Craig Memorial Bascule Bridge

Over the Maumee River

2023 In-Depth Structural, Mechanical and Electrical Inspection Report

ODOT Bridge No. LUC-65-05.35

NBI Bridge No. 4805917

Final Report

Toledo, OH

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List of Abbreviations / Acronyms

Abut	Abutment	NE	Northeast
Brg / BX	Bearing / Bearing number	NW	Northwest
CW	Counterweight	NVL	No Visible Loss
CF / CFX	Cross Frame / Cross Frame number	PI / PIX	Pier / Pier number
Dia / DPX	Diaphragm / Diaphragm number	SB	Southbound
Dp	deep / depth	SF / sft	square foot / square feet
EB	Eastbound	SL ASL	section loss arrested section loss
FB / FBX	Floorbeam / Floorbeam number	SB	Southbound
ft	foot / feet	SN / SNX	Span / Span number
G / GX	Girder / Number	ST / STX	Stringer / Stringer number
h	height / high	SE	Southeast
HDR	HDR, Inc.	SW	Southwest
in	inch / inches	w	width / wide
LF	linear feet	WB	Westbound
l	length / long	N, E, S, W	Standard Cardinal Directions
NB	Northbound		
Bridge Element Naming Conventions based on Bridge Orientation of South to North			
B1W	First Deck Bay from West	G1W	First Girder from West
BRG1W	First Bearing from West	P1S	First Panel (between floorbeams) from South
CF1S	First Cross Frame from South	PI1S	First Pier from South
DP1S	First Diaphragm from South	ST1W	First Stringer from West
FB1S	First Floorbeam from South or beginning of structural unit		

1.0 Executive Summary

The Craig Memorial Bascule Bridge 2023 In-Depth Structural, Mechanical, and Electrical Inspection was conducted on September 18 through 22, 2023. The inspection was conducted by a nine-person team, consisting of four structural, three mechanical and two electrical bridge engineers / inspectors, each experienced within their disciplines in movable bridge inspections. The inspection was led by a certified bridge inspector licensed as a Professional Engineer in the State of Ohio. This inspection provided an in-depth visual and physical review of the bridge's current structural, mechanical, electrical and operational conditions with a focus on detailing a package of repair recommendations to maintain the structure's serviceability and continued safe operation.

The bridge roadway, superstructure and substructure are in overall fair condition, exhibiting scattered minor to localized moderate deterioration to several bridge elements, and most prevalent in the bascule span. The approach spans on either side of the bascule span exhibit minor painted over section loss to superstructure components located below previous drainage features or otherwise exposed to roadway runoff or the elements, including the expansion joints and previous curb drains. The approach and main piers have previous concrete patch and crack sealing repairs throughout that are in generally good condition, however, also exhibit minor deterioration to repaired and adjacent areas. The bascule span exhibits scattered to widespread painted over section loss to girders, floorbeams, secondary members and connections, to varying degrees relative to percentage loss. There are other corrosion-related deficiencies, such as packing corrosion, holes, and cracking, to both the primary and secondary members in the span. The grid deck and supporting stringers in the bascule span exhibit localized areas of corrosion holes and cracked or broken welds at the grid deck to stringer top flange connections. The roadway deck and topside bridge elements are in generally good to fair condition, exhibiting minor cracking and service deterioration.

The mechanical components and operations for the bridge are generally in fair condition. The rack gear segment mounting bolts show substantial section loss, up to 100%, as well as corrosion. The open gearing displays excessive backlash, severe scoring and moderate corrosion build up. While it is acceptable for now, the teeth's scoring will exacerbate and expedite operational wear. In addition, the manual brake release levers on both the North and South side required between 120-150 lbs. of force to release. These proved difficult for many of the local personnel to operate. As the leaves are descending, the bridge seats abruptly, starting and stopping multiple times before finally becoming fully closed. There were no signs of brake or trunnion rubbing noises, however, the bascule leaves occasionally made clunking noises while operating. Furthermore, both the North and South leaves made loud screeching noises during the opening sequence, though the origin of these sounds was unknown. Where they are absent, lubrication ports should be inserted in the motor couplings and span lock couplings as indicated. The machinery components generally displayed moderate corrosion, the gear reducers exhibited some oil purging, the gear teeth had scoring on their surfaces, and fasteners were generally corroded. Lastly, the barrier gates would not properly function in the event a vehicle did not stop while the bridge was operating. The bridge is otherwise mechanically sound. The machinery's service life will be extended with regular maintenance and the repair and/or replacement of the parts as mentioned further in this report.

The electrical distribution and control systems for the bridge and its auxiliaries are generally in poor condition, primarily due to age. The existing electrical and control systems are over 50 years old and are past their useful life expectancy. Due to the age of the existing equipment, operational inconsistencies are the norm and as well as reported continual emergency repairs. Some of the existing control components do not have readily available spare parts, and/or the ability for in-kind replacement due to physical space constraints and orientations. In addition, the overcurrent protection, such as circuit breakers, may not operate as intended and should be evaluated.

The list below includes the **Priority Level repair recommendations**. Refer to by-discipline condition and repair recommendation summaries for the full listing of prioritized repair recommendations.

Structural:

- Repair the locations of corrosion holes to the bascule span grid deck main bars.
- Replace the connection bolts (missing and in-place) at the vertical plates of the steel barriers in the bascule span.
- Repair locations of disconnected, broken, and missing piping at the drainage components below deck and at the piers.

Mechanical:

- Replace the railings in the machinery rooms around the staircases and open gearing for the safety of maintenance team.
- Adjust/repair manual release hand brakes across all machinery.
- Adjust brakes to factory settings for torque, clearance, and thruster reserve stroke.
- Remove corrosion from brake wheels and ensure brake pads are in contact when set and release fully when energized.
- Replace auxiliary engine batteries.
- Remove stacks of counterweight blocks from machinery room floors to prevent injury and move to storage room or counterweight pit.
- Tighten or replace all loose fasteners across motors, brakes, actuators, housings and supports.
- Fix bottom driven limit switch that slightly contacts target on NE outboard span lock.
- Replace selsyn motor on south side cam assembly and tighten chains on span drive machinery.
- Tighten loose guy wires on traffic gates.

Electrical:

- Tighten loose guy wires on traffic gates.
- Re-align crank arms and shafts in NE and SW traffic gate housings. Replace arms if they are deformed.
- Test and replace circuit breakers
- Replace missing light at southeast gate
- Install wire numbers for each conductor in termination cabinets and control console
- Replace missing seals at outdoor enclosures
- Replace missing bulbs and fixtures throughout
- Install emergency lighting
- Install GFCI receptacles in wet locations

This Cost Estimate for the recommended repairs presented in this report assumes a construction year of 2028 for adequate planning, design, and contracting necessary for a project for the set of recommended repairs. Estimate provided is a high-level estimate based on the conditions observed during this inspection, and quantities for deteriorated conditions determined based on these observations. Estimate is not detailed or comprehensive but is to serve as guideline for estimated costs based on current unit costs for similar repair activities and types. A detailed engineer's cost estimate would be required once the scope of repairs is finalized and detailed plans, drawings and specifications are established.

Repair Type	Structural	Mechanical	Electrical	Sub-Totals:
Priority Repairs	$ 59,000	$51,000	$93,500	$203,500
Contract Work	$ 3,054,388	$1,374,000	$1,096,000	$5,524,388
Capital Maintenance	$ 21,650	$58,000	$700,000	$779,650
Sub-Totals:	$ 3,135,038	$1,483,000	$1,889,500	
			Overall Total:	**$6,507,538**

This report is generated solely as information for the Ohio Department of Transportation (ODOT), and nothing in this report shall create or give to third parties any claim or right of action against HDR, Inc. Inspection procedures were in accordance with Federal and Ohio inspection standards, requirements, and guidelines, including 23 CFR Part 650 (National Bridge Inspection Standards). The inspection has been made in conformity with generally recognized and established principles, standards, and procedures considered necessary or practicable in the circumstances within the limits of the project scope of work for ODOT. There is no representation that all latent or other defects have been disclosed.

2.0 Introduction

2.1 Location & Description

The Robert Craig Memorial Bascule Bridge is a 10-span, 1600 ft long structure carrying state route 65 over the Maumee River in Toledo, OH. Construction started in 1951 and the bridge opened in January 1957 as part of Ohio's Toledo Expressway System, which later became interstate route IR-280. The Craig Bridge was the last drawbridge on Ohio's interstate system. It was the northernmost vehicular crossing of the Maumee River in the city until the Veterans' Glass City Skyway Bridge was built in 2007 immediately east of the Craig Bridge, carrying the re-routed I-280. The Craig Bridge was re-routed and re-configured to carry SR-65. The bridge is named in memory of second lieutenant Robert Craig, a Scottish-born 'Toledoan' who received the medal of honor during the second world war. The bridge currently carries four lanes of vehicular traffic and a multi-use trail as an expanded sidewalk.

The main lift span is approximately 245 ft long double leaf bascule, each leaf consisting of four built-up riveted steel bascule girders, seven transverse floorbeams, 29 stringers, diagonal lateral bracing elements, and sidewalk framing elements. The span provides 200-ft of horizontal clearance for the shipping channel. The roadway deck is an open steel grid welded directly to the stringer top flanges at the grid main bars. The bascule spans are supported on two cellular trunnion piers located in the Maumee River. Foundations located below the channel flowline are steel pile driven to bedrock and capped with reinforced concrete.

The bascule span is flanked by four approach spans to the south and five to the north. Each approach span is composed of riveted built-up steel girders with floorbeams, stringers and reinforced concrete deck. The approach spans vary in size and configuration, including lanes, sidewalks and the mixed-use trail. The west sidewalk runs the full length of the bridge. The east sidewalk ends in Span 7 where it joins the mixed-use trail. The approach spans are supported on concrete wall type piers in the Maumee River and cap and column type piers on land. The pier foundations are concrete capped steel pile driven to bedrock. The North abutment is a cantilevered wall supported on capped pile foundations. The South abutment is cellular with a reinforced concrete deck supported on reinforced concrete walls on pile and with capped pile internal piers. The control room is located in the North trunnion pier. The previous ramps at the north end of the bridge were removed when the bridge was re-configured for local traffic. The bridge also crosses the Ann Arbor Railroad spur to the Toledo Harbor Warehousing.

Each leaf is driven under normal power using two 100 HP motors running at 695 RPM power each bascule leaf. The motors power a differential-equipped core set of enclosed gears. There are two motor brakes and two machinery brakes, one each per leaf. The brakes are GE thrustor brakes and have a maximum torque of 1600 ft-lbs. An open gear reduction is achieved on the east and west sides of each leaf outside of the enclosed gearing, which divides the torque to two-line shafts. The final pinions, which are connected to the outputs of these open secondary reductions, drive rack gears that are fastened to the underside of the main bascule girders.

Each of the bascule leaves utilize large counterweights between the main girders at the back of the span and the total load of the leaf is distributed across four main trunnions mounted in eight independent bearings. The counterweight pit located underneath the operating machinery is equipped with a pair of seated buffer cylinders and a pair of open/raised buffer cylinders to ease the load during opening and closing. Wooden bumper blocks are also mounted to the pit concrete walls to stop the leaves should they overtravel their normal limits when raising.

There are a total of four live load shoes located rear of the trunnions to resist load from roadway traffic. When seated, the two leaves are secured at the center of the span with four jaw locks driven by machinery on the North leaf. The span lock machinery is located on the North leaf. A reducer is driven by a motor that has a brake on its rear extension shaft. Several line shafts and couplings are driven by the reducer's output shafts. Each of the four-line shaft assembly's keyed pinions mesh with a straight rack. The jaw linkage assembly that the rack is attached to is gripped by a receiver on the south leaf.

The electrical system includes power distribution and operational controls. The power distribution systems include the main electrical service to the structure, backup service (in case of power outage), transformers, breakers, and disconnect switches. The operational controls include the operator console, motor control cabinet, programmable logic controller (PLC), limit switches, position feedback devices, and equipment operation feedback devices. Other systems include navigation lighting, traffic control, and house electrical distribution (lighting, HVAC, receptacle, etc.).

Bridge Location Plans

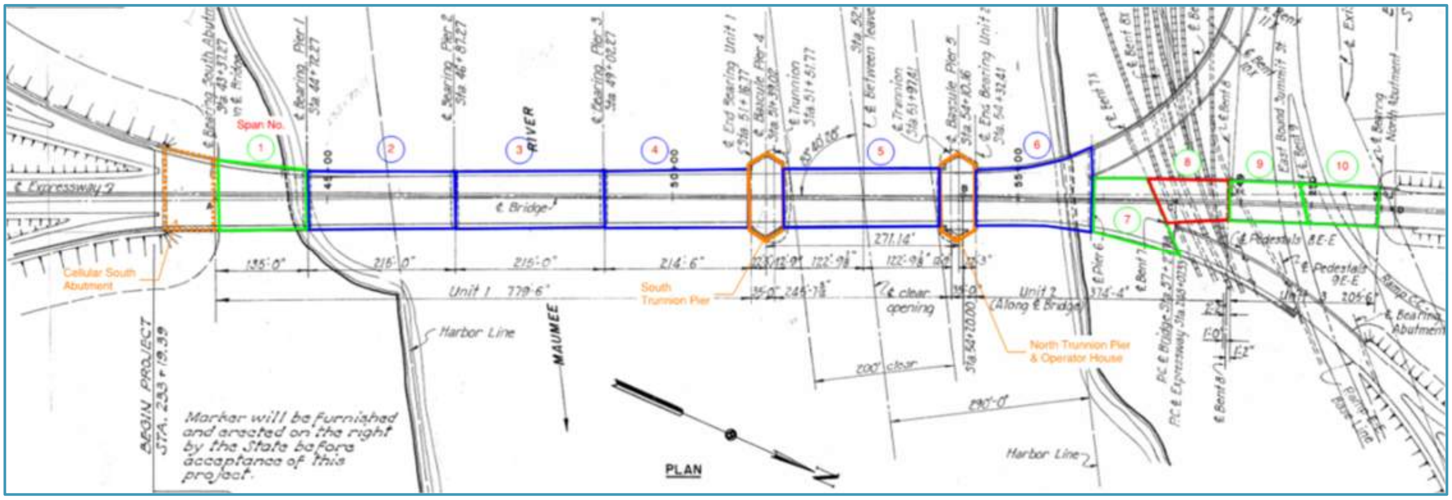


Figure 1: General Plan of Bridge, inspection plan color-coded for span type and access

2.2 Work History

1951-1957:	Designed by consulting engineers Howard, Needles, Tammen & Bergendoff, Kansas City, MO and New York, NY Contractor – Mc Dowell Co. Inc., Cleveland OH Fabricator – Fort Pitt Bridge Works, Pittsburg, PA
1958:	Bascule pier roofs over the machinery rooms were changed from concrete to steel roofs
1970:	Median curbs were changed to barriers
1980:	Bascule span steel grid deck was replaced, structural steel painted
1996-1997:	Bridge deck replacement, including barriers, railings, joints, drainage; structural steel repairs, painting
2001:	Rebuild of center locks, gear reducers and replacement of gate actuators
2003:	Replacement of brake thrusters
2004:	Replaced auxiliary backup gas engines with diesel engines
2007-2008:	Bridge approaches, sidewalks, barriers and railings were modified for rerouting to SR-65, removal of approach structures at north side of bridge
2011:	Replaced Tender house and Trunnion machine room roofs
2014:	Painting of Structural steel and structural steel repairs

2.3 In-Depth Inspection Procedures

Structural Inspection Scope of Work / Work Plan:

Our performance of an "In-Depth Inspection" included visual, physical, and non-destructive evaluation of the bridge elements to evaluate, assess and quantify areas requiring repair. This covered bridge deck elements, superstructure components, substructure units above the water line, approaches, utilities and related site and geometric conditions, to a depth and breadth sufficient to prepare a comprehensive recommendation package. We followed the guidelines from the Ohio Department of Transportation (ODOT) Manual of Bridge Inspection including more recent Addendums and FHWA's Bridge Inspector's Reference Manual (FHWA) for deterioration evaluation, documentation, and repair recommendation development.

- Field deck sketches outlined and quantified areas of deterioration at the topside and underside. The sketches were prepared following physical evaluation of the deck and its components, measuring extents of deterioration, locating from known or repeatable reference points, and marking areas of deterioration for photos.
- Primary members were physically evaluated, and conditions were documented on structure framing plans, tabular notes and sketches to outline extent and severity of deterioration for load rating and repair design, as applicable based on conditions observed. Areas were cleaned of debris for proper evaluation and accurate documentation of conditions and section loss measurements. Areas of measured section loss were verified using calipers, depth gauges, or a probing ruler where appropriate. Section loss was found generally isolated in the fixed spans and widespread in the bascule spans, so individual locations were not marked as originally planned.
- Suspected cracking in steel members was not found, however, dye penetrant testing equipment was available if needed. In the event of an observed crack, the procedures for notifying the ODOT PM for 'critical findings' would be followed. The extents and location of the crack would be marked and dated for condition reporting and future monitoring.
- Movable bearings were measured for alignment/tilt, noting direction and limits of expansion/contraction and summarized in a table for reporting, where an appreciable tilt was observed.
- Substructure concrete were sounded to locate deterioration severity and extents, then marked (in a limited fashion) for condition sketches and photography including relative location from reference points. Additionally, any signs of movement or settlement, undermining of bearings, local erosion, types of cracking and the condition of previous repairs were documented.
- Condition photography included both general and detailed views to aid in describing the observed conditions. General views of affected components show deterioration relative to a component's function and its relationship to the structure.

Mechanical Inspection:

An in-depth condition assessment and inspection of the span drive machinery, support machinery, and traffic protection equipment are required. These systems are critical to allow for safe and reliable bridge operations. The span drive machinery included in this assessment includes: the electric motors, Detroit diesel auxiliary drives, thrustor brakes, gear and grid type couplings, shafts, enclosed gearing, bearings, trunnion bearings, open gears, and instrumentation.

The support machinery includes: the span lock machinery components, air buffers, live load bearings, counterweight bumper blocks, and traffic control machinery components. Machinery supports and guards for all mechanical components are included as part of the inspection.

Inspectors used visual and aural observations, field measurements, and photographs to support the condition assessment while the bridge is open, closed, and operating. During the inspection the team was in constant communication with the bridge operator and provide the status and location of all team members. The inspectors used appropriate lock out-tag out procedures if mechanical components were required to be taken out of service to allow for proper inspection. Defects identified during the previous inspection cycle were reviewed to determine if the condition has changed. Newly identified defects found during the current inspection were summarized and reported similarly to previous detailed inspection reports. Condition recording was in accordance with AASHTO and ODOT MBI recommended procedures. The summary of the inspection requirements and maintenance procedures for specific components of the mechanical systems for this bridge, provided by ODOT, was referenced as a guide during this inspection.

In addition to the visual and aural inspection, and contingent on accessibility, field measurements were recorded for gear tooth thicknesses, bearing clearances, brake pad thicknesses, and span lock clearances. Oil samples were collected for analysis from the enclosed gear reducers with working plugs or valves. Easily removable machinery covers and inspection hatches were removed during the mechanical inspection.

Electrical Inspection:

A visual inspection of the electrical power distribution and control systems for the bridge are required. These systems are critical to allow for safe and reliable bridge operations. The primary power distribution equipment included in this assessment includes: the electric utility service, generator and transfer switch, service entrance equipment, panelboards, power distribution equipment, motor control centers, raceway system, cable condition, insulation resistance of motors, lighting systems, and lighting transformers. The primary control equipment included in this assessment includes: bridge control system, control panels, electric actuators and/or motor controlling equipment, limit switches, navigation lighting, CCTV systems and communication systems. In addition to equipment critical to bridge operations, other ancillary type systems such as lighting and receptacles, HVAC, and security will also be included in the assessment.

The traffic control provided by normal bridge operations (traffic warning signals and gates) was inspected and assessed for operability and function during bridge test openings.

Inspectors used visual and aural observations, field measurements, and photographs to support the condition assessment while the bridge is open, closed, and operating. During the inspection the team was in constant communication with the bridge operator and provide the status and location of all team members. The inspectors used appropriate lock out-tag out procedures if electrical components were required to be taken out of service to allow for proper inspection. Defects identified during the previous inspection cycle were reviewed to determine if the condition has changed. Newly identified defects found during the current inspection were summarized and reported similarly to previous detailed inspection reports. Condition recording was in accordance with AASHTO recommended procedures. The summary of the inspection requirements for specific components of the power distribution and control systems for this bridge, provided by ODOT, was referenced as a guide during this inspection.

Span Balance Testing:

The span balance testing required installation of strain gages to each intermediate span drive shaft. Surface preparation of the shaft and mounting of the gages were performed in accordance with the strain gage manufacturer's requirements. The strain gages on each span were wired to a single data acquisition unit. An inclinometer was also wired to the data acquisition unit to measure the angle of leaf opening during operation.

The strain gage measurements and leaf opening position were simultaneously recorded for three openings, consisting of full, uninterrupted opening and closing cycles. The data was verified for repeatability following each opening. Similar testing was conducted on each leaf. The testing was concurrent with the mechanical inspection.

After the inspection, calculations were performed to convert the shaft strain to shaft torque. The shaft torque was used to calculate the torque, span balance, and friction on each leaf during operation. Span balance was reported as a total moment at a given angle and as an equivalent toe reaction while the bridge is closed. The data collected from the three operations was averaged to provide the most accurate results.

The report in Appendix 5 presents the calculated torque constant, the angular position of the center of gravity and the average friction for each run. Opening and closing data in the system for each run is presented graphically. Strip charts for a representative run for each leaf, containing data for the instrumented shafts and the inclinometer during both the opening and closing cycle, are provided. Additionally, the report documents weather conditions during testing and limitations to the test method. Recommendations are provided indicating corrective action if the span balance is outside the industry standard recommended range.

2.3.1 Equipment Required for In-Depth Inspection

The bridge is operated in accordance with 33 CFR 117.647, which requires the bridge to open on signal from marine traffic or by coordinated schedule from marine traffic during the shipping channel normal operations (April 1 to December 1). The 9th U.S. Coast Guard District Bridge Management Specialist was notified of the inspection a minimum of one month in advance to process the permit to deviate from normal operations for bridge inspection and to request an extended advance notice. The detailed work plan, outlining specific activities regarding bridge openings, was submitted for approval. The USCG issued an official notice to mariners with the specified schedule and protocols for bridge opening notification and restrictions during the inspection period. For the 2023 inspection, a 30-minute advance notice was requested for Monday and Friday of the inspection (where operational component inspection will not interfere with operations), and a 3-hour advance notice was requested for Tuesday through Thursday of the inspection (where operational component inspection will require reassembly for bridge openings). This permit and the advance notice were shared with ODOT and the bridge tender for reference. Access to the bascule span (Span 5) super and substructures above the water line requires the use of a 60-foot under bridge inspection unit (UBIU, NE Bridge Riggers, Inc.) to perform the visual and physical inspection of the bridge elements. This unit is also used to inspect Spans 2, 3, 4 and 6 over the water, portions of Span 7 and is operated from the bridge roadway. Spans 1, 7, 8, 9 and 10 super and substructures are inspected with a 40-ft bucket truck (Premier Aerials) operated from the ground surfaces below each span. Span 8 over the railroad tracks requires additional coordination and flagging services with Ann Abror Railroad to conduct the inspection.

Additionally, access to the control house, control center, motor control panels, machinery rooms, counterweight pits and other areas of the bridge housing mechanical, electrical and structural components are required to complete the inspections. Use of small ladders, access catwalks and stairways, and the areas surrounding the bridge by walking is required. Operation of the bridge for testing purposes is required to assess the operability and function of the mechanical and electrical systems, as well as inspecting portions of the structure otherwise not accessible when in the closed position (center lock, girder track bearing, etc.).

Use of the under bridge inspection equipment and deck topside inspection requires a temporary single lane closure on the roadway, provided by A&A Safety, Inc. We performed one lane closure each day primarily for the under bridge unit's access, with a second lane closed in the opposite direction to accommodate the topside inspection. ODOT District 2 stated that local permits with the City of Toledo are not required for conducting lane closures on the bridge. Traffic control vendors are selected from ODOT's pre-qualified vendor list for 'Maintenance of Traffic'. The traffic control setup used for inspection shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) and follow coordination approval from ODOT District 2 for these activities.

The inspections were performed in accordance with governing state and federal safety laws and following OSHA guidelines and requirements. Hazards present at the bridge location include but are not limited to: equipment use over water, working near active traffic, slips/trips/falls, paint removal, moving machinery and parts, pressurized equipment and hydraulic lines, exposed electrical service equipment, pinch points, and ladder use. Inspectors working with the MEWP equipment will wear full-body harnesses with lanyard attachments to the anchor points in the basket. Inspection personnel will maintain communication with the bridge operator and within the team during inspection activities and bridge openings primarily with two-way radios. These were used as a combination of those supplied by bridge and ODOT staff, and by HDR. Daily safety meetings were held on-site prior to inspection activities to review site conditions, specifics of inspection, job site hazards and mitigations, emergency procedures and general communications, and the work plan for the shift. The discussions from these meetings were carried over for ODOT staff working alongside HDR personnel.

Inspection tools used included: hammers, scrapers, wire brushes, rulers, tape measures, levels, calipers, flashlights, "V-WAC" gage (measures depth of pitting section loss), mirrors and a digital camera. Additionally, NDT equipment included dye-penetrant testing kit and an ultrasonic thickness measuring device (D-meter). Personal Protective Equipment (PPE) included: hard hat, Type II ANSI safety vest, safety glasses, gloves, hearing protection, safety toe footwear, fall protection harness & lanyard, personal floatation device (PFD), fire extinguisher, and cellular phone (operations and marine communication).

2.3.2 Traffic Control

A traffic control vendor (A&A Safety, Inc.) provided temporary single-lane closures on the bridge during the inspection. Each closure covered the length of the bridge in one of the four travel lanes and included: a truck-mounted attenuator (TMA) for personnel and equipment protection, necessary arrow board(s), cones or barrels, and advance warning signs. Formal traffic control plans were not prepared. In lieu of such, aerial view maps of the bridge and roadway locations were utilized to coordinate the lane closure layouts with the traffic control vendor. The sidewalks remained opened to pedestrian traffic during the inspection. Upon a 15-minute notice from the bridge operator, the inspection crew and UBIU cleared the bascule span so that it could be opened for marine traffic in the river. Similar procedures were coordinated for bridge openings for inspection purposes.

2.4 NBIS Coding Information

The rating system used for assigning numerical condition ratings to members to describe their overall or general condition is outlined below. This system follows the NBIS guidelines and can be found in the ODOT Manual of Bridge Inspection. This system was used to provide numerical ratings for the bridge components and should be used as the reference for the numerical ratings discussed in this report and on the field inspection notes.

Numerical Condition Rating	Condition Rating Description (General)	Supplemental Rating Guidelines
9	Excellent Condition	Elements are properly constructed and in new condition
8	Very Good Condition – No problems noted	There are no noteworthy deficiencies which affect the structural capacity or function of the members
7	Good Condition – Some minor problems exist	Minor problems include non-structural hairline cracking in concrete; presence of corrosion or rust without section loss in steel
6	Satisfactory Condition – Structural elements show some minor deterioration	Minor deterioration includes hairline structural cracking, isolated or small presence of delamination or spalling in concrete; presence of corrosion or rust with less than 2% thickness section loss in critical areas
5	Fair Condition – All primary structural elements are sound, but may have minor deterioration	Minor deterioration includes numerous hairline structural cracking, presence of delamination or spalling in concrete where section loss to reinforcing is possible; presence of corrosion or rust with up to 5% thickness section loss in critical areas and corrosion affecting non-critical areas
4	Poor Condition – Advanced section loss, deterioration, spalling or scour may be present	Extensive deterioration is present and loss of structural capacity, including measurable structural cracks, large spalled areas, exposed reinforcing steel with section loss in concrete; 5 to 25% thickness section loss in critical areas, fatigue or out-of-plane distortion or cracking, local buckling of compression members or connections, elongation of tension members, corrosion affecting function and capacity
3	Serious Condition – Loss of section, deterioration, spalling or scour have seriously affected primary structural components; local failures are possible	Shear cracking in concrete or fatigue cracking in steel is present; Severe deterioration including advanced loss of section (over 25%), local member failure and significant weakening or loss of structural capacity
2	Critical Condition – Advanced deterioration of primary structural elements may be present	Shear cracking in concrete or fatigue cracking in steel is present; typically accompanied by severe loss of section (over 50% and/or holes) and loss of structural capacity; Scour removal of substructure support; Closure of bridge may be necessary
1	“Imminent” Failure Condition – Major deterioration or section loss is present in critical structural components or obvious vertical or horizontal movement affecting structural stability	Bridge is closed to traffic due to major deterioration, but corrective action may put it back into light service
0	Failed Condition	Bridge is out of service and beyond corrective action

3.0 Structural Inspection Observations

3.1 Approaches

3.1.1 Pavement: The asphalt wearing surface is in good to fair condition at both the south and north approaches (see Photos S-5 to S-15). The South approach pavement exhibits sealed cracking throughout the four roadway lanes. There are a few scattered locations where the sealant is deteriorated and worn, exposing the original cracking. The North approach pavement exhibits isolated minor transverse cracking, without sealant, across the three lanes.

South approach concrete slab, SB lanes

The South approach cellular abutment structure is composed of concrete substructure, walls, framing and a concrete slab. The slab exhibits longitudinal and connected transverse cracking up to 0.05" wide throughout the roadway lanes, east sidewalk / trail and the west shoulder area (see Photos S-10, S-12, S-13). There are a few locations of delaminated concrete along the finger joint at the north side of the approach structure.

South approach pavement to slab, NB lanes

There is a hot poured rubber (HPR) sealed joint at the South approach between the concrete slab and asphalt. This joint is in fair condition and exhibits minor to moderate wear, loss of adhesion, depression with debris accumulation, and slight uplifting of the HPR material (see Photos S-16 & S-17).

It is recommended to replace the HPR joint material at the South approach.

3.1.2 Shoulders and Guard Railing: There are sidewalks at each of the four quadrants approaching the bridge with a combination of steel railings, concrete barriers, and guard railings. In general, the concrete sidewalks and various railing components are in good condition at each quadrant.

Southwest sidewalk, barrier, railing

The southwest sidewalk, barrier and 5-tube steel railing are in good condition. The sidewalks exhibit minor scattered surface cracking less than 0.03" wide and the concrete barrier exhibits scattered vertical cracks at both faces up to 0.03" wide. The curb island at the west side of the approach structure is in good to fair condition, exhibiting scattered transverse cracking up to 0.03" wide across the sides and top and isolated longitudinal cracking with similar widths (see Photos S-18 & S-19).

Southeast sidewalk / trail barrier & railing

The southeast approach trail timber railing, the roadway concrete barrier, and the 2-tube railing are each in good condition. The barrier exhibits scattered vertical cracks at both faces up to 0.03" wide (see Photos S-20 to S-22). The timber railing transitions to the bridge exterior barrier with a 5-tube steel railing at the approach structure, each connected to the concrete end block. The outer concrete barrier and railing are in good condition with vertical cracks throughout spaced 3 ft to 5 ft at both faces of the barrier up to 0.03" wide.

The northwest sidewalk and guard railing are in good to fair condition (see Photos S-23 to S-26). There is up to 3" deep localized settlement of the sidewalk to the north of the abutment joint (at the end of the concrete barrier) with evidence of erosion below and immediately west of the sidewalk. There is vegetation growth throughout the sidewalk and curb.

The northeast guard railing is in fair condition exhibiting minor impact dents and scrapes scattered throughout. The transition and connection to the bridge barrier near the north abutment are in good condition. The approach sidewalk, timber railing, and transition to bridge barrier and railing are in good condition (see Photos S-27 & S-28).

It is recommended to remove the vegetation growth from the northwest quadrant sidewalk and repair the settlement of the sidewalk at the railing transition.

3.1.3 Slopes: The slopes / embankments at the four quadrants are in good condition and appear stable. The embankments are at approximately 1v:3h slopes and are grassy and well vegetated with isolated locations of small brush and trees (see Photos S-29 to S-32).

3.1.4 Drainage: There are four curb drains across the south approach roadways, at the west sidewalk curb, at the southbound roadway curb, at the northbound roadway curb, and the east trail / sidewalk curb. Each drain is clear and in good condition (see Photos S-33 & S-34). There are two curb drains at the end of the north approach roadway, one at each side near the Summit Street intersection. Each drain is clear and in good condition.

Northwest sidewalk settlement at transition

Northwest sidewalk vegetation growth

Southeast drain inlet at sidewalk / trail

3.2 Top of Deck

3.2.1 Deck Surface: The bridge deck was replaced during the 1996 structure rehabilitation project, and generally consists of two vehicular lanes in each direction plus a mixed-use trail section along the east side of the main roadway. The roadway transitions in Spans 6 to 10 due to previous connecting ramps, and is configured with one southbound lane, two northbound lanes, and the mixed-use trail.

The concrete deck surface is in generally good to fair condition throughout the spans exhibiting isolated longitudinal and transverse cracking up to 0.03" wide (see Photos S-35 to S-51 and S-62 to S-67). There are several isolated locations of delaminated and spalled concrete, typically next to the expansion joints. There are areas where roadway reconfiguration repairs are evident, due to removal of the median barrier, and the concrete patches at these locations remain in good condition.

In the bascule spans the bridge deck consists of a +/- 5" deep grid deck, which is filled for the segment along the rear break joint of each leaf. The grid deck is in generally good to fair condition typically exhibiting minor wear in the wheel paths and minor deterioration to the paint throughout (see Photo S-52 & S-59 to S-61). The grid deck is welded directly to the stringer top flanges along the lower main bars, typically as a pair of 1"-2" long welds on one side of the main bar, from the edge of the stringer flange. There are numerous locations where these welds are cracked and/or broken, and typically both welds at a main bar to stringer location are cracked or broken (see Photos S-53 and S-54). These locations typically exhibit minor rubbing wear / fretting corrosion due to deck grid vibration. The locations are sporadic and random across both leaves, but not to an extent that any panel sections exhibited visible or audible movement or deflection.

Additionally, there are three localized areas of corrosion holes to the main bars of the grid deck, in the south leaf along Stringers 8W and 16W between Floorbeams 5s-7s, and in the north leaf along Stringer 17W between Floorbeams 5n-6n. The holes range in size up to 12" long by 2" high and are at a series of 6-12 main bars between each pair of floorbeams (see Photos S-55 to S-57).

There are fiberglass panels attached to the grid deck at the mixed-use trail. These are in good condition.

Span 4 deck surface, SB lanes

Grid deck north leaf, SB lanes

Grid deck main bar corrosion holes

Grid deck main bar corrosion holes

See condition sketches in Appendix 3 for additional details.

It is recommended to install an epoxy overlay to the concrete deck surface across the bridge. It is recommended to monitor the bascule span grid deck for additional cracking at the main bar to stringer connections. It is recommended to repair the locations of corrosion holes to the grid deck main bars.

Grid deck main bar to stringer top flange broken welds

3.2.2 Bridge Fascia: The bridge fascia consists of the exterior built-up steel beam below the bridge railing at the sidewalks. This longitudinal beam is part of the framing off the exterior girders that supports the sidewalk, railing and light poles. The fascia beams are in good condition at both the west and east sides of the bridge in each span (see Photos S-68 to S-81). The fascia beams typically exhibit up to 1” thick packing corrosion along the top edge of the vertical plate and top angle along their full length. The packing corrosion has been cleaned and caulked throughout both fascia beams, however, minor corrosion bleeding and staining is present, indicating continued active corrosion under the caulking.

Span 2 East fascia packing corrosion

3.2.3 Bridge Railing: The bridge railing varies on location across the bridge. At the west and east sidewalks there is a 5-tube steel railing which is in good condition throughout. Between the west sidewalk and roadway there is a concrete barrier which exhibits full height (42”) vertical cracks at both the roadway and sidewalk faces (full depth or thru-cracks), scattered throughout and spaced up to every 3-5 feet (see Photos S-82 to S-90 and S-94 to S-101). Between the roadway and east trail there is a concrete barrier and a 2-tube steel railing on top of the barrier. The barrier exhibits similar vertical cracking as at the west side and the railing is in good condition throughout. Between the east trail and the east sidewalk there is a concrete barrier which exhibits similar vertical cracking as the other barrier locations.

Span 3 west roadway barrier, typical cracks

In the bascule span, the concrete barriers between the west sidewalk and roadway, and between the east trail and east sidewalk, are steel plate barriers. These are in generally fair condition with widespread flaking and peeling paint, minor surface corrosion, and several missing connection bolts at the vertical plates at the sidewalk side of the barriers (see Photos S-91 to S-93).

Span 8 east roadway and exterior barriers, typical cracking

It is recommended to apply silane treatment to the faces of the concrete barriers and to clean and paint the steel barriers in the bascule span. It is recommended to replace the connection bolts (missing and in-place) at the vertical plates of the steel barriers.

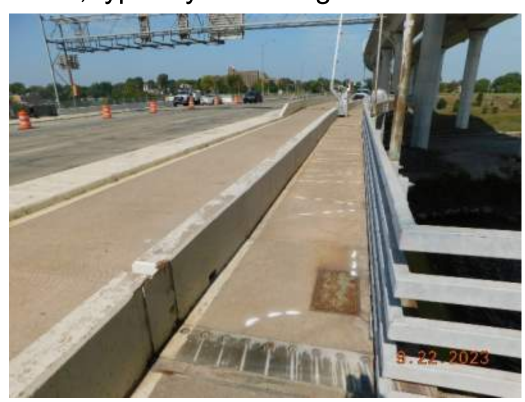

Span 5 south leaf east trail to sidewalk barrier, missing bolts at vertical plate

3.2.4 Curbs: There are curbs at the sidewalks along the west side of the bridge in Spans 7-8-9-10, and at the east side in Span 7. There is a curb / median island in Spans 4-5-6 between the northbound roadway lanes and the mixed-use trail. The sidewalk curbs are in good condition throughout, exhibiting isolated minor edge spalls and isolated minor vegetation growth (see Photos S-82 to S-90 and S-94 to S-101). The median island in Spans 4-5-6 is in good condition, exhibiting minor scrapes and chips at isolated locations of the concrete portions of the curb. The fiberglass curb and grating of the median island in the bascule span is in good condition.


Span 5 North leaf West sidewalk

3.2.5 Sidewalks: There are sidewalks along the west and east sides of the bridge. The west sidewalk connects the pedestrian access trail at the south across the bridge to the sidewalks on the north approach. The east sidewalk similarly connects from the south approach to the north approach, but merges with the mixed-use trail at Pier 7. Both sidewalks are in generally good condition, typically exhibiting isolated to scattered transverse and longitudinal cracking up to 0.03” wide. There are a few locations of concentrated groups of cracks as well as a few locations of wider cracks, up to 0.06” wide (see Photos S-102 to S-120).

It is recommended to apply a silane treatment to the surface of the concrete sidewalks to seal existing cracking.


Span 6 East sidewalk

3.2.6 Joints: There are finger plate expansion joints at the South abutment, Pier 4 (south side), Pier 5 (north side), Pier 8 and the North abutment. The joints at the bascule piers and Pier 8 also have elastomeric troughs connected to drainage pipes.

The joint at the South abutment is in fair condition and exhibits a horizontal misalignment in the northbound lanes, with the fingers touching. The finger plates in the southbound shoulder and right lane at the south side of the joint are up to 0.75” higher than the span side finger at the north side plates. The joint at the west sidewalk has seized and broken apart at the Span 1 side concrete header (see Photos S-121 to S-128).


South abutment finger joint, SB right lane

The joint at the North abutment is in fair condition and exhibits slight horizontal misalignment of the finger plates, primarily in the two northbound lanes. The joint at the east sidewalk / mixed-use trail exhibits debris accumulation along the barriers and uplift at the middle of the cover plate, up to 0.5" (see Photos S-129 to S-132).

The joint at Pier 4 is in fair condition and exhibits slight horizontal misalignment of the finger plates in the northbound lanes. There are small areas of spalled and delaminated concrete along the south joint header in the northbound and southbound lanes (see Photos S-133 to S-135).

The joint at Pier 5 is in good condition with minor debris accumulation at both sidewalks at the roadway barriers (see Photos S-136 & S-137).

There are three joints in the bascule spans: south rear break, center break, north rear break. The rear break joints are open joints between the filled grid and pier span over the counterweight. The center break joint has finger plates similar to the other expansion joints and is an open joint.

The center break joint exhibits horizontal and slight vertical mis-alignment of the fingers across the lanes. The fingers are touching and wearing into each other in the southbound lanes and have a slight vertical misalignment (up to 0.25") (see Photos S-138 to S-141). The fingers at the sidewalks are in good condition. The supporting elements and connections below the center break joint are in good condition.

The rear break joints are in good condition in the roadways with no deterioration observed. The rear break joints at the sidewalks exhibit vertical uplift of the cover plates along the transverse break of the joint up to 0.5", due to packing corrosion between components of the framing below (see Photos S-111 and S-142 to S-144).

The longitudinal breaks at the girder caps are in fair condition, and exhibit rubbing and wear between the side vertical plates at the cap and the edge angles around the break. This is due to packing corrosion at the bottom of the vertical plates, causing them to bow outward and rub on the edge plates as the span opens and closing. This was observed at each of the eight girder cap longitudinal breaks (see Photo S-144).

South abutment joint, West sidewalk


Pier 4 finger joint in NB lanes


Span 5 center break joint fingers in contact


Span 5 South leaf East sidewalk joint cover at rear break joint

The joint at Pier 8 is in good condition across the roadway lanes and at the west sidewalk. At the east sidewalk there is minor debris accumulation at the roadway barriers and uplift at the middle of the cover plate, up to 0.5" (see Photos S-145 & S-146).

It is recommended to repair the misalignment of the expansion joint finger plates by removing the plates, cleaning pack rust, painting, and adjusting as necessary during re-installation. It is recommended to repair the uplift at the sidewalk joint cover plates similarly. It is recommended to repair the rear longitudinal breaks at the girders by cleaning the pack rust causing the warping at the bases of the plates and straightening the warping.


Span 5 North leaf East sidewalk at rear break

Pier 8 expansion joint at mixed-use trail

3.2.7 Drainage: There are roadway scuppers for drainage along the west and east barriers at varying spacing across Spans 1-4 and 6-10. The scuppers are in good to fair condition and are typically free of debris accumulation, aside from a few isolated locations. The scuppers exhibiting debris accumulation are fully clogged, and are located at: Span 1 west side 3rd drain north of abutment, Span 3 west side 2nd drain south of Pier 3, Span 6 west side 3rd drain north of Pier 5 (see Photos S-147 to S-149).


Span 3 drainage scupper at west barrier

Below deck the system of connected downspouts, drainage pipes and their support connections to the superstructure are in generally good condition. At the South abutment, the downspouts are disconnected next to Bearing 4W. At Pier 8 the elastomeric drainage troughs are disconnected from the drainage piping below, and the piping system is generally broken and disconnected throughout the pier with several missing segments of pipe (see Photos S-150 to S-152). At the North abutment the downspouts are disconnected or clogged as evident by the erosion to the soil around each of the three downspouts.

It is recommended to replace the elastomeric troughs below the finger joints and repair locations of disconnected, broken, and missing piping at the drainage components.


Span 7 drainage downspouts and piping


Pier 8 drainage troughs and piping

3.2.8 Deck Underside: The concrete deck was replaced in 1996 and the underside in Spans 1-4 and 6-10 remains in generally good condition throughout. There are areas where roadway reconfiguration and removal of the median barrier in 2008 are evident, in the form of pop-out spalls from anchoring new roadway barriers, full depth patch repairs due to removal of drainage scuppers, and other minor defects such as honeycombing.

The most prevalent condition at the deck underside in the fixed spans is transverse and map cracking. These conditions are generally widespread throughout the deck underside; however, the crack widths are very narrow, typically less than 0.02” wide. Much of the cracking appears to be shrinkage cracking based on size, pattern and layout throughout a given deck bay and the span. Map cracking patterns are generally in 6” to 12” grids, with smaller and larger variations. There are isolated locations where the cracking is slightly wider and a larger pattern of map cracks, but these areas remain solid when sounded with a hammer. The transverse cracking is typically less than 0.03” wide, spaced 3’-6’ longitudinally in each bay (between stringers), and are a full bay width (see Photos S-153 to S-161).

There are isolated locations of minor efflorescence at transverse cracks, most prevalent in Spans 9 and 10 between Girders 3W and 4W. Additionally, there are a few locations of delaminated and spalled concrete (not related to 2008 construction), and these are typically located along or near expansion joints and drainage scuppers where water infiltration is causing the deterioration.

It is recommended to monitor the deck underside to track changes in the existing minor cracking and note future in-service deterioration.

Span 2 deck underside typical general view

Span 2 deck underside typical shrinkage map cracking

Span 2 deck underside typical shrinkage map cracking and honeycombing

Span 7 deck underside typical patch repair

3.3 Superstructure

3.3.1 Approach Spans *(Spans 1-4 & 6-10)*

The approach spans are configured as multi-span continuous structural units, per the original plans. Spans 1 to 4 are Unit 1, Spans 6 to 8 are Unit 2, and Spans 9 & 10 are Unit 3. The framing varies in Spans 6 to 8 due to the previous entrance/exit ramps connected to the main structure, which were removed during the 2008 construction project. Each structural unit and span are composed of girder-floorbeam-stringer framing (primary members) to support the deck and roadway, and the girders are supported at the piers on rocker or fixed bearings. In general, there are four girders, ten floorbeams, and six stringers comprising the cross section of each span. Additional girders, floorbeams and stringers are noted for spans with flared sections. There are two levels of diagonal and transverse bracing between the girders and floorbeams (secondary members) (see Photos S-162 to S-172). Girders and stringers are numbered from west to east, floorbeams are numbered from south to north within each structural unit.


Span 1 typical interior framing


Span 1 Girder 4W west face SL at abutment

<u>*Girders:*</u>

The main girders in Spans 1 to 4 and 6 to 10 are in good condition throughout. Due to framing for the removed approach ramps the exterior girder numbers vary in Spans 6-10 to keep the core four girders consistent through these spans. There are isolated to patterned scattered locations of painted over previous section loss (arrested section loss) typically located at the lower webs and bottom flanges of the exterior faces of the exterior girders. The locations vary from small spots (4” to 8” diameter) to widespread areas between floorbeams and are generally larger areas around downspouts where previous roadway drains without downspouts exposed the girders to runoff (see Photo S-175). The section loss varies from less than 0.0625” deep scattered pitting, up to 0.25” deep localized section loss around vertical stiffener and bottom flange angle / web fill plate connections. The areas of deeper section loss are typically up to 6” high of the lower web along the top of the bottom flange angles and vary up to 6 ft long. The exterior girder bottom flanges also exhibit scattered locations of warping to the cover plate edges, due to varying amounts of cleaned and arrested packing corrosion. Warping and pack rust thickness varies from 0.25” to 1.5” and generally occurs over large lengths of the bottom flanges at several locations within each span (see Photos S-173 to S-185).


Span 2 Girder 4W east BF pack rust & SL


Span 3 Girder 4W east BF pack rust

- Span 1, the ends of Girders 1W thru 5W adjacent to the connections to FB0S exhibit widespread painted over section loss up to 0.12" deep to the webs and bottom flange (see Photo S-174).
- Span 2, Girder 4W east bottom flange between Floorbeams 9S-10S exhibits an area of painted over and cleaned out packing corrosion causing warping to the cover plates. The bottom plate is split into two 0.25" thick segments with areas of 100% section loss. The warping is from the plate edge to the first line of rivets and is up to 1" in height (see Photo S-176).

Span 4 Girder 4W stiffener hole

Span 9 Girder 1W bearing stiffener pack rust

- Span 3, Girder 1W west bottom flange exhibits partially cleaned out packing corrosion and warping at the cover plates between Floorbeams 19S to 22S. The warping of the plates and pack rust thickness is up to 1" and there are several areas of isolated section loss to the bottom flange angle up to 0.1875" deep next to downspout locations (see Photo S-177).
- Span 3, Girder 4W east bottom flange exhibits partially cleaned out packing corrosion and warping at the cover plates between Floorbeams 19S to 22S. The warping of the plates and pack rust thickness is up to 1" and there are several areas of the plates with 100% edge section loss up to 6" L x 3" W (see Photo S-178 & S-179).
- Span 4, Girder 4W east lower web and bottom flange exhibit widespread painted over section loss between Floorbeams 28S to 30S (see Photos S-180 & S-181).
- Span 4, Girder 4W East lower web between FB30S-31S exhibits a 2" diameter hole in the base of the vertical stiffener (see Photo S-182).
- Span 7, Girders 2W and 3W next to Pier 7 exhibit up to 0.5" thick partially cleaned packing corrosion with warping to the bottom flange cover plates at both sides.
- Span 8, Girder 1W between Floorbeams 16S and 19S exhibits up to 0.75" thick partially cleaned packing corrosion with warping to the bottom flange cover plates at the west side (see Photo S-183).
- Span 9, Girder 1W west bearing stiffener angles at Pier 8 exhibit up to 1.25" thick packing corrosion and warping between the outstanding legs (see Photo S-184).
- Span 9, Girders 1W and 4W exhibit packing corrosion between the bottom flange cover plates throughout the span, varying up to 0.75" thick (see Photo S-185). Girders 2W and 3W at Pier 9 exhibit similar packing corrosion for lengths up to 10 ft from the pier.
- Span 10, Girder 4W exhibits minor packing corrosion along the east side of the bottom flange cover plates between Floorbeams 7S and 10S, up to 0.5" thick.

It is recommended to continue to monitor girder locations of packing corrosion for growth and additional warping. It is recommended to continue to monitor girder areas of painted over section loss for paint failure and re-initiating corrosion.

<ins>*Floorbeams:*</ins>

The main floorbeams between the girders are in good condition throughout. These floorbeams are protected from runoff and weather at the interiors of spans without joints and other water infiltration. There are scattered locations of minor bleeding and blistering corrosion around connected components below the finger joints at the south abutment, Piers 4, 5 and 8, and the north abutment. At these locations there is also widespread painted over section loss to the floorbeam webs and flanges, and the connections to the girders and bracing members. The section loss varies from 0.0625" deep up to 0.375" deep, the latter of which at isolated locations due to previous water infiltration (see Photos S-186 to S-196).

At the South Abutment, Floorbeam 0S (the end floorbeam below the finger joint at the abutment) exhibits widespread 0.125"-0.25" deep painted over section loss throughout the web and flange surfaces, between each of the girders (see Photos S-186 & S-187).

At Pier 4, Floorbeam 36S (the end floorbeam below the finger joint at south side of bascule pier) exhibits 0.125"-0.1875" deep painted over section loss across the south face lower web, from 12" to 48" high (full height), between Girders 1W-2W and 3W-4W, with 0.5" to 1" diameter holes in the lower web at Stringers 2W, 5W, and 6W (see Photos S-188 & S-189).

At Pier 5, Floorbeam 0S (the end floorbeam below the finger joint at north side of bascule pier) exhibits 0.125"-0.1875" deep painted over section loss across the south face lower web, from 12" to 48" high (full height) between each of the five girders, and holes in the lower web between G2W-G3W, 4" x 1" at the east side and two 0.5" diameter at the west side (see Photo S-190).

At Pier 8, Floorbeam 20S exhibits up to 1" thick packing corrosion between the bottom flange angle and the lower diagonal bracing connection above Bearing 1W at the south side of the floorbeam, with warping to the angle.

Span 1 FB0s at South abutment, web SL

Span 4 FB36s at Pier 4, web SL and holes

Span 6 FB0s at Pier 5, web SL and holes

Span 8 FB20s south BF and web SL

Floorbeam 20S also exhibits scattered section loss to the web up to 0.125" deep, between Girders 2W-3W, and an area of the bottom flange angle horizontal leg with 0.25" section loss across a 16" L by full width area (0.25" section remaining) (see Photo S-192). The south top flange at Stringer 3W exhibits up to 0.375" edge section loss for a 36" length on either side of the stringer, with daylight visible from the finger joint above (see Photo S-193). Floorbeam 0S on the Span 9 side at Pier 8 exhibits active corrosion across the top flange with rust staining down the web (see Photo S-194).

Span 10 FB11s at North abutment, BF SL

At the North Abutment, Floorbeam 11S (the end floorbeam below the finger joint at the abutment) exhibits widespread 0.125"-0.25" deep painted over section loss throughout the south face web and flange surfaces, between each of the girders (see Photo S-195). The north face exhibits similar, active section loss across the lower web and bottom flange (see Photo S-196).


Span 3 West exterior FB20s web SL

The west and east exterior floorbeams are in fair condition throughout. The lower webs at these beams typically exhibit scattered to localized painted over section loss at one or both faces, varying from 0.0625" to 0.1875" deep and as areas from 6" diameter to full length (+/- 7 ft) by 12" high. Additionally, several locations of web section loss are scattered across the entire face of the web and up to 0.125" deep (see Photos S-197 to S-200). These conditions are consistent throughout each exterior floorbeam in Spans 1 to 4 and 6 and vary from scattered to isolated locations in Spans 7 to 10.

It is recommended to continue to monitor floorbeam areas of painted over section loss and corrosion holes for paint failure and re-initiating corrosion. It is recommended to repair FB11S at the North Abutment.


Span 2 Stringer 6W at FB15s typical connection

<u>Stringers:</u>

The interior stringers are in generally good condition throughout Spans 1 to 4 and 6 to 10. These members are protected from water infiltration at the interiors of the spans without joints. The stringer to floorbeam connections include welded plates at the stringer top and bottom flanges and floorbeam web to provide continuous framing of these members. The visible portions of these connections, the welds, and welded components, were found in good condition throughout. The stringer ends at the floorbeam connections below finger joints exhibit up to 0.0625" deep painted over section loss to the lower web and bottom flange, with isolated locations up to 0.125" deep, in addition to localized minor corrosion and staining (see Photos S-201 to S-203).

Stringer 3W at the North Abutment exhibits a 2" diameter hole in the lower web at the connection to Floorbeam 11S (see Photo S-203).

<ins>Sidewalk Framing:</ins>

The transverse framing members are in generally fair condition throughout. Many members exhibit painted over section loss up to 0.1875" deep around the connection to the girder, below the location of the previous roadway curb / sidewalk. At a few locations there are small holes in the member or distortion to the thinned section of the web. Span 4 West sidewalk support between FB35S-FB36S exhibits a 2" diameter hole in the web (see Photo S-204). Span 4 East sidewalk support between FB34S-FB35S exhibits 0.25" deep section loss, a pinhole, and minor web buckling (see Photo S-205). The section loss was likely due to previous water infiltration. There are several locations with repairs or replacement sections in place, such as Span 6 east sidewalk between Floorbeams 1S and 2S (see Photo S-206).

It is recommended to continue to monitor sidewalk framing areas of painted over section loss and corrosion holes for paint failure and re-initiating corrosion. It is recommended to repair the locations of section loss, pinhole and warping to the sidewalk framing in Span 4.

Span 10 Stringer 3W at FB11s, hole in web

Span 4 East sidewalk support at FB35s, buckling web with pinhole

<ins>Diagonal and Transverse Bracing:</ins>

The upper and lower diagonal and transverse bracing members are in good condition throughout (see Photos S-207 & S-209). These members are protected from water infiltration at the interiors of the spans without joints. There are isolated to scattered locations of pigeon nesting at the upper diagonal members connection plates to the girders and floorbeams. These locations are more prevalent at the spans over land. The bracing members exhibit minor corrosion at the connections to the girders and floorbeam at areas below the finger joints.

Span 6 East sidewalk repair between FB1s and FB2s

Span 4, mid-level diagonal bracing at the connection to Girder 2W below Floorbeam 36S at Pier 4 exhibits painted over section loss and several holes up to 4" x 1" (see Photo S-208).

Span 9 typical bracing in good condition

Span 4 lower diagonal to G2W flange holes

3.3.2 Bascule Span *(Span 5)*

The bascule span consists of two leaves, each framed in a Girder-Floorbeam-Stringer configuration. The girders are built-up, variable depth members generally composed of 0.625” to 0.75” thick web plates, 8x8 flange angles, and up to six cover plates up to 1” thick each. The floorbeams vary from rolled shapes (36WF182 & 36WF150) to built-up members. The stringers are 14WF38 rolled beams and spliced continuous for each leaf’s length. The girders and stringers are numbered from west to east, and the floorbeams are numbered from the center to the trunnion and designated as north or south based on north or south leaf (see Photos S-165 & S-166).

See the condition location plan summary sheets following the description of the conditions observed in the bascule span for details on location and type of category deterioration.

<u>*Girders:*</u>

The bascule girders are in generally fair condition in both leaves, typically exhibiting painted over section loss to areas at the lower webs, bottom flanges, floorbeam connections and diagonal bracing connections. The section loss is generally widespread to the webs and bottom flanges between Floorbeams 7 and 5 (both north and south leaves) at both faces of the four girders. Most locations of section loss vary from 0.125” to 0.25” deep, with several locations at member connections or above edges of plates or connected parts exhibiting locally deeper section loss, up to 0.375” (see Photos S-210 to S-215).

At locations of plate and angle section loss, the rivets within these areas generally exhibit section loss to the heads up to 50%. There are two locations of holes in the bases of the vertical stiffeners. Additionally, there are areas of localized pack rust between built-up member components and at connections to floorbeams and bracing members, typically up to 0.5” thick.

There are areas throughout the girder of blistering and bleeding corrosion and rust staining, indicating active corrosion, typical at plate edges, connected components, and tight corners at connections where debris accumulation is causing deterioration to the paint.

In the North leaf, Girder 3W, bottom flange at FB2n, exhibits one missing bolt at the repaired diagonal bracing connection plate (see Photo S-215).


Span 5 South leaf, G3W, East lower web SL


Span 5 North leaf, G2W West lower web SL


Span 5 South leaf, G3W stiffener base holes


Span 5 North leaf G3W missing bolt at BF

There are a few locations of minor debris accumulation to the bottom flanges, generally at the uphill side at lower diagonal bracing members connection plates.

It is recommended to continue to monitor girder areas of painted over section loss for paint failure and re-initiating corrosion. It is recommended to clear debris from horizontal surfaces.

<u>*Floorbeams:*</u>

The floorbeams are in generally fair condition, typically exhibiting painted over section loss to areas across lower webs and tops of bottom flanges, bottom flange undersides, and along connections to girder and bracing members. The rolled shape floorbeams (FB4, 5 & 6) exhibit widespread section loss to the lower webs generally across the full length and up to 12" H, with spotty areas across the full height of the web, and at both faces of the web (see Photos S-216 to S-233). The section loss is generally up to 0.1875" deep.

The built-up floorbeams (FB1, 2, 3 & 7) generally exhibit more scattered to localized section loss across the lower webs and across the tops of the bottom flanges, including holes in the bases of the vertical stiffener angles. The section loss is also generally up to 0.1875" deep, aside from stiffener holes which are typically up to 3" diameter. There are a few locations of holes in lower webs and bottom flanges, typically less than 0.5" diameter with a couple locations up to 1" diameter (see Photos S-216 to S-233). There are a total of nine locations of holes in floorbeam webs, bottom flanges, or vertical stiffener bases.

The floorbeam connection angles to the girders typically exhibit up to 0.75" thick packing corrosion between the angle and floorbeam web, heavier towards the bottom of the floorbeam. This is causing warping of the connection angles. Packing corrosion is also present along plate edges of FB7 bottom flange up to 1" thick. At connections with section loss to members or connection components, the section loss includes rivet and bolt head/nut loss up to 50%.

There are a few locations of repairs at the floorbeams, typically to the lower 12" of the vertical stiffeners and at a few connection components, at the built-up floorbeams.

Span 5 South leaf, FB7s web SL throughout

Span 5 South leaf, FB6s lower web SL

Span 5 South leaf, FB3s b/w G3W-G4W, BF hole below catwalk

Span 5 FB0s + FB0n, lower web SL below joint, debris accumulation

There is minor debris accumulation throughout the tops of the floorbeam top and bottom flanges, generally roadway debris through the open grating. Several locations exhibit moderate debris, such as the bottom flanges of FB1 and FB2.

It is recommended to continue to monitor floorbeam areas of painted over section loss for paint failure and re-initiating corrosion. It is recommended to clear debris from horizontal surfaces. It is recommended to repair the locations of holes in the floorbeam bottom flanges, webs, and bases of vertical stiffeners.

Stringers:

The stringers are in generally good to locally fair condition. There are corrosion holes in the webs of the stringers at isolated locations scattered throughout both leaves, typically above floorbeams or near mid-panel between floorbeams. The locations observed are cleaned and painted over and are typically less than 1”. There are two locations of larger holes, measuring 6” x 2” (north leaf ST13W north side FB6n) and 6” x 3” (south leaf ST26W mid-panel FB5s-FB4s) (see Photos S-234 to S-236). There are a total of 20 locations of holes in the webs of the stringers.

It is recommended to repair the locations of holes in the stringer webs.

Span 5 North leaf, Stringers 10W + 11W web holes

Span 5 South leaf, Stringer 26W web hole

Diagonal and Transverse Bracing:

The K-bracing (transverse) and diagonal bracing members are in generally fair condition, and typically exhibit painted over section loss to the member ends and connection plates to the floorbeams and girders. There are several locations of small holes in the plates and ends of the members, as well as in the middle of bracing members below Floorbeams 7s and 7n (see Photos S-244 to S-246). These occur at both upper and lower member connections to the girders and floorbeams. At a few locations, there is section loss to the center connection plates and the member ends at these connections. Additionally, there is typically packing corrosion between the member and the connection plate and the connection plate and the girder or floorbeam, as well as at the center connections.

There is scattered minor debris accumulation across k-frame member horizontal legs and horizontal connection plates, similar to the debris accumulation at girder and floorbeam flanges.

Span 5 K-brace connection plate hole

There are several locations of cracked and broken connection angles where the upper diagonal members connect to the floorbeam and girders near the top flanges. Some locations are edge corrosion holes or cracks, while others have cracked or broken fully across the length of the angle. These are due to excessive corrosion to plates where debris accumulates, causing section loss and corrosion holes or section loss then cracking (see Photos S-237 to S-243). There are several locations where repairs have been made to previously broken connection angles, typically consisting of a new horizontal connection plate and new angle, and at some locations, a replacement diagonal member. There are eleven locations of corrosion holes, cracking, and fully or partially broken connection angles.

It is recommended to continue to monitor bracing member areas of painted over section loss for paint failure and re-initiating corrosion. It is recommended to clear debris from horizontal surfaces. It is recommended to repair the locations of holes in bracing members and connection plates. It is recommended to repair the upper diagonal connections with holes, cracks or fully broken angles.


Span 5 South leaf, upper diagonal at FB7s north side to G3W east side


Span 5 South leaf, upper diagonal at FB6s north side to G2W west side

Sidewalk Support Framing:

The sidewalk transverse support beams (12WF27) and vertical support posts are in generally fair condition, typically exhibiting areas of up to 0.125” deep painted over section loss and scattered locations of small corrosion holes, less than 2” diameter (see Photos S-247 to S-250). There are a few isolated locations of larger corrosion holes, typically at the bases of the posts. There are a total of eleven locations of holes in the sidewalk beams and posts, and a few locations of reinforcement repairs at these elements.

It is recommended to continue to monitor sidewalk framing areas of painted over section loss for paint failure and re-initiating corrosion. It is recommended to repair the locations of holes in the sidewalk support beam and post webs.


Span 5 lower diagonal connection plate hole


Span 5 sidewalk supports, holes in webs

Catwalks and Support Framing:

The catwalks run between the girders from the bascule piers out to the center break joint, where there is a set of transverse catwalks to access the jaw and diaphragm center locks and connect both leaves. The catwalks are composed of a pair of channels with a grid deck walking surface and angles for posts, middle, and upper handrails. The catwalks generally span from floorbeam to floorbeam (FB1-2-3) and from the vertical connection plates for the K-bracing (FB4-5-6-7), and have intermediate supports above the diagonal bracing center connections. The middle catwalk has access to the bascule pier while the east and west catwalks provide access between the other girders in the span.

Span 5 North leaf, catwalk channel web holes

The catwalks are in generally good to locally fair condition in both leaves, typically exhibiting isolated to scattered areas of painted over section loss up to 0.125” deep at the channel webs. This was typically localized at areas next to support connections. There are several locations along the middle catwalk with corrosion holes in the main channels, typically small and up to 1” diameter. In the north leaf between FB7n and FB5n there are several holes up to 12” L x 3” H in the west channel (see Photo S-253).

Span 5 North leaf, center catwalk support connection FB1n-FB2n with web hole

The middle catwalk support connections at the lower diagonal bracing are connected with a T-section aligned with the diagonal bracing. Two locations exhibit heavy corrosion with pack rust causing section loss and corrosion holes to the web of the T-section. Between FB2n and FB3n the pack rust is up to 1” thick and there are holes propagating from the end of the T-section (see Photo S-252). Between FB1n and FB2n, there is a 31” W x 1” H corrosion hole and up to 0.5” pack rust across the T-section web, with approximately 24” of web remaining (see Photo S-251).

It is recommended to repair the locations of holes in the catwalk channels. It is recommended to repair the locations of deteriorated catwalk supports at the diagonal bracing.

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

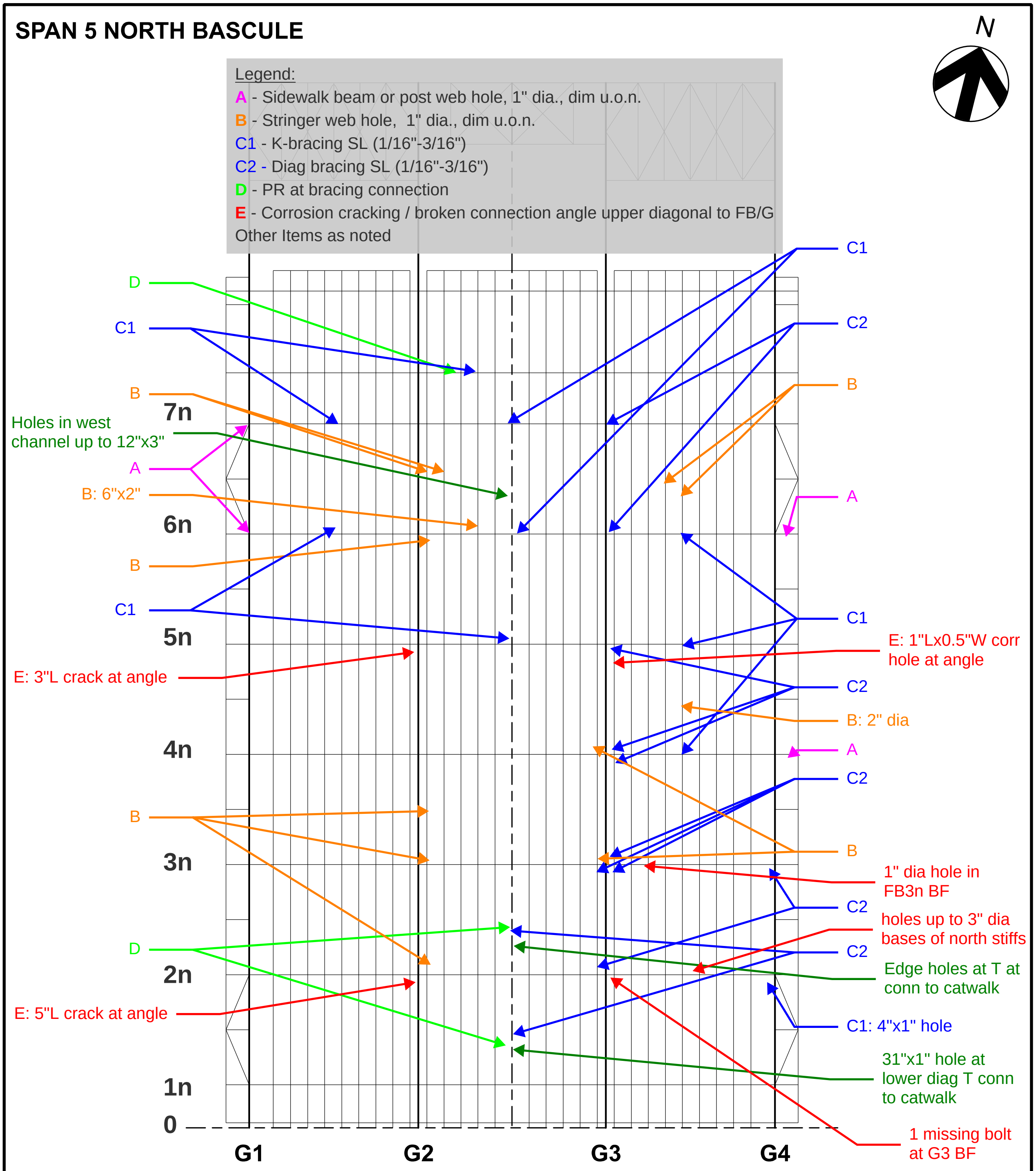
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/22/2023

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 5 NORTH BASCULE



OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

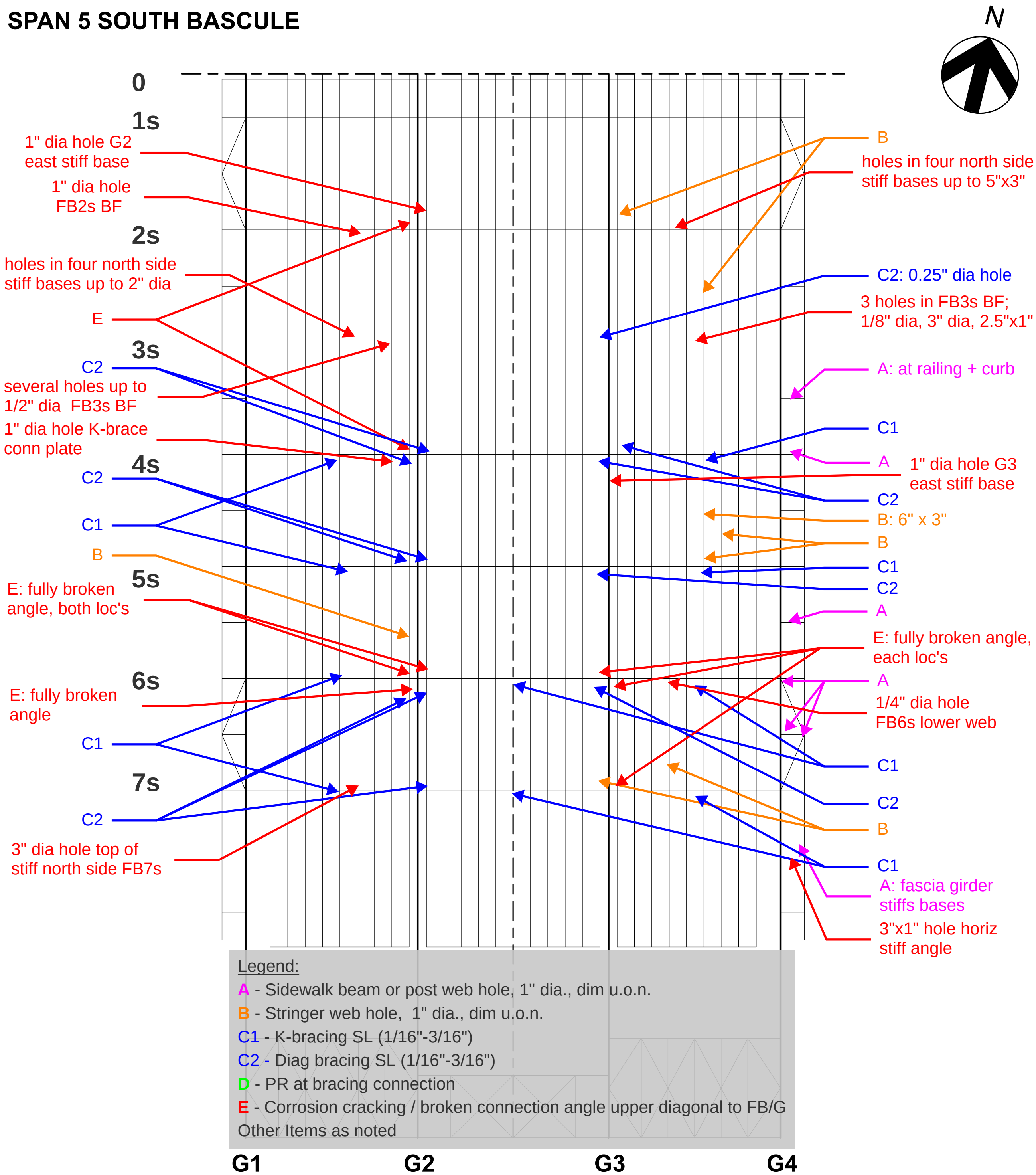
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/22/2023

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 5 SOUTH BASCULE



3.3.3 Bearings

There are three types of bearings supporting the fixed spans, fixed shoes with 7" diameter pins, high rocker shoes with 7" diameter pins, and high rocker shoes with 4" diameter pins. The rocker bearings sit on 3" to 5" masonry plates and are secured against sliding with pintles. The fixed bearings are at Piers 2, 6 and 9, and the rockers are at the abutments, Piers 1, 3, 4 south, 5 north, 7, and 8. The bearings are in generally good condition exhibiting minor rust staining, bleeding corrosion, and minor debris (see Photos S-254 to S-269). Most rocker bearings at the piers and abutments were observed in a generally plumb position or slightly tilted.

The rocker bearings at the north side of Pier 5 (supporting Span 6) were observed tilted in expansion at an average ambient temperature of 72° F, and measurements were taken. The calculated tilt varied from approximately 2.9 to 5.7 degrees (see Photos S-260 to S-263). The allowable tilt of the bearings that would maintain the rockers are within the inner 50% of the rocking surface is approximately 10.0°, based on height and width of the bearings. The inner 50% of the rocker surface is a general guideline for design normal bearing position based on thermal expansion and contraction, and maintains the rocker in a generally vertical position without approaching overtipping. See Rocker Bearing Measurements in Appendix 4 for details.

The trunnion bearings supporting the bascule girders at Piers 4 & 5 are discussed in the Mechanical Inspection Observations, Section 4.0.

It is recommended to monitor bearing positions during summer and weather months to confirm normal operation. It is recommended to monitor the tilted bearings at Pier 5 north.

South abutment Rocker Bearing 4W


Pier 4 (south side) Rocker Bearing 2W


Pier 5 (north side) Rocker Bearing 3W

Pier 8 Rocker Bearing 3W (Span 9 side)

3.4 Substructure

3.4.1 Abutments & Wing Walls

The South abutment is a cellular concrete frame structure with integral wingwalls and is composed of steel pier columns, concrete cap beams, and structural deck. The solid pier wall supporting Span 1 is considered the abutment as the interior is not accessible; the hatch at the base of the wall needs to be opened by ODOT (interior was previously inspected by ODOT).

The South abutment wall is in good condition, exhibiting large areas of patch repairs throughout. Many of the repair areas exhibit mapcracking up to 0.02" wide, however these locations are sound, and the cracking appears to be shrinkage cracking at the surface of the repairs (see Photos S-272 to S-275). There are a few areas of repaired vertical cracks at the west and east sides of the wall, as well as unrepaired vertical cracks, typically less than 0.03" wide. Additionally, there are a few vertical to diagonal cracks up to 0.125" wide, as shown on the condition sketches. The face of the wall exhibits rust staining from water infiltration at the joint above. The wing walls are in good condition, exhibiting isolated minor cracking up to 0.02" wide (see Photos S-276 & S-277). The backwall behind the girder ends and bearings is in fair condition, exhibiting diagonal and vertical cracking up to 0.03" wide, some with minor efflorescence. There are a few small shallow spalls with exposed reinforcement, and a few small areas of delamination.

The North abutment is a concrete cantilever-style wall with integral columns to support Span 9. The abutment wall is in good condition, exhibiting isolated vertical cracks up to 0.03" wide, typically between the girders (see Photos S-278 to S-280). The columns supporting the span bearings are in good condition with no deterioration noted. There is minor erosion along the face of the wall between the columns due to disconnected drainage downspouts and deteriorated joint troughs, allowing runoff through the joint directly to the soil area (see Photos S-281 to S-284).

See Condition Sketches in Appendix 3 for details.

It is recommended to injection-seal cracks greater than 0.0625" wide in the abutment walls. It is recommended to concrete patch repair areas of delaminated and spalled concrete. It is recommended to apply a concrete surface coating over the vertical and horizontal surfaces of the abutments and wingwalls to seal previous repairs and minor cracking, and prevent water infiltration.

South abutment stem wall, middle section

North abutment columns and backwall

Pier 1 North face, crack repairs throughout

Pier 3 South face, crack and patch repairs

3.4.2 Piers

Piers 1, 2, 3 and 6 are concrete solid wall piers. These piers are in generally good to fair condition, typically exhibiting large concrete patch repair areas across both south and north faces, as well as areas of vertical and diagonal cracking (see Photos S-285 to S-291). Most of the patched areas exhibit minor cracking sporadic or throughout patched areas, typically less than 0.02" wide and likely shrinkage cracking. There are areas of dampness at and around concrete patches, and a few small locations of delamination along edges of patches into the original concrete. The vertical and diagonal cracking at the pier faces is both repaired / sealed and unrepaired. The sealed cracking repairs are in generally good condition without further deterioration. At isolated locations, additional cracking has occurred as cracks in the sealant material, cracks adjacent or alongside sealed cracks, or cracks between and parallel to repaired locations. At most of these locations, the additional cracking is less than 0.03" wide, however there are a few locations up to 0.125" wide (see Photo S-292). At the north side of Pier 6, there are a few locations of failing sealant with cracks open up to 0.25" wide. The locations of unrepaired cracking are generally around concrete patch repairs or other repaired cracks, and typically towards the west and east sides of the piers. These typically vary between 0.03" and 0.1" wide, some with efflorescence.

