



FRACTURE CRITICAL PIER CAP INSPECTION REPORT

SFN3106659 (HAM-71-0197W)
TWO SINGLE LANES OF RAMP TOWARD
SB I-471 OVER A RAMP FROM GILBERT
AVENUE TO NB I-71
HAMILTON COUNTY, OH
DISTRICT 8

Prepared for:



Prepared by:

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FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0	INTRODUCTION	1
1.1	Purpose and Scope	1
1.2	General Description of the Structure	1
1.3	Method of Investigation	2
1.4	Condition Ratings	4
2.0	EXISTING CONDITIONS.....	5
2.1	Pier Cap Conditions	5
2.1.1	Pier Cap 1	5
2.1.1.1	Pier Cap 1 Interior.....	5
2.1.1.2	Pier Cap 1 Exterior	6
2.1.1.4	Fatigue Prone Details.....	8
3.0	EVALUATION AND RECOMMENDATIONS	10
	EXHIBIT 1 – EXISTING PIER PLANS	12
	EXHIBIT B – REHABILITATION PLANS.....	14

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



EXECUTIVE SUMMARY

- Project:** VAR-District 8 Bridge Inspections No. 2023-4. (PID No. 105476)
- Purpose of Project:** To perform a fracture critical inspection of fracture critical steel pier caps of bridges for the Ohio Department of Transportation, District 8.
- Inspection Team:**
Team Leader – Michael Seal, P.E. – Collins Engineers, Inc.
Team Member – Trent Graham – Collins Engineers, Inc.
Team Member – Matt McFadden E.I.T. – Gannett Fleming, Inc.
- Inspection Date(s):** July 13, 2023

Summary of Findings:

- At the east (compass south) access hatch corrosion has reactivated on the end plate, resulting in slight growth to the small area of 100% section loss. The corrosion hole now measures in total 1-1/2 in. in length x 1/2 in. in height. There is up to 50% section loss for the rest of the width and scattered areas of light pitting around the east hatch as well.
- Areas where ponding typically would build were dry throughout the 2023 inspection. There is active corrosion located on Diaphragm T likely cause from prior water ponding in the past.
- The drilled hole and sawcut retrofits are performing as designed.
- Overall, there were no major changes to the structure from the prior inspection.

Summary of Recommendations:

- Spot clean and paint the interior, focusing on the underside of the flange tie plates and adjacent areas, and repaint the south end plate.
- Future inspections should monitor the drilled hole retrofits and sawcuts to ensure they continue to function as designed.
- Future inspections should monitor the interior for ponding water or other signs are moisture infiltration. While noted in the past, the cap interior has been dry over the past couple inspection cycles.

NBI Ratings:

<u>Item ID</u>	<u>Description</u>	<u>Condition Rating</u>	<u>Summary</u>
B.C.14	NSTM	7-Good	Small, isolated section loss. Active corrosion has reactivated on the end plates.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



AASHTO National Bridge Element (NBE) Ratings:

Element #	Description	Units	Total	Condition State			
				1	2	3	4
152	Steel Floor Beam	LF	60	5	54	1	0

Note: Ratings were developed using the FHWA Specifications for the National Bridge Inventory and AASHTO Manual for Bridge Element Inspection, 2nd Edition.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



1.0 INTRODUCTION

1.1 Purpose and Scope

This report consists of the results of a detailed inspection of non-redundant steel tension members (fracture critical) performed at the two single lanes of ramp traffic to southbound I-471 Bridge over a ramp from Gilbert Avenue to NB I-71 in Hamilton County, OH. Collins Engineers, Inc. (Collins) conducted the fracture critical pier cap investigation for the Ohio Department of Transportation (ODOT), District 8 on July 13, 2023.

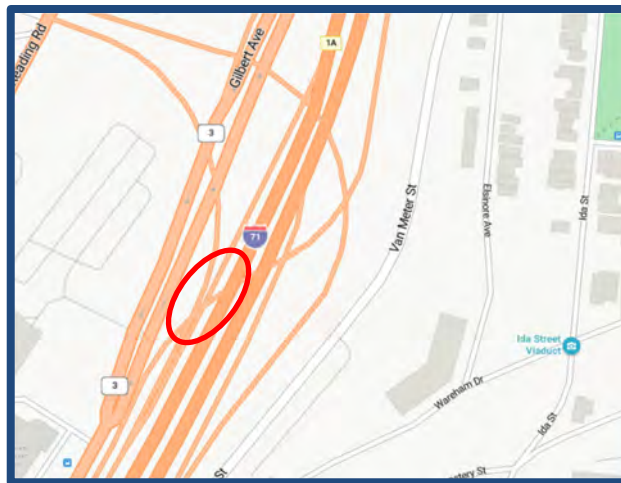


Figure 1: Bridge Location Map

1.2 General Description of the Structure

The HAM-71-0197W Bridge is a three-span welded steel plate girder structure with a reinforced concrete deck that carries two single lanes of ramp traffic to southbound Interstate I-471. The west lane carries traffic from the intersection of Liberty Street and Reading Road, and the east lane carries traffic from southbound Interstate I-71. A ramp from Gilbert Avenue to northbound Interstate I-71 passes beneath the structure.

The structure has one fracture critical integral pier cap which is located at Pier 1. The pier cap is a welded steel plate box girder that is simply supported on two circular reinforced concrete columns. Seven I-girders frame into the pier cap and are made continuous by bottom flange tie plates that pass-through slots and are welded to the pier cap webs, and by top flange tie plates that bear on and are bolted to the top flange of the

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



pier cap. The girder webs are connected to the pier cap webs by bolted connection plates. Knee braces are welded to the bottom tie plates and pier cap webs for additional rigidity.

The nomenclature and girder designation shown on the design plans were used in the inspection of the pier cap. In 2009, the bridge pier cap was rehabilitated to improve areas of corrosion and problematic weld details. The exterior of the cap was also painted, and zone painting was completed on the interior.

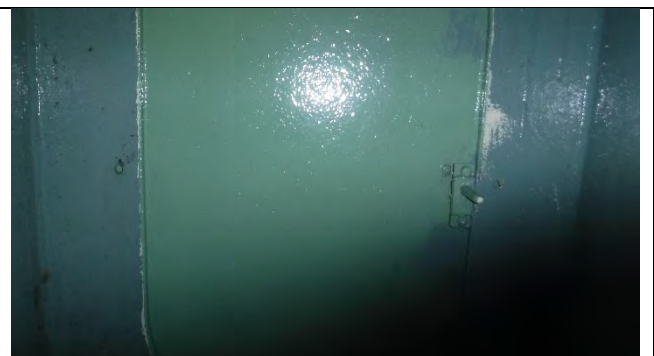
This bridge is inventoried in a south to north direction, and superstructure units are labeled from left to right looking north. Substructure units are labeled as Rear and Forward Abutments and Piers 1 and 2. For the purposes of this report, directions are given with bridge roadway directions, and not necessarily compass directions. For the example, the left hatch looking forward is addressed as the west hatch in this report, though it is towards the compass north side of the structure. Refer to Photograph 3 below for an overall view of the pier cap.

