

Ohio Department of Transportation 2016 Physical Condition Report

Detroit-Superior Bridge over Cuyahoga River
Bridge No. CUY-6-1456

SFN: 1800930



April 2017

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DETROIT-SUPERIOR BRIDGE OVER CUYAHOGA RIVER

2016 PHYSICAL CONDITION REPORT

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I. Introduction

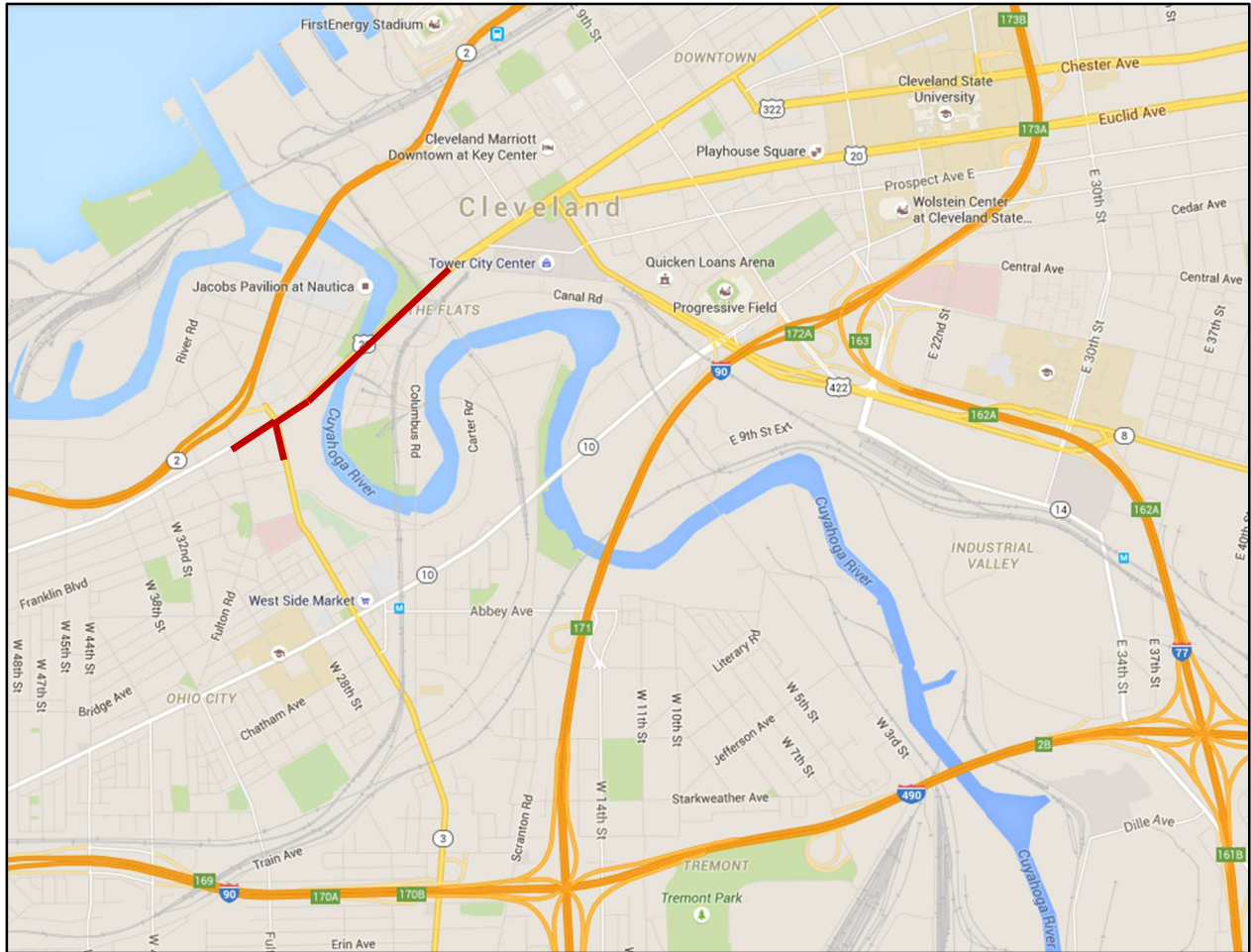


Figure 1 – CUY-6-1456 (Detroit-Superior Bridge) Location Map.

Bridge Description

CUY-6-1456 (SFN 1800930), commonly known as the Detroit-Superior Bridge and later renamed the Veteran's Memorial Bridge, is a 1917 double-deck structure carrying vehicular and pedestrian traffic over the Cuyahoga River Valley (**Photos 1 & 2**). The bridge is approximately 2,880 feet long, including 1,673 feet of subway tunnel that is linked by the lower deck. In its original design, the upper deck carried vehicular and pedestrian traffic while the lower deck had four streetcar lines and capacity for two future tracks. The streetcar lines across the Detroit-Superior Bridge were discontinued in 1953. The Detroit-Superior Bridge is included on the National Register of Historic Places.

General plan and elevation views of the Detroit-Superior Bridge are included in **Figure 2**. **Figure 3** shows the schematic plan and elevation views, and a typical cross section. **Figure 4** contains the typical nomenclature of the concrete elements of the main concrete spans.

The Detroit-Superior Bridge is composed of three distinct units. The first unit, the West Approach, is comprised of the West Station area spanning a total of 350 feet west of Tower A and two abandoned subway tunnels: the Detroit Avenue Tunnel (660 feet long) and the West 25th Street Tunnel (480 feet long). Several utilities are pass through the West Station and tunnels. Since the late 1980s, the West Station has been opened to the public for occasional tours and festivals.

The main unit is Spans 1A, 1B and 1 through 13. Spans 1A and 1B are transition structure from the subterranean West Station to the double-deck approach and main spans. These two concrete cellular spans total 220 feet long and each has enclosed cellular construction below the lower deck.

The main spans, Span 1 through 13, are double-deck spans with vehicular and pedestrian traffic on the upper deck and utilities and maintenance access on the lower deck. Occasional tours and festivals have also taken place on the lower deck. Spans 1 through 3, 5 through 11 and Span 13 are concrete open spandrel arch spans, and Span 12 is a concrete encased steel half through arch. The main span, Span 4, is a 591-foot, three-hinged steel half-through arch truss in a Pratt configuration.

The third unit, the East Station, is a concrete cellular span that extends 165 feet past the East Abutment. A three-panel long, cellular construction is present under the East Station lower deck immediately behind the East Abutment.



Photo 1 – North Elevation, Spans 4 through 8.



Photo 2 – Deck View, West Approach Spans, Looking East.

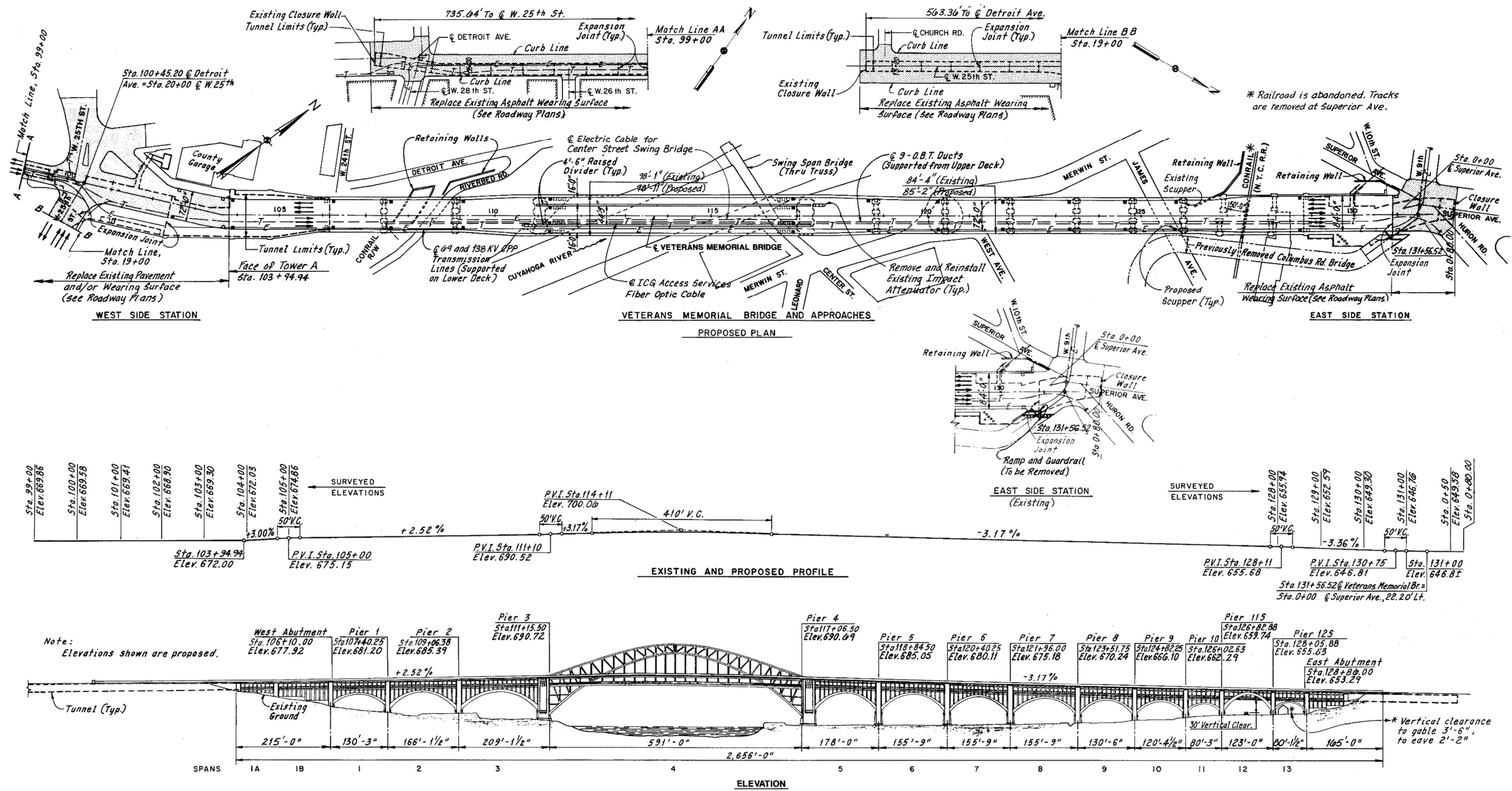


Figure 2 – CUY-6-1456 Plan & Elevation (Veterans Memorial Bridge Rehabilitation Plans, 1994).

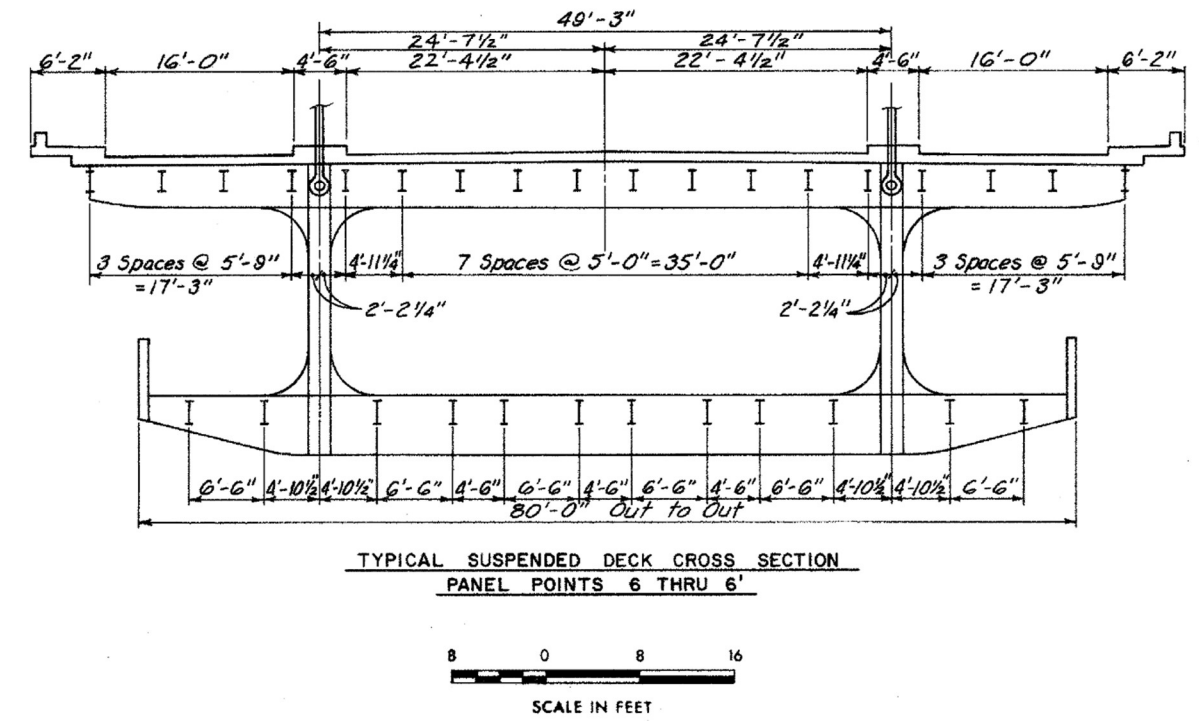
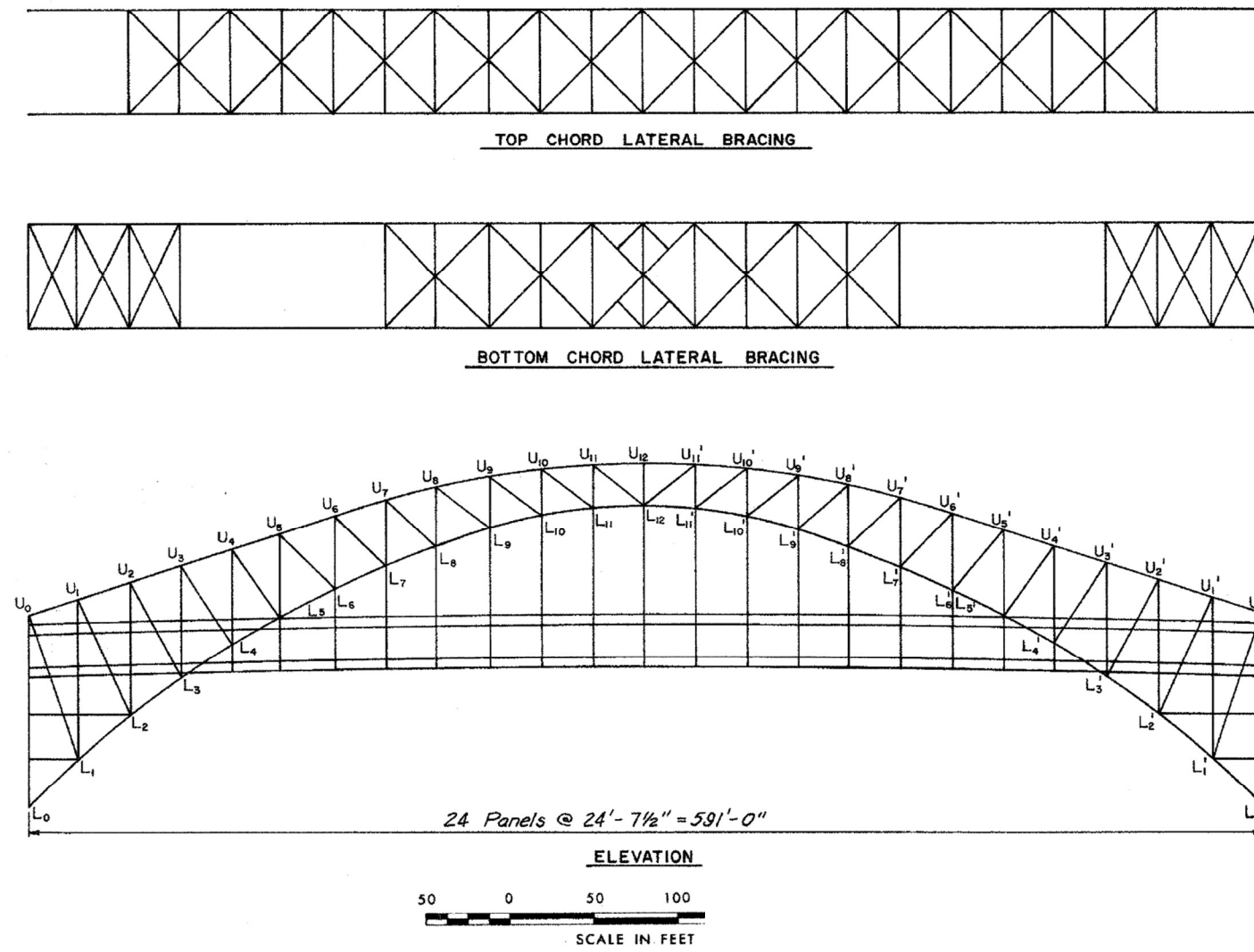


Figure 3 – Span 4 Nomenclature.

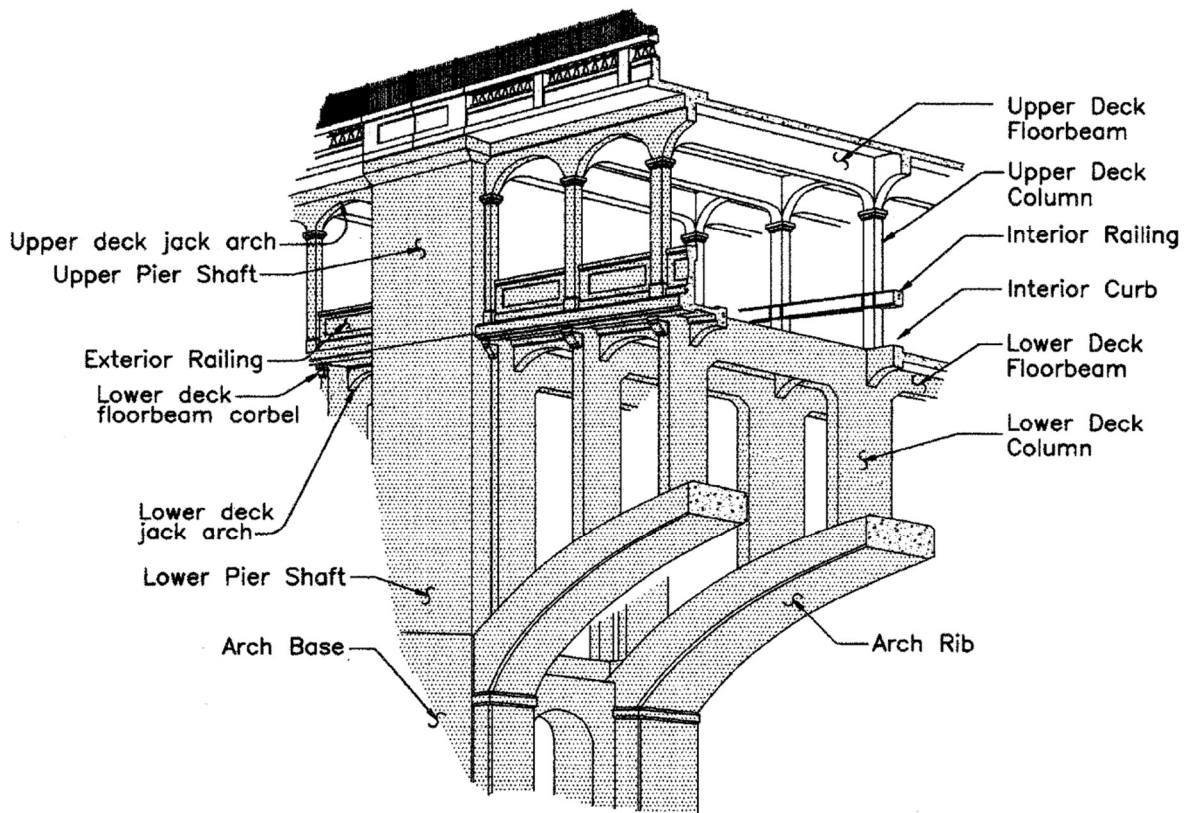


Figure 4 – Upper & Lower Deck Element Nomenclature, Approach Spans.

Construction, Service & Rehabilitation History

The Detroit-Superior Bridge was constructed from 1914 through 1915 to provide a high level vehicular and streetcar crossing over the Cuyahoga River, connecting the Ohio City community and Downtown Cleveland. The bridge replaced the Superior Viaduct, opened in 1878. Construction of the foundation began in 1913. The steel arch truss, Span 4, was erected from July 24 to November 6, 1915. On October 8, 1915, the two halves of the main truss were connected¹.

The Detroit-Superior Bridge was opened to vehicular traffic in November 1917, and streetcar traffic in January 1918. By 1930, the average daily traffic was 70,000, making it briefly the most highly used bridge in the United States.²

By the mid-1930s, spalled concrete was occurring due to improper drainage. Repairs were discussed but postponed due to the needs of World War II, and ultimately not performed until the 1960s.

¹ Beyer, William E, *The History of the Veterans Memorial Bridge*, 90th Anniversary Edition, Bookmasters, Inc, Ashland, Ohio.

² *Cleveland Plain Dealer*, *High Level Span is Busiest in U.S.*, October 17, 1930, p. 6.

The Detroit-Superior Bridge has received a series of various major and minor rehabilitations as follows³:

1. *1967-70 Major Rehabilitation*
 - a. Removal of the original upper deck consisting of four vehicular lanes and two 15-foot wide sidewalks.
 - b. Strengthening or replacement of all upper deck concrete floorbeams.
 - c. Span 4: Erection of new steel floorbeam cantilevers.
 - d. Construction of the new upper deck with six vehicular lanes and two five-foot wide sidewalks.
2. *1995-97 Major Rehabilitation*
 - a. Replacement of the upper and lower deck floors.
 - b. Replacement of select upper and lower concrete floorbeams, columns, jack arches and pier shafts (**Table 1**).
 - c. Application of epoxy-urethane or non-epoxy sealer to most exposed concrete surfaces.
 - d. Span 4: Replacement of all steel hangers, Panel Points 6 through 6'.
 - e. Replacement of Upper Deck and Lower Deck Floor Beams 5 and 5' and stringers.
 - f. Painting of all steel superstructure components.
 - g. Installation of new drainage system.
 - h. Installation of architectural lighting.
3. *2003 North Sidewalk Linear Park Conversion.*
 - a. Conversion of vehicular traffic to two westbound and one eastbound lane between the steel trusses and on eastbound lane on the Span 4 south cantilever.
 - b. Widening of the north sidewalk. With longitudinal trench drainage.
 - c. Installation of public art and benches along the modified north sidewalk.
4. *2014-2016*
 - a. Span 1A through Span 13: Patching deficient upper deck wearing surface areas.
 - b. Patch deficient concrete super- and substructure components in West Station, Detroit Avenue Tunnel, West 25th Street Tunnel and Spans 1-3 and 5-13. (Note: In Spans 1-3 and 5-13, the patching below the lower deck was later restricted to areas adjacent to and over public areas.)
 - c. Span 4: Perform zone painting of primary and secondary truss members between upper and lower decks.
 - d. Install hanger caps at hanger opening in upper deck, Panel Points 6 through 6'.
 - e. Replace four concrete columns in West Station. (This task has not yet started.)
 - f. Perform pipe cleanout for pedestrian tunnels in the West and East Station. (This task was performed but not successful.)

³ Vermes, William J., Gasparini, Dario A. & Conley, Natalie, *Cleveland's Historic Bridges: Architectural & Engineering Masterpieces*, Publication of the 7th Historic Bridge Conference, Cleveland, Ohio, 2001.

During the mid-2000s, new cracks appeared in the substructure of Span 1A and increasing movement in Tower B South was observed. In 2013, a series of slope inclinometers were installed along the north and south sides of the bridge from Tower A to Pier 2 (**Photo 3**) and crack gauges were installed on Tower B South and under Spans 1A and 1B. The inclinometer readings are included in **Appendix D**.

Member	Total Members	Members Replaced	Total Percent Replaced
Upper Deck Floor Beams	686	316	38%
Upper Deck Columns	693	179	26%
Upper Deck Jack Arches	564	260	45%
Lower Deck Floor Beams	548	50.5	11%
Lower Deck Corbels	279	79	28%
Lower Deck Jack Arches	520	176	34%
Lower Deck Columns	488	8	2%
Upper Exterior Pier Shafts	32	17.5	55%
Lower Exterior Pier Shafts	28	5.5	20%

Table 1 – 1995-97 Detroit-Superior Bridge Rehabilitation Concrete Superstructure Member Replacement Summary, Spans 1 to 3, 5 to 13 & East Station.⁴

⁴ Vermes, William J., *Rehabilitation of The Detroit-Superior Bridge*, Proceedings of an International Conference on Historic Bridges to Celebrate the 150th Anniversary of the Wheeling Suspension Bridge, West Virginia University Press, 1999, pp. 117-132.



Photo 3– Slope Inclinometer, Tower B South.

Inspection Procedure

Pennoni performed a routine inspection of this structure from September 10 through December 23, 2015, and was performed in conjunction with the ongoing bridge rehabilitation feasibility study. The inspection team consisted of William J. Vermes, P.E. (Lead Inspector), Christian Lunt, PE (Team Leader), Dale Arnold, PE, Jessica Sizemore, CBSI, Elizabeth Trapp, EI, Alisha Ruff, EI and Mathew Paroda, EI. Inspection equipment consisted of achieved via 80-foot manlift, modified rock climbing equipment and extension ladders. Confined space entry procedures were performed for the cellar construction areas beneath the lower deck in Spans 1A, 1B and the East Station. LED lighting with heavy duty extension cords were used to provide supplemental lighting in the Detroit Avenue and West 25th Street tunnels, West Station, East Station and the confined space area beneath Span 1A.

The 2016 SMS Bridge Inspection Field Report is included in **Appendix A**. Significant inspection findings of the Upper and Lower Deck Superstructure and Structure Lines A through D of the West Station are included in **Appendix B** and **Appendix C** respectively.

Condition & Element Level Inspection 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. Table 1 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.

Since the 1995-97 bridge rehabilitation, a different bridge nomenclature system has been used. With the original construction and rehabilitation drawings included as a significant element of the bridge record, and past FHWA policy of recommending that original member identification system be followed, this inspection therefore followed the structure's original member identification. This practice ensure that this inspection will at a minimum conform to the original shop drawings and documentation for prior bridge rehabilitation.

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.	Document deficiencies quantitatively. Consider taking photos or making sketches.
	5	Fair	All primary structural elements are sound but have minor section loss, deterioration spalling or scour.	
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... <u>And</u> 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... <u>And</u> the bridge is a candidate to dispatch road closure and/or immediate and/or increased monitoring (Interim Inspections). Confirm in writing, <u>critical finding</u> .
	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... <u>And Dispatch immediate lane or bridge closure</u> . 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.	

Table 2 – ODOT & NBIS Condition Rating Guidelines.

II. Deck

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

Floor-Upper Deck (c7.1)

The upper deck floor is in **Fair** condition. The observed deficiencies vary due to the diverse floor design and period of construction. Thus, the floor condition is discussed by section as follows:

<i>Element Level Quantities – Floor</i>					
Section	Total Quantity	CS 1	CS 2	CS 3	CS 4
Detroit Ave. Tunnel	17,950 SF	17,950 SF			
West 25 th St. Tunnel	13,750 SF	13,650 SF	100 SF	100 SF	
West Station	37,800 SF	29,600 SF	7,350 SF	850 SF	
Spans 1A, 1B, 1-13	232,250 SF	232,250 SF			
East Station	31,150 SF	31,150 SF			
Total Structure	332,900 SF	324,500 SF	7,450 SF	950 SF	

Detroit Avenue Tunnel: During the 1995-97 rehabilitation, the Detroit Avenue Tunnel slab was uncovered for full-depth replacement at the slab joints and for application of a new waterproofing membrane. The top of the tunnel slab was found to be in poor condition, and the most economical repair was determined to be placement of a new reinforced slab on top of the original slab (**Photo 4**). The new slab covers the entire original slab and was designed for a HS20 live load with the original slab contributing no structural support. Neither the top nor bottom surfaces of the new structural slab are visible, thus the Detroit Avenue Tunnel floor is assumed to be in good condition despite the poor and critical conditions of the original tunnel slab underside.

West 25th Street Tunnel: The original floor is extant, except for sections replaced full depth adjacent to the tunnel joints. The West 25th Street Tunnel floor is in good condition with local areas of delamination and shallow spalls.

West Station: The original floor is extant except for the southeast corner, which was replaced in the 1995 rehabilitation due to on-going instability of the south embankment. In the West Station, the floor has a minimum 16-inch thickness. When the West Station floor was uncovered in Fall 1995, a large area along and under the south upper deck roadway curb was found to be unsound due to water ponding under the asphalt wearing surface and passing through the failed 1917 waterproofing. The subsequent floor patching averaged a depth of four to six inches with one patch area reaching a depth of nine inches. A

Type 3 waterproofing was applied to the station slab prior to the placement of the new asphalt wearing surface.

Following condition state inspection guidelines, the West Station floor is in **Fair** condition with areas of efflorescence, active water infiltration and exposed bottom mat reinforcement (**Photo 5**). A 3-inch deep spall is present between Columns C25 & D26 due to the obvious failure of the 1995 waterproofing membrane and continued concrete corrosion (Photo 5). As shown in Figure B-1, the most significant areas of deterioration are adjacent to the restored floor joints and in Bays A and B.

Span 1A, 1B, and 1 through 13: The upper deck floor in the main spans were constructed in the 1995-97 rehabilitation. The floor is in **Good** condition with few cracks and efflorescence observed. However, there are indications of accelerated deterioration after 18 years of service. In the Panel 3, Center Bay, of Span 8, water has been observed leaking from an area of mottled concrete floor. In Span 9, an area of wearing surface spalled in November 2015, resulting in an emergency deck patching operation. The resulting patch revealed 1/8-in section loss to the top reinforcement with one area of full-depth repair in Panel 3, Center Bay. Local areas of infiltration efflorescence are present in Panel 4, Center Bay, Span 7 and at Floor Beam 8, Span 8 (**Photo 6**).

East Station: The East Station floor was replaced during the 1995-97 rehabilitation, and no deficiencies were observed.



Photo 4 - Construction of Detroit Avenue Tunnel Supplemental Roof Slab, Looking East, 1996.



Photo 5 – Floor Spall with Infiltration, Bay C25, West Station.



Photo 6 – Active Infiltration Through Upper Deck Floor, Floor Beam 8, Center Bay, Span 8.

Edge of Floor-Upper Deck (c7.2)

The upper deck edge of floor is in **Good** condition with no deficiencies noted.

<i>Element Level Quantities – Edge of Floor</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
5,312 LF	5,312 LF			

Floor – Lower Deck

The lower deck floor is in good condition with minor deficiencies present. The lower deck consists of reinforced concrete slab with stay-in-place forms in Spans 1 through 3, and Spans 5 through 13. In Span 4, the lower deck is a combination of an interior vehicular steel grid deck and exterior pedestrian fiberglass grating. Spans 1A and 1B still retain the original reinforced concrete deck.

At Span 2, Panel 15, Center Bay, the stay-in-place form has advanced corrosion due to water infiltration through the lower deck expansion joint above. In Span 1B, the South Bay has exposed top mat reinforcement, indicating concrete loss at least four inches deep in the 12-inch thick slab. Below, isolated corrosion with diagonal cracking is present in the center and south bays.

Wearing Surface (c8)

The wearing surface is in **Fair** condition with increasing deterioration noted at an accelerated pace.

<i>Element Level Quantities – Wearing Surface</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
191,232 SF	176,232 SF	191,232 SF	1,000 SF	

Over the West Station, the asphalt wearing surface has wide longitudinal cracks coinciding with the placement seams (**Photo 7**). Infiltration is present on the West Station floor slab below.

As part of the concurrent rehabilitation feasibility study, over 90% of the upper deck concrete wearing was sounded via, indicating that over 8% of the total concrete wearing surface being unsound (**Table 3**). In Span 4, large delaminations along with advanced wear of the wearing surface tying placed for skid resistance are present in Panel 2' and the eastbound lane above the south floor beam cantilevers. Large delaminations along with recent asphalt patches are present in Spans 7 through 10 (**Photo 8**). Also, the wearing surface surrounding the November 2015 emergency repairs continue to deteriorate. Throughout the concrete wearing surface, scattered longitudinal crack up to 0.030" wide are also present. Wearing surface delaminations and other deck findings from Span 1A through the East Station Unit are including in **Appendix B**.

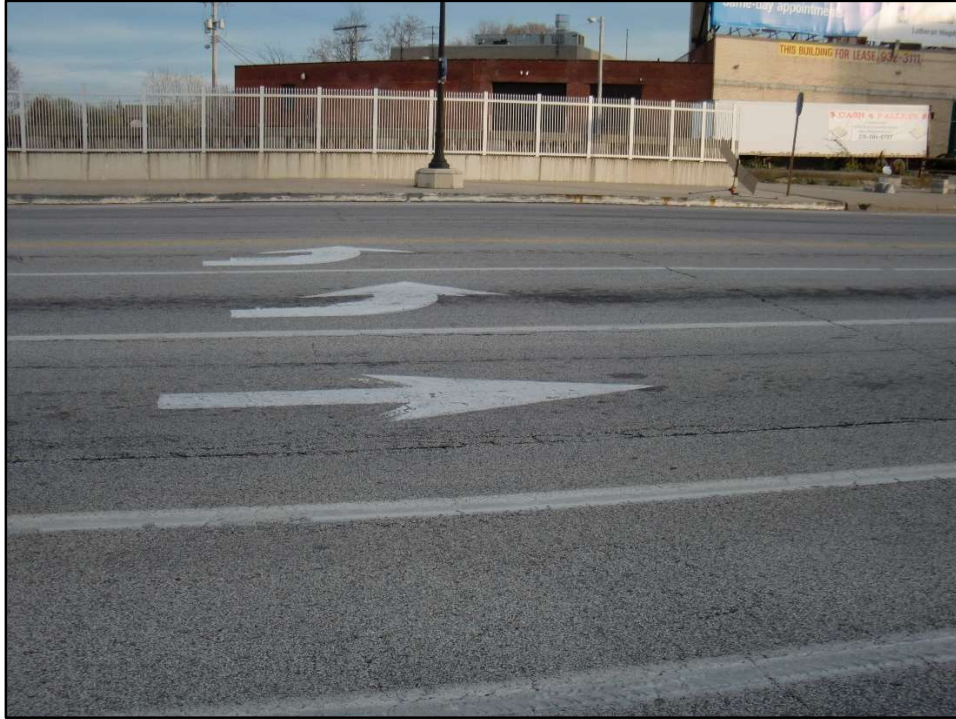


Photo 7 - Cracked Asphalt Wearing Surface, West Station.



Photo 8 – Recent Wearing Surface Patching, Span 9.

Span	Wearing Surface Deterioration (SF)		WB Area of Deck (SF)	EB Area of Deck (SF)	Concrete Repair (%)		
	WB	EB			WB	EB	Total
Span 1A	36	128	2890	2890	1.2	4.4	2.8
Span 1B	81	162	3607	3607	2.2	4.5	3.4
Span 1	450	627	3718	3718	12.1	16.9	14.5
Span 2	0	0	4685	4685	0.0	0.0	0.0
Span 3	56	59	6368	6368	0.9	0.9	0.9
Span 4	1495	2441	17228	17228	8.7	14.2	11.4
Span 5	0	19	5186	5186	0.0	0.4	0.2
Span 6	259	8	4191	4191	6.2	0.2	3.2
Span 7	1367	664	4117	4117	33.2	16.1	24.7
Span 8	1724	1792	4170	4170	41.3	43.0	42.2
Span 9	814	354	3698	3698	22.0	9.6	15.8
Span 10	642	754	3688	3688	17.4	20.4	18.9
Span 11	76	360	2864	2864	2.7	12.6	7.6
Span 12	108	229	3444	6642	3.1	3.4	3.3
Span 13	28	0	2245	4331	1.2	0.0	0.4
East Station	44	0	8904	17172	0.5	0.0	0.2

Traffic

Direction

Subtotals: **7,180** **7,597** **81,003** **94,555**

Total: **14,777** SF

Total % Deteriorated = **8.42%**

Table 3 – Upper Deck Wearing Surface Deterioration Summary



Curb & Sidewalks (c9)

The curbs and sidewalks are in *Fair* condition.

<i>Element Level Quantities – Curbs & Sidewalks</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
5,312 LF		5,312 LF		

Isolated spalls on the south sidewalk surfaces are present along the curb plates. Along the Span 4 south sidewalk, scaling of the light weight concrete is present through the span (Photo 9). On the north sidewalk, local spalls and delaminations are present in the sidewalk concrete placed during the 2003 linear park widening (**Photo 10**). Longitudinal cracks are also present throughout the linear park concrete (**Photo 11**).



Photo 9 – Scaling of Lightweight Sidewalk Concrete, Span 4 South Sidewalk.



Photo 10 – Spalls Along Longitudinal Drain, 2003 Linear Park Sidewalk, Span 4.

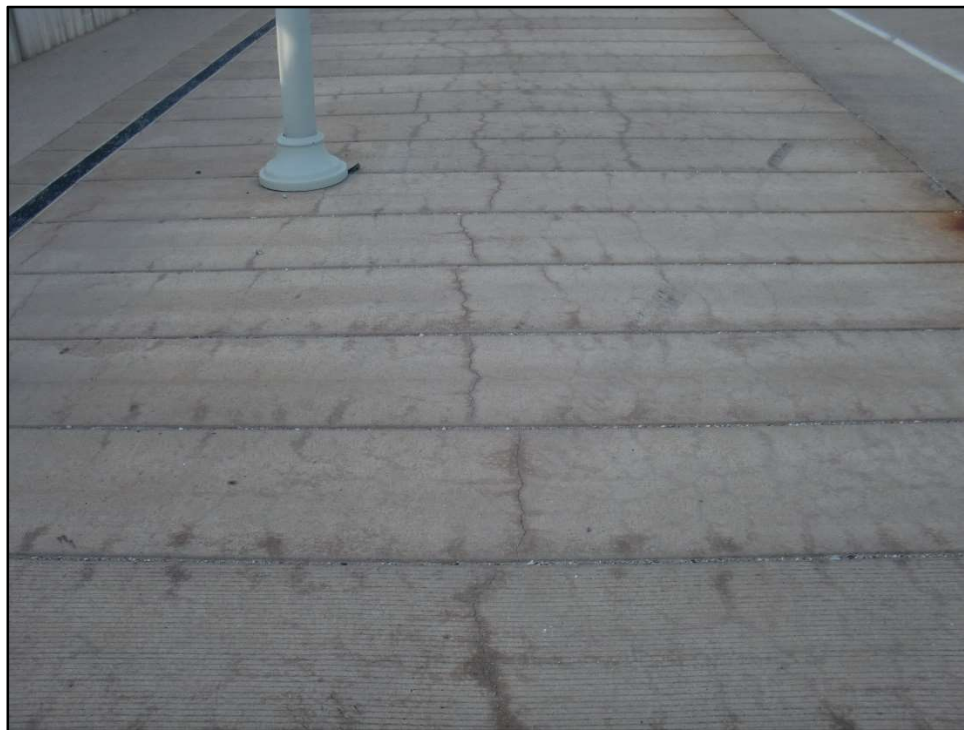


Photo 11 – Typical Longitudinal Cracks, 2003 Linear Park Sidewalk.

Median (c10)

The median, located along the south truss line, is in **Good** condition.

Element Level Quantities – Median				
Total Quantity	CS 1	CS 2	CS 3	CS 4
674 LF	635 LF	40 LSF		

Shallow spalls are present on the concrete median. At the time of this inspection, the traffic attenuator had no signs of collision damage with one cover panel dented and slightly misaligned.

Railing (c11)

The railing is in **Good** condition.

Element Level Quantities – Railing				
Total Quantity	CS 1	CS 2	CS 3	CS 4
5,312 LF	5,312 LF			

The railing exhibits shallow shrinkage cracks that have been present soon after completion of the 1995-97 rehabilitation. The non-epoxy sealer placed on the interior surfaces of the balustrade and top cap, and all of exterior surfaces, has flaked or worn away (**Photo 12**). Also along the south rail, misalignment of the top of rail is present at the Tower A and Tower B expansion openings, with the east top of rail $\frac{7}{8}$ " and $\frac{1}{4}$ ", respectively). This top rail misalignment may be associated with the south slope movement below. See **Substructure, Tower B South** for further discussion.

The aluminum architectural vandal protection fence on the south railing has one panel in Span 6 and Span 8 each dented due to vandalism and/or attempted theft (**Photo 13**). This vandalism appears to be repeated attempts over the previous year on the same panels. In Span 4, one south rail panel has been repaired following an attempted theft.