Piers 4 and 5 are the bascule piers and support the approach spans at the exteriors, and the bascule span and related elements at the interiors. The pier exterior faces are in generally good to fair condition, typically exhibiting large concrete patch repair areas across both south and north faces, as well as areas of vertical and diagonal cracking (see Photos S-293 to S-304). Most of the patched areas exhibit minor cracking sporadic or throughout patched areas, typically less than 0.02" wide and likely shrinkage cracking. The vertical and diagonal cracking at the pier faces is both repaired / sealed and unrepaired. The sealed cracking repairs are in generally good condition without further deterioration. At isolated locations, additional cracking has occurred as cracks in the sealant material, cracks adjacent or alongside sealed cracks, or cracks between and parallel to repaired locations. At most of these locations, the additional cracking is less than 0.03" wide.


Pier 3, South side at East end, cracking in patched areas


Pier 4, South face detail view, East side


Pier 4 North face detail view, East side


Pier 5 North face detail view, center to west

The angled east and west faces of Piers 4 and 5 are in good condition, exhibiting isolated to scattered sealed vertical cracks across nearly the full height of the piers. Interior elements and conditions are discussed in Section 3.6.

Pier 6, South side detail view, West side

Piers 7, 8 and 9 are concrete column and cap beam piers. These piers are in generally good condition, typically exhibiting isolated small spalls and delaminated areas, and several concrete patches, in both the caps and columns (see Photos S-305 to S-314). The patches are sound and in good condition. There are areas of minor map cracking at the caps and minor horizontal cracking around corners of the columns, each less than 0.03” wide.

See Condition Sketches in Appendix 3 for details.

Pier 8, South face general view

It is recommended to injection-seal cracks greater than 0.0625” wide in the solid wall piers. It is recommended to concrete patch repair areas of delaminated and spalled concrete. It is recommended to apply a concrete surface coating over the vertical and horizontal surfaces of the piers (walls, columns and cap beams) to seal previous repairs and minor cracking, and prevent water infiltration.

3.5 Lights, Signs, Utilities & Miscellaneous Items

3.5.1 Lights and Light Poles

The roadway lights and light poles along the west and east sidewalks are in generally fair to locally poor condition. The lights were observed as functional throughout. Most poles are missing the caps at the tops of the poles, allowing water infiltration to the pole interior and base. Additionally, there are missing hand hole access covers at the sidewalk level and below, also allowing water infiltration.

Span 1 West side light pole base with holes

There are four locations of severe corrosion and section loss at the pole bases which has led to large holes around the perimeter of the pole base around the anchor bolts. At each location, the steel was thin enough to be hammered free around small holes observed visually. There is debris accumulation in several of the pole bases. The light poles are secured to the bridge via a base plate connected to the bottom of the fascia beam, and a U-bolt clamp at the top of the fascia beam. The deterioration to these pole bases was immediately reported to ODOT with a recommendation that the poles be taken out of service and removed from the structure. ODOT has since advised that this work has been completed.

Span 1 East side light pole base with holes

The locations and condition specifics of light poles with holes at the bases are:

- Span 1, West light pole at FB0S / South Abutment exhibits 1" diameter to 2" x 1" holes in the base around 75% of the base perimeter (see Photo S-315).
- Span 1, East light pole at FB4S exhibits several holes in the base up to 6" W x 3" H (see Photo S-316).
- Span 3, East light pole at FB18S exhibits several holes in the base up to 4" W x 1.5" H, and the hand hole cover above is open (see Photo S-317).
- Span 3, East light pole at FB25S exhibits 100% SL around 75% of base perimeter (see Photos S-319 & S-320). The interior at the base is full of debris and bird nesting.

Span 3, FB18s East side light pole base with holes

Span 3, FB25s East side light pole base with holes

Other light pole conditions observed include:

- Span 2, West light pole at FB14S exhibits missing wiring protection.
- Span 5, West light pole between FB3s and FB4s (south leaf) exhibits 1 of 4 anchor bolt covers missing.

The navigational lights attached to the Span 5 fascias and along the channel side of Piers 4 and 5 are in generally good to fair condition. Lights were observed to be operational with red light on at each location except at the west fascia (see Photos S-321 to S-324). The north light at this location exhibits a cracked and broken bottom red lens. The south light was stuck against the upper rivets at the fascia beam but was corrected to be in the correct position when the span is down.

Span 5 East side navigation lights

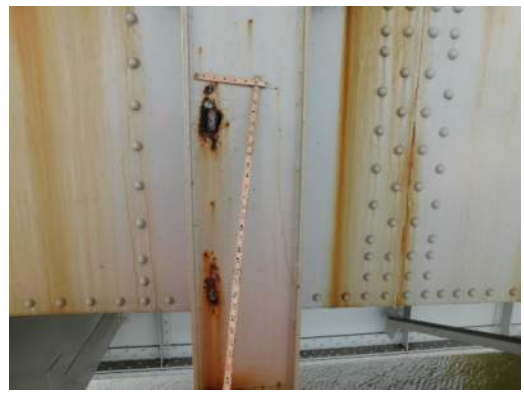
See Section 5.0 Electrical Inspection Observations for other lighting fixtures.

It is recommended to replace missing caps at the tops of light poles. It is recommended to monitor corrosion conditions at light pole bases and remove / replace poles as needed in a similar fashion to those removed following this inspection. It is recommended to repair or replace missing or out of place hand hole covers at the light poles. It is recommended to repair or replace non-functioning navigational lights at Span 5 and the bascule piers.

3.5.2 Signs and Overhead Sign Gantries

Span 4 sign gantry north elevation

There are two overhead sign gantries on the bridge, which carry the signs and signal lights for bridge operations and assist in traffic notification for bridge openings. These are located across the north end of Span 4 and the south end of Span 6. Both gantries are composed of dual post supports at each side, and a tri-chord truss with intermediate splices. These gantries were visually inspected for safety and structural related defects. Both gantries are in generally good condition, including attachment to fascia beams, support post and tri-chord connections, sign panel connections, and galvanized coating (see Photos S-325 to S-330).



Span 6 East fascia support, holes at south post base web plate

Span 4: The sign on the southeast corner of the gantry exhibits peeling and is becoming hard to read. The SE ladder access exhibits missing and damaged metal meshing.

Span 6: The east side post supports attached to the east fascia exhibit two corrosion holes in the east vertical plate at the south post, up to 4” high x 2” wide, exposing the anchor bolts inside and showing evidence of debris accumulation at the interior (see Photo S-329).

It is recommended to repair the corrosion holes at the Span 6 sign gantry east support at the fascia.

3.5.3 Utilities and Utility Supports

Span 3 junction box at FB18s east exterior, corrosion holes in box

There are utility piping and conduits carrying a variety of items at several locations throughout the bridge. The conduits and piping are generally attached to various bridge super and substructure elements. The condition of the utilities and their supports vary, however, most items observed were found in good condition. Below is a summary of items observed during the structural inspection activities. See also the Mechanical and Electrical Inspection Sections 4.0 and 5.0 for additional details and condition summaries for utility and support elements related to the scope of those inspections.

There are several light pole junction boxes attached to exterior floorbeam top flanges with heavy corrosion and areas of 100% SL (holes) of various sizes. These locations are listed below:

- Span 2, West LP at FB7S
- Span 2, East LP at FB11S (see Photo S-331)
- Span 3, East LP at FB18S (see Photo S-332)
- Span 3, West LP at FB21S
- Span 3, East LP at FB25S
- Span 4, East LP at FB32S

Span 5, abandoned conduit along east side of G3W above floorbeam top flanges has been mostly removed, however, one section between FB3n-FB4n remains with deteriorated clamp supports at both floorbeams (see Photo S-333). Several adjacent sections of conduit to this location were found to be loose and were removed by the inspectors.

Span 6 at Pier 5, broken conduit below East sidewalk

Span 6 at Pier 5 at East exterior FB0S – conduit support angle connection to floorbeam bottom flange is broken with 100% section loss to the conduit at several locations, exposed wiring and the conduit is only supported at the Girder 4W bottom flange connection (see Photo S-334).

Pier 6 North side, disconnected conduits with rope supports

Span 7 at Pier 6 exhibits three conduits at the north face of the pier near Girder 4W that are disconnected with exposed wiring and supported by rope tied off to the upper and lower diagonal bracing members (see Photos S-335 & S-336).

It is recommended to repair the deteriorated conduit connections, supports and junction boxes throughout the bridge.

3.5.4 Swing Gate Housings

The Swing gate supports and housings attached to the exterior girders are in generally good condition at each of the four locations (Span 4 west and east, Span 6 west and east). The lower framing typically exhibits painted over section loss up to 0.125” deep throughout the channels and connections with blistering and bleeding corrosion at scattered locations across underside. There are isolated small holes in the channel webs, typically the exterior longitudinal members. Minor packing corrosion between floorplates and channels is up to 0.5” thick, which are also primary locations of active corrosion and section loss to channel members. The east swing gate in Span 6 exhibits section loss throughout the support framing channels with several small holes in the upper webs of the east and north side channel members (see Photos S-337 & S-338).

Span 4 East side swing gate support & housing at G4W

The security fencing in Span 10 attached to the main framing elements along Floorbeam 6S is in good condition throughout, including connections to floorbeams, girders and bracing members (see Photo S-339).

3.6 Bascule Pier Interior

3.6.1 Structural Concrete

Pier 4 Basement Level F water & silt

Pier 4 Basement Level F exterior wall cracks

Pier 5 Counterweight Pit Level E upper wall diagonal cracking throughout

Piers 4 and 5 are the bascule piers supporting the approach spans at the exteriors, and the bascule span and related elements at the interiors. The pier exteriors are concrete solid pier wall type, including the walls at the east and west sides that complete the enclosures for these structures. The piers are composed of several levels vertically, and main and side rooms transversely, which are used to locate and describe structural features and deterioration. Levels are A thru F, where A is the control house uppermost level (only at Pier 5), and F is the foundation level below the waterline. East and west denote side rooms.

The pier interiors are in generally good to fair condition, typically exhibiting isolated cracking, cracking with edge spalling, cracking with efflorescence, delamination, and spalling at various locations. The foundation level (Level F) at Pier 4 exhibit a layer of silt and water accumulation across the floor in each side and main room area up to 3” deep (see Photo S-340). The foundation level at Pier 5 has minor water, silt, and debris accumulation. These lower levels are generally cool with heavy moisture and dampness throughout the walls. There are typically half- to full-height vertical cracks in the north and south walls in each room across the main portion, and a few in the east and west rooms. These cracks typically exhibit heavy efflorescence and build-up. There are approximately 6-8 cracks in this lower level at each pier at the exterior walls, and a few random vertical to diagonal cracks elsewhere at the side rooms (see Photos S-341 & S-342).

The counterweight pits (Level E) exhibit minor isolated vertical cracking and delamination to the perimeter walls. These are primarily located at the south wall at Pier 4 and the north wall at Pier 5, and are typically at the upper wall adjacent to the girder end wall cut-outs or at the wall between the columns (at the floor area) (see Photos S-343 & S-344). There is scattered minor debris throughout the floor and the drain scuppers to the foundation level below are clear. The debris is primarily concrete debris from isolated minor spalling at the top surface of the counterweight, and other roadway debris. At Pier 4, the south wall between Girders 3W and 4W exhibits a 10 ft wide by 3 ft tall by 2 in deep spall with exposed and rusted reinforcement. There are two smaller spalls at similar locations between Girders 1W and 2W.

The machinery areas (Level D) concrete exhibits minor isolated cracking, edge chipping and spalling typically at the corners below the girder longitudinal breaks by the doorways, around the windows and doors at the channel side wall, and adjacent to the metal roofing. The upper areas of the east, west and span side walls are in generally good condition. At Pier 4, there are wide vertical cracks behind the drainage pipes that go through the wall. The visible portions are approximately 0.125" wide by 8 ft tall (see Photo S-345).

Pier 4 roadway span underside (Level C), deck spalling above G4W

The roadway slab above the counterweight (Main Room Level C) is in generally good to locally fair condition at both piers. The areas of the slab underside next to the sidewalk longitudinal breaks exhibits dampness, efflorescence and minor cracking, and areas of rust staining and spalling. This deterioration is generally minor but covers areas up to 20 ft long by 4 ft wide at each location. There are isolated locations of cracking and delamination across the interior areas of the slab underside, at both random locations and around the interior girder breaks. Cracking is generally less than 0.03" wide and delaminations are generally less than 2 SF, but clearly visible from the upper catwalks with the span opened (see Photos S-346 & S-347). At Pier 5 the slab underside exhibits a 4 ft x 3 ft x 3 in deep spall with exposed and rusted reinforcement above G1W towards the north end of the span (see Photo S-348).

Pier 5 roadway span underside (Level C), deck spalling above G1W

The concrete walls and flooring at the east and west side rooms in Levels C, D, and E are in generally good condition throughout. There are scattered areas of minor deterioration such as scrapes, chips and small spalls that are attributed to use rather than loading. The structural portions of Levels B and A at Pier 5 are in generally good condition throughout.

It is recommended to perform concrete patching repairs on areas of delaminated and spalled concrete, and seal cracking that is greater than 0.0625" wide. The repairs are located throughout the piers, however, focus should be placed on the counterweight pit walls, machinery level channel wall, foundation level walls, counterweight and roadway span over the counterweight.

3.6.2 Trunnion Towers


Pier 4 Trunnion Tower 1W lower portion


Pier 4 Trunnion Tower 3W, West leg interior at base, typical corrosion and section loss


Pier 4 Trunnion Tower 4W, West leg base, exterior plate section loss

The trunnion towers are pairs of built-up steel frames that support the trunnion bearings and girder ends. These elements support the bascule span in both seated and open positions. The towers are in generally good to locally fair condition in both piers. The lower 3 ft to 6 ft of each tower exhibits painted over and active section loss up to 0.1875” deep typically, with a few locations of up to 0.25” deep section loss. The areas of loss vary at each tower leg from 6” to 16” high and are consistent around the perimeter of the base at the concrete floor, at both the exterior and interior faces (see Photos S-349 to S-351). The interior diaphragm plates at the bases exhibit similar active corrosion, section loss and have some areas of 100% section loss / holes along the base. Additionally, there is minor debris accumulation within the tower interiors at the bases at several locations.

In Pier 4, Tower 4W exhibits widespread painted over section loss, typically 0.125”-0.1875” deep, throughout the west leg east face of the east vertical plate for nearly the full height from the base to the bearing. There is a 1/4” diameter corrosion hole at the base of the west plate. The east leg columns exhibit similar section loss throughout. At the machinery level, the north column exhibits up to 0.25” localized section loss around the north channel for up to 4” high with a 1/4” diameter hole in the east flange (see Photos S-352 to S-354). At the upper portion of the tower at the pin access catwalk, the framing extending from the north side of the north column exhibits 100% edge section loss throughout the angles and holes in the diaphragm plates up to 4” x 2” (see Photo S-355). This framing supports the concrete header at the top corner of the pier.

The other portions of the towers are in good condition throughout both piers, aside from minor debris accumulation to the areas adjacent to the tower pairs at the machinery level, and minor corrosion staining at the upper portions of the framing, below the longitudinal breaks for the girders.

It is recommended to perform spot cleaning and painting at the tower bases and locations of active corrosion. It is recommended to install reinforcement repairs at the tower bases and other locations of section loss and corrosion holes, and provide drainage protection for the tower interiors.

3.6.3 Bascule Girders & Bearings

The portions of the girders within the bascule piers are in generally good condition throughout. The paint on these girders remains in good condition as these portions of the girders are well protected from roadway runoff. There are localized areas of rust staining and minor blistering, bleeding corrosion. These are generally at areas below the longitudinal breaks for the roadways above the girders and the corrosion typically is initiating from plate edges and corners (see Photos S-356 to S-359). There are several areas scattered across the lower webs and bottom flanges of painted over section loss, typically less than 0.1875" deep.

The side plates at the longitudinal breaks for the roadway section above the girder top flanges (girder caps) exhibit bowing at the bases of the plates due to pack rust on the inside edge of the framing. This slight bowing of the plate bottom edges is rubbing against the longitudinal break steel angles at the roadway. See also Section 3.2.6 for the longitudinal break joint conditions.

The trunnion bearings are enclosed in housings and their condition is detailed in the Mechanical Inspection Observations, Section 4.4.

The live load bearings at the girder end cut-outs in the rear walls of the piers are in good condition. The bearings for G2W and G3W are only visible during span opening from the upper catwalks. The bearings and the support framing at the concrete pier wall typically exhibit minor bleeding corrosion and rust staining. The mating plates at the top flanges of the girders are in good condition.

3.6.4 Counterweight

The counterweights are steel frames with concrete encasement and pockets accessible for weight adjustment. They are built directly into the bascule girder tail ends. Structurally the counterweight blocks are each in good condition, typically exhibiting minor to moderate corrosion to the exposed portion of the framing at the top of the blocks for widths up to 4 ft longitudinally below / adjacent to the girder caps (longitudinal breaks in the roadway). The corrosion includes blistering, bleeding, and packing, and has led to shallow spalling of the concrete (see Photos S-360 to S-363).


Pier 4, G3W East face widespread painted over section loss


Pier 5, G3W East face widespread painted over section loss


Pier 4, counterweight top at east side


Pier 5, counterweight top at east side

Areas of the pockets and small weight blocks are in good condition. There are numerous blocks not in the pockets scattered at the upper catwalks, on the machinery level floor, and stacked on the floor of the counterweight pit.

It is recommended to clean and paint the areas of corrosion at the tops of the counterweight and determine if patching repairs are necessary to the counterweight concrete block.

Pier 5 upper catwalks and counterweight pockets, general view at G1W-G2W

3.6.5 Access Stairways, Catwalks & Railings

The stairways, catwalks and railings providing access throughout the pier interiors are in various condition states based on their location and exposure (see Photos S-364 to S-370). The listing below details the condition of stairways, catwalks, and railings throughout both piers.


Pier 5, broken railing at machinery level


Pier 5 base of stairs at Level F heavy corrosion and hole in web

- Control house Levels A and B: good condition throughout
- East and West exterior rooms Levels C and D: good to fair condition with minor deterioration to galvanizing or paint typical to steel elements
- East and West exterior rooms Level E: railings exhibit minor corrosion at scattered locations
- The upper catwalks between the trunnion towers are in good condition in both piers (see Photo S-364)
- The lower walkway areas around the machinery exhibit broken railings. At Pier 4, the railing is broken at the east side of G3W next to the drive gear (see Photo S-365). At Pier 5, the railing is broken at the west side of G3W next to the drive gear (see Photo S-366) and the post base below G2W is broken.
- Exterior room stairways Level E to F: stairs and railings exhibit widespread galvanizing breakdown and areas of active corrosion, including connections to walls and cut-out in Level E floor. At Pier 5, the base of the stairs in the East exterior room exhibits heavy surface and laminating corrosion and section loss to the channel, with a 3" diameter hole in the web (see Photo S-367). At the first landing above Level F floor, the railing post exhibits 100% section loss around the connection of the lower mid-rail to the post (see Photo S-368). The railings around the Level E floor cut-out exhibit laminating corrosion that is breaking the railings from their connection to the floor, and similarly at the base of the adjacent stairs to Level D (see Photo S-369).

It is recommended to repair or replace broken, missing or otherwise deteriorated access stairs, hand railings or related items throughout both pier interiors.

3.6.6 Control House

The Control House roof, windows, doors, and general interior amenities were found in good condition with no defects noted (see Photos S-371 to S-374). Specifics concerning HVAC, lighting, plumbing, etc. are included in the Mechanical and Electrical sections of this report. Structurally, the bascule pier interior spaces for operations and control of the bridge are in good condition.

Pier 5, Operator house and roadway access

Doors between rooms are in generally fair and serviceable condition throughout both pier interiors. The access shed / hatch enclosure at Pier 4 East side, and the access hatch at the West side are in good condition.

Pier 5 Operator house roof in good condition

Within each pier, no fire alarms, smoke, or carbon monoxide detectors were observed. The state of the electrical system is generally functional, but components are dated and/or original construction, such as lower-level light switches and light fixtures. There are fire extinguishers at a few locations within each pier, located on the machinery level and above at the exterior rooms. The service / inspection tags are not dated, and the tags are labeled for 2004-2007 inspections. The indicator dials were in the green areas.

Based on discussion with ODOT and operations personnel, the windows and roof are not leaking, the HVAC system works well, and there are no lighting or plumbing problems. There are no fire alarms, smoke or carbon monoxide detectors in Levels B or A for the operator house / controls room.

It is recommended to install fire and life safety items within both pier interiors and replace fire extinguishers.

3.7 Structural Condition Summary and Repair Recommendations

Overall, the bridge is in good to fair structural condition. Previous structure reconstruction, rehabilitation, and repairs have served to maintain the bridge's service life, and for some components, extend the service life. The generally good condition of the bridge topside elements including deck surface, joints, barriers, railings, and drainage contribute to the overall good structural condition. There are minor repairs recommended to the bridge topside elements that will improve roadway drainage, address minor deterioration, and add protection to these components to maintain their current good condition.

The condition of the bridge superstructure elements should be discussed in terms of the two types of superstructures, due to the differing design, function, and exposure. The superstructure in the fixed spans is in good condition throughout, exhibiting localized minor deterioration around areas of exposure to elements and roadway runoff, at both previous and current drainage areas. The deterioration is primarily painted over section loss (arrested) to framing members, and re-initiating corrosion as those hard-to-reach areas from previous cleaning and painting. Most of the corrosion is blistering and bleeding type, from areas of debris accumulation and water infiltration, and the other type of corrosion is packing. Numerous areas at girder and floorbeam bottom flanges, and member connections, exhibit previous and partially cleaned packing corrosion. There is typically minor to moderate warping at plate edges, as well as section loss. These areas have been caulked and coated though the warping remains. There are isolated locations of corrosion re-initiation at areas of packing corrosion. There are minor repairs recommended to the superstructure, however, monitoring conditions thru future inspections is the higher priority recommendation.

The superstructure in the bascule span is in fair condition due to widespread minor section loss and packing corrosion throughout the girders, floorbeams and connections. This span was cleaned and painted as part of the 2014 structure painting project which revealed the depth and breadth of the previous corrosion to the superstructure. The section loss varies across each member type, in depth, dimension and location. Section loss to member webs and flanges is typically less than 0.1875" deep and tends to affect the lower halves of the girders and floorbeams, with some localization of deeper section loss around connections. The floorbeam to girder connections also exhibit packing corrosion with warping to the connection angles and plates. There have been numerous minor reinforcement and replacement repairs made to the secondary bracing, floorbeams and girders. With the open grid deck for the roadway the entire superstructure is exposed to the elements and runoff, and corrosion is re-initiating at several locations. These are primarily around connections, steel to concrete interfaces, areas of partially cleaned packing corrosion, and locations where debris can accumulate. Recommendations include additional structural steel repairs and localized cleaning and painting. A review and/or update of the load rating is recommended to determine the full extent of required repairs and improve structural load-carrying capacity.

The upper diagonal bracing connections to the floorbeams and girders exhibit heavy deterioration at the connection plates and angles in the forms of corrosion holes, section loss, and cracking. The cracking is located at the connection angle, is due to loss of section and structure movement (lifting span and vibration), and varies from partial length across the angle fillet to completely across, effectively breaking the connection. There are a few locations of repairs made to these connections, so this is not a new deteriorated condition.

The continuous design and generally protected areas of the fixed spans assists in keeping the superstructure components in good condition. There has been a positive effect from reduced traffic volume and types since the conversion from interstate to local roadway; the lower stress levels on a bridge designed for higher volume service will continue to benefit the service life of the bridge components. This can be seen at the superstructure specifically by the lack of service cracking in paint (from members flexing) as well as the lack of other in-service types of deterioration such as cracking in the deck underside.

The reduced stress on the superstructure is also evident in the bascule span, where locations of arrested section loss, cleaned packing corrosion, and the small corrosion holes in members or member components do not exhibit additional deterioration to the surrounding areas (buckling around web holes, cracking from corrosion hole edges, stress cracks in paint).

The open grid decking in the bascule span is in generally good condition. The lower main bars are welded directly to the stringer top flanges and most of these welds are in-tact. There are scattered to localized areas where single or groups of welds are broken between the main bars and stringers. Minor vibration is present as evidenced by fretting corrosion (rubbing) along the stringer flange edge. The welds are along ones side of the main bar only, and are typically less than 3” long from each edge of the stringer top flange (not fully across the stringer top flange). The weld size and start-stop of the weld locations may contribute to the locations where these welds are cracked or broken, as corrosion at the stringer tops and grid deck main bars is minor and isolated. Additionally, there are a few localized locations of corrosion holes in the webs of the main bars. These locations affect several main bars in a series and the holes are typically up to 12” wide by 2” high. Debris and corrosion is typically very minor between the grid deck and stringers, so it is unclear the cause of the main bar corrosion holes. Recommendations include monitoring and repair of these specific deteriorated conditions.

The substructure piers (solid wall, bascule, and column-cap frames) are in good condition throughout. There have been crack injection sealing and concrete patch repairs made throughout the piers at widespread locations to the larger pier walls, and isolated locations to the smaller pier column and cap beam frames. The patch repairs are in generally good to fair condition, typically exhibiting fine map cracking (less than 0.02” wide) throughout. The crack repairs are generally sound. There is additional cracking deterioration around many sealed cracks and around areas of patch repairs, but it is minor and typically less than 0.03” wide. Recommendations include additional crack and patching repairs.

The miscellaneous elements are in good to fair condition and there are several light poles in poor condition. Four light pole bases were found with heavy section loss and corrosion holes throughout their bases, typically across 50%-75% of the base perimeter. These locations were isolated, as other light pole bases were found in-tact. The light poles were recommended for removal. Signs, utilities, utility supports are each in generally good to fair condition with minor deficiencies and recommendations for repair to both safety and structural/support conditions.

The bascule pier interior elements are in good to locally fair condition, with several recommendations are to address isolated concrete deterioration and access improvements.

The following set of recommended repairs are specific to the structural components of the bridge as presented herein. They are prioritized based on immediacy of the repair need and listed based on type of bridge component. The prioritization categories used are defined as follows.

1. Priority Repairs – Required work within a one-year period to address deficiencies that require emergency operations that may affect the load capacity of the structure, bascule span operation, or public safety.

2. Contract Work – Extensive work within a 2- to 5-year period that if deficiencies become worse, they may cause further damage, prevent span operations, affect traffic or public safety. These may also include engineering analysis, planning, and/or details and drawings.

3. Capital Maintenance – Recommended maintenance or repair activities within a 5-year period to be address deficiencies that may affect span operation for non-emergency operations, regulatory compliance, access deficiencies and aesthetics. This is work that may be performed by the Department's maintenance personnel or small-scale repair contracts.

4. Monitoring – Field observations where actual repair is not required but will require action if deficiency substantially worsens. There is no cost estimated for these recommendations; they should be implemented into the structure's inspection procedures and this effort should be included with the cost of future structure inspections.

Priority Repairs

- Repair the locations of corrosion holes to the bascule span grid deck main bars.
- Replace the connection bolts (missing and in-place) at the vertical plates of the steel barriers in the bascule span.
- Repair locations of disconnected, broken, and missing piping at the drainage components below deck and at the piers.

Contract Work

- Replace the HPR joint material at the South approach.
- Install an epoxy overlay to the concrete deck surface across the bridge.
- Apply silane treatment to the faces of the concrete barriers in the fixed spans.
- Clean and paint the steel barriers in the bascule span.
- Repair the misalignment of the bascule span expansion joint finger plates by removing the plates, cleaning pack rust, painting, and adjusting as necessary during re-installation.
- Repair the bascule span rear longitudinal breaks at the girders by cleaning the pack rust causing the warping at the bases of the plates and straightening the warping.
- Replace the elastomeric troughs below the finger joints at the South Abutment, Piers 4, 5, 8 and the North Abutment.
- Repair the broken concrete header at the South Abutment joint at the West sidewalk.
- Repair the deteriorated areas of FB11S lower web and bottom flange at the North Abutment.
- Repair the locations of holes in the bascule span girder and floorbeam bottom flanges, webs, and bases of vertical stiffeners.
- Repair the locations of holes in the bascule span stringer webs.
- Repair the locations of holes in bascule span bracing members and connection plates.
- Repair the bascule span upper diagonal connections with holes, cracks or fully broken angles.

- Repair the locations of holes in the bascule span sidewalk support beam and post webs.
- Repair the locations of holes in the bascule span catwalk channels.
- Repair the locations of deteriorated bascule span catwalk supports at the diagonal bracing.
- Clean and paint areas of corrosion and localized paint failure at superstructure components in the fixed and bascule spans, localized at areas below expansion joints in the fixed spans and throughout the bascule span.
- Repair cracks greater than 0.0625” wide with injection-seal type repair in the abutment walls and in the solid pier walls.
- Perform concrete patch repairs to areas of delaminated and spalled concrete at the abutment walls, solid pier walls, and column-cap beam piers.
- Apply a concrete surface coating over the vertical and horizontal surfaces of the abutments, wingwalls and piers to seal previous repairs, minor cracking, and prevent water infiltration.
- Repair the corrosion holes at the Span 6 sign gantry east support at the fascia.
- Repair the deteriorated conduit connections, supports and junction boxes throughout the bridge.
- Repair cracks greater than 0.0625” wide with injection-seal type repair in the bascule pier interior walls and other locations within the pier interiors.
- Perform concrete patch repairs to areas of delaminated and spalled concrete at the bascule pier interior walls, counterweight span underside, and other locations within the pier interiors.
- Perform spot cleaning and painting at the tower bases and locations of active corrosion.
- Install reinforcement repairs at the tower bases and other locations of section loss and corrosion holes, and provide drainage protection for the tower interiors.
- Clean and paint the areas of corrosion at the tops of the counterweight and determine if patching repairs are necessary to the counterweight concrete block.
- Repair or replace broken, missing or otherwise deteriorated access stairs, hand railings or related items throughout both pier interiors.
- Install fire and life safety items within both pier interiors.

Capital Maintenance

- Remove the vegetation growth from the northwest quadrant sidewalk and repair the settlement of the sidewalk at the railing transition.
- Repair damaged metal meshing at the overhead sign gantry in Span 4 at the SE access ladder.
- Repair the uplift at the bascule span rear break sidewalk joint cover plates by removing the plates, cleaning pack rust, painting, and adjusting as necessary during re-installation.
- Clear debris from horizontal surfaces in the fixed spans superstructure and pier tops (bird nesting, etc.).
- Clear debris from bascule span horizontal surfaces of girders, floorbeams, secondary members, and other superstructure components.
- Replace missing caps at the tops of light poles.
- Repair or replace missing or out of place hand hole covers at the light poles.
- Repair or replace non-functioning navigational lights at Span 5 and the bascule piers.
- Replace fire extinguishers.

Monitoring

- Monitor the bascule span grid deck for additional cracking at the main bar to stringer connections.
- Monitor the concrete deck underside to track changes in the existing minor cracking and note future in-service deterioration.
- Monitor fixed span girder locations of packing corrosion for growth and additional warping.
- Monitor fixed span girder areas of painted over section loss for paint failure and re-initiating corrosion.
- Monitor fixed span floorbeam areas of painted over section loss and corrosion holes for paint failure and re-initiating corrosion.
- Monitor fixed span sidewalk framing areas of painted over section loss and corrosion holes for paint failure and re-initiating corrosion.
- Monitor bascule span girder areas of painted over section loss for paint failure and re-initiating corrosion.
- Monitor bascule span floorbeam areas of painted over section loss for paint failure and re-initiating corrosion.
- Monitor bascule span bracing member areas of painted over section loss for paint failure and re-initiating corrosion.
- Monitor bascule span sidewalk framing areas of painted over section loss for paint failure and re-initiating corrosion.
- Monitor bearing positions during summer and weather months to confirm normal operation.
- Monitor the tilted bearings at Pier 5 north.
- Monitor corrosion conditions at light pole bases and remove / replace poles as needed in a similar fashion to those removed following this inspection.

3.7.1 Repair Recommendations Cost Estimate

Cost Estimate provided assumes a construction year of 2028 for adequate planning, design, and contracting necessary for a project for the set of recommended repairs. Estimate provided is a high-level estimate based on the conditions observed during this inspection, and quantities for deteriorated conditions determined based on these observations. Estimate is not detailed or comprehensive but is to serve as guideline for estimated costs based on current unit costs for similar repair activities and types. A detailed engineer’s cost estimate would be required once the scope of repairs is finalized and detailed plans, drawings and specifications are established.

Priority Repairs	$ 59,000
Contract Work	$ 3,054,388
Capital Maintenance	$ 21,650
Structural Sub-Total	**$ 3,135,038**

4.0 Mechanical Inspection Observations

4.1 Span Drive Machinery

The general machinery room layout can be found in Appendix 6 (see Photo M-1).

4.1.1 Motors

- Both the NE and NW motor shafts displayed moderate surface corrosion with minor paint chipping (see Photo M-2) and isolated corrosion on the housings (see Photo M-3).
- There was corrosion found at the base of the supports but only on the surface (see Photo M-4). In addition, both motors utilized finger shims rather than captive shims and these too exhibited moderate corrosion on the NE side.
- The corrosion at the supports was less severe on the NE side than the NW.
- The grease plugs are not removed during lubrication; as a result grease may be pushing inside the motor.

4.1.2 Diesel/Auxiliary Machinery

Each leaf has a diesel engine that is used to provide power to the span during emergencies. It is tested monthly and was last used three weeks prior to this inspection (per operations interview). The battery utilizes a trickle charger. Local personnel mentioned the battery drains when trickle charger is left off.

- The engine on the North side was started and ran successfully. The engine on the South side was not able to start due to a dead battery.
- Both the chain housings on the North and South side leaked oil and the lubrication seemed to contain debris (see Photos M-5 and M-6).
- Oil was cleaner on the South side compared to the North but both samples contained an abnormal level of contamination. See Oil Sample Testing Reports in Appendix 7.
- Oil and coolant levels on both sides were acceptable.

4.1.3 Brakes

- There is a slight leak near the top of each of the brake thrustors on both the North and South sides across all motor brakes (see Photo M-7).
- There is minor scoring rust and contamination on all the brake wheel surfaces (see Photo M-8). There is also no reserve stroke on the thrustors. This could reduce braking torque as spring partially loads thrustor and not brake pads.
- There is minor paint failure, surface corrosion, corrosion on the base, corrosion on fasteners and seized equalizer bolts on both the motor brakes on the North side (see Photo M-9).
- Loose nuts can be found in multiple areas for both the NW and NE motor brakes.
- The manual release lever for the NE motor break was extremely difficult to release and required 150+ lbs. of force to do so. The brake pads do have solid contact before release and seem to release normally after using the manual lever. The NW brake pads however, have poor contact, the North pad having <50% contact and the south pad having about 50% (see Photo M-10).

- On the NW side, the support for the motor brake has severe corrosion and section loss (see Photo M-11) as well as a seized locking pin.
- The SW motor brake has severe corrosion on the base and fasteners along with minor paint failure and surface rust. The pads are tight all around except for the top corner of the south pad on the side closest to the motor.
- The SW manual brake releases with roughly 120 lbs. of force and the top 30% of the North pad stays in contact after release (see Photo M-12).
- The SE motor brake has better conditions in terms of surface and fastener corrosion, however there is corrosion at the base of the spring. Both the North and south brakes stay in contact after release, roughly 10% for the North and 25% for the south (see Photo M-13). The locking pin on the manual release is seized.

4.1.4 Motor Couplings

Per operations interview, the lubrication at the motor couplings has not been changed in 5+ years.

- The couplings exhibit surface paint failure as well as surface corrosion throughout. The grease plugs appear to be stripped as well (see Photo M-14).
- There is grease purging that can be seen coming from the coupling covers. There is moderate rust on the hubs.
- The NE coupling cover has a loose nut (see Photo M-15).
- The SW coupling has slight bulging on the O-ring that is meant to act as a seal (see Photo M-16).

4.1.5 Shafts

- The shafts have minor paint failure and surface corrosion. There were no obvious signs of distress, including at the shaft keyways.

4.1.6 Central Enclosed Gearing

Overall, the South and North sides exhibit similar conditions at the central enclosed gearing.

- The clutch levers operate smoothly.
- The oil inside looks to be contaminated (see Photo M-17) and is leaking outside of the gear box (see Photo M-18).
- The bearings purge grease within the gear box and on the outside. The gear teeth generally exhibit minimal scoring, minor surface corrosion, and minor pitting. In addition, the inspection hatches don’t fully open due to being painted over (see Photo M-19).
- There are missing fasteners along the outer seams as well as moderate paint failure and corrosion on the south side of the North gear box (see Photo M-20). There is abandoned instrumentation on the west side of the North gear box; it is not functional yet is still maintained (per operations / electrician interview).
- The South side gear box severely leaks oil, likely due to overfilling (see Photo M-21).
- Oil samples were taken at each enclosed gear reducer and the findings can be found in Appendix 7.

4.1.7 Bearings

The bearings generally exhibit moderate surface corrosion throughout. See Appendix 6 for machinery layout.

- Bearing 1 (B1) on the NW side has pack rust below the bearing base (see Photo M-22) as well as severe corrosion on the inboard side (see Photo M-23).
- B2 and B3 on the NW side have severe corrosion and section loss at the base, roughly 9" of the base has corroded (see Photo M-24).
- B1 on the NE side exhibits moderate surface corrosion on the inboard side of the anchorage (see Photo M-25). B2 and B3 exhibit similar, typical conditions.
- The B1 bearing on the SW side has minor pack rust and surface corrosion near the base along with corrosion on fasteners. The bearings on South side exhibit similar, typical conditions.
- The main reducer output bearing clearances can be found in Table-2 in Appendix 6.

4.1.8 Open Gearing

Appendix 6 contains the machinery layout as well as a table of open gearing measurements and clearances.

- The open gears generally exhibit moderate to severe scoring (see Photo M-26) on the teeth along with surface rust and rust build up near the edges of the teeth (see Photo M-27) throughout.
- There is severe corrosion and section loss on both rack segment fasteners on the North and South side leaves (see Photo M-28). The inboard side is worse than the outboard side and exhibits up to 100% section loss.
- P1 on the NE side seems to have contaminated lubrication with dirt and debris. P1 on the NW side is poorly lubricated, and the lubrication is contaminated with dirt and debris (see Photo M-29).
- Furthermore, there is mild scoring, minor pitting, and moderate surface corrosion on the gear teeth. The gear cover gasket is also failing (see Photo M-30).
- The measured backlash on some gears was at or near five times the theoretical backlash. The worst case being the NW rack and pinion which was measured to be 0.55" between the teeth.
- The highest measured wear was 15%, located at the SE rack gear.

4.1.9 Span Drive Instrumentation Machinery

Overall, the instrumentation machinery is in satisfactory condition. On each side of the bridge there is a rotary cam assembly as well as other instrumentation connected directly to the central gear box.

- The machinery on the eastern side of the North central gear box is abandoned yet still maintained as if it was functional (see Photo M-31). The gear boxes on the North rotary cam machinery are leaking oil and there is surface corrosion on the shafting. The chain a the gear box is loose (see Photo M-32).
- The rotary machinery on the South side has overall typical conditions. There is isolated corrosion on the fasteners and a missing foot on the selsyn motor (see Photo M-33). There is grease accumulation on the shaft connecting to the adjacent B1 bearing.

4.2 Span Support Machinery

4.2.1 Trunnion Bearings

Overall, the trunnion bearings are in good condition except for section loss on some fasteners that are painted over (see Photo M-34), and some minor grease purging mixed with debris (see Photo M-35).

- Fretting corrosion is present on the trunnion hub of the North and South side trunnions (see Photo M-36).
- Due to the presence of the end plates, the trunnion bearings were not accessible for clearance measurements.

4.2.2 Live Load Shoes

- Each of the live load shoes exhibit minor surface rust on the contacting surfaces and have an approximate 1/8" gap between the shoe and mating plate on the girder tail (see Photo M-37).
- The SE shoe exhibits moderate corrosion on the contacting surface.

4.3 Span Lock and Buffer Machinery

4.3.1 Span Lock Machinery

- The thruster brake linkages are not lubricated, and the shaft exhibits heavy corrosion (see Photo M-38). The lever is severely corroded and cannot be removed due to seized wingnuts (see Photo M-39). The manual hand release does not have a lock. The limit switch does not work and does not appear to be original as it is different from limit switches at similar locations.
- The motor has heavy corrosion on the shafts (see Photo M-40), keys, and base, and heaviest on the SE foot mount (see Photo M-41). The name plate is illegible. The motor coupling does not appear to be lubricated since the last painting. The plugs and gaskets are covered by paint and there is no key on the reducer side (see Photo M-42).

- Leaks are typical on the reducer at the bearing, sight gauge, and drain. The breather, name plate, and inspection cover are painted over and could not be removed. There is isolated paint failure and corrosion on the fasteners and housing (see Photo M-43). Old corrosion was painted over, and the plugs and bearings have been painted over. It is unclear if the bearings are oil or grease lubricated. The square shaft is rusted but could still be used and the lever is mounted adjacent. The drain valve is not easily accessible and not safe to remove. It posed the risk of both dropping in the water and contaminating the water with oil. An oil sample was not taken at this location.
- The RCLS instrumentation has a seized wingnut on the top. The grease is old and too heavily applied on the chain. The tensioner is held by wire. The box exhibits heavy corrosion and there is a large amount of dirt and debris throughout (see Photo M-44).
- The couplings on the NW side exhibit moderate paint failure and corrosion. There is minimal section loss on fasteners and the flex hubs are rusted. There is grease purging from some hubs and keys (see Photo M-45). Some of the keys/keyways are painted over and recessed so they could not be inspected. Most zerk fittings appear to be lubricated but plugs are painted over and not removed during maintenance posing the possibility of blowing out the seals. The NE couplings have similar and typical conditions to the NW couplings.
- The NW inboard locking mechanism exhibits moderate paint failure and corrosion. There is grease and debris accumulation on the machinery and inside the rack and pinion housing (see Photo M-46). No limit switch is present. Moderate scoring is seen on the rack and pinion teeth (see Photo M-47) in addition to fastener corrosion and section loss up to 20%. There is pack rust on receiver plates and the bolts on the plates are severely corroded (see Photo M-48). There is good contact made on the bottom jaws with no movement under light vehicle traffic. Wear up to 1/32” is present on the receiver plates. There is up to a 1/8” gap on the square slide and guide. There is a 1/16” gap on the top jaw and movement under heavy live load.
- The NE inboard mechanism has no jaw gap with good contact on both the top and bottom jaws. There is no movement, however there is pack rust forming (see Photo M-49). There is 1/8” clearance between the bronze guide shoe and guide and heavy scoring and wear on the rack and pinion. The remaining elements at the NE inboard locking mechanism are in similar and typical condition as the NW inboard mechanism.
- The NW outboard locking mechanism exhibits heaving scoring on gear teeth and a gap on the square slide (see Photo M-50). The receiver plates look newer, and the bolts are less corroded. Overall, there is minimal wear and good contact with the top and bottom jaws with no gaps and no movement.
- The NE outboard locking mechanism has poor welds on limit switch targets (see Photo M-51). The bottom driven limit switch slightly contacts the target. There is good jaw contact with no gaps and no movement. The cover on top is seized due to paint (see Photo M-52) and there is heavy scoring on the rack and pinion (see Photo M-53). A 1/8” gap can be seen on the square slide as well as heavy corrosion on the girder above.
- The bearings exhibit isolated paint failure and corrosion with some pack rust at the base below the shims (see Photo M-54). The lubrication is adequate. One bolt has a hex nut while the others have square nuts (see Photo M-55). The NE and NW bearings have similar conditions.

4.3.2 Air Buffers

- The NW seated buffer exhibits transverse misalignment with the strike, and the relief valves are painted over (see Photo M-56). The anchors appear to be in good condition. The NE seated buffer exhibits similar typical conditions to the NW buffer.
- The seated buffer on the SW side has minor surface corrosion throughout and corrosion on the back lever that extends a rod during opening (see Photo M-57). The SW seated buffer exhibits similar typical conditions to the buffers on the North side.
- The SE seated buffer exhibits moderate grease purge (see Photo M-58) and has typical conditions to the other seated buffers.
- There are two raised buffers that are fixed to each bascule leaf, that assist to reduce the speed of the span during raising. The buffers on the North side are severely corroded on the roller and relief valves with seized rollers on both the NE and NW (see Photos M-59 and M-60). There is less corrosion on the NE relief valves. The SW raised buffer remains retracted when the bridge is closed; it should be extended when the bridge is closed.

4.4 Miscellaneous Mechanical Items

4.4.1 Counterweight Bumpers

- There are three wooden counterweight bumpers mounted to the walls of the counterweight pits on both the North and South sides. Each bumper exhibits isolated wood failure and severe fastener corrosion (see Photo M-61).

4.4.2 Traffic Gates

The traffic gates to the NE and SW are vertical arm warning gates that descend into the traffic lane. Both gates have loose guy wires (see Photo M-62).

At the NE Gate:

- One of the turnbuckles is missing a jam nut (see Photo M-63). There are cracked welds at the base of the gate arm as well as minor corrosion on the gate arm connection fasteners (see Photo M-64).
- The motor exhibits heavy corrosion on top and minor corrosion on the hand crank shaft. There is moderate corrosion on the hand crank shaft limit switch fasteners and gear box fasteners (see Photo M-65).
- Oil leaks from the gear box and there is heavy corrosion on top of the gear box. Light debris is building up at the bottom of the housing. There is widespread paint failure and surface corrosion on the moving components (see Photo M-66). The top input crank arm is misaligned, possibly due to deformation (see Photo M-67). The chain lubrication is contaminated, and the east door limit switch does not extend (see Photo M-68).
- Heavy corrosion is present on the top west door latch and a cover is missing for the electrical access below the gate arm (see Photo M-69). The gate bumper does not contact the ground when lowered and the lights on top are extremely dim (see Photo M-70).

At the SW Gate:

- The traffic gate has a crack at the base of the sidewalk gate arm at the conduit inlet (see Photo M-71). The gasket on the west door is split at the base and the bottom door latch of the east door is seized, preventing the door from opening.
- There is a loose fastener on the rotary cover. The chain on the inside of the housing is rusted and the levers exhibit slight deformation and misalignment (see Photo M-72). This doesn't affect operation. There is one light that doesn't work. The gate exhibits difficulty operating properly.

The NW and SE traffic gates are swing gates that utilize linear actuators located below the sidewalks. Both gates exhibit widespread paint failure and surface corrosion on the linear actuator, the gate itself and the fasteners.

At the SE Gate:

- The brake release and hand wheel appear to work. The lower fasteners on the RACO limit switch housing are loose and there is light lubrication and debris build up (see Photo M-73).
- The lower bearing is fit with a button head grease fitting. The limit switch rollers are seized due to paint, and they make poor contact with their targets (see Photo M-74). The shaft of the actuator exhibits surface corrosion inside the upper guide.
- Heavy corrosion is evident on the access door with section loss at the hinges (see Photo M-75).
- The barrier gate appears to be retrofit with a traffic arm. There is severe corrosion and section loss on the upper bearing anchors (see Photo M-76). One of the guy wire fasteners is corroded along with heavy corrosion around the bearing in the gate housing (see Photo M-77).
- There are cracks on the corners of the housing. One of the lights is broken off and another has a broken fastener. The original lock machinery appears abandoned in place and the stop sign is damaged. The gate uses two different types of lights and has corroded guy wire fasteners. The gate doesn't drive all the way and slams aggressively on closure.

At the NW Gate:

- The swing gate has mismatched actuator bracket bolts (see Photo M-78). The top cap screws are corroded and use field clipped washers. The nuts use lock washers. There are dissimilar materials used and there is no boot on the actuator arm (see Photo M-79).
- The limit switch rollers do not make good contact with their target (see Photo M-80).
- There is wear on the lever arm.
- The hatch door exhibits heavy corrosion and section loss at the hinges.
- There is corrosion on the rear post and section loss at the base. There is also severe corrosion and section loss on the upper bearing fasteners and shaft (see Photo M-81).
- General corrosion is widespread on light and sign hardware. The gate splice is heavily corroded with some deformation and one of the stop lights does not work.

4.4.3 Miscellaneous

- There are counterweights stacked and scattered around on the floors of the machinery rooms at both North and South sides. These present a safety hazard and access restriction to personnel (see Photo M-82).
- There are multiple railings that have completely fallen apart and others that have severely corroded fasteners. See structural findings and recommendation for details.
- The bridge does not seat smoothly and is stopped and started several times before finally closing.
- The span balance was tested via strain gage analysis. See Appendix 5 for the strain gage balancing report.

4.5 Mechanical Repair Recommendations

Overall, the mechanical operations systems on the bridge are in fair condition.

The following set of recommended repairs are specific to the electrical components of the bridge as presented herein. They are prioritized based on immediacy of the repair need and listed based on type of bridge component. The prioritization categories used are defined below.

1. Priority Repairs – Required work within a one-year period to address deficiencies that require emergency operations that may affect the load capacity of the structure, bascule span operation, or public safety.

2. Contract Work – Extensive work within a 2- to 5-year period that if deficiencies become worse, they may cause further damage, prevent span operations, affect traffic or public safety. These may also include engineering analysis, planning, and/or details and drawings.

3. Capital Maintenance – Recommended maintenance or repair activities within a 5-year period to be address deficiencies that may affect span operation for non-emergency operations, regulatory compliance, access deficiencies and aesthetics. This is work that may be performed by the Department’s maintenance personnel or small-scale repair contracts.

4. Monitoring – Field observations where actual repair is not required but will require action if deficiency substantially worsens. There is no cost estimated for these recommendations; they should be implemented into the structure’s inspection procedures and this effort should be included with the cost of future structure inspections.

Priority Repairs:

- Replace the railings in the machinery rooms around the staircases and open gearing for the safety of maintenance team.
- Adjust/repair manual release hand brakes across all machinery.
- Adjust brakes to factory settings for torque, clearance, and thruster reserve stroke.
- Remove corrosion from brake wheels and ensure brake pads are in contact when set and release fully when energized.
- Replace auxiliary engine batteries.

- Remove stacks of counterweight blocks from machinery room floors to prevent injury and move to storage room or counterweight pit.
- Tighten or replace all loose fasteners across motors, brakes, actuators, housings and supports.
- Fix bottom driven limit switch that slightly contacts target on NE outboard span lock.
- Replace selsyn motor on south side cam assembly and tighten chains on span drive machinery.
- Tighten loose guy wires on traffic gates.

Contract Work:

- Evaluate the rack mounting system and bolts, which should be rated by a mechanical or structural engineer based on various loading circumstances.
- Install new lighting in South machinery room.
- Replace swing gates with a sturdier design that includes a locking mechanism to restore intended function of swing gates.
- Clean and repaint areas of corrosion across all machinery.
- Rehabilitate raised buffer cylinders as well as the strike plates and their fasteners.
- Re-align seated buffer cylinders and rehabilitate corroded hardware.
- Rehabilitate supports for open gearing bearings where section loss occurs, and pack rust is forming.
- Rehabilitate gear covers and gaskets for G2 gears.
- Replace open gearing.

Capital Maintenance:

- Install new lubrication and purge fittings on the motor couplings and add the couplings to the bridge lubrication schedule.
- Clean open gearing of all lubrication, corrosion, and debris. Re-lubricate with fresh grease.
- Monitor gear condition and consider open gearing rehabilitation.
- Lubricate span lock motor couplings regularly. Pull purge plugs when lubricating.
- Replace bulging O-Ring being used on SE motor coupling.
- Install drainage system below roadway breaks to prevent wear and corrosion on open gearing caused by the elements.
- Re-align crank arms and shafts in NE and SW traffic gate housings. Replace arms if they are deformed.
- Clean auxiliary engines of excess grease and oil. Address fluid leaks.
- Clean span lock gearing and racks of all contamination and debris then re-lubricate.
- Adjust bumper for NE vertical traffic gate to ensure it contacts roadway upon lowering.

- Replace all non-functional and missing lighting on traffic gates.
- Replace all locks and handles on traffic gate machinery housings.
- Rehabilitate access doors for swing gate machinery.
- Clean machinery of all excess debris to prevent further wear.
- Monitor condition of wooden counterweight bumpers and contacting plates in counterweight pit along with their fasteners.

4.5.1 Repair Recommendations Cost Estimate

Cost Estimate provided assumes a construction year of 2028 for adequate planning, design, and contracting necessary for a project for the set of recommended repairs. Estimate provided is a high-level estimate based on the conditions observed during this inspection, and quantities for deteriorated conditions determined based on these observations. Estimate is not detailed or comprehensive but is to serve as guideline for estimated costs based on current unit costs for similar repair activities and types. A detailed engineer’s cost estimate would be required once the scope of repairs is finalized and detailed plans, drawings and specifications are established.

Priority Repairs	$ 51,000
Contract Work	$ 1,374,000
Capital Maintenance	$ 58,000
Mechanical Sub-Total	**$ 1,434,000**

5.0 Electrical Inspection Observations

The electrical distribution and control systems for the bridge and its auxiliaries are generally in poor condition, primarily due to age.

The detailed inspection performed was a hands-on, visual, and auditory inspection of the electrical distribution and control equipment on the bridge, including but not limited to the incoming service, electrical distribution equipment (panelboards, motor control cabinets, disconnects), motor starters, contactors, resistors, motors, brakes, traffic control devices, lighting, navigation aids, and control system with its associated control equipment, such as limit switches. Electrical equipment enclosures and cabinets that are accessible were opened to assess the condition of devices, wire terminations, and conductors.

The following electrical condition summary details the field findings, analysis, and recommendations from the detailed inspection.

5.1 Service Entrance Equipment

Originally the bridge was equipped with two (2) utility feeds, one (1) from the north and the other from the south. It should be noted that it was reported the south utility feed is no longer in service and has been abandoned in place (See Photo E1). This report is further confirmed due to the utility meter having been removed. All abandoned equipment should be removed to avoid confusion on what is energized.


Photo E1: Abandoned Equipment in the South Pier

The utility owned medium voltage conductors (power) are routed along the approach spans to the utility owned medium voltage transformers located within both the north and south rest pier (See Photo E2). The transformers at both rest piers are three (3), single phase, pole mount type transformers which have been arranged to provide three-phase power. While the transformers are typically mounted on poles, these have been set on the floor. Both sets of transformers are within a fence to prevent unauthorized people from gaining access.


Photo E2: Medium Voltage Transformers in the Control House

Due to the south utility service being abandoned in place, the bridge currently does not have a second power source as an emergency back up generator has not been installed. Note that each leaf does have a backup diesel engine for operating the span.

The 500kva utility owned transformers provide 600A of 480VAC, three-phase, power. The transformers feed a recently installed main disconnect switch (See Photo E3). It was reported that the new main disconnect switch was installed due to safety concerns on the existing switch location.


Photo E3: Service Entrance Disconnect

It was further reported that the bridge was out of service for several weeks while the fence was moved and the new disconnect switch was installed.

The location of the existing medium voltage transformers within the rest pier is not ideal as it is generally unwanted to have oil filled transformers located indoors. In addition, the only way to remove power to the transformers will require the utility to pull the cutouts/fuses at the utility pole to the north. The location of the main disconnect is also a concern as this is the only location where power can be removed from the bridge without contacting the utility. The National Electric Code (NEC) requires that the main service disconnect be located outdoors or in a location that is readily accessible. The disconnect switch would likely not be considered accessible since it is located on a lower level of the rest pier.

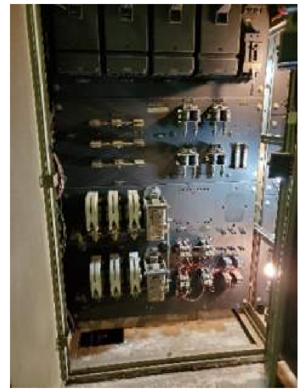


Photo E4: South Leaf Motor Starter Cabinet

Other than the abandoned equipment and the unconventional locations of the oil filled transformers and main disconnect, the service entrance equipment is in good condition.

5.2 Panelboards and Lighting Transformers

In addition to the service entrance equipment, both leaves also contain various power 480V, three-phase panelboards, lighting transformers, and 120/240V, singe-phase panelboards located throughout the bridge. The panelboards and transformers are utilized for the various house loads, such as lighting, receptables, and heaters, among others.

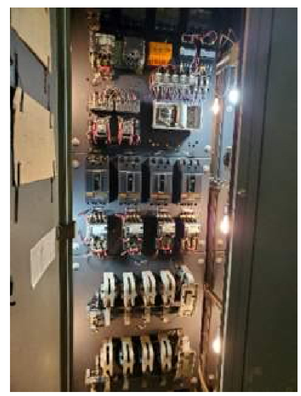


Photo E5: South Leaf Motor Starter Cabinet

In general, the exiting panelboards are in good/fair condition, with a couple that are past their expected design life.

5.3 Motor Starter Cabinets

The motor starters and contactors for the main drive motors, brakes, span locks, and traffic gates for each span are located within a single motor starter cabinet located on each rest pier (See Photos E4 and E5). An Allen-Bradley Variable Frequency Drive (VFD) is also mounted to the side of the cabinet for operating the swing gates. The cabinets themselves were manufactured by General Electric, double sided and appear to be the original 1950’s type equipment. The cabinet is physically in good condition; however, it is a safety concern and does not meet current NEC requirements as there are no interlocks to ensure that power is removed internally before the doors are opened. When opening the back of the cabinet, bare bus bar and open terminations could easily be contacted by staff (See Photo E7).

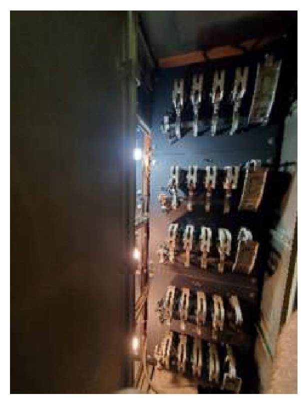


Photo E6: South Leaf Motor Starter Cabinet

It is evident that a significant amount of wiring has been replaced due to its color (red) when compared to the original color (black). Due to the amount of wiring that appears to have been replaced, it indicates that there have been several significant conductor failures over the years. It was also noticeable a significant number of control components, such as motors starters and relays, have been replaced over the years.

Photo E7: Back Side of the South Leaf Motor Starter Cabinet

The existing motors staters and contactors for the main drive motors are a type of "horizontal" contactor that is no longer available. Due to how the existing contactors were built they are physically very different from modern contactors, making replacing them significantly more difficult. Due to the difficulty in finding replacement components, it was reported that a coil for the Power Point 5 contactor was utilized at another location. Fortunately, that power point is not required to operate the bridge.

Photo E8: 1950s Circuit Breakers

In addition to the 70+ year old control equipment, there are several circuit breakers located in the cabinet that provide overcurrent protection (See Photo E8). Due to the age of the circuit breakers, it is possible that they will not function as intended and should be tested. This is especially concerning considering a small electrical fire occurred in the far side submarine cable termination cabinet. The exact cause was not determined, but it was reported that a short appeared to have occurred within the cabinet.

It is highly likely that the original 1950s conductors and arc chutes for the contactors contain asbestos and should be evaluated before any of the conductors are replaced or maintenance is performed with the cabinets.

Photo E9: Southeast Main Drive Motor

5.4 Main Drive Motors

Each span is typically driven by two (2), General Electric 100HP, 440V, 695 RPM wound rotor motors (See Photo E9). During normal operations both motors are utilized to operate the span, but a single motor could be utilized to move a leaf. Each main motor is controlled by switching contactor and associated resistors.

The motors underwent a series of bridge openings in which they were carefully inspected visually for signs of rust, corrosion, and proper operation. The cover plates for each motor were removed to inspect the interiors and the brushes. All the main drive motors except for the southeast main drive motor have inconsistent wear marks (See Photo E10).

In general, the motors are in fair condition. Electrical measurements included the voltage and current of the motors individually as well as motor insulation measurements at the safety disconnects. Insulation to ground measurements on all motors were less than expected with a range of 0.7 to 4.3 MΩ. The insulation measurements are lower than what is typically acceptable but are similar to the previous inspection report. Voltage and current measurements can be found in Appendix 8. Voltage and current measurements were within expected ranges and equipment ratings.

Photo E10: Southeast Main Drive Motor Brush

5.5 Diesel Engine Auxiliary Dive

A diesel engine on each leaf can be utilized to operate the bridge in the event of a power failure or the main drive motors are no longer operational. Limit switches are utilized to provide interlocking with the control system to ensure that either the main drive motors are being utilized and the diesel engine cannot be utilized at the same time. The diesel engines were turned on during the inspection, but the leaves were not operated with them.

Photo E11: Northeast Motor Brake

5.6 Motor and Machinery Brakes

Each leaf is equipped with two (2) motor and two (2) machinery brakes (See Photo E11). All of the brakes are 480V, three-phase, thrustor type brakes. Each brake was visually inspected for signs of excess heat, rust, scoring and were found to be in poor to fair condition. Each brake is equipped with three (3) limit switches, to provide SET, RELEASED and HAND RELEASED indication. Insulation measurements for each motor were measured and can be found in Appendix 8. Voltage and current measurements were within expected ranges and equipment ratings. Voltage and current measurements can be found in Appendix 8.

Photo E12: Motor Brake Junction Box

The existing junction boxes for most of the brakes are severely corroded and are no longer properly mounted. The conductors are also connected utilizing wire nuts.

5.7 Traffic Gates and Signals

Each leaf is equipped with two (2) traffic warning gates for a total of four (4) gates. The on-coming (northwest and southeast) gates on each span are horizontal swing type gates, while the off-going (northeast and southwest) gates are the more typical vertical traffic gates. The traffic gates are equipment with red warning lights.

The on-coming (horizontal) traffic gates operated using a RACO actuator that is installed under the sidewalk (See Photo E12). The actuators are controlled by a VFD. The end travel positions were originally indicated by the rotary cam limit switches internal to the actuator, but it was reported that they were not reliable and have since been replaced with lever arm type limit switches at the machinery shaft. The horizontal gates are in poor to fair condition. The actuators have moderate amount of surface corrosion. Some of the conduit bodies and covers are severely corroded or are completely missing. The existing conductors within the junction boxes located near the actuators are missing wire numbers. Each conductor should have a wire number to identify how it is utilized and without wire numbers troubleshooting can be significantly more difficult. On the southeast gate one of the red lights was missing.


Photo E13: Southeast Traffic Gate Acuator

The off-going (vertical) traffic gates are B&B Roadway gates and utilize rotary cam switches for end of travel indication. The internal components of the northeast traffic exhibit a fair amount of water intrusion as the interior equipment exhibits corrosion (See Photo E13).


Photo E14: Northeast Traffic Gate

Traffic signals on an overhead structure with two (2) red traffic lights that flash alternately when directing traffic to stop for bridge operations. The traffic junction/pull boxes are in poor condition and show signs of water intrusion.

5.8 Control System

Other than randomly stopping while lowering, the control system functions as desired and is in fair condition.

5.8.1 Control System Operation/Components and Interlocks

The bridge utilizing a relay-based control system. Most of the interlocks are done by utilizing a minimal number of relays in the motor starter cabinets, limit switches located throughout the span and the drum type controllers located on the control console.

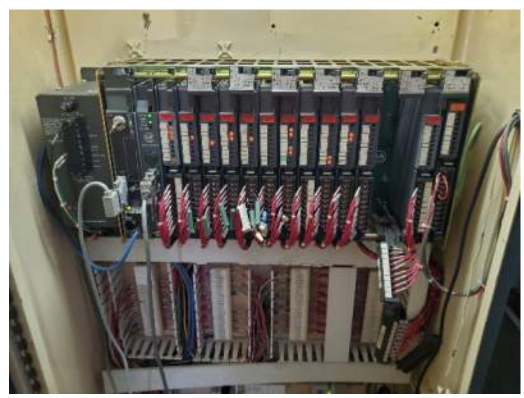


Photo E15: PLC

There is also an Allen-Bradley PLC5 programmable logic controller (PLC) located in the roadway level of the control house as well as a remote input/output (I/O) rack on the far rest pier (See Photo E14). It was reported that the PLC is only utilized for monitoring purposes and does not provide any control functions. It was also reported that while the PLC is still connected, it is no longer utilized to provide information to the bridge tender or maintenance staff. The printer that is associated with the PLC is no longer operational nor is the autodialer that would have been used to provide automatic notification to bridge staff.

The control system appeared to operate as intended; however, it was reported and witnessed that the bridge appears to go into an “emergency” type stop while lowering and the drum switches must be returned to the center position before the bridge can be moved again. The number of times that the bridge stops is random and is not always in the same location. This repeated starting and stopping is putting unnecessary wear on the machinery. It is theorized that while lowering the bridge is over speeding and the over speed switches are causing the bridge to stop. Additional testing will need to be performed to confirm the cause of the bridge stopping.


Photo E16: Control Console

5.8.2 Control Console

The control console is located on the top level of the control house (See Photo E15). The control console is adequately located to provide good visibility of the movable spans, gates and waterway. The indication lights and other instruments are from the original construction in the 1950s and are in full working order and accurately displayed span information: angle, voltage, speed, and the status of limit switches.

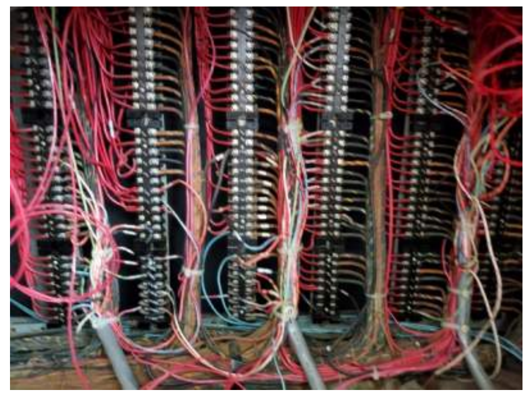


Photo E17: Control Console Interior

It is evident that a significant amount of wiring has been replaced due to its color (red) when compared to the likely original color (black) (See Photo E16). Due to the amount of wiring that appears to have been replaced, it indicates that there have been several significant conductor failures over the years associated with the conductors. Almost all of the conductors lacked wire numbers. Wire numbers are essential for a properly documented control system. Troubleshooting will also be severely limited if wire numbers are missing.


Photo E18: North Leaf Rotary Cam Limit Switch and Selsyn

In addition to the control console for the bridge, a “remote control station” is also located on the top level of the control house. The remote control station is intended to be used to operate the Port Clinton and Lorain Bridges, but it is currently not being utilized.

5.8.3 Limit Switches and Instrumentation

Each leaf is equipment a rotary cam type limit switch and selsyn position transmitter to provide span position, and a fully seated plunger switch. Both rotary cam switch enclosures were opened, inspected, and determined to be in good condition (See Photo E17). The interior of both switches was found to be free of moisture, debris, corrosion, and rust and in good condition. The selsyn transmitter appeared to be in fair condition while the conductors are connected with wire nuts.

An abandoned rotary cam switch and selsyn transmitter are also installed near the main drive motors. All abandoned equipment should be removed to avoid confusion.

An overspeed switch is located near the main gear reducer. The overspeed switch appears to have an excessive amount of grease and oil, likely due maintenance staff not knowing how to properly maintain the switch.

Rotary cam and proximity type limit switches are utilized for the span locks and appear to be in fair condition (See Photo E19).

Photo E19: Abandoned Rotary Cam Limit Switch

Photo E20: Span Lock Proximity Switch

Photo E21: Conduit Near the Southeast Acuator

5.9 Conduits, Wiring and Boxes

5.9.1 Conduits/Raceways and Junction/Pull Boxes

Most of the conduits located on the bridge is rigid galvanized steel (RGS) conduit with the only exception being polyvinyl chloride (PVC) coated RGS is used at the on-coming gates. Liquid tight flexible conduit is utilized in several locations, particularly for connections to equipment that is prone to vibration, such as motors and limit switches.

Most of the conduit is in poor condition, with the only exceptions being conduit that had been replaced within the last year. Based on the amount of corrosion where the RGS conduit meets the concrete, it is highly likely that conduit embedded within the concrete is in poor condition and/or the conduit at the concrete penetration is on the verge of breaking or creating sharp edges internal to the conduit.

A significant amount of conduit bodies and fittings also shown signs of excessive corrosion.

Most of the junction/pull boxes are in fair condition with some outdoor boxes missing their seals.

5.9.2 Conductors

Due to the color of the conductor insulation, it is apparent that a significant amount of the original 1950's conductors have been replaced over the last 20 years, but there are still several locations where the original wiring is still in place. It is highly likely that the conductors were replaced due to failure.

5.9.3 Submarine Cables and Cabinets

The submarine cable cabinets are currently in fair condition and provide sufficient protection for the conductors and terminations located inside (See Photo E22). It should be noted that some of the water-tight seals are starting to come loose. There is one cable that has been disconnected. Measurements of the spare conductors within the submarine cables were taken. All spare conductors are in good condition with a measurement of 550 MΩ each.

Photo E22: South Pier Submarine Cable Termination Cabinet

5.10 Navigation and Pier Lights

The bridge is equipped with navigation and pier lights as per the United States Coast Guard. All lights were inspected during bridge operation and observed to change colors appropriately.

5.11 Lighting and Receptacles

General lighting and maintenance receptacles are provided throughout the span and the control house. Lighting is primarily incandescent type lighting. None of the receptacles located in wet locations were GFCI type. In several locations fixtures and/or bulbs were either missing or no longer operational.

Emergency lighting is not provided throughout the span.

Photo E23: Southeast Navigation Light

5.12 Roadway Lighting

Light poles and fixtures are installed on the approaches and movable span. The fixtures and poles are in fair condition.

5.13 Electrical Conclusions and Recommendations

Overall, the electrical distribution and control systems on the bridge are in poor condition.

The following set of recommended repairs are specific to the electrical components of the bridge as presented herein. They are prioritized based on immediacy of the repair need and listed based on type of bridge component. The prioritization categories used are defined below.

1. Priority Repairs – Required work within a one-year period to address deficiencies that require emergency operations that may affect the load capacity of the structure, bascule span operation, or public safety.

2. Contract Work – Extensive work within a 2- to 5-year period that if deficiencies become worse, they may cause further damage, prevent span operations, affect traffic or public safety. These may also include engineering analysis, planning, and/or details and drawings.

3. Capital Maintenance – Recommended maintenance or repair activities within a 5-year period to be address deficiencies that may affect span operation for non-emergency operations, regulatory compliance, access deficiencies and aesthetics. This is work that may be performed by the Department's maintenance personnel or small-scale repair contracts.

4. Monitoring – Field observations where actual repair is not required but will require action if deficiency substantially worsens. There is no cost estimated for these recommendations; they should be implemented into the structure's inspection procedures and this effort should be included with the cost of future structure inspections.

Priority Repairs

Deficient Item	Repair Recommendation
The circuit breakers located in the motor starter cabinet are original and have not been recently tested. An electrical fire was also reported in the far submarine cable termination cabinet.	Test the circuit breakers and replace as necessary.
Southeast gate has a missing light	Replace the missing light
The conductors in the termination cabinets next to the traffic gate actuators are missing wire numbers	install wire numbers for each conductor
The bridge stops randomly while lowering.	Further investigate the stopping
The replaced conductors within the control console do not have wire numbers.	install wire numbers for each conductor
Several outdoor enclosures are missing their watertight seals.	Replace the missing seals
There are several fixtures and/or bulbs that are missing or not working.	Replace bulbs and fixtures as needed
There are no emergency lights throughout the bridge.	Install emergency lighting
None of the receptacles located in wet locations are GFCI type.	Install GFCI receptacles for all receptacles located in wet locations.

Contract Work

Deficient Item	Repair Recommendation
There is abandoned utility owned equipment on the south pier.	Remove all abandoned equipment
There are abandoned distribution equipment near the utility owned transformers in the north and south piers.	Remove all abandoned equipment
Several panelboards are past their useful life expectancy.	Replace all original panelboards
Main drive motor starters and contactors are original and replacement parts are not available.	Install a second motor starter cabinet dedicated to the main drive motors or replaced the existing cabinet.
Some of the original motor starters and relays are still utilized.	Replace the remaining starters and relays
The main drive motors have low insulation ratings and most of the brushes are wearing abnormally.	Rehabilitate or replace the existing main drive motors
The brake junction boxes are severely corroded, poorly mounted and contain wire nuts.	Replace the existing brake junction boxes with termination cabinets.
Conduits located near the traffic gate actuators are severely corroded.	Replace the conduit
The junction/pull/termination boxes for the traffic signal are in poor condition.	Replace the enclosures
The monitoring PLC and associated I/O rack is no longer being utilized and is essentially abandoned in place.	Remove all abandoned equipment
An abandoned rotary cam limit switch and selsyn transmitter are located near the main gear reducer.	Remove all abandoned equipment
The overspeed switch appears to have an excessive amount of grease and oil.	Clean and properly maintain the overspeed switch
The majority of the RGS conduit and conduit bodies and fittings are in poor condition.	Replace the existing conduit system
There are still several locations were the original conductors are still in use.	Replace the original 1950s conductors.

Capital Maintenance

Deficient Item	Repair Recommendation
Utility owned equipment is located in the control house.	Relocate the utility owned medium voltage transformers to the roadway deck off of the span
The service entrance disconnect switch is located on a lower level of the control house.	Relocate the disconnect to the roadway deck level of the control house.
Most of the existing conductors in the motor starter cabinet have been replaced.	Replace the remaining conductors
The 1950s conductors and contactor arc chutes likely contain asbestos.	Test the conductors and arc chutes
The brakes are original from the 1950s and replacement parts are difficult to procure.	Replace the existing brakes
There are two (2) different types of traffic gates installed at the bridge.	Replace the horizontal swing type gates to match the other gates that have more readily available parts
The control console switches, pushbuttons, lights and meters are original.	Replace the equipment with modern parts
The selsyn transmitters are in poor condition and replacements are difficult to procure.	Replace the selsyn transmitters with modern transmitters

5.13.1 Repair Recommendations Cost Estimate

Cost Estimate provided assumes a construction year of 2028 for adequate planning, design, and contracting necessary for a project for the set of recommended repairs. Estimate provided is a high-level estimate based on the conditions observed during this inspection, and quantities for deteriorated conditions determined based on these observations. Estimate is not detailed or comprehensive but is to serve as guideline for estimated costs based on current unit costs for similar repair activities and types. A detailed engineer's cost estimate would be required once the scope of repairs is finalized and detailed plans, drawings and specifications are established.