1.3 Method of Investigation

On July 13, 2023, Collins Engineers Inc. performed a fracture critical inspection of the fracture critical pier cap of Bridge SFN3106659 (HAM-71-0197W). A 46 ft bucket truck was used to access the pier cap interior and perform the “arm’s length” exterior inspection. The east (compass south) pier cap hatch cover was removed for the entry, replaced with an impact wrench, and resealed with exterior grade silicone caulk after the inspection. Both hatch covers were recently retrofitted with rain guards, hinges, and door handles (Photograph 1). Note that the door handle mechanisms were installed without interior latches (Photograph 2). Two bolts secure each door.



Photograph 1: View of Hatch Exterior, West Hatch Shown. Looking South.



Photograph 2: View of No Interior Latch, West Hatch Shown. Looking West.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



Traffic control provided by A&A Safety was used to gain access to the box cap exterior and consisted of single lane closures as follows:

- Gilbert Ave Ramp to I-71 Northbound – Single Lane closures between the hours of 8:00 AM to 4:00 PM were utilized to inspect Pier Cap 1.

OSHA confined space entry procedures were followed while inspectors were working inside the pier cap. Entry was performed in accordance with complete permit-required confined space entry procedures per GF SOP #10 and 29 CFR 1910.146. This included the use of an entry permit system, pre-entry air monitoring, continuous air monitoring, the designation of qualified entrants, attendants, and supervisor(s), and available emergency response. OSHA compliant safety harnesses and lanyards were worn by inspectors when working in the bucket truck.

Field measurements were taken using tape measures, calipers, and an ultrasonic thickness gauge to verify structural component dimensions. Observed deficiencies were recorded on member-specific field inspection forms. Digital photographs were taken of the fatigue prone details and other areas of interest or concern to further document the physical condition of the pier cap.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



1.4 Condition Ratings

State and Federal guidelines for evaluating the condition of bridges have been developed to promote uniformity in the inspections performed by different teams at different times. Condition ratings are used to describe the existing, in-place bridge as compared to the as-built condition. The following table was used as a guide in evaluating the condition of the various members of the pier cap.

CODE	CONDITION	DESCRIPTION
N	NOT APPLICABLE	Component does not exist.
9	EXCELLENT	Isolated inherent defects.
8	VERY GOOD	Some inherent defects.
7	GOOD	Some minor defects.
6	SATISFACTORY	Widespread minor or isolated moderate defects.
5	FAIR	Some moderate defects; strength and performance of the component are not affected.
4	POOR	Widespread moderate or isolated major defects; strength and/or performance of the component is affected.
3	SERIOUS	Major defects; strength and/or performance of the component is seriously affected. Condition typically necessitates more frequent monitoring, load restrictions, and/or corrective actions.
2	CRITICAL	Major defects; component is severely compromised. Condition typically necessitates frequent monitoring, significant load restrictions, and/or corrective actions in order to keep the bridge open.
1	IMMINENT FAILURE	Bridge is closed to traffic due to component condition. Repair or rehabilitation may return the bridge to service.
0	FAILED	Bridge is closed due to component condition, and is beyond corrective action. Replacement is required to restore service.

The inspection of this bridge was performed in accordance with the following documents:

1. Manual of Bridge Inspection, Ohio Department of Transportation (ODOT), 2014.
2. Manual for Bridge Element Inspection, AASHTO, 2019.
3. Bridge Inspector's Reference Manual, U.S. Department of Transportation, 2002 (rev 2012).
4. Inspection of Fracture Critical Bridge Members, U.S. Department of Transportation, 1986.
5. Specifications for the National Bridge Inventory, U.S. Department of Transportation, 2022.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



2.0 EXISTING CONDITIONS

2.1 Pier Cap Conditions

2.1.1 *Pier Cap 1*

Pier Cap 1 is in Good Condition [7] overall (Photograph 3). No moisture was found inside of the cap at the time of inspection. Surface corrosion with no section loss was present on the bottom of one interior pier diaphragm, on the underside of several flange tie plates, and on the interior bottom flange at one location. Overall no changes from the prior inspection.



Photograph 3: Elevation Photograph of Pier Cap 1 Looking South.

2.1.1.1 *Pier Cap 1 Interior*

The exterior paint is in Good Condition [7] overall, with only minor deficiencies present. There were no significant changes overall compared to the prior inspection. Specific items to note include:

- Prior inspections noted ponding water between the east (compass south) bearing stiffener and the end plate. For this inspection, as with 2021, there was no ponding water present at this location inside the cap (Photograph 4). There was minor surface corrosion with no section loss in this area during this inspection.
- Isolated areas of active surface corrosion with no section loss are present at isolated locations. This included the bottom of the Girder T diaphragm (Photograph 5) and on the bottom flange tie plates of Girders T, U, V, and Z. This has been previously noted and has not changed.
- Intermittent tack welds were removed from the bottom flange backer bars and web plates, but were still present at the cap webs to top flange corners along the cap length (Photograph 6).

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



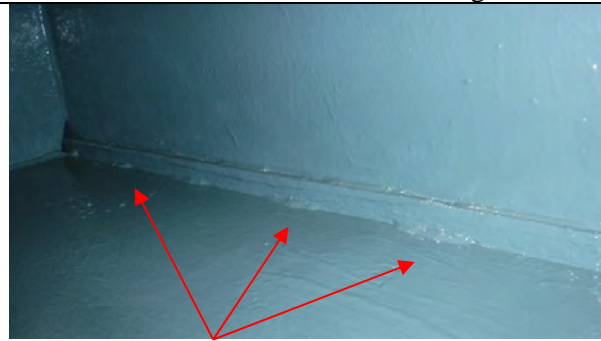
- The underside of the flange tie plates were not consistently re-painted during a previous rehabilitation. The south face diaphragm by Girder Z appears to have been primed but not painted. These are old conditions and have not changed since the prior inspection.
- There were numerous areas of paint cracks and peeling paint due to excess paint thickness throughout the interior of the pier cap.



Photograph 4: View of Cap Bottom Plate Between the East (Compass South) Bearing Stiffener and End Plate. Note No Ponded Water. Looking Down.