Photo 12 – Worn Non-Epoxy Railing Sealer (Pier 4 North shown).

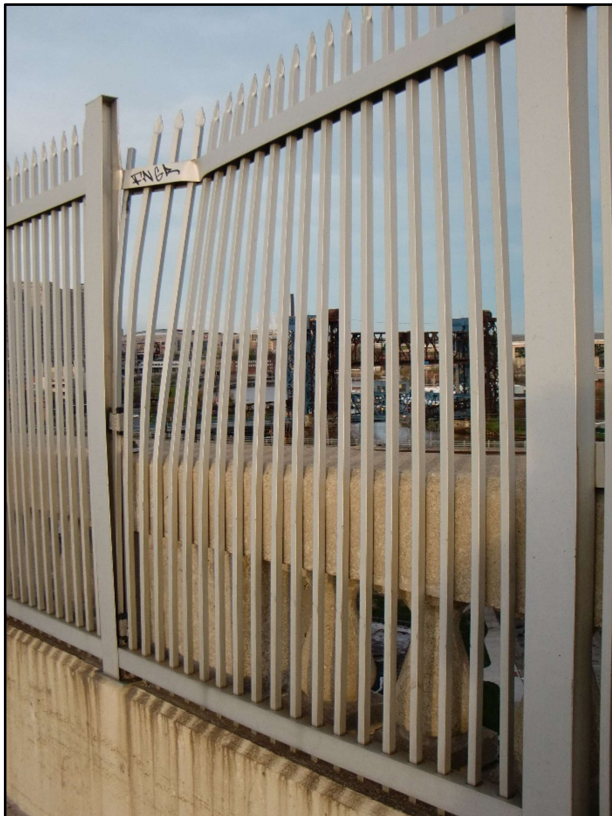


Photo 13 – Repeated Vandalism & Attempted Theft of Aluminum Fence, Span 6 South Rail.

Drainage (c12)

The drainage is in **Fair** condition. The drainage system was installed during the 1995-97 rehabilitation, and was initially specified to be galvanized steel pipe throughout the structure. However, at the contractor's recommendation, PVC pipe was installed for most drainage components to meet critical path benchmarks and reduce some construction costs.

<i>Element Level Quantities – Drainage</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
27	27			

Drainage system deficiencies are noted as follows:

At Upper Deck Level -

- North sidewalk: Most longitudinal trench drains added during the 2003 linear park construction are filled with grit and are not functioning. Several original PVC grating panels have been replaced with cut open grid steel panels, while several new grating panels are recently missing (**Photo 14**).
- Along the south curb over the West Station, deck runoff is ponding immediately east of the Panel D20 catch basin, permitting water infiltration through the asphalt wearing surface and past the top of floor waterproofing.
- West Abutment, North Sidewalk: A steel plate has been placed over the missing rectangular drain cover (**Photo 15**).
- Span 3 Upper Deck: A drain tube for an art installation above continuously drips during and following snow and rain (**Photo 16**). In the winter months, a stream of saltwater is blown onto the private parking area below.
- Pier 11 North: Sidewalk drainage spills over the upper deck expansion joint onto the ground below.

At Ground Level -

- West Abutment: The south drain pipe which is clogged at the catch basin.
- Pier 1 South: The drainpipe is broken and the catch basin is buried in soil and/or construction material.
- Pier 1 North: The catch basin grating is missing.
- Pier 3 North: The end of the PVC drain pipe is fractured and hanging disconnected from the upper portion of drain pipe.
- Pier 8 South: Catch basin is clogged.
- Pier 9 North: Catch basin is partially clogged.
- Pier 9 South: Catch basin is clogged with concrete frame dislodged seven inches.



Photo 14 – Missing Sidewalk Drain Trough Cover with Debris Build-Up, North Sidewalk.



Photo 15 – Steel Cover Plate over Missing Sidewalk Drain Grate, Span 3.



**Photo 16 – Leaking Sidewalk Subdrain, Span 3 North Exterior Column Line.
(Inset: Salt spray on car in private parking lot below.)**

Expansion Joints (c13)

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

Element Level Quantities – Expansion Joints				
Total Quantity	CS 1	CS 2	CS 3	CS 4
1,494 LF	1,419 LF	75 LF		

At the left westbound lane of the Tower B expansion joint, pack rust has broken several fillet welds attaching the joint extrusion to the joint armor, resulting in several gaps (**Photo 17**). At the Tower A expansion joint, the concrete joint anchorage is cracked, permitting salt water infiltration onto the concrete floor beam below (**Photo 18 & Concrete Floor Beams, Substructure**). Snow plow damage is present on several joint extrusions, especially at the Tower B west bound joint where the west armor is 1/2-inch higher than the east half. Along the Pier 3 north sidewalk expansion joint, concrete spalls beneath the joint armor permit sidewalk drainage to directly access the Span 4 steel members below (**Photo 19**).



Photo 17 – Cracked Concrete Anchorage, Tower A Expansion Joint.



Photo 18 – Daylight Highlighting Two Broken Extrusion Welds, Tower B Expansion Joint.



Photo 19 – Spalled Concrete Beneath Joint Armor, Pier 4, North Sidewalk.

Lighting

The lighting is in **Fair** condition. At this inspection's conclusion, six upper deck lights were inoperative, which is a sharp increase from no inoperative light following the 2015 inspection. All general upper deck lighting installed in 1997 is functioning. Eight pedestrian lights along the north sidewalk and seven architectural pedestal light are also inoperative. Additionally, several architectural light pole bases are cracked with missing sections, and the steel light standards on top of Pier 3 and 4 have light corrosion (**Photo 20**). In Span 1, a junction box cover is missing (**Photo 21**).



Photo 20 – Typical Failed Protective Coating & Corrosion on Architectural Light Standard (Pier 4 South shown).



Photo 21 – Missing Junction Box Cover, Span 1 South Rail.

III. Superstructure

The superstructure is in **Fair** condition, or **5** on the NBIS condition rating guidelines. Superstructure findings are shown in **Appendix B**. Condition of individual superstructure items are as follows:

Alignment of Members (c14)

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

<i>Element Level Quantities – Alignment</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
13	13			

Concrete Superstructure

Arch (c27)

The concrete arches are in **Fair** condition.

<i>Element Level Quantities – Arch</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
6,085 LF	327 LF	5,558 LF	200 LF	

During the current rehabilitation, the concrete arches of Span 2, 3, 5 through 10, and 13 were repaired with select patching over public areas and epoxy injection of open cracks. Inspection of the arches reveal two diverse trends in advancing deterioration.

Vertical & Horizontal Cracking:

Following the customary design practice of early concrete arch design and review of the final original construction plans, no shear reinforcement was placed in the concrete arch ribs. Inspection of the arch ribs noted that open vertical cracks are present in 19 of the 44 reinforced concrete arches (**Table 4**). Several arch cracks were present prior to the 1995 reghabilitation while other cracks received epoxy injection in 2014. As shown in **Figure 5**, one crack in the Span 5 NE Arch Rib is suspected to be completely through the rib section longitudinally and has propogated into the the bases of several spandrel columns. A crack monitor was installed across this crack bewteen Lower Deck Columns 12 and 13 (**Photo 22**) Additionally, several horizontal cracks are present in other arch ribs (**Photo 23**). One horizontal crack on the north face of Span 3 NI Arch Rib epoxy injected in 1996 exhibits new cracking through the concrete sealer and concrete surface. **Sheets B-4** through **B-6** further illustrate the location and detail of these arch rib cracks.

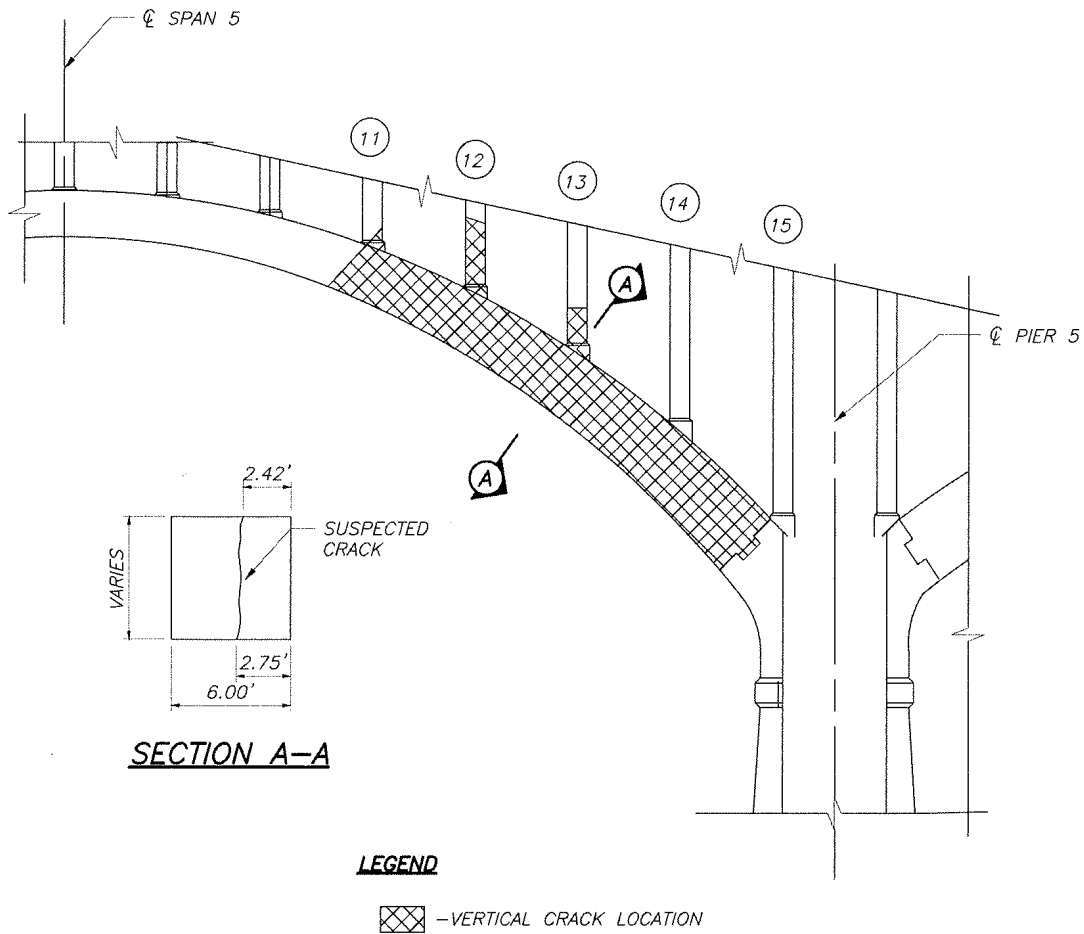
Span	Longitudinal Arch Rib Crack Location	Comments
1	NI East	
2	SE East	
3	NE West	
	NE West	(1995 Qty.: NE 43 LF)
	NI East	(1995 Qty.: 36 LF)
	SE East	Surrounded by map cracking.
5	NE West	(1995 Qty.: 28 LF)
	NE East	Crack on intrados epoxy injected in 2014/15. Crack location & widths measured on intrados and extrados. See Photos 20 & 21.
	SI West	
	SE West & East	Located adjacent to deep three-sided 1996 patch. May be related to deterioration.
6	NE West & East	
	NI East	
7	NE East	(1995 Qty.: 18 LF)
	SE West	
8	NE East	
9	NE West	(1995 Qty.: 8 LF)
	NE East	
10	NE West	
11	NE East	(1995 Qty.: 6 LF)

Table 4 - Longitudinal Vertical Arch Rib Crack Summary.

**Other 1995 Plan Quantities -
Arch Rib Epoxy Injection Repairs:**
Span 9 SE Arch – 3 LF
Span 13 SI Arch- 3 LF

**Other 2013 Plan Quantities -
Arch Rib Epoxy Injection Repairs:**
Span 2 NE Arch East End – 40 LF
Span 2 SE Arch Center – 10 LF
Span 8 SI Arch Center





**Figure 5 – Estimated Alignment of Vertical Crack,
 Span 5 NE Arch & Spandrel Columns.**



**Photo 22 – Crack Monitor Set Across Vertical Arch Rib Crack, NE Arch, Span 5.
(Inset: Close-up of Crack Monitor installed December 23, 2016.)**



Photo 23 – Typical Horizontal Crack, Span 3 NE Arch Rib Shown.

Arch Rib Delamination & Spalls:

Over public areas, most arch rib surfaces are sound, however corner delaminations and spalls are present due to ongoing concrete corrosion (**Photo 24**). One delaminated area not previously repaired is on the lower north corner of the Span 7 SI Arch Rib, at the center of the arch. Upon removal of the unsound concrete, the 1995 shotcrete material was found to be intact with post-1995 fractures in the original concrete section above the patch.⁵ Examination of the reinforcement shows an ongoing corrosion that is causing the new delaminations. This area is one that not subjected to chloride contamination throughout its 99-year service life, and without shear reinforcement, these bottom mat reinforcement bars have little electrical connectivity to other reinforcement subject to chlorides. The cause for the reinforcement continuing corrosion likely is the loss of the concrete passivation layer due to decreased pH of the concrete.

This field inspection also verified the presence or not of main steel reinforcement placed at the arch rib quarter points. Plans indicate no top and bottom mat steel reinforcement was placed for generally two panels at each end of all arch ribs, however during repairs, steel reinforcement has been observed at these locations. Using a Garrett ACE 250 hand-held metal detector, this inspection verified that top and bottom mat steel was placed continuously in the arches of Span 1 through 3, 5, and 7 through 9. In Span 6, however, no main reinforcement was detected in the North Exterior and Interior arch ribs between Columns 3 and 5, and Columns 11 and 13. Span 6 was the first concrete span constructed, and therefore likely the only span to have discontinuous reinforcement. Furthermore, during construction, Span 6 Arch Rib NE developed a horizontal crack between Columns 12 and 13 soon after casting. This arch was repaired by relieving the load from the arch rib, removal of the defective section, and recasting the section, again unreinforced.⁶ The repaired section contained hairline map cracking but no signs of major cracks or delaminations (**Photo 24**).

⁵ 2015 *Detroit-Superior Bridge Physical Condition Report*, Jones-Stuckey, A Division of Pennoni, p. 29.

⁶ Zesiger, A.W., Crack in New Concrete Arch Explained by Freezing of Pocketed Water, *Engineering News*, Vol. 77, No. 9, March 1, 1917, pp. 356-9.



**Photo 24 – Outline of Delaminated Arch Rib Corner, SI Arch Rib, Span 7.
(Inset: Active rebar corrosion present.)**



**Photo 25 – Sound 1996 Shotcrete Patch (Left of Paint Line) & Cracked
and Unsound Patch, Span 6 NE Arch Rib.**



Photo 26 – Cracked Concrete at Location of 1915 Arch Repair, NE Arch Rib, Span 6.
 (Note: Rust staining likely from steel form connectors or discarded nails.)

Arch Columns (c28)

The arch columns are in *Fair* condition. This element covers the columns set on the arch ribs and arch bases.

<i>Element Level Quantities – Arch Columns</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
1,118	1,108	50		

Upper Deck Columns:

Several upper deck columns exhibit corner cracking or shallow spalls due to unmitigated corrosion though no chloride attack is present (**Photos 27 & 28**). Two columns cast during the 1995 rehabilitation, have spalled concrete due to corrosion despite having epoxy coated steel reinforcement (**Photo 29**).

In the East Station and East Subway, three original columns (L18, M22 and M27) have advanced deterioration (**Photo 30**). East Subway Column N22 has 60% section loss near the top due a history of infiltration through the adjacent expansion joint and longitudinal floor joints above (**Photo 31**).



Photo 27 – Cracked Capital & Column Corner, NE Column 10, Span 3.



Photo 28 – Occasional Delamination & Spall of Original Upper Deck Columns.



Photo 29 – Corner Spall with Corrosion to Epoxy Coated Reinforcement, Column D3, West Station.



Photo 30 – Advanced Deterioration to Column G18, East Station.



Photo 31 – Advanced Deterioration of Column M22, East Subway. (Inset: Exposed Reinforcement at top of column with 60% section loss.)

Lower Deck Columns:

Many lower deck columns exhibit shallow spalls due to corrosion of the $\frac{1}{2}$ -inch stirrup reinforcement (**Photo 32**). Most lower deck columns adjacent to piers have large delaminated areas. One column, Lower Deck Column SE 1, Span 9, exhibits deep cracks resulting in large pieces of concrete loose and nearing a fall onto the public space below (**Photo 33**).



Photo 32 – Common Lower Deck Column Spall at Stirrup Reinforcement.



Photo 33 – Cracked & Spalled Surfaces (Circled) on Lower Deck Column SE 1, Span 9. (Inset: Loose concrete near column base, south face.)

Floorbeams – Concrete (c18)

The concrete floorbeams are in *Fair* condition. Isolated spalls are present of original 1917 upper deck floor beams, most of which are in the north bay and strengthened in the 1967-70 rehabilitation.

Among the upper deck floor beams, isolated delaminated areas are present among concrete surfaces, including floorbeams cast in the 1970 and 1995 rehabilitations (**Photo 34**). Infiltration through the Tower A expansion joint and adjacent deck has caused deterioration to the 1995 upper deck floorbeam below (**Photo 35**).

The lower deck floorbeams exhibit increasing delamination, especially among center bay floorbeams that have been generally shielded from chloride contamination (**Photo 36**). Loose and dangerous concrete delaminations are present over public areas of the east approach spans (**Photo 37**). In Span 6, removal of the bottom delamination of Floorbeam 15, South Bay, reveals that continued reinforcement corrosion is resulting in the delamination in the 20-year old shotcrete material (See **2015 Physical Condition Report**).

While appearing as architectural embellishments, the lower deck corbels are cantilevered end of the lower deck floorbeams, directly supporting the exterior upper deck column loads above. Many lower deck corbels were patched or replaced in the 1995 and 2014 rehabilitations. Additional cracks, delaminations and spalls are present on several lower deck corbels due to concrete corrosion of the main compressive diagonal reinforcement (**Photo 38**).

The lower deck floorbeams of the East Station, behind the East Abutment and accessible from an access opening in the south exterior wall gate, have the bottom mat of reinforcement exposed. This deterioration has changed little since the 1980s, and with no live load carried by these floorbeams, no repairs are recommended.



Photo 34 – Deterioration of Newer Upper Deck Floorbeam 11, Span 5.



Photo 35 – Delaminated & Spalled Surfaces of Upper Deck Floorbeam 31, between Lines B & C and below Tower A Expansion Joint. (Note: This floor beam was cast during the 1995 rehabilitation.)



Photo 36 – Common Cracked & Delaminated Lower Deck Floorbeam Surface (Circled).



Photo 37 – Loose Concrete (Circled) over Parking Lot Removed, Lower Deck Floorbeam 2, Center Bay, Span 5. (Inset: Active corrosion of reinforcement steel present.)



Photo 38 – Common Spalls on Lower Deck Corbels. (Inset: Diagonal crack indicating concrete corrosion present.)

Beams – Concrete (c15.1)

The beams are in *Fair* condition. These elements consist of the longitudinal beams in the Detroit Tunnel, West 25th Street Tunnel and West Station.

<i>Element Level Quantities – Beams</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
7,394 LF	7,205 LF	189 LF		

Repairs of the West Station concrete beams were non-performed in the 1995 rehabilitation due to budget considerations and general shallow spalls present. Since this rehabilitation, several beams have continued to spall despite being protected from continued chloride penetration (**Photo 39**).



Photo 39 – Spalled Beam D21-D22, West Station.

Steel Superstructure

The load bearing components (web plates and flange angles) of the primary truss members and gusset plates are composed of nickel steel, an early high strength steel also known for its corrosion resistant properties.⁷ The original hangers, composed of nickel steel, were replaced with 50 ksi steel. All lacing member components of the primary truss members, upper and lower deck floorbeams, lateral and longitudinal bracing and sway bracing are composed of 30 ksi carbon steel.

Stringers (c17)

The stringers are in **Good** condition with little deterioration noted. All upper deck stringers have shear studs welded to the top flange providing composite action with the deck. The upper and lower deck stringers in Panels 4, 5, 5' and 4' were replaced in 1995.

<i>Element Level Quantities – Stringers</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
17,730 LF	17,730 LF			

All upper deck stringers are in good condition. Light pitting is present on the bottom flanges of the original curb stringers of Lines 5 and 14. The lower deck stringers supporting the steel grid deck and the outer pedestrian fiberglass grid deck are also in good condition. Stringer F, Panel 6' has two bolts missing in the lug connection (**Photo 40**).



Photo 40 – Missing Bolts at Lug Connection, Stringer F, Panel 6'.

⁷ Vermes, William J., Performance of Early 20th Century High Strength Steels on American Bridges, The First Fatigue & Fracture Conference, Philadelphia, Pennsylvania, August 7, 2006, pp.7, 13-15.

Floorbeams – Steel (c18)

The Span 4 floorbeams are in **Good** condition. New bolted upper deck floorbeam cantilevers were installed during the 1967-70 rehabilitation to support the new wider upper deck. The Upper and Lower Deck Floorbeams 5 and 5' were replaced in kind in 1995. The lower deck floor beams received no structural repair though corroded top and bottom flanges received local removal of thin and knife-edge sections.

Element Level Quantities – Floorbeams				
Total Quantity	CS 1	CS 2	CS 3	CS 4
3,925 LF	3,921 LF	4 LF		

The Upper Deck Floorbeams 8' and 10' have web perforations above the upper deck bracing gusset plates (**Photo 41**). This section loss has not increased since 1997. Additionally, Upper Deck Floorbeam 11 is missing one connector along the bottom flange built-up connection. The lower deck floor beams have light active corrosion adjacent to the recently protective coating system below the north and south truss lines.



Photo 41 – Web Perforation on Upper Deck Floorbeam 8', Span 4.

Truss Verticals (c19)

The truss verticals are in **Good** condition. Local perforations are present on diaphragm plates located between the upper and lower decks and minor corrosion of the lacing bars below the lower deck.

<i>Element Level Quantities – Verticals</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
50	50			

Truss Diagonals (c20)

The truss diagonals are in **Good** condition. Little or no section is present on the web plates or flange angles. Below the lower deck, several top stay plates at the lower chord gusset connection have minor pitting.

<i>Element Level Quantities – Diagonals</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
48	48			

Truss Upper Chord (c21)

The truss upper chord members are in **Good** condition. Isolated rust staining is present on the upper chord members with no significant section loss present. At North U₁₂U₁₁' (a zero load member), pack rust between the hinge cover plate and truss top flange has resulted in minor perforations of the cover plate.

<i>Element Level Quantities – Truss Upper Chord</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
48	48			



Truss Lower Chord (c22)

The truss lower chord members are in **Good** condition.

<i>Element Level Quantities – Truss Lower Chord</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
48	36	12		

Despite the age of the steel truss span, little pack rust and section loss is present throughout the lower chord due the corrosion-resistant nickel steel and the relatively thick sections. Additional comments are as follows:

- From L₀ to L₅ and L₀' to L₅' on both truss lines, many uphill lower transverse angles of the lower chord diaphragms have caught water and debris, resulting in pitting and perforations of these carbon steel truss diaphragm plate and transverse angles (**Photo 42**).
- The resulting local paint failure has resulted in vertical interior section loss up to $\frac{5}{16}$ " of the two 1-inch thick nickel steel lower chord web plates.
- Several top and bottom lacing channels have corrosion holes.
- On South L₀L₁, a fractured bolt installed in 1995 is present on a top lacing channel connection. Close inspection of the fracture shows the bolt either had a material flaw or was overtightened during installation.



**Photo 42 – Common Perforations of Lower Chord Diaphragm
& Debris on Lower Transverse Angle.**

Main Gusset Plates (c23)

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

<i>Element Level Quantities – Gusset Plates</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
104	102	2		

Most $\frac{3}{4}$ "-thick gusset plates have minor corrosion above the top of the lower chord member. At North L₃, south plate and South L₂, north plate, moderate section loss is present (**Photo 43**). Elsewhere below the lower deck, rust nodules are present on the interior gusset plate surfaces.



Photo 43 – Active Corrosion of Main Truss Gusset Plate above Lower Chord, Panel Point L2, South Truss.

Lateral Bracing (c24)

The lateral bracing is in **Good** condition.

Element Level Quantities – Lateral Bracing				
Total Quantity	CS 1	CS 2	CS 3	CS 4
36	36			

Below the upper deck, the uphill bottom angles of the lateral bracing catch water and dirt, resulting in local paint failure and corrosion. The lower lateral bracing of Panel 3' has advanced section loss (**Photo 44**). The upper lateral bracing gusset plate at Panel Point U₅' has a 1 1/4" tear and is pulled upward (**Photo 45**).



Photo 44 – Active Corrosion & Section Loss of Lower Lateral Bracing, Panel 3'.



Photo 45 – Upper Lateral Gusset Plate Tear at Panel Point U₅'.
(Inset: View of tear looking up.)

Sway Bracing (c25)

The truss lower chord is in **Good** condition.

<i>Element Level Quantities – Sway Bracing</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
28	28			

Below the lower deck, isolated perforations are present at the connections to the truss verticals members.

Bearing Devices (c26)

The bearing devices are in *Fair* condition.

<i>Element Level Quantities – Bearings</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
4		4		

The cracks on the non-structural bearing pin cover plates have not significantly propagated. On all four bearing castings, steel shot blasting material from the 1997 painting operation is piled within the casting chambers. Also on the interior surfaces of all four bearing castings, the OZEU paint has failed with active corrosion present (**Photo 46**).



Photo 46 – Typical Steel Shot Blast Material & Corrosion within Truss Bearing.

Protective Coating System (c30)

The protective coating system is in **Good** condition.

<i>Element Level Quantities – Floorbeams</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
14,469 LF	12,869 LF	1,200 LF	400 LF	

Pockets of local protective coating systems failure are present on the main truss members below the lower deck (See **Photos 42, 43 & 44**). The structural steel between the upper and lower decks have been repainted in 2014-15, and is in very good condition. Below the lower deck, however, blast material not contained during the recent painting operation has accumulated on bracing and gusset connections. Immediately above limits of the new 2014-15 protective coating system, local paint failure is present within the truss members immediately above the upper deck (**Photo 47**). Above the upper deck, the top coat of the OZEU system is oxidized with some areas of paint cracks and peeling (**Photo 48**).

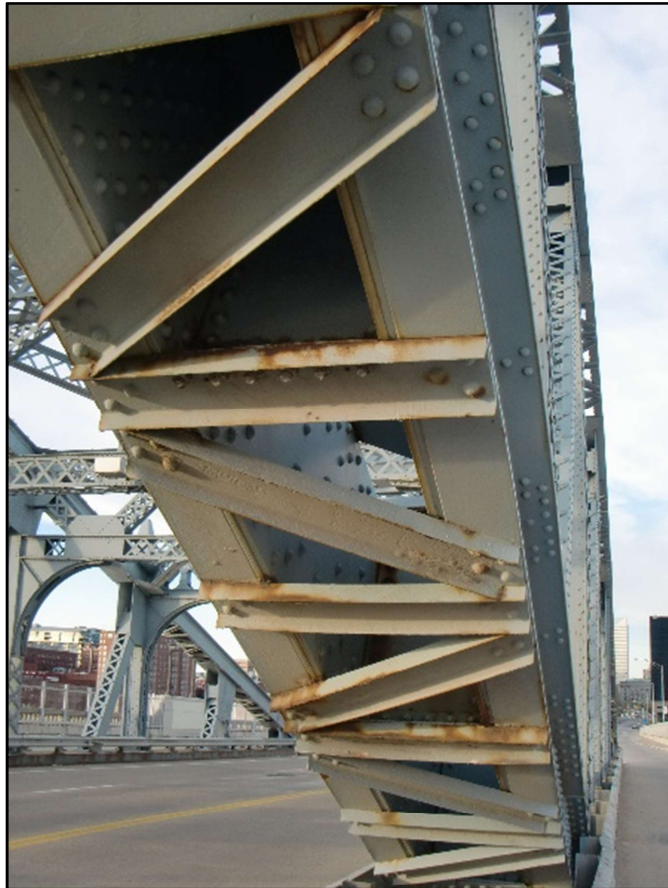


Photo 47 – Local Paint Failure within Lower Chord Immediately Above Upper Deck.



Photo 48 – Oxidized Top Coat & Peeling Paint Above Upper Deck.

Pins, Hangers & Hinges (c31)

The pins, hangers and hinges are in **Good** condition with no deficiencies noted. Following the 2014 zone painting of the Span 4 superstructure below the upper deck, minor section is now seen on the hangers immediately below the upper deck pins (**Photo 49**).

<i>Element Level Quantities – Pins & Hinges</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
192		172	20	



Photo 49 – Common Minor Pitting on Hangers Below Upper Deck Pin.

Fatigue (c32)

The fatigue prone details are in **Good** condition.

<i>Element Level Quantities – Fatigue</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
14,469 LF	14,469 LF			

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 abutment walls are in **Good** condition. This item consists of the West and East Abutments and also the walls of the Detroit Avenue and West 25th Street Tunnels.

Element Level Quantities – Abutment Walls				
Total Quantity	CS 1	CS 2	CS 3	CS 4
166 LF	151 LF	20 LF		

The spalls and delaminations along the tunnel walls have changed little since late 1980s and likely have been present decades earlier. Deep spalls behind the first layer of steel reinforcement is present at the wall section adjacent to construction joints (**Photo 50**). These spalls were not repaired as part of the 1995-97 rehabilitation due to construction cost limitations, with some sections repairs during the 2014-15 rehabilitation. Of these wall panels patched in 2015, hairline cracks and one area of delamination is present (Photos 51 & 52).

At the East Abutment, two 1/2" drainpipes have been installed to relieve the water pool in the three cellular concrete panels behind the abutment. Previous opinion suggested these drains would relieve the water in the East Station pedestrian tunnels and in the Lower Deck profile sag. However, a sediment-clogged drain leading into the cellular area suggests that the ineffective pedestrian tunnel drainage had once emptied into the East Abutment chambers.



Photo 50 – Deep & Slow-Growing Spalls on Wall Joint, West 25th Street Tunnel.



Photo 51 – Hairline Cracks on New Wall Patch, Detroit Avenue Tunnel.



Photo 52 – Delaminated Area (Highlighted in Paint) on New Wall Patch, Detroit Avenue Tunnel.

Pier Walls (c36)

The pier walls are in **Good** condition. This element consists of the solid cellular construction of Pier 3 and Pier 4.

<i>Element Level Quantities – Pier Walls</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
200 LF	200 LF			

Pier Columns/Bent (c36)

The pier walls are in *Fair* condition. With the redesign of the upper deck pier slabs and the elimination of the paired expansion joints, the upper deck pier shafts no longer support live loads and the lower deck interior and exterior pier shafts (pier walls) only support the end of the lower deck spans and occasional lower deck live loads. In the original design, vitrified clay drain pipes were placed within the south exterior upper and lower deck shafts. With 90° bends at the pier base, this drainage likely soon proved ineffective and spilled onto the lower deck. This drainage system was bypassed in the 1967-70 rehabilitation, and largely removed with the pier shaft replacement during the 1995 rehabilitation.

<i>Element Level Quantities – Piers</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
40	39		1	

The South Exterior Lower Deck Shaft at Pier 6 exhibits deep scaling over most of its exterior surface (**Photos 53**). This deterioration likely is attributed to the failed original drainage that was bypassed over 40 years ago. Sound concrete may not be present for depths between 6 to 12 inches. Also on the exterior pier shafts, fractured concrete continues to occur at the interface with the lower deck corbels due to inadequate bond breaker placed in the 1995 rehabilitation (**Photo 54**).

Pier Columns – Tunnels, West Station & East Station (c38)

The pier columns of the tunnels and station area are in *Fair* condition.

<i>Element Level Quantities – Wingwalls</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
371	337	30	4	

In the West Station, four columns, C13, C14, C23 & C24, were replaced as part of the current rehabilitation project. These columns were to be patched in 1995, but the repairs were non-performed due to construction budget constraints. Over the nearly 20 years since, these columns have steadily deteriorated despite no evidence of salt water saturation or other chloride contamination.



**Photo 53 – Deeply Scaled & Delaminated Area
(Highlighted in Paint), SE Lower Deck Pier
Shaft, Pier 6.**



**Photo 54 – Spalled & Loose Concrete Due to Ineffective Bond Breaker,
Pier 5 Lower Deck Pier Shaft & South Lower Deck Corbel 1, Span 6.**

Backwalls (c39)

The abutment backwalls are in **Good** condition. The backwalls consist of the closure panels of the West 25th Street and Detroit Avenue Tunnels and the low slump mortar fill of the end of the East Station.

<i>Element Level Quantities – Backwall</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
92 LF	92 LF			

West Slope Movement

The south embankment of the west approach has had a history of movement dating at least to the 1960s. During the 1995-97 rehabilitation, the southeast corner of the West Station, including Tower A South, were reconstructed due to slope instability. While few signs of movement are present in the West Station, movement and opening cracks are present in the cellular construction and Tower B South. Crack gages and slope inclinometers have been installed since 2007 to document structure and soil movements. **Table 5** documents the crack gage measurements and the slope inclinometer measurements are included in **Appendix D**.

Date	No. 5B Tower B Lower Deck		No. 1		No. 2		No. 3		No. 4	
	V (mm)	H (mm)	V (mm)	H (mm)	V (mm)	H (mm)	V (mm)	H (mm)	V (mm)	H (mm)
May 17, 2007	---	---	0	0	0	0	0	0	0	0
April 16, 2013	---	---	2.0	1.0	2.5	0.3	0	0	0.8	0.2
October 3, 2014	6.0	2.0	2.3	1.0	3.0	0.6	0	0	0.8	0.2
August 16, 2015	8.0	2.0	2.8	1.1	4.5	0.8	0	0	0.9	0.5
September 14, 2016	11.0	0.0	3.0	1.1	4.8	0.8	0	0	1.0	0.5

Table 5 – Crack Gage Measurements, Span 1A Cellular Construction & Tower B South.

Wingwalls (c40)

The abutment wingwalls are in **Good** condition. The wingwalls consist of the south wall of the West Station, Spans 1A and 1B, and East Station and the north wall of the East Station.

Element Level Quantities – Wingwalls				
Total Quantity	CS 1	CS 2	CS 3	CS 4
12	12			

Tower B South

Tower B South has had an active history of movement for at least the past 10 years, but overall, slope movement in this area has been documented for over 50 years. Slope instability was first observed in 1963 with a landslide that came within 15 feet of the bridge.⁸

While this current movement likely is a continuation of the movement that resulted in the 1995 rebuilding of the Southeast corner of the West Station, this inspection identified the correct nature of the Tower B movement. Within the cellular construction below, the footing for Tower B and the adjacent approach span wall has cracked and rotated over a length of three panels (**Photo 55**). With identification of this cracked footing, three crack monitors were installed during this inspection's conclusion (**Photo 56**). Crack monitor No. 2 will measure any future drop in the footing elevation. Inspection in the cellular construction verified the construction of the Span 1A, Span 1B and Tower B footings per original plan sheet A2.38. The location and nature of the footing crack, and the placement of the three new crack monitors, is shown in **Figure 6**.

Measurements indicate the tower is leaning approximately $\frac{1}{8}$ -inch per foot. The tower has shifted outward and rotated at least six inches (**Photo 57**) while at the lower deck level, the gap between that the upper deck column and face of tower is $4\frac{3}{4}$ inches, included the 1-inch original construction space. Also at the top of the tower, the section is spalled and cracked because it is wedged up against the upper deck sidewalk above (**Photo 58**).

⁸ *Reconstruction of the Detroit-Superior Bridge Criteria for Design*, Howard, Needles Tammen & Bergendoff, October 1965, p. 12.

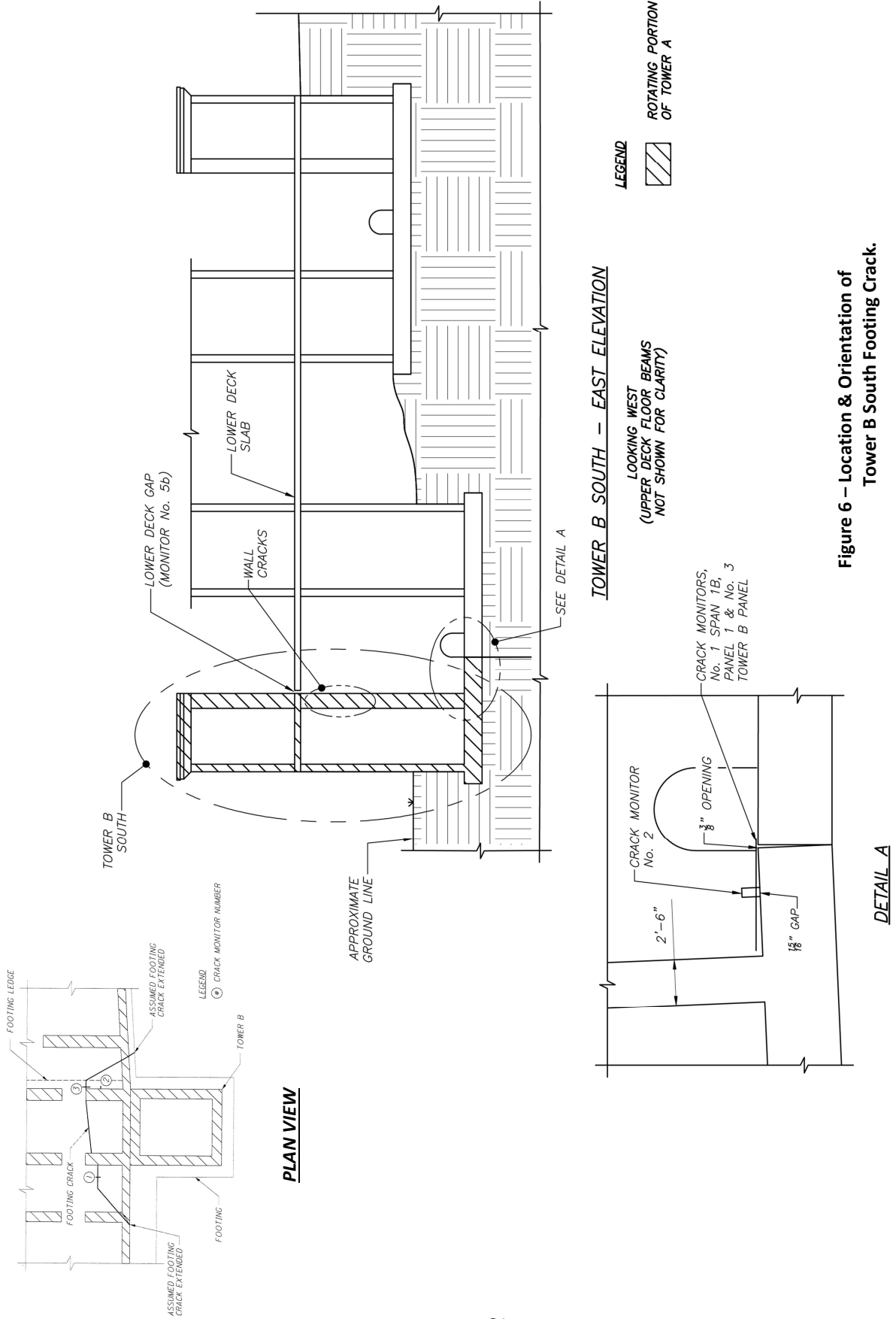


Figure 6 – Location & Orientation of Tower B South Footing Crack.



Photo 55 – Location of Tower B Footing Crack (at Arrow), Looking South in Cellular Construction, Panel 2, Span 1B.



Photo 56 – Tower B Footing Crack (Highlighted with Red Arrows), and Footing Rotation & Drop with Respect to Transverse Wall (at Yellow Arrows), Looking South.



Photo 57 – Tower B Wall Shaft Wedged & Fracturing Against Sidewalk Cantilever.



Photo 58 – Four-Inch Movement of Embedded Pipe Between Tower B Wall Shaft & Sidewalk Cantilever Above.

Scour (c42)

The scour is in **Good** condition. No scour was identified. The most recent underwater inspection was performed in 2015.

<i>Element Level Quantities – Scour</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
2	2			

Slope Protection (c43)

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

<i>Element Level Quantities – Slope Protection</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
2	2			

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.

<i>Element Level Quantities – Alignment</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
2		2		

Protection (c52)

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

<i>Element Level Quantities – Protection</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
200 LF		200 LF		

Hydraulic Opening (c53)

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

<i>Element Level Quantities – Hydraulic Opening</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
1	1			

Navigation Lights (c54)

The navigation lights are in **Poor** condition as the lights have very dim illumination. The lights were raised and the globes were removed, verifying that the fixtures have power (**Photo 59**). A night time visit later also verified the lights are on though with inadequate illumination.

