Ohio Department of Transportation
2015 Physical Condition Report

Main Avenue Bridge over Cuyahoga River
Bridge No. CUY-2-1441

DRAFT

SFN: 1800035

April 2016

Prepared By:

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A Division of Pennoni

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Location Map

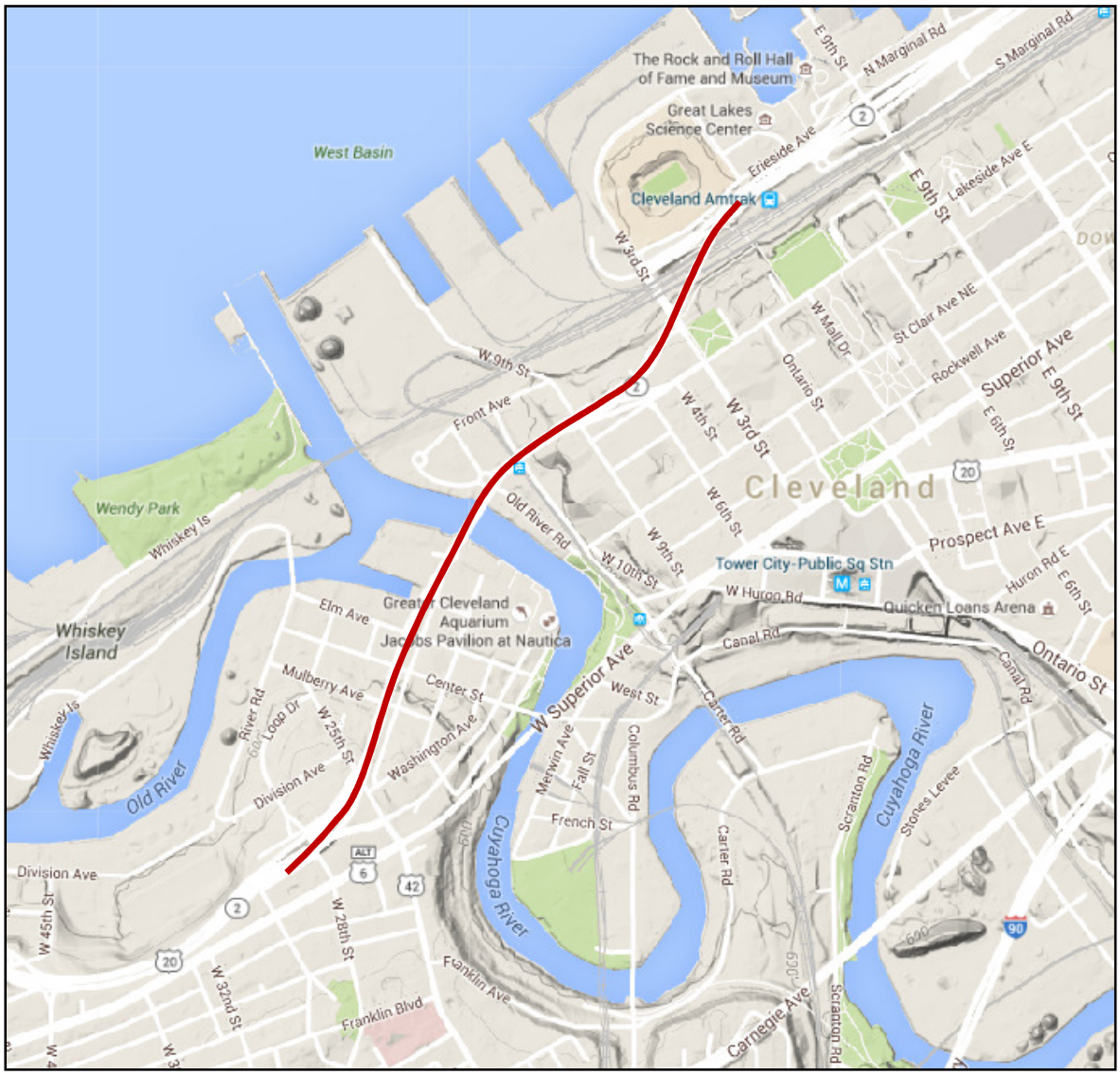


Figure 1 – Main Avenue Bridge Location Map.

Bridge Description

CUY-2-1441 (Main Avenue Bridge, SFN 1800035) carries four to six lanes of State Route 2 traffic, 6580 feet through downtown Cleveland, over numerous local streets, RTA railroad tracks, Norfolk Southern/CSX railroad tracks and the Cuyahoga River. The bridge was fabricated and erected from 1938 to 1940. The West Approach, Main Truss Spans, and East Approach-Forward sections were opened to traffic on October 6, 1939; and the Lakefront Trestle and Lakefront Ramp were opened to traffic in 1940. The bridge was closed for a major rehabilitation project from April 13, 1991 to October 6, 1992. Work included replacing and widening the deck, updating safety features, improving the drainage system, installing new floor system members, and strengthening or replacing deteriorated sections.

The Main Avenue Bridge consists of five distinct units of varying structure types within each section.

- Unit I - West Approach
- Unit II - Main Truss Spans
- Unit III - East Approach - Forward Section
- Unit IV - East Approach - Lakefront Trestle Section
- Unit V - East Approach – Lakefront Ramp Section

Plan views of the Main Avenue Bridge with the units and sections identified are shown in **Figures 2 and 3**.

Unit I – West Approach

The West Approach section consists of similar east and west bound structures, each carrying three lanes of traffic from West 29th Street to 250 feet east of West 25th Street. These structures merge into one structure near West 25th Street.

The West Approach section consists of four main structure types: Transverse rigid concrete frames supporting a concrete deck slab (Sections B', D, J' and M); concrete stringers and diaphragms (Section P); longitudinal rigid steel frames supporting floorbeams & stringers (Sections C, K and L') and a steel floorbeam/stringer system (Section N). The steel floorbeam/stringer system consists of continuous stringers bearing on top of floorbeams, which are supported by steel columns. The various steel sections consist of rolled beams, welded plate girders, and riveted built-up plate girders.

Unit II – Main Truss Spans

Beginning east of West 25th street, the Main Truss Spans carry six lanes of traffic on the Cuyahoga River Valley and the Cuyahoga River, ending near West 10th Street. This unit consists of ten cantilevered Pratt deck trusses. The upper and lower chords are composed of riveted built-up box sections. Truss diagonal and verticals are a combination of rolled wide flange section and riveted box sections. The floor system is composed of rolled steel beam stringers set on top of riveted and welded floor beams. The floorbeams frame into the truss at the upper chord panel point connections.

Unit III – East Approach – Forward Section

Beginning at West 10th Street, at the base of the Flats, the Forward Section carries the six lanes of traffic from the Cuyahoga River Valley up to West 9th Street. The Forward Section consists of steel truss bents that support rolled steel floorbeams with rolled steel stringers bearing on top (**Photo 2**). The steel truss bent members consist of rolled steel sections connected by riveted gusset plates. Below the eastbound lanes, a lower utility/parking deck was present, however it has been removed as part of the recent rehabilitation project. The Pratt deck truss members consist of rolled wide flange sections, with a similar deck framing system to the main truss spans of Unit II.

Unit IV – East Approach – Lakefront Trestle

This section starts at West 9th Street and continues to West 3rd Street carrying four lanes of traffic. The Lakefront Trestle superstructure carries four lanes of traffic and is supported by two lines of longitudinal rigid steel frames composed of riveted built-up beams and columns (**Photo 3**). Transverse floorbeams frame into the longitudinal frames and support rolled stringers.

Unit V – East Approach – Lakefront Ramp

The Lakefront Ramp carries four lanes of traffic, beginning at West 3rd Street, continuing over the RTA and the Norfolk Southern/CSX railroad tracks, and terminating near First Energy Stadium (**Photo 4**). The superstructure consists of three riveted, built-up plate girders with rolled floorbeams and stringers.

The structure's alignment varies over the length of the bridge. Nomenclature of this bridge will follows the 1990 rehabilitation plans previous inspection reports. All compass directions will be based upon this relative assignment.

Construction and Maintenance History

The following is a summary of significant events in the history of the Main Avenue Bridge:

- 1930-37: Planning and design for the Main Avenue Bridge was performed following the Cuyahoga County Engineer's Office decision to build the Lorain-Carnegie Bridge first as a means to relieve congestion on the Detroit-Superior Bridge. The structure was designed by Fred L. Plummer, Chief Design Engineer of the Cuyahoga County Engineer's Office. Consulting engineer was Wilbur Watson & Associates.
- 1937-40: The West Approach, main truss spans and Main Avenue Bridge was constructed in 17 months. The bridge project was one of the initial projects funded by the Federal Emergency for Public Works.
- October 6, 1939: Main Avenue Bridge was dedicated and opened to traffic the following morning.
- 1954-55: Bridge superstructure was repainted.
- April 1984-November1985: Complete removal of the existing paint and application of a Zinc-Vinyl-Vinyl (ZVV) paint system on the steel superstructure was performed.
- 1986: Bridge was rededicated as the Harold Burton Memorial Bridge.
- April 13, 1991 to October 6, 1992: The Main Avenue Bridge was closed to traffic for an 18-month major rehabilitation. Repair work consists of the following activities:
    - Removal of the deck, sidewalks and stringers.

- Placement of new stringers on top of existing floor beams.
- Replacement of approximately 40% of the main truss spans floor beam cantilevers with welded floor beam brackets.
- Removal of the existing drainage system, including drain troughs along interior portions of the lower chord.
- Local painting of new steel elements with an OZEU protective coating system.
- Application of pack rust caulk sealant along open structural steel seams.

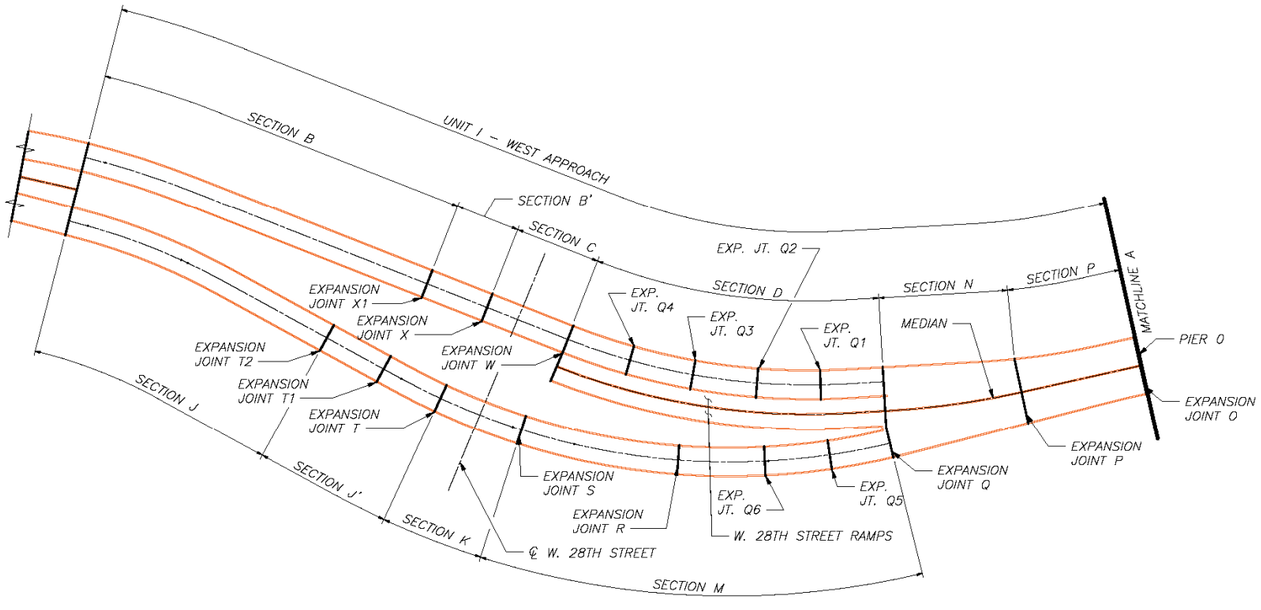
- 2007: Main Truss Spans – Complete painting of the steel superstructure.
- 2007: Emergency retrofits were performed on $L_{24}L_{25}$, North and South Trusses, Span 8.
- 2014 to Present: A series of minor rehabilitation projects have been conducted: Construction tasks include:
  - Gusset plate retrofits.
  - Truss member repairs and strengthening.
  - Replacement of select lower lateral bracing members.
  - Drainage replacement, Main Truss Spans.
  - Removal of sheared rivets due to vehicular impact and installation of high-strength bolts, Lakefront Ramp.
  - Concrete railing and median repairs (2016).
  - Combination of expansion joint membrane replacement and expansion joint membrane replacement (2016).

Photo 1 – South Elevation, Main Truss Spans.

Photo 2 – South Elevation, East Approach – Lakefront Trestle.

Photo 3 – North Elevation, East Approach – Forward Section.

Photo 4 – South Elevation, East Approach – Lakefront Ramp.



