



## We are a Full Service Firm

Oil & Natural Gas Systems  
Development

Public Water & Wastewater Systems  
Development

Bridge & Structural Engineering

Transportation Engineering

Construction Management

Geotechnical Engineering

Surveying & Technology

Mine Engineering

Land Planning & Landscape  
Architecture

Site Development

**PID 101682**

**CUY-17-02.83**  
*Fairview Park, Ohio*

# DRAFT DECK CONDITION SURVEY

**Prepared for:**



**District 12**

**5500 Transportation Blvd,  
Garfield Heights, Ohio 44125**

**April 2016**



## TABLE OF CONTENTS

Scope and Bridge Description	1
Summary of Inspection Findings	2
Approach Spans	2
Arch Spans	4
Summary of Deck Concrete Testing	8
Conclusions and Recommendations	9
Appendix A – Top of Deck and Bottom of Deck Condition Survey	
Appendix B – Concrete Core Testing Report	



**SCOPE AND BRIDGE DESCRIPTION**

ODOT District 12 has contracted E. L. Robinson Engineering of Ohio (ELR) to perform a deck condition survey of the Brookpark Road Bridge over the Rocky River (Bridge No. CUY-17-0283). This included sounding the top of the deck, a visual inspection of the bottom of deck and a report of the findings with photographs and CAD sketches with the deficiencies mapped out.

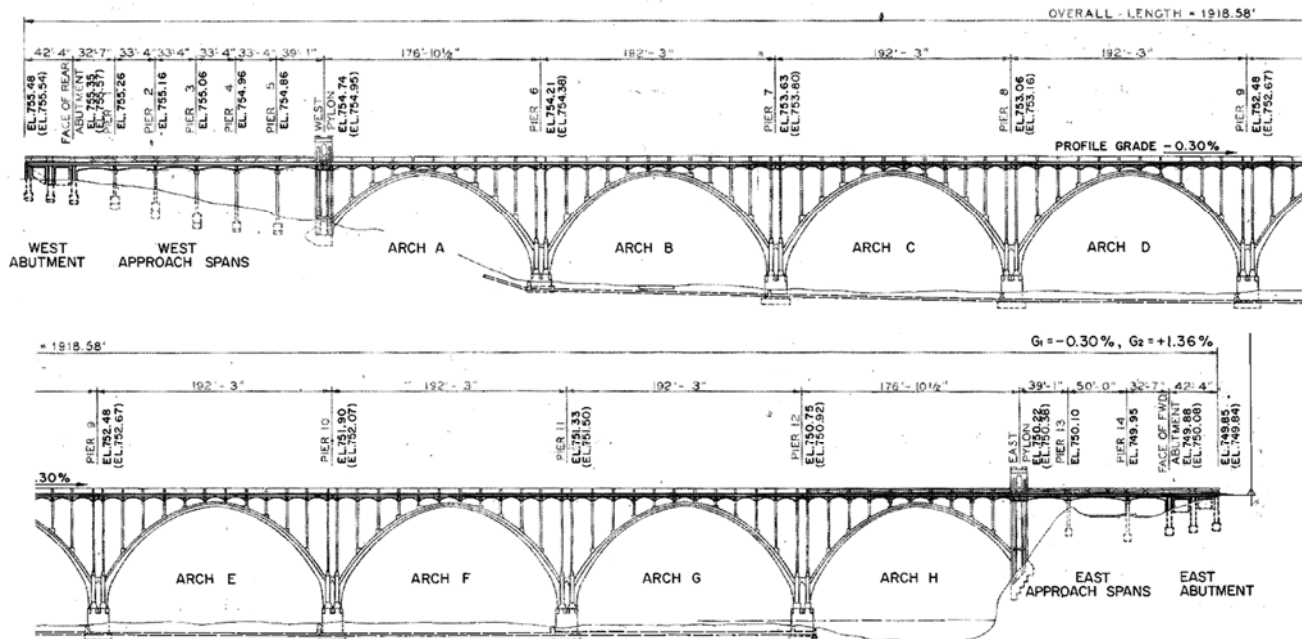


Figure 1 – South Elevation of the Brookpark Road Bridge showing the span arrangements.

The Brookpark Road Bridge over the Rocky River (Bridge No. CUY-17-0283) is a 1,918'-7"± open spandrel, reinforced concrete arch bridge with two approach spans and cellular abutment spans (see *Figure 1*). The deck is 52'-0"± face to face curbs and carries four lanes of traffic and two 5 foot wide sidewalks. The structure was originally built in 1933, with minor retrofits and repair projects, and one major rehab in 1989. This rehabilitation consisted, in part, of widening the existing deck, removing the asphalt overlay and placing a variable thickness (2-7/8" to 1-1/2") latex modified concrete overlay on the entire roadway surface. The original deck has uncoated reinforcing and the 1989 widened deck has epoxy coated reinforcing.

The bridge deck consists of a concrete 7-1/4" slab on concrete stringers at the West Approach (Spans 1 through 6) and the East Approach (Spans 7 through 9). The decks in the Arch Spans (Arches A through H Spans) consist of 13-1/2" thick structural slab that spans 16'-8" longitudinally from floor beam to floor beam. For a typical section showing locations of the construction joint between the original and widened portions of the deck see *Figure 2* on the following page.



### SUMMARY OF INSPECTION FINDINGS

The top of deck condition survey was performed on Tuesday March 15<sup>th</sup> and Wednesday March 16<sup>th</sup>, 2016, and the field notes were transferred to a CAD drawing. The bottom of deck was visually inspected per the scope of work on February 2<sup>nd</sup> and 3<sup>rd</sup> and Friday, March 25<sup>th</sup>, 2016. Since the underside could not be sounded, photographs of the deck underside were stitched together where possible to form one continuous image per span. Most of the Approach Span photos could not be stitched together but the photos are still presented in the Appendix. The CAD top of deck drawings and the bottom of deck images are placed side by side in Appendix A. These figures depict delaminated and spalled areas, and show only the main longitudinal cracks that are at least 1/16" open, all other cracks are referred to by note for clarity. See *Table 1* on page 6 for a summary of the deteriorated areas by span.

#### Approach Spans:

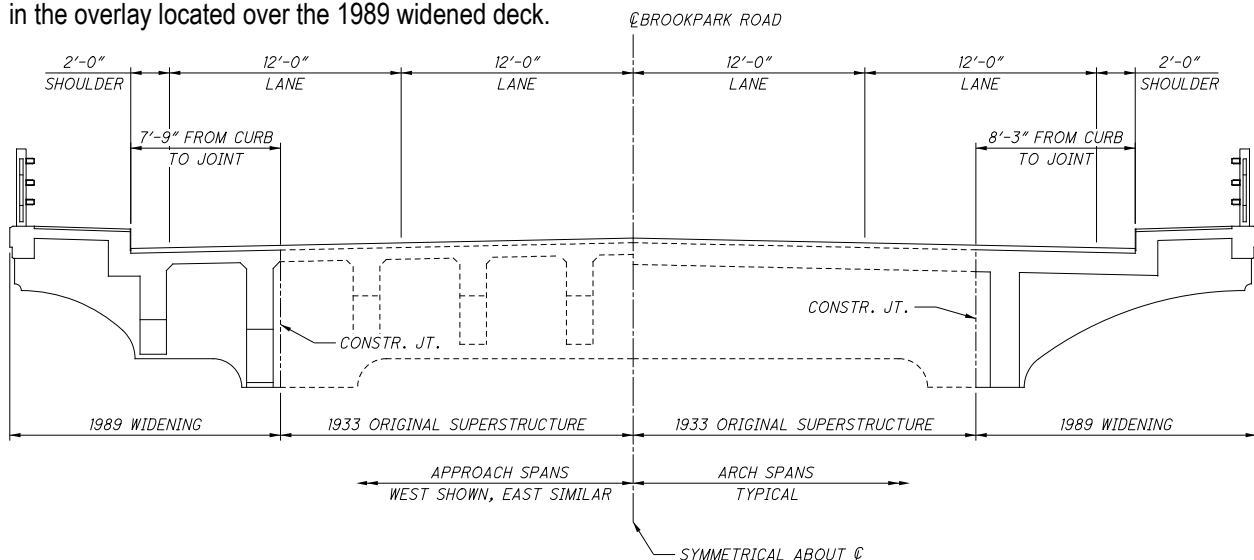
In general, the wearing surface is in Poor Condition, particularly in the areas over the original 1933 deck. Both approach spans exhibit large areas of pattern or map cracking with de-bonded overlay throughout (see *Photos 1 and 2*), and scattered areas of deep delamination and isolated locations of spalls. Please refer to the figures in Appendix A for detailed mapping of deterioration. These areas of deterioration typically begin 7' to 8' from the face of both curbs. The construction joint between the 1989 widening and the original 1933 deck is located at 7'-9" from the face of the both curbs (see *Figure 2*). Near this joint is a 1/16" open crack running longitudinally for the entire East and West Approach spans that stays within 7' to 8' of the face of the curbs. There is minor map cracking in the overlay located over the 1989 widened deck.



*Photo 1 – Large map cracks at least 1/16" wide throughout the East Approach Spans over the original deck area.*



*Photo 2 – Detail of irregular transverse cracks joining longitudinal cracks, typical. The overlay is typically de-bonded throughout both the East and West Approach spans in the original deck area.*



*Figure 2 – Superstructure typical sections showing the construction joints between the 1933 and 1989 construction.*





The original 1933 deck undersides for the West Approach Spans (Spans 1 through 6) are in Poor Condition and exhibit typical transverse cracks with water infiltration with delaminations and spalls. Approximately 14% of the slab is deteriorated, mostly following transverse cracks (see *Photos 3 and 4*).