Photograph 5: View of Active Surface Corrosion Located Under Tie Plate on the South (Compass West) Face of Girder T Diaphragm.



Photograph 6: View of Tack Welds Present Along Cap Top Plate Backer Bars. Cap Web Between Diaphragm U and Diaphragm V Shown.



Photograph 7: Typical Example of Interior Diaphragm Condition and Configuration. East (Compass South) Face of Girder U Shown.

2.1.1.2 Pier Cap 1 Exterior

The exterior paint is in Good Condition [7] and exhibits small, isolated spots of surface corrosion with no section loss. These overall have not changed since the prior inspection. The east hatch corrosion has reactivated around the hatch perforation. Localized section loss of 100% is present in an area measuring 1-1/2 in. length x 1/2 in. height (Photograph 8). Section loss up to 50% is present around this corrosion hole. This overall has slightly increased since the prior inspection and the corrosion continues. Painted over pitting up to 1/16 in.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



maximum is present on small, isolated areas on the end plate at the east hatch. This has not changed since the prior inspection. Other items to note on the exterior include:

- Previous rehabilitations were performed on these pier caps. Work performed included the cap web plates being retrofit with drilled stress relief holes connected by vertical sawcuts adjacent to the welded connections of the bottom flange tie plates of the interior girders at both webs (Photograph 9), at Girder T at the east (compass south) web, and at Girder Z at the west (compass north) web. Additionally, the drainpipes were rerouted or otherwise reconfigured with the bolted connections of the drainpipe support brackets left in place (Photograph 10). These retrofits function as designed and have not changed since the prior inspection.
- Fillet welds between the cap north (compass east) web and knee braces below Girders X, Y, and Z intersect the groove weld along the cap web and bottom flange (Photograph 11). This is an old comment that has not changed.
- Weld porosity was noticed in the fillet welds around the bottom flange tie plates. This is an old comment that has not changed over prior inspections.
- As stated above, both access hatches have been retrofit with bolts and rain shields (Photographs 1 and 2).
- Both bearings exhibited minor surface corrosion but appear to function as designed.



Photograph 8: View of 100% Section Loss Measuring 1 1/2 in. in Length at East (Compass South) Hatch Opening. Looking West.



Photograph 9: Typical Example of Drilled Hole and Sawcut Retrofit. South Cap Web West Side of Girder Y Shown. Looking North.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



Photograph 10: General View of Bolted Drainpipe Connection in Place With Updated Drain Members and Configuration.



Photograph 11: Typical Example of Girder Knee Brace Welds Intersecting the Cap Web To Cap Bottom Flange Weld. Looking North.

2.1.1.4 Fatigue Prone Details

Fatigue Prone Detail 1

Fillet welds between diaphragms or stiffeners and web or flange plates.

Category: C'

Location: All girder diaphragms and we stiffeners.

Fatigue Prone Detail 2

Full penetration groove weld of flange splice.

Category: B

Location: Two bottom flange splices.

Fatigue Prone Detail 8

Intersection of fillet welds.

Category: E

Location: Fillet weld between the west web and knee brace below girder Z intersecting the groove weld of the web and bottom flange.

Fatigue Prone Detail 9

Drilled hole stress relief retrofit in web plates.

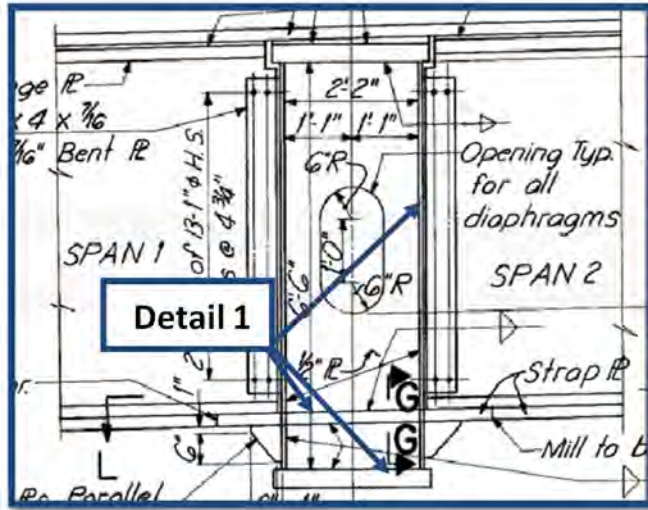
Category: B.

Location: Both web plates on each side of all interior girders, east web plate on each side of girder T, and west web plate on each side of girder Z.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



3.0 EVALUATION AND RECOMMENDATIONS

Based on the in-depth inspection, the fracture critical Pier 1 Cap of Bridge No. HAM-71-0197W and its associated fatigue prone details continue to be in Good Condition [7] overall. While the corrosion and section loss around the east cap hatch has reactivated, this is confined to an isolated area on the cap end and there overall were no major changes to the pier cap conditions. No ponded water was observed during this inspection. The drilled hole and sawcut retrofits continue to perform as designed.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)
Hamilton County, OH • July 2023



Collins appreciates the opportunity to work with the Ohio Department of Transportation on this project and looks forward to working together in the future. We would be happy to discuss any aspect of the report with you in person or via phone or email.

Respectfully Submitted,
COLLINS ENGINEERS, INC.

A handwritten signature in blue ink that reads "Michael Seal".

Michael Seal, P.E.

Project Manager

Originated by:

A handwritten signature in black ink that reads "Kevin Mitchell".

Kevin Mitchell, E.I.T.

FRACTURE CRITICAL INSPECTION

SB I-471 over a ramp from Gilbert Ave to I-71NB • SFN3106659 (HAM-71-0197W)

