITEM 16 – DIAGONAL TRUSS MEMBERS

The diagonal members are in FAIR CONDITION [2] due to isolated batten plates and lacing members exhibiting advanced section losses with holed through sections, particularly on members located below the upper deck (see photo 22). The diagonal members above the upper deck exhibit isolated minor section losses, generally within the traffic spray zone. These areas of minor pitting have typically been cleaned and painted. Paint failures and light surface rust are evident in isolated areas of the box sections, particularly adjacent to the lower chord panel point connections.

ITEM 17 – END POSTS

The end posts are in GOOD CONDITION [1] with minor pitting noted and light surface corrosion on isolated members. North Truss member U0-L0 exhibits minor impact damage to the northwest flange angle within the U0 gusset plate connection at deck level. End post U24-L24 on the South Truss exhibits one location of active impacted rust up to 1/2" thick between the flange angles and lacing bars.

ITEM 18 – UPPER CHORD TRUSS MEMBERS

The upper chord members are in GOOD CONDITION [1] overall with minor active corrosion noted around the aesthetic treatments and bronze name plates at the terminations of each top chord. South Truss member U7-U8 exhibits an 8" long laminar tear in the outstanding leg of the north top flange angle, extending longitudinally from a lacing channel connection (see photo 23). Isolated top chord members, splice plates, and connection plates exhibit blank rivet holes.

Photo 23 – South Truss U7-U8 with 8" long by 1/2" wide by 1/16" thick laminar tear in north top flange angle.

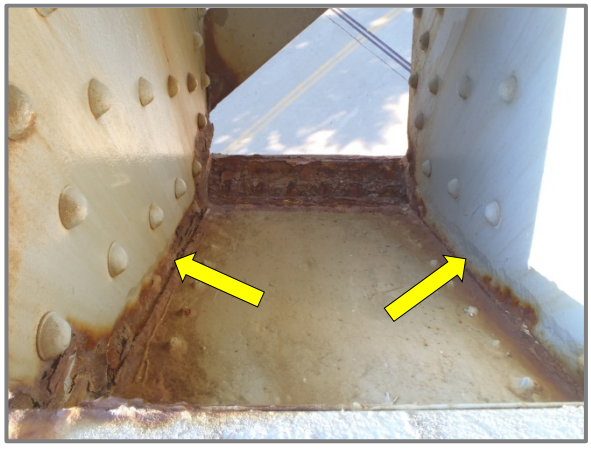


Photo 24 – South Truss L23-L24 with pitting on interior web plates up to 3/8" along the internal diaphragm at L24.

ITEM 19 – LOWER CHORD TRUSS MEMBERS

The lower chord members are in FAIR CONDITION [2] due to areas of advanced section loss in members below the upper deck level, typically occurring within L0-L4 and L20-L24. The most severe pitting typically occurs on the interior faces of web plates along internal diaphragm or gusset plate connections (see photo 24). Corrosion in these areas is typically active or beginning to reactivate in crevices. Numerous internal diaphragms, stay plates, and lacing channels exhibit active section losses with isolated sections holed through (see photo 25).

Impacted rust was commonly noted between lower chord stay plates and lacing channels and the flange angles to which they attach; however, no evidence of significant distress is present at any location. In addition, above the upper deck, the lacing channels passing over the middle intermediate diaphragms typically exhibit impacted rust up to 3/4" thick. Section losses up to 1/4" deep were noted on both the lacing and diaphragm flanges at these locations. Light surface rust was commonly noted along the horizontal planes at built-up member interfaces throughout the remainder of the lower chord; however, no signs of distortion or section losses due to pack rust were observed.

Photo 25 –North Truss member L20-L21 with heavy section loss on top lacing channels east of L20.

Photo 26 – North truss interior L20 gusset plate with heavy pitting and active corrosion on south face along west lower chord connection.

ITEM 20 – GUSSET PLATES

The gusset plates are in POOR CONDITION [3] overall due to advanced section losses on the lower gusset plates along connections to lower chord members (see photo 26). The most severe losses were commonly noted along the interface with lower chord top flanges, with isolated plates exhibiting up to 1/2" maximum section loss to a 3/4" thick plate along these shear planes (see photo 27). This condition was typically restricted to the gusset plates below the upper deck level at several panel points. The remaining gusset plates on the structure are generally in better condition, typically exhibiting intact paint with no active corrosion.

Photo 27 – South Truss L2 interior gusset plate with 1/4" effective thickness remaining for 24" along connection to member L2-L3.

South Truss gusset plates at L4 and L20 exhibit misdrilled holes with plug welds along the vertical member connections. Six such plug welds are present on each plate at L4 (see photo 28), while the gusset plates at L20 each have four plug welds. Isolated lower chord gusset plates above the roadway deck have abandoned welded attachments or threaded rods. No evidence of cracking or signs of distress were noted at any of these locations.

The gusset plates at L12 on both trusses exhibit a bowed condition, with the worst case observed at the L12 southwest gusset on the North Truss, which has a bow of approximately 3/8" to the south. At the each L12 panel, both the inboard and outboard gussets exhibit similar magnitude and direction of bowing.

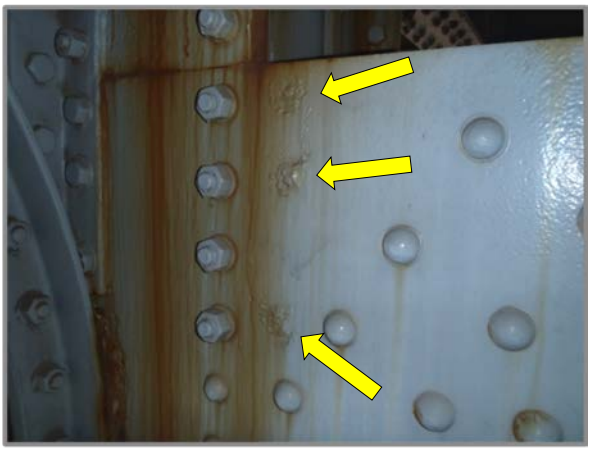


Photo 28 – 3 of 6 plugs welds on L4 north gusset plate on South Truss along connection to vertical truss member.

ITEM 21 – LATERAL BRACING

The lateral bracing is in FAIR CONDITION [2] with localized areas of advanced section loss and holed through sections near connection locations. Numerous lateral bracing members have been modified with bolted or welded retrofit plates in areas with heavy loss (see photo 29). Lateral bracing angles and connection plates below the lower deck fiberglass walkways exhibit isolated areas of 100% section loss throughout Span 4.

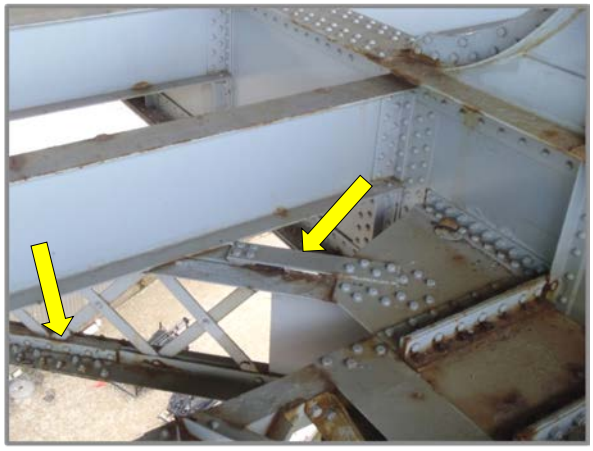


Photo 29 – Lower framing lateral bracing member with multiple bolted retrofits near connection to east face of Floorbeam 16.

ITEM 22 – SWAY BRACING

The sway bracing is in GOOD CONDITION [1] overall with isolated lacing bars below the upper deck level exhibiting moderate pitting. These locations have typically been cleaned and painted, although rust is commonly reactivating at the lacing connections. Sway bracing members above the deck level are typically in much better condition, with only light active rust present in isolated areas (see photo 30). The lower mid-panel connection gusset at panel point 15 (ML15) has two blank rivet holes at the connection to the ML15-U15 South diagonal.

Photo 30 – General view of main truss sway bracing, looking west from Panel Point 8.

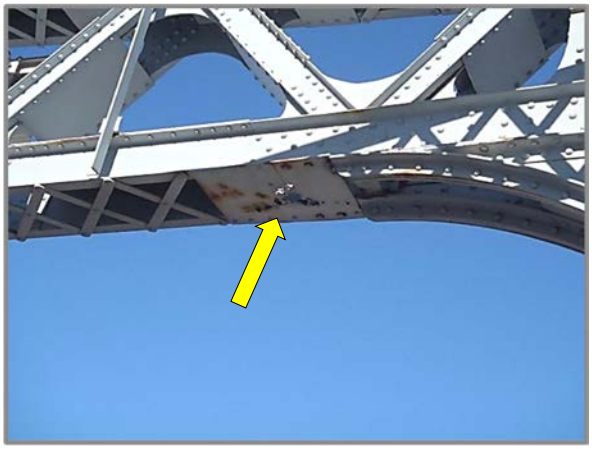


Photo 31 – Holed through section in U22 lower portal batten plate near connection to South Truss.

ITEM 23 – PORTALS

The portals are in FAIR CONDITION [2] overall due to localized areas of heavy pitting on portal batten plates at U2 and U22, with the lower batten plates adjacent to the South Truss exhibiting up to 100% section loss (see photo 31). Light surface rust is common at isolated connections throughout the built-up portals at these panel points.

ITEM 24 – BEARING DEVICES

The bearings are in FAIR CONDITION [2] overall due to truss bolster components with moderate to advanced corrosion, cracked bearing pin retainer washers, and extensive deterioration of isolated lower deck stringer saddle bearings. The four main truss bolsters exhibit significant section losses to the bearing stiffeners (see photo 32). These areas have been previously cleaned and painted, but rust has typically reactivated throughout this location on each bearing. Debris has accumulated throughout the voids on the interior of the bearing and adjacent to the stiffeners, a condition which has accelerated the rate of paint failure and associated corrosion. Despite the losses noted, the truss bearings appear to be functioning as intended.

Photo 32 – Northwest truss bolster with substantial section loss to bearing stiffeners and rust reactivation.

Photo 33 – North pin retaining washer at L0 South Truss with 2 radial cracks.

A history of cracking has been reported in several of the bearing pin retaining washers at the truss bolster bearings. These cracks typically extend radially through the washer, originating either at the center nut or the outer edge of the washer (see photo 33). No significant changes were noted in the condition of any of these washers since last documented during the previous inspection.

Isolated lower deck stringer saddle bearings exhibit advanced deterioration, including locations where 100% section loss was noted on one or both sides of the bearing steel (see photo 34). Corrosion at these saddle bearings is typically active, with heavy losses to the adjacent stringer ends common within the bearings. It should be noted that the bearings exhibiting this condition are no longer functioning under live load, as these stringers are found on the abandoned lower deck. Furthermore, the specific stringers with the worst deterioration do not support any deck surface, as these members are located between the limited use utility (center) deck and the exterior cantilever pedestrian walkways.

Photo 34 – Lower deck Stringer 10 south face saddle bearing at Floorbeam 21. Note 100% section loss on the stringer web, bottom flange, and saddle bearing.