*Photo 3 – Overall view of the original West Approach Span 3 underside exhibiting typical delaminations and spalling.*

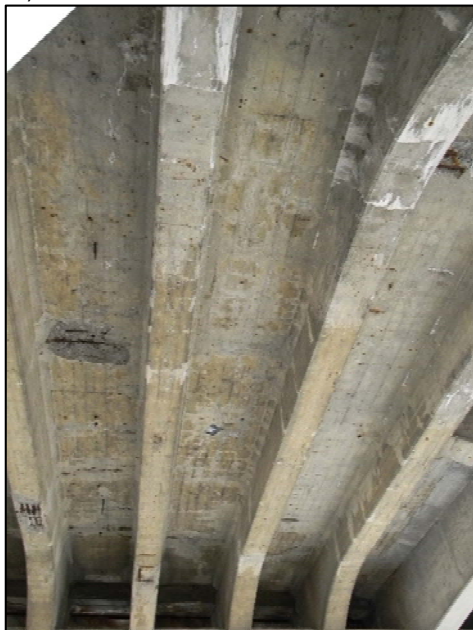


*Photo 4 – Overall view of the original West Approach Span 4 underside exhibiting typical delaminations and spalling. Note extensions of spalls to the stringers.*

The East Approach Spans (Spans 7 through 9) have similar cracks and spalls; however, they are more randomly located (see *Photo 5*). In both the West and East Approach spans, the 1989 widened portion of the deck exhibits transverse cracks with efflorescence that extend into the sidewalk framing (see *Photo 6*). The sidewalk framing condition is specifically discussed in the Railing Alternative Study as a separate document. The construction joints between the original and widened portions of the deck exhibit heavy efflorescence and seepage in all three East Approach Spans (see *Photo 7*).



*Photo 6 – Typical transverse cracks with efflorescence at 2-6 foot spacing in widened deck. Span 4, south end shown.*



*Photo 5 – Original East Approach Span 7 underside exhibiting typical delaminations and spalling. Note heavy efflorescence on stringers.*



*Photo 7 – Typical heavy efflorescence at construction joint. East Approach Span 9, south joint shown.*

### Arch Spans:

In general, the wearing surface is in Poor Condition, with a localized area of Serious Condition (Arch A Span described on the next page). The Arch spans have various longitudinal cracks that are 1/16" to 3/16" open, not including the areas of the crack that have chipped edges. Many cracks also exhibit locations of rust staining on the deck surface (see *Photo 8*). In addition, there are transverse cracks (many along the floor beams locations) that intersect the longitudinal cracks with typical de-bonding of the overlay adjacent to these cracks.

Large areas of delamination and scattered spalls are typical throughout all spans over the original 1933 deck area (see *Photos 9 and 10*). However, the 1989 widened deck overlay exhibits minor map cracking throughout. Please refer to the Figures in Appendix A for detailed mapping of deterioration. These areas of deterioration typically begin 8' to 8.5' from the face of both curbs. The construction joint between the 1989 widening and the original 1933 deck is located at 8'-3" from the face of the both curbs (see *Figure 2* above, and *Photo 11*). The arch spans also exhibit the same reflective minimum 1/16" open longitudinal crack near this joint.



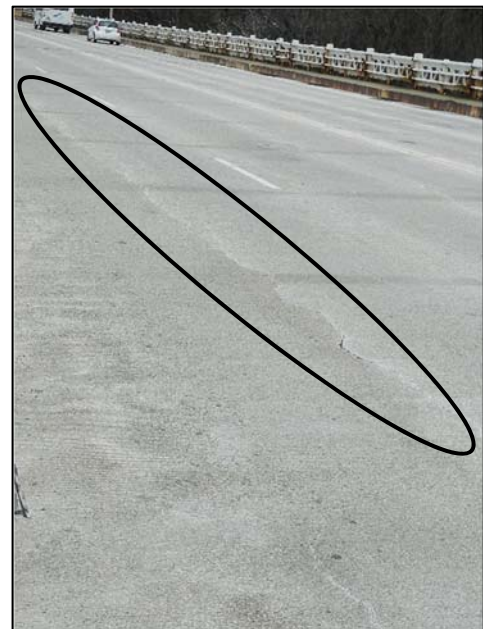
*Photo 9 – Localized area of delamination that has fractured and settled 1". This location is in the East end of Arch F, center EB lane shown.*



*Photo 10 – Typical spall filled in with asphalt. Arch D, north EB lane shown – the surrounding area is fully delaminated and note the rust staining.*



*Photo 8 – Longitudinal crack exhibiting active rust staining from crack. Arch H, center WB lane shown.*



*Photo 11 – Typical 1/16" longitudinal crack, approximately 8.5' from the curb face. Arch B, south EB lane shown.*





## CUY-17-02.83 Brookpark Rd Over the Rocky River Deck Inspection Report



The critical span is the Arch A span due to the approximately 1400 SF of failed wearing surface as a result of the spalling, fracturing, settling and rutting of the surface from 3/4" to little more than an 1", located at the west end of the center lanes (see *Photos 12 through 15*). This area also has at least two distinct, coincident layers of patches that have failed, indicating the deterioration is deep and continuous. In addition, the longitudinal cracks are open up to 1/4". This area should be monitored. Outside of this area, the overlay exhibits the typical cracks and delaminations as the other Arch spans.



*Photo 12 – Fully fractured and settled overlay and patches with a spall filled in with cracking asphalt.*



*Photo 13 – The overlay is beginning to fracture and settle at the asphalt-filled spalls. Note the conchoidal breaking of the deck surface at the bottom of the asphalt patch.*



*Photo 14 – Severe "block" cracking of the overlay and patches leading to fractured concrete.*



*Photo 15 – Overview of the failed overlay at the west end of Arch A showing various longitudinal cracks splitting and the fracturing of the surface indicating the spalled areas are actively growing. Photo taken during the sidewalk framing inspection atop the UB-40 truck.*



The Arch Span decks are generally in Poor Condition (excluding Arch A) with the original portions of the deck underside exhibiting large areas of water infiltration, cracks, delaminations, spalls with exposed reinforcing throughout all spans (see *Photos 16 through 18*). The exposed reinforcing is actively corroding, water stains the deck underside after rainfall or snow melt. Efflorescence stalactites occasionally form in these areas. Appendix A shows the estimated areas of deterioration (spalls and suspected areas of delamination) per bay. Arch A is discussed on the following page.



*Photo 16 – Overview of Arch B, interior Bays 9 and 10, seen from the south end. Typical water infiltration and efflorescence at the cracks. Note the continuation of spalling at locations where the deck was epoxy sealed.*



*Photo 17 – Delaminations with a fresh spall near the 1989 widening construction joint. Arch F, north end of interior Bay 7*



*Photo 18 – General view of the bottom of Arch G deck showing extent of water infiltration.*





CUY-17-02.83 Brookpark Rd Over the Rocky River  
Deck Inspection Report



The Arch A deck underside is in Serious Condition with large areas of exposed, corroding rebar (see *Photos 19 through 21*). There are various locations in the two west bays where water constantly drips a day after rainfall. This area coincides with the failed and settling patches in the deck surface above. This area should be monitored for a future, potential through-hole.

See Table 1 for a summary of the areas of deterioration in the overlay and in the 1933 deck undersides. Summing all the totals in the table below, 20% of the overlay and 26% of the deck underside are deteriorated.



Photo 19 – Interior Bay 1 of Arch A viewed from the south.



Photo 20 – Interior Bay 2 of Arch A viewed from the south.



Photo 21 – Interior Bay 4 of Arch A viewed from the south.

Summary of Deteriorated Areas of the Overlay and 1933 Deck Undersides						
Span Location	Wearing Surface			Deck Undersides		
	Total Area of Overlay (SF)	Deteriorated Area (SF)	Percentage	Total Area of 1933 Deck (SF)	Deteriorated Area (SF)	Percentage
West Approach Spans 1-6	10840	5614	52%	5259	813	15%
Arch A Span	9198	2123	23%	5644	2384	42%
Arch B Span	9997	2605	26%	6247	2266	36%
Arch C Span	9997	871	9%	6247	1309	21%
Arch D Span	9997	1924	19%	6247	1597	26%
Arch E Span	9997	731	7%	6247	1392	22%
Arch F Span	9997	505	5%	6247	1390	22%
Arch G Span	9997	987	10%	6247	1384	22%
Arch H Span	9198	217	3%	5644	1910	34%
East Approach Spans 7-9	6525	3972	61%	3096	380	12%

Table 1 – Summary of overlay and deck underside concrete deterioration by span. The deck underside area excludes any stringers and floor beams.



**SUMMARY OF DECK CONCRETE TESTING**

A total of 14 deck cores were taken throughout the structure by PSI, and compression strength and acid soluble chloride ion tests were taken (see Appendix B for PSI's full report and location map). Seven cores total were taken in the outside two lanes and seven cores total were taken in the center two lanes.

Cores were not taken in the failed, settled areas, to determine if the condition of concrete in general rather than focus on areas that are known to be deficient. *Table 2* shows the summary of the compressive strengths and the amount of chlorides. The amount of chlorides shown in the table are taken from the bottom of the core to show how deep the chlorides have penetrated the deck. Twelve of fourteen cores have more than 2 pounds of chlorides per cubic yard, which according to BDM 412, can serve as an indication that corrosion is active.

	Core Identification	Compressive Strength (psi)	Acid Soluble Chlorides (lb/cy) at Bottom of Core
Outside Lanes	C-1	4770	0.30456
	C-2	6630	2.43648
	C-3	4159	3.99735
	C-4	6160	2.55069
	C-5	2630	2.2842
	C-6	4080	3.88314
	C-7	5750	0.60912
Center Lanes	C-8	3680	5.10138
	C-9	6210	2.58876
	C-10	6690	4.22577
	C-11	6900	3.31209
	C-12	8390	3.27402
	C-13	7310	4.26384
	C-14	5820	3.12174

*Table 2 – Summary of Concrete Core testing. The red text are the chloride contents above 2 lb/cy*



## CONCLUSIONS AND RECOMMENDATIONS

The overlay is generally in Poor Condition and is nearing Serious Condition (by NBIS standards) because of localized areas of failure. The amount of open cracks, delaminations and spalls (approximately 20% of the total overlay area) is allowing salt water to penetrate the structural deck. The overlay is no longer functioning.

The Deck is in Serious Condition at the west end of Arch A with active corrosion and deterioration that is settling the surface of the deck. There is a potential of through hole(s) in this span. The condition of the deck elsewhere is in Poor Condition with delaminations, spalls, and exposed corroding reinforcing in the original 1933 deck concrete. Visually, approximately 26% of the original deck underside is deteriorated.