Hamilton County, OH • July 2023



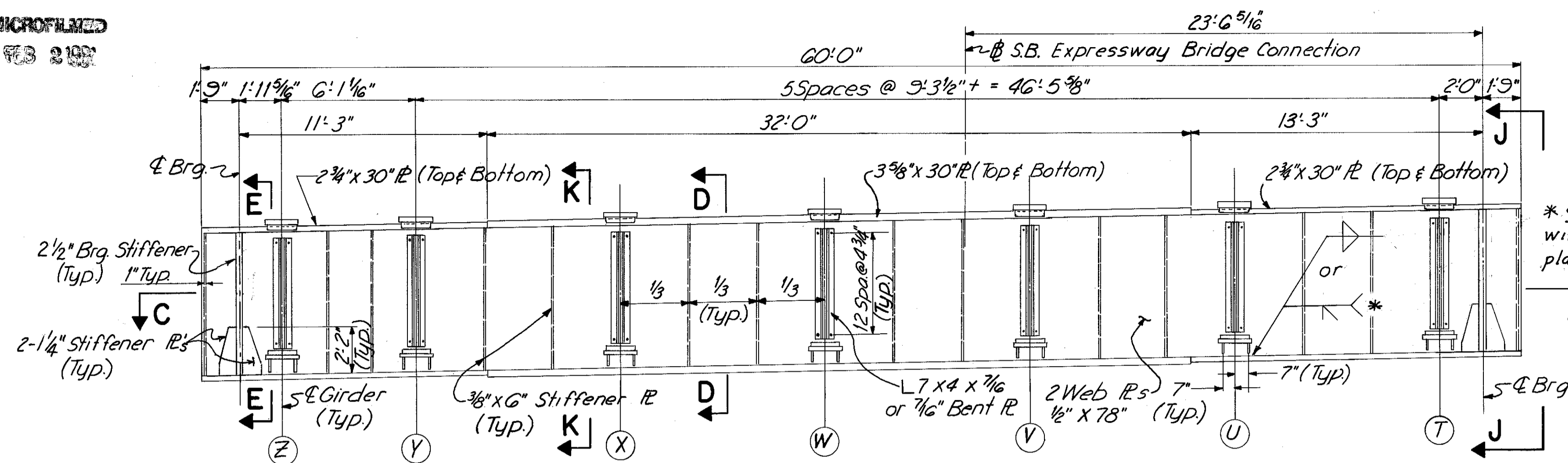
EXHIBIT 1 – EXISTING PIER PLANS

MICROFILMED
FEB 2 1972

FED. RD. DIV.	STATE	PROJECT	FISCAL YEAR
2	OHIO		

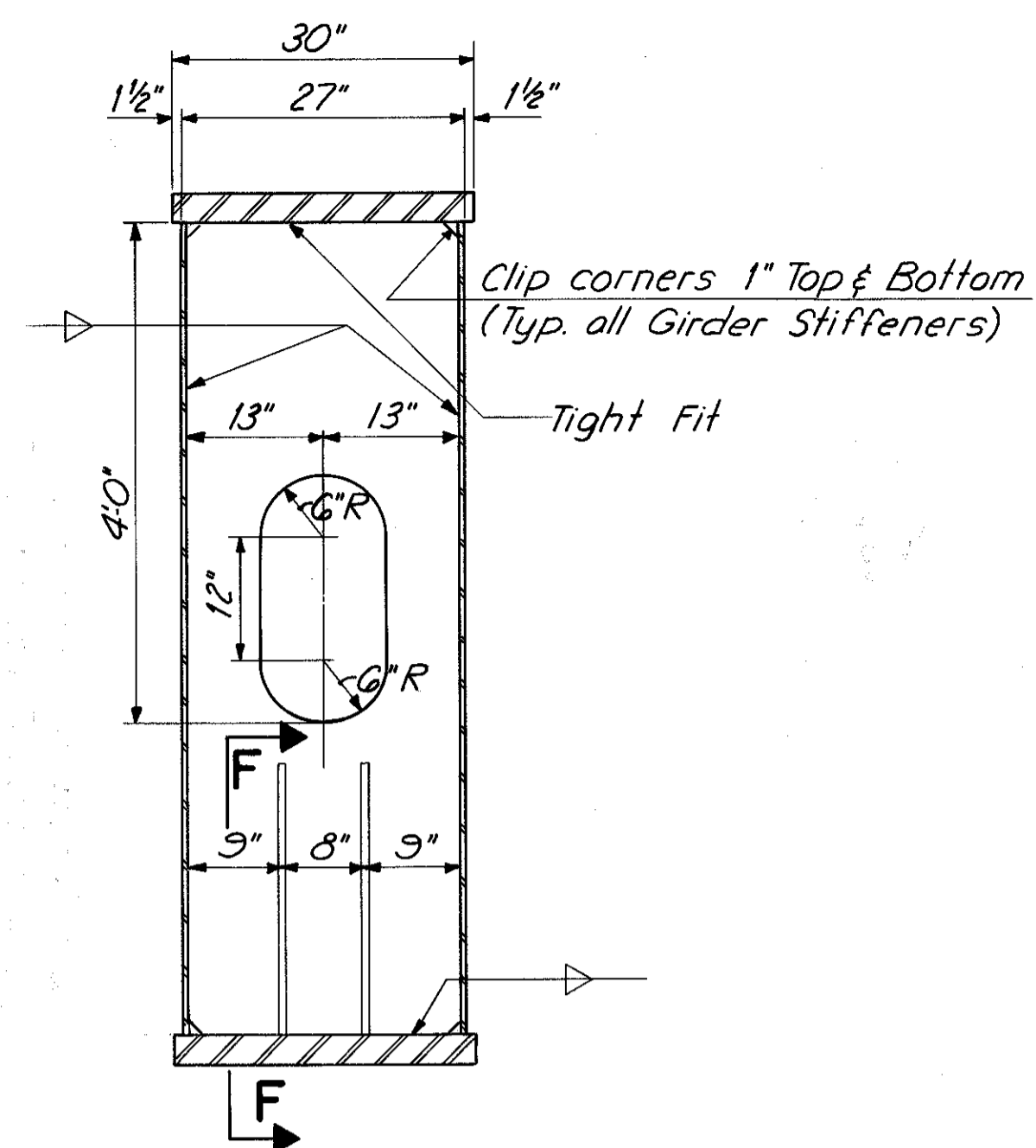
402
494

HAMILTON COUNTY
HAM-471-0.30

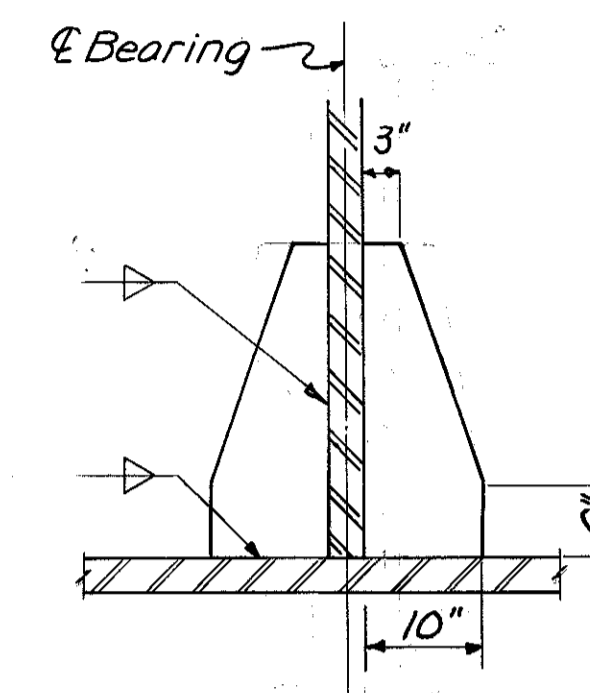


ELEVATION OF FLOORBEAM
AT PIER I

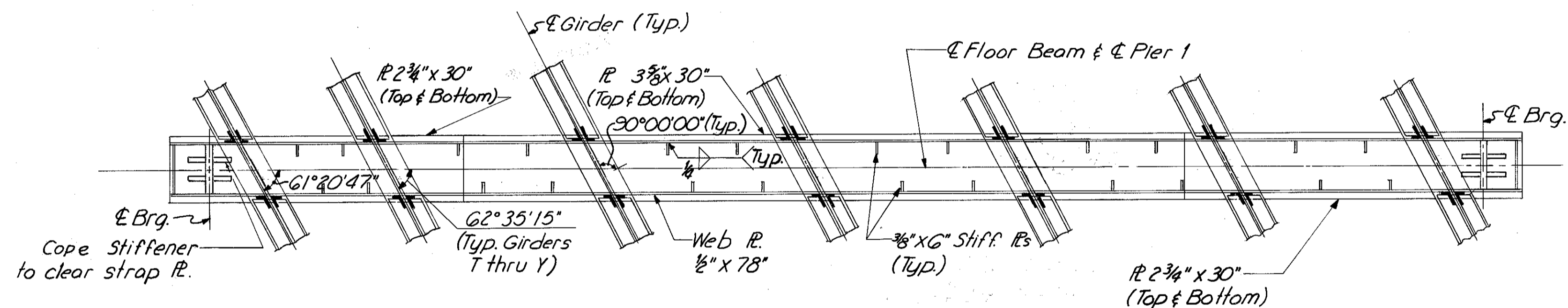
Note: WELD JOINTS MADE WITH BACKING STRIPS TO BE LEFT IN PLACE: Backing strip shall be made continuous for the full length of weld. Joints in backing strip shall be full penetration butt weld.



