August 31, 2019

Mr. Josh Rogers, P.E.
Branch Manager – Bridge Preservation Branch
Kentucky Transportation Cabinet
200 Mero Street, 3rd Floor
Frankfort, Kentucky 40622

Re: ***Broadway Bridge (KY 3506) over Kentucky River***
Bridge No. 037B00066N
Frankfort, Kentucky
In-Depth Bridge Inspection Report

Dear Mr. Rogers:

Enclosed herewith is one (1) copy of the In-Depth Bridge Inspection Report for the Broadway Bridge, *037B00066N*, over the Kentucky River in Frankfort, Kentucky. We have completed the field inspection of this bridge in accordance with the Scope of Work, and this report is being submitted for your records.

INSPECTION METHODS

Palmer Engineering completed the In-Depth Inspection of the Broadway Bridge (KY 3506) over the Kentucky River on June 4, 2019. The total bridge length is approximately 517 feet. Bridge component nomenclature and numbering is in accordance with Exhibit 9201 of the *Kentucky Bridge Inspection Procedures Manual*, published 07/07/2017. The route direction is from Frankfort (Abutment 1 is at River View Park) to Benson Valley (Abutment 7 is near intersection of Benson Valley Road and Taylor Avenue). The inspection covered all bridge components, from the ground line or water line upwards, from Abutment 1 to Abutment 7.

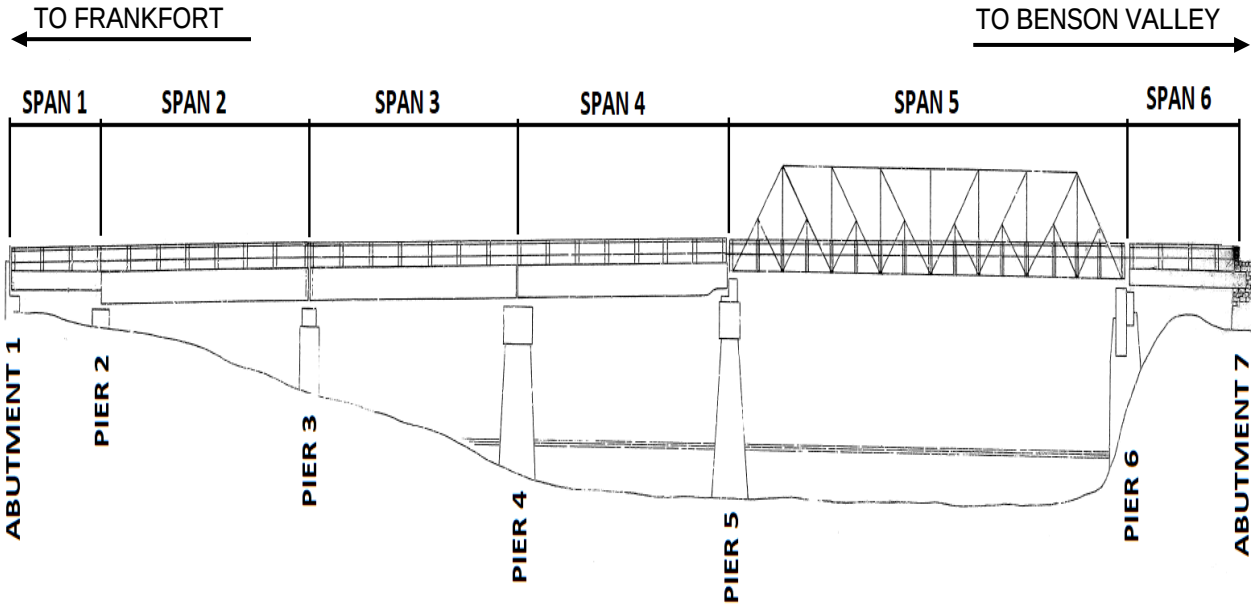

Figure 1: Elevation of the Broadway Bridge with span and substructure numbering.

In fulfillment of KYTC In-Depth Inspection requirements, work included the following items:

- Arm's length inspection of all Fracture Critical members and Fatigue Prone details including category E details in truss members, girders, and floorbeams.
- Arm's length inspection and sounding of truss connection pins and pin & hanger assemblies.
- Arm's length inspection of primary truss gusset plates.
- Arm's length inspection of floorbeam end support connections.
- Visual inspection of non-fracture critical truss members from each panel point.
- Arm's length inspection of floor system elements under expansion joints.
- Visual inspection of non-fracture critical members in girder spans.
- Arm's length inspection of significant problems discovered during prior inspections.
- Magnetic Particle or Dye Penetrant testing performed where new cracks were visually found or suspected and where cracks were suspected to have grown to verify the crack and determine its limits.
- Walk-over inspection of the deck and sidewalk.
- Arm's length inspection of bearings and substructure caps.
- Visual inspection of all substructure units above water and deemed practical.
- Inspection of all other elements at a distance deemed practical, without requiring climbing or specialized equipment.
- Data gathering and condition reporting for NBI inspection reporting.
- Measurement gathering for condition summary and feasibility options.

The Broadway Bridge is closed to vehicular and pedestrian traffic due to its deteriorated condition. As such, mechanical access methods using heavy equipment staged from the deck were not practical. Instead, a combination of access methods was utilized to inspect the different bridge elements.

Industrial rope access techniques in accordance with SPRAT (Society of Professional Rope Access Technicians) standards and guidance were utilized for the inspection of the above-deck portion of the truss and for the inspection and sounding masonry piers inaccessible by ladder.

Photo 1: Inspection of the truss using industrial rope access in accordance with SPRAT.

The arm's length inspections of the Spans 3 and 4 twin-girder superstructures as well as the below-deck inspection of the truss were staged from pickboards supported by cable rigging.

Photo 2: Below-deck inspection of the truss from pickboard supported by cable rigging.

Extension ladders were utilized for the arm's length inspections of the Spans 1, 2, and 6 twin-girder superstructures and for sounding substructures where access was practical.

Photo 3: Inspection of Span 6 from extension ladder.

A manned safety boat patrolled the water while inspectors performed the In-Depth Inspection over the Kentucky River, and it was utilized to inspect and sound the piers inaccessible by land. Photos showing the overall bridge and site layout were taken from the safety boat.

Photo 4: Broadway Bridge elevation looking upstream.

All other inspection tasks were performed from the ground.

The inspectors assigned to this project included the following:

David Rust, P.E. (Chief Inspector, Qualified Team Leader, SPRAT Level I)
Aaron Thomas, P.E. (Qualified Team Leader, SPRAT Level I)
Ryan Damon, P.E. (Qualified Team Leader)
Logan Sallee, P.E. (Qualified Team Leader)
Jon Murrin, E.I.T. (Inspector)

The cable rigging, pickboards, and safety boat were provided by Intech Contracting, LLC of Lexington, Kentucky.

SUMMARY OF FINDINGS

Based on our inspection observations, The Broadway Bridge is in "imminent" failure condition overall (NBI Rating is 1 out of 9). This condition rating accounts for the major deterioration and section loss present on major structural components. It also considers that although the bridge is closed to traffic, corrective action may put it back in light service. See the general condition rating guidelines in the *FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* for additional information.

Inspection findings in accordance with the *AASHTO Manual for Bridge Element Inspection, First Edition* are described below. The deck and superstructure are discussed on a per-element basis. Due to the

variety of element types within each substructure unit, each substructure is discussed individually rather than per element.

For defect location purposes, the bridge runs east to west and the Kentucky River flows south to north. All references to waterline are at a gauge height of 8.00ft from USGS gauge 03287500, which is located on the bridge, or at Elevation 469.58ft.

All referenced photos are at the end of the report.

Element Summary:

12 Reinforced Concrete Deck (with #510 Wearing Surface and # 804 Sidewalk)

- The deck is in serious condition (NBI Rating is 3 out of 9).
- The asphalt wearing surface has widespread transverse, longitudinal, and map cracking. There is heavy vegetation growth in the gutterlines, and intermittent light vegetation growth in the surface cracks. There is heavy rutting adjacent the curbs. (See Photo 12-1)
- Asphalt is bulging at deck expansion joints and has failed above deck expansion joints creating a 6" long x 3" vertical x full width transition between spans. (See Photo 12-2)
- The underside of the deck on all spans has widespread heavy map cracking with efflorescence and rust staining. The underside of the deck on the approach spans has more widespread cracking with heavier accumulation of efflorescence. (See Photos 12-3 through 12-5)
- The sidewalk is in similar, but slightly worse condition than the deck. In addition to the aforementioned deck deficiencies, the sidewalk has large areas of spalling with exposed reinforcement. (See Photo 12-6)
- There is a wood stay-in-place form under the downstream sidewalk the near mid-span of Span 5. The plywood is not solidly attached to the underside of the sidewalk and is a falling hazard for boat traffic under the bridge. (See Photo 12-7)

107 Steel Girders (with #515 Steel Protective Coating)

- The steel girders are in poor condition (NBI Rating is 4 out of 9).
- The steel protective coating is partially effective and in poor condition. Large areas of the girders have exposed steel with no protective coating. (See Photo 107-1)
- There is pack rust and section loss of the girder top flange and top flange cover plates throughout all girder spans. This is more prevalent adjacent the floorbeam connection plates (See Photos 107-2 and 107-3)
- Active corrosion is widespread on the girder webs. There are isolated areas where there is pitting and section loss (See Photos 107-4 through 107-6)
- Pack rust between the bottom flange angles, cover plates, and splice plates is common throughout all spans. There are isolated locations of section loss of the bottom flange cover plates. (See Photos 107-7 through 107-9)
- Active corrosion with up to 100% section loss is common on the bearing stiffeners. (See Photo 107-10)

113 Steel Stringer (with #515 Steel Protective Coating)

- Steel stringers are present in Span 5. The steel stringers are in "imminent" failure condition (NBI Rating is 1 out of 9).
- The protective coating has failed in many locations and active corrosion is widespread on the stringer webs and bottom flanges. The interior stringers show less deterioration than the fascia stringers. (See Photo 113-1)
- Stringer 1 has failed at its connection to the east face of Floorbeam (FB) 12. The stringer has separated from the bridge deck and is only being supported as a cantilever by its connection to the west face of FB 11. (See Photos 113-2 and 113-3)
- There are locations of heavy laminar corrosion on the stringer bottom flanges and webs. This laminar corrosion is more prevalent on the fascia stringers, but the two interior stringers have isolated areas as well. (See Photos 113-4 through 113-6)
- There are corrosion holes in the fascia stringer webs adjacent to the floorbeam connections. (See Photo 113-7)
- The sidewalk stringers have 100% section loss of the web and flanges throughout. (See Photo 113-8)

120 Steel Truss (with #515 Steel Protective Coating)

- Span 5 is a pin-connected Baltimore Petit Truss. The steel truss is in "imminent" failure condition (NBI Rating is 1 out of 9).
- The protective coating is peeling off the truss members throughout, leaving bare metal exposed. (See Photo 120-1).
- There is active corrosion with up to 100% section loss on the counter-diagonal pin connection plates at deck level. Although these counter-diagonals are not primary tension and compression load path members, they are critical to the overall stability of the Baltimore Petit Truss design. This is the impetus for the "imminent" failure condition of the steel truss. (See Photos 120-2 through 120-8)
- There is active corrosion with pitting on the primary tension eyebar members.
  - The pitting is worse at the lower panel point connections due to salt spray from vehicular traffic. (See Photos 120-9 through 120-15)
  - At the middle panel point connections, the pitting is much less severe with 1/16" deep pitting typical. (See Photos 120-16 through 120-18)
  - At the top panel point connections, the upper chord provides protection from the weather, but there are locations where fretting corrosion and pack rust between the eyebars and upper chord members have caused up to 1/16" section loss. (See Photos 120-19 through 120-21)
- There is active corrosion, pack rust, pitting, and section loss on the primary compression built-up members.
  - There is heavy pitting and section loss of the 3/4" stiffening plate on the inboard face of both trusses at panel points L0 and L16. (See Photo 120-22)
  - 9/16" pack rust is typical between the upper chord top flange plate and the horizontal splice plate along with 1/4" pitting of the top flange plate at this location. (See Photo 120-23)
  - Upper chord member U6-U8 on the upstream truss has 7/8" pack rust between the top flange plate and the horizontal splice plate at panel point U6. There is 7/16" deep pitting that is 1 1/2" wide and extends for 15" across the top flange plate. There is a 1" diameter

corrosion hole within this pitting. The nominal thickness of the top flange plate is 1/2" and this is the worst location of pitting on the top flange plate. (See Photos 120-24 and 120-25)
    - There is intermittent 1/8" deep pitting of the upper chord bottom flange angle throughout. (See photo 120-26)
    - The worst-case upper chord bottom flange angle deterioration is located on member U2-U4 on the upstream truss. There is pitting up to 7/16" deep located 4 feet from panel point U2. The nominal angle thickness is 5/8". (See Photo 120-27)
- The washers beneath pin fastening nuts have broken at two locations.
    - The washer on the outboard face of the pin at downstream truss panel point U6 has broken and only 50% of the washer is in contact with the pin nut. (See Photo 120-28)
    - The washer on the inboard face of the downstream pin at U10 has broken and only 20% of the washer is in contact with the pin nut. (See Photo 120-29)
- There is active corrosion with isolated locations of section loss on lacing bars and their connection angles throughout. (See Photos 120-30 and 120-31)
- Two truss members have significant impact damage.
    - Member L0-U2 on the upstream truss is distorted 3" to the east just above the traffic rail. One rivet is severed and there is a tear in the top flange plate connection angle. (See Photo 120-32).
    - The inboard eyebar of downstream member L11-M11 is distorted 1 1/2" to the east at the traffic rail welded connection (which is a fatigue-prone detail in and of itself). MT was performed and there were no crack indications. (See Photos 120-33 and 120-34)

152 Steel Floorbeam (with #515 Steel Protective Coating)

The floorbeams in all spans are in "imminent" failure condition (NBI Rating is 1 out of 9).

