

**PHYSICAL CONDITION REPORT  
FOR THE 2011 ROUTINE INSPECTION**

**VETERAN'S MEMORIAL (DETROIT-SUPERIOR) BRIDGE**

**BR#: CUY-6-1456**

**SFN: 1800930**

**OHIO DEPARTMENT OF TRANSPORTATION**

**DISTRICT 12**

**PID #87601**



**Inspected: September 19 through September 23, 2011**  
**Report: January 20, 2012**



**Routine  
PHYSICAL CONDITION REPORT  
of**

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

**CUYAHOGA COUNTY, OHIO**

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Inspected on:

September 19, 2011 through September 23, 2011

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**OHIO DEPARTMENT OF TRANSPORTATION  
DISTRICT 12**

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## 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.

The Detroit-Superior Bridge has received several rehabilitations and modifications from original design during its service life, including major work in 1965 and 1994. 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 Figure 1 and Cross Section 1)
- Section III – East Approach (Reinforced Concrete Spans) (See Figure 2)

### Section I – West Approach (West Tunnels, West Approach Spans, and Spans 1A -3)

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 25<sup>th</sup> Street utilize similar column/jack arch construction. The cellular construction spans are located in Spans 1A and 1B and consist of reinforced concrete walls supporting the upper deck columns above (see Appendix A for cellular notation).



Location Map

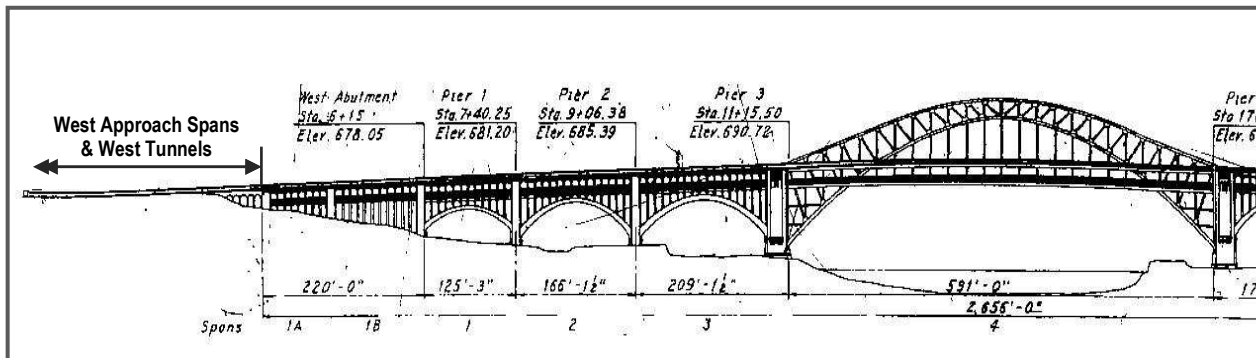


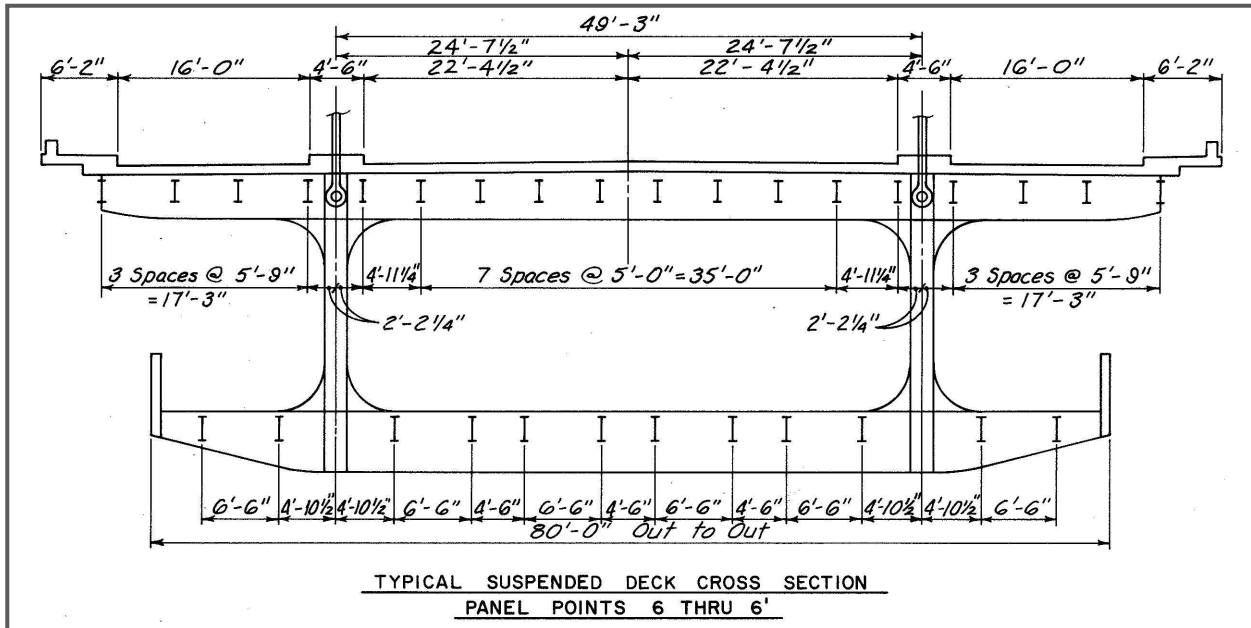
Figure 1 – Partial south elevation of CUY-6-1456 (Span 1A – Span 4 shown).

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 hangers (eyebars) from panel points 4 to 4' where the decks are below the arch. Members from Panels 0 to 3 and 3' to 0' 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 a 9" slab.

Section III – East Approach (Spans 5-13)

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



Cross Section 1 – Typical main span deck cross section.

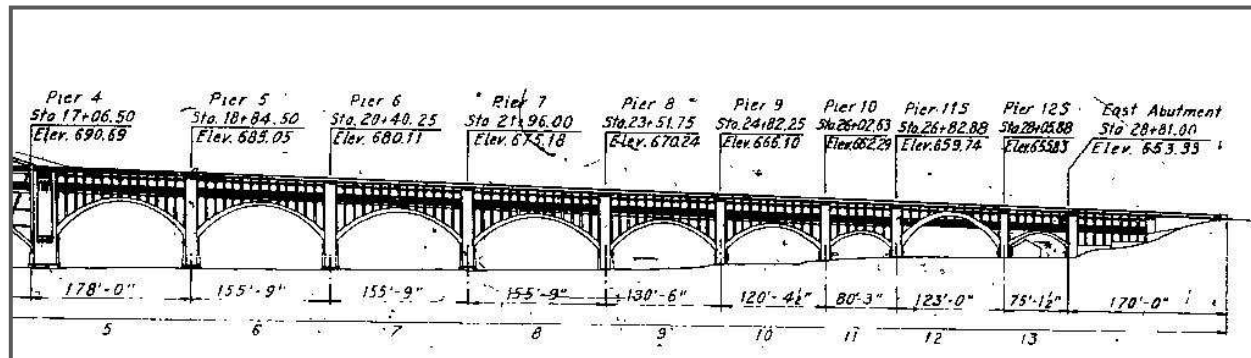


Figure 2 – Partial south elevation of CUY-6-1456 (Span 5 – East Abutment shown).

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## INSPECTION PROCEDURE

A routine inspection of the structure was performed between September 19, 2011 and September 23, 2011. 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 access required for this type of inspection, modified technical climbing was utilized.

## INSPECTION TEAM

The inspection team members are as follows:

- Brian Corson-Marquess, PE – TranSystems
- Carolyn Guion, PE – TranSystems
- Nicholas Fisco, EI – TranSystems
- Donald Cartwright, EI – TranSystems
- Kevin Williams, NICET II – TranSystems
- Kimberly Hastings – TranSystems
- Brett Russell, PE – Northwest Consultants, Inc.
- Kenneth Jansing, PE – Northwest Consultants, Inc.

**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, 2<sup>nd</sup> 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 areas exhibiting transverse cracking and heavy efflorescence on the deck underside in the West Approach and west tunnel sections. At the deck surface, minor spalls were typically noted at joint headers and isolated locations throughout the deck surface. Expansion joints typically exhibit heavy granular debris buildup. All components are functioning as designed and have not deteriorated significantly since the last inspection.

### ITEM 1 - FLOOR

The bridge floor is in FAIR CONDITION [2] overall due to localized heavy spalling with exposed reinforcement and cracking with heavy efflorescence in the West Approach Spans and west tunnel sections (**see photos 1 and 2**). Full depth repairs were typically seen at each of the joint locations in the west tunnels and West Approach spans. The remaining spans are without major floor deficiencies.

### ITEM 2 - WEARING SURFACE

The wearing surface is in GOOD CONDITION [1] with isolated areas of spalls and moderate wear throughout the length of the structure. This condition has not changed since the last inspection.

Isolated spalls up to 4' in diameter were noted throughout the deck, most of which have received asphaltic patching (**see photo 3**). Small, shallow spalls are typical adjacent to the joint extrusions. The most severe deck spalling is occurring in the right eastbound lane in Span 4 due to elevated truck traffic.

### ITEM 3 – CURBS, SIDEWALKS & WALKWAYS

The curbs, sidewalks and walkways are in GOOD CONDITION [1] overall with isolated minor cracking in the sidewalks and minor rusting of the curb plates.



Photo 1 – Deck spall near the junction of the West 25th Street tunnel and the West Approach Spans.



Photo 2 – Deck spall with exposed reinforcement and crack with heavy efflorescence in the West Approach.

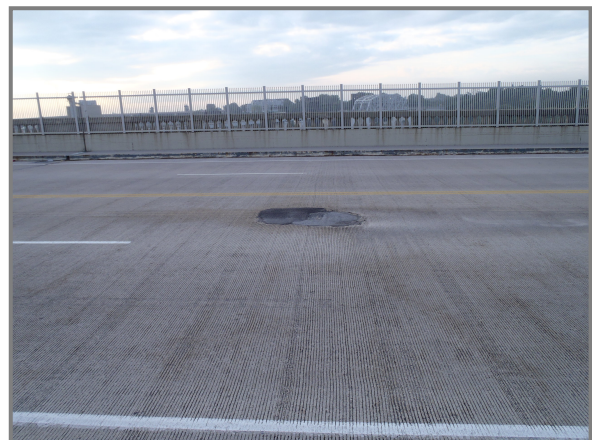


Photo 3 – Isolated spall with asphaltic patch in the deck surface (westbound lanes shown).



## ITEM 5 - RAILING

The parapets are in GOOD CONDITION [1] overall with minor hairline vertical cracking noted at isolated locations. The pedestrian protection fences exhibit isolated locations with minor to moderate impact damage; however, no damages appear to compromise the fence's integrity. The guardrails dividing the eastbound lanes and protecting the south arch exhibit minor impact damage.

## ITEM 6 - DRAINAGE

The drainage is in FAIR CONDITION [2] with typical partially clogged curb drains and vegetation growth (see photo 4). The joint membranes are typically filled with granular debris of sufficient quantity to adversely impact drainage flow.

Isolated drainage panels are missing or broken in the longitudinal north sidewalk trench drain, with isolated locations becoming clogged with vegetation (see photo 5). It was noted during a rain event that flow in the longitudinal trench drain was greatly reduced and overflowed in several locations due to the heavy debris.



Photo 4 – Typical curb drain and heavy granular debris in the joint membrane at the curb.

## ITEM 7 - EXPANSION JOINTS

The expansion joints are in FAIR CONDITION [2] overall, with typical heavy debris in the glands (see photo 6) and minor gouging of the joint armor. Joint alignment was typically satisfactory with minor vertical misalignment noted at some locations, contributing to the armor gouging.



Photo 5 – Missing grate at longitudinal north sidewalk trench drain and vegetation becoming established.



Photo 6 – Typical joint membrane with heavy granular debris.

## 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 gusset plates, deficiencies at various steel bearing elements, and widespread moderate to advanced concrete deterioration throughout the West Approach 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 at isolated locations within the West Approach spans and west tunnel sections (**see photo 7**). Areas adjacent to expansion joints typically exhibit the most severe concrete deterioration; however, the joints and the adjacent 5' of slab were typically replaced during the last major rehabilitation. Isolated beam repairs were found in conjunction with these joint and slab repairs.

The jack arches throughout the remainder of the structure are typically in good condition with isolated vertical hairline cracks and small areas with spalls. Much of the concrete in Spans 1A thru 3 and Spans 5 thru 13 was repaired during the last major rehabilitation.