ITEM 25 – ARCHES

The concrete arches in Spans 1 thru 3 and Spans 5 thru 13 are in FAIR CONDITION [2] due to minor cracking and spalled or delaminated concrete throughout the spans. Large areas of map cracking are common in the approach span arches, typically located on the undersides and vertical faces of concrete approach spans (see photo 35). The most advanced cracking occurs on the north exterior concrete arch rib (Arch A) in Span 5, where a 1/4" wide crack extends longitudinally along the arch centerline on the underside for approximately 40 feet in length (see photo 36). Isolated arch ribs exhibit large regions of delaminated concrete.

Photo 35 – Map cracking throughout underside of Arch A in Span 10, looking west toward Pier 9.

Photo 36 – Span 5 Arch A exhibiting longitudinal crack approximately 1/4" wide by 40' long on underside of arch rib.

Photo 37 – Column C13 in West Side Station with advanced spalling and fully exposed reinforcement exhibiting moderate loss of section. Condition has worsened since previously noted during the 2011 inspection.

ITEM 26 – ARCH COLUMNS OR HANGERS

The concrete columns and hangers are in POOR CONDITION [3] due to widespread deterioration of the jack arch columns in the West Approach Spans (see photo 37). Isolated columns exhibit spalls exposing all exterior reinforcement, typically at the column base or near decorative capitals (see photo 38). Some of the columns have lost nearly 100% of the concrete cover, including isolated locations with significant section loss to fully unconfined reinforcing bars.

Photo 38 – Easternmost column in West Side Station jack arch Line C with heavy spalling and exposed rebar on all faces.

Isolated jack arch columns have been repaired due to previous deterioration, particularly in the West Approach and tunnel spans. Typical column repair details include replacement of decorative capitals, full height column replacements, column base repairs for the bottom 2 feet to 3 feet, and isolated concrete patches. Nonetheless, the overall condition of the concrete columns in the West Approach Spans has worsened since the previous inspection. Jack arch columns in the concrete arch spans and east cellular construction are in satisfactory with only minor deficiencies noted.

The open spandrel arch columns in Spans 1 thru 3 and Spans 5 thru 13 generally exhibit small areas of spalled or delaminated concrete. Isolated columns exhibit more advanced spalling with minor section loss to exposed reinforcement (see photo 39). Similar conditions are present on the concrete hangers in Span 12, and minor to moderate cracking is present throughout the open spandrel columns in the concrete arch spans.

Photo 39 – Span 2 Column 1C with southeast corner spall and exposed reinforcement with section loss.

Photo 40 – General view of South Arch, looking west, showing overall paint condition of members above deck.

ITEM 28 – PROTECTIVE COATING SYSTEM

The protective coating system is in SATISFACTORY CONDITION [6-NBIS] due to isolated paint failures and typical chalking. The most advanced stages of paint failure and corrosion were documented at or below the lower deck, as well as locations where steel truss members pass through the upper deck. Localized areas of active rust are present as a result of the paint failures, including isolated components which exhibit advanced section loss. Members above the lower deck exhibit isolated paint chalking, with this condition more prominent in the truss elements above the upper deck (see photo 40).

Photo 41 – East lower eyebar connection at L4 North. Note active corrosion in area and up to 3/8" pitting on pin plate.

ITEM 29 – PINS AND HANGERS

The pins and hangers are in FAIR CONDITION [2] overall due to localized moderate pitting on eyebar heads at isolated connections to the lower floorbeams (see photo 41). The lower pins and collars, where exposed, exhibit active laminate rusting around the circumference between the eyebar and adjacent pin plates. Active corrosion with advanced section loss is present on the pin plates at some locations.

The eyebar hangers in Span 4 also exhibit localized active corrosion where the eyebar shank passes through the upper deck (see photo 42). The net sections of eyebar heads in these locations commonly exhibit locations of active corrosion and small paint flumes but no measureable section loss. Three isolated pin nuts at eyebar connections to the truss lower chord above deck level are unpainted with active rust but no loss (see photo 43).

Photo 42 – West face of eyebar at connection to south lower pin at Panel Point 11. Note moderate corrosion throughout area but section loss on eyebar.

Photo 43 – Unpainted west pin nut on upper eyebar connection at L13 North. Active rust present with no measureable section loss.

ITEM 30 – FATIGUE PRONE DETAILS (E & **E'**)

The fatigue prone connections are in FAIR CONDITION [2] overall with localized losses occurring at the eyebar heads within the net section, which classifies as a Category E fatigue detail. The section losses at these locations have previously been cleaned and painted, but rust is beginning to reactive. However, no signs of fatigue related distress or cracking were noted.

ITEM 42 – SUBSTRUCTURE SUMMARY

The substructure is in POOR CONDITION [4-NBIS] due to the continued rotation of South Tower B, as well as large cracks in the cellular construction areas in Spans 1A and 1B. Evidence of differential settlement exists within these spans, and numerous crack gauges have been installed in order to monitor changes in condition. These elements control the substructure rating.

ITEM 33 – ABUTMENTS

The abutments are in FAIR CONDITION [2] overall due to isolated minor cracking and minor spalls on the face of the East Abutment breastwall.

ITEM 34 – ABUTMENT SEATS

No abutment seats are located on this structure.

ITEM 35 – PIERS (TOWERS AND CELLULAR CONSTRUCTION)

Photo 44 – East elevation of South Tower B. Note the gap between the upper portion of the tower and the lower deck fascia members.

Piers

The piers are in POOR CONDITION [3] with the South Tower B controlling the rating. Settlement has resulted in the tower rotating to the south away from the structure (see photo 44). ODOT installed a crack monitoring gauge at the lower deck level of South Tower B in 2006 to track the progression of the tower's rotation. This tower is reported to be on a 4-Month Special Inspection cycle, and the gauge showed a reading of 38.5mm on May 9, 2011. During last year's routine inspection (September 20, 2011), TranSystems documented the same monitor with a measurement of 39.5mm, indicating approximately 1mm of moment over a 4½ month period (see photo 45). During TranSystems's 2012 in-depth inspection (September 21, 2012), the crack monitor at this location provided a measurement of 49.0mm (see photo 46). With a total of approximately 59.0mm (2.32") since the initial installation in 2006, the tower has exhibited approximately 9.83mm (0.39") movement per year at this location. This number is consistent with the 9.5mm of movement observed during the year between inspections by TranSystems in 2011 and 2012, indicating that the tower rotation has continued to progress at a constant rate.

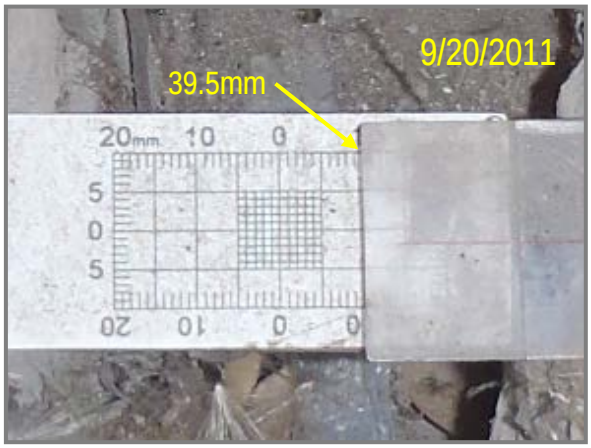


Photo 45 – September 20, 2011 South Tower B crack gauge reading (during 2011 routine inspection by TranSystems).

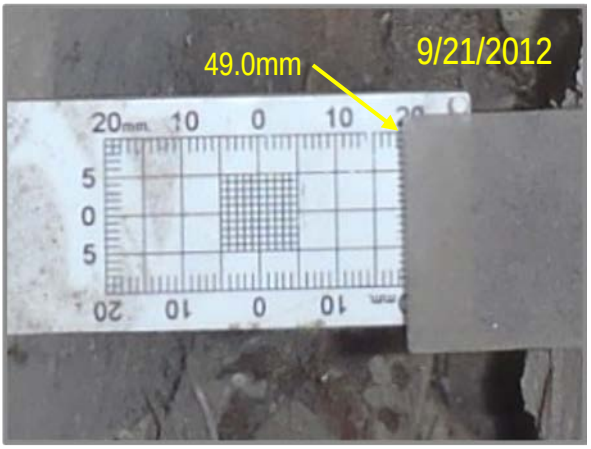


Photo 46 – September 21, 2012 South Tower B crack gauge reading (during 2012 in-inspection by TranSystems).

The pier towers throughout the remainder of the structure do not exhibit significant deficiencies due to settlement or alignment. However, minor to moderate map cracking is typical at the thrust blocks at each tower base and throughout the adjacent lower struts (see photo 47). Isolated spalls and delaminated areas were noted during the inspection in the pier elements, but these conditions were generally minor in nature.

Photo 47 – Pier 7 lateral strut between Arch lines B and C with map cracking throughout.

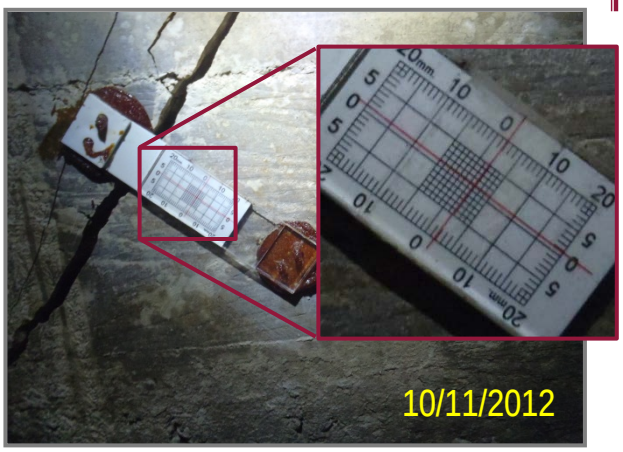


Photo 48 – Crack Gauge 1 showing approximately 2mm of movement since installation in 2007.

Cellular Construction

The cellular units (Cells) in Spans 1A and 1B exhibit numerous areas of heavy cracking with indications of differential settlement in several walls within the separate cells. Five crack gauges have been installed to monitor separation/cracks in the following cells in Span 1A: Cell 0S on the east wall (Gauge 1), two gauges in Cell 2S on the north and east walls (Gauges 2 and 3, respectively), Cell 4S on the west wall (Gauge 4), and in Span 1B on the east wall of Cell 10S (Gauge SI). Of these gauges, only Gauges 1 and 2 exhibit evident separation since installation, with just over 2mm of total movement noted in each monitor at the time of inspection (crack opening) (see photo 48). Numerous crack gauges have moved a noticeable but less than measureable amount since the 2011 routine inspection.

The walls and soffit of the cellular construction below the lower deck exhibit other large cracks throughout with numerous areas of heavy water seepage and efflorescence (see photo 49). The center chamber (Cell 0C in Span 1B) exhibits cracking up to 1" wide between the slab and both the north and south walls. This location is laterally aligned with South Tower B, indicating potential reflection of the tower movement into the adjacent cellular units. In addition, a full height spall, with daylight visible, was noted in the southwest corner of Cell 0S in Span 1B.

See Appendix A for a detailed layout of the cellular construction, including unified nomenclature and crack gauge locations.

Photo 49 – Cell 0N in Span 1B with 1/2" crack with spalls and heavy efflorescence on east face.

ITEM 36 – PIER SEATS

The pier seats for the Span 4 trussed arches are in FAIR CONDITION [2] due to map cracking and minor spalling noted at each location.