Immediate Recommended Deck Work (within the year):

- For the next inspection cycle, perform an arm's length, in-depth inspection of the slab utilizing testing or other methods to quantify full-depth repair.
- Perform full-depth repairs in conjunction with replacing the overlay with a latex modified concrete to keep water away from the deck for the remaining useful life.
- Remove all loose concrete over the roadway and park trails

Rehabilitation Recommended Deck Work (within 7-10 years as necessary):

- Option 1: Remove the existing deck and replace in-kind
- Option 2: Replace the existing deck with adjacent, prestressed box beams on modified widened floor beams (see *Figure 3* of example BEL-40-2338 Blaine Hill Open Spandrel Arch Bridge)

Maintenance Recommended Deck Work (Yearly):

- Continue to monitor the deck underside for potential spalling on park property. Provide netting as needed.

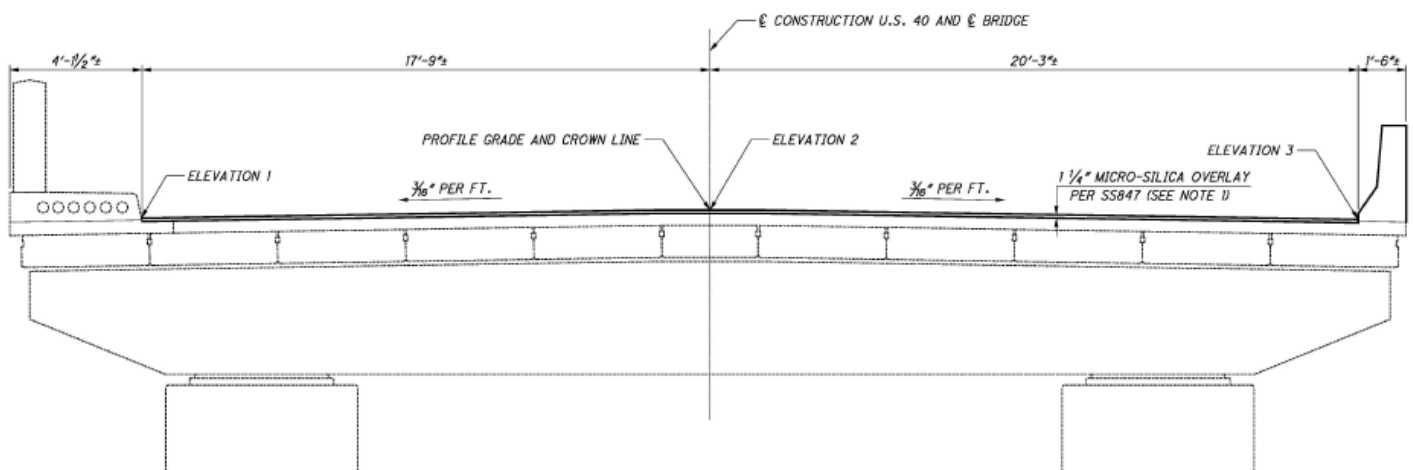


Figure 3 – Typical Section of BEL-40-2338 showing box beams on floor beam. Arch ribs shown at their highest point.




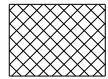


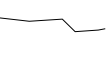
## APPENDIX A

### TOP OF DECK AND BOTTOM OF DECK CONDITION SURVEY

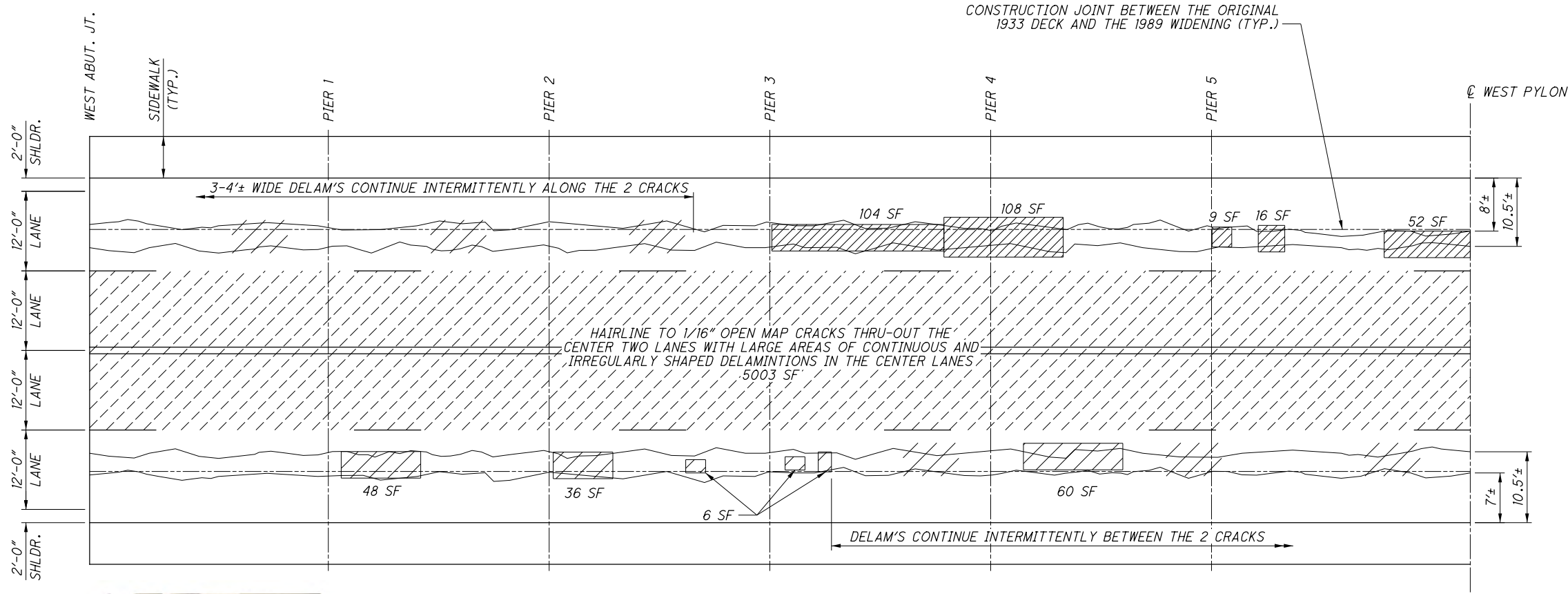




**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  OVERLAY DE-BONDING, SHALLOW DELAMINATION THROUGHOUT
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE

TOTAL AREA OF OVERLAY = 10840 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 5614 SF  
 52% DETERIORATION EXCLUDING CRACKS



**WEST APPROACH SPANS - TOP OF DECK**

**LEGEND:**

-  XXX SF VISUALLY ESTIMATED AREA OF DETERIORATION PER SPAN IN ORIGINAL DECK UNDERSIDE (SPAN AREA VARIES)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING STRINGERS AND BRACKETS = 5259 SF  
 TOTAL AREA OF DETERIORATION = 813 SF  
 15% DETERIORATION



**WEST APPROACH SPANS - BOTTOM OF DECK PHOTOS**

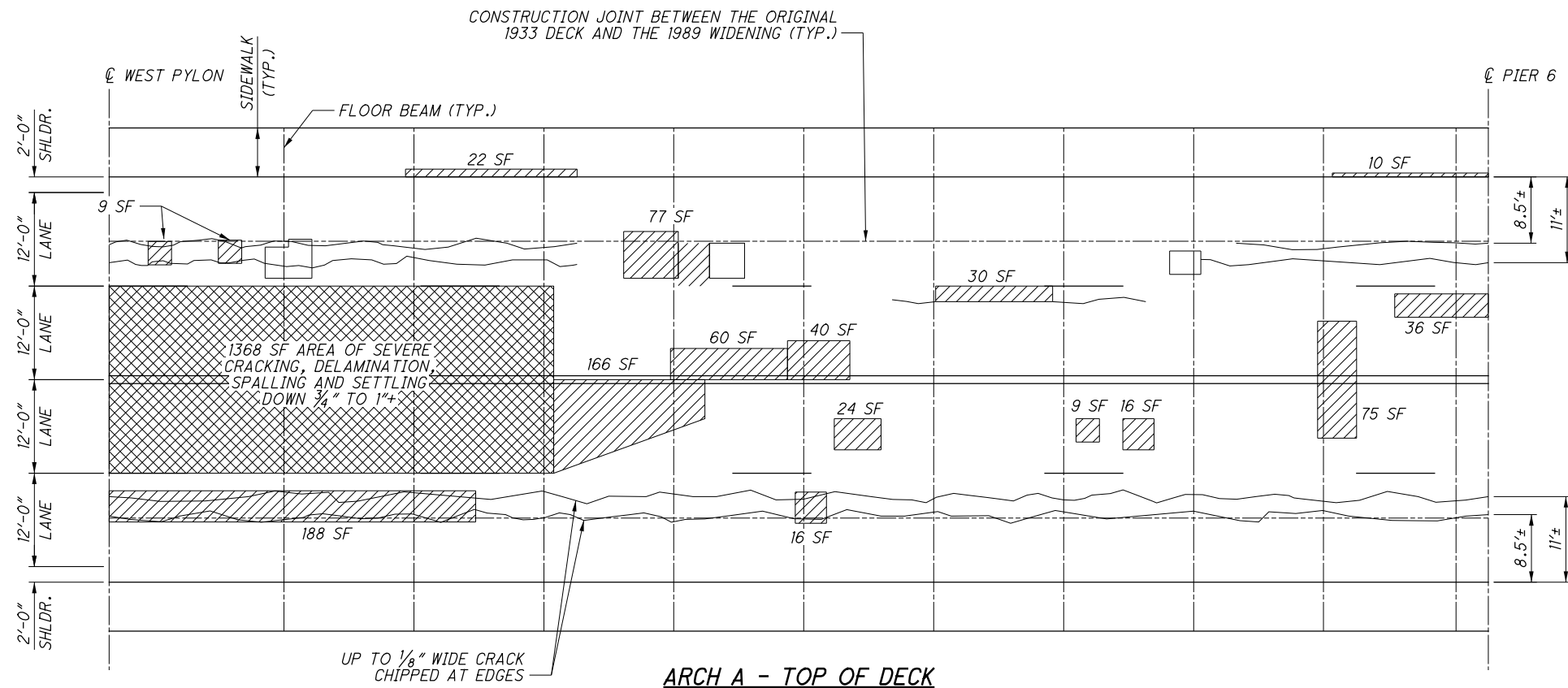
(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTOS REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)