Element Level Quantities – Navigation Lighting				
Total Quantity	CS 1	CS 2	CS 3	CS 4
6			6	



Photo 59 - Power Verification of Navigation Light (West Edge of Channel, South Face shown).

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.

<i>Element Level Quantities – Approach Pavement</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
2		2		

The West Approach pavement has isolated spalls. Moderate map cracking throughout the East and West Approaches was observed.

Embankment (c4)

The approach embankment is in **Good** condition.

<i>Element Level Quantities – Embankment</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
4	3		1	

Following the completion of this inspection, a 2 1/2-foot deep soil erosion gully occurred at the manhole installed north of the 1995 Tower A reconstruction (**Photo 60**). This manhole is filled with water, suggesting that the entire line is clogged and overflows during rain events.

Under Span 3, the embankment has several slope depressions. Much of this embankment was loose soil placed over demolition debris. Beneath this loosely placed fill is a concrete strut between Piers 2 and 3 used as a means of structure stability during construction. This strut is preventing portions of the fill from sliding into the Cuyahoga River.

For additional discussion regarding the west embankment movement, see **Substructure, West Slope Movement**.



Photo 60 – Embankment Erosion at Span 1A Manhole, North of Tower A South.

Guardrail (c5)

The approach guardrail is in **Good** condition.

<i>Element Level Quantities – Guardrail</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
1	1			

Signs & Sign Supports (c5)

The signs are in generally **Good** condition. A bracket for the westbound chevron at the east of the Span 4 North Truss has broken, resulting in the sign not being properly aligned (**Photo 61**).



Photo 61 – Misaligned Chevron Sign, East End of Span 4 North Truss.

Security & Vandalism

Following the terrorist attacks on September 11, 2001, security fencing was installed around the bases Piers 2 and 3, and also from Tower A South to Pier 1, enclosing the land beneath Span 1 and along Spans 1A and 1B. The gate to this enclosed area is unlocked, permitting public access and homeless camping under Span 1 and access along the south wall of Spans 1A and 1B.

Unauthorized access to the lower deck has become rampant. Furthermore, the steel mesh placed outside Span 1A to prevent unauthorized access to the lower deck has been breached (**Photos 62**). Makeshift ladders have been continuously removed, but vandal access continued. The north face of Span 13, near the East Abutment, has become a new access point (**Photo 63**). On the west side of Pier 4, a covered chain-link enclosure for the Center Street bridge operator's vehicle has been built. From inside this enclosure, vandals have climbed through the top fencing cover to access the sway bracing, and paint graffiti on Pier 4. From this sway bracing, vandals also have unauthorized access to the truss lower chord and lower deck.

From the above three access points, vandals are now starting to place graffiti throughout the lower deck (**Photo 64**). Additionally, vandals destroyed all lighting and electrical conduits for the West Station lighting and outlets.



Photo 62 – Broken Ties to Fencing, Span 1A at Tower A.



Photo 63 – Step Ladder Used for Vandal Access to Lower Deck, Span 13, North Face.



Photo 64 – New Graffiti Vandalism, Span 11, North Face.

Land Use

Within the intended secure area beneath Span 1, the homeless tents that were present earlier are now gone. However, the gate of the security fence that encloses the area below Span 1 and along the south wall of Spans 1A and 1B is unlocked and open, stuck in mud. Furthermore, holes have been cut in this fence near Tower 1A. Immediately adjacent to and outside this south security fence, a series of shanties are also present.

Utilities

The utilities are in *Fair* Condition. One lower deck telephone junction chamber in Span 2 and Span 13 each are severely corroded and lacking security due to salt water infiltration through the manhole above. (**Photo 65**). In the West Station, the bottom access panel for the junction chamber near Column D12 is unlocked and open (**Photo 66**).

<i>Element Level Quantities – Utilities</i>				
Total Quantity	CS 1	CS 2	CS 3	CS 4
12,000 LF		12,000 LF		



**Photo 65 – Failing Utility Bracket (Channel Web Hole Circled),
Panel A3-A4, West Station.**



**Photo 66 – Unsecure Telephone Junction Chamber, Near Column D12,
West Station.**

Architectural Lighting

For the City of Cleveland Bicentennial Celebration in 1996, architectural lighting was installed throughout the structure. All exterior pier shaft light brackets exhibit paint failure and corrosion with minor section loss present. Since early 2016, these lights are being restored. After this inspection, most exterior substructure lights and lower deck silhouette lights are functioning. Additionally, three south lower deck silhouette light in Span 13 have been broken from vandalism.

VII - Summary & Recommendations

The Detroit-Superior Bridge over the Cuyahoga River is in **Fair** condition, or **5** on the NBIS rating guideline (Table 2, Page 11). The complete Bridge Inspection Report Form (BIFR) reflecting element level condition ratings is included in **Appendix A**.

The following repairs and maintenance tasks shown in **Table 6** are recommended to improve the General Appraisal of the Detroit-Superior Bridge, to minimize future repair costs, and to extend the service life of the bridge.

Repair/Maintenance Task		2017	2018	2019	2020	2021
1.	Span 1A South Exterior Wall: Remove vandal fencing and Install cinder block wall on top of lower deck rail.	X				
2.	Pier 4: Place anti-climb fence along back of bridge operators' car storage area and keep area locked at all times.	X				
3.	Span 13, North Edge of Lower Deck: Install cinder block wall on top of lower deck rail.	X				
4.	Replace West Station lighting and conduit.	X				
5.	Conduct ground penetrating radar survey of upper deck floor, West Station and Spans 1A through 13, and East Station.	X				
6.	Restore navigation lighting.	X				
7.	Clear West Abutment drain pipe.	X				
8.	Clean out all catch basins Piers 1, 2 and 5 through East Abutment.	X				
9.	Pier 4: Repair sink holes along sheet pile wall.					
10.	Tower B South: Establish plumb bob to monitor lean and top movement of concrete section.	X				
<i>As part of the 2016 Deck Rehabilitation Contract, the following tasks are recommended to be included:</i>						
11.	Replace upper deck concrete wearing surface.			X		
12.	Repair broken drain pipes at Pier 2 and 3.			X		
13.	Stabilize Tower B South.			X		
14.	Place FRP sheets with cathodic protection on select concrete surfaces over public areas. (Note: An active cathodic protection system is also being evaluated.)			X	X	
15.	Pier 3: Install fender system at southeast corner of pier.				X	

Table 6 – Five-Year Repair & Maintenance Schedule.

APPENDIX A

**2016 BRIDGE INSPECTION
FIELD REPORT**



STATE OF OHIO DEPARTMENT OF TRANSPORTATION BRIDGE INSPECTION FIELD REPORT

Structure File Number: 1800930

Inventory Bridge Number: CUY 00006 14.560

Bridge Type: 3 - STEEL/5 - ARCH/4 - THRU

Sufficiency Rating: 66.0

Date Built: 7/1/1917

District: 12 Place Code (FIPS): CLEVELAND

USR 6 over (1499)CUY. RIVER & RTA

Type of Service on: HIGHWAY-PEDESTRIAN

APPROACH ITEMS

- c1. Approach Wearing Surface (EA)
- c2. Approach Slabs (SF)
- c3. Relief Joint (LF)
- c4. Embankment (EA) d
- c5. Guardrail (EA)

QTY.	condition state				TR
	1	2	3	4	
2	0	2			2.00
168	168				1.00
4	3	0	4		3.00
1	1	0			1.00

N36. Safety Features:
Tr, Gr, Tm

36)B N 36)C 1 36)D 0
(9-0) 6

c6. Approach Summary

DECK ITEMS

- c7.1 Floor/Slab (SF)
- c7.2 Edge of Floor/Slab (LF)
- c8. Wearing Surface (SF)
- c9. Curb/Sidewalk/Walkway (LF)
- c10. Median (LF)
- c11. Railing (LF)

QTY.	condition state				TR
	1	2	3	4	
226203.55	2262	7500	1000		1.12
	03.55				
5312	5312	0			1.00
191232	1762	1400	1000	0	1.19
	32	0			
5312.00	0	5312.			2.00
		00			
675	675	40		0	1.08
5312	5312		0		1.00

N36. Safety Features: Rail

36)A 1
0.00 0 0.00 0.00
0.00 0 0.00 0.00

c12. Drainage (EA) d

c13. Expansion Joint (LF) d

N58. Deck Summary

(9-0) 6

SUPERSTRUCTURE ITEMS

- c14. Alignment (EA) d
- c15.1 Beams/Girders (LF)
- c15.2 Slab (SF)
- c16. Diaphragm/X-Frames (EA)
- c17. Stringers (LF)
- c18. Floorbeams (LF)
- c19. Truss Verticals (EA)
- c20. Truss Diagonals (EA)
- c21. Truss Upper Chord (EA)
- c22. Truss Lower Chord (EA)
- c23. Truss Gusset Plate (EA) d
- c24. Lateral Bracing (EA)
- c25. Sway Bracing (EA)
- c26. Bearing Devices (EA) d
- c27. Arch (LF)
- c28. Arch Column/Hanger (EA)
- c29. Arch Spandrel Walls (LF)
- c30. Prot. Coating System (LF) d
- c31. Pins/Hangers/Hinges (EA) d
- c32. Fatigue (LF) d

QTY.	condition state				TR
	1	2	3	4	
13	13				1.00
17487	1656	600	200	120	1.51
	7				
0.00	0				
17730	1773	0			1.00
	0				
37468	3146	5000	1000	2	1.54
	6				
50	50	0			1.00
48	48	0			1.00
48	48				1.00
48	48	12			1.27
104	72	28	4		1.76
36	0	36			2.00
28	28	0.00			1.00
4	0	4			2.00
6085	327	5558	200		2.14
1118	1118	50.0			1.06
14469	1446	1200	400		1.45
	9				
30	30				1.00
0.00	0	0.00			

N59. Superstructure Summary

(9-0) 5

SUBSTRUCTURE ITEMS

- c33. Abutment Walls (LF)
- c34. Abutment Caps (LF)
- c35. Abut. Columns/Bents (EA)
- c36. Pier Walls (LF)
- c37. Pier Caps (LF)
- c38. Pier Columns/Bents (EA)
- c39. Backwalls (LF)
- c40. Wingwalls (EA)
- c42. Scour (EA) d
- c43. Slope Protection (EA) d

N60. Substructure Summary

CULVERT ITEMS

- 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

CHANNEL ITEMS

- c51. Alignment (LF) d
- c52. Protection (LF) d
- c53. Hydraulic Opening (EA) d
- c54. Navigation Lights (EA) d

N61. Channel Summary

SIGN/UTILITY ITEMS

- c55. Signs (EA) d
- c56. Sign Supports (EA) d
- c57. Utilities (LF) d

General Appraisal

N41. Operating Status

Inspector Name	Vermes, William				
Inspection Date/Type	12/23/2016	Routine and In-Depth and Fracture			
PE Number	53391				
Reviewer Name	Vermes, William				
Review Date	02/12/2017				
PE Number	53391				

QTY.	condition state				TR
	1	2	3	4	
170.33	0	3289	170.33		3.00
170.33	0				
0.00	0				
1022.00	0	1022.00			2.00
1022.00	0	1022.00			2.00
48.0	0	47.0	1		2.11
170.33	0	170.33			2.00
0.00	0	0.00	0.00		
14	0	14			2.00
0.00	0	0.00			

(9-0) 5

QTY.	condition state				TR
	1	2	3	4	

(9-0) N

QTY.	condition state				TR
	1	2	3	4	
200.00	200.00	.0			2.00
200.00		200.00			2.00
1	1				1.00
0.00	0	6			2.00

(9-0) 6

QTY.	condition state				TR
	1	2	3	4	
0.00	0	0.00	0.00		3.00
4	4	0.00			1.00
12000.00	0	1200.00	0.00		2.00

(9-0) 5
 A

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
BRIDGE INSPECTION FIELD REPORT

Structure File Number: 1800930

Inventory Bridge Number: CUY 00006 14.560

Bridge Type: 3 - STEEL/5 - ARCH/4 - THRU

Sufficiency Rating: 66.0

Date Built: 7/1/1917

District: 12 Place Code (FIPS): CLEVELAND

USR 6 over (1499)CUY. RIVER & RTA

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

SMS Quantities have been revised.

Comments

APPROACH

c1. Approach Wearing Surface

This bridge lacks conventional approach slabs so the asphalt area the width of the tunnels and extending 30' beyond the tunnel bulkhead was rated. Though the approach tunnels on the west end of the bridge diverge to the south, only the approach surfaces on the main route US 6 were considered in the rating of this item. These regions lie just west of the intersection with West 28th and east of the intersection with West Huron Road. Overall, these areas are in fair condition with some cracking and isolated patched areas.

c4. Embankment

The SE embankment has been shored at its interface with the parking lot below where some erosion has occurred. No settlement along the south wall of the East Station is present.

At the NE embankment, where the bridge shares the embankment with the old Superior Viaduct there are some sink holes possibly due to a faulty water or sewer line below. These sinkholes do not affect the performance of the embankment.

The NW embankment is the County bridge garage parking lot and in good condition.

The SW embankment adjacent to the abandoned Riverbed Road is experiencing slope movement and is being monitored. This failure has led to the movement and cracks of the south west approach wingwall between Tower A and Tower B.

c5. Guardrail

For approach guardrail, only the portion at the SE end of the bridge adjacent to the parking lot was considered. The guardrail is composed of a concrete parapet topped with an aluminum picket. The guardrail is in good condition with only very minor shrinkage cracks noted. (Note median impact attenuator is rated with the median)

DECK

c7.1 Floor/Slab

This item includes the floor slab of the Detroit Avenue Tunnel, the West 25th Street Tunnel, the West Station, Upper deck floor in Spans 1A, 1B and 1 through 13, and the East Station. The top of floor is covered by wearing surface, curb, walk, or railing, thus this rating is governed primarily by the underside inspection.

A structural floor slab was placed on top of the Detroit Avenue Tunnel during the 1995-97 rehabilitation, and is considered to be in CS 1.

West 25th Street Tunnel: One location of exposed bottom mat rebar, say CS 3, 100

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SF.

The West Station floor slab has areas of CS 2 and CS 3 primarily beneath the south curb line and along deficient floor joints. CS 2 - 7342 SF, CS 3 - 832 SF. Top of West Station slab was extensively patch in Fall 1995. Waterproofing placed in 1995 is not effective. The slab is 16 inches thick minimum.

Main Spans: No deficiencies noted except as follows:

Span 8, Center Bay: Water dripping during rain events.

Span 9: One full depth patch was performed in November 2015

c7.2 Edge of Floor/Slab

The edge of floor quantity applies only to the concrete bridge sections was rated. With 19 years of service, the slab edge is still in good condition with only minor cracks noted.

c8. Wearing Surface

The wearing surface quantity includes the four lanes of concrete wearing surface on the bridge as well as the asphalt overlay of the West Station and tunnels.

Over 95% of the concrete wearing surface was sounded in December 2016 (Spans 1A though por. Over 8% of this wearing surface is delaminated, with several areas of failing cold patch repairs. Portions of the the concrete wearing surface were repaired in 2014, 2015 and 2016. Spalls and delaminations are present Local sounding of the concrete wearing surface revealed the following percent delaminated or spalled:

c9. Curb/Sidewalk/Walkway

The bridge has two walks that run its length. No walk quantities paralleling the tunnel sections were considered. The walk concrete has local spalls and delaminations, mostly on the north walk added in 2003.. This is primarily along the trench drain that runs for much of its length. Some of the drain cover panels are damaged and much of the drain is filled with sediment or vegetation. There is also plow debris accumulating on the walk at several points along the bridge.

c10. Median

The bridge has a single median at the point where the southern eastbound lane diverges around the steel arch superstructure. The median received a poor rating due to the condition of the attenuator on the eastbound leading edge. As shown in the pictures below, several of the attenuator bays show evidence of collision damage. The visibility paint on the west end of the barrier is also nearly gone.

c11. Railing

The entire length of concrete railing on the bridge was considered in this item. There was also Type 5 railing on the north side of Span 4 protecting the bridge truss and hangers. All concrete railing was in good condition with minor cracking, staining, and isolated distress.

c12. Drainage

This item encompassed the entire drainage system of the bridge moving from the deck scuppers to the outlets at the bases of the piers. During rainfall the deck had little to no ponding. The majority of the deficiencies occurred at the drainage outlets. Some of the downspouts or the basins into which they drained were completely clogged. There was also one catchbasin with dislodged lid. The south drain outlet at

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pier 1 is clogged up to the downspout and is preventing drainage from the structure.

At the south side of Pier 3, the plastic downspout the lower 10 feet up is broken.

Most of the curb drains are partially clogged, but drainage is not impacted.

c13. Expansion Joint

The bridge has expansion joints within the tunnel sections, concrete spans, and main steel arch. Expansion joints are not present in the west approach tunnels, West Station or East Station. The concrete arches sections have expansion joints between spans. Most joints are in good condition. The Tower B expansion joint membrane is torn. The armor above is in good condition, but some surrounding concrete has occasional delaminations and spalls on both the leading and trailing edges. The joints are nearly full of debris. There are four joints within the steel arch section. On the deck these joints show similar concrete damage and debris accumulation with minimal staining at the interface with the concrete spans. There is some plow damage.

SUPERSTRUCTURE

c14. Alignment

ISMS does not permit activation of spandrel columns. Since they are not piers, the columns of the West Station, East Station and tunnels would be included in this category.

Three columns require replacement in the East Station, and are in Condition State 4. One column, M22, has an estimated 40% remaining. The adjacent north tunnel wall supports a portion of the tributary load. One column in the West Station, A2, is delaminated over 50% of its surface.

c15.1 Beams/Girders

This item is the concrete beams between the columns in the tunnels, West Station, and UD and LD jack arches. Overall these are in fair condition. Few have been patched as part of the 2014-16 rehab project.

Ten jack arch beams in the West Station are delaminated or spalled over 50% of their surface areas, and will require partial or full replacement. Many jack arch beams in Line A, B and C have delaminated surfaces.

c17. Stringers

Normal vehicular and pedestrian traffic is not dependent on the lower deck stringers.

c18. Floorbeams

Element level floor beam quantities includes all concrete and steel floorbeams in both the upper and lower decks. Concrete floorbeams are supported by columns in the spans approaching the central steel arch. Floorbeams in the steel section are supported from hangers from the lower arch chord.

Most lower deck concrete floor beams have delaminations and spalls along the side and bottom surfaces. Several LD floor beams have loose bottom concrete that pose a hazard to the public below.

Span 4: The lower deck steel floorbeams are in poor condition. All show severe corrosion and section loss especially around the hangers connecting the decks. Pack

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rust is common between the plates that compose the members. Through holes in the web, flanges, and stiffeners were also noted. The upper deck floor beams have some section loss along the truss lines.

c19. Truss Verticals

Minor corrosion on lacing bars

c20. Truss Diagonals

Minor section loss on lacing bars.

c21. Truss Upper Chord

Minor corrosion present at U12 hinge cover plate

c22. Truss Lower Chord

Minor section loss typical L0 to L3.

c23. Truss Gusset Plate

Both gusset plates at South L2 have 3/16" loss above lower chord. All gusset plates except those at U12 are nickel steel.

c24. Lateral Bracing

Lateral bracing below upper deck has minor section loss.

c26. Bearing Devices

Steel Arch bearing has minor deterioration. Steel shot blast material not removed during the 1997 painting is present within the chambers of all bearing frames. The bearing pin covers have cracks at all four bearing locations. Cracks do not affect the performance of the bearing.

c27. Arch

This item consists 6,085 feet of concrete arch ribs. (See truss items for steel arch condition rating.) Overall the concrete arch ribs are in fair condition with about 5% areas with spalls.

Except Span 12, all arches have no shear reinforcement and top and bottom mat of reinforcement is discontinuous.

Span 3 NE, NI & SE arches, Span 5 NE and SE arches: Evidence present that the arches are cracked vertically through full section centered on the 1/4 point of the arches.

Evidence also present that concrete patches are cracked and spalling due to continued rebar corrosion. Removed portions of shotcrete patches shows signs of sufficient adhesion to original concrete.

See detailed report for additional information.

c28. Arch Column/Hanger

See c31 Pins/Hangers/Hinges for steel hangers in Span 4..

Overall the Concrete Columns are in fair condition, with the ones that were replaced

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with the 1994 rehab in fair condition. Most of the deteriorated columns from the 2013 bridge inspection are were being repaired under the current construction project. Current rehabilitation work patched only columns over public areas.

c30. Protective Coating System

Above Upper Deck: Minor paint PCS deficiencies are present, including the oxidized top coat, are present.

At upper and lower deck levels: PCS has been restored and is in good condition.

Below lower deck, L0 to L3 and lateral bracing connections: Local PCS failure on lower chord and lateral bracing connections.

c31. Pins/Hangers/Hinges

Quantity The bridge has a single pin on each side at the center of each lower steel arch chord. From PP 5 to PP 5', the steel hangers were replaced during the 1994 Rehab and are in good condition.

Original hangers at PP4 and PP4' were not removed in 1995 since these elements were within contained steel and are redundant elements. They are not included in this condition rating.

One hanger set on South Truss exhibits unequal tension.

c32. Fatigue

No fatigue distress was noted at the eyebar heads. Lower pins with grease fitting were greased during the 2014 inspection.

SUBSTRUCTURE

c33. Abutment Walls

The abutment wall include the tunnel walls. Abutment wall concrete shows signs of staining and minor cracking with some spalls. North East Approach Tunnel Wall was under construction during out initial inspections, with many areas of 360 degree rebar exposure during the repair process. These ares were repaired by the completion of the inspection and the rating is based on the repaired walls.

Overall the Pier Columns are in fair condition.

c38. Pier Columns/Bents

Piers 1-3 and 5-12. Minor cracking and some unsound areas where previously patched with shotcrete. (Note South Tower B is rated under wingwall)

Upper and lower deck pier shafts: Most 5 South Upper Deck Pier Shaft were replaced in 1995-96. The Pier 6 South Lower Deck Pier Shaft is deeply scaled with indications that it is deficient deep inside.

c36. Pier Walls

Arch Span Abutments and Piers 3 and 4. Minor cracks with active rebar corrosion is present.

c39. Backwalls

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Tunnel Ends. Minor Staining, Wet, and isolated cracking.

c40. Wingwalls

Soft concrete at southwest wingwall and cracking. Spalls at curtain walls typical with no significant change.

South Tower B settlement has slowed as thge top of Tower B is wedge into the bottom of the sidewalk cantilever. The footing crack has been identified and three crack monitors have been installed January 2017.

c43. Slope Protection

Stone in some areas along West Side.

CHANNEL

c51. Alignment

Bridge has navigation lights, but SMS will not allow this item to be rated. All 6 navigation lights are very dimly lit., and thus not effectively working.

c52. Protection

Sheet Pile walls at Pier 4. Small sink hole behind sheet pile wall.

There is no collision protection present at Pier 3. Former sheet pile sea wall that defined the west dock line downstream Pier 3 is mostly missing, remaining section is just visible above the water.

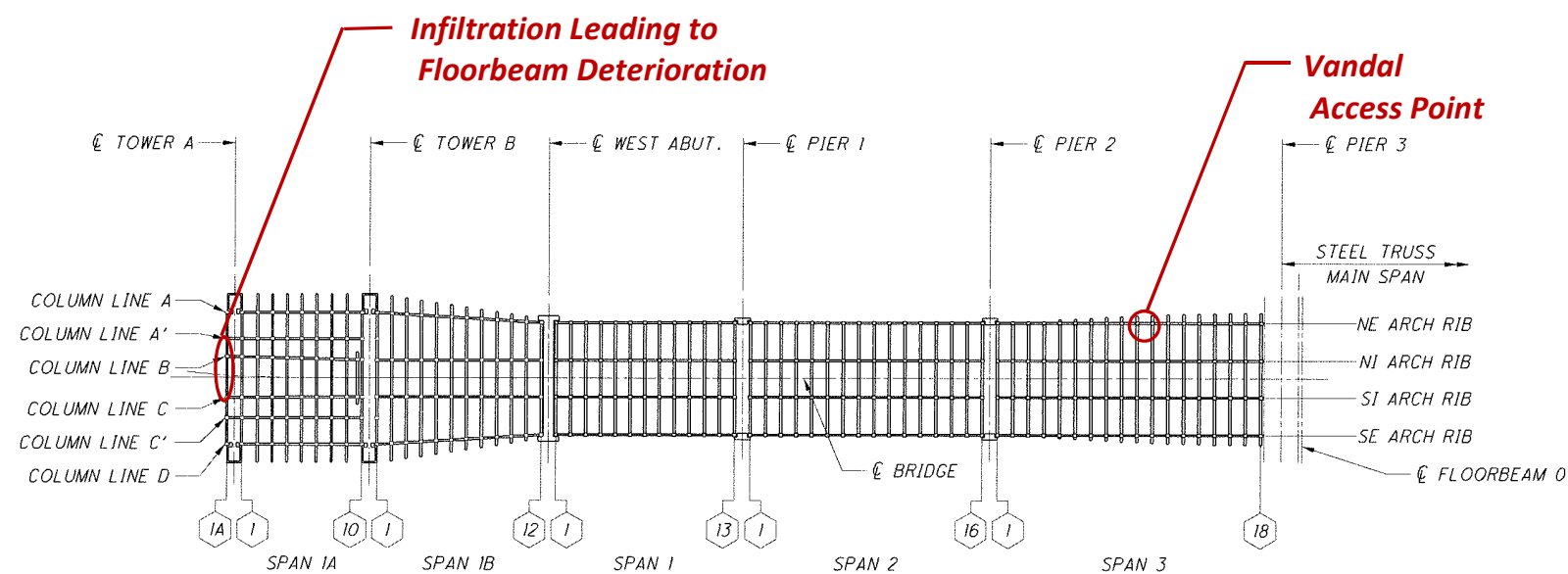
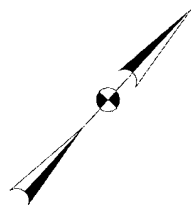
c53. Hydraulic Opening

Span 4 has 96-ft minimum navigation clearance.

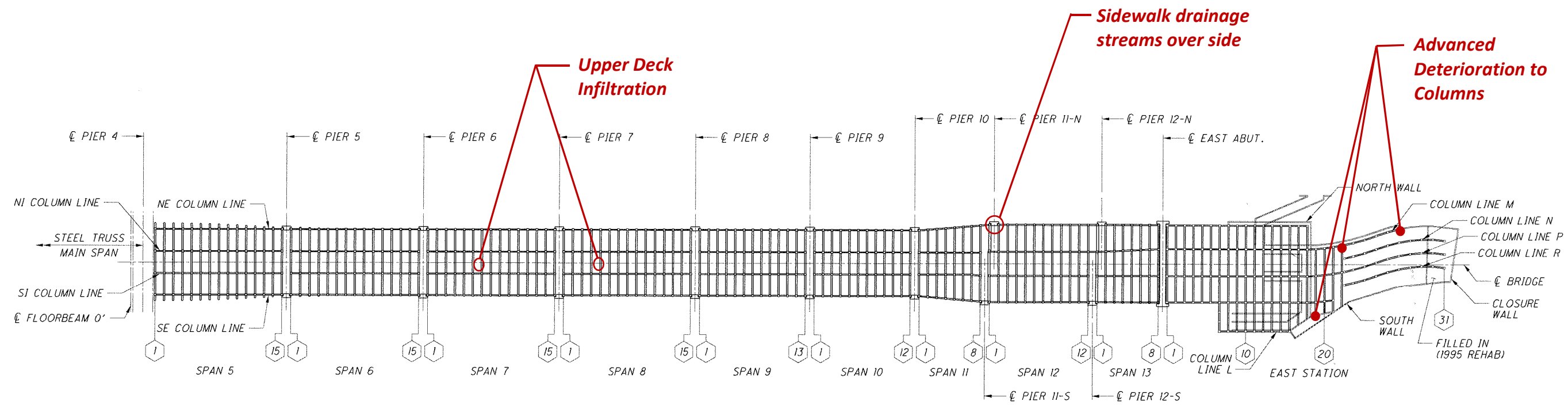
APPENDIX B

2016 INSPECTION FINDINGS



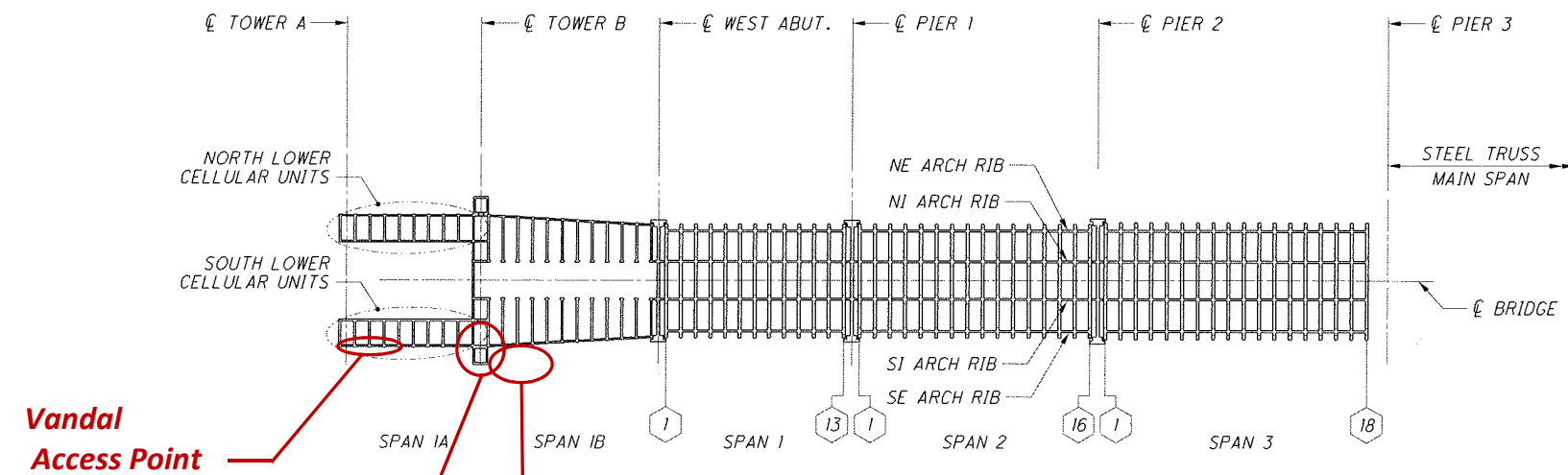
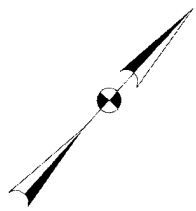


WEST UPPER DECK SUPERSTRUCTURE



EAST UPPER DECK SUPERSTRUCTURE



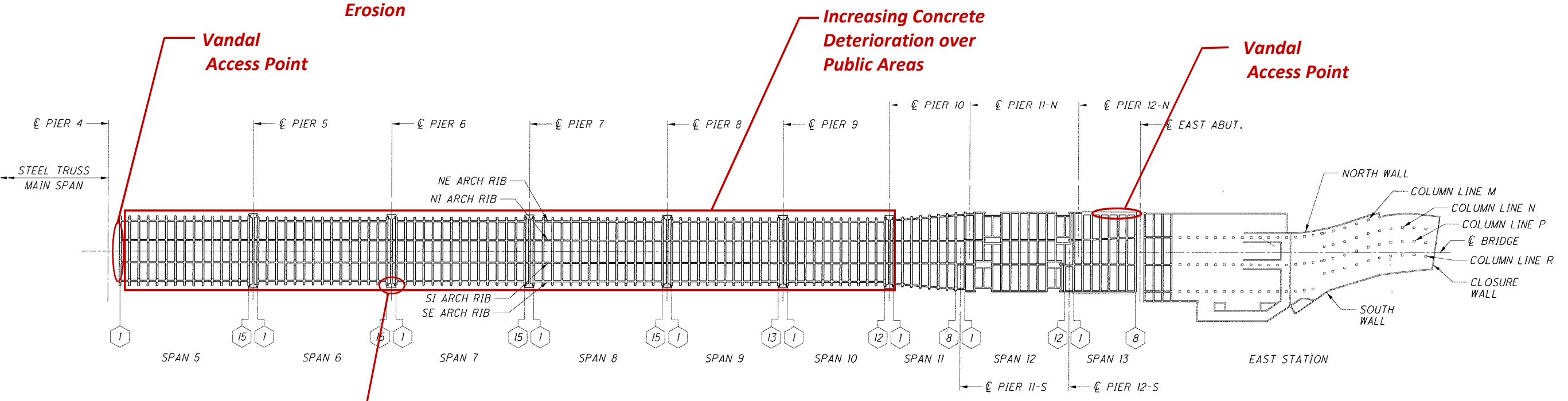


Vandal Access Point

Rotating Tower B South

Embankment Erosion

WEST LOWER DECK SUPERSTRUCTURE



Vandal Access Point

Increasing Concrete Deterioration over Public Areas

Vandal Access Point

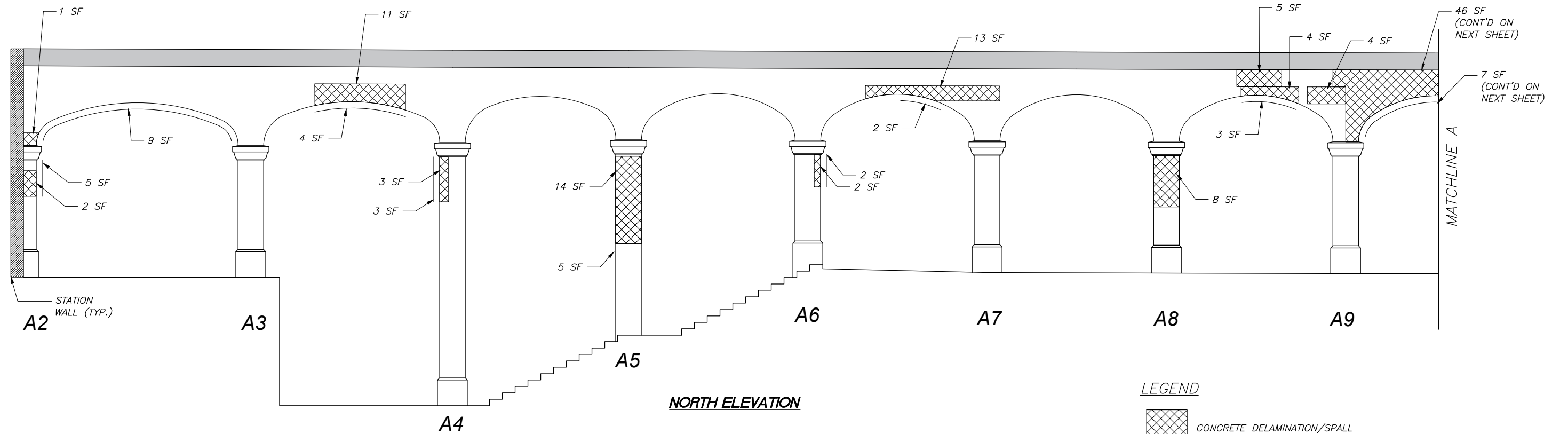
Deteriorating Lower Deck Pier Shaft

EAST LOWER DECK SUPERSTRUCTURE





APPENDIX C

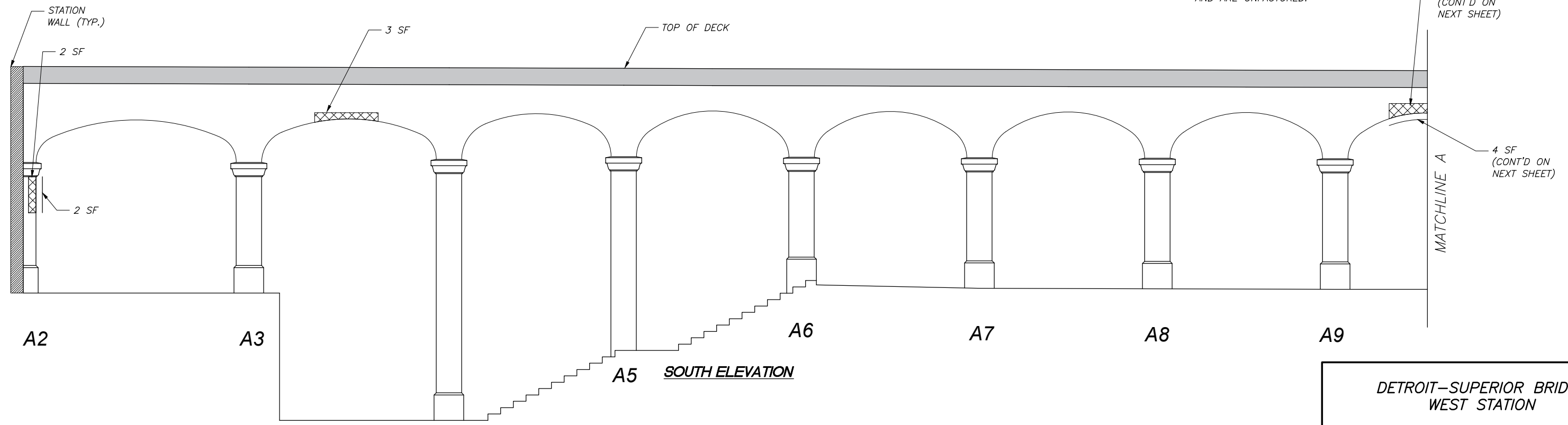




LEGEND

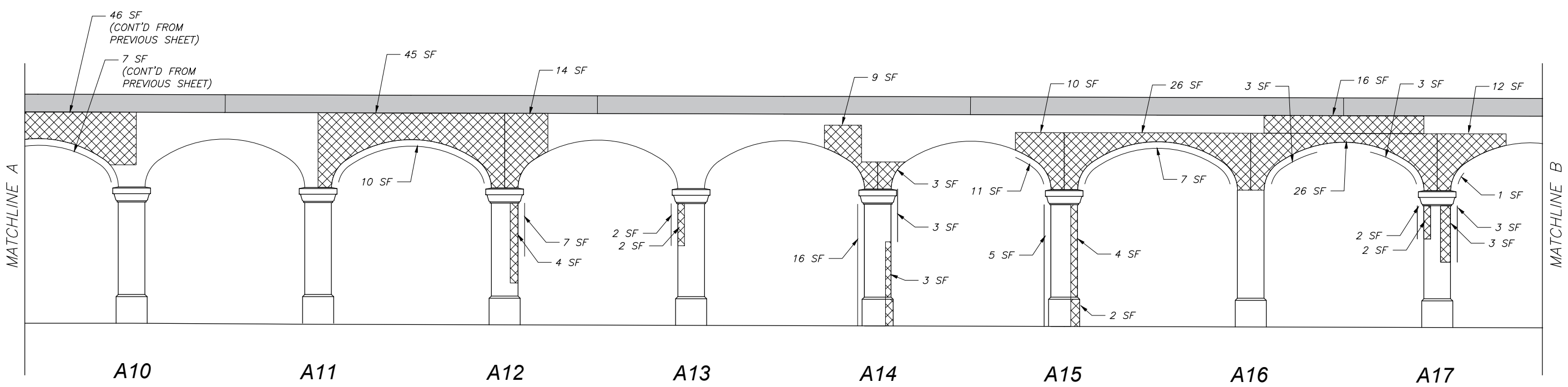
-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE A, COLUMNS A2 TO A9

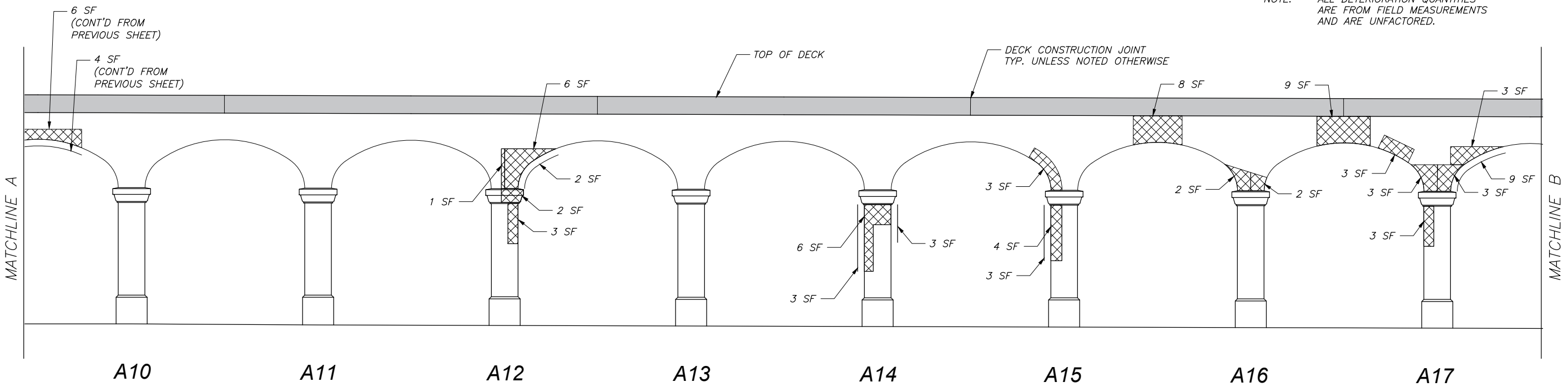


NORTH ELEVATION

LEGEND

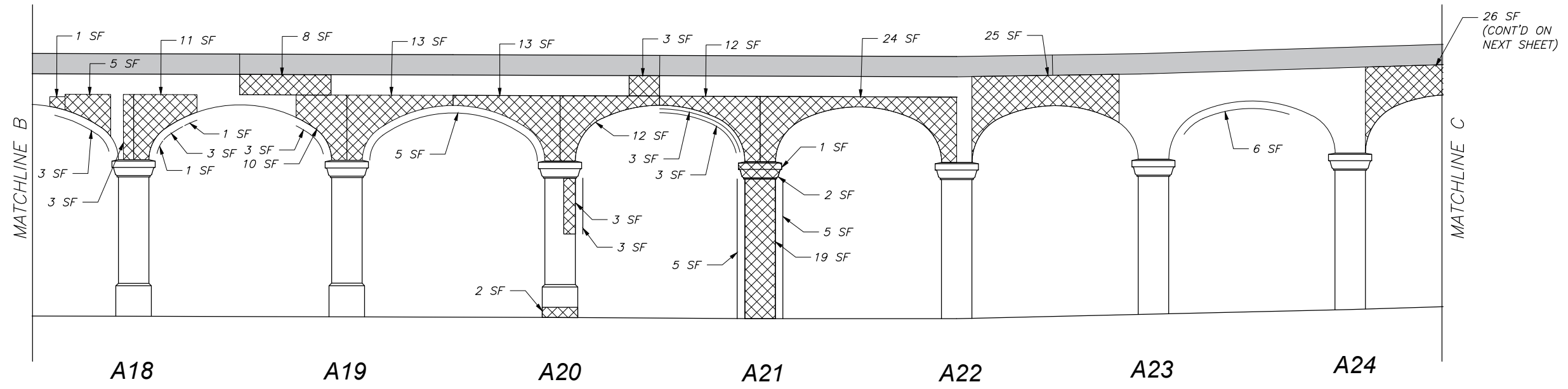
- CONCRETE DELAMINATION/SPALL
- CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.





SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE A, COLUMNS A10 TO A17
C-2

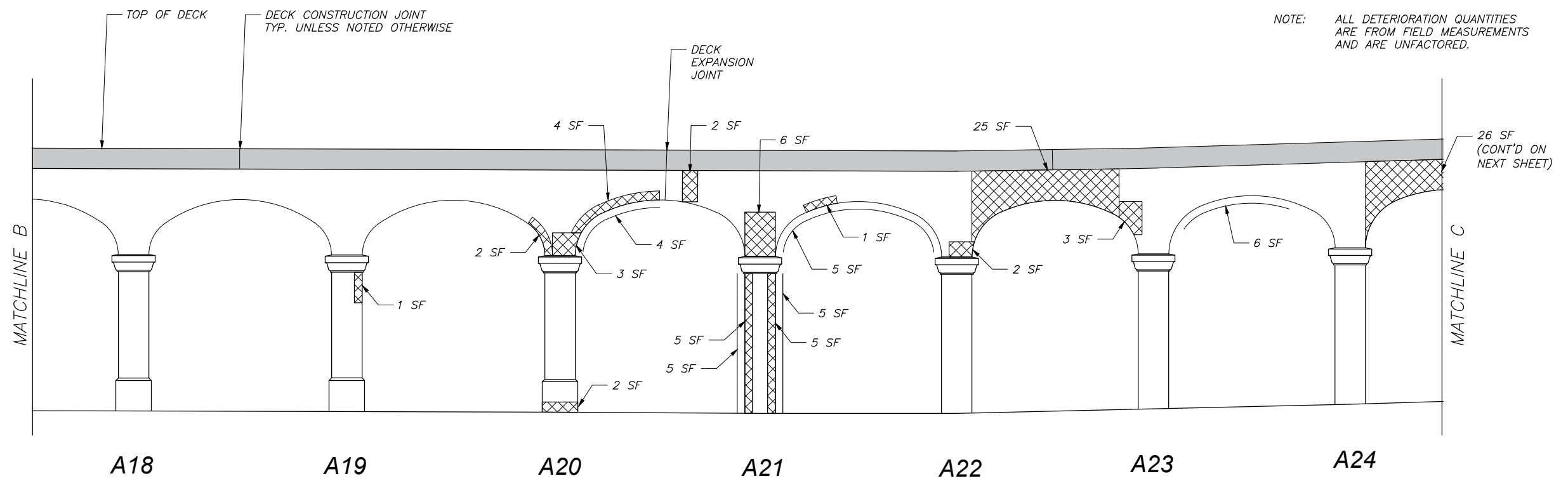


NORTH ELEVATION

LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.

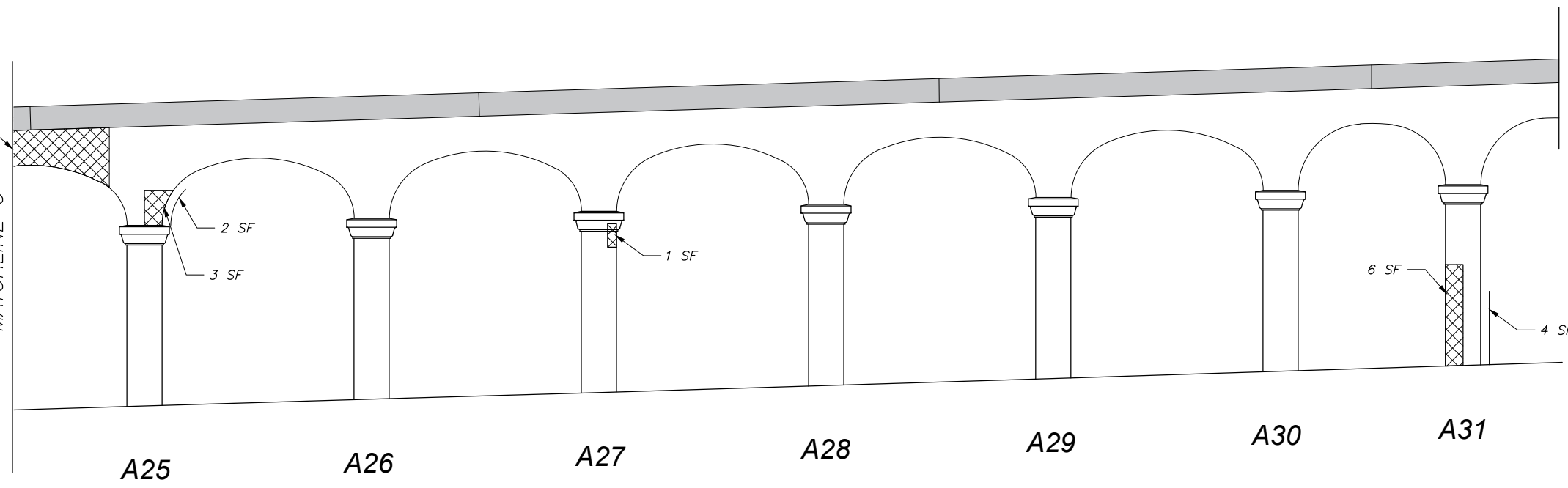


SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE A, COLUMNS A18 TO A24
C-3



26 SF
(CONT'D FROM
PREVIOUS SHEET)

MATCHLINE C



NORTH ELEVATION

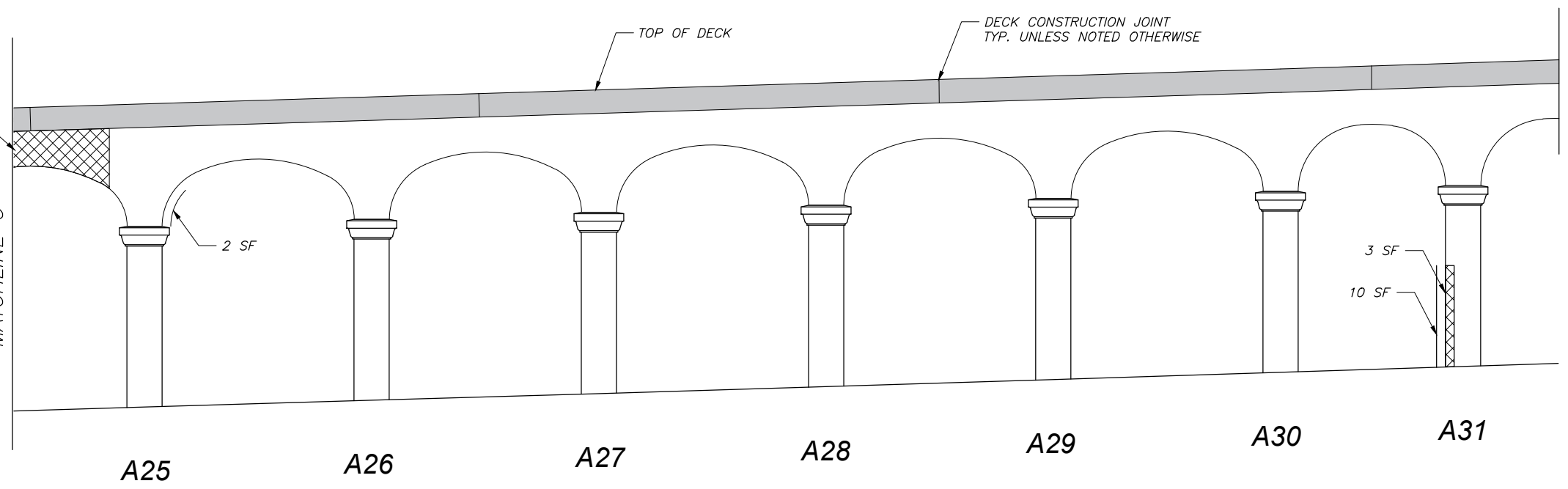
LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.

26 SF
(CONT'D FROM
PREVIOUS SHEET)

MATCHLINE C

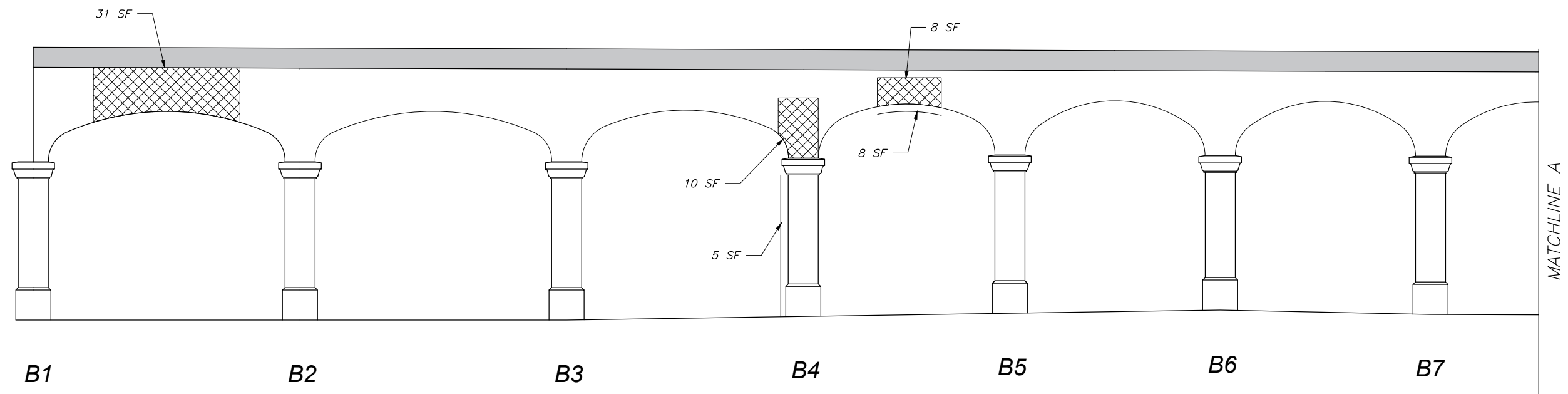


SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE A, COLUMNS A25 TO A31



C-4



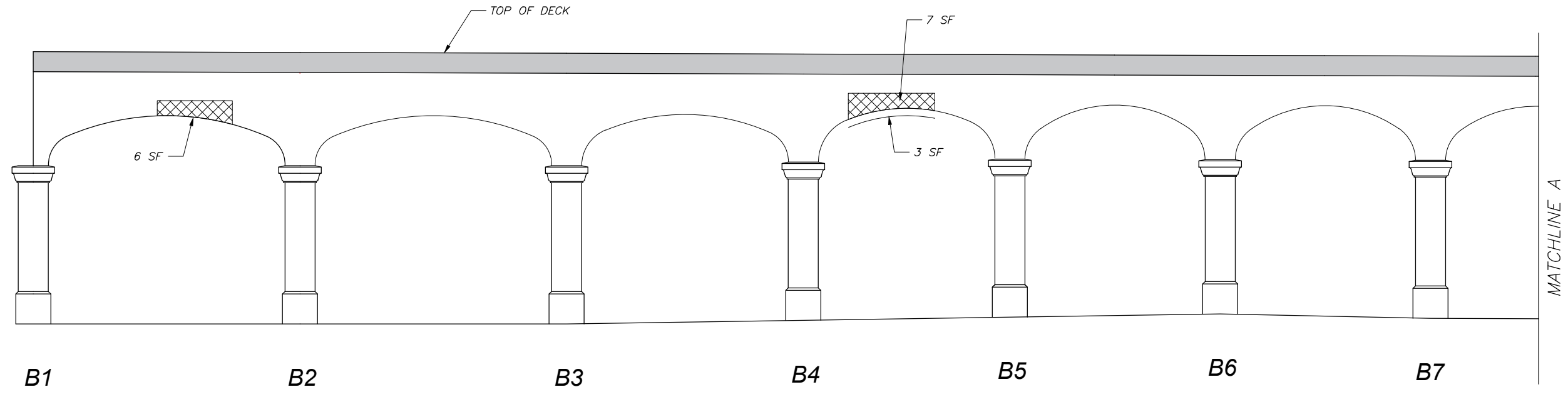
B1 B2 B3 B4 B5 B6 B7

NORTH ELEVATION

LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

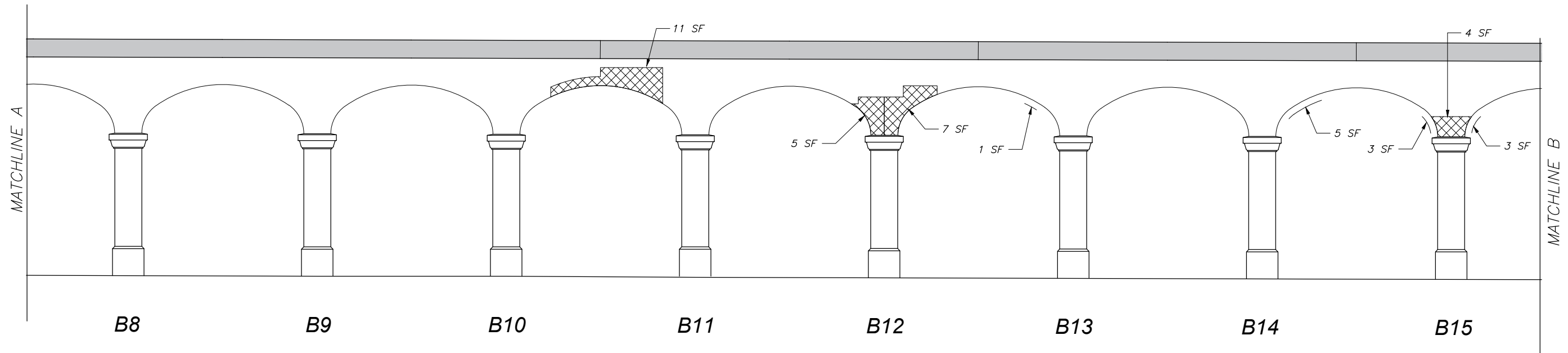
NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



B1 B2 B3 B4 B5 B6 B7

SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE B, COLUMNS B1 TO B7
C-5

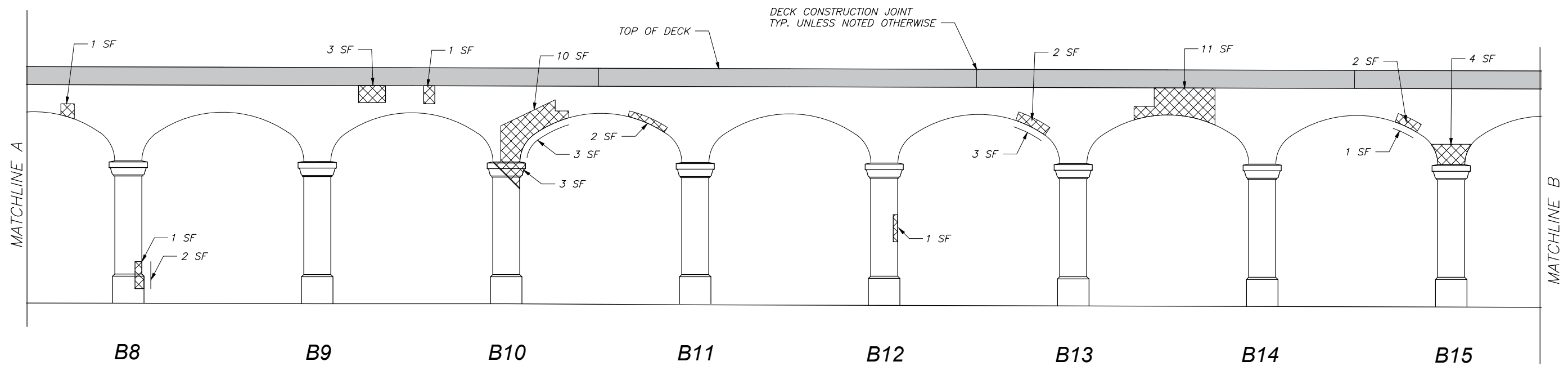


NORTH ELEVATION

LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

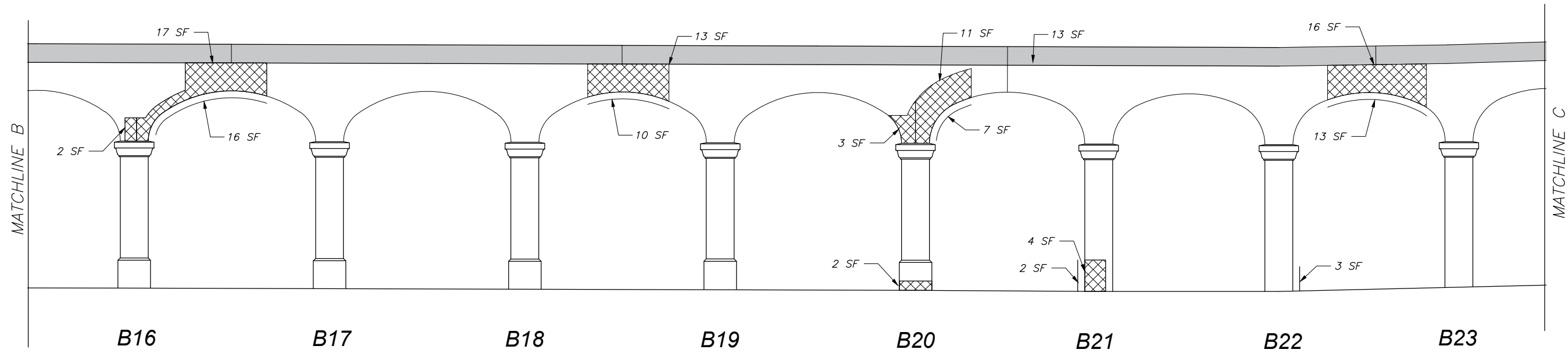
NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE B, COLUMNS B8 TO B15



NORTH ELEVATION

LEGEND

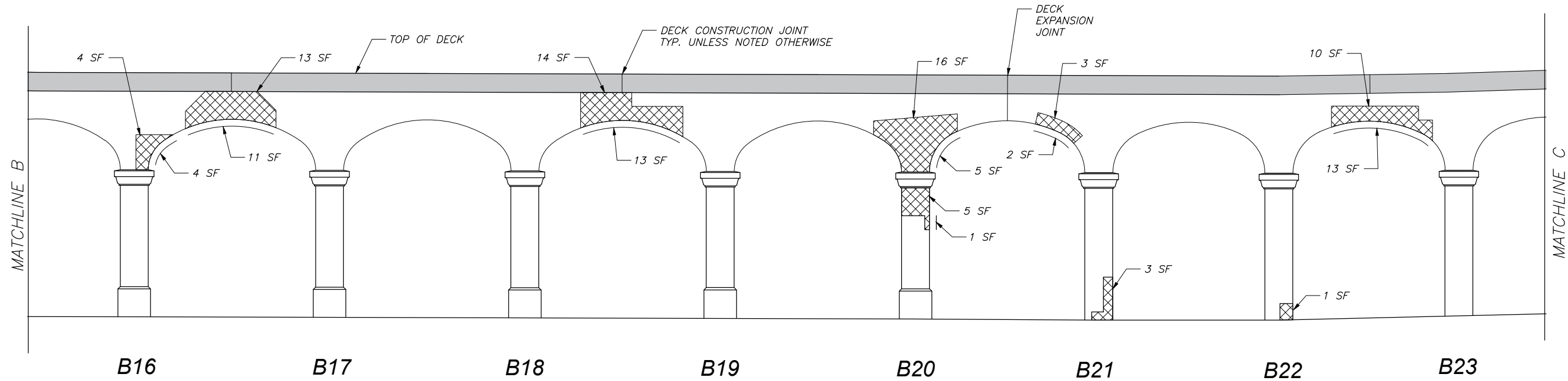


CONCRETE DELAMINATION/SPALL



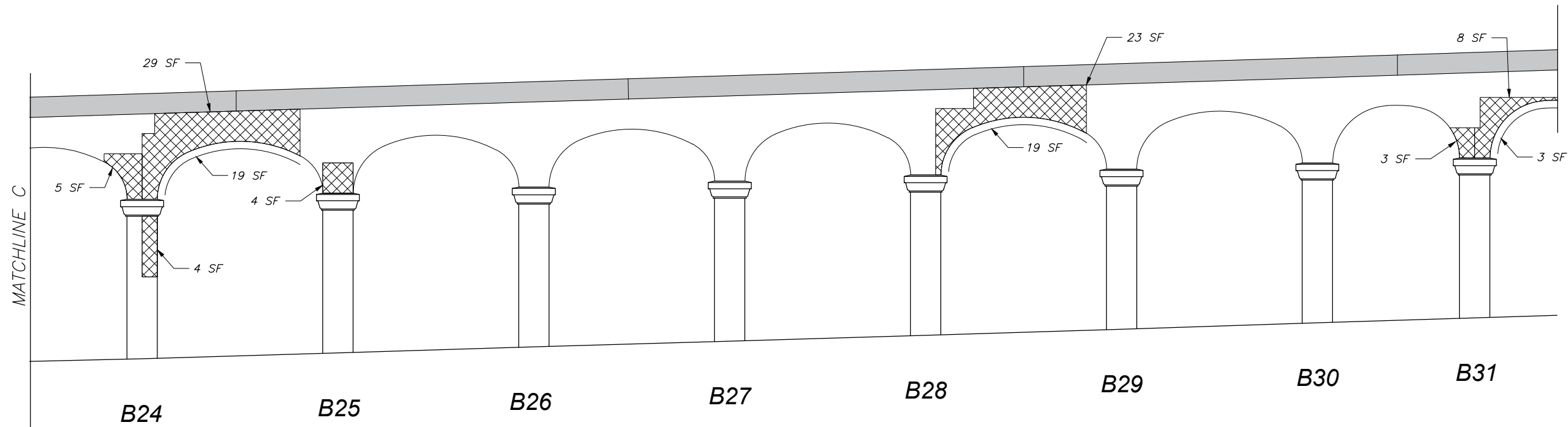
CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE B, COLUMNS B16 TO B23
C-7



NORTH ELEVATION

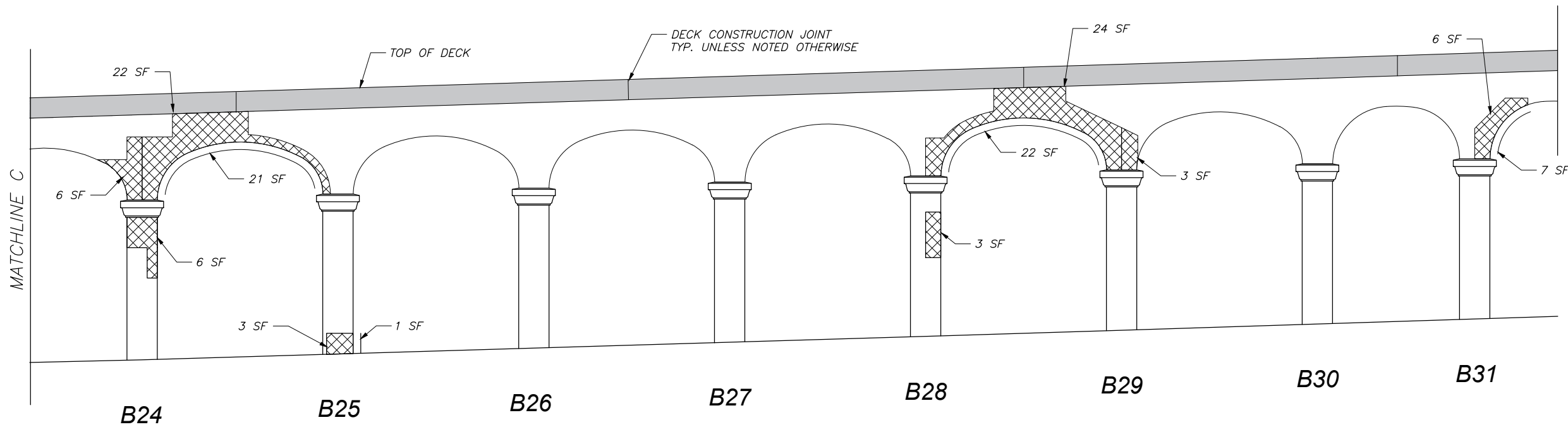
LEGEND



CONCRETE DELAMINATION/SPALL

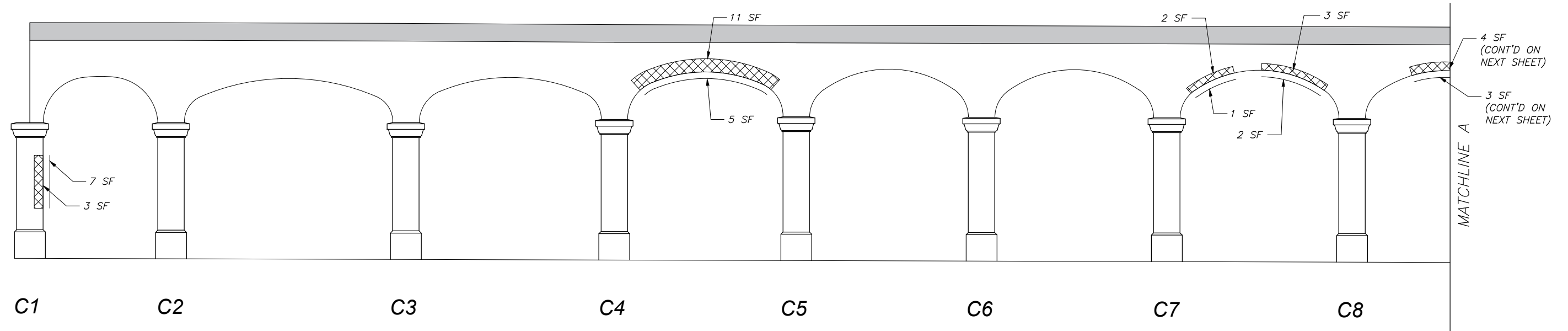
CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.





SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE B, COLUMNS B24 TO B31

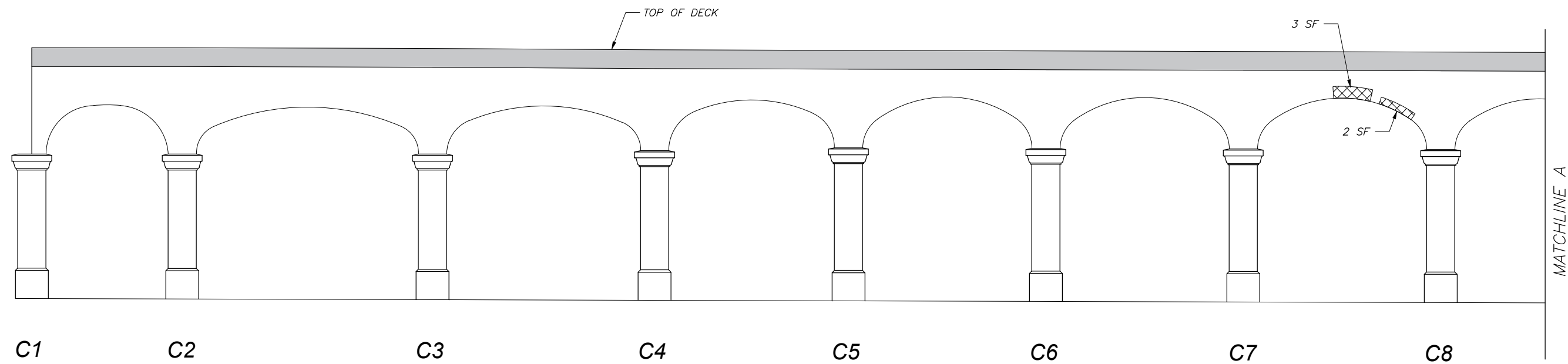


NORTH ELEVATION

LEGEND

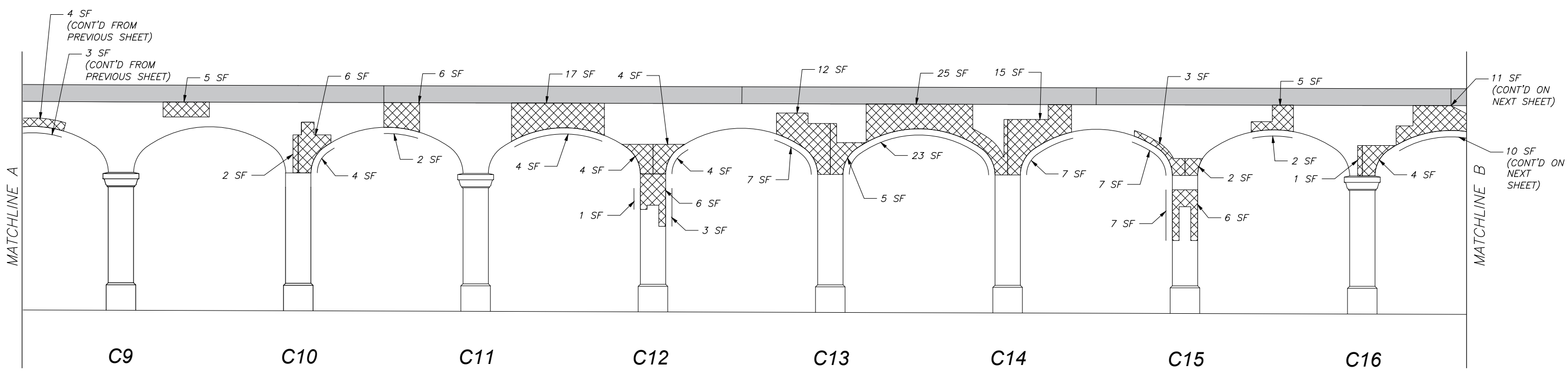
-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.





SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE C, COLUMNS C1 TO C8
C-9

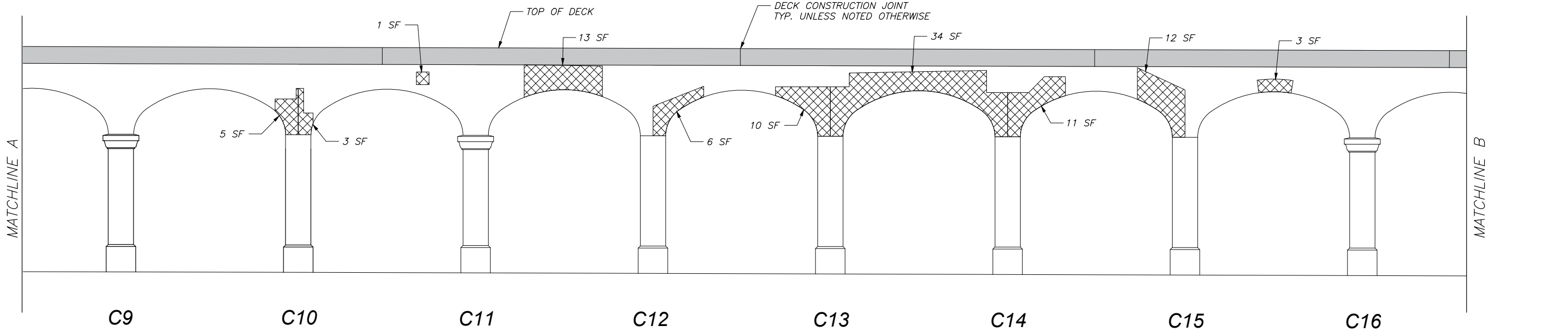


NORTH ELEVATION

LEGEND

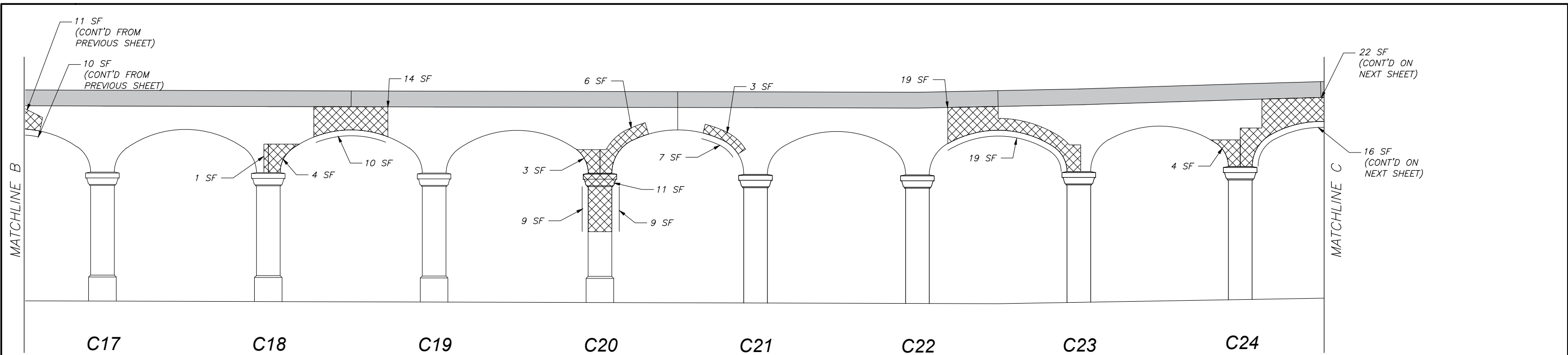
-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



SOUTH ELEVATION



DETROIT-SUPERIOR BRIDGE
 WEST STATION
 LINE C, COLUMNS C9-C16
 C-10



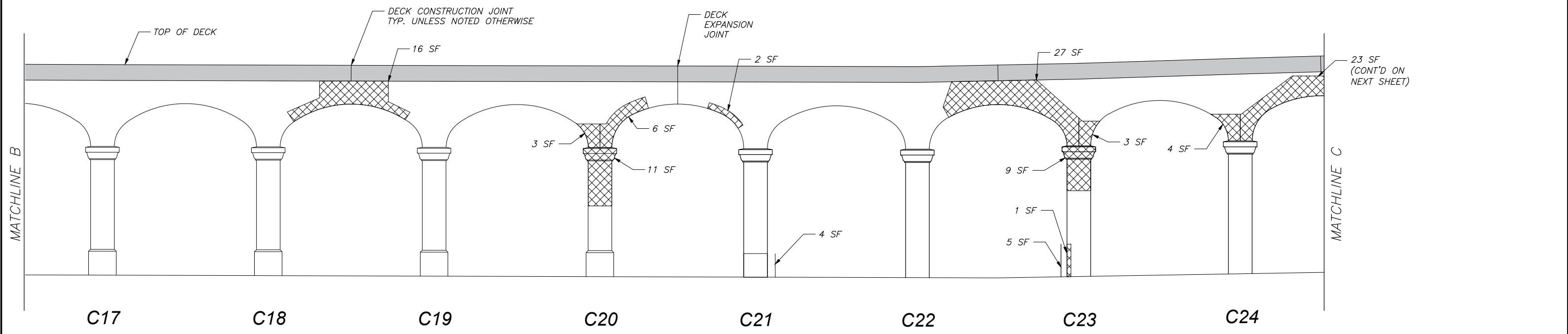
C17 C18 C19 C20 C21 C22 C23 C24

NORTH ELEVATION

LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



C17 C18 C19 C20 C21 C22 C23 C24

SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE C, COLUMNS C17 TO C24
C-11

22 SF
(CONT'D FROM
PREVIOUS SHEET)

16 SF
(CONT'D FROM
PREVIOUS SHEET)

2 SF

CL TOWER A
EXPANSION JOINT

MATCHLINE C

4 SF

3 SF

4 SF

6 SF

2 SF

2 SF

C25

C26

C27

C28

C29

C30

C31

NORTH ELEVATION

LEGEND



CONCRETE DELAMINATION/SPALL



CONCRETE DELAMINATION/SPALL
ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES
ARE FROM FIELD MEASUREMENTS
AND ARE UNFACTORED.