ITEM 38 – WINGWALLS

The wingwalls and curtain walls are in FAIR CONDITION [2] due to deterioration of a small portion of the southwest wing, mortar and cinder block deterioration at the east curtain walls, and miscellaneous minor deficiencies throughout the remainder of the walls. The extreme west end of the southwest wingwall exhibits soft and disintegrating concrete. The northeast wingwall exhibits several full height vertical cracks with one up to 1/2" wide near the easternmost lamp post. The cinder blocks that comprise the curtain walls at the East Abutment exhibit isolated cracking with deteriorated mortar throughout.

ITEM 39 – FENDERS AND DOLPHINS

The fenders and dolphins are in POOR CONDITION [3] with no protection present at Pier 3 controlling the condition rating. A failed sheet pile wall is present downstream (see photo 50), and abandoned timber piles are exposed upstream of Pier 3; however, neither feature currently provides any collision protection for the structure. A concrete cap serves as protection from incoming traffic for Pier 4 and appears to be functioning sufficiently.

Photo 50 – Failed sheet pile protection downstream of Pier 3.

Photo 51 – Sinkhole along north face of Pier 4 which has increased in size since last inspected.

ITEM 40 – SCOUR

The river channel was visually inspected and scour is in SATISFACTORY CONDITION [2], with a sinkhole present along the north face of Pier 4 behind the concrete cap wall (see photo 51). The sinkhole is approximately 4'-6" wide, 10 feet long and 7 feet deep, indicating that the sinkhole has grown in size since the last inspection. This void appears to extend down to water level, as the surface of the water was visible in the bottom of the sinkhole at the time of inspection.

ITEM 54 – CHANNEL SUMMARY

The channel is in SATISFACTORY CONDITION [6-NBIS] due to the lack of channel protection at the west bank.

ITEM 51 – ALIGNMENT

The alignment is in GOOD CONDITION [1] with the Cuyahoga River passing under the steel main span at a heavy skew. This alignment has been engineered and does not exhibit any evidence of migration from the intended path.

ITEM 52 – PROTECTION

The channel protection consists of driven steel sheet pile walls which are in FAIR CONDITION [2] with no protection present upstream and downstream from Pier 3 along the west bank. Moderate corrosion was noted along the sheet pile wile on the east bank, particularly at the waterline.

Photo 52 – General view looking toward the structure from the East Approach.

Photo 53 – Eastbound impact attenuator exhibiting damage from vehicular impact at the west end of the South Truss.

ITEM 53 – HYDRAULIC OPENING

The hydraulic opening appears to be sufficient and in GOOD CONDITION [1]. The structure does not impede the flow of the waterway, and no obstructions are present in the channel.

ITEM 60 – APPROACHES SUMMARY

The approaches are in SATISFACTORY CONDITION [6-NBIS] within minor patches, cracking in the wearing surface, and asphalt shoving at both approaches (see photo 52).

ITEM 55 – PAVEMENT

The pavement is in FAIR CONDITION [2] overall due to widespread map cracking and minor shoving noted at both approaches.

ITEM 57 – GUARDRAIL

The guardrails are in FAIR CONDITION [2] due to vehicular impact damage to the eastbound impact attenuator (see photo 53). No significant deficiencies were noted along the guardrails protecting the steel arches in Span 4.

ITEM 59 – EMBANKMENT

The embankment is in FAIR CONDITION [2] overall due to a minor erosion channel forming along the northeast wingwall. This condition has not significantly changed since the previous inspection.

ITEM 66 – GENERAL APPRAISAL & OPERATIONAL STATUS

Overall, the Detroit-Superior Bridge is in POOR CONDITION [NBIS – 4], OPEN WITH NO RESTRICTIONS [ODOT - A] due to advanced concrete deterioration throughout the West Approach Spans and locations of advanced section loss in Span 4. Crack widths in the Span 1A cellular units are increasing as a result of continued settlement and rotation of South Tower B.

ITEM 61 – NAVIGATION LIGHTS

The navigation lights are in GOOD CONDITION [1] with no significant deficiencies noted. The lights were observed to be operational during the inspection.

ITEM 62 – WARNING SIGNS

The warning signs are in FAIR CONDITION [2] with end markers only located at the northeast and southwest corners of the main span where the truss end posts pass through the deck. No end markers are present at the four corners of the bridge limits.

ITEM 63 – SIGN SUPPORTS

The sign supports are in GOOD CONDITION [1] with no significant deficiencies noted.

ITEM 64 – UTILITIES

The utilities are in POOR CONDITION [3] due to a utility junction box in Span 6 exhibiting advanced deterioration. Active corrosion is present throughout all components with section loss of numerous support members and portions of the corrugated metal outer containment failed (see photo 54). Existing conduits and utility boxes throughout the rest of the structure exhibit minor damage, including isolated broken or leaking conduits and boxes with active corrosion.

Photo 54 – Utility junction box in Span 6 with advanced corrosion throughout and failed outer containment. Deterioration is due to water infiltration through access manhole above.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of our in-depth inspection, the Detroit-Superior Bridge (CUY-6-1456) is in POOR CONDITION [4-NBIS] overall. Several deficiencies throughout the structure contribute to this rating, including the ongoing settlement of South Tower B and advanced section losses to structural members in the reinforced concrete approach and steel main spans. Lower chord truss members and gusset plates in Span 4 exhibit heavy losses below the upper deck, and isolated gusset plates are bowed at the L12 hinge. Advanced section losses were also documented on isolated steel stringers and bearing devices in this span. The concrete columns and jack arches in the West Approach Spans exhibit widespread heavy spalling with exposed reinforcement. South Tower B has continued to exhibit rotation away from the structure and is being monitored on a four month inspection cycle.

We present our recommendations for CUY-6-1456 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.

CUY-6-1456 RECOMMENDATIONS

Priority Work:

General

1. Perform a load rating of structural elements in the concrete approach spans not included in the scope of the 2012 load rating done by TranSystems (West Tunnels, West Side Station, and East Approach Tunnels).

2. Investigate means to prevent further settlement of South Tower B. Continue monitoring, on 4-month cycle, South Tower B and the cellular construction in Spans 1A and 1B for signs of rotation and further crack separation.

3. Remove and replace loose or deteriorated corbels in the reinforced concrete approach spans. Remove and repair any loose concrete over traveled areas.

Rehabilitation/Evaluation:

Deck

4. Repair concrete throughout the deck floor exhibiting spalls with exposed reinforcement.

5. Improve drainage in the East Tunnel and West Side Station in order to prevent ponding water on the lower deck.

Superstructure

6. Repair deteriorated concrete columns, jack arches, and floorbeams throughout the structure. Repair walls in Detroit Avenue tunnel which exhibit large spalls with exposed reinforcement.

7. Replace or repair isolated upper deck steel stringers exhibiting advanced section losses.

8. Develop rehabilitation or removal plan for the lower deck stringer saddle bearings.

9. Zone paint areas in Span 4 exhibiting rust activation and active section losses.

Substructure

10. Provide fender system for Pier 3 on the west embankment. Perform analysis of the Pier 4 protection to determine adequacy of concrete cap for collision protection.

11. Develop rehabilitation plan for wingwalls and other retention structures at each end of the bridge that currently exhibit deficient concrete.

Channel

12. Repair the sinkhole along Pier 4 by backfilling with large riprap stone in order to prevent further washout of bank material.

13. Place riprap or other slope protection along west embankment.

Maintenance:

General

14. Remove granular debris and vegetation from deck expansion joints. Clean out longitudinal trench drain in north sidewalk.

15. Replace deteriorated utility junction box in Span 6 and seal access manhole above in order to prevent future water infiltration.

Approaches

16. Replace damaged impact attenuator at the southwest corner of the steel main span.

Top of Deck

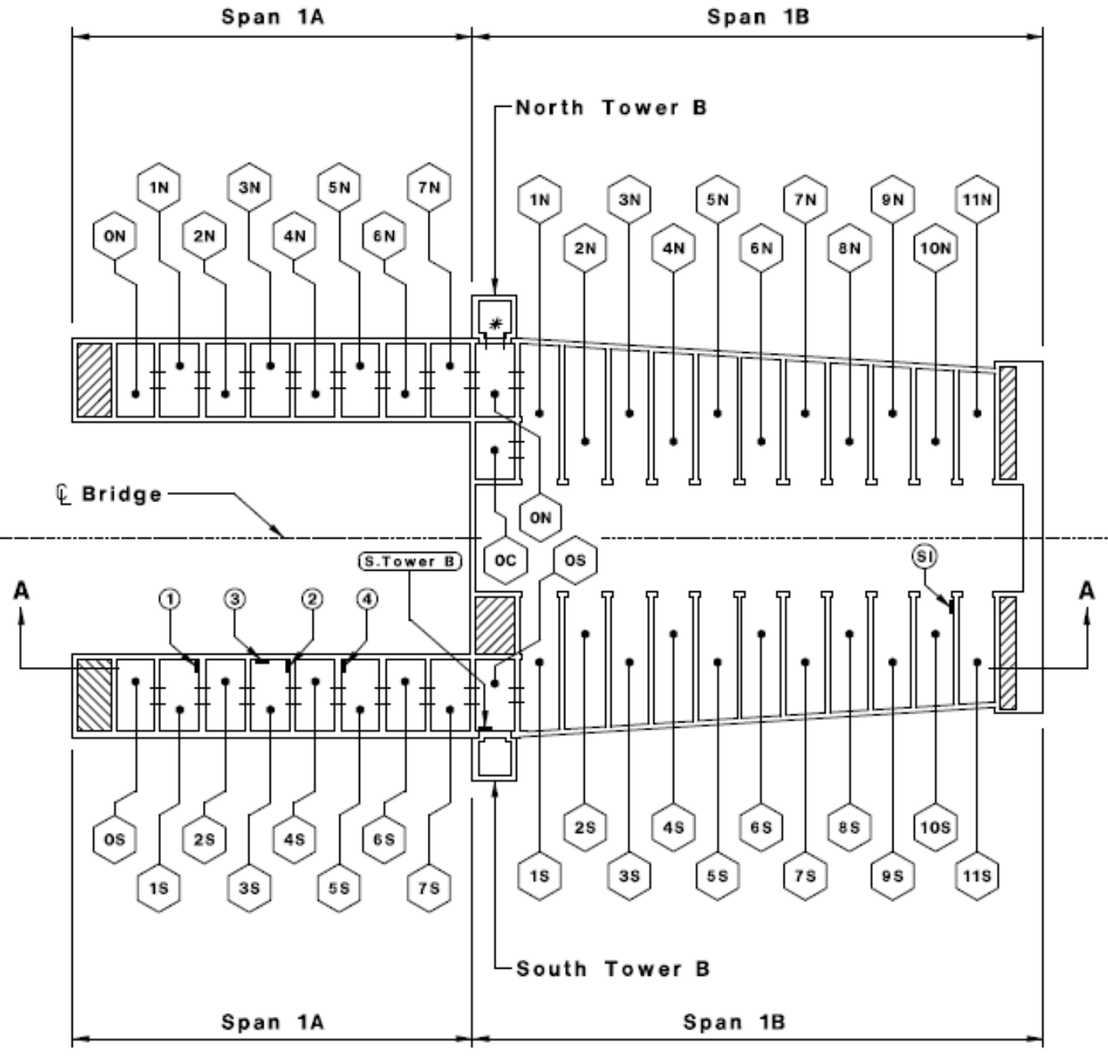
17. Replace missing grating in longitudinal sidewalk trough.

