

August 30, 2019

Mr. Craig Bessinger, City Manager
City of Ferrysburg
17290 Roosevelt Road
PO Box 38
Ferrysburg, MI 49409-0038

RE: Inspection Report for West Spring Lake Road Bridge

Dear Mr. Bessinger:

We have completed our inspection of the West Spring Lake Road Bridge over Smith's Bayou (structure number 8941, aka "Smith's Bridge"). Our report follows:

BACKGROUND & UNDERSTANDING

The original crossing of Smith's Bayou was constructed by the Michigan Department of Transportation (MDOT) in the 1940's. In 1972, the Ottawa County Road Commission constructed its replacement, the structure that exists currently. Jurisdiction of the structure was transferred to the City of Ferrysburg in 1985.

The existing structure is an 8-span bridge with an overall span of 448 feet (8 spans of approximately 56 feet). The substructure consists of two cast-in-place concrete curtainwall abutments supported on piles and seven pile bent type piers (6 H piles with concrete jackets connected with a concrete cap). The superstructure consists of eleven (11) adjacent prestressed concrete box beams, tensioned together to form a deck structure, with an asphalt wearing surface to carry vehicular traffic. One additional box beam on each side, separated from the deck structure by a utility chase, carries the concrete sidewalk and tube railing. This type of structure was fairly common in Michigan in the era of its construction, given its relatively quick and cost-effective construction. It has since been largely abandoned, as agencies have encountered relatively rapid deterioration of the asphalt wearing surface and concrete box beams, which are difficult to repair.

The City made repairs to Smith's Bridge in 1989 and 2008. Work in 1989 included approach repairs and joint replacement. Work in 2008 included replacement of the asphalt wearing surface (and waterproofing membrane), joint replacement and pier jacket improvements. The Department of Public Works (DPW) maintains the structure with the majority of their efforts dedicated to sealing and patching the asphalt wearing surface.

Despite the repairs and improvements made by the City, the structure continued to deteriorate, to the extent that loads were restricted on the bridge. In recent years, the load restrictions have increased at a greater rate, from 68 tons to 58 tons in 2012, to 55 tons in 2013, to 35 tons in 2016, to 20 tons in spring 2019 (with truck traffic prohibited). Concerned with the rate of deterioration and the potential for failure of the top of the concrete box beams (according to the shop drawings, the top flanges are just 4 inches thick, see Attachment 1), City Council voted to close the bridge to vehicular traffic in June 2019.

The City has been actively seeking funds to replace Smith's Bridge for several years. Applications have been submitted to MDOT's Local Bridge Program annually since 2016, but have not been successful thus far, as the project would represent over 25% of the funds available statewide. Results of the 2019 application should be available in November or December. The City also issued a millage proposal in 2017, which was not passed, and pursued funding through the United States Department of Transportation's Better Utilizing Investments to Leverage Development (BUILD) Grant, which has not been successful to date.

STATEMENT OF PURPOSE

Fleis & VandenBrink (F&V) was retained by the City of Ferrysburg (City) to review the available inspection materials and related information and provide a second opinion on the bridge condition. F&V met with City staff and performed a routine inspection on August 1, 2019. We have reviewed the 2018 and 2019 routine inspection reports, the 2017 underwater inspection report and a quality control inspection by MDOT in 2017, as well as other background information provided.

EXISTING CONDITIONS – REVIEW OF APRIL 24, 2019 INSPECTION

The Federal Highway Administration (FHWA) and MDOT utilize the following rating criteria to assess bridge condition and identify deficiencies:

- New: 9
- Good: 7-8
- Fair: 5-6
- Poor: 4
- Serious: 3
- Critical: 2
- Imminent: 1
- Failed: 0
- Not Applicable: N/A

Bridge inspectors throughout the state work to maintain consistency from inspector to inspector, but some aspects of the process are subjective in nature. In their reviews, MDOT considers a bridge inspector's ratings to be appropriate when they are plus or minus 1 rating point from the MDOT reviewer's rating. For example, if a bridge inspector rates a component a 6 and the MDOT inspector rates it a 5 during their review, there is no disagreement. We have utilized this process in our review.

Following is our review of the April 24, 2019 inspection report, following the order components are listed in MDOT's Bridge Safety Inspection Report (BSIR). For consistency with prior reports and ease of description, we have assumed that the bridge has a north-south orientation as opposed to its diagonal one. Similarly, we have utilized the prior numbering scheme. Spans are numbered south to north (e.g. the southernmost span is 1S,). Piers are also numbered south to north (e.g. the second pier from the south is 2S). Beams are numbered west to east (e.g. the fourth beam from the west is 4W). Photographs illustrating the various comments are attached for reference (Attachment 2), along with a figure showing the existing cross section and nomenclature (Attachment 3).

DECK

Surface

As indicated previously, the bridge surface is an asphalt overlay (placed in 2008), approximately 1-1.5" thick placed on the top of the concrete box beams after application of a waterproofing membrane. The asphalt surface is significantly deteriorated and is worst in the northbound wheel lines on the north half of the bridge. In this area, the wheel lines have alligator cracking (some sealed), spalling and cold patch with areas of re-spall. The south half of the northbound lane and the southbound lane have scattered alligator cracking and spalling with cold patch, most in the wheel lines.

The surface was rated a 3 in April – the rating was lowered from 4 in 2017 to 3 in 2018. The MDOT QC inspection in 2017 agreed with the 2017 rating of 4. A rating of 3 indicates that spalling is affecting more than 25% of the surface area and ride quality may be impacted. While a case can be made for a rating of 4 with the spalling primarily in the wheel paths on a portion of the structure (other pavement being in fair condition), it would still support the rating of 3 assigned in April, 2019.

Joints

The joints on Smith's Bridge (located at the piers) all appear to be expansion type (as opposed to fixed). Concrete structures with 56-foot spans do not need to accommodate a significant amount of thermal expansion or rotation. The joints consist of polymer concrete headers with compression seals (apparently constructed in 1989 and replaced by or overlaid with hot rubber in 2008) as opposed to expansion joint devices with neoprene glands. The headers on the deck are cracked in a number of locations (coinciding with box beam joints in many cases) and have scattered spalling/cold patch. The joints between the concrete headers and asphalt wearing surface are sealed. Evidence of leakage was noted on the pier caps – heavy at the utility chases and less at box beam joints. The joints on the sidewalks are in better condition, however, the seals appear to be deteriorating and some slight offsets (~1/4") were noted.