**LEGEND:**

- DELAMINATION
- SPALL (UNFILLED OR FILLED WITH ASPHALT)
- INTERMITTENT DELAMINATIONS ALONG CRACKS
- LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
- EXISTING PATCH

TOTAL AREA OF OVERLAY = 9198 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 2123 SF  
 23% DETERIORATION EXCLUDING CRACKS



MAP CRACKING THRU-OUT ORIGINAL DECK AREA

**LEGEND:**

- XXX SF VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



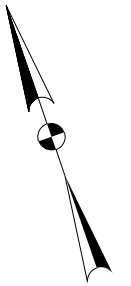
258 SF
195 SF
215 SF
393 SF
216 SF
255 SF
212 SF
233 SF
215 SF
192 SF

**ARCH A - BOTTOM OF DECK PHOTO**






(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 5644 SF  
 TOTAL AREA OF DETERIORATION = 2384 SF  
 42% DETERIORATION

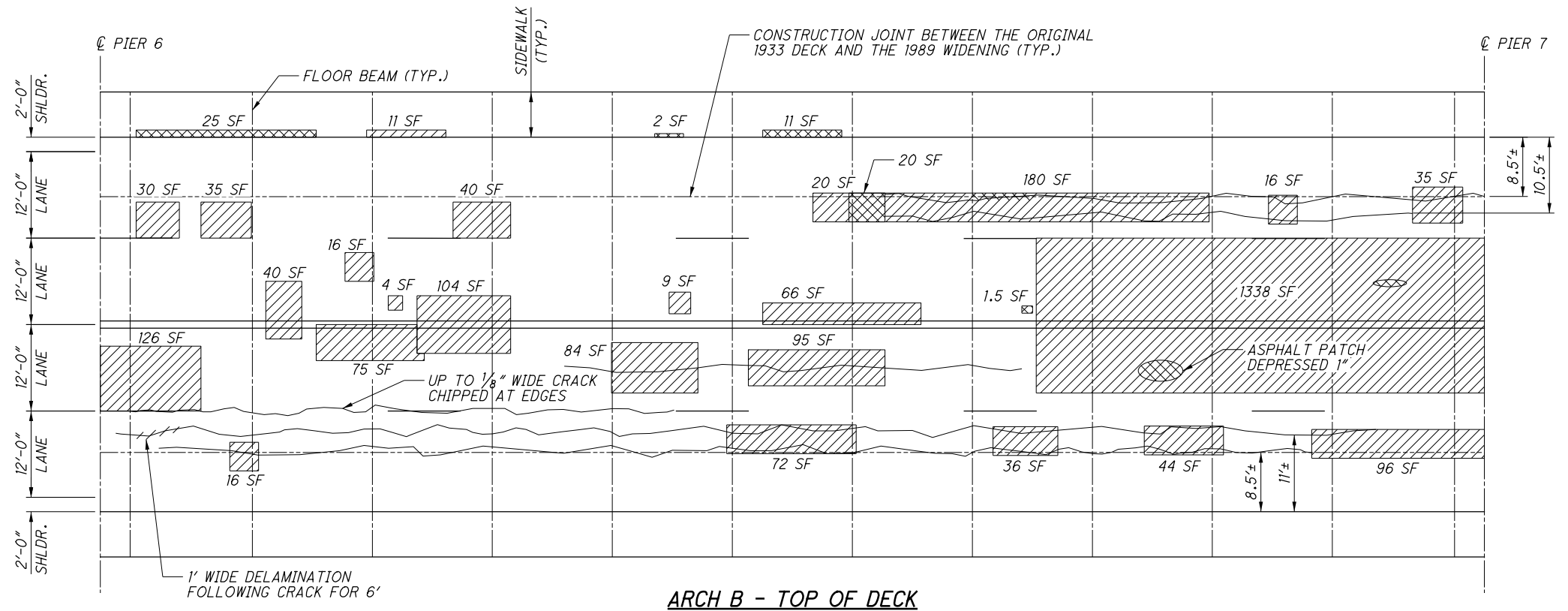




**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

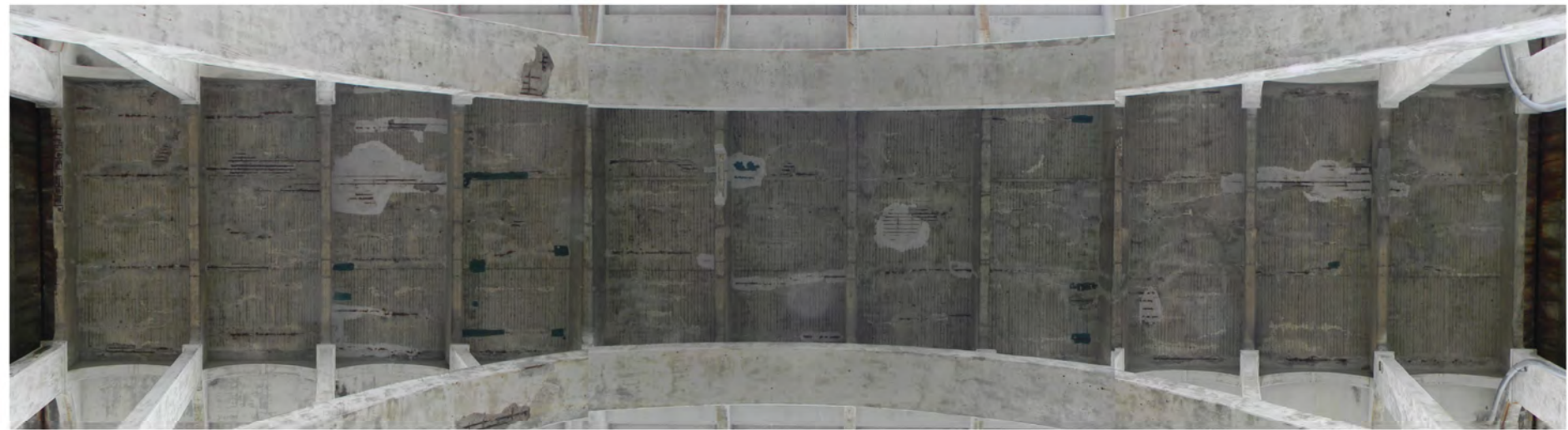
TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETEIORATION (SPALLS AND DELAMINATIONS ONLY) = 2605 SF  
 26% DETEIORATION EXCLUDING CRACKS



MAP CRACKING THRU-OUT ORIGINAL DECK AREA

**LEGEND:**

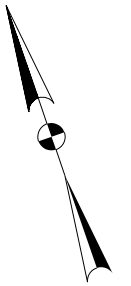
-  VISUALLY ESTIMATED AREA OF DETEIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



**ARCH B - BOTTOM OF DECK PHOTO**

(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

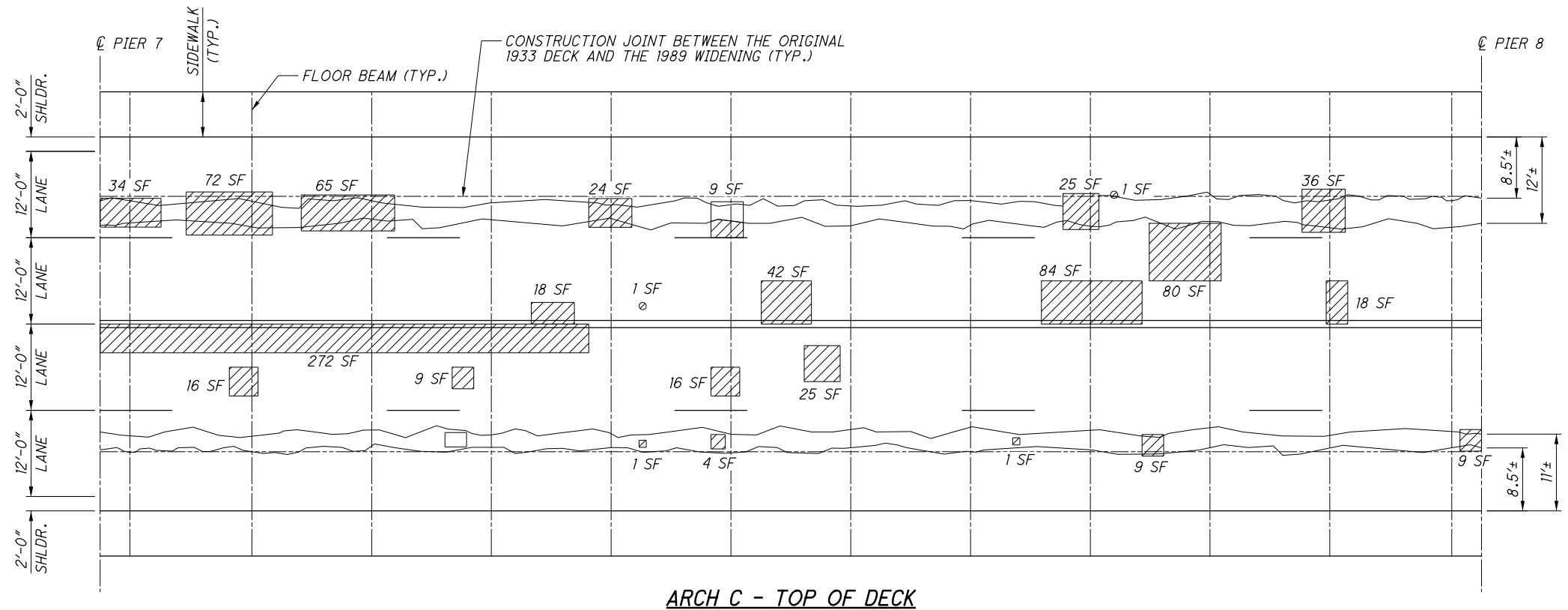
TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETEIORATION = 2266 SF  
 36% DETEIORATION



**LEGEND:**

- DELAMINATION
- SPALL (UNFILLED OR FILLED WITH ASPHALT)
- INTERMITTENT DELAMINATIONS ALONG CRACKS
- LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
- EXISTING PATCH

TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 871 SF  
 9% DETERIORATION EXCLUDING CRACKS



**LEGEND:**

- XXX SF VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



119 SF
35 SF
111 SF
71 SF
94 SF
145 SF
109 SF
210 SF
134 SF
175 SF
106 SF

**ARCH C - BOTTOM OF DECK PHOTO**







(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETERIORATION = 1309 SF  
 21% DETERIORATION

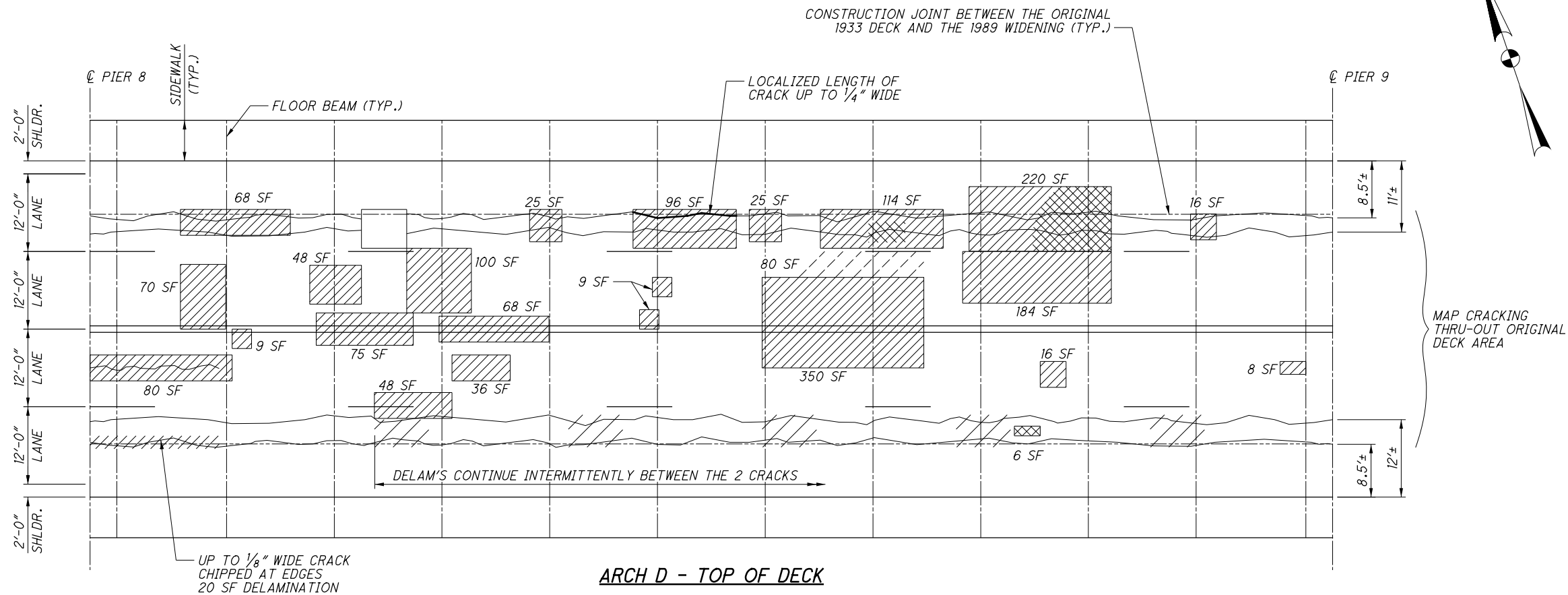


P:\101682\_CUY-17-2.83\Design\Structures\CUY17\_2.83C\Inspection\deck\_base\map\deck\_base\map.dgn 4/12/2016 10:28:25 AM nroman

**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH
-  OVERLAY DE-BONDING, SHALLOW DELAMINATION THROUGHOUT

TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 1924 SF  
 19% DETERIORATION EXCLUDING CRACKS



**LEGEND:**

-  XXX SF VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



**ARCH D - BOTTOM OF DECK PHOTO**






(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETERIORATION = 1597 SF  
 26% DETERIORATION

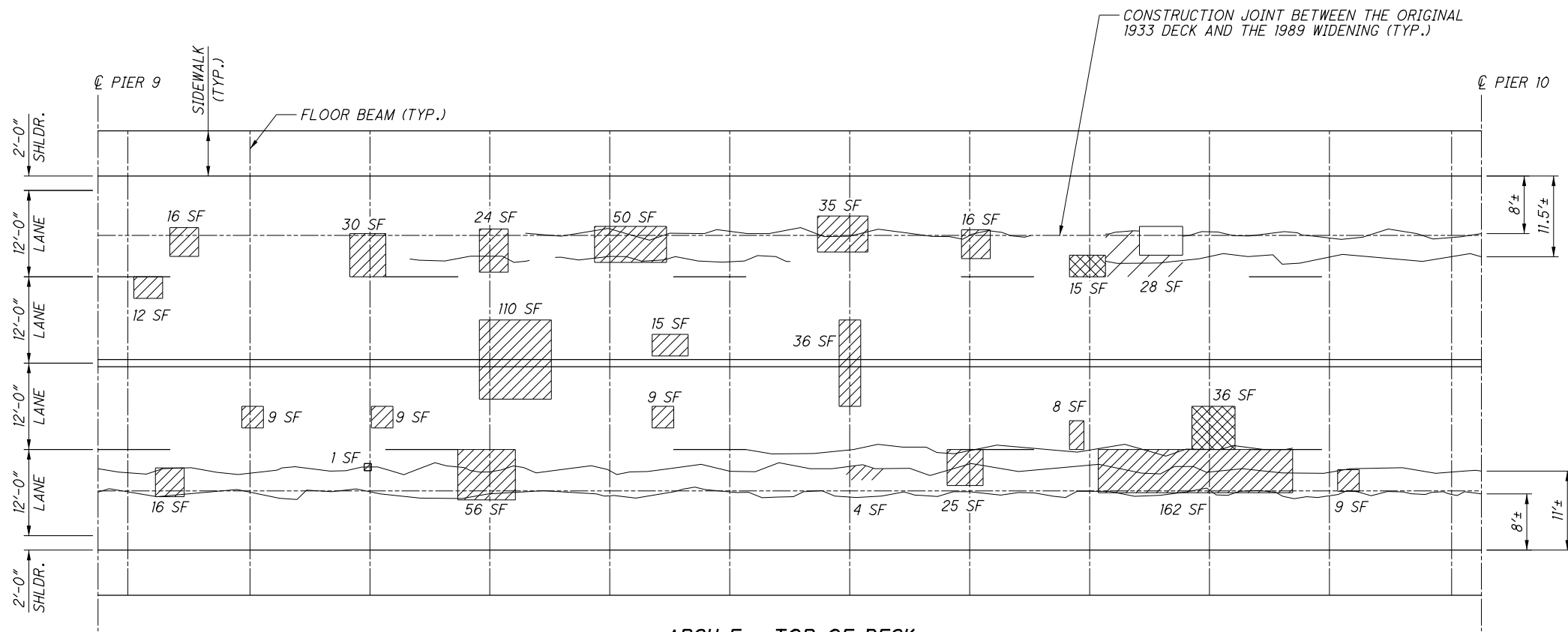


P:\101682\_CUY-17-2.83\Design\Structures\CUY17\_2.83C\inspection\deck\_base\map\deck\_base\map.dgn 4/12/2016 10:28:43 AM nroman

**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 731 SF  
 7% DETERIORATION EXCLUDING CRACKS



**ARCH E - TOP OF DECK**

**LEGEND:**

-  VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



114 SF    111 SF    186 SF    92 SF    86 SF    112 SF    160 SF    132 SF    154 SF    117 SF    128 SF






**ARCH E - BOTTOM OF DECK PHOTO**

(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

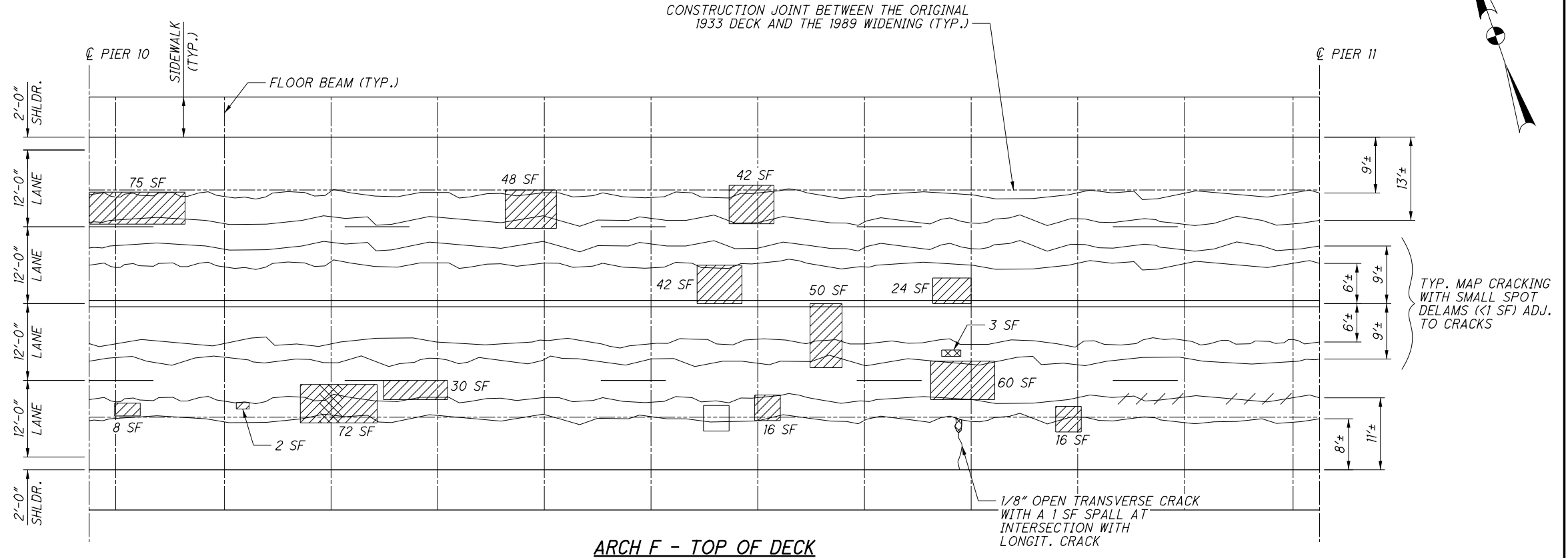
TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETERIORATION = 1392 SF  
 22% DETERIORATION