Monitoring:

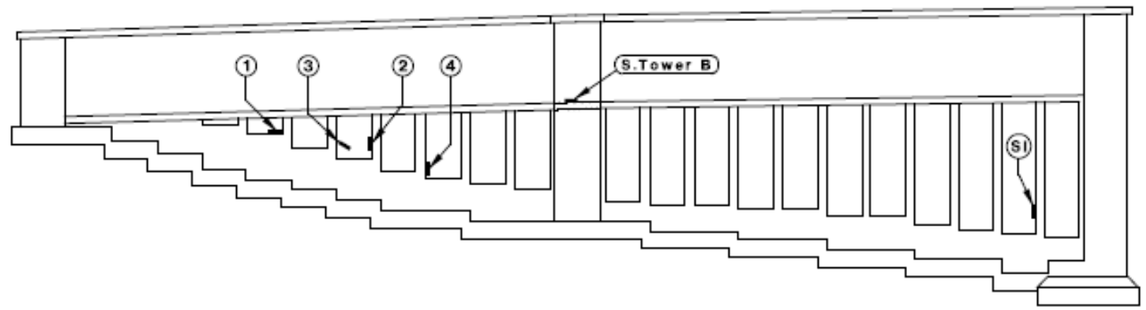
Superstructure

18. Continue to monitor fracture critical members and fatigue prone details on a 12-month cycle.

Appendix A
Cellular Construction Layout, Unified Nomenclature and Crack Gauge Locations



Plan



Section A-A

= Enclosed/Inaccessible Area

= Wall Opening

1N - Cell/Vault Number

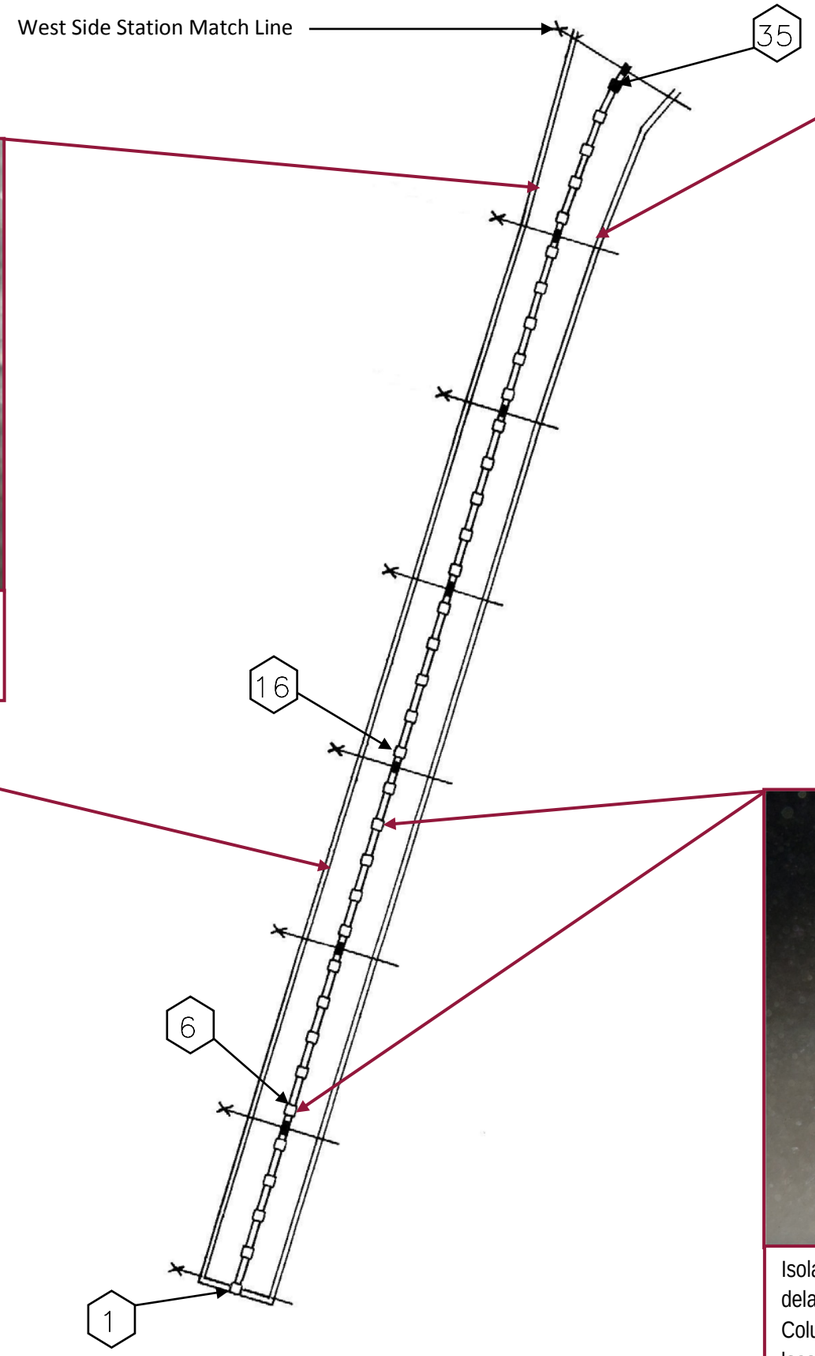
1 = Crack Gauge

✳ - Surface Access Location

Appendix B
Highlighted Structural Deficiency Layout

The transverse utility conduit in Bay 31 exhibits moderate corrosion of the projecting pipes at both walls (west wall shown). The deck slab is leaking above this location, contributing to the corrosion.

The east wall in Bay 30 (joint location) exhibits a full height spall and partial concrete repair. This condition is common at joint locations throughout the West 25th Street Tunnel.



Approximately 8' long section of localized spalling along the bottom of the west wall in Bay 12. Exposed reinforcement typically exhibits negligible loss.

Isolated columns throughout the West 25th Street Tunnel exhibit delaminations or spalls with exposed reinforcement at the base (left; Column 14). Numerous column bases have received repairs at this location (right; Column 6).

LEGEND

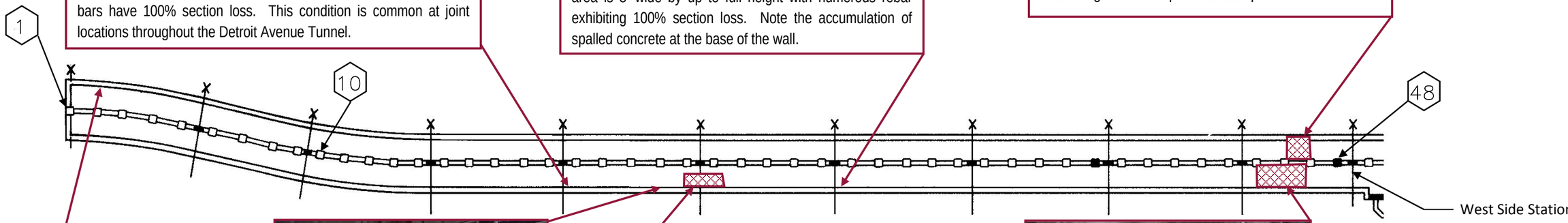
(#) Column #

West 25th Street Tunnel Plan

Full height by 8' wide spall with exposed reinforcement in south wall between Columns 19 and 20 (joint location). Several reinforcing bars have 100% section loss. This condition is common at joint locations throughout the Detroit Avenue Tunnel.

Up to 3" deep spall with exposed reinforcement in north wall at joint location between Columns 29 and 30. Spalled area is 8' wide by up to full height with numerous rebar exhibiting 100% section loss. Note the accumulation of spalled concrete at the base of the wall.

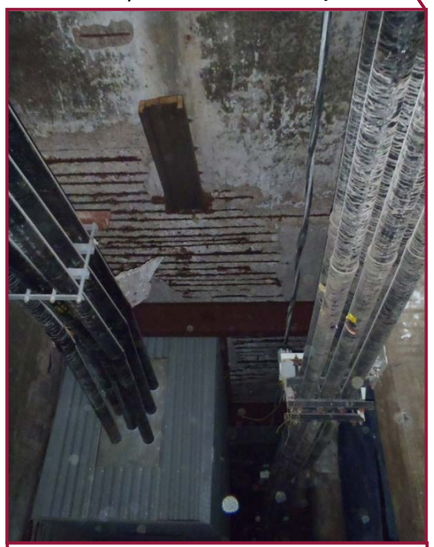
Large spall (~200 ft²) in deck underside adjacent to the north wall between Columns 46 and 47. All transverse reinforcing bars are exposed within spalled area.



The north wall adjacent to Column 2 exhibits a full height spall 18' wide with exposed reinforcement. Numerous vertical bars have 100% section loss. A photo of this deficiency could not be obtained due to particulate matter in the tunnel during the inspection.

South wall exhibits a 6' wide by full height spall with exposed reinforcement adjacent to Column 23. Several vertical bars exhibit 100% section loss

15' long by 8' wide spall with exposed reinforcing in the deck underside. Numerous similar spalls are present throughout the Detroit Avenue Tunnel.



Large spall in deck underside (approximately 20' long by 8' wide) with all transverse bars exposed at east end of the Detroit Avenue Tunnel.

LEGEND

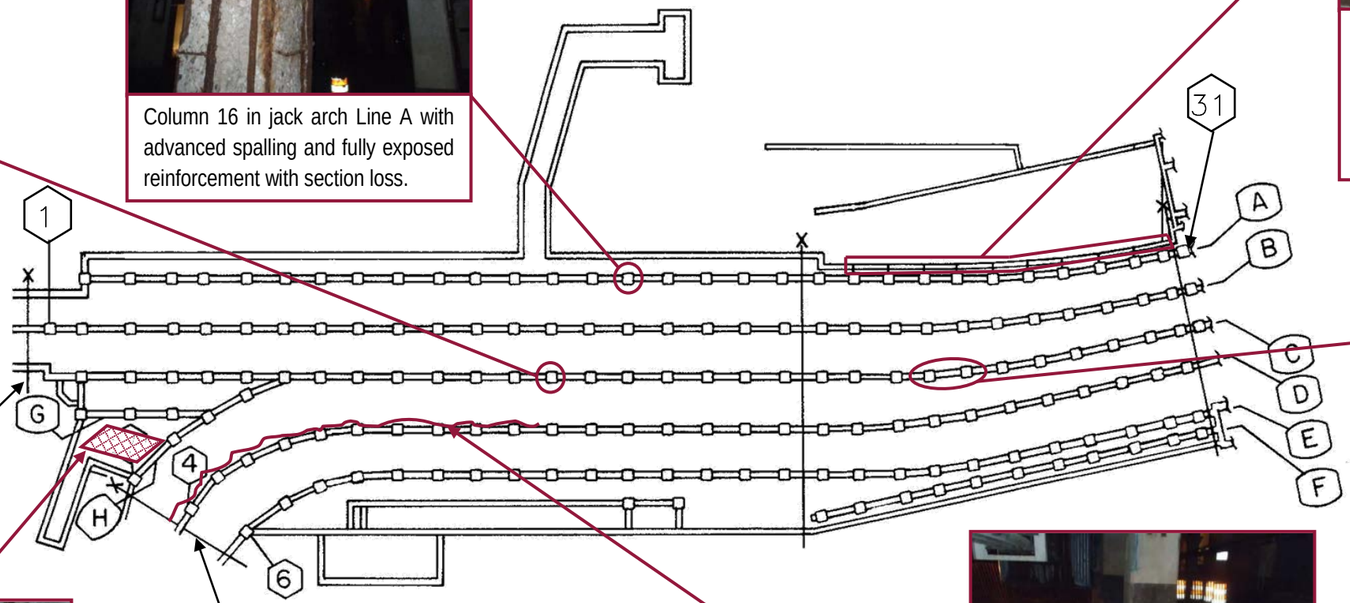
(#) Column #

Detroit Avenue Tunnel Plan

Column 14 in Line C exhibits up to 5" deep spalling, significant loss of concrete cover and exposed rebar with minor section loss. While large spalls are common throughout the concrete columns, the magnitude of deterioration shown here is isolated to only a few locations.