The MDOT BSIR uses two fields to rate joints – Expansion Joints and Other Joints. The April report has comments related to expansion joints on the deck surface in the Expansion Joints field and those on the sidewalks in the Other Joints field. Both fields have been rated as 4 since 2017, and the MDOT QC inspection agreed with those ratings. Based on the deterioration of the headers on the deck and the evidence of leakage below (more than 5% of the joint length), the ratings appear to be appropriate.

Railings

The bridge railings are a metal three-tube style which was commonly used in 1972 but are no longer standard. This type of railing does not meet current standards for crashworthiness or geometry (maximum opening sizes) for pedestrians. No significant collision damage was noted. Light surface corrosion/oxidation was noted on several base plates and anchor bolts. Several anchor bolts were missing nuts.

Railings are rated not based on their design limitations (the BSIR includes separate fields for coding design limitations), but on their condition. The railings have been rated as 6 since at least 2014, and the MDOT QC inspection agreed with that rating. The guidelines for a rating of 6 are 2% surface area deterioration (no loss of section), minor collision damage and all connections securely attached. The missing nuts are less critical given the 35mph speed limit and 20-ton load limit in April (though we would still recommend their replacement). In light of that, the rating appears to be appropriate.

Sidewalks or Curbs

As indicated previously, the sidewalks are cast-in-place concrete, spanning between the fascia (exterior) beam and first interior beam to form the utility chase area. The sidewalks are raised, functioning as a curb. Cracking is limited. We noted scattered edge spalling, but none was severe enough to expose reinforcing steel. An isolated area of moderate spalling/grinding with exposed steel was noted on the east fascia (outer face) at Pier 2S.

Sidewalks have been rated as a 6 since 2016, and the 2017 MDOT QC inspection agreed with that rating. The guidance for a 6 is “Open cracks greater than 1/16” wide spaced at less than 10’. Spalling, delaminations, and unsound repairs affecting 2% or less of the area. Surface scaling may be ¼” to ½” deep.” Given the lack of open cracking and relatively minor and isolated nature of the edge and fascia spalling, a case could be made for a rating of 7, however, it would still support the rating assigned in April.

Deck Bottom Surface

In an adjacent box beam superstructure with asphalt wearing surface, the top flanges of the box beams are considered the “deck”. Due to the geometry, the bottom surface of the deck is not accessible for inspection, and therefore this item should be coded N, which it has been since 2018 (as a result of the MDOT QC inspection).

Deck

As indicated above, the top flanges of the concrete box beams function as the deck for this structure. The only portion accessible for inspection is the outside faces of the outer beams (first interior beams in this case, due to the utility chases). The deck is a critical component of the structure, and FHWA requires that a rating be given. Thus, the rating is based on the condition of the asphalt surface and the bottom surface of the beams, including evidence of leakage between and through the box beams.

The guidance for rating significantly deteriorated decks is as follows:

- 4/Poor: Delamination, spalling, heavily map cracked areas, or efflorescence with heavy rust staining. Deterioration of the combined area of both deck surfaces is between 10% and 25% of the total area. Structural review and/or load analysis is not required.
- 3/Serious: Excessive delamination, spalling, or cracking that may affect capacity. Deterioration of the combined area of both deck surfaces is more than 25% of the total area. Structural review and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading.
- 2/Critical: The deck will not support design loads and is posted, emergency repairs or temporary shoring is required.
- 1/Imminent Failure: The bridge is closed to traffic due to the potential for deck failure, but corrective action may put it back in service.
- 0/Failed: Bridge is closed due to deck condition.

The deck has been rated a 3 since 2017, and unfortunately MDOT did not note whether they agreed with that rating in their QC inspection (it is the only rating they didn’t comment on one way or the other). It was rated 6 in 2014 and 4 in 2016. The asphalt surface is significantly deteriorated, and the bottom surface of the beams has scattered cracking, delamination and spalling. Absent other information, we would typically rate the deck as a 4. Given the anecdotal evidence from the DPW (they have indicated that the concrete is very deteriorated in areas they have patched), a 3 may be justified. The MDOT rating guidance for a rating of 3 indicates “structural review and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading”. As this item is the critical one in determining whether the bridge can safely be

reopened to traffic, we would recommend a more in-depth evaluation. Several options for further evaluation are presented in the Alternatives section of our report.

Drainage

There is no rating associated with this field. It is included in the BSIR for comments only. This structure does not have specific drainage features – it is constructed with vertical curvature to direct surface water to the curbed approaches, conveyed to the lake via storm sewer or spillway.

SUPERSTRUCTURE

Stringer

This item is used to rate the primary load-carrying component of the superstructure. For this structure, that is the thirteen (13) prestressed concrete box beams – eleven (11) of them adjacent and tensioned together to carry vehicular traffic and one (1) on each side supporting the sidewalks. We noted cracking, delamination, spalling and broken steel prestressing strands throughout the beams. As expected, the worst/most concentrated deterioration was noted on the northern spans, correlating to some degree with the worst asphalt deterioration above. While cracking and delamination are indications of problems, spalling and (to a greater extent) broken strands are the defects that significantly impact the load-carrying capacity of the beams. We noted four (4) beams with broken prestressing strands:

- Span 6S, Beam 11W, 1 strand from midspan to ~15' south of midspan
- Span 6S, Beam 11W, 1 strand ~15' south of Pier 6S
- Span 7S, Beam 9W, 1 strand at Pier 6S
- Span 8S, Beam 6W, 3 strands at Pier 7S

Attachment 4 is a figure illustrating specific comments referenced by location.

We noted in the assumptions used for the load rating for the beams that as many as 4 strands have been removed for the analysis. This appears to be conservative, based on the location of most of the broken strands (the rating is dictated by tension/flexure at midspan, and most of the broken strands are near the end of beams).