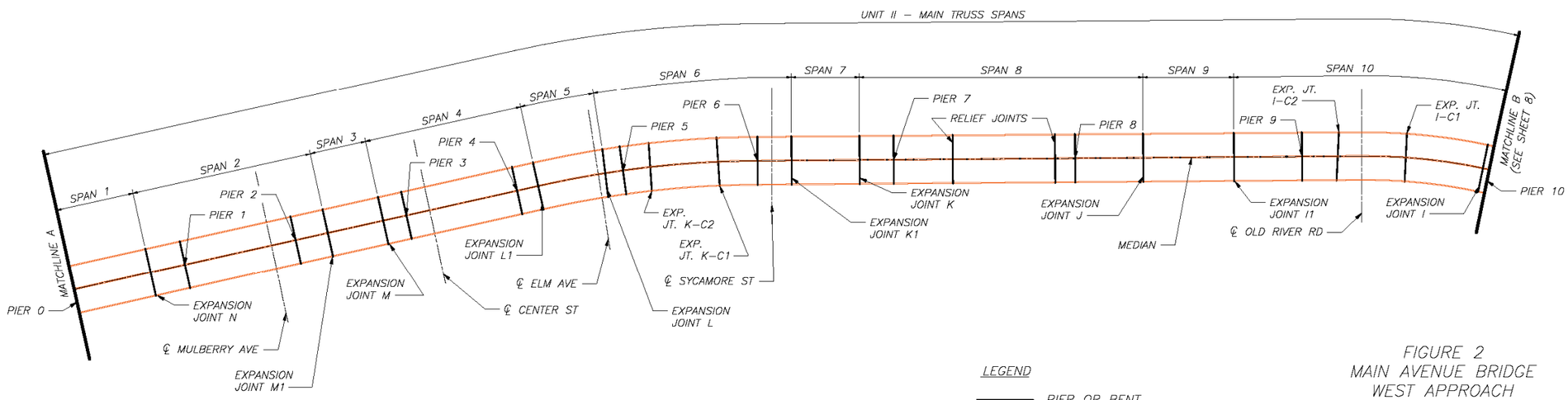


FIGURE 2
MAIN AVENUE BRIDGE
WEST APPROACH
& MAIN TRUSS

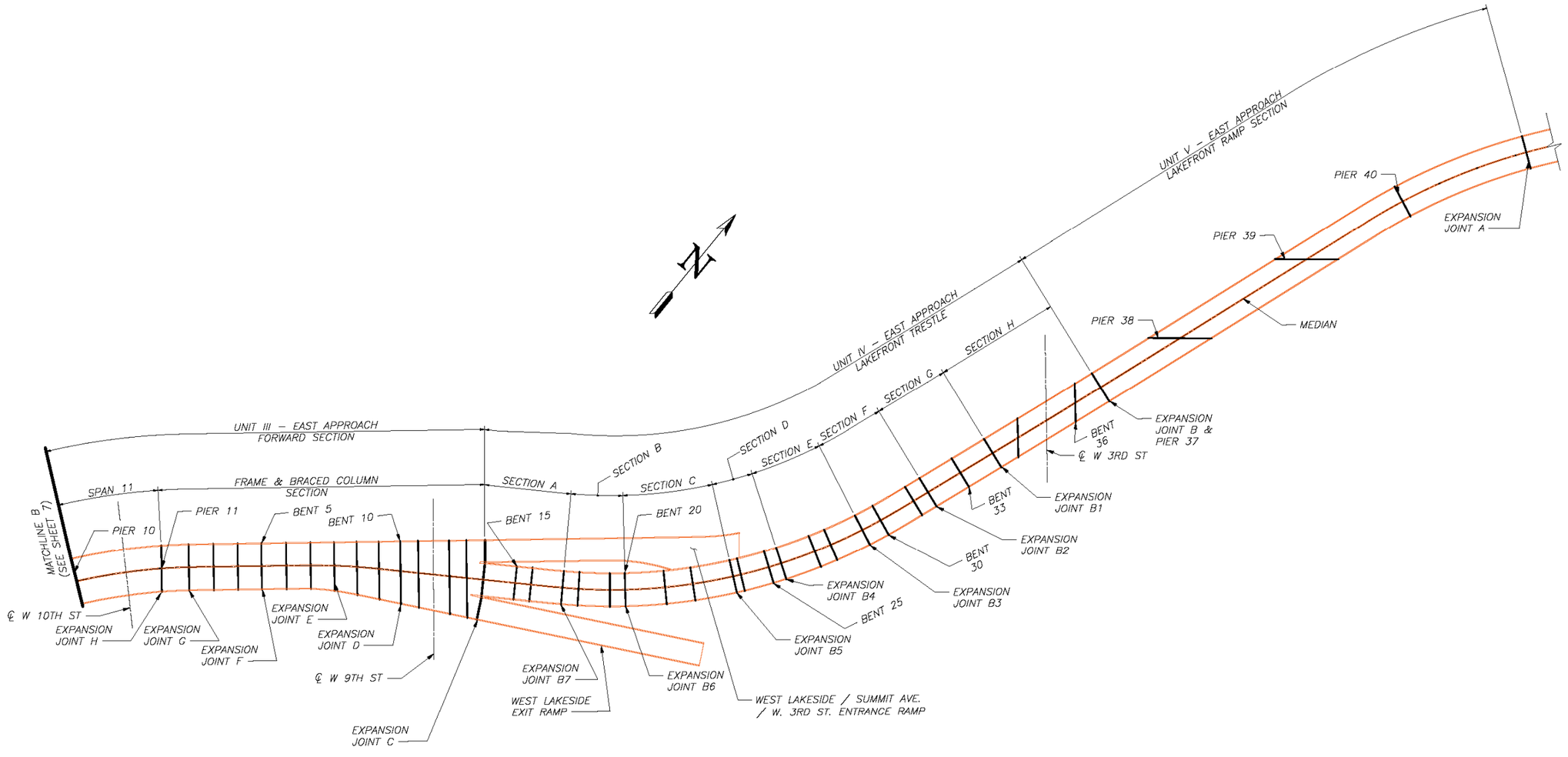


FIGURE 3
MAIN AVENUE BRIDGE
EAST APPROACH

Inspection Procedure

Jones-Stuckey performed an in-depth inspection of this structure from October 12 through December 18, 2015, and January 29, 2016. The superstructure inspection access was achieved via snooper, manlift and extension ladders. The NBIS Program Manager was David Jones, PE. The NBIS Reviewer was William Vermes, PE. The Team Leaders were William Vermes, PE, Christian Lunt, PE, Elizabeth Trapp, EI and Jessica Sizemore, CBSI. The Team Members on this inspection were Matthew Paroda, EI, and Dale Arnold, PE

A copy of the Bridge Inspection Field Report is included in **Appendix A**. Additionally, **Appendix B** contains the Main Span Condition State Schematics**, Appendix C** contains the Inspection Findings and **Appendix D** contains the Undercrossing Minimum Vertical Clearances.

Condition & Element Level Rating Guidelines

Ohio and National Bridge Inspection Standards (NBIS) guidelines for evaluating the condition of bridges have been developed to promote uniformity of bridge inspections performed by different teams and at different times. **Figure 4** contains the bridge inspection rating matrix established by the Federal Highway Administration (FHWA), using a 0-Failure through 9-Excellent scale, and used by the Ohio Department of Transportation (ODOT). In this report, component conditions will generally be discussed based on the ODOT rating guidelines for individual components, 1-Good through 4-Critical. The General Appraisal, the Deck, Superstructure, Substructure, Channel and Approach Summaries, and the Protective Coating System rating will follow the NBIS/ODOT 0 through 9 rating guidelines.

Additionally, this bridge inspection was performed in accordance with the following documents:

- Manual of Bridge Inspection, Ohio Department of Transportation, 2014.
- Manual for Condition Evaluation of Bridge, 2nd Edition, American Association of State Highway and Transportation Officials (AASHTO), 2011.
- Bridge Inspector's Reference Manual (BIRM), U.S. Department of Transportation, revised December 2012.

RATING		CONDITION	RATING GUIDELINES	Inspector Guidelines
ODOT	NBIS			
1 – Good	9	Excellent		Make brief comments as necessary. Communicate the predominant deficiency.
	8	Very Good	No problems noted.	
	7	Good	Some minor problems present.	
2 – Fair	6	Satisfactory	Structural elements show some minor deterioration.	
	5	Fair	All primary structural elements are sound but have minor section loss, deterioration spalling or scour.	Document deficiencies quantitatively. Consider taking photos or making sketches.
3 – Poor	4	Poor	Advanced section loss, deterioration, spalling or scour.	Candidate to establish monitoring benchmarks to track the rate-of-change. Take photos, make sketches and document quantitatively in order to determine if a re-load rating is possible. Include in-service conditions to verify capacity.
	3	Serious	Loss of section, deterioration, spalling or scour has seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	Above… And discuss the deficiency immediately with Control Authority.
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 is taken.	Above… And the bridge is a candidate to dispatch road closure and/or immediate and/or increased monitoring (Interim Inspections). Confirm in writing, critical finding.
	1	Imminent Failure	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structural stability. Bridge is closely monitored is closed to traffic but corrective action may put bridge back into light service.	Above… And Dispatch immediate lane or bridge closure. Contact the Control Authority. Stay at the bridge until the safety of the traveling public is achieved. Confirm in writing.
	0	Failure	Out of Service, beyond corrective action.	

*** Advanced** – widespread deficiencies or a likely reduction to capacity (more examples on following page).

**** Structurally Deficient (SD) –**Bridge Deck, Superstructure, or Substructure Summary rated 4- Poor or below.

Figure 4 – ODOT & NBIS Condition Rating Guidelines (*Manual of Bridge Inspection, V. 8*, Ohio Department of Transportation (2014).

II. Deck Items

The deck is in ***Good*** Condition, or ***7*** on the NBIS condition rating guidelines. Deck findings are shown in **Appendix C**. Condition findings of individual deck items are as follows:

Floor (c7.1)

The deck floor is in ***Good*** condition (**Photo 5**).

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
562,590 SF	562,590 SF				1.00

The replacement deck, opened to traffic in 1992, consists of epoxy coated reinforcement with stay-in-place metal galvanized steel forms. The haunches in the deck above the stringers have isolated minor spalling. The stay in place forms have moderate corrosion at expansion joints on the main truss.

Photo 5 – Typical Good Condition of Slab.

Auxiliary Deck, Lakefront Trestle, East Approach

The Auxiliary Deck on the Lakefront Trestle was removed prior to 2015 inspection (**Photo 6**).

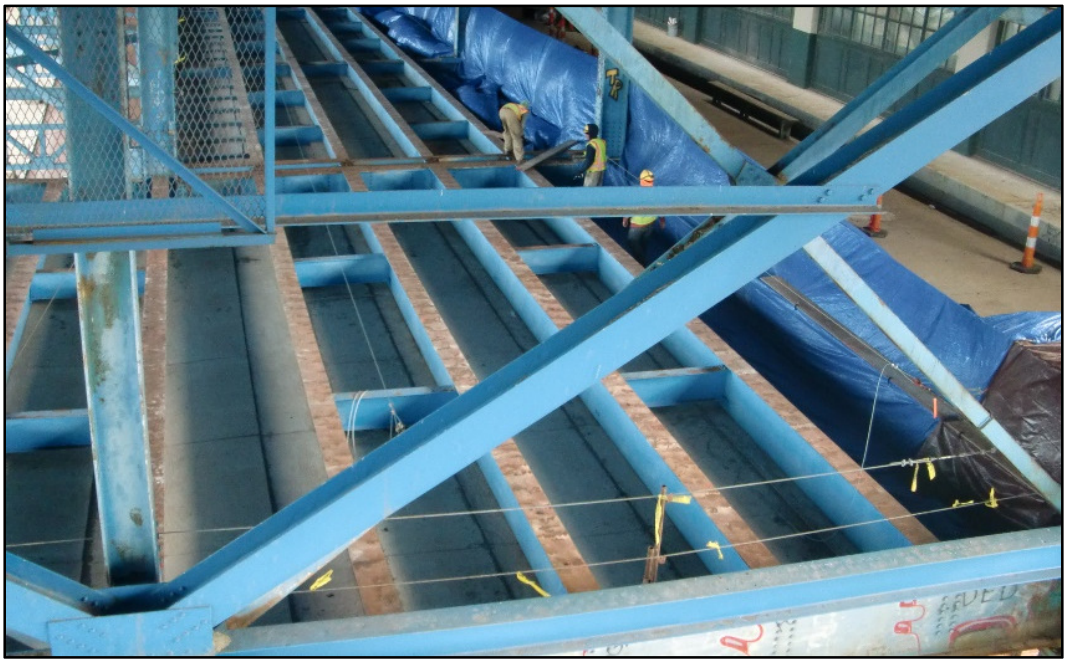


Photo 6 – Deck Removed, Lakefront Trestle - East Approach.

Edge of Floor (c7.2)

The edge of floor is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
13,160 LF	13,160 LF				1.00

Wearing Surface (c8)

The concrete wearing surface is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
539,560 SF	539,060 SF	500 SF			1.00

Distressed areas include isolated surface scaling and minor hairline cracks. Minor spalls are present adjacent to expansion joint armor. Minor isolated spalls are present along the gutterline on the eastbound main truss spans (**Photos 7 & 8**).

Photo 7 – Typical Gutterline Spalling, Wearing Surface.

Photo 8 – Wearing Surface Spall Along Gutterline, Span 4.

Median (c10) & Railing (c11)

The concrete median and railings are both in ***Good*** condition.

Component	Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
Median	6,580 LF	6,380 LF	100 LF	100 LF		1.26
Railing	13,160 LF	12,560 LF	400 LF	200 LF		1.28

The median and railings constructed in the 1991-92 rehabilitation were placed using slip form construction. Following the reopening of the bridge, cracks and local spalls were observed in the top section of the parapet and repaired.

Numerous large spalls exist in the top face, along the exterior reveal, and at deck joint locations. The existing spalls have increased in size and exposed additional reinforcing bars since the prior inspection (**Photos 9 & 10**). There are isolated locations that exhibit delaminations and pose a hazard to the public below.

Local spalls similar to those before the rehabilitation are currently present on numerous locations of the south parapet. During this inspection, several loose piece of concrete over public areas in the Lakefront Trestle were removed from the south railing exterior surface. Examination of the spalls show the deterioration begins with a horizontal crack (**Photo 11**), followed by spalling of the concrete section above and below the horizontal crack (**Photo 12**). Examination of the top longitudinal steel reinforcement shows the epoxy coating intact. Additionally, the deterioration is advancing longitudinally without evidence of corrosion. This deterioration pattern suggests that it is possibly the result of poor concrete or construction practices and not the result of deicing salts and reinforcement corrosion.

The median has isolated spalls with exposed reinforcing bars similar to the deterioration pattern if the railings (**Photo 13**). Existing spalls have increased in size and exposed additional reinforcing bars since the last inspection. The impact attenuators on the Lakeside Avenue and West 28th Street exit ramps have had various levels of collision damage (**Photo 14**).

Photo 9 – Typical Top of Railing Spall without Corrosion, Span 7 South Railing.

Photo 10 – Typical Top of Railing Spall, Span 7 South Railing.

Photo 11 – Early Stage of Railing Deterioration.

Photo 12 – Typical Spall and Delamination, Edge of Deck & Exterior Face of Parapet over Traffic.

Photo 13 – Spalling of Median Parapet with Exposed Reinforcing, Span 4.

Photo 14 – Damaged Impact Attenuator, Lakeside Ramp - East Approach.
(Note: Attenuator was repaired after inspection.)

Drainage (c12)

The drainage system is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
268	250	14	4		1.30

Drainage troughs and hoppers on the Main Truss typically exhibit advanced section loss with holed through sections causing water to drain onto the structure below. Torn rubber splices between drain pipe secions were observed. Some gutterline scuppers and Section D catch basins are partially clogged with debris (**Photos 15 & 16**). All above ground collectors of the Forward Approach (Bent 0 to Bent 10) are clogged (**Photo 17**). Rehabilitation of the drainage system was ongoing at the time of inspection.

Photo 15 – Typical Partially Clogged Scuppers.

Photo 16 – Typical Clogged Catch Basin.

Photo 17 – Typical Clogged Above Ground Collector, Lakefront Approach.

Expansion Joints (c13)

The expansion joints are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
3,548 LF	3,328 LF	120 LF	100 LF		1.45

The metal expansion joint armor is corroding with paint failure at multiple locations (**Photo 18**). The modular expansion joints have corrosion and section loss and joint armor with minor gouges and section loss (**Photo 19**). The expansion joint at Bent 14, East Approach – Forward Section, has failed and is leaking (**Photo 20**). At numerous locations, new precompressed foam seals have been installed to replace isolated failures in the seal. The precompressed foam seal at Joint C exhibits a 24" section detached from the joint armor (**Photo 21**). Isolated joint locations exhibit minor vertical misalignment resulting in plow catch point and damage to joint armor.