P:\101682\_CUY-17-2.83\Design\Structures\CUY17-2.83C\inspection\deck\_base\map\deck\_base\map.dgn 4/12/2016 10:28:59 AM nroman

**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 505 SF  
 5% DETERIORATION EXCLUDING CRACKS



**LEGEND:**

-  VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



90 SF    90 SF    88 SF    133 SF    200 SF    110 SF    146 SF    113 SF    119 SF    182 SF    119 SF

**ARCH F - BOTTOM OF DECK PHOTO**






(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETERIORATION = 1390 SF  
 22% DETERIORATION

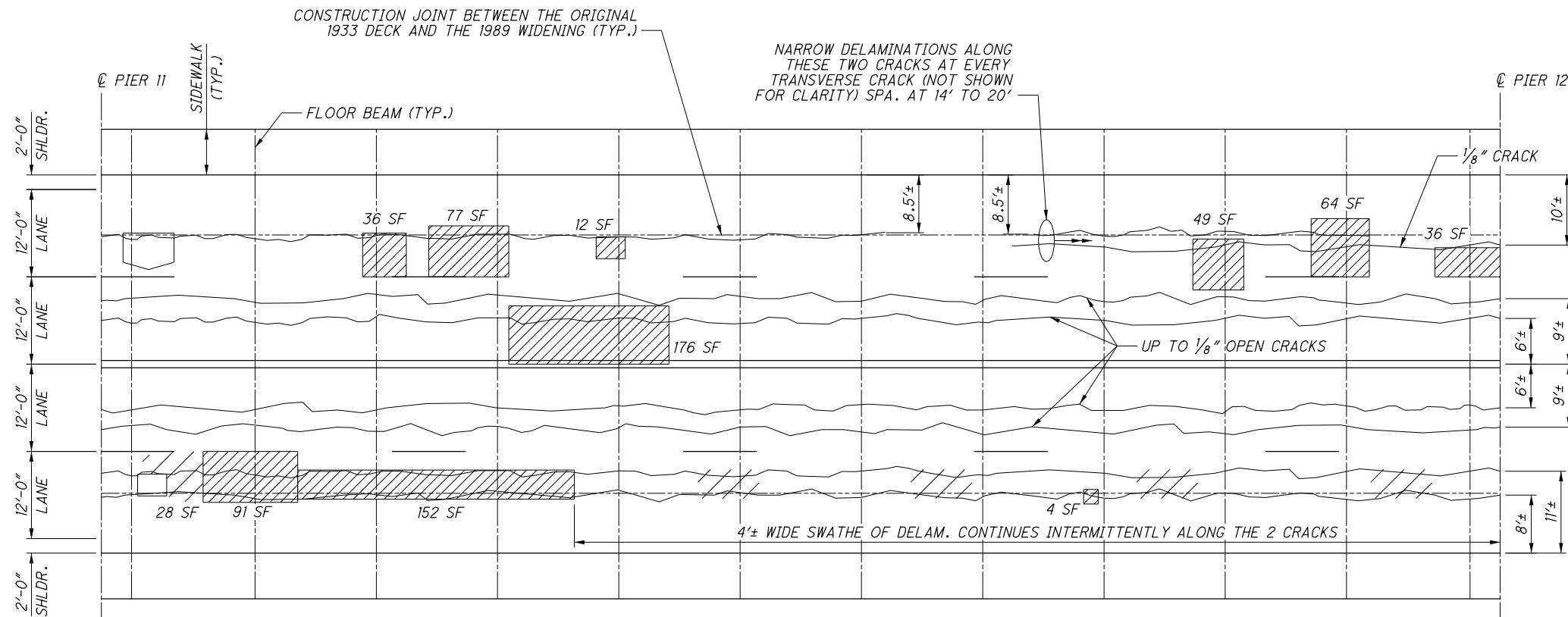


P:\101682\_CUY-17-2.83\Design\Structures\CUY17-2.83C\inspection\deck\_base\map\deck\_base\map.dgn 4/12/2016 10:29:16 AM nroman

**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

TOTAL AREA OF OVERLAY = 9997 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 987 SF  
 10% DETERIORATION EXCLUDING CRACKS



TYP. MAP CRACKING WITH SMALL SPOT DELAMS (<1 SF) ADJ. TO CRACKS

**ARCH G - TOP OF DECK**

**LEGEND:**

-  VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)



163 SF    221 SF    173 SF    101 SF    80 SF    77 SF    89 SF    113 SF    116 SF    84 SF    131 SF

**ARCH G - BOTTOM OF DECK PHOTO**






(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 6247 SF  
 TOTAL AREA OF DETERIORATION = 1384 SF  
 22% DETERIORATION

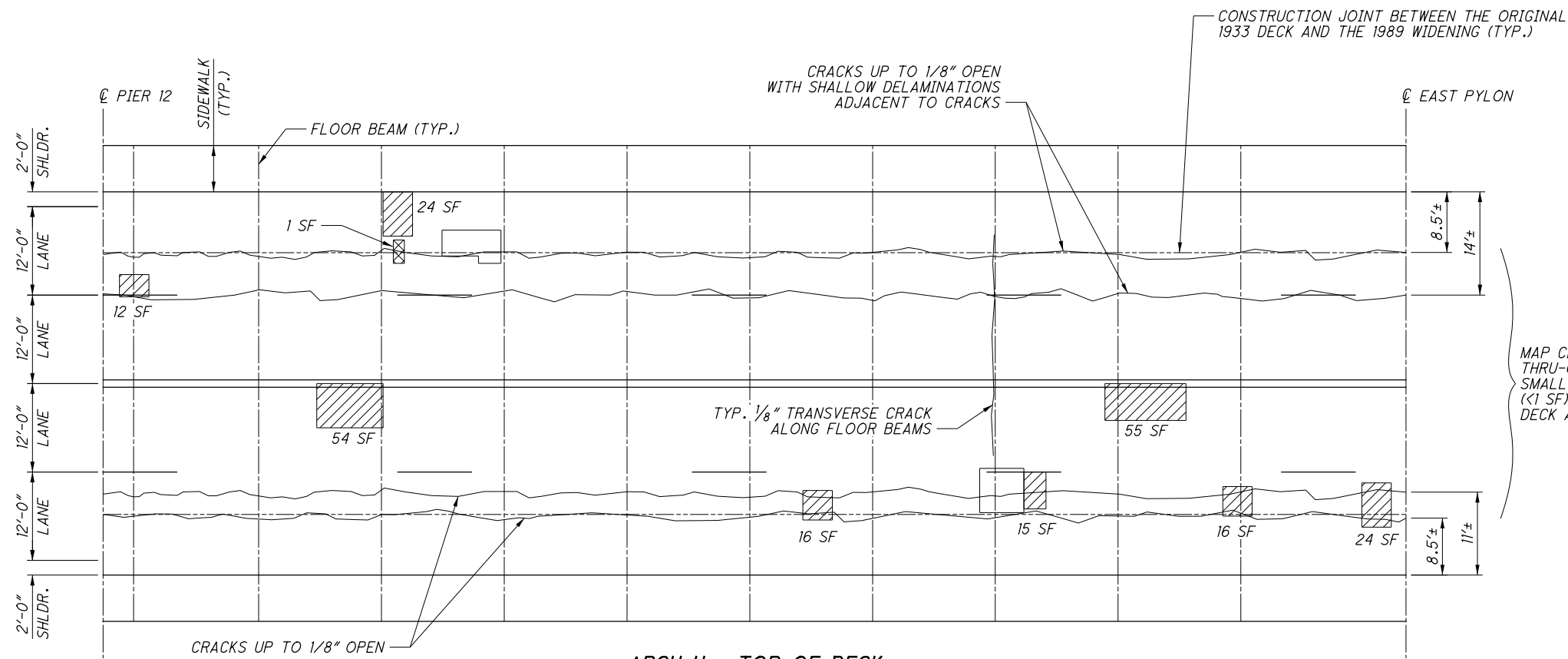


P:\101682\_CUY-17-2.83\Design\Structures\CUY17-2.83C\inspection\deck\_base\map\deck\_base\map.dgn 4/12/2016 10:29:32 AM nroman

**LEGEND:**

-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  INTERMITTENT DELAMINATIONS ALONG CRACKS
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

TOTAL AREA OF OVERLAY = 9198 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 217 SF  
 3% DETERIORATION EXCLUDING CRACKS



**ARCH H - TOP OF DECK**

**LEGEND:**

-  VISUALLY ESTIMATED AREA OF DETERIORATION PER BAY IN DECK UNDERSIDE (TYPICAL BAY IS APPROXIMATELY 565.8 SF)

UNABLE TO SCALE PICTORIALY, DUE TO EXTREME ANGLE OF PHOTOS. PHOTOS ARE ANGLED SINCE ARCH H SPANS OVER THE ROCKY RIVER. SCALED BY COUNTING REBAR WHERE POSSIBLE AND ESTIMATING. (TYP.)



162 SF    460 SF    158 SF    225 SF    177 SF    168 SF    181 SF    146 SF    125 SF    108 SF

**ARCH H - BOTTOM OF DECK PHOTO**

(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTO TAKEN NORTH AT TOP, PICTURE REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)






TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING FLOOR BEAMS = 5644 SF  
 TOTAL AREA OF DETERIORATION = 1910 SF  
 34% DETERIORATION

**NOTE:**

REBAR SPACING IS ASSUMED 6" AT MIDSPAN AND 12" AT FLOORBEAMS DUE TO ALTERNATING STRAIGHT AND BENT BARS.