The rating for this item was reduced from 6 to 5 in 2016, which the MDOT QC inspector agreed with in 2017. It was again reduced to 4 in 2018 and 3 in 2019. A rating of 4 indicates that there is exposed prestressing but no section loss and that “all members continue to function as design”. A rating of 3 indicates the presence of “structural cracking or reinforcement loss that may affect load capacity”. A rating of 2 indicates “the superstructure will not support design loads”. Based on the rating criteria, a rating of 2 would be justified, however given the redundancy of this type of superstructure (the damaged beams are connected to beams in better condition), we concur with the rating of 3. While the load rating analysis appears to be conservative, we understand that concern for the integrity of the tops of beams and not overall beam capacity was the primary reason for bridge closure.

Paint & Section Loss

These two fields are reserved for steel superstructures and are appropriately coded N.

Bearings

The box beams bear on elastomeric bearing pads, which is quite common for this structure type. We didn't note significant deterioration of the pads themselves, however, delamination and spalling of the concrete pier caps has impacted the bearings in several areas.

This item was rated 7 in 2017, which the MDOT QC inspection agreed with, and was reduced to 6 in 2018 and 4 in 2019. Based on the deterioration of the pier caps, we concur with the rating of 4.

SUBSTRUCTURE

Abutments

The abutments are cast-in-place concrete curtain walls supported by piles. Rock riprap is in place in front of both abutments to help prevent scour. No significant deterioration was noted.

The abutments were rated as 7 since at least 2014, and the MDOT QC inspector agreed with that rating. The rating was decreased to 6 in 2019. Based on incomplete riprap coverage, we would rate the abutments as 7, which is within 1 rating point, but a case could be made for a rating of 8.

Piers

The piers consist of six (6) steel H piles with concrete jackets to protect against impact/corrosion and concrete caps to connect the piles and provide a uniform bearing area. The concrete jackets were repaired and supplemented with fiber reinforced polymer (FRP) wraps in 2008. On the concrete pile jackets, we noted vertical cracking on the order of 1/16" on many of the original jackets, scattered honeycombing and spalling with exposed reinforcing steel. On the concrete pile caps we noted evidence of heavy leakage at the utility chases, minor to moderate leakage at box beam joints, scattered cracking and delamination. We noted a severe spall with exposed positioning dowels and undermined bearings on the south face of Pier 1S at Beam 9W and beyond. A figure illustrating specific comments referenced by location is included as Attachment 5.

The piers were rated as 6 in 2014, reduced to 5 in 2016 which the MDOT QC inspector agreed with in 2017, and reduced again to 4 in 2018. The underwater inspection in 2017 rated the portion of the piers below the water line as a 5. The guidance for a rating of 5 is "Moderate delamination, spalling or efflorescence. Reinforcement exposure without section loss. Moderate deterioration affecting structural components including minor settlement, shallow scour, or impact damage." The guidance for a rating of 4 is "Considerable cracking, spalling, and efflorescence with heavy build-up or rust staining. Considerable deterioration affecting structural members including partial settlement or scour. All members continue to function as designed." Based on the severity of the spalling on Pier 1S, we concur with the rating of 4.

Slope Protection

This field is reserved for non-waterway crossings (railroad crossings, e.g.) and is appropriately coded N.

Channel

The flow at this crossing is fairly minimal, however wave action can deteriorate the banks and slopes around the structure. The channel is well-defined and while coverage is not 100%, rock riprap is in place around both abutments.

This item has been rated 7 since at least 2014, and the MDOT QC inspector agreed with it in 2017. We concur with the rating of 7.

Scour Inspection

Scour is reviewed at routine inspections to the extent practical and is inspected in greater detail during the underwater inspections. No scour was noted, however, the underwater inspection noted that approximately 1 foot of the steel H piles are exposed above the channel bottom.

This item has been rated 7 since 2016 (the first inspection cycle after MDOT added it to the form), and the MDOT QC inspector agreed with it. We concur with the rating of 7.

APPROACH

Approach Pavement

The approaches are asphalt with early block/map cracking, many of which are in the wheel lines and most of which have been sealed. Sealed transverse cracking was noted at both abutments. No significant settlement or rutting was noted.

This item was rated 7 since at least 2014, and the MDOT QC inspector agreed with it in 2017. It was lowered to 6 in 2019. While the amount of cracking is more consistent with a rating of 5 (a rating of 5 indicates 2% to 10% of the pavement has cracking and other deterioration; a rating of 6 indicates cracking at a spacing of 50 feet or more), we concur with the rating of 6 because the cracking is sealed and no “other deterioration” (rutting, shoving, or raveling) was noted.

Approach Shoulders/Sidewalks

Both approaches are curbed. The sidewalk transitions to a concrete spillway in the northwest and narrow asphalt in the northeast and southeast. There is no approach sidewalk in the southwest. Sidewalk settlement at the ends of the structure (a common occurrence) was measured at almost 2 inches in the northeast quadrant.

This item was rated 8 in 2014, lowered to 7 in 2016 which the MDOT QC inspector agreed with, and lowered again to 6 in 2019. Based on settlement, we would rate this item 5, which is within 1 rating point.

Approach Slopes

There is no rating associated with this field. It is included in the BSIR for comments only. The slopes along the approaches are vegetated (maintained lawn in the northeast, trees and brush in the other three quadrants) and appear to be stable. Approach guardrail is in place in all 4 quadrants to redirect errant vehicles away from the slopes.

Utilities

There is no rating associated with this field. It is included in the BSIR for comments only. Overhead bridge lighting is located on the east side of the bridge, with electric conduits in the east sidewalk. Telephone is located in the west sidewalk. Natural gas and suspected cable is housed in the east utility chase and an apparent water main in the west utility chase. All appear to be in fair condition with no notable deterioration.

Drainage Culverts

There is no rating associated with this field. It is included in the BSIR for comments only. None were noted at this crossing.