Girder Spans

- There is severe active corrosion with up to 100% section loss of the floorbeam webs. (See Photos 152-1 and 152-2)
- There is heavy active corrosion with section loss of the floorbeam flanges. (See Photo 152-3)

Truss Span

- Floorbeams 0 and 16 have severe active corrosion, and the members are severely deteriorated with failure imminent. (See Photos 152-4 and 152-5)
- The upstream end of Floorbeam 1 has active corrosion with section loss up to 100% in the web. (See Photo 152-6)
- The downstream end of Floorbeam 4 has 100% section loss in the web and heavy corrosion extending onto the bottom flange. (See Photo 152-7)
- Floorbeams 4, 9, 12, and 13 all have active corrosion with section loss on the top flange adjacent to the fascia stringers. The remaining section ranges from 0.25"-0.475". (See Photo 152-8).
- Floorbeams 4, 5, 7, 8, 12, 14 have web pitting with section loss. The remaining section ranges from 0.1875"- 0.5. (See Photo 152-9)
- Floor beams 4, 8, 10, and 15 have bottom flange section loss with 0.3125"-0.5" remaining on the bottom flange. (See Photo 152-10)

161 Steel Pin and Hanger Assembly (with #515 Steel Protective Coating)

- The pins are in fair condition (NBI Rating is 5 out of 9) and the floorbeam hangers are in poor condition (NBI Rating is 4 out of 9).
- There is active surface corrosion on the pins and collars, especially at the lower chord and mid-height panel points. Minor pitting of the collars is present. (See Photos 161-1 through 161-3)
- The pin at panel point L2 of the downstream truss has 1" of section loss. 4" diameter remains out of a nominal 5" diameter. (See Photo 161-4)
- There is active corrosion with pitting and section loss on the floorbeam hangers. Minimum section remaining is 0.28". (See Photos 161-5 through 161-7)

Substructure Units

Abt. 1 Abutment 1

- Abutment 1 is a Reinforced Concrete Abutment (Element 215) in fair condition (NBI Rating is 5 out of 9).
- There is scaling and pop-outs throughout the entire face of the abutment along with vertical and horizontal cracking with efflorescence. (See photo Abt. 1-1)
- The north end of the backwall has several locations of vertical and diagonal cracking with heavy efflorescence along with spalling that exposes rebar. (See photos Abt.1-2 and 3)

P2 Pier 2

- Pier 2 is a Reinforced Concrete Pier Wall (Element 210) in satisfactory condition (NBI Rating is 6 out of 9). There are minor vertical cracks throughout and graffiti covering the majority of the pier. (See photos P2-1 and 2)

P3 Pier 3

- Pier 3 is a Masonry Pier Wall (Element 213) with a Reinforced Concrete Pier Cap (Element 234). Pier 3 is in serious condition (NBI Rating is 3 out of 9). There is heavy cracking of the stones throughout along with several stones missing and heavy deterioration of the mortar.
- A drainage issue has caused heavy deterioration on the south end of the Pier 3 cap adjacent to the beam seat. This deterioration has formed a ditch in the cap that is 30in wide by 18in deep, at its worst point on the east edge of the cap. The water from this location has severely deteriorated the mortar and stones in the below masonry pier wall causing several stones to dislodge and a 2ft wide x 5ft tall x 2.5ft deep void in the east face of Pier 3. (See photos P3-1 to 2)
- The east face of Pier 3 has heavy cracking of the stones throughout with the majority of the stones cracked or delaminated. In addition to the large void on the south end, the north end has 3in wide voids between stone that extend 2.5ft into the pier. (See photos P3-3 to 5)
- The west face has heavy cracking and delamination on both the north and south ends, exterior of the concrete beam seat and the bottom 8ft with up to 90% delamination of the rock face. The upper 10ft directly under the concrete beam seat only has minor cracking of the stone

along with minor mortar deterioration and only 50% delamination of the stone face. (See photos P3-6 to 9)

P4 Pier 4

- Pier 4 is shared with the R.J. Corman Railroad Bridge. This pier was originally a Masonry Pier Wall (Element 213) that was encased in with concrete when the railroad bridge was built in 1929 and is now considered a Reinforced Concrete Pier Wall (Element 210) with a Reinforced Concrete Pier Cap (Element 234). Pier 4 is in fair condition (NBI Rating is 5 out of 9).
- There is horizontal cracking with efflorescence throughout the pier that appears to be in line with the masonry joints that are behind the concrete. (See photo P4-1)
- Vertical cracking with efflorescence and rust staining is also common throughout. A higher concentration of cracking with heavy efflorescence occurs on the east face near the pier cap. (See photos P4-2 and 3)
- There is a large tree and debris collecting on the upstream (south) face of the pier at the water level. (See photos P4-4 and 5)
- The north face has rust staining on the pier wall directly below the pier cap. There is a 1ft wide section of honeycombing 10ft above the water line. (See photo P4-6)
- The concrete pier cap is in good condition with only minor cracking.

P5 Pier 5

- Pier 5 is a Masonry Pier Wall (Element 213) with a Reinforced Concrete Pier Cap (Element 234). Pier 5 is in poor condition (NBI Rating is 4 out of 9).
- There is moderate cracking of the stones and deterioration of the mortar throughout with heavy cracking and mortar deterioration of the stones at the water line. (See photo P5-1)
- There is a large number of trees growing out of the cracks or voids between the stones with the largest tree having a diameter of 3in on the north east face. (See photos P5-2 and 3)
- There is a 3in wide void that is 43in deep void between stones at the water line on the north east face under the 3in diameter tree. Voids between stones 2in to 3in wide and up to 2ft deep are common near the water line. (See photo P5-4)
- The east face has 3 full height vertical cracks with minor delamination of the rock face along these cracks. There is one crack 5ft from the north end and two cracks on the south end that both start 3ft from the edge and then spread away from each other as they move downward. All the cracks grow in width near the water line with the south most crack being the widest at 7/8in. (See photos P5-2, 3, and 5 to 7)
- The bottom row of stone at the water line is heavily cracked the full width of the east face with 50% of the stone face delaminated.
- The south face has 2 full height vertical cracks along with rust staining from the anchor reinforcement in the top row of stone. There is minor delamination of the stone face along the cracks and 100% loss of mortar in the bottom 2 rows of stone at the water line. (See Photos P5-8 to 11)
- The west face has rust staining from the anchor rebar in the top row of stones. There are 3 full height vertical cracks, one in the middle and then one on each end. The stone face has minor delamination along these cracks. The bottom 3 rows of stone, from the water line, on the north end are heavily cracked with 80% of the stone face delaminated. (See Photos P12 to P14)

- The 2 voids in the middle of the pier west face appear to be from shoring when the superstructure was built and not defects.
- The south face is similar to the north face with rust staining in the top row of stone with full height vertical cracking and the crack width increases significantly at the water line. The bottom 2 rows of stones at the water line have heavy cracking with 100% deterioration of the mortar. (See Photos P5-15 to 17)
- The concrete pier cap is in satisfactory condition with some cracking with efflorescence throughout. (See Photo P5-18)

P6 Pier 6

- Pier 6 is a Masonry Pier Wall (Element 213) with a Reinforced Concrete Pier Cap (Element 234). The stone on the east face of Pier 6 appears to be a different type of limestone than on the west face and other substructures, and it is in better condition. However, due to defects on the west face and the concrete pier cap above, Pier 6 is in poor condition (NBI Rating is 4 out of 9).
- The east face has minor vertical cracking throughout with minor delamination of the stone face near these cracks. Most of the cracks are less than 1/8in wide with a few near the waterline having a width of 1/4in. The row of stones at the waterline is encased in concrete and is sound with a few cracks throughout. The mortar between the stones has been repaired and is good condition with only very minor deterioration and cracks. Only 40% of the stones at the waterline have delamination of the stone face. (See photos P6-1 to 10)
- The east face of the concrete cap has map cracking with efflorescence along with spalling and delamination throughout. The corners of the cap have moderate deterioration and crumble when touched by hand. (See photos P6-10 and 11)
- The south face has very minor cracking throughout. (See photo P6-12)
- The west face has more cracking of the stone and heavy deterioration of the mortar. A few stone are heavily cracked and deteriorated to a point that they are easily crumbled. 50% of the stone face on the west face of the pier is delaminated. (See photos P6-13 to 16)
- The west face of the concrete cap is heavily map cracked and deteriorated that the exterior layer of cement has crumbled off the cap face. (See photo P6-17)
- There is minor cracking in the stone on the north face. (See photo P6-18)

Abt. 7 Abutment 7

- Abutment 7 is a Masonry Abutment (Element 217) with a Reinforced Concrete Abutment (Element 215) on top of the stone masonry. Abutment 7 is in poor condition (NBI Rating is 4 out of 9).
- The masonry on the east face of the abutment has minor to moderate cracking throughout. The gout has been re-pointed, but 25% of the grout is heavily deteriorated or missing. There are a few partial missing stones that have caused significant voids in the face. 50% of the stone face is delaminated. There are vines growing on 10% of the abutment face and the face is covered in graffiti. (See photos Abt. 7-1 and 2)
- The concrete abutment beam seat is in satisfactory condition with minor cracking throughout the beams seat and abutment back wall.
- The south face of the concrete abutment has a vertical crack and significant spall, up to 2ft wide and 4in deep, where the abutment backwall meets the wing wall. 80% of the concrete face is delaminated. (See photo Abt. 7-3)

- The masonry retaining wall, which was rebuilt in the 1950s, on the north end of Abutment 7 is in good condition. (See Photo Abt. 7-4)

BRG Bearings (with #515 Steel Protective Coating)

- The bearings at the abutments are in fair condition (NBI Rating is 5 out of 9) with active corrosion and pack rust under the bearing plates. (See Photos BRG-1 through BRG-3)
- The bearings at the approach piers are in poor condition (NBI Rating is 4 out of 9) with active corrosion, pack rust under the bearing plates and section loss of the anchor bolts. (See Photos BRG-4 and BRG-5)
- The bearings for the truss span are in fair condition (NBI Rating is 5 out of 9) with active corrosion and minor section loss of the rivet heads and pitting of the bearing plates. (See Photo BRG-6)
- The stub columns supporting the Span 1 Girders at Pier 2 have active corrosion with pack rust, laminar corrosion, up to 100% web section loss at the base, and flange local buckling at the base. They are in serious condition (NBI Rating is 3 out of 9). (See Photo BRG-7)

330 Metal Bridge Railing (with #515 Steel Protective Coating)

- The bridge railing is in fair condition (NBI Rating is 4 out of 9) and the protective coating has no remaining effectiveness.
- There is active corrosion the entire length of both bridge railings. (See Photo 330-1 and 330-2)
- The pedestrian metal railing is in fair condition with widespread active corrosion. (See Photo 330-3)

850 Secondary Element

- The lateral bracing in the approach spans has active corrosion. The gusset plates have section loss and there is pack rust between the gusset plates and the lateral bracing members. (See Photos 850-1 through 850-3)
- The lateral bracing below the deck of the truss span has similar corrosion. The lateral bracing gusset plates have section loss up to 100%. (See Photo 850-4 though 850-6)
- There is deformation of the lateral bracing between Floorbeams 7 and 8. (See Photo 850-7)
- The lateral bracing on the top chord of the truss has active corrosion. (See Photo 850-8)

853 Utilities

- There is a USGS Water Resource Station attached to the north end of Pier 6. Access to this station attaches to the Broadway Bridge sidewalk. The channels that support the access platform have pack rust and laminating corrosion at their bearings on Piers 6, and there are corrosion holes in the webs and bottom flanges throughout. (See Photos 853-1 and 853-2)
- There are navigation light electric service panels on the downstream truss at panel points L0, L8, and L16 (See Photo 853-3). These navigation lights were checked at dusk for functionality. The red light marking Pier 5 and the green light marking the center of the navigation span were illuminated. The red light marking Pier 6 was not illuminated. (See Photo 853-4)

- The street lights on the bridge do not have utility cables running to them and are not functioning. (See Photo 853-5)
- There are solar panels for the navigation lights located at downstream panel points U2, U8, and U15. (See Photo 853-6)
- There is a 5" diameter pipe and an 8.5" diameter pipe, both suspected gas lines, attached to the bridge. (See Photos 853-7 and 853-8)

859 Vegetation

- There is vegetation, including a 3" diameter tree, growing in the masonry joints of the substructure units. There is also vegetation growing the full length of the bridge in both gutter lines, and a tree growing across the deck near Pier 3. (See Photos 859-1 and 859-2)

OBC Other Bridge Components

- The gates at both ends of the bridge are locked (See Photos OBC-1 and OBC-2). However, pedestrians are climbing around the gates and crossing the bridge.
- The retaining wall north of Abutment 7 is in place and functioning. There is minor vegetation growth on the wall. (See Photo OBC-3)

RECOMMENDATIONS:

Options for the rehabilitation, deck removal, and full superstructure removal of the Broadway Bridge are provided in a Feasibility Report by Palmer Engineering under separate cover. It is recommended that a decision is made quickly due to the continued deterioration of major structural components. In the meantime, there is a risk of falling concrete and other superstructure debris onto the public using River View Park and the Kentucky River beneath the bridge.