P:\101682\_CUY-17-2.83\Design\Structures\CUY17-2.83C\inspection\deck\_base\map\dgn 4/12/2016 10:29:49 AM nroman

**LEGEND:**

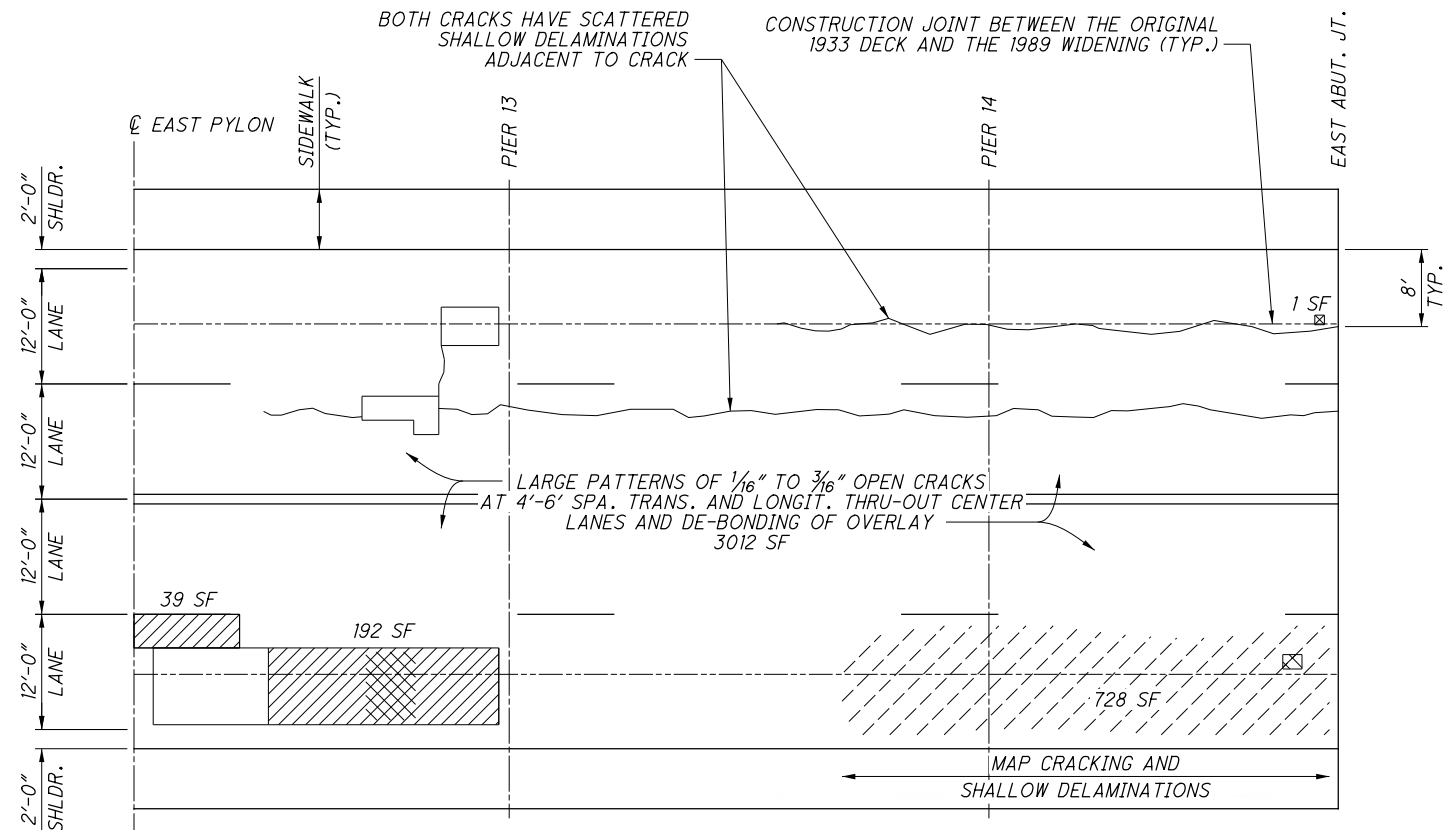
-  DELAMINATION
-  SPALL (UNFILLED OR FILLED WITH ASPHALT)
-  OVERLAY DE-BONDING, SHALLOW DELAMINATION THROUGHOUT
-  LONGITUDINAL CRACK OPEN 1/16" UNLESS NOTED OTHERWISE
-  EXISTING PATCH

TOTAL AREA OF OVERLAY = 6525 SF  
 TOTAL AREA OF DETERIORATION (SPALLS AND DELAMINATIONS ONLY) = 3972 SF  
 61% DETERIORATION EXCLUDING CRACKS

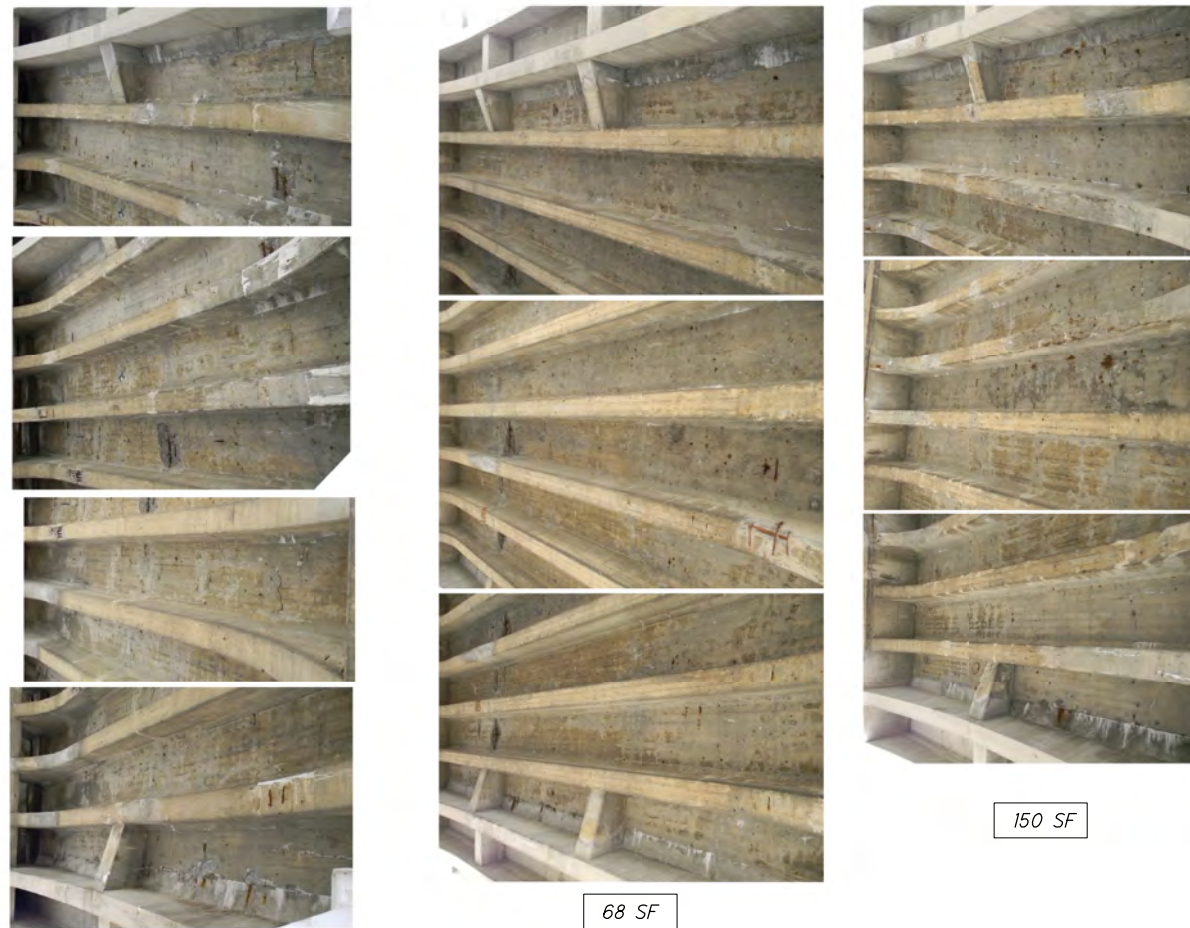
**LEGEND:**

-  VISUALLY ESTIMATED AREA OF DETERIORATION PER SPAN IN ORIGINAL DECK UNDERSIDE (SPAN AREA VARIES)

TOTAL ORIGINAL DECK UNDERSIDE AREA NOT COUNTING STRINGERS AND BRACKETS = 3096 SF  
 TOTAL AREA OF DETERIORATION = 380 SF  
 12% DETERIORATION



**EAST APPROACH SPANS - TOP OF DECK**



**EAST APPROACH SPANS - BOTTOM OF DECK PHOTOS**

(ORIGINAL CONCRETE SHOWN ONLY)  
 (PHOTOS REVERSED TO MATCH WEST-EAST ORIENTATION OF DECK TOP PLAN)



## APPENDIX B

### CONCRETE CORE TESTING REPORT



April 6, 2016

Mr. Jason T. Wise, P.E.  
**E.L. Robinson Engineering**  
Project Manager - Cleveland  
1468 West 9th Street, Suite 500  
Cleveland, OH 44113  
[www.elrobinsonengineering.com](http://www.elrobinsonengineering.com)

Re: Report for Bridge Deck Coring  
Cuy-17-2.83  
PID No.: 101682  
Cleveland, Cuyahoga County, Ohio  
**PSI Project No.: 01412287**

Dear Mr. Wise:

Enclosed is PSI's Report of Pavement Cores regarding the cores that were obtained from the site at the above-referenced project. PSI's services for this project were performed in accordance with PSI's Proposal No. 0141-169366, dated December 29, 2015. Authorization to perform this exploration was in the form of a signed sub consultant agreement between PSI and E.L Robinson Engineering, on February 2, 2016.

The scope of services for this project included pavement coring at fourteen (14) specified locations, taking photographs of the existing pavement condition, measuring the GPS readings at each core location, measuring the thickness and condition of the pavement sections, and taking photographs of each core. Laboratory test results include acid soluble chloride ion content and compressive strength test.

The number and locations of the pavement cores were selected and field located by representatives of E.L Robinson Engineering. Enclosed with this report are the following:

- Pavement Core Location Plans, showing the approximate locations of each pavement core;
- Core Photo Logs: showing the core number, approximate GPS reading, approximate thickness, composition, and condition of the pavement cores;
- Pavement Photo Logs: Show the existing condition of pavement at core locations.