23 SF
(CONT'D FROM
PREVIOUS SHEET)

TOP OF DECK

DECK CONSTRUCTION JOINT
TYP. UNLESS NOTED OTHERWISE

CL TOWER A
EXPANSION JOINT

MATCHLINE C

C25

C26

C27

C28

C29

C30

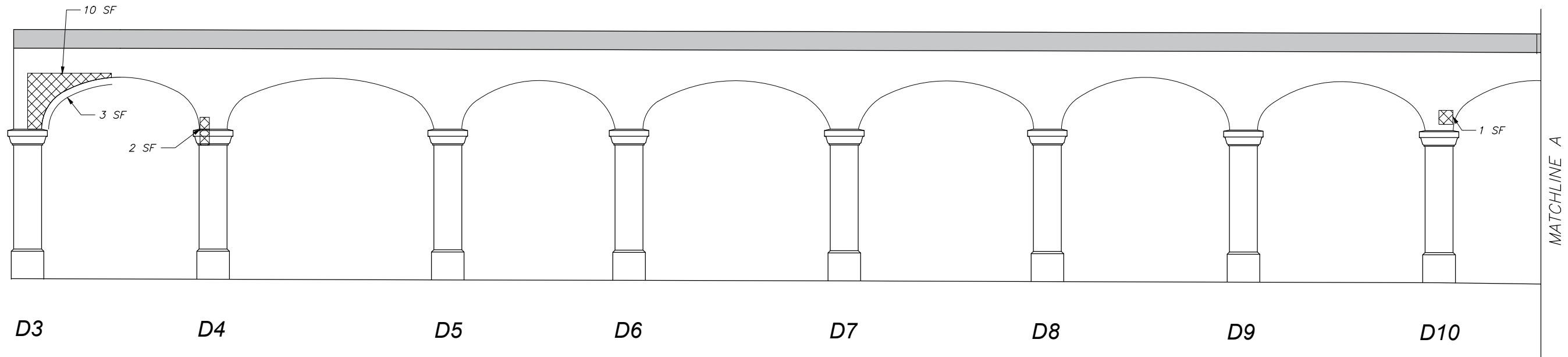
C31

SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE C, COLUMNS C25-C31



C-12



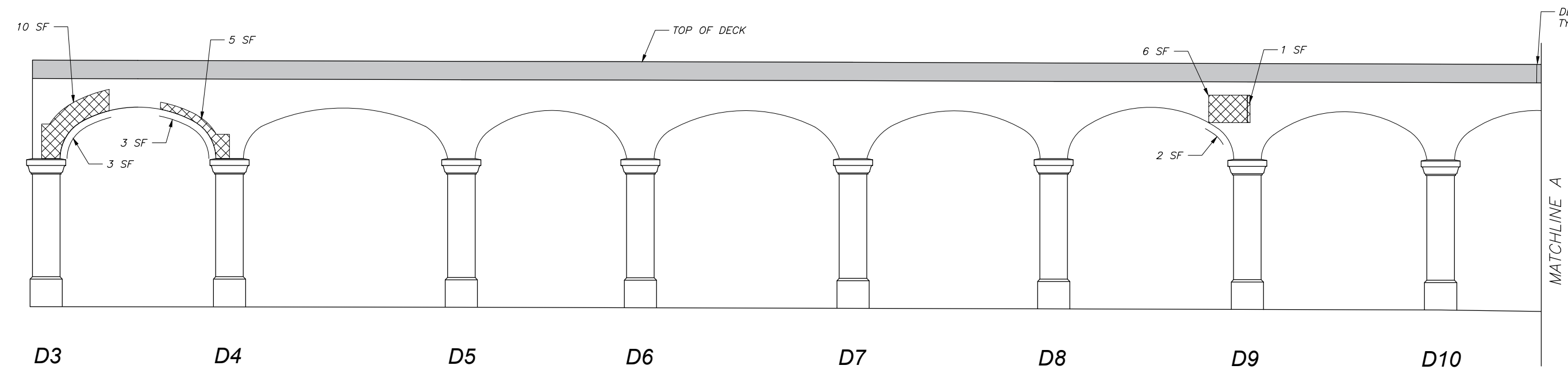
D3 D4 D5 D6 D7 D8 D9 D10

NORTH ELEVATION

LEGEND

-  CONCRETE DELAMINATION/SPALL
-  CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

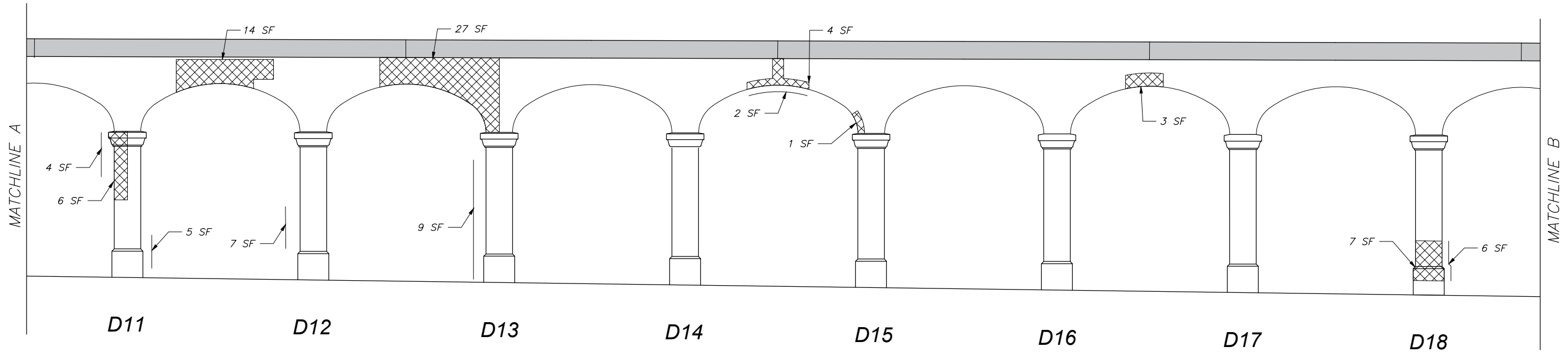
NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



D3 D4 D5 D6 D7 D8 D9 D10

SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE D, COLUMNS D3 TO D10
C-13



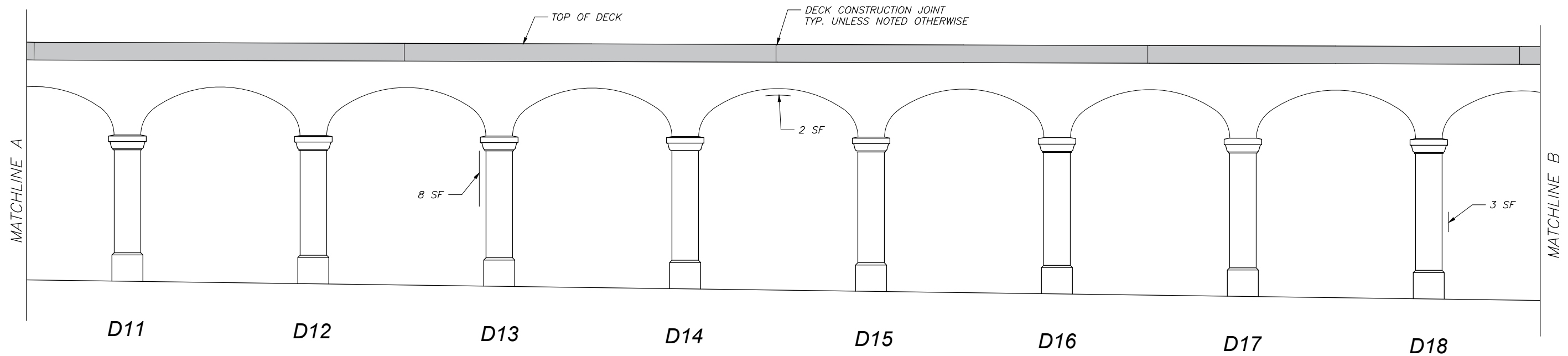
NORTH ELEVATION

LEGEND

 CONCRETE DELAMINATION/SPALL

 CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

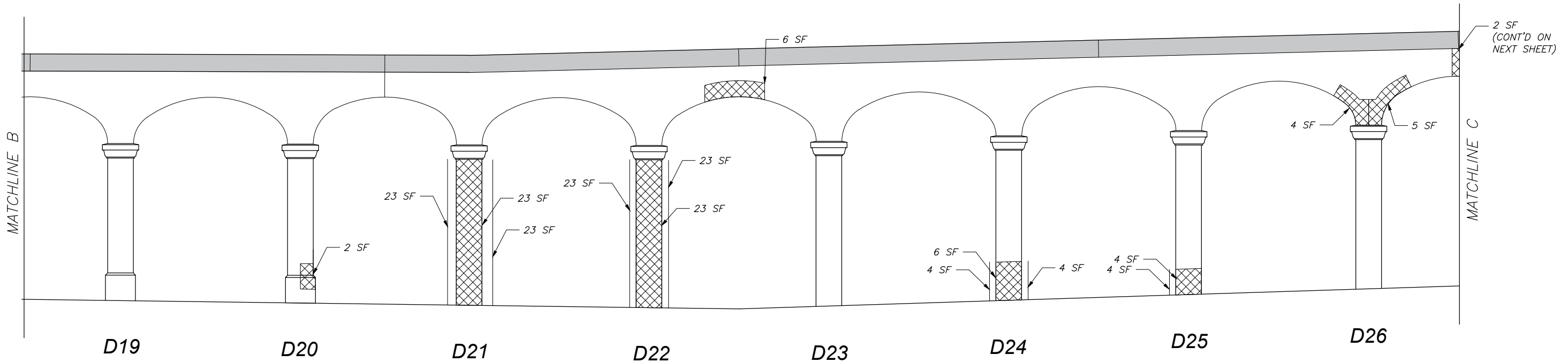
NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE D, COLUMNS D11 TO D18



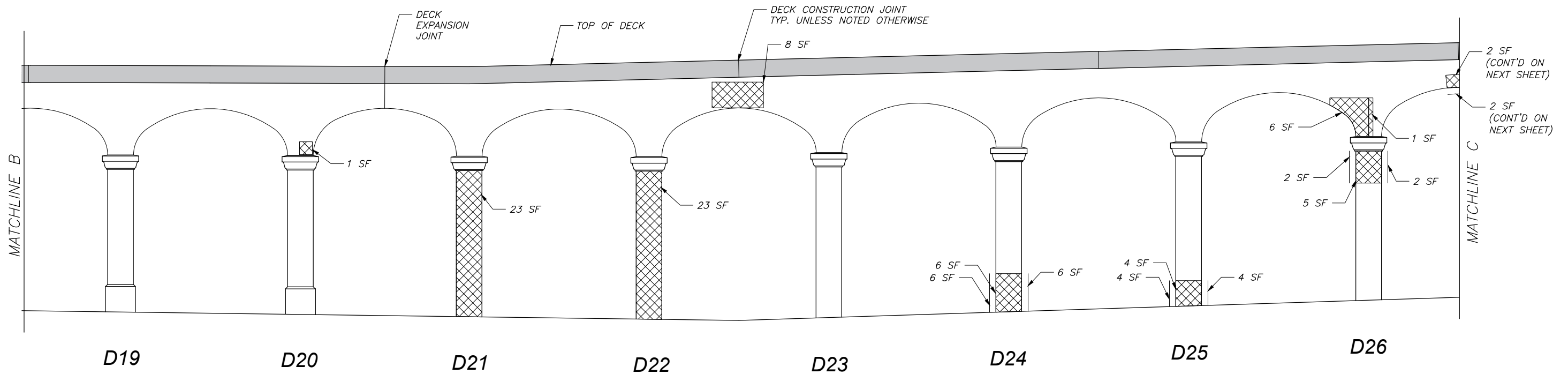
D19 D20 D21 D22 D23 D24 D25 D26

NORTH ELEVATION

LEGEND

- CONCRETE DELAMINATION/SPALL
- CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

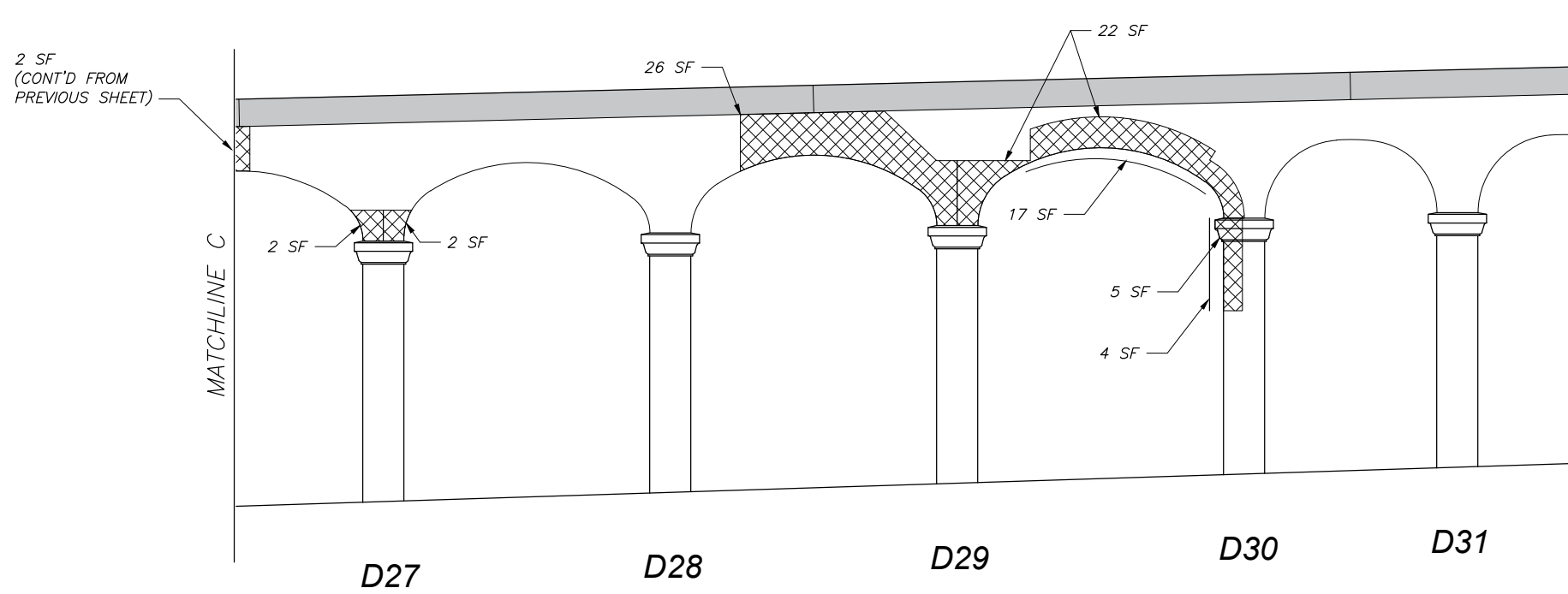
NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



D19 D20 D21 D22 D23 D24 D25 D26

SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION
LINE D, COLUMNS D19 TO D26
C-15



NORTH ELEVATION

LEGEND

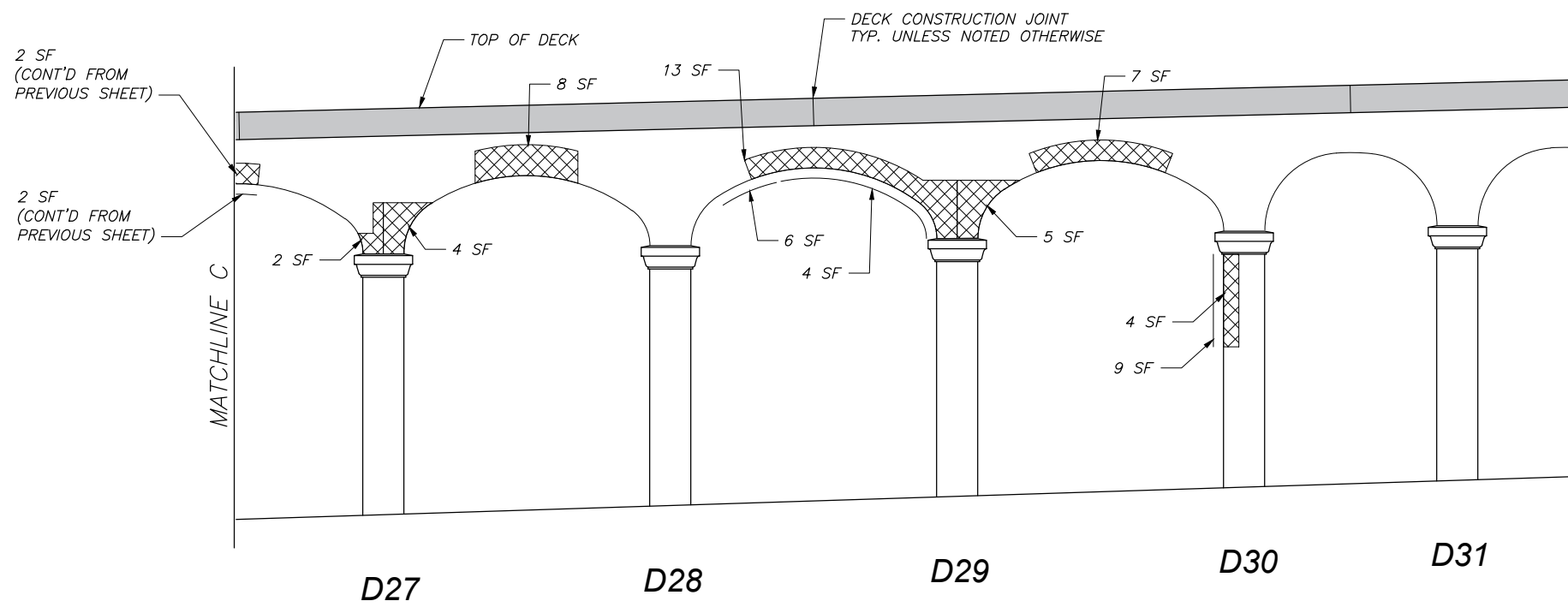


CONCRETE DELAMINATION/SPALL



CONCRETE DELAMINATION/SPALL ON VERTICAL FACE

NOTE: ALL DETERIORATION QUANTITIES ARE FROM FIELD MEASUREMENTS AND ARE UNFACTORED.



SOUTH ELEVATION

DETROIT-SUPERIOR BRIDGE
WEST STATION

LINE D, COLUMNS D27 TO D31

APPENDIX D

SLOPE INCLINOMETER MEASUREMENTS





B-004-0-13

B-004-1-13

Tower B North

B-003-0-13

B-002-0-13

B-003-1-13

B-001-0-13

Tower B South

B-002-1-12

B-002-2-12

B-001-1-13

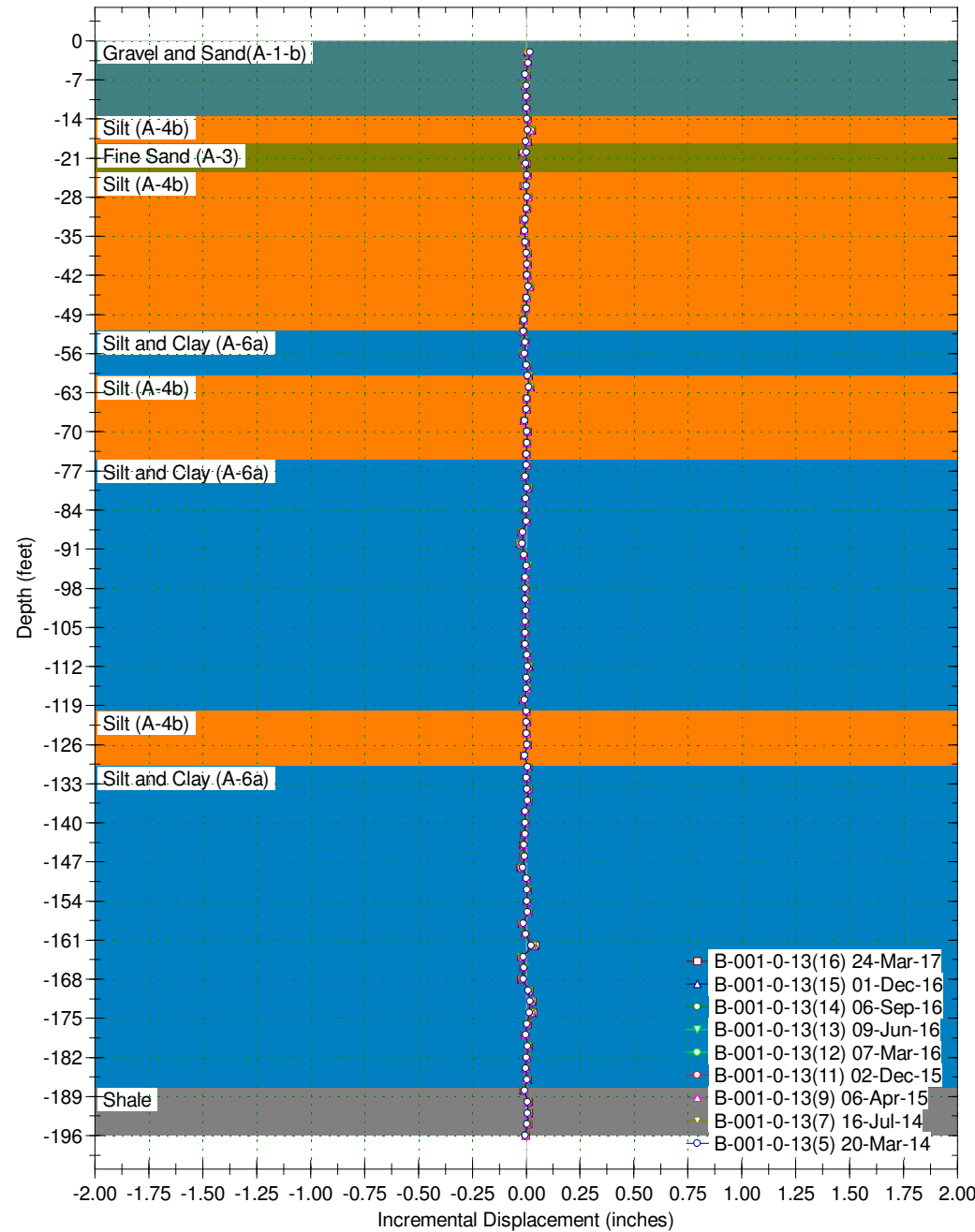
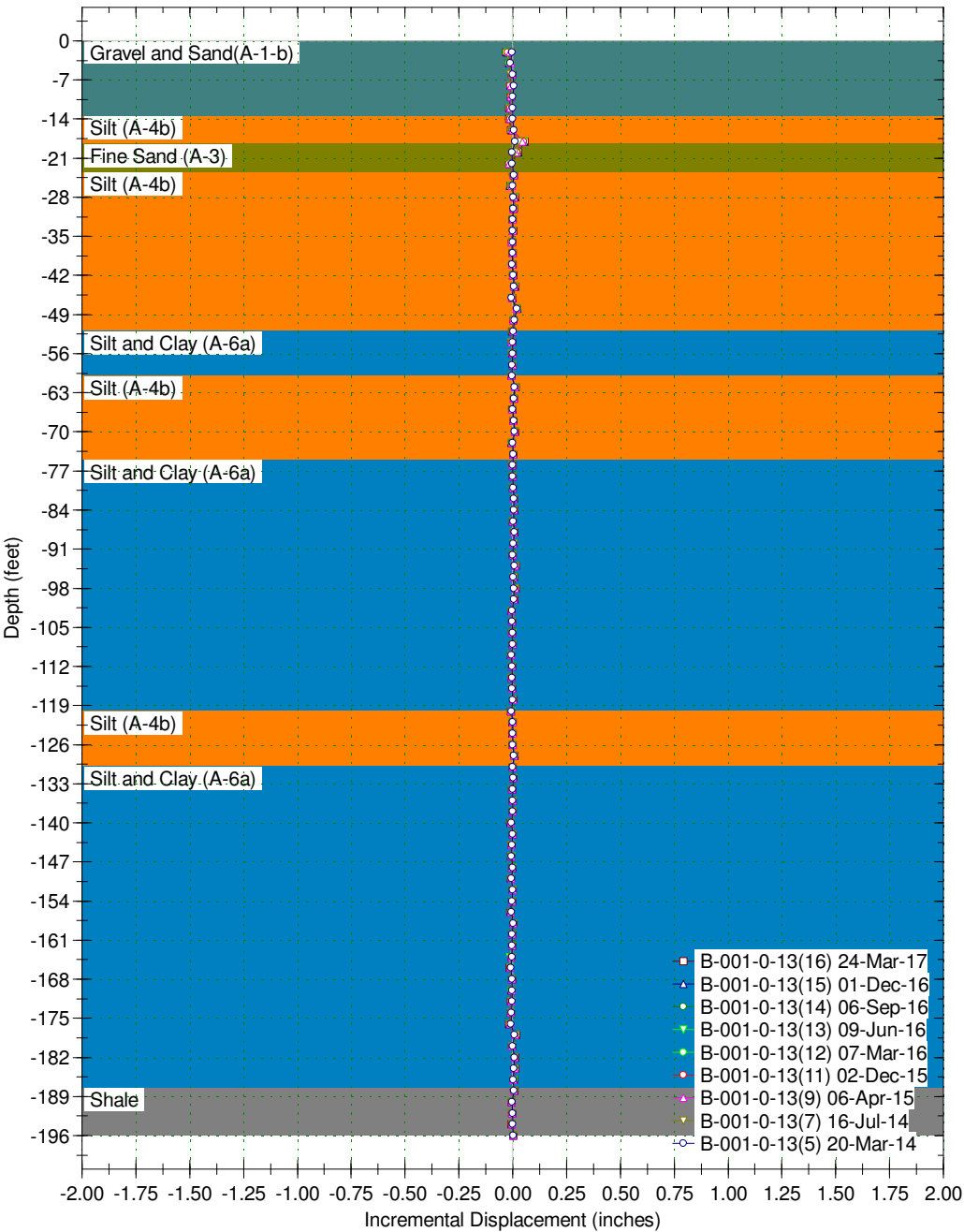
B-002-3-13

Borehole : B-001-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 196.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 15:19
 Applied Azimuth : 0.0 degrees

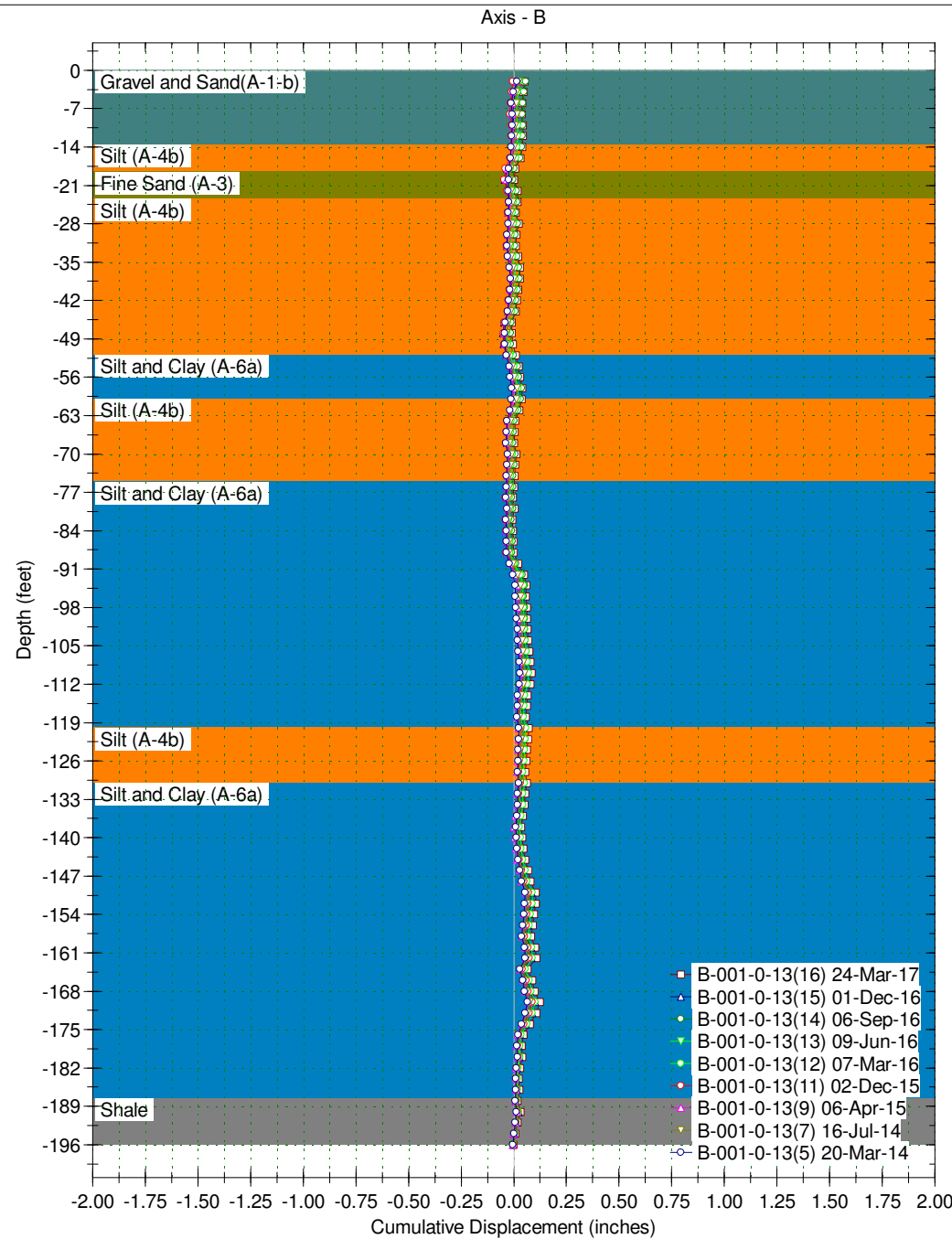
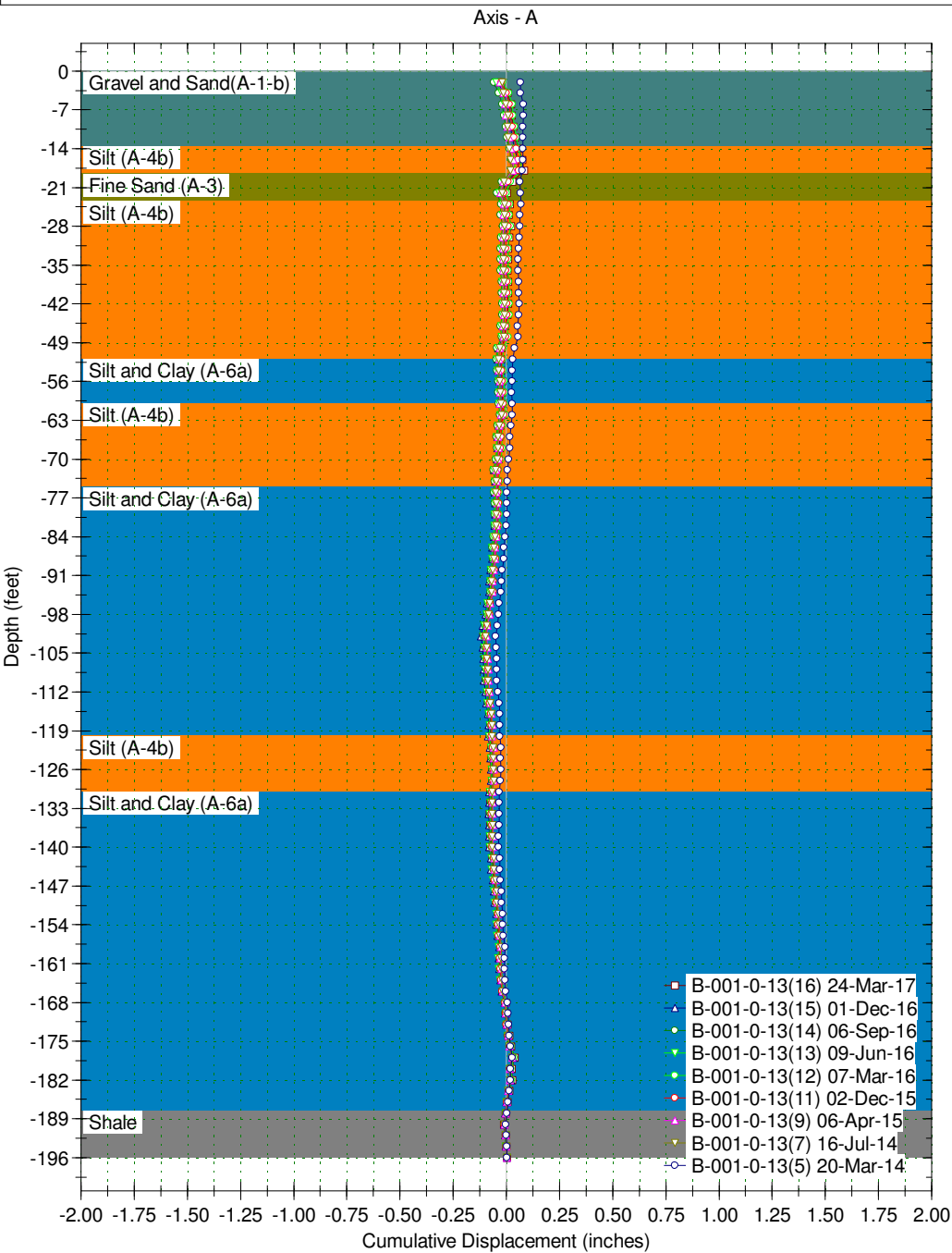
Axis - A

Axis - B



Borehole : B-001-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 196.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 15:19
 Applied Azimuth : 0.0 degrees

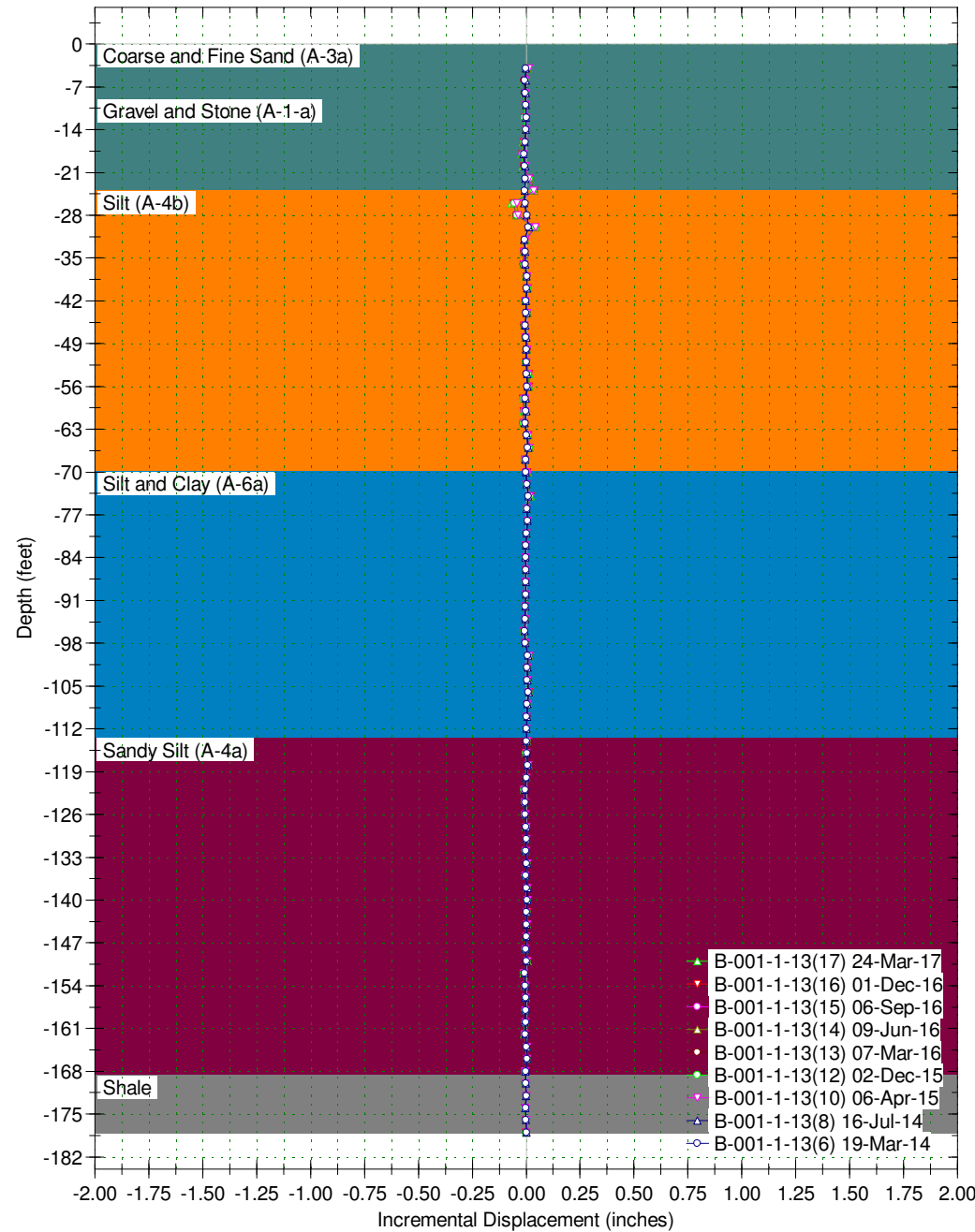
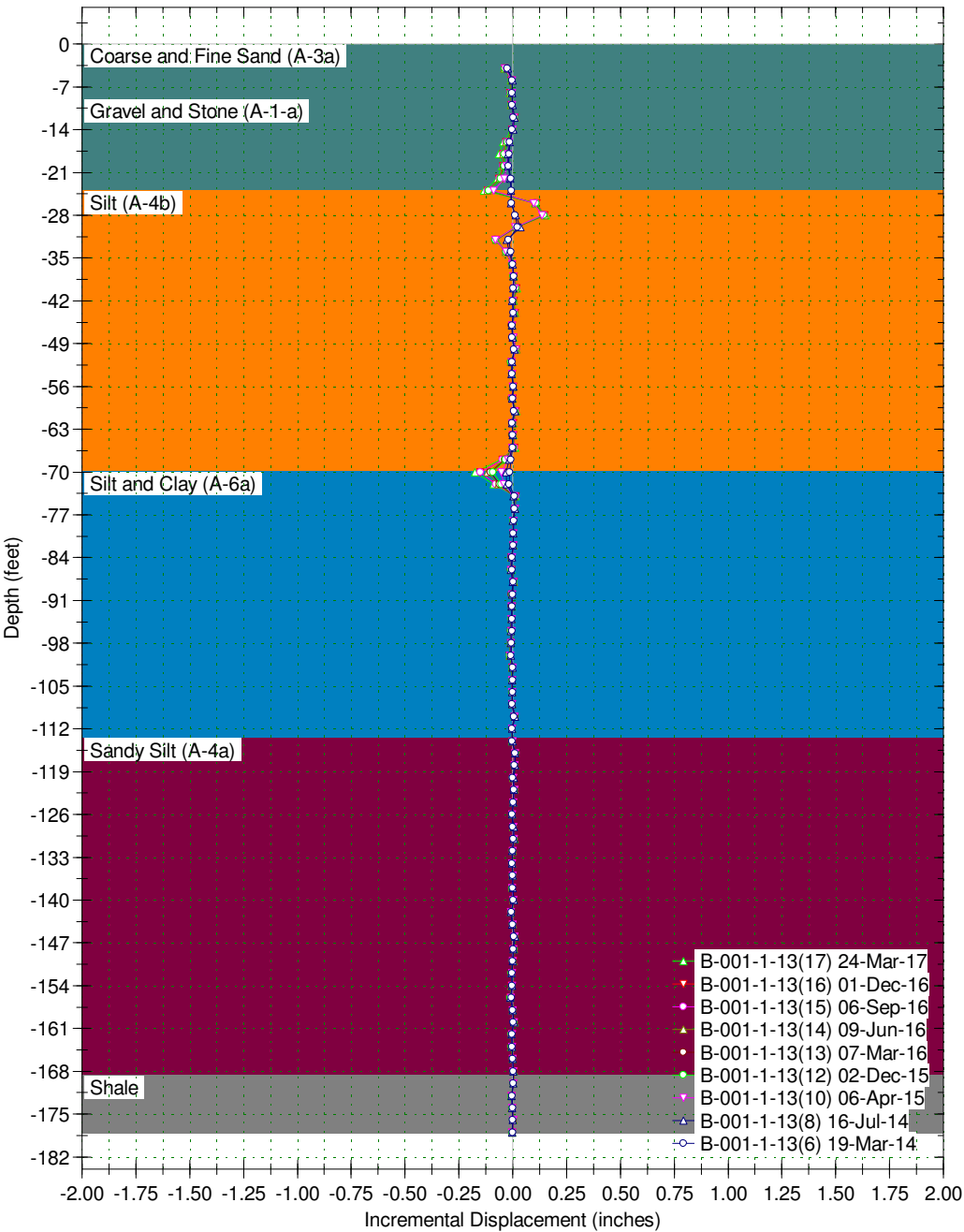


Borehole : B-001-1-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 178.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 13:15
 Applied Azimuth : 0.0 degrees