SECTION E-E

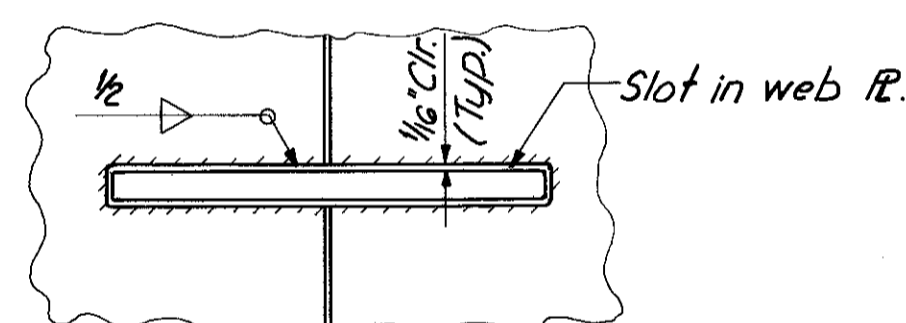


SECTION F-F

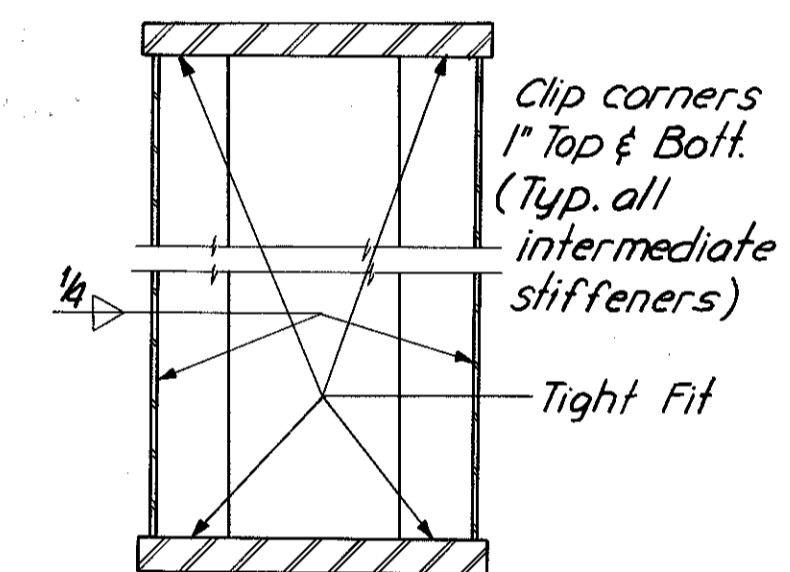


SECTION C-C

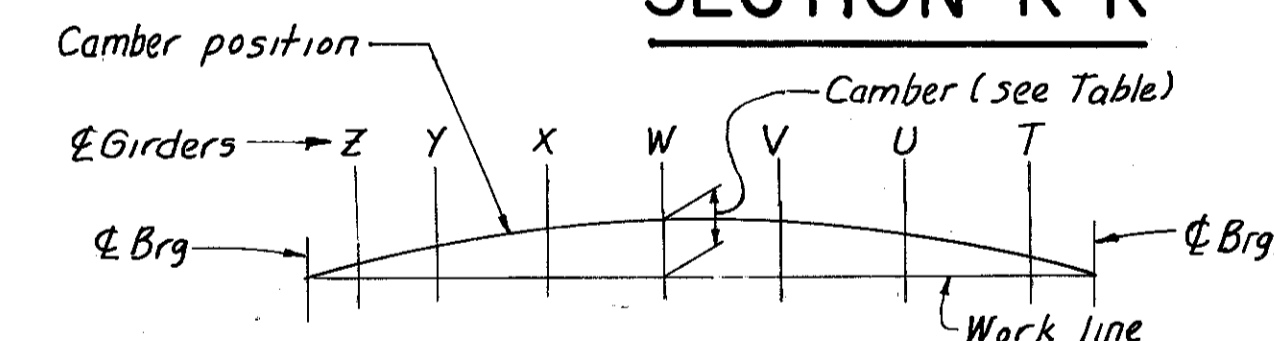
Note: Milled ends of Compression Splice on bottom flanges of girders shall be brought to full bearing against milled ends of floorbeam brackets before the holes in the compression strap plate are field drilled full size and bolts tightened. Holes may be sub-punched or sub-drilled in the shop.