### ITEM 12 – JOISTS/STRINGERS

The stringers are in FAIR CONDITION [2] overall with isolated heavy pitting of stringer ends, typically occurring below expansion joints. Isolated, abandoned lower deck stringer bottom flanges at saddle bearings exhibit the heaviest losses, with 100% loss of the flange noted at some locations (**see photo 8**). The bottom flanges within the saddles typically exhibit active rusting. At the same bearing areas, isolated stringers exhibit up to 1/4" deep pitting on the top flange and are typically cleaned and painted with no active rusting.

The upper deck stringers exhibit minor losses to the exterior stringers in isolated locations, but are typically cleaned and painted and free of major deficiencies (**see photo 9**).



Photo 7 – Jack arch spalling in the West Approach. Jack arch 12-13 in Line C shown.

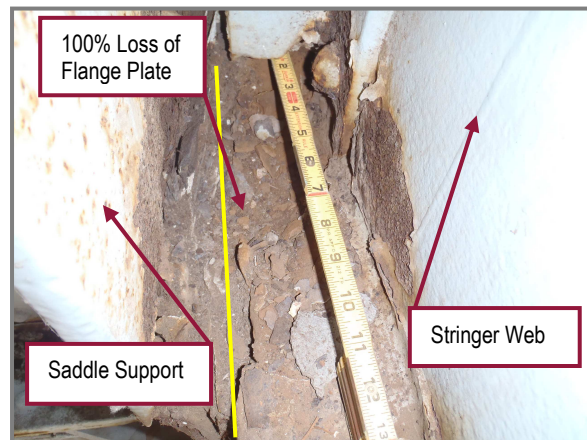


Photo 8 – Lower deck, Stringer 3 at the saddle bearing, east face of Floorbeam 3, 100% loss of bottom flange.



Photo 9 – Upper deck typical stringer condition, Bay 1-2 shown.



Photo 10 – Isolated spall with exposed reinforcement on the bottom face of upper Floorbeam 6 in Span 13. Note the retrofitted bottom flange.



Photo 11 – Floorbeam 9 in Span 6, Bay B-C with epoxy injection repairs at transverse floorbeam cracking.

### ITEM 13 – FLOORBEAMS

The floorbeams are in FAIR CONDITION [2] overall with isolated locations with heavy active pitting and section losses. Holed through flange and web sections are locally common near the vertical post connections, particularly at the lower deck floorbeams. Isolated moderate spalling with exposed reinforcement was noted throughout both approaches. Transverse hairline cracking was noted throughout the floorbeams.

#### 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. Isolated minor to moderate spalls with exposed reinforcement are commonly found in areas that were not repaired during the last major rehabilitation (**see photo 10**).

Transverse hairline cracking was commonly noted across the bottom face of concrete upper deck floorbeams. In the East Approach, epoxy injection repairs were noted in many locations (**see photo 11**). Isolated floorbeams exhibit a bottom flange widening retrofit. These retrofits typically exhibit hairline map cracking with minor efflorescence (**see photo 10**). Lower deck floorbeams exhibit isolated spalling with exposed reinforcement and isolated hairline cracking.

#### Span 4 (Steel):

The steel floorbeams in Span 4 exhibit localized heavy pitting and advanced section losses with active corrosion, particularly at the lower floorbeam cantilevers and areas at and adjacent to the built-up hanger connections. These areas are exposed and prone to collecting rainwater due to the complex built up configurations at the member connections. Additionally, a history of leaking joints has resulted in floorbeams below the joints with accelerated corrosion conditions.



Photo 12 – West face, Floorbeam 0 north cantilever with heavy losses to both west flanges.



Photo 13 – Holed through Floorbeam 7' web (6" long x 1" tall) between south hanger and Stringer 10.

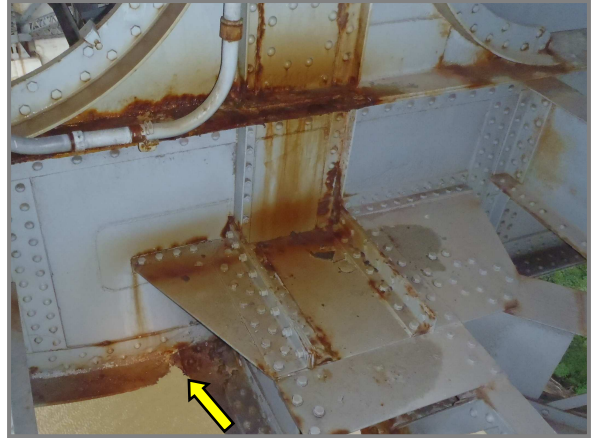


Photo 14 – Typical path of water running down built up hanger onto lower deck framing components. Note bottom flange losses and welded web retrofit plates on floorbeam. Floorbeam 8 at the south vertical post connection.

The lower deck floorbeams exhibit locations with small areas of 100% section loss on the webs and flanges in the cantilevered beam ends (see photo 12). Isolated floorbeam web perforations were noted to the interior of the built-up hanger connections where water runs down the hanger and collects at the web to bottom flange angle interface (see photo 13). Heavy active pitting up to 1/4" deep was noted on the top flanges between the built-up hanger knee braces.

Bottom flange angle outstanding legs were commonly noted to be either flame cut or corroded through below the lower longitudinal strut connections (see photo 14). These areas had been previously cleaned and painted but now exhibit paint failures and active rusting. The lower deck floorbeams have several retrofit plates welded to the web below and adjacent to the built-up hanger connections (see photo 15). There were no indications of distress to the retrofit welds at the time of the inspection.

Multiple circular, welded web retrofits are present at upper deck Floorbeams 1' and 2' near the truss connections. These welds had previously cracked and the condition has not changed since the last inspection cycle.

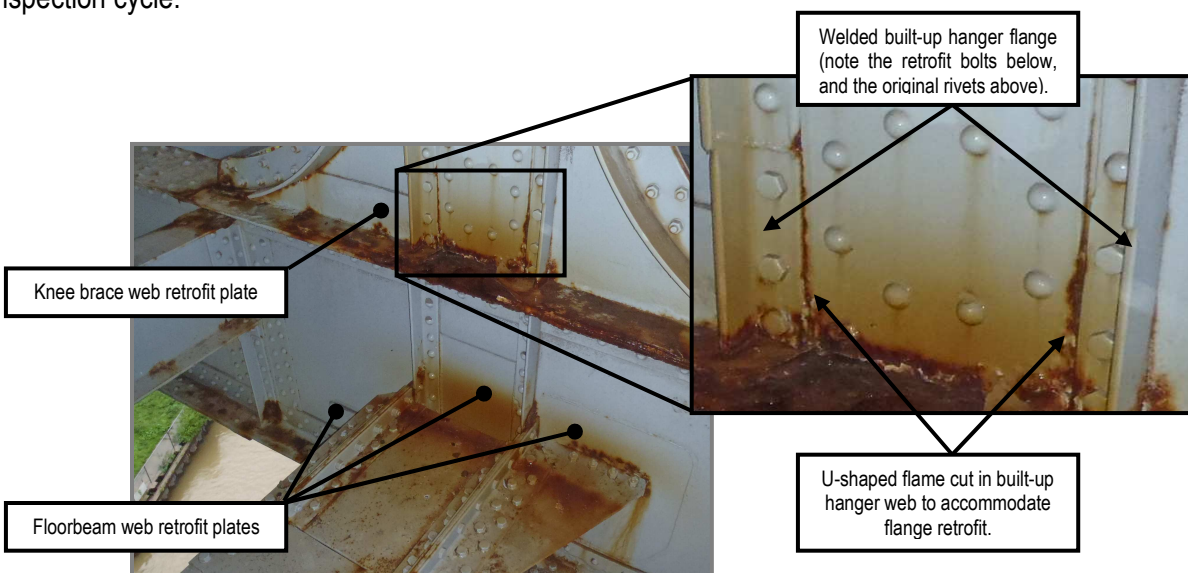


Photo 15 – Typical lower floorbeam retrofits.

## ITEM 14 – FLOORBEAM CONNECTIONS

The floorbeam connections are in FAIR CONDITION [2], with reactivating rust typical at the lower floorbeam connections. The areas adjacent to the hanger connections typically exhibit previous section losses that had been cleaned and painted; however, rust had reactivated, and in isolated locations exhibits significant new loss. The upper steel floorbeams typically exhibit reactivating corrosion in the same locations; but is generally less severe. Additionally, isolated locations exhibit impacted rust between the built up members.

## TRUSS INSPECTION FINDINGS

The truss members are in POOR CONDITION [4-NBIS] with areas of moderate to advanced section loss and active corrosion, typically localized to the lower gusset plates and lacing members. The truss bearing and isolated stringer saddle bearings were noted with significant section loss.

### ITEM 15 – VERTICAL TRUSS MEMBERS

The vertical members are in FAIR CONDITION [2] overall with isolated members exhibiting up to 1/16" pitting, along the web plates at the lower gusset and floorbeam interfaces (see photo 16). The vertical members exhibiting active corrosion are all at or below the upper deck level within L0-L4 and L4'-L0'. The vertical members above the upper deck exhibit isolated paint failures and light surface rust on the interior of some built-up box members and isolated cleaned and painted losses to lacing members in the traffic spray zone - up to approximately five feet above the roadway (see photo 17).

### ITEM 16 - DIAGONAL TRUSS MEMBERS

The diagonal members are in FAIR CONDITION [2] overall with isolated stay plates and lacing members exhibiting 100% loss, generally on members below the upper deck level (see photo 18). The diagonal members above the upper deck exhibit isolated minor losses that are generally cleaned and painted. Isolated box sections exhibit signs of paint failure and surface rust localized to the lower panel connections.



Photo 16 – Interior face of U4' L4' web with 1/16" deep pitting along the lower floorbeam top flange interface.



Photo 17 – Typical vertical member above the upper deck level with no significant deficiencies. Member U8L8 South shown.

### ITEM 17 – END POSTS

The end posts are in GOOD CONDITION [1] overall with minor cleaned and painted pitting noted and one location of active rust packing up to 1/2" thick between lacing bars and flange angles on member U0'LO' on the South Truss.

### ITEM 18 – UPPER CHORD TRUSS MEMBERS

The upper chord members are in GOOD CONDITION [1] overall with active minor corrosion noted at some aesthetic treatments at the top chord terminations (U0 south and north, U0' south and north). These deficiencies do not impact structural components of the bridge.

### ITEM 19 - LOWER CHORD TRUSS MEMBERS

The lower chord members are in FAIR CONDITION [2] with areas of advanced section loss in the web plates at the internal diaphragm or gusset connections (see photo 19). These heavy losses are restricted to the lower chord members below the upper deck level, typically occurring within L0-L4 and L4'-L0', and corrosion is active or is beginning to reactivate in the crevices. Active rust packing is occurring between the lower chord stay plates and lacing channels and the flange angles to which they attach; however, no signs of significant distress were noted at any location. Additionally, above the upper deck, the lacing channels (both upper and lower) passing over the middle intermediate diaphragm typically exhibit impacted rust measuring up to 3/4" thick, with adjacent losses up to 1/4" deep on both the lacing and the diaphragm flanges (see photo 20).



Photo 18 – Holed through portion of the underside stay plate at the lower panel connection of U1L2.



Photo 19 – Heavy losses on the interior face of the lower chord web plate at L1'LO'.



Photo 20 – Member L8L9 on the North Truss with 3/4" impacted rust between the middle intermediate diaphragm flange and the upper lacing channel.

Throughout the remainder of the lower chord, rust at built-up member interfaces is most common along the horizontal planes; however, no signs of distortion due to pack rust were seen.

**ITEM 20 – GUSSET PLATES**

The gusset plates are in POOR CONDITION [3] with advanced losses to the lower gusset plates along the adjacent chord connections. This condition was noted on the gussets below the lower deck level at several panel points (see photo 21). The gusset plates above the lower deck level are generally in better condition than those below, typically exhibiting intact paint with no active corrosion. The L12 gusset plates on both trusses exhibit a bowed condition, with the worst case seen at the L12 southwest gusset on the North Truss, with approximately 3/8" bow to the south (see photo 22). At the each L12 panel, both the inboard and outboard gussets exhibit similar magnitude and direction of bowing.



Photo 21: – West free edges of the south truss L2 gusset plates with pitting from 1/16" to 3/16" deep along the lower chord interface.