Priority Repairs	$ 93,500
Contract Work	$ 1,096,000
Capital Maintenance	$ 700,000
Electrical Sub-Total	**$ 1,889,500**

6.0 Recommendations Summary with Cost Estimate

Structural:

Priority Level / Recommendation & Details	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
Priority				
Repair the locations of corrosion holes to the bascule span grid deck main bars (3 groups of locations)	3	EA	$8,000	$24,000
Replace the connection bolts (missing and in-place) at the vertical plates of the steel barriers in the bascule span.	1	LS	$10,000	$10,000
Repair locations of disconnected, broken, and missing piping at the drainage components below deck and at the piers.	1	LS	$25,000	$25,000
			sub-total:	**$59,000**
Contract Work				
Replace the HPR joint material at the South approach.	66	LF	$28	$1,848
Install an epoxy overlay to the concrete deck surface across the bridge, include south approach structure deck surface.	21600	SYD	$48	$1,036,800
Apply silane treatment to the faces of the concrete barriers in the fixed spans.	23328	SF	$7	$163,296
Clean and paint the steel barriers in the bascule span.	3552	SF	$17	$60,384
Repair the misalignment of the bascule span expansion joint finger plates by removing the plates, cleaning pack rust, painting, and adjusting as necessary during re-installation.	85	LF	$110	$9,350
Repair the bascule span rear longitudinal breaks at the girders by cleaning the pack rust causing the warping at the bases of the plates and straightening the warping.	400	LF	$125	$50,000
Replace the elastomeric troughs below the finger joints at the South Abutment, Piers 4, 5, 8 and the North Abutment.	5	EA	$15,000	$75,000
Repair the broken concrete header at the South Abutment joint at the West sidewalk.	1	EA	$6,000	$6,000
Repair the lower web and bottom flange of FB11S at the North Abutment, areas of active corrosion and section loss (reinforcement repair).	1	EA	$10,000	$10,000
Repair the locations of holes in the bascule span girder and floorbeam bottom flanges, webs, and bases of vertical stiffeners.	3	EA	$8,000	$24,000
Repair the locations of holes in the bascule span stringer webs.	20	EA	$2,500	$50,000
Repair the locations of holes in bascule span bracing members and connection plates.	7	EA	$2,000	$14,000
Repair the bascule span upper diagonal connections with holes, cracks or fully broken angles.	11	EA	$6,000	$66,000
Repair the locations of holes in the bascule span sidewalk support beam and post webs.	11	EA	$3,500	$38,500

Priority Level / Recommendation & Details	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
Contract Work, cont'd				
Repair the locations of holes in the bascule span catwalk channels.	1	LS	$10,000	$10,000
Repair the locations of deteriorated bascule span catwalk supports at the diagonal bracing.	2	EA	$5,000	$10,000
Clean and paint areas of corrosion and localized paint failure at superstructure components in the fixed and bascule spans, localized at areas below expansion joints in the fixed spans and throughout the bascule span.	8500	SF	$75	$637,500
Repair cracks greater than 0.0625" wide with injection-seal type repair in the abutment walls and in the solid pier walls.	274	LF	$70	$19,180
Perform concrete patch repairs to areas of delaminated and spalled concrete at the abutment walls, solid pier walls, and column-cap beam piers.	123.5	CF	$360	$44,460
Apply a concrete surface coating over the vertical and horizontal surfaces of the abutments, wingwalls and piers to seal previous repairs, minor cracking, and prevent water infiltration.	8800	SYD	$47	$413,600
Repair the corrosion holes at the Span 6 sign gantry east support at the fascia.	1	LS	$4,000	$4,000
Repair the deteriorated conduit connections, supports and junction boxes throughout the bridge.	1	LS	$75,000	$75,000
Repair cracks greater than 0.0625" wide with injection-seal type repair in the bascule pier interior walls and other locations within the pier interiors.	331	LF	$70	$23,170
Perform concrete patch repairs to areas of delaminated and spalled concrete at the bascule pier interior walls, counterweight span underside, and other locations within the pier interiors.	42.5	CF	$360	$15,300
Perform spot cleaning and painting at the tower bases and locations of active corrosion.	400	SF	$35	$14,000
Install reinforcement repairs at the tower bases and other locations of section loss and corrosion holes, and provide drainage protection for the tower interiors.	1	LS	$30,000	$30,000
Clean and paint the areas of corrosion at the tops of the counterweight and determine if patching repairs are necessary to the counterweight concrete block.	400	SF	$70	$28,000
Repair or replace broken, missing or otherwise deteriorated access stairs, hand railings or related items throughout both pier interiors.	1	LS	$75,000	$75,000
Install fire and life safety items within both pier interiors.	1	LS	$50,000	$50,000
			sub-total:	**$3,054,388**

Priority Level / Recommendation & Details	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
Capital Maintenance				
Remove the vegetation growth from the northwest quadrant sidewalk and repair the settlement of the sidewalk at the railing transition.	-	-	-	-
Repair the uplift at the bascule span rear break sidewalk joint cover plates by removing the plates, cleaning pack rust, painting, and adjusting as necessary during re-installation.	2	EA	$4,000	$8,000
Clear debris from horizontal surfaces in the fixed spans superstructure and pier tops (bird nesting, etc.).	-	-	-	-
Clear debris from bascule span horizontal surfaces of girders, floorbeams, secondary members, and other superstructure components.	-	-	-	-
Replace missing caps at the tops of light poles.	22	EA	$25	$550
Repair or replace missing or out of place hand hole covers at the light poles.	1	LS	$1,500	$1,500
Repair or replace non-functioning navigational lights at Span 5 and the bascule piers.	1	LS	$10,000	$10,000
Replace fire extinguishers - 1 per level at each pier in main access rooms	8	EA	$200	$1,600
			sub-total:	**$21,650**
			Structural Total:	**$3,135,038**

Mechanical:

Priority Level / Recommendation & Details	***Quantity***	***Unit***	***Unit Cost***	***Item Cost***
Priority				
Replace the railings in the machinery rooms around the staircases and open gearing for the safety of maintenance team.	1	LS	$20,000	$20,000
Adjust/repair manual release hand levers for brakes across all machinery.	1	LS	$10,000	$10,000
Adjust brakes to factory settings for torque, clearance, and thruster reserve stroke.	1	LS	$4,000	$4,000
Remove corrosion from brake wheels and ensure brake pads are in contact when set and release fully when energized.	1	LS	$4,000	$4,000
Replace auxiliary engine batteries.	2	EA	$500	$1,000
Remove stacks of counterweight blocks from machinery room floors to prevent injury and move to storage room or counterweight pit.	1	LS	$4,000	$4,000
Tighten or replace all loose fasteners across motors, brakes, actuators, housings and supports.	1	LS	$2,000	$2,000
Fix bottom driven limit switch that slightly contacts target on NE outboard span lock.	1	LS	$1,000	$1,000
Replace selsyn motor on south side cam assembly and tighten chains on span drive machinery.	1	LS	$4,000	$4,000
Tighten loose guy wires on traffic gates.	1	LS	$1,000	$1,000
			sub-total:	**$51,000**
Contract Work				
Evaluate the rack mounting system and bolts, which should be rated by a mechanical or structural engineer based on various loading circumstances.	1	LS	$10,000	$10,000
Install new lighting in South machinery room.	1	LS	$50,000	$50,000
Replace swing gates with a sturdier design that includes a locking mechanism to restore intended function of swing gates.	1	LS	$400,000	$400,000
Clean and repaint areas of corrosion across all machinery.	1	LS	$60,000	$60,000
Rehabilitate raised buffer cylinders as well as the strike plates and their fasteners.	8	EA	$2,000	$16,000
Re-align seated buffer cylinders and rehabilitate corroded hardware.	4	EA	$2,000	$8,000
Rehabilitate supports for open gearing bearings where section loss occurs, and pack rust is forming.	1	LS	$60,000	$60,000
Replace gear covers and gaskets for G2 gears.	4	EA	$5,000	$20,000
Replace open gearing.	1	LS	$750,000	$750,000
			sub-total:	**$1,374,000**

Priority Level / Recommendation & Details	Quantity	Unit	Unit Cost	Item Cost
Capital Maintenance				
Install new lubrication and purge fittings on the motor couplings and add the couplings to the bridge lubrication schedule.	1	LS	$2,000	$2,000
Clean open gearing of all lubrication, corrosion, and debris. Re-lubricate with fresh grease.	1	LS	$5,000	$5,000
Monitor gear condition and consider open gearing rehabilitation.	1	LS	$0	$0
Lubricate span lock motor couplings regularly. Pull purge plugs when lubricating.	1	LS	$2,000	$2,000
Replace bulging O-Ring being used on SE motor coupling.	1	LS	$1,000	$1,000
Install drainage system below roadway breaks to prevent wear and corrosion on open gearing caused by the elements.	1	LS	$20,000	$20,000
Re-align crank arms and shafts in NE and SW traffic gate housings. Replace arms if they are deformed.	1	LS	$5,000	$5,000
Clean auxiliary engines of excess grease and oil. Address fluid leaks.	1	LS	$1,000	$1,000
Clean span lock gearing and racks of all contamination and debris then re-lubricate.	1	LS	$4,000	$4,000
Adjust bumper for NE vertical traffic gate to ensure it contacts roadway upon lowering.	1	LS	$1,000	$1,000
Replace all non-functional and missing lighting on traffic gates.	1	LS	$2,000	$2,000
Replace all locks and handles on traffic gate machinery housings.	1	LS	$5,000	$5,000
Rehabilitate access doors for swing gate machinery.	1	LS	$5,000	$5,000
Clean machinery of all excess debris to prevent further wear.	1	LS	$5,000	$5,000
Monitor condition of wooden counterweight bumpers and contacting plates in counterweight pit along with their fasteners.	1	LS	$0	$0
			sub-total:	**$58,000**
			Mechanical Total:	**$1,434,000**

Electrical:

Priority Level / Recommendation & Details	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
Priority				
Test circuit breaker in motor starter cabinets and replace breakers as necessary	1	LS	$40,000	$40,000
Replace missing light at southeast gate	1	LS	$500	$500
Install wire numbers at termination cabinets near span lock actuators	1	LS	$5,000	$5,000
Further investigate the random stopping of the bridge while lowering	1	LS	$8,000	$8,000
Install wire numbers at control desk	1	LS	$10,000	$10,000
Install seals for outdoor cabinets	1	LS	$5,000	$5,000
Replace bulbs and/or fixtures	1	LS	$5,000	$5,000
Install emergency lighting	1	LS	$15,000	$15,000
Install GFCI receptacles for all receptacles located in wet locations	1	LS	$5,000	$5,000
			sub-total:	**$93,500**
Contract Work				
Remove abandoned utility equipment in the south pier	1	LS	$25,000	$25,000
Remove abandoned low voltage distribution equipment in the north and south piers	1	LS	$5,000	$5,000
Replace all original panelboards	1	LS	$30,000	$30,000
Install a second motor starter cabinet dedicated to the main drive motors or replaced the existing cabinet.	1	LS	$300,000	$300,000
Replace the remaining original conductors in the motor starter cabinets	1	LS	$100,000	$100,000
Replace the remaining original motor starters and relays in the motor starter cabinets	1	LS	$75,000	$75,000
Rehabilitate or replace the existing main drive motors	4	EA	$60,000	$240,000
Replace the existing brake junction boxes with termination cabinets.	8	EA	$3,000	$24,000
Replace the corroded conduit near the gate actuators	1	LS	$3,000	$3,000
Replace the corroded enclosures near the traffic signals	1	LS	$3,000	$3,000
Remove the PLC and associated I/O Racks	1	LS	$5,000	$5,000
Replace control console pilot devices and meters	1	LS	$25,000	$25,000
Replace the existing selsyn transmitters with new equipment	1	LS	$10,000	$10,000
Clean and properly maintain the overspeed switch	1	LS	$1,000	$1,000
Replace the existing conduit system	1	LS	$250,000	$250,000
			sub-total:	**$1,096,000**

Priority Level / Recommendation & Details	***Quantity***	***Unit***	***Unit Cost***	***Item Cost***
Capital Maintenance				
Relocate the utility owned medium voltage transformers to the roadway deck of off of the span	1	LS	$200,000	$200,000
Relocate service entrance disconnect switch to the roadway deck level of the control house.	1	LS	$60,000	$60,000
Replace the original remaining conductors	1	LS	$50,000	$50,000
Test the original conductors and arc chutes	1	LS	$5,000	$5,000
Replace the existing brakes	8	EA	$25,000	$200,000
Replace the horizontal swing type gates to match the other gates that have more readily available parts	2	EA	$75,000	$150,000
Replace control console pilot devices and meters	1	LS	$25,000	$25,000
Replace the existing selsyn transmitters with new equipment	1	LS	$10,000	$10,000
			sub-total:	**$700,000**
			Electrical Total:	**$1,889,500**

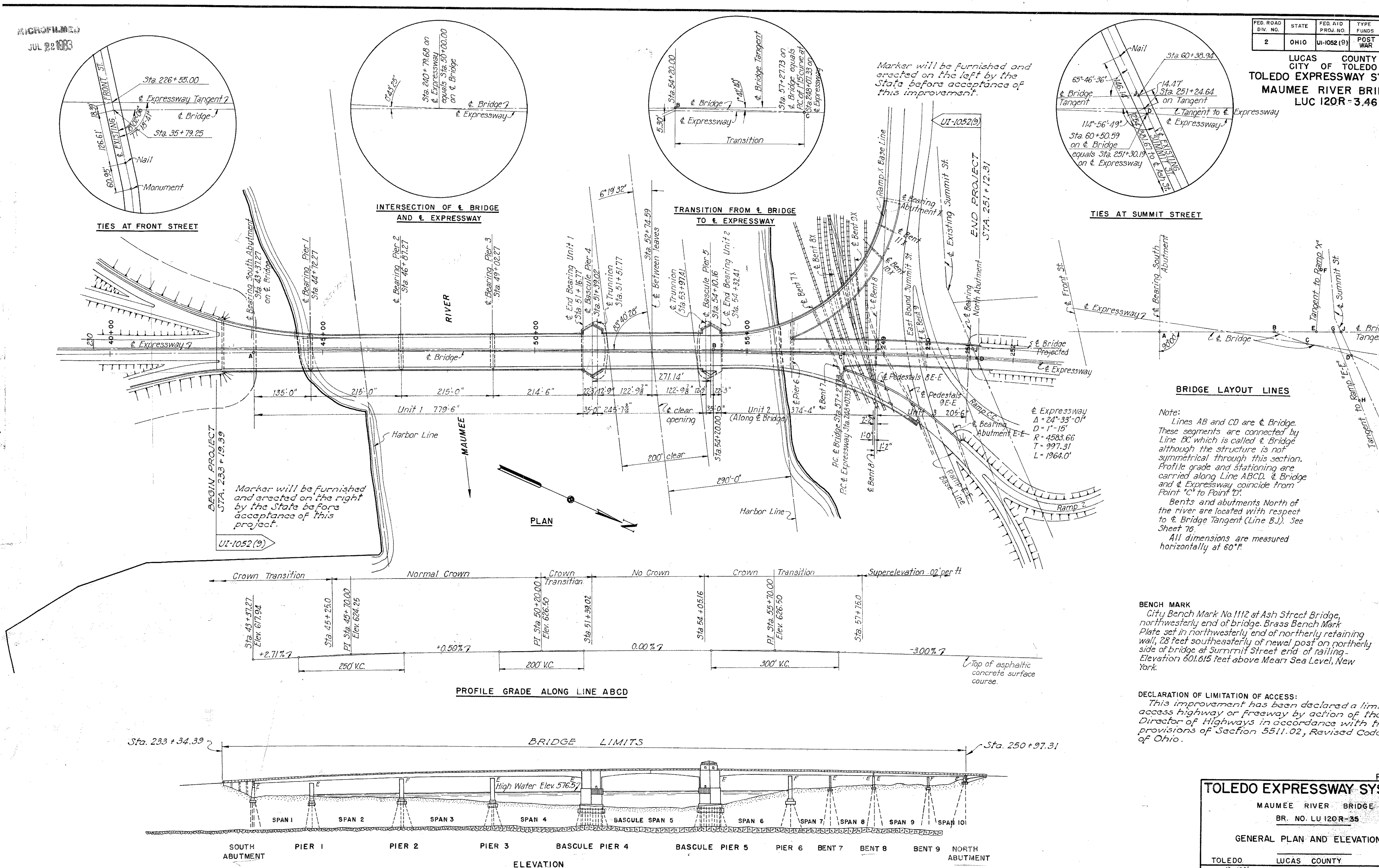
Cost Estimate Total:

This Cost Estimate assumes a construction year of 2028 for adequate planning, design, and contracting necessary for a project for the set of recommended repairs. Estimate provided is a high-level estimate based on the conditions observed during this inspection, and quantities for deteriorated conditions determined based on these observations. Estimate is not detailed or comprehensive but is to serve as guideline for estimated costs based on current unit costs for similar repair activities and types. A detailed engineer's cost estimate would be required once the scope of repairs is finalized and detailed plans, drawings and specifications are established.

Repair Type	Structural	Mechanical	Electrical	Sub-Totals:
Priority Repairs	$ 59,000	$51,000	$93,500	$203,500
Contract Work	$ 3,054,388	$1,374,000	$1,096,000	$5,524,388
Capital Maintenance	$ 21,650	$58,000	$700,000	$779,650
Sub-Totals:	$ 3,135,038	$1,483,000	$1,889,500	
			Overall Total:	**$6,507,538**

Appendix 1:

Structure Reference Drawings



Note:
Lines AB and CD are ℄ Bridge. These segments are connected by Line BC which is called ℄ Bridge although the structure is not symmetrical through this section. Profile grade and stationing are carried along Line ABCD. ℄ Bridge and ℄ Expressway coincide from Point "C" to Point "D".
Bents and abutments North of the river are located with respect to ℄ Bridge Tangent (Line BJ). See Sheet 76.
All dimensions are measured horizontally at 60°F.

BENCH MARK
City Bench Mark No. 1112 at Ash Street Bridge, northwesterly end of bridge. Brass Bench Mark Plate set in northwesterly end of northerly retaining wall, 28 feet southeasterly of newel post on northerly side of bridge at Summit Street end of railing. Elevation 601.615 feet above Mean Sea Level, New York.

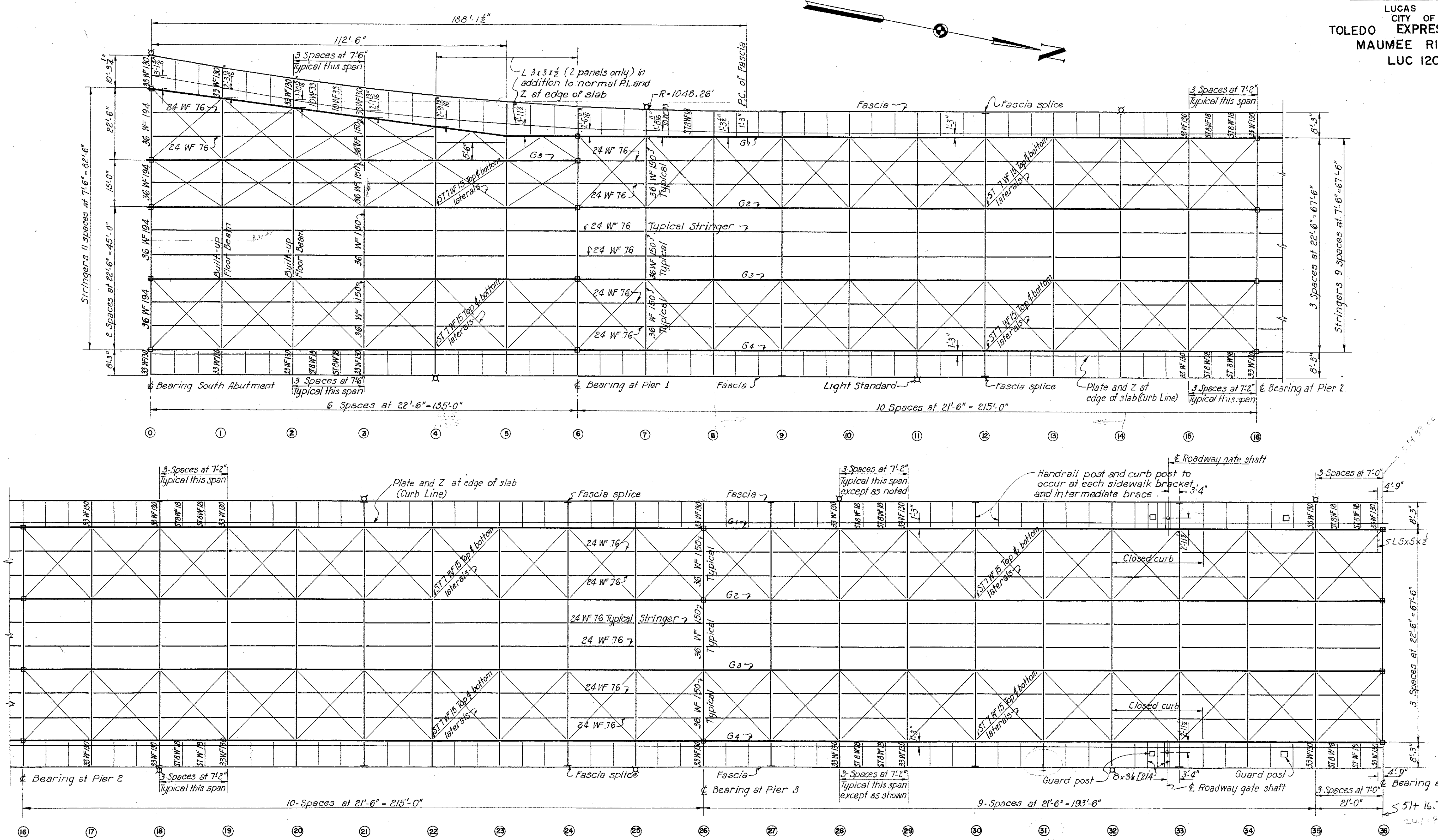
DECLARATION OF LIMITATION OF ACCESS:
This improvement has been declared a lim[...] access highway or freeway by action of th[...] Director of Highways in accordance with t[...] provisions of Section 5511.02, Revised Cod[...] of Ohio.

TOLEDO EXPRESSWAY SYS[...]
MAUMEE RIVER BRIDGE
BR. NO. LU 120R-35
GENERAL PLAN AND ELEVATION
TOLEDO LUCAS COUNTY
SCALE 1" = 100'
MADE H.B.K.-E.H.L. DATE 8-16-51
TRCD. B.L.B. DATE 8-21-51
CKD. J.T. DATE 8-29-53
HOWARD, NEEDLES, TAMMEN & BE[...]
CONSULTING ENGINEERS
KANSAS CITY NEW Y[...]

702

FED. ROAD DIV. NO.	STATE	
2	OHIO	UI-

LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RI
LUC 12C



FRAMING PLAN

Note:
Closed curb is not required for Unit I except at roadway gates as shown on Framing Plan.
In general, angles and other shapes shall not be bent to make a skewed connection.

TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU
UNIT
STEEL FRAI
TOLEDO LUCAS CO

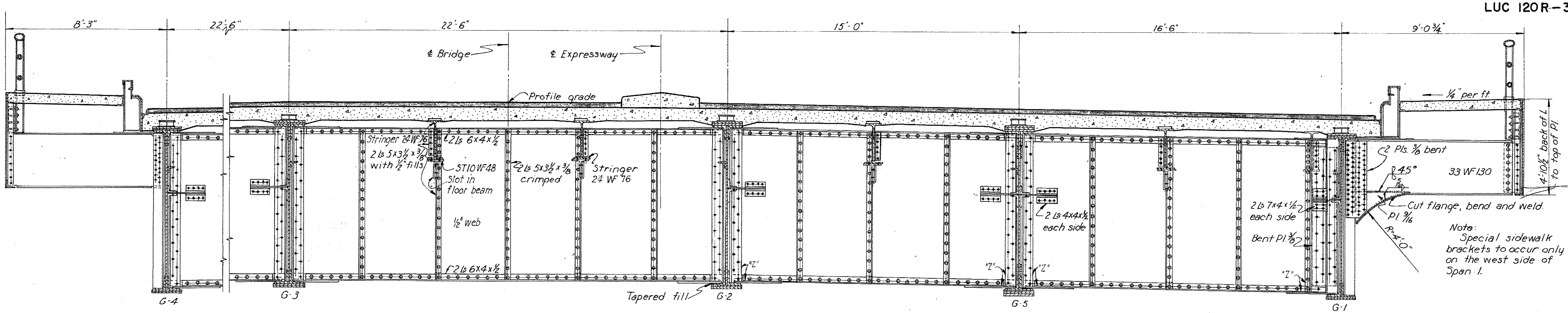
SCALE 1/16" = 1'-0"
MADE W.B.C. DATE 1-28-52
TRCD. A.H. DATE 5-12-52
CKD. AHS DATE 4-24-53

HOWARD, NEE
KANSAS

707

FED. ROAD DIV. NO	STATE	FED. AID PROJ. NO.
2	OHIO	UI-1052(2)

LUCAS COU
CITY OF TOLE
TOLEDO EXPRESSWA
MAUMEE RIVER
LUC 120R-3

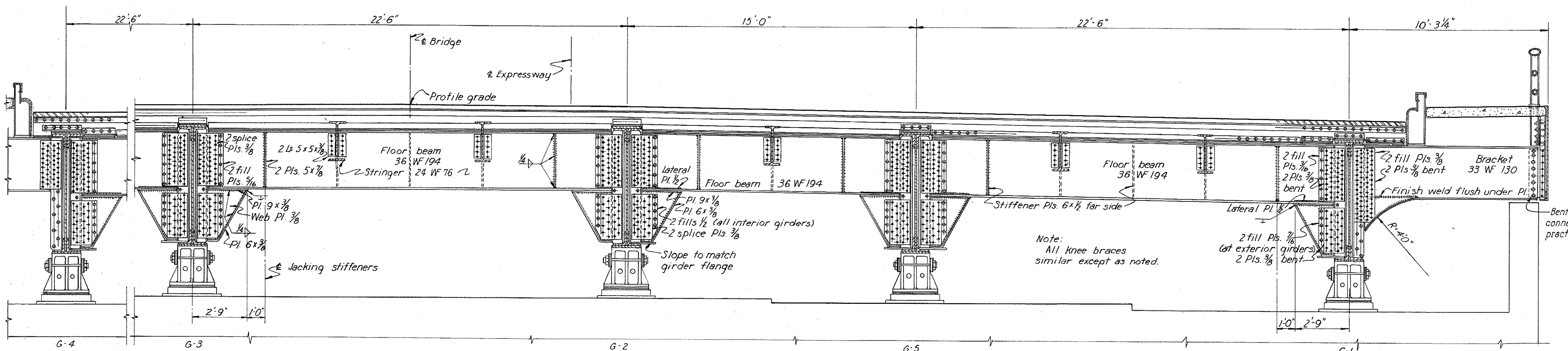


Note:
Floor beam between G-3 and G-4 to be similar to that shown between G-2 and G-3.

PART CROSS SECTION AT POINT 2
Cross section at point 1 similar except for depth of girder and floor beam and distance between G-1 and G-5.

Note:
Special sidewalk brackets to occur only on the west side of Span 1.

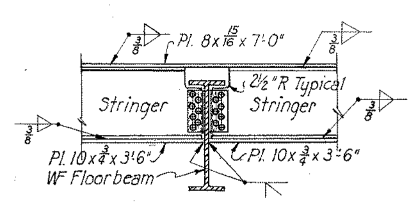
At points ① and ② connections marked "Z" shall be reamed or drilled and then riveted after concrete slab and asphalt surface have been placed. Provide erection bolts as required.



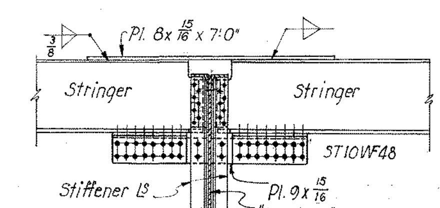
Note:
All knee braces similar except as noted.

Note:
Floor beam between G-3 and G-4 to be similar to that shown between G-1 and G-5.

PART CROSS SECTION AT SOUTH ABUTMENT
Point 0



STRINGER CONNECTION AT WF FLOOR BEAMS



STRINGER CONNECTION AT "BUILT UP" FLOOR BEAMS

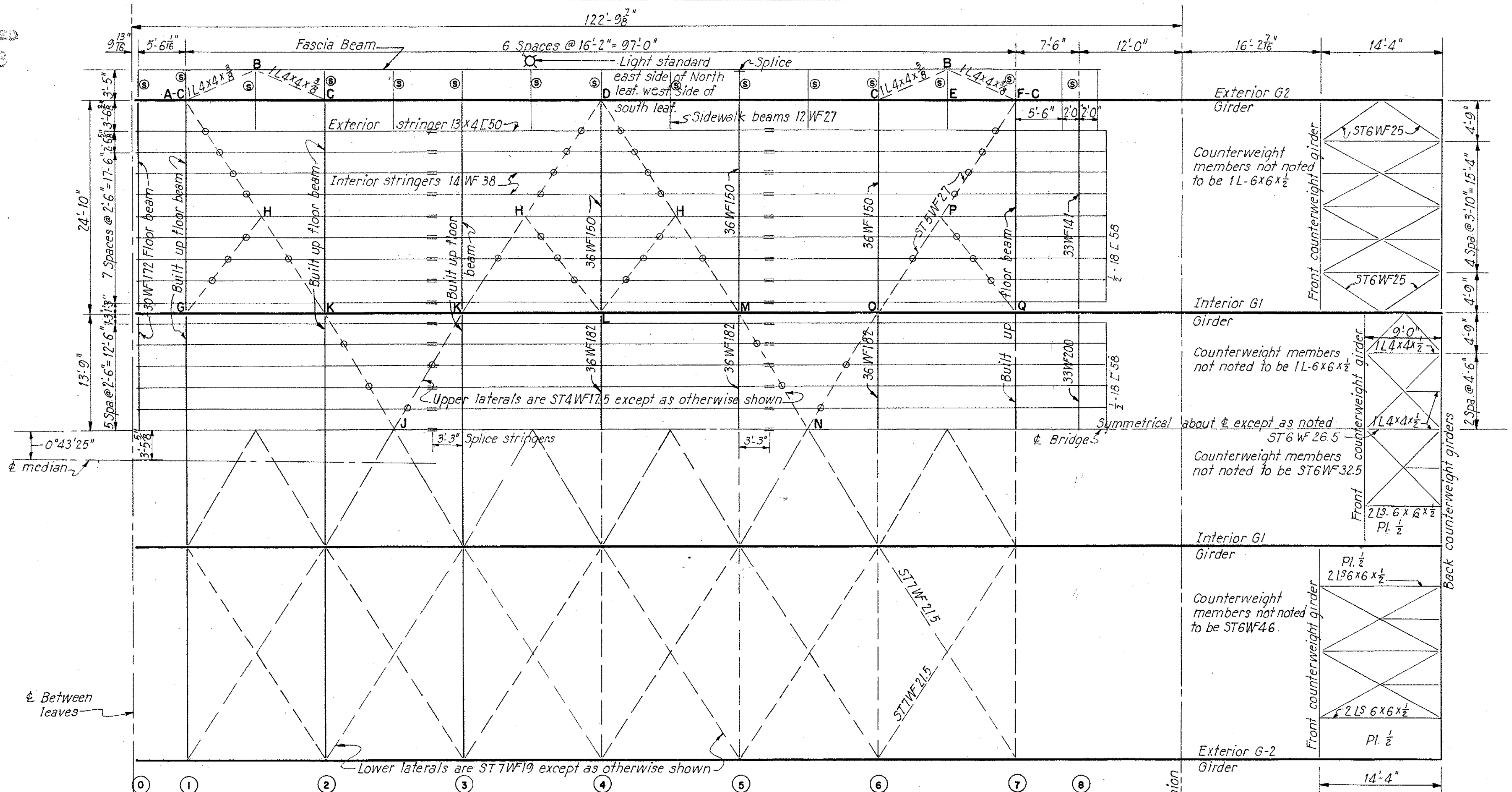
TOLEDO EXPRESSWAY
MAUMEE RIVER BR
BR. NO. LU 120 R-3
UNIT I
ROADWAY CROSS SECT
TOLEDO LUCAS COUNTY,

SCALE 3/8" = 1'-0"
MADE G.D. DATE 3-27-52
TRCD KLG DATE 4-29-53
CKD AHS DATE 5-6-53
HOWARD, NEEDLES, TA...
CONSULTING
KANSAS CITY

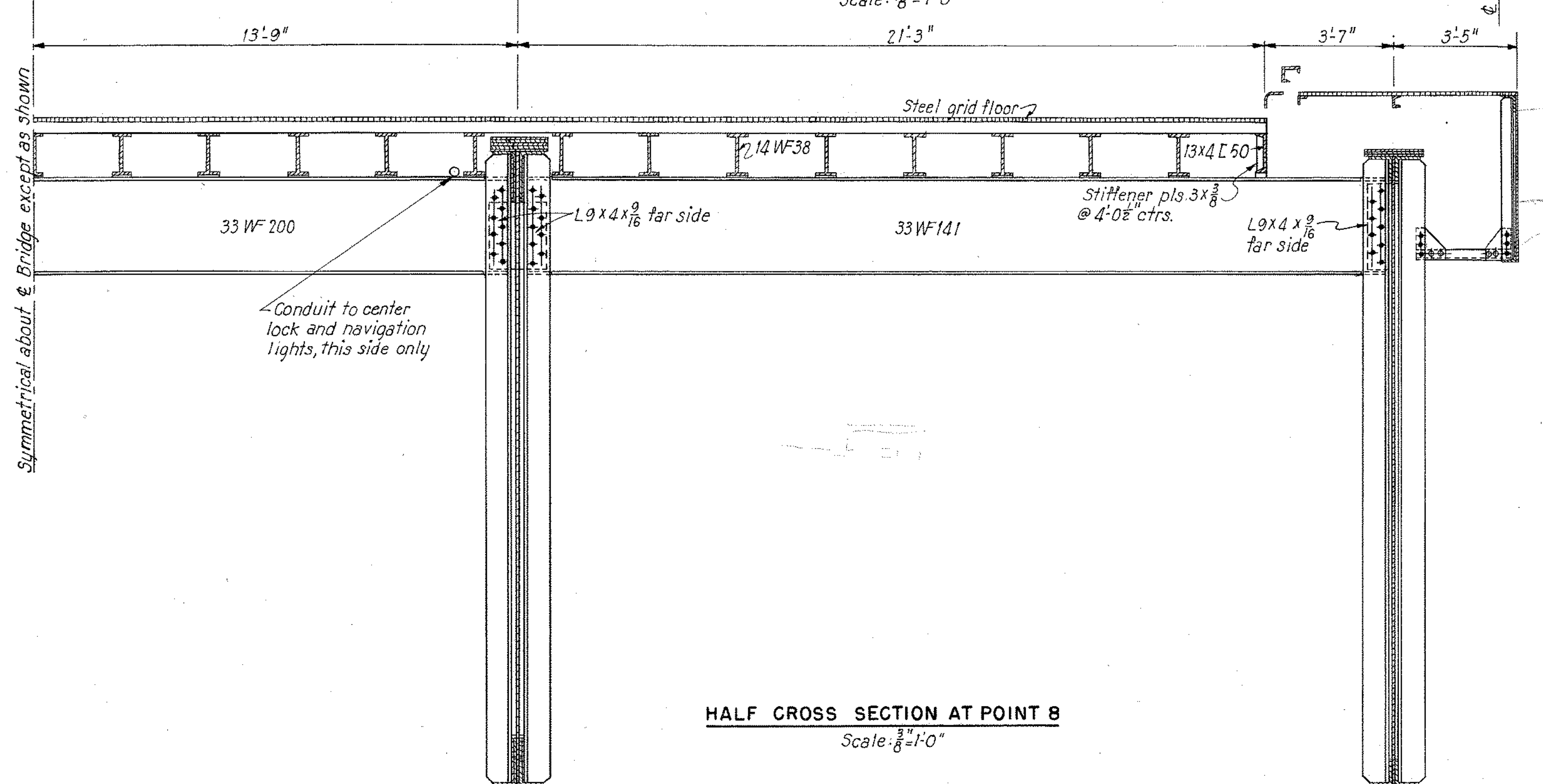
705

FED. ROAD DIV. NO.	STATE	FED. PRO.
2	OHIO	UI-10

LUCAS
CITY OF
TOLEDO EXPRESS
MAUMEE RIV
LUC 120



FRAMING PLAN
Scale: 1/8" = 1'-0"



HALF CROSS SECTION AT POINT 8
Scale: 3/8" = 1'-0"

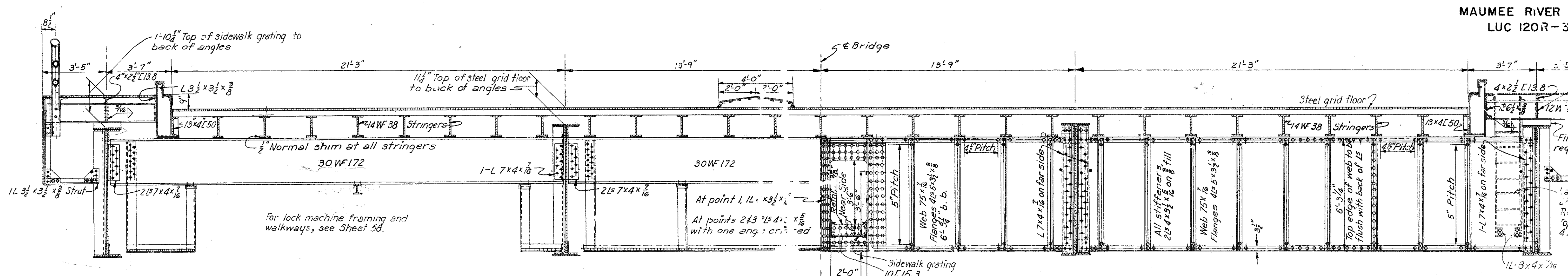
Notes:
Ⓢ Indicates struts between flange of fascia beam and exterior girder.
Letters "H" on framing plan refer to connecti[on] types on Sheet No. 34.
⊗ Indicate connection of upper laterals and st[...] which is connection I.
For stringer splice details see Section B-B o[n] Sheet 35.

TOLEDO EXPRESSW
MAUMEE RIVER
BR. NO. LU I
BASCULE S
STEEL FRAMING
TOLEDO LUCAS COU
SCALE 1/8", 3/8" = 1'-0" — HOWARD, NEED
MADE W.B.C. DATE 7-17-52 — CON
TRCD E.N. R.R. DATE 9-18-52 — KANSAS CI
CKD DME DATE 9-19-52

43

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.
2	OHIO	UI-1052 (2)

LUCAS COUNTY
CITY OF TOLEDO
TOLEDO EXPRESSWAY
MAUMEE RIVER
LUC 120R-3



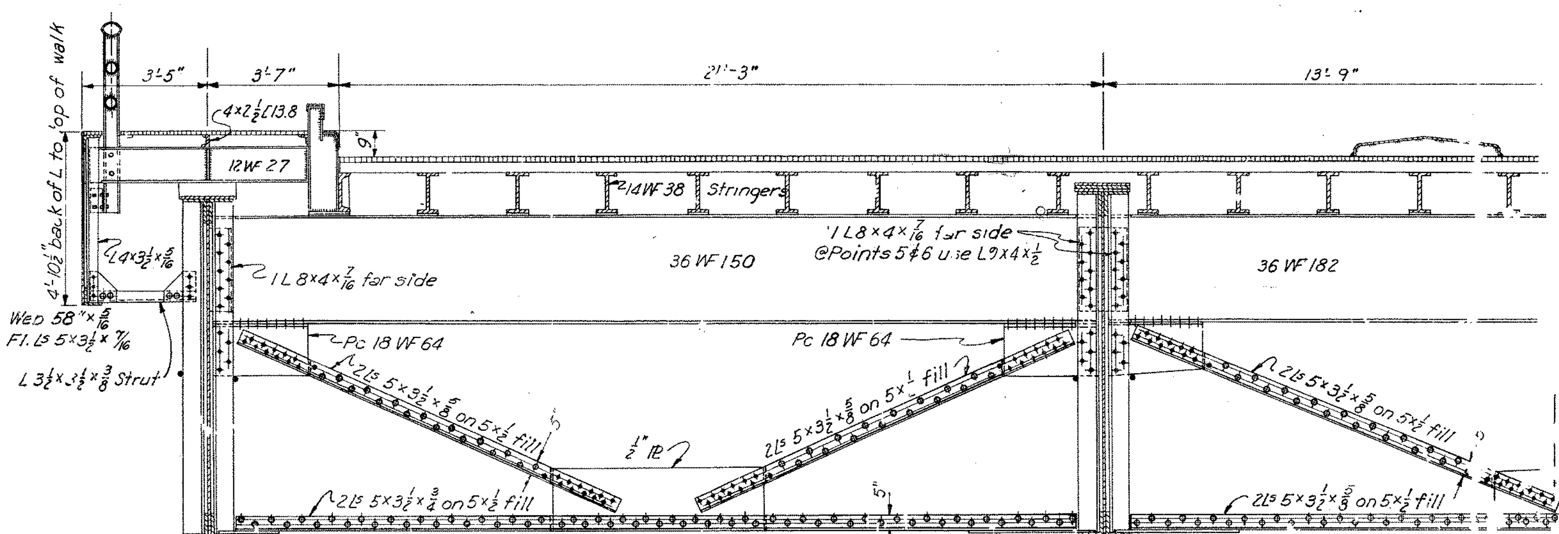
HALF CROSS SECTION AT POINT 0

Looking toward ℄ between leaves

Access Openings Through Beams off center as shown. Opening on West side of ℄ of Bridge in North Leaf only.

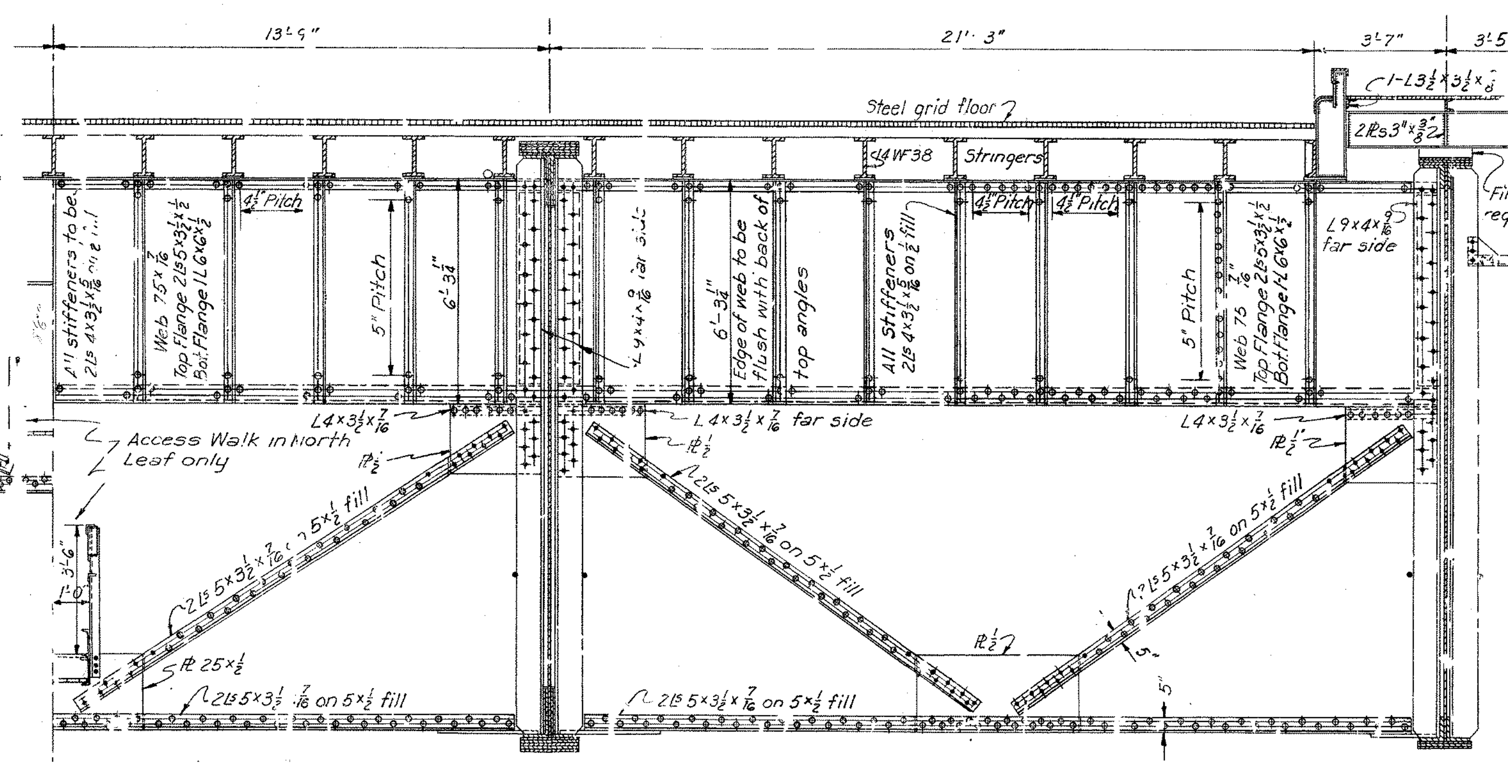
HALF CROSS SECTION AT POINT 1

Cross section at points 2 and 3 similar except depth of floor beam at point 2 6'-7½" and at point 3 = 7'-5¼". Use 79¼x7/16 web at point 2 and 85 x 7/16 web at point 3. Ladder at point 1 only.



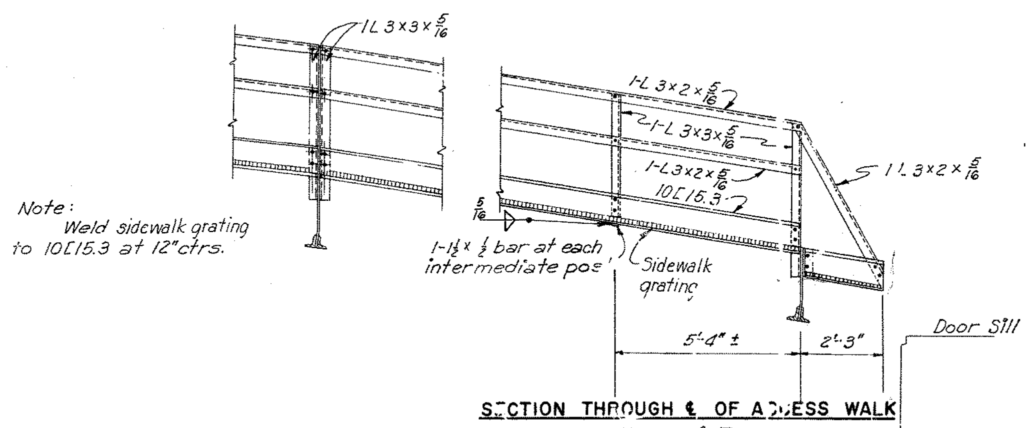
HALF CROSS SECTION AT POINT 4

Cross section at points 5 and 6 similar except for depth of girders and depth of cross-frame.



HALF CROSS SECTION AT POINT 7

Note: ¾" ϕ handbars 4'-6" above lower flange on both sides of each girder, continuous between floorbeams and welded to stiffener angles. Stiffener angles under stringers on floor beams shall be milled to bear on upper ends.



Note: Weld sidewalk grating to 10[15.3 at 12" ctrs.

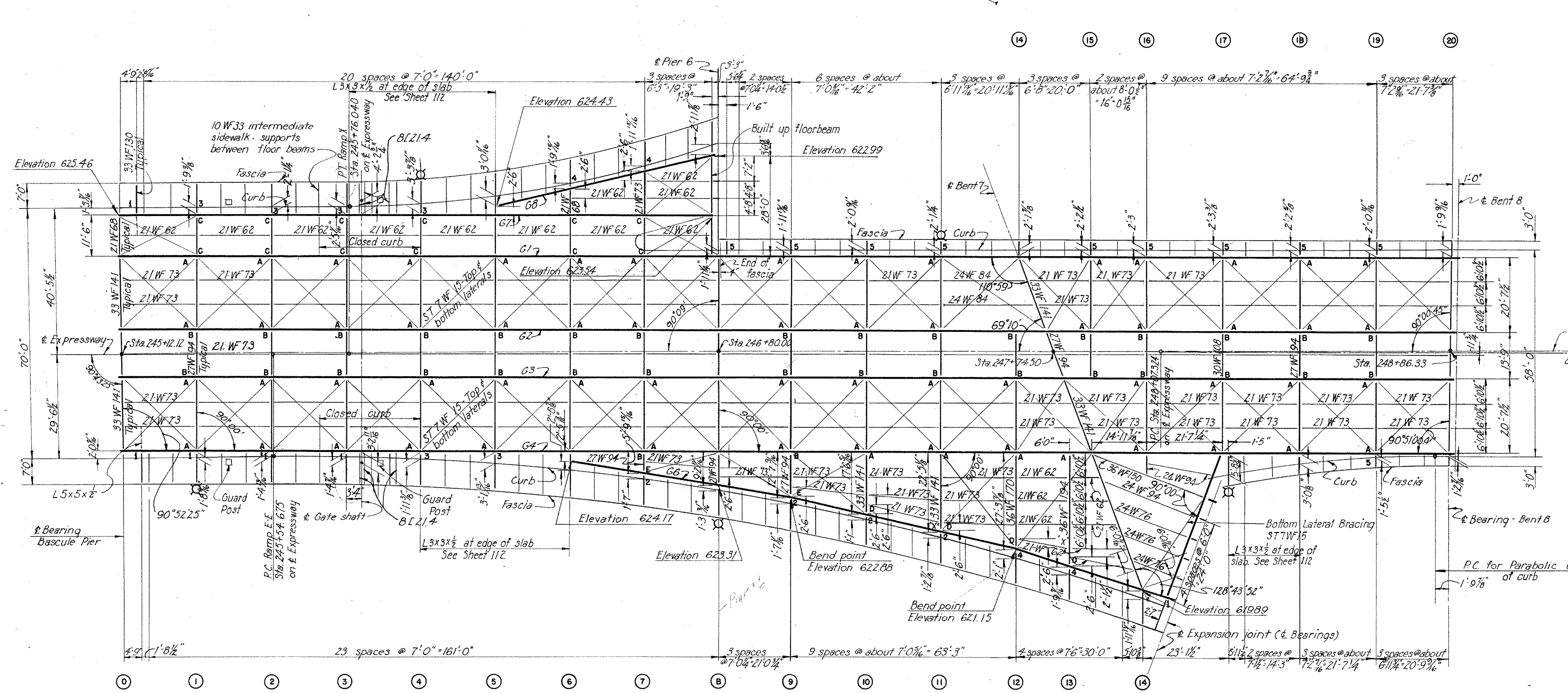
SECTION THROUGH ℄ OF ACCESS WALK

TOLEDO EXPRESSWAY
MAUMEE RIVER B...
BR. NO. LU 120R...
BASCULE SPAN
ROADWAY CROSS SE...
LUCAS COUNTY
SCALE: ⅜" = 1'-0"
DRAWN: 12-13-51
TRACED: 9-27-52
CHECKED: ...-53
HARD, NEEDLES ... CONSULTING ENGINEERS KANSAS CITY

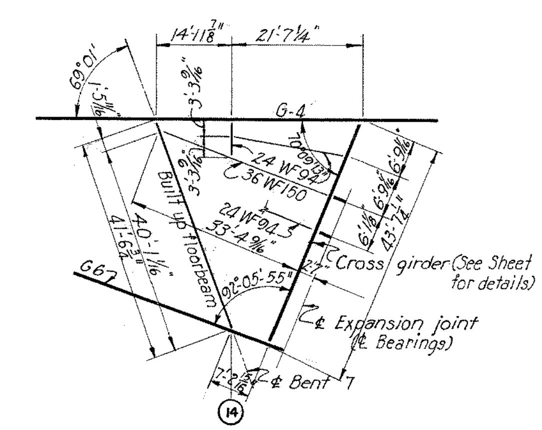
742

FED. ROAD DIV. NO.	STATE
2	OHIO

LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC 12



FRAMING PLAN



Notes:

On stringers "X" at points ⑪ and ⑬ do not use top and bottom flange plates.

In general, angles and other shapes shall not be bent to make a skewed connection.

Curb posts and handrail posts shall occur at every sidewalk bracket and intermediate sidewalk support.

Letters and numbers shown on the framing plan refer to connections of floor beams and sidewalk brackets as shown on Cross Section sheets.

Closed curb is required along G1 from Bent 7 to Bent 8, along G4 from Ramp E-E to Bent 8, and at roadway gates at Point ③ as shown on Framing Plan.

For typical connection details of sidewalk supports between floor beams, see Sheet 10. Use bent 3/8" plate connections where angles are not practical.

Elevations given are to back of top flange angles over points of bearing.

TOLEDO EXPRES
MAUMEE RIVE
BR. NO. L
UNIT
STEEL FRAM

TOLEDO LUCAS C

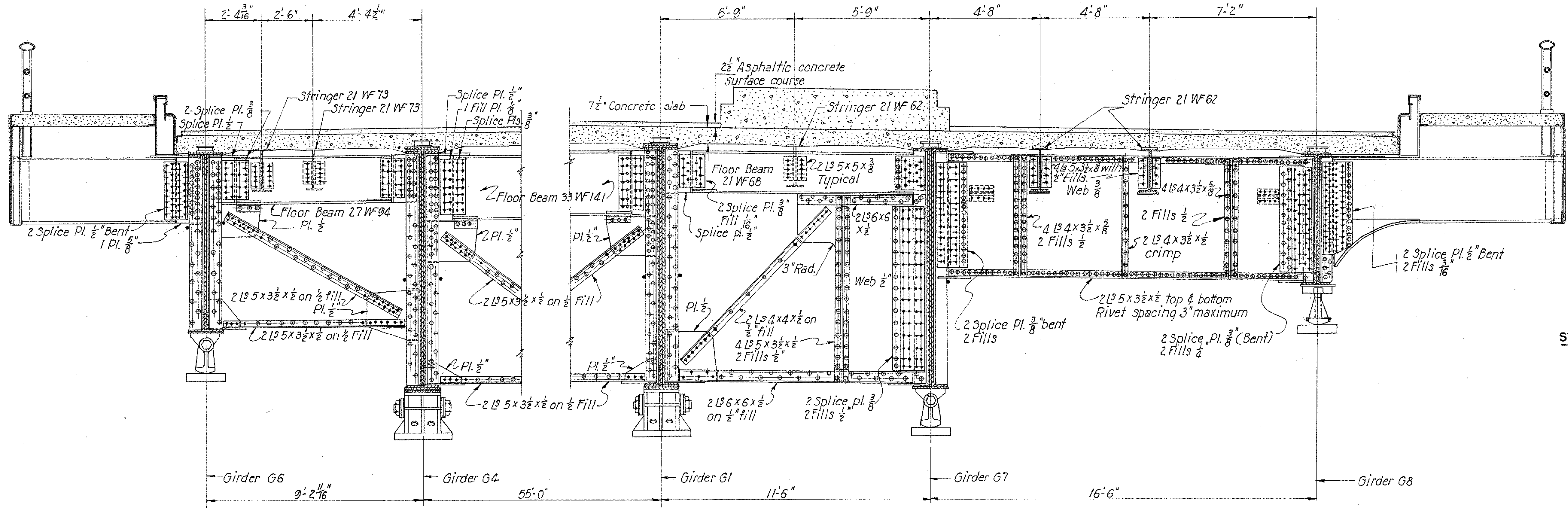
SCALE 1/16" = 1'-0"
MADE BGW DATE 8-19-52
TRCD EJM KLG DATE 4-16-53
CKD A.H.S. DATE 9-11-53

HOWARD, N
KANSA

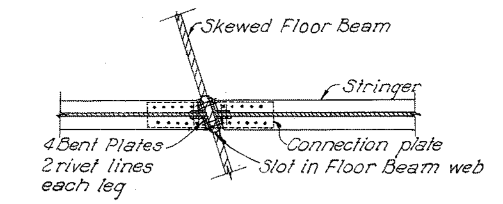
805

FED. ROAD DIV. NO	STATE	FED. AID PROJ. NO.
2	OHIO	UI-1052(

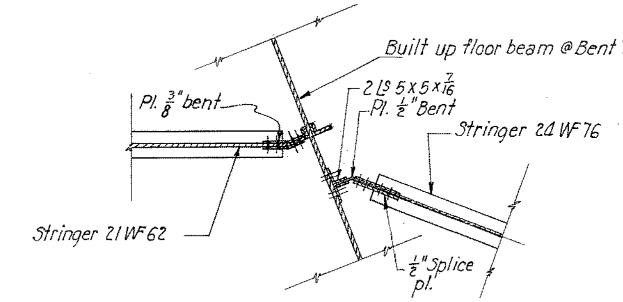
LUCAS CO
CITY OF TO
TOLEDO EXPRESSW
MAUMEE RIVER
LUC 120R-



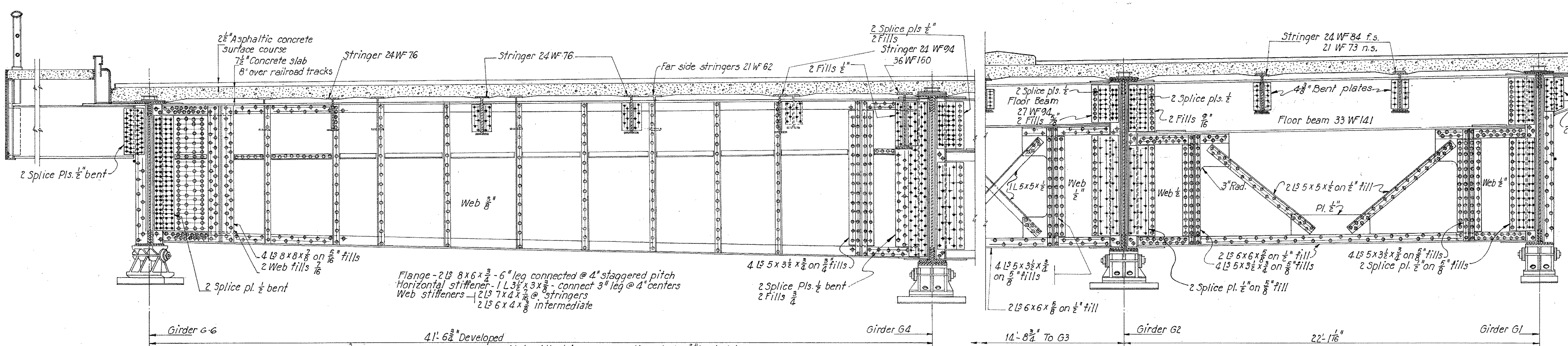
PART CROSS SECTION PIER 6 LOOKING SOUTH



STRINGER CONNECTION AT SKEWED FLOOR BEAM



DETAIL SHOWING BENT STRINGER CONNECTIONS

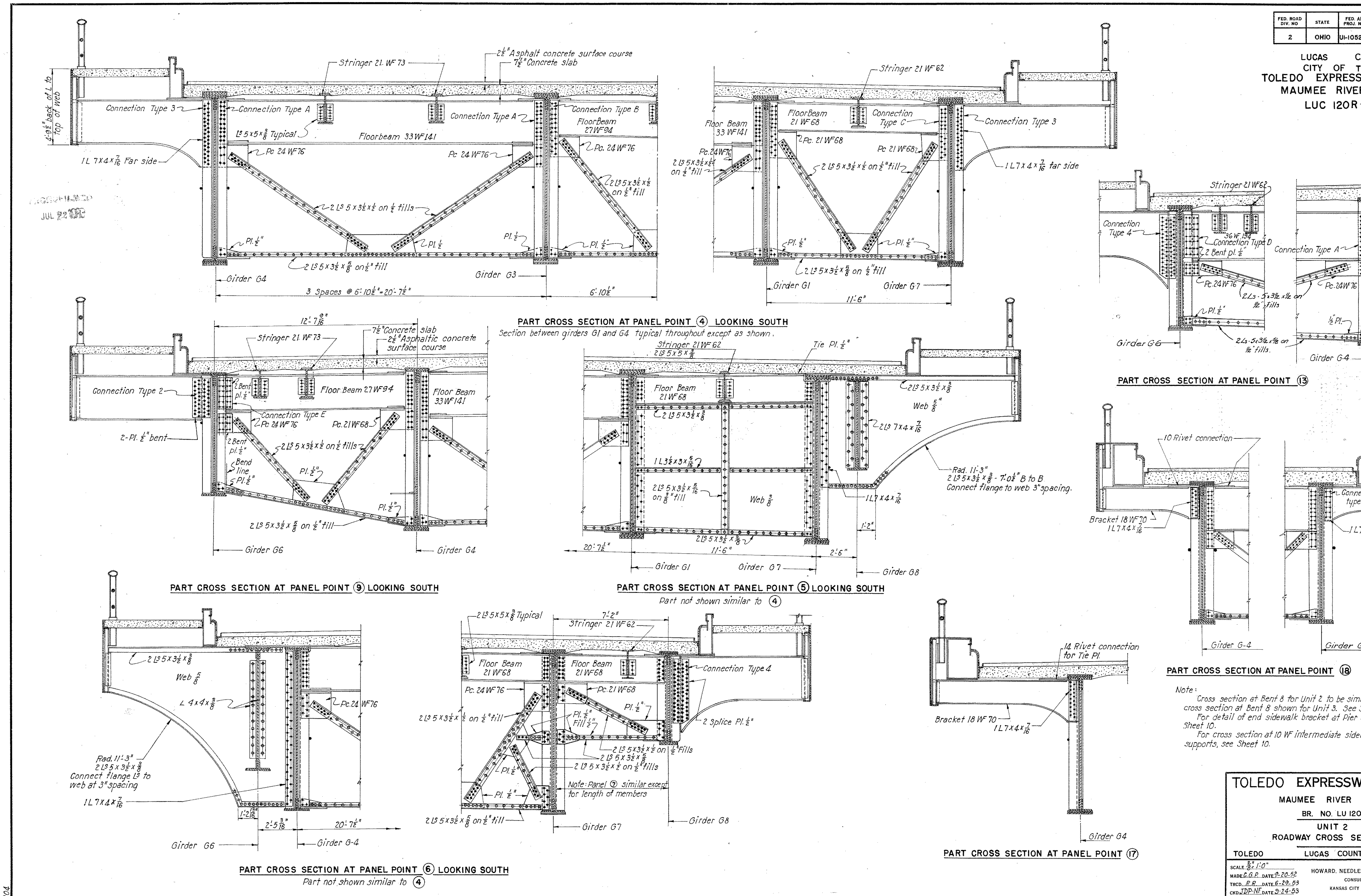


PART CROSS SECTION BENT 7 LOOKING SOUTH

TOLEDO EXPRESSWA
MAUMEE RIVER
BR. NO. LU 120R
UNIT 2
ROADWAY CROSS SEC
TOLEDO LUCAS COUNTY

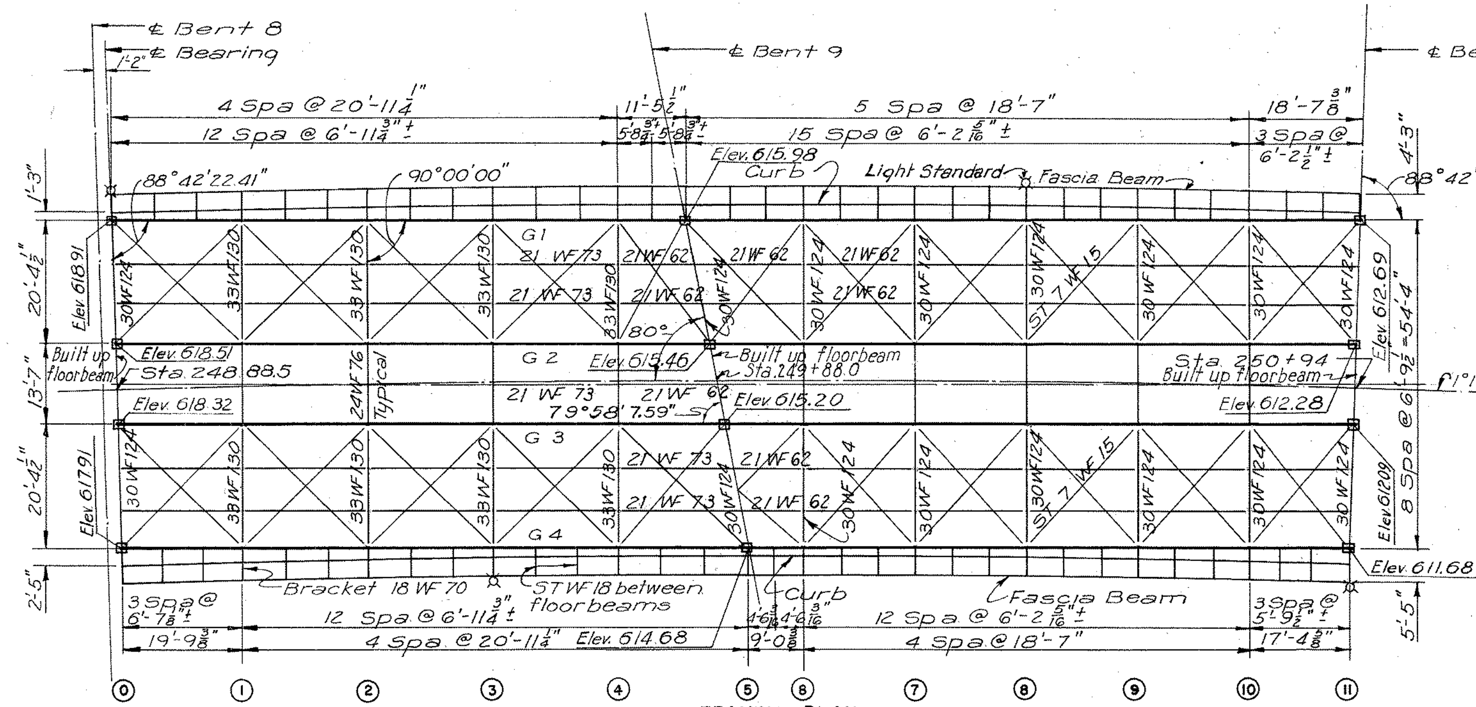
SCALE 3/8" = 1'-0"
MADE G.G.P. DATE 10-16-52
TRCD. R.R. DATE 7.14.53
CKD. JDP-NF DATE 9-15-53

HOWARD, NEEDLES,
CONSULT
KANSAS CITY

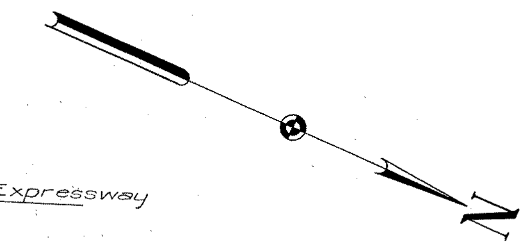

FED. ROAD DIV. NO | STATE | FED. AID PROJ. NO
2 | OHIO | UI-1052
LUCAS
CITY OF
TOLEDO EXPRESS
MAUMEE RIVER
LUC 120R
2½" Asphalt concrete surface course
7½" Concrete slab
Stringer 21 WF 73
Connection Type 3
Connection Type A
Connection Type B
Floorbeam 27WF94
Floorbeam 33WF141
L^s 5×5×⅜ Typical
Pc 24 WF 76
1 L 7×4×7/16 Far side
2 L^s 5×3½×½ on ½ fills
2 L^s 5×3½×⅝ on ½" fill
Pl. ½"
Girder G4
Girder G3
3 Spaces @ 6'-10½" = 20'-7½"
6'-10½"
Stringer 21 WF 62
Floor Beam 33 WF141
FloorBeam 21 WF 68
Connection Type C
Pc. 21 WF68
2 L^s 5×3½×½ on ½" fill
Girder G1
Girder G7
11'-6"
PART CROSS SECTION AT PANEL POINT ④ LOOKING SOUTH
Section between girders G1 and G4 typical throughout except as shown.
Connection Type 4
36 WF 194
Connection Type D
2 Bent pl. ½"
2 Ls 5×3½×½ on ½" fills
Girder G6
Girder G-4
PART CROSS SECTION AT PANEL POINT ⑬
12'-7 9/16"
7½" Concrete slab
2½" Asphaltic concrete surface course
Stringer 21 WF 73
Connection Type 2
2 Bent pl. ½"
Floor Beam 27 WF94
Floor Beam 33 WF141
Connection Type E
Pc 24 WF 76
Pc. 21 WF68
2-Pl. ½" bent
Bend line
2 L^s 5×3½×½ on ½" fills
2 L^s 5×3½×⅝ on ½" fill
Girder G6
Girder G4
PART CROSS SECTION AT PANEL POINT ⑨ LOOKING SOUTH
Stringer 21 WF 62
2 L^s 5×5×⅜
Tie Pl. ½"
Floor Beam 21 WF 68
2 L^s 5×3½×⅜
2 L^s 7×4×7/16
Web ⅝"
1 L 3½×3×5/16
2 L^s 5×3½×5/16 on ⅜" fill
Web ⅜
Rad. 11'-3"
2 L^s 5×3½×⅜ - 7'-0½" B to B
Connect flange to web 3" spacing.
1 L 7×4×7/16
1'-2"
20'-7½"
11'-6"
2'-6"
Girder G1
Girder G7
Girder G8
PART CROSS SECTION AT PANEL POINT ⑤ LOOKING SOUTH
Part not shown similar to ④
10 Rivet connection
Bracket 18 WF 70
1 L 7×4×7/16
Girder G-4
PART CROSS SECTION AT PANEL POINT ⑱
2 L^s 5×3½×⅜
Web ⅝
L 4×4×⅜
Pc. 24 WF76
Rad. 11'-3"
2 L^s 5×3½×⅜
Connect flange L^s to web at 3" spacing
1 L 7×4×7/16
1'-2 7/16
2'-5 3/4"
20'-7½"
Girder G6
Girder G-4
PART CROSS SECTION AT PANEL POINT ⑥ LOOKING SOUTH
Part not shown similar to ④
2 L^s 5×5×⅜ Typical
7'-2"
Stringer 21 WF 62
Floor Beam 21 WF68
Connection Type 4
Pc. 24 WF 76
Pc. 21 WF68
2 L^s 5×3½×½ on ½" fill
Pl. ½" Fill ½"
2 Splice Pl. ½"
2 L^s 5×3½×½ on ½" Fills
2 L^s 5×3½×⅝
2 L^s 5×3½×½ on ½" fills
Note: Panel ⑦ similar except for length of members
2 L^s 5×3½×⅝ on ½" fill
Girder G7
Girder G8
14 Rivet connection for Tie Pl.
Bracket 18 WF 70
1 L 7×4×7/16
Girder G4
PART CROSS SECTION AT PANEL POINT ⑰
Note:
Cross section at Bent 8 for Unit 2 to be sim... cross section at Bent 8 shown for Unit 3. See S...
For detail of end sidewalk bracket at Pier ... Sheet 10.
For cross section at 10 WF intermediate side... supports, see Sheet 10.
TOLEDO EXPRESSW...
MAUMEE RIVER
BR. NO. LU 120...
UNIT 2
ROADWAY CROSS SE...
TOLEDO
LUCAS COUNT...
SCALE ⅜" = 1'-0"
MADE G.G.P. DATE 9-20-52
TRCD. R.R. DATE 6-29-53
CKD. JDP-NF DATE 9-24-53
HOWARD, NEEDLE...
CONSU...
KANSAS CITY

FED. ROAD DIV. NO.	STATE	F… PR…
2	OHIO	UI-…

LUCAS
CITY OF
TOLEDO EXPRES…
MAUMEE RIV…
LUC 120…

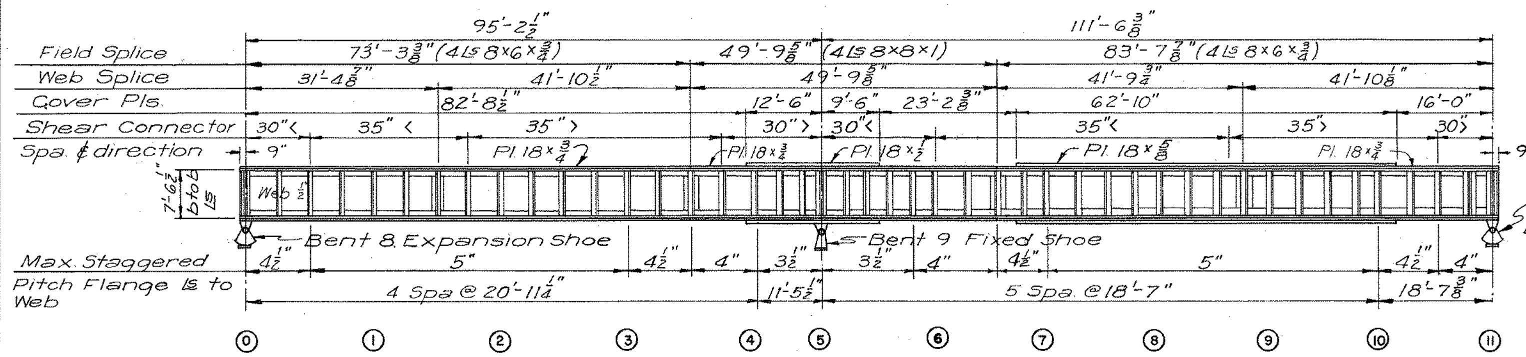


FRAMING PLAN

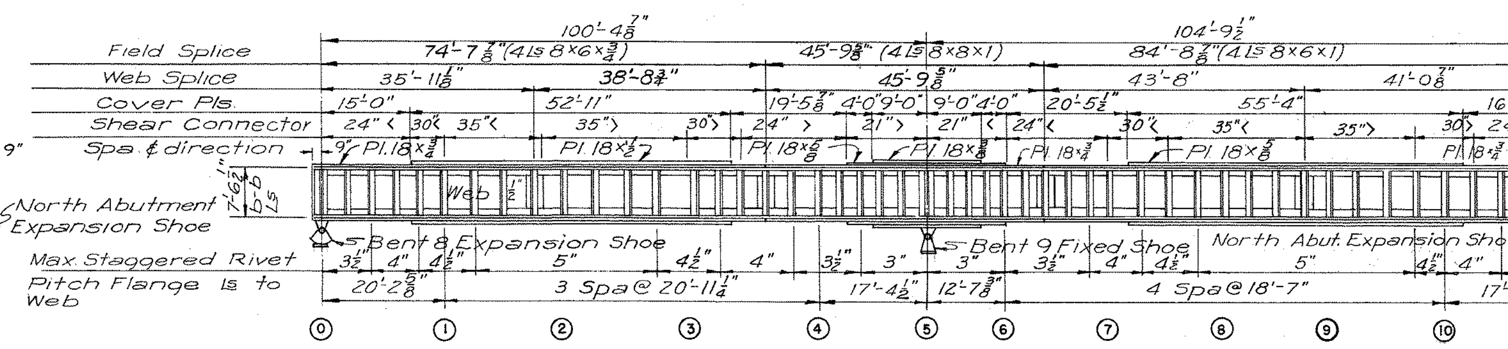


Note:
All dimensions are normal to girders except as shown.
Elevations given on framing plan are to back of top flange angles.
In general, angles and other shapes will not be bent to make skewed connections.

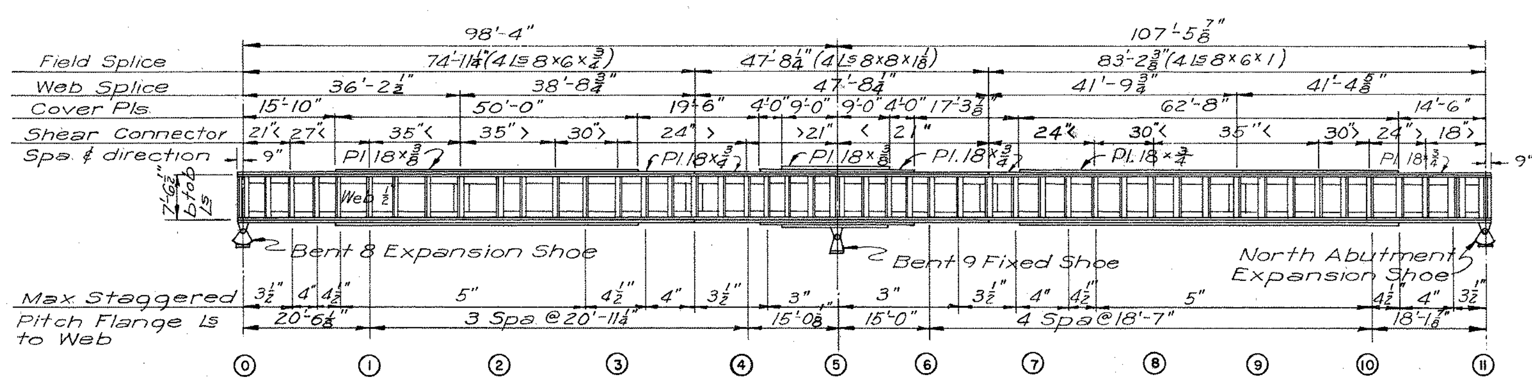
SCHEDULE OF STIFFENER ANGLES		
	G1 & 4	G2 & 3
Intermediate	2 Ls 5×3½×5/16	2 Ls 5×3½×5/16
Floorbeams	2 Ls 7×4×7/16	2 Ls 7×4×7/16
Brg. @ Pier No. 8	4 Ls 7×4×7/16	4 Ls 7×4×½
Brg. @ Pier No. 9	4 Ls 7×4×¾	4 Ls 7×4×1
Brg. @ North Abut.	4 Ls 7×4×7/16	4 Ls 7×4×9/16
Jacking @ North Abut.	4 Ls 7×4×7/16	4 Ls 7×4×7/16



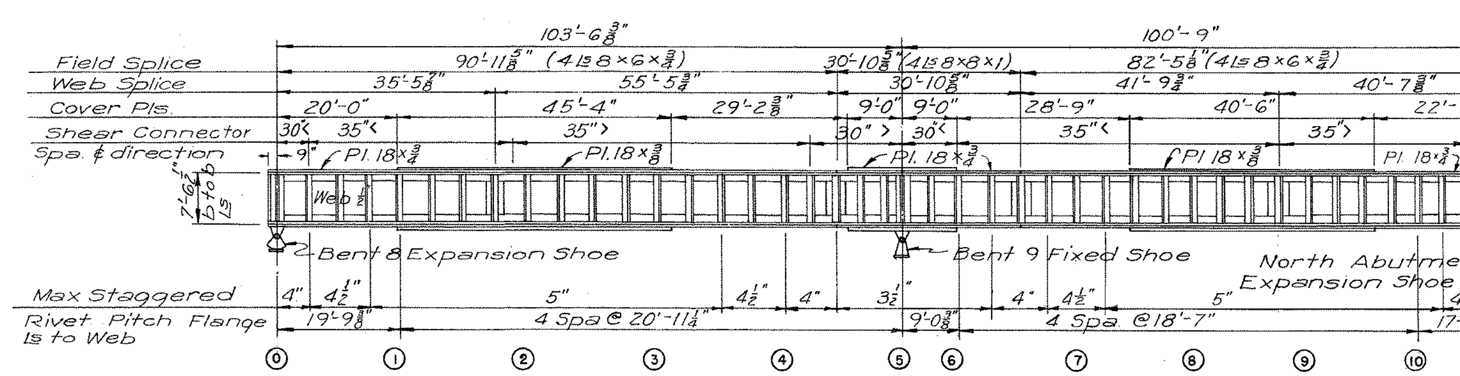
EXTERIOR GIRDER G1



INTERIOR GIRDER G3



INTERIOR GIRDER G2



EXTERIOR GIRDER G4

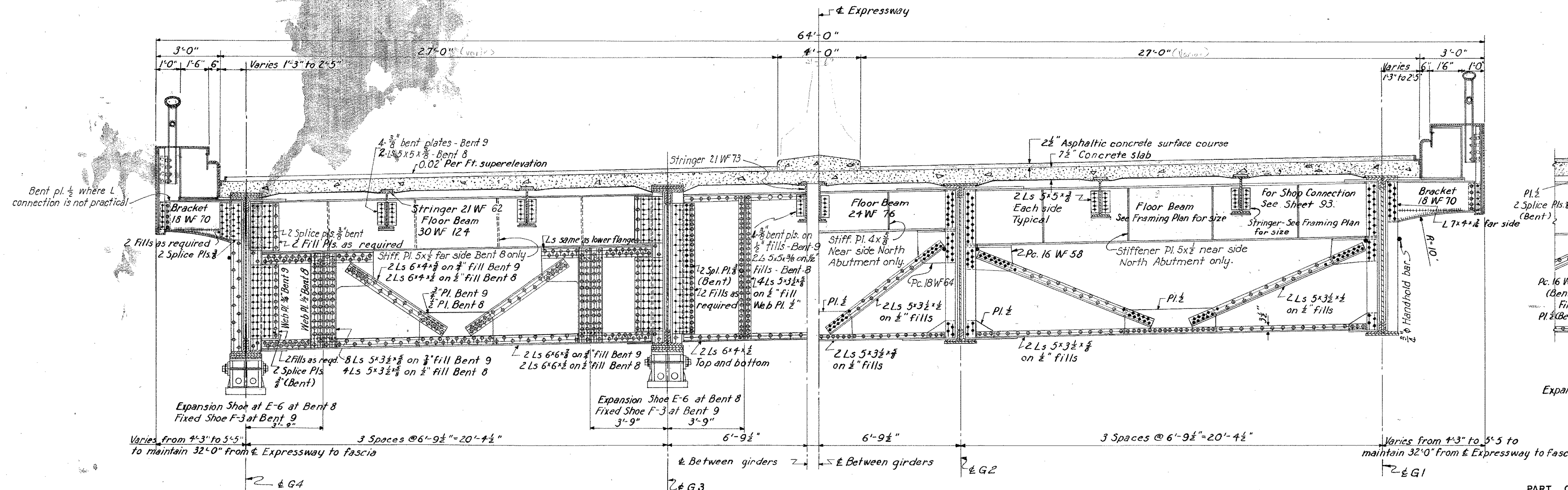
Notes:
All material shall be carbon steel.
All rivets shall be ⅞" ⌀.
See General Notes Sheet 14.