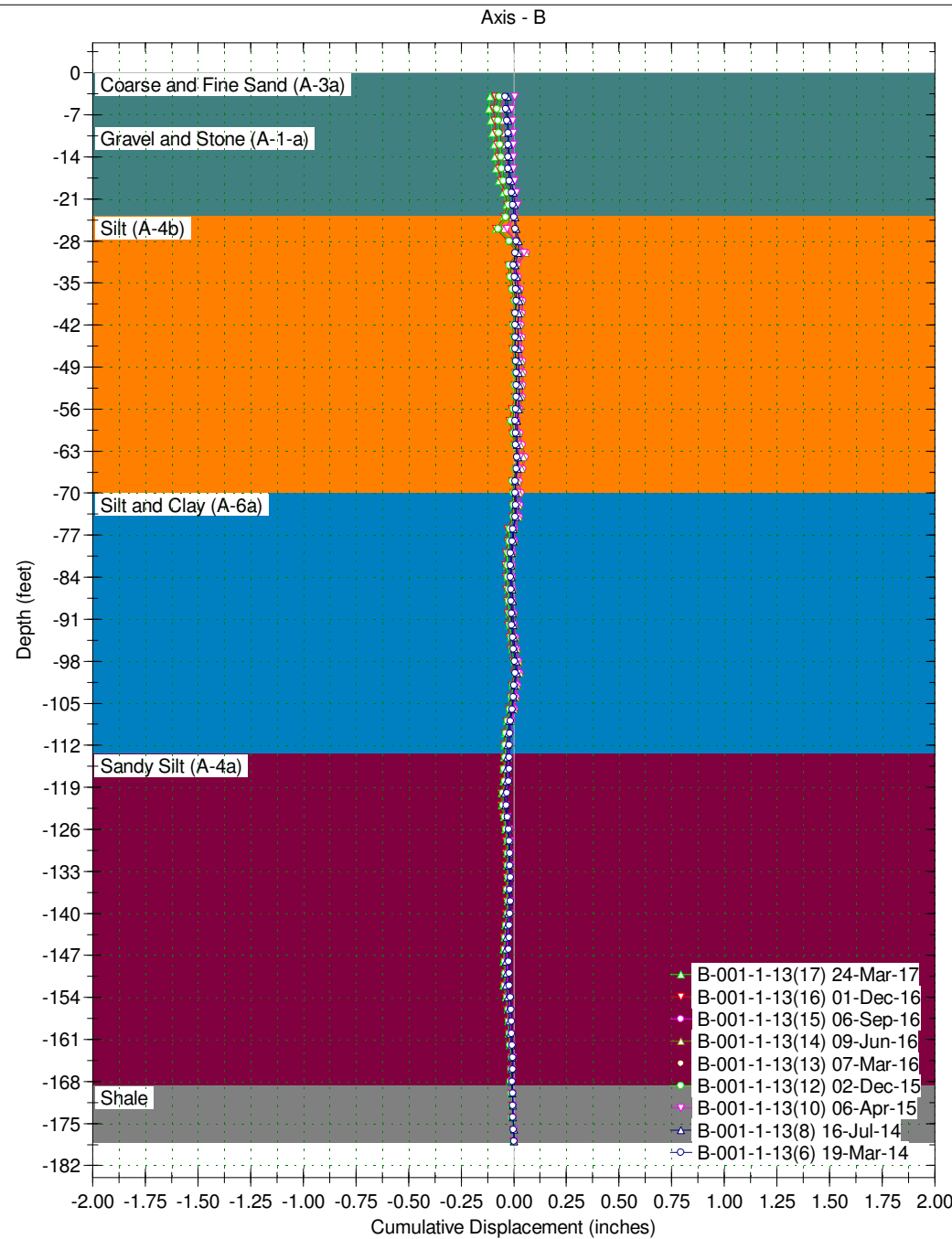
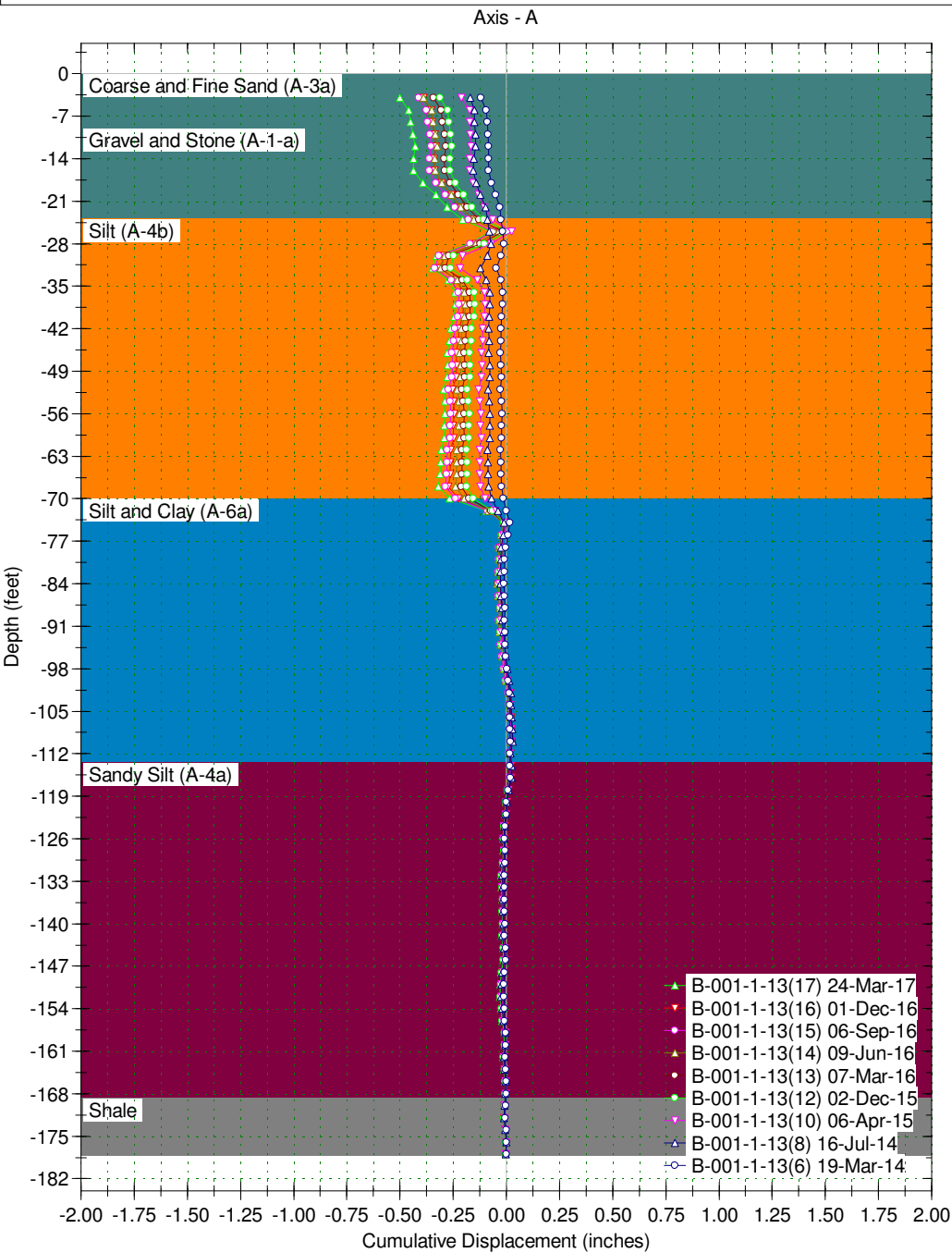
Axis - A

Axis - B



Borehole : B-001-1-13
Project : Detroit Superior Bridge
Location :
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 178.0 feet
A+ Groove Azimuth :
Base Reading : 2013 Oct 21 13:15
Applied Azimuth : 0.0 degrees

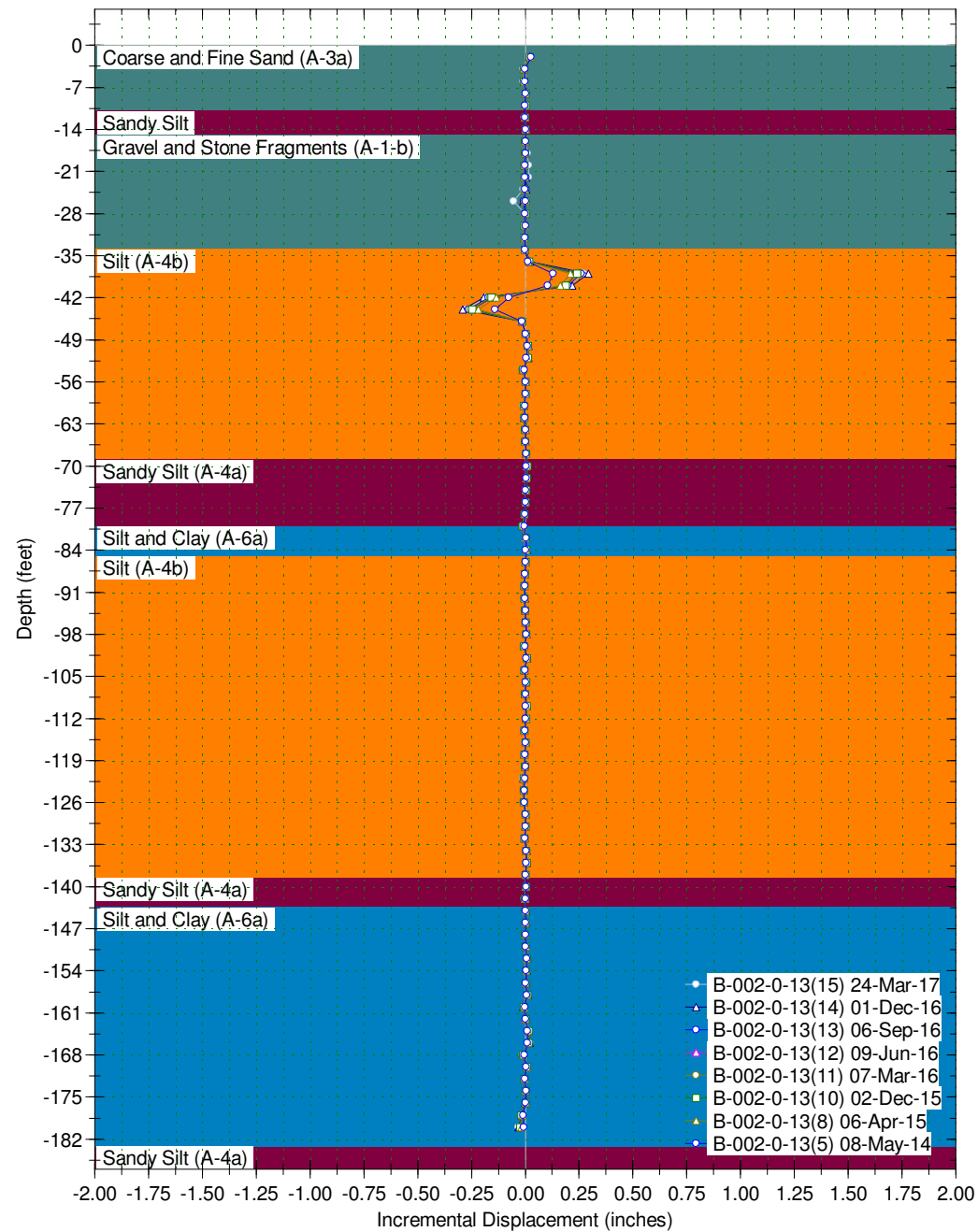
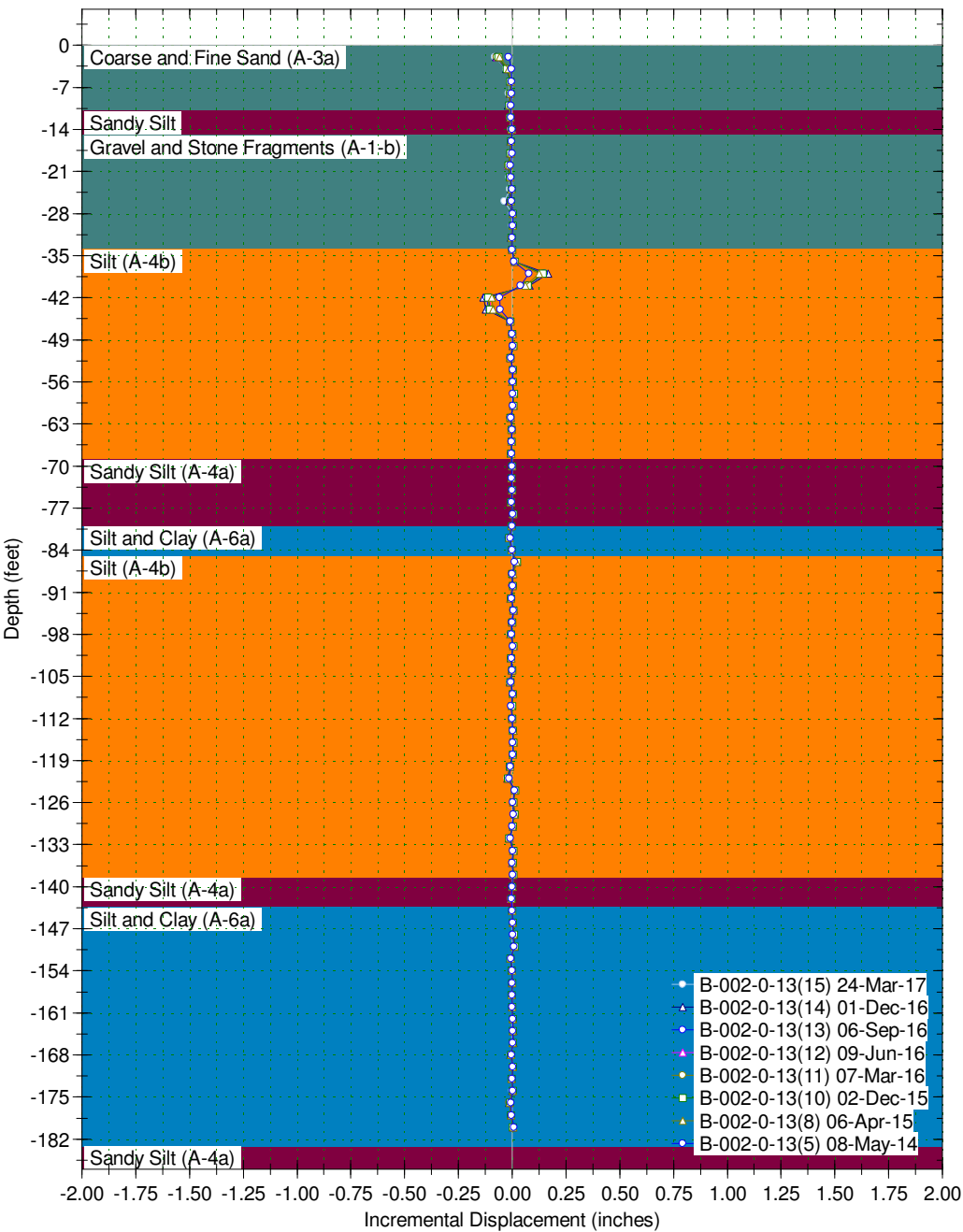


Borehole : B-002-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 180.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 14:51
 Applied Azimuth : 0.0 degrees

Axis - A

Axis - B

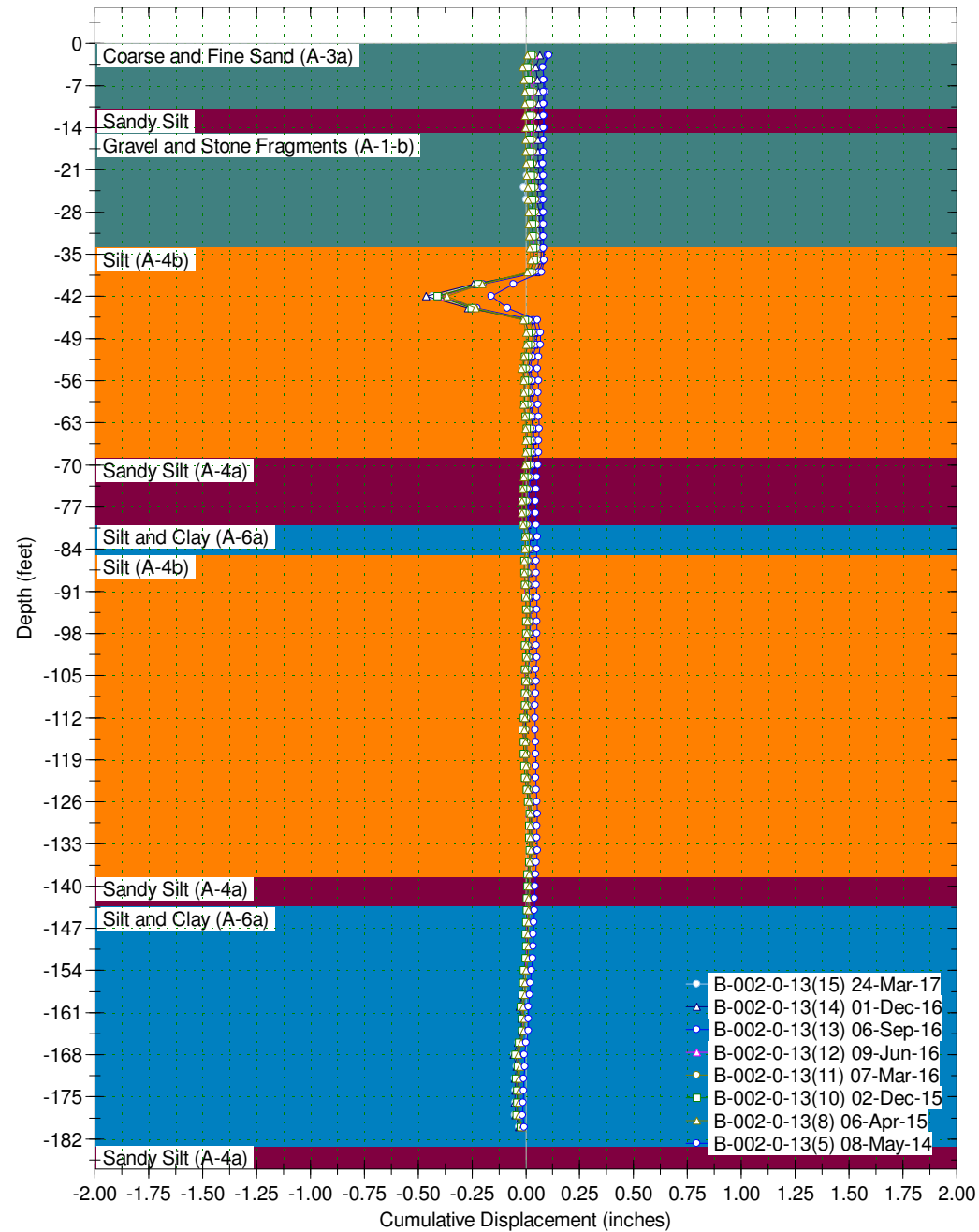
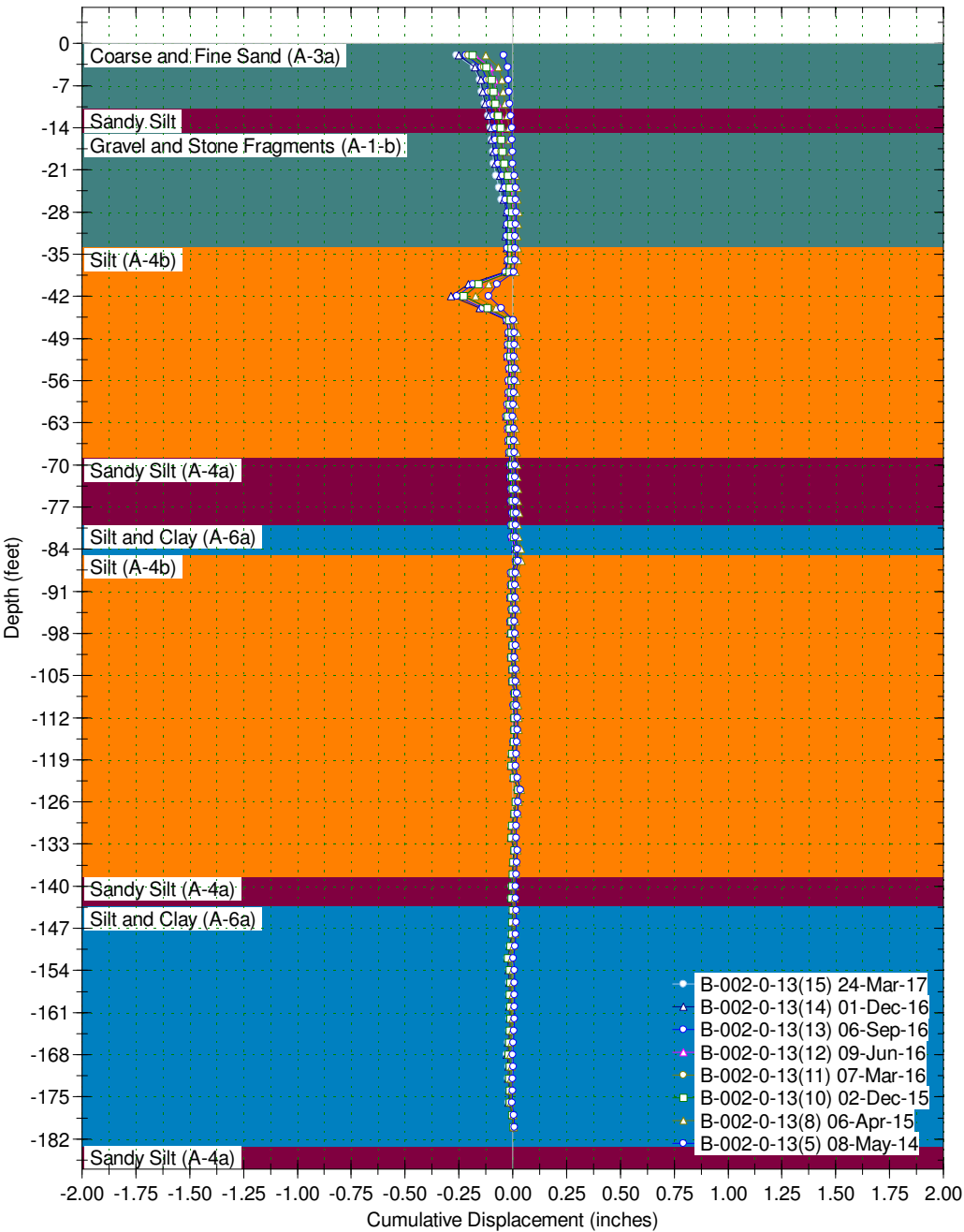


Borehole : B-002-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 180.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 14:51
 Applied Azimuth : 0.0 degrees

Axis - A

Axis - B



- B-002-0-13(15) 24-Mar-17
- ▲ B-002-0-13(14) 01-Dec-16
- B-002-0-13(13) 06-Sep-16
- ▲ B-002-0-13(12) 09-Jun-16
- B-002-0-13(11) 07-Mar-16
- B-002-0-13(10) 02-Dec-15
- ▲ B-002-0-13(8) 06-Apr-15
- B-002-0-13(5) 08-May-14

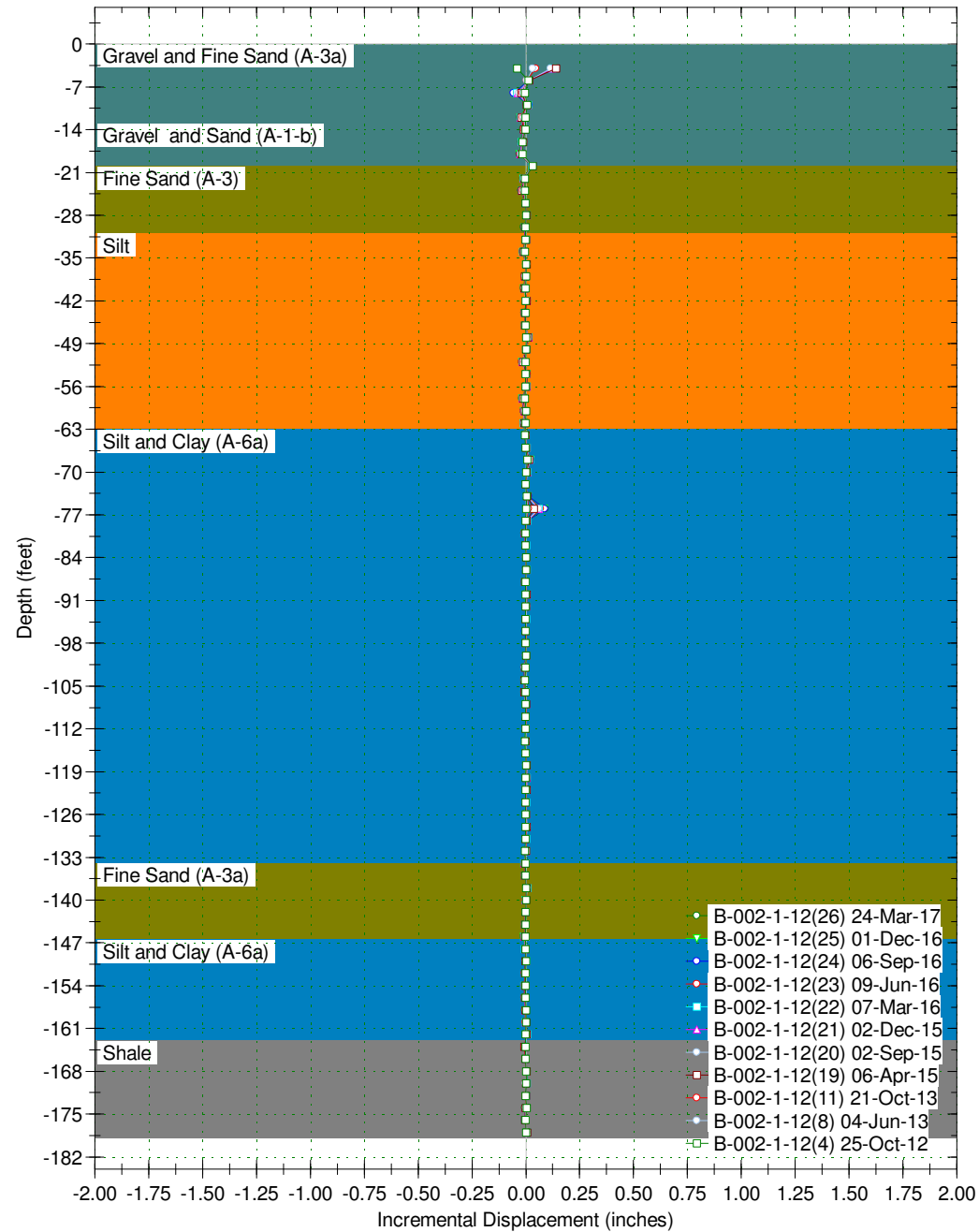
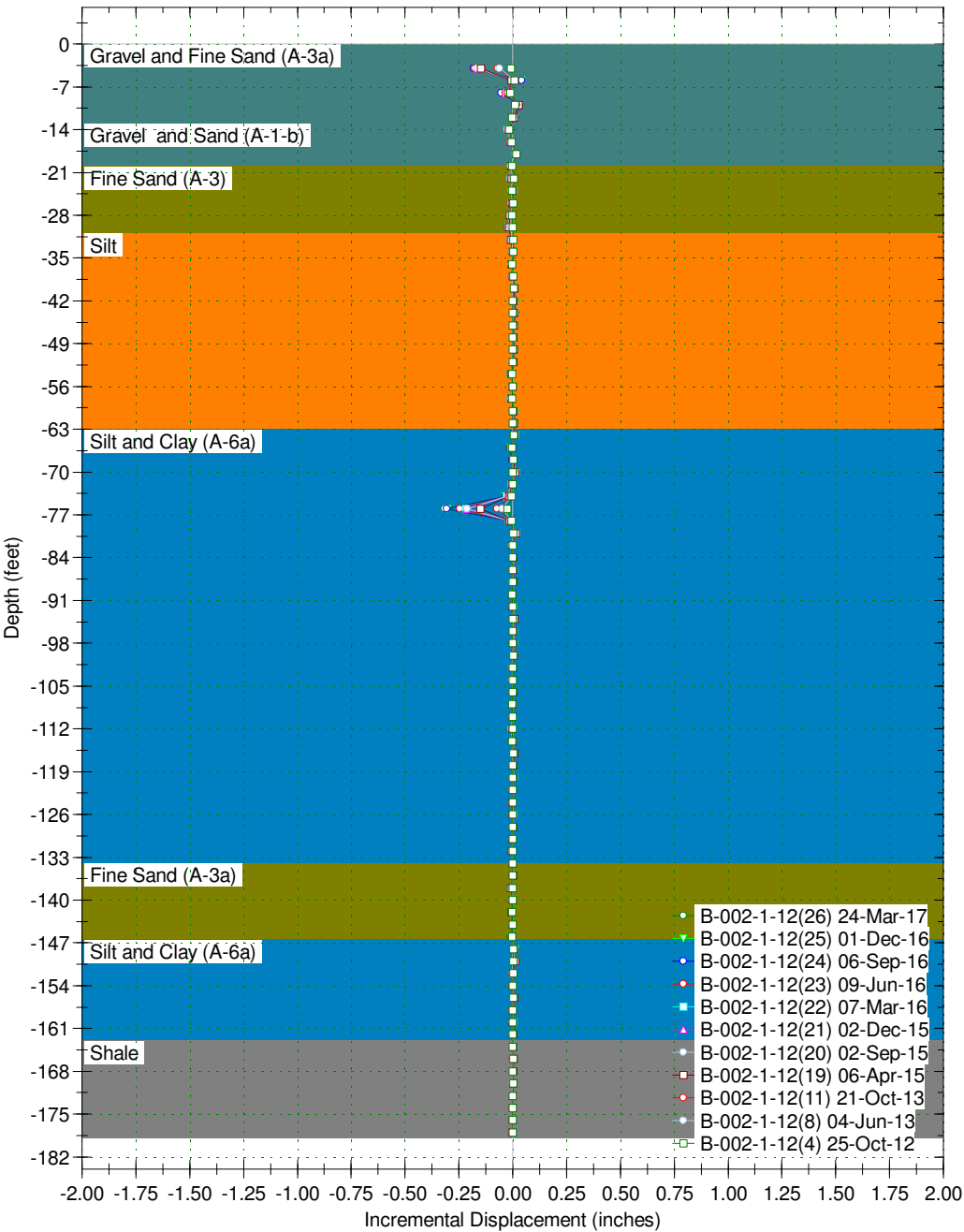
- B-002-0-13(15) 24-Mar-17
- ▲ B-002-0-13(14) 01-Dec-16
- B-002-0-13(13) 06-Sep-16
- ▲ B-002-0-13(12) 09-Jun-16
- B-002-0-13(11) 07-Mar-16
- B-002-0-13(10) 02-Dec-15
- ▲ B-002-0-13(8) 06-Apr-15
- B-002-0-13(5) 08-May-14

Borehole : B-002-1-12
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 178.0 feet
 A+ Groove Azimuth :
 Base Reading : 2012 Jun 25 10:24
 Applied Azimuth : 0.0 degrees

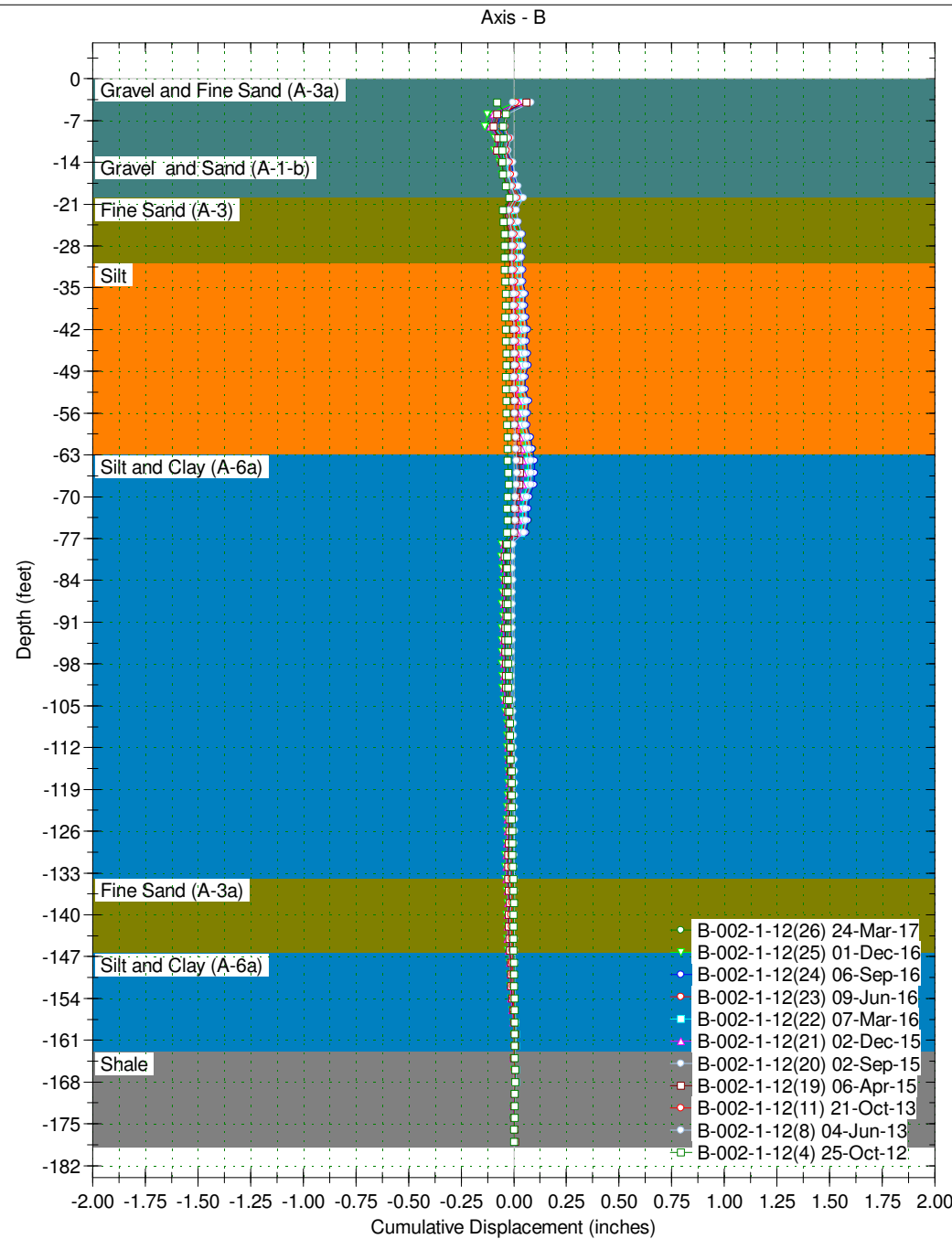
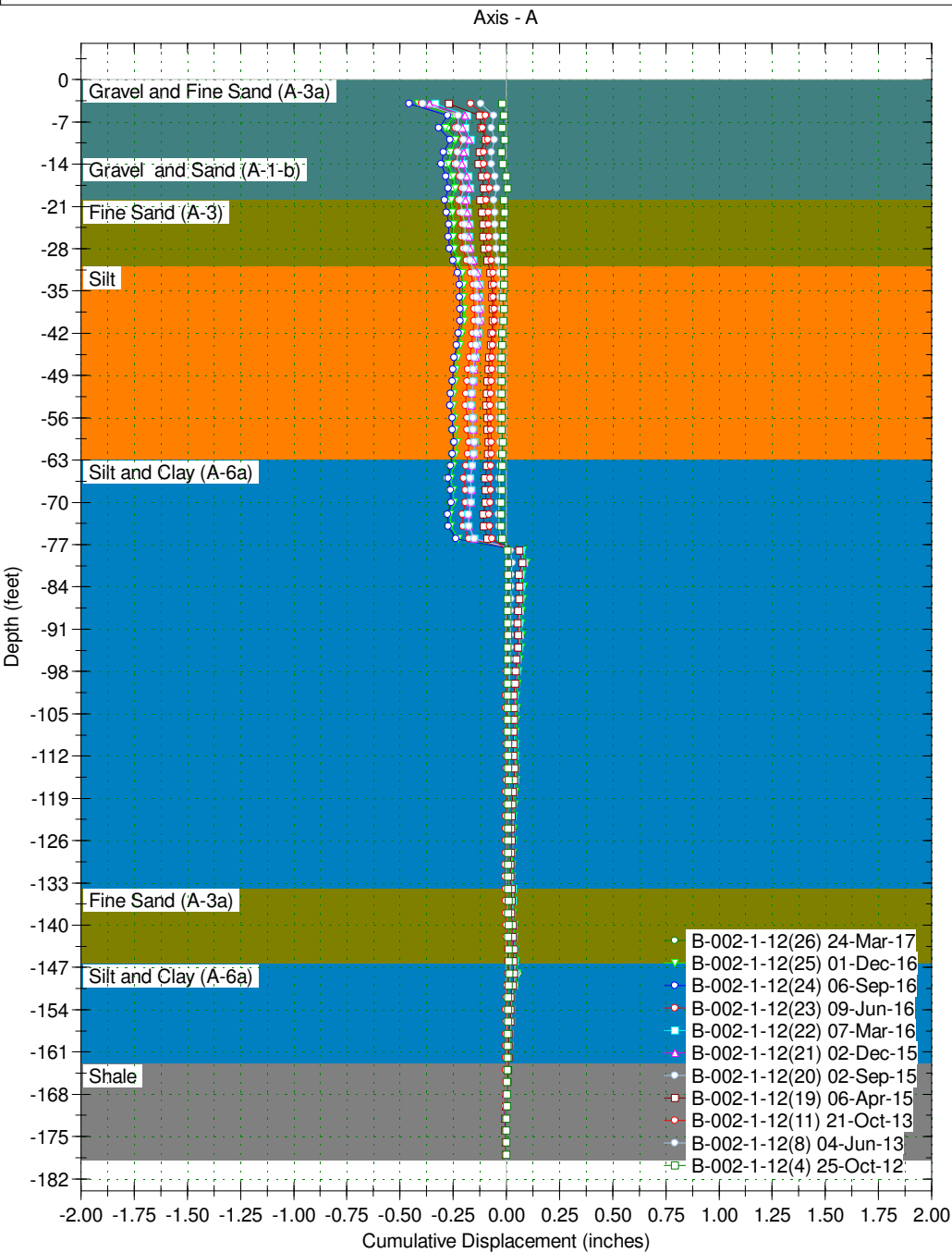
Axis - A