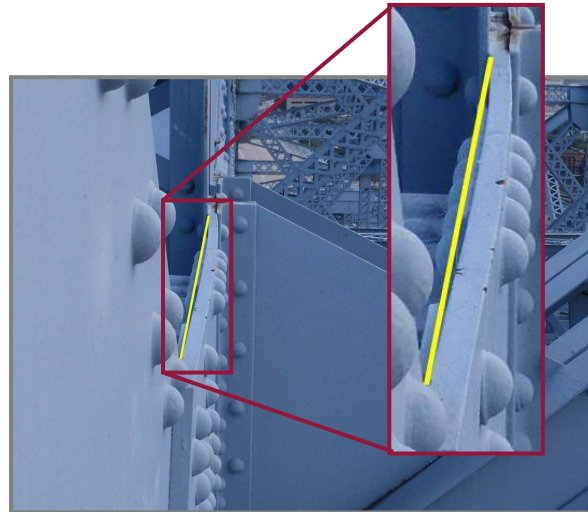


Photo 22 – L12 southwest gusset on the North Truss with approximately 3/8" southerly bow. Note the yellow line indicating original plane of the gusset edge.

**ITEM 21 – LATERAL BRACING**

The lateral bracing is in GOOD CONDITION [1] with only minor paint defects and minor surface rust noted in isolated locations.

**ITEM 22 – SWAY BRACING**

The sway bracing is in GOOD CONDITION [1] with isolated locations below the upper deck exhibiting moderate pitting of the lacing bars (cleaned and painted) and reactivating rust typical at lacing connections. The lower mid-panel gusset at panel point 15 (ML15) has two blank holes at the ML15-U15 South diagonal connection (see photo 23).

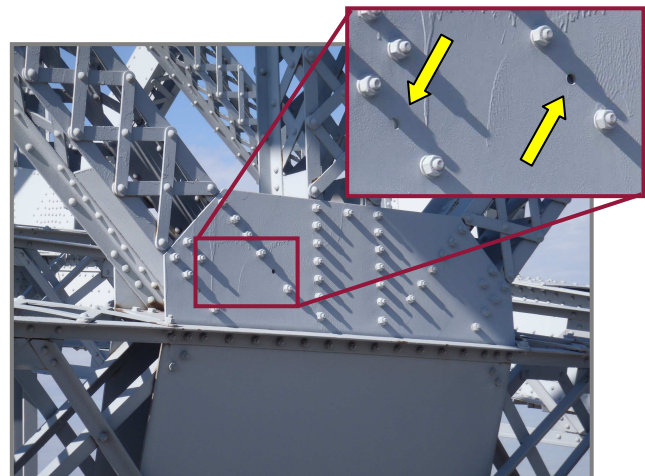


Photo 23: – East face of the lower mid-panel gusset at panel point 15 (ML15) showing two blank bolt holes (retrofit) for the ML15-U15 South diagonal connection.



Photo 24 – Southwest truss bolster with significant section loss to the bearing stiffeners and rust reactivation.

### ITEM 23 – PORTALS

The portals are in FAIR CONDITION [2] due to localized areas of 100% section loss to portal batten plates and lacing members at U2 and U2' adjacent to the south truss.

### ITEM 24 – BEARING DEVICES

The bearings are in FAIR CONDITION [2] overall with moderate to heavy corrosion to the truss bolster components, cracked bearing pin retainer washers, and extensive deterioration of isolated lower deck stringer saddle bearings. The truss bolsters exhibit significant losses to the bearing stiffeners that had been previously cleaned and painted; however, rust has reactivated throughout this location (see photo 24). This condition is similar but losses are generally less severe at the remaining three truss bolsters. Debris has accumulated in the voids between the stiffeners and at the interior voids, accelerating the rate of paint failure and subsequent corrosion.

Additionally, a history of cracking of several bearing pin retaining washers at the truss bolster bearings has been previously reported. These retaining washers were located during the inspection and determined to be approximately the same condition as previously noted with no significant changes.

Isolated lower deck stringer saddle bearings exhibit advanced section losses, including areas with 100% loss of one or both sides of the bearing steel (see photo 25). It should be noted that the bearings seen with this condition are no longer primary load bearing stringers as they are only found at the abandoned lower deck and, further, are located between the limited use utility (center) deck and the exterior cantilevered walking decks.



Photo 25 – Saddle bearing with 100% section loss.





Photo 26 – Arch D in Span 1, South Elevation showing 1/16" wide cracking in the arch near the tower base. Note the large (~30sqft) delamination between the tower and column 1 (arrow).

## ITEM 25 – ARCHES

The concrete arches in Spans 1 thru 3 and Spans 5 thru 13 are in FAIR CONDITION [2] overall due to spalled or delaminating concrete and map and longitudinal cracking (see photo 26) Isolated locations exhibit longitudinal cracking of the arch faces and the cracking is generally minor in nature. The most advanced cracking occurs in Span 5 on Arch A, where a 1/4" wide crack extends along the arch centerline on the underside for approximately 40' in length (see photo 27).



Photo 27 – Arch A in Span 5 with an approximately 1/4" wide x 40' long longitudinal crack.

## ITEM 26 – ARCH COLUMNS OR HANGERS

The concrete arches columns and hangers are in FAIR CONDITION [2] with jack arch columns in the West Approach spans exhibiting widespread concrete deterioration. Isolated columns exhibit spalls exposing all exterior reinforcement, typically at the column base or near the decorative capitals; however, some columns have lost nearly 100% of the cover concrete (see photo 28).

Isolated columns have been repaired due to previous deterioration, particularly in the West 25<sup>th</sup> Street tunnel and the West Approach spans, where several deteriorated columns have been repaired for the bottom 2'-3' (see photo 29).



Photo 28 – Jack arch line B, Column 16 in the West Approach span with nearly 100% loss of cover.



Photo 29 – Typical column base repaired (left) and unrepaired conditions (right).

## ITEM 28 – PROTECTIVE COATING SYSTEM

The protective coating system is in SATISFACTORY CONDITION [6-NBIS] with isolated paint failures and typical chalking. Areas on the truss exhibiting the most advanced stages of paint failure and corrosion were noted at and below the lower deck. As a result of the failures, localized areas are actively rusting and isolated components exhibit advanced section loss. Above the lower deck level, typical isolated failures with paint chalking were noted throughout. This condition was more pronounced on the truss members exposed above the upper deck.

## ITEM 29 – PINS AND HANGERS

The hangers are in FAIR CONDITION [2] overall due to isolated eyebars exhibiting localized moderate pitting of the eyebar heads at the lower connections (see photo 30). The lower pins and pin collars, where exposed, exhibit active laminate rusting around the circumference between the eyebar and the adjacent pin plates (see photo 31).

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

The fatigue prone connections are in FAIR CONDITION [2] overall with losses occurring at the eyebar heads at the net section, which classifies as a Category E fatigue detail. The previously cleaned and painted areas of loss at the eyebar heads are beginning to reactivate; however, no signs of fatigue related distress was noted.



Photo 30 – East hanger, lower deck Floorbeam 4 of the North Truss with 3/16" - 1/4" deep pitting to the exterior face of the eyebar at the net section. Note the reactivation of rust and the advanced losses to the adjacent web-reinforcing pin plate.

## ITEM 42 – SUBSTRUCTURE SUMMARY

The substructure is in POOR CONDITION [4-NBIS] due to the progressive rotation of South Tower B and the large cracks in the cellular construction areas in Spans 1A and 1B. These elements control the substructure rating.

## ITEM 33 – ABUTMENTS

The abutments are in FAIR CONDITION [2] overall with isolated minor cracks located at each and minor spalls on the face of the East Abutment breastwall.

## ITEM 34 – ABUTMENT SEATS

No abutment seats are located on this structure.

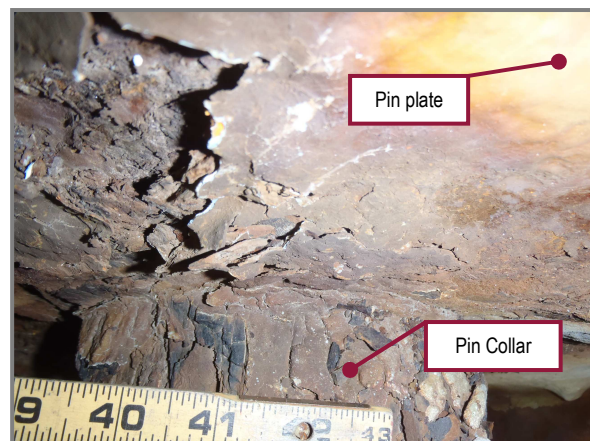


Photo 31 – Heavy laminate rusting at the lower hanger pin collar at the South Truss Floorbeam 4' connection.

**ITEM 35 –PIERS (TOWERS AND CELLULAR CONSTRUCTION)**Piers

The piers are in POOR CONDITION [3] with the South Tower B controlling the rating. This tower is rotating to the south away from the structure (see photo 32). ODOT installed a monitoring gauge at 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 and the gauge showed a reading of 38.5mm on May 9, 2011 (see photo 33). The same monitor read 39.5mm during TranSystems's routine inspection (September 20, 2011) (see photo 34), indicating approximately 1mm of movement over the 4½ month period. The gauge indicates approximately 48.5mm (1.91") of movement has occurred at this location since the installation in 2006, equating to approximately 9.68mm (0.38") movement per year.

The towers throughout the remainder of the structure do not exhibit significant alignment or settlement deficiencies; however, minor to moderate concrete cracking is typical at each tower base (thrust blocks) and the adjacent lower struts. Isolated spalls were noted during the inspection throughout the tower elements, but are generally minor in nature.



Photo 32 – Leaning South Tower B. Note the gap between the upper portion of the tower and the lower deck fascia members.



Photo 33 – May 9, 2011 South Tower B gauge reading.

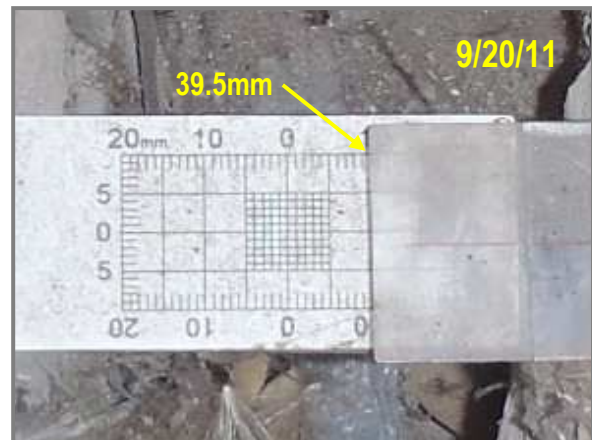


Photo 34 – September 20, 2011 South Tower B gauge reading.

### Cellular Construction

The cellular units (Cells) in Spans 1A and 1B exhibit areas of heavy cracking with indications of differential settlement in several walls and in several 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 east and north 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 5). Of these gauges, only Gauge 2 exhibits noticeable movement since monitor installation. Gauge 2 now reads approximately 2mm of movement (crack opening) (see photo 35).



Photo 35 – Crack Gauge 2 showing approximately 2mm of movement since the installation in 2007.



Photo 36 – Diagonal cracking and heavy efflorescence, north wall of North Cell 1.

The walls and soffit of the cellular construction exhibit other large cracks throughout and areas of heavy seepage and efflorescence (see photo 36). The center chamber (Cell 0C in Span 1B) exhibits cracks up to 1" wide between the slab and both the north and south walls. This location corresponds laterally with the location of South Tower B, indicating potential reflection of the tower's movement into the adjacent cellular units. In addition, a full height spall, with day light visible, was noted in the south west corner of Cell 0S of Span 1B.

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

### ITEM 36 –PIER SEATS

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

### ITEM 38 – WINGWALLS

The wingwalls and curtain walls are in FAIR CONDITION [2] due to concrete 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 concrete at the extreme west end of southwest wingwall was noted to be soft and disintegrating (see photo 37). Several full height vertical cracks are present in the northeast wing with one up to 1/2" wide near the east-most lamp post. The cinder blocks that comprise the curtain walls at the east abutment exhibit isolated cracking and the mortar is deteriorated throughout.



Photo 37 – Heavy deterioration of concrete at the southwest wing.

**ITEM 39 – FENDERS AND DOLPHINS**

The fenders and dolphins are in POOR CONDITION [3] with no protection present at Pier 3 controlling the rating. Abandoned timber piles are exposed upstream and a failed sheet pile wall is present downstream of Pier 3; however, neither feature currently provides collision protection. A concrete cap protects Pier 4 from incoming traffic and appears to be functioning as designed.