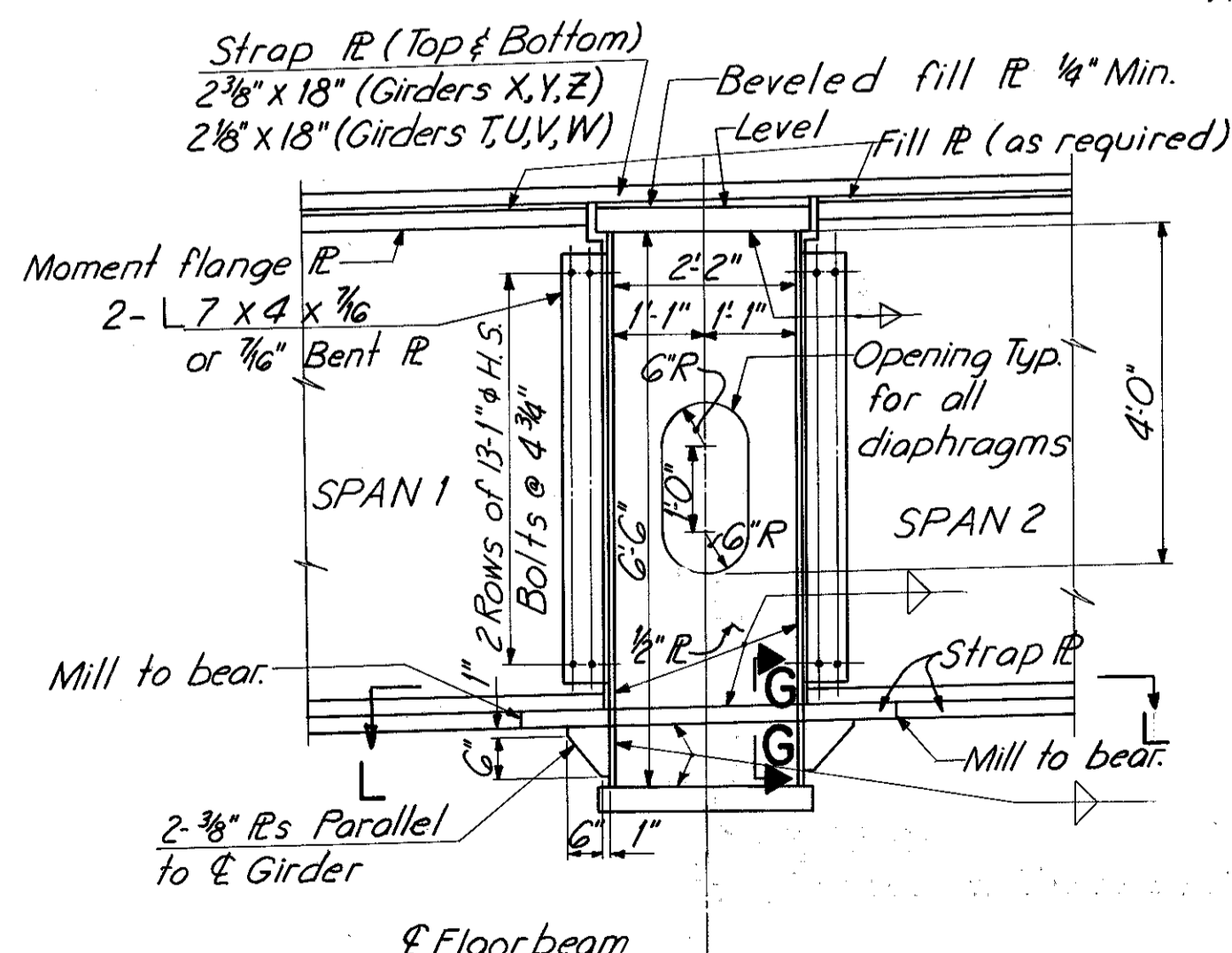
SECTION G-G



SECTION K-K

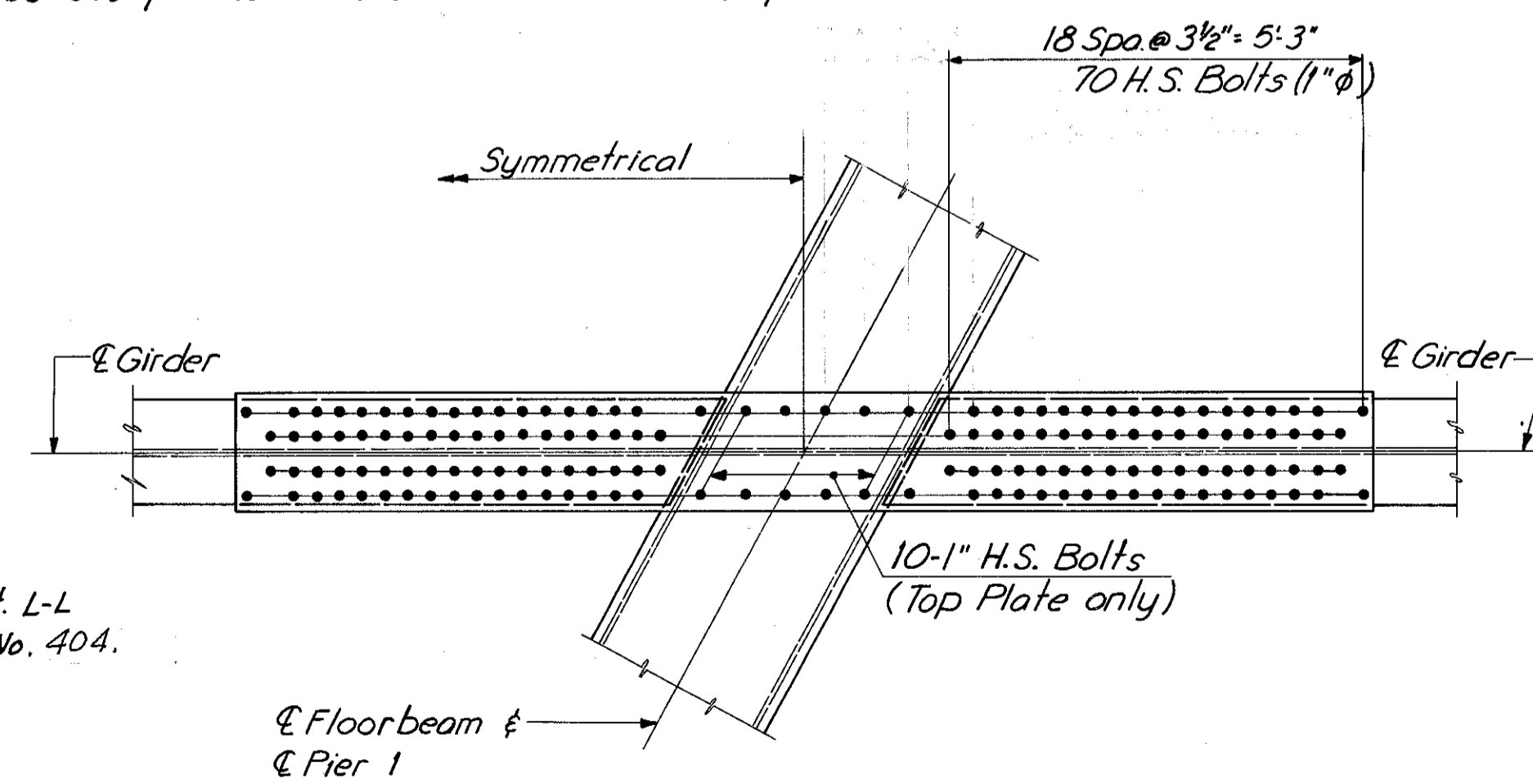


FLOORBEAM CAMBER DIAGRAM

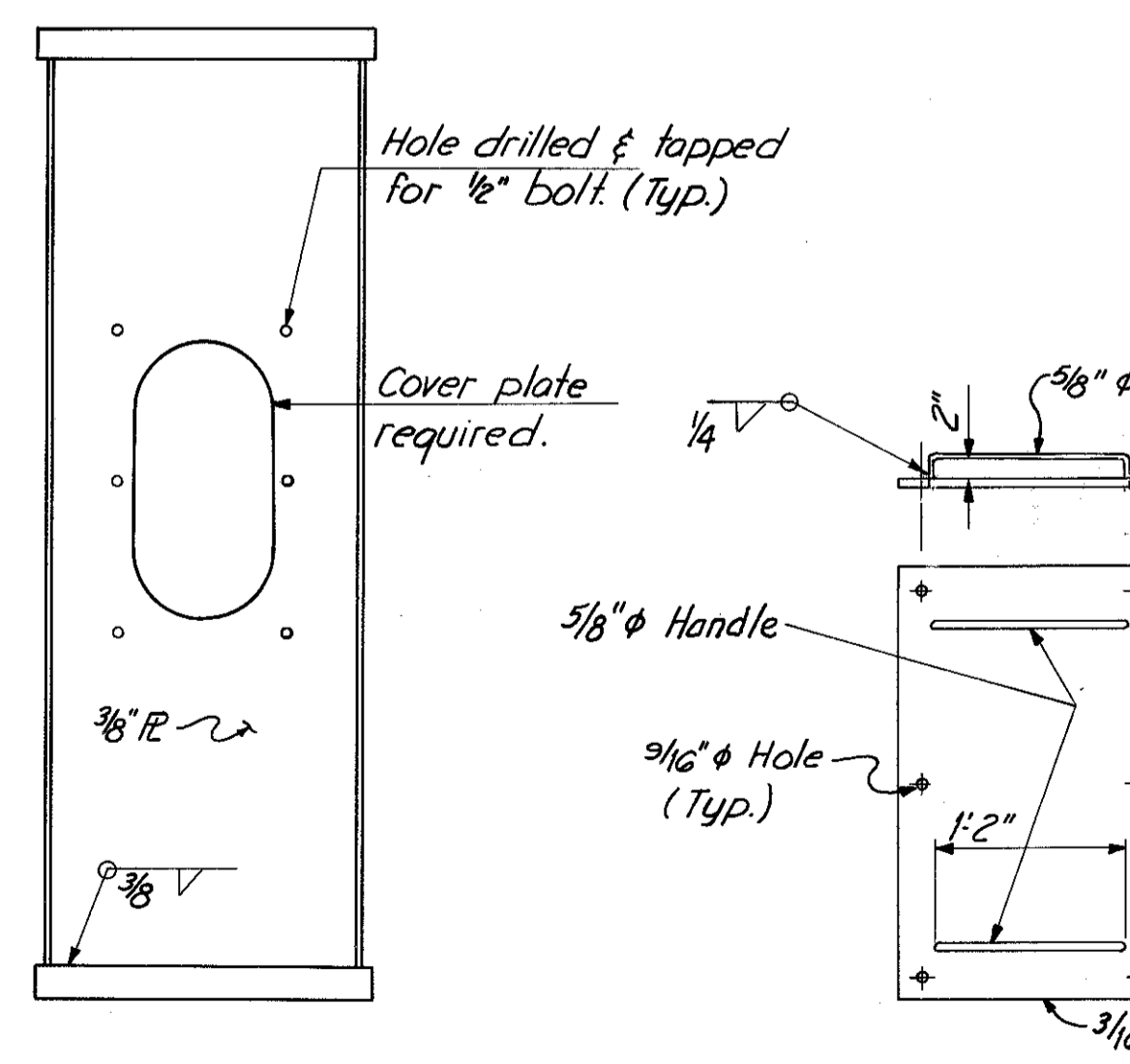


SECTION D-D

For fillet weld sizes not shown see "Table of Fillet Weld Sizes" Sh. No. 468.



PLAN OF SPLICE PLATE



SECTION J-J

(Typ each end)

COVER PLATE

(For Access Hole)

DEFLECTIONS & CAMBER (INCHES)

	Girders						
	Z	Y	X	W	V	U	T
Def. due to weight of steel	0	0	1/16	1/16	1/16	1/16	0
Def. due to remaining D.L.	1/16	1/8	1/4	5/16	3/8	3/16	0
Adjustment req'd for convexity	1/16	3/4	1 3/16	1 7/8	1 7/8	1 1/8	3/4
Required shop camber	1/8	7/8	2 1/8	2 1/4	1 3/4	1 3/8	3/4

HAZLET & ERDAL
CONSULTING ENGINEERS
CINCINNATI, OHIO

12/23

STRUCTURAL STEEL DETAILS
BRIDGE NO. HAM-471-0076

SOUTHBOUND EXPRESSWAY BRIDGE
CONNECTION AND RAMP GF OVER

RAMP GD H&E BRIDGE NO. 12

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED DATE	REVISED
WL	JHD		YV.L.	JHD	
			3-1-71	11-9-72	