TOLEDO EXPRESS…
MAUMEE RIVE…
BR. NO. LU…
UNIT 3…
STEEL FRAMING PLAN & G…
TOLEDO LUCAS CO…

SCALE 1/16" = 1'-0"
MADE JHG DATE 4-29-52
TRCD JHG DATE 5-8-52
CKD DME, AHS. DATE 7-6-53
HOWARD, NEE…
CO…
KANSAS C…

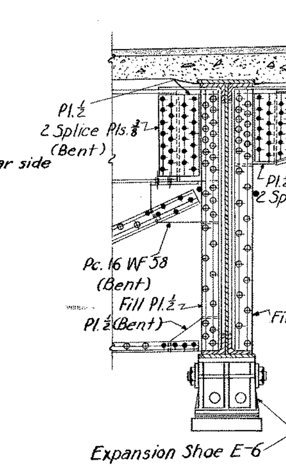
FED. ROAD DIV. NO.	STATE
2	OHIO

LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE R
LUC. 12



HALF CROSS SECTION AT BENT 9
Cross section at Bent 8 similar except as noted

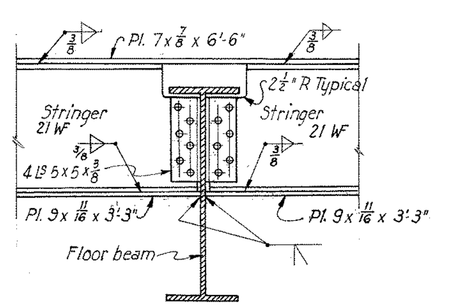
HALF CROSS SECTION AT INTERMEDIATE FLOOR BEAMS
Cross section at North Abutment similar except as shown



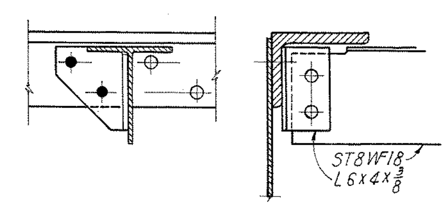
PART CROSS SECTION

AT NORTH ABUTMENT

Note:
At handrail posts between ... use ST8WF 18 strut to support ... See Unit 1 Cross Sections for ... details.
Closed curb is required e... of Unit 3.
For typical connection det... supports between floor beams,...



STRINGER CONNECTION
Scale: ¾"=1'-0"

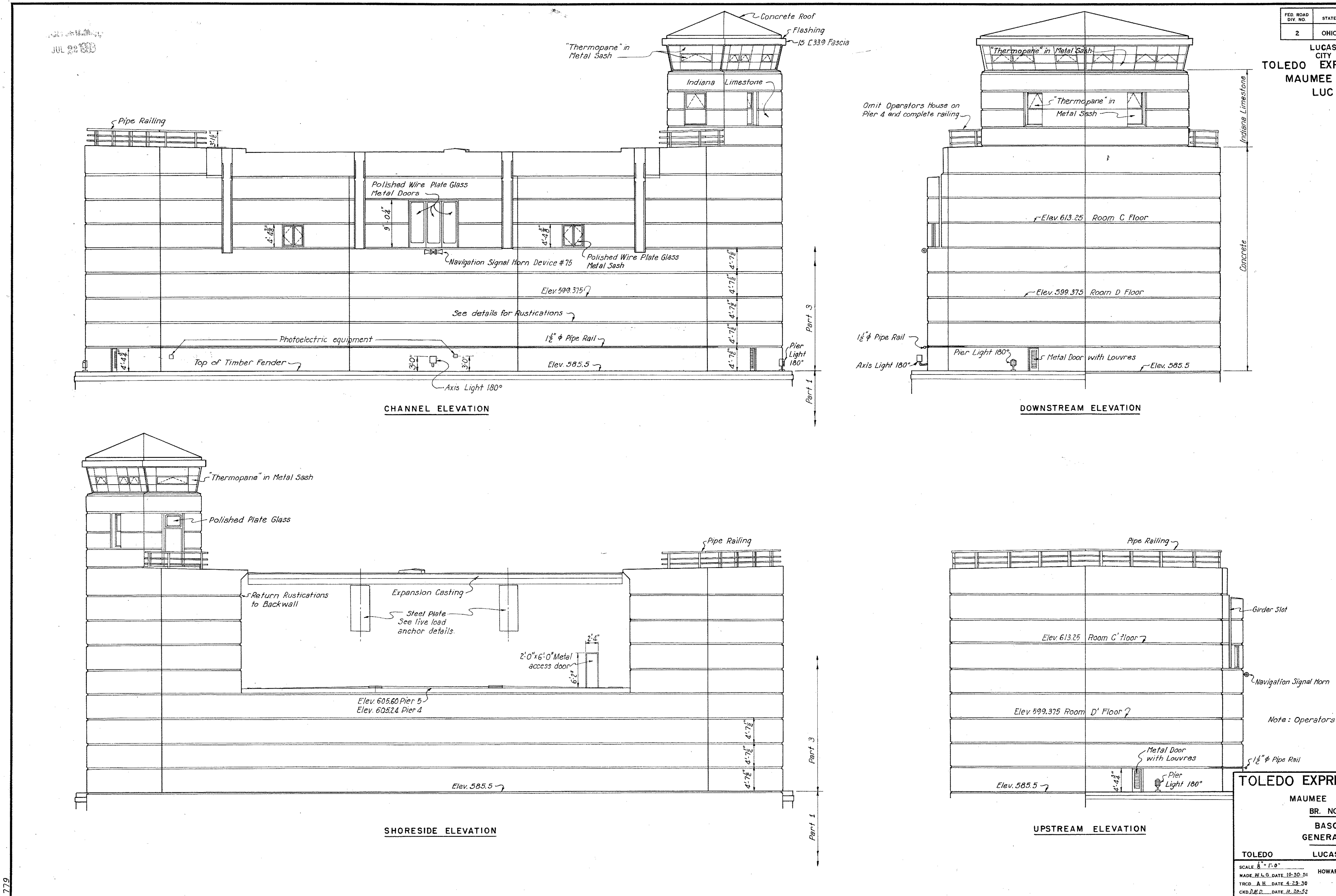


SIDEWALK SUPPORT CONNECTION
TO 8"X 6" FLANGE ANGLE
Scale: 1½"=1'-0"

TOLEDO EXPRES...
MAUMEE RIV...
BR. NO. L...
UNIT ...
ROADWAY CROSS...
TOLEDO LUCAS C...

SCALE ¾"=1'-0"
MADE G.D. DATE 4-10-52
TRCD. N.A.M. DATE 10-6-52
CKD. I.P.S./B.E.B. DATE 12-9-53
HOWARD, N...
KANSA...

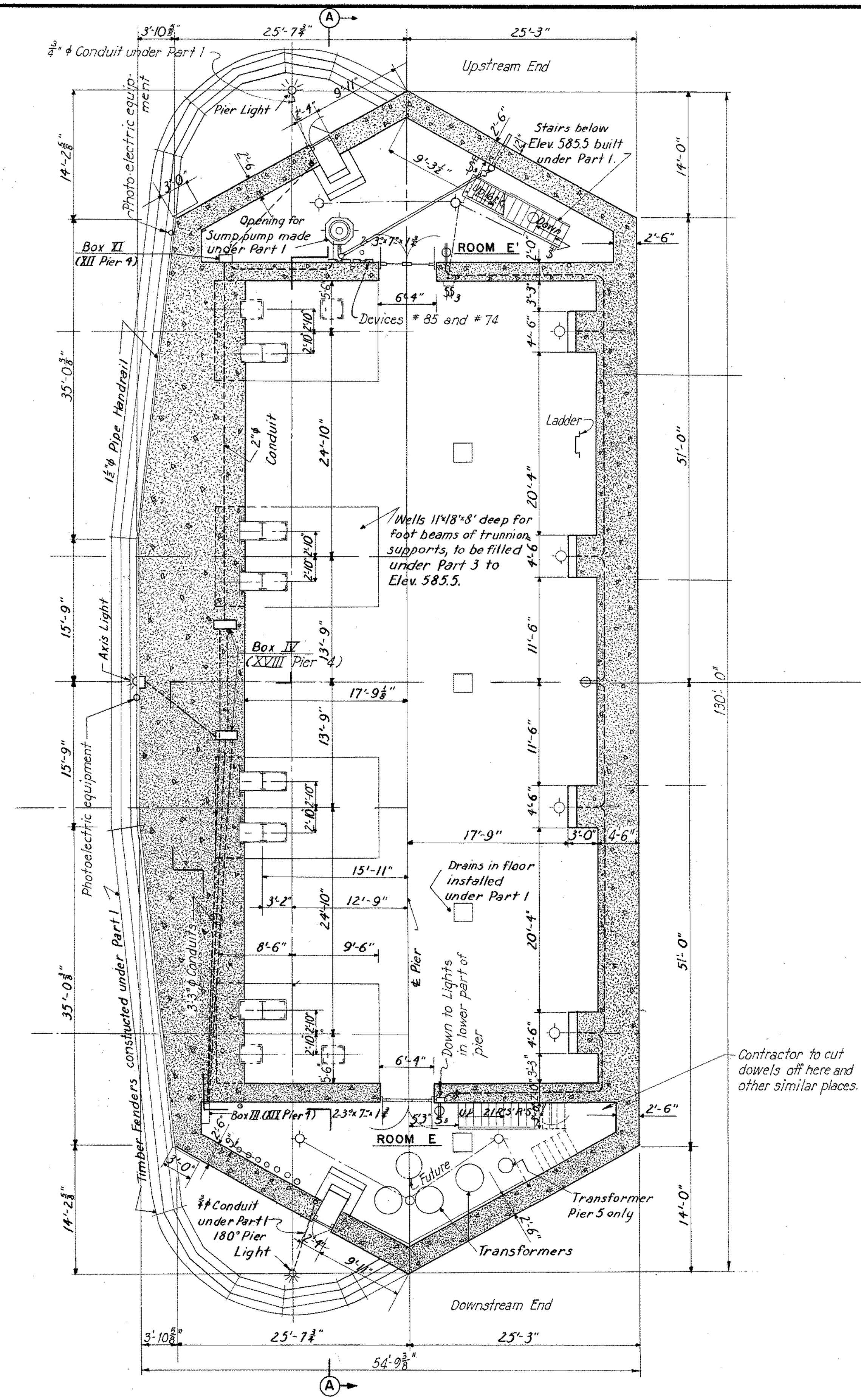
830



JUL 22 1953
FED. ROAD DIV. NO.
STATE
2
OHIO
LUCAS
CITY
TOLEDO EXP
MAUMEE
LUC
Concrete Roof
Flashing
15 [33.9 Fascia
"Thermopane" in Metal Sash
Indiana Limestone
Pipe Railing
3'-1½"
Polished Wire Plate Glass Metal Doors
9'-0¾"
4'-4⅜"
Navigation Signal Horn Device #75
Polished Wire Plate Glass Metal Sash
Elev. 599.375
See details for Rustications
Photoelectric equipment
1½" φ Pipe Rail
Top of Timber Fender
Elev. 585.5
3'-0"
Axis Light 180°
4'-7½"
4'-4⅜"
Pier Light 180°
Part 3
Part 1
CHANNEL ELEVATION
Omit Operators House on Pier 4 and complete railing
"Thermopane" in Metal Sash
"Thermopane" in Metal Sash
Indiana Limestone
Concrete
Elev. 613.25 Room C Floor
Elev. 599.375 Room D Floor
1½" φ Pipe Rail
Pier Light 180°
Metal Door with Louvres
Axis Light 180°
Elev. 585.5
DOWNSTREAM ELEVATION
"Thermopane" in Metal Sash
Polished Plate Glass
Pipe Railing
Return Rustications to Backwall
Expansion Casting
Steel Plate See live load anchor details
2'-4"
2'-0"x6'-0" Metal access door
6'-2"
Elev. 605.60 Pier 5
Elev. 605.24 Pier 4
4'-7½"
Elev. 585.5
Part 3
Part 1
SHORESIDE ELEVATION
Pipe Railing
Girder Slot
Elev. 613.25 Room C' Floor
Navigation Signal Horn
Elev. 599.375 Room D' Floor
Note: Operators
Metal Door with Louvres
1½" φ Pipe Rail
Elev. 585.5
4'-4⅜"
Pier Light 180°
UPSTREAM ELEVATION
TOLEDO EXPR
MAUMEE
BR. NO
BASC
GENERA
TOLEDO
LUCAS
SCALE ⅛" = 1'-0"
MADE W.L.G. DATE 10-30-51
TRCD. A.H. DATE 4-29-30
CKD. D.M.D. DATE 10-30-52
HOWAR
779

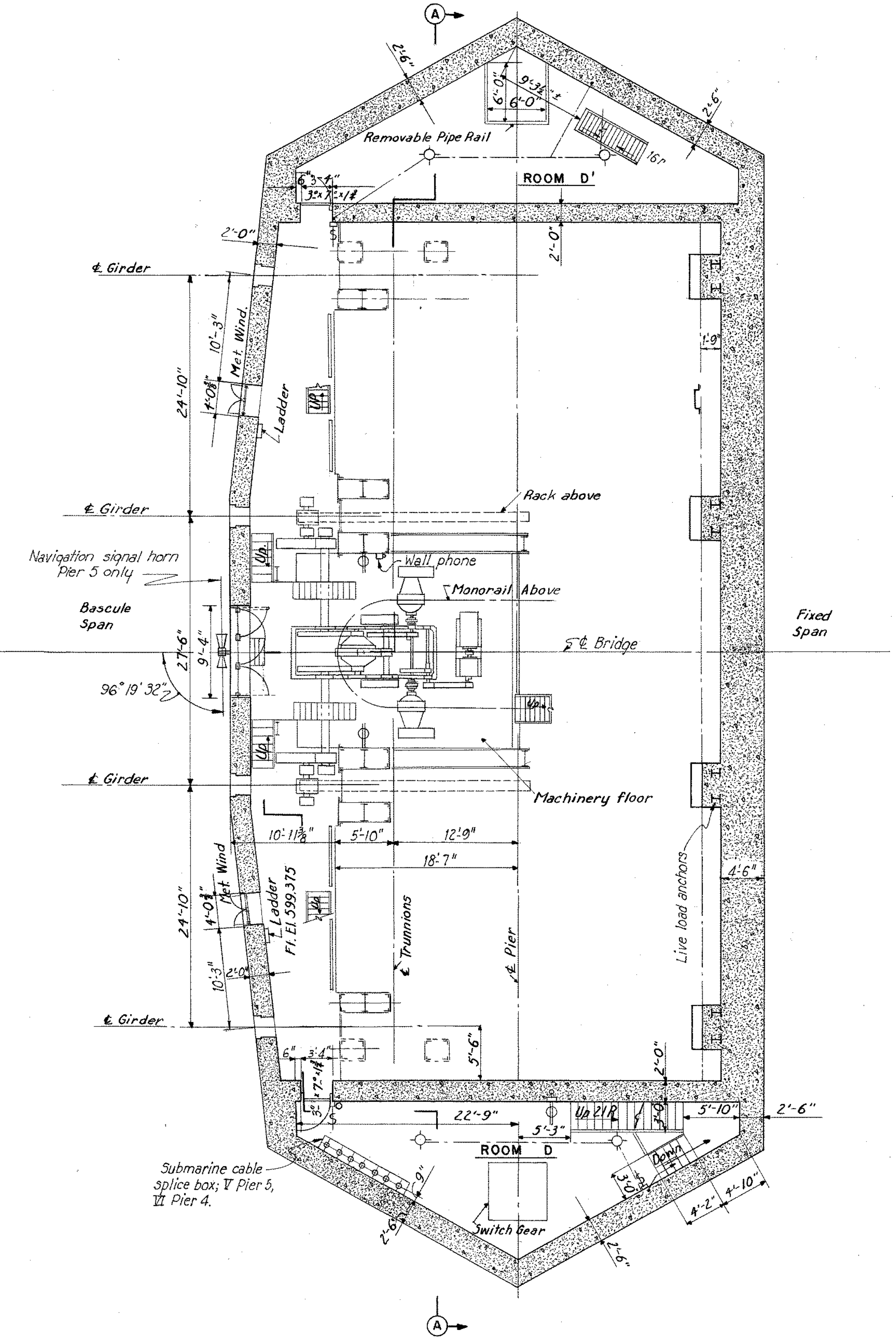
FED. ROAD DIV. NO.	STATE
2	OHIO

LUC
CITY O
TOLEDO EXPR
MAUMEE R
LUC



PLAN AT BOTTOM OF COUNTERWEIGHT PIT

Elev. 585.5



PLAN AT MACHINERY FLOOR

Machinery floor Elev. 604.23
Room D floor Elev. 599.375

See sheet 53 for Section A-A

TOLEDO EXPRES
MAUMEE RIV
BR. NO.
BASCULE
GENERAL
TOLEDO LUCAS

SCALE ⅛" = 1'-0"
MADE W.L.G. DATE 1-24-52
TRCD N.A.M. DATE 10-9-52
CKD D.M.D. DATE 10-20-52
HOWARD,
KA

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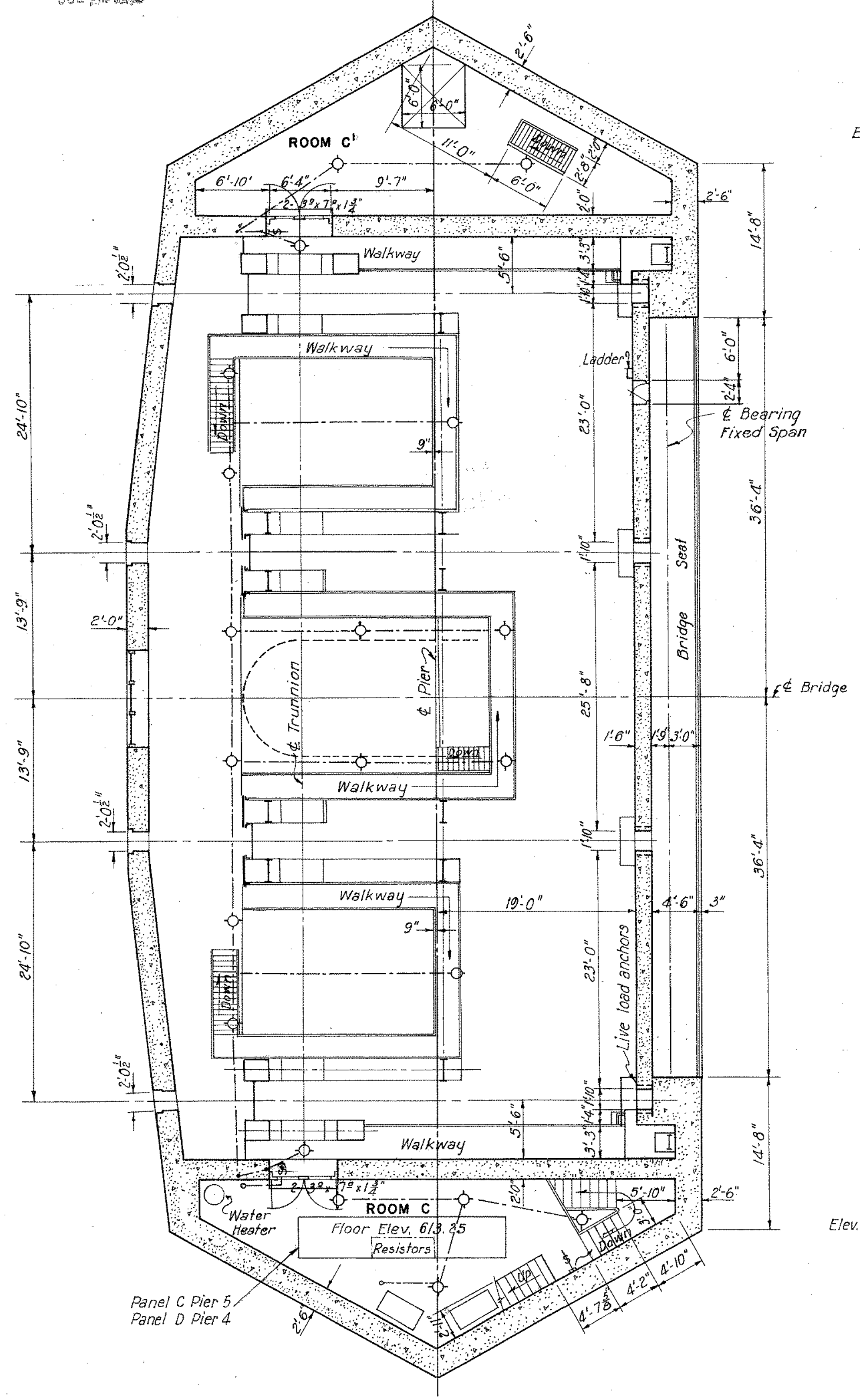
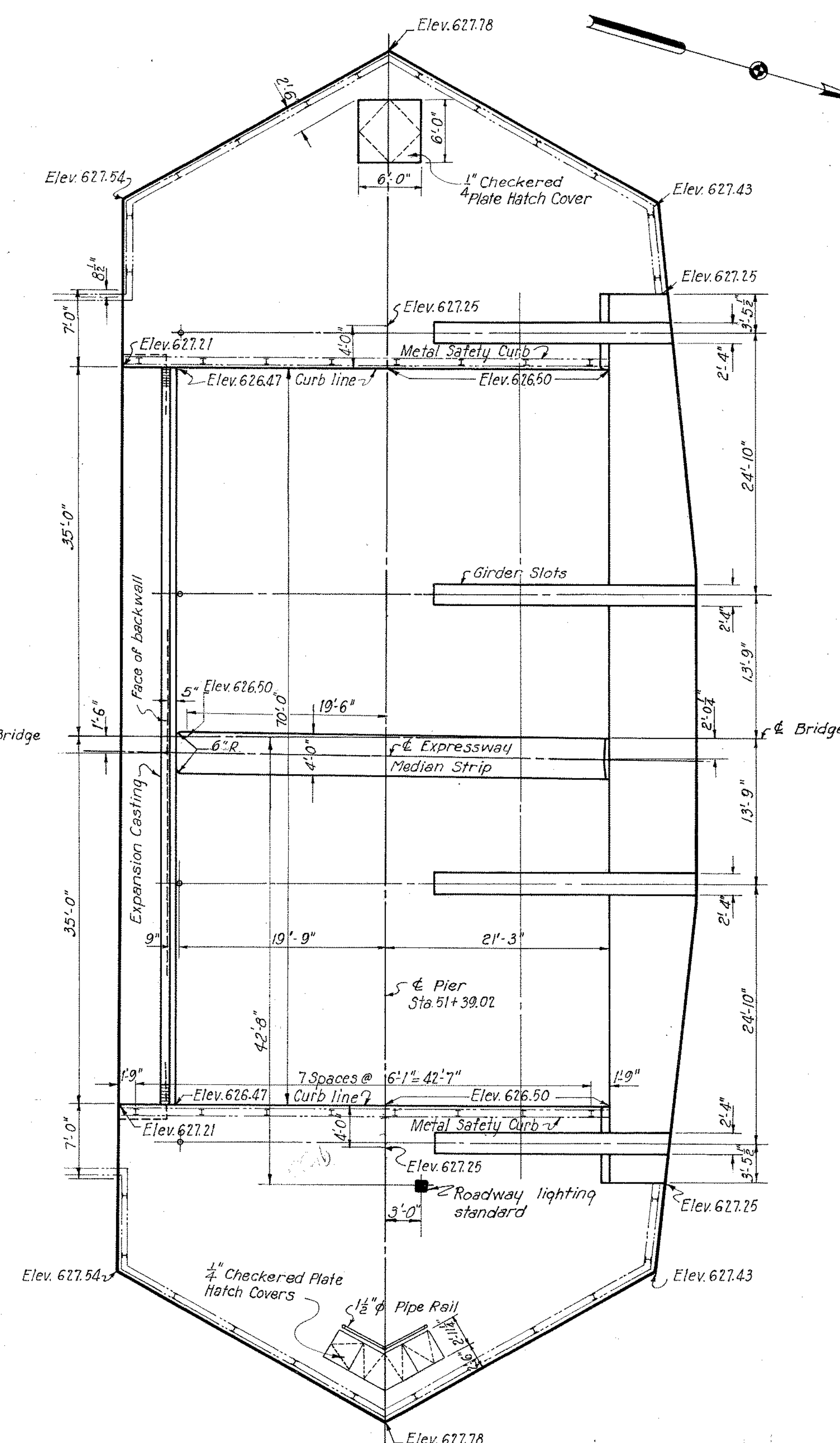
LUCAS
CITY
TOLEDO EXP
MAUMEE
LUC

Note: Except as no
shown are typ
Bascule Piers.

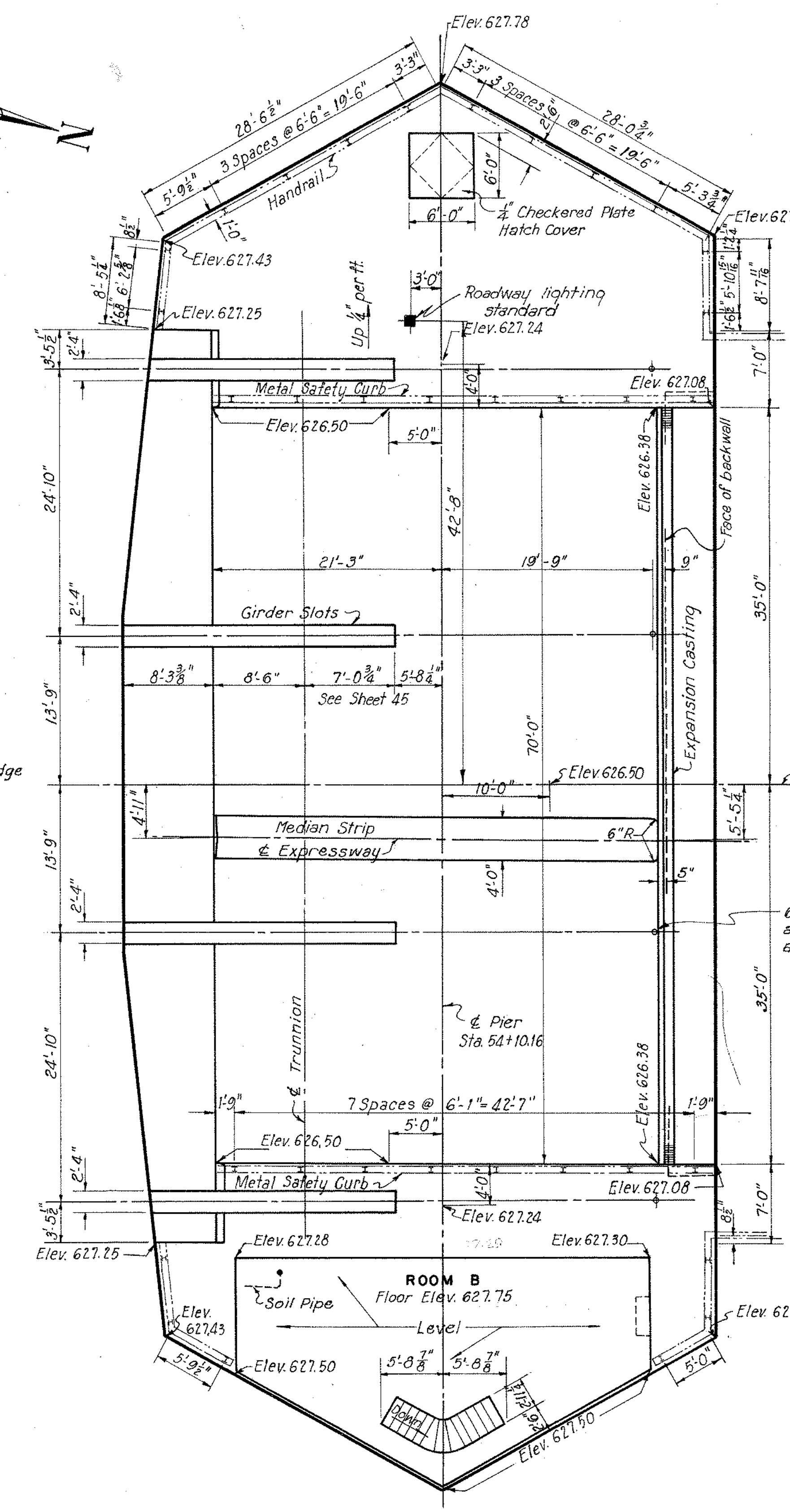


PLAN AT UPPER WALKWAYS

Walkways Elev. 615.00
Rooms C & C' Elev. 613.25



PIER 4



PIER 5

PLAN AT ROADWAY LEVEL

Elevation 626.5

TOLEDO EXPRE

MAUMEE R

BR. NO.

BASCU

GENERA

TOLEDO LUCAS

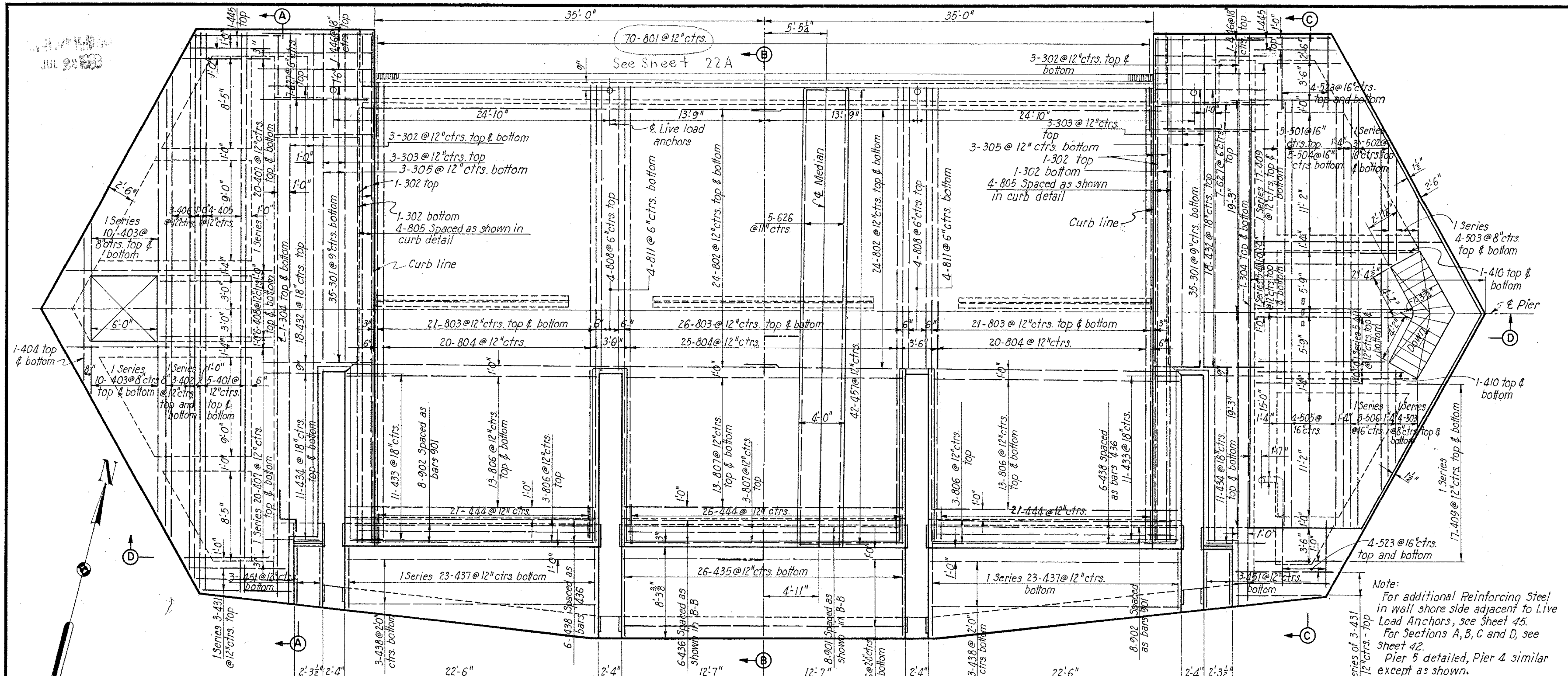
SCALE 1/8" = 1'-0"
MADE W.I.G. DATE 11-3-51
TRCD A.H. DATE 5-23-52
CKD D.M.D. DATE 10-20-52

HOWARD

781

FED. ROAD DIV. NO.	STATE
2	OHIO

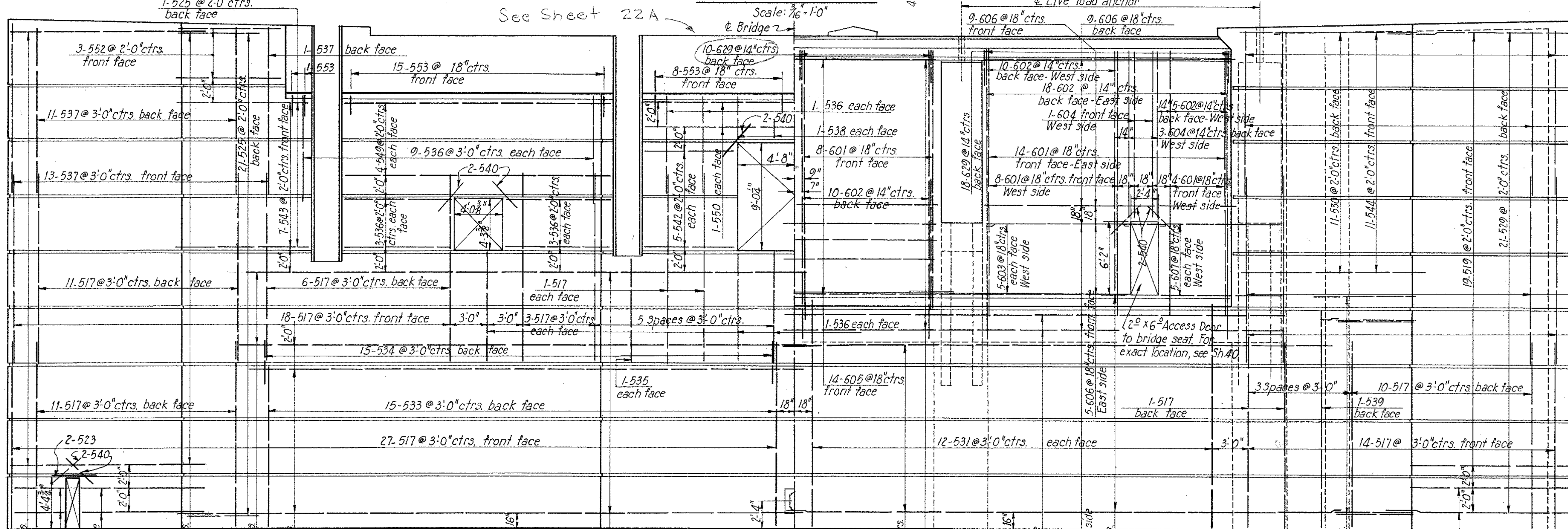
LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC 12



PLAN AT ROADWAY LEVEL

Scale: $\frac{3}{16}$" = 1'-0"

Note:
For additional Reinforcing Steel in wall shore side adjacent to Live Load Anchors, see Sheet 45.
For Sections A, B, C and D, see Sheet 42.
Pier 5 detailed, Pier 4 similar except as shown.

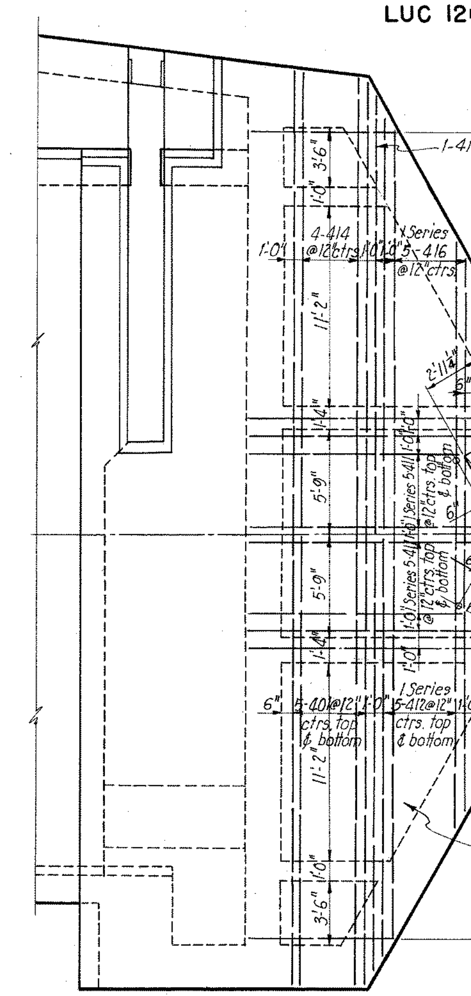


HALF ELEVATION CHANNEL SIDE

WALL REINFORCING

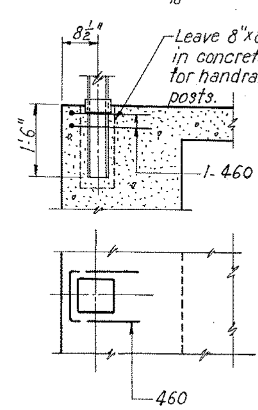
Scale: $\frac{3}{16}$" = 1'-0"

HALF ELEVATION SHORE SIDE

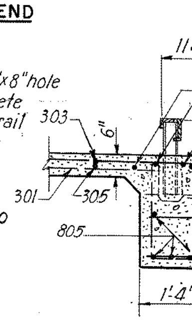


PIER 4 - EAST END

Scale: $\frac{3}{16}$" = 1'-0"



REINFORCING STEEL AT HANDRAIL POST



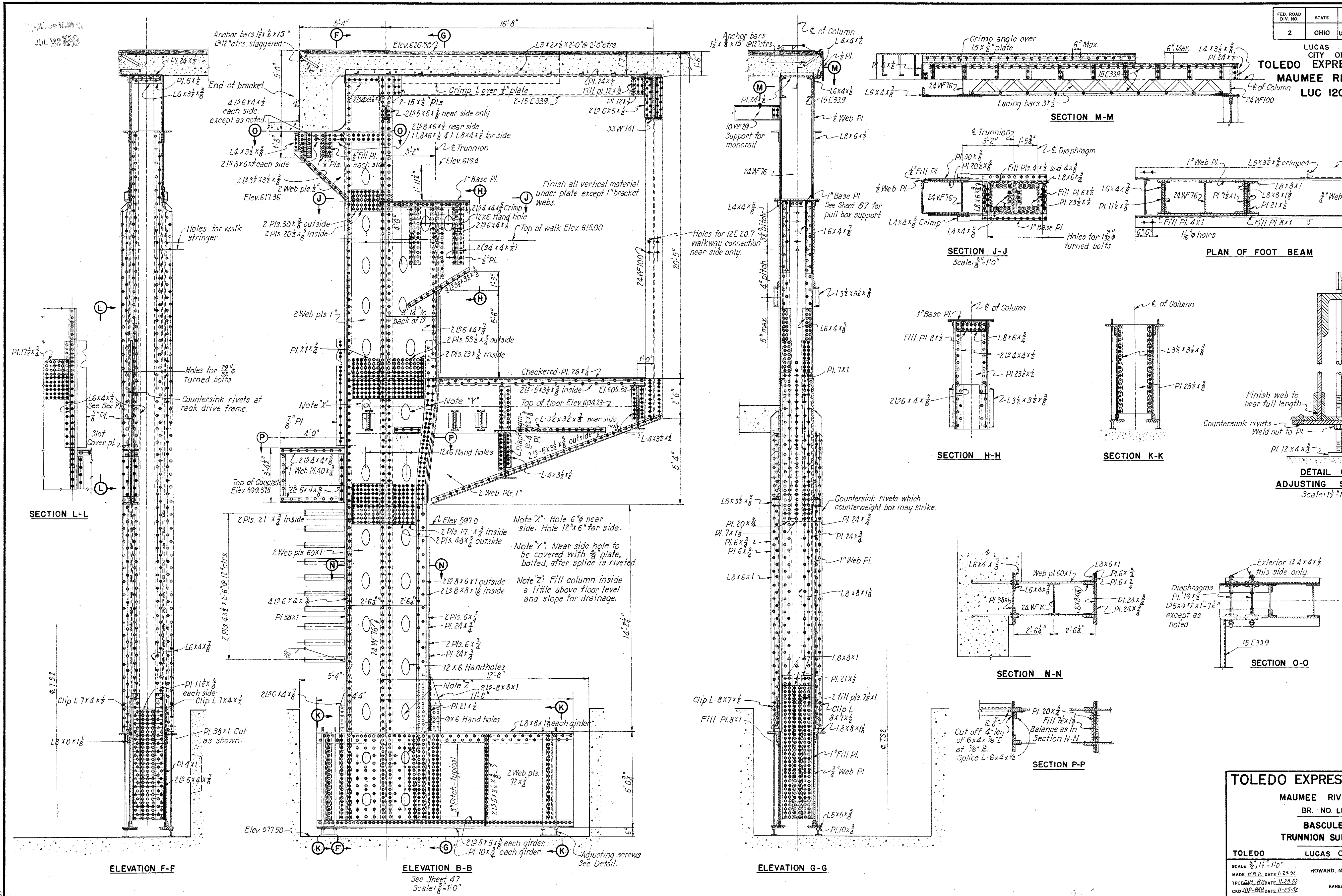
CURB D

Scale: 1'

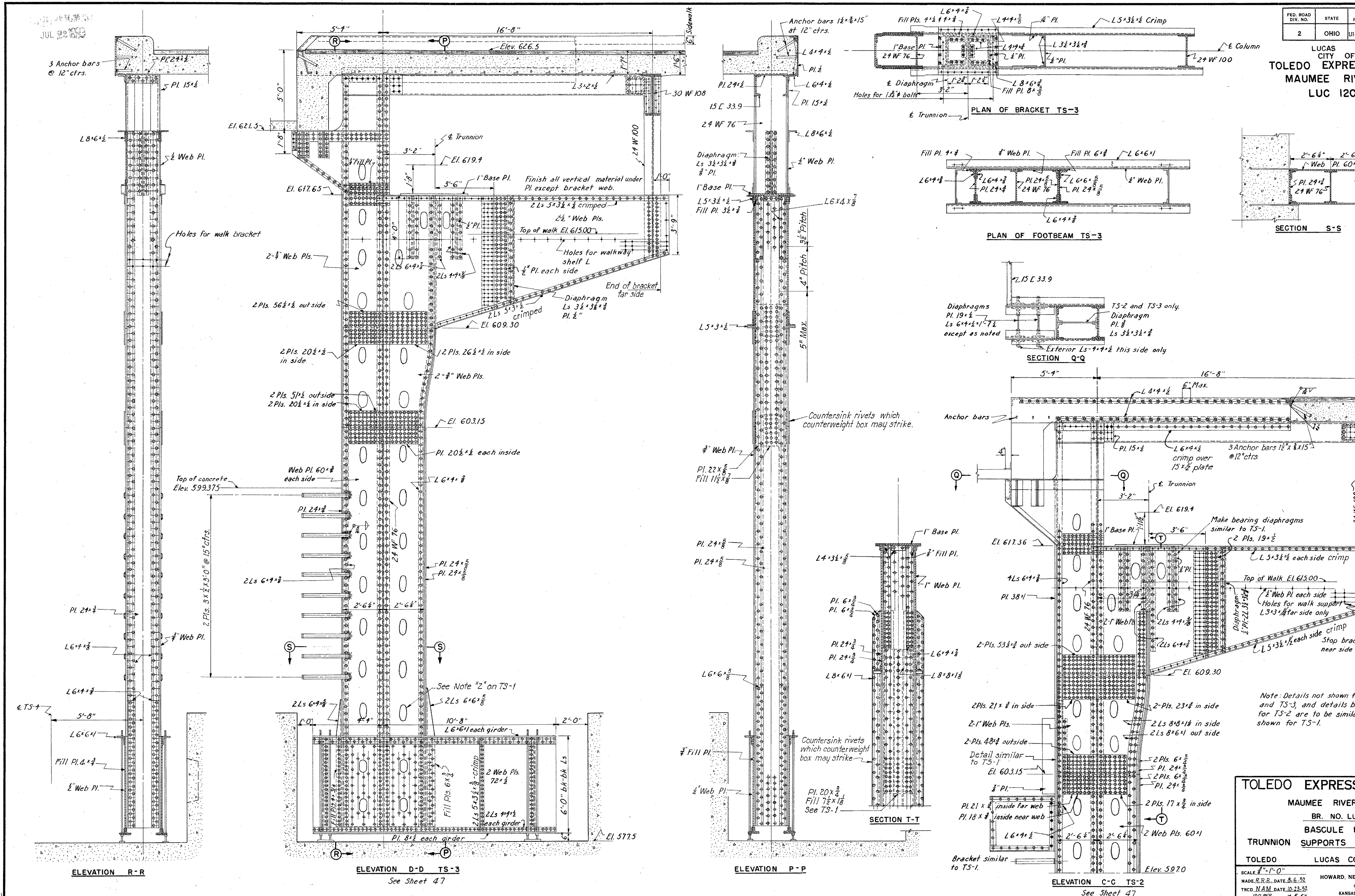
Pencil Rev

TOLEDO EXPRES
MAUMEE RIV
BR. NO. 12
BASCULE
CONCRETE
TOLEDO LUCAS C

SCALE $\frac{3}{16}$" = 1'-0"
MADE W.L.G. DATE 8-29-52
TRCD R.R. DATE 11-8-52
CKD MKA-THE DATE 4-15-53
HOWARD, N
KANS



FED. ROAD DIV. NO.
STATE
2
OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 120
SECTION M-M
SECTION J-J
Scale: $\frac{3}{8}$" = 1'-0"
PLAN OF FOOT BEAM
SECTION H-H
SECTION K-K
DETAIL
ADJUSTING
SECTION L-L
SECTION N-N
SECTION P-P
SECTION O-O
ELEVATION F-F
ELEVATION B-B
See Sheet 47
Scale: $\frac{3}{8}$" = 1'-0"
ELEVATION G-G
Finish all vertical material under plate except 1" bracket webs.
Note "X": Hole 6"φ near side. Hole 12"x6" far side.
Note "Y": Near side hole to be covered with $\frac{3}{8}$" plate, bolted, after splice is riveted.
Note "Z": Fill column inside a little above floor level and slope for drainage.
Countersink rivets which counterweight box may strike.
Anchor bars $1\frac{1}{2}$" x $\frac{3}{8}$" x 15" @ 12" ctrs. staggered
Holes for walk stringer
Countersink rivets at rack drive frame.
Checkered Pl. 26 x $\frac{1}{4}$
Top of floor Elev. 604.23
Top of walk Elev. 615.00
Elev. 626.50
Elev. 597.0
Elev. 577.50
Adjusting screws See Detail.
TOLEDO EXPRES
MAUMEE RIV
BR. NO. L
BASCULE
TRUNNION SU
TOLEDO
LUCAS C
SCALE $\frac{3}{8}$", $1\frac{1}{2}$" = 1'-0"
MADE R.R.R. DATE 1-23-52
TRCD GJM, RR DATE 11-25-52
CKD JDP-BKH DATE 11-25-52
HOWARD, N
KANSA

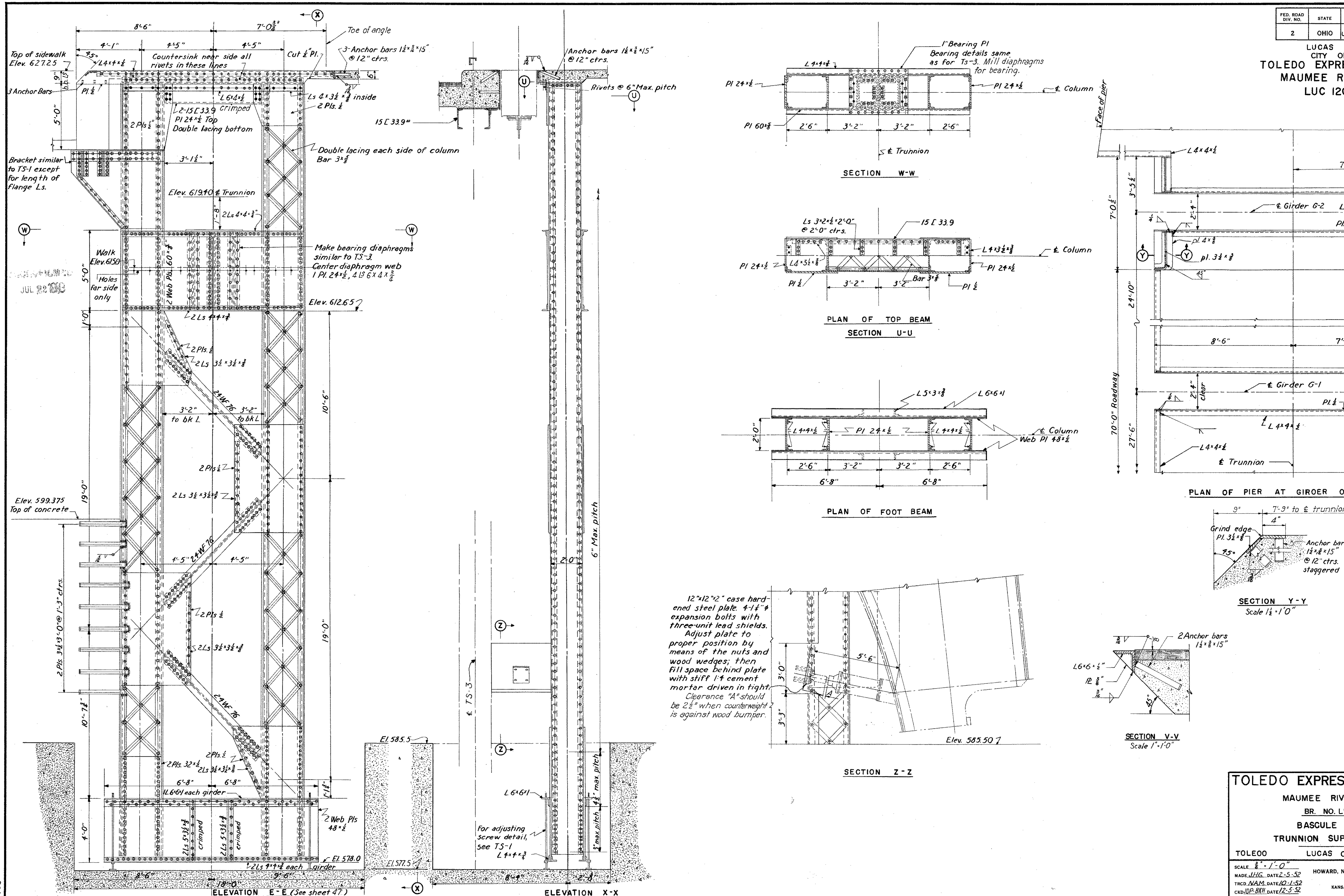


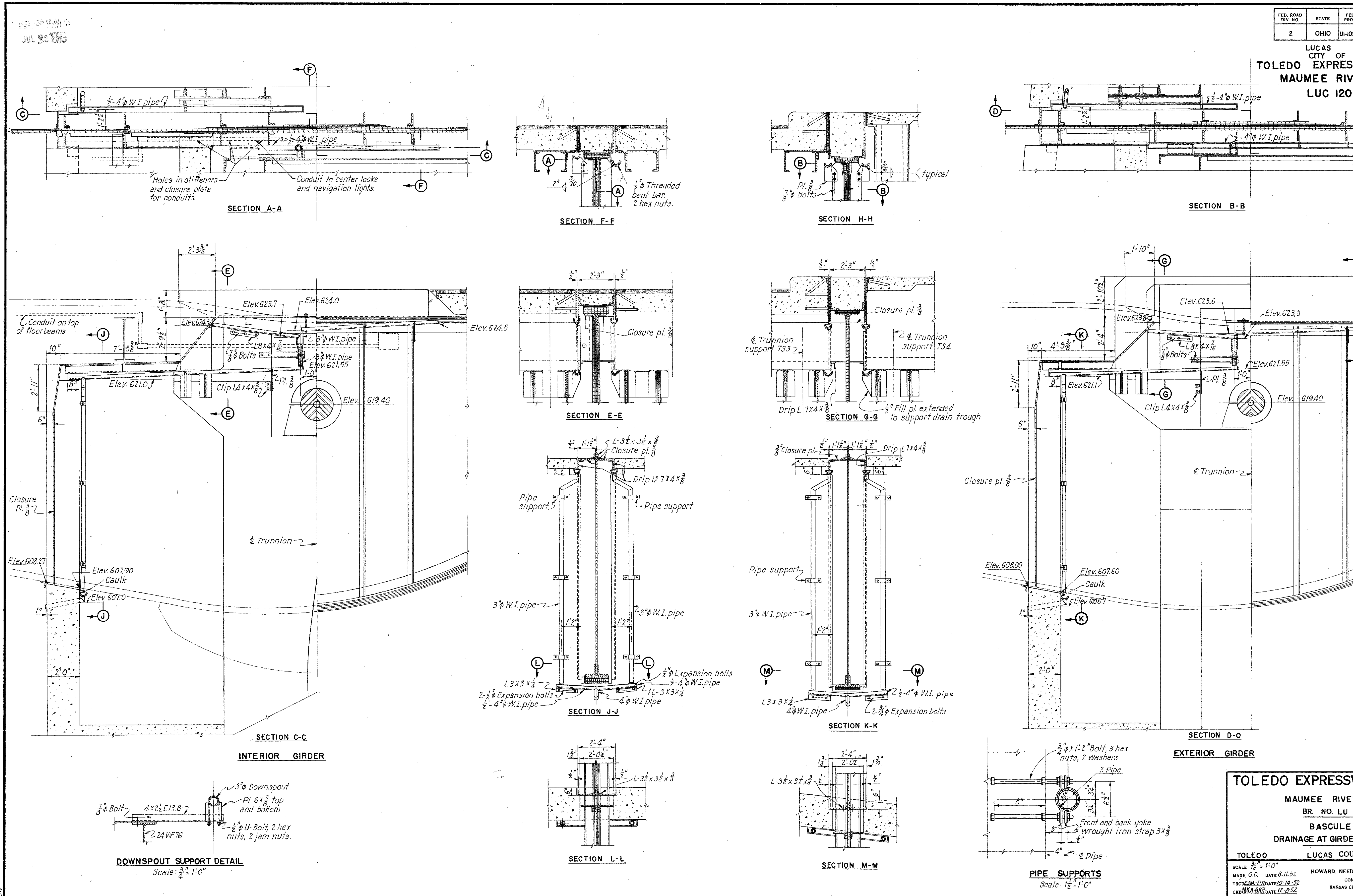
FED. ROAD DIV. NO.	STATE	
2	OHIO	

LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 12C

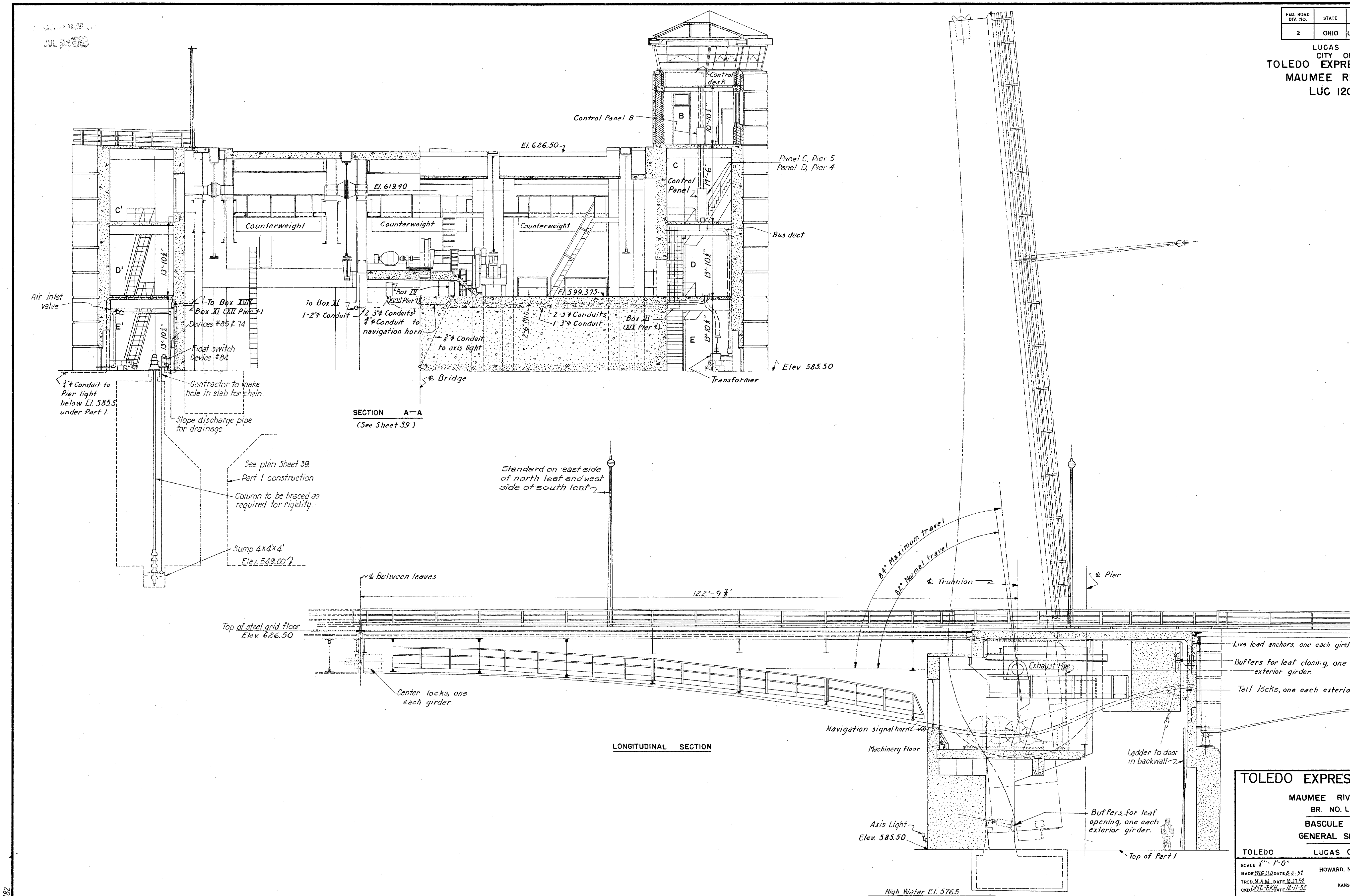
TOLEDO EXPRESS
MAUMEE RIVER
BR. NO. L
BASCULE
TRUNNION SUPPORTS
TOLEDO LUCAS C

SCALE ⅜"=1'-0"
MADE R.R.B. DATE 8-6-52
TRCD N.A.M. DATE 10-23-52
CKD JDP-BKH DATE 11-5-52
HOWARD, NE
KANSAS

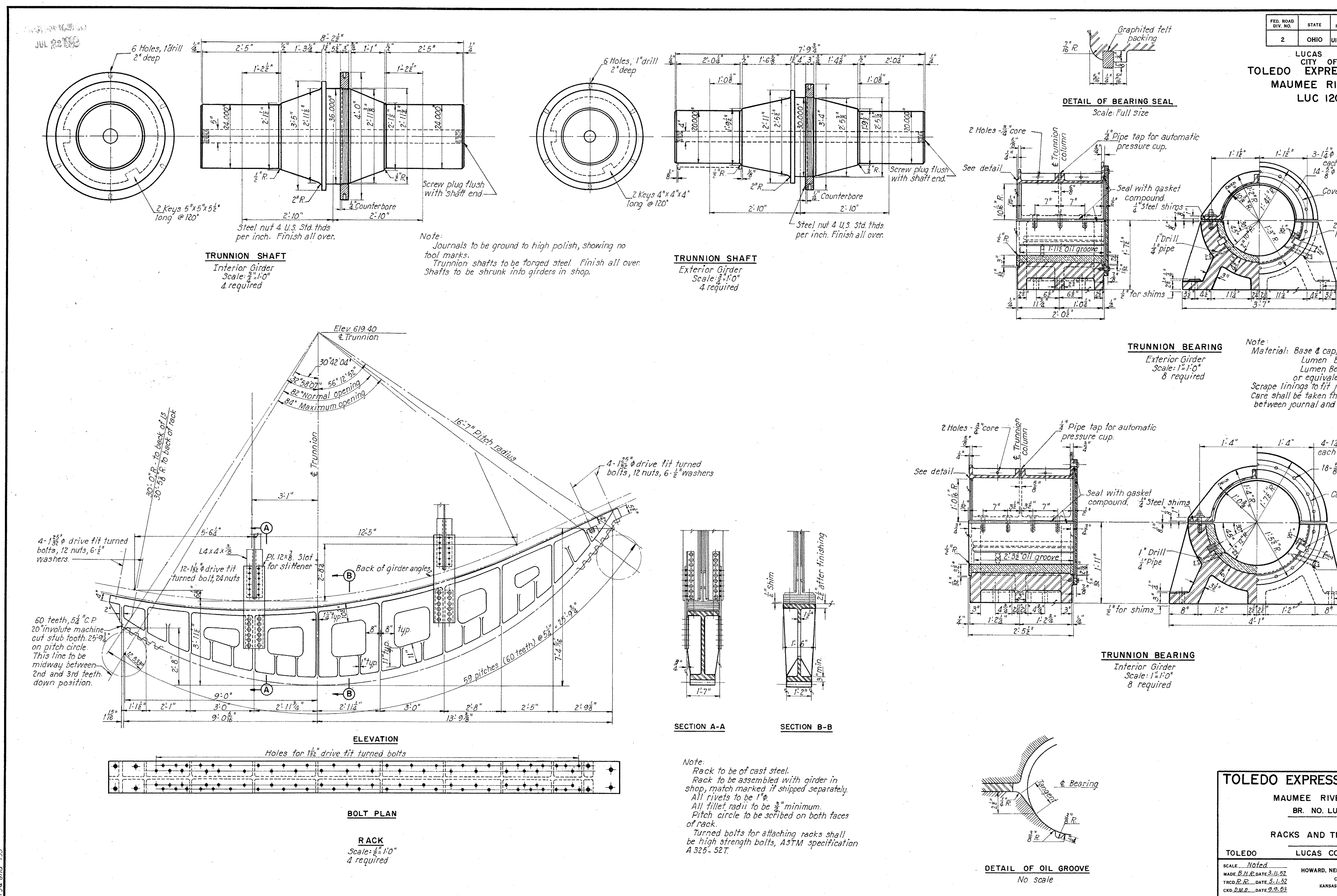

FED. ROAD DIV. NO. 2
STATE OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE R
LUC 12
ELEVATION E-E (See sheet 47)
ELEVATION X-X
SECTION W-W
PLAN OF TOP BEAM
SECTION U-U
PLAN OF FOOT BEAM
SECTION Z-Z
PLAN OF PIER AT GIRDER
SECTION Y-Y
Scale 1½"=1'0"
SECTION V-V
Scale 1"=1'0"
Top of sidewalk Elev. 627.25
3 Anchor Bars
Countersink near side all rivets in these lines
Cut ⅞" Pl.
Toe of angle
3-Anchor bars 1½×⅝×15" @ 12" ctrs.
Ls 4×3½×⅝ inside
2 Pls. ½
L2-15[33.9 Pl 24×½ Top Double lacing bottom
Double lacing each side of column Bar 3×⅝
Bracket similar to TS-1 except for length of flange Ls.
Elev. 619.40 ℄ Trunnion
Walk Elev. 615.0
Holes far side only
2 Web Pls. 60×⅝
Make bearing diaphragms similar to TS-3. Center diaphragm web 1 Pl. 24×½, 4 Ls 6×4×¾
Elev. 612.65
Elev. 599.375 Top of concrete
2 Pls. 3½×3-0" @ 1'-3" ctrs.
2 Web Pls 48×½
El. 578.0
El. 585.5
El. 577.5
15[33.9"
Anchor bars 1½×⅝×15" @ 12" ctrs.
Rivets @ 6" Max. pitch
6" Max. pitch
℄ TS-3
For adjusting screw detail, see TS-1
1" Bearing Pl
Bearing details same as for TS-3. Mill diaphragms for bearing.
℄ Column
℄ Trunnion
Ls 3×2×½×2'-0" @ 2'-0" ctrs.
Web Pl 48×½
12"×12"×2" case hardened steel plate. 4-1¼"φ expansion bolts with three-unit lead shields. Adjust plate to proper position by means of the nuts and wood wedges; then fill space behind plate with stiff 1:4 cement mortar driven in tight. Clearance "A" should be 2½" when counterweight is against wood bumper.
Elev. 585.50
Face of pier
℄ Girder G-2
℄ Girder G-1
70'-0" Roadway
Grind edge Pl. 3½×⅝
Anchor bars 1½×⅝×15" @ 12" ctrs. staggered
2 Anchor bars 1½×⅝×15"
TOLEDO EXPRES
MAUMEE RIV
BR. NO. L
BASCULE
TRUNNION SUP
TOLEDO
LUCAS C
SCALE ⅜"=1'-0"
MADE JHG DATE 2-5-52
TRCD NAM DATE 10-1-52
CKD JDP-BKH DATE 12-5-52
HOWARD, N
KANS



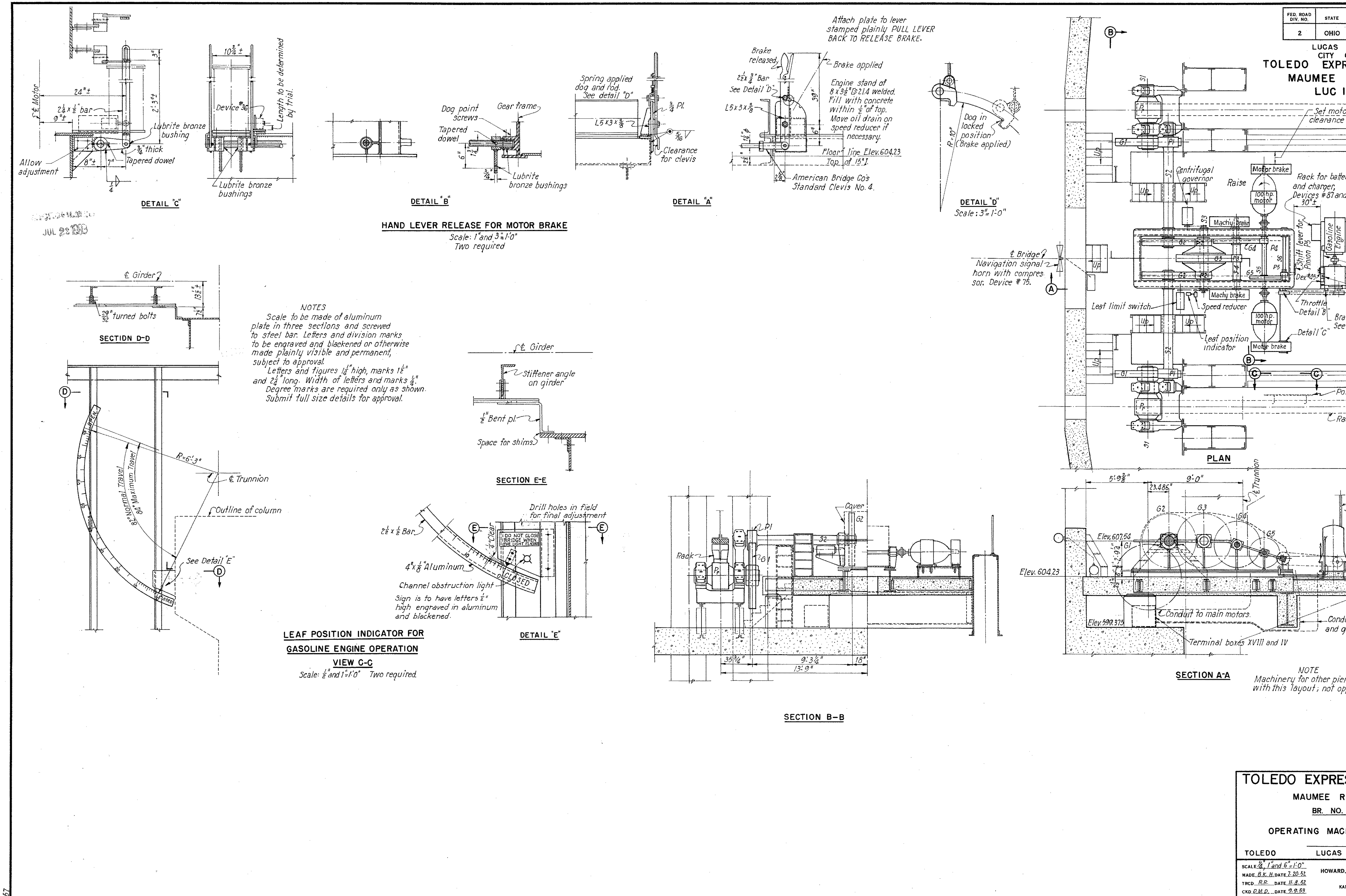
JUL 28 1953
FED. ROAD DIV. NO.
STATE
2
OHIO
LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RIV
LUC 120
SECTION A-A
Holes in stiffeners and closure plate for conduits.
Conduit to center locks and navigation lights.
SECTION F-F
$\frac{1}{2}$"φ Threaded bent bar, 2 hex nuts.
SECTION H-H
typical
SECTION B-B
SECTION E-E
Closure pl. $\frac{3}{8}$
SECTION G-G
℄ Trunnion support TS3
℄ Trunnion support TS4
Drip L 7x4x$\frac{3}{8}$
$\frac{1}{2}$" Fill pl. extended to support drain trough
Conduit on top of floorbeams
Elev. 623.7
Elev. 624.0
Elev. 624.5
Elev. 621.55
Elev. 621.0
Elev. 619.40
Clip L4x4x$\frac{3}{8}$
℄ Trunnion
Closure Pl. $\frac{3}{8}$
Elev. 608.27
Elev. 607.90
Caulk
Elev. 607.0
SECTION C-C
INTERIOR GIRDER
SECTION J-J
Pipe support
3"φ W.I. pipe
$\frac{1}{2}$"φ Expansion bolts
SECTION K-K
SECTION D-D
Elev. 623.6
Elev. 623.3
Elev. 621.1
Elev. 608.00
Elev. 607.60
Elev. 606.7
EXTERIOR GIRDER
DOWNSPOUT SUPPORT DETAIL
Scale: $\frac{3}{4}$" = 1'-0"
3"φ Downspout
24 WF 76
SECTION L-L
SECTION M-M
PIPE SUPPORTS
Scale: $1\frac{1}{2}$" = 1'-0"
Front and back yoke $\frac{1}{4}$" wrought iron strap 3x$\frac{3}{8}$
TOLEDO EXPRESSW
MAUMEE RIVE
BR. NO. LU
BASCULE
DRAINAGE AT GIRDE
TOLEDO
LUCAS COU
HOWARD, NEED



FED. ROAD DIV. NO. | STATE
2 | OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE R
LUC 12
JUL 22
Control desk
Control Panel B
B
10'-10½"
El. 626.50
C
Control Panel
14'-6"
Panel C, Pier 5
Panel D, Pier 4
El. 619.40
Counterweight
Counterweight
Counterweight
C'
D'
13'-10½"
E'
13'-10½"
Bus duct
D
13'-10½"
E
13'-10½"
Air inlet valve
To Box XVII
Box XI (XII Pier 4)
Devices #85 & 74
Float switch Device #84
To Box XI
1-2"φ Conduit
Box IV (XVIII Pier 1)
2-3"φ Conduits
¾"φ Conduit to navigation horn
¾"φ Conduit to axis light
2'-6" Min.
El. 599.375
2-3"φ Conduits
1-3"φ Conduit
Box III (XIX Pier 4)
Elev. 585.50
Transformer
¾"φ Conduit to Pier light below El. 585.5 under Part I.
Contractor to make hole in slab for chain.
℄ Bridge
SECTION A—A
(See Sheet 39)
Slope discharge pipe for drainage
See plan Sheet 39.
Part I construction
Column to be braced as required for rigidity.
Sump 4'x4'x4'
Elev. 549.00
Standard on east side of north leaf and west side of south leaf
84° Maximum travel
82° Normal travel
℄ Trunnion
℄ Pier
℄ Between leaves
122'-9⅞"
Top of steel grid floor Elev. 626.50
Center locks, one each girder.
Exhaust Pipe
Live load anchors, one each gird
Buffers for leaf closing, one exterior girder.
Tail locks, one each exterio
Navigation signal horn
Machinery floor
Ladder to door in backwall
LONGITUDINAL SECTION
Axis Light Elev. 585.50
Buffers for leaf opening, one each exterior girder.
Top of Part I
High Water El. 576.5
TOLEDO EXPRES
MAUMEE RIV
BR. NO. L
BASCULE
GENERAL S
TOLEDO
LUCAS C
SCALE ⅛" = 1'-0"
MADE WIG LLD DATE 8-4-52
TRCD N.A.M. DATE 10-17-52
CKD DMD-BKH DATE 12-11-52
HOWARD, N
KANS
82