Photo 18 – Typical Corrosion Debris on Parapet Expansion Joint Armor.

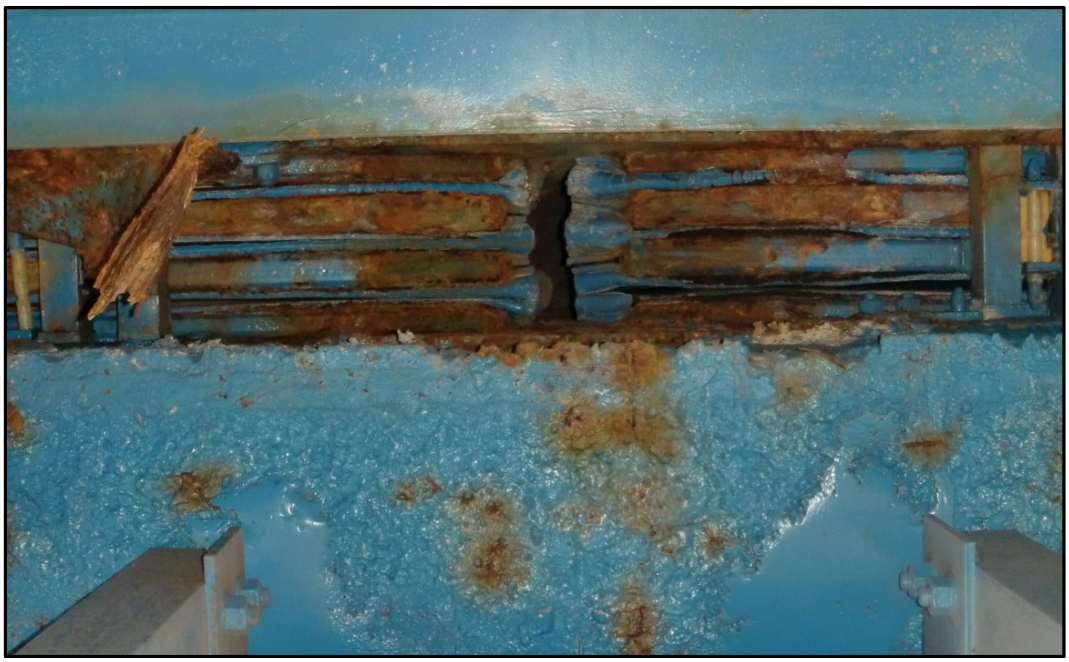


Photo 19 – Corrosion to Bottom of Modular Expansion Joint.

Photo 20 – Leakage through Damaged Joint Membrane, East Approach - Forward Section.

Photo 21 – Detached Joint Seal.

Lighting

The deck lighting is in ***Fair*** condition. The deck lighting consists of metal poles with cobra head fixtures. The lights mounted to the North rail for the westbound traffic were not functioning at the conclusion of this inspection. At the pole bases, several pull boxes have either missing or loose covers with exposed wiring (**Photo 22**).

Photo 22 – Open Pull Box, South Railing, Span 9.

III. Superstructure

The superstructure is in ***Poor*** condition, or ***4*** on the NBIS condition rating guidelines. Superstructure findings are shown in **Appendix C**. Condition of individual superstructure items are as follows:

Alignment of Members (c14)

The alignment of primary superstructure members is ***Good***.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
40	**40**				**1.00**

Between Bent 11 and Bent 12, Forward Approach, Beam FSS (the south fascia beam) was misaligned due to numerous hits from vehicles travelling northbound on West 9th Street. Beam FSS has recently been heat straightened and nearly returned to its original alignment (**Photo 23**). Measured minimum clearance at this beam is 13.57 feet.

Beams and Girders (c15.1)

The beams and girders are in ***Good*** condition with isolated areas of pack rust with minor section loss or distortion due to pack rust.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
7,394 LF	7,205 LF	189 LF			1.04

The West Approach superstructure consists of rolled beams, welded plate girders and riveted built-up plate girders. These members have areas of minor corrosion and broken rivets. Girder GF5 has one broken rivet in the bottom flange of a splice connection. Fracture of this rivet is likely due to extreme tensile stresses in the shank from overheating during installation (**Photo 24**).

The East Approach Lakefront Trestle consists of riveted built-up girders. These girders have isolated deep pockets of pack rust on the bottom flange (**Photo 25**).

The East Approach Lakefront Ramp superstructure consists of three riveted built-up plate girders. These members have isolated areas of minor section loss and corrosion. There is existing surface pitting from past deck leaks (**Photo 26**) and pack rust in the bottom flange moment plates (**Photo 27**). There are also two missing bolts in the top flange (**Photo 28**).

Photo 23 – Heat-Straightened & Repainted Beam FSS with New Vehicle Scrapes, over West 9th Street.

Photo 24 – Broken Rivet, Bottom Flange of Girder GF5, West Approach.

Photo 25 – Typical Pack Rust on Bottom Flange, Lakefront Trestle - East Approach.

Photo 26 – Typical Surface Pitting, Lakefront Ramp - East Approach.

Photo 27 – Typical Pack Rust at Moment Plate, Lakefront Ramp - East Approach.

Photo 28 – Missing Bolts, Lakefront Ramp - East Approach.

Diaphragms & Crossframes (c16)

The diaphragms and crossframes are in ***Good*** condition with no section loss or surface rust.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
1,203	1,203				1.00

Stringers (c17)

The stringers are in ***Good*** condition with no section loss and isolated areas of freckled rust. All stringers were replaced during the 1991-1992 rehabilitation project.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
71,947 LF	71,939 LF	8 LF			1.00

Floor Beams & Floor Beam Connections (c18)

The floor beams and floor beam connections are in ***Good*** condition with isolated areas of pack rust and pitting with section loss.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
27,168 LF	25,691 LF	1,231 LF	246 LF		1.21

The steel floor beams have areas of section loss with pitting ranging from $^{1}/_{16}$" to $^{1}/_{8}$" deep. Corrosion is present on the floor beams in the form of freckled rust. A minor crack was found in a connection from pack rust (**Photo 29**). Surface pitting is most likely a result of inadequate painting (**Photos 30, 31 & 33**). Additional rust staining and active corrosion is from leaking joints above (**Photo 32**). There are unnecessary welds on the floor beams from previous drainage. In the main truss spans, minor pitting is present on the bottom of top flange tension tie plates connecting the center floor beam section and the floor beam cantilever brackets. See **Table C1 - Floor Beam Deficiencies, Main Truss Spans, Appendix C**, for additional inspection findings.

Photo 29 – New Pack Rust Induced Crack at Floor Beam Cantilever Seat at Column K6, Unit K (SR 2 EB over West 28th Street).

Photo 30 – Typical Top Flange Surface Pitting, Main Truss Floor Beam.

Photo 31 – Typical Floor Beam Bottom Flange Surface Pitting, Main Truss Spans.

Photo 32 – Typical Rust Staining on Main Truss Floor Beam Under Deck Joint.

Photo 33 – Typical Top Flange Tension Tie Plate Surface Pitting, Floor Beam, Main Truss.

Truss Verticals (c19)

The truss verticals are in ***Good*** condition with isolated areas of pack rust and pitting with section loss.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
272	265	4	3		1.15

The steel truss verticals have areas of minor section loss with pitting. Section loss is present on the truss verticals in the form of pack rust between the gusset plates, fill plates and vertical flanges (**Photo 34**). See **Table C2 - Verticals, Main Truss Spans, Appendix C**, for additional inspection findings.

Photo 34 – Typical Pack Rust on Fill Plate, Main Truss Vertical.

Truss Diagonals (c20)

The truss verticals are in ***Good*** condition with isolated areas of pack rust and pitting with section loss.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
268	253	4	10	1	1.74

The steel truss diagonals have areas of section loss with pitting on the top face of web surfaces in the form of pitting and from pack rust on flanges and truss connection fill plates (**Photos 35**). On member $L_{14}U_{15}$, Span 8 North, there is $^{5}/_{8}$" pack rust and a perforation in the fill plate (**Photo 36**). For additional inspection findings, see **Table C3 - Main Truss Diagonal Deficiencies, Appendix C**.

Photo 35 – Typical Fill Plate Section Loss, Main Truss Diagonals.

Photo 36 – $^{5}/_{8}$" Pack Rust Crack & Perforation in Fill Plate from Pack Rust, Diagonal $U_{14}U_{15}$, Span 8.

Truss Upper Chord (c21)

The truss upper chord is in ***Good*** condition with isolated areas of pack rust and pitting with section loss

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
268	252	7	9		1.50

The steel truss upper chord has areas of section loss with pitting and pack rust (**Photos 37 & 38**). No active corrosion is present on the truss upper chord. Existing section loss was caused by leakage through the original bridge deck and an inadequate protective coating system. **Table C4 -Main Truss Upper Chord Deficiencies, Appendix C**, contains additional inspection findings.

Photo 37 – Typical Surface Pitting, Main Truss Upper Chord.

Photo 38 – Typical Pack Rust, South Main Truss, Span 6, $U_{14}U_{15}$.

Truss Lower Chord (c22)

The truss lower chord is in ***Poor*** condition. This structural element controls the superstructure condition rating and general appraisal.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
268	176	23	59	10	2.78

The lower chord has various degrees of deterioration throughout the structure. Estimated section losses is as high as 22%, including loss due to pack rust and pitting (**Photos 39 & 40**). Previous inspection findings stated that the pack rust has caused bowing across the web and flange plates of lower chord members. Inspection of these plate deformations shows that all plates are essentially flat between the inner rivet lines, and that all deformation occurs from the inner rivet lines to the plate edges (**Photo 41**).

Various degrees of pack rust located between the flange angles and the web plates are prevalent throughout the exterior lower chords, with isolated perforations of the top plate. The greatest net section loss is located in Spans 11 through 13. In these spans, twelve lower chord members have between 5 and 22% net section loss. Two lower chord members were retrofit in 2007 due to advanced section loss (**Photo 42)**. See **Table C5 - Main Truss Lower Chord Deficiencies**, **Appendix C**, for additional inspection findings.

Photo 39 – Typical Pitting of Lower Chord Top Plate.

Photo 40 – Typical Lower Chord Pack Rust & Section Loss.

Photo 41 – Typical Lower Chord Plate Distortion Due to Pack Rust Distortion (Note: top plate is flat between inner rivets, shown by red line).

Photo 42 – 2007 Lower Chord Retrofit, $L_{24}L_{25}$, Span 8.

Truss Gusset Plates (c23)

The steel truss gusset plates are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
1088	1019	18	51		1.63

The truss gusset plates have isolated areas of pack rust and pitting with section loss but no misalignment observed (**Photos 43 & 44**). Several gusset plates have been retrofitted in the recent rehabilitation. See **Table C6 - Main Truss Upper Chord Deficiencies, Appendix C**, for additional inspection findings.

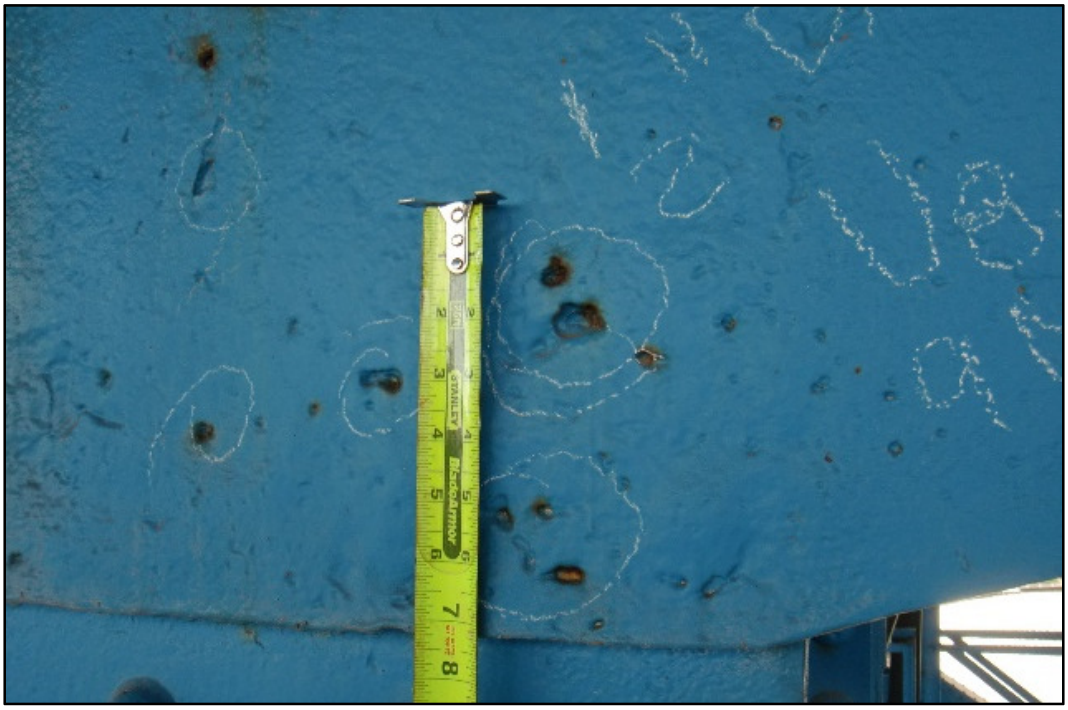


Photo 43 – ½-Inch Deep Pitting of Gusset Plate, U_8 North, Span 9.

Photo 44 – Typical Gusset Plate Section Loss.

Lateral Bracing (c24)

The lateral bracing is in ***Good*** condition with no section loss or surface rust.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
370	370				1.00

Recent repairs have been made to the lower lateral bracing as part of ongoing rehabilitation to the bridge. Construction debris, including steel shaving and grounded glass blasting material used from paint removal, are present on the bracing (**Photo 45**). Ponding water was present during the inspection in several location on the lower lateral bracing between the web and bottom flange (**Photo 46**).

Photo 45 – Common Construction Debris left on Lower Lateral Bracing.

Photo 46 – Water Accumulation on Lower Lateral Bracing.

Sway Bracing (c25)

The sway bracing is in ***Good*** condition with no section loss or surface rust.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
364	364				1.00

Bearing Devices (c26)

The bearing devices are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
364	364				1.00

At Bent 37, a spall has undermined the south bearing plate approximately 4" wide by 1" deep (**Photo 47**). At the East Abutment, the south bearing is in a slightly expanded position during temperatures under 50° F.