Column 16 in jack arch Line A with advanced spalling and fully exposed reinforcement with section loss.

The south face of the north wall exhibits widespread spalled and delaminated areas from approximately Colum 23 to Column 31. The full height of the wall exhibits spalls/imminent spalls between Columns 26 and 28.



The Line C jack arch between Columns 24 and 25 exhibits advanced spalling with exposed reinforcement throughout the north face. This spalled area extends into Column 25.

Large spall (~30 ft²) in the deck underside between jack arch Lines G and H. Spalls are common throughout the upper deck floor in the West Approach, typically ranging from 2 ft²-10 ft².

Crack in lower deck up to 1" wide extends from approximately Column 3 to Column 14 along Line D.

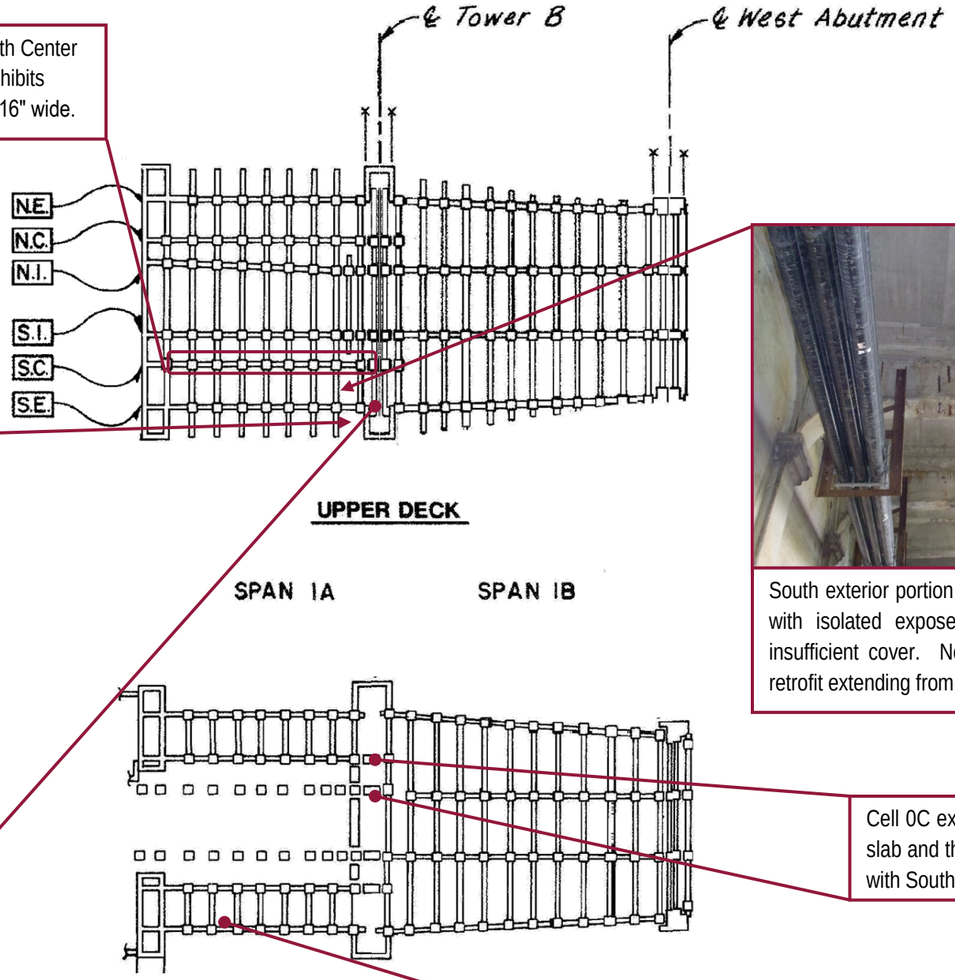
LEGEND

(#) Column #

West Side Station Plan

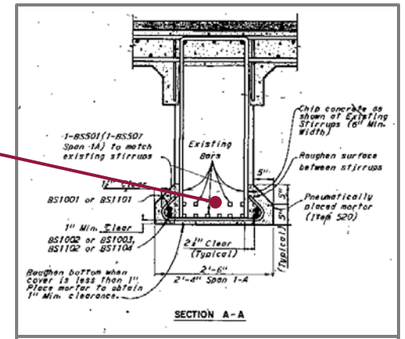
The south face of the South Center curtain wall in Span 1A exhibits diagonal cracking up to 1/16" wide.

Various jack arch elements exhibit minor spalls, delaminations and cracking throughout the upper deck arches, columns and slab. The upper deck floorbeams in Span 1B have typically been rehabilitated and are without significant deficiencies.



West elevation of South Tower B, showing rotation of upper portion away from the structure.

South exterior portion of Floorbeam 8 in Span 1A with isolated exposed reinforcing bars due to insufficient cover. Note bottom flange widening retrofit extending from exterior column.



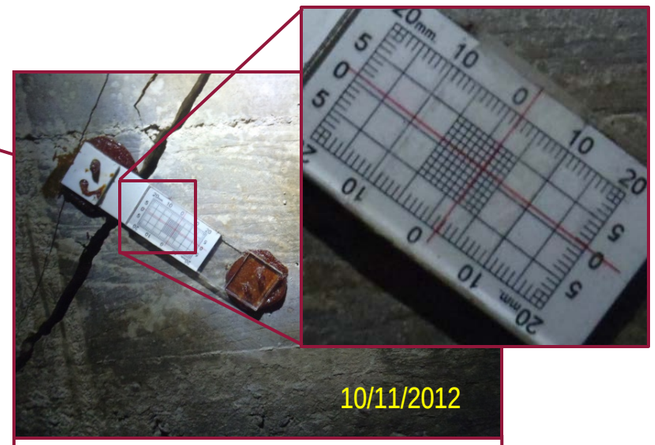
Typical cross section showing floorbeam bottom flange strengthening detail during the 1965 Rehabilitation.

Cell 0C exhibits large cracks up to 1" wide between the lower deck slab and the north and south walls. This location is aligned laterally with South Tower B.

South Tower B crack gauge at the upper deck level showing nearly 10mm of movement over the past year. This gauge was originally installed in 2006 and indicates approximately 59.0mm (2.32") of movement since at an average rate of 9.83mm (0.39") per year.

West Approach Plan

Spans 1A & 1B

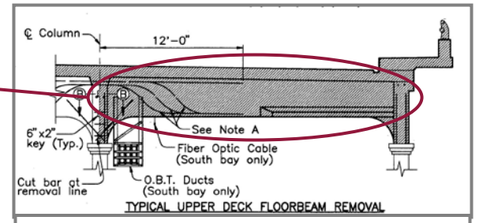


Crack Gauge 1 within the lower cellular units showing approximately 2mm of movement since installation in 2007.

Isolated floorbeams throughout Spans 1 thru 3 exhibit transverse hairline cracking and light efflorescence on the bottom face, particularly at floorbeams that have not been rehabilitated.

Spalls with exposed reinforcement are common in decorative column capitals throughout all concrete approach spans (west face of Column C2 in Span 1 shown).

General view looking east from Span 1 between Lines A and B. Isolated floorbeams, columns and jack arches have been repaired (light in color), while many elements are from original construction (discolored).

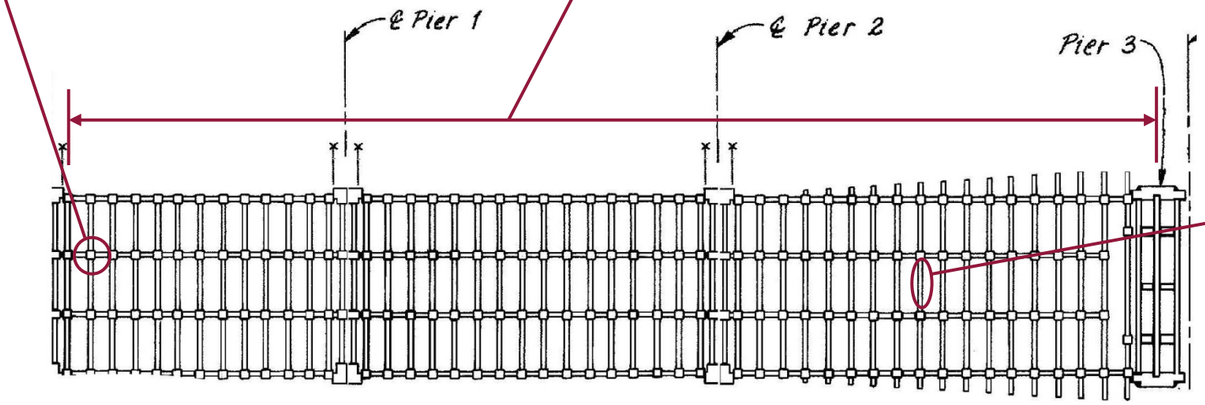


Typical concrete floorbeam removal/repair detail per the 1994 rehabilitation plans.

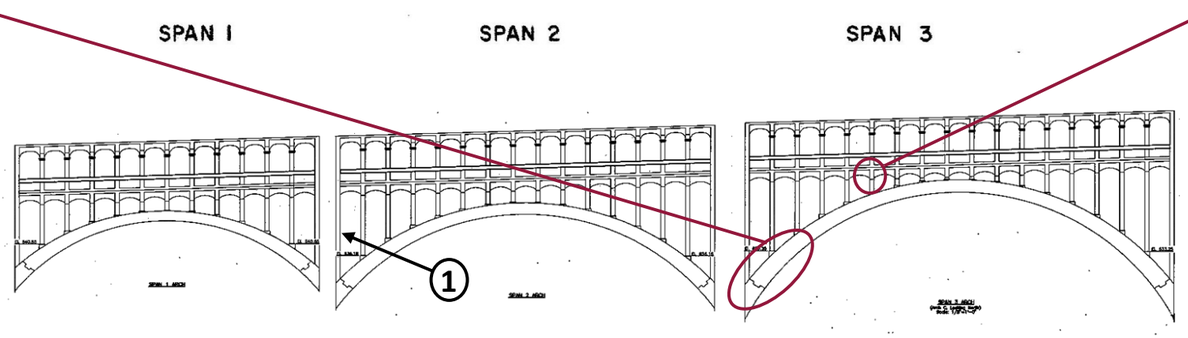
1

Arch C westernmost open spandrel column with southeast corner spall with exposed reinforcement and 1/4" wide vertical crack in south face. West face of column is delaminated at this location.

Span 3 Floorbeam 9 with 33" long x 20" wide x 3" deep underside spall with exposed reinforcement between Lines B and C. Isolated spalling is common throughout Spans 1-3.