Axis - B



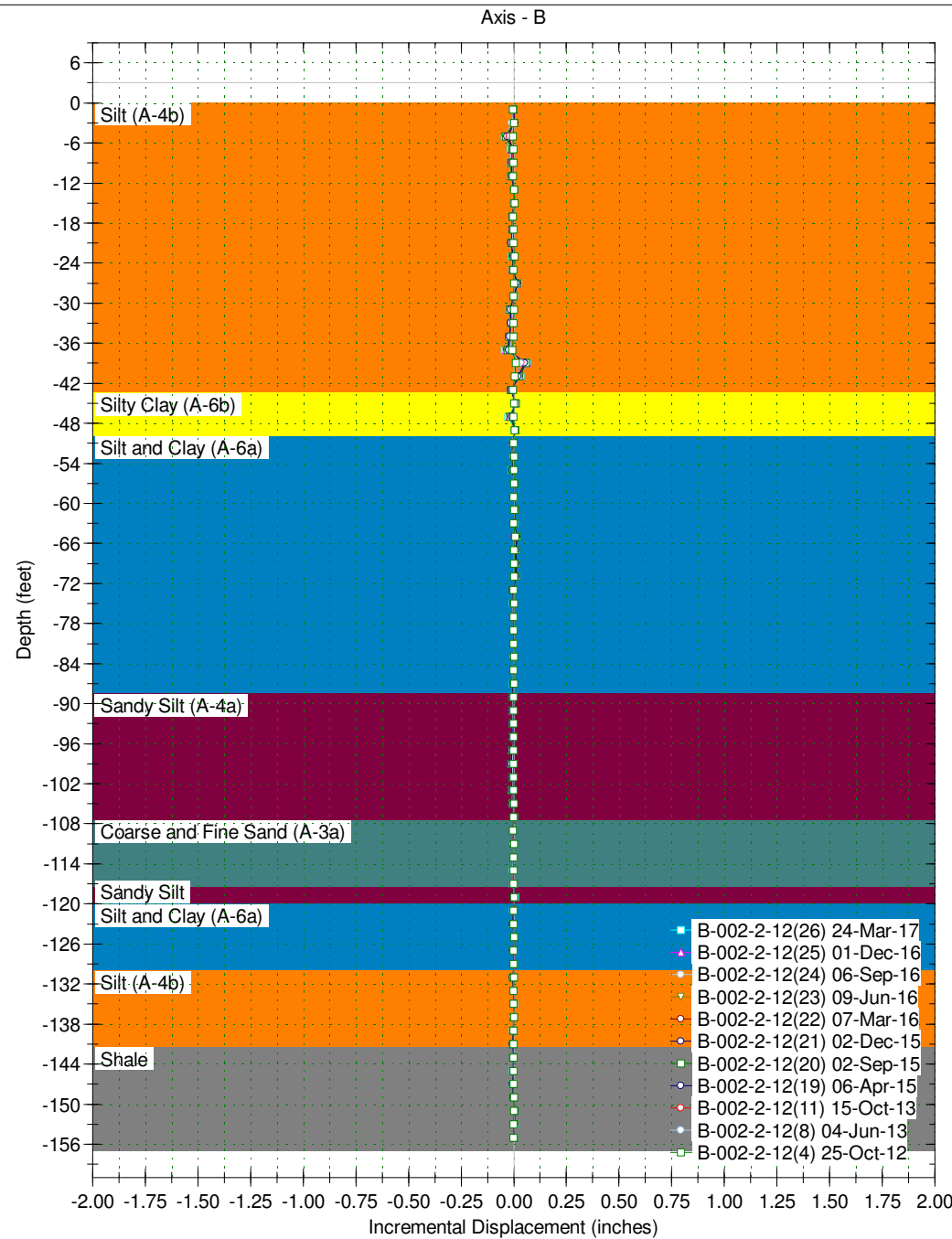
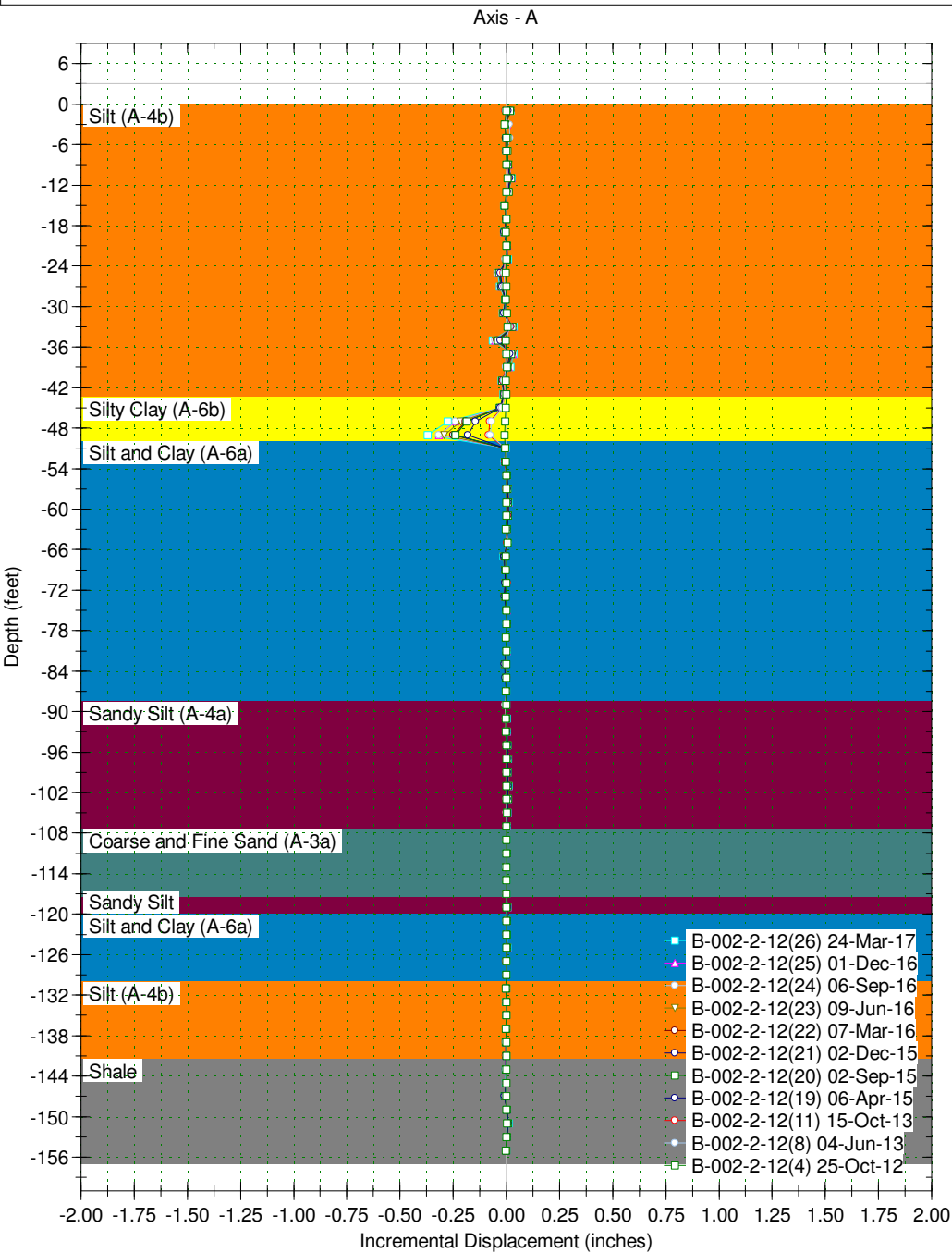
Borehole : B-002-1-12
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 178.0 feet
 A+ Groove Azimuth :
 Base Reading : 2012 Jun 25 10:24
 Applied Azimuth : 0.0 degrees



Borehole : B-002-2-12
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 3.0 feet
 Borehole Total Depth : 158.0 feet
 A+ Groove Azimuth :
 Base Reading : 2012 Jun 25 10:59
 Applied Azimuth : 0.0 degrees

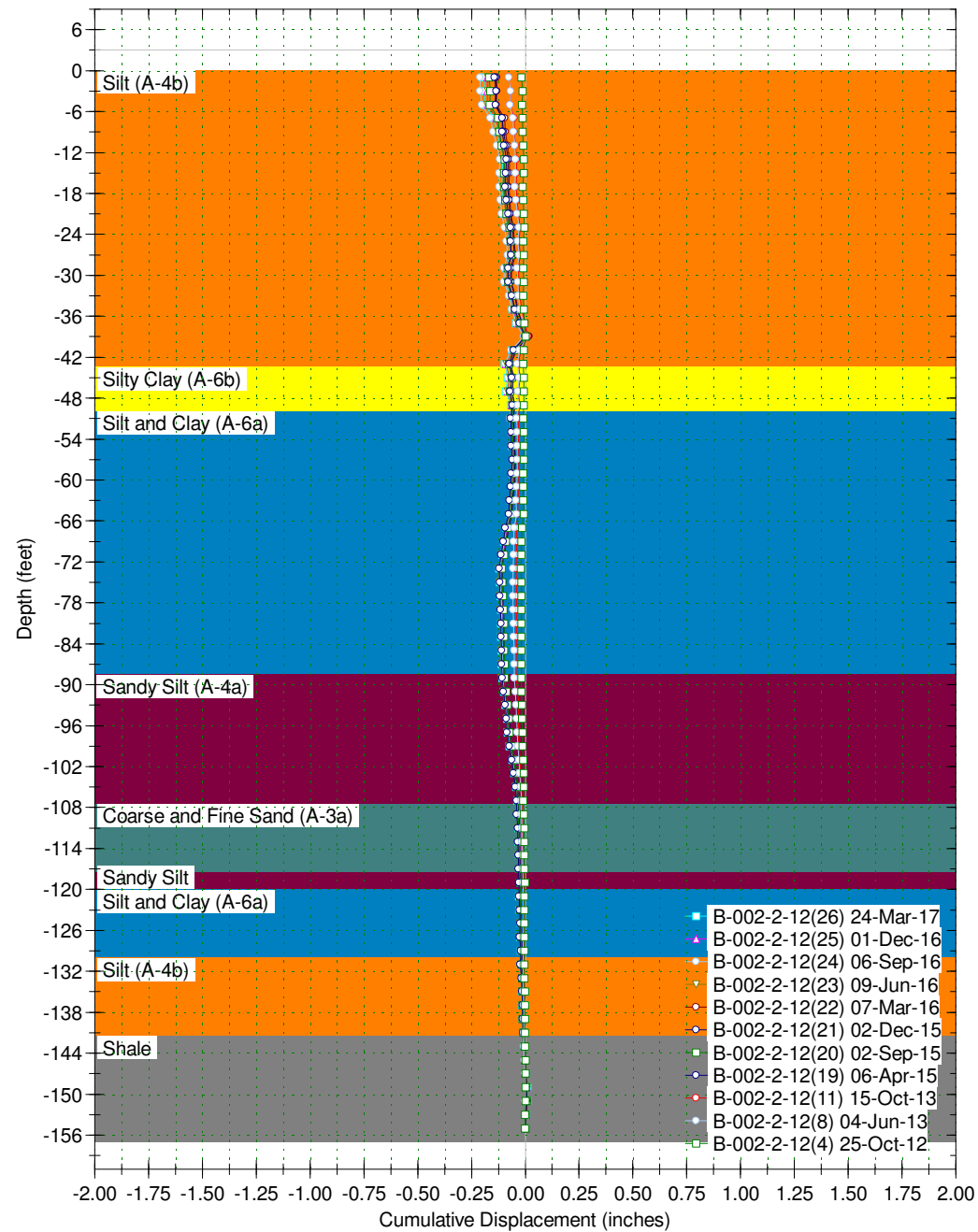
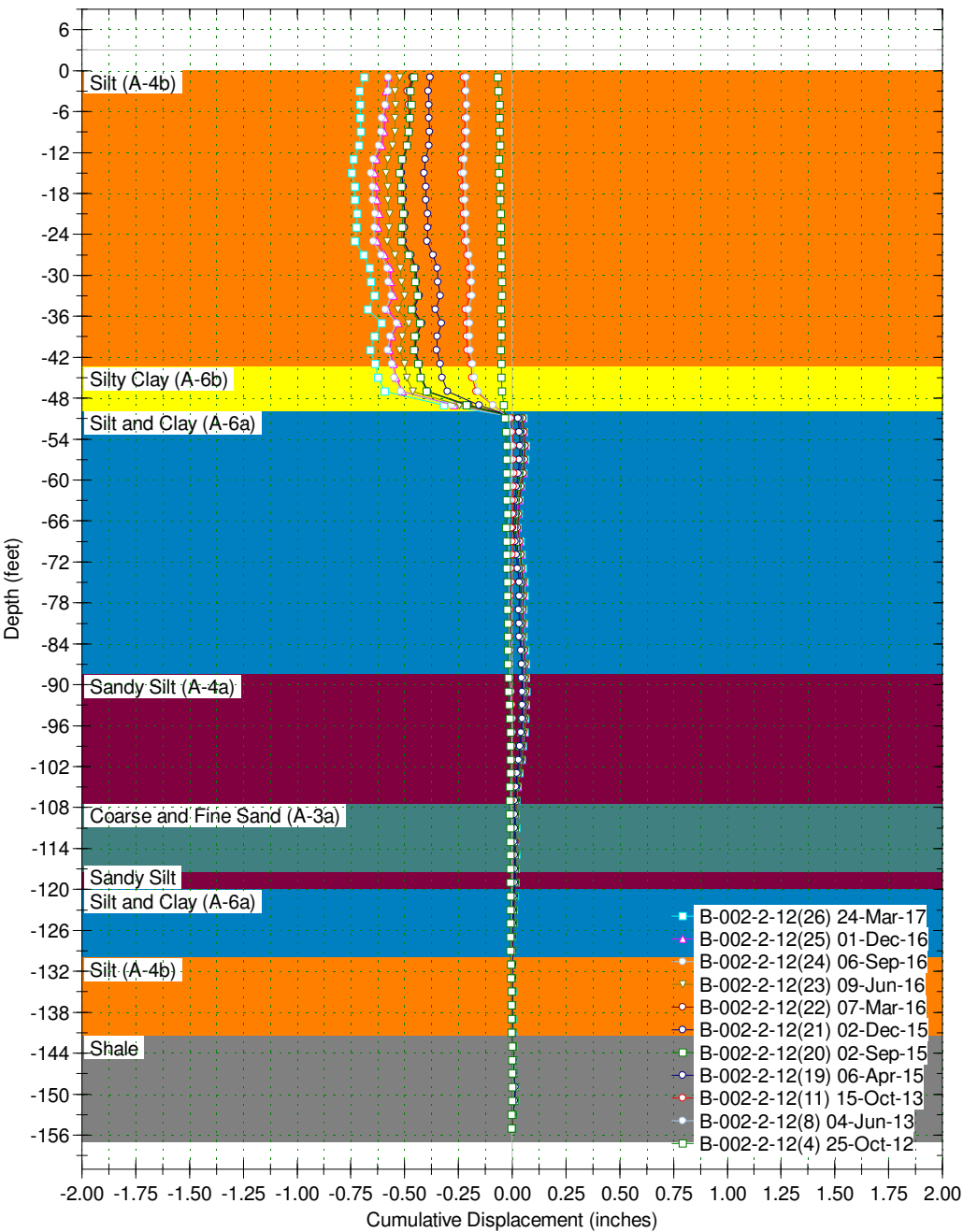


Borehole : B-002-2-12
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 3.0 feet
 Borehole Total Depth : 158.0 feet
 A+ Groove Azimuth :
 Base Reading : 2012 Jun 25 10:59
 Applied Azimuth : 0.0 degrees

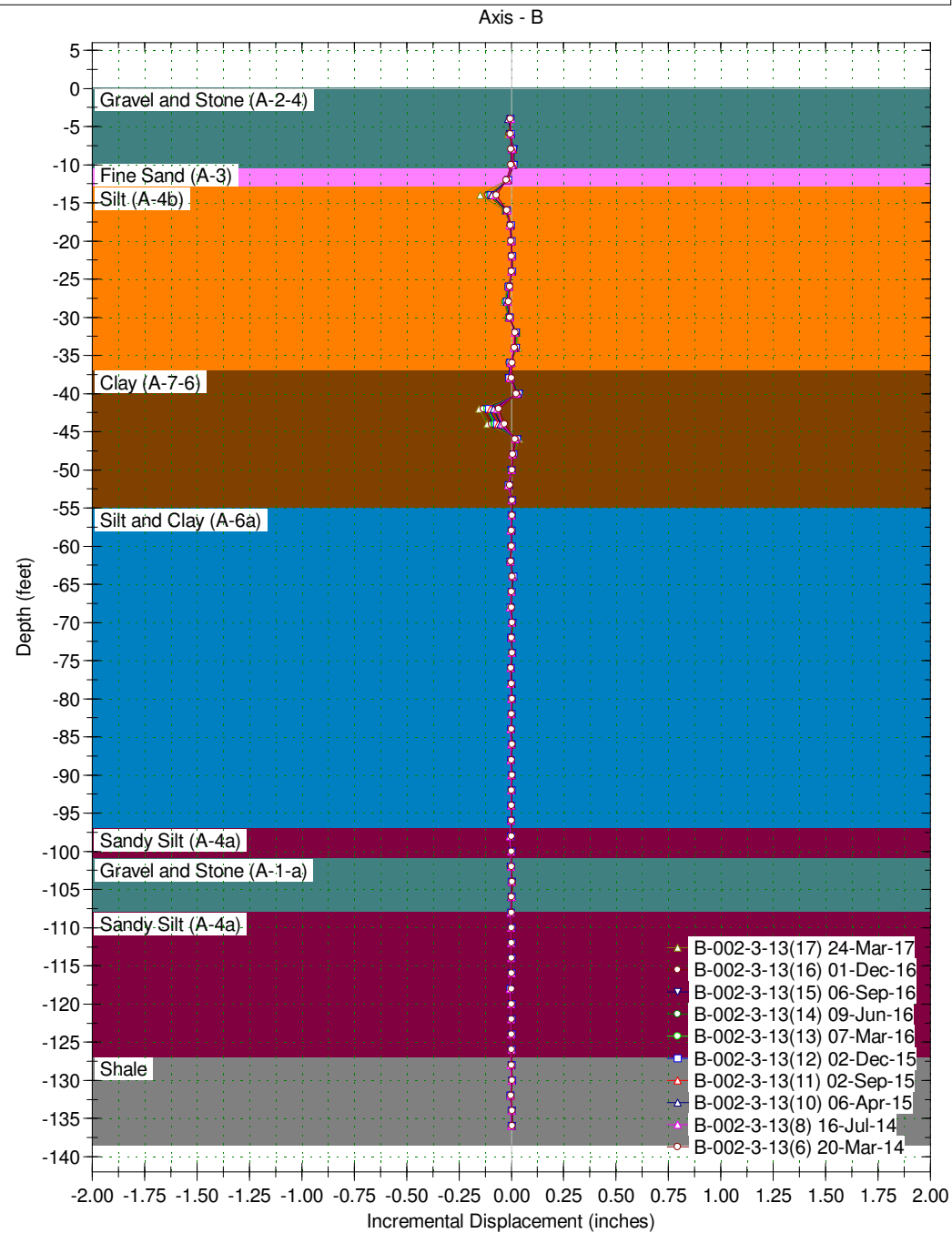
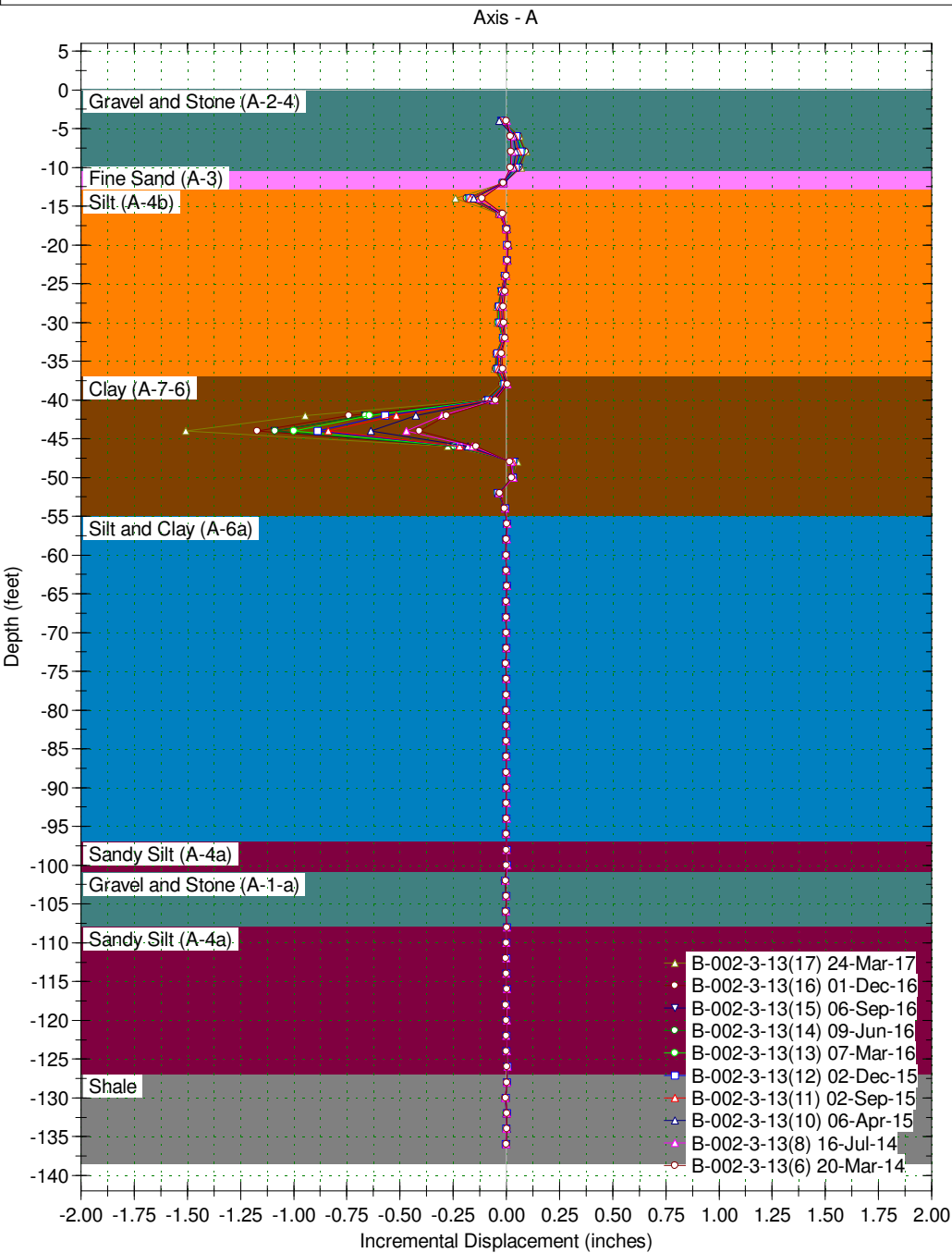
Axis - A

Axis - B



Borehole : B-002-3-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 136.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 14:34
 Applied Azimuth : 0.0 degrees

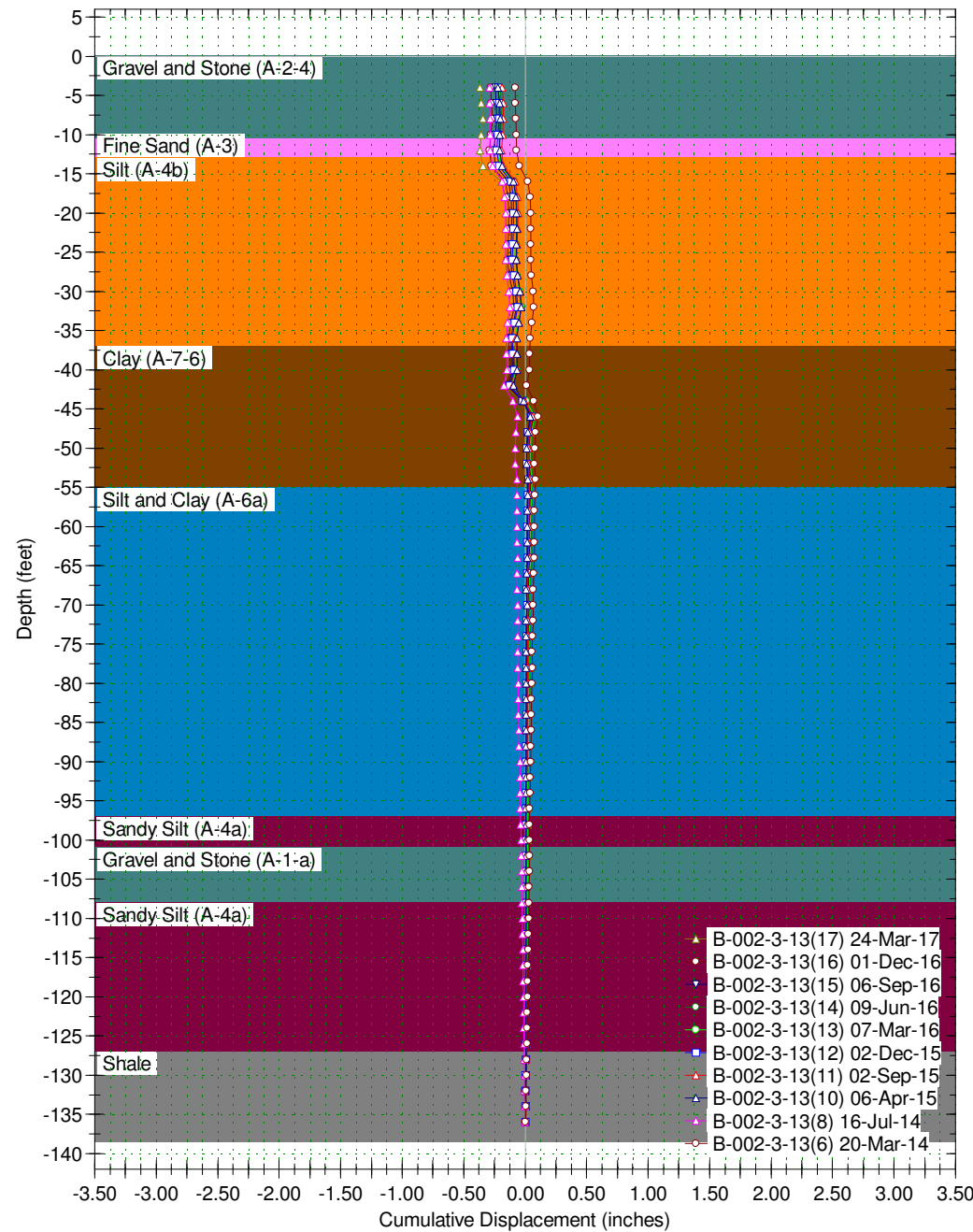
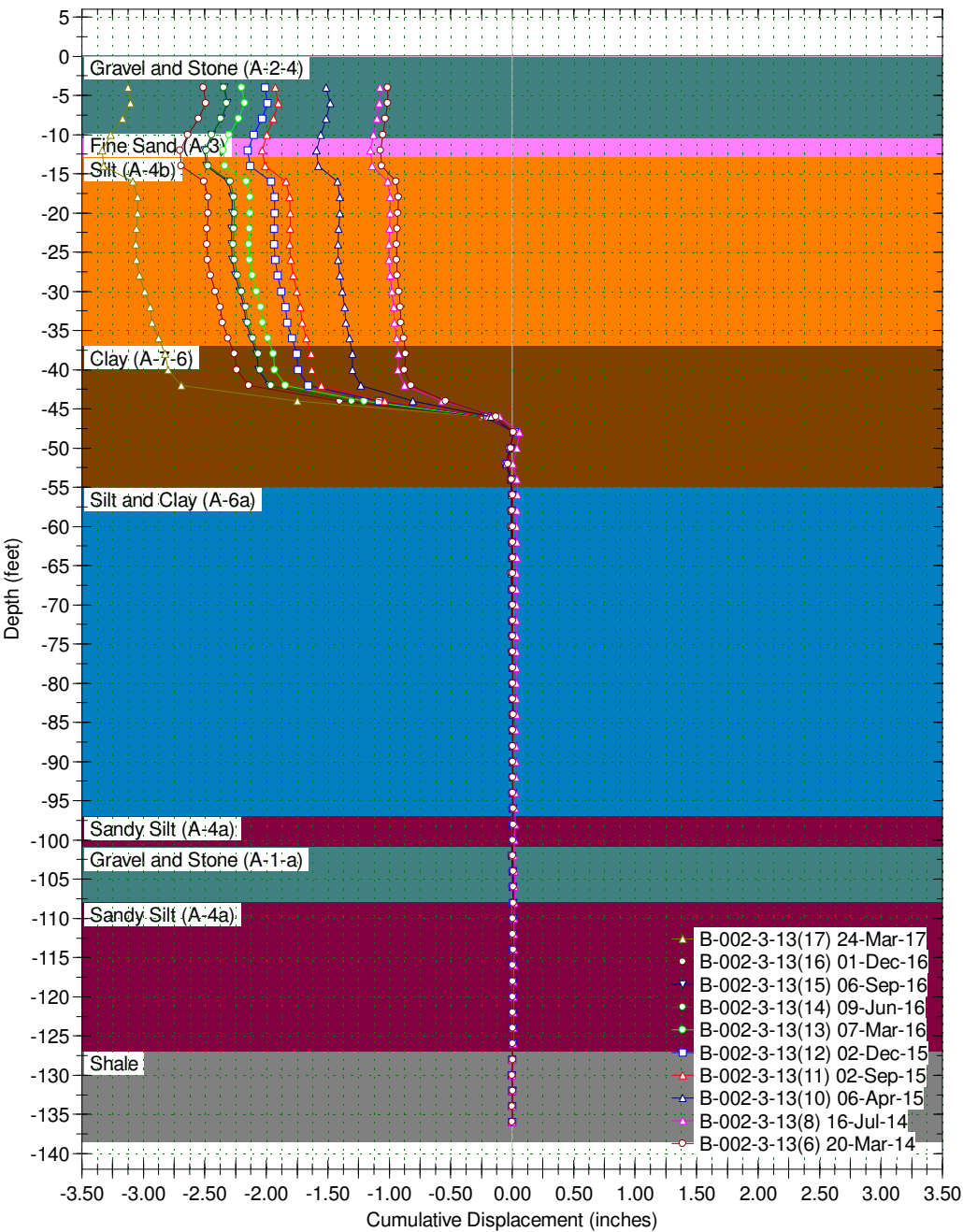


Borehole : B-002-3-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 136.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 14:34
 Applied Azimuth : 0.0 degrees

Axis - A

Axis - B

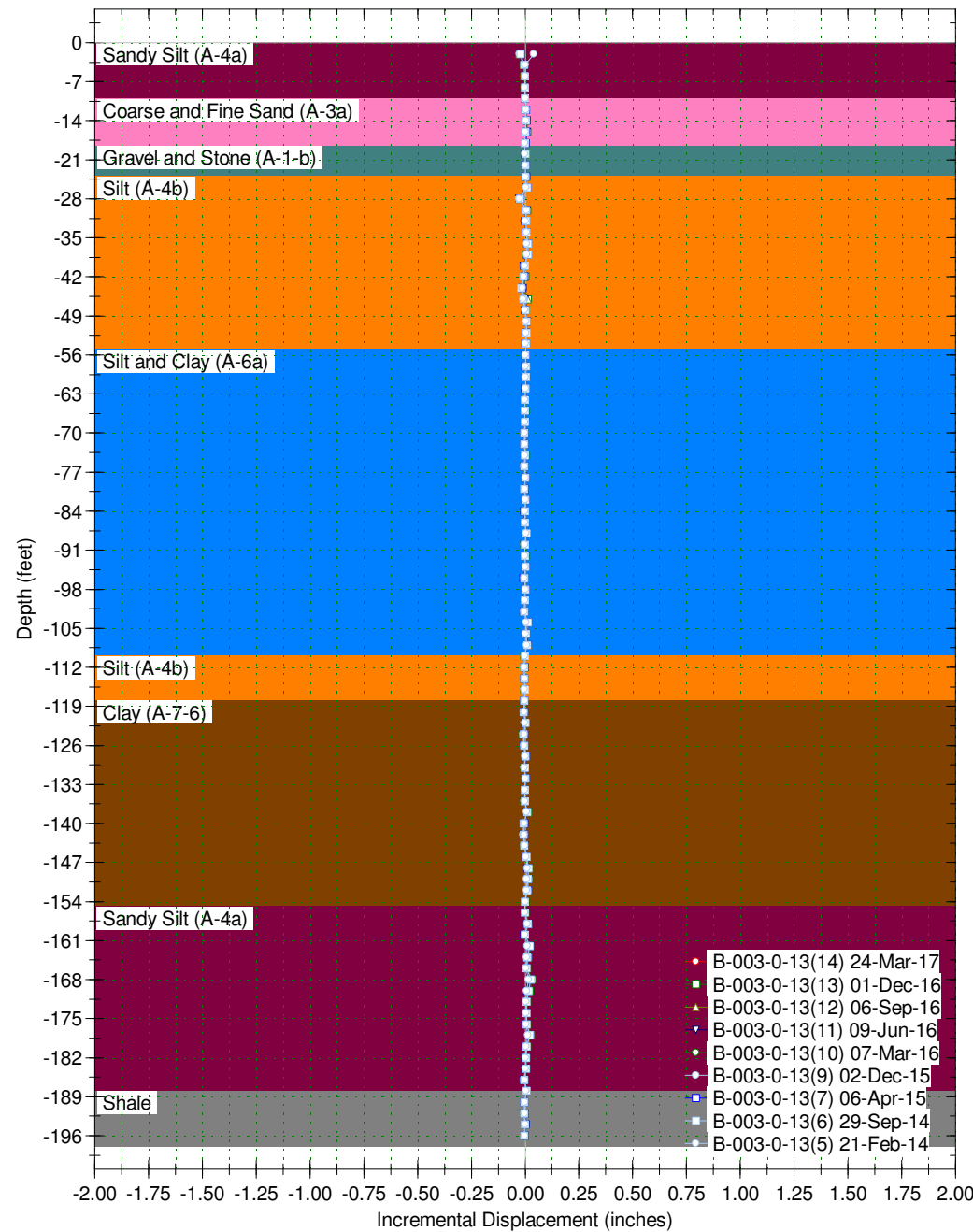
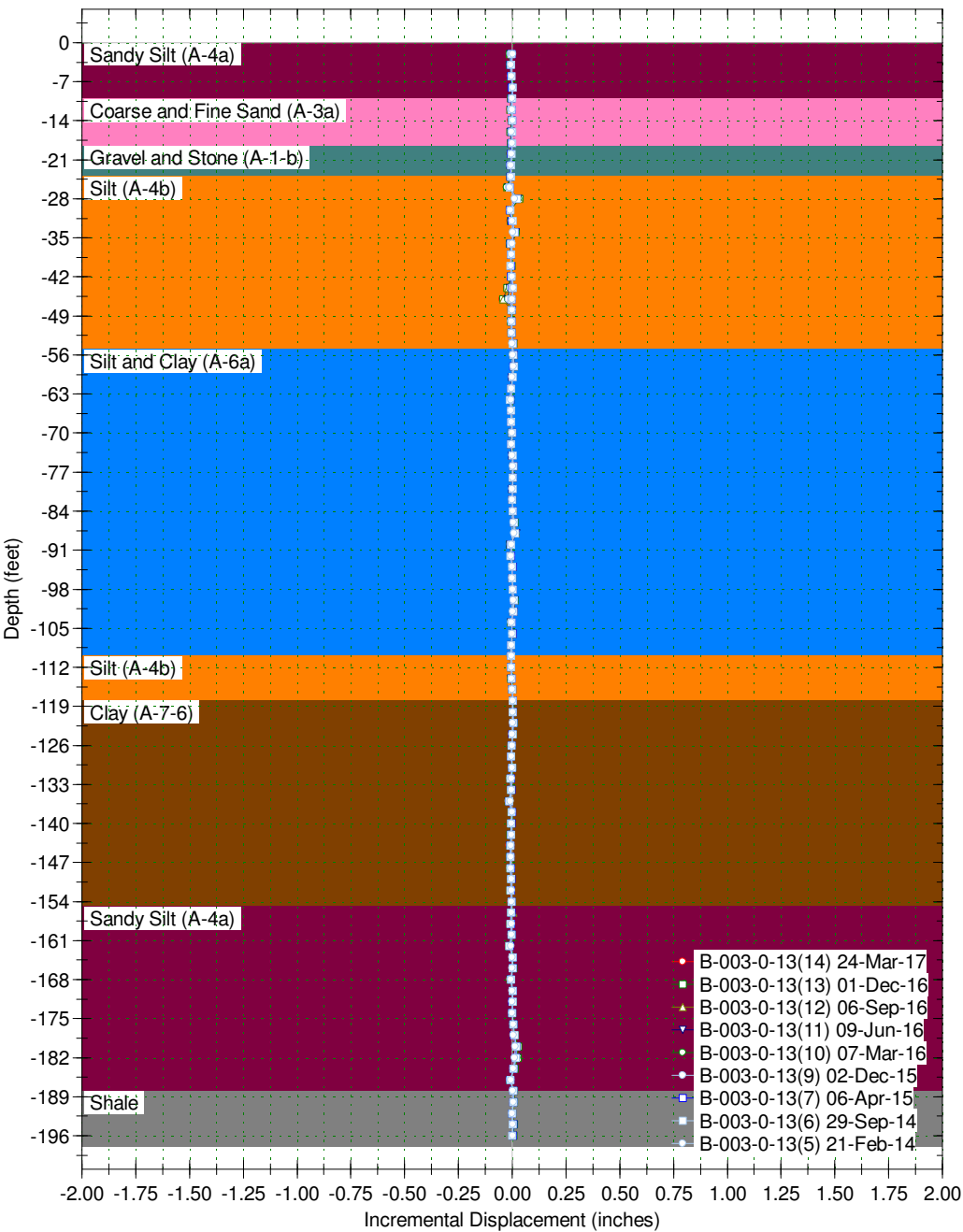


Borehole : B-003-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 196.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 14:25
 Applied Azimuth : 0.0 degrees

Axis - A

Axis - B

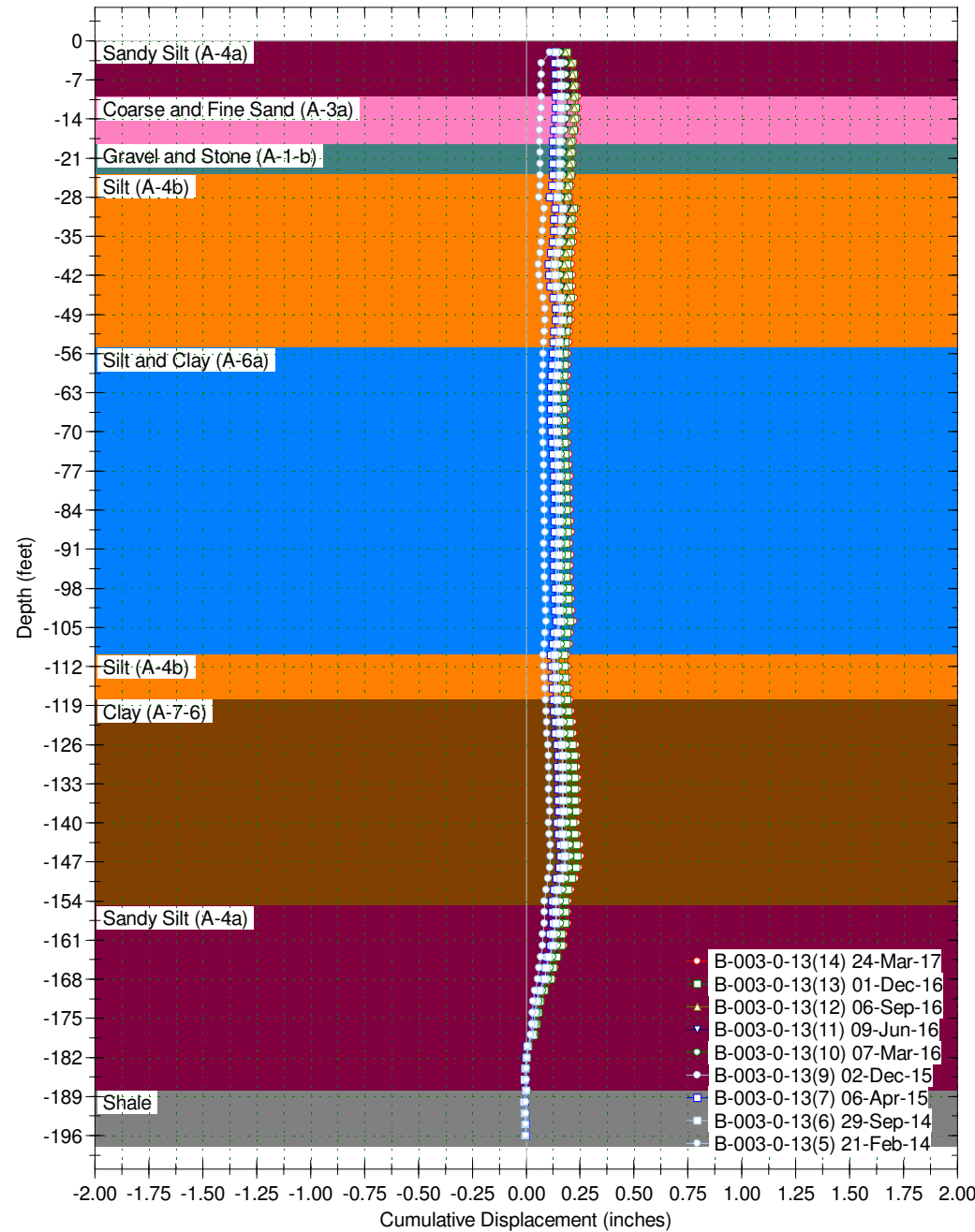
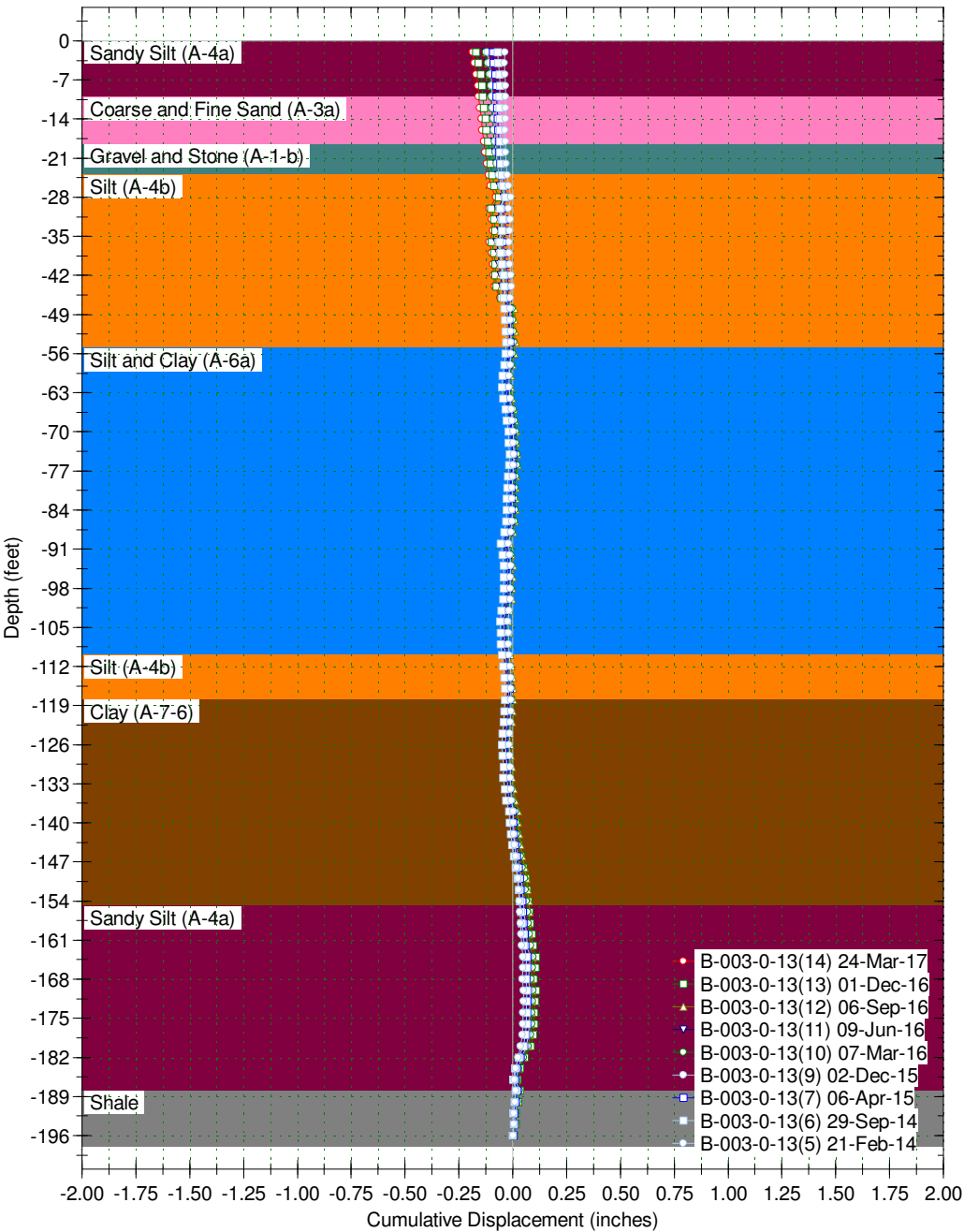