The following bearings have standing water above the truss diagonal connections due to blocked drain hole were covered with standing water during the inspection:

- Pier 1, North Truss: West drain hole is blocked.
- Pier 2, North and South Truss: Both drain holes are blocked.
- Pier 3, North and South Truss: Both drain holes are blocked.
- Piers 5 & 6, North and South Truss: Both drain holes are blocked.

At the expansion bearings of Piers 1, 3, 5, 7 and 9, debris within the roller nest may also be affecting the roller's ability to move (**Photo 48**). At the fixed bearings of Piers 2, 4, 6 and 8, standing water is common within the castings due blocked drain holes. These blockages are likely due to the presence of blast material not fully removed during previous truss painting operations and an undocumented steel obstruction aligned with the drain holes (**Figure 5, Photos 49A & 49B**). During the inspection, attempts were made to unplug the debris from the drainage holes, with only one blockage successfully removed. The standing water will continue to be an issue until the bearings are cleaned and the drainage holes are maintained (**Photo 50**).

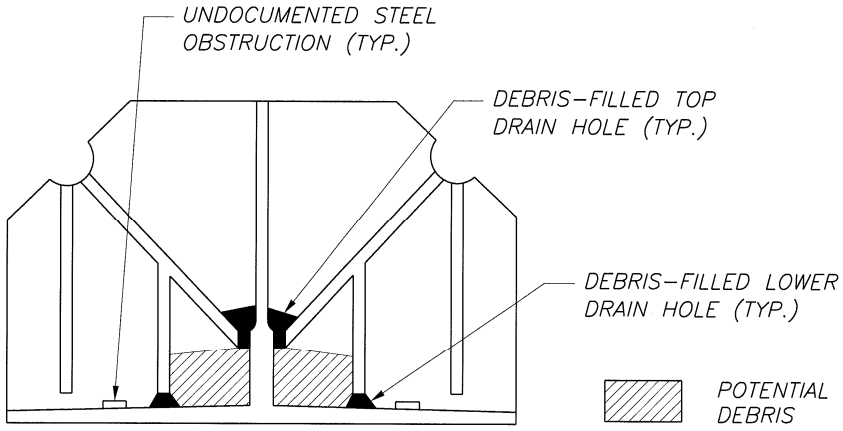


Figure 5 – Location of Typical Drain Hole Blockages, Truss Bearing Castings.

In the Forward Approach, the anchor bolts securing the pier bents from Bent 1 through Bent 10 commonly have moderate section loss due to pack rust occurring between the anchor bolt, the bearing frame and bearing stiffeners (**Photo 51**).

Photo 47 – Spall Undermining of South Bearing Plate, Bent 37.

Photo 48 – Close-up of Debris & Steel Shot Blast within Expansion Bearing Box.

Photo 49A – Typical Debris within Bearing Casting.

Photo 49B – Steel Casting Blocking Drainage Path.

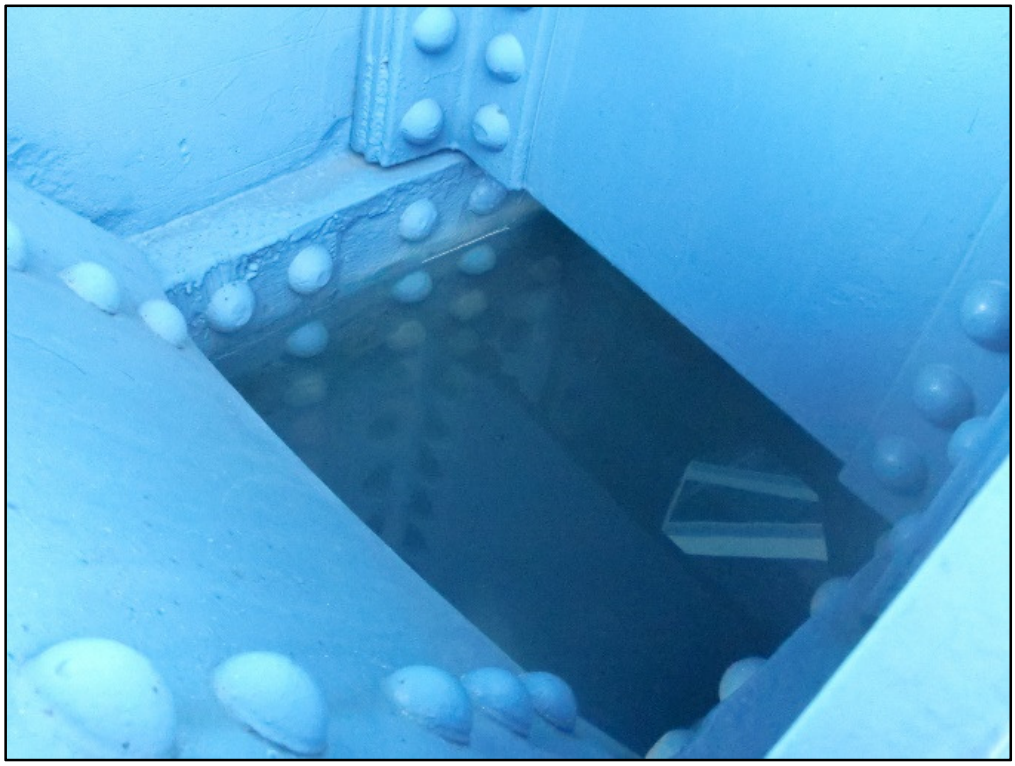


Photo 50 – Standing Water in Bearing Joint, Main Truss Spans.

Photo 51 – Active Corrosion within Anchor Bolt Stiffener Chamber, Forward Approach.

Protective Coating System (c30)

The protective coating system (PCS) is in ***Fair*** condition. The PCS of the Main Truss spans was applied in 2007, and the PCS of the West Approach, Forward Section, Lakefront Trestle and Lakefront Ramp dates to 1984. Due to the varying age of the overall PCS, the PCS condition states are listed for each section ads shown below. PCS quantities include lengths of the following steel components: stringers, beams, floorbeams, girders, truss lines (per *ODOT Manual of Bridge Inspection, Revised 2014 (v. 8)*), and the estimated length of steel pier bents.

Section	Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
West Approach	24,857 LF	13,357 LF	10,000 LF	1500 LF		2.00
Main Truss Spans	51,003 LF	50,153 LF	800 LF	50 LF		1.04
Forward Section	15,937 LF	11,497 LF	3,740 LF	700 LF		1.78
Lakefront Trestle	16,832 LF	10,332 LF	4,000 LF	2,500 LF		2.31
Lakefront Ramp	13,611 LF	5,211 LF	6,400 LF	2,000 LF		2.39
Total	122,240 LF	90,550 LF	24,940 LF	6,750 LF		1.84

The West Approach, Forward Section, Lakefront Trestle and Lakefront Ramp have prevalent areas of PCS failure. Corrosion and active pack rust are present along built member seems (**Photo 52**). Among the girders of the West Approach and Lakefront Trestle, worn paint with light corrosion patches are present on the web surfaces (**Photo 53**). Among areas protected from the weather, flaked and missing PCS section have been present likely due to poor surface preparation (**Photo 54**).

Pins, Hangers & Hinges (c31)

The pins, hangers and hinges are in ***Good*** condition. Rivet head interference is present among several hangers in the Lakefront Trestle (**Photo 55**).

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
14	11	3			1.29

Photo 52 – Typical Local Seam Corrosion, West Approach Superstructure.

Photo 53 – Common Worn Protective Coating on Girder Web, Lakefront Trestle.

Photo 54 – Common Cracked & Flaked Protective Coating, Lakefront Trestle.

Photo 55 – Common Rivet Interference with Hanger, East Approach Spans.

Fatigue (c32)

The fatigue prone details are in ***Good*** condition with several pack rust cracks observed.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
122,240 LF	122,240 LF				1.00

Between Bents 14 and 15, Section A of the Lakefront Trestle, an obsolete utility bracket is welded to the south twin girder (**Photo 56**). The top flange weld on the field splice of Girder GF2 has a deep crevice between adjacent weld passes (**Photo 57**). Both of these welded connections represent stress riser and potential fatigue prone details.

Photo 56 – Obsolete Utility Bracket Welded to South Twin Girder, Lakefront Trestle - East Approach.

Photo 57 - Crevice between Adjacent Weld Passes, Girder GF2, Section C.

IV. Substructure

The substructure is in ***Satisfactory*** Condition, or ***6*** on the NBIS condition rating guidelines. Condition findings of individual substructure items are as follows:

Abutment Walls (c33)

The abutments are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
263 LF	263 LF				1.00

Pier Walls (c36)

The pier walls are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
55 LF	55 LF				1.00

Pier Caps (c37)

The pier caps are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
90 LF	90 LF				1.00

The south pedestal at Trestle Bent 37 is spalled with minor undermining of the bearing plate (see **Photo 47)**.

Pier Columns/Bents (c38)

The pier columns and bents are in ***Fair*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
197		197			2.00

Steel bents exhibit isolated cleaned and painted pitting. The steel piers in the Lakefront Ramp Section exhibit active corrosion. Rust flakes and debris are present in the bottom of pier bents (**Photo 58**). In Section D, West Approach, Columns 1N, 11N and 50S have isolated spalls and exposed rebar (**Photo 59**). Debris is present within the bases of most pier bents from Bent 1 through 10, Forward Approach.

Photo 58 – Light Corrosion & Debris on Pier Bent 0/Pier 11.

Photo 59 – Spall with Exposed Rebar, Column 1N, Section D.

Backwalls (c39)

The abutment backwalls are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
263 LF	263 LF				1.00

Minor vertical cracks with one small area of delaminated concrete are present on the East Abutment backwall.

Wingwalls (c40)

The abutment wingwalls are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
12	12				1.00

Several minor vertical cracks are present on the wingwalls of the east approach along with scaling of the sandstone cladding of the remaining portions of the East Pylon from the original construction.

Mask Walls

Non-structural mask walls are present beneath the superstructure along West 28th Street, West 25th Street and West 9th Street. Large areas of spalls and exposed steel reinforcement are present on the streetside face of the West 25th east wall and on the interior faces of the West 9th Street walls. This deterioration has advanced little since the 1991-92 rehabilitation and does not pose a serious hazard to public safety (**Photo 60**).

Photo 60 –Typical Mask Wall Deterioration.

Scour (c42)

The scour is in ***Good*** condition. Sea walls are present along both river banks, providing protection for Pier 8 and 9. No underwater inspection is required for this structure

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
2	2				1.00

Slope Protection (c43)

The slope protection is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
40	40				1.00

The erosion to the slope protection on east side of Pier 37 has been repaired as part of the 2015 minor rehabilitation project (**Photo 61**).

Photo 61 – Slope Protection Repair, East Side of Pier 37.

V. Channel

The channel is in ***Very Good*** Condition, or ***8*** on the NBIS condition rating guidelines. Condition findings of individual channel items are as follows:

Alignment (c51)

The channel alignment is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
200 LF	200 LF				1.00

Protection (c52)

The channel protection is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
200 LF	200 LF				1.00

The erosion holes between Pier 9 and the sea wall are no longer present due to recent construction for the new water taxi dock and ramp.

Hydraulic Opening (c53)

The hydraulic opening is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
2	2				1.00

Navigation Lights (c54)

The navigation lights are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
5	5				1.00

VI. Approaches & General Items

The approaches are in ***Satisfactory*** Condition, or ***6*** on the NBIS condition rating guidelines. Condition findings of individual approach items are as follows:

Approach Wearing Surface (c1)

The approach wearing surfaces are in ***Fair*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
6		6			2.00

The West Approach pavement has isolated spalls. Moderate transverse and map cracking throughout the East and West Approaches was observed (**Photo 62**).

Photo 62 – Patched Spalls in Approach Pavement, East Approach.

Approach Slabs (c2)

The approach slabs are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
6,788 SF	6,788 SF				1.00

The approach slabs have minor spalls at the relief joints (**Photo 63**). The concrete approach pavement on the eastbound lanes of the east approach has settled, creating an uneven joint in the pavement (**Photo 64**). The settlement varied from 2" to 3" deep over 200 feet in length. A portion of the travel lanes sits on a cracked raised retaining wall that supports the approach parapet (**Photo 65**).

Photo 63 – Typical Approach Slab Condition, W 28th St. Ramp.

Photo 64 – Typical Condition, W 28th St. Ramp.

Photo 65 – Approach Slab Settlement, East Approach.

Relief Joints (c3)
The relief joints are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
272 LF	272 LF				1.00

Embankment (c4)
The approach embankment is in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
1	1				1.00

Guardrail (c5)
The approach guardrails are in ***Good*** condition.

Total Quantity	CS 1	CS 2	CS 3	CS 4	Transition Rating
13	13				1.00

Security
There are several locations where the structure can be accessed by non-bridge personnel. The lock is missing from the gate at the East Abutment of the Lakefront Ramp, and nearby Pier 37 can be easily accessed with a ladder. Large debris piles are present on the Lakefront Ramp's catwalk from vagrants (**Photo 66**). Additionally, a drone was found in Panel Point North L_{13}, Span 4, and was removed (**Photo 67**).

Land Use
During this inspection vertical clearances of undercrossings were measured and are included in **Appendix D**. A tree is encroaching into the Unit L superstructure of the W 25th Subway Ramp West Approach Spans (**Photo 68**). Mounted lights and extension cords were found on Piers 2 and 3. These lights face the parking lot and volleyball courts for Mulberry's, a restaurant/bar located along Span 3 (**Photo 69**).

Photo 66 – Debris from Vagrants, Lakefront Ramp Catwalk.

Photo 67 – Drone in Panel Point North L_{13}, Span 4.

Photo 68 – Tree along W 25th Subway Ramp, Section L.

Photo 69 – Private Light Mounted on Top of Pier 2 South.

Architectural Lighting

For the City of Cleveland Bicentennial Celebration in 1996, architectural lighting was installed on Piers 7, 8 and 9. Over time, the lighting has been inoperative. During evenings, near the end of this inspection, these lights were functioning.

VII. Summary & Recommendations

The Main Avenue Bridge over the Cuyahoga River is in ***Poor*** condition, or ***4*** on the NBIS rating guideline (**Figure 4**, Page 10). The lower chord are the element governing this condition rating. The complete Bridge Inspection Report Form is included in **Appendix A**. The following repairs and maintenance tasks shown in Table 1 are recommended to improve the General Appraisal of the Main Avenue Bridge, to minimize future repair costs, and to extend the service life of the bridge.

Two maintenance/rehabilitation projects are scheduled to be let in 2016 and 2017. Among the work upcoming in 2016 the railings and expansion joints will be repaired/replaced. Following this project, the protective coating system of the East and West Approach steel superstructure will be replaced. To minimize costs it is recommended that a rehabilitation of the roadway lighting be included in this project.