SUMMARY

A summary of ratings is provided for comparison:

Item/Component	4/24/19 Rating	F&V Rating
Surface	3	3-4
Expansion Joints	4	4
Other Joints	4	4
Railings	6	6
Sidewalks or Curbs	6	7
Deck Bottom Surface	N	N
Deck	3	3-4
Stringer	3	3
Paint	N	N
Section Loss	N	N
Bearings	4	4
Abutments	6	7-8
Piers	4	4
Slope Protection	N	N
Channel	7	7
Scour Inspection	7	7
Approach Pavement	6	6
Approach Sidewalks/Shoulders	6	5

ALTERNATIVES FOR CONSIDERATION

As evidenced above, we agree with most of the condition ratings that were assigned during the April 2019 inspection. However, the current course of action would leave the bridge closed indefinitely while the City seeks the significant outside funding required for a replacement project. The ratings for the deck and beams suggest the need for structural evaluation or load analysis. This has been performed for the beams overall (and was the basis for the load restrictions prior to closure), but not specifically for the top flanges that form the deck. Therefore, we have developed a range of alternatives the City could explore to reopen the bridge with load restrictions.

Further Evaluation

The question of whether the bridge can safely carry vehicular traffic hinges on the condition of the top flanges of the prestressed concrete box beams, which happen to be one of the least accessible components of the bridge. We have identified two methods that would provide additional information at relatively low cost:

- **Destructive Testing:** The City could obtain core samples on the top flanges of the box beams. A drilling company would use a circular bit (similar to what is used to core concrete pavement) to obtain cores throughout the deck area (quantity to be determined based on City's comfort level and budget). Those cores could then be evaluated visually and

analyzed based strength characteristics to help evaluate the structural adequacy of the deck. Holes would then be patched.

- Semi-Destructive Testing: The DPW could remove areas of cold patch to provide inspectors with access to the tops of the box beams. Non-destructive testing, such as rebound hammer or ultrasonic, could then be used to supplement the visual inspection. The asphalt surface would then be re-patched.

Depending on the results of the testing, the bridge could potentially be re-opened while the City continues to pursue replacement funds, likely with increased load restrictions. We would view this as a 2- to 5-year solution, again depending on the results of the testing. The testing would also provide valuable information for the design of any of the options that follow.

Steel Plating/Grating

Steel plates have been used effectively as a temporary measure for a number of structures in the state with severely deteriorated decks. The plating bridges over holes in the deck and can be used either as a repair for holes that have already developed or proactively. One drawback is reduced skid resistance, but that can be mitigated with surface treatments/texturing. Another option would be to utilize open steel grating infilled with asphalt. We would view either of these as a 5 to 10-year solution.

Concrete Overlay

In this alternative, the asphalt wearing surface would be removed and replaced with a non-composite concrete overlay (not structurally connected to the box beams beneath). The concrete would be reinforced with fiber and/or welded wire fabric to help spread wheel loads and significantly reduce the chances of a hole developing. However, the added dead load would reduce the load-carrying capacity of the beams (an analysis would be needed to confirm the viability of this option and the new load restrictions associated with it). We would view this as a 10 to 15-year solution.

Structural Concrete Overlay

In this alternative, the asphalt wearing surface would be removed, along with any unsound concrete from the tops of the box beams. Steel reinforcement dowels would be installed in the box beams to connect them structurally with a new concrete overlay/deck. This would increase the structural capacity of the beams to offset the additional dead load and all but eliminate the chances of a hole developing. We would view this as a 15 to 20-year solution. A figure illustrating this concept is included as Attachment 6.

General Comments

- All three options involving improvements to the bridge should be combined with pier repairs to prevent pier deterioration from shortening the useful life of the structure. All would be eligible for MDOT Local Bridge Program funding, and may even qualify under the emergency funding process. If successful, that would allow the City to proceed with design and construction ahead of the normal 3-year funding timeline. Depending on the extent of the plating/grating, a locally-funded project may be more appropriate for that option.
- The east sidewalk could be widened under any of the three improvement options. This would reduce the existing clear width, but the current 32-foot width is more than adequate for 2 lanes of traffic at 35mph, especially with load restrictions in place. Sidewalk widening would need to be coordinated with work on the approaches to transition or continue that width.
- Maintenance activities would still be required over the useful life of the improvement.
- The useful life would still be limited by the condition of the bottom of the box beams – eventually enough strands could be lost such that the bridge would need to be closed from a beam analysis as opposed to a deck evaluation. However, replacement of the joints in

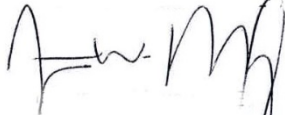
conjunction with either of the concrete options would help to slow the deterioration of the beams.

- The abutments are in good condition, and it may be possible to expand/reinforce them to incorporate into a replacement structure to help reduce cost.
- The load rating process for the concrete box beams is based on visual assessment of their condition. There are tools available to test the beams in the field and refine the load rating analysis, if overall beam capacity (as opposed to the condition of the top flange) becomes the primary concern.
- The 2017 underwater inspection report included the following recommendations that we would reiterate, especially if the City decides to proceed with one of the improvement options to extend the life of the bridge:
 - Replace FRP column jacket at pier 6S, column 6W.
 - Add riprap at south abutment to address bare areas.
 - Confirm bridge is on a navigable waterway per USCG. If waterway is navigable, evaluate need for pier protection systems. Update SIA Item #38 (Navigation control) and #111 (Pier protection) accordingly.

We appreciate the opportunity to assist you with this review and look forward to ongoing discussions to help resolve this urgent infrastructure need. Please feel free to contact us with any questions.