UPPER DECK



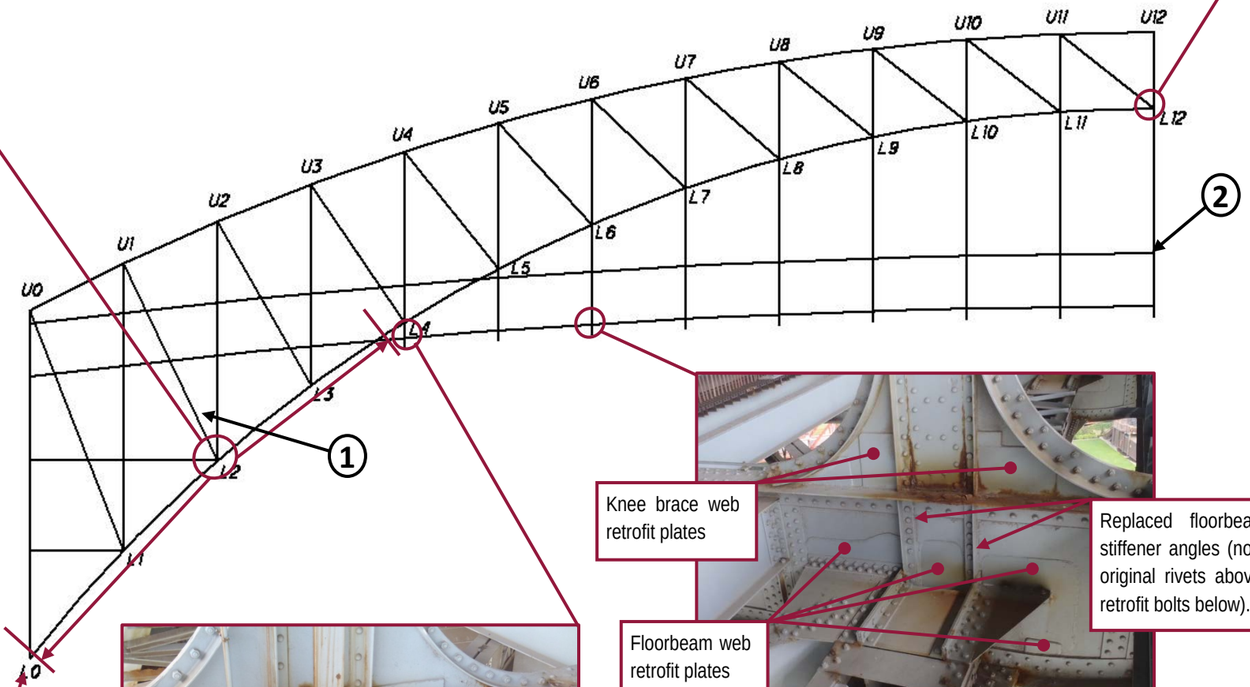
North face of Arch D in Span 3 with widespread map cracking for the western 25' of the arch. Arch cracking is typical in Spans 1-3, with the condition most pronounced adjacent to drainage elements at the piers.

Span 3 Lower Floorbeam 6 with large underside spall and exposed reinforcement with minor section loss.

West Approach Plan

Spans 1-3

South Truss L2 interior gusset plate with 1/4" (of 3/4" original) effective thickness remaining for 24" along connection to L2-L3. Section loss along the shear plane of lower chord connections is common in gusset plates below the upper deck level (Panel Points 0 to 4).



The L12 gusset plates on both trusses exhibit bowing, with the worst case seen at the North Truss, where the southwest gusset is bowed approximately 3/8" to the south. At each L12 panel, the corresponding inboard and outboard gussets exhibit similar magnitude and direction of bowing.

North Truss U1-L2 underside batten plate within connection to gusset plate U1 with a portion holed through. Isolated diagonal and vertical member batten plates below the upper deck level exhibit this condition.

Knee brace web retrofit plates

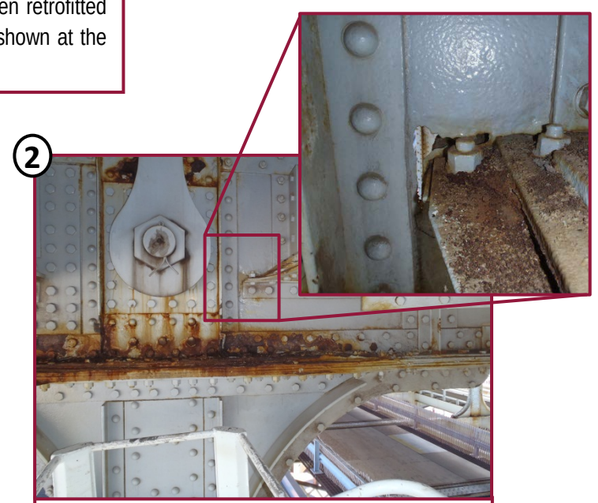
Replaced floorbeam stiffener angles (note original rivets above, retrofit bolts below).

Floorbeam web retrofit plates

Typical lower hanger and floorbeam connection, with isolated rust activating throughout the area. Many floorbeams in Span 4 have been retrofitted with bolted and/or welded plates as shown at the south end of Floorbeam 6.

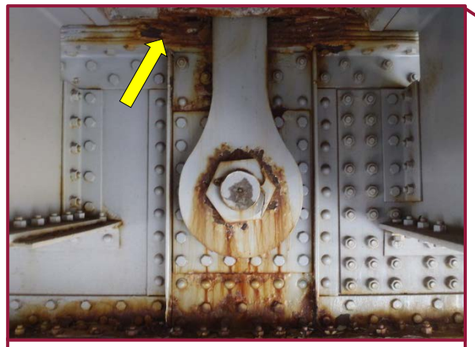
Moderate to heavy pitting is common at the lower pin connections below the upper deck. East face of Lower Floorbeam 4 shown at south connection, with 3/16" section loss to the eyebar head. Note active corrosion throughout this location.

The north pin retaining washer at L0 on the North Truss exhibits a radial crack from the center bolt to the edge. A history of cracking has been reported in several of the bearing pin retaining wasters at truss bolster bearings throughout the main span.



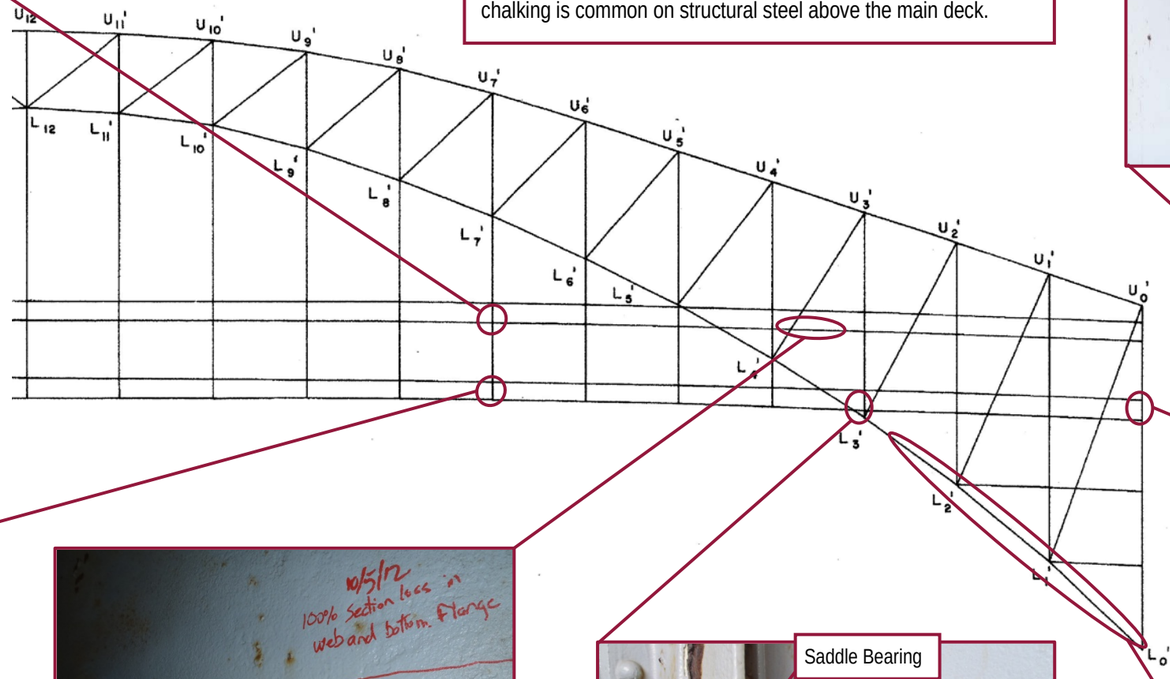
Floorbeam 12 west face with perforation in web along lateral brace connection plate. Isolated upper floorbeams throughout Span 4 exhibit similar conditions at this location.

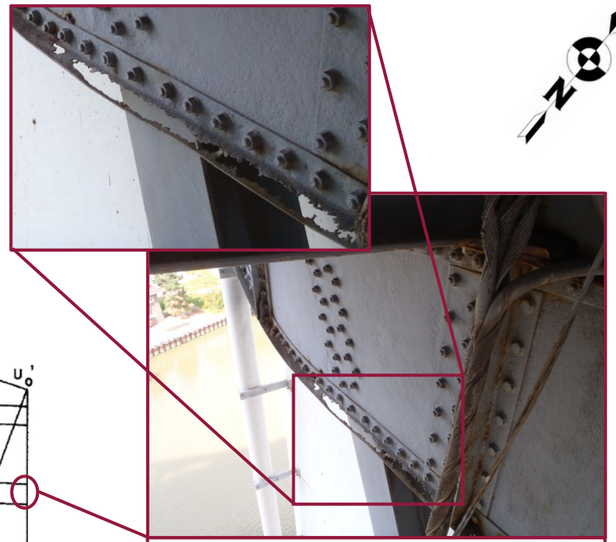
Main Span
Half South Elevation (West)



Pin connections at the upper floorbeams (from Panels 5 to 19) typically exhibit rust activation and staining throughout the adjacent floorbeam components. Additionally, moderate to heavy pack rust between the top flange and deck is typical at these locations (north hanger at Floorbeam 17 shown).

Upper chord and web members above the upper deck are typically without major deficiencies. Isolated top chord members, splice plates, and connection plates exhibit blank holes, and paint chalking is common on structural steel above the main deck.

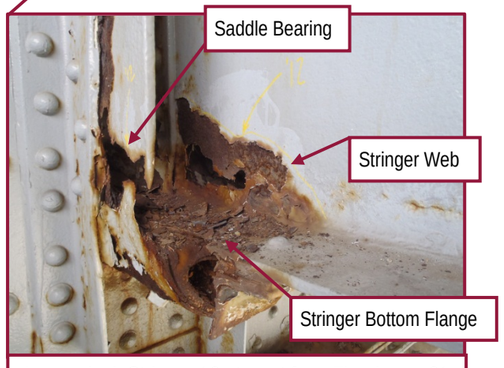




The north cantilever bracket at Floorbeam 24 exhibits advanced section loss of the bottom flange with holed through sections. This condition is locally common at the end floorbeams and isolated throughout the truss where the members are exposed.

West face of Lower Floorbeam 17 adjacent to south hanger connection with advanced section loss and active corrosion. The west bottom flange exhibits an 8" wide by full width area of 100% section loss, and a 4" long by 1" high perforation is present in the web along the bottom flange vertical leg.