Borehole : B-003-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 196.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 21 14:25
 Applied Azimuth : 0.0 degrees

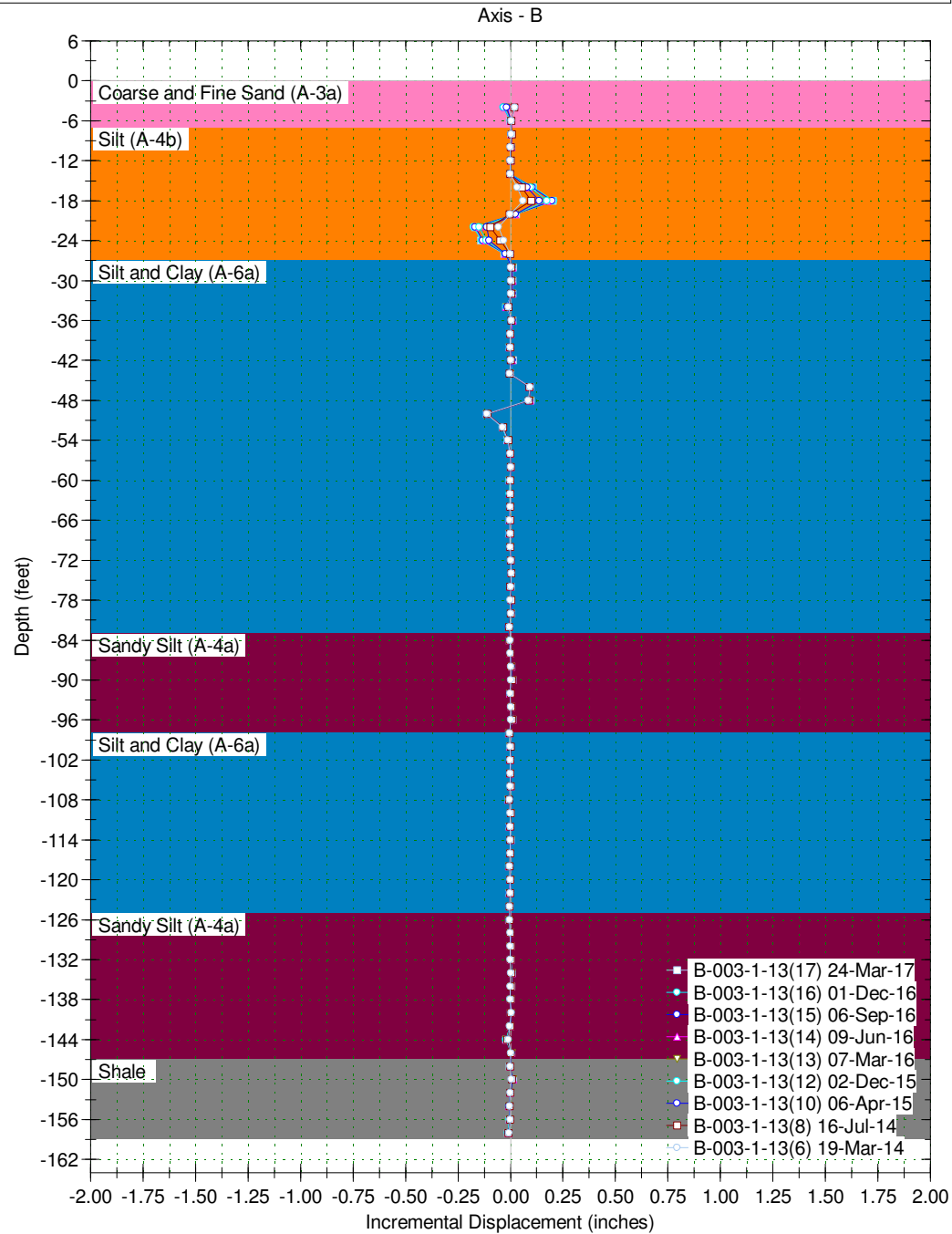
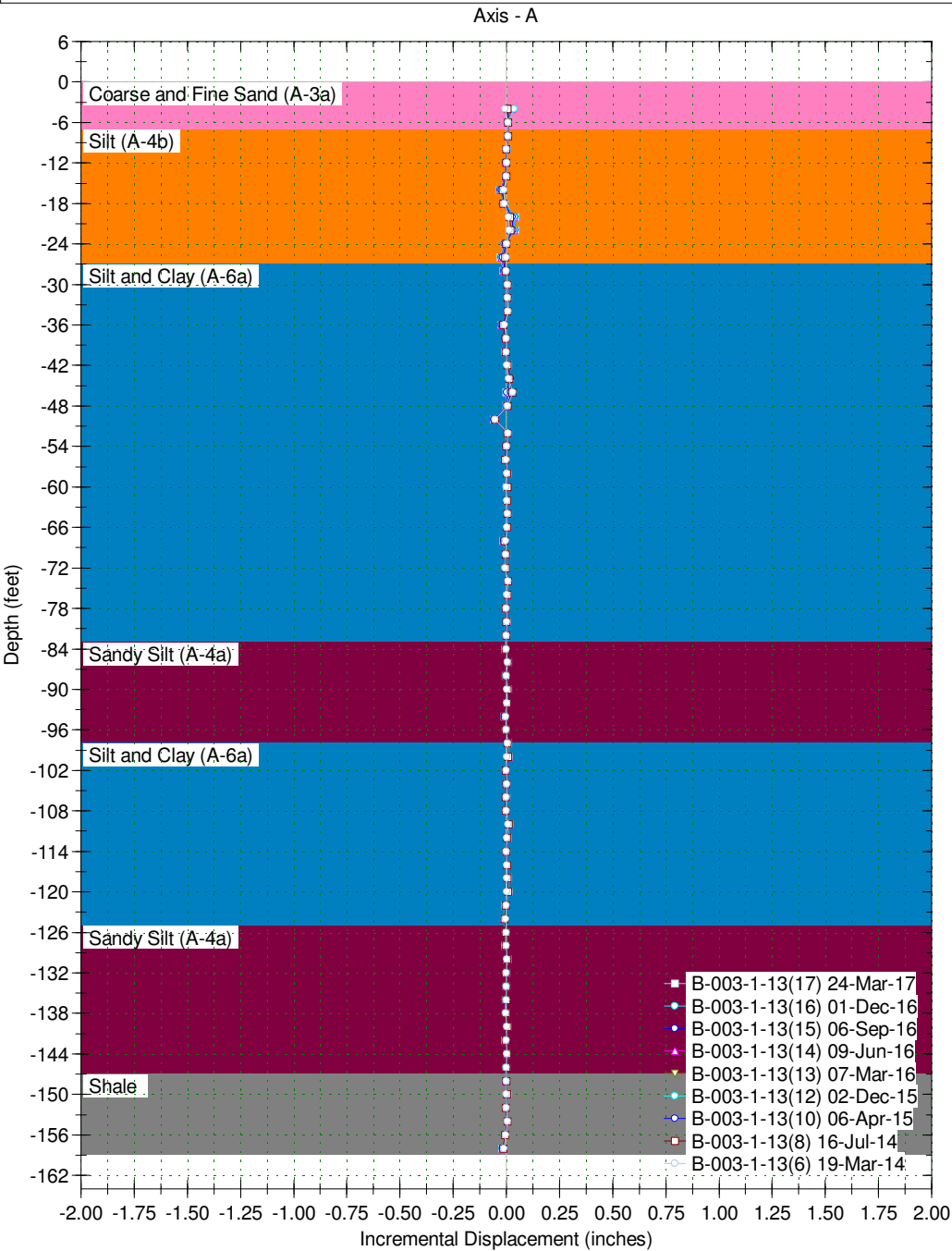
Axis - A

Axis - B



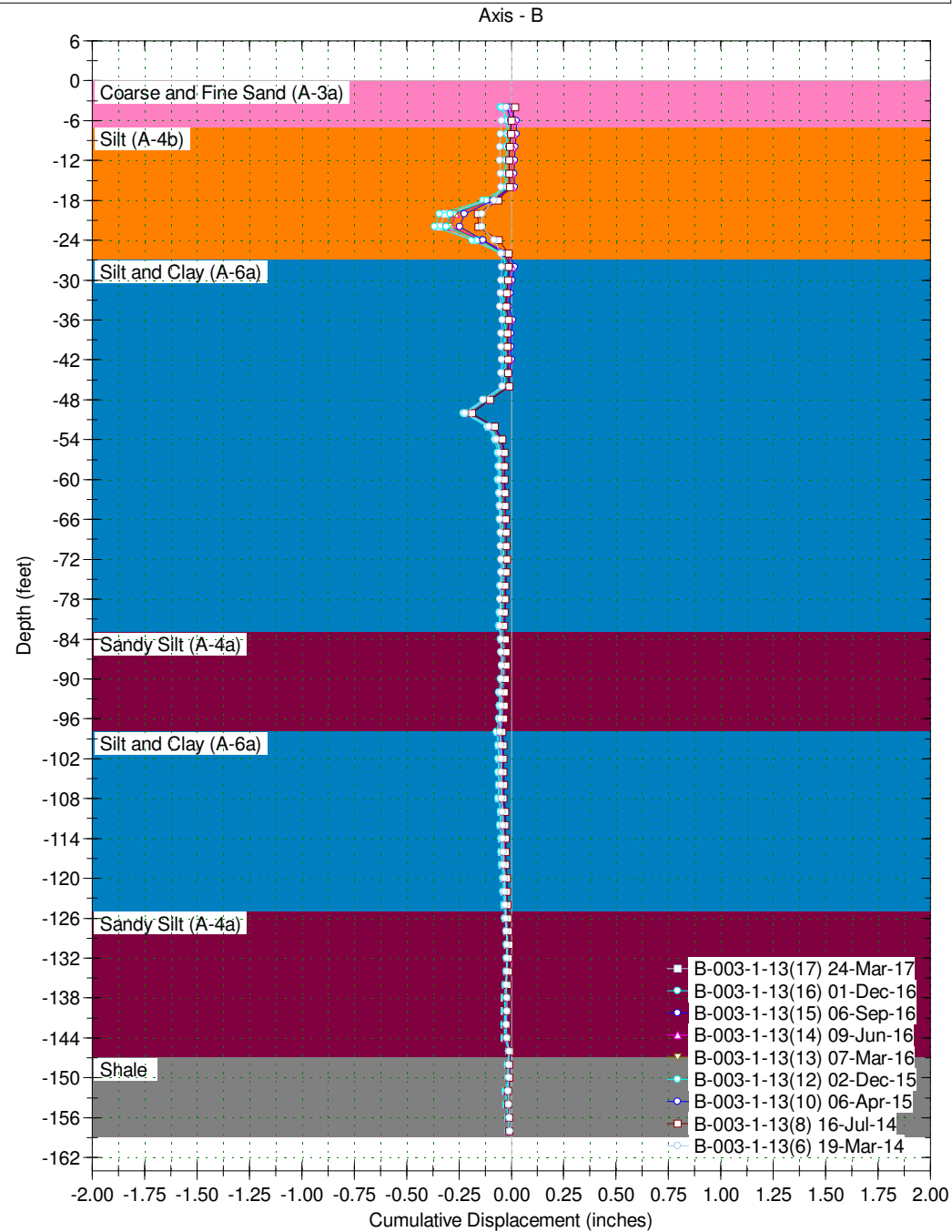
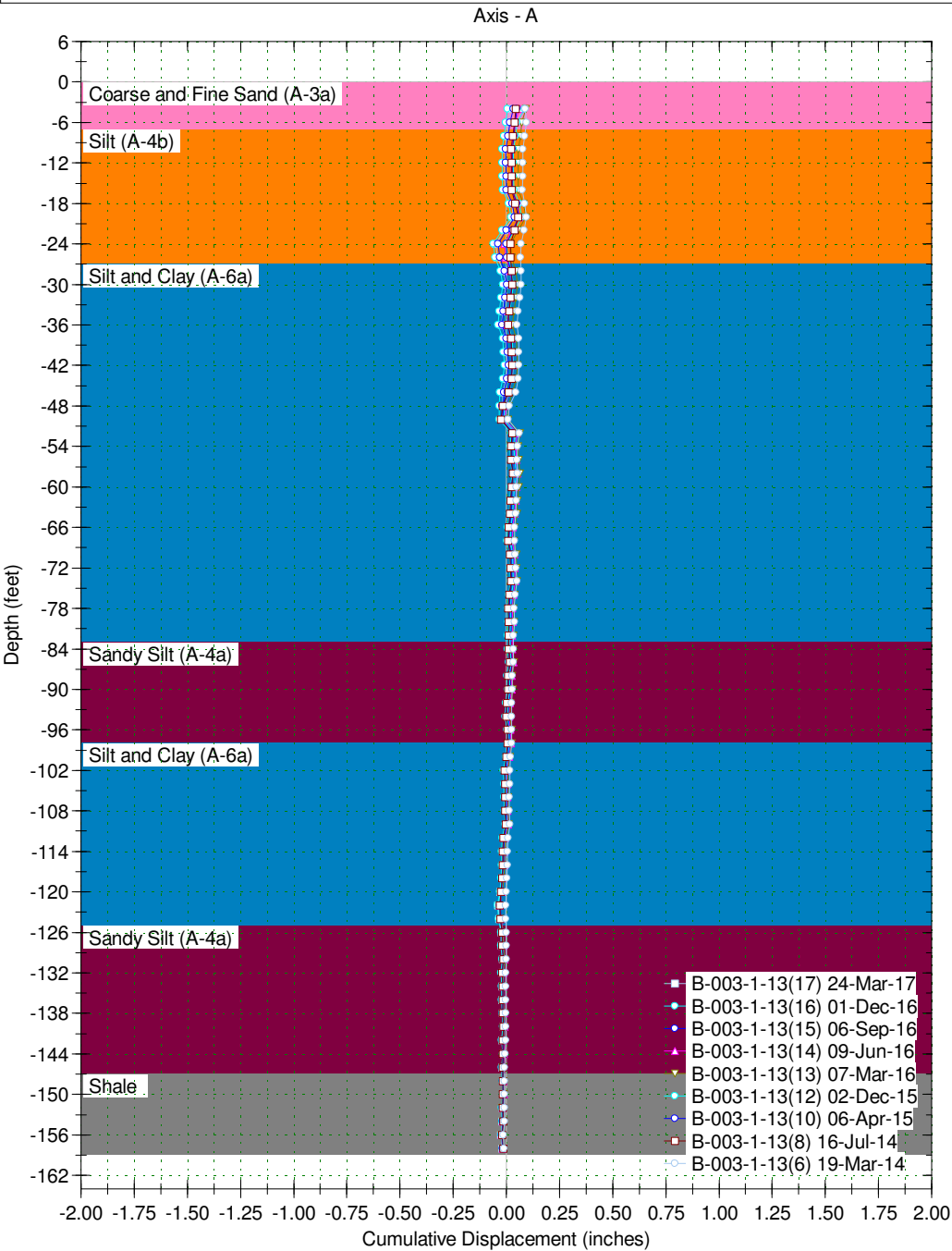
Borehole : B-003-1-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 158.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 15:21
 Applied Azimuth : 0.0 degrees



Borehole : B-003-1-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 158.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 15:21
 Applied Azimuth : 0.0 degrees

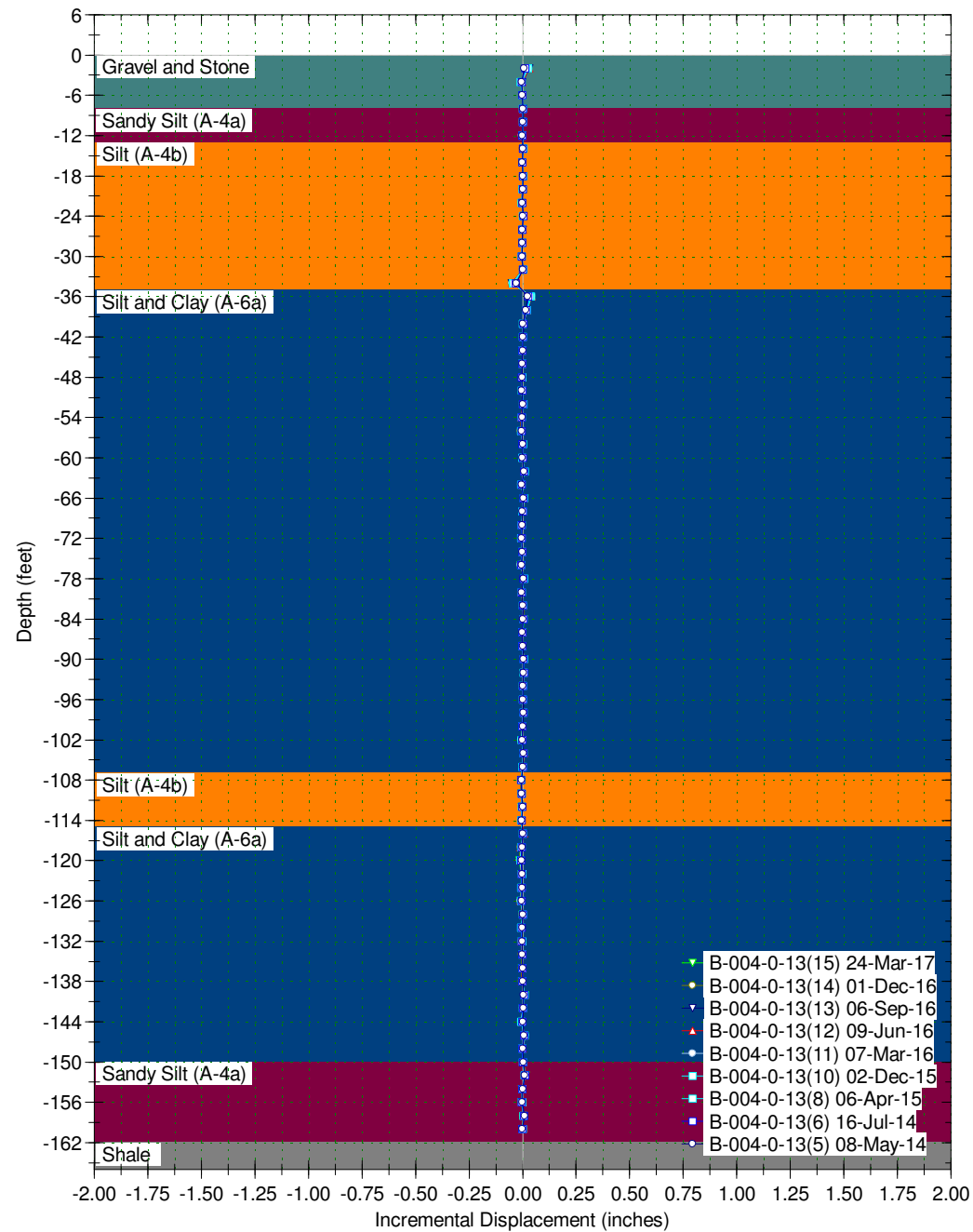
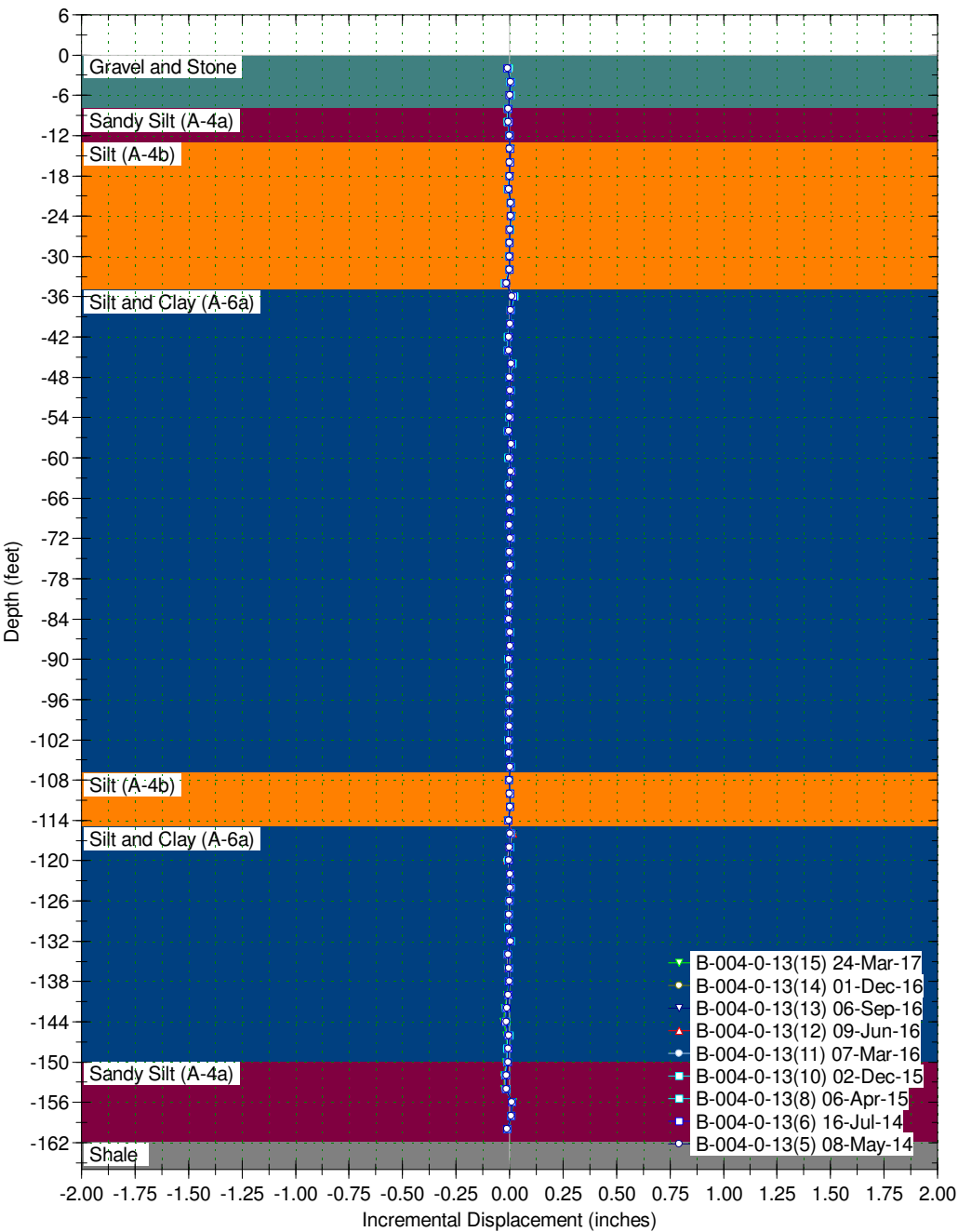


Borehole : B-004-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 160.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 16:29
 Applied Azimuth : 0.0 degrees

Axis - A

Axis - B

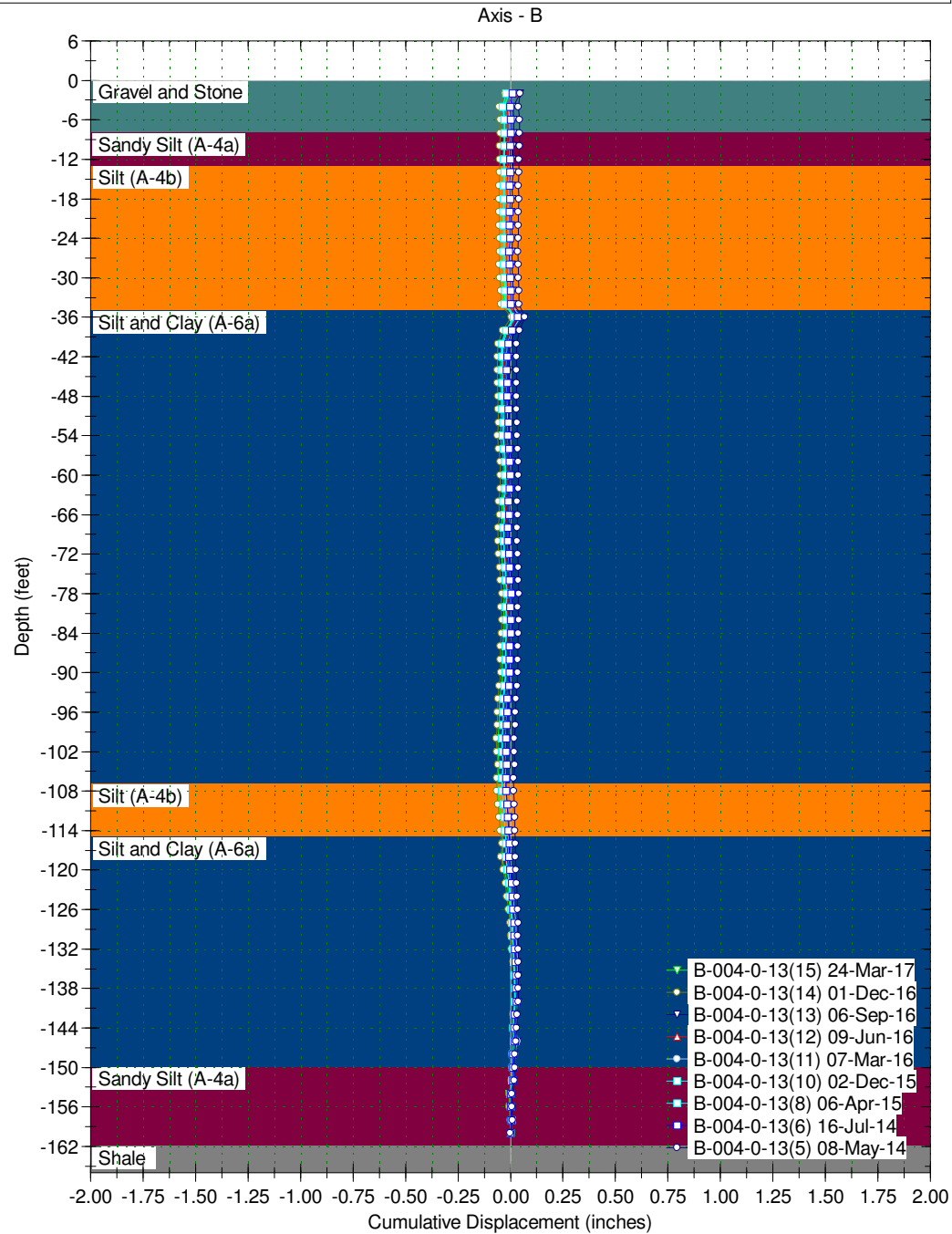
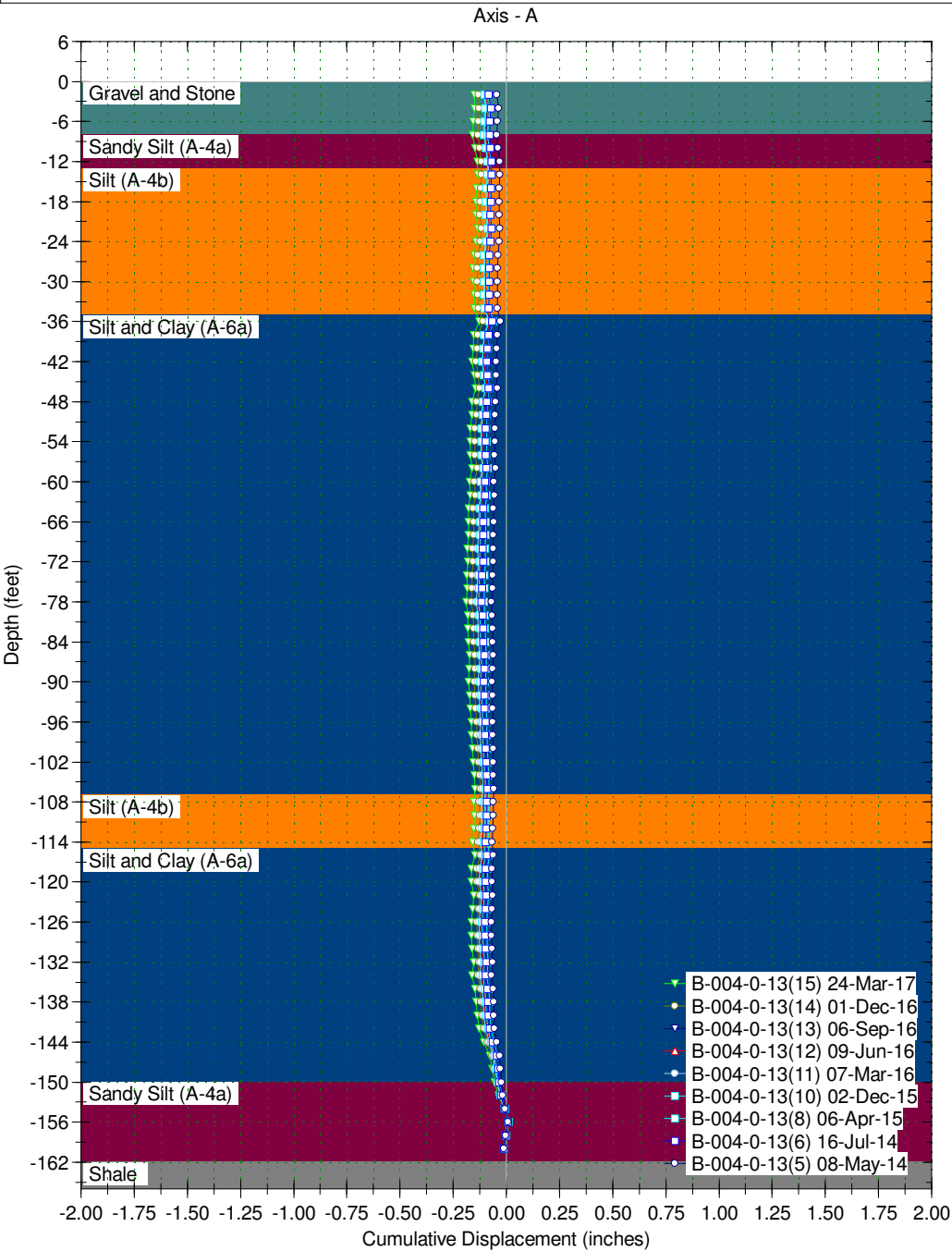


- ▼ B-004-0-13(15) 24-Mar-17
- B-004-0-13(14) 01-Dec-16
- ▼ B-004-0-13(13) 06-Sep-16
- ▲ B-004-0-13(12) 09-Jun-16
- B-004-0-13(11) 07-Mar-16
- B-004-0-13(10) 02-Dec-15
- B-004-0-13(8) 06-Apr-15
- B-004-0-13(6) 16-Jul-14
- B-004-0-13(5) 08-May-14

- ▼ B-004-0-13(15) 24-Mar-17
- B-004-0-13(14) 01-Dec-16
- ▼ B-004-0-13(13) 06-Sep-16
- ▲ B-004-0-13(12) 09-Jun-16
- B-004-0-13(11) 07-Mar-16
- B-004-0-13(10) 02-Dec-15
- B-004-0-13(8) 06-Apr-15
- B-004-0-13(6) 16-Jul-14
- B-004-0-13(5) 08-May-14

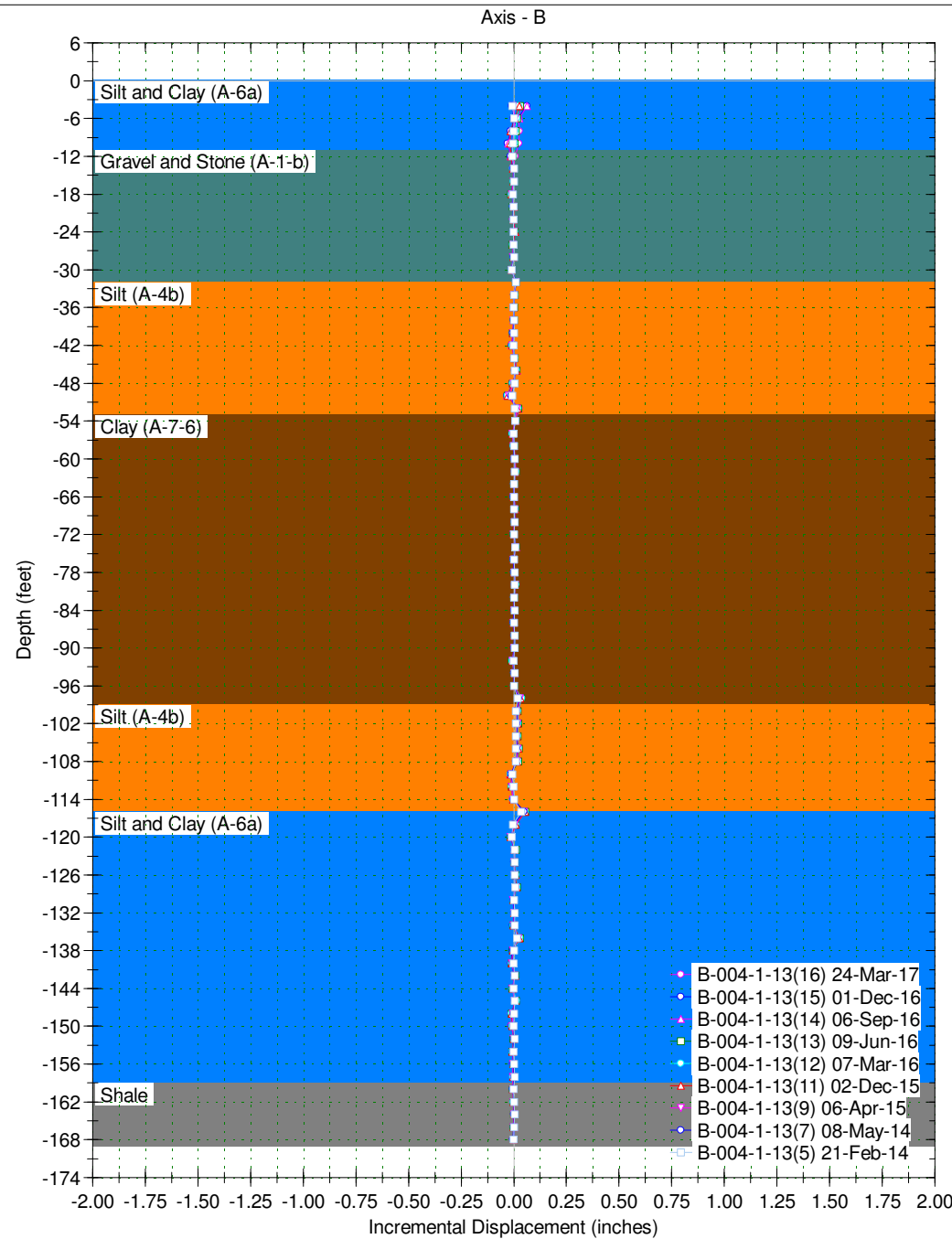
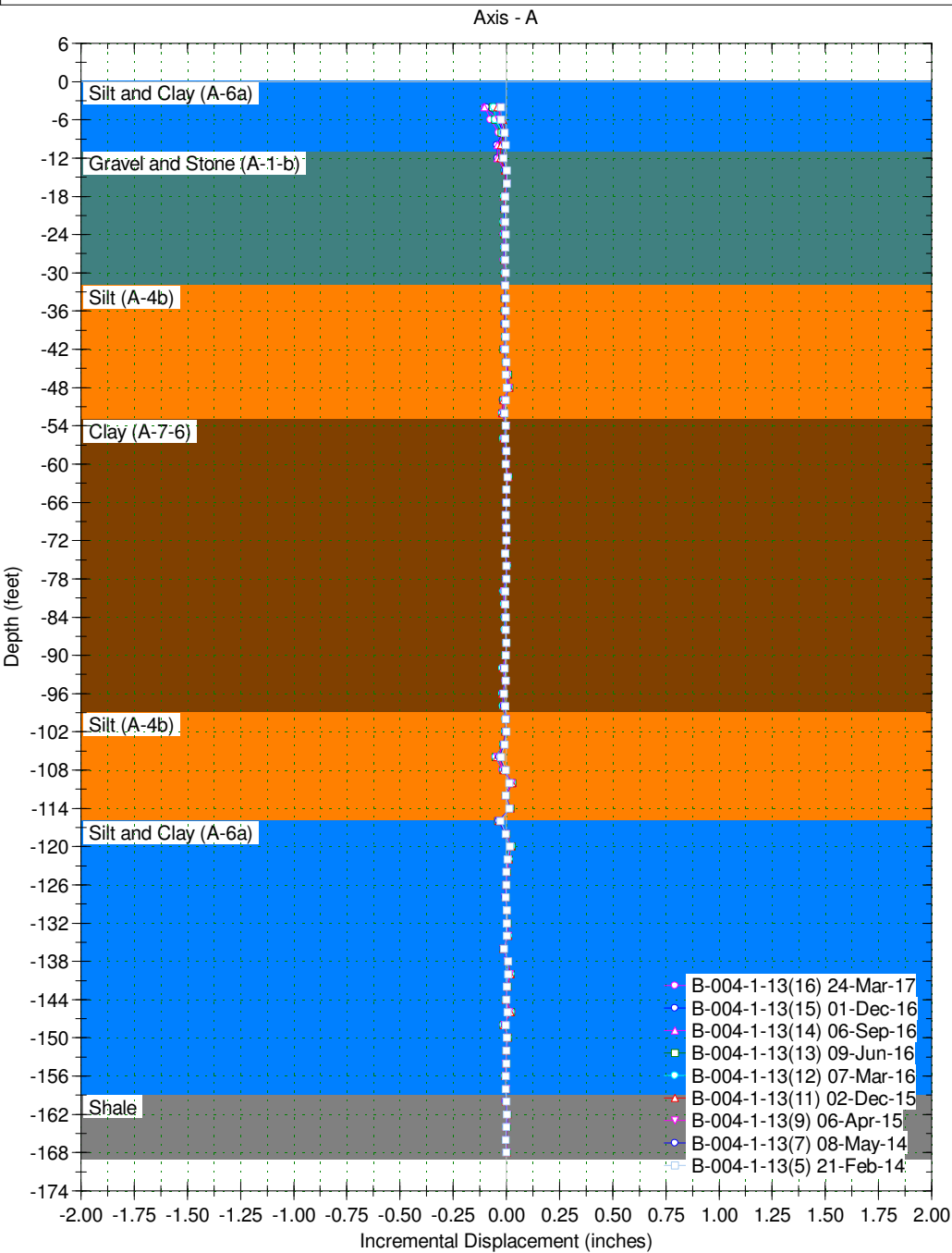
Borehole : B-004-0-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 160.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 16:29
 Applied Azimuth : 0.0 degrees



Borehole : B-004-1-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 168.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 15:53
 Applied Azimuth : 0.0 degrees



Borehole : B-004-1-13
 Project : Detroit Superior Bridge
 Location :
 Northing :
 Easting :
 Collar :

Spiral Correction : N/A
 Collar Elevation : 0.0 feet
 Borehole Total Depth : 168.0 feet
 A+ Groove Azimuth :
 Base Reading : 2013 Oct 15 15:53
 Applied Azimuth : 0.0 degrees