**ITEM 40 – SCOUR**

The river channel was visually inspected and scour is in GOOD CONDITION [1], with no significant findings noted.

**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 trussed arch span at a heavy skew. This alignment is engineered and does not exhibit any signs of migrating from the designed path.

**ITEM 52 – PROTECTION**

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

**ITEM 53 – HYDRAULIC OPENING**

The hydraulic opening appears to be sufficient and in GOOD CONDITION [1] with no obstructions.

**ITEM 60 – APPROACHES SUMMARY**

The approaches are in SATISFACTORY CONDITION [6-NBIS] with minor patching, cracking and asphalt shoving occurring at both approaches (see photo 38).

**ITEM 55 – PAVEMENT**

The pavement is in FAIR CONDITION [2] with map cracking and minor shoving noted at both approaches.

**ITEM 57 – GUARDRAIL**

The guardrails are in GOOD CONDITION [1] with no deficiencies noted.



Photo 38 – View looking west from the East Approach

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### **ITEM 59 – EMBANKMENT**

The embankment is in FAIR CONDITION [2] overall with a minor erosion channel forming along the northeast wing wall.

### **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 the increasing crack widths in the cellular units in Span 1A caused by settlement and rotation of South Tower B, as well as locations of advanced section losses in the truss members and gusset plates in Span 4.

### **ITEM 61 – NAVIGATION LIGHTS**

The navigation lights are in GOOD CONDITION [1] with no significant deficiencies noted. The lights were 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 at the truss-deck interface and none at the four corners of the structure.

### **ITEM 63 – SIGN SUPPORTS**

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

### **ITEM 64 – UTILITIES**


No significant utility conditions were noted during this inspection

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## CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of our routine inspection, the Detroit-Superior Bridge CUY-6-1456 is in POOR CONDITION [4-NBIS] overall. Several deficiencies contribute to this rating, including the leaning south Tower B, advanced losses and bowing at isolated lower chord gusset plates, jack arch deterioration in the West Approach spans, and steel bearing deterioration in Span 4. South Tower B continues 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.
- 
- 

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## CUY-6-1456- RECOMMENDATIONS

### Priority Work:

#### General

1. Perform load rating and gusset plate analysis to include all Span 4 section losses.
2. Investigate means to prevent further rotation 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.

### Rehabilitation/Evaluation:

#### Deck

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

#### Superstructure

4. Repair deteriorated concrete columns, jack arches, and floorbeams throughout the structure.
5. Develop rehabilitation or removal plan for the lower deck stringer saddle bearings.
6. Zone paint areas in Span 4 exhibiting rust activation and active section losses.

#### Substructure

7. Provide collision protection for Pier 3 on the west embankment. Perform analysis of the Pier 4 protection to determine adequacy of concrete cap.
8. Develop rehabilitation plan for wingwalls and other retention structures at each end of the bridge that currently exhibit deficient concrete.

#### Channel

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

### Maintenance:

#### General

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

#### Top of Deck

11. Replace missing grating in longitudinal sidewalk trough.

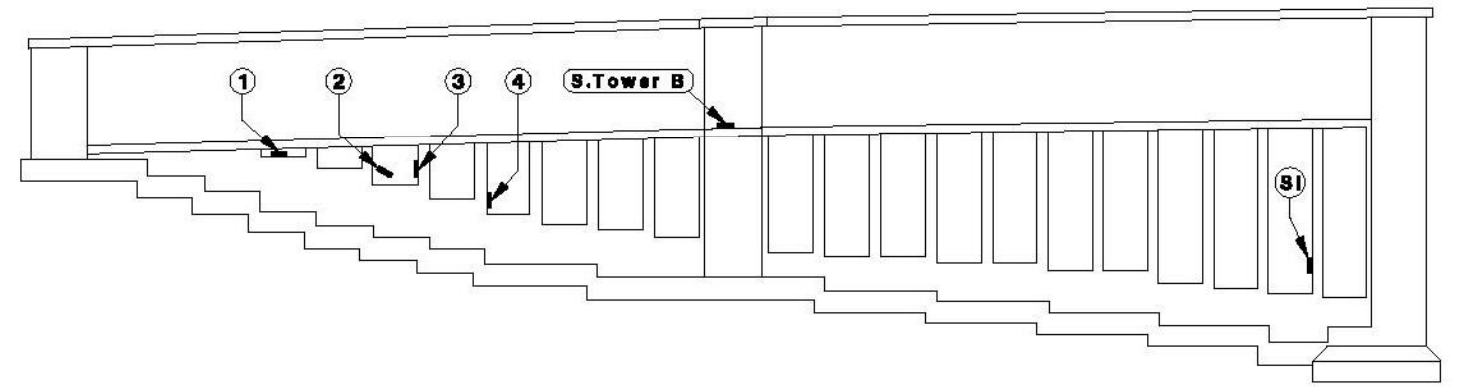
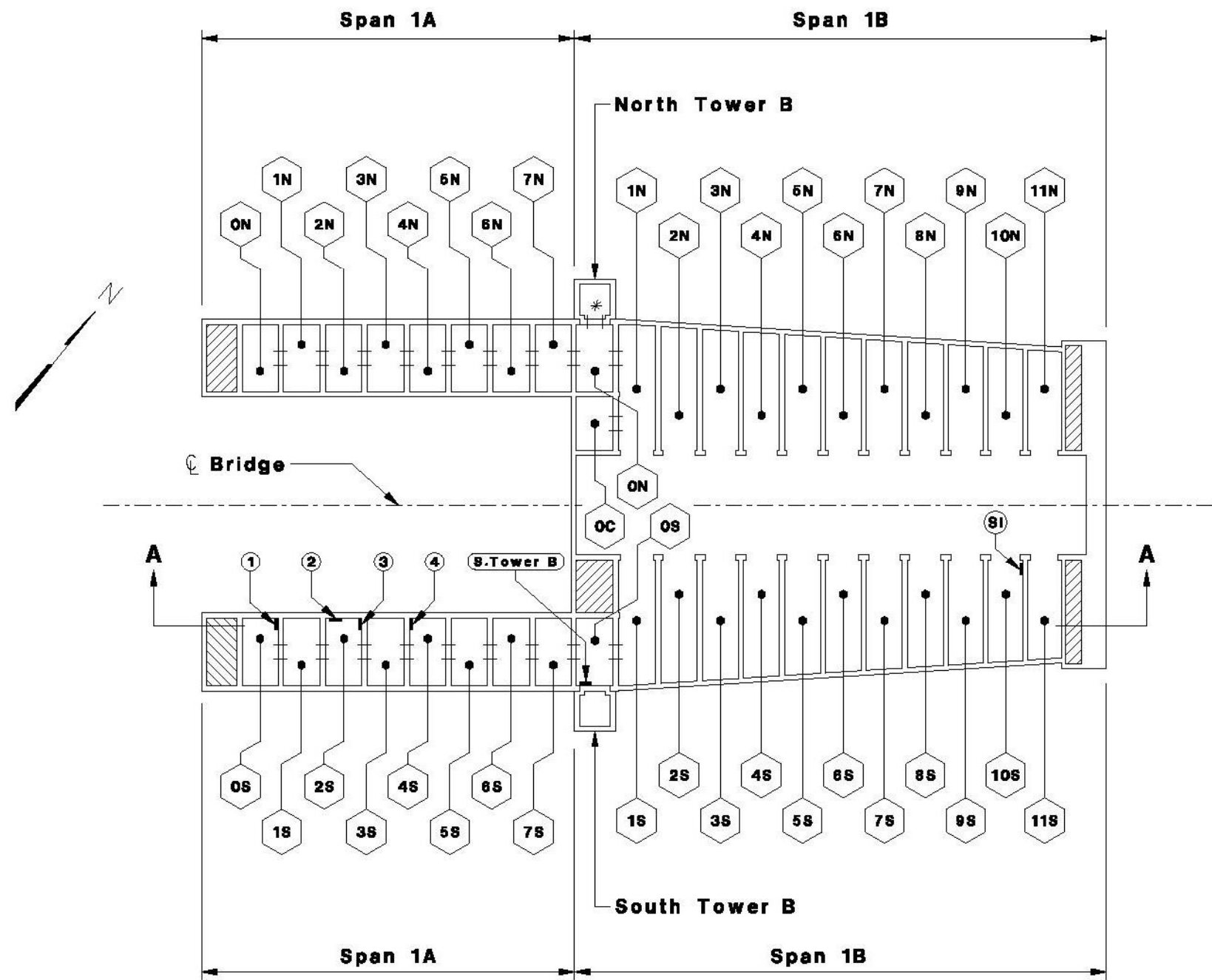
### Monitoring:

#### Superstructure






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



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



**Section A-A**

-  = Enclosed/Inaccessible Area
-  = Wall Opening
-  = Cell/Vault Number
-  = Crack Gauge
-  = Surface Access Location

**Plan**

## **Appendix B**

### Highlighted Structural Deficiency Layout

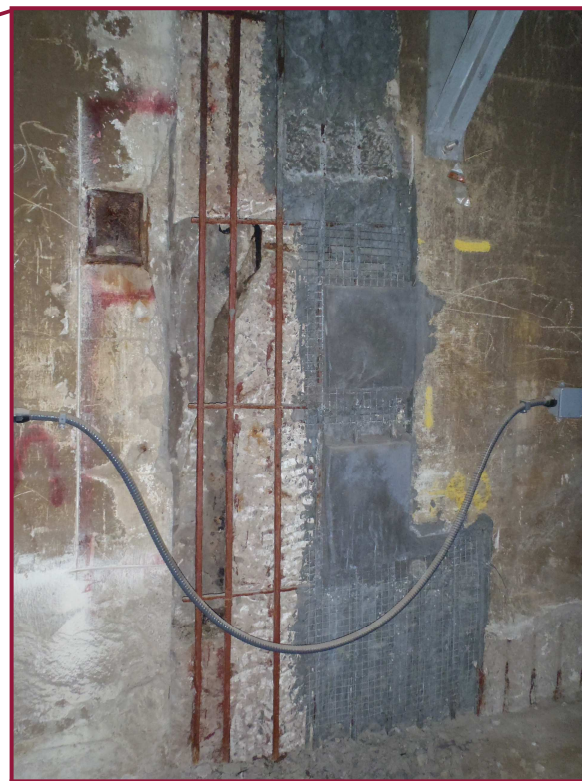


West Side Station Match Line

35



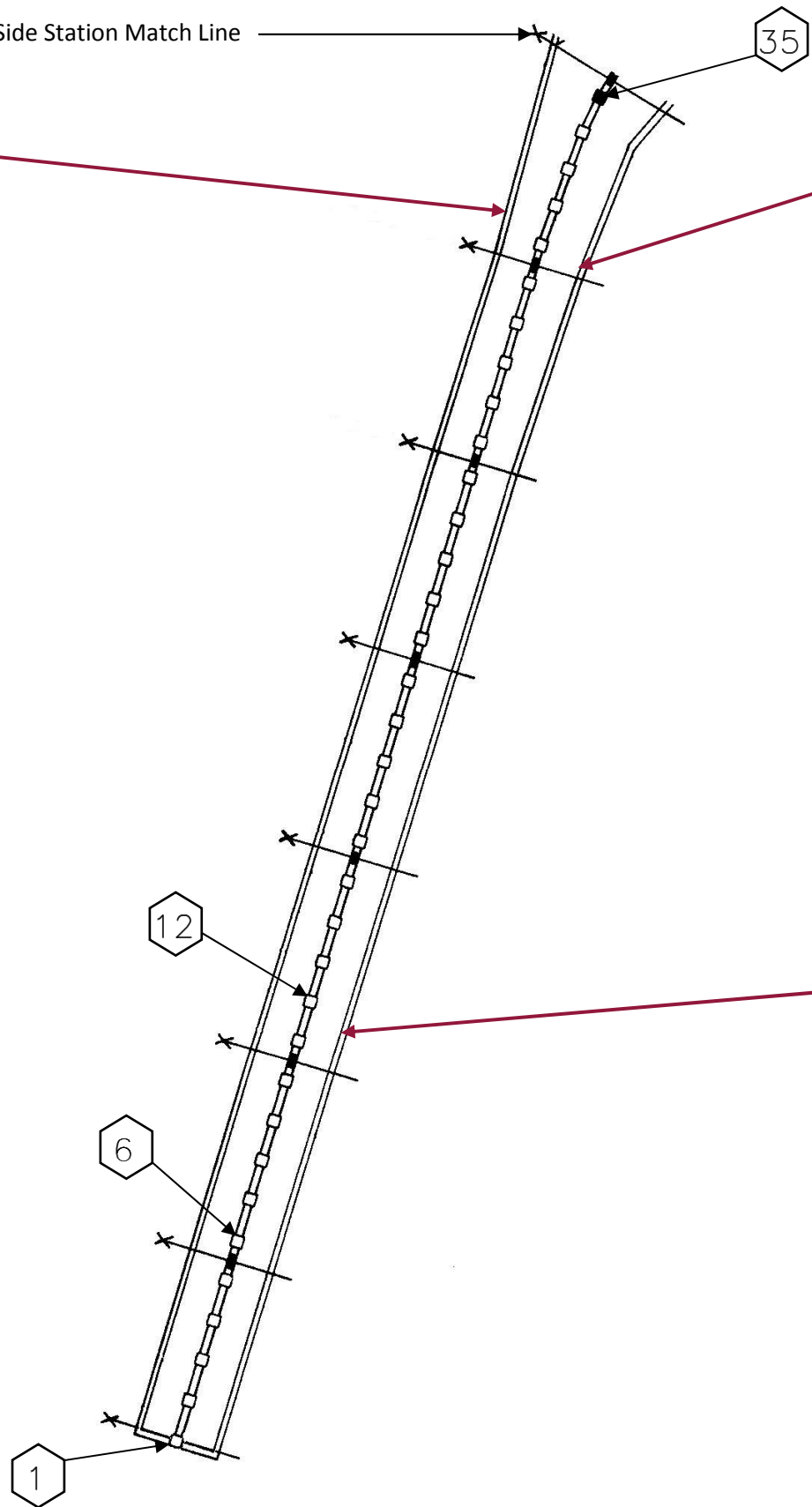
The utility conduit in Bay 31 (transverse to the tunnel) exhibits moderate corrosion of the projecting pipes at both walls (west wall shown). Note that the deck slab is leaking above this location, contributing to the corrosion.