Compressive strength testing was conducted on each core sample in general accordance to ASTM C42/C42M-13 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete. Test results can be found summarized in the table below.

<b>Core Number</b>	<b>Diameter (in)</b>	<b>Height (in)</b>	<b>Area (in<sup>2</sup>)</b>	<b>H/D</b>	<b>Load (lbs)</b>	<b>Correction Factor</b>	<b>Compressive Strength (psi)</b>
<b>C-1</b>	3.70	8.18	10.75	2.21	51290	1.00	<b>4770</b>
<b>C-2</b>	3.70	6.56	10.75	1.77	72760	0.98	<b>6630</b>
<b>C-3</b>	3.70	6.08	10.75	1.64	46110	0.97	<b>4159</b>
<b>C-4</b>	3.70	5.82	10.75	1.57	68230	0.97	<b>6160</b>
<b>C-5</b>	3.70	3.92	10.75	1.06	32180	0.88	<b>2630</b>
<b>C-6</b>	3.70	7.69	10.75	2.08	43840	1.00	<b>4080</b>
<b>C-7</b>	3.70	8.21	10.75	2.22	61790	1.00	<b>5750</b>
<b>C-8</b>	3.70	4.17	10.75	1.13	44480	0.89	<b>3680</b>
<b>C-9</b>	3.66	4.29	10.52	1.17	73440	0.89	<b>6210</b>
<b>C-10</b>	3.70	6.35	10.75	1.72	73420	0.98	<b>6690</b>
<b>C-11</b>	3.70	6.55	10.75	1.77	75660	0.98	<b>6900</b>
<b>C-12</b>	3.70	7.49	10.75	2.02	90220	1.00	<b>8390</b>
<b>C-13</b>	3.70	7.55	10.75	2.04	78580	1.00	<b>7310</b>
<b>C-14</b>	3.66	6.18	10.52	1.69	63070	0.97	<b>5820</b>

Acid Soluble Chloride Ion Content testing was conducted on each sample in general accordance to AASHTO T-260. Test results can be found summarized in the table below.

Core Number	Depth (in)	Acid Soluble Chlorides (lbs/cy <sup>3</sup> )**	Acid Soluble Chlorides (%)	Core Number	Depth (in)	Acid Soluble Chlorides (lbs/cy <sup>3</sup> )**	Acid Soluble Chlorides (%)
C-1	2"	0.79947	0.021	C-8	5"	5.86278	0.154
C-1	10"	0.30456	0.008	C-8	8.5"	5.10138	0.134
C-2	2"	3.807	0.1	C-9	6.5"	7.57593	0.199
C-2	10"	2.43648	0.064	C-9	10.5"	2.58876	0.068
C-3	2.5"	4.11156	0.108	C-10	3.5"	5.10138	0.134
C-3	11"	3.99735	0.105	C-10	11.5"	4.22577	0.111
C-4	2.5"	7.46172	0.196	C-11	3.5"	4.60647	0.121
C-4	8"	2.55069	0.067	C-11	12"	3.31209	0.087
C-5	3"	5.25366	0.138	C-12	4.5"	5.67243	0.149
C-5	11"	2.2842	0.06	C-12	12"	3.27402	0.086
C-6	4"	12.82959	0.337	C-13	4.5"	4.75875	0.125
C-6	10"	3.88314	0.102	C-13	11.5"	4.26384	0.112
C-7	2"	2.24613	0.059	C-14	4.5"	3.23595	0.085
C-7	10"	0.60912	0.016	C-14	11"	3.12174	0.082

\*\*Based on an assumed concrete unit weight of 141 lbs/ft<sup>3</sup>.

PSI assumes no responsibility for interpretation made by others. The collected pavement core samples are available for inspection. The cores will be retained for a period of 30 days after the date of this report and disposed thereof.

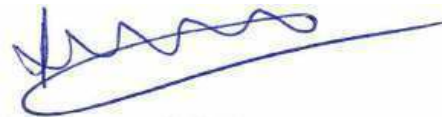
PSI appreciates the opportunity to have been of service to you on this project. If we can be of further assistance, please do not hesitate to contact us at 216-447-1335.

Respectfully submitted,

**PROFESSIONAL SERVICE INDUSTRIES, INC.**



Andrew Croasmun  
 Laboratory Supervisor



A. Veeramani, P.E.  
 Vice President

Enclosures:

- Pavement Core Location Plans
- Core Photo Logs with Core Descriptions
- Pavement Photo Logs





**psi** Information  
To Build On  
Engineering • Consulting • Testing

Pavement Coring  
CUY-17-2.83 (PID No.: 101682)  
Cuyahoga County, Ohio

Date: 4/5/2016

Taken By: AC

Scale: NA

Core Location Plan

PSI Project No.:

01412287





**psi** Information  
 To Build On  
 Engineering • Consulting • Testing

Pavement Coring  
 CUY-17-2.83 (PID No.: 101682)  
 Cuyahoga County, Ohio

Date: 4/5/2016

Taken By: AC


Scale: NA

Core Location Plan

PSI Project No.:


01412287




Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-1	<b>CUY-17-2.83</b> <b>WB-RL-MOL</b> Latitude : 41.4196888° Longitude : -81.8582516°	A	1 ½"	--	Good Condition
		B	--	11"	Good Condition
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>






Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-2	<b>CUY-17-2.83 WB-RL-LWT</b> Latitude : 41.4196888° Longitude : -81.8582516°	A	1 ½"	--	Good Condition	
		B	--	11"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016	<b>Core Photo Log</b>
					Taken By: AC	
					Scale: NA	01412287




Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-3	<b>CUY-17-2.83</b> <b>WB-RL-LWT</b> Latitude : 41.4201411° Longitude : -81.8599976°	A	2"	--	Good Condition, Separated During Coring
		B	--	11"	Good Condition
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-4	<b>CUY-17-2.83 EB-RL-MOL</b> Latitude : 41.4203670° Longitude : -81.8612659°	A	2"	--	Good Condition	
		B	--	6 ½"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016	<b>Core Photo Log</b>
					Taken By: AC	
					Scale: NA	01412287






Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-5	<b>CUY-17-2.83 EB-RL-LWT</b> Latitude : 41.4201703° Longitude : -81.8604578°	A	2 ¼"	--	Good Condition
		B	--	10 ¾"	Good Condition, Cracked During Coring
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-6	<b>CUY-17-2.83</b> <b>EB-RL-RWT</b> Latitude : 41.4196973° Longitude : -81.8586651°	A	3 ½"	--	Good Condition, Separated During Coring	
		B	--	8 ½"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Date: 4/5/2016</b> <b>Taken By: AC</b> <b>Scale: NA</b>	<b>Core Photo Log</b> <b>PSI Project No.:</b> <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-7	<b>CUY-17-2.83 EB-RL-MOL</b> Latitude : 41.4192599° Longitude : -81.8570190°	A	1 ½"	--	Good Condition, Separated During Coring
		B	--	10 ½"	Good Condition
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>






Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-8	<b>CUY-17-2.83 WB-LL-LWT</b> Latitude : 41.4189748° Longitude : -81.8556629°	A	4 ¼"	--	Good Condition, Cracked During Coring	
		B	--	4 ½"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-9	<b>CUY-17-2.83 EB-LL-LWT</b> Latitude : 41.4190941° Longitude : -81.8562100°	A	6"	--	Good Condition	
		B	--	5 ½"	Fair Condition, Cracked Prior to Coring	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-10	CUY-17-2.83 WB-LL-MOL Latitude : 41.4194450° Longitude : -81.8574588°	A	2 ½"	--	Good Condition	
		B	--	9 ¾"	Fair Condition, Cracked Prior to Coring	
		Pavement Coring CUY-17-2.83 (PID No.: 101682) Cuyahoga County, Ohio			Date: 4/5/2016 Taken By: AC Scale: NA	Core Photo Log PSI Project No.: 01412287






Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
C-11	<b>CUY-17-2.83</b> <b>EB-LL-MOL</b> Latitude : 41.4195077° Longitude : -81.8578268°	A	3"	--	Good Condition, Cracked Prior to Coring	
		B	--	10"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>




Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-12	<b>CUY-17-2.83</b> <b>WB-LL-MOL</b> Latitude : 41.4198822° Longitude : -81.8591331°	A	3 ¾"	--	Good Condition, Separated Prior to Coring
		B	--	9"	Good Condition
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>



Core Number	Location	Layers	Core Composition		Remarks
			LMC Overlay	Bridge Deck	
C-13	<b>CUY-17-2.83 EB-LL-LWT</b> Latitude : 41.4199421° Longitude : -81.8594755°	A	3 ¾"	--	Good Condition
		B	--	8 ½"	Good Condition
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>






Core Number	Location	Layers	Core Composition		Remarks	
			LMC Overlay	Bridge Deck		
<b>C-14</b>	<b>CUY-17-2.83</b> <b>WB-LL-LWT</b> Latitude : 41.4203146° Longitude : -81.8608126°	A	3 ¾"	--	Good Condition, Separated Prior to Coring	
		B	--	7 ¾"	Good Condition	
		<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			Date: 4/5/2016 Taken By: AC Scale: NA	<b>Core Photo Log</b> PSI Project No.: <b>01412287</b>



Pavement Photo C-1



Pavement Photo C-2

	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016






Pavement Photo C-3



Pavement Photo C-4

	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>		<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016






Pavement Photo C-5



Pavement Photo C-6


	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016	PSI Project No: <b>01412287</b>



Pavement Photo C-7



Pavement Photo C-8

	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016	PSI Project No: <b>01412287</b>






Pavement Photo C-9



Pavement Photo C-10

	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016	PSI Project No: <b>01412287</b>






Pavement Photo C-11



Pavement Photo C-12


	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016	PSI Project No: <b>01412287</b>



Pavement Photo C-13



Pavement Photo C-14

	<b>Pavement Coring</b> <b>CUY-17-2.83 (PID No.: 101682)</b> <b>Cuyahoga County, Ohio</b>			<b>Pavement Photo Log</b>
	Scale: NA	Taken By: AC	Date: 4/6/2016	PSI Project No: <b>01412287</b>