Stringer P between Floorbeams 20 and 21 with 100% section loss in web and bottom flange. Isolated stringers exhibit heavy section losses throughout the span, typically localized to the areas adjacent to the truss lines and hanger connections.



Lower deck Stringer 10 at west face Floorbeam 21 saddle bearing. Note 100% section loss on the stringer web and bottom flange, as well as the saddle bearing.

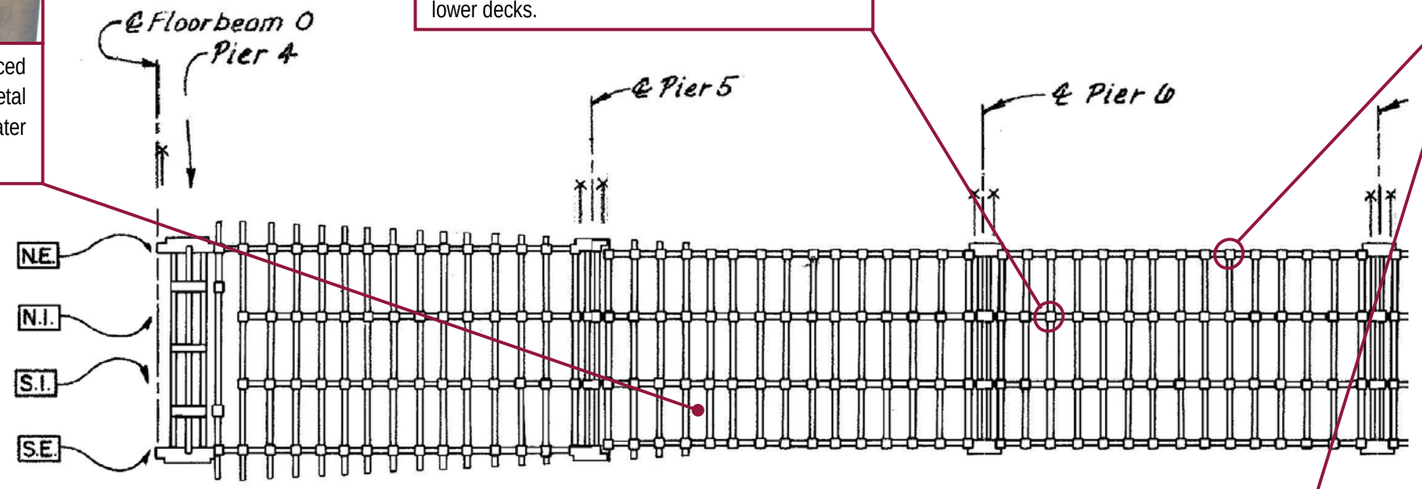
South Truss L23-L24 with pitting on interior web plates up to 3/8" along the internal diaphragm at L24. Heavy section losses are typical on lower chord members below the lower deck level.

Main Span
Half South Elevation (East)

Utility junction box in Span 6 with advanced corrosion throughout and failed corrugated metal outer containment. Deterioration is due to water infiltration through access manhole above.

Spall with exposed reinforcement in the west face of Column 3B in Span 7 between the upper and lower decks.

In Spans 5-7, concrete jack arches typically exhibit transverse hairline vertical cracks along the bottom face, extending up both webs at the crown. Cracks in isolated locations have been repaired with epoxy injections.



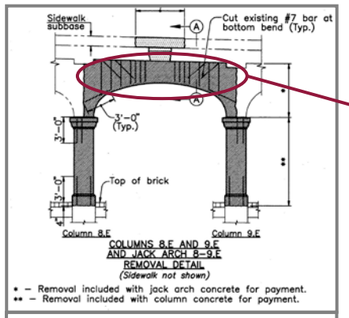
Span 7 Column 10 corbel outside northernmost concrete arch with front face spall and exposed reinforcing.

Arch A at the east end of Span 5 exhibits a longitudinal crack approximately 1/4" wide by 40' long on the arch rib underside. This represents the most advanced cracking in the concrete approach spans.

West Approach Plan

Spans 5-7

Arch A Column 5 in Span 7 exhibits a spall with exposed reinforcing 39" high x 25" wide x 3" deep below the lower concrete corbel.



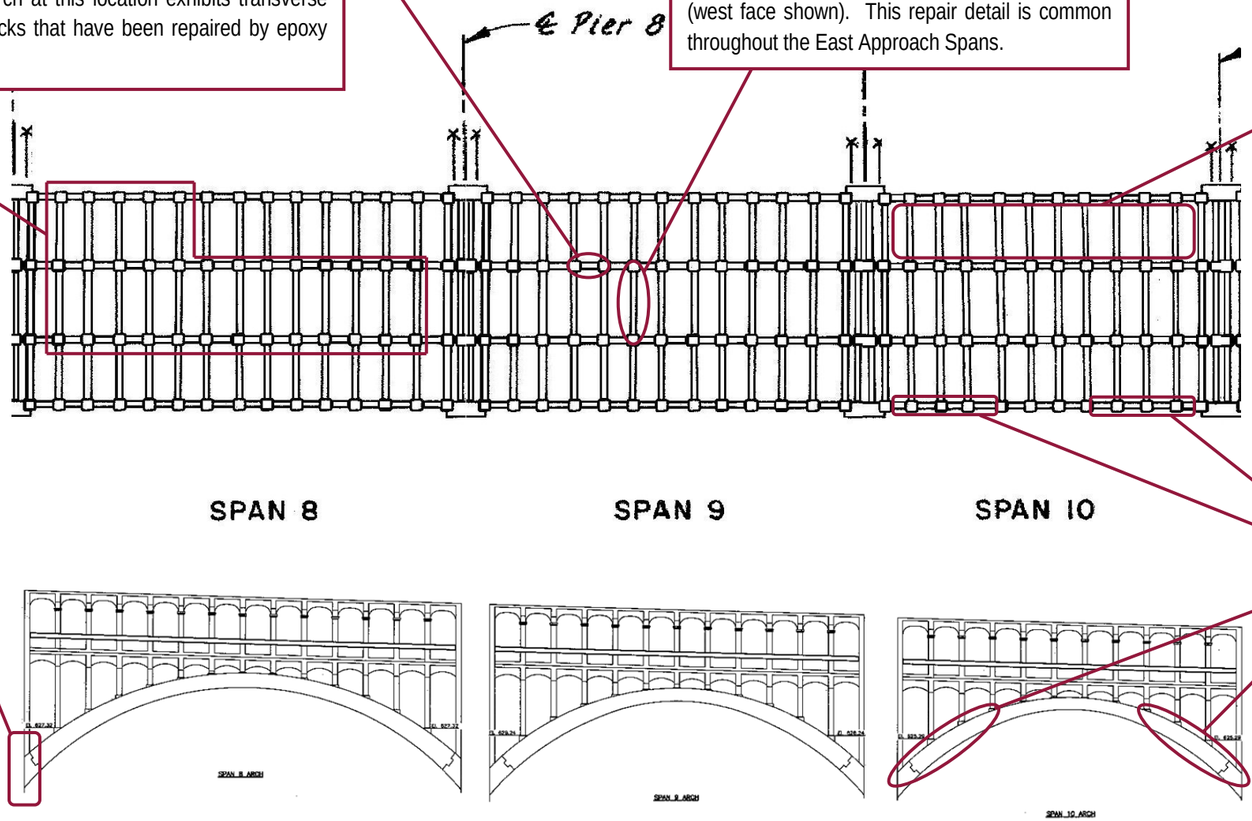
Typical jack arch removal/repair detail per the 1994 rehabilitation plans.

Typical replaced concrete jack arch in Span 9 (Line B between Floorbeams 4 and 5 shown). The jack arch at this location exhibits transverse vertical cracks that have been repaired by epoxy injection.

Span 9 Floorbeam 6 with vertical cracks repaired by epoxy injection between Column Lines B and C (west face shown). This repair detail is common throughout the East Approach Spans.

Lower floorbeam 10 in Span 10 exhibits intermittent spalling across the west face between Arches A and B, corresponding to locations of reinforcement. This condition is typical for the north bay in Span 10.

Floorbeams in Span 8 exhibit transverse hairline cracking along the bottom face of the beam. Between Lines A and B, the cracking is on the bottom face of the beam at Floorbeams 2-6. Between Lines B and C, the cracks exhibit light efflorescence and typically extend the full height of the web on both faces from Floorbeams 2-14.



Pier 7 lateral strut between Arches B and C with map cracking throughout. Minor to moderate map cracking is typical at the thrust blocks at each tower base and throughout these adjacent lower struts.

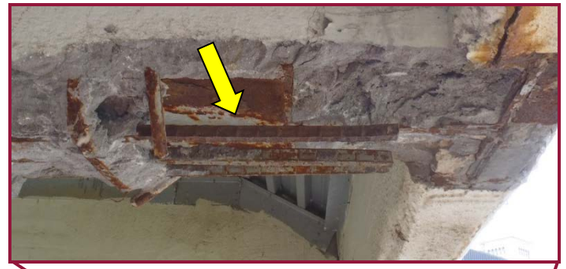
Arch A in Span 10 exhibits widespread map cracking throughout the bottom face of the arch rib, especially in the end 30' to 40' adjacent to the piers (west end at Pier 9 shown, east end similar).

West Approach Plan
Spans 8-10

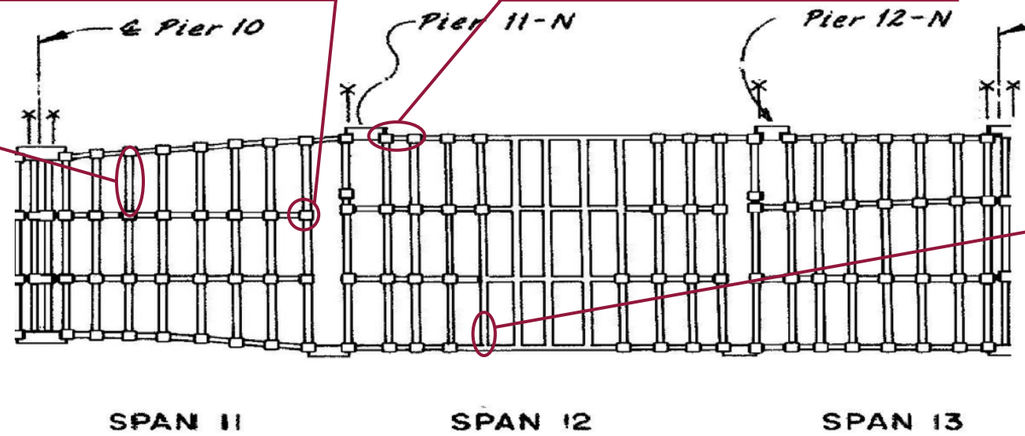
Floorbeam 3 in the north bay of Span 12 exhibits isolated web spalling at vertical reinforcement locations along the east face.

Jack arch to floorbeam connection misaligned horizontally with approximately 4" offset to the east with respect to column B8 below in Span 11.