East wall in Bay 30 (joint location) with deteriorated concrete and partial concrete repair.



Columns in the West 25<sup>th</sup> Street tunnel with typical base repair (left; column 6) and base deterioration (right; column 12).



**West 25<sup>th</sup> Street Tunnel Plan**



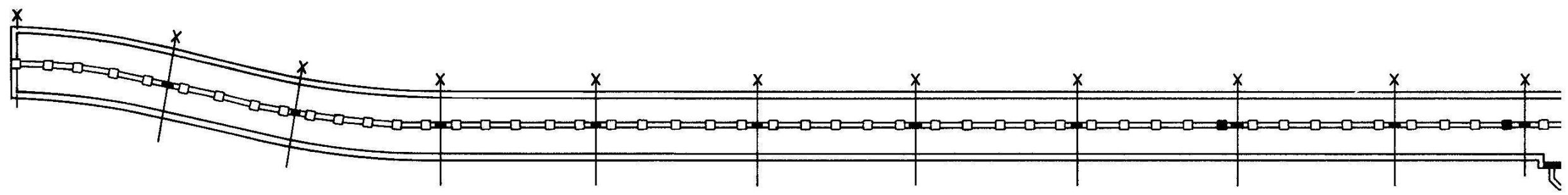
Approximately 8' long section of localized spalling of the bottom 2'-3' of the east wall in Bay 11. Exposed reinforcement exhibits negligible loss.

**LEGEND**

# Column #



The Detroit Avenue tunnel west of the West 25<sup>th</sup> Street Station was inaccessible during the 2011 Routine Inspection due to entrance barricades.



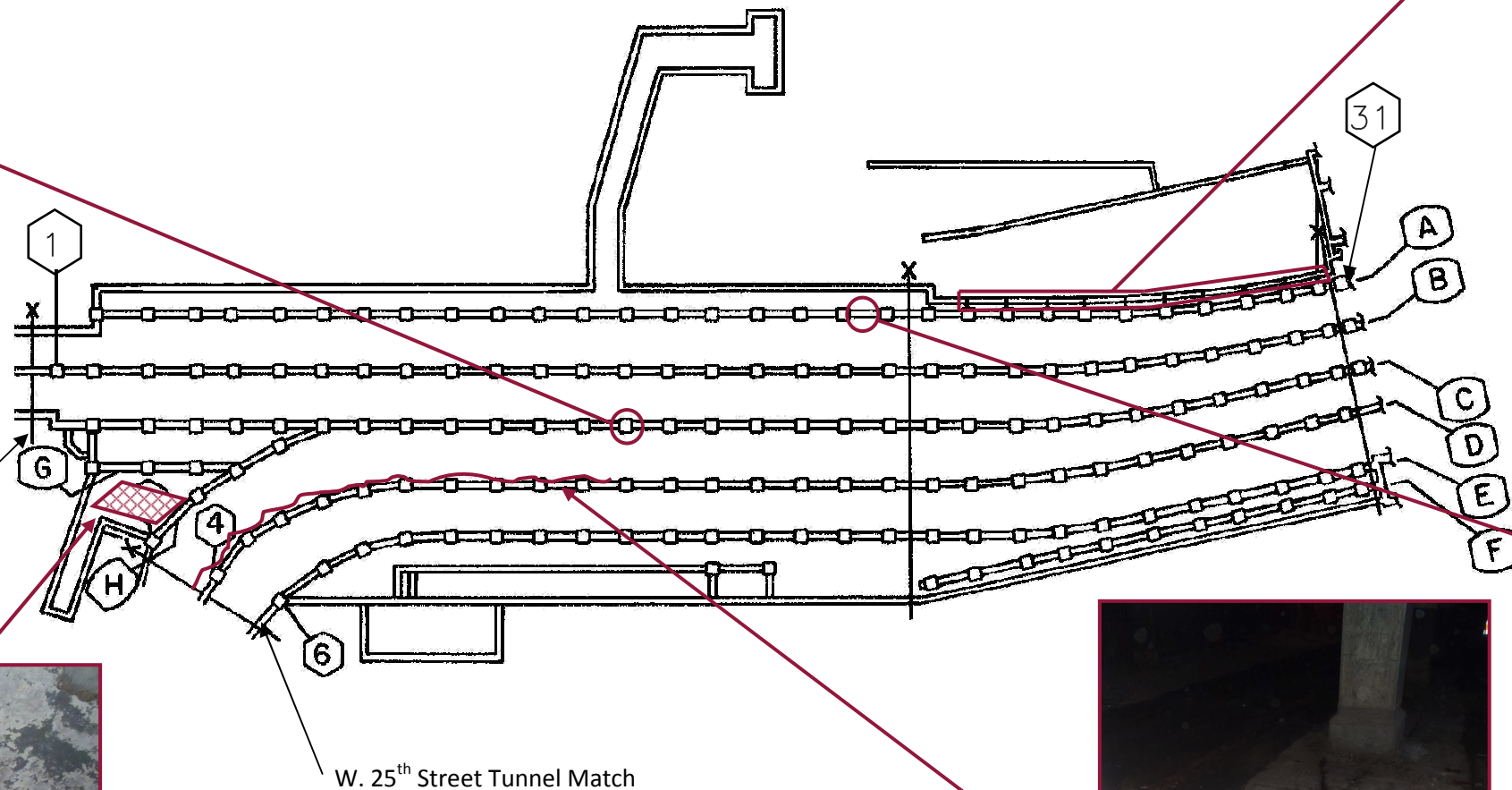
**Detroit Avenue  
Tunnel Plan**



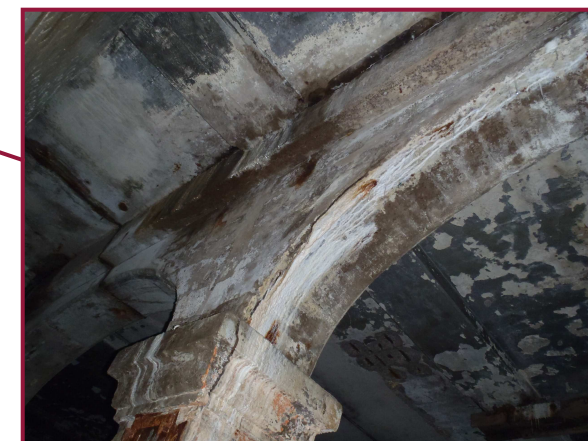
Column 14 in Line C exhibits significant loss of cover and exposed reinforcement with minor section loss. While column spalls are common throughout the west jack arches, the magnitude of deterioration shown here is isolated to only a few locations.



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



Large spall (~30 ft<sup>2</sup>) between jack arch Lines G and H. Spalls are common throughout the underside of the upper deck in the West Side Station, typically ranging from 2 ft<sup>2</sup>-10 ft<sup>2</sup>.




Line A jack arch above Column 20 with large delamination of cover concrete at the north face of the haunch. Upper deck is actively dripping onto jack arch at this location and concrete condition.



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

### West Side Station Plan

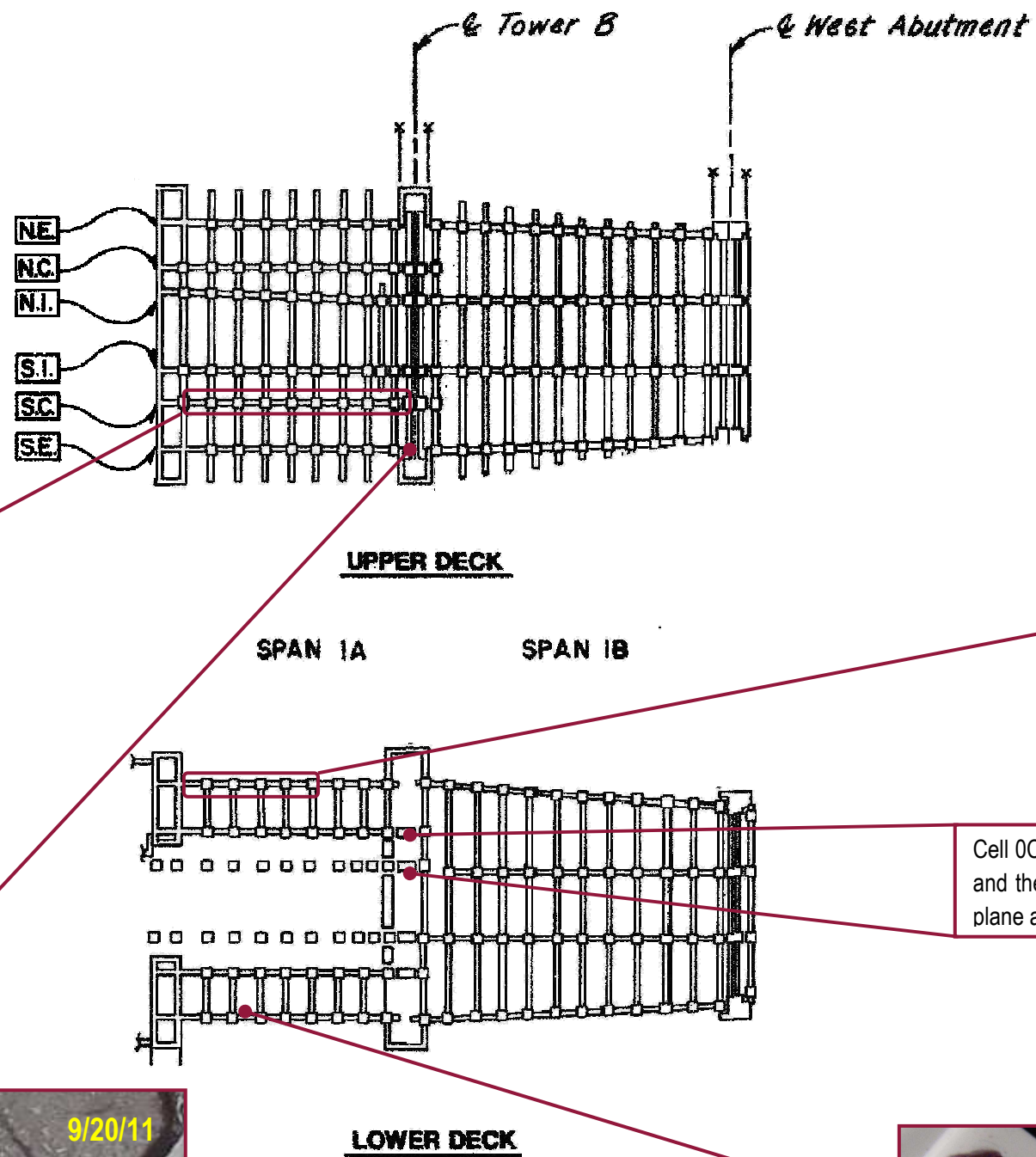
**LEGEND**

 Column #

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.