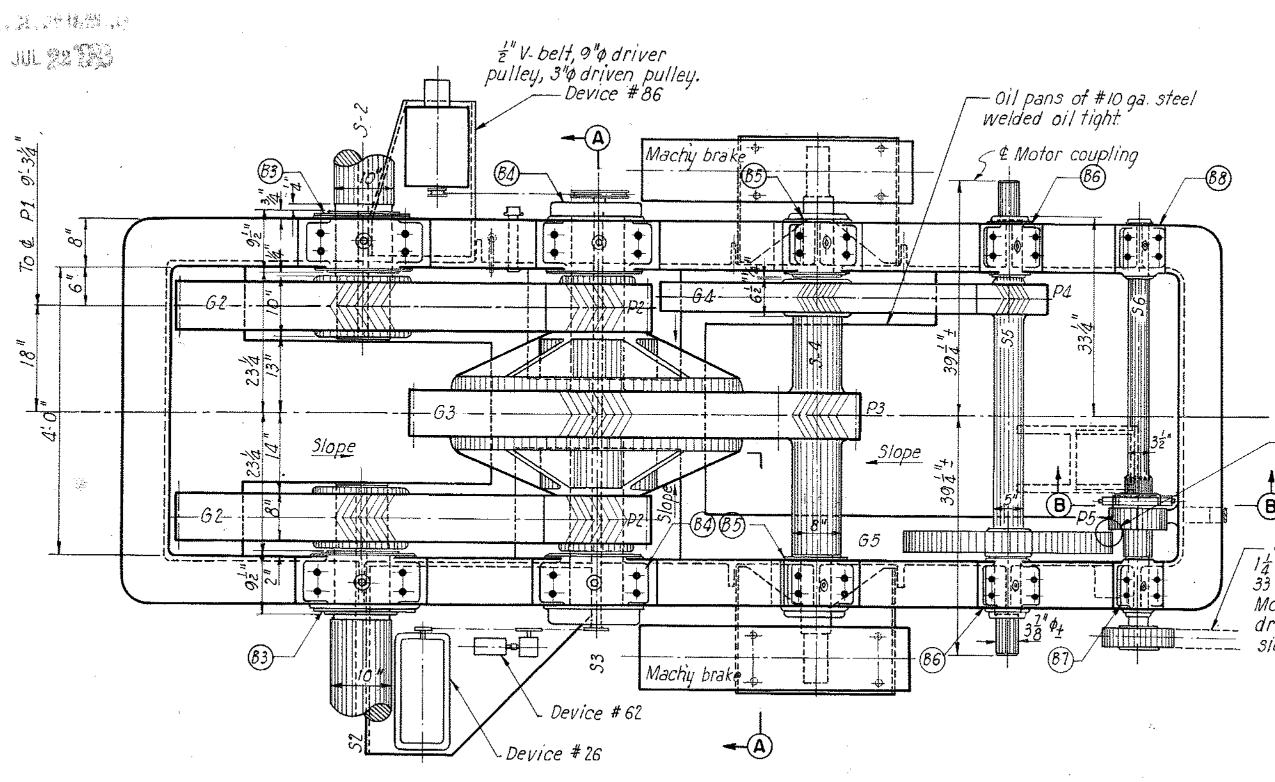
JUL 22 1953
FED. ROAD DIV. NO.
STATE
2
OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 12
6 Holes, 1"drill 2" deep
2 Keys 5"x5"x5½" long @ 120°
Steel nut 4 U.S. Std. thds per inch. Finish all over.
Screw plug flush with shaft end
TRUNNION SHAFT
Interior Girder
Scale: ¾"=1'-0"
4 required
Note:
Journals to be ground to high polish, showing no tool marks.
Trunnion shafts to be forged steel. Finish all over.
Shafts to be shrunk into girders in shop.
2 Keys 4"x4"x4" long @ 120°
TRUNNION SHAFT
Exterior Girder
Scale: ¾"=1'-0"
4 required
Graphited felt packing
DETAIL OF BEARING SEAL
Scale: Full size
¼" Pipe tap for automatic pressure cup.
Seal with gasket compound.
¼" Steel shims
1" Drill
¼" pipe
½" for shims
TRUNNION BEARING
Exterior Girder
Scale: 1"=1'-0"
8 required
Note:
Material: Base & cap,
Lumen
Lumen Be
or equivale
Scrape linings to fit
Care shall be taken th
between journal and
TRUNNION BEARING
Interior Girder
Scale: 1"=1'-0"
8 required
Elev. 619.40
℄ Trunnion
82° Normal opening
84° Maximum opening
16'-7" Pitch radius
4-1 25/32" ϕ drive fit turned bolts, 12 nuts, 6-½" washers
60 teeth, 5¼" C.P. 20° involute machine-cut stub tooth. 25'-9¾" on pitch circle. This line to be midway between 2nd and 3rd teeth, down position.
59 pitches (60 teeth) @ 5¼" = 25'-9¾"
Back of girder angles
ELEVATION
Holes for 1 3/32" drive fit turned bolts
BOLT PLAN
RACK
Scale: ½"=1'-0"
4 required
SECTION A-A
SECTION B-B
Note:
Rack to be of cast steel.
Rack to be assembled with girder in shop, match marked if shipped separately.
All rivets to be 1" ϕ
All fillet radii to be ¾" minimum.
Pitch circle to be scribed on both faces of rack.
Turned bolts for attaching racks shall be high strength bolts, ASTM specification A 325-52T.
℄ Bearing
Tangent
DETAIL OF OIL GROOVE
No scale
TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU
RACKS AND T
TOLEDO
LUCAS CO
SCALE Noted
MADE B.H.R. DATE 3-11-52
TRCD R.R. DATE 5-1-52
CKD D.M.D. DATE 9-9-53
HOWARD, NE
KANSAS
754 and 755



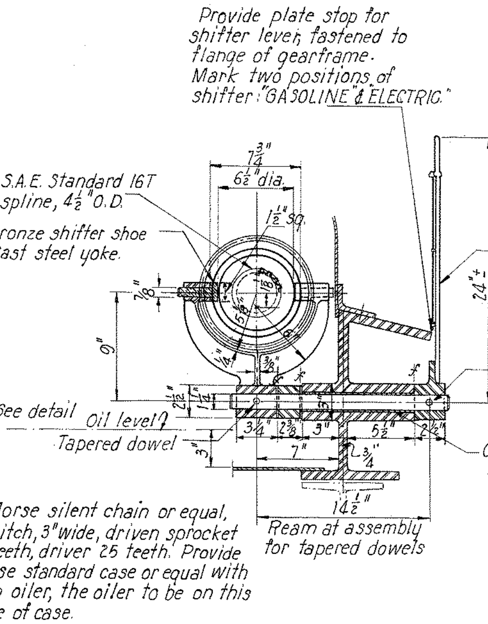
DETAIL "C"
Allow adjustment
Lubrite bronze bushing
Tapered dowel
3/4" thick
Device #36
Length to be determined by trial.
Lubrite bronze bushings
DETAIL "B"
Dog point screws
Gear frame
Tapered dowel
Lubrite bronze bushings
HAND LEVER RELEASE FOR MOTOR BRAKE
Scale: 1" and 3" = 1'-0"
Two required
Spring applied dog and rod. See detail "D"
3/4" Pl.
Clearance for clevis
DETAIL "A"
Attach plate to lever stamped plainly PULL LEVER BACK TO RELEASE BRAKE.
Brake released
Brake applied
Engine stand of 8 x 3½" [21.4 welded. Fill with concrete within ½" of top. Move oil drain on speed reducer if necessary.
Floor line Elev. 604.23
American Bridge Co's Standard Clevis No. 4.
Dog in locked position (Brake applied)
DETAIL "D"
Scale: 3" = 1'-0"
JUL 22 1953
℄ Girder
29/32" turned bolts
SECTION D-D
NOTES
Scale to be made of aluminum plate in three sections and screwed to steel bar. Letters and division marks to be engraved and blackened or otherwise made plainly visible and permanent, subject to approval.
Letters and figures 1¼" high, marks 1½" and 2¼" long. Width of letters and marks ¼".
Degree marks are required only as shown.
Submit full size details for approval.
℄ Girder
Stiffener angle on girder
½" Bent pl.
Space for shims
SECTION E-E
R=6'-3"
℄ Trunnion
82° Normal Travel
84° Maximum Travel
Outline of column
See Detail "E"
Drill holes in field for final adjustment
2½ x ½ Bar
4" x ⅛" Aluminum
DO NOT CLOSE BRIDGE WHEN THE LIGHT FLASHES
CLOSED
Channel obstruction light
Sign is to have letters ½" high engraved in aluminum and blackened.
DETAIL "E"
LEAF POSITION INDICATOR FOR GASOLINE ENGINE OPERATION
VIEW C-C
Scale: ½" and 1" = 1'-0" Two required.
Rack
Cover
SECTION B-B
℄ Bridge
Navigation signal horn with compressor. Device # 75.
Leaf limit switch
Centrifugal governor
Raise
Motor brake
100 hp. motor
Mach'y brake
Speed reducer
Leaf position indicator
Set motor clearance
Rack for battery and charger, Devices #87 and
Gasoline Engine
Shift lever for Pinion P5
Throttle Detail "B"
Detail "C"
PLAN
Elev. 607.54
Elev. 604.23
Elev. 599.375
Conduit to main motors.
Terminal boxes XVIII and IV
SECTION A-A
NOTE
Machinery for other pier with this layout; not op
FED. ROAD DIV. NO. 2
STATE OHIO
LUCAS
CITY
TOLEDO EXPR
MAUMEE
LUC I
TOLEDO EXPRES
MAUMEE R
BR. NO.
OPERATING MAC
TOLEDO
LUCAS
SCALE ½", 1" and 6" = 1'-0"
MADE B.K.H. DATE 7-20-52
TRCD R.R. DATE 11-8-52
CKD D.M.D. DATE 9-9-53
HOWARD,

FED. ROAD DIV. NO.	STATE
2	OHIO

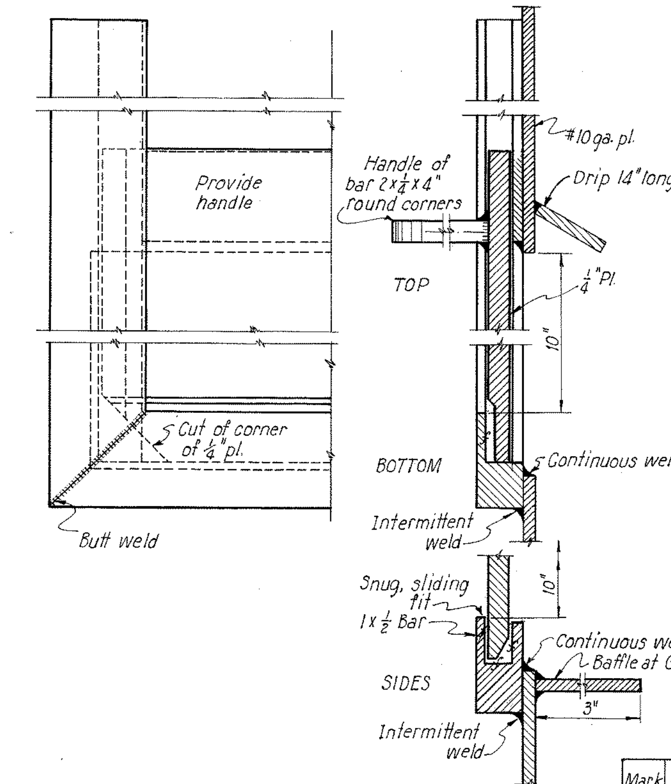
LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC 12



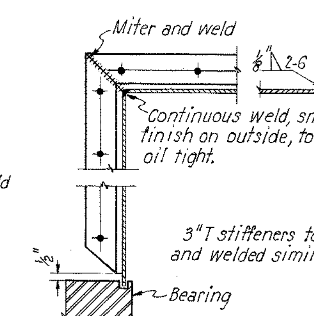
PLAN



SECTION B-B
Shifter Lever Yoke Assembly.
Scale: $1\frac{1}{2}$" = 1'-0"



DETAILS OF INSPECTION HOLES
Scale: Full size

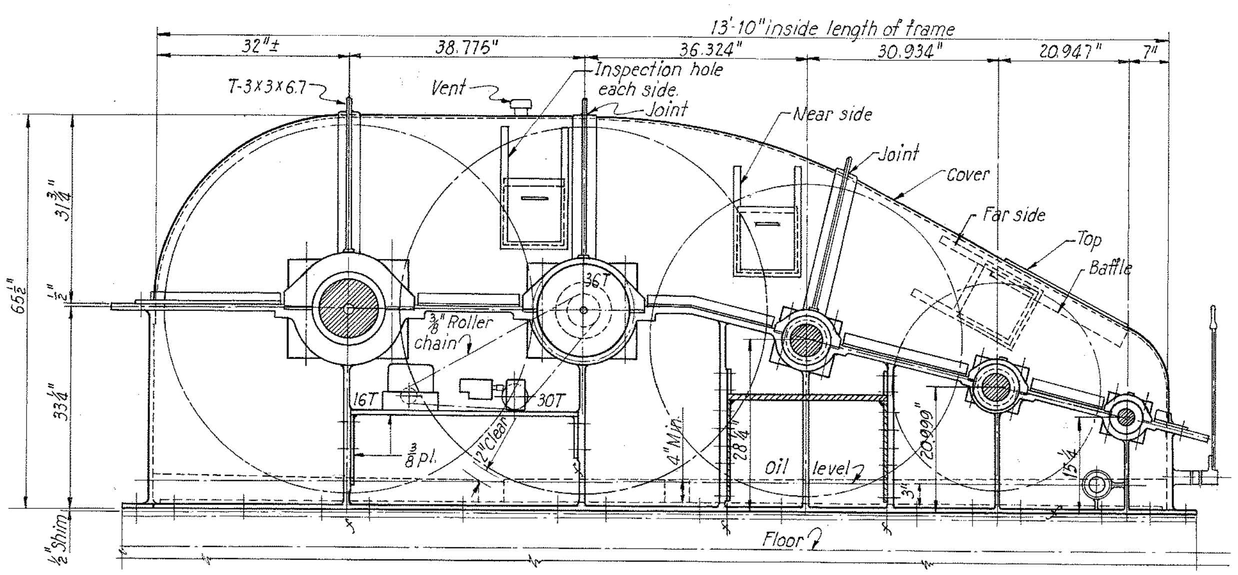


JOINTS IN
Scale: 1

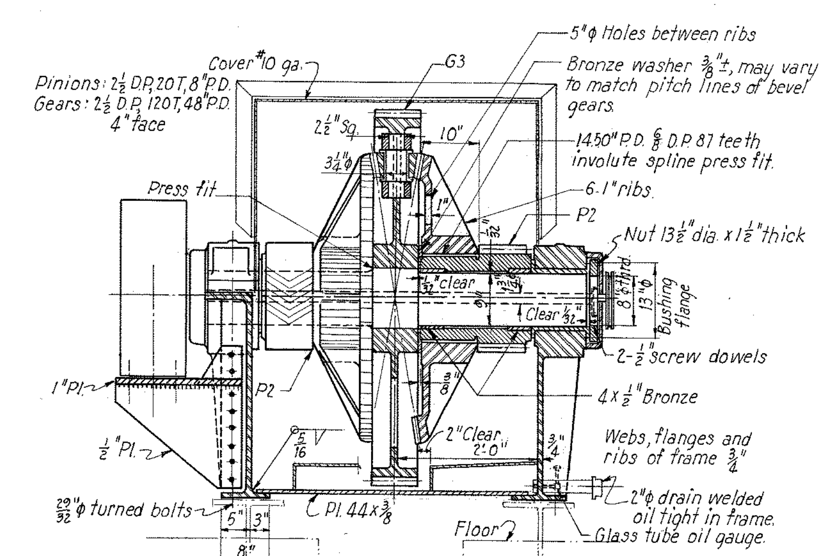
GEAR TABLE

Mark	No. Req'd	Teeth	D.P.	Circ. Pitch	Pitch Dia.	Face
Rack	2	—	—	5.25	398"	14
Pr	4	15	—	5.25	25.067	19
G1	4	54	$\frac{3}{4}$	4.189	72.0	8
P1	4	15	$\frac{3}{4}$	4.189	20.0	11
G2	4	76	$1\frac{1}{4}$	2.513	60.75	8
P2	4	21	$1\frac{1}{4}$	2.513	16.80	8
G3	2	91	$1\frac{1}{2}$	2.094	60.667	8
P3	2	19	$1\frac{1}{2}$	2.094	12.667	8
G4	2	102	2	1.571	51.00	5
P4	2	25	2	1.571	12.500	5
G5	2	102	3	1.047	34.00	$3\frac{1}{2}$
P5	2	27	3	1.047	9.00	$3\frac{1}{2}$

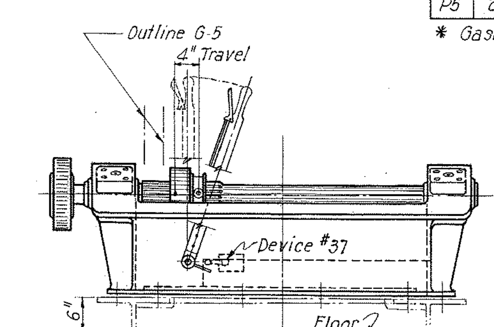
* Gasoline engine operation.



ELEVATION



SECTION A-A
Differential



END VIEW

NOTES

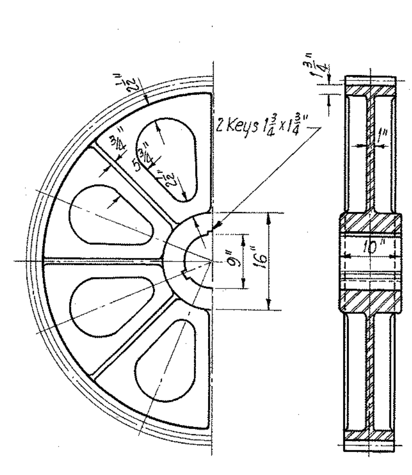
Motor couplings, Falk Steel

Centrifugal Speed Relay, D
Cutler-Hammer Centrifuga
Type N13, contacts closed
set to open at 26 rpm. of

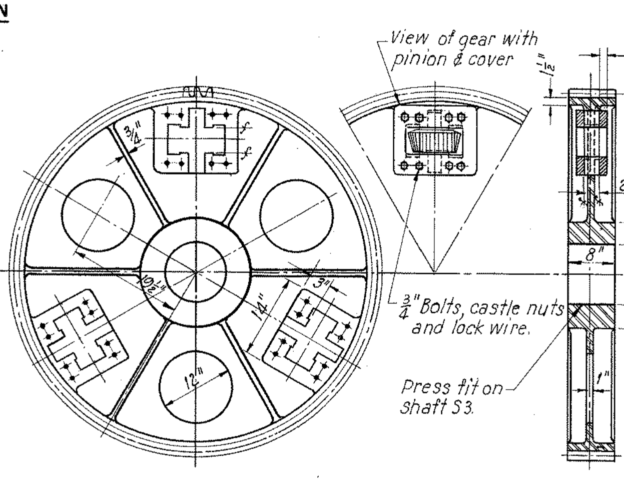
Speed Reducer for Device
Model AT 13, ratio 20 to 1.
to revolve approximately 2
for 84° leaf movement.

Device #26 to revolve abo

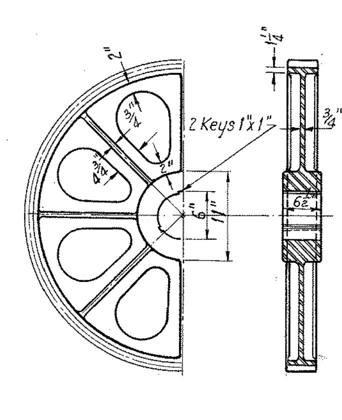
Open holes are for $\frac{29}{32}$"ϕ tu
unless shown otherwise.



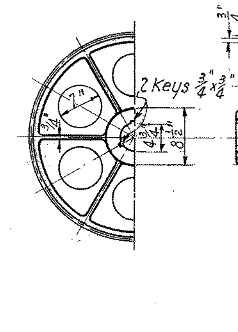
GEAR G2



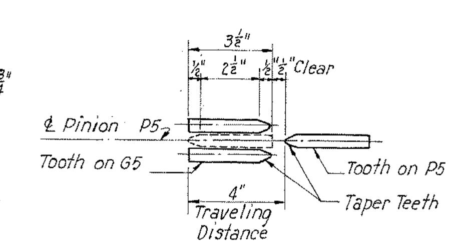
GEAR G3



GEAR G4



GEAR 5



DETAIL OF TEETH IN G5 & P5
Scale: 3" = 1'-0"

TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU

CENTRAL MA

TOLEDO LUCAS C

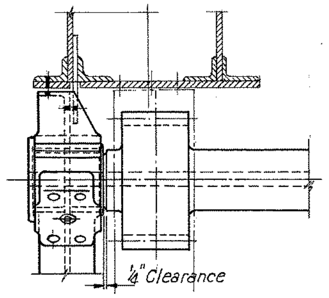
SCALE *As shown*
MADE *B.K.H.* DATE *5.6.52*
TRCD *R.R.* DATE *11.1.52*
CKD *D.M.D.* DATE *9.9.53*

HOWARD, NE
KANSA

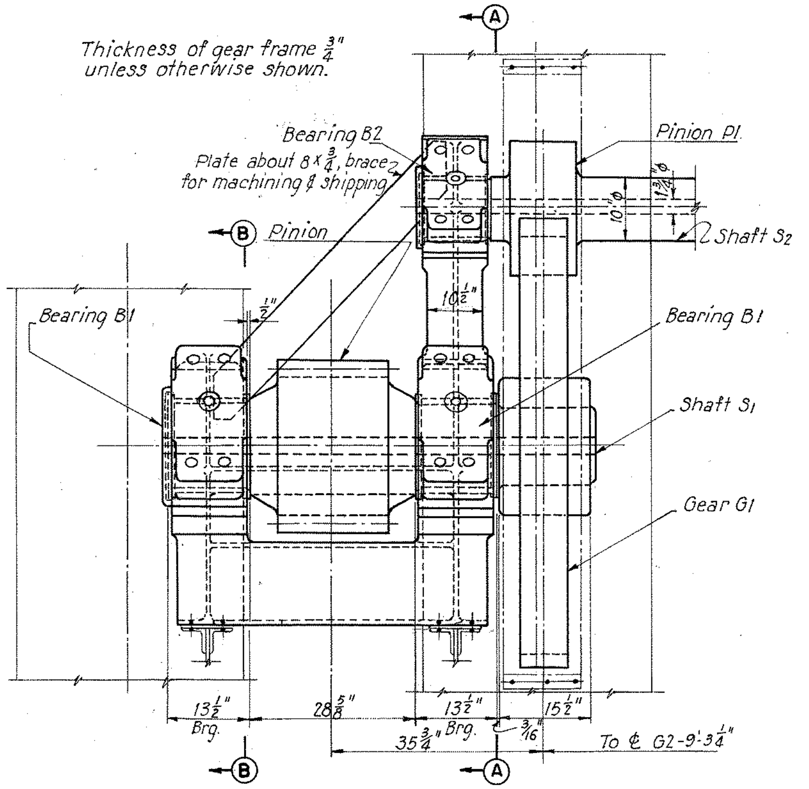
758

FED. ROAD DIV. NO.	STATE
2	OHIO

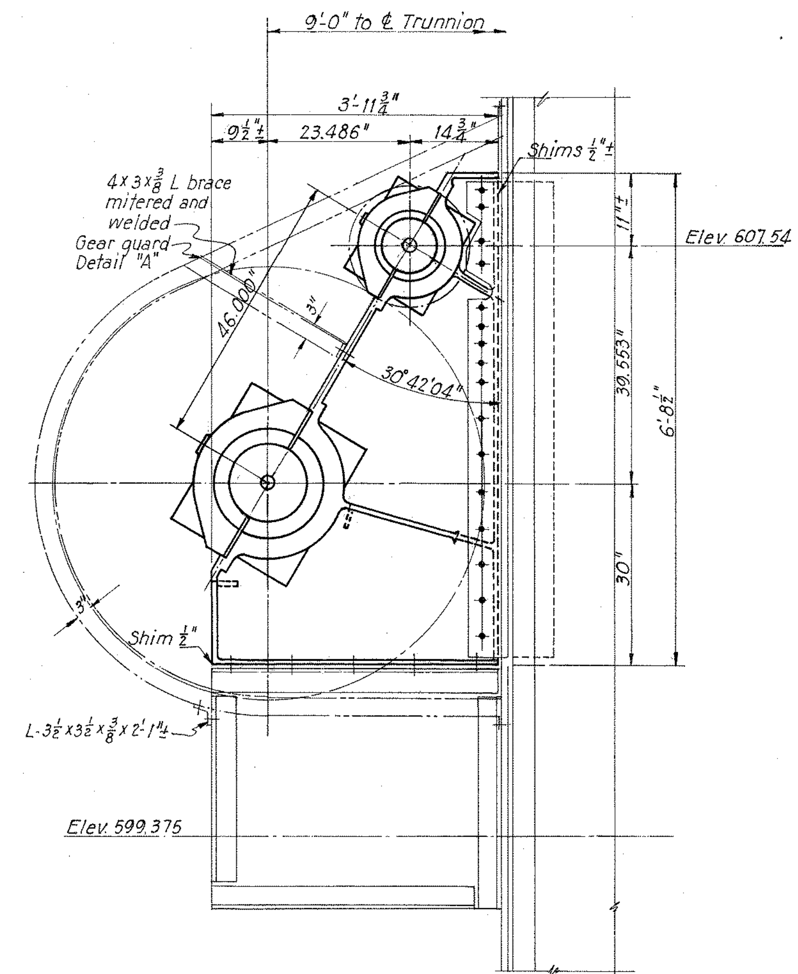
LUCAS
CITY O…
TOLEDO EXPR…
MAUMEE R…
LUC 12…



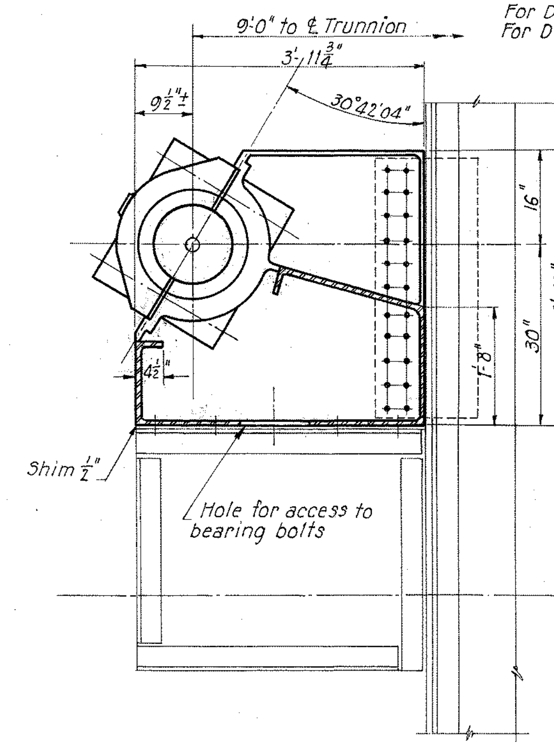
PLAN



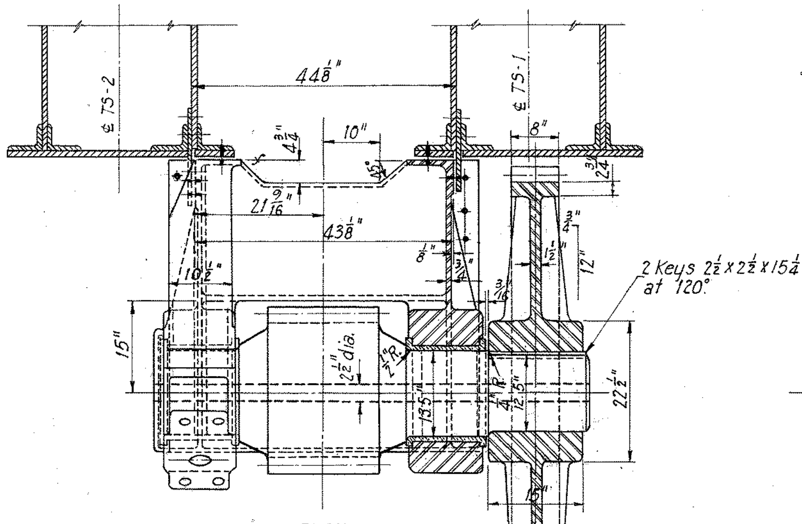
ELEVATION



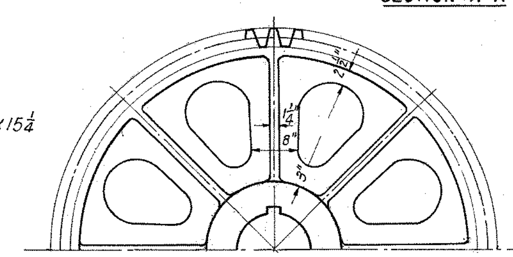
SECTION A-A



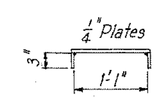
SECTION B-B



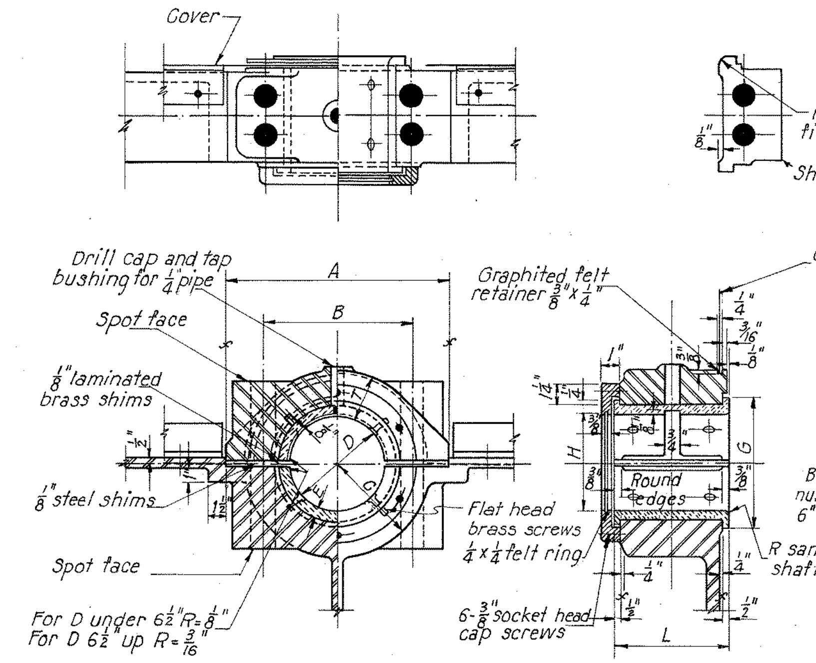
PLAN



GEAR G1
Cast steel



DETAIL "A"



TYPICAL BEARING DETAILS

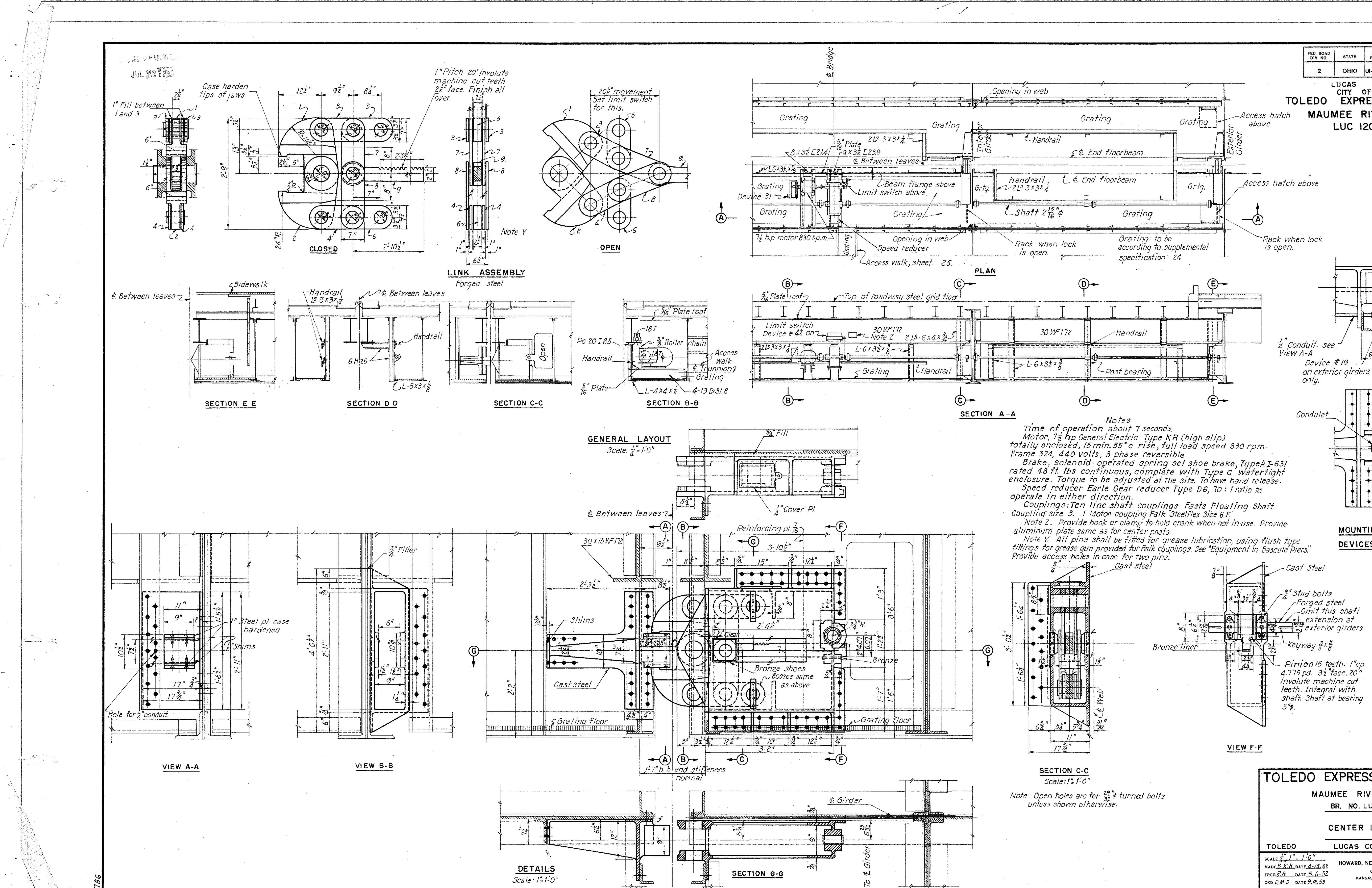
DIMENSIONS OF BEARINGS										
Mark	D	A	B	C	E	T	G	H	L	Bolts…
B1	13½	30	20½	13½	1 3/16	6¾	16⅜	—	13½	4-2 25/32…
B2	9	20½	14	8 13/16	13/16	4 5/16	11⅞	9 1/32	13½	4-2 9/32…
B3	9½	21½	14¾	9 5/16	13/16	4 9/16	11⅝	9 17/32	9½	4-1 17/32…
B4	9	20½	14	8 13/16	13/16	4 5/16	13	⊕	9½	4-1 17/32…
B5	5	11¼	7¾	4 11/16	7/16	2 13/16	6⅜	5 1/32	9½	4-1 1/32…
B6	4½	10	7	4⅜	⅜	2⅛	5¾	4 17/32	9½	4-29/32"…
B7	3½	8	5¼	3⅞	5/16	2⅛	4⅝	3 17/32	9½	4-25/32"…
B8	3	7¼	4¾	3⅝	5/16	2⅛	4⅛	3 1/32	9½	4-25/32"…

⊕ As required for sprocket and pulley shafts.

Note:
Open holes are for 29/32" ϕ turned bolts.

TOLEDO EXPRES…
MAUMEE RI…
BR. NO. L…
RACK DRIVE M…
TOLEDO   LUCAS C…

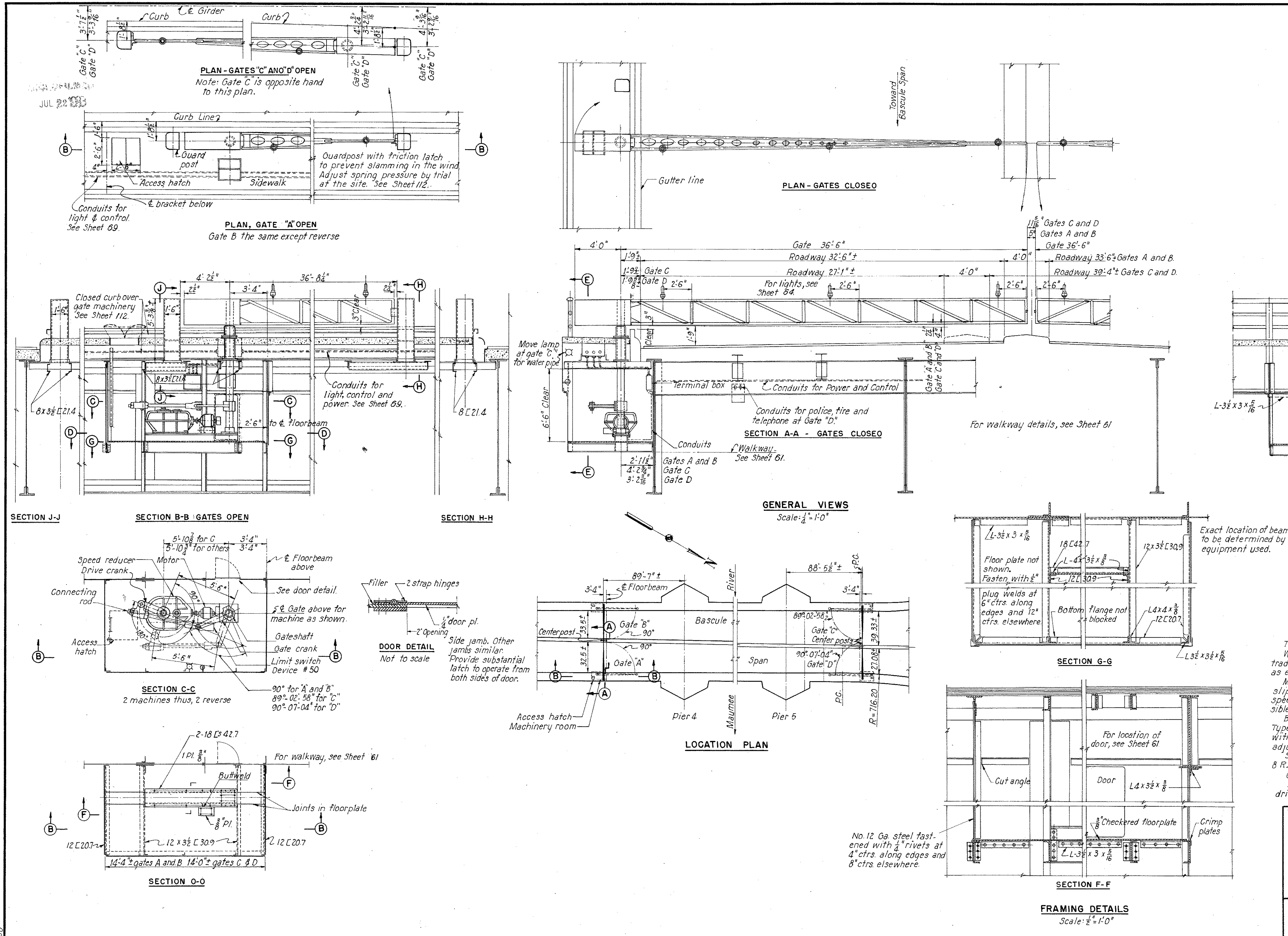
SCALE ¾" = 1'-0"
MADE B.K.H. DATE 5-6-52
TRCD R.R. DATE 7-1-52
CKD D.M.D. DATE 9-9-53
HOWARD, …
KANS…



JUL 28 1953
LINK ASSEMBLY
Forged steel
CLOSED
OPEN
1" Pitch 20° involute machine cut teeth 2½" face. Finish all over.
20½" movement Set limit switch for this.
Case harden tips of jaws.
1" Fill between 1 and 3
Note Y
PLAN
SECTION A-A
SECTION E E
SECTION D D
SECTION C-C
SECTION B-B
GENERAL LAYOUT
Scale: ¼"=1'-0"
VIEW A-A
VIEW B-B
VIEW F-F
SECTION C-C
Scale: 1"=1'-0"
DETAILS
Scale: 1"=1'-0"
SECTION G-G
MOUNTI
DEVICES
Access hatch above
Grating
Handrail
℄ End floorbeam
℄ Between leaves
Beam flange above
Limit switch above
Shaft 2 15/16" φ
Rack when lock is open.
Opening in web
Speed reducer
Access walk, sheet 25.
7½ h.p. motor 830 r.p.m.
Grating: to be according to supplemental specification 24
Top of roadway steel grid floor
Limit switch Device #42 on
Post bearing
Cast steel
Bronze shoes
Bosses same as above
Grating floor
Shims
Steel pl. case hardened
Hole for ½" conduit
Pinion 15 teeth. 1" cp. 4.775 pd. 3½" face. 20° involute machine cut teeth. Integral with shaft. Shaft at bearing 3"φ.
Note: Open holes are for 29/32"φ turned bolts unless shown otherwise.
Notes
Time of operation about 7 seconds.
Motor, 7½ hp General Electric Type KR (high slip) totally enclosed, 15 min. 55°c rise, full load speed 830 rpm. Frame 324, 440 volts, 3 phase reversible.
Brake, solenoid-operated spring set shoe brake, Type AI-631 rated 48 ft. lbs. continuous, complete with Type C watertight enclosure. Torque to be adjusted at the site. To have hand release.
Speed reducer Earle Gear reducer Type D6, 70 : 1 ratio to operate in either direction.
Couplings: Ten line shaft couplings Fasts Floating Shaft Coupling size 3. 1 Motor coupling Falk Steelflex Size 6 F.
Note Z. Provide hook or clamp to hold crank when not in use. Provide aluminum plate same as for center posts.
Note Y. All pins shall be fitted for grease lubrication, using flush type fittings for grease gun provided for Falk couplings. See "Equipment in Bascule Piers." Provide access holes in case for two pins.
FED. ROAD DIV. NO. | STATE
2 | OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 12
TOLEDO EXPRESS
MAUMEE RIV
BR. NO. LU
CENTER L
TOLEDO
LUCAS CO
SCALE ¼", 1" = 1'-0"
MADE B.K.H. DATE 4-15-52
TRCD R.R. DATE 5-6-52
CKD D.M.D. DATE 9-9-53
HOWARD, NE
KANSAS
766

FED. ROAD DIV. NO.	STATE
2	OHIO

LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 12



NOTES

Time of operation about 15½ s

Where products are specified
trade name, other products, acce
as equivalent may be used.

Motor, 3 hp. Gen. Electric Typ
slip), totally enclosed, 15 min.
speed 830 rpm. frame 254, 440
sible.

Brake, solenoid-operated spr
Type AI-431 rated 35 ft lbs. cont
with Type C water tight enclosu
adjusted by trial at the site. T

Speed reducer, Falk vertical
8 RX, 430:1 ratio, to operate in

Coupling, Falk steelflex size 4

Limit switch drive, ½" pitch r
driver, 35T. driven sprocket.

TOLEDO EXPRESS

MAUMEE RIV

BR. NO. LU

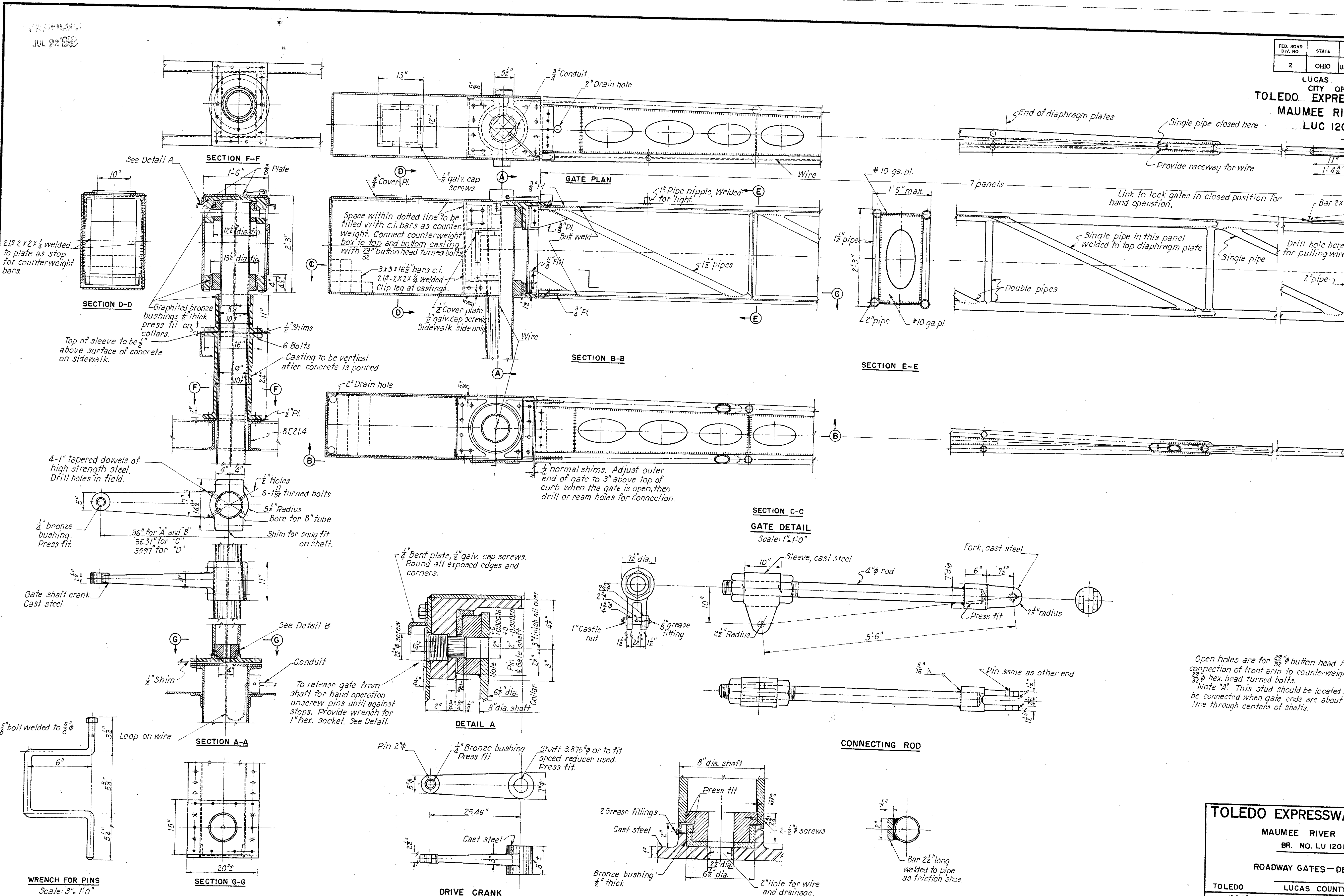
ROADWAY GATES

TOLEDO LUCAS C

SCALE 1/4"; 1/2" = 1'-0"
MADE B.K.H. DATE 5-10-52
TRCD R.R. DATE 5-21-52
CKD D.M.D. DATE 9-9-53

HOWARD, NE

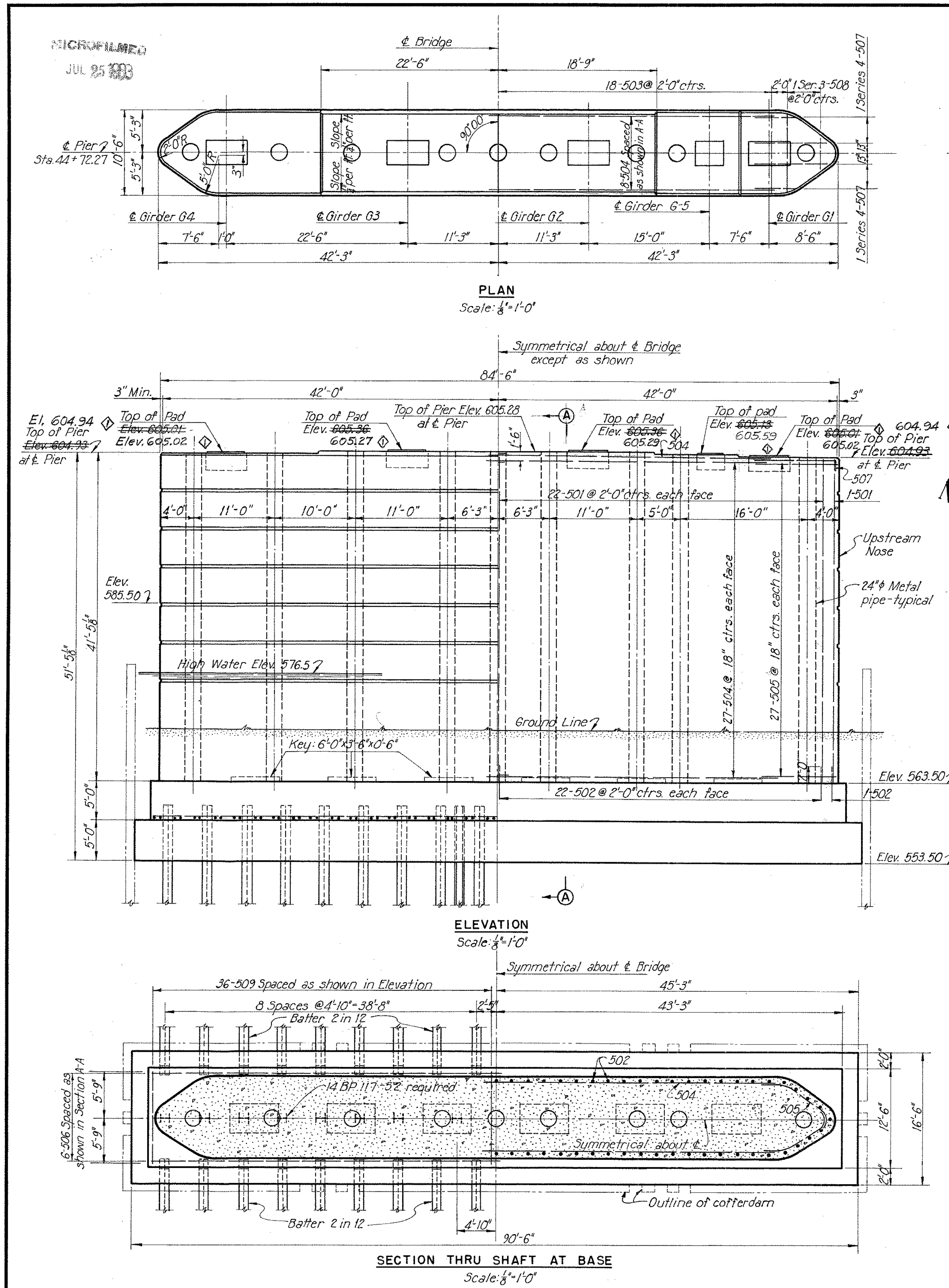
KANSA



JUL 22 1932
FED. ROAD DIV. NO.
STATE
2
OHIO
LUCAS
CITY OF
TOLEDO EXPRE
MAUMEE RI
LUC 120
SECTION F-F
SECTION D-D
2∠s 2x2x¼ welded to plate as stop for counterweight bars.
See Detail A
⅜" Plate
Graphited bronze bushings ½" thick press fit on collars.
Top of sleeve to be ½" above surface of concrete on sidewalk.
½" Shims
6 Bolts
Casting to be vertical after concrete is poured.
8[21.4
4-1" tapered dowels of high strength steel. Drill holes in field.
½" Holes
6-1 17/32 turned bolts
5½" Radius
Bore for 8" tube
Shim for snug fit on shaft.
¼" bronze bushing. Press fit.
36" for "A" and "B"
36.31" for "C"
35.97" for "D"
Gate shaft crank Cast steel.
See Detail B
Conduit
½" Shim
Loop on wire
SECTION A-A
⅝" bolt welded to ⅝"φ
WRENCH FOR PINS
Scale: 3" = 1'-0"
SECTION G-G
¾" Conduit
2" Drain hole
½" galv. cap screws
GATE PLAN
Wire
⅜" Cover Pl.
Space within dotted line to be filled with c.i. bars as counter weight. Connect counterweight box to top and bottom casting with 29/32" button head turned bolts.
3x3x16½" bars c.i.
2∠s 2x2x¼ welded
Clip leg at casting.
¼" Cover plate
½" galv. cap screws
Sidewalk side only
1" Pipe nipple, Welded for light.
⅜" Pl.
Butt weld
⅝" Fill
1½" pipes
¾" Pl.
SECTION B-B
2" Drain hole
¼" normal shims. Adjust outer end of gate to 3" above top of curb when the gate is open, then drill or ream holes for connection.
SECTION C-C
GATE DETAIL
Scale: 1" = 1'-0"
#10 ga. pl.
1'-6" max.
1½" pipe
2" pipe
#10 ga. pl.
SECTION E-E
7 panels
End of diaphragm plates
Single pipe closed here
Provide raceway for wire
Link to lock gates in closed position for hand operation.
Single pipe in this panel welded to top diaphragm plate
Double pipes
Single pipe
Drill hole here for pulling wire
2" pipe
Bar 2x
¼" Bent plate, ½" galv. cap screws. Round all exposed edges and corners.
2½"φ screw
⅛" finish all over
Pin φ Gate shaft
6½" dia.
8" dia. shaft
Collar
To release gate from shaft for hand operation unscrew pins until against stops. Provide wrench for 1" hex. socket. See Detail.
DETAIL A
7½" dia.
1" Castle nut
⅛" grease fitting
2½" Radius
Sleeve, cast steel
4"φ rod
Fork, cast steel
Press fit
2¼" radius
5'-6"
Pin same as other end
CONNECTING ROD
Pin 2"φ
¼" Bronze bushing Press fit
Shaft 3.875"φ or to fit speed reducer used. Press fit.
25.46"
Cast steel
DRIVE CRANK
8" dia. shaft
Press fit
2 Grease fittings
Cast steel
2-½"φ screws
Bronze bushing ½" thick
2" Hole for wire and drainage.
Bar 2½" long welded to pipe as friction shoe.
Open holes are for 29/32"φ button head t... connection of front arm to counterweig... 29/32"φ hex. head turned bolts.
Note "A". This stud should be located... be connected when gate ends are about... line through centers of shafts.
TOLEDO EXPRESSWA
MAUMEE RIVER
BR. NO. LU 120
ROADWAY GATES—DE
TOLEDO
LUCAS COUNTY

FED. ROAD DIV. NO.	STATE
2	OHIO

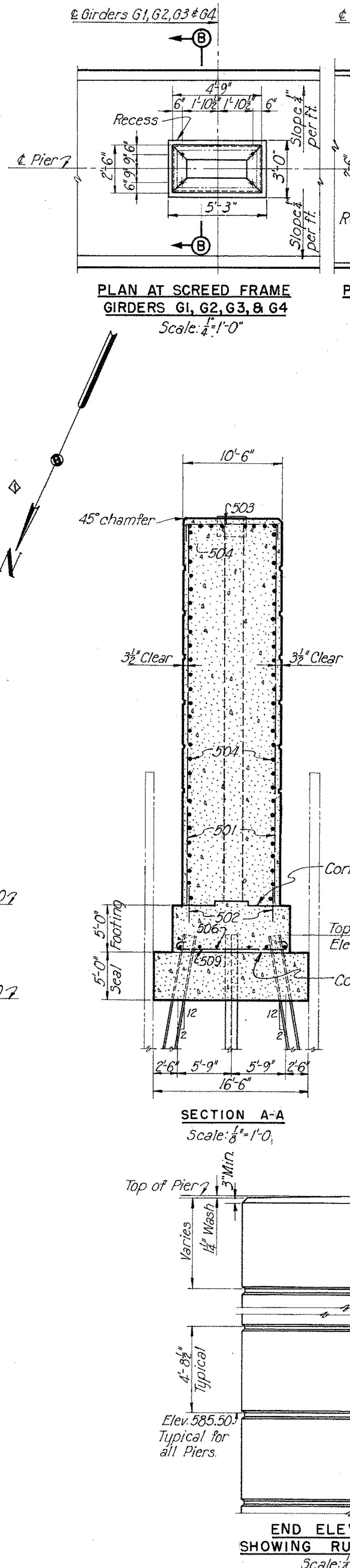
LUCAS
CITY
TOLEDO EXPR
MAUMEE
LUC



PLAN
Scale: 1/8" = 1'-0"

ELEVATION
Scale: 1/8" = 1'-0"

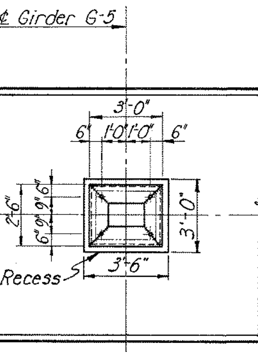
SECTION THRU SHAFT AT BASE
Scale: 1/8" = 1'-0"



PLAN AT SCREED FRAME GIRDERS G1, G2, G3, & G4
Scale: 1/4" = 1'-0"

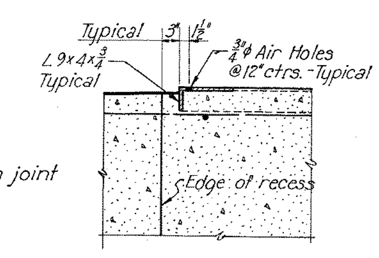
SECTION A-A
Scale: 1/8" = 1'-0"

END ELEVATION SHOWING RUSTICATION
Scale: 1/8" = 1'-0"

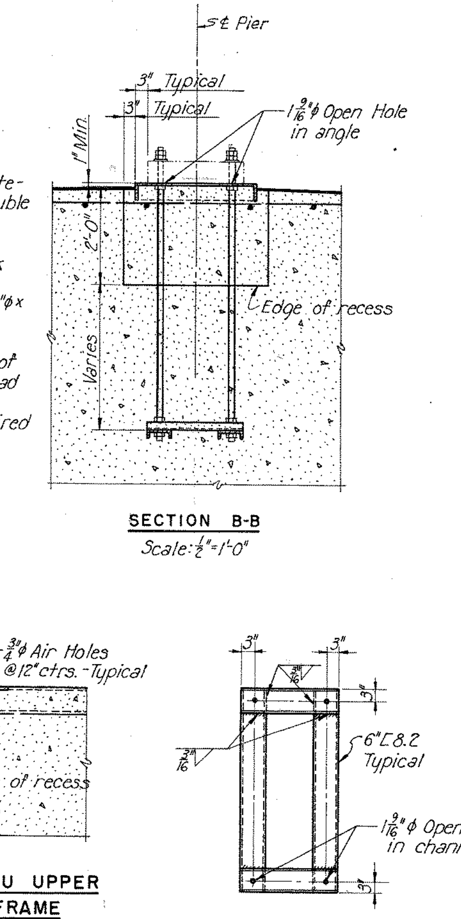


PLAN AT SCREED FRAME GIRDER G5
Scale: 1/4" = 1'-0"

Note: Miter corners of template-screed frame and weld with double bevel weld equal to thickness of material.
Grind weld flush with back of angles.
All anchor bolts shall be 1 1/2"φ x 6'-0" long and shall have 5 hex. nuts and 1-3 1/2"φ x 1/4 Washer each. Bolts shall project a minimum of 10" above the screed frame. Thread bolts 1'-2" at top end and 6" at bottom end. Twenty bolts required for Pier 1.



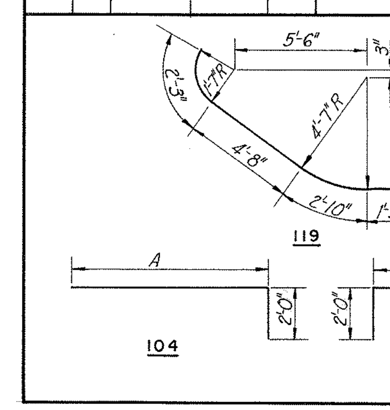
SECTION THRU UPPER SCREED FRAME
Scale: 3/4" = 1'-0"

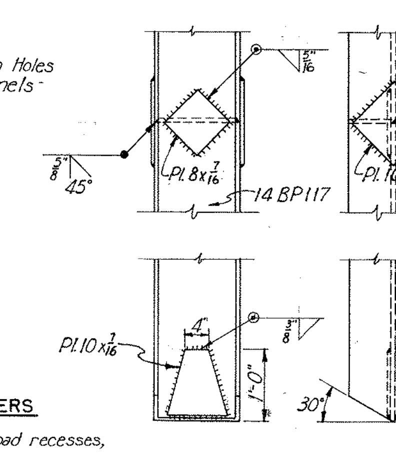


SECTION B-B
Scale: 1/2" = 1'-0"

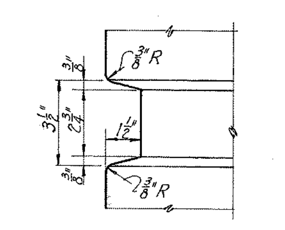
LOWER TEMPLATE
Scale: 1/2" = 1'-0"

REINFORCING BAR LIST AND B					
Mark	Size	Number	Length	Type	A
501	5	88	41'-0"	Str.	
502	5	88	4'-0"	Str.	
503	5	35	13'-8"	105	9'-8"
504	5	124	36'-0"	Str.	
505	5	108	11'-2"	119	
506	5	12	43'-9"	Str.	
507	5	4 Ser. of 4	5'-6" to 10'-1"	104	3'-6" to 8'-1
508	5	2 Ser. of 3	8'-4" to 13'-6"	105	4'-4" to 9'-6
509	5	72	13'-3"	100	11'-7"
Test	replacement bar				
	5	1	8'-0"	Str.	





PILE SPLICE & TIP REINF
Scale: 3/4" = 1'-0"



RUSTICATION DETAILS
Scale: 3" = 1'-0"

GENERAL NOTES ON PIERS

For special concrete in shoe pad recesses, see General Notes, Sheet 3.
For class of concrete, see Sheet 3.
Spacing of piles shown is at bottom of seal.
In Piers 1, 2 and 3 provide 24"φ ventilation cells formed with metal pipe. Pipes shall be flush with top of pier, and shall be filled with concrete 3 months after pier wall concrete has been placed. Embeco concrete or equal, shall be used for top 3 feet. Provisions shall be made to keep cells dry during freezing weather.

Rev. ① 11-4-52

STATE OF
DEPARTMENT OF
BUREAU OF

TOLEDO EXPRES
(FRONT STREET TO
MAUMEE RIVE
BR. NO. LU-

PIER

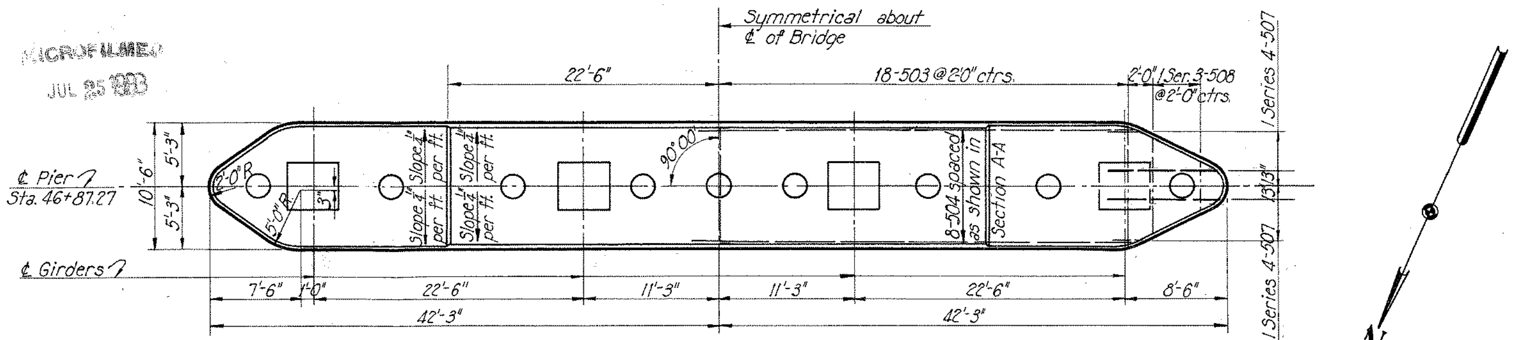
TOLEDO, LUCAS C

SCALE 1/8", 1/4", 1/2", 3/4", 3" = 1'-0"
MADE HBM, EB DATE 8-8-51 HOWARD, NE
TRCD BLB DATE 8-29-51
CKD HAM DATE 8-30-51 KANSA

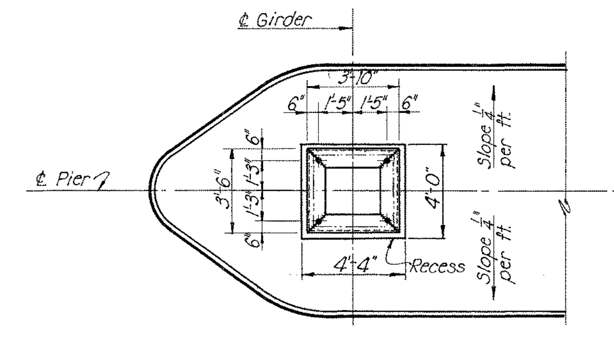
503

FED. ROAD DIV. NO.	STATE	FED. PROJ
2	OHIO	UH05

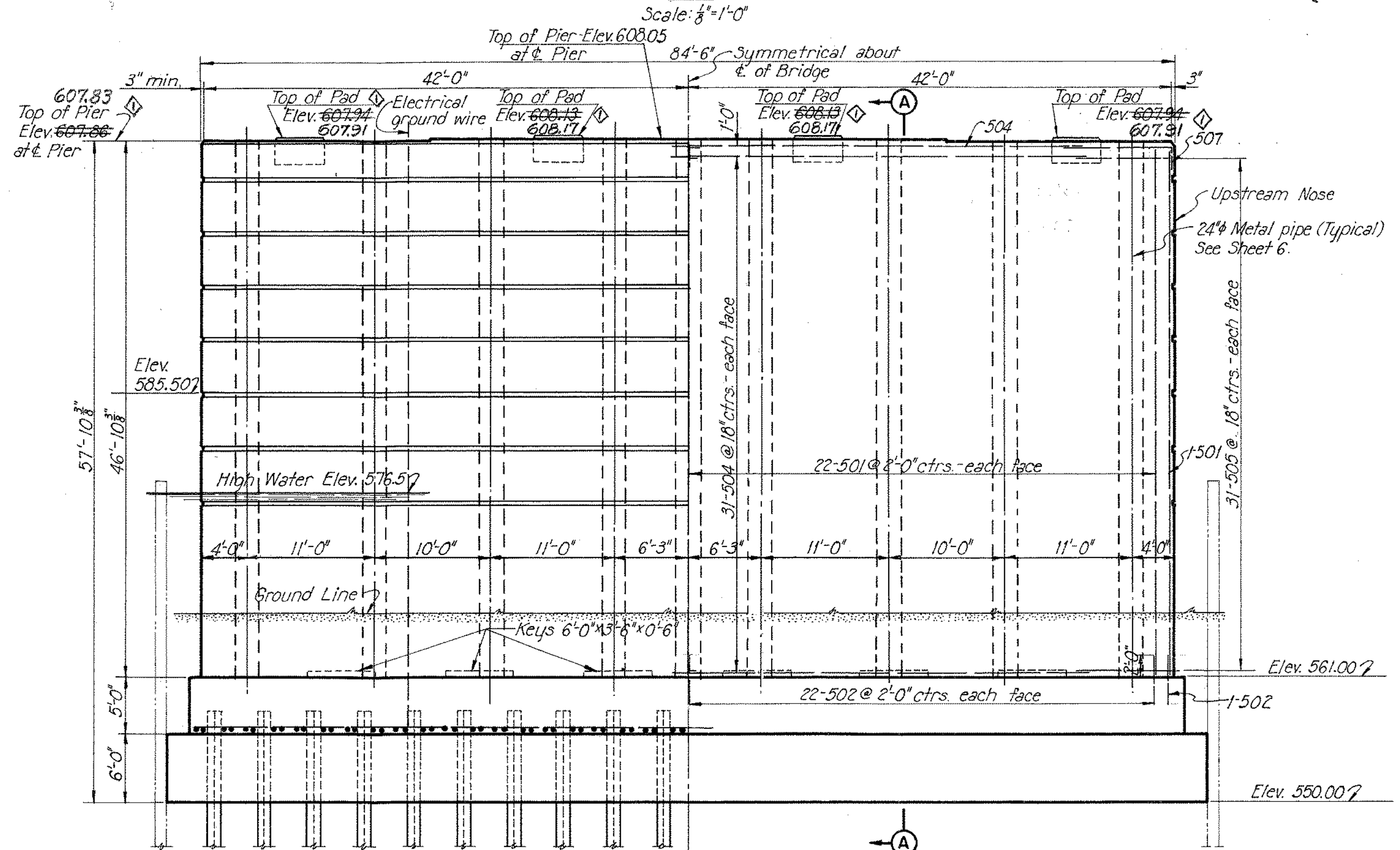
LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RIV
LUC 12C



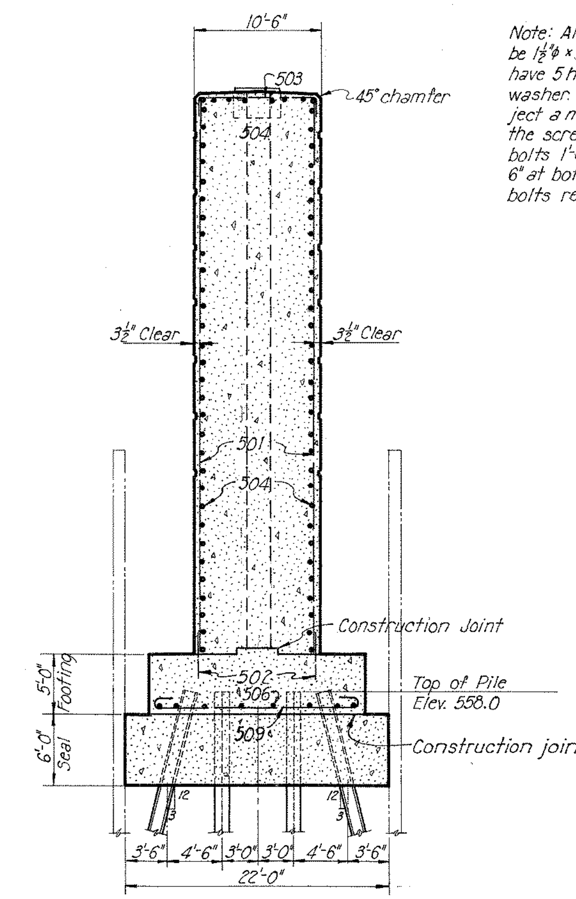
PLAN
Scale: 1/8"=1'-0"



PLAN AT SCREED FRAMES
Scale: 1/4"=1'-0"

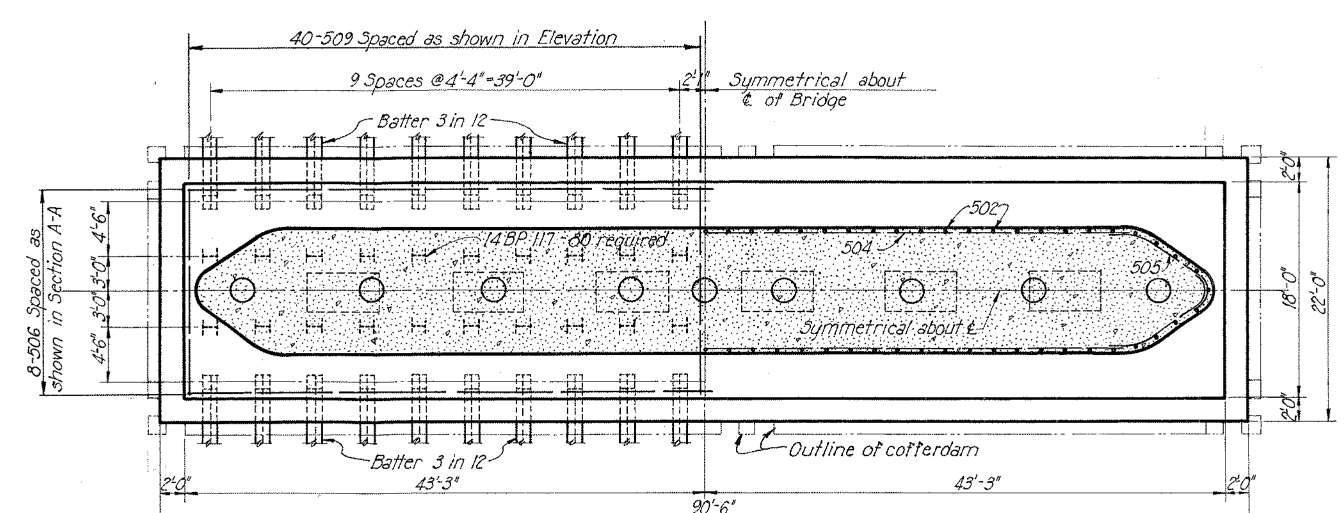


ELEVATION
Scale: 1/8"=1'-0"



SECTION A-A
Scale: 1/8"=1'-0"

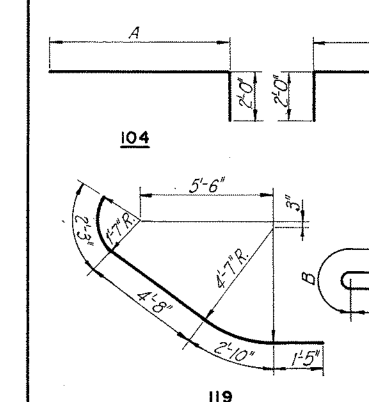
Note: All anchor bolts shall be 1 1/4"φ x 6'-0" long and shall have 5 hex. nuts and 1-3 1/2"φ x 1/4" washer each. Bolts shall project a minimum of 8" above the screed-frame. Thread bolts 1'-0 1/2" at top end and 6" at bottom end. Sixteen bolts required for Pier 2.



SECTION THRU SHAFT AT BASE
Scale: 1/8"=1'-0"

Note:
For typical screed frame details, rustication details, pile details, and general notes on piers, see Sheet 6.

REINFORCING BAR LIST AND BE				
Mark	Size	Number	Length	Type
501	5	88	46'-6"	Str.
502	5	88	4'-0"	Str.
503	5	35	13'-8"	105
504	5	140	36'-0"	Str.
505	5	124	11'-2"	119
506	5	16	43'-9"	Str.
507	5	4 Series of 4	5'-6" to 10'-1"	104
508	5	2 Series of 3	8'-4" to 13'-6"	105
509	5	80	18'-9"	100
Test replacement bar				
	5	2	8'-0"	Str.