Sincerely,

FLEIS & VANDENBRINK



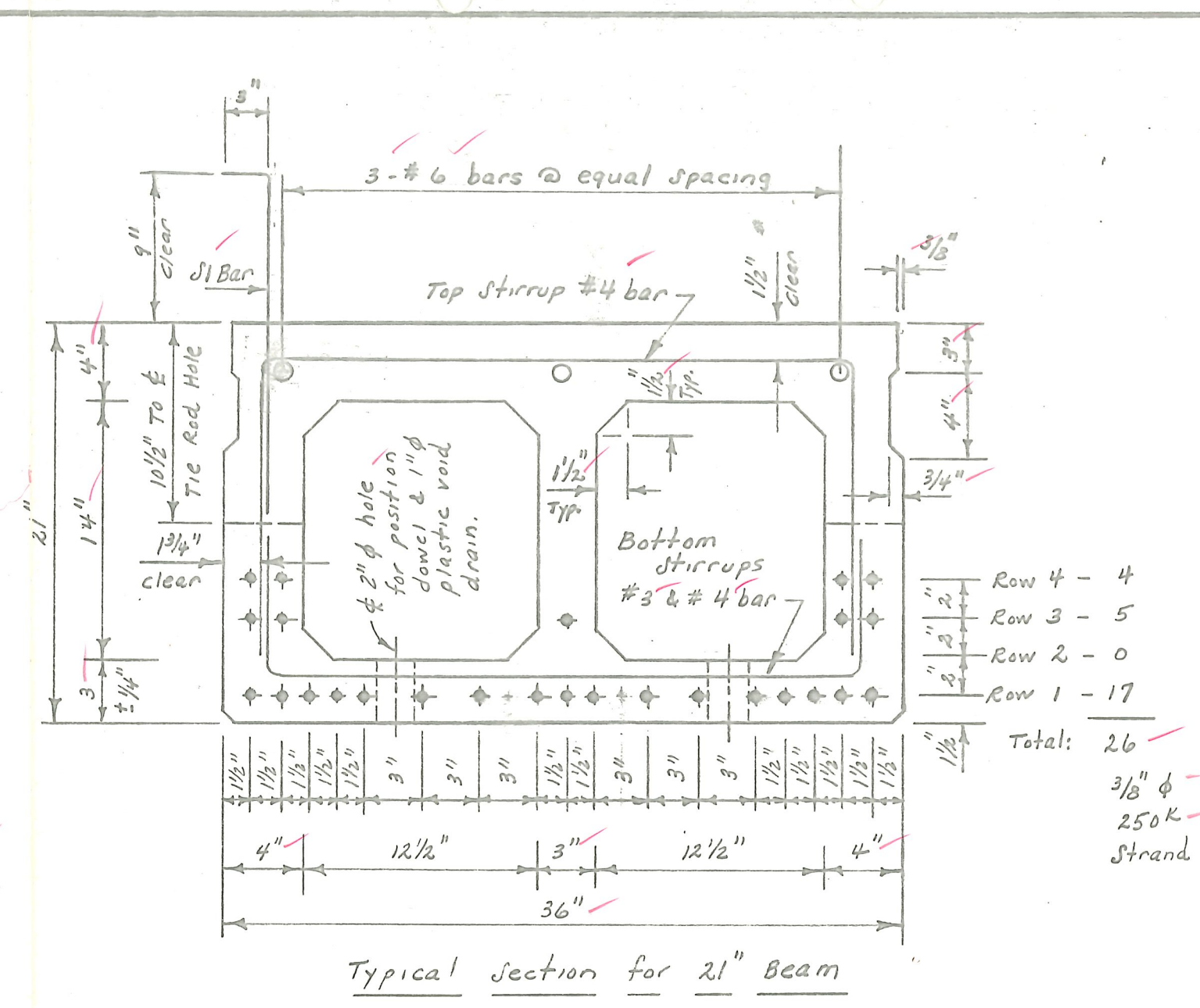
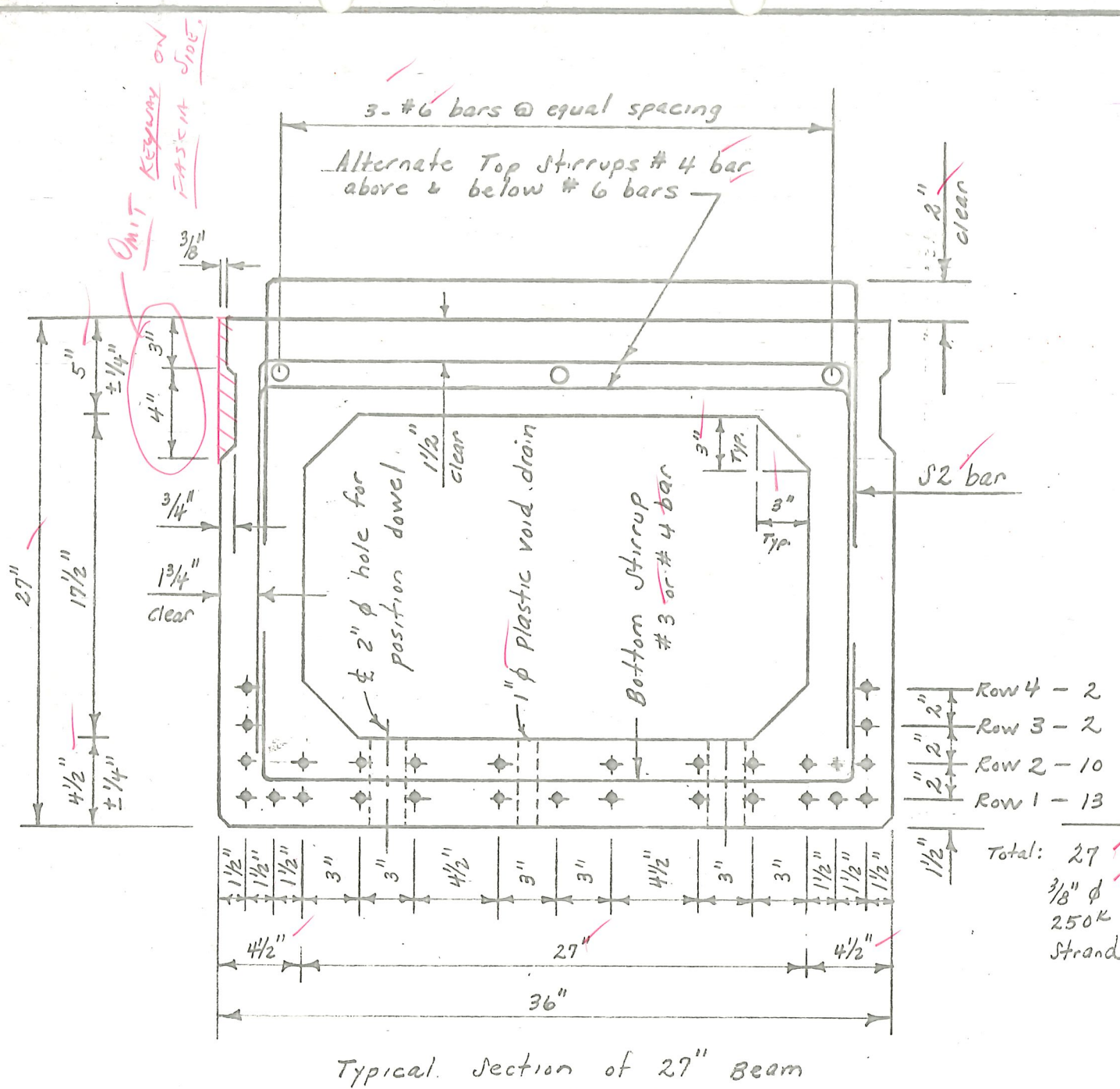
Jonathan W. Moxey, P.E.
Project Manager/Lead Bridge Inspector