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



The north walls of the Vaults 0N to 4N exhibit diagonal hairline cracking with heavy efflorescence in Span 1A (Cell 0N shown). The direction of the cracking is consistent between adjacent cells and magnitude of the deterioration increases from east to west starting at Cell 4N.

Cell 0C exhibits cracking up to 1" wide between the lower deck slab and the north and south walls. This location is in the same lateral plane as South Tower B.



South Tower B crack gauge at the upper deck level showing 1mm of movement over a 4-month period. This gauge was originally installed in 2006 and indicates approximately 48.5mm (1.91") of movement since.

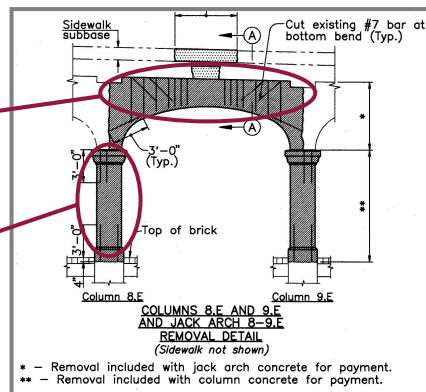


Crack Gauge 2 in Cell 2S of Span 1A exhibits approximately 2mm of movement since the gauge was installed in 2007.

**West Approach Plan  
Spans 1A & 1B**



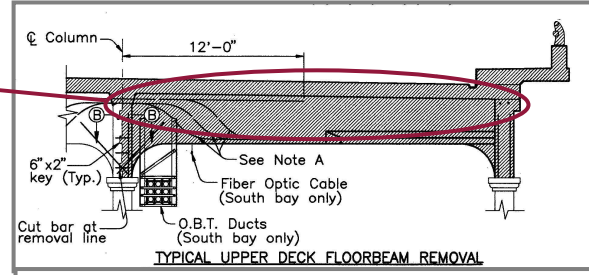
Jack arch Line B in Span 3, typical for Spans 1-3. Note that portions of the arches, columns and floorbeams have been repaired (light in color), while other portions were not (discolored).



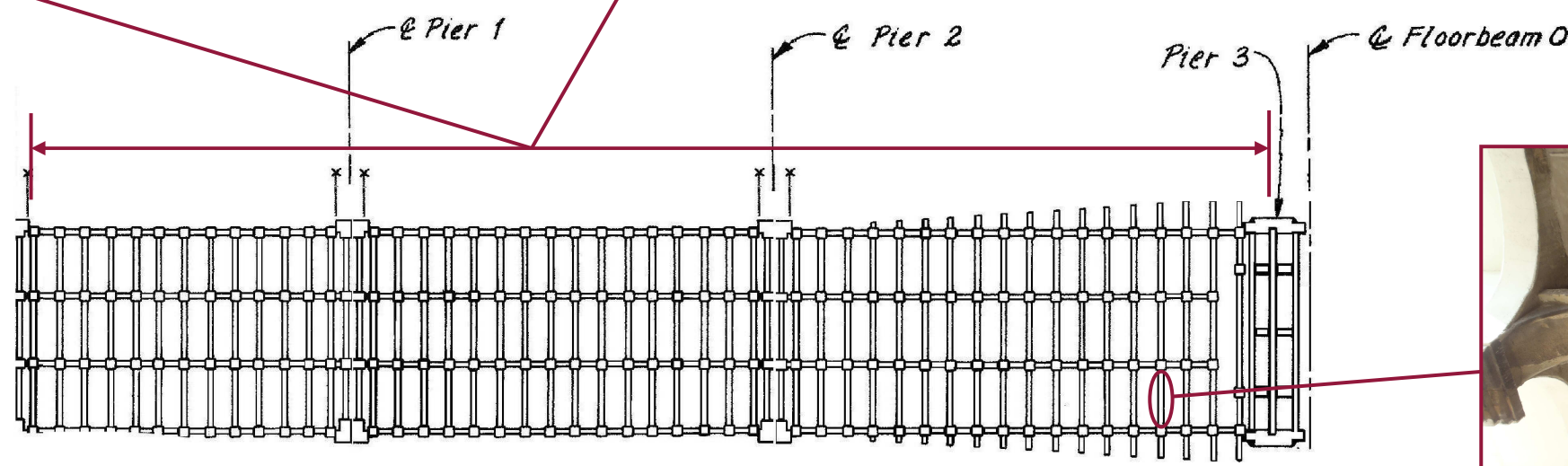
Typical jack arch removal/repair detail per the 1994 rehabilitation plans.



Typical repaired floorbeam condition, Span 2, Floorbeam 5 between Lines A and B shown.



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



**UPPER DECK**

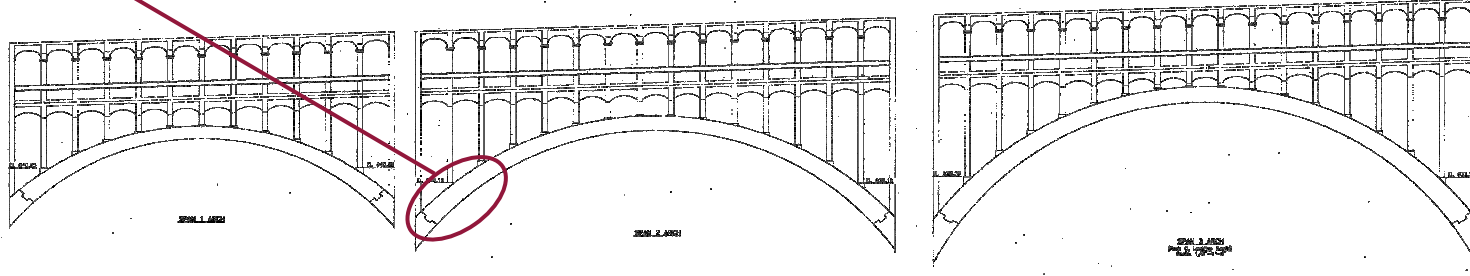
SPAN 1

SPAN 2

SPAN 3



North face of Arch D in Span 2 with widespread cracking in the western 25' of the arch. Arch cracking is typical in Spans 1-3; however, the condition shown is worse than typical due to the adjacent drainage elements at this location.



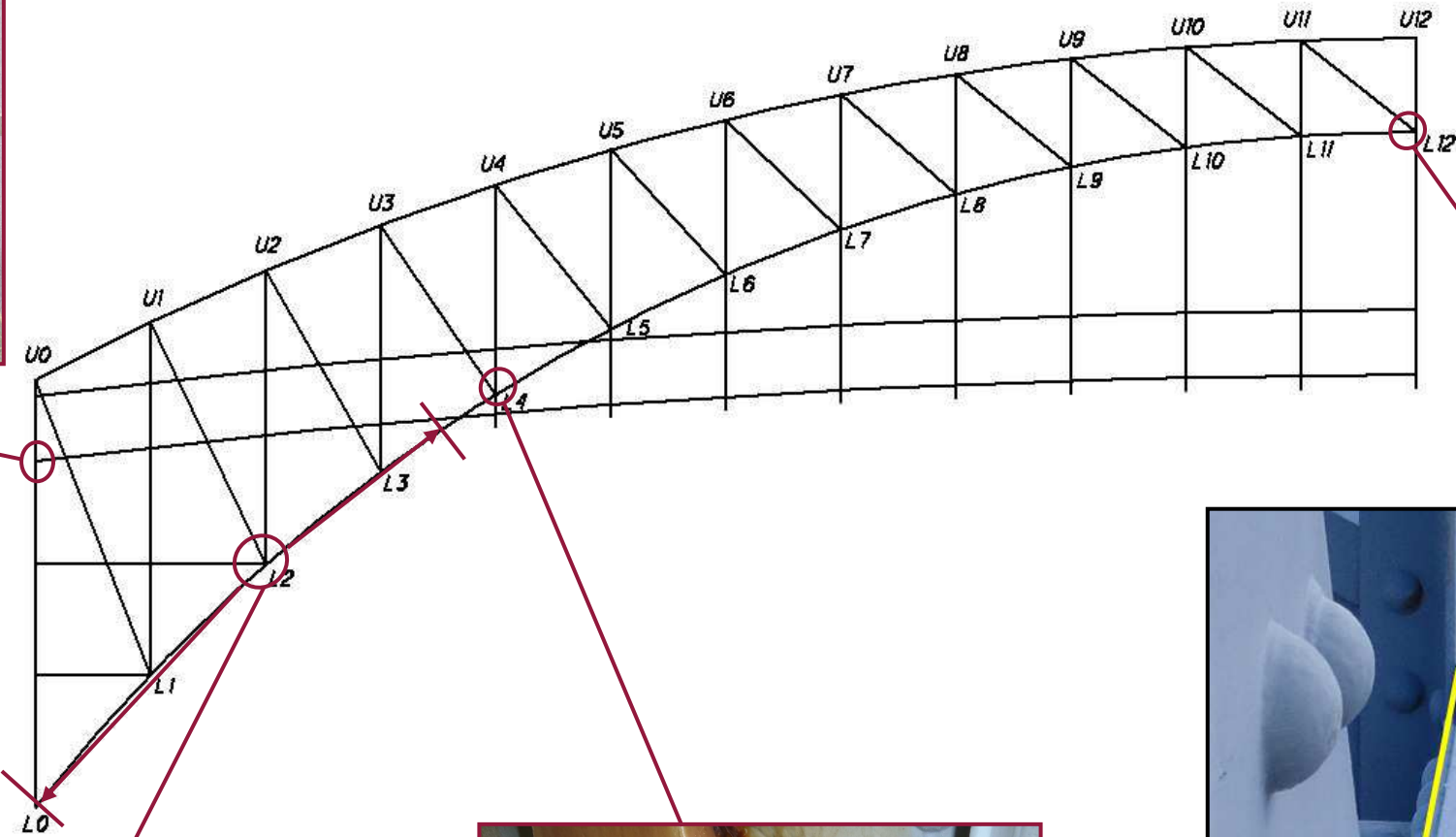
Floorbeam 16 between jack arch Lines C & D with transverse hairline cracking and light efflorescence throughout the bottom face. This condition is isolated throughout Spans 1-3, especially at floorbeams that have not been rehabilitated, as shown.

**West Approach Plan  
Spans 1-3**





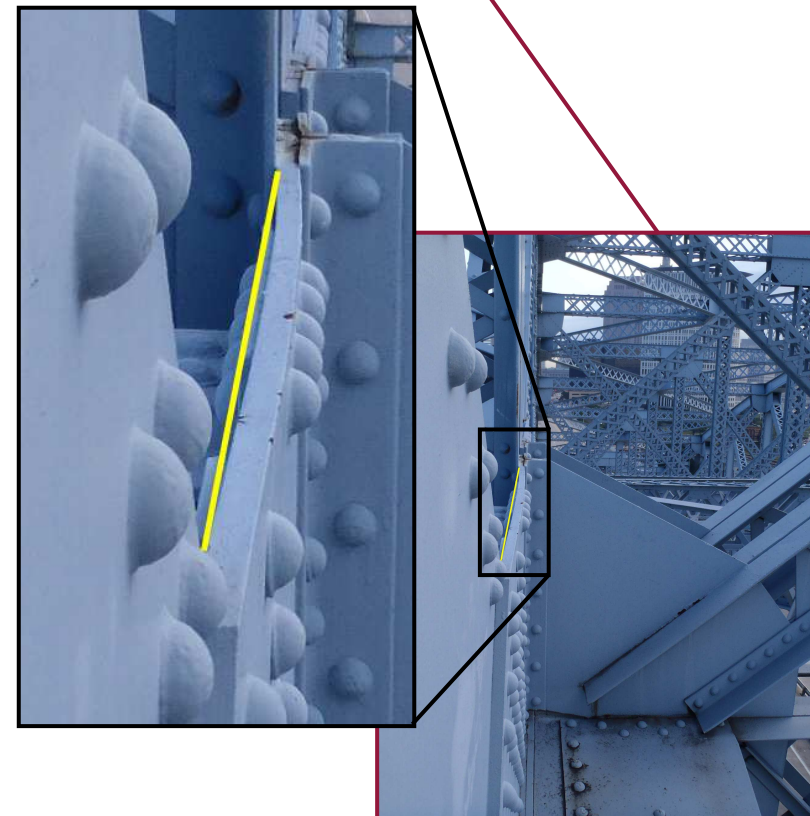
The Floorbeam 0 north cantilever bracket exhibits advanced section loss of the bottom flange with holed through sections. This condition is locally common at the end floorbeams and isolated throughout the truss where the members are exposed.