STATE OF OH
DEPARTMENT OF H
BUREAU OF BR

TOLEDO EXPRESS
(FRONT STREET TO SU
MAUMEE RIVER
BR. NO. LU-12C

PIER 2

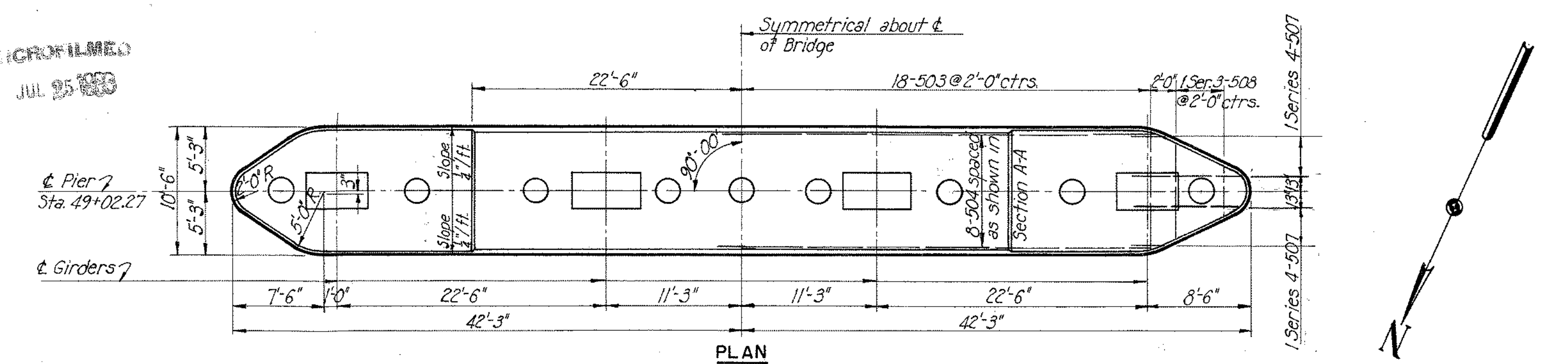
TOLEDO, LUCAS COU

SCALE 1/8", 1/4" = 1'-0"
MADE EBJ DATE 8-3-51
TRCD BLB DATE 8-15-51
CKD HAM DATE 8-27-51

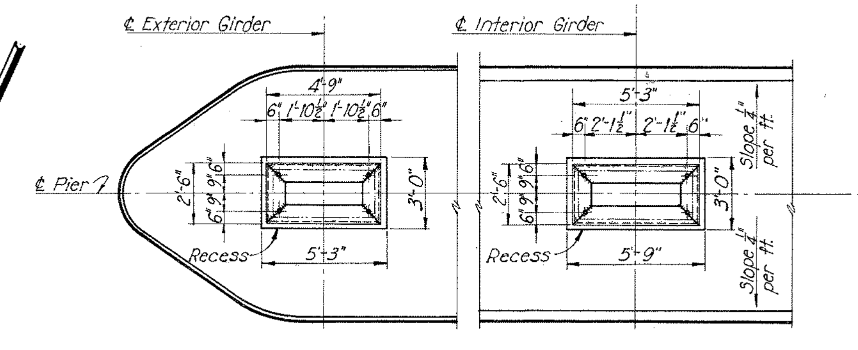
HOWARD, NEEDE
CONS
KANSAS CIT

Rev. ① 11-4-52

504

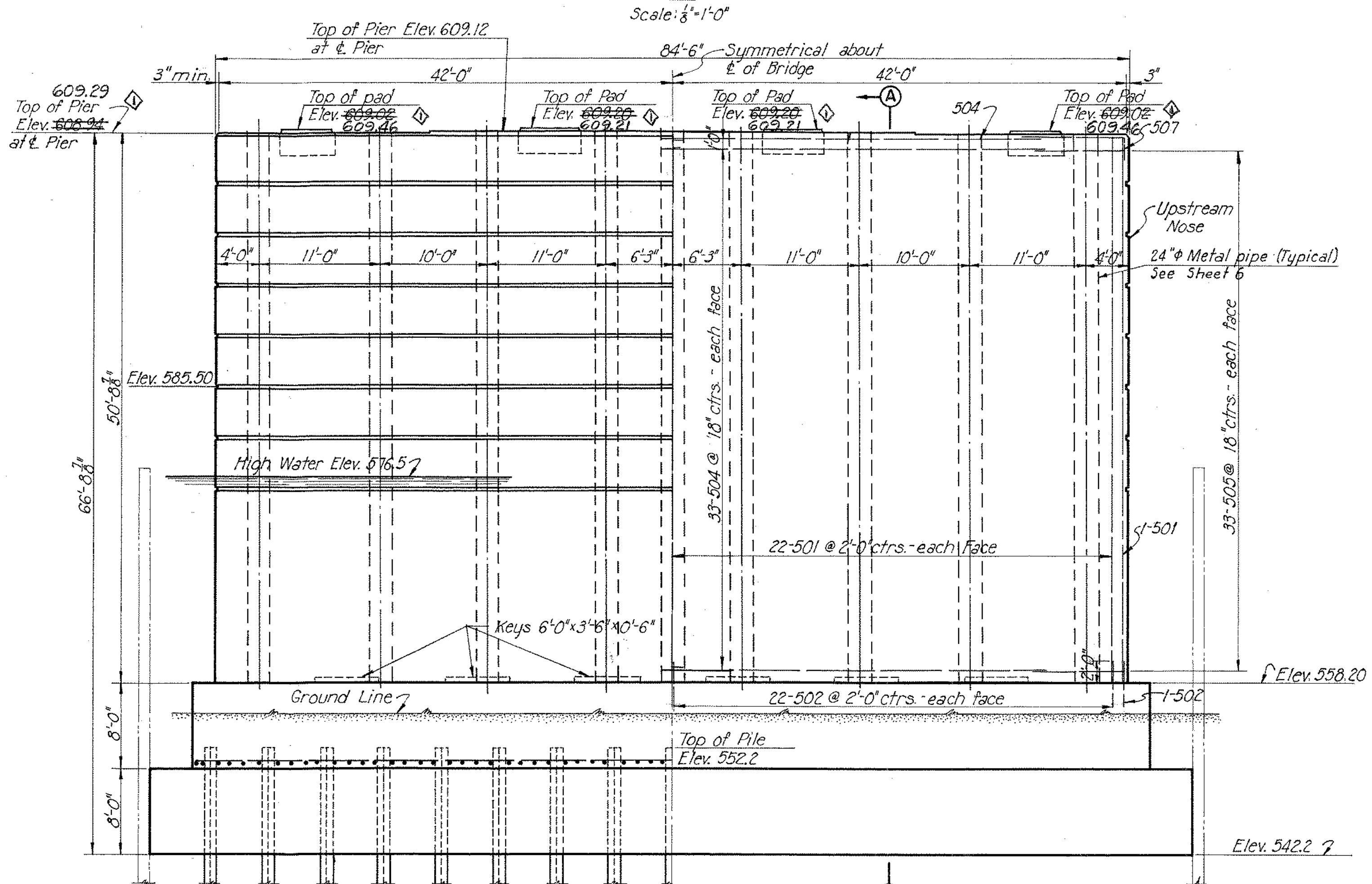


PLAN
Scale: 1/8"=1'-0"

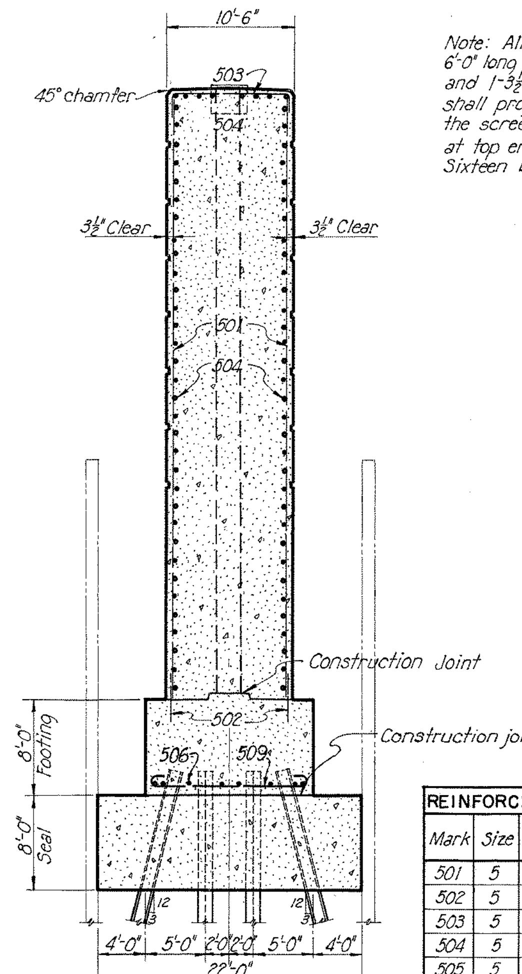


PLAN AT SCREED FRAMES
Scale: 1/4"=1'-0"

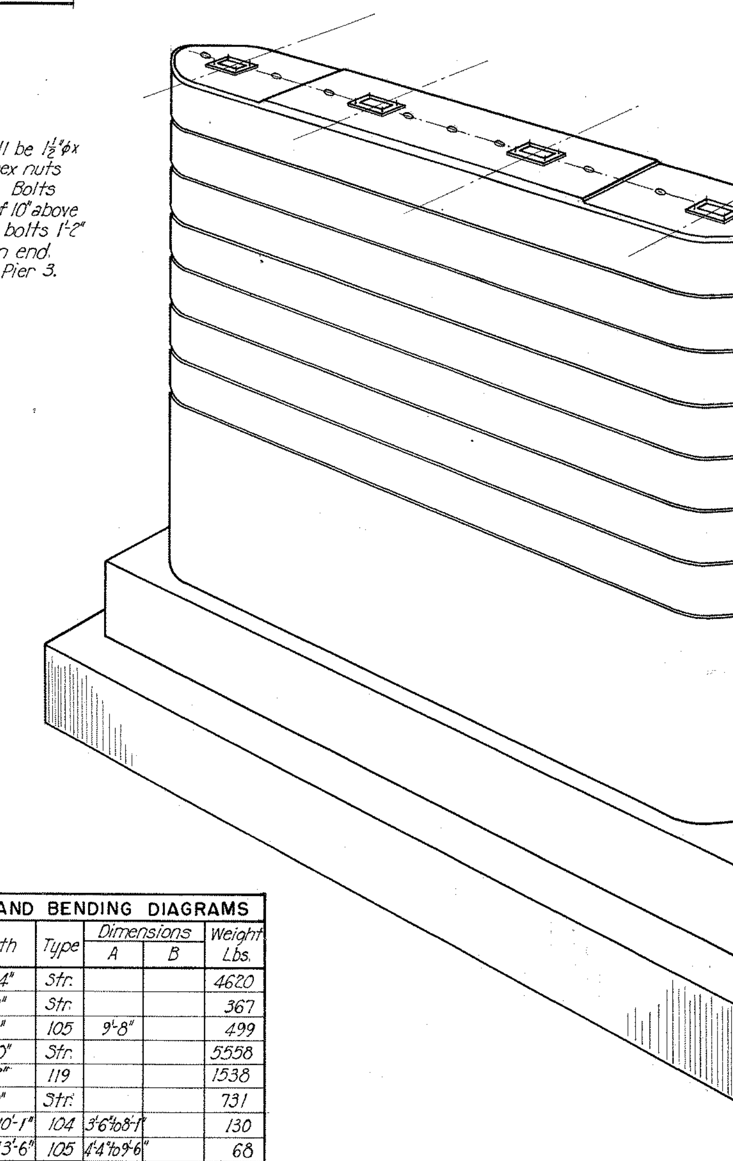
Note: All anchor bolts shall be 1½"ϕ x 6'-0" long and shall have 5 hex nuts and 1-3½"ϕ x ¼" washer each. Bolts shall project a minimum of 10" above the screed-frame. Thread bolts 1'-2" at top end and 6" at bottom end. Sixteen bolts required for Pier 3.



ELEVATION
Scale: 1/8"=1'-0"

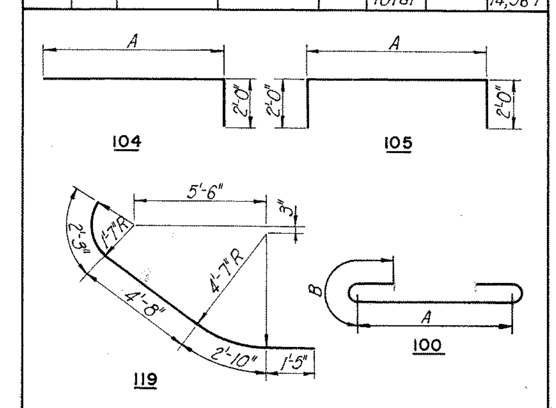


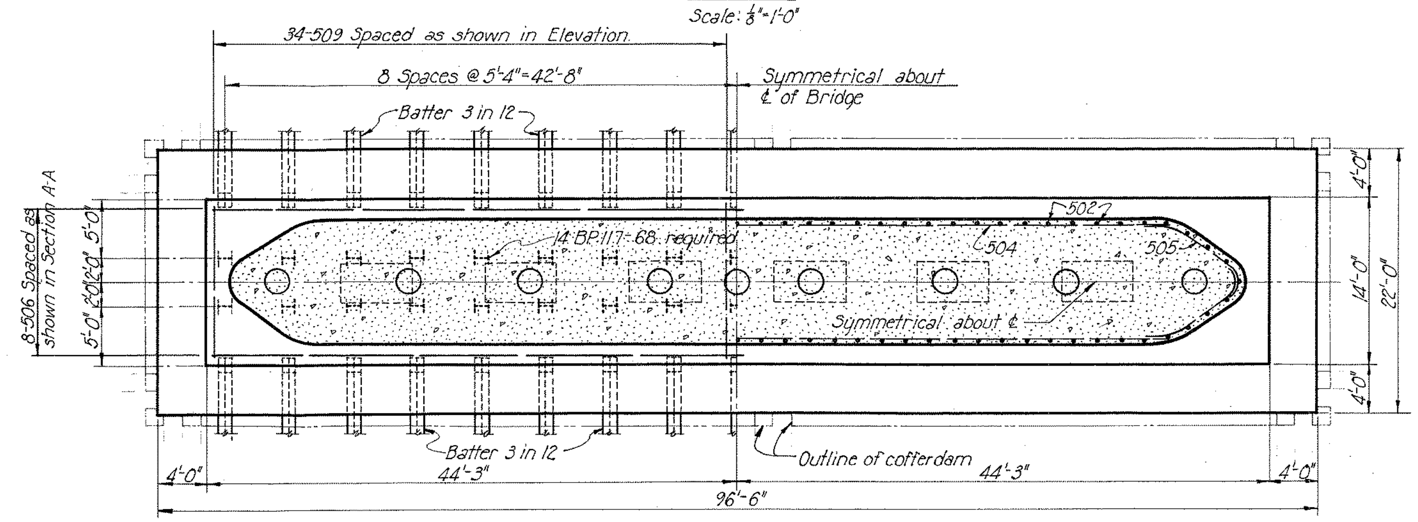
SECTION A-A
Scale: 1/8"=1'-0"



PERSPECTIVE VIEW OF PIER 3
Piers 1 and 2 similar

REINFORCING BAR LIST AND BENDING DIAGRAMS							
Mark	Size	Number	Length	Type	Dimensions A	Dimensions B	Weight Lbs.
501	5	88	50'-4"	Str.			4620
502	5	88	4'-0"	Str.			367
503	5	35	13'-8"	105	9'-8"		499
504	5	148	36'-0"	Str.			5558
505	5	132	11'-2"	119			1538
506	5	16	43'-9"	Str.			731
507	5	4 Series of 4	5'-6" to 10'-1"	104	3'-6" to 8'-1"		130
508	5	2 Series of 3	8'-4" to 13'-6"	105	4'-4" to 9'-6"		68
509	5	68	14'-9"	100	13'-1"	10"	1047
Test replacement bar							
	5	1	8'-0"	Str.			9
					Total		14,567





SECTION THRU SHAFT AT BASE
Scale: 1/8"=1'-0"

Note:
For typical screed frame details, rustication details, pile details and general notes on piers, see Sheet 6.

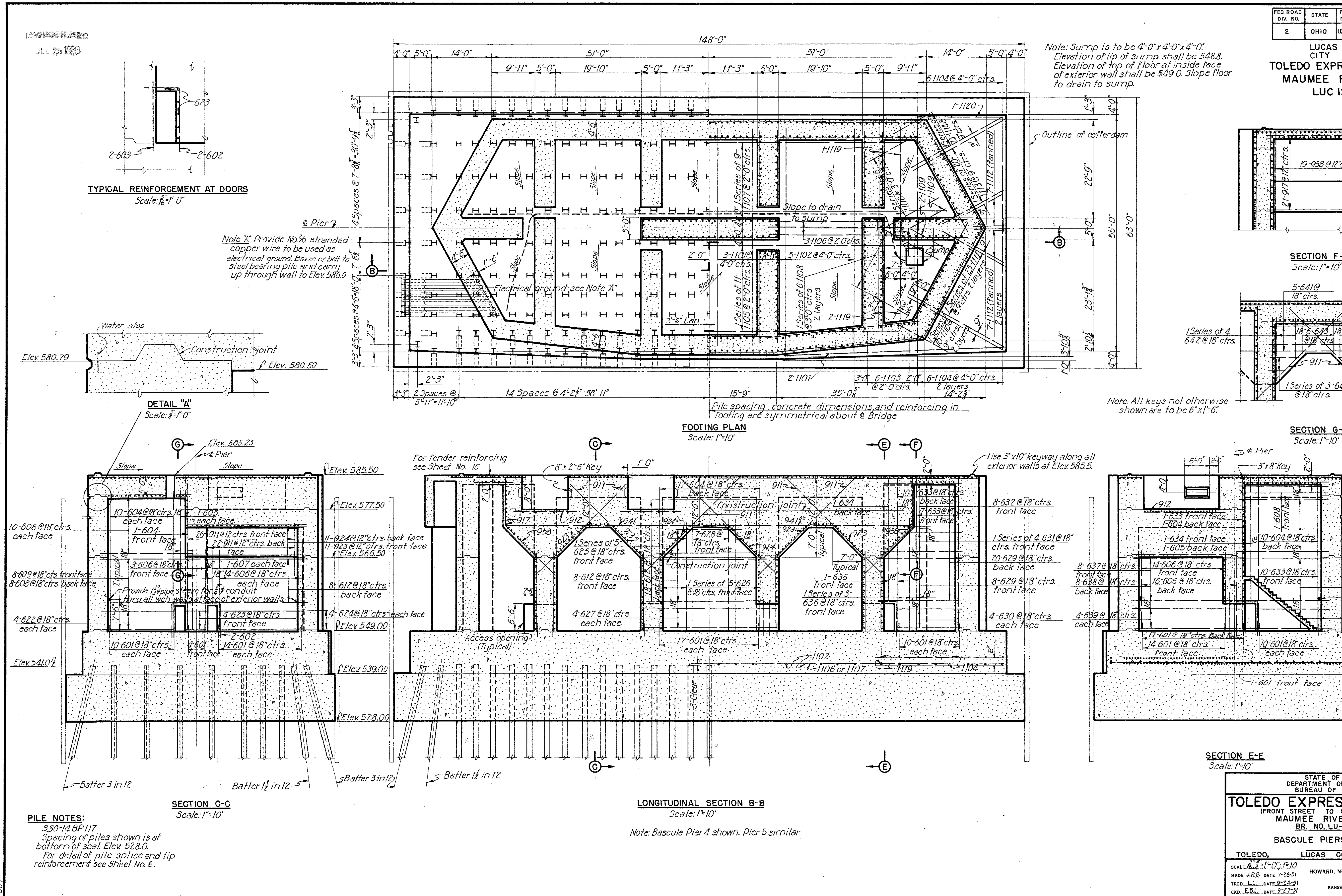
Rev. ① 11-4-52

FED. ROAD DIV. NO.	STATE	FE… PR…
2	OHIO	UHC…

LUCAS
CITY O…
TOLEDO EXPRE…
MAUMEE R…
LUC 12…

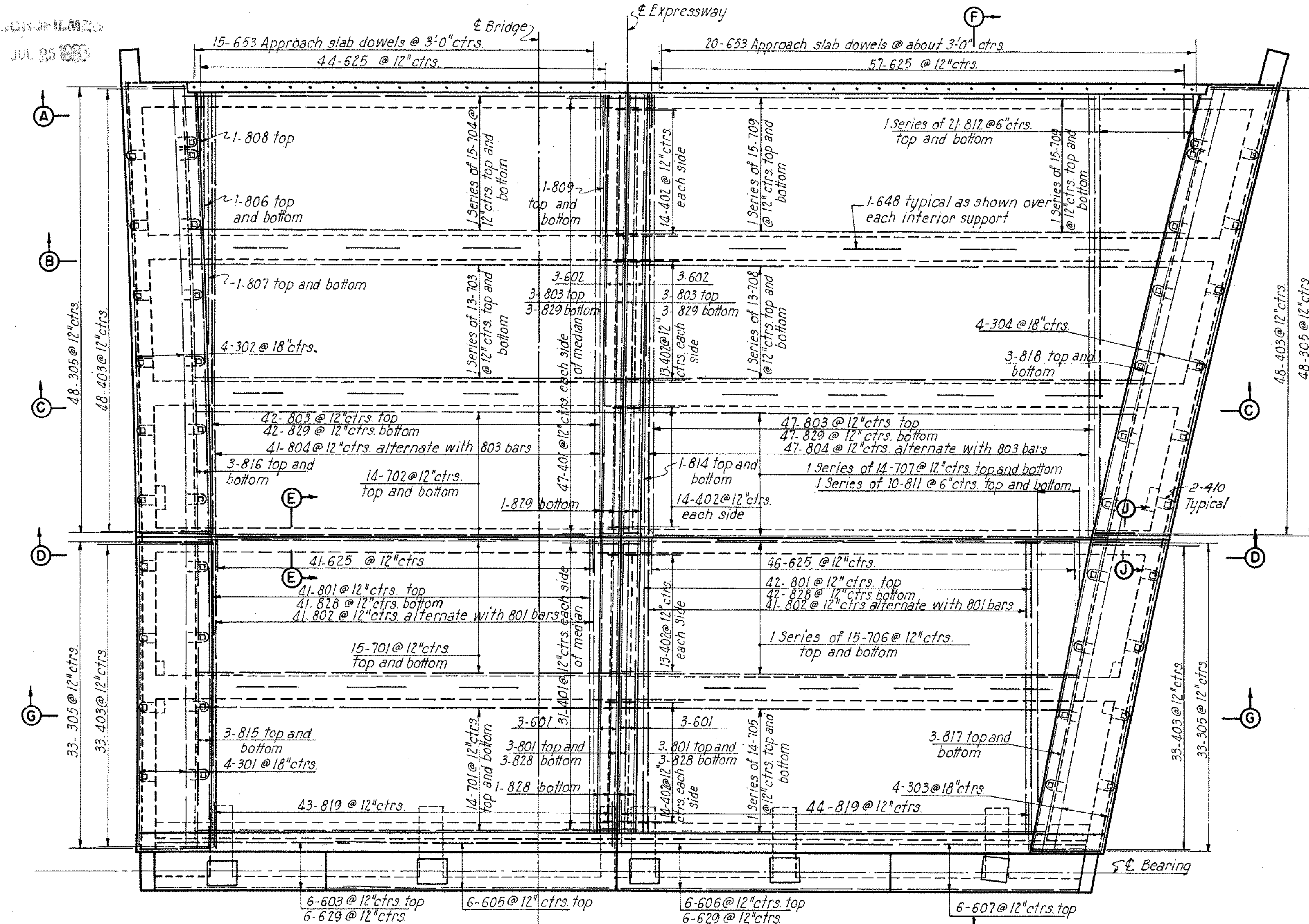
STATE OF …
DEPARTMENT OF …
BUREAU OF B…
TOLEDO EXPRESS…
(FRONT STREET TO S…
MAUMEE RIVER…
BR. NO. LU-12…
PIER 3
TOLEDO, LUCAS CO…
SCALE 1/8" 1/4" = 1'-0"
MADE FBJ/HWL DATE 8-10-51
TRCD BLB DATE 8-14-51
CKD. HBA DATE 8-27-51
HOWARD, NEE…
CO…
KANSAS C…

505

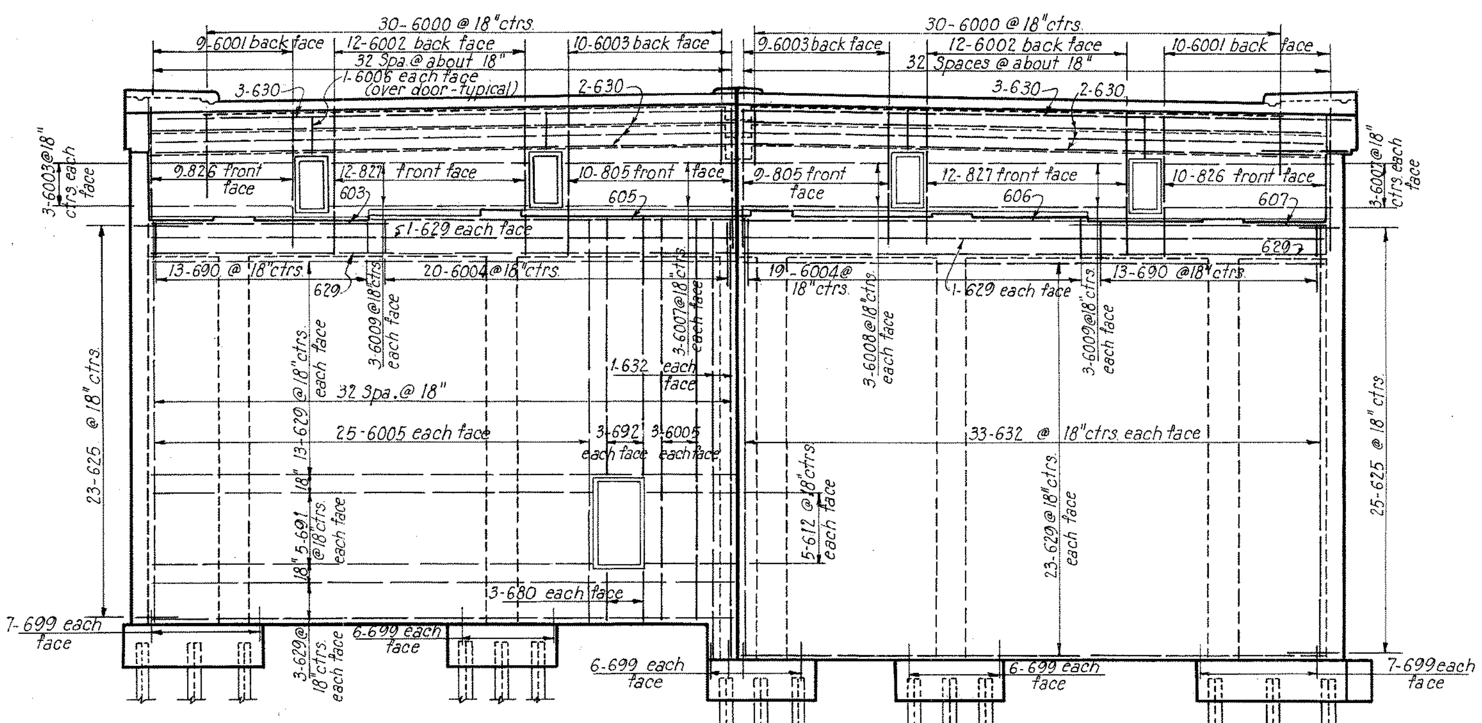

MICROFILMED
JUL 25 1983
FED. ROAD DIV. NO. 2
STATE OHIO
LUCAS
CITY
TOLEDO EXPR
MAUMEE R
LUC 1
TYPICAL REINFORCEMENT AT DOORS
Scale: 3/16"=1'-0"
Note "A" Provide No. 6 stranded copper wire to be used as electrical ground. Braze or bolt to steel bearing pile and carry up through wall to Elev. 586.0
DETAIL "A"
Scale: 3/4"=1'-0"
Note: Sump is to be 4'-0"x 4'-0"x 4'-0". Elevation of lip of sump shall be 548.8. Elevation of top of floor at inside face of exterior wall shall be 549.0. Slope floor to drain to sump.
Outline of cofferdam
Pile spacing, concrete dimensions and reinforcing in footing are symmetrical about ℄ Bridge
FOOTING PLAN
Scale: 1"=10'
Note: All keys not otherwise shown are to be 6"x 1'-6".
SECTION F-
Scale: 1"=10'
SECTION G-
Scale: 1"=10'
For fender reinforcing see Sheet No. 15
Use 3"x10" keyway along all exterior walls at Elev. 585.5.
SECTION C-C
Scale: 1"=10'
LONGITUDINAL SECTION B-B
Scale: 1"=10'
Note: Bascule Pier 4 shown. Pier 5 similar
SECTION E-E
Scale: 1"=10'
PILE NOTES:
330-14 BP 117
Spacing of piles shown is at bottom of seal. Elev. 528.0.
For detail of pile splice and tip reinforcement see Sheet No. 6.
STATE OF
DEPARTMENT O
BUREAU OF
TOLEDO EXPRES
(FRONT STREET TO
MAUMEE RIVE
BR. NO. LU-
BASCULE PIERS
TOLEDO, LUCAS C
MADE J.R.B. DATE 7-28-51
TRCD. L.L. DATE 9-24-51
CKD. F.B.J. DATE 9-27-51
HOWARD, N
507

FED. ROAD DIV. NO.	STATE
2	OHIO

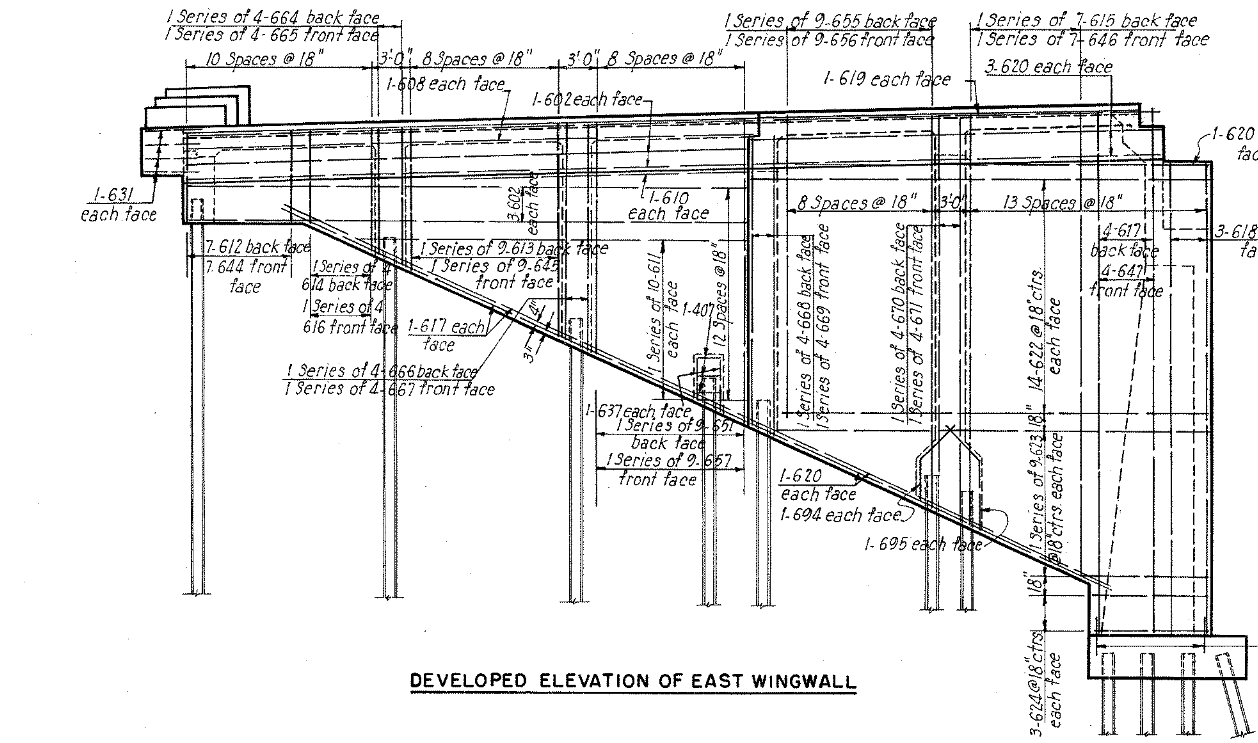
LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RIV
LUC 120



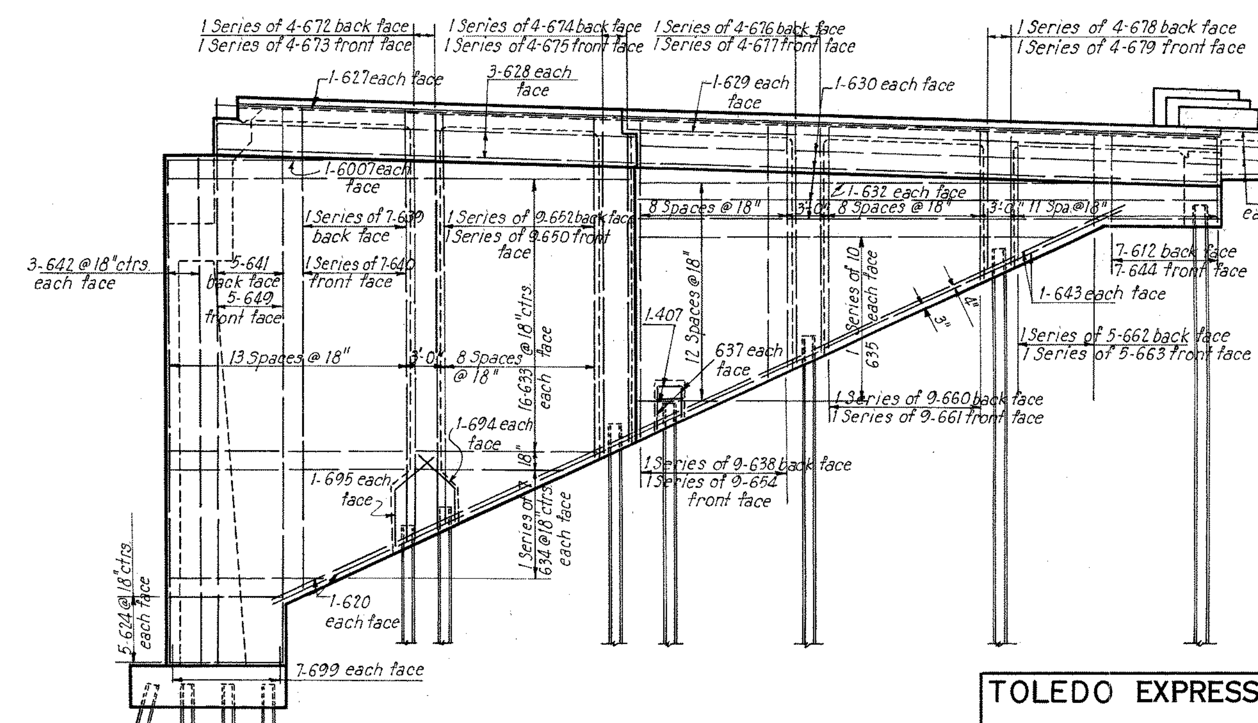
SLAB PLAN



FRONT ELEVATION



DEVELOPED ELEVATION OF EAST WINGWALL



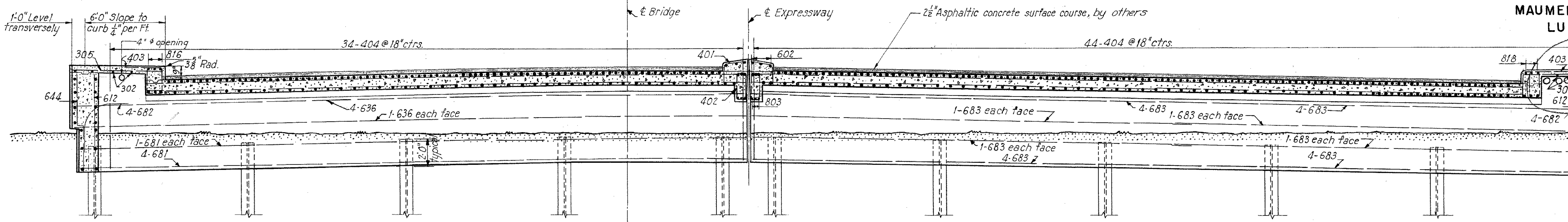
DEVELOPED ELEVATION OF WEST WINGWALL

TOLEDO EXPRESS
MAUMEE RIVER
BR NO LU
SOUTH ABUT
TOLEDO LUCAS CO

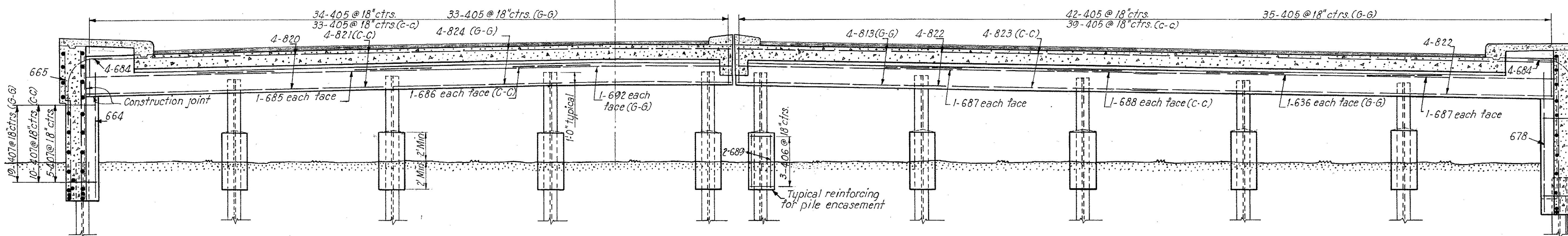
SCALE 1/8" = 1'-0"
MADE C.R. DATE 1-9-52
TRCD GAS R.R. DATE 8-18-52
CKD J.P.S. DATE 8-20-52
HOWARD, NEE
KANSAS

FED. ROAD DIV. NO.	STATE
2	OHIO

LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC

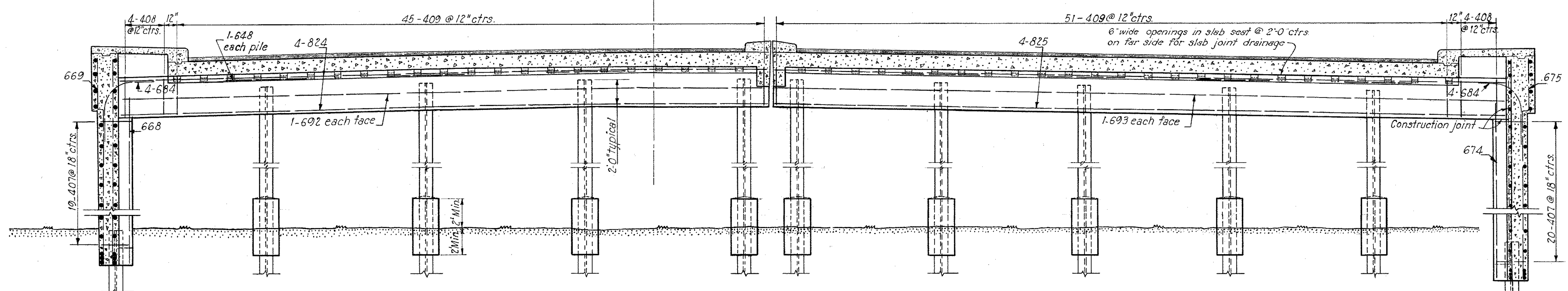


SECTION A-A



SECTIONS B-B, C-C AND G-G

Section B-B shown
Section C-C and G-G similar.



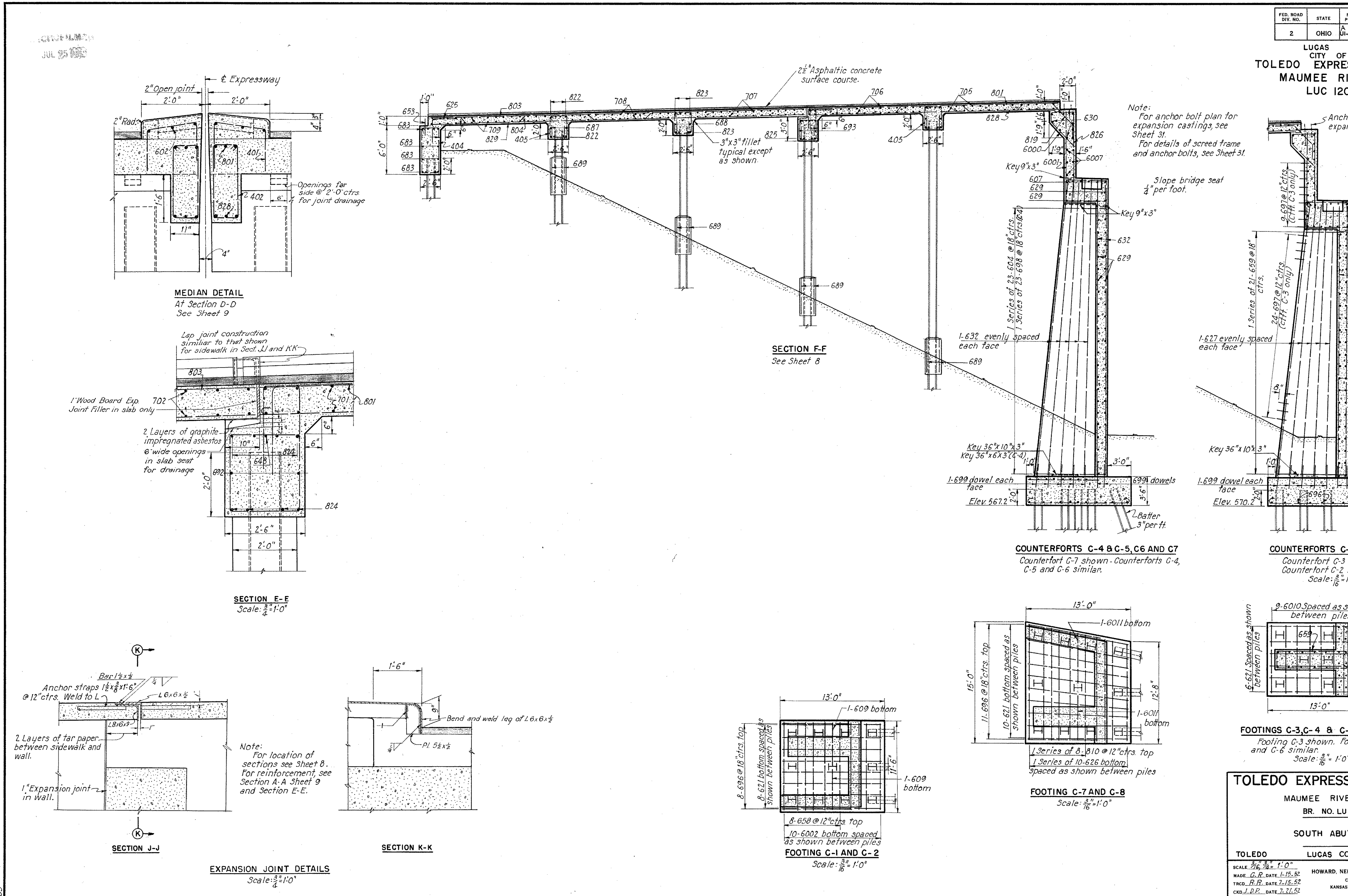
SECTION D-D

Note:
Reinforcing steel in slab and sidewalk of Section B-B, C-C, D-D and G-G similar to that in Section A-A. For location of sections, see Sheet 8.

Rev. 2-8-54

TOLEDO EXPRES
MAUMEE RI
BR. NO. L
SOUTH A
TOLEDO LUCAS

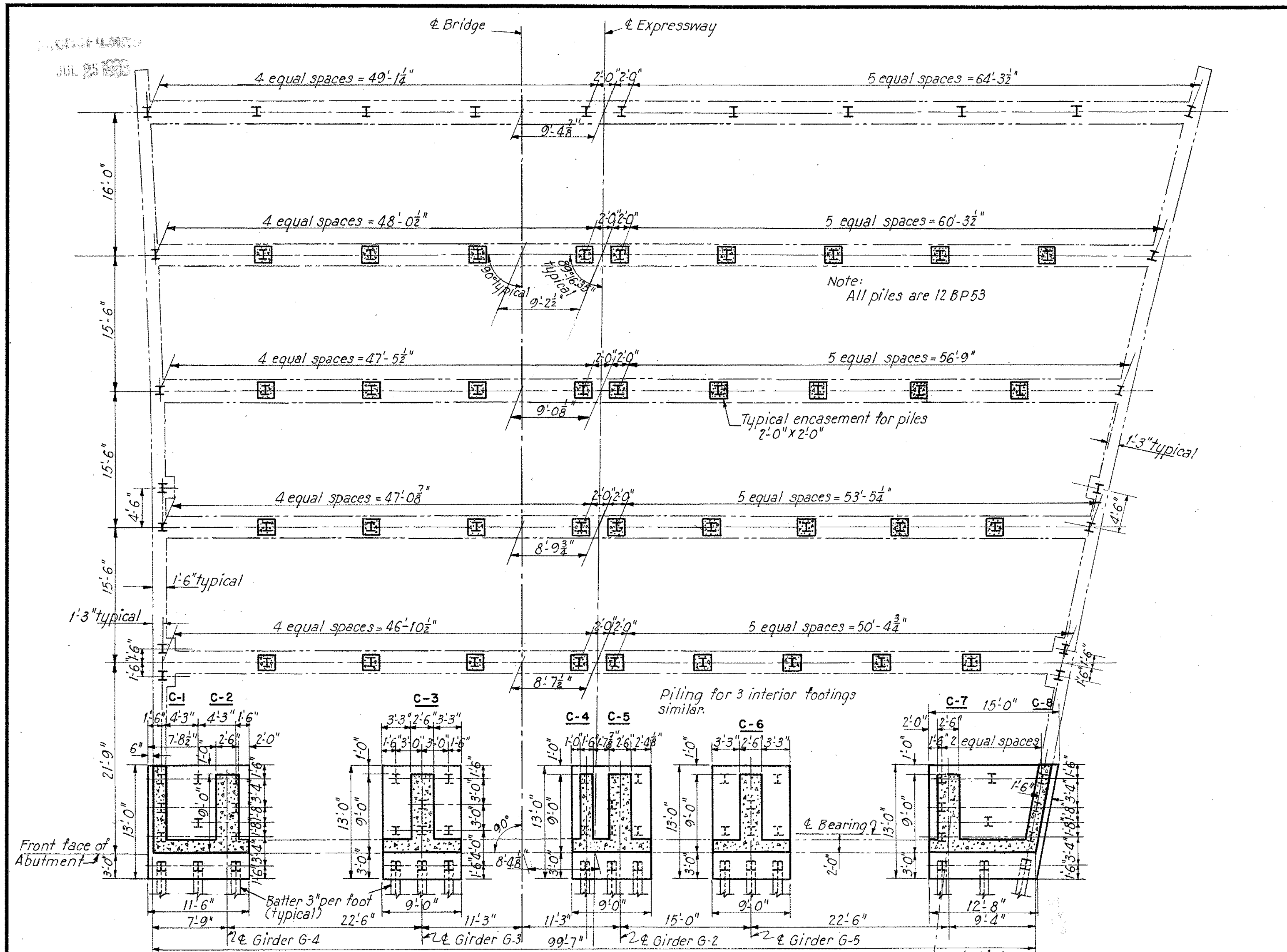
SCALE 1/4" = 1'-0"
MADE C.R. DATE 1-8-52
TRCD J.M.RR DATE 7-9-52
CKD J.D.P. DATE 7-10-52
HOWARD,



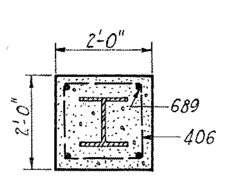
FED. ROAD DIV. NO. 2
STATE OHIO
LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RI
LUC 12C
JUL 25 1962
MEDIAN DETAIL
At Section D-D
See Sheet 9
2" Open joint
℄ Expressway
Openings for side @ 2'-0" ctrs. for joint drainage
SECTION E-E
Scale: 3/4"=1'-0"
Lap joint construction similiar to that shown for sidewalk in Sect. JJ and KK
1" Wood Board Exp. Joint Filler in slab only
2 Layers of graphite impregnated asbestos
6" wide openings in slab seat for drainage
2 1/2" Asphaltic concrete surface course.
3"x3" fillet typical except as shown.
SECTION F-F
See Sheet 8
Note:
For anchor bolt plan for expansion castings, see Sheet 31.
For details of screed frame and anchor bolts, see Sheet 31.
Slope bridge seat 1/4" per foot.
1 Series of 23-604 @ 18" ctrs.
1 Series of 23-698 @ 18" ctrs. (C-4)
1-632 evenly spaced each face
Key 36"x10"x3"
Key 36"x6"x3" (C-4)
1-699 dowel each face
Elev. 567.2
699 dowels
Batter 3" per ft.
COUNTERFORTS C-4 & C-5, C6 AND C7
Counterfort C-7 shown - Counterforts C-4, C-5 and C-6 similar.
1-627 evenly spaced each face
Elev. 570.2
COUNTERFORTS C-
Counterfort C-3
Counterfort C-2
Scale: 3/16"=1'-0"
13'-0"
1-6011 bottom
1-696 @ 18" ctrs. top
10-621 bottom spaced as shown between piles
1 Series of 8-810 @ 12" ctrs. top
1 Series of 10-626 bottom
spaced as shown between piles
FOOTING C-7 AND C-8
Scale: 3/16"=1'-0"
9-6010 Spaced as shown between piles
6-621 Spaced as shown between piles
FOOTINGS C-3, C-4 & C-
Footing C-3 shown. Fo and C-6 similar.
Scale: 3/16"=1'-0"
1-609 bottom
8-696 @ 18" ctrs. top
8-621 bottom spaced as shown between piles
8-658 @ 12" ctrs. top
10-6002 bottom spaced as shown between piles
FOOTING C-1 AND C-2
Scale: 3/16"=1'-0"
Bar 1 1/2 x 1/2
Anchor straps 1 1/2 x 3/8 x 1'-6" @ 12" ctrs. Weld to L
L 6x6x1/2
2 Layers of tar paper between sidewalk and wall.
1" Expansion joint in wall.
SECTION J-J
Note:
For location of sections see Sheet 8.
For reinforcement, see Section A-A Sheet 9 and Section E-E.
Bend and weld leg of L 6x6x1/2
Pl. 5 1/2 x 1/2
SECTION K-K
EXPANSION JOINT DETAILS
Scale: 3/4"=1'-0"
TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU
SOUTH ABU
TOLEDO
LUCAS CO
SCALE 3/16, 3/4 = 1'-0"
MADE G.R. DATE 1-15-62
TRCD R.R. DATE 7-15-62
CKD J.D.P. DATE 7-21-62
HOWARD, NE
KANSAS

FED. ROAD DIV. NO.	STATE
2	OHIO

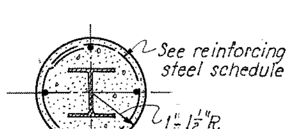
LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC 12



FOOTING PLAN
Scale: 1/8" = 1'-0"



TYPICAL PILE ENCASEMENT
Scale: 1/2" = 1'-0"



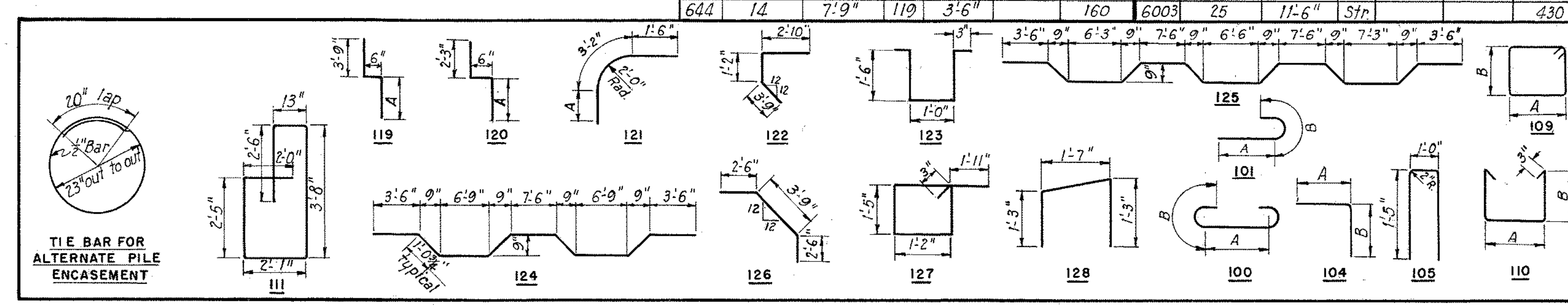
ALTERNATE PILE ENCASEMENT
Scale: 1/2" = 1'-0"

REINFORCING STEEL SCHEDULE

Mark	Number	Length	Type	Dimensions A	Dimensions B	Weight
301	4	33'-0"	Str.			50
302	4	47'-6"	Str.			70
303	4	33'-6"	Str.			50
304	4	48'-6"	Str.			70
305	162	6'-6"	Str.			400
401	156	4'-4"	128			450
402	136	5'-0"	109	0'-6 1/2"	2'-1 1/2"	450
403	162	7'-4"	127			790
404	78	16'-2"	109	2'-1 1/2"	5'-7 1/2"	840
405	216	10'-0"	109	2'-1 1/2"	2'-7 1/2"	1440
406	108	7'-0"	109	1'-7 1/2"	1'-7 1/2"	510
407	112	9'-0"	109	2'-1 1/2"	2'-1 1/2"	670
408	104	9'-4"	109	1'-1 1/2"	2'-3 1/2"	650
409	96	13'-9"	111			880
410	84	3'-10"	105			220
601	6	31'-0"	Str.			280
602	16	46'-6"	Str.			1120
603	6	20'-0"	Str.			180
604	3 Ser. of 23	13'-2" to 19'-8"	110	2'-1 1/2"	5'-3" to 8'-6"	1700
605	6	30'-6"	Str.			270
606	6	28'-9"	Str.			260
607	6	21'-6"	Str.			190
608	4	47'-6"	Str.			290
609	2	5'-11"	101	5'-0"	0'-11"	20
610	2	24'-0"	Str.			70
611	2 Ser. of 10	7'-0" to 34'-0"	Str.			620
612	24	7'-3"	Str.			260
613	1 Ser. of 9	11'-9" to 18'-0"	Str.			200
614	1 Ser. of 4	7'-9" to 10'-0"	Str.			50
615	1 Ser. of 7	33'-6" to 38'-0"	Str.			380
616	1 Ser. of 4	8'-3" to 10'-3"	119	4'-0" to 6'-0"		60
617	8	42'-6"	Str.			510
618	6	39'-3"	Str.			350
619	2	33'-3"	Str.			100
620	16	34'-3"	Str.			820
621	36	13'-10"	100	12'-0"	0'-11"	750
622	28	37'-6"	Str.			1580
623	2 Ser. of 9	10'-6" to 35'-9"	Str.			620
624	16	9'-6"	Str.			230
625	236	4'-9"	104	2'-0"	2'-9"	1680
626	1 Ser. of 10	13'-6" to 15'-10"	100	11'-8" to 14'-0"	0'-11"	220
627	22	33'-6"	Str.			1110
628	6	34'-9"	Str.			310
629	98	49'-0"	Str.			7200
630	26	48'-0"	Str.			1870
631	16	5'-3"	Str.			130
632	112	36'-0"	Str.			6050
633	32	38'-6"	Str.			1850
634	2 Ser. of 7	13'-0" to 30'-3"	Str.			460
635	2 Ser. of 10	6'-0" to 36'-0"	Str.			630
636	8	52'-0"	Str.			630
637	8	3'-9"	Str.			50
638	1 Ser. of 9	19'-0" to 24'-0"	Str.			290
639	1 Ser. of 7	35'-6" to 39'-9"	Str.			400
640	1 Ser. of 7	36'-0" to 40'-6"	119	31'-9" to 36'-3"		400
641	5	43'-6"	Str.			330
642	6	41'-6"	Str.			370
643	4	44'-0"	Str.			260
644	14	7'-9"	119	3'-6"		160

Mark	Number	Length	Type	Dimensions A	Dimensions B	Weight
645	1 Ser. of 9	12'-6" to 19'-0"	119	8'-3" to 14'-6"		210
646	1 Ser. of 7	34'-3" to 39'-0"	119	30'-0" to 34'-9"		380
647	4	43'-9"	119	39'-6"		260
648	28	6'-0"	Str.			250
649	5	46'-9"	119	42'-6"		350
650	1 Ser. of 9	28'-3" to 35'-3"	119	23'-0" to 30'-0"		430
651	1 Ser. of 9	18'-0" to 25'-0"	Str.			290
652	1 Ser. of 9	27'-9" to 34'-9"	Str.			420
653	35	2'-6"	Str.			130
654	1 Ser. of 9	21'-0" to 24'-9"	119			310
655	1 Ser. of 9	26'-9" to 32'-3"	Str.			400
656	1 Ser. of 9	27'-3" to 32'-9"	119			410
657	1 Ser. of 9	18'-6" to 25'-6"	119	15'-3" to 21'-3"		300
658	18	12'-4"	100	10'-6"	0'-11"	330
659	2 Ser. of 21	12'-8" to 19'-8"	110	2'-1 1/2"	5'-0" to 8'-6"	1020
660	1 Ser. of 9	12'-9" to 18'-6"	Str.			210
661	1 Ser. of 9	13'-6" to 19'-0"	119	9'-3" to 15'-0"		220
662	1 Ser. of 5	7'-6" to 11'-0"	Str.			70
663	1 Ser. of 5	8'-0" to 11'-9"	119	3'-9" to 7'-6"		70
664	1 Ser. of 4	10'-0" to 11'-3"	Str.			60
665	1 Ser. of 4	10'-9" to 12'-0"	119	6'-6" to 7'-9"		70
666	1 Ser. of 4	18'-0" to 19'-0"	Str.			110
667	1 Ser. of 4	18'-6" to 19'-6"	119	14'-3" to 15'-3"		110
668	1 Ser. of 4	23'-6" to 24'-6"	Str.			140
669	1 Ser. of 4	24'-0" to 25'-0"	120	21'-3" to 22'-3"		150
670	1 Ser. of 4	32'-9" to 33'-6"	Str.			190
671	1 Ser. of 4	33'-3" to 34'-0"	119	29'-0" to 29'-9"		200
672	1 Ser. of 4	34'-6" to 35'-6"	Str.			210
673	1 Ser. of 4	35'-0" to 36'-0"	119	30'-9" to 31'-9"		210
674	1 Ser. of 4	25'-3" to 26'-3"	Str.			150
675	1 Ser. of 4	25'-3" to 26'-3"	120	22'-6" to 23'-6"		160
676	1 Ser. of 4	19'-0" to 20'-0"	Str.			120
677	1 Ser. of 4	19'-6" to 20'-6"	119	15'-3" to 16'-3"		120
678	1 Ser. of 4	11'-0" to 12'-0"	Str.			70
679	1 Ser. of 4	11'-6" to 12'-6"	119			70
680	6	4'-3"	Str.			40
681	6	51'-6"	Str.			460
682	8	6'-5"	121	1'-9"		80
683	24	34'-6"	Str.			1240
684	32	7'-11"	121	3'-3"		380
685	2	49'-3"	Str.			150
686	2	48'-3"	Str.			140
687	4	32'-6"	Str.			200
688	2	58'-3"	Str.			170
689	144	3'-6"	Str.			760
690	26	13'-2"	109	3'-8"	2'-8"	510
691	10	36'-6"	Str.			550
692	6	21'-3"	Str.			190
693	2	54'-6"	Str.			160
694	4	7'-0"	108	2'-9"	4'-3"	40
695	4	9'-6"	108	5'-3"	4'-3"	60
696	19	8'-6"	Str.			240
697	33	4'-6"	123			220
698	1 Ser. of 23	12'-2" to 18'-8"	110	1'-1 1/2"	5'-3" to 8'-6"	530
699	152	3'-0"	Str.			680
6000	60	7'-9"	122			700
6001	19	10'-6"	Str.			300
6002	24	11'-0"	Str.			400
6003	25	11'-6"	Str.			430

Mark	Number	Length	Type
6004	39	13'-6"	109
6005	56	33'-0"	Str.
6006	8	3'-3"	Str.
6007	14	14'-0"	Str.
6008	6	12'-3"	Str.
6009	12	16'-3"	Str.
6010	27	9'-10"	100
6011	2	6'-8"	101
701	58	44'-3"	Str.
702	28	44'-9"	Str.
703	2 Ser. of 13	45'-3" to 45'-9"	Str.
704	2 Ser. of 15	46'-0" to 46'-6"	Str.
705	2 Ser. of 14	45'-0" to 47'-0"	Str.
706	2 Ser. of 15	48'-0" to 50'-9"	Str.
707	2 Ser. of 14	50'-9" to 54'-0"	Str.
708	2 Ser. of 13	54'-3" to 57'-0"	Str.
709	4 Ser. of 15	30'-3" to 32'-3"	Str.
801	89	30'-6"	Str.
802	82	31'-11"	124
803	95	46'-6"	Str.
804	88	48'-3"	125
805	19	11'-6"	Str.
806	2	14'-6"	Str.
807	2	35'-6"	Str.
808	1	8'-0"	Str.
809	2	20'-0"	Str.
810	1 Ser. of 8	15'-2" to 17'-4"	100
811	2 Ser. of 10	5'-6" to 31'-0"	Str.
812	2 Ser. of 21	2'-6" to 43'-0"	Str.
813	8	52'-0"	Str.
814	2	24'-6"	Str.
815	6	33'-0"	Str.
816	6	47'-6"	Str.
817	6	33'-6"	Str.
818	6	48'-6"	Str.
819	87	8'-9"	126
820	8	49'-3"	Str.
821	8	48'-3"	Str.
822	16	33'-0"	Str.
823	8	58'-3"	Str.
824	8	48'-0"	Str.
825	8	54'-6"	Str.
826	19	10'-6"	Str.
827	24	11'-0"	Str.
828	93	33'-1"	100
829	99	48'-5"	100

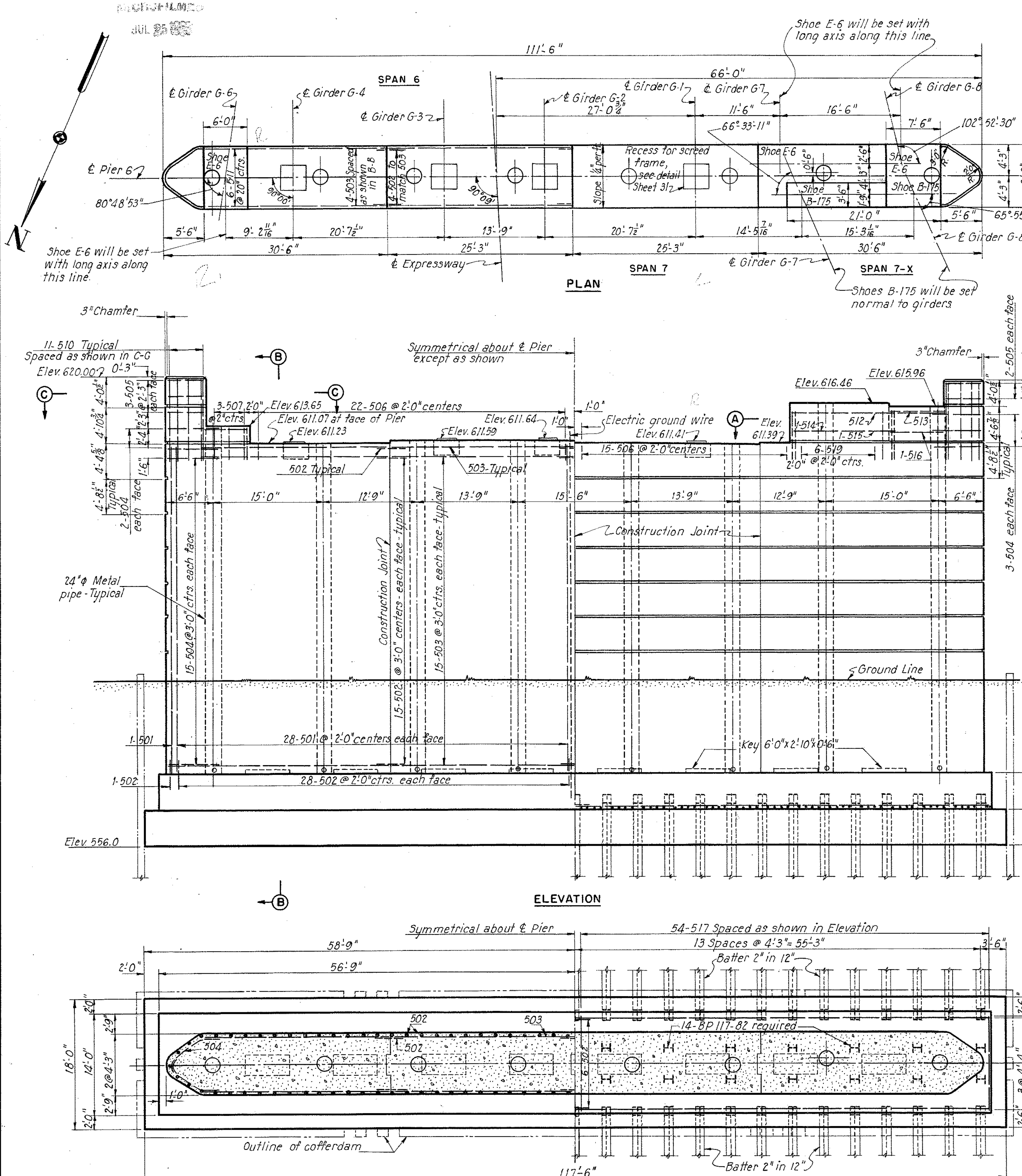


TOLEDO EXPRES
MAUMEE R
BR. NO.
SOUTH AB
TOLEDO
LUCAS

SCALE 1/8" = 1'-0"
MADE C.R. DATE 12-19-51
TRCD R.R. DATE 7-28-52
CKD J.P.S. DATE 7-29-52
HOWARD,
KAN

FED. ROAD DIV. NO.	STATE
2	OHIO

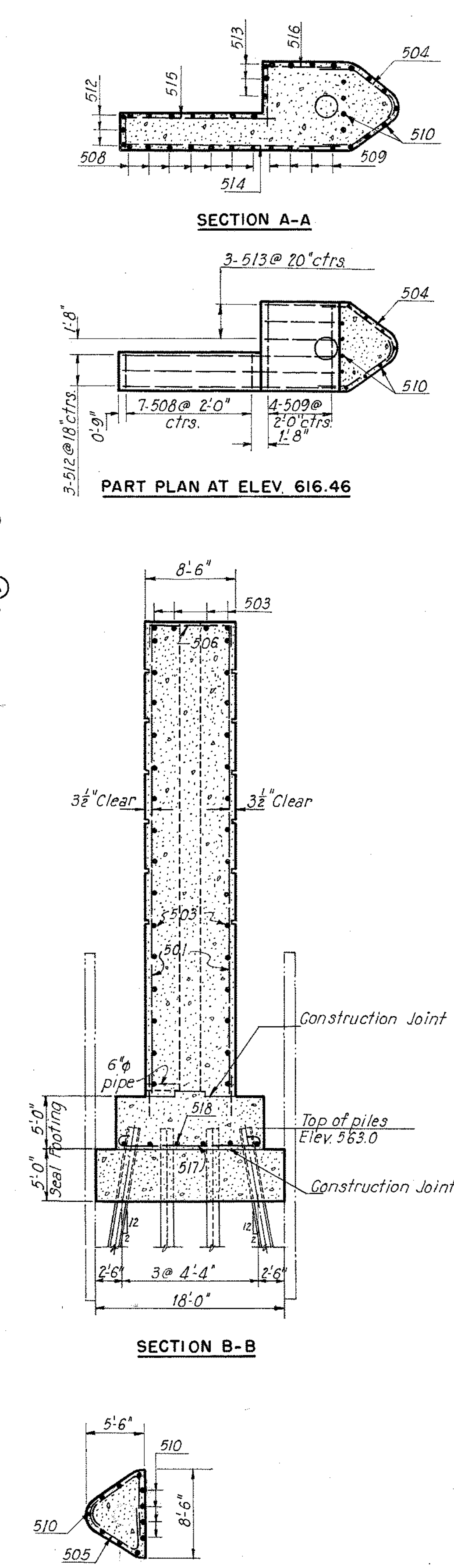
LUCAS
CITY O
TOLEDO EXPR
MAUMEE R
LUC 12



PLAN

ELEVATION

SECTION THRU SHAFT AT BASE



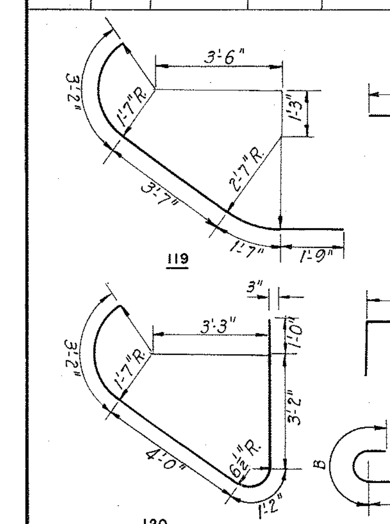
SECTION A-A

PART PLAN AT ELEV. 616.46

SECTION B-B

SECTION C-C

REINFORCING STEEL SCH				
Mark	No.	Length	Type	Dime A
501	114	44'-9"	Str.	
502	222	4'-0"	Str.	
503	136	25'-0"	Str.	
504	70	10'-1"	119	
505	10	12'-6"	120	
506	37	11'-10"	105	7'-10"
507	3	16'-6"	105	7'-10"
508	7	15'-8"	105	3'-0"
509	4	20'-6"	105	7'-10"
510	22	11'-0"	Str.	
511	6	10'-1"	104	5'-9"
512	3	27'-1"	104	20'-9"
513	3	13'-7"	104	7'-3"
514	1	20'-9"	Str.	
515	1	17'-3"	104	14'-3"
516	1	12'-11"	104	7'-3"
517	108	14'-9"	100	13'-1"
518	12	56'-3"	Str.	
519	6	7'-9"	104	5'-9"
				Total



Notes:

For pile splice and tip reinforcement, see Sheet 32.

For rustication details, see Sheet 32.

Provide 24"φ ventilation cells formed with metal pipe. Pipes shall be flush with top of pier, and shall be filled with concrete three months after pier wall concrete has been placed. Embeco concrete, or equal, shall be used for top three feet. Provisions shall be made to keep cells free of water and simultaneously provide ventilation.

All piles to be 14 BP117.

Top of pier shall be finished to a true plane surface at the elevations given except for areas adjacent to screed frames which shall be finished to slope ¼" per ft. each way from ℄ pier.

Ventilation pipes are included with concrete for payment.

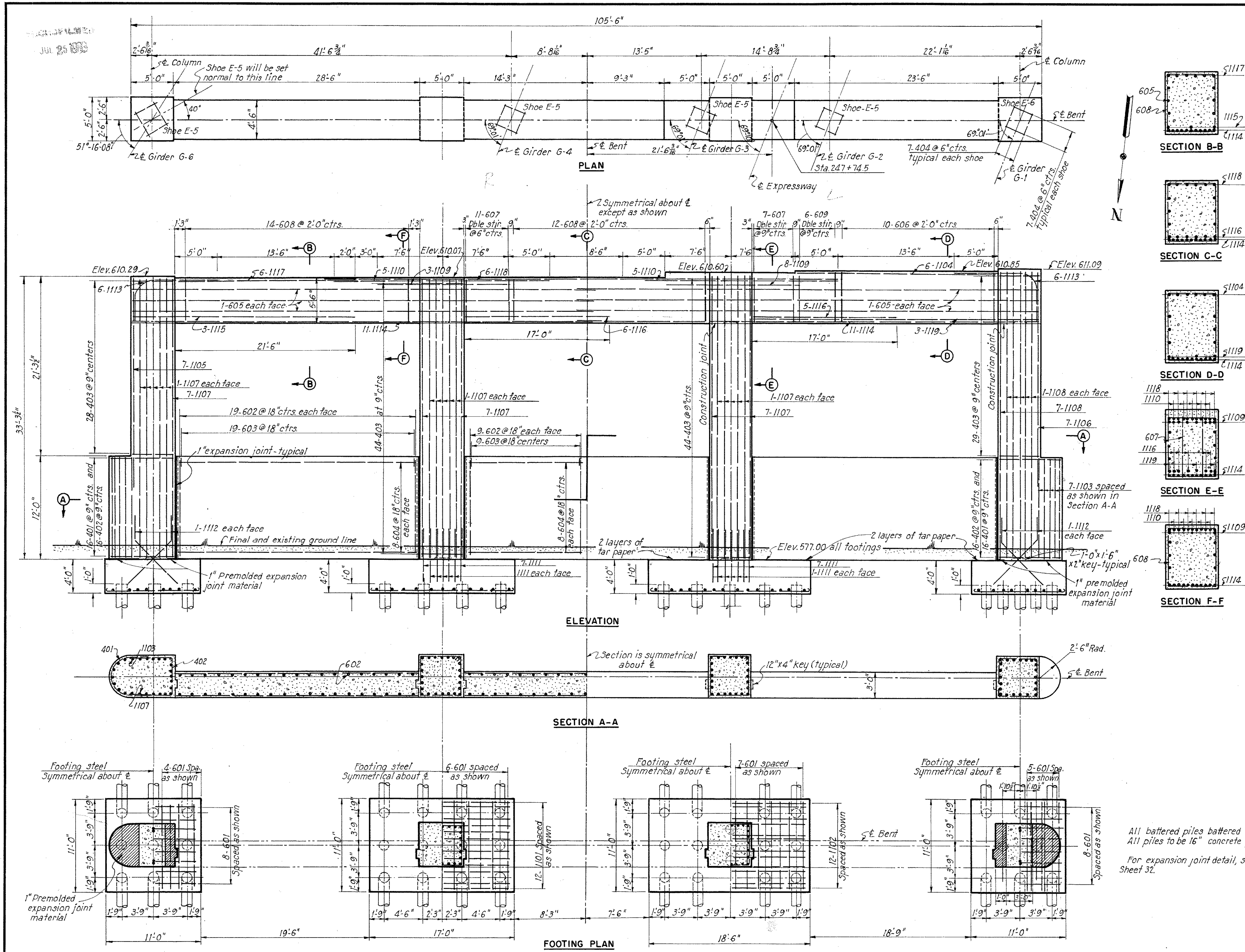
TOLEDO EXPRES
MAUMEE RI
BR. NO. L
PIER
TOLEDO LUCAS

SCALE ⅛" = 1'-0"
MADE M.K.A. DATE 6-27-52
TRCD. R.R. DATE 8-6-52
CKD. J.P.S. DATE 8-17-52

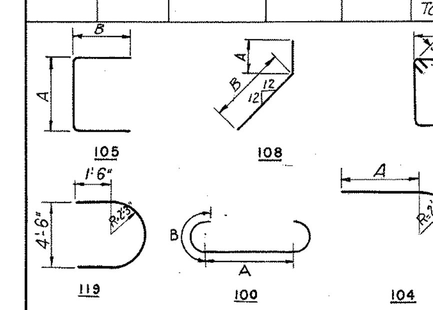
HOWARD,
KAN

FED. ROAD DIV. NO.	STATE	F… PR…
2	OHIO	A- UI-…

LUCAS
CITY OF
TOLEDO EXPRES…
MAUMEE RI…
LUC 120…



REINFORCING STEEL SCHEDU…				
Mark	No.	Length	Type	Dimensi… A
401	32	10'-1"	119	
402	32	14'-0"	105	4'-7½"
403	145	19'-0"	109	4'-7½"
404	70	5'-6"	105	3'-6"
601	59	11'-10"	100	10'-0"
602	114	11'-6"	Str.	
603	57	4'-6"	105	2'-6"
604	48	28'-0"	Str.	
605	12	54'-0"	Str.	
606	10	20'-5"	109	4'-1½"
607	36	16'-9"	109	3'-0"
608	26	19'-0"	109	4'-1½"
609	12	18'-2"	109	3'-0"
1101	12	19'-6"	100	15'-8"
1102	12	21'-0"	100	17'-2"
1103	18	11'-9"	Str.	
1104	6	23'-0"	Str.	
1105	7	24'-6"	Str.	
1106	7	25'-3"	Str.	
1107	65	32'-9"	Str.	
1108	17	33'-9"	Str.	
1109	11	15'-0"	Str.	
1110	10	25'-0"	Str.	
1111	48	7'-0"	Str.	
1112	8	10'-0"	108	3'-0"
1113	12	12'-6"	104	6'-0"
1114	22	54'-3"	Str.	
1115	3	26'-3"	Str.	
1116	11	17'-0"	Str.	
1117	6	20'-9"	Str.	
1118	6	59'-0"	Str.	
1119	3	33'-3"	Str.	



All battered piles battered 2 in 12.
All piles to be 16" concrete piles.

For expansion joint detail, see Sheet 32.