	Repair/Maintenance Task	2016	2017	2018	2019	2020
1.	Restore bridge lighting for Westbound Roadway & W. 28th Street Ramps.	X				
2.	Install minimum overhead clearance signs as required by ODOT & City of Cleveland policy.	X				
3.	Lakefront Ramp - Remove piled debris from catwalks.	X				
4.	Section L - Remove tree interfering with superstructure.	X				
5.	East Abutment - Restore lock on gate securing area in front of East Abutment.	X				
6.	Lateral Bracing – Blow off construction debris.	X				
As part of the 2016 Deck Rehabilitation Contract, the following tasks are recommended to be included:						
8.	Remove & replace edge and lane lines.	X				
9.	Install pull box covers on bridge light poles where needed.	X				
As part of the 2017 Painting Contract for Units I, III, IV and V, the following tasks are recommended to be included:						
10.	Lakefront Trestle: Remove all obsolete welded attachments.		X			
11.	Section C: Remove adjacent weldment and crevice at top flange welded field splice, Girder C2.		X			
12.	Section K: At floor beam cantilever brackets, remove pack rust and reweld both sides of the bottom flange-to-bracket connection.		X			
13.	Forward Approach: Clean debris from ground level drainage collectors and clear underground storm sewer pipe.		X			
14.	Forward Approach - Apply packrust inhibitor behind and between bearing anchor bolts and stiffeners.		X			
15	Forward Approach - – Apply a High Ratio Co-Polymerized Calcium Sulfonate protective coating system and pack rust inhibitor to the anchor bolt and frame bases, Bent 0 to Bent 10.		X			
16.	Clear demolition debris from Bent 0.		X			
17.	Main Truss Spans: Remove obstructions from drain holes and chambers on bearing castings.		X			
18.	Main Truss Spans: Remove expansion bearing containment walls, remove debris and paint roller nest.					

Table 1 – Five-Year Repair & Maintenance Schedule.

Appendix A

2015 Bridge Inspection Field Report

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
BRIDGE INSPECTION FIELD REPORT

Structure File Number: 1800035 | Inventory Bridge Number: CUY 00002 14.410 N | Bridge Type: 3 - STEEL/4 - TRUSS/3 - DECK

Sufficiency Rating: 23.5 | Date Built: 7/1/1939

District: 12 Place Code (FIPS): CLEVELAND | SR 2 over (1476)CUY RIVER,RTA,FLATS | Type of Service on: HIGHWAY-PEDESTRIAN

APPROACH ITEMS

	QTY.	1	2	3	4	TR
c1. Approach Wearing Surface (EA)	6	0	6			2.00
c2. Approach Slabs (SF)	6788	6788				1.00
c3. Relief Joint (LF)	272	272				1.00
c4. Embankment (EA) d	1	1				1.00
c5. Guardrail (EA)	13	13				1.00

N36. Safety Features: Tr, Gr, Tm — 36)B 1 36)C 1 36)D 1

c6. Approach Summary (9-0) 6

DECK ITEMS

	QTY.	1	2	3	4	TR
c7.1 Floor/Slab (SF)	562590.0	562590				1.00
c7.2 Edge of Floor/Slab (LF)	13160	13160				1.00
c8. Wearing Surface (SF)	539560	539060	500			1.00
c9. Curb/Sidewalk/Walkway (LF)						
c10. Median (LF)	6580	6380	100	100		1.26
c11. Railing (LF)	13160	12560	400	200		1.28

N36. Safety Features: Rail — 36)A 1

	QTY.	1	2	3	4	TR
c12. Drainage (EA) d	268	250	14	4		1.30
c13. Expansion Joint (LF) d	3548	3328	120	100		1.45

N58. Deck Summary (9-0) 7

SUPERSTRUCTURE ITEMS

	QTY.	1	2	3	4	TR
c14. Alignment (EA) d	40	40				1.00
c15.1 Beams/Girders (LF)	7394	7205	189			1.04
c15.2 Slab (SF)						
c16. Diaphragm/X-Frames (EA)	1203	1203				1.00
c17. Stringers (LF)	71947	71947				1.00
c18. Floorbeams (LF)	27168	25691	1231	246		1.21
c19. Truss Verticals (EA)	272	265	5	2		1.15
c20. Truss Diagonals (EA)	268	253	4	9	2	1.74
c21. Truss Upper Chord (EA)	268	252	7	9		1.50
c22. Truss Lower Chord (EA)	268	176	23	59	10	2.78
c23. Truss Gusset Plate (EA) d	1088	1019	18	51		1.63
c24. Lateral Bracing (EA)	370	370				1.00
c25. Sway Bracing (EA)	364	364				1.00
c26. Bearing Devices (EA) d	191	183	8			1.06
c27. Arch (LF)						
c28. Arch Column/Hanger (EA)						
c29. Arch Spandrel Walls (LF)						
c30. Prot. Coating System (LF) d	122,210	90550	24910	6750		1.84
c31. Pins/Hangers/Hinges (EA) d	14	11	3			1.29
c32. Fatigue (LF) d	107793	107793				1.00

N59. Superstructure Summary (9-0) 4

SUBSTRUCTURE ITEMS

	QTY.	1	2	3	4	TR
c33. Abutment Walls (LF)	263	263				1.00
c34. Abutment Caps (LF)		0				
c35. Abut. Columns/Bents (EA)		0				
c36. Pier Walls (LF)	55	55				1.00
c37. Pier Caps (LF)	90	90				1.00
c38. Pier Columns/Bents (EA)	197	0	197			2.00
c39. Backwalls (LF)	263	263				1.00
c40. Wingwalls (EA)	12	12				1.00
c42. Scour (EA) d	2	2				1.00
c43. Slope Protection (EA) d	40	40				1.00

N60. Substructure Summary (9-0) 6

CULVERT ITEMS

	QTY.	1	2	3	4	TR
c44. General (LF)						
c45. Alignment (LF) d						
c46. Shape (LF) d						
c47. Seams (LF) d						
c48. Headwall/Endwall (LF)						
c49. Scour (LF) d						
c50. Abutments (LF)						

N62. Culvert Summary (9-0) N

CHANNEL ITEMS

	QTY.	1	2	3	4	TR
c51. Alignment (LF) d	200.0	200.0				1.00
c52. Protection (LF) d	200.0	200.0				1.00
c53. Hydraulic Opening (EA) d	2	2				1.00
c54. Navigation Lights (EA) d	0.0				0.0	

N61. Channel Summary (9-0) 8

SIGN/UTILITY ITEMS

	QTY.	1	2	3	4	TR
c55. Signs (EA) d						
c56. Sign Supports (EA) d						
c57. Utilities (LF) d						

General Appraisal (9-0) 4

N41. Operating Status A

Inspector Name	Vermes, William	
Inspection Date/Type	12/11/2015	Routine and In-Depth and Fracture Critical
PE Number	53391	
Reviewer Name	Vermes, William	
Review Date	02/15/2016	
PE Number	53391	

Structure File Number: 1800035 Inventory Bridge Number: CUY 00002 14.410 N Bridge Type: 3 - STEEL/4 - TRUSS/3 - DECK

Sufficiency Rating: 23.5 Date Built: 7/1/1939

District: 12 Place Code (FIPS): CLEVELAND SR 2 over (1476)CUY RIVER,RTA,FLATS Type of Service on: HIGHWAY-PEDESTRIAN

Key: "Qty" = Quantity for Element Level inspection; "(LF)" = Linear Feet; "(SF)" = Square Feet; "(EA)" = Each or count; "CR" = 1-4 Condition Rating or average of worst span unless Summary item 9-0, then the average of entire bridge influenced by the bold boxes; "TR" = Transition Rating or weighted average of condition states; "d" = dedicated or specific chart and guidance, all others use Material specific chart/guidance; "c" = condition prefix; "N" = NBIS rating

Inspection Procedures

Next Insp Cycle is in 2016 and Est. Hours is 60 and TTC is MT-95.31.

Comments

APPROACH

c1. Approach Wearing Surface

Isolated spalls in the West Approach pavement. Moderate transverse and map cracking throughout the East and West Approaches.
East approach, EB lanes: Concrete slab has settled 3" over 200 feet.

c2. Approach Slabs

Minor spalling at the relief joints.

DECK

c7.1 Floor/Slab

Isolated minor spalls at stringer haunches. SIP forms exhibit moderate corrosion at expansion joints on the Main Truss.

c8. Wearing Surface

Isolated surface scaling and minor hairline cracks. Minor spalls adjacent to joint armor at isolated locations.
Minor and isolated spalls along gutterline, EB main truss spans.

c10. Median

Existing spalls have increased in size and exposed additional reinforcing bars.

c11. Railing

Numerous large spalls exist in the top face, along the exterior reveal, and at deck joint locations. Existing spalls have increased in size and exposed additional reinforcing bars. Isolated locations exhibit delaminations and pose a hazard to the public below.

Spalls on top of railing appear to be due to material or design failure, not corrosion of top longitudinal rebar. During the 1991-92 rehab, the railing was slipformed, and exhibited deterioration soon after the bridge resumed service.

c12. Drainage

Drainage troughs and hoppers on the Main Truss typically exhibit advanced section loss with holed through sections causing water to drain onto the structure below. Rehabilitation of the drainage system was ongoing at the time of inspection.

c13. Expansion Joint

Quantity includes all deck joints in main truss spans.

The joint at Bent 14, East Approach, has failed and is leaking.

New precompressed foam seals have been installed throughout the structure. The precompressed foam seal at Joint C exhibits a 24" section detached from the joint armor. Isolated joint locations exhibit minor vertical misalignment resulting in plow catch point and damage to joint armor. The joint armor typically exhibits minor gouges and section loss.

SUPERSTRUCTURE

c14. Alignment

The impact damage to the south fascia beam over W. 9th St. (northbound lane) has been repaired with new scrape marks to the bottom flange due to vehicles hit. Clearance is
13.5 feet, no vertical clearnace sign is present.

Isolated stringer sliding bearings exhibit minor vertical misalignment at the bearing interface in the East Approach Trestle Section.

c15.1 Beams/Girders

There is corrosion present in the form of park rust resulting in section loss without deformation in the built up girders. See report for detailed locations and descriptions of deficiencies.

c16. Diaphragm/Cross Frames

Minor section loss to steel crossframes and isolated spalls and cracks in concrete diaphragms.

c17. Stringers

The fascia stringers in Sections C and K (over W. 28th St.) exhibit localized web distortion adjacent to the top flange. Retrofit angles have been installed. Previously noted cracks in the fascia stringers show no propagation since the previous inspection.

c18. Floorbeams

There is corrosion present in the form of pack rust and pitting. See report for detailed locations and descriptions of deficiencies.

c19. Truss Verticals

There is corrosion present in the form of park rust and pitting. See report for detailed locations and descriptions of deficiencies.

c20. Truss Diagonals

There is corrosion present in the form of park rust and pitting. See report for detailed locations and descriptions of deficiencies.

c21. Truss Upper Chord

There is corrosion present in the form of park rust and pitting. See report for detailed locations and descriptions of deficiencies.

c22. Truss Lower Chord

There is corrosion present in the form of park rust and pitting. See report for detailed locations and descriptions of deficiencies.

c23. Truss Gusset Plate

There is corrosion present in the form of park rust and pitting. See report for detailed locations and descriptions of deficiencies.

c24. Lateral Bracing

Areas below and adjacent to the truss expansion joints typically exhibit cleaned and painted pitting. Ongoing repairs are strengthening members with advance section loss at the time of inspection. Isolated areas in the Lakefront Ramp Section exhibit up to 1" of pack rust.

c25. Sway Bracing

Deficient sway bracing has been restored in current rehabilitation. Contractor has left steel shaving in uphill side of bottom flanges.

c26. Bearing Devices

Main Truss Expansion Bearing Assemblies: Welded covers are not preventing water and dirt from accumulating within the voids between the rollers.

Minor misalignment of stringer sliding bearings at isolated locations in the Trestle section. Bearings throughout the structure typically exhibit minor pitting and surface corrosion.

c30. Protective Coating System

Widespread paint failures throughout the Lakeside Ramp and Trestle Sections, with isolated locations exhibiting active surface corrosion. Locations under joints typically exhibit active corrosion.

c31. Pins/Hangers/Hinges

Light corrosion present in the form of park rust and pitting. Three hangers have contact with rivet not countersunk for clearance. See report for detailed locations and descriptions of deficiencies.

c32. Fatigue

No fatigue distress was noted at locations of tack welds and welded cover plates in the West Approach and Trestle Sections.

SUBSTRUCTURE

c38. Pier Columns/Bents

Steel bents exhibit isolated cleaned and painted pitting. Steel piers in the Lakefront Ramp Section exhibit active corrosion.

Rust flakes and debris in bottom of pier bents.

c37. Pier Caps

The south pedestal at Trestle Bent 37 is spalled with minor undermining of the bearing. Concrete patching has been completed.

c39. Backwalls

Minor vertical cracking and delaminated concrete at the East Abutment.

c40. Wingwalls

Localized minor spalling and cracks are present on the West and East Approach curtain walls.

c43. Slope Protection

Slope protection on east side of Pier 37 has been repaired.