FRACTURE CRITICAL INSPECTION

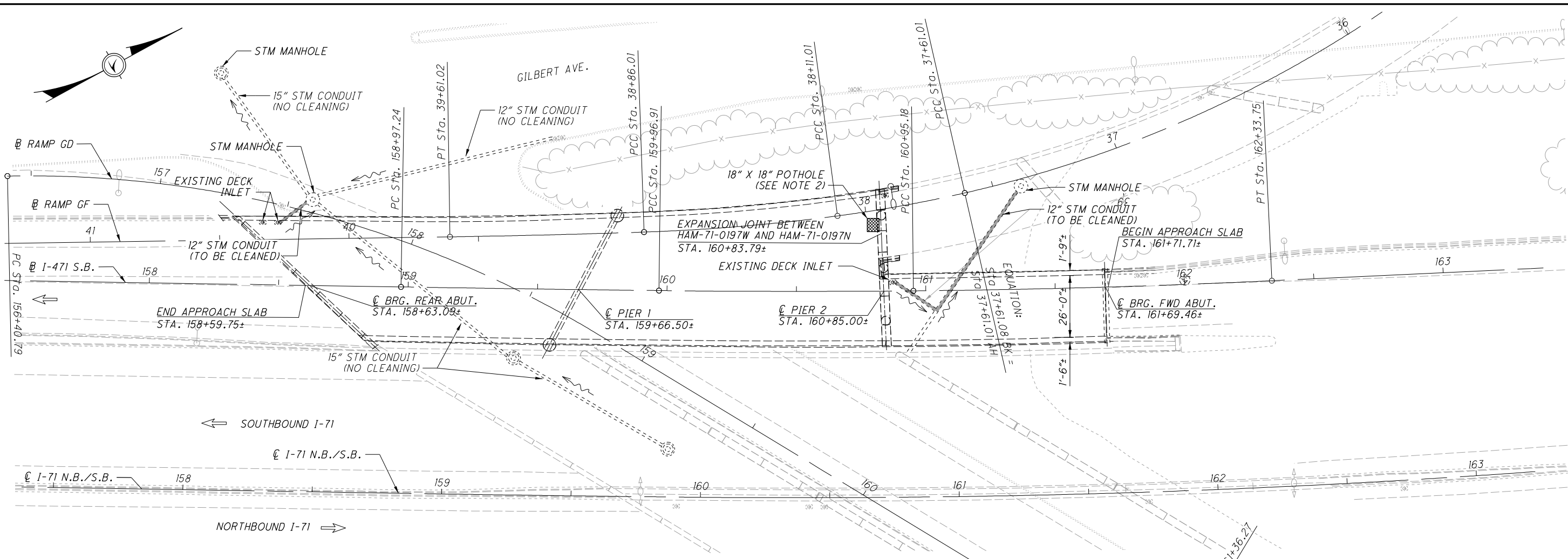
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Hamilton County, OH • July 2023

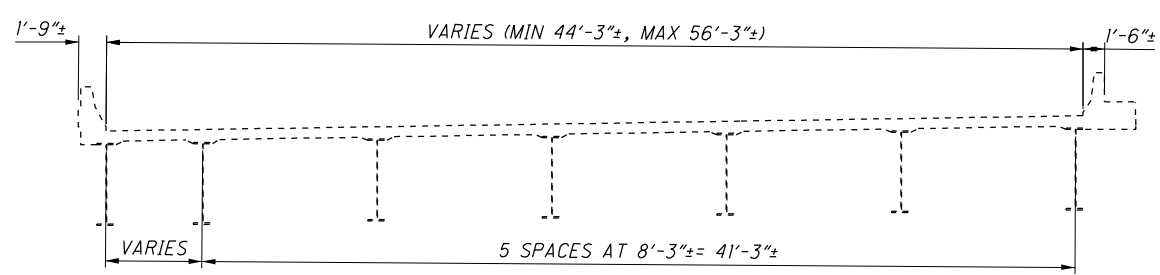


EXHIBIT B – REHABILITATION PLANS

O:\ODOT\HAM_82975_HAM-71-1.34\Design\Structures\HAM071_0197W_Sheets\071_0197W_SG001.dgn HAM-71-1970W SHEET 9/16/2016 2:59:18 PM don-f



PLAN



TYPICAL SECTION (SPANS 1 AND 2)

PROPOSED WORK

- 1) CLEAN EXISTING DRAINAGE SYSTEM FROM THE DECK INLETS TO THE FIRST MANHOLE.
- 2) PATCH SMALL POTHOLE (APPROXIMATELY 18"X18") NEAR THE EXPANSION JOINT AT HAM-71-0197N WITH ITEM 519 PATCHING.
- 3) SEAL WEARING SURFACE WITH GFR.

EXISTING STRUCTURE	
TYPE:	CONTINUOUS STEEL PLATE GIRDERS (SPAN 1 & 2) SIMPLE SPAN STEEL GIRDER (SPAN 3) WITH WITH REINFORCED CONCRETE DECK AND SUBSTRUCTURE
SPANS:	103'-5", 118'-6", & 84'-5½" C/C BRGS
ROADWAY:	VARIES
LIVE LOADING:	HS 20-44 AND THE INTERSTATE ALTERNATE LOADING
SKIEW:	VARIES
WEARING SURFACE:	2¼" MICROSILICA MODIFIED CONCRETE OVERLAY
APPROACH SLABS:	AS-1-67 (25'0" LONG)
ALIGNMENT:	VARIES
SUPERELEVATION:	VARIES
STRUCTURAL FILE NUMBER:	3106659
DATE BUILT:	1976
DISPOSITION:	MINOR REPAIRS

PROPOSED STRUCTURE	
TYPE:	CONTINUOUS STEEL PLATE GIRDERS (SPAN 1 & 2) SIMPLE SPAN STEEL GIRDER (SPAN 3) WITH WITH REINFORCED CONCRETE DECK AND SUBSTRUCTURE
SPANS:	103'-5", 118'-6", & 84'-5½" C/C BRGS
ROADWAY:	VARIES
LIVE LOADING:	HS 20-44 AND THE INTERSTATE ALTERNATE LOADING
SKIEW:	VARIES
WEARING SURFACE:	2¼" MICROSILICA MODIFIED CONCRETE OVERLAY
APPROACH SLABS:	AS-1-67 (25'0" LONG)
ALIGNMENT:	VARIES
SUPERELEVATION:	VARIES
COORDINATES:	LATITUDE 39° 06' 33" N LONGITUDE 84° 30' 07" W

GENERAL PLAN	HAMILTON COUNTY STA. 158+59.75 STA. 161+71.71	DESIGN AGENCY PALMER ENGINEERING 280 E. POWER RD. SUITE B CLINTON TOWNSHIP CLINTON, IN 47524
BRIDGE NO. HAM-71-0197W I-471 S.B. OVER RAMP RD	DATE 5/30/2016	REVIEWED BUJ
PID No. 82975	STRUCTURE FILE NUMBER 3106659	DRAWN E1
1 / 1	DESIGNED SDW	CHECKED CEJ
261 292	REVISED XXX	DATE 5/30/2016