TOLEDO EXPRESS…
MAUMEE RIVE…
BR. NO. LU …
BENT 7…

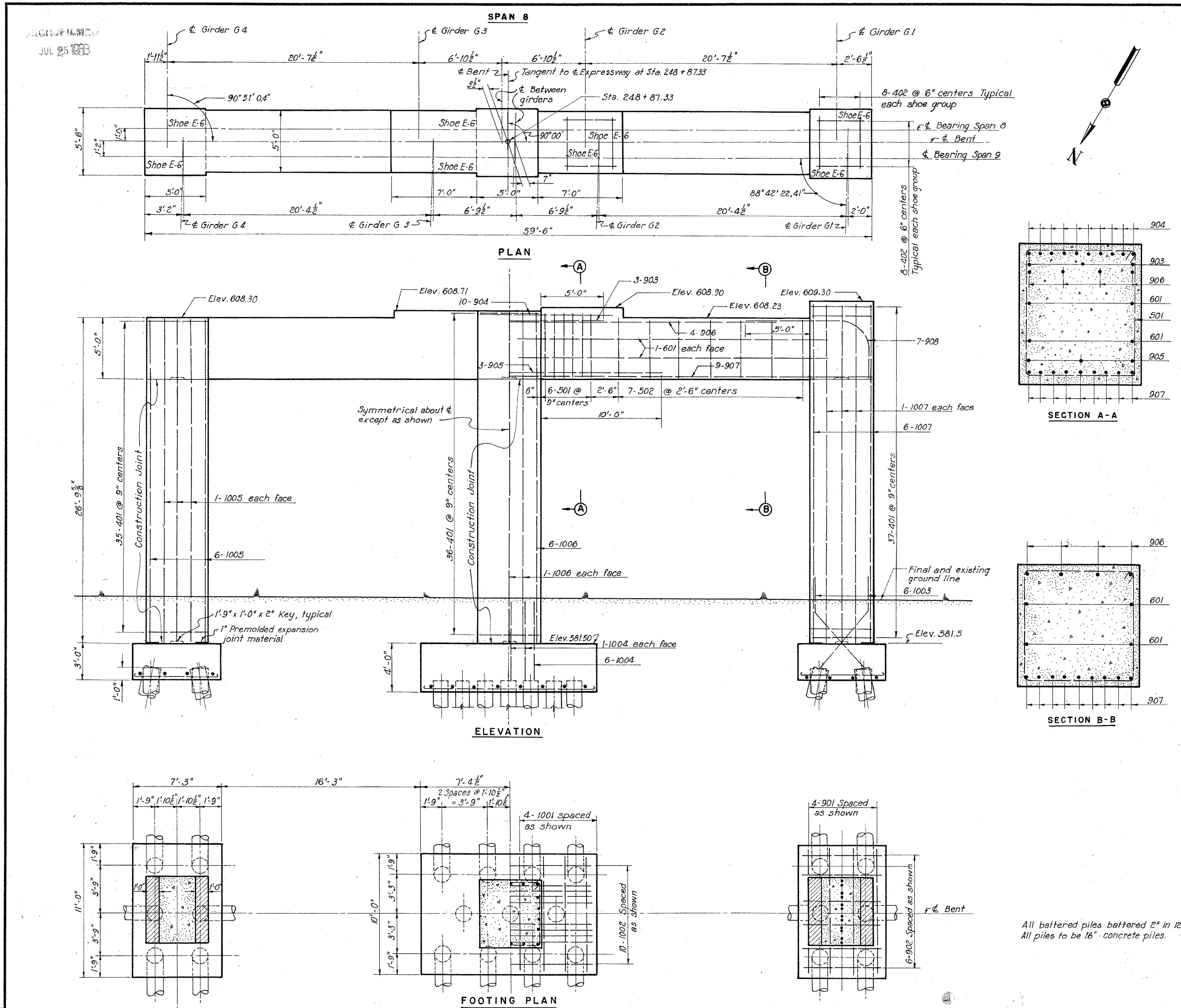
TOLEDO LUCAS COU…

SCALE 3/16" = 1'-0"
MADE L.L.D. DATE 6-19-52
TRCD. R.R. DATE 7-24-52
CKD. I.P.S. DATE 7-25-52

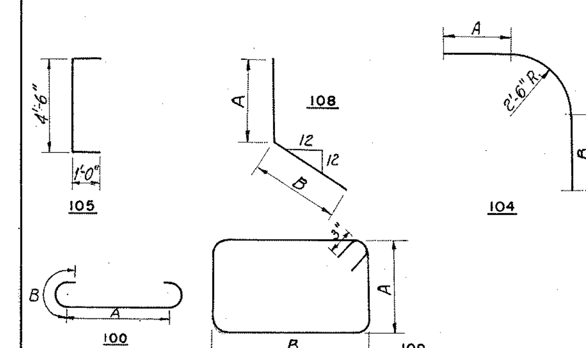
HOWARD, NEE…
CO…
KANSAS C…

FED. ROAD DIV. NO.	STATE
2	OHIO

LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE R
LUC 120



REINFORCING STEEL SCHEDULE						
Mark	No.	Length	Type	Dimension A	Dimension B	W
401	108	20'-0"	109	4'-7½"	5'-1½"	1
402	64	6'-6"	105			
501	12	19'-9"	109	4'-7½"	5'-0"	
502	14	19'-0"	109	4'-7½"	4'-7½"	
601	8	26'-0"	Str.			
901	8	12'-8"	100	9'-8"	1'-6"	3
902	12	8'-11"	100	5'-11"	1'-6"	3
903	3	15'-0"	Str.			
904	10	18'-6"	Str.			
905	3	25'-0"	Str.			
906	4	46'-0"	Str.			
907	9	59'-0"	Str.			1,
908	14	13'-3"	104	7'-3"	2'-1"	
1001	8	12'-4"	100	8'-8"	1'-9"	4
1002	10	16'-11"	100	13'-5"	1'-9"	7
1003	24	9'-0"	108	3'-6"	5'-6"	
1004	18	6'-0"	Str.			
1005	18	26'-6"	Str.			2,
1006	18	27'-0"	Str.			2,
1007	18	27'-6"	Str.			2,
Total						16,



TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU
BENT
TOLEDO
LUCAS CO

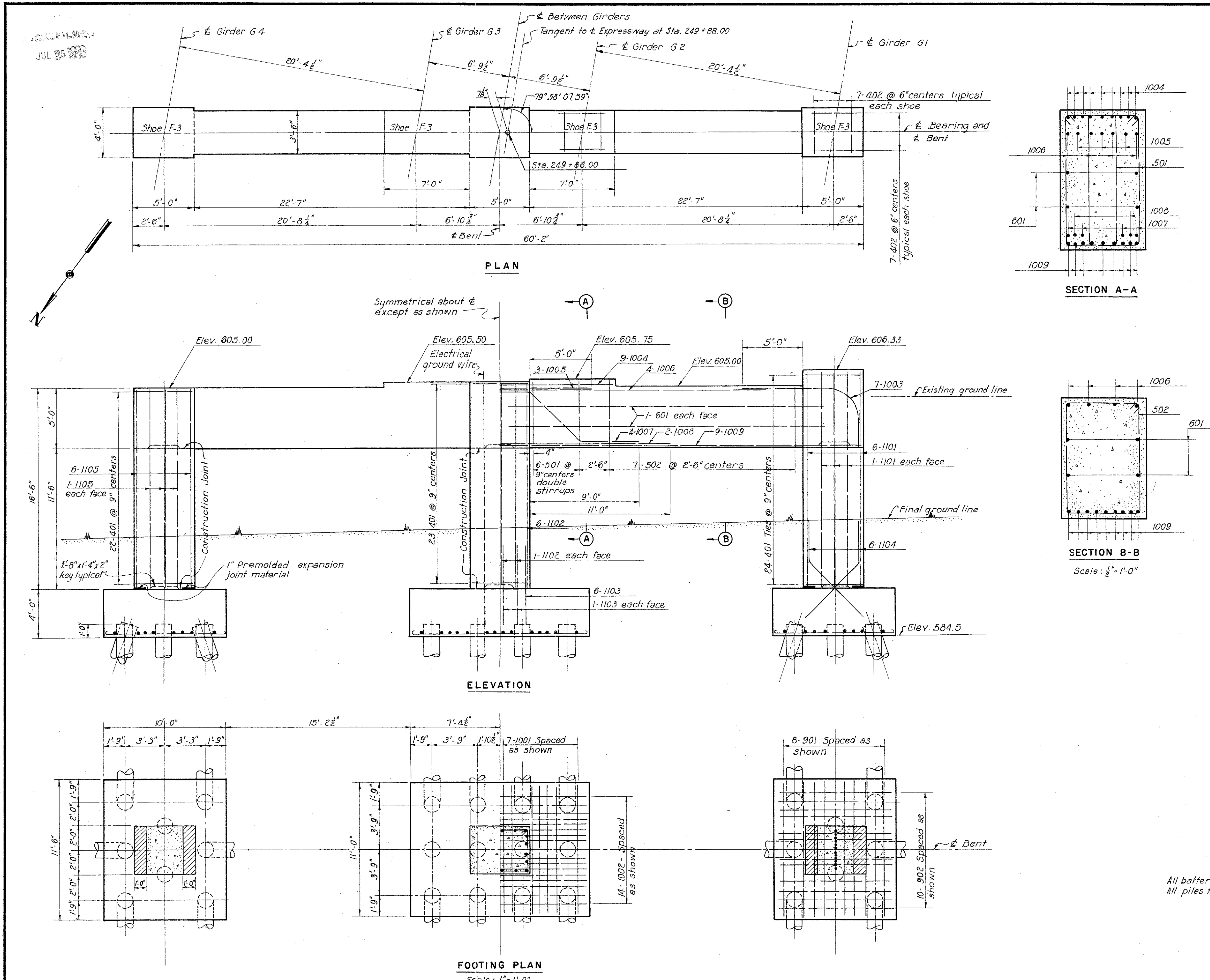
SCALE ¼" = 1'-0"
MADE L.L.D. DATE 6-11-52
TRCD A.H. DATE 6-23-52
CKD J.P.S. DATE 7-17-52

HOWARD, NEE
CO
KANSAS

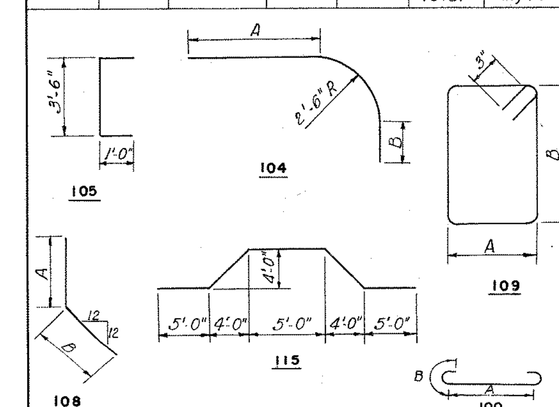
612

FED. ROAD DIV. NO.	STATE	FE… PRO…
2	OHIO	A UI-1…

LUCAS
CITY OF
TOLEDO EXPRES…
MAUMEE RIV…
LUC 120…



REINFORCING STEEL SCHEDULE						
Mark	No.	Length	Type	Dimension A	Dimension B	Weight
401	69	17'-0"	109	3'-7½"	4'-7½"	780
402	56	5'-6"	105			210
501	24	15'-1"	109	2'-2"	5'-1½"	380
502	14	16'-0"	109	3'-1½"	4'-7½"	230
601	8	26'-3"	Str.			320
901	16	13'-2"	100	10'-2"	1'-6"	720
902	20	11'-8"	100	8'-8"	1'-6"	790
1001	14	13'-0"	100	9'-6"	1'-9"	790
1002	14	16'-9"	100	13'-3"	1'-9	1010
1003	14	13'-3"	104	7'-3"	2'-1"	800
1004	9	18'-6"	Str.			720
1005	3	15'-0"	Str.			190
1006	4	46'-6"	Str.			800
1007	4	26'-4"	115			450
1008	2	27'-0"	Str.			230
1009	9	59'-9"	Str.			2 320
1101	18	17'-6"	Str.			1670
1102	18	16'-9"	Str.			1600
1103	18	6'-6"	Str.			620
1104	24	10'-0"	108	3'-6"	6'-6"	1280
1105	18	16'-3"	Str.			1550
					Total	17,460



All battered piles battered 2" in 12".
All piles to be 16" concrete piles.

TOLEDO EXPRESS…
MAUMEE RIVE…
BR. NO. LU…
BENT…
TOLEDO
LUCAS COU…

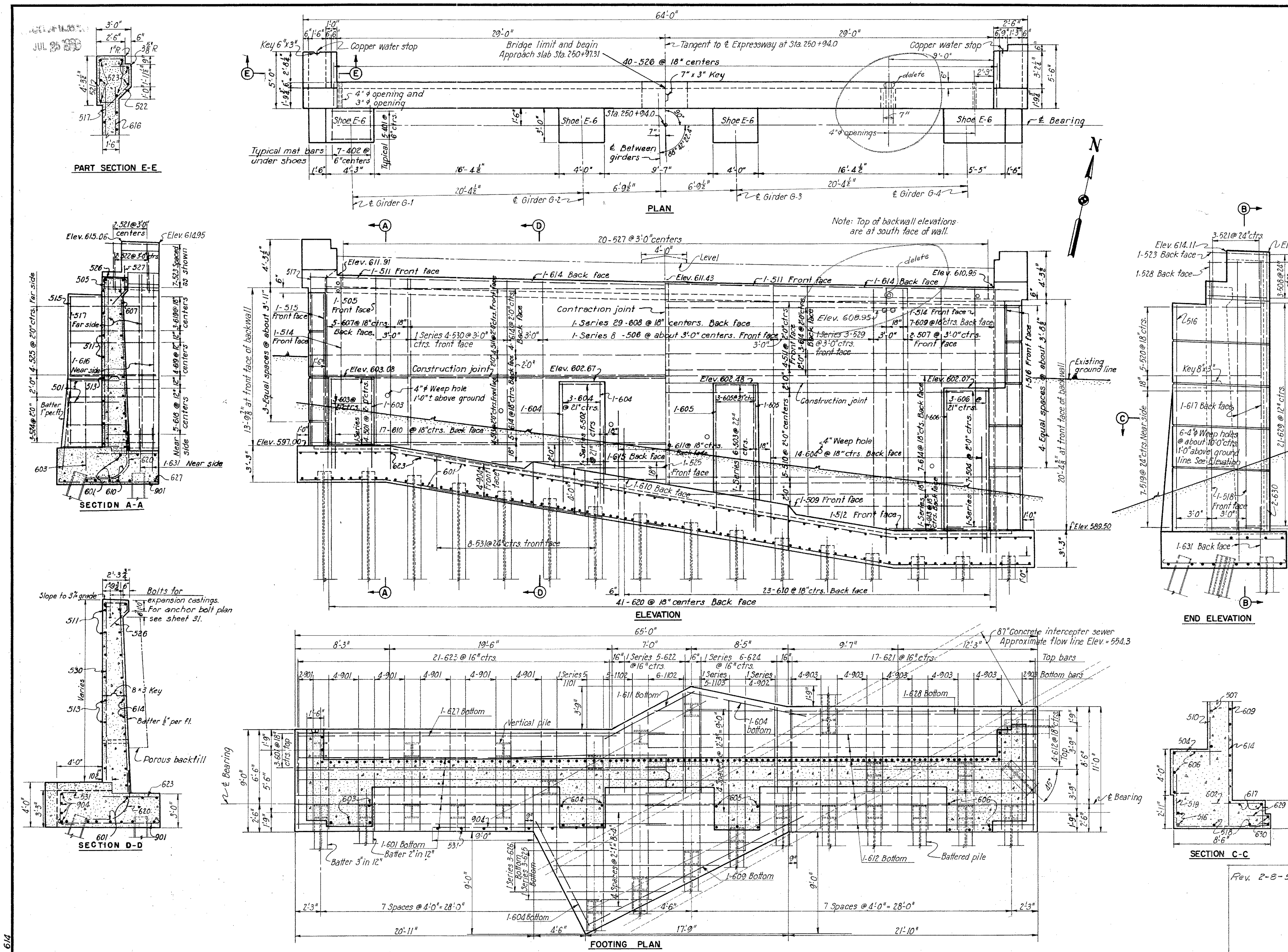
SCALE 1/4" ; 1/2" = 1'-0"
MADE J.H.G. DATE 5-2-52
TRCD A.H. DATE 5-20-52
CKD J.P.S. DATE 7-17-52

HOWARD, NEED…
CO…
KANSAS C…

613

FED. ROAD DIV. NO.	STATE	FED. A PROJ.
2	OHIO	A UI-1052

LUCAS
CITY OF T
TOLEDO EXPRESS
MAUMEE RIVE
LUC 120 -



Notes:
All battered piles shall be battered
unless otherwise noted.
All piles to be 14BP73.
For expansion and contraction j
not shown, see Sheet 32.

TOLEDO EXPRESSW

MAUMEE RIVER

BR. NO. LU 12

NORTH ABUT

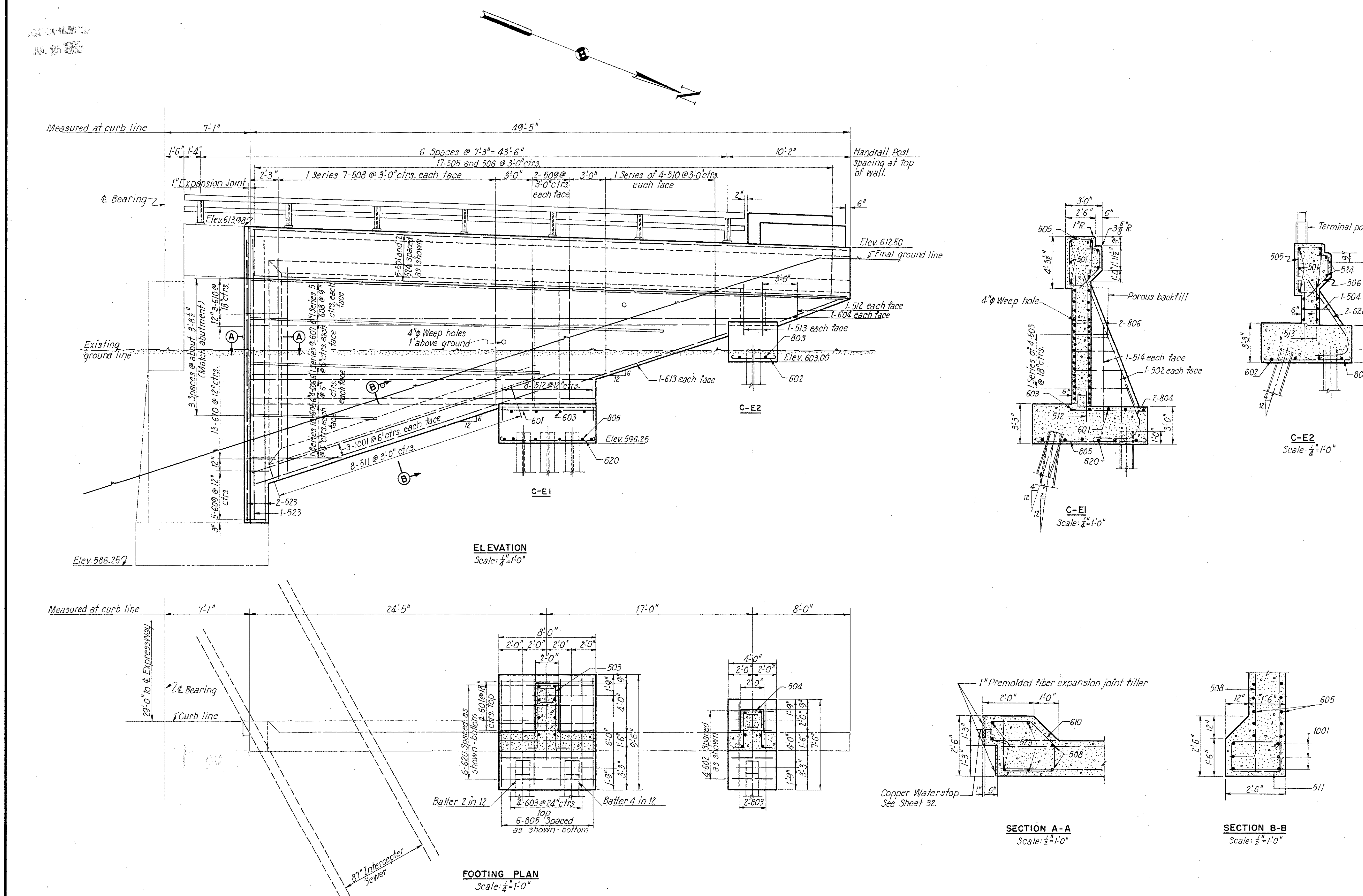
TDLEDO LUCAS COUN

SCALE $\frac{1}{4}$" = 1'-0"
MADE GD DATE 11-17-52
TRCD AH-EM-RB DATE 11-29-52
CKD J.D.P. DATE 11-29-52

HOWARD, NEEDLE
CONSU
KANSAS CITY

FED. ROAD DIV. NO.	STATE	
2	OHIO	UI-

LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RIV
LUC 120



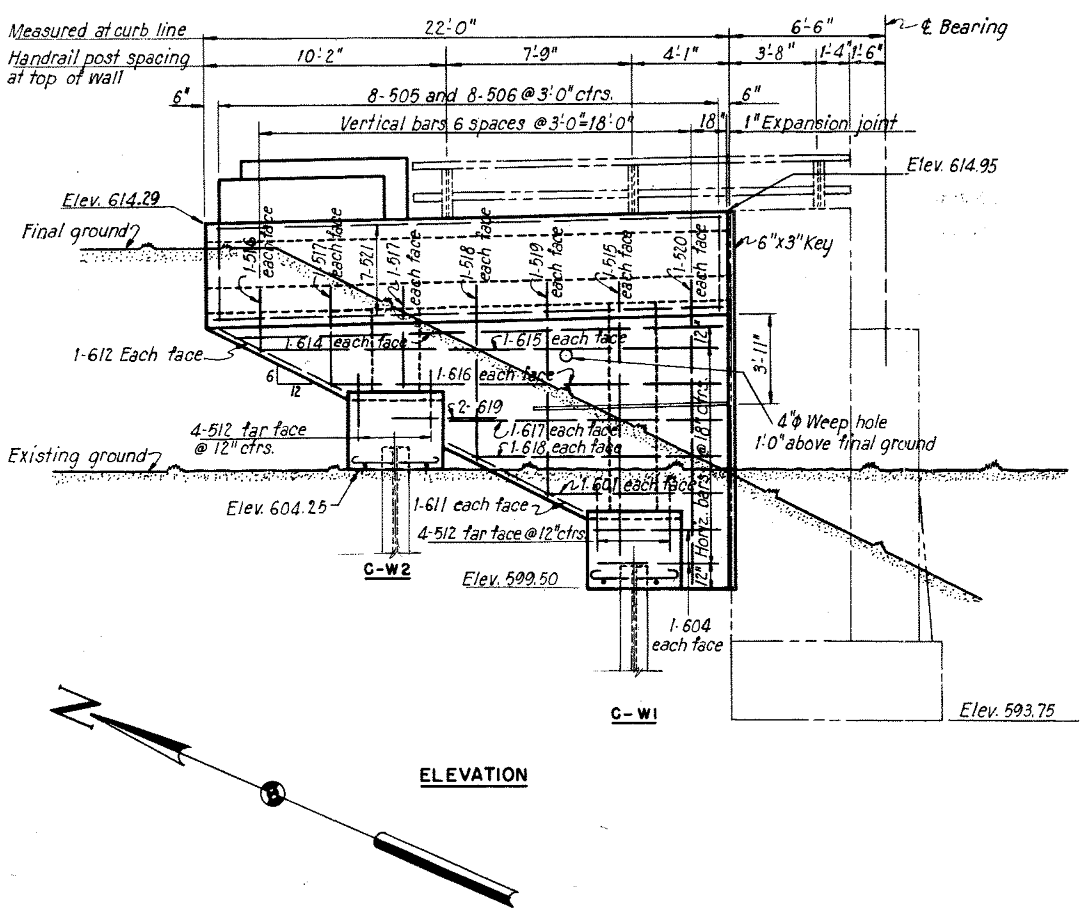
Notes:
All piles to be 14BP73
See Sheet 18 for reinforcing st
For details of Terminal Posts, s
Handrail will be furnished by
Contractor for Part 2 shall leav
handrail posts. See Sheet 32.

TOLEDO EXPRESS
MAUMEE RIVER
BR. NO. LU
NORTH ABUT
EAST WING

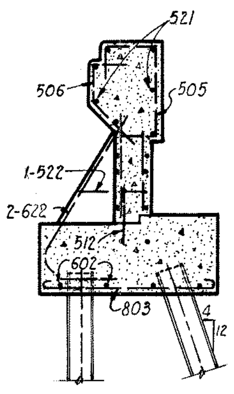
TOLEDO LUCAS CO

SCALE 1/4", 1/2" = 1'-0"
MADE JDP BKE DATE 11-13-52
TRCD. R.R. DATE 11-26-52
CKD. B.K.H. DATE 11-27-52

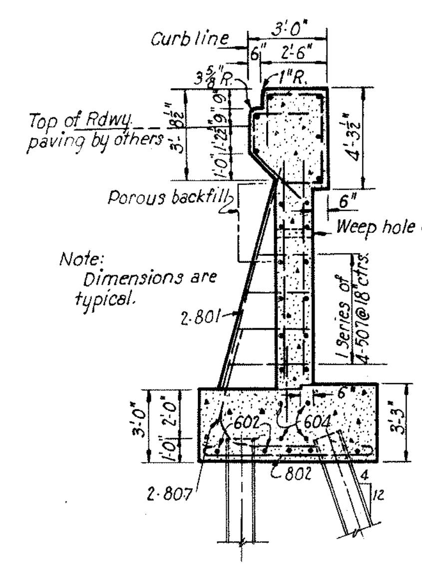
HOWARD, NEE
KANSAS



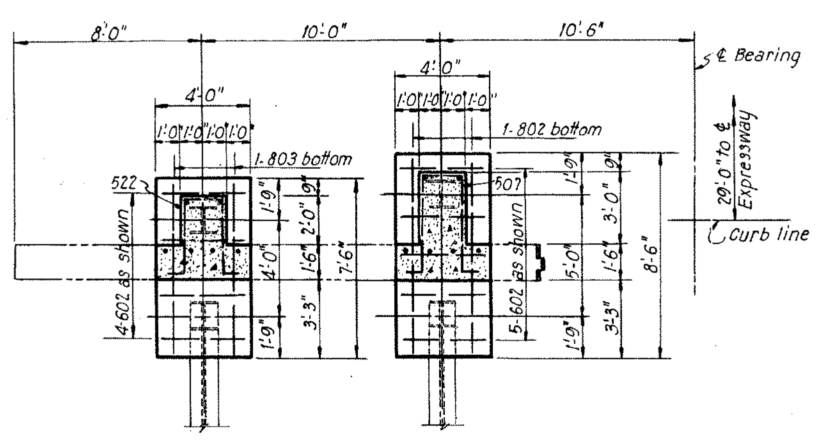
ELEVATION



C-W2

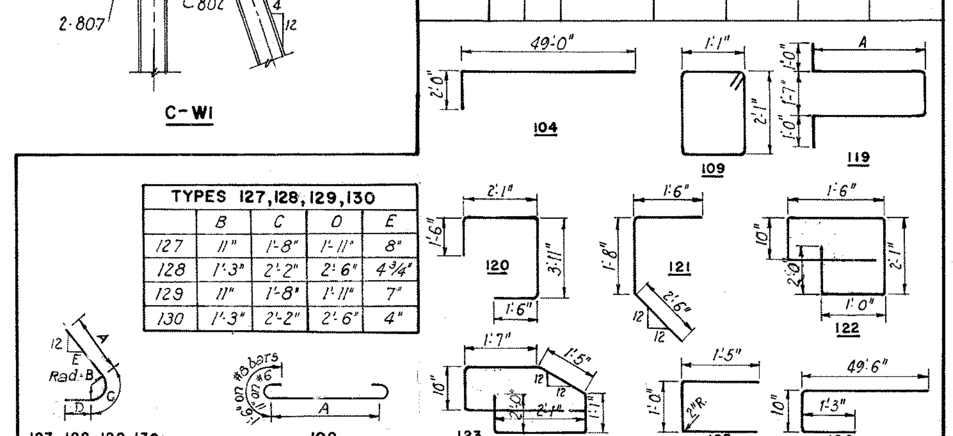


C-W1



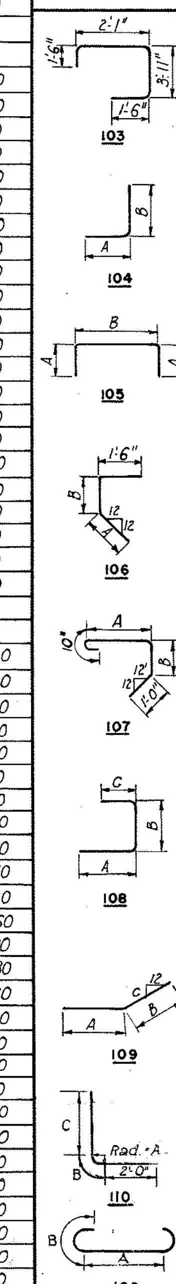
FOOTING PLAN

Mark	No. East Wall	No. West Wall	Length	Type	Dimension A	Weight East Wall	Weight West Wall
REINFORCING STEEL SCHEDULE FOR WINGWALLS							
401	12	4	3'-10"	125		30	10
501	5		51'-0"	104		270	
502	2		4'-6"	Str.		10	
503	Ser. 4		9'-1" to 12'-7"	119	2'-9" to 4'-6"	50	
504	1		7'-11"	119	2'-2"	10	
505	17	8	9'-0"	120		160	80
506	17	8	5'-8"	121		100	50
507		1 Ser. of 4	7'-11" to 11'-3"	119	2'-2" to 3'-10"		40
508	2 Ser. 7		12'-0" to 18'-6"	Str.		220	
509	4		11'-6"	Str.		50	
510	2 Ser. 4		8'-9" to 5'-6"	Str.		60	
511	8		6'-10"	109		60	
512	10	8	3'-0"	Str.		30	30
513	4		5'-6"	Str.		20	
514	2		8'-3"	Str.		20	
515		2	9'-9"	Str.			20
516		2	2'-6"	Str.			10
517		4	4'-0"	Str.			20
518		2	7'-3"	Str.			20
519		2	9'-0"	Str.			20
520		2	12'-6"	Str.			30
521		7	21'-6"	Str.			160
522		1	8'-9"	119	2'-7"		10
523	5		23'-3"	Str.		120	
524	2		51'-7"	126		110	
622		2	10'-4"	129	6'-9"		30
621	2		9'-7"	127	6'-0"	30	
601	4	2	7'-6"	Str.		40	20
602	4	9	4'-10"	100	3'-0"	30	70
603	4		6'-3"	Str.		40	
604	2	4	5'-3"	Str.		20	30
605	2 Ser. 10		20'-0" to 7'-6"	Str.		410	
606	4		28'-0"	Str.		170	
607	2 Ser. 9		29'-0" to 39'-0"	Str.		920	
608	2 Ser. 5		44'-3" to 49'-0"	Str.		700	
609	5		8'-11"	122		70	
610	16		11'-3"	123		270	
611		2	6'-9"	Str.			20
612		2	6'-0"	Str.			20
613	2		12'-6"	Str.		40	
614		2	20'-6"	Str.			60
615		2	19'-6"	Str.			60
616		2	16'-6"	Str.			50
617		2	11'-6"	Str.			30
618		2	10'-6"	Str.			30
619		2	4'-9"	Str.			10
620	6		8'-10"	100	7'-0"	80	
801		2	10'-0"	Str.			50
802		2	10'-2"	100	7'-2"		50
803	2	2	9'-2"	100	6'-2"	50	50
804	2		8'-5"	128	3'-9"	50	
805	6		11'-2"	100	8'-2"	180	
806	2		12'-0"	Str.		60	
807		2	8'-2"	130	3'-6"		40
1001	6		26'-3"	Str.		840	
					Total	5320	1120



TYPES 127, 128, 129, 130	B	C	D	E
127	11"	1'-8"	1'-11"	8"
128	1'-3"	2'-2"	2'-6"	4¾"
129	11"	1'-8"	1'-11"	7"
130	1'-3"	2'-2"	2'-6"	4"

Mark	No.	Length	Type	Dimension A	Dimension B	Dimension C	Weight
REINFORCING STEEL SCHEDULE FOR NORTH ABUTMENT							
401	20	5'-6"	105	1'-0"	3'-6"		70
402	28	4'-6"	105	1'-0"	2'-6"		80
501	1 Series of 4	9'-5" to 9'-11"	108	4'-6" to 5'-0"	3'-7½"	1'-3½"	40
502	1 Series of 5	12'-8" to 14'-2"	105	4'-6" to 5'-3"	3'-7½"		70
503	1 Series of 6	12'-8" to 14'-8"	105	4'-6" to 5'-6"	3'-7½"		90
504	1 Series of 7	9'-5" to 10'-11"	108	4'-6" to 6'-0"	3'-7½"	1'-3½"	70
505	1	14'-6"	Str.				20
506	1 Series of 8	16'-0" to 19'-0"	Str.				150
507	2	21'-0"	Str.				40
508	3	7'-10"	108	5'-0"	1'-4"	1'-6"	20
509	1	15'-0"	Str.				20
510	5	26'-3"	Str.				140
511	10	31'-0"	Str.				320
512	1	6'-6"	Str.				10
513	4	27'-6"	Str.				110
514	2	10'-6"	Str.				20
515	2	13'-3"	Str.				30
516	2	19'-6"	Str.				40
517	2	15'-3"	Str.				30
518	2	21'-6"	Str.				40
519	7	12'-0"	104	4'-6"	7'-6"		90
520	5	12'-7	108	7'-6"	1'-1"	4'-0"	70
521	5	9'-0"	103				50
522	2	5'-6"	106	2'-6"	1'-6"		10
523	8	4'-6"	Str.				40
524	3	10'-6"	104	3'-0"	7'-6"		30
525	5	7'-6"	Str.				40
526	40	4'-4"	107	1'-8"	9½"		180
527	20	2'-0"	Str.				40
528	1	5'-6"	104	4'-0"	1'-6"		10
529	1 Series of 3	20'-0" to 21'-0"	Str.				60
530	1 Series of 4	15'-0" to 16'-3"	Str.				70
531	8	5'-9"	105	1'-6"	2'-9"		50
601	9	33'-0"	109	25'-0"	8'-0"	2"	450
602	24	6'-6"	104	4'-6"	2'-0"		230
603	4	8'-0"	Str.				50
604	21	10'-6"	Str.				330
605	5	13'-0"	Str.				100
606	4	14'-6"	Str.				90
607	5	14'-9"	Str.				110
608	1 Series of 29	15'-0" to 21'-0"	Str.				780
609	8	21'-3"	Str.				260
610	41	10'-7"	110	2'-0"	3'-2"	5'-6"	650
611	10	8'-6"	Str.				130
612	11	33'-9"	109	21'-6"	12'-3"	2"	560
613	1 Series of 3	11'-0" to 30'-0"	Str.				90
614	21	31'-0"	Str.				980
615	1	15'-0"	Str.				20
616	2	15'-6"	Str.				50
617	2	25'-0"	104	23'-6"	1'-6"		80
618	5	4'-6"	Str.				30
619	7	7'-6"	Str.				80
620	41	8'-1"	110	2'-0"	3'-2"	3'-0"	500
621	17	7'-0"	Str.				180
622	1 Series of 5	5'-9" to 8'-6"	Str.				50
623	21	5'-3"	Str.				170
624	1 Series of 6	7'-3" to 8'-9"	Str.				70
625	1 Series of 3	7'-0" to 17'-6"	Str.				60
626	1 Series of 3	8'-9" to 19'-3"	Str.				60
627	1	28'-0"	109	20'-0"	8'-0"	2"	40
628	1	22'-0"	109	12'-3"	9'-9"	2"	30
629	21	5'-4"	105	2'-3"	10"		170
630	2	24'-3"	Str.				70
631	4	10'-0"	110	11"	1'-6"	6'-7"	60
901	22	10'-8"	100	7'-8"	1'-6"		800
902	1 Series of 4	13'-5" to 15'-5"	100	10'-5" to 12'-5"	1'-6"		200
903	22	12'-8"	100	9'-8"	1'-6"		950
904	4	15'-0"	Str.				200
1101	1 Series of 5	15'-3" to 20'-3	100	11'-5" to 16'-5"	1'-11"		470
1102	11	19'-0"	100	15'-2"	1'-11"		1110
1103	1 Series of 5	18'-9" to 17'-0"	100	14'-11" to 13'-2"	1'-11"		480
						Total	12,890



FED. ROAD DIV. NO.	STATE
2	OHIO

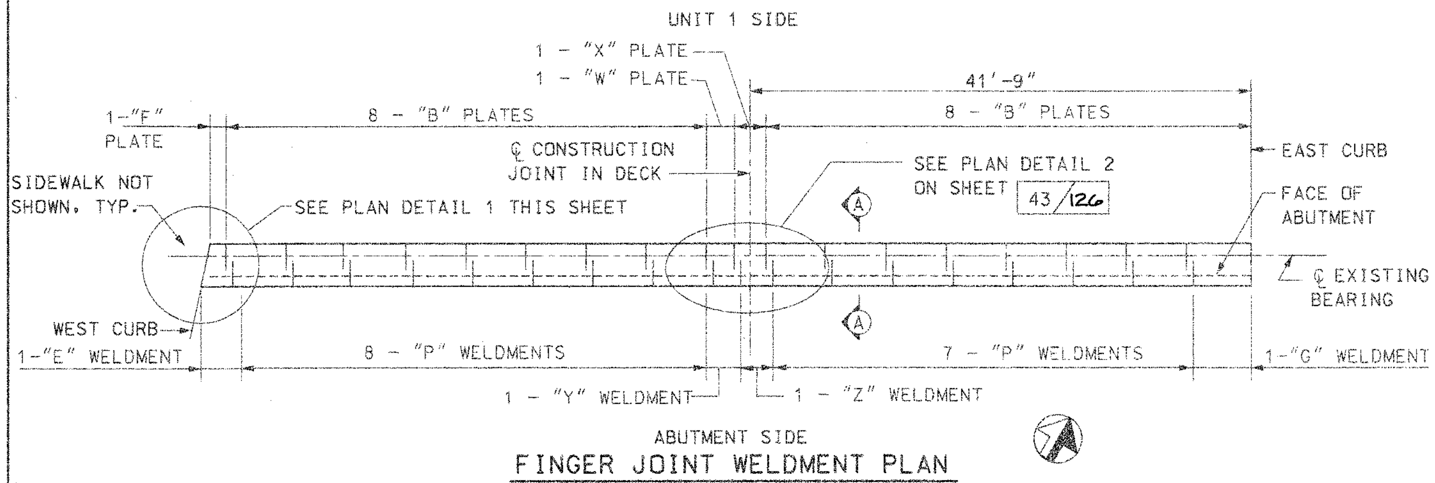
LUCAS
CITY OF
TOLEDO EXPRES
MAUMEE RIV
LUC 120

For Gener

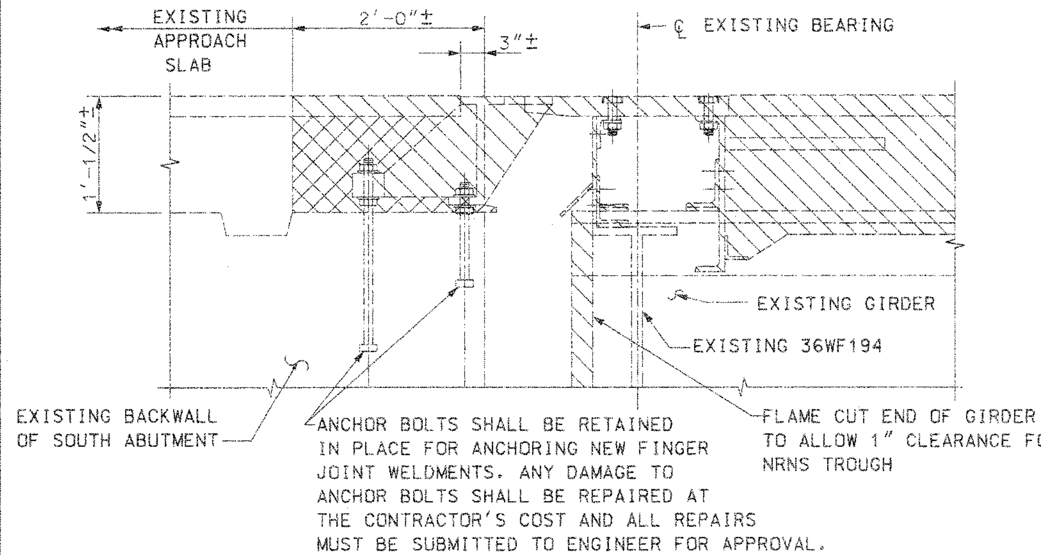
TOLEDO EXPRESS
MAUMEE RIVE
BR. NO. LU
NORTH ABU
WEST WING
TOLEDO LUCAS CO

SCALE 1/4" = 1'-0"
MADE J.P.S. DATE 7-17-52
TRCD DATE 8-19-52
CKD DATE 12-2-52
HOWARD, NE
KANSAS

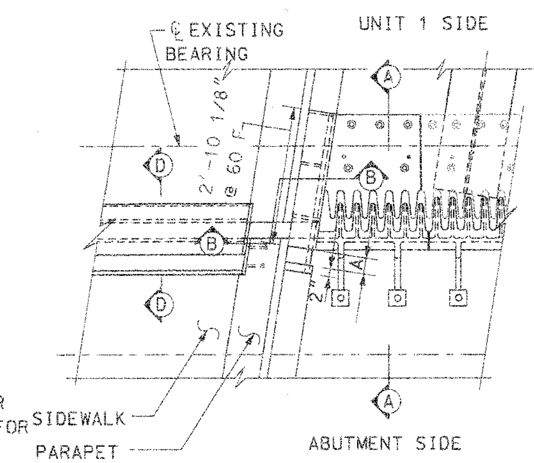
919



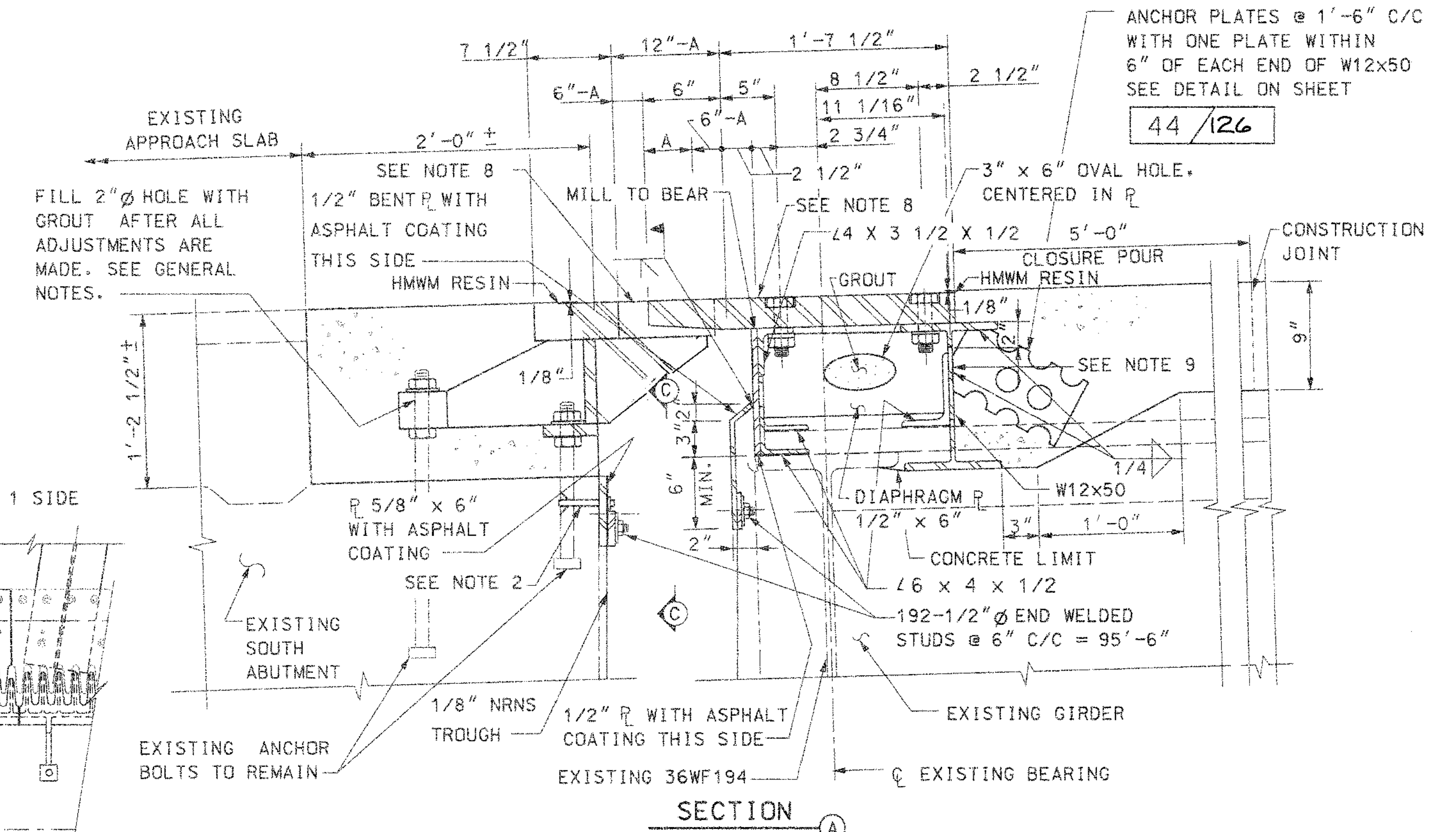
FINGER JOINT WELDMENT PLAN



SECTION (A)
(REMOVAL)

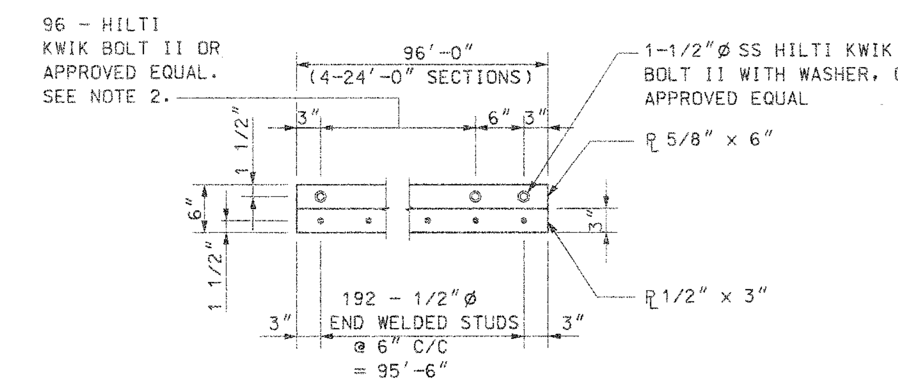


PLAN DETAIL 1
(WEST END SHOWN, EAST END SIMILAR)

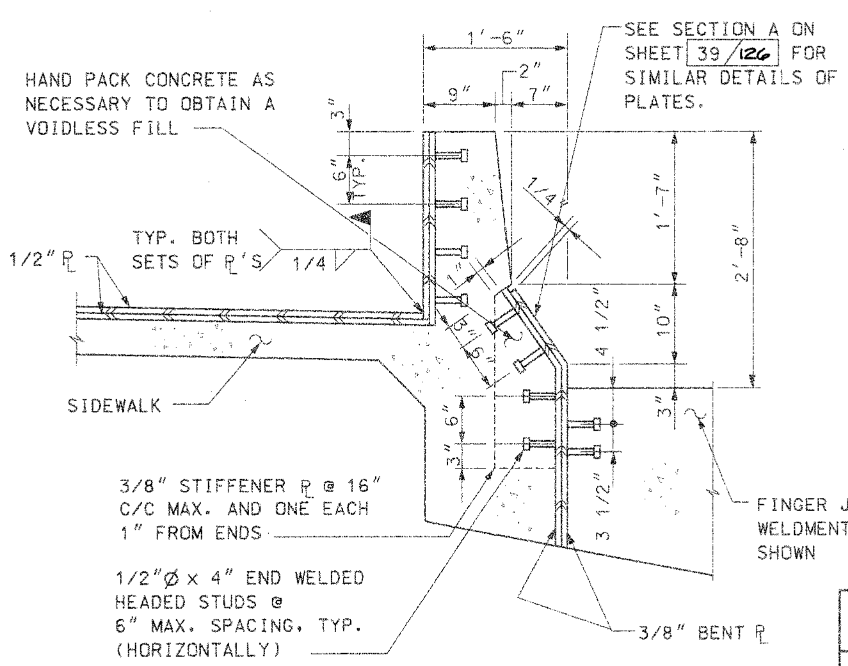


ANCHOR PLATES @ 1'-6" C/C WITH ONE PLATE WITHIN 6" OF EACH END OF W12x50 SEE DETAIL ON SHEET 44/126

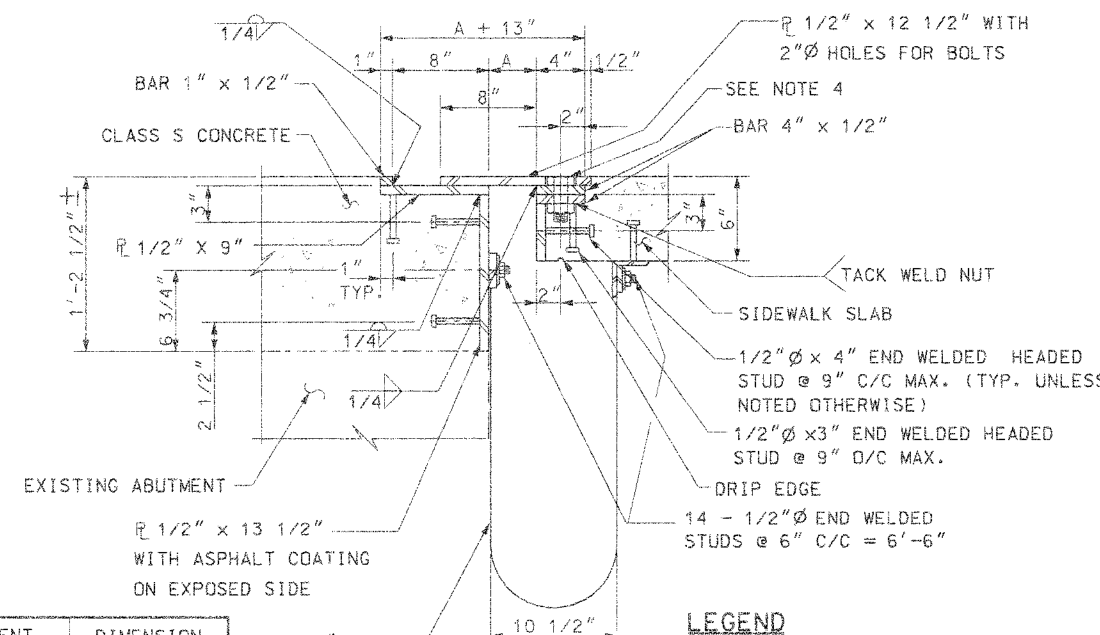
SECTION (A)



VIEW (C)
(SIMILAR AT OTHER LOCATIONS)



SECTION (B)



SECTION (D)

AMBIENT TEMPERATURE	DIMENSION "A" IN.
90°F	2
80°F	2 3/8
70°F	2 5/8
60°F	3
50°F	3 3/8
40°F	3 5/8
30°F	4

LEGEND

(diagonal hatch) DENOTES REMOVAL LIMITS

(cross hatch) DENOTES REMOVAL BY HYDRODEMOLITION

NRNS = NYLON REINFORCED NEOPRENE SHEET

* = @ 68°F

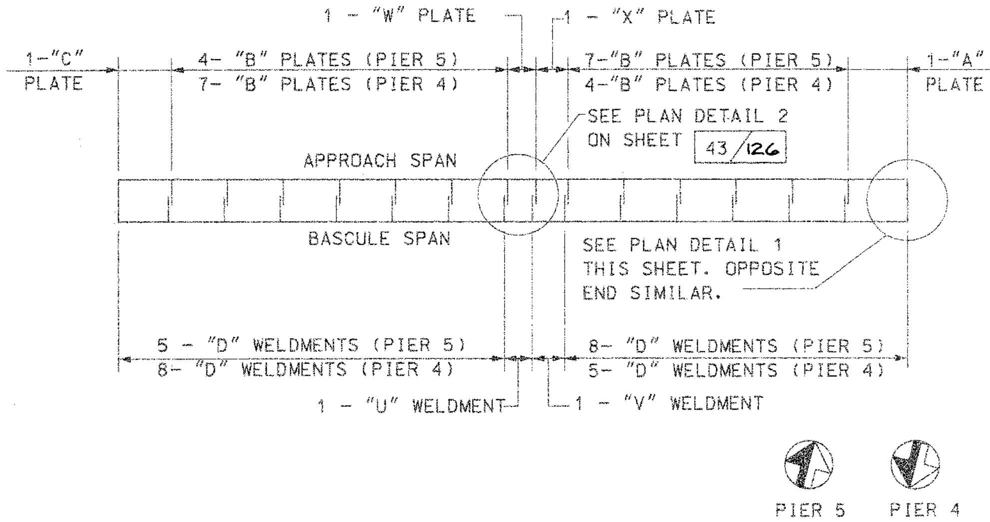
NOTES

1. SEE TABLE ON SHEET 46/126 FOR WELDMENT TYPE & DIMENSIONS.
2. 1/2"Ø SS HILTI KWIK BOLT II W/ WASHER OR APPROVED EQUAL W/ 3 1/2" MIN. EMBEDMENT @ 1'-0" C/C. ADJUST SPACING TO AVOID EXISTING ANCHOR BOLTS (IF NECESSARY).
3. 5/8" Ø x 1 3/4" HEX. HEAD BOLTS WITH HEX. NUTS AND WASHERS @ 6" MAX. C/C, STAINLESS STEEL, ASTM A276, TYPE 302 DRILL 3/4" ØHOLES IN BARS 4" x 1/2". FIELD WELD HEAD OF BOLTS TO BAR 4" x 2" WITH 3/16" FILLET.
4. SEE SHEET 10/126 FOR GENERAL NOTES.
5. SEE SHEET 44/126 FOR TYPICAL FINGER JOINT SUPPORT DETAIL.
6. SEE TABLE ON THIS SHEET FOR DIMENSION "A".
7. STEEL WELDMENTS. SEE SHEETS 44/126, 45/126 AND 46/126 FOR NOTES AND DETAILS.
8. 6"Ø HOLE IN WEB. SEE SECTION A ON SHEET 44/126.

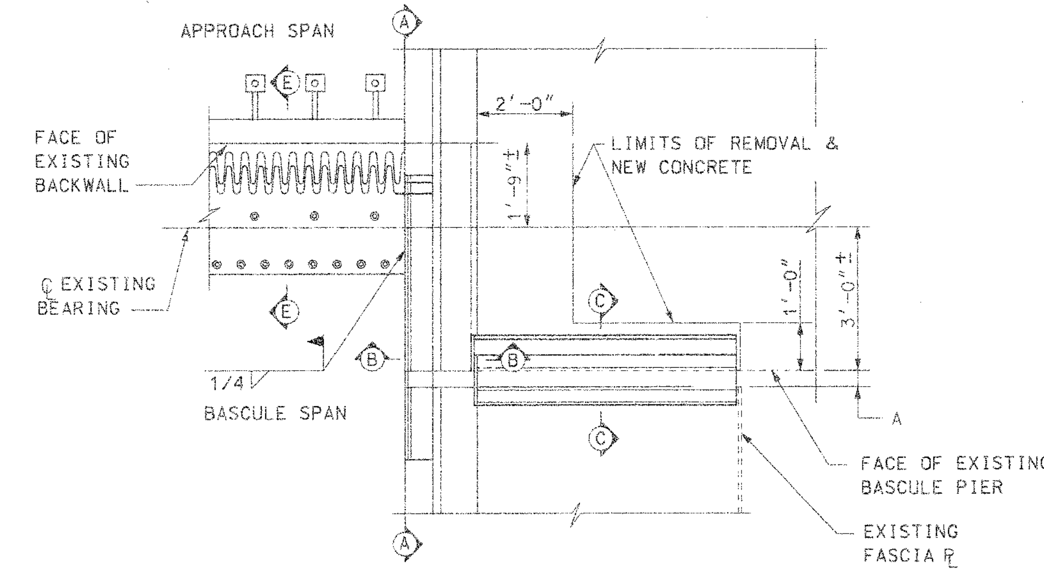
DESIGNED RWM | CHECKED KEK | DRAWN KEK | REVIEWED RKM | DATE 23-OCT-96 | STRUCTURE FILE NUMBER 4805917

FINGER JOINT DETAILS 1 - SOUTH ABUTMENT
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

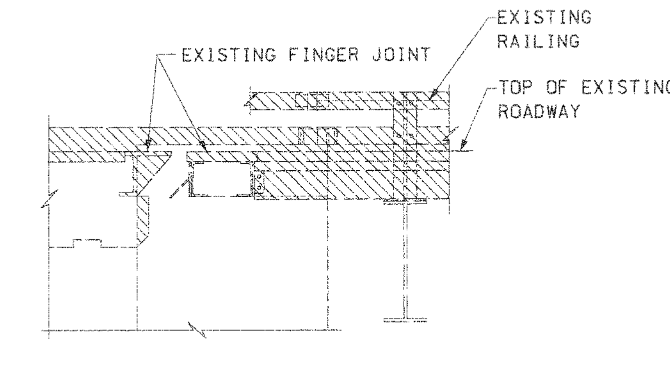
LUC-280



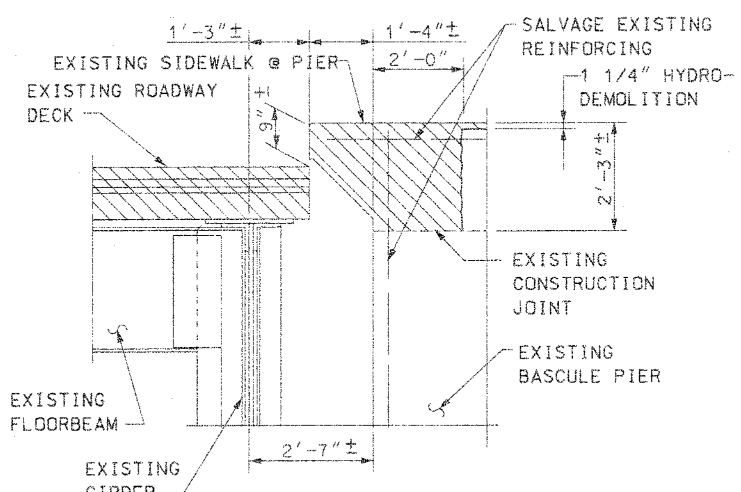
FINGER JOINT WELDMENT PLAN - BASCULE PIERS 4 & 5



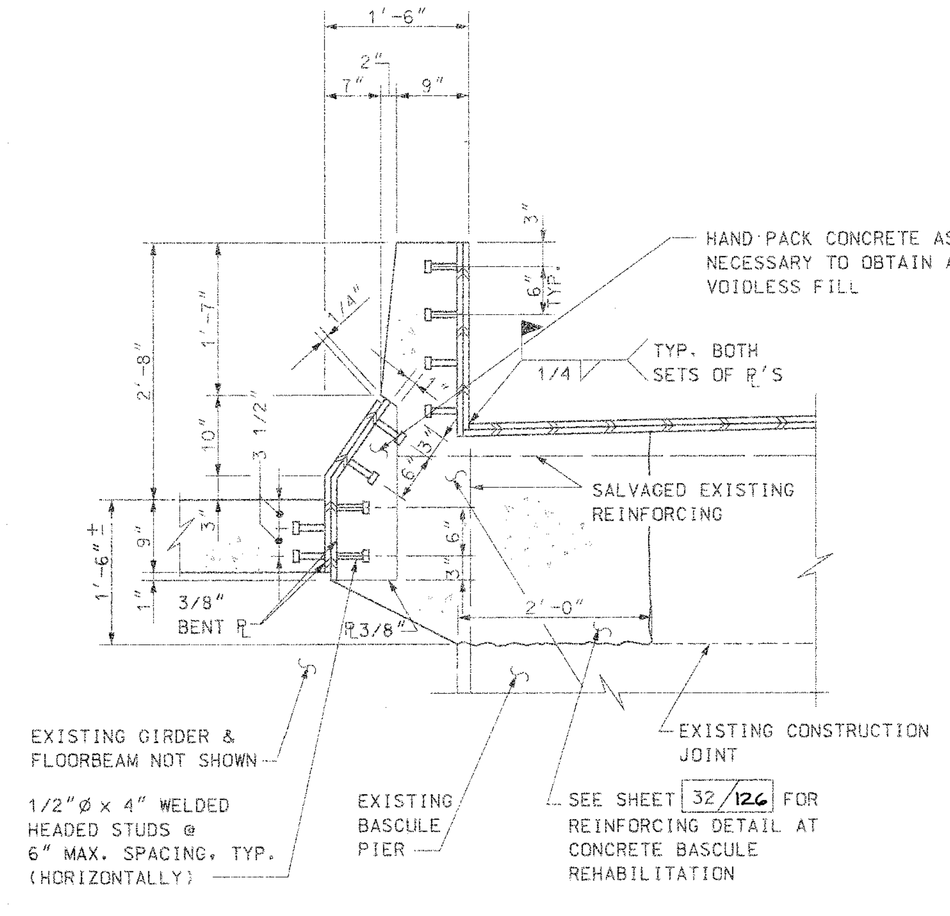
PLAN DETAIL 1



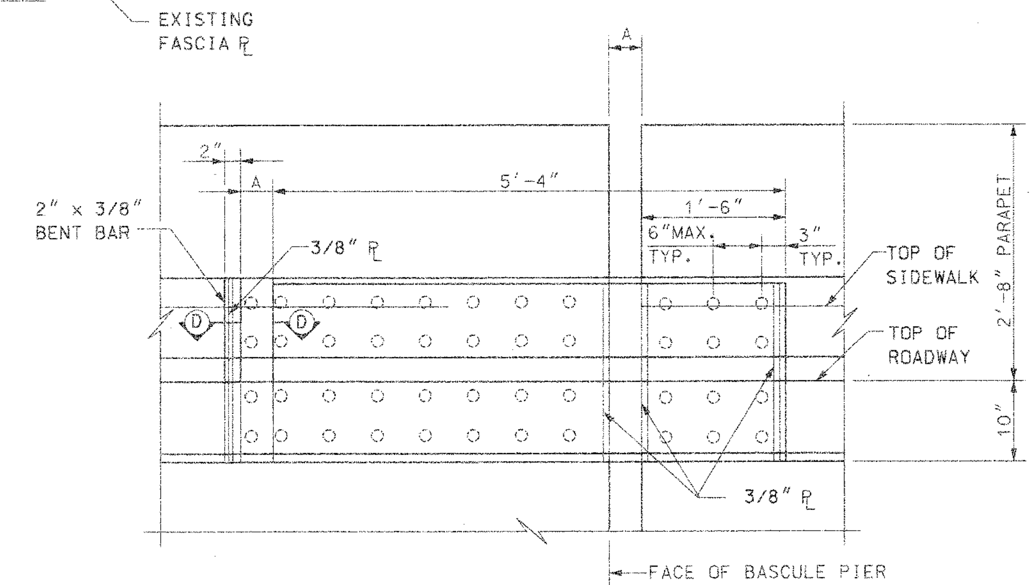
SECTION (A)
(REMOVAL)



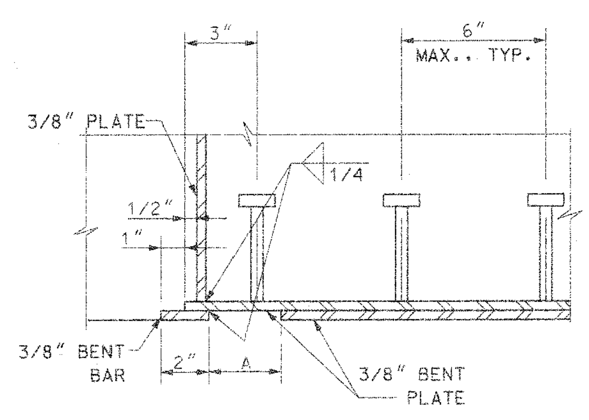
SECTION (B)
(REMOVAL)



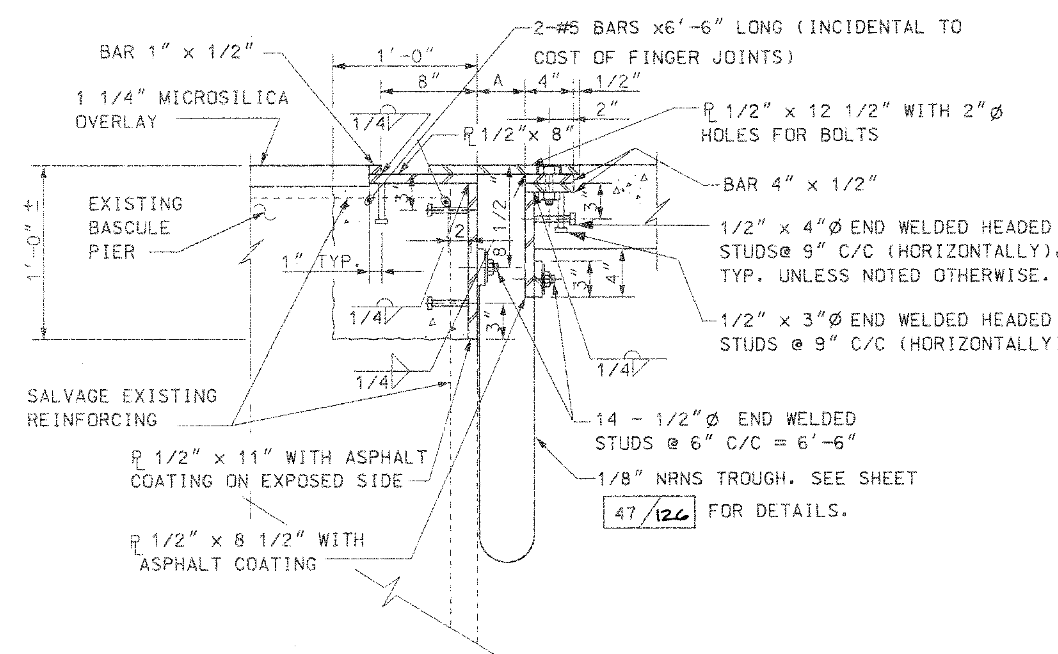
SECTION (B)



SECTION (A)
(FINGER JOINT HARDWARE NOT SHOWN)



SECTION (D)



SECTION (C)

NOTES

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 40/126 FOR SECTION E.

SEE TABLE ON SHEET 38/126 FOR DIMENSION "A".

LEGEND

Ø = DIAMETER

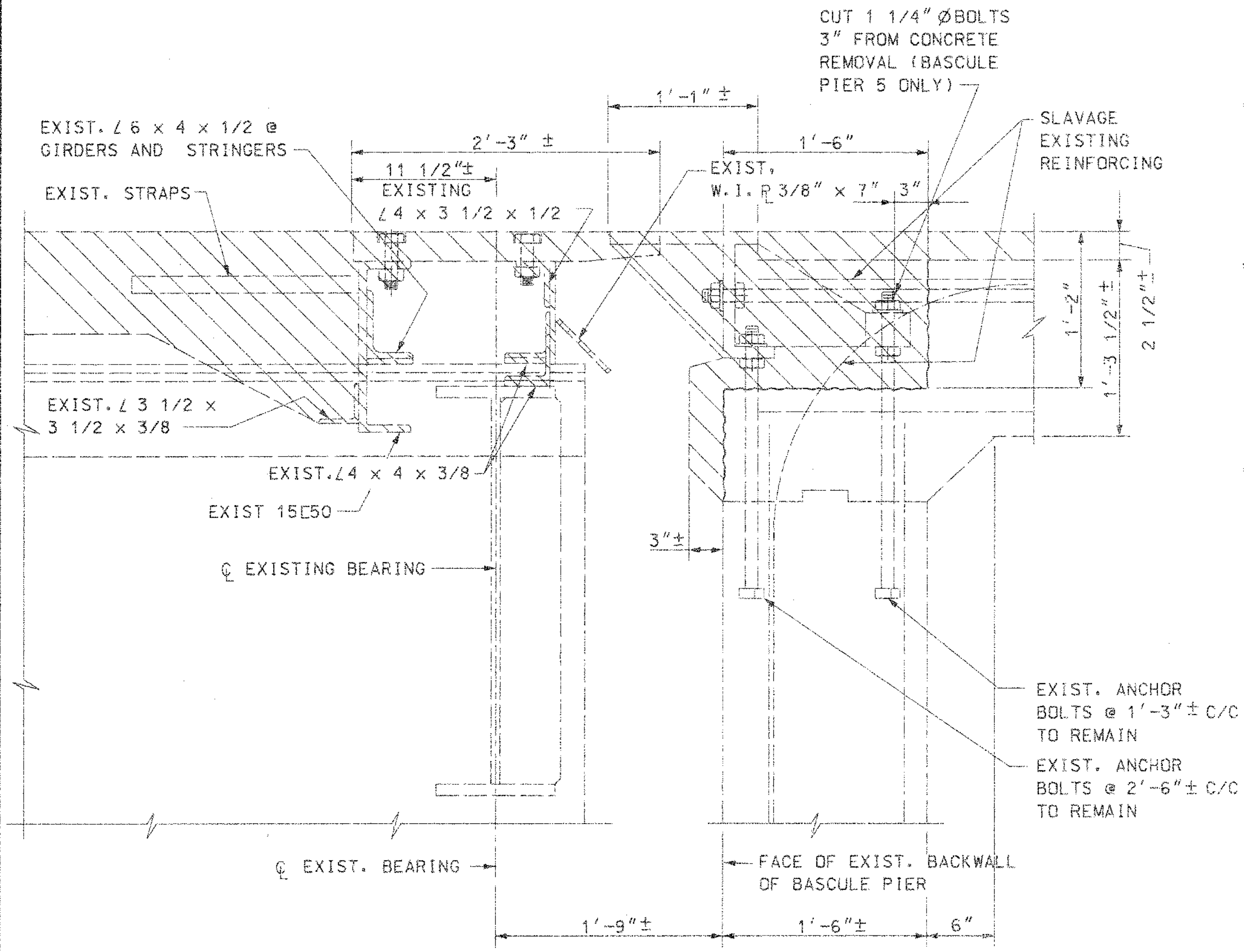
(hatch) = REMOVAL LIMITS

ENGINEERS ARCHITECTS

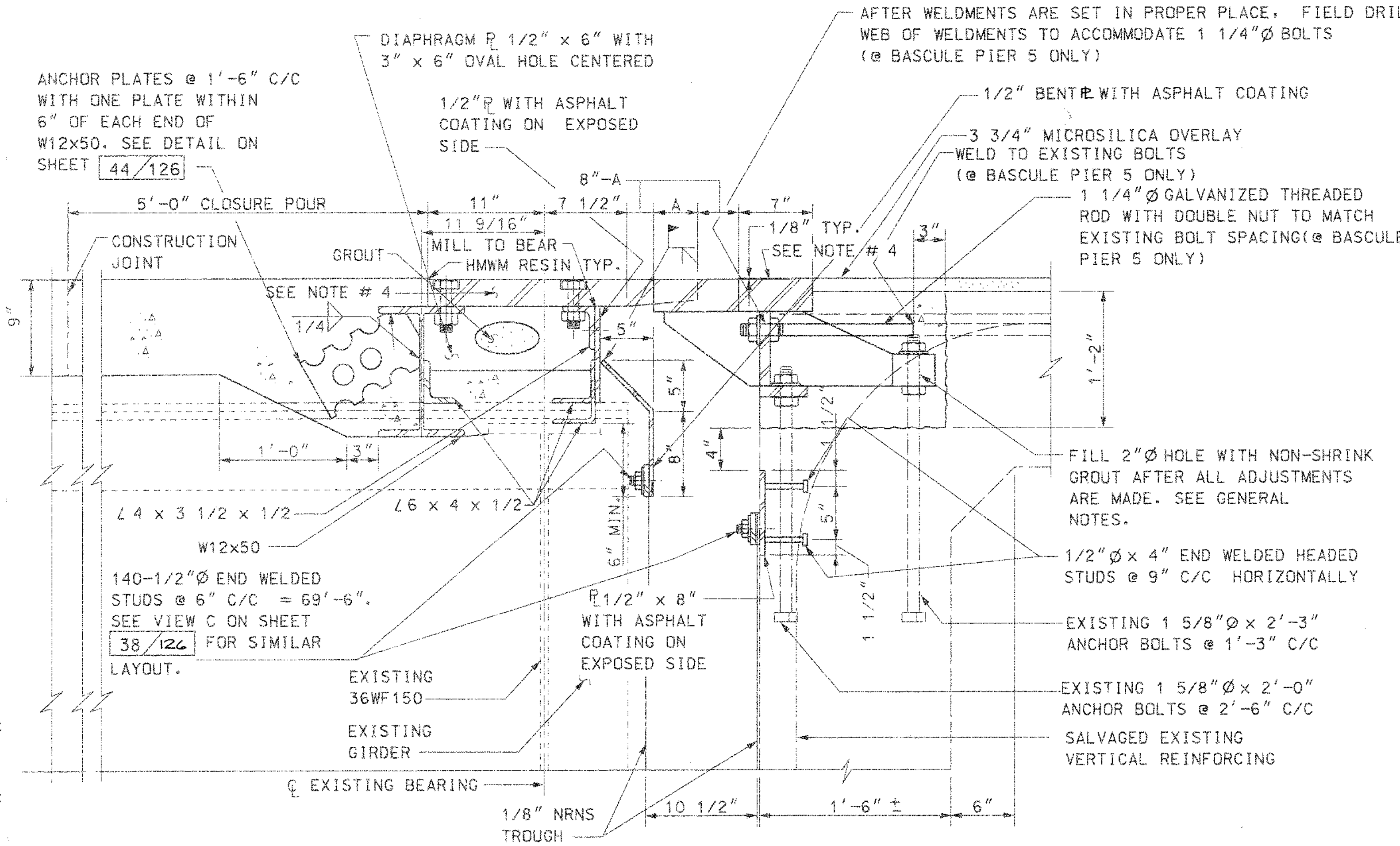
DESIGNED	DRAWN	REVIEWED	DATE
RWM	KEK	RKM	23-OCT-96
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MAK		4805917	

FINGER JOINT DETAILS 2 - BASCULE PIERS 4 & 5
BRIGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280



SECTION (E)
(REMOVAL)



SECTION (E)

LEGEND

[hatch] = REMOVAL LIMITS

NRNS = NYLON REINFORCED NEOPRENE SHEET

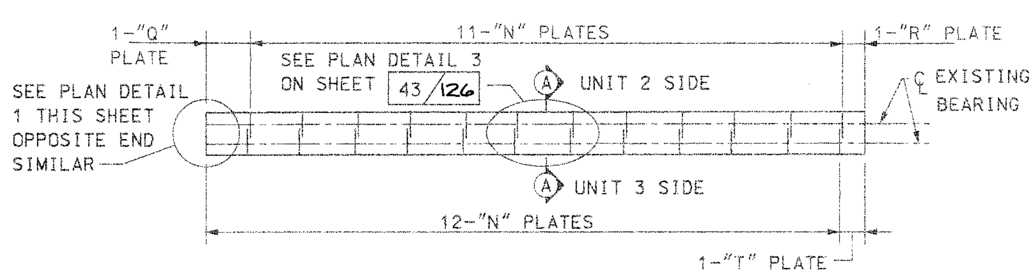
NOTES

1. SEE SHEET 10/126 FOR GENERAL NOTES.
2. SEE SHEET 44/126 FOR TYPICAL FINGER JOINT SUPPORT DETAIL.
3. SEE TABLE ON THIS SHEET FOR DIMENSION "A".
4. STEEL WELDMENTS & PLATES, SEE SHEETS 44/126, 45/126 AND 46/126, FOR NOTES AND DETAILS.
5. WORK THIS SHEET WITH SHEET 39/126.

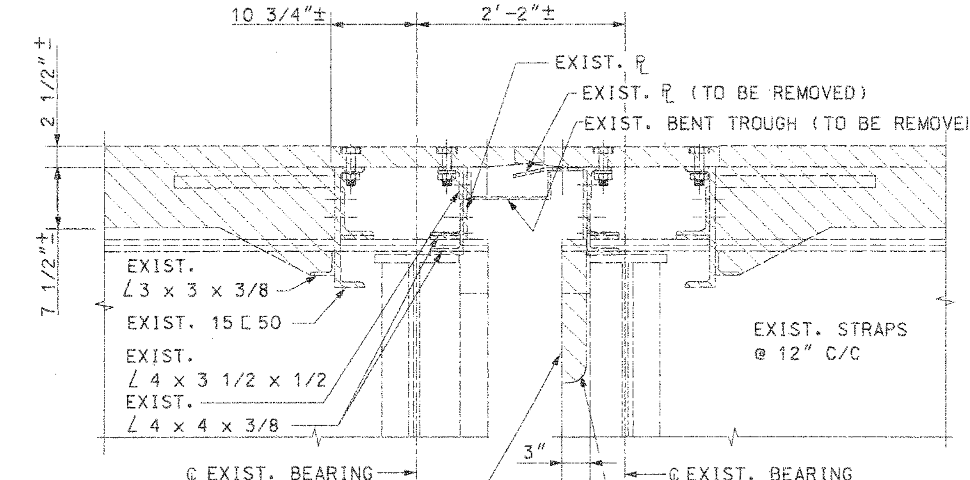
DESIGNED RWM | CHECKED MAK | DRAWN KEK | REVISED | REVIEWED RKM | DATE 23-OCT-96 | STRUCTURE FILE NUMBER 4805917

FINGER JOINT DETAILS 3 - BASCULE PIERS 4 & 5
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

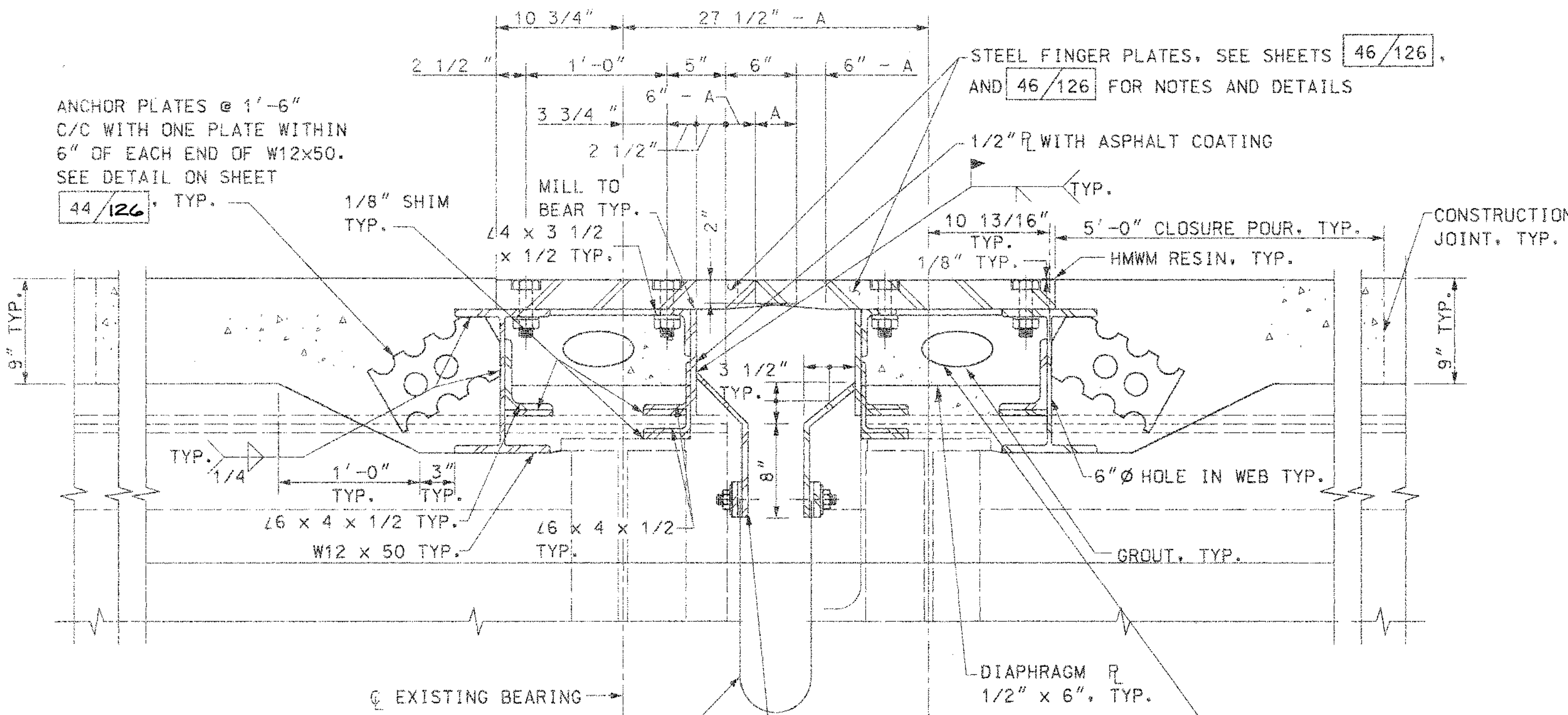


FINGER JOINT PLATE PLAN

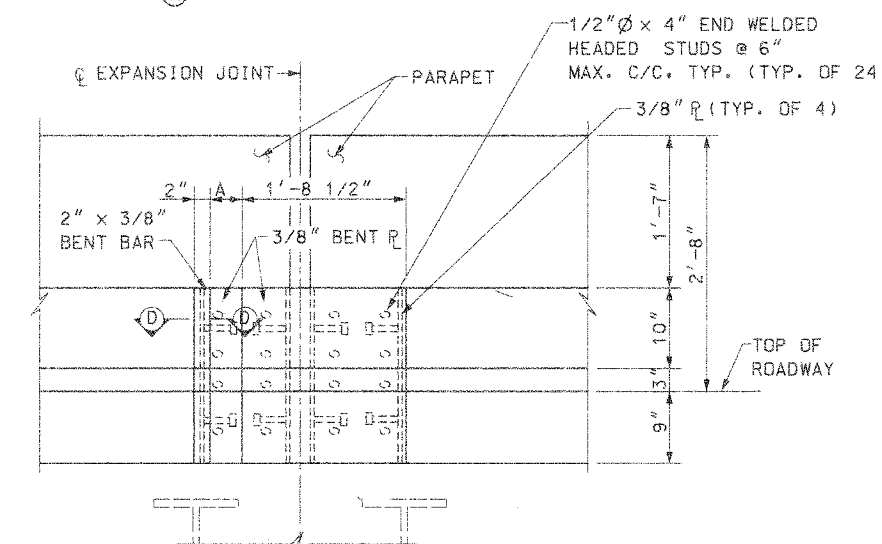


REMOVE PORTION OF WEB, ANGLE, & TOP PLATES TO CLEAR PROPOSED ELASTOMERIC TROUGH @ EXISTING GIRDERS G-2, G-3, & G-4 AS REQUIRED. CONTRACTOR SHALL FLAME CUT AND SMOOTHLY GRIND.