Don DeVries, P.E.
Muskegon Group Manager

Attachments:

1. 1972 Box Beam Shop Drawing (excerpt)
2. August 1, 2019 Inspection Photographs
3. Existing Cross Section/Nomenclature
4. Beam Defect Locations
5. Pier Defect Locations
6. Structural Concrete Overlay Concept



Attachment 1 - Box Beam Shop Drawing Excerpt

General Notes:

1. Design loading H-20.
2. Use 1 piece of 0.187 Mesh 2" in from each end of each beam.
3. Place 1" ϕ plastic void drains in each end of all voids.
4. Mark Abutment A end of each beam as shown on sheet 1572-1.
5. Remove shear key on fascia side of 27" beams & outside 21" beams.
6. Approx. weight of beams: 27" - 16.2 Tons each.
21" - 12.9 Tons each.

LAMAR CORPORATION Structural Products DIVISION		
SCALE: None	APPROVED BY:	DRAWN BY RCL
DATE: 5-25-72		REVISED
Ottawa County Road Commission Smith's Bayou Bridge		
Box Beam Details		DRAWING NUMBER SPD 1572-4

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of structure from north approach



East elevation of structure looking southwest

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



Alligator cracking, spalling and cold patch in northbound wheel lines, north half of structure



Alligator cracking, spalling and cold patch in northbound wheel lines, north half of structure

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of southbound lane near center of structure, looking southwest



View of expansion joint in southbound lane, looking west

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



Partially sealed alligator cracking in northbound wheel line, south half of structure, looking south



View of expansion joint in northbound lane, south half of structure, looking east



Spalling in asphalt wearing surface with exposed waterproofing membrane



Photo illustrating thickness of asphalt, approximately 1 inch



Alligator cracking, spalling and cold patch in southbound lane near center of structure, looking southwest



Spalling along expansion joint header and deteriorating joint seal



Cold patch on expansion joint header



Shallow delamination and edge spalling on east sidewalk

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



Partially sealed alligator cracking and cold patch in northbound lane, south half of structure, looking south



Spalling on expansion joint header in southbound lane

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of south approach pavement, looking southwest



Sealed transverse cracking at south abutment, looking west



Deteriorating joint seal on sidewalk



View of expansion joint looking east

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of southbound lane, north half of structure, looking north



Spalling on expansion joint header



Photo illustrating settlement of northeast approach sidewalk, approximately 2 inches



Missing hardware on northwest railing post

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of closure signage at north approach, looking south



Heavy surface corrosion on post tensioning steel

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

PHOTOS: AUGUST 1, 2019



View of west elevation, looking southeast



View of west utility chase, Span 8S



Span 8S, Beam 6W, spalling with 3 broken strands at Pier 7S



Close-up of spalling at Span 8S, Beam 6W, Pier 7S



Span 8S, Beam 3W, cracking and delamination at Pier 7S



Corner spalling on Beam 1W, Span 8S at Pier 7S



Span 7S, Beam 5W, cracking and delamination north of midspan



Span 7S, evidence of leakage between Beams 5W and 6W and cracking on 6W near midspan



Span 7S, Beam 6W, cracking and delamination near midspan



Span 7S, Beam 5W, spalling with broken strand (right) and cracking/delamination (left) at Pier 6S



Span 7S, Beam 8W, spalling with no exposed steel near Pier 6S



Span 7S, Beams 10W and 11W, cracking and delamination at Pier 6S



Isolated spall with exposed steel on bottom of sidewalk at Pier 6S



Span 6S, Beam 11W, spalling with broken strand ~15' south of Pier 6S and cracking/delamination on 10W



Span 6S, Beam 11W, spalling with broken strand south of midspan



Span 6S, Beam 10W, cracking and rust staining ~15' from Pier 5S



Span 6S, Beam 12W, cracking and delamination at Pier 5S



Span 6S, Beam 13W, spalling with exposed steel on inside face at Pier 5S



Span 5S, Beam 13W, spalling with exposed steel on interior face at Pier 5S



Span 3S, Beam 5W, cracking and delamination at Pier 2S



Spalling and grinding on east sidewalk fascia at Pier 2S



Span 2S, Beam 9W, cracking and delamination at Pier 1S



Span 1S, Beam 2W, cracking and delamination ~6' south of Pier 1S



Evidence of leakage at box beam joints on south abutment



Pier 1S, south face, severe spalling with exposed positioning dowels at Beam 9W



Pier 1S, south face, cracking and delamination at Beam 12W



Pier 1S, south face, cracking and delamination at Beam 1W



Pier 1S, north face, diagonal cracking at Pile 2W



Pier 2S, south face, cracking and delamination at Beam 12W



Pier 2S, south face, vertical and map cracking on concrete pile cap, honeycombing on pile jacket



Pier 2S, north face, patched area at Beams 2W and 3W and vertical/diagonal cracking



Pier 2S, north face, horizontal/map cracking near bottom of cap between Piles 4W and 5W