Please feel free to call us if you have any questions or require additional information. We will be pleased to discuss any aspect of this project at your convenience.

Sincerely,

PALMER ENGINEERING COMPANY

David E Rust, P.E.
Chief Inspector

Copy: Carl Van Zee, KYTC
Jonathan Kellogg, KYTC
Sara Anderson, City of Frankfort

Photo 12-1: Typical cracking and rutting of the asphalt wearing surface with vegetation growth.

Photo 12-2: 6” long x 3” vertical x full width transition between Spans 4 and 5.

Photo 12-3: Heavy map cracking with efflorescence on the underside of the deck in Span 1.

Photo 12-4: Map cracking with rust staining on the underside of the deck between FB 13 and FB 14 of Span 5.

Photo 12-5: Heavy map cracking with efflorescence and exposed rebar on the underside of the deck in Span 6.

Photo 12-6: Heavy spalling with exposed reinforcement on the underside of the sidewalk in Span 5. The poor condition of the sidewalk concrete is a risk to the public beneath the bridge due to falling of spalled concrete.

Photo 12-7: Plywood protection for spalling concrete under the sidewalk that has become a hazard to boat traffic underneath; the location is around mid-span of span 5 near the blue navigation light.

Photo 107-1: Typical condition of the protective coating on the steel girders. The inside face of Girder 2 in Span 3 is shown.

Photo 107-2: Top flange section loss on the Girder 2 at FB 5 in Span 1. 0.32" thickness out of 3/8" remains of the cover plate.

Photo 107-3: Typical pack rust causing deformation of the top flange cover plate. Girder 2 in Span 3 is shown.

Photo 107-4: Section loss in the Span 4 Girder 1 web at Pier 3. Minimum thickness remaining is 0.185” out of 0.5”.

Photo 107-5: Section loss of the Span 4 Girder 1 web just above the bottom flange adjacent Pier 3. Minimum thickness remaining is 0.22” out of 0.5”.

Photo 107-6: 0.11” deep pitting of the Span 6 Girder 1 web at Pier 6.

Photo 107-7: 1 1/8” of pack rust between the Girder 1 bottom flange cover plate and splice plate in Span 4.

Photo 107-8: 1 ½" pack rust between the Girder 1 bottom flange angles and cover plate in Span 3.

Photo 107-9: Section loss of the Girder 1 bottom flange in Span 6. 0.35" out of 3/8" splice plate thickness remains, 0.46" out of 9/16" cover plate thickness remains, and 0.47" out of 5/8" double angle thickness remains. (Girder 2 is similar)

Photo 107-10: Active corrosion with 100% section loss of the bottom 6" of the Girder 1 end bearing stiffeners over Pier 3.

Photo 113-1: Typical active corrosion of the truss stringers.

Photo 113-2: Stringer 1 has failed at its connection to the east face of FB 12.

Photo 113-3: Stringer 1 has separated from the deck between FB 11 and FB 12 due to its failure adjacent FB 12. The stringer is only being supported as a cantilever by the connection at FB 11.

Photo 113-4: Heavy laminar corrosion of Stringer 4 at the connection to the west face of FB 10.

Photo 113-5: Section loss of the Stringer 4 web (0.3” thickness remains out of 0.305”) and heavy corrosion of both flanges mid-span between FB 2 and FB 3.

Photo 113-6: Minor corrosion of the Stringer 3 web and section loss of the bottom flange (0.45" thickness remains out of 0.54") between FB 12 and FB 13.

Photo 113-7: 6" x 4" hole in the Stringer 4 web at the west face of FB 4. A similar condition also exists on Stringer 4 west of FB 6.

Photo 113-8: The sidewalk stringers exhibit 100% section loss in the web and flanges throughout. Many of the stingers are no longer in contact with the concrete sidewalk above.

Photo 120-1: Overall condition of the truss with peeling paint and exposed metal throughout.

Photo 120-2: 100% section loss of the counter-diagonal pin connection plates at panel point L2 on the downstream truss.

Photo 120-3: 100% section loss of the counter-diagonal pin connection plate at panel point L4 on the downstream truss.

Photo 120-4: 100% section loss of the counter-diagonal pin connection plate at panel point L6 on the downstream truss.

Photo 120-6: 1/16” out of 1/2” thickness remains on the counter-diagonal pin connection plate at panel point L10 on the downstream truss.

Photo 120-7: 100% section loss on the counter-diagonal pin connection plate at panel point L12 on the upstream truss.

Photo 120-8: 100% section loss on the counter-diagonal pin connection plate at panel point L14 on the downstream truss.

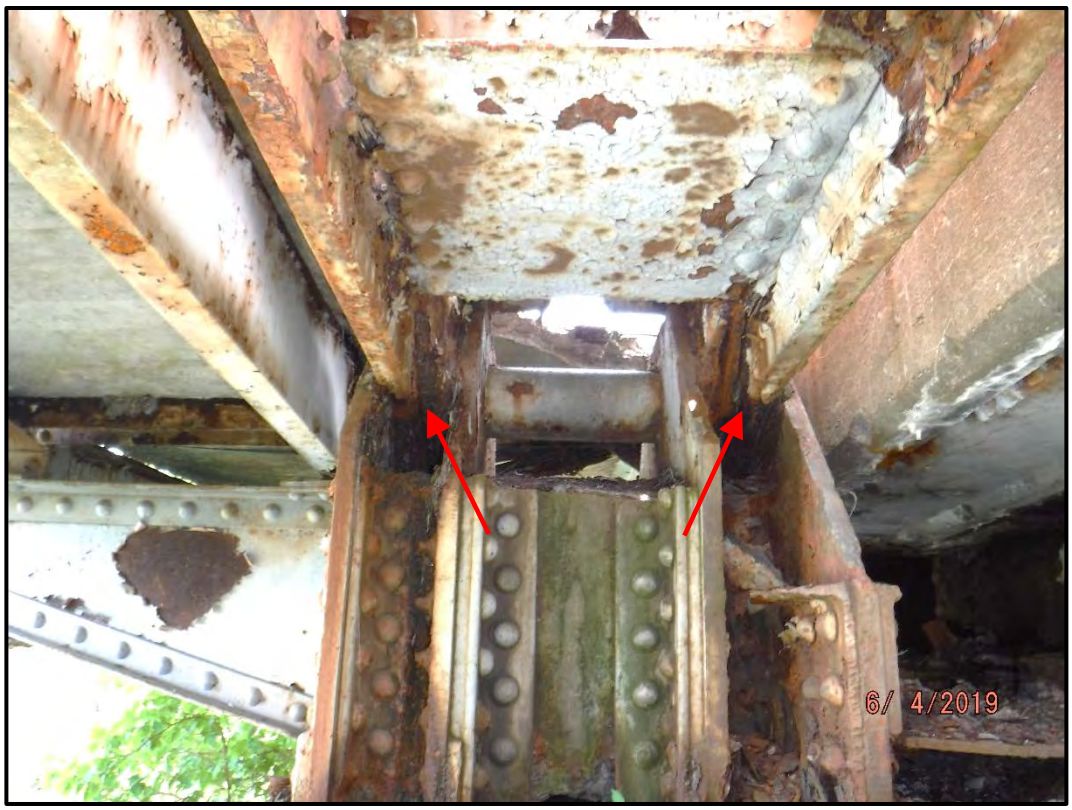

Photo 120-9: 10% section loss of the eyebar heads at panel point L0 on the downstream truss.

Photo 120-10: 10% section loss of the inboard eyebar head at panel point L0 on the upstream truss. The outboard eyebar is in similar condition.

Photo 120-11: 15% section loss of the outboard eyebar head at panel point L16 on the downstream truss. The inboard eyebar is in similar condition.

Photo 120-12: 15% section loss of the outboard eyebar head at panel point L16 on the upstream truss. The inboard eyebar is in similar condition.

Photo 120-13: Active corrosion and pitting on the eyebar head at panel point L7 on the upstream truss. 9/16" out of 3/4" thickness remains.

Photo 120-14: Pack rust and section loss on the lower chord pin connection at L8 on the downstream truss.

Photo 120-15: Pack rust and section loss on the lower chord pin connection at L8 on the upstream truss.

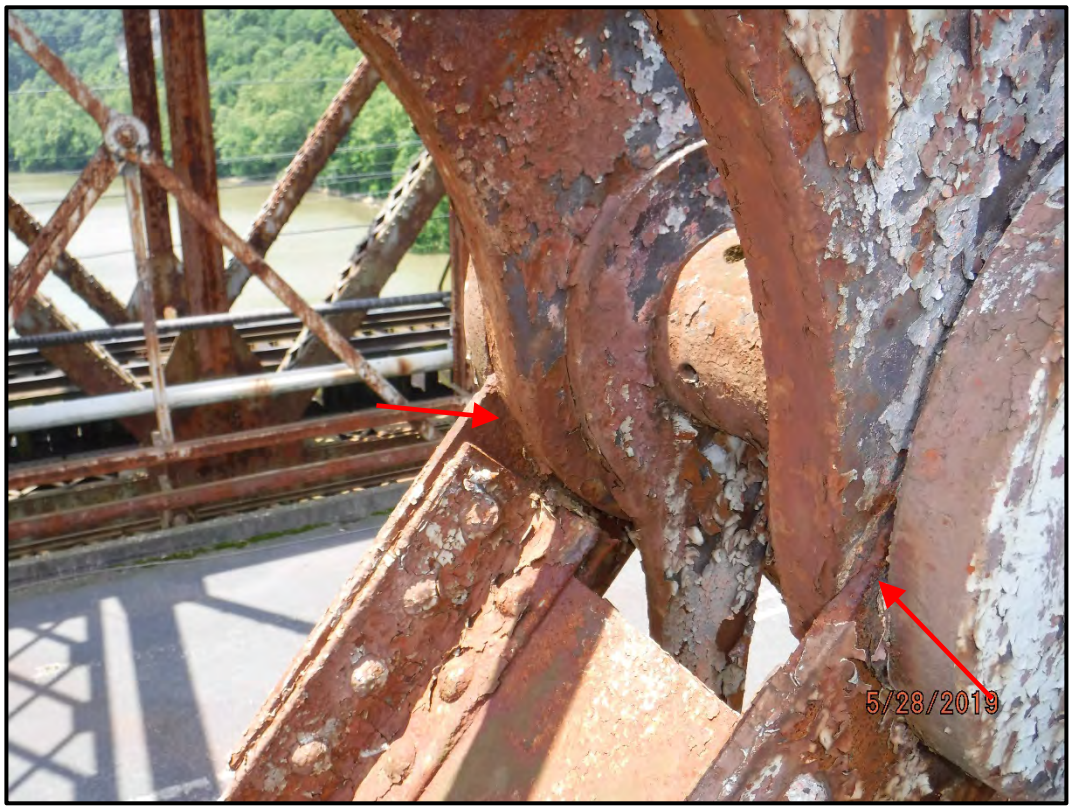

Photo 120-16: Eyebars at panel point M3 on the downstream truss have up to 1/16” deep pitting. Note the 50% section loss of the counter-diagonal pin connection plates.

Photo 120-17: Eyebars at panel point M11 on the downstream truss have up to 1/16” deep pitting.

Photo 120-18: Eyebars at panel point M5 on the upstream truss have up to 1/16” deep pitting.

Photo 120-19: No measurable section loss of eyebar members and plates inside the upper chord at panel point U2 on the upstream truss.

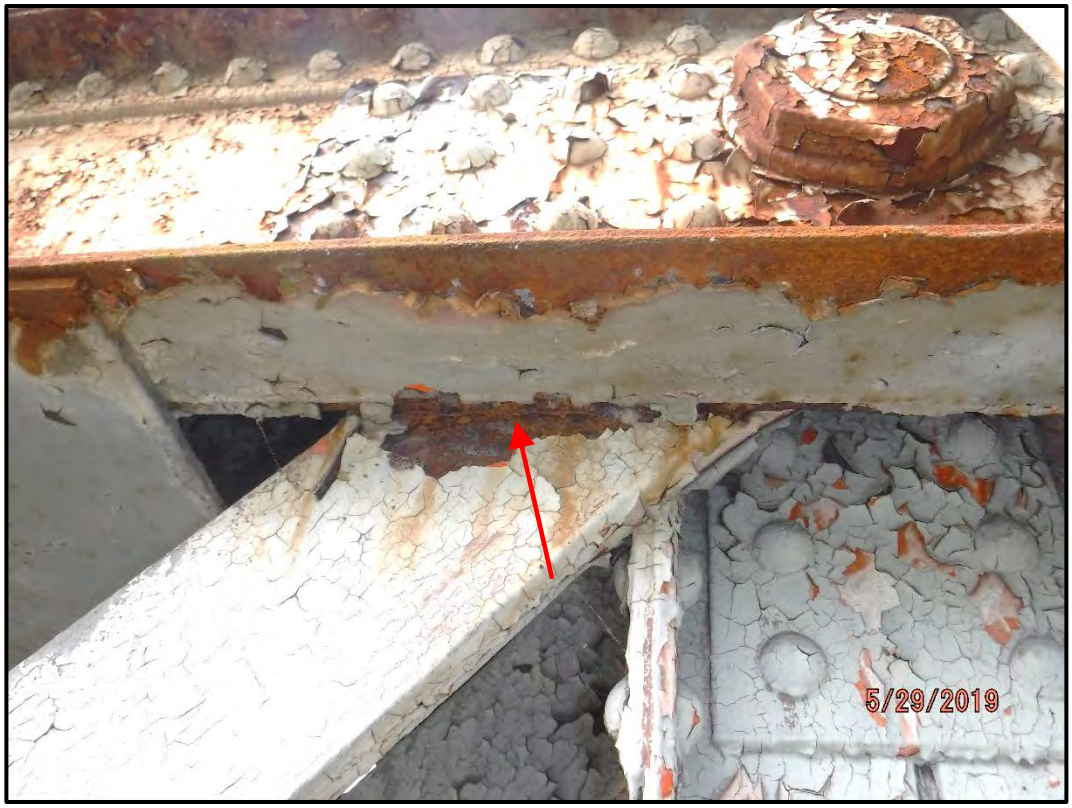

Photo 120-20: Outboard eyebar at panel point U12 on the downstream truss has 1/16” section loss due to fretting corrosion and pack rust between it and the upper chord member.

Photo 120-21: Outboard eyebar at panel point U14 on the upstream truss has 1/16" section loss due to fretting corrosion and pack rust between it and the upper chord member.

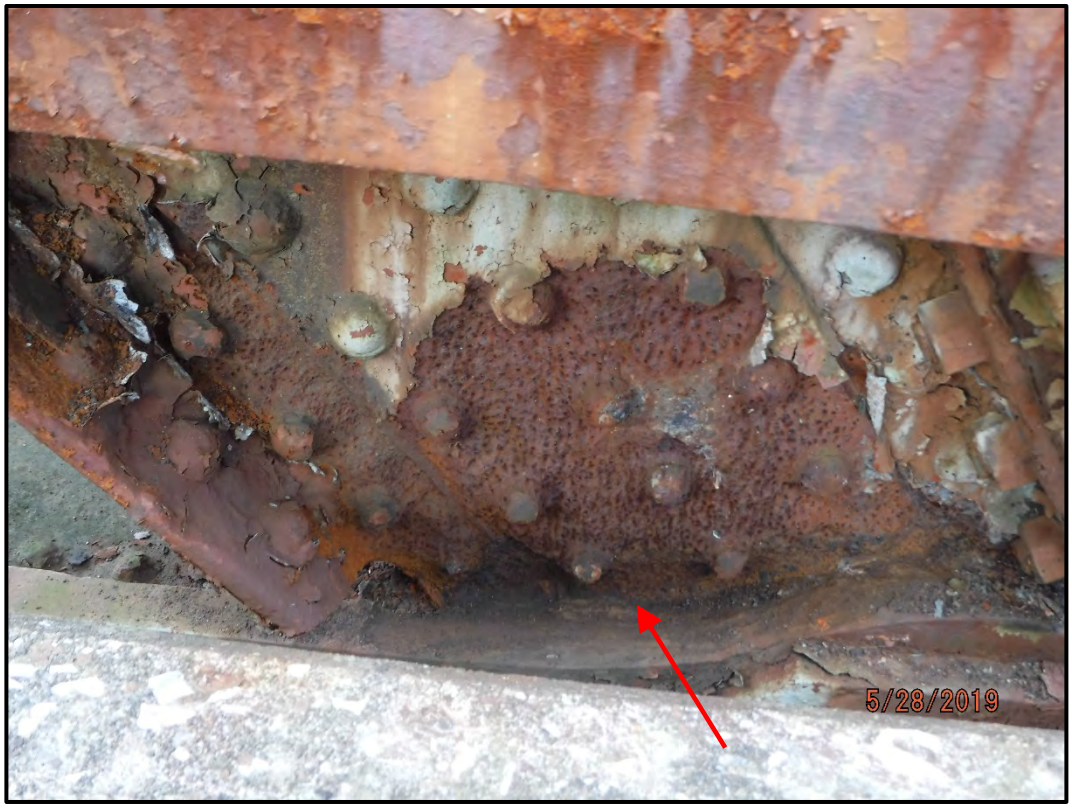

Photo 120-22: Pitting of the ¾" stiffening plate on the inboard face of downstream truss member L0-U2 at panel point L0. Note the 50% section loss of the rivet heads directly above the eye bar.

Photo 120-23: Typical 9/16” pack rust and 1/4” pitting of the upper chord along the top flange splice plate at panel point U8 on the upstream truss.

Photo 120-24: 7/8” pack rust and 7/16” deep pitting of the upstream U6-U8 upper chord at panel point U6. The pitting is 1 1/2” wide and extends 15” across the top flange plate with a 1” diameter corrosion hole. The nominal plate thickness is 1/2”. This is the worst-case upper chord pitting.

Photo 120-25: Close-up of Photo 120-24.

Photo 120-26: Typical 1/8” deep pitting that is collecting debris on the upper chord bottom flange angle. Picture is of the downstream truss between panel points U10 and U12.

Photo 120-27: 7/16" deep pitting of the upstream truss upper chord member U2-U4 bottom flange angle located 4 feet from panel point U2. The nominal angle thickness is 5/8".

Photo 120-28: The washer on the outboard face of the pin at downstream truss panel point U6 has broken and only 50% of the washer is in contact with the pin nut.

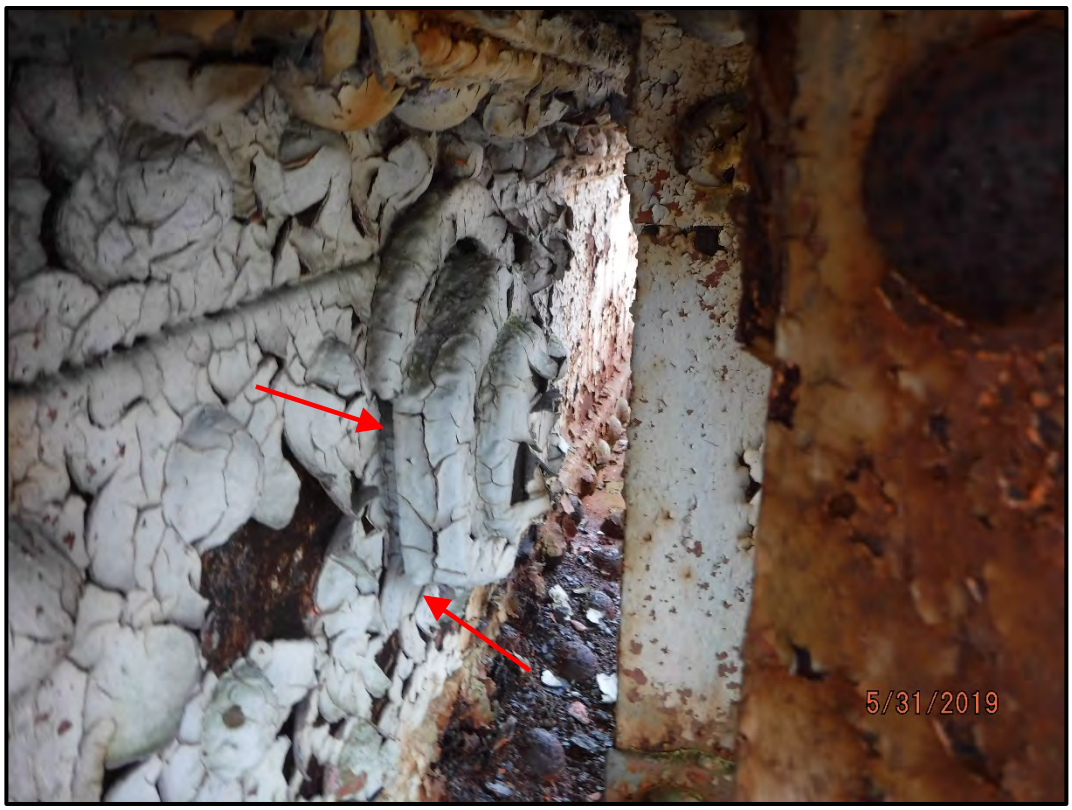

Photo 120-29: The washer on the inboard face of the downstream pin at U10 has broken and only 20% of the washer is in contact with the pin nut.

Photo 120-30: Corrosion holes in the lacing bars and connection angles of member L0-L2 on the downstream truss.

Photo 120-31: Corrosion holes in the lacing bars and connection angles of member L14-L16 on the downstream truss.

Photo 120-32: Impact damage to member L0-U2 on the upstream truss just above the traffic rail. One rivet is severed and there is a tear in the top flange plate connection angle.

Photo 120-33: Impact damage has distorted the inboard eyebar of downstream truss member L11-M11 1 1/2" to the east at the traffic rail welded connection (which is a fatigue-prone detail in and of itself).

Photo 120-34: Impact damage to the inboard eyebar of downstream truss member L11-M11 after MT was performed. No crack indications were found.

Photo 152-1: Severe section loss and multiple holes in the web of the Span 4 floorbeam at Pier 3. Other floorbeams over the piers have similar section loss.

Photo 152-2: There is heavy laminar corrosion with up to 100% section loss in the web of the floorbeam at Abutment 1.

Photo 152-3: Typical active corrosion of the floorbeams. The floorbeams in Span 3 are shown.

Photo 152-4: Floorbeam 0 in the truss span is severely deteriorated with failure imminent.

Photo 152-5: Floorbeam 16 of the truss span is severely deteriorated with failure imminent.

Photo 152-6: There is active corrosion with section loss at the bottom of the web of Floorbeam 1. There is a corrosion hole in the web 2.5' from the upstream end of the floorbeam.

Photo 152-7: There is active corrosion with up to 100% section loss on the web and bottom flange of Floorbeam 4. There is 0.4" section remaining of the bottom flange.

Photo 152-8: There is active corrosion with section loss of the top flange and web of Floorbeam 12 adjacent to Stringer 1. There is 0.25" remaining thickness of the top flange and 0.36" remaining thickness of the web.

Photo 152-9: There is active corrosion with section loss on the upstream end of Floorbeam 8. The section loss measures 8.5"x2" and there is 0.18" thickness remaining.

Photo 152-10: There is efflorescence and active corrosion on the web and bottom flange of Floorbeam 10 under Stringer 4. There is 0.4" remaining on the bottom flange.

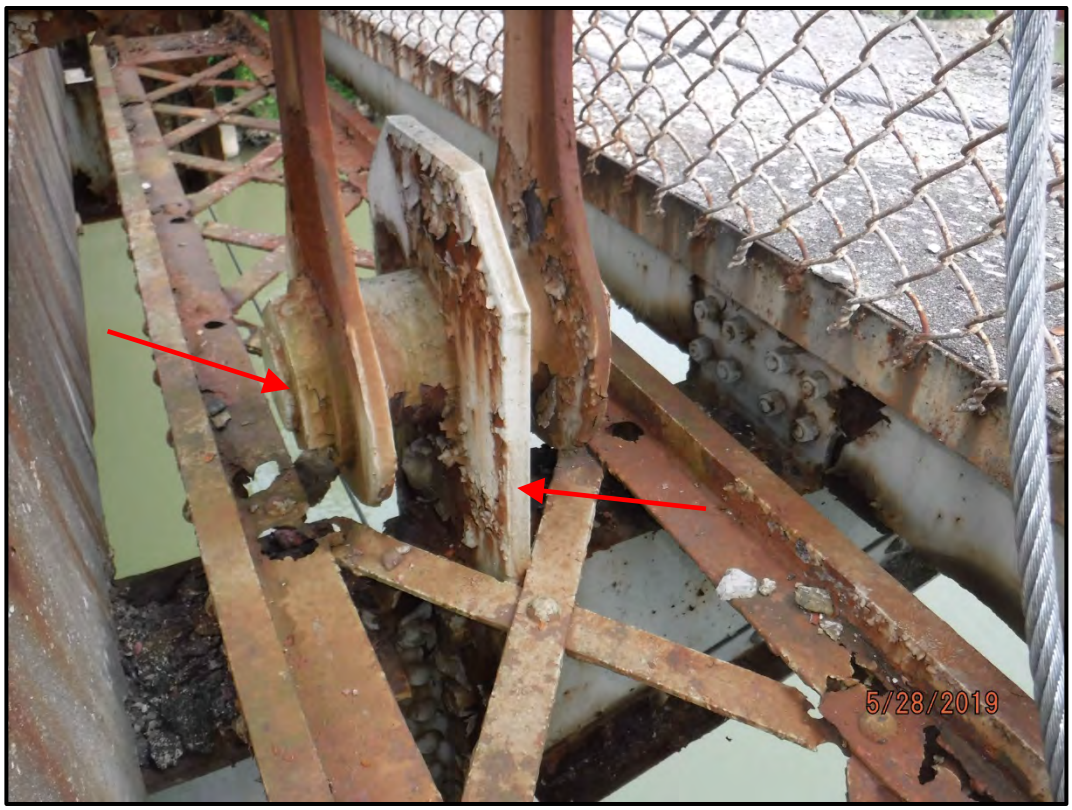

Photo 161-1: Typical truss pin and floorbeam hanger. Panel point L1 on the downstream truss is shown.

Photo 161-2: Typical mid-height panel point pin and collar. Note the hole in the collar that appears to have been drilled, perhaps to measure the collar thickness and pin diameter.

Photo 161-3: Typical upper chord pin and collar. Note there is less corrosion than the mid-height and lower chord panel points.

Photo 161-4: Pin at panel point L2 of the downstream truss has 1" of section loss. 4" diameter remains out of a 5" nominal diameter.

Photo 161-5: Floorbeam hanger at panel point L1 on the downstream truss exhibits worst case section loss with 0.28” remaining out of 1” nominal thickness.

Photo 161-6: 3/8” deep pitting of the floorbeam hanger at panel point L7 downstream. The depicted pitting is typical beneath the pins.

Photo 161-7: 5/16" deep pitting of the floorbeam hanger at panel point L11 downstream. The depicted pitting is typical along the top of the floorbeam connection angles.

Photo Abt. 1-1: Face of Abutment 1. Note full length horizontal cracks with scaling and pop outs throughout the entire face of abutment along with a few vertical cracks with efflorescence.

Photo Abt. 1-2: Cracking with heavy efflorescence and spalling in the Abutment 1 backwall behind Girder 2. Note the scaling on the face of the abutment.

Photo Abt. 1-3: Spalling with exposed reinforcement at the top of the Abutment 1 back-wall on the exterior face of Girder 2.

Photo P2-1: East face of Pier 2. Only minor deterioration is present.

Photo P2-2: West face of Pier 2. Only minor deterioration is present.

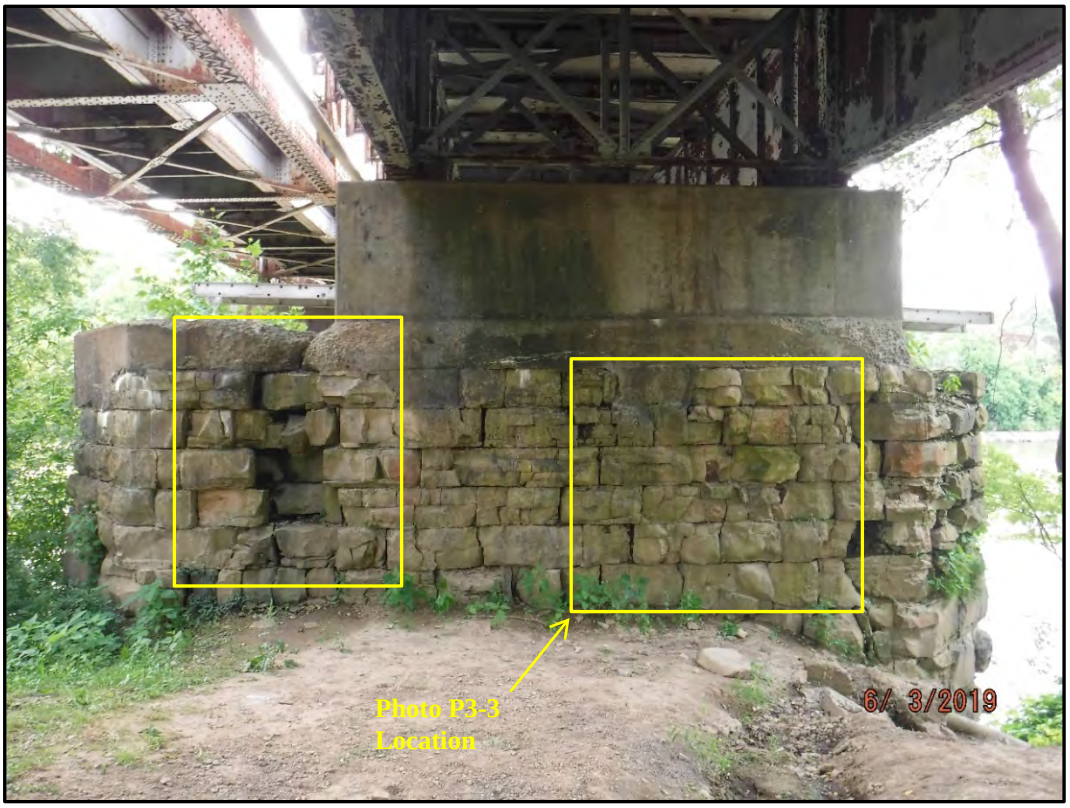

Photo P3-1: East face of Pier 3. Note the heavy cracking of the stones throughout and the large 2ft wide x 5ft tall x 2.5ft deep void at the south end of the concrete beam seat.

Photo P3-2: A drainage issue has caused heavy deterioration on the south end of the Pier 3 cap adjacent to the beam seat. This deterioration has formed a ditch in the cap that is 30in wide by 18in deep at the east edge of the cap.

Photo P3-3: Close-up of the typical masonry cracking and heavy deterioration of the mortar on the north end of the Pier 3 east face.

Photo P3-4: Northeast face of Pier 3. Note the heavy cracking and voids that are 3in wide and up to 2.5ft deep.

Photo P3-5: Southeast face of Pier 3.

Photo P3-6: West face of Pier 3. Note the heavy cracking and deterioration of the bottom 8ft and exterior of the concrete beam seat. The top 10ft directly under the concrete beam seat is in fair condition with minor cracking.

Photo P3-7: Close-up of the typical heavy masonry cracking and deterioration of the mortar on the south end of the Pier 3 west face. Note the higher concentration of cracking in the top 8ft that is exterior of the concrete beam seat.

Photo P3-8: Minor to moderate cracking and delamination on the north end of the Pier 3 west face. Note the higher concentration of cracking exterior of the concrete beam seat.

Photo P3-9: Northwest face of Pier 3. With heavy cracking and delamination throughout. Note the vegetation growing in the voids.

Photo P4-1: East face of Pier 4 has horizontal and vertical cracking with efflorescence throughout.

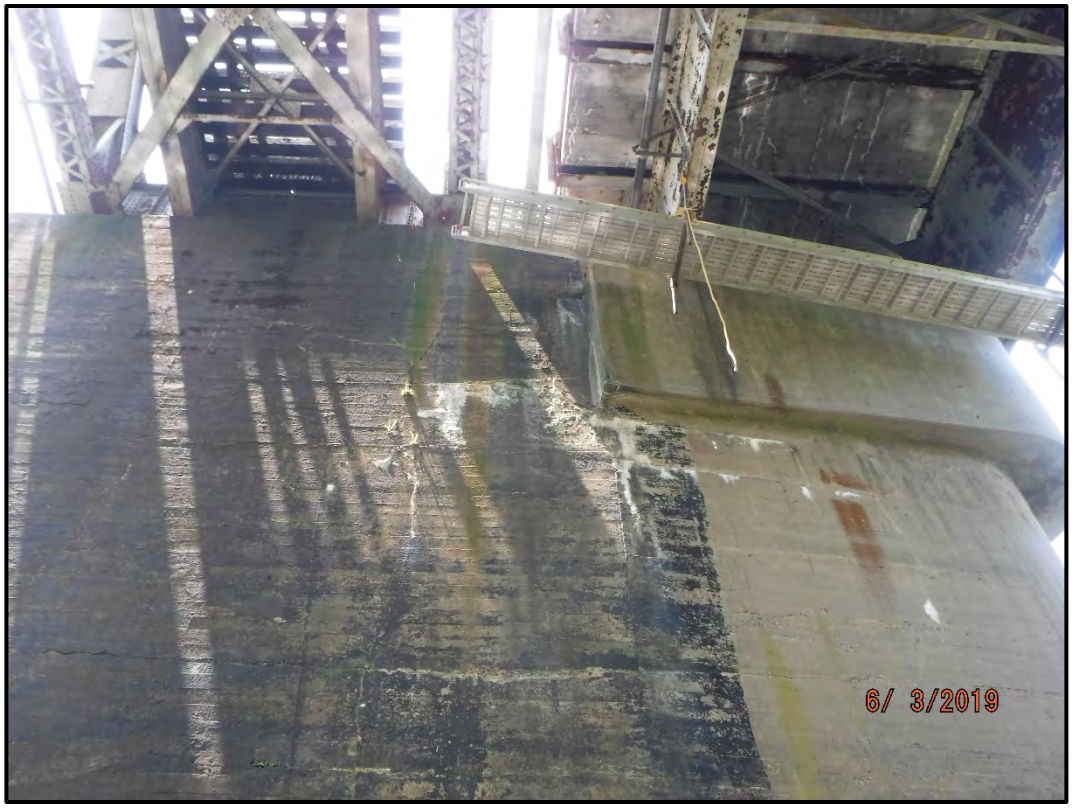

Photo P4-2: Close-up of the cracking with heavy efflorescence on the east face of Pier 4 under the pier cap. Notice the horizontal cracking is consistent with the masonry joints that are encased in concrete.

Photo P4-3: Close-up of the cracking with efflorescence on the south end of the Pier 4 east face.

Photo P4-4: South face of Pier 4. Note the cracking with heavy efflorescence near the top of the pier and the debris collected on the upstream face of the pier.

Photo P4-5: West face of Pier 4. Note the cracking with rust staining and efflorescence throughout and the debris collecting on the pier.

Photo P4-6: North face of Pier 4. There is rust staining on the pier wall directly below the pier cap. Note the 1ft wide honeycombing 10ft above the water line along with horizontal and vertical cracking with efflorescence.

Photo P5-1: East face of Pier 5 with vertical cracks extending the full height of the masonry. Note the large amount of vegetation on the pier and the heavy deterioration of the masonry at the water line.

Photo P5-2: Vertical cracking on the east face of Pier 5 under Girder 2 that extends from the pier cap to the water line. Note how the cracks get wider as they extend downward and the amount of vegetation on the pier.

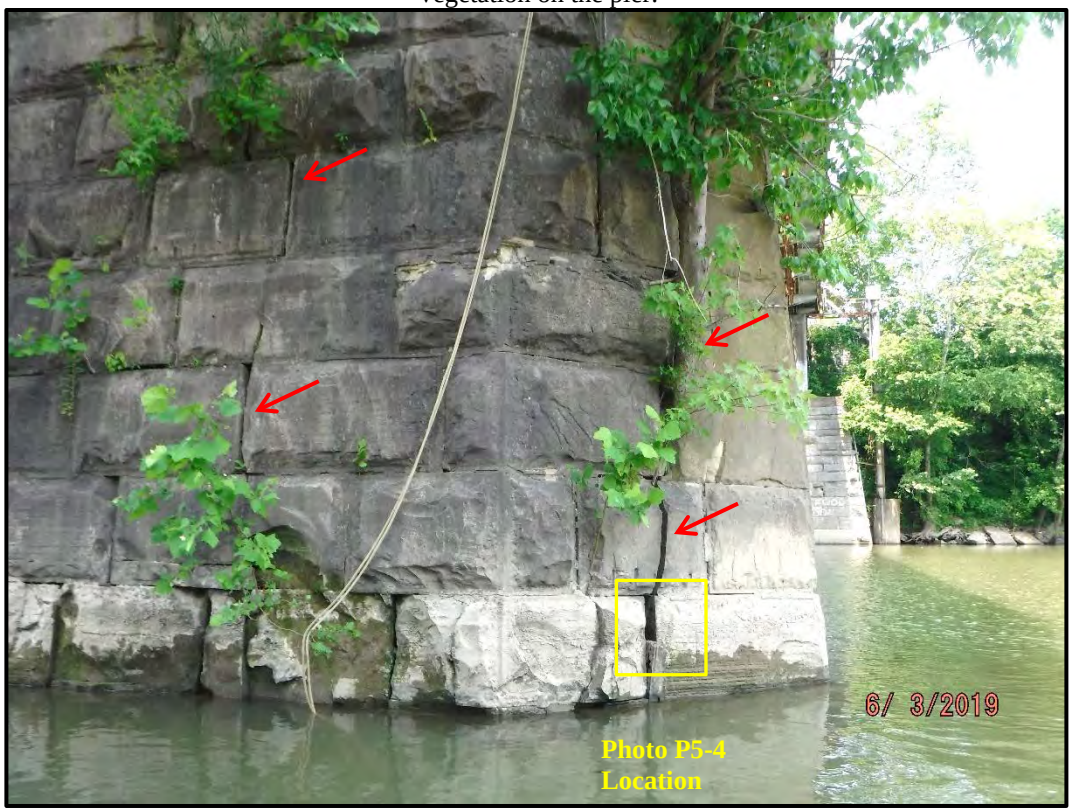

Photo P5-3: 3in diameter tree growing from a void in the north east face of Pier 5. Note the vertical crack in the stone under the tree and the vertical crack on the east face that extends from the pier cap to the water line.

Photo P5-4: A 3in wide by 43in deep void between stones at the water line on the north east face of Pier 5 under the 3in diameter tree.

Photo P5-5: Vertical cracking on the east face of Pier 5 that extends from the pier cap, at the south edge of the truss beam seat, to the waterline with the crack width increasing to 7/8in wide at the waterline.

Photo P5-6: Vertical cracking on the east face of Pier 5 that extends from the pier cap, at the south edge of the truss beam seat, to the waterline with the crack width increasing to 7/8in wide at the waterline.