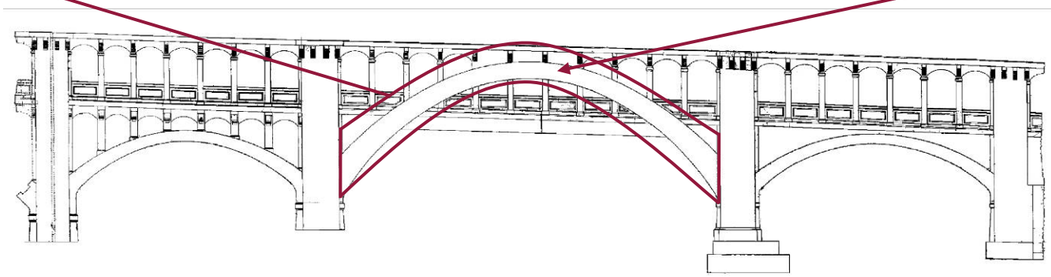
The jack arch between Columns A1 and A2 in Span 12 exhibits a large spalled/delaminated area on the north face, approximately 7 feet wide and up to 2" deep.



Isolated hangers and floorbeam members in Span 12 consist of concrete-encased steel beams. The underside of Floorbeam 4 is spalled at the connection to the south fascia, exposing a portion of the embedded steel beam and surrounding reinforcing.



General view of Span 12 overall (north elevation shown). This span is unique in that the lower deck is supported by concrete hangers, making this span a through-arch system.



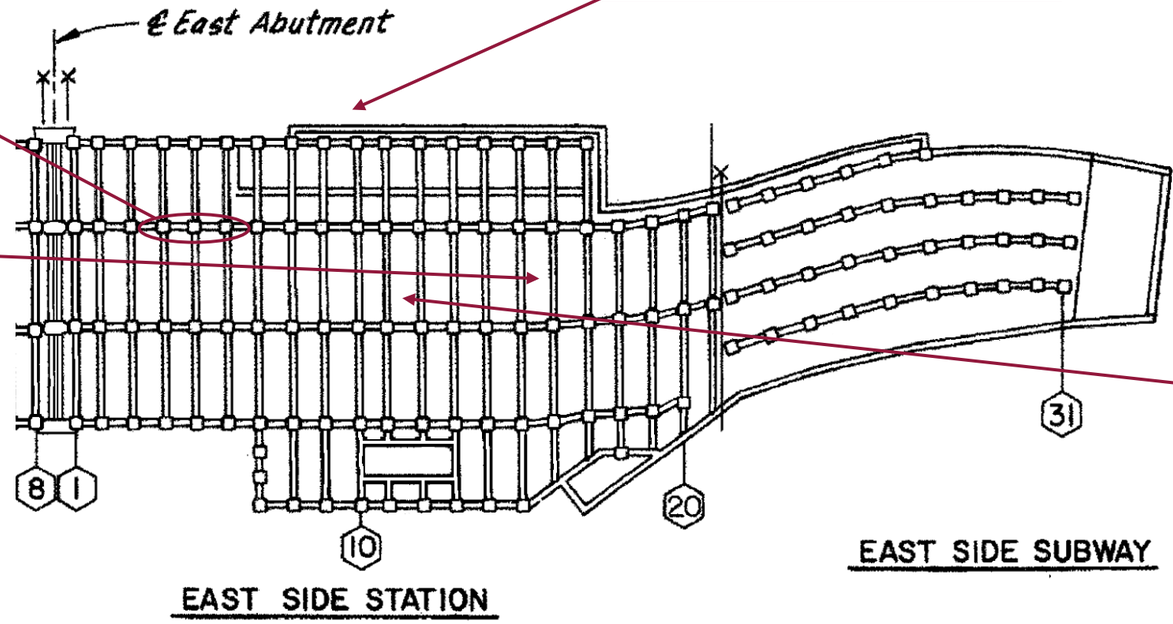
Isolated cracking is common on the concrete arch ribs and hangers in Span 12. The arch ribs typically exhibit moderate map cracking on the undersides as they pass though the lower deck, while large vertical cracks and delaminations are common on the concrete hangers.

West Approach Plan
Spans 11-13

The concrete columns in the East Side Station typically do not exhibit significant deficiencies.

General view in tunnel section within the north wall of the East Side Station.

The eastern half of the East Side Station, as well as the East Approach Tunnel, could not be accessed due to the presence of standing water during the time of inspection. Elements inspected visually typically exhibited only minor deficiencies.



East approach cellular construction with standing water on the lower deck level, looking east. This standing water covers the entire width of the deck, beginning midway through the East Side Station and increasing to a maximum depth of roughly 3' at the east end.

General view looking west through center bay of West Side Station. Note utility conduits mounted to structural elements within the area.

East Side Station and Tunnel Plan

Appendix C
BR-86 Form

OHIO DEPARTMENT OF TRANSPORTATION

BRIDGE INSPECTION REPORT

1 8 0 0 9 3 0	CUY	00006	1456	YEAR BUILT 1917
STRUCTURE FILE NUMBER	CO	ROUTE	UNIT	

DIST 12 BRIDGE TYPE 354 TYPE OF SERVICE 58 Cuy. River, RTA rail, other

DECK					
1. Floor	2		2. Wearing Surface		1
3. Curbs, Sidewalks & Walkways	1		4. Median		
5. Railing	1		6. Drainage		2
7. Expansion Joints	2		8. SUMMARY		6
SUPERSTRUCTURE					
9. Alignment of Members	1		10. Beams/Girders/Slab		2
11. Diaphragms or Cross frames			12. Joists/Stringers		3
13. Floorbeams	3		14. Floorbeam Connections		2
15. Verticals	2		16. Diagonals		2
17. End posts	1		18. Upper Chord		1
19. Lower Chord	2		20. Gusset Plates		3
21. Lateral Bracing	2		22. Sway Bracing		1
23. Portals	2		24. Bearing Devices		2
25. Arch	2		26. Arch Columns or Hangers		3
27. Spandrel Walls			28. Protective Coating System (PCS)		6
29. Pins/Hangers/Hinges	2		30. Fatigue Prone Detail (E & E')		2
31. Live Load Response *(E or S)*	S		32. SUMMARY		4
SUBSTRUCTURE					
33. Abutments	2		34. Abutment Seats		
35. Piers	3		36. Pier Seats		2
37. Backwalls			38. Wingwalls		2
39. Fenders and Dolphins	3		40. Scour *(Insp Type – 1, 2, 3)*	1	2
41. Slope Protection			42. SUMMARY		4
CULVERT					
43. General			44. Alignment		
45. Shape			46. Seams		
47. Headwall or Endwalls			48. Scour *(Insp Type - 1,2,3)*		
49. Abutments			50. SUMMARY		
CHANNEL					
51. Alignment	1		52. Protection		2
53. Hydraulic Opening	1		54. SUMMARY		6
APPROACHES					
55. Pavement	2		56. Approach Slabs		
57. Guardrail	2		58. Relief Joint		
59. Embankment	2		60. SUMMARY		6
GENERAL					
61. Navigation Lights	1		62. Warning Signs		2
63. Sign Supports	1		64. Utilities		3
65. Vertical Clearance *(1, 2-change, N)*	1		66. General Appraisal & Operational Status	4	A

67. Inspected By, First & Last Name

68. Reviewed By, First & Last Name

Donald W. Cartwright		Wesley R. Weir, P.E.	P.E.# 69991
	PE Number		PE Number
Date 10/11/1012	1 N 1 0 0 0 1 N		Date 12/19/2012

69. Survey (1, 0, N)

OHIO DEPARTMENT OF TRANSPORTATION

BRIDGE INSPECTION REPORT

1	8	0	0	9	3	0	CUY	00006	1456	YEAR BUILT 1917
STRUCTURE FILE NUMBER							CO	ROUTE	UNIT	

DIST 12 BRIDGE TYPE 354 TYPE OF SERVICE 58 Cuy. River, RTA rail, other

Deck

1. Isolated heavy spalls w/ exp. rebar w/ mod. section loss, floor cracking with efflo throughout the west approach and tunnels.
2. Isolated deck spalls noted, up to 20 square feet, typically with asphaltic patches.
3. Isolated minor damage to isolated sections of pedestrian fencing, minor cracking in sidewalks, isolated small spalls.
6. Partially clogged curb drains, joints typically filled with debris, missing grating in north longitudinal sidewalk trough. Ponded water was noted along the north sidewalk in Span 4.
7. Heavy debris in glands, isolated minor plow damage was noted due to vertical misalignment of adjacent joint armor. Shallow spalling of joint headers noted throughout the bridge.

Superstructure

10. Localized areas of heavy spalls and delaminated concrete in the west approach/tunnel sections, minor section loss to reinforcement typical. Minimal change since the 2011 inspection.
12. Upper and lower deck stringers in Span 4 with localized advanced section loss. Stringer P in Bay 21 with advanced web losses (up to 100%) adjacent to FB 20 in the lower 4" of the web.
13. Localized holed through sections of floorbeam webs, particularly along the arch lines and near lateral bracing connections. The circular weld retrofit at upper deck FB 22 was previously cracked, but noted to have propagated a total of ~3/8" since last marked (2010). This crack remains confined to the weld material. The exterior floorbeam corbels in the concrete approach spans exhibit large spalls and exposed reinforcing with isolated locations with the entire front face spalled off.
14. Lower floorbeams with heavy losses adjacent to hanger connections. Previously cleaned and painted but now rusting with localized significant additional losses.
15. Locations below the upper deck level (PPs 0-4 and 20-24) with active corrosion at vertical member connections.
16. Locations below the upper deck level (PPs 0-4 and 20-24) with active corrosion at diagonal member connections.
19. Localized moderate to advanced section loss, typically at gusset plate to lower chord interface, panels 0-4 and 20-24, typical.
20. Localized advanced section loss to gusset plates at lower chord interface, panels 0-4 and 20-24, typical.
21. Isolated lateral bracing members with localized advanced section loss and holed through areas near the connection locations.
23. Localized areas with 100% loss of portal batten plates and lacing members.
24. Moderate rusting primarily on the interior of the truss bolsters, multiple saddle bearings with 100% loss.
25. Minor cracking, spalling and/or delaminated areas typical for all arches. Isolated arches exhibit large delaminated areas and/or moderate longitudinal or map cracking.
26. Columns in the west approach and tunnel sections with heavy spalling and exposed reinforcement with moderate corrosion. Isolated columns exhibit loss of concrete behind outermost reinforcement.
28. Paint failures typical at truss connections below the upper deck. Estimated between 10%-15%
29. Moderate pitting at eyebar heads at the lower connections at isolated panel points. Not significantly changed since 2011.
30. No fatigue distress was noted at the eyebar heads.

Substructure

33. Abutment concrete with minor cracking.
35. South Tower B settlement has continued. On 9/21/12, the crack gauge at the lower deck showed approximately 10mm of movement since the previous inspection (9/17/11).
36. Minor cracking was noted at the truss bearing seats with no significant change since the previous inspection.
38. Soft concrete at southwest wing. Cracking & spalls at curtain walls typical with no significant change since previous inspection.
39. No functional collision protection is present for Pier 3.
40. Scour hole at Pier 4 has slightly increased in size since last inspection.

Channel

52. West embankment lacks any type of bank protection.

Approaches

55. Minor shoving and cracking throughout both asphalt approaches.
57. Eastbound impact attenuator damaged from vehicle impact.
59. Minor erosion channel at the northeast wing has not significantly changed since the previous inspection.

General

62. Warning signs present only at the northeast and southwest corners of the truss.
64. Utility junction box in Span 6 exhibits advanced corrosion throughout all components with failed corrugated metal outer containment. Condition is a result of water infiltration through access manhole above junction box.