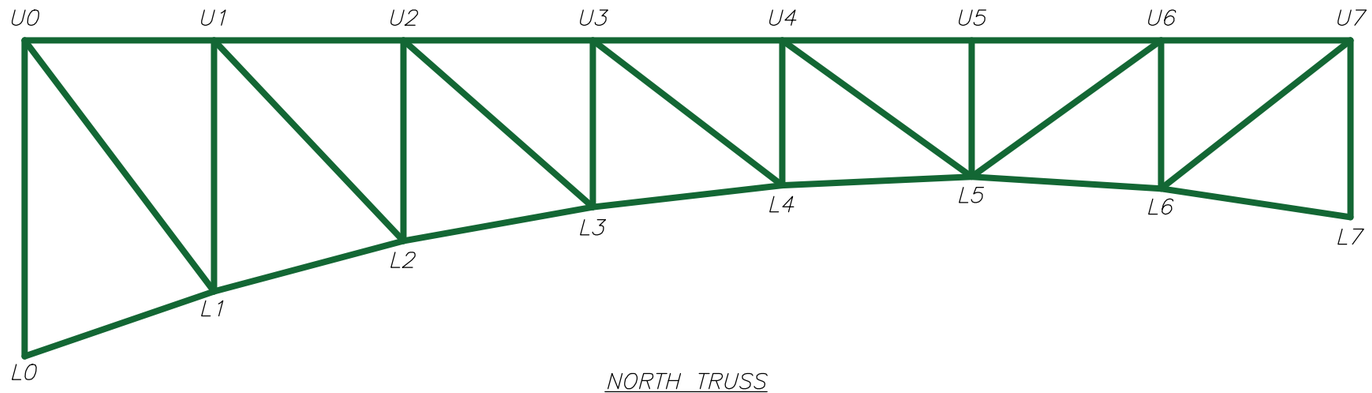
CHANNEL

c52. Protection

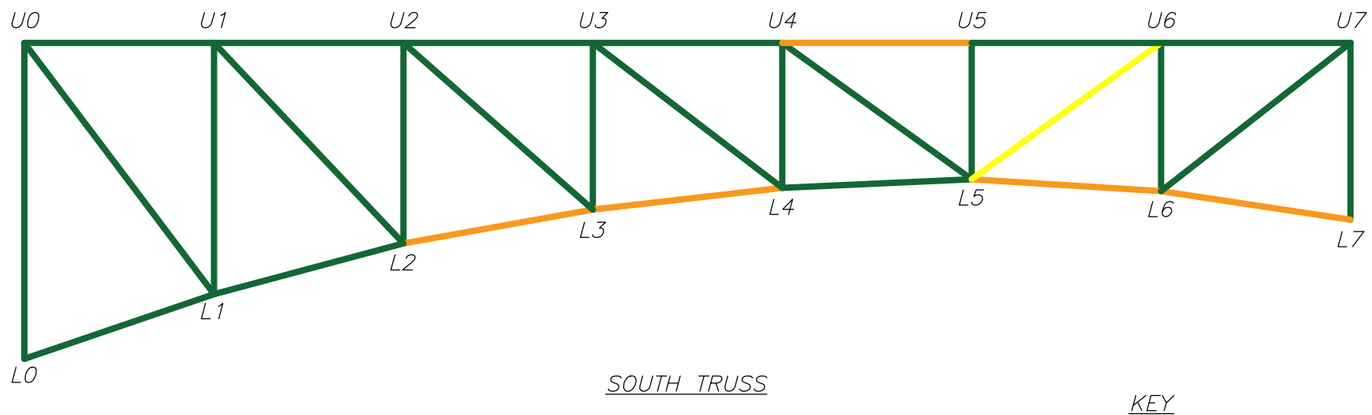
Isolated erosion holes exist in the area between Pier 9 and the river wall.

Appendix B

2015 Main Span Condition State Schematics



NORTH TRUSS



SOUTH TRUSS

KEY

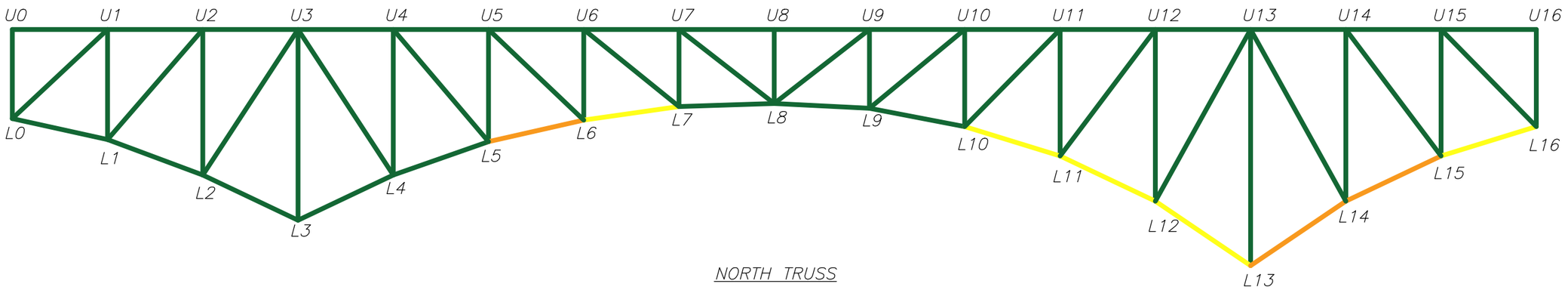
- CS1
- CS2
- CS3
- CS4

Jones Stuckey
A Division of Pennoni

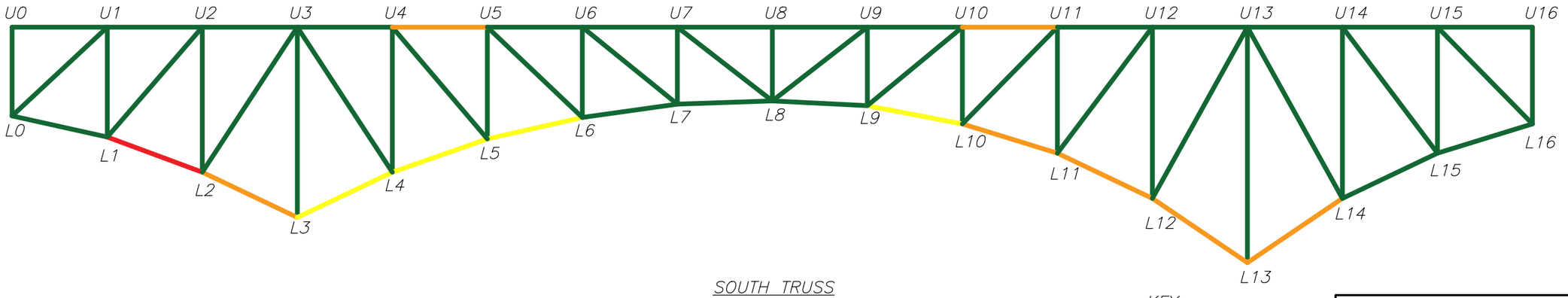
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 1

B–1



NORTH TRUSS



SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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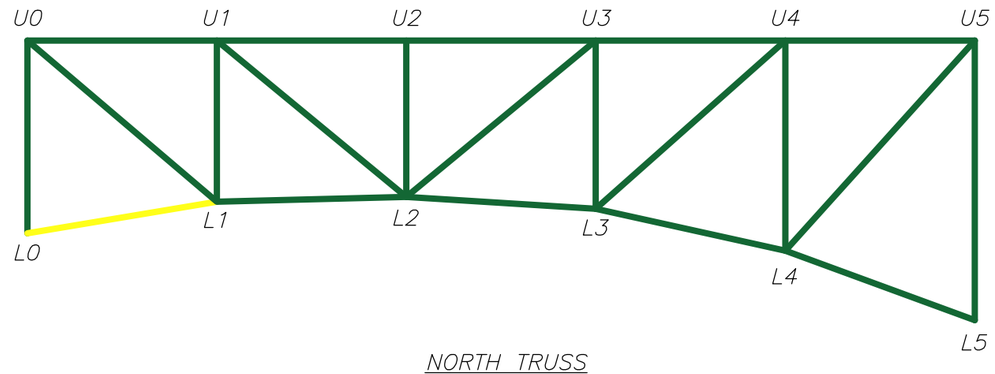
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 2

B–2



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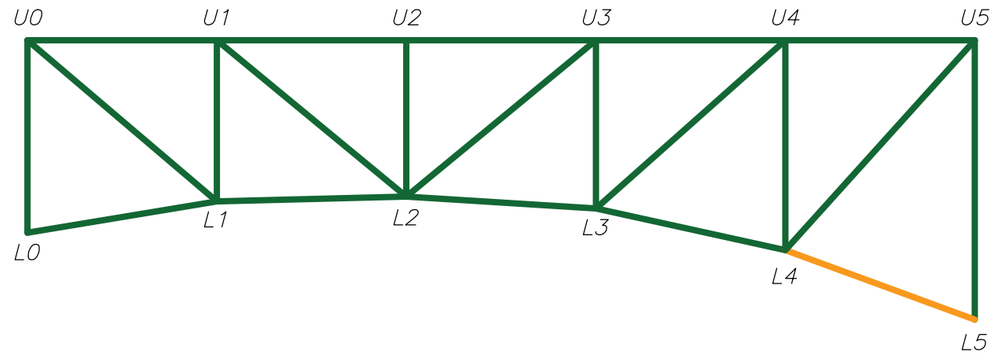

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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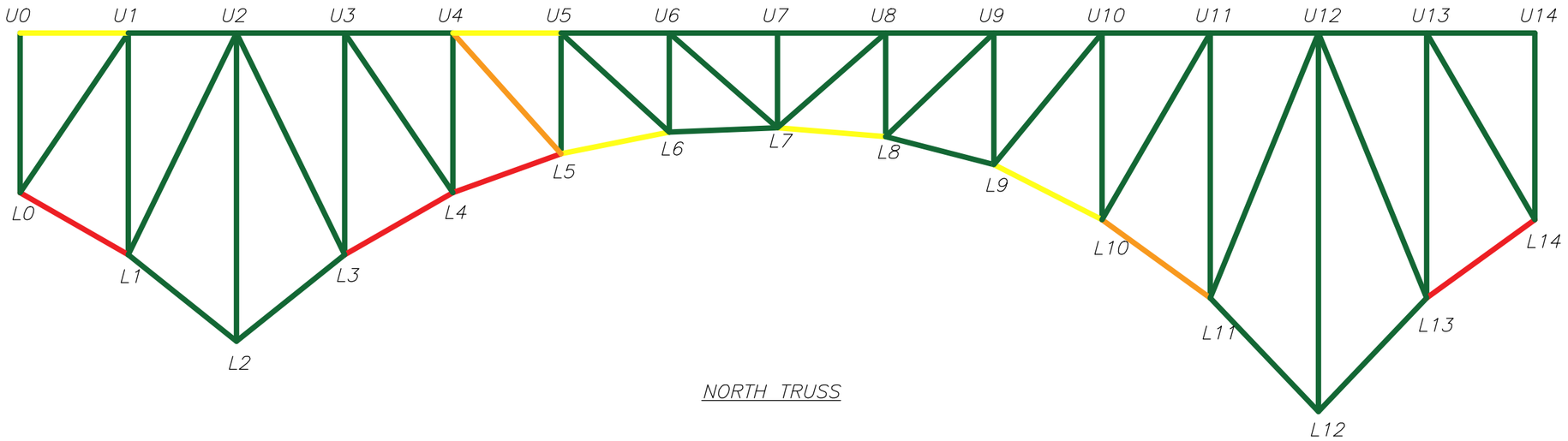
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 3

B–3



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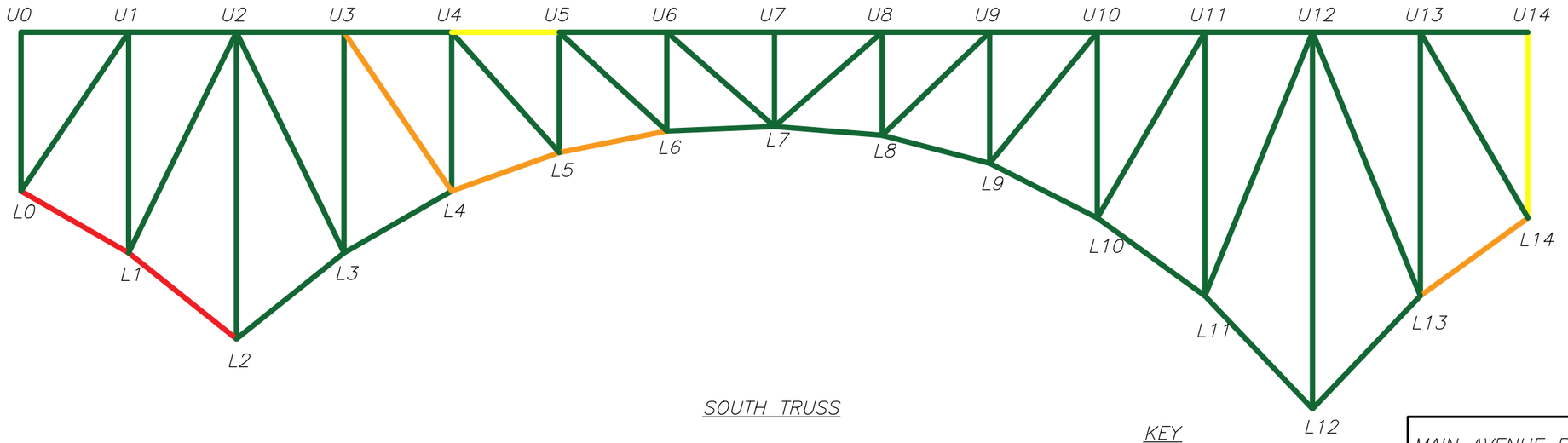

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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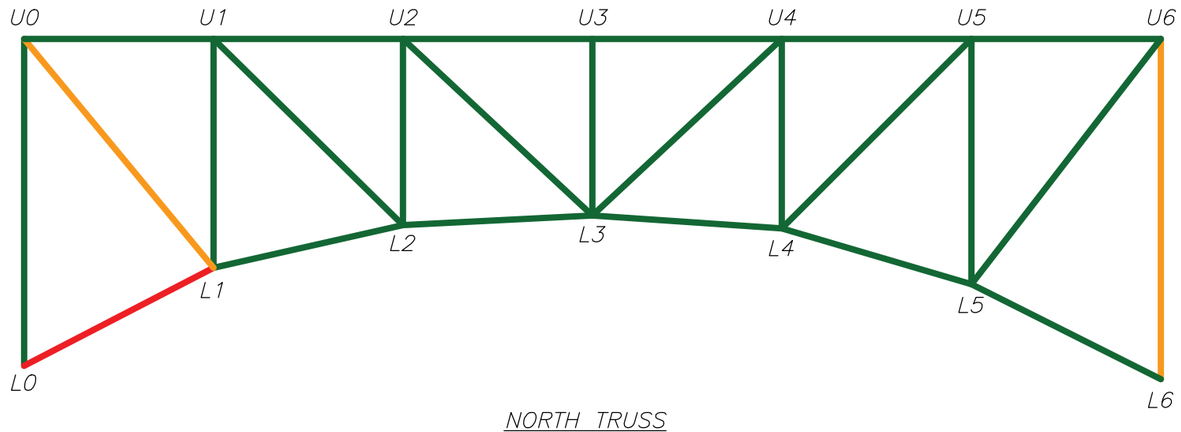
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 4

B-4



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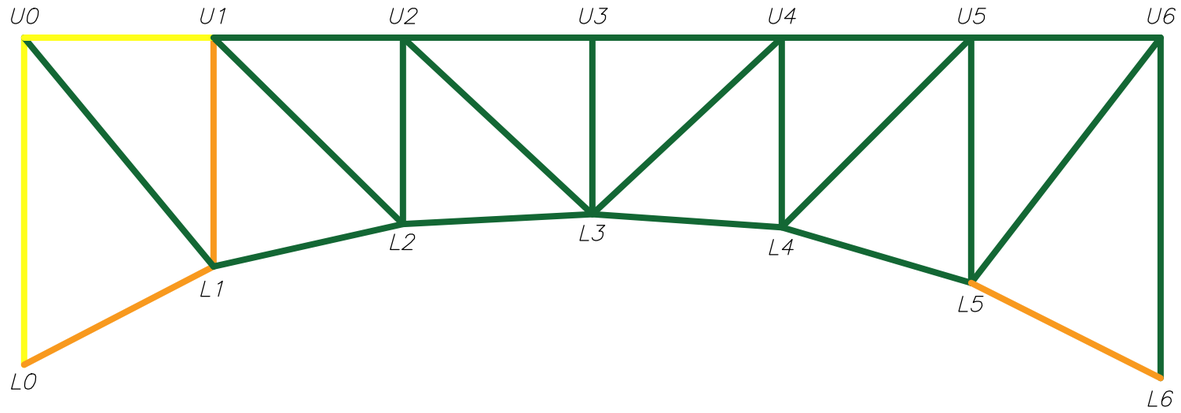