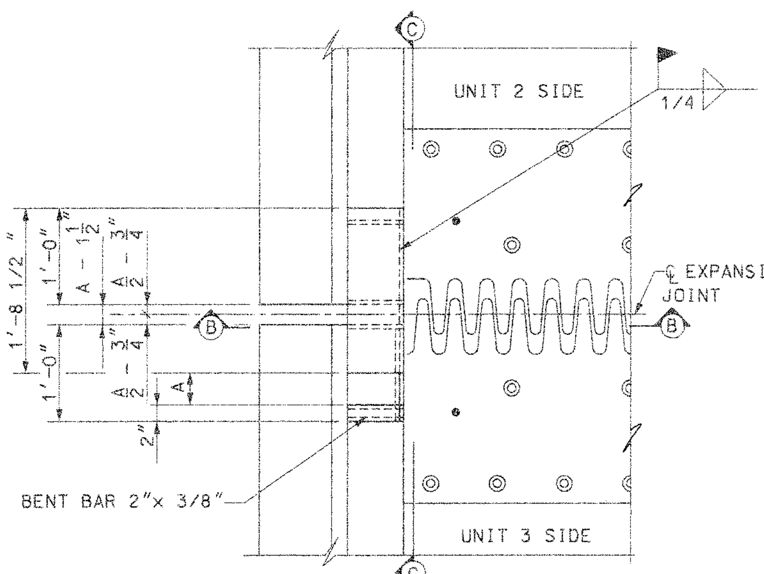
SECTION A
(REMOVAL)



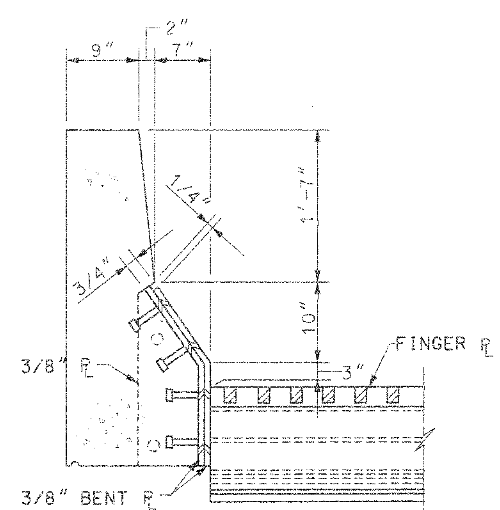
SECTION A



SECTION C
(FINGER JOINT HARDWARE NOT SHOWN FOR CLARITY)



PLAN DETAIL 1



SECTION B

NOTES

SEE TABLE ON SHEET 46/126 FOR FINGER PLATE TYPE & DIMENSIONS.

SEE TABLE ON SHEET 38/126 FOR DIMENSION "A".

SEE SHEET 44/126 FOR TYP. FINGER JOINT SUPPORT DETAIL.

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 39/126 FOR SECTION D.

LEGEND

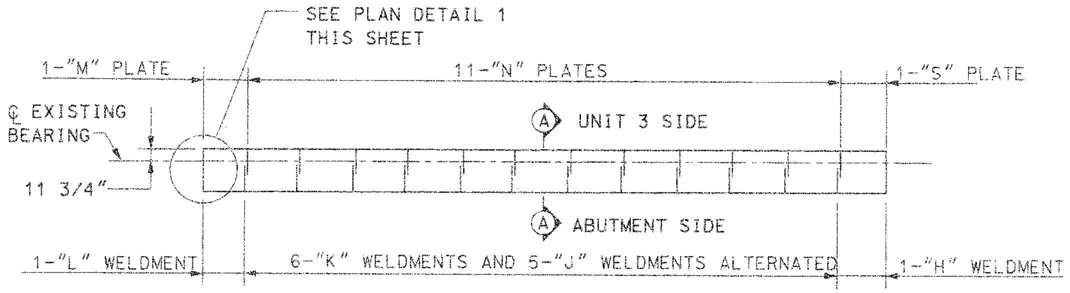
▧ = REMOVAL LIMITS

ENGINEERS ARCHITECTS

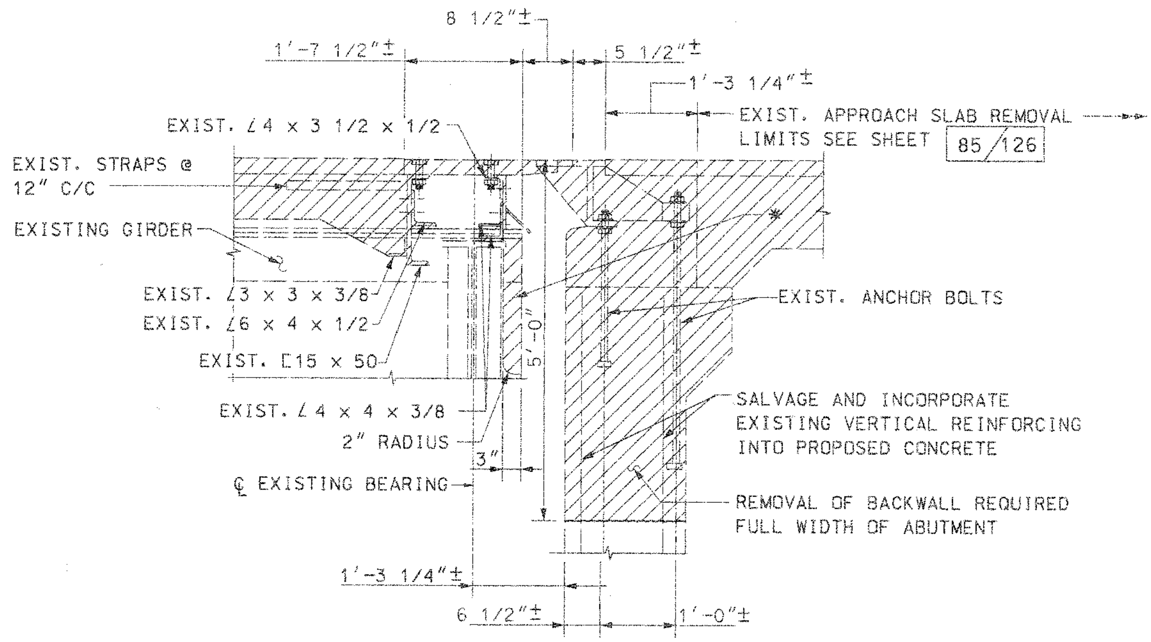
DATE 23-OCT-96
STRUCTURE FILE NUMBER 4805917
DESIGNED RWM | CHECKED MAK | DRAWN KEK | REVIEWED RK/TT

FINGER JOINT DETAILS 4 - BENT 8
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

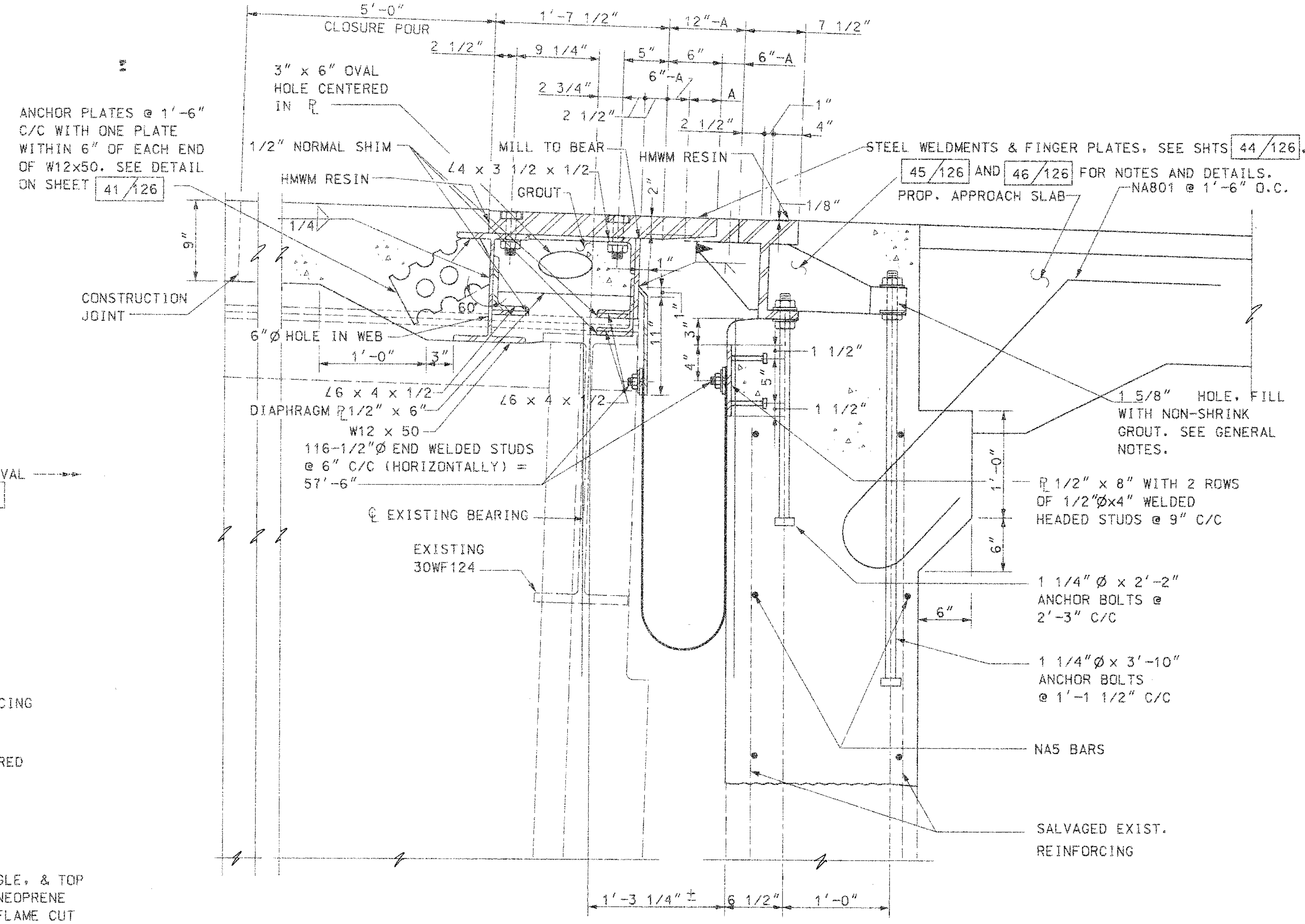


FINGER JOINT WELDMENT PLAN

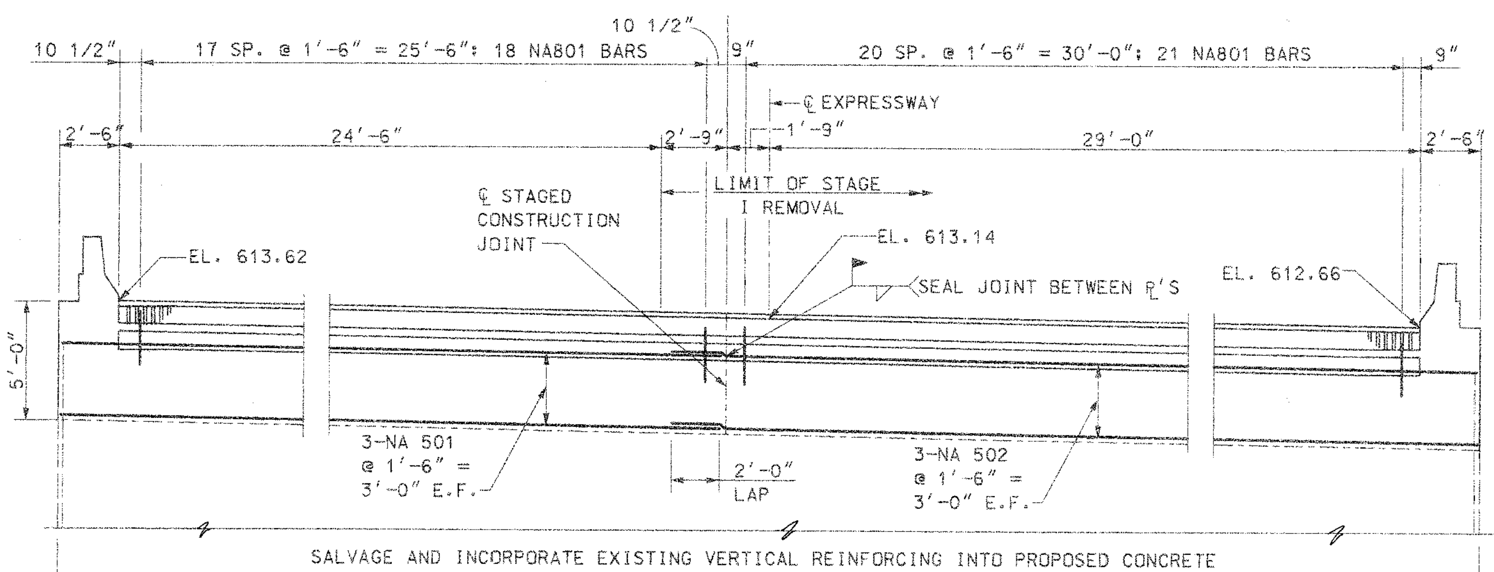


SECTION (A)
(REMOVAL)

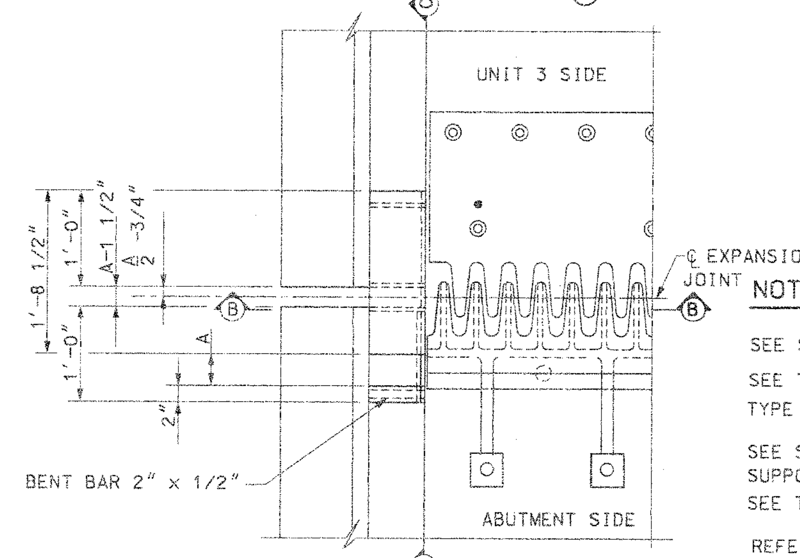
* REMOVE PORTION OF WEB, ANGLE, & TOP PLATES TO CLEAR PROPOSED NEOPRENE TROUGH. CONTRACTOR SHALL FLAME CUT AND SMOOTHLY GRIND EDGES PRIOR TO PAINTING.



SECTION (A)



NORTH ABUTMENT ELEVATION



PLAN DETAIL 1

NOTES

SEE SHEET 41/126 FOR SECTION B & C (SIMILAR).

SEE TABLE ON SHEET 46/126 FOR WELDMENT & FINGER PLATE TYPE & DIMENSIONS.

SEE SHEET 44/126 FOR TYPICAL FINGER JOINT SUPPORT DETAILS.

SEE TABLE ON SHEET 38/126 FOR DIMENSION "A".

REFER TO ODOT STD. DWG AS-1-81 FOR APPROACH SLAB DETAILS.

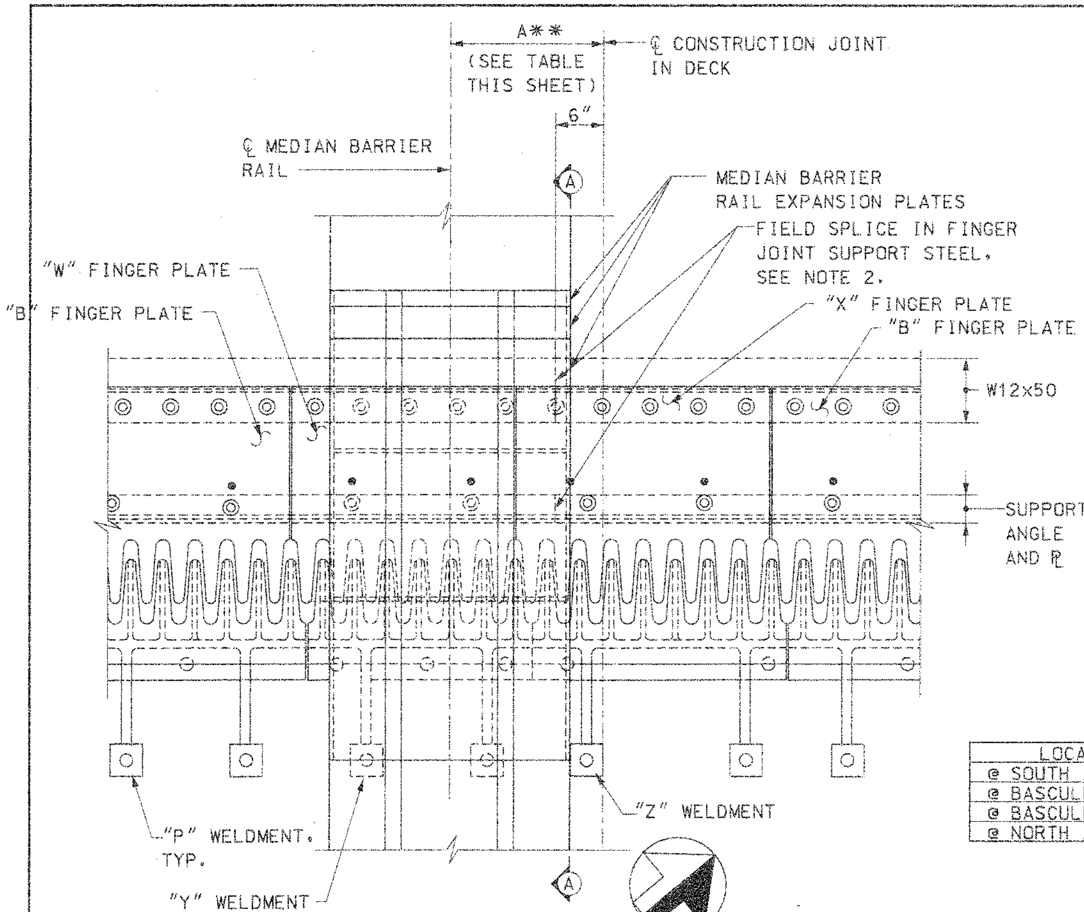
EXISTING BACKWALL AND APPROACH SLAB TO BE REMOVED PER ITEM 202, PORTION OF STRUCTURES REMOVED.

DESIGNED	CHECKED	DRAWN	REVISED	REVIEWED	DATE
RWM	MAK	KEK		RKM	23-OCT-96

STRUCTURE FILE NUMBER 4805917

FINGER JOINT DETAILS 5 - NORTH ABUTMENT
BRIDGE NO. LUC-280
OVER MAUMEE RIVER

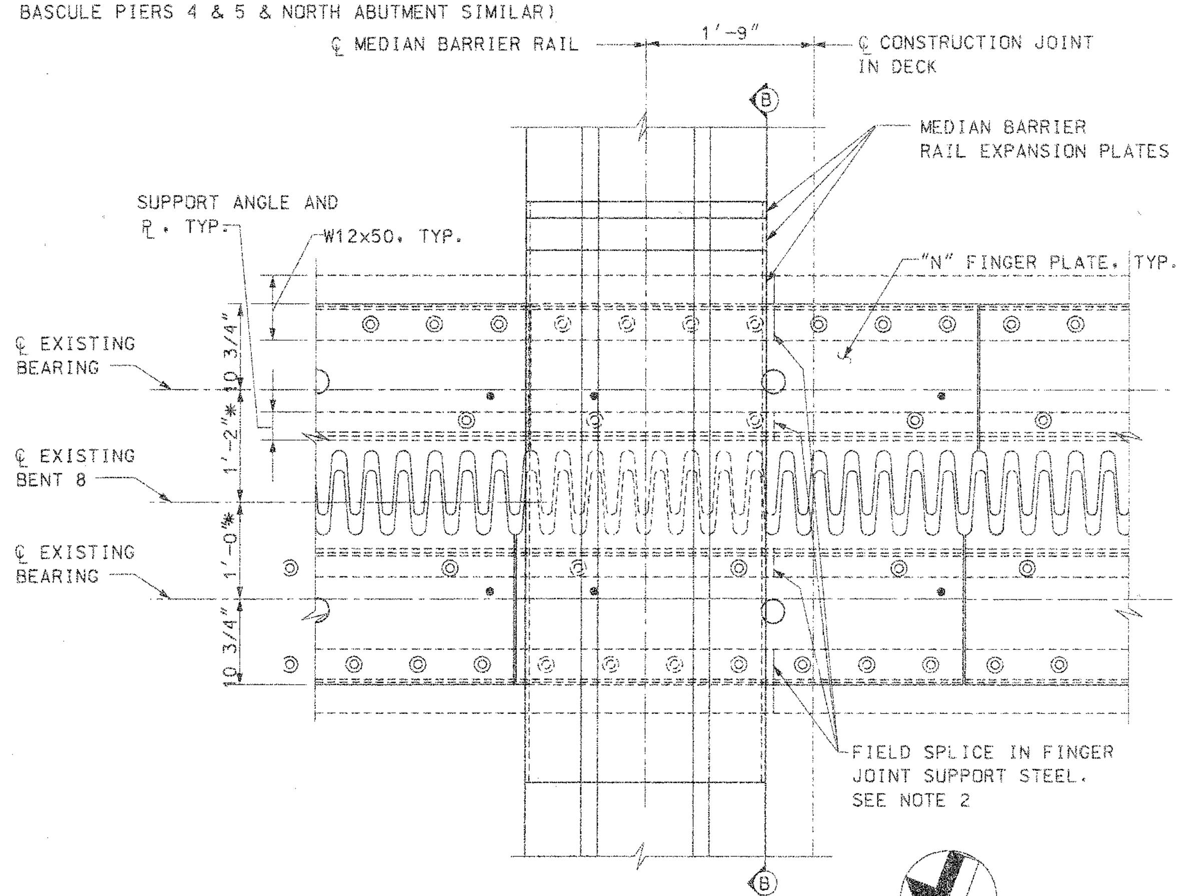
LUC-280



PLAN DETAIL 2

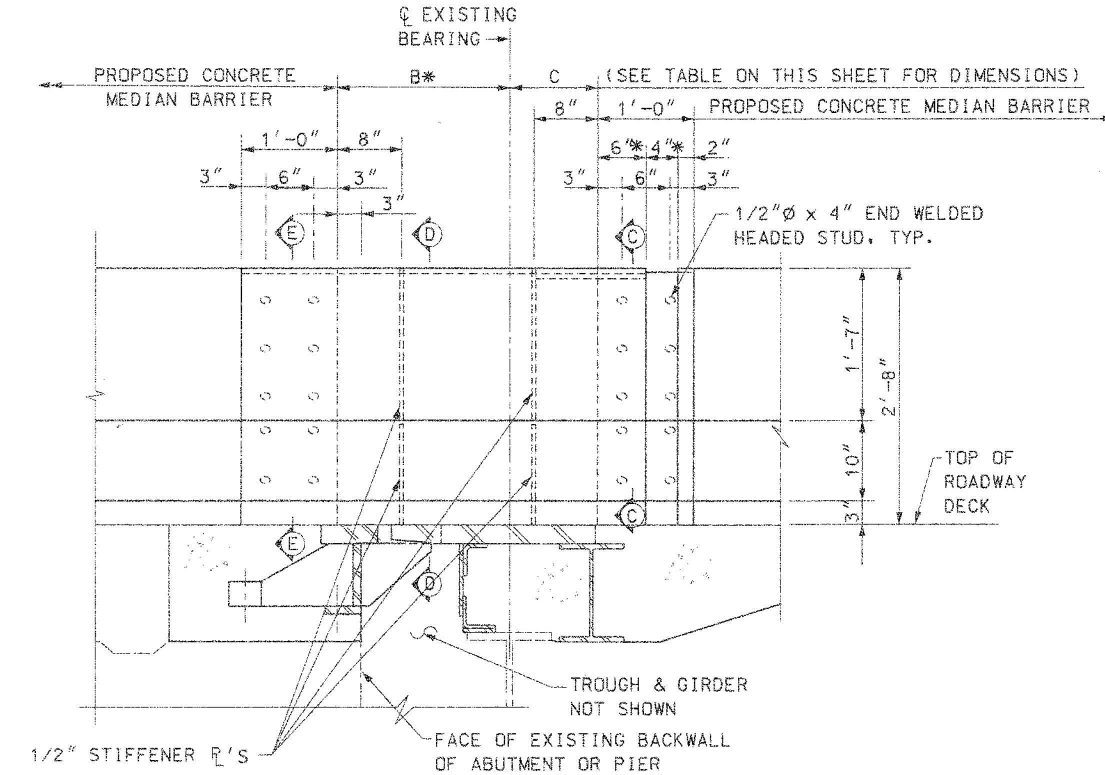
(EXPANSION JOINT @ SOUTH ABUTMENT SHOWN, BASCULE PIERS 4 & 5 & NORTH ABUTMENT SIMILAR)

LOCATION	A**	B	C
@ SOUTH ABUTMENT	1'-7 3/8"	1'-9 1/2"	11"
@ BASCULE PIER 4	8'-2 3/4"	2'-0"	11 1/2"
@ BASCULE PIER 5	1'-9"	2'-0"	11 1/2"
@ NORTH ABUTMENT	1'-9"	1'-9 3/4"	11 3/4"

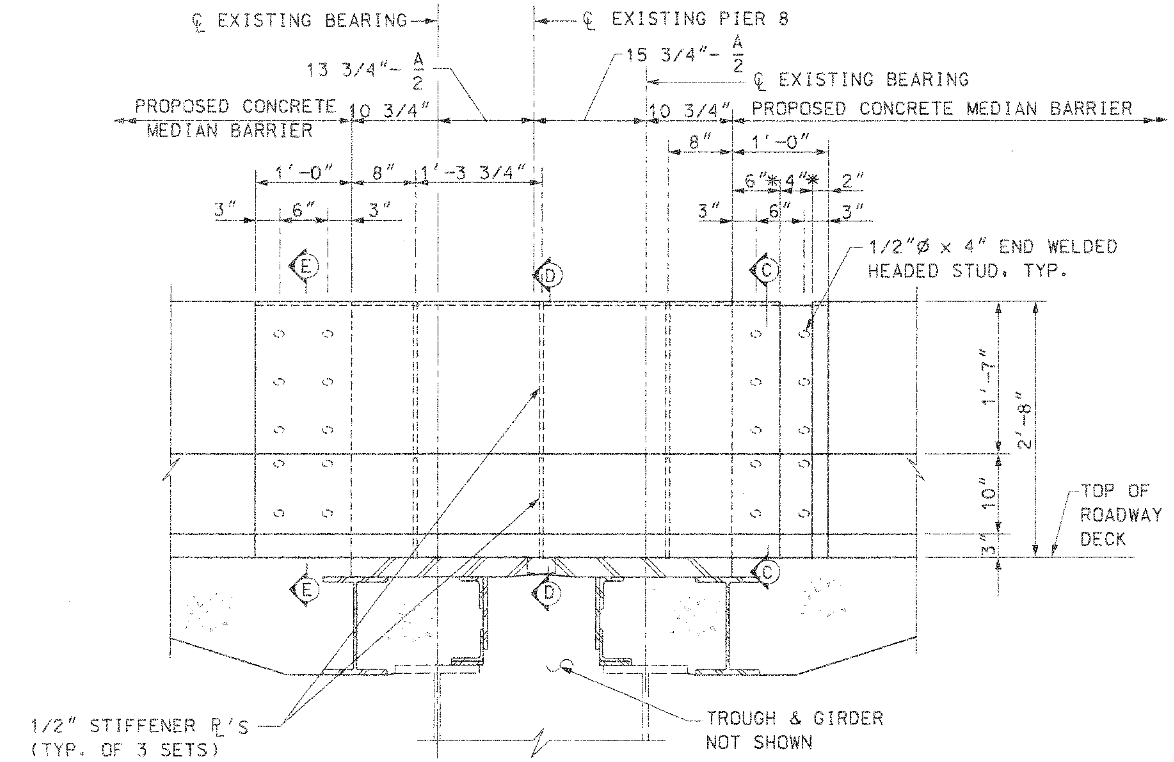


PLAN DETAIL 3

(BENT 8)



SECTION (A)



SECTION (B)

NOTES

1. SEE SHEET 10/126 FOR GENERAL NOTES.
2. PLACE SPLICE 6" WEST OF ℄ CONSTRUCTION JOINT AND PROVIDE COMPLETE JOINT PENETRATION WELD.

LEGEND

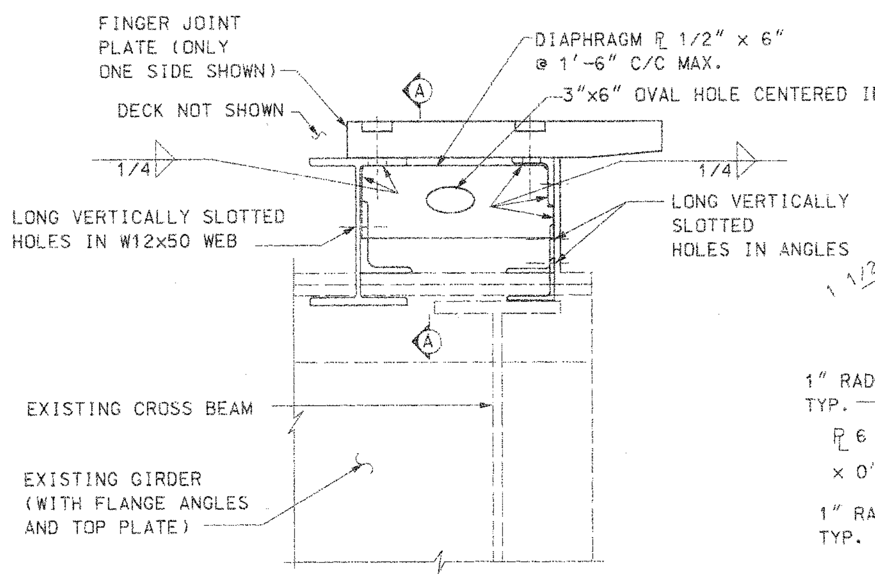
* @ 68 F

** DIMENSION "A" IS MEASURED EAST FROM THE MEDIAN BARRIER TO THE CONSTRUCTION JOINT IN THE DECK AT THE SOUTH ABUTMENT (WEST AT BASCULE PIERS 4 & 5 AND NORTH ABUTMENT).

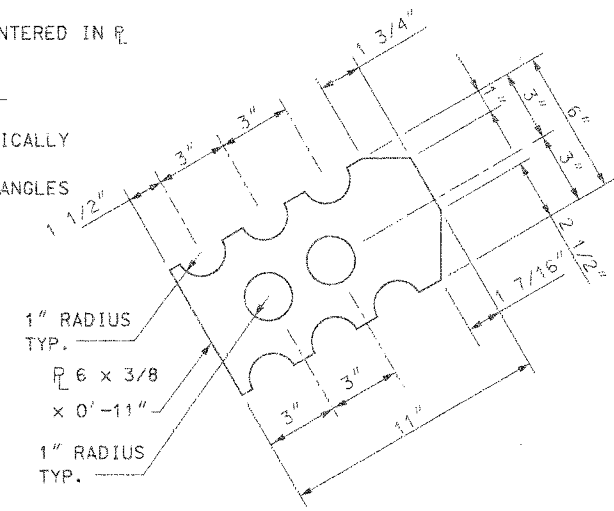
DESIGNED RWM | CHECKED MAK | DRAWN KEK | REVIEWED RKM | DATE 23-OCT-96 | STRUCTURE FILE NUMBER 4805917

FINGER JOINT DETAILS 6 – TYPICAL SECTIONS & DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

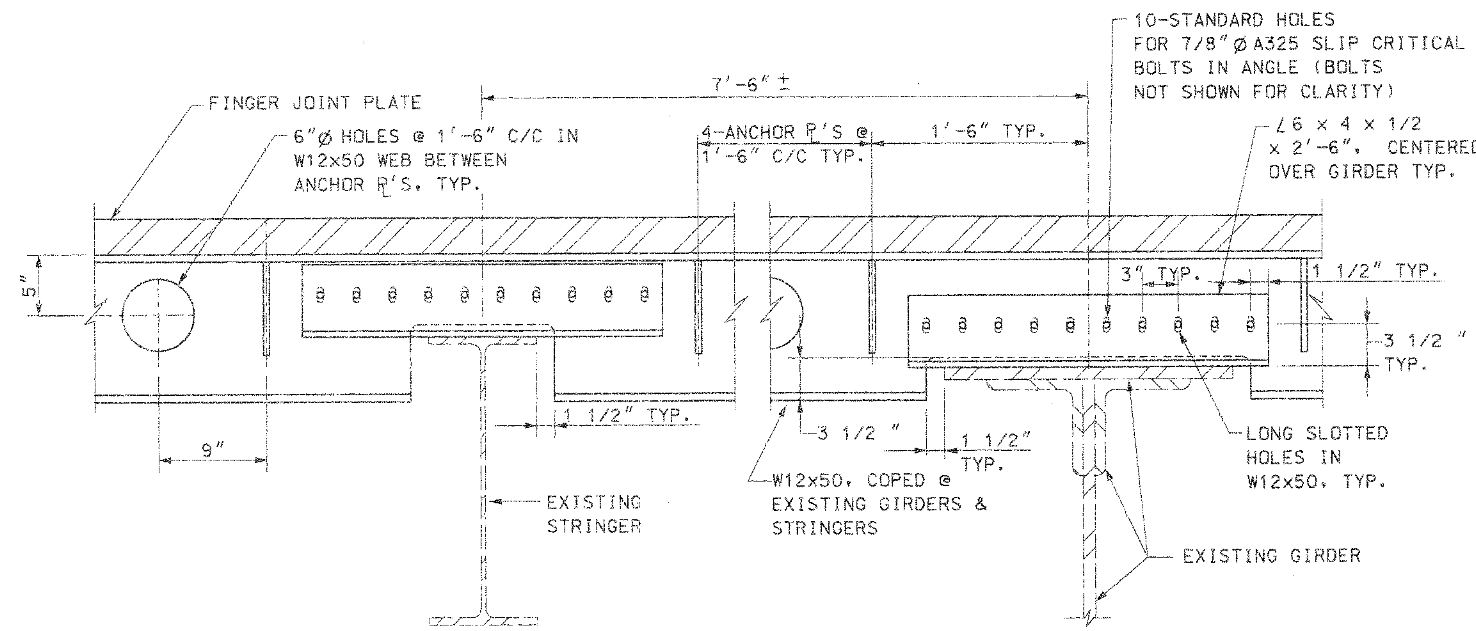
LUC-280



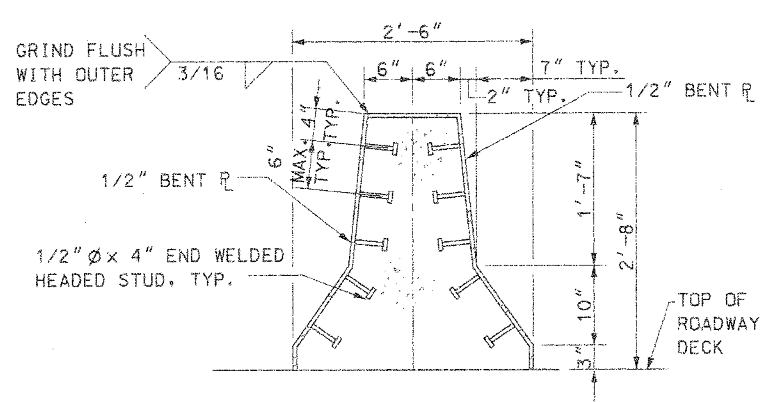
TYPICAL FINGER JOINT SUPPORT DETAIL



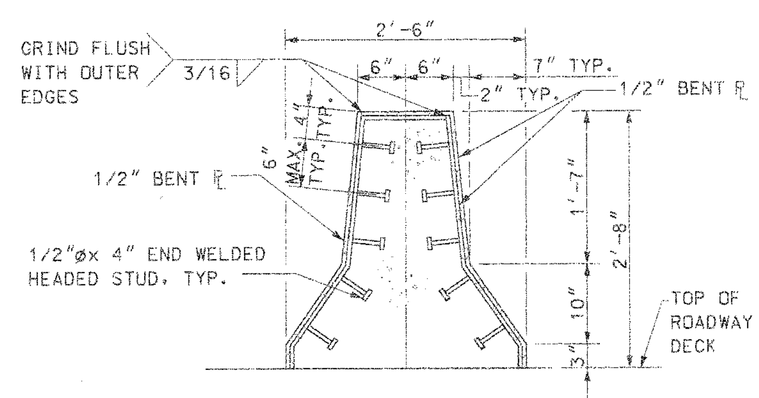
ANCHOR PLATE DETAIL



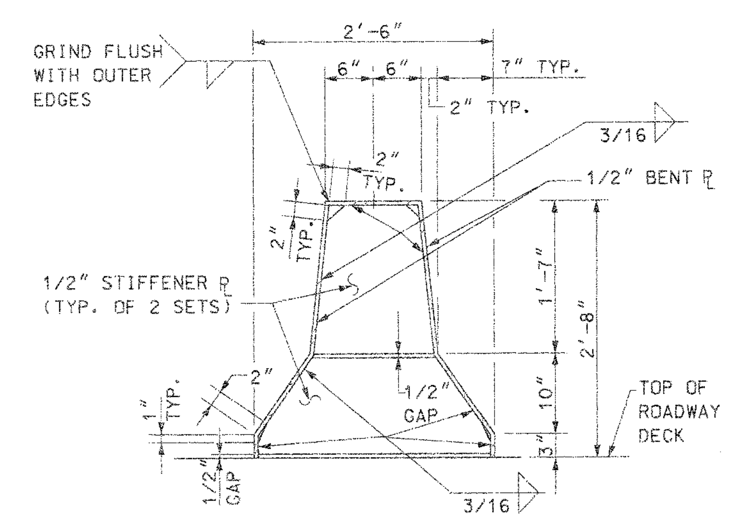
SECTION A



SECTION E



SECTION C

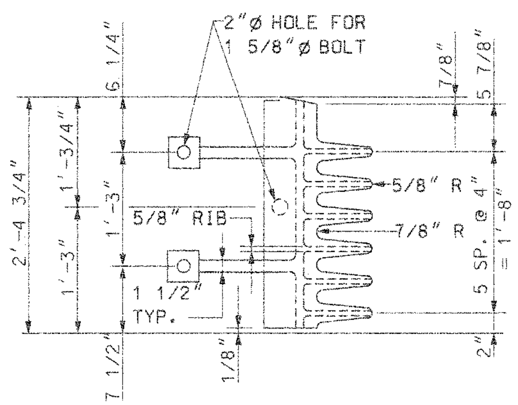


SECTION D

DESIGNED RWM
CHECKED MAK
DRAWN KEK
REVIEWED RKM
DATE 23-OCT-96
STRUCTURE FILE NUMBER 4805917

FINGER JOINT DETAILS 7 - TYPICAL SECTIONS & DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

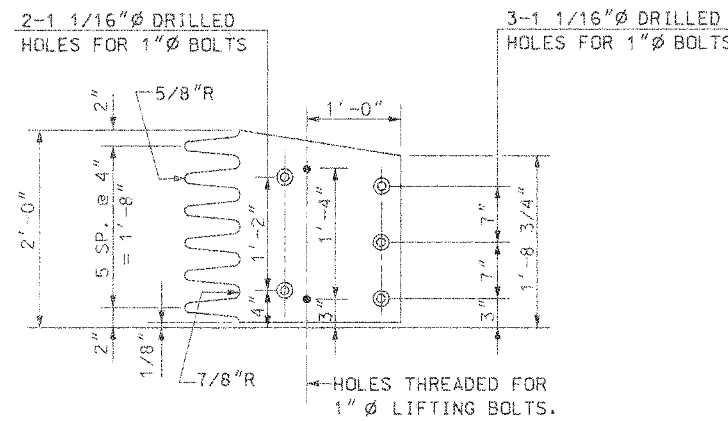
LUC-280



PLAN

(ELEVATION SIMILAR TO WELDMENT TYPE VI)

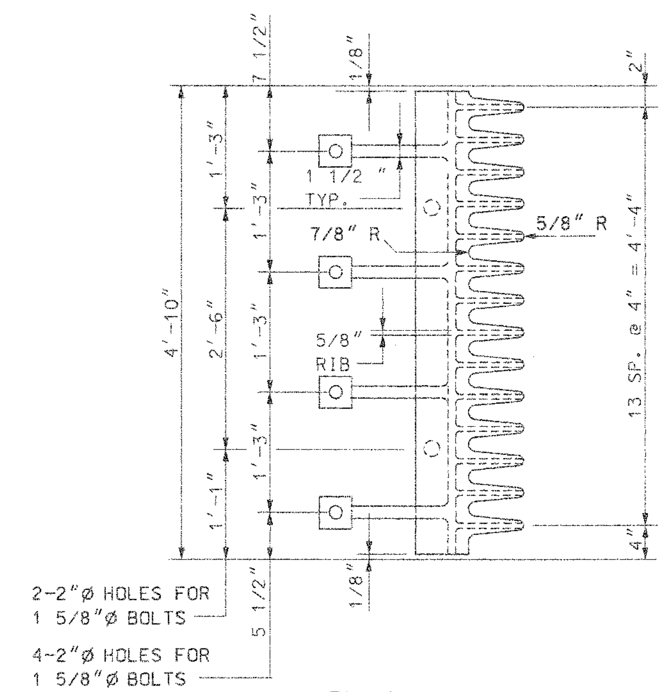
WELDMENT TYPE I



PLAN

(ELEVATION SIMILAR TO FINGER PLATE TYPE IV)

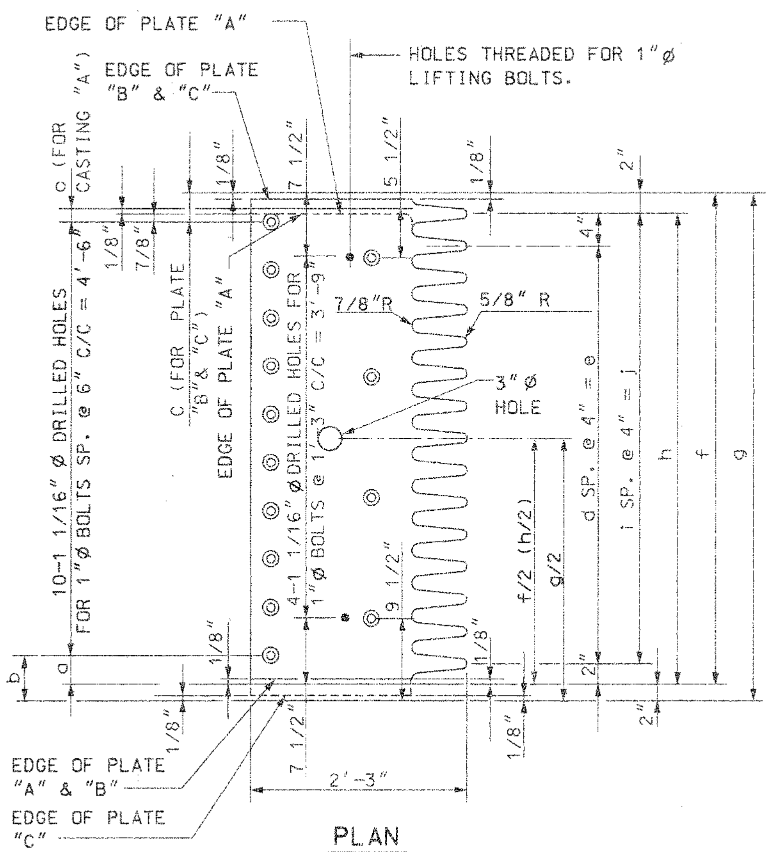
FINGER PLATE TYPE II



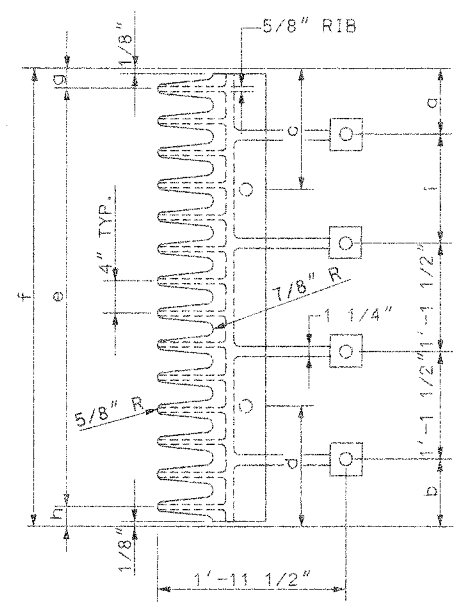
PLAN

(ELEVATION SIMILAR TO WELDMENT TYPE VI)

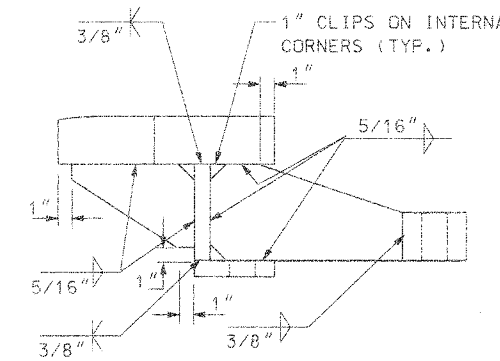
WELDMENT TYPE III



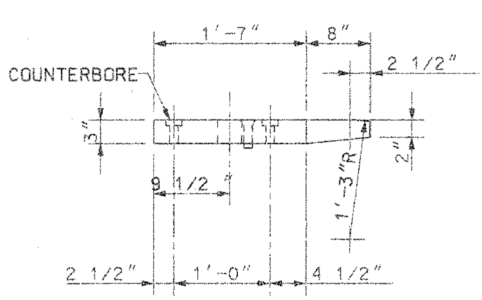
PLAN



PLAN

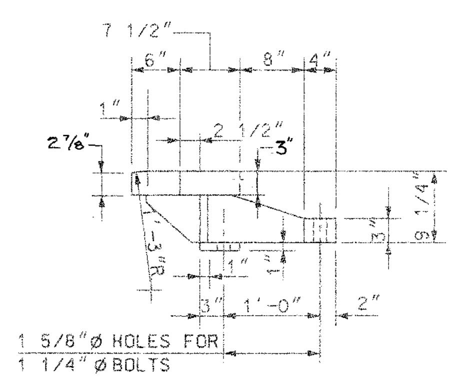


WELDMENT WELDING DETAIL



ELEVATION

FINGER PLATE TYPE IV



ELEVATION

WELDMENT TYPE V

NOTES

SEE TABLE ON SHEET 46/126 FOR DIMENSIONS NOT SHOWN.

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 46/126 FOR WELDMENT & FINGER PLATES TYPES VI THROUGH X

BOLTS IN WELDMENTS & FINGER PLATES SHALL BE ASTM A276 TYPE 304 STAINLESS STEEL.

WORK THE WELDMENT WELDING DETAIL W/ ALL WELDMENT TYPES

LEGEND

R = RADIUS

FINGER JOINT DETAILS 8- WELDMENT & FINGER PLATE DETAILS

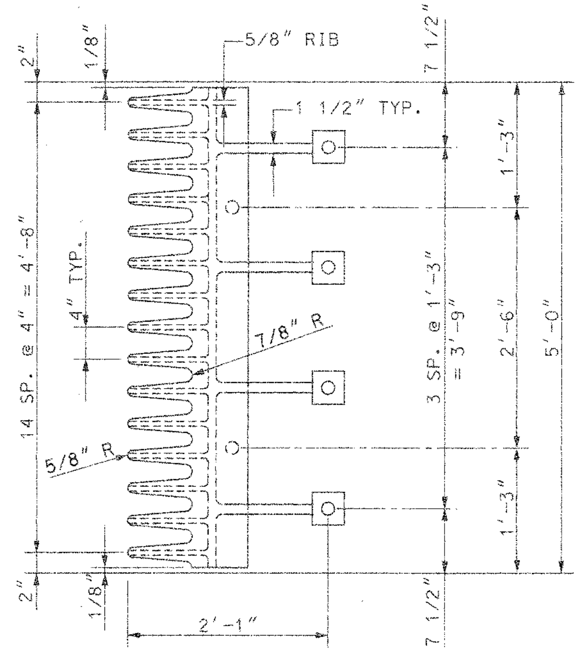
BRIDGE NO. LUC-280-0346

OVER MAUMEE RIVER

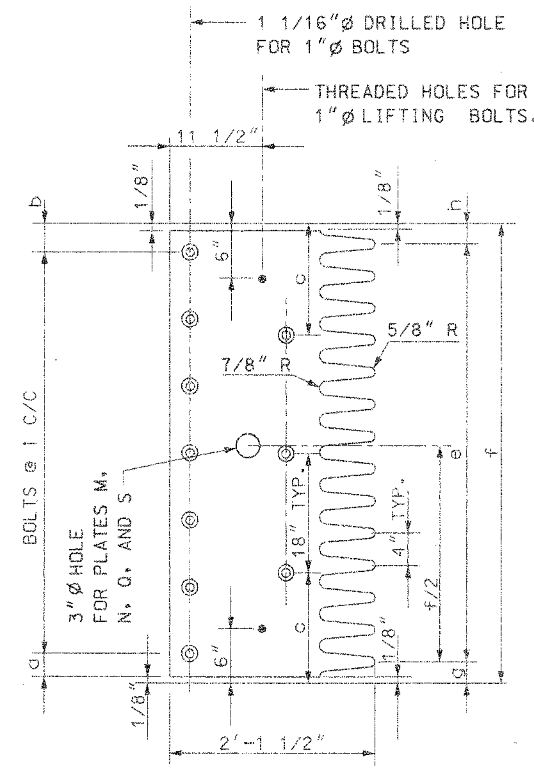
DESIGNED RWM CHECKED MAK DRAWN KEK REVISED REVIEWED RKM DATE 23-OCT-96

STRUCTURE FILE NUMBER 4805917

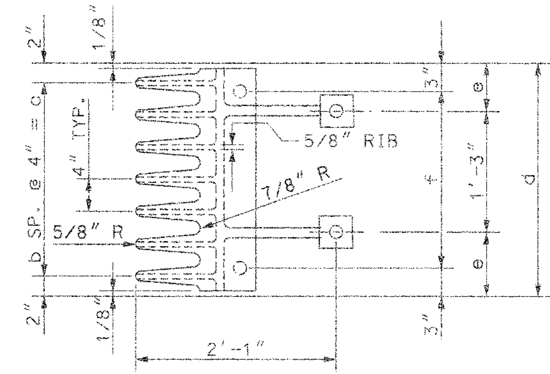
LUC-280



PLAN



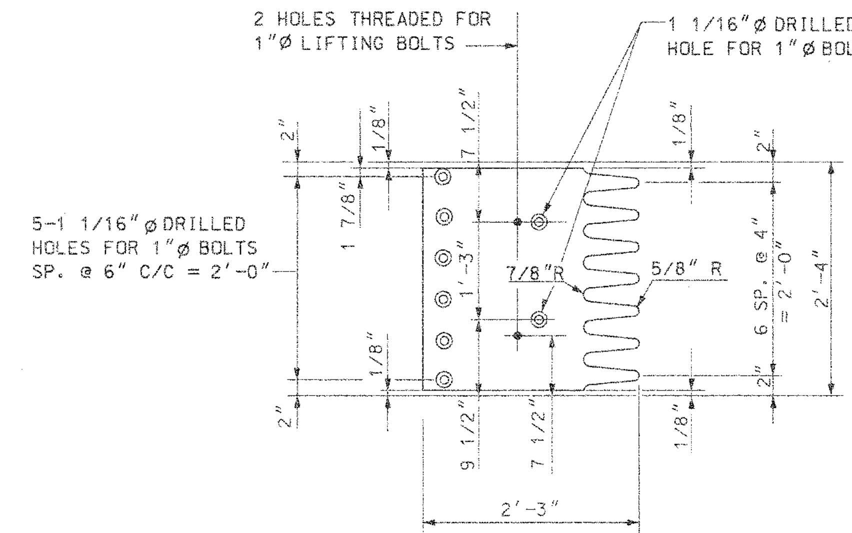
PLAN



PLAN

(ELEVATION SIMILAR TO WELDMENT TYPE VI)

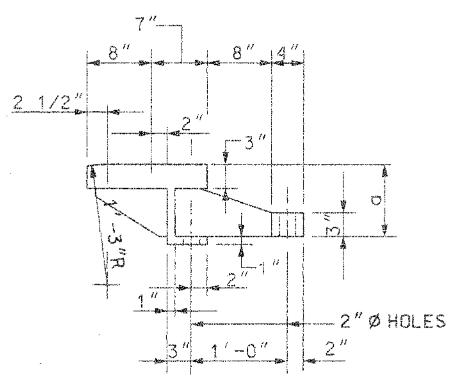
WELDMENT TYPE VIII



PLAN

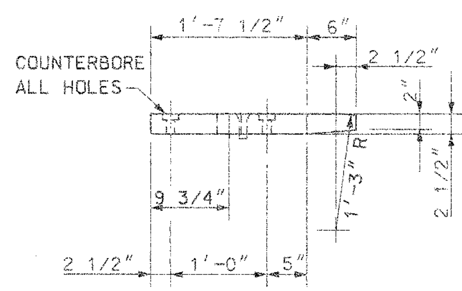
(ELEVATION SIMILAR TO FINGER PLATE TYPE IV)

FINGER PLATE TYPE IX



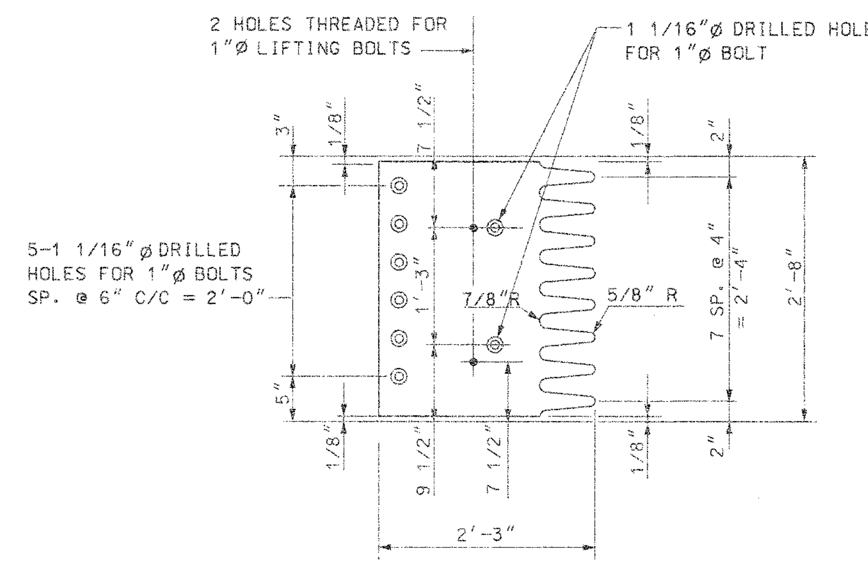
ELEVATION

WELDMENT TYPE VI



ELEVATION

FINGER PLATE TYPE VII



PLAN

(ELEVATION SIMILAR TO FINGER PLATE TYPE IV)

FINGER PLATE TYPE X

WELDMENT / FINGER PLATE	WELDMENT & FINGER PLATE DIMENSION TABLE												
	TYPE	NUMBER	a	b	c	d	e	f	g	h	I	J
A	IV	2	2"	N/A	2"	13	4'-4"	N/A	N/A	4'-10"	N/A	N/A
B	IV	38	3"	N/A	3"	N/A	N/A	5'-0"	N/A	N/A	14	4'-8"
C	IV	2	N/A	5"	3"	N/A	N/A	N/A	5'-2"	N/A	14	4'-8"
D	VI	27	10"	–	–	–	–	–	–	–	–	–
E	I	1	11 1/2"	–	–	–	–	–	–	–	–	–
F	II	1	–	–	–	–	–	–	–	–	–	–
G	III	1	11 1/2"	–	–	–	–	–	–	–	–	–
H	V	1	6 3/4"	7 3/4"	10 1/2"	1'-2 1/2"	3'-8"	4'-1"	3"	2"	7 1/2"	–
J	V	5	7 3/4"	7 3/4"	1'-2 1/2"	1'-2 1/2"	4'-4"	4'-8"	2"	2"	1'-1 1/2"	–
K	V	6	5 3/4"	5 3/4"	1'-0 1/2"	1'-0 1/2"	4'-0"	4'-4"	2"	2"	1'-1 1/2"	–
L	V	1	7 3/4"	6 3/4"	1'-2 1/2"	1'-1 1/2"	4'-4"	4'-7"	2"	5"	1'-1 1/2"	–
M	VII	1	5"	4"	1'-1"	8"	3'-0"	3'-5"	3"	2"	8"	–
N	VII	34	4"	4"	8"	8"	4'-4"	4'-8"	2"	2"	8"	–
P	VI	15	11 1/2"	–	–	–	–	–	–	–	–	–
Q	VII	1	6"	4"	10"	8"	4'-4"	4'-10"	4"	2"	8"	–
R	VII	1	4"	4"	11"	11"	1'-4"	1'-10"	2"	4"	7"	–
S	VII	1	4"	3"	8"	11"	2'-8"	3'-3"	2"	5"	8"	–
T	VII	1	4"	4"	1'-0"	1'-0"	1'-8"	2'-0"	2"	2"	8"	–
U	VIII	2	10"	6	2'-0"	2'-4"	6 1/2"	1'-10"	–	–	–	–
V	VIII	2	10"	7	2'-4"	2'-8"	8 1/2"	2'-2"	–	–	–	–
W	IX	3	–	–	–	–	–	–	–	–	–	–
X	X	3	–	–	–	–	–	–	–	–	–	–
Y	VIII	1	11 1/2"	6	2'-0"	2'-4"	6 1/2"	1'-10"	–	–	–	–
Z	VIII	1	11 1/2"	7	2'-4"	2'-8"	8 1/2"	2'-2"	–	–	–	–

NOTES

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 45/126 FOR WELDMENT & PLATE TYPES I THROUGH V.

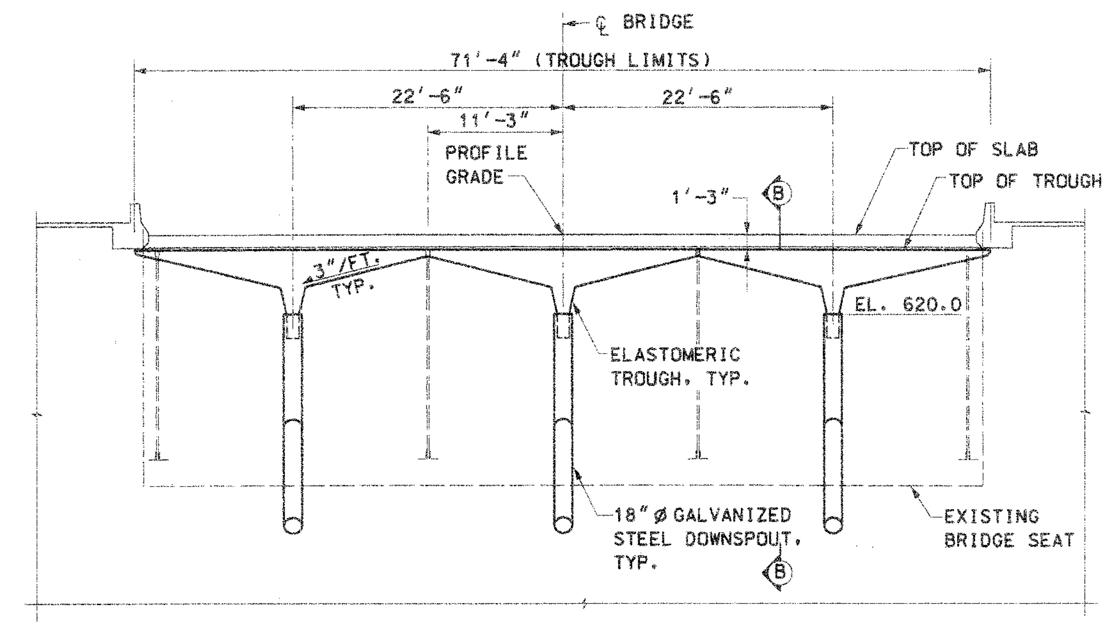
LEGEND

R = RADIUS

FINGER JOINT DETAILS 9 – WELDMENT & PLATE DETAILS & TABLE
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

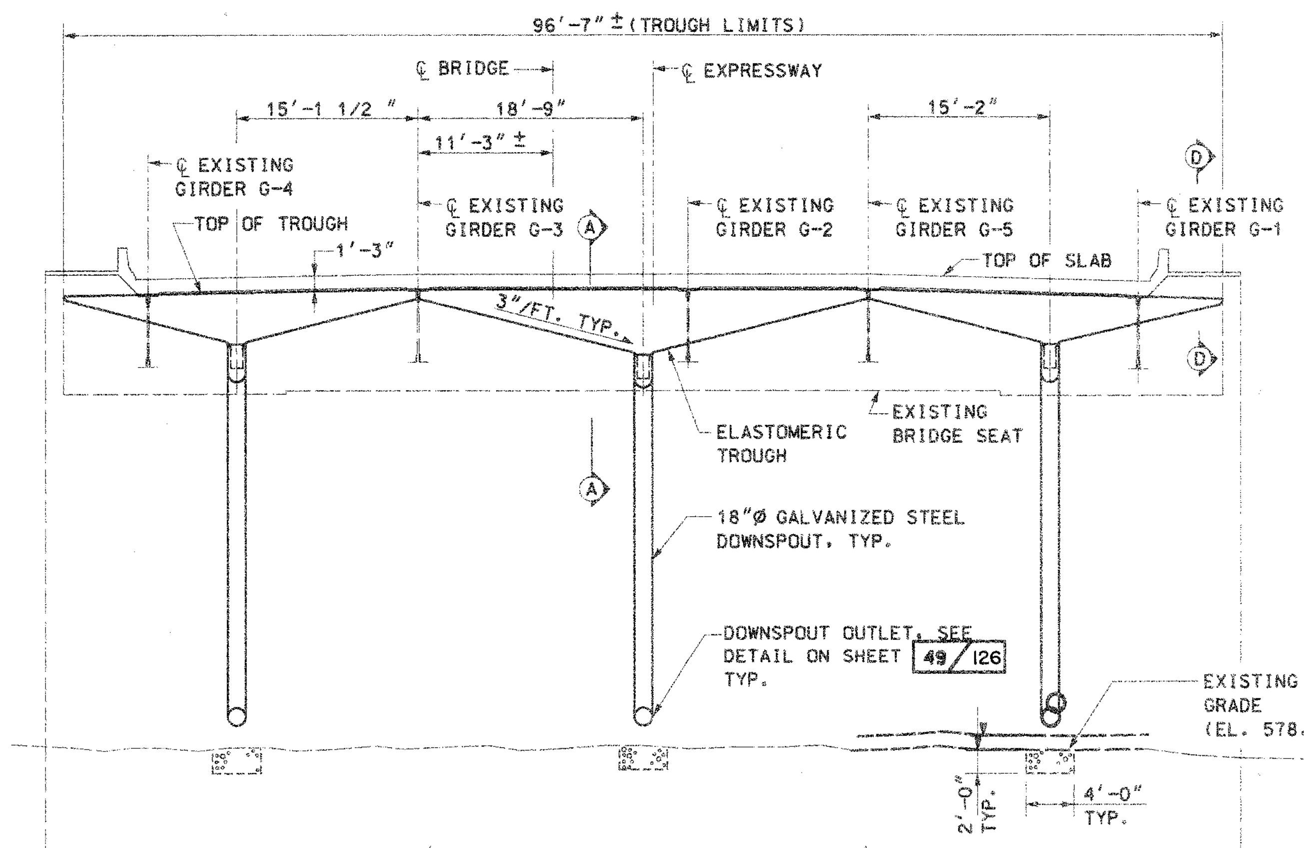
DESIGNED RWM CHECKED MAK DRAWN KEK REVISED REVIEWED RKM DATE 23-OCT-96 STRUCTURE FILE NUMBER 4805917

LUC-280

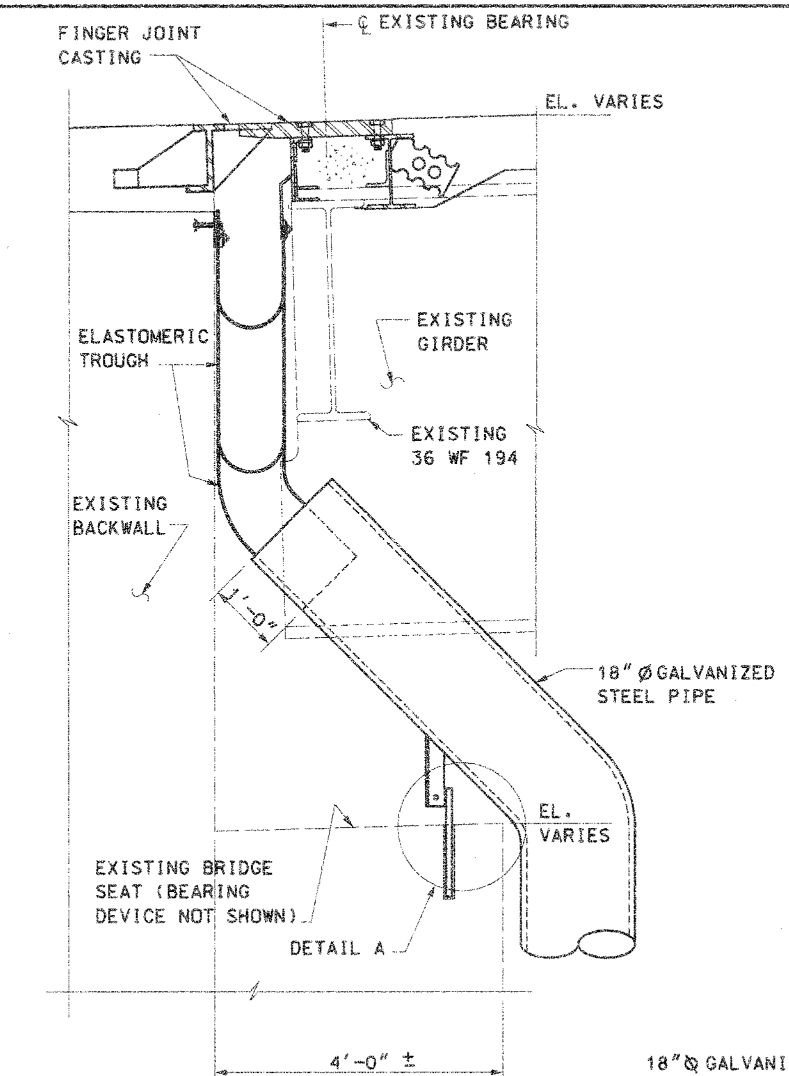


TROUGH ELEVATION @ BASCULE PIERS 4 & 5

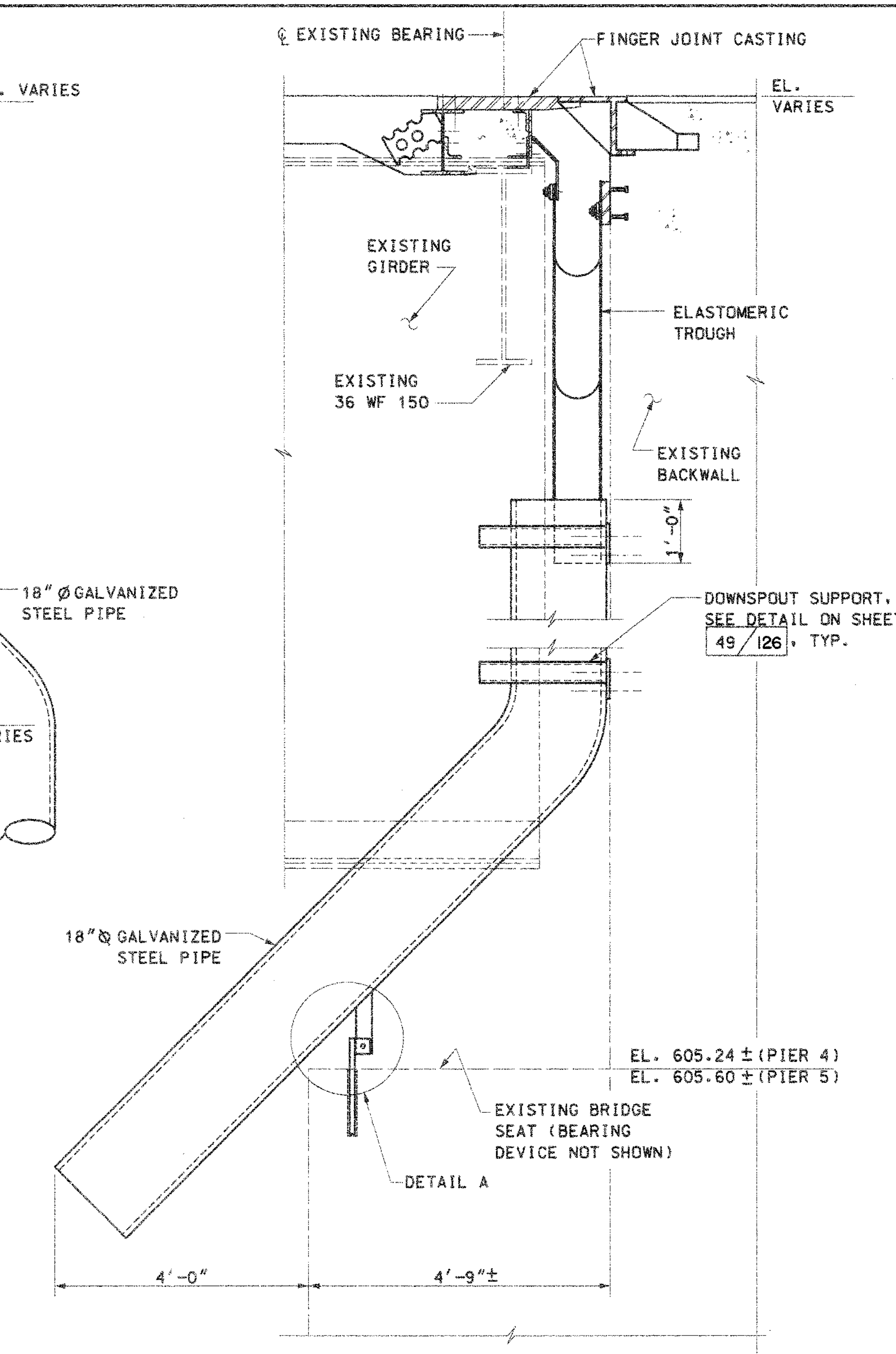
(SHORE SIDE)



TROUGH ELEVATION @ SOUTH ABUTMENT



SECTION (A)



SECTION (B)

NOTES

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 50/126 FOR TYPICAL ELASTOMERIC TROUGH DETAILS.

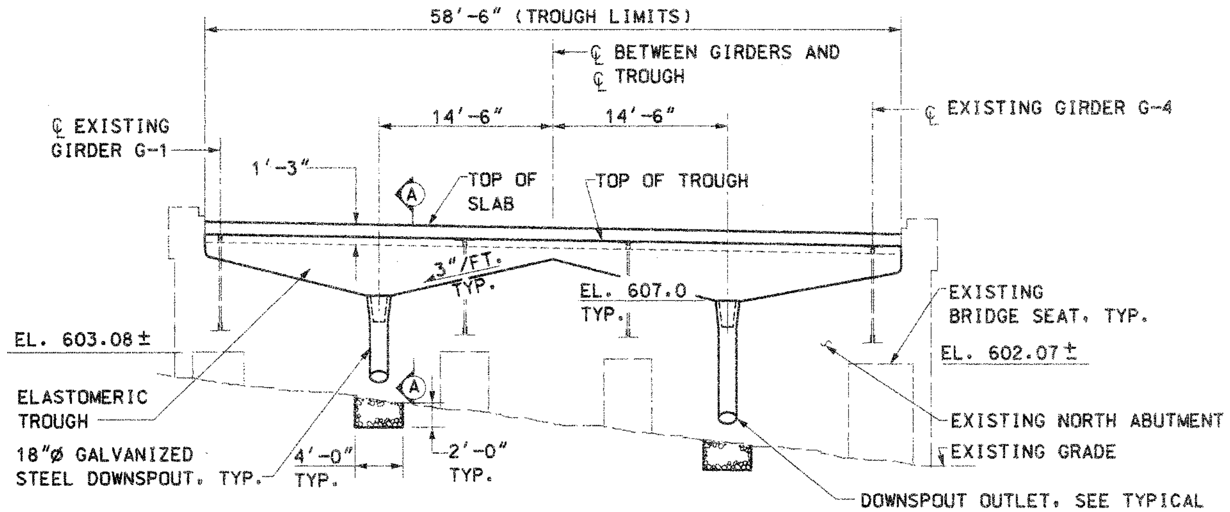
SEE SHEET 49/126 FOR DETAIL A.

SEE SHEET 38/126 FOR SECTION D.

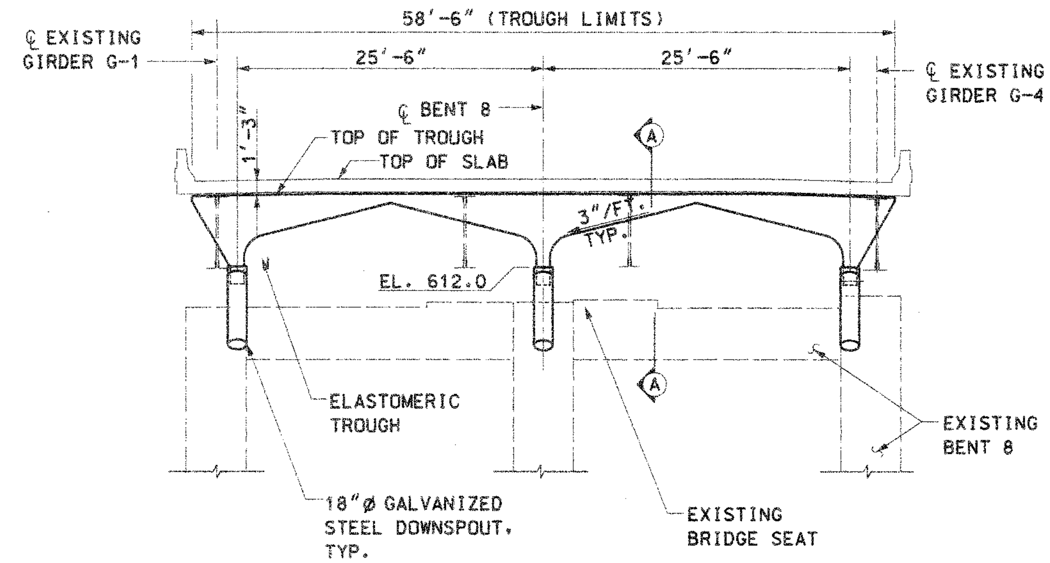
DESIGNED RWM | DRAWN KEK | REVIEWED RKM | DATE 14-Feb-96 | STRUCTURE FILE NUMBER 4805917 | CHECKED MAK | REVISED

FINGER JOINT TROUGH DETAILS 1
SOUTH ABUTMENT & BASCULE PIERS 4 & 5
BRIDGE NO. LUC-280-0346