South Truss L2 gusset plate with heavy pitting along the lower chord interface. Similar advanced losses were noted at several lower chord panels below the lower deck level.



Moderate to heavy pitting is common at lower pin connections below the upper deck. North Truss lower Panel 4 shown.

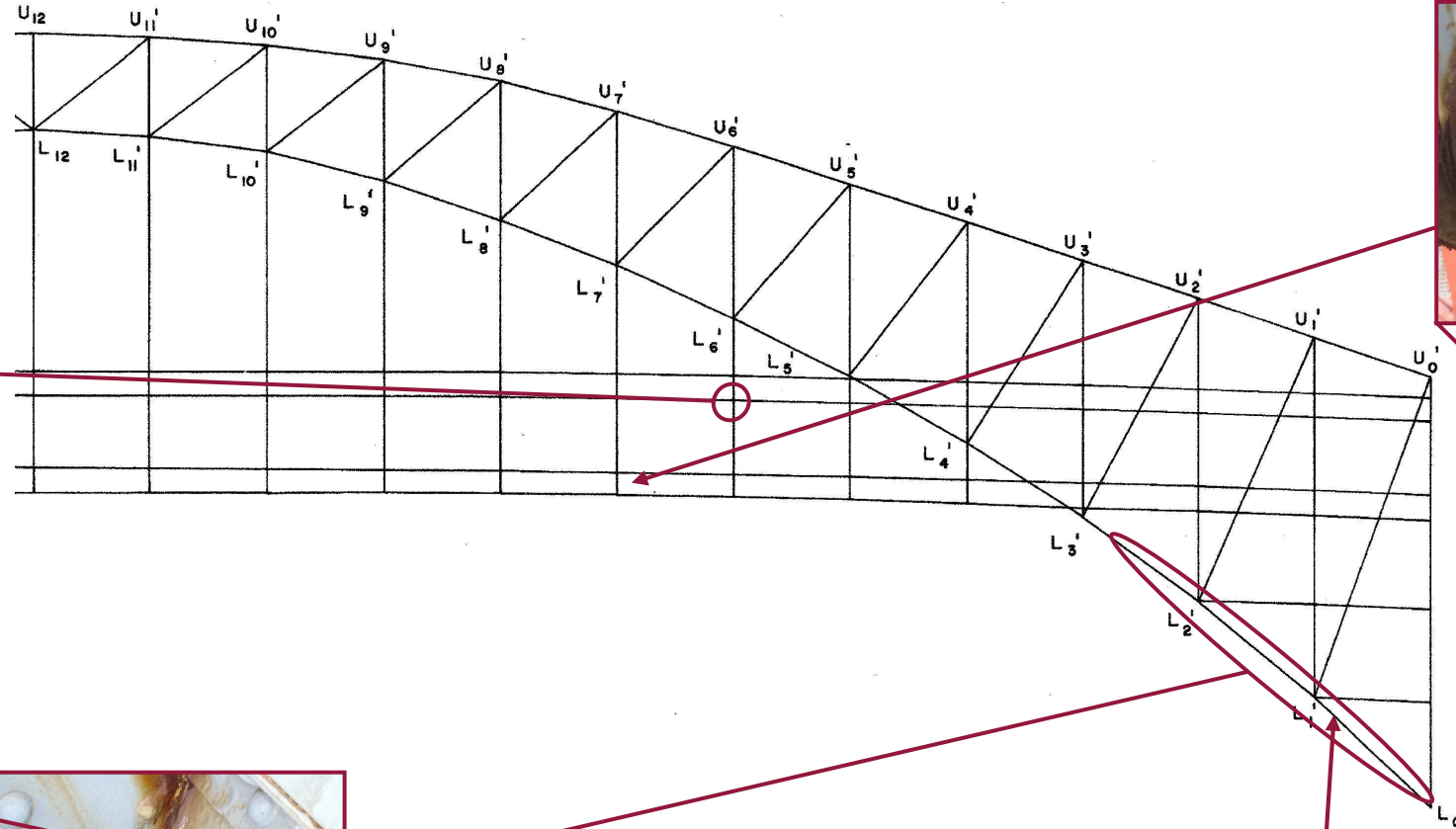


The L12 gusset plates on both trusses exhibit bowing, with the worst case seen at the North Truss, where the southwest gusset is bowed approximately 3/8" to the south. At each L12 panel, the corresponding inboard and outboard gussets exhibit similar magnitude and direction of bowing.

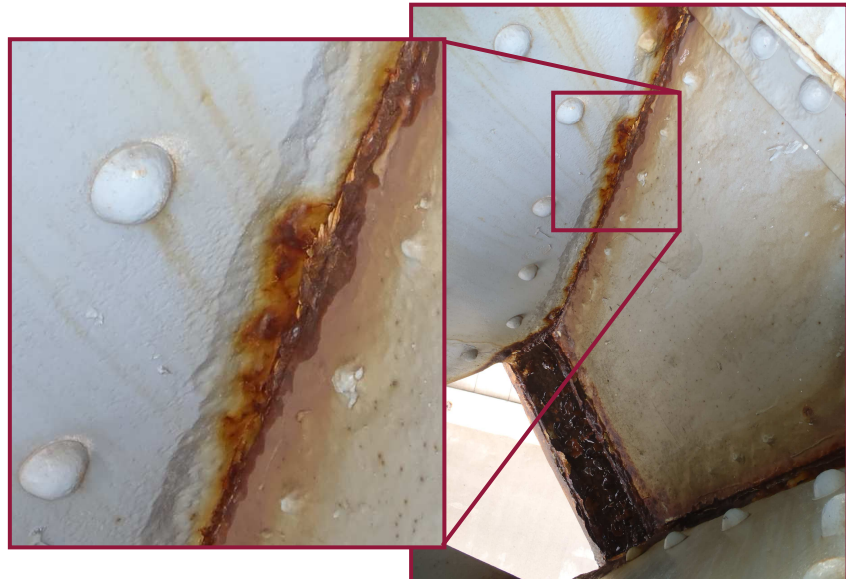
**Main Span  
Half South Elevation (West)**



Pin connections at the upper floorbeams (Panels 5 to 5') 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 (south hanger at Floorbeam 6' shown).



Typical lower hanger and floorbeam condition with rust activating throughout. Many floorbeams throughout the truss have been retrofitted with bolted and/or welded plates; however, the web of Floorbeam 7' remains holed through to the interior of the south hanger (shown).



Advanced section loss (up to 1/2" deep) was noted on the interior faces of the lower chord web members below the lower deck (Panels 3'-0'). The losses occur immediately adjacent to the intermediate diaphragms and have been cleaned and painted; however, rust is reactivating at most locations. South Truss, L0'L1' shown.

**Main Span  
Half South Elevation (East)**



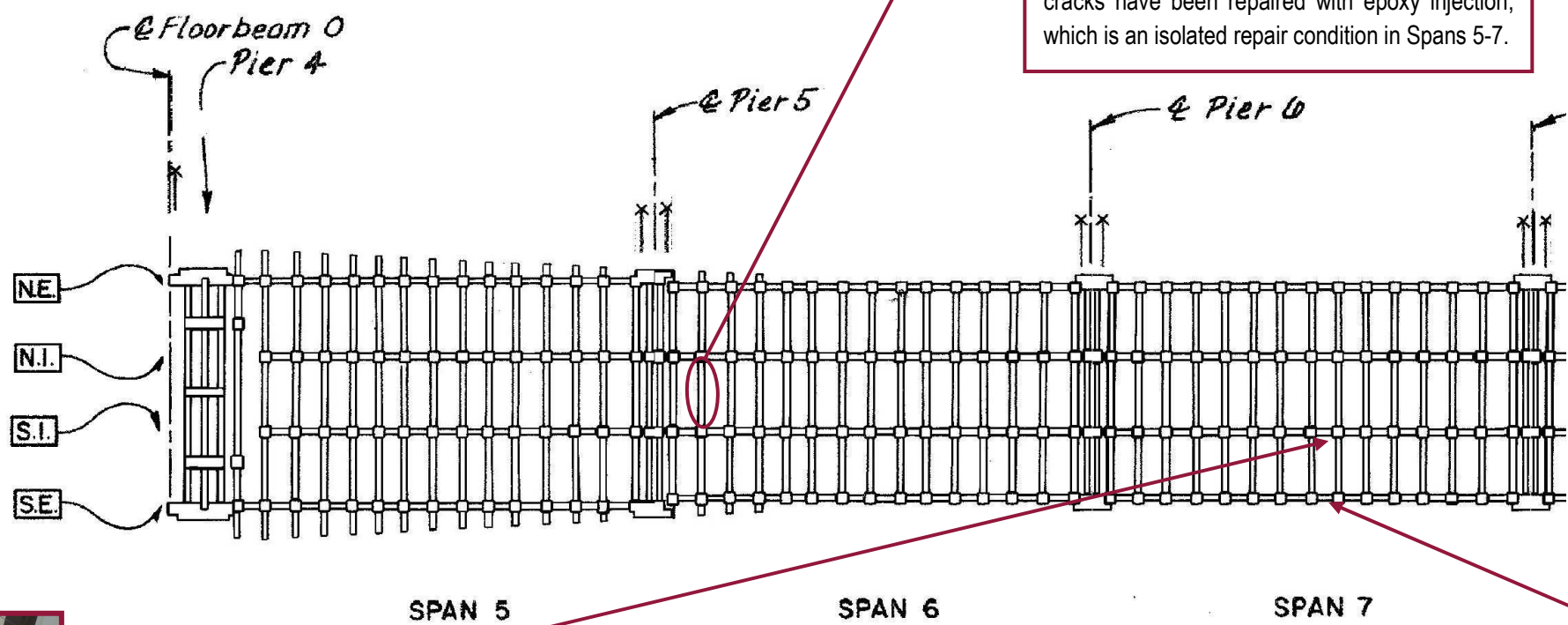
Several intermediate lower chord diaphragms below the lower deck level (Panels 3'-0') exhibit advanced section losses, including holed through sections. Adjacent bottom lacing channels exhibit similar conditions, as shown here at L0'L1' near L1'.



In Spans 5-7, jack arches typically exhibit transverse hairline vertical cracks along the bottom face extending up both web faces at the crown.



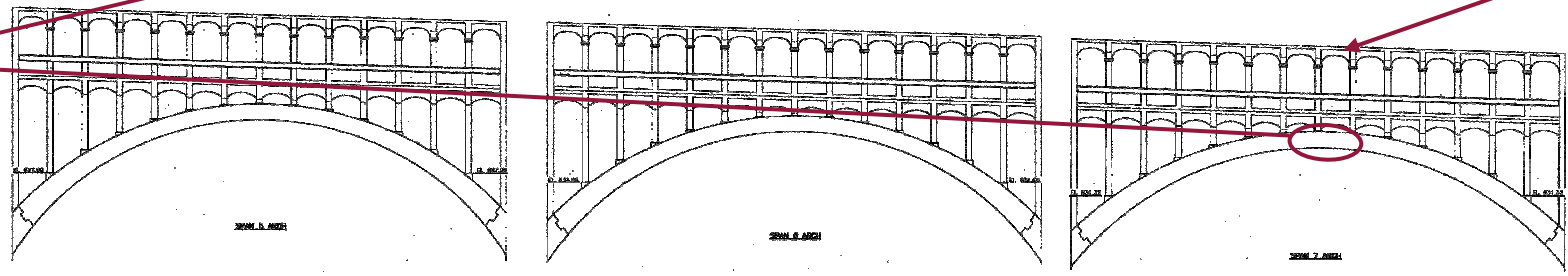
Floorbeam 2 in Span 6 with vertical cracks in the south face (north face similar). Note that the cracks have been repaired with epoxy injection, which is an isolated repair condition in Spans 5-7.



Arch C in Span 7 exhibits a 12' long x 6" wide spall on the south bottom corner of the rib. This minor spalling exemplifies the most advanced concrete deterioration in Spans 5-7.