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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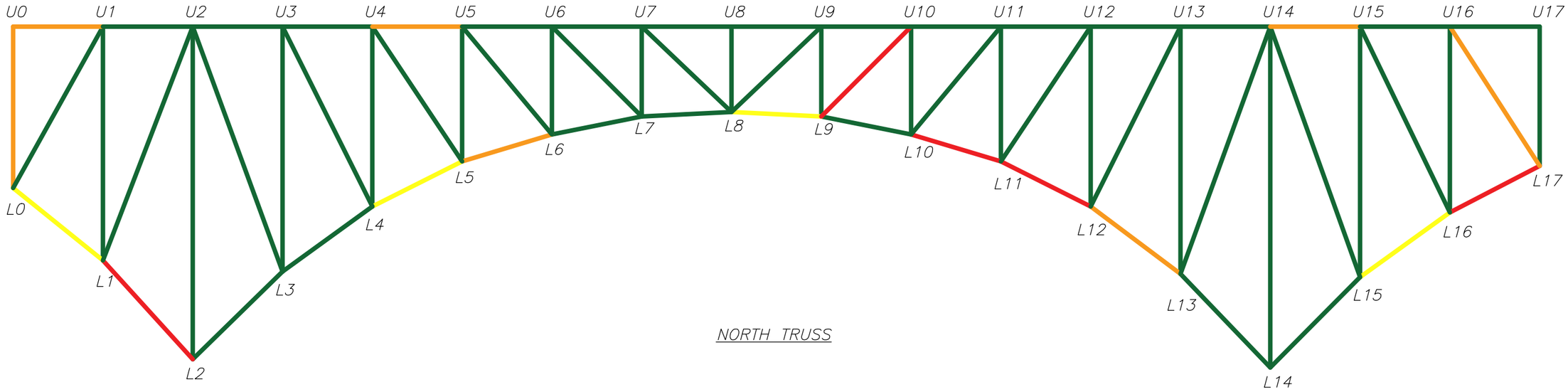
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 5

B–5



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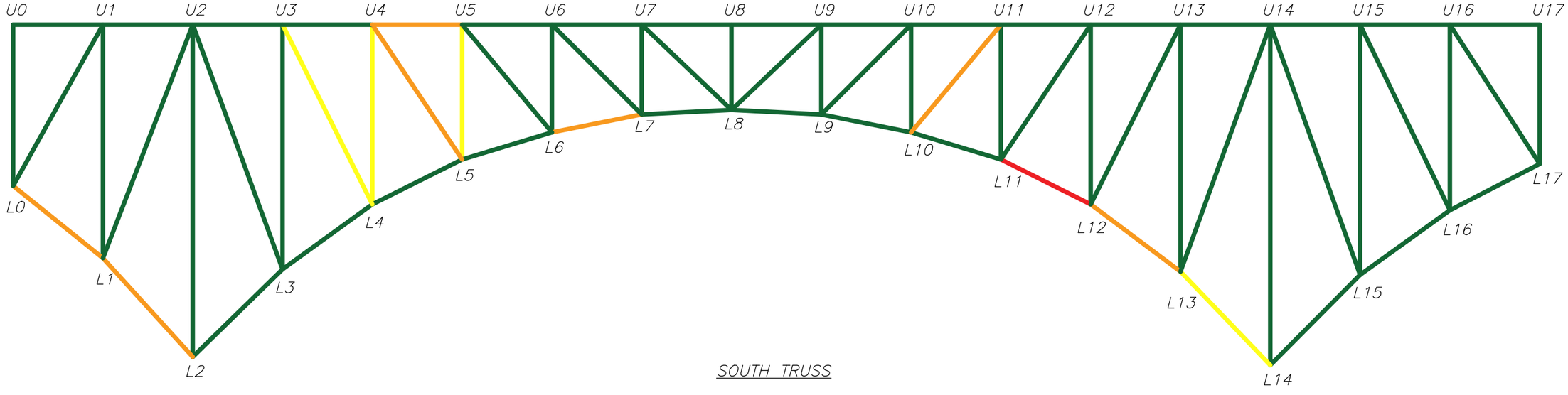

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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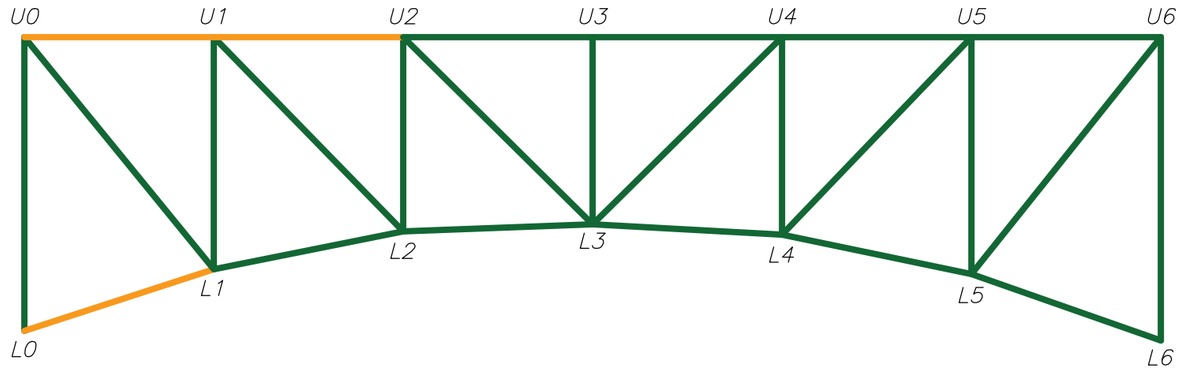
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 6

B-6



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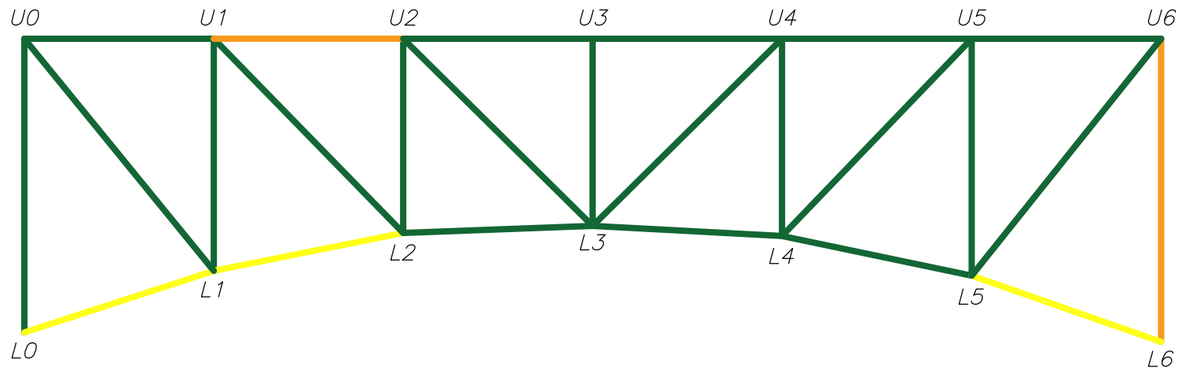

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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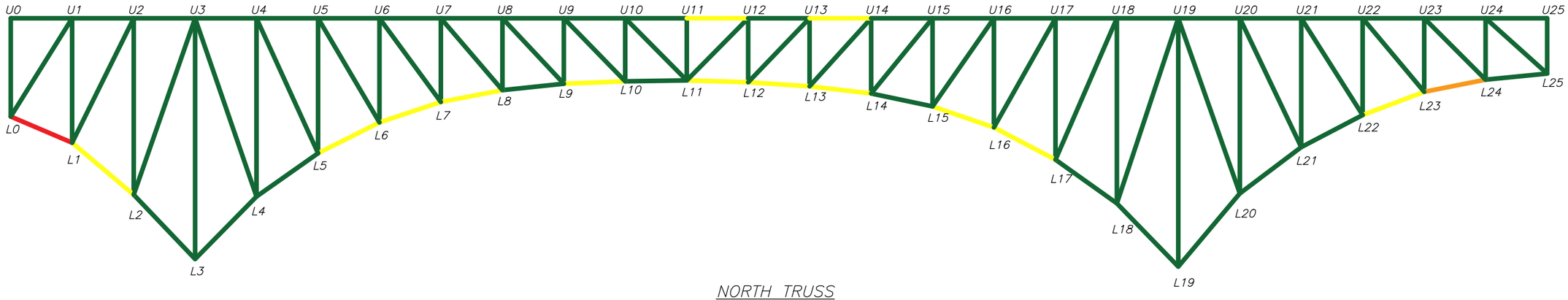
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 7

B–7



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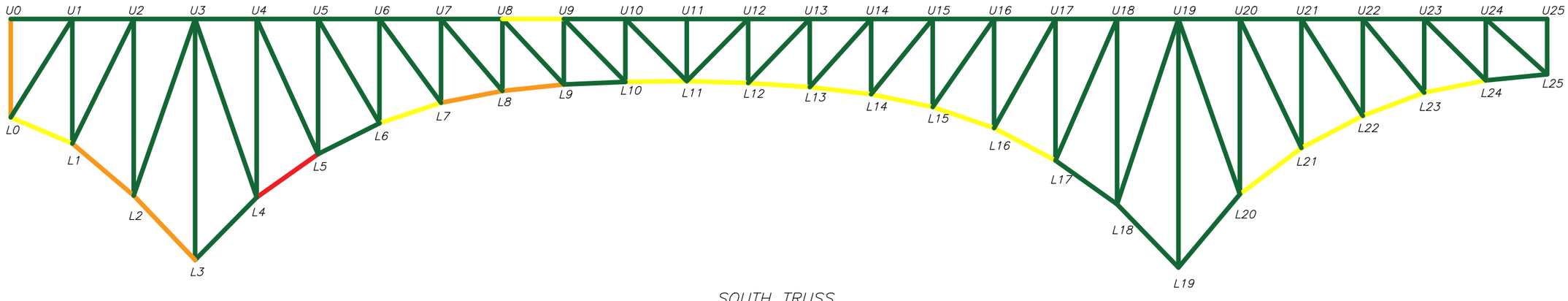

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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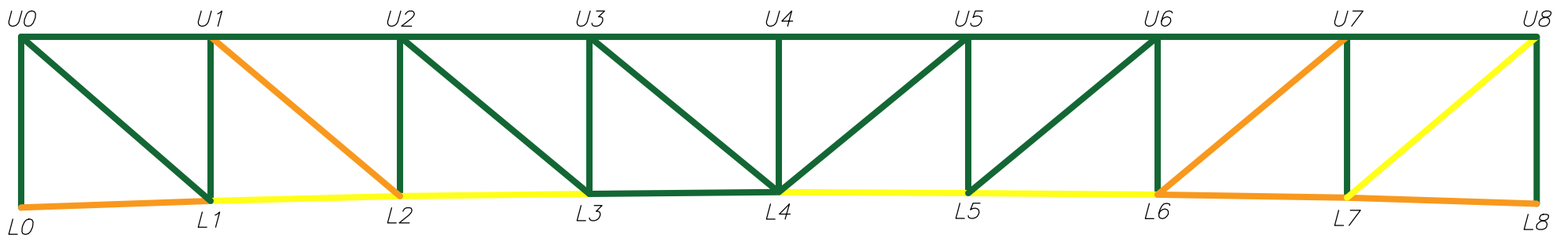
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 8

B–8



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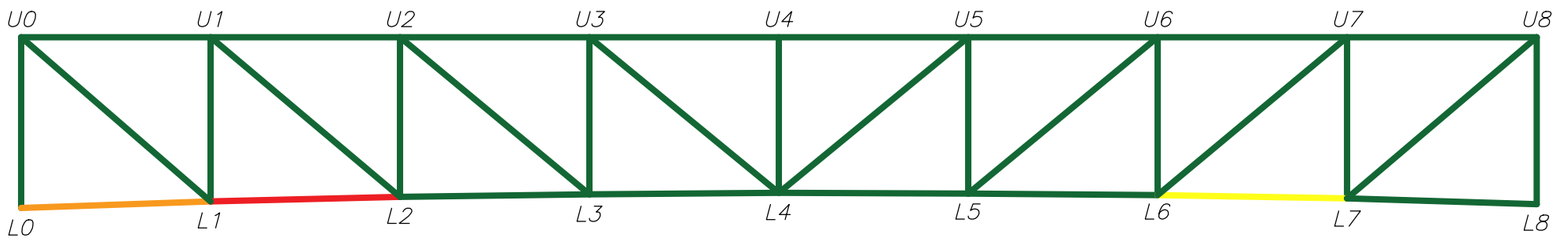

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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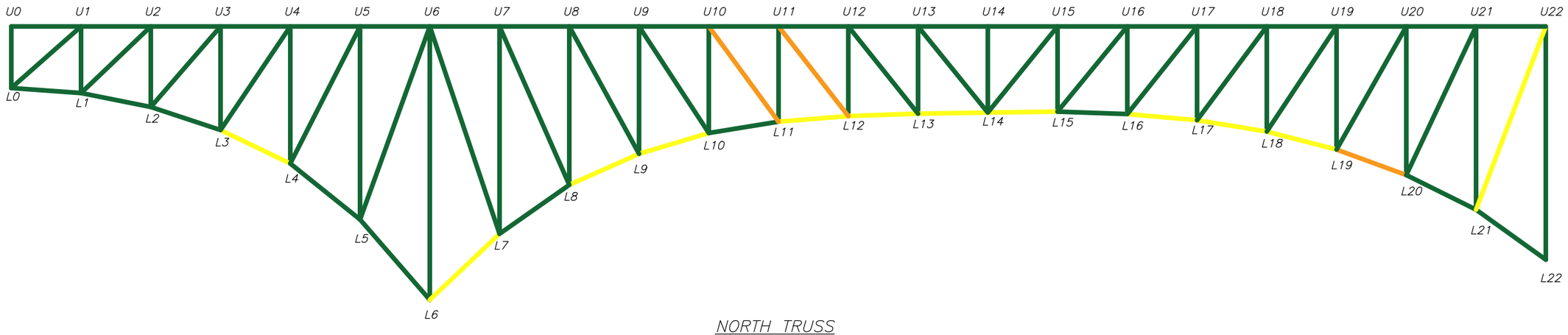
MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 9

B-9



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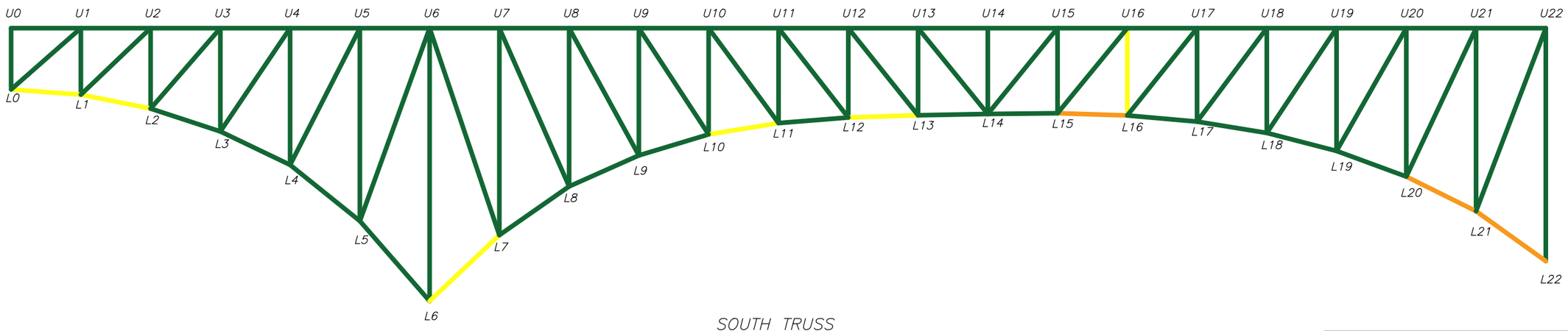

SOUTH TRUSS

KEY

- CS1
- CS2
- CS3
- CS4

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MAIN AVENUE BRIDGE TRUSS MEMBER CONDITION STATE SCHEMATIC

SPAN 10

B–10

Appendix C

2015 Superstructure Inspection Findings

Location		Condition State/ Description of Deficiency
Span	FB	CS 3
2	6	0.25" section loss to top flange.
10	7	Section Loss, 0.125" pitting in both flanges.
10	10	Section Loss, 0.125" pitting in bottom flange.

Table C1 – Floor Beam Deficiencies, Main Truss Spans.

Location		Condition State/ Description of Deficiency
Span	Member	CS 3
5 S	L_1U_1	Pack Rust, 0.875” inward bow in flange.
6 N	L_0U_0	0.25" section loss to top flange.
7 S	L_6U_6	Section Loss, 1.5” diameter hole and 0.125” deep pitting in web plate.

Table C2 – Main Truss Vertical Deficiencies.

Location		Condition State/ Description of Deficiency	
Span	Member	CS 3	CS 4
4 N	U_4L_5	Cracking, 1” in fill plate at U_4.	
4 S	U_3L_4	Pack Rust, distorting fill plate at L_4.	
5 N	U_0L_1	Section Loss, 0.25" pitting on web plate.	
6 N	L_9U_{10}		Section Loss, 2” dia. hole in flange plate.
6 N	$U_{16}L_{17}$	Section Loss, 0.125” pitting.	
6 S	U_4L_5	Section Loss, 0.1875” pitting.	
6 S	$L_{10}U_{11}$	Pack Rust, 0.75” distortin g edges of north web plate.	
9 N	L_6U_7	Pack Rust, 0.5” distorting edges of both flange plates.	
9 N	U_1L_2	Pack Rust, 0.25” distorting edges of top flange plate.	
10 N	$U_{11}L_{12}$	Damage, 0.75” gouge to web plate.	
10 N	$U_{10}L_{11}$	Section Loss, 0.125” pitting.	

Table C3 – Main Truss Diagonal Deficiencies.

Location		Condition State/ Description of Deficiency
Span	Member	CS 3
1 S	U_4U_5	Section Loss, 0.125" pitting in flange plate.
2 N	$U_{10}U_{11}$	Section Loss, 0.125" pitting in flange plate.
6 N	U_0U_1	Section Loss, 0.25" pitting in both web plates.
6 N	U_4U_5	Section Loss, 0.125" pitting in web plate.
6 N	$U_{14}U_{15}$	Section Loss, 0.125" pitting in top flange plate.
6 S	U_4U_5	Section Loss, 0.125" pitting in web plate.
7 N	U_0U_1	Section Loss, 0.125" pitting in top flange and both web plates, 0.125” remaining section of bottom flange.
7 N	U_1U_2	Section Loss, 0.125" pitting in top flange plate.
7 S	U_1U_2	Section Loss, 0.125" pitting in both web plates.

Table C4 – Main Truss Upper Chord Deficiencies.

Location		Condition State/ Description of Deficiency	
Span	**Member**	**CS 3**	**CS 4**
1 S	L_5L_6	Section Loss, 0.375” pack rust distorting top flange plate.	
1 S	L_3L_4	Section Loss, 0.5” pack rust distorting top flange plate.	
1 S	L_2L_3	Section Loss, 1” pack rust distorting top flange plate.	
1 S	L_6L_7	Section Loss, 0.125” pitting in top flange plate.	
2 N	$L_{10}L_{11}$	Section Loss, 0.5” pack rust distorting top flange plate.	
2 S	$L_{10}L_{11}$	Section Loss, 0.5” pack rust distorting top flange plate, 4” dia. hole in angle.	
2 N	$L_{14}L_{15}$	Section Loss, 0.25” pitting in top flange plate.	
2 N	$L_{15}L_{16}$	Section Loss, 0.25” pitting in top flange plate.	
2 N	L_1L_2	Section Loss, 1.5” pack rust distorting top flange plate.	
2 N	L_0L_1	Section Loss, 0.125” pitting in both web plates.	
2 S	$L_{11}L_{12}$	Section Loss, 1.5” pack rust distorting bottom edge of both web plates.	
2 S	$L_{12}L_{13}$	Section Loss, 1” pack rust distorting top edge of both web plates.	
2 S	L_2L_3	Section Loss, 0.5” pack rust distorting both edges of top flange plate.	
2 S	$L_{13}L_{14}$	Section Loss, 1” pack rust distorting both edges of top flange plate.	
2 S	L_1L_2		Section Loss, 1.25” pack rust distorting both edges with perforations of top flange plate.

Table C5 – Main Truss Lower Chord Deficiencies.

(Cont. on next page.)

Location		Condition State/ Description of Deficiency	
Span	**Member**	**CS 3**	**CS 4**
3 N	L_0L_1		Section Loss, 0.125” pitting in both web plates.
3 N	L_4L_5	Section Loss, 0.125” pitting in top flange plate.	
3 S	L_4L_5	Section Loss, 0.25” pitting in top flange plate.	
4 N	L_5L_6	Section Loss, 0.25” pack rust distorting north web plate.	
4 N	L_0L_1	Section Loss, 0.375” pack rust distorting top flange plate.	
4 N	L_3L_4		Section Loss, 0.125” of section remaining in bottom flange plate, isolated 1” dia. through holes near joint L_4.
4 N	L_4L_5		Section Loss, 0.125” of section remaining in bottom flange plate.
4 N	L_7L_8	Section Loss, 0.125” pitting in north web plate.	
4 N	L_9L_{10}	Section Loss, 0.125” pitting in top flange plate.	
4 N	$L_{10}L_{11}$	Section Loss, 0.125” pitting in top flange plate.	
4 N	$L_{13}L_{14}$	Section Loss, 0.1875” pitting in top flange plate, 0.5” pack rust distorting top flange plate.	
4 S	L_0L_1		Section Loss, 0.5” dia. hole in bottom splice plate, 0.25” pitting on all plates.
4 S	L_1L_2		Section Loss, 0.25” pitting in top flange plate.
4 S	L_4L_5	Section Loss, 0.125” pitting in top flange plate.	
4 S	L_5L_6	Section Loss, 0.3” bow/distortion from pack rust.	
4 S	$L_{13}L_{14}$	Section Loss, 0.25” perforation in bottom flange plate.	
5 N	L_0L_1	Section Loss, 0.25” pitting in top flange plate.	
5 S	L_0L_1	Section Loss, 0.125” pitting in top flange plate.	

Table C5 – Main Truss Lower Chord Deficiencies. (Cont.)

Location		Condition State/ Description of Deficiency	
Span	**Member**	**CS 3**	**CS 4**
5 S	L_5L_6	Section Loss, 0.25" bow/distortion from pack rust in exterior web plate.	
6 N	L_0L_1		Section Loss, 5" dia. hole and 0.25" pitting in bottom flange plate.
6 N	L_1L_2		Section Loss, 5" dia. hole and 0.25" pitting in bottom flange plate.
6 N	L_4L_5		Section Loss, 0.1875" section remaining in 5' dia. area.
6 N	L_5L_6	Section Loss, 0.125" pitting.	
6 N	L_8L_9	Section Loss, 1.5" bow/distortion from pack rust in top flange plate.	
6 N	$L_{10}L_{11}$	Section Loss, 0.25" bow/distortion from pack rust in top flange plate.	
6 N	$L_{11}L_{12}$	Section Loss, 0.25" pitting and 0.25" dia. hole in top flange plate.	
6 S	L_0L_1	Section Loss, up to 0.25" pitting in member.	
6 S	L_1L_2		Section Loss, 0.125" pitting in each face of bottom flange plate.
6 S	L_4L_5	Section Loss, 1" pack rust distorting south web plate.	
6 S	L_6L_7	Section Loss, 0.5" pack rust distorting bottom flange plate.	
6 S	L_7L_8	Section Loss, 0.5" pack rust distorting bottom flange plate.	
6 S	$L_{11}L_{12}$	Section Loss, 1" pack rust distorting both flange plates.	
6 S	$L_{16}L_{17}$	Section Loss, 0.125" pitting in web plate.	
7 N	L_0L_1	Section Loss, 0.25" pitting in top flange plate, 5x2" hole in bottom flange plate.	
7 S	L_0L_1	Section Loss, 0.125" pitting in top flange plate.	

Table C5 – Main Truss Lower Chord Deficiencies. (Cont.)

Location		Condition State/ Description of Deficiency	
Span	**Member**	**CS 3**	**CS 4**
9 N	L_0L_1	Section Loss, 0.25” pitting in top flange plate.	
9 S	L_0L_1		Section Loss, 0.25” pitting in top flange plate with 0.5” through holes.
10 N	L_0L_1	Section Loss, 0.25” bow/distortion from pack rust in top flange plate.	
10 N	L_6L_7	Section Loss, 0.125” pitting on top flange plate.	
10 N	$L_{11}L_{12}$	Section Loss, 0.125” pitting on top flange plate.	
10 S	$L_{10}L_{11}$	Section Loss, 0.25” pitting and 3” dia. hole in top flange plate.	
10 S	$L_{20}L_{21}$	Section Loss, 2” to 4” dia. holes in bottom flange plate.	
10 S	$L_{21}L_{22}$	Section Loss, 2” to 4” dia. holes and 0.125” pitting in bottom flange plate.	

Table C5 – Main Truss Lower Chord Deficiencies. (Cont.)

Location			Condition State/ Description of Deficiency
Span	**Member**	**Quantity**	**CS 3**
1 S	L_2	1	Pack Rust, 0.5" at connection with L_1L_2.
2 N	U_{11}	1	Section Loss, 0.25" pitting on exterior face of exterior plate.
2 N	L_{14}	2	Section Loss, 0.125" pitting on both plates.
2 S	L_0, L_2, L_3	6	Section Loss, 0.125" pitting on both plates.
3 N	L_0	1	Section Loss, 0.25" pitting on exterior face of exterior plate.
4 N	L_8	1	Section Loss, 2” dia. hole in exterior plate under L_8U_8. No change from 2013 inspection.
5 S	U_6	1	Bowing, exterior plate bowed 0.3”.
5 S	L_0, L_2, L_3	6	Section Loss, 0.125" pitting on both plates.
6 N	U_0	2	Section Loss, 0.25" pitting on both plates.
6 N	U_6	1	Section Loss, 0.3125" pitting on exterior plate.
6 N	U_2	1	Broken rivet in exterior plate on U_2L_3 connection.
6 N	L_4	1	Section Loss, 0.125" pack rust in top joint on exterior plate.
6 N	L_9	1	Section Loss, 0.125" pitting on exterior plate.
6 S	L_0	1	Section Loss, 0.25" pitting on exterior plate.
6 S	L_5	1	Section Loss, 1.125" bowing of exterior vertical filler plate.
6 S	L_{11}	2	Section Loss, 0.125" pitting on both plates.
6 S	U_{17}	1	Section Loss, 0.1875" bowing of south plate from pack rust.
6 S	L_{12}	1	Section Loss, 0.1875" pitting on exterior plate.
7 N	U_1	1	Section Loss, 0.5" pack rust distorting exterior plate.
7 N	L_0	1	Section Loss, 0.375” pack rust distorting exterior plate.
7 S	L_3	1	Section Loss, 0.125" pitting on exterior plate.
10 N	L_0, L_8, L_9, L_{10}, L_{12}, L_{13}, L_{14}, L_{15}, L_{16}, L_{17}, L_{18}, L_{19}, U_0, U_{10}, U_{15}, U_{17}	18	Section Loss, 0.125"-0.25” pitting and pack rust on both interior and exterior plates.
10 S	U_{15}	1	Section Loss, 0.25" pitting in both plates.
11 S	U_7	1	Section Loss, 0.125" pitting in interior face of plate.

Table C6 – Main Truss Gusset Plate Deficiencies.

Appendix D

Undercrossing Minimum Vertical Clearances

Roadway Below	Vertical Clearance	Comments
W.28th Street - North	NB: 15.91'	
	SB: 15.65'	
W.28th Street - South	NB: 14.37'	
	SB: 13.79'	
W. 25th Street Ramps (Subway)	WB Entrance: 18.1’	W. 28th St. overpass poses restrictive clearance.
	EB Exit: >25.0'	W. 28th St. overpass poses restrictive clearance.
W. 25th Street	NB: 15.17'	
	SB: 14.88'	
Main Avenue (East)	EB: 17.47'	At W. 9th St. intersection.
	WB: 19.24'	At W. 9th St. intersection.
W. 9th Street	NB: 13.57'	At east curb.
	SB: 14.20'	At centerline.
W. Lakeside Avenue WB	14.53'	At FB, between Bents 14 & 15.
W. Lakeside Ave. Ramp to SR 2	Superstr.: 14.62' Drain Pipe: 13.85'	Along east edge line.
Summit Avenue	EB: 16.93'	At south girder
	WB: 16.20'	At north girder
W. 3rd Street	NB: 14.91'	At east curb.
	SB: 16.50'	At W. 3rd Street centerline of roadway.
W. 3rd St./ Port Authority Ramp to SR 2 EB	14.05'	At recently installed bolt shank.

Table D – Main Avenue Bridge Minimum Vehicular Vertical Clearances Under Bridge.