Pier 3S, north face, spalling with exposed steel in jacket of Pile 3W



Pier 4S, south face, honeycombing and vertical cracking on jacket of Pile 5W



Pier 4S, south face, patching and rust staining on jacket of Pile 4W



Pier 4S, south face, honeycombing and patching on jacket of Pile 2W



Pier 4S, north face, honeycombing on jacket of Pile 2W



Pier 4S, north face, honeycombing on jacket of Pile 3W



Pier 5S, south face, cracking and delamination on jacket of Pile 5W



Pier 5S, south face, vertical cracking with efflorescence in cap at Pile 3W



Pier 6S, north face, honeycombing on jacket of Pile 6W



Pier 7S, south face, diagonal cracking with efflorescence on cap at Pile 2W

W. SPRING LAKE ROAD OVER SMITH BAYOU (SMITH'S BRIDGE)

STRUCTURE #: 8941

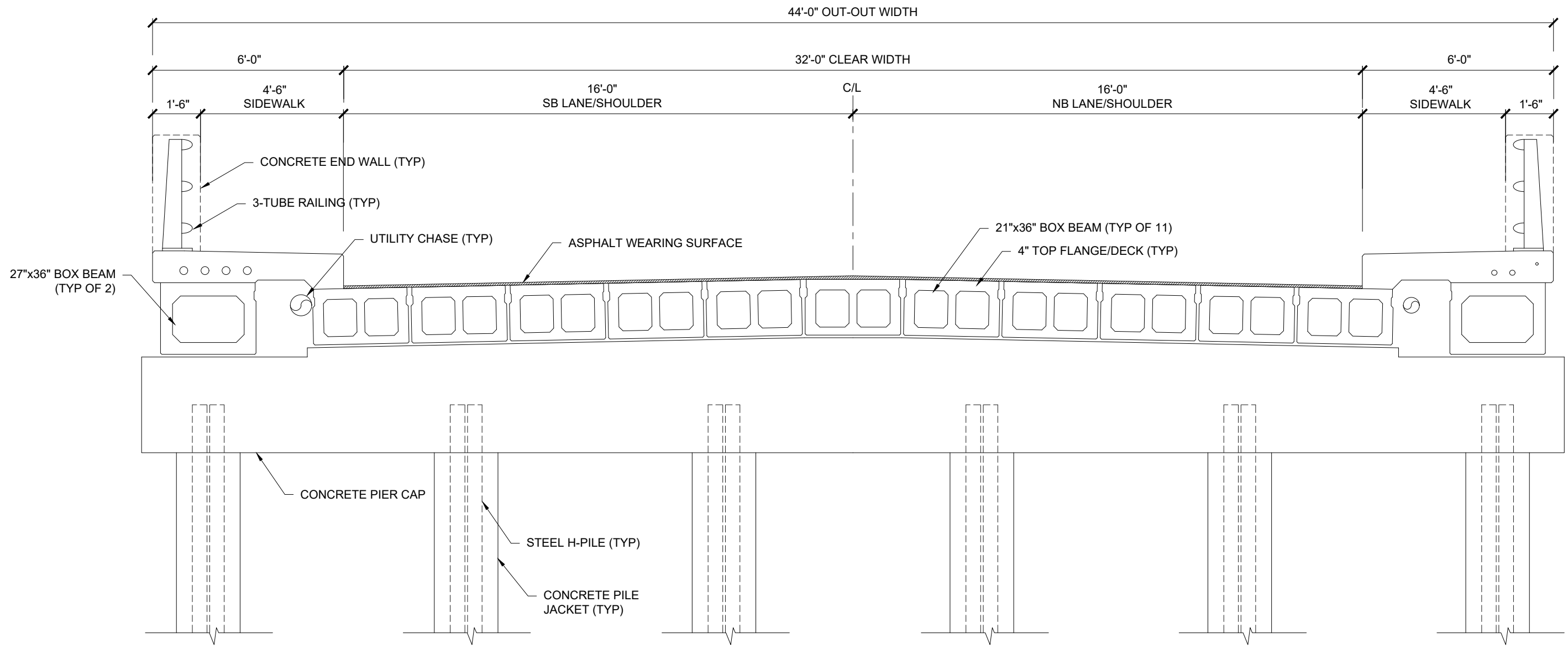
PHOTOS: AUGUST 1, 2019



View of north abutment looking north



East elevation of structure, looking southwest from northeast shore



EXISTING CROSS SECTION / NOMENCLATURE
NOT TO SCALE

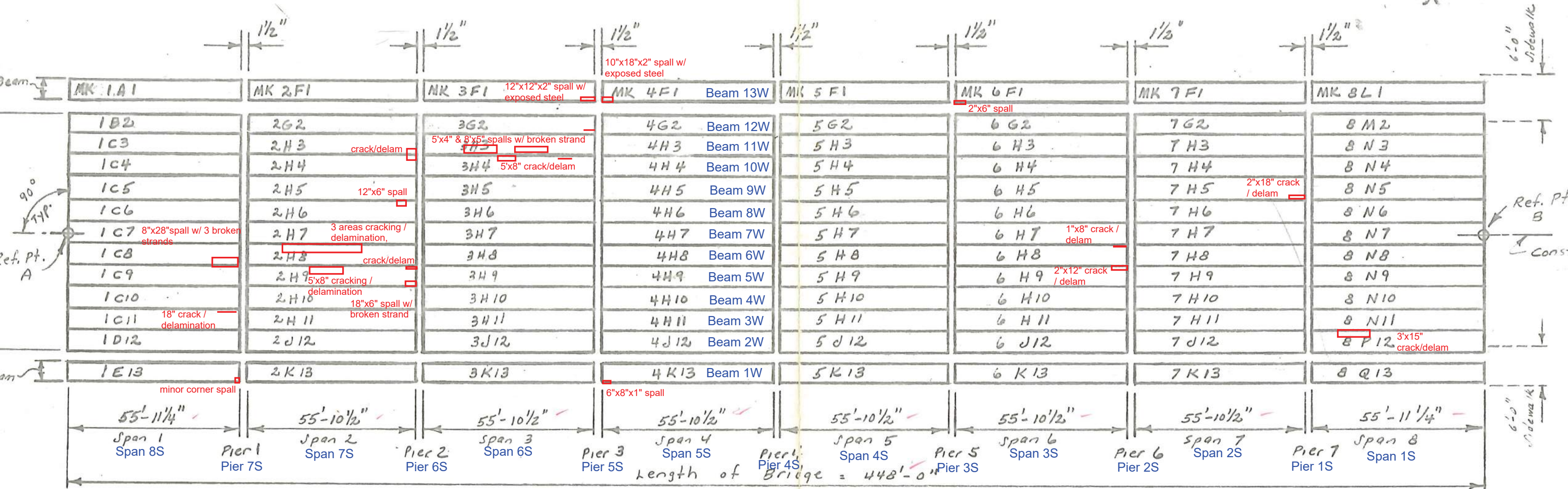
CITY OF FERRYSBURG
OTTAWA COUNTY, MICHIGAN
SMITH'S BRIDGE INSPECTION

FIGURE 3



peted/M: \Proj839001-841000\840860 Ferrysburg - Smith Bridge Inspection\Cad\Plns\840860_figure3.dwg

(6) Rows of 3/4" star inserts @ 4'-0" centers will be cast in beam sides: one row on each side of the 27" beams & one row on the fascia side of the outside 21" beams. (1344) Req'd.

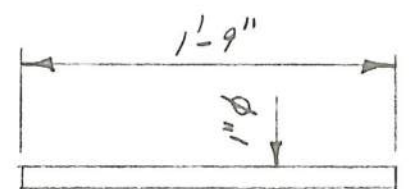
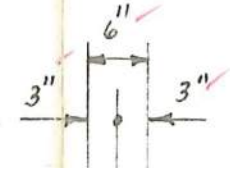


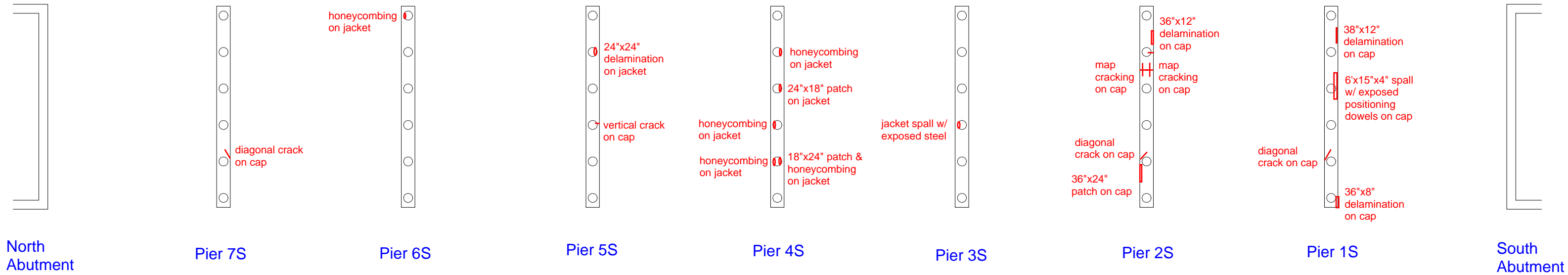
Abutment A
North Abutment

Abutment B
South Abutment

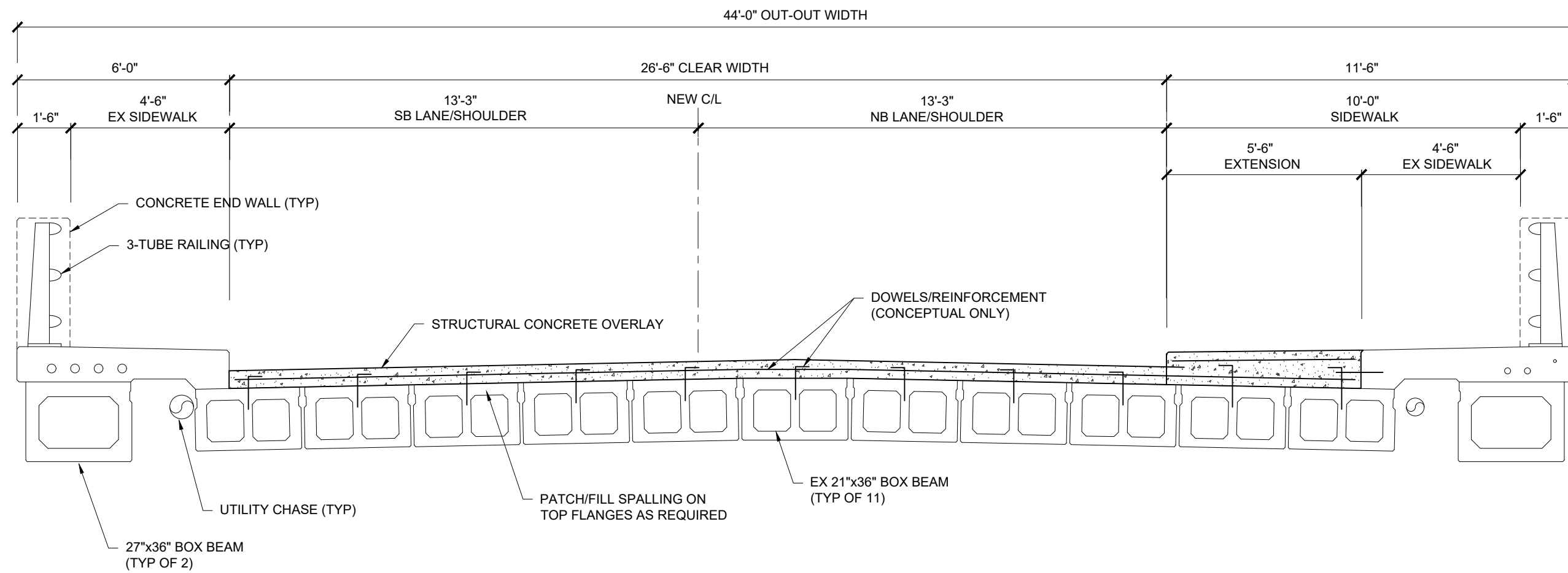
Plan View
Beam Defect Locations

Sidewalk outline





Pier Defect Locations

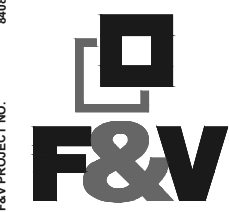


STRUCTURAL CONCRETE OVERLAY CONCEPT
NOT TO SCALE

CITY OF FERRYSBURG
OTTAWA COUNTY, MICHIGAN
SMITH'S BRIDGE INSPECTION

FIGURE 6

840860
F&V PROJECT NO.



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