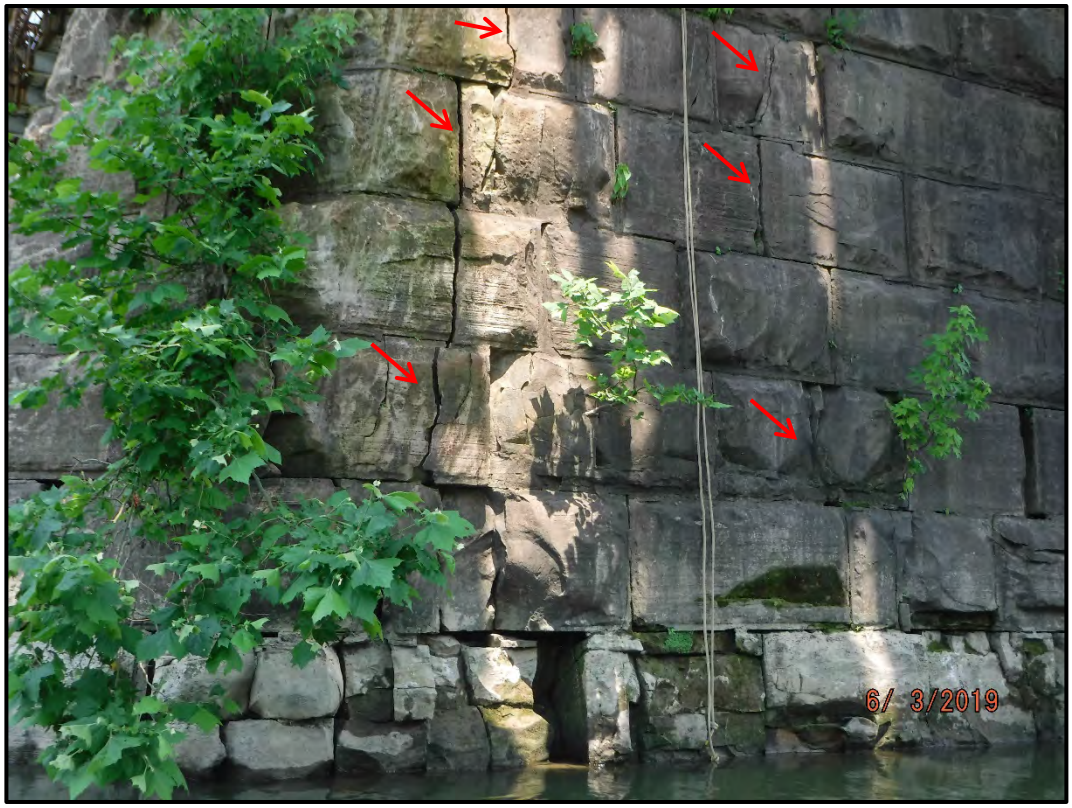

Photo P5-7: Vertical crack on the east face of Pier 5 that extends from the pier cap, at the south edge of the truss beam seat, to the waterline with the crack width increasing to 7/8in wide at the waterline. Note the typical heavy cracking of the stone at the waterline.

Photo P5-8: South face of Pier 5.

Photo P5-9: Rust staining from the top stones on the southeast face of Pier 5. Note the vertical cracking that extends from the pier cap to the water line and the vegetation growing in the cracks.

Photo P5-10: Vertical cracking on the south face of Pier 5 that extends from the pier cap to the water line and the vegetation growing in the cracks.

Photo P5-11: Vertical cracking on the south west face of Pier 5 that extends from the pier cap to the water line and the vegetation growing in the cracks.

Photo P5-12: West face of Pier 5 has rust staining from the top row of stones and 3 full height vertical cracks, one in the middle and then one on each end. Note the vegetation and the heavy cracking of the stones near the water line. The voids near the middle of the pier appear to be from shoring when the superstructure was built.

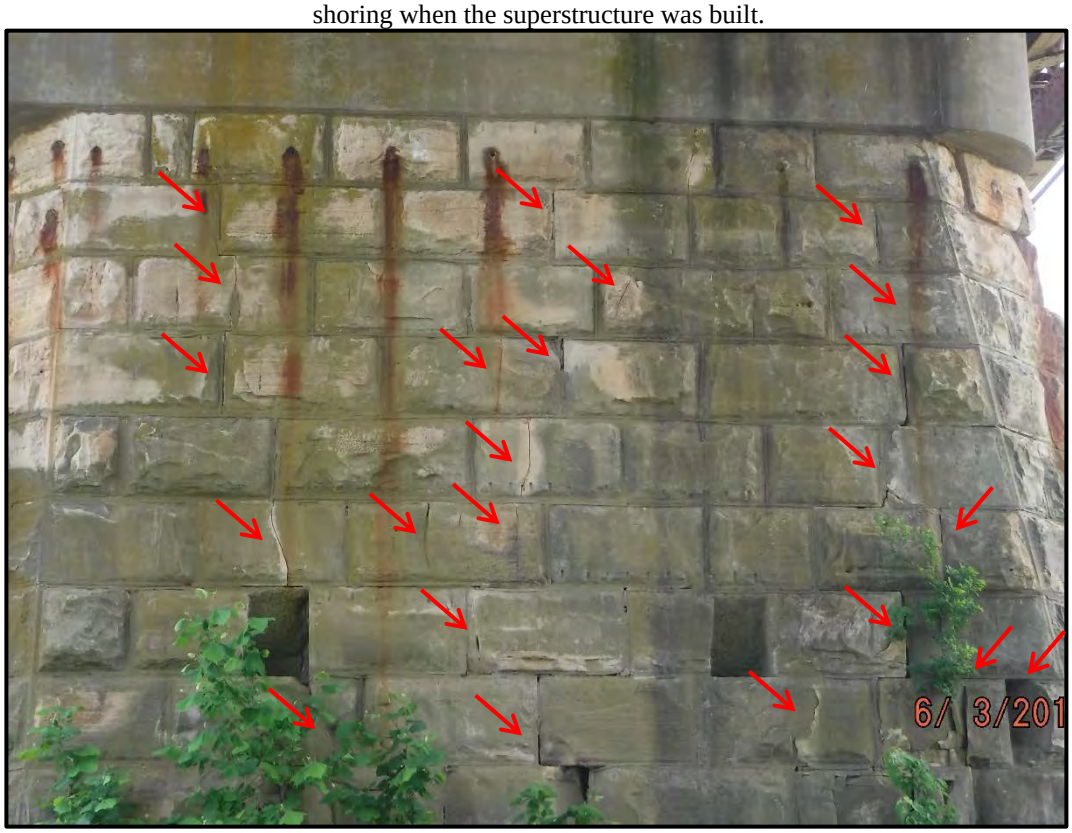

Photo P5-13: West face of Pier 5 has rust staining from the top row of stones and 3 full height vertical cracks, one in the middle and then one on each end.

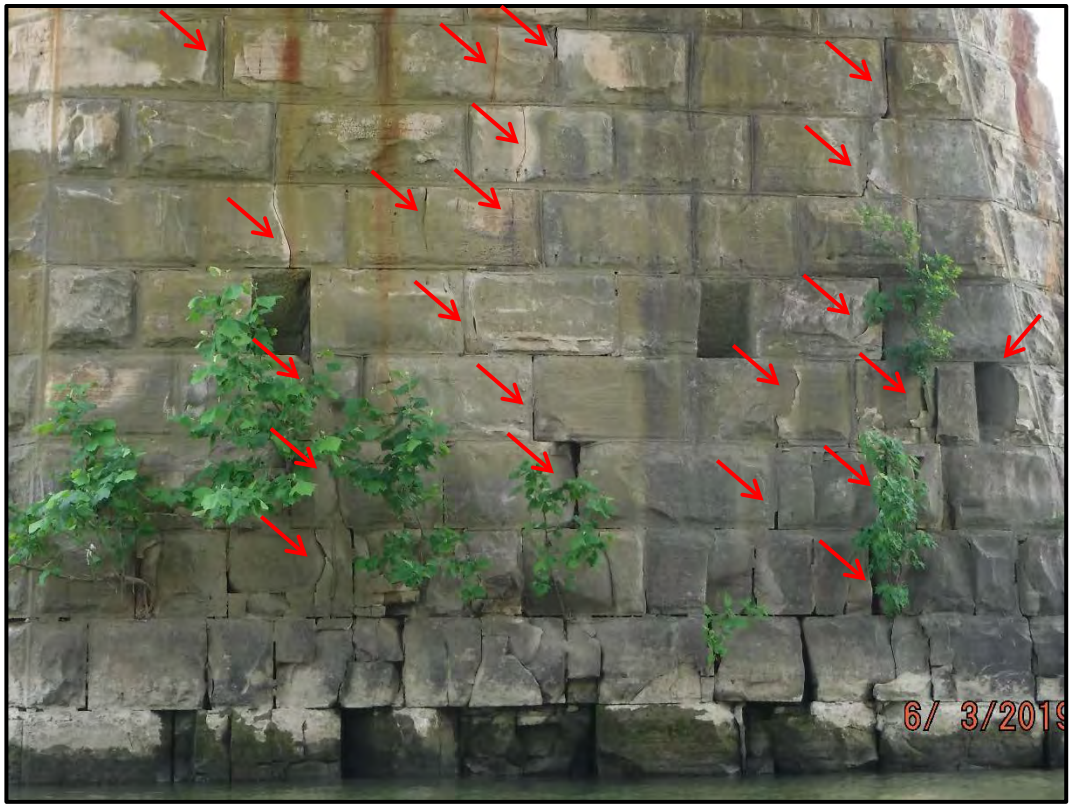

Photo P5-14: West face of Pier 5 has 3 full height vertical cracks, one in the middle and then one on each end. Note the vegetation and the heavy cracking of the bottom 3 rows of stones near the water line.

Photo P5-15: North face of Pier 5. Note the 3in diameter tree growing from the pier and the large cracks near the water line.

Photo P5-16: Vertical cracking on the northwest face of Pier 5 that extends the full height of the pier.

Photo P5-17: Heavy vertical cracking and mortar deterioration on the northwest face of Pier 5 at the water line that extends the full height of the pier.

Photo P5-18: Minor cracking with efflorescence on east face of the Pier 4 cap, typical throughout.

Photo P6-1: East face of Pier 6.

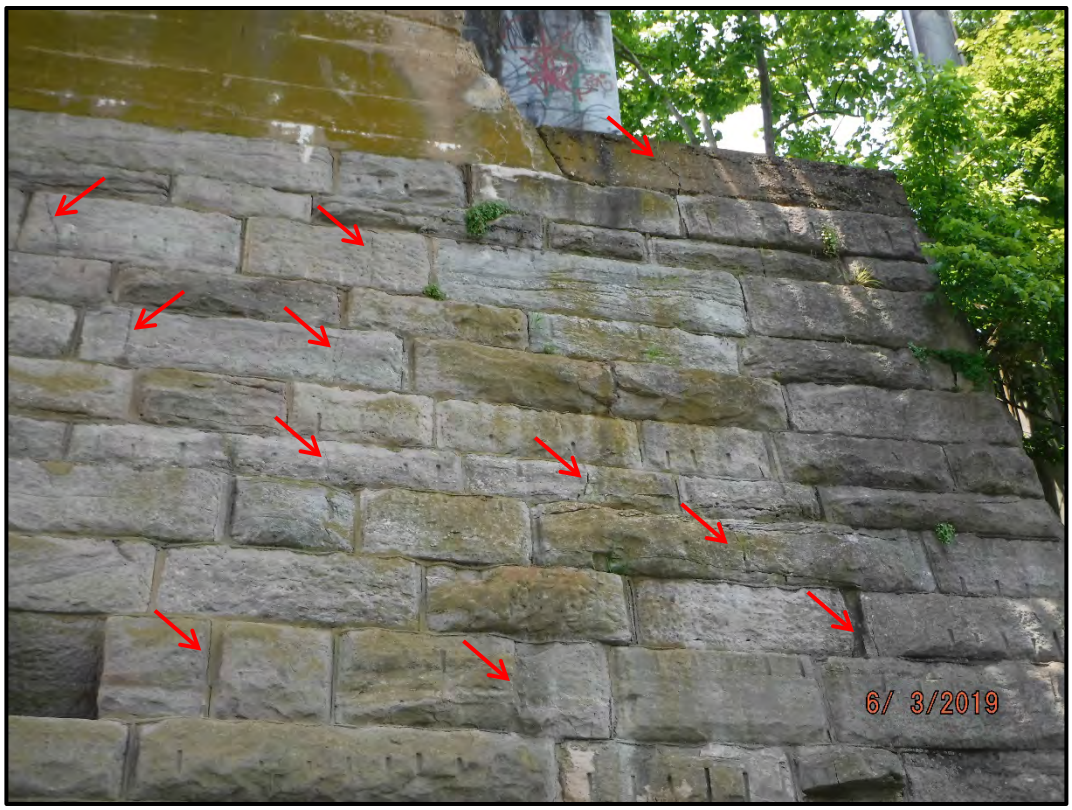

Photo P6-2: Minor cracking throughout the north end of the Pier 6 east face.

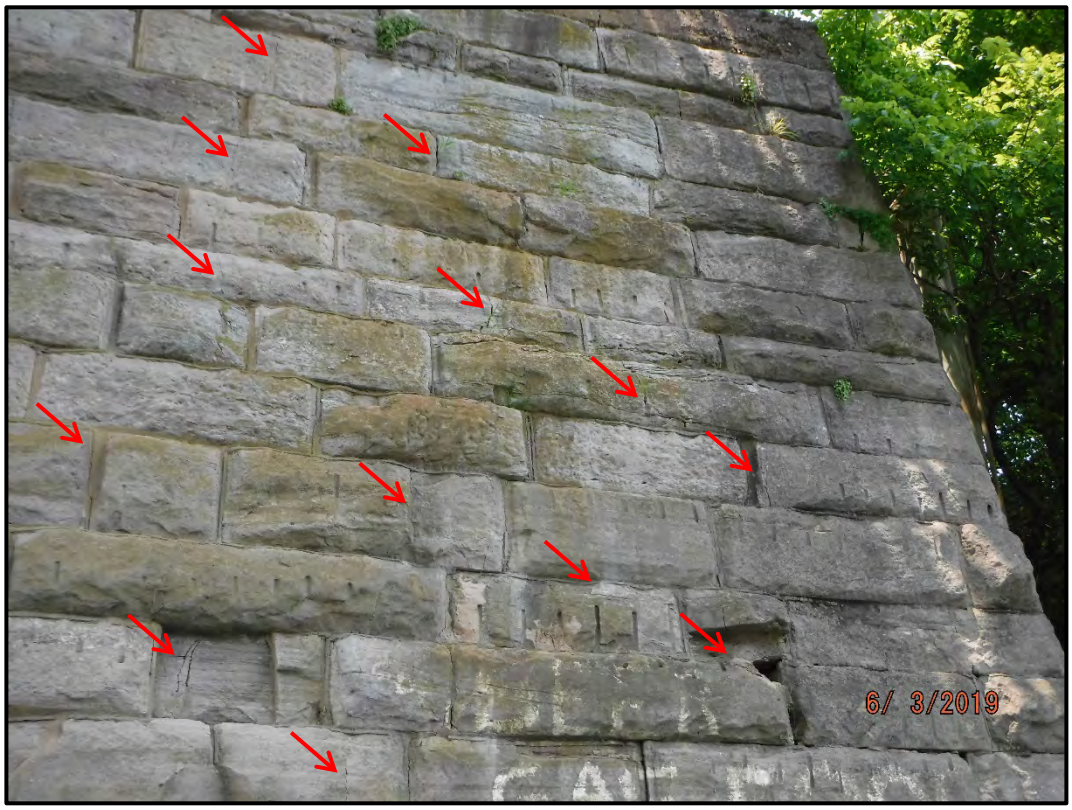

Photo P6-3: Minor cracking throughout the north end of the Pier 6 east face.

Photo P6-4: Minor cracking throughout the north end of the Pier 6 east face. Note the 2 sections of partial missing stones and that the stones at the waterline are encased in concrete. The stones at the waterline have vertical cracks spaced at 2ft.

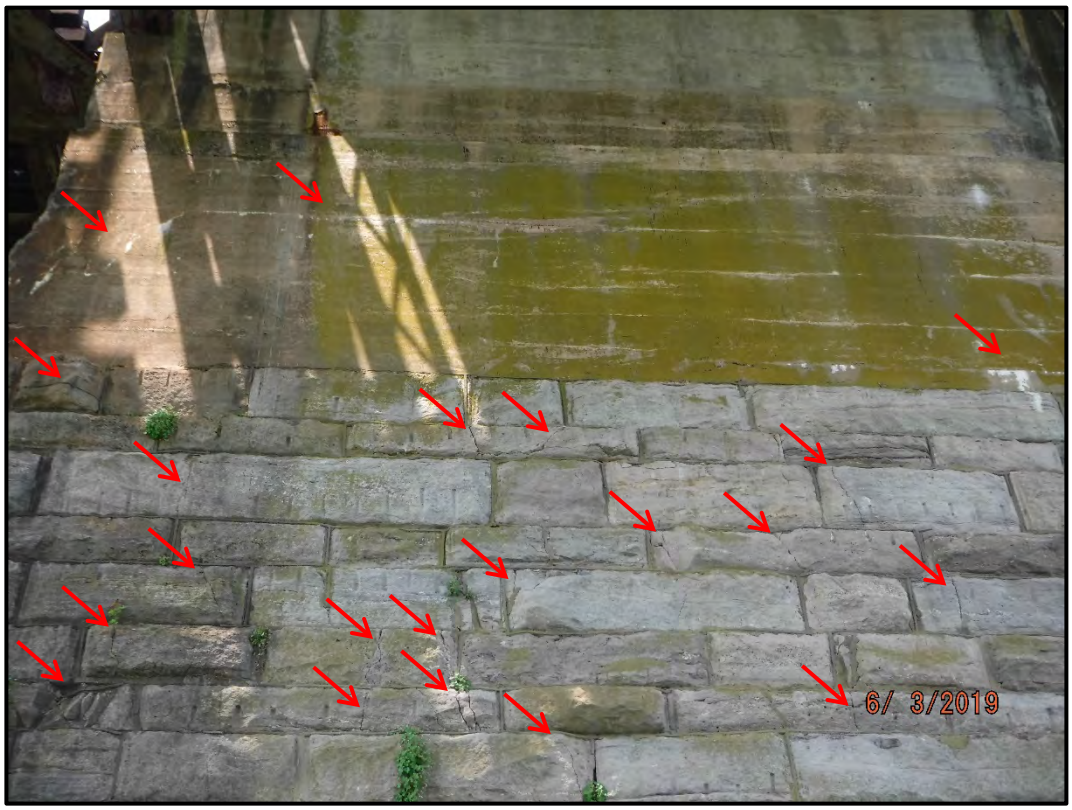

Photo P6-5: Minor cracking throughout the middle of the Pier 6 east face. Note the cracking with efflorescence on the face of the concrete pier cap.

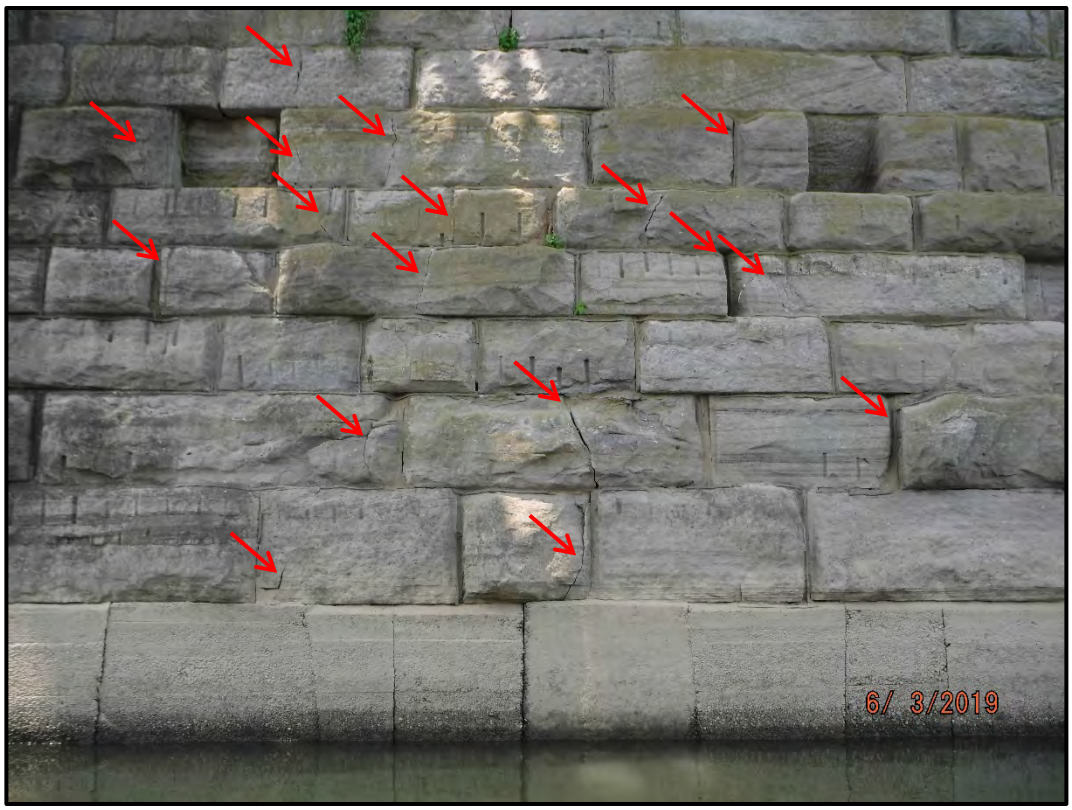

Photo P6-6: Minor cracking throughout the middle of the Pier 6 east face. Note the stones at the waterline are encased in concrete and have vertical cracks spaced at 2ft.

Photo P6-7: Minor cracking throughout the south end of the Pier 6 east face. Note the deterioration of the cap concrete and the heavy efflorescence.

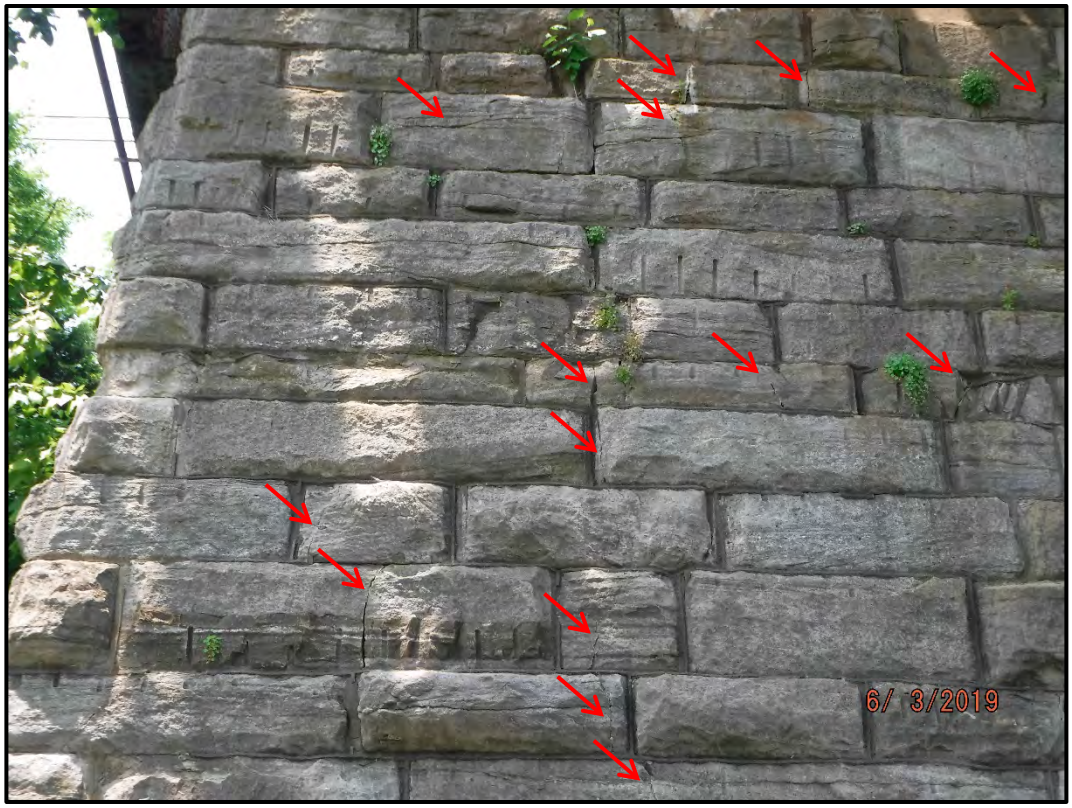

Photo P6-8: Minor cracking throughout the south end of the Pier 6 east face.

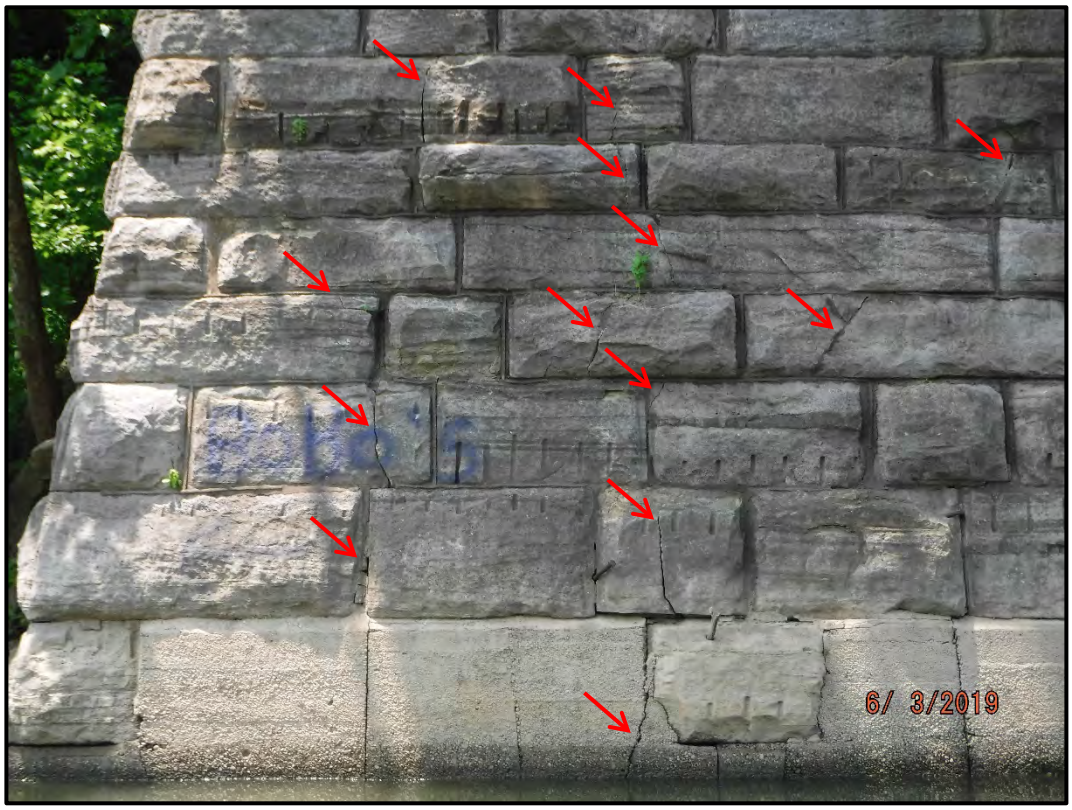

Photo P6-9: Minor cracking throughout the south end of the Pier 6 east face. Note the stones at the waterline are encased in concrete and have vertical cracks spaced at 2ft.

Photo P6-10: 6ft by 6ft area on the south end of the Pier 6 concrete cap east face has heavy map cracking with efflorescence and is delaminated.

Photo P6-11: Spalling and deterioration on the south east corner of the Pier 6 concrete cap. Note the map cracking with efflorescence throughout. The north east corner of the concrete cap is similar.

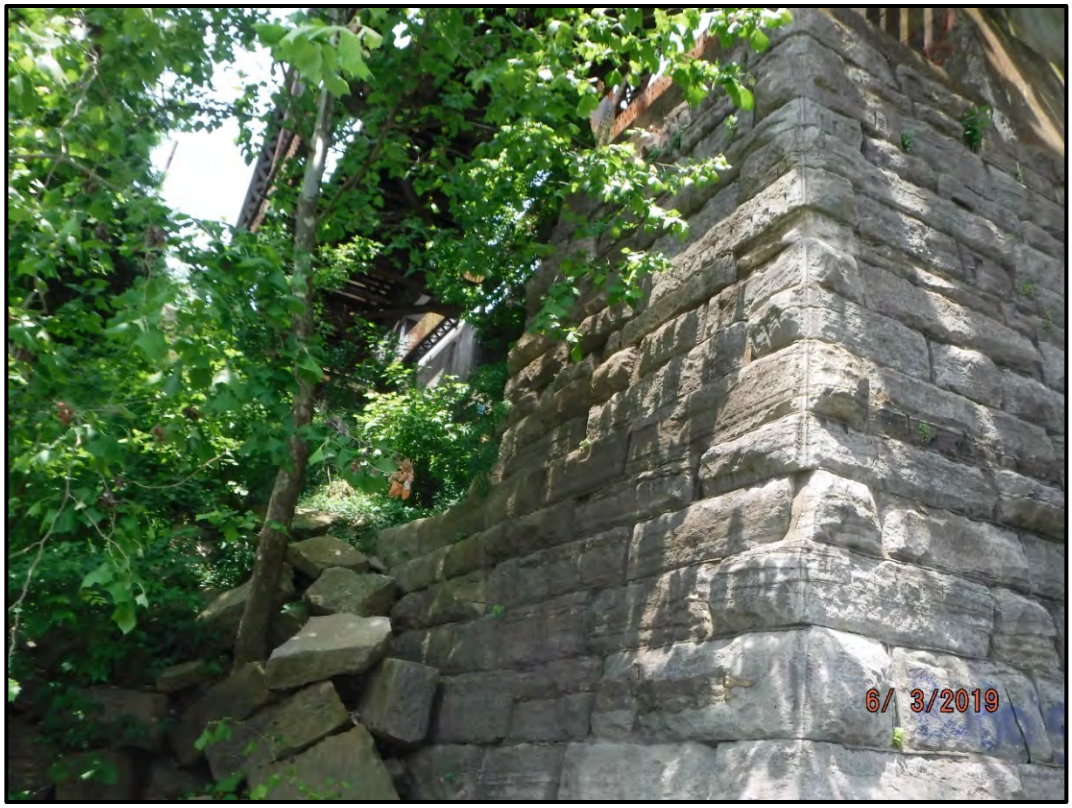

Photo P6-12: South face of Pier 6.

Photo P6-13: West face of Pier 6.

Photo P6-14: West face of Pier 6. Moderate cracking on the south end with delamination of the stone face around the cracks. Note the heavy deterioration of the pier cap concrete and heavy efflorescence, where the outer cement layer is flaking off.

Photo P6-15: Heavy cracking of the stones at the centerline of Pier 6 on the west face. Note the moderate cracking throughout the remaining stones and the graffiti on the concrete face.

Photo P6-16: Cracking on the north end of the Pier 6 west face. Note the heavy efflorescence on the stone and the deterioration of the concrete cap.

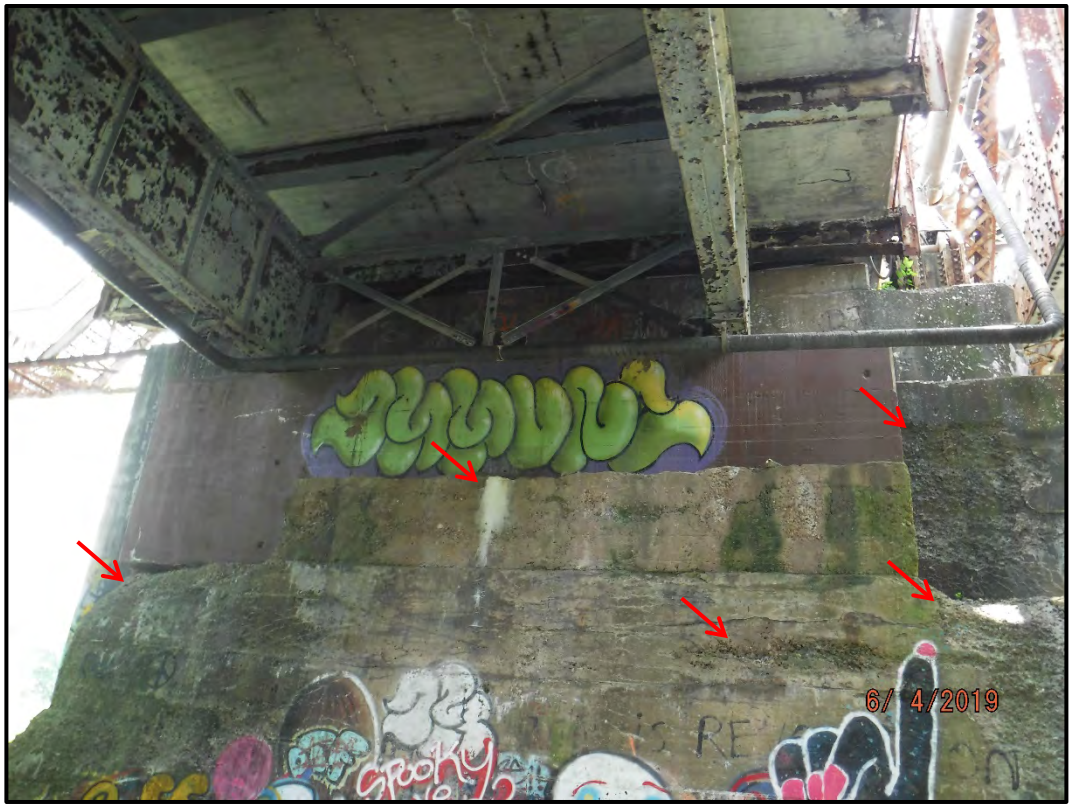

Photo P6-17: West face of the Pier 6 concrete cap has map cracking and deterioration throughout that has caused the exterior layer of cement to crumble. Note the heavy efflorescence at the center line of the cap.

Photo P6-4: North face of Pier 6.

Photo Abt. 7-1: East face of Abutment 7. Note the cracking, mortar deterioration, and voids in the stone.

Photo Abt. 7-2: Close-up of the voids on the south end of the Abutment 7 east face.

Photo Abt. 7-3: Vertical crack and large 4in deep spall on the south face of Abutment 7 where the backwall meets the wing wall.

Photo Abt. 7-4: Retaining wall north of Abutment 7 is in good condition.

BRG-1: Abutment 1 bearing. There is pack rust on the bearing rocker.

BRG-2: Abutment 7 bearing. There is section loss of the anchor bolt head.

BRG-3: Abutment 7 bearing. There is pack rust on the bearing rocker.

BRG-4: Span 3 bearing at Pier 3. There is section loss of the anchor bolt head.

BRG-4: Span 3 bearing at Pier 3. There is pack rust on the bearing rocker.

BRG-5: Bearing of the upstream truss. There is active corrosion with section loss of the rivet heads and pitting on the bearing plates.

BRG-7: Typical stub column at Pier 2 under Girder 2 of Span 1. There is active corrosion and section loss up to 100% at the base of the column.

Photo 330-1: Typical condition of the downstream metal bridge rail. Active surface corrosion with minor pitting corrosion is typical along both bridge rails for the entire length of the bridge.

Photo 330-2: Up close view of corrosion on bridge railing. The downstream rail at L8 is shown.

Photo 330-3: Pedestrian bridge railing on downstream side is in fair condition with widespread active corrosion.

Photo 850-1: Typical underside of Span 4 showing lateral bracing and steel diaphragm. Moderate corrosion is apparent on the lateral bracing.

Photo 850-2: Typical lateral bracing in Span 1.

Photo 850-3: Typical top flange lateral bracing connection. There is active corrosion with section loss of the plates with pack rust between the lateral bracing members and the plates.

Photo 850-4: Typical underside of Span 5 looking east showing lower lateral bracing in the truss spans.

Photo 850-5: Active corrosion with corrosion hole in the lateral bracing gusset plate at the downstream end of Floorbeam 8.

Photo 850-6: Active corrosion on the lateral bracing connection on the downstream end of Floorbeam 4.

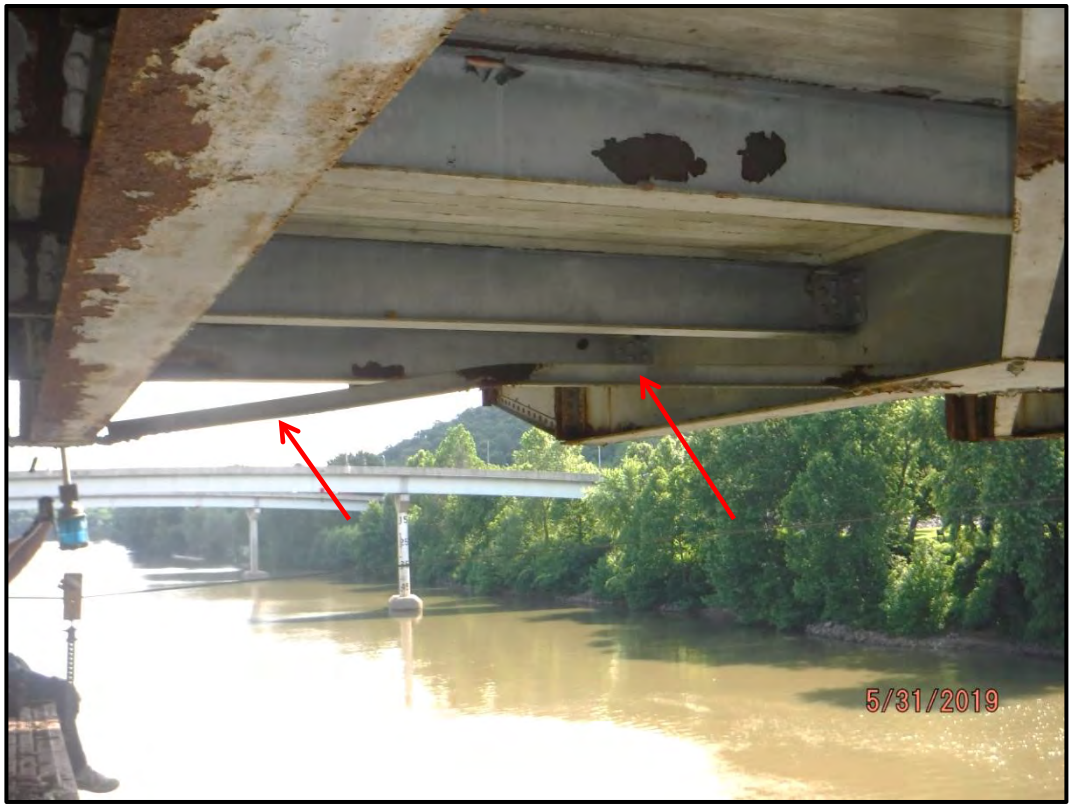

Photo 850-7: Deformation of the lateral bracing between L8 and L7.

Photo 850-8: Typical active corrosion on the lateral bracing on the top chord of the truss.

Photo 853-1: The USGS station adjacent to Pier 6 has access coming from the Broadway Bridge sidewalk.

Photo 853-2: Channels supporting the USGS station have pack rust and laminating corrosion at their bearings on Pier 6, and there are corrosion holes in the webs and bottom flanges.

Photo 853-3: Navigation light electric service panel at panel point L0 on the downstream truss. The same type of service panel is present at panel point L8 and L16.

Photo 853-4: The red light marking Pier 5 and the green light marking the center of the navigation span are illuminated at dusk. The red light marking Pier 6 is not illuminated.

Photo 853-5: Utility line hanger and street light at downstream panel point U2 not functional.

Photo 853-6: Navigation light solar panels located at downstream panel points U2, U8, and U15.

Photo 853-7: Suspected gas lines hanging from the upstream side of the truss. Pipe diameters are 5” and 8.5”.

Photo 853-8: Suspected 5” diameter gas line hanging from Girder 2 in Span 6, across the west face of Pier 6, and then along the upstream side of the truss

Photo 859-1: 3” diameter tree and other vegetation growing in the mortar joints on Pier 5. This is the worst case of the substructures.

Photo 859-2: Vegetation is growing the full length of the bridge in both gutter lines. There is also a large tree overgrowing across the deck near Pier 3.

Photo OBC-1: The metal gate at the west end of the bridge is locked. A "No Trespassing" sign is mounted to the fence.

Photo OBC-2: The gate at the east end of the bridge is locked. There is not a "No Trespassing" sign at the east end of the bridge.

Photo OBC-3: Retaining wall north of Abutment 7.