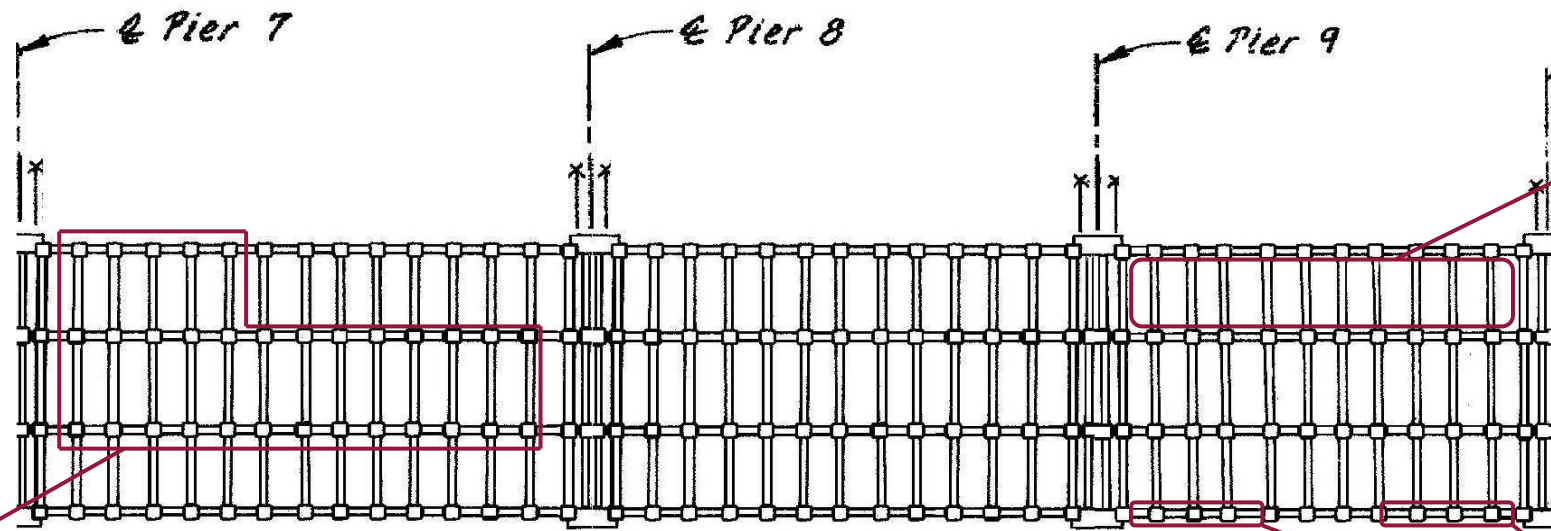
Isolated 1/4" longitudinal cracking in the bottom face of the arch between Columns 8 and 9, Line D in Span 7.



### West Approach Plan Spans 5-7



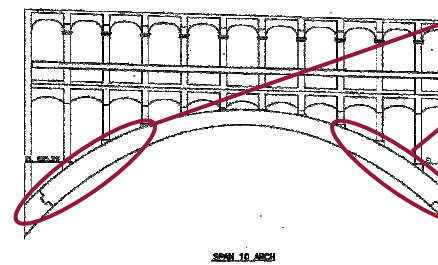
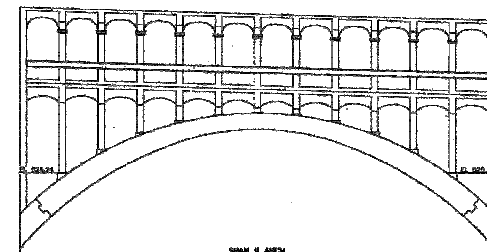
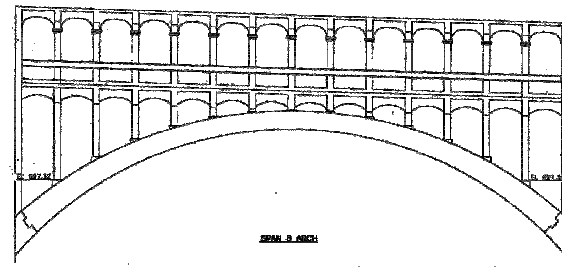
Interior bay of Floorbeam 9 in Span 8 with transverse hairline cracking along the bottom face of the beam. Between Lines A and B, the cracking is on the bottom face of the beam at Floorbeams 2-6. Between Lines B and C, the cracks exhibit light efflorescence and typically extend the full height of the web on both faces from Floorbeams 2-14.



SPAN 8

SPAN 9

SPAN 10



Floorbeam 10 in Span 10 exhibits intermittent spalling across the west face in the north bay, corresponding to locations of reinforcement. This condition is typical for the north bay in Span 10.

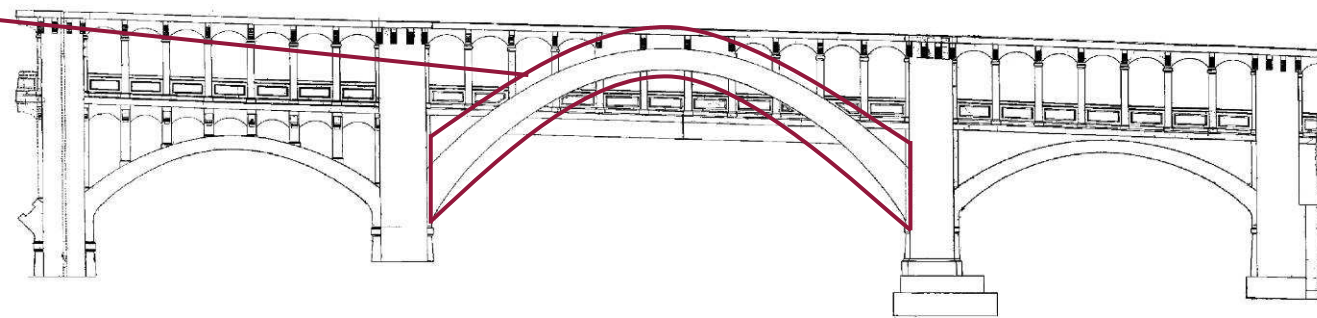
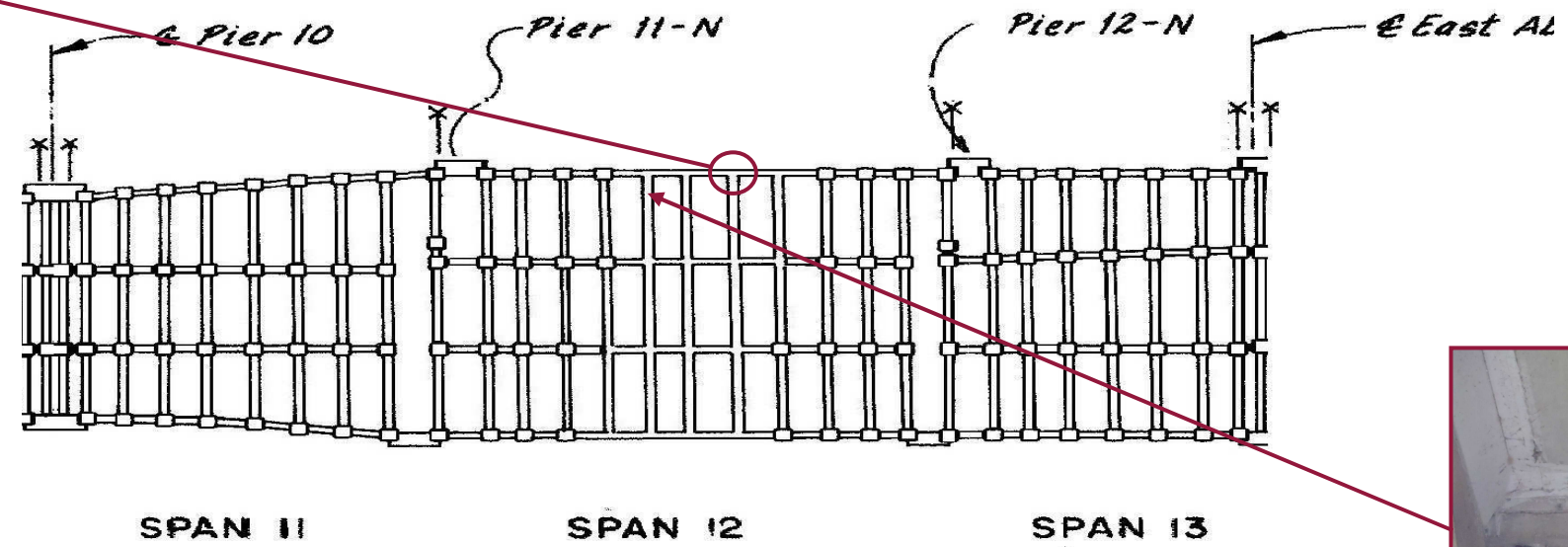


Arch A in Span 10 exhibits widespread map cracking throughout the bottom face of the rib, especially in the end 30' to 40' adjacent to the piers.

**West Approach Plan  
Spans 8-10**



Vertical cracking of the arch Line D concrete hangers is typical in Span 12 (Hanger 7 shown above). Additionally, the arch rib exhibits moderate cracking as it passes through the lower deck (below).



Floorbeam 5 north bay in Span 12 exhibits isolated web spalling at vertical reinforcement near the north floorbeam connection.

**West Approach Plan  
Spans 11-13**

## Appendix C

### BR-86 Form

OHIO DEPARTMENT OF TRANSPORTATION

**BRIDGE INSPECTION REPORT**

1	8	0	0	9	3	0
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STRUCTURE FILE NUMBER

CUY

00006

1456

YEAR BUILT

1917

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	2
13. Floorbeams	2	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	1	22. Sway Bracing	1
23. Portals	2	24. Bearing Devices	2
25. Arch	2	26. Arch Columns or Hangers	2
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	5

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
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	1	58. Relief Joint	
59. Embankment	2	60. SUMMARY	6

GENERAL

61. Navigation Lights	1	62. Warning Signs	2
63. Sign Supports	1	64. Utilities	1
65. Vertical Clearance (1, 2-change, N)	1	66. General Appraisal & Operational Status	4

67. Inspected By, First & Last Name

68. Reviewed By, First & Last Name

P.E.# 74292

P.E.# 69991

Brian Corson-Marquess, P.E.

PE Number

Wesley R. Weir, P.E.

PE Number

Date 12/7/2011

1	1	1	1	0	0	1	N
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Date 12/7/2011

## BRIDGE INSPECTION REPORT

1	8	0	0	9	3	0
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STRUCTURE FILE NUMBER

CUY

00006

1456

YEAR BUILT

1917

CO

ROUTE

UNIT

DIST 12

BRIDGE TYPE

354

TYPE OF SERVICE

58

Cuy. River, RTA rail, other

## Deck

1. Localized heavy spalling, exp. rebar with losses, cracking with heavy efflo. in west approach spans and tunnels.
2. Isolated heavy deck spalls, typically w/ asphaltic patches. Worst in right east bound lane.
6. Partially clogged curb drains, joints typically filled with debris, missing grating in north longitudinal sidewalk trough.
7. Heavy debris in glands, minor vertical misalignment resulting in plow damage.

## Superstructure

10. Jack arches in the west approach and tunnel spans with heavily spalled areas, exp. rebar and section loss on reinforcement.
11. Lower deck stringers with localized heavy losses, isolated rust reactivating at connections.
13. Active pitting at areas that were previously cleaned and painted, localized, isolated holed-through sections typ. near arch conn's.
15. Locations below the upper deck level with active corrosion at connections.
16. Localized areas with active corrosion at connections.
19. Locations below the upper deck level with active corrosion at connections.
20. Localized advanced section losses, on gusset plate, at lower chord interface, panels 0-4 and 4'-0', typ.
24. Moderate to heavy corrosion to truss bearing bolsters, isolated saddle bearings with 100% loss.
28. Paint failures typical at truss connections below the upper deck.
29. Moderate pitting at eyebar heads at the lower connections at isolated panel points.

## Substructure

33. Minor cracking at the abutment concrete elements.
35. Rotation progressing at South Tower B. Heavy cracking in cellular spans, Crack Gauge 2 indicating opening since installation.
36. Minor cracking at the truss bearing seats.
38. Soft concrete at the southwest wing, cracking and spalls at the curtainwalls is typical.
39. Pier 3 is without collision protection.

## Channel

52. West embankment is without sheet pile wall or other bank protection.

## Approaches

55. Minor cracking and shoving at both approaches.
57. Isolated, minor impact damage noted.
59. Minor erosion channel forming along the northeast wing.

## General

62. Warning Signs only placed at the through truss northeast and southwest corners. Warning signs are missing at the other two truss corners, and at all four corners of the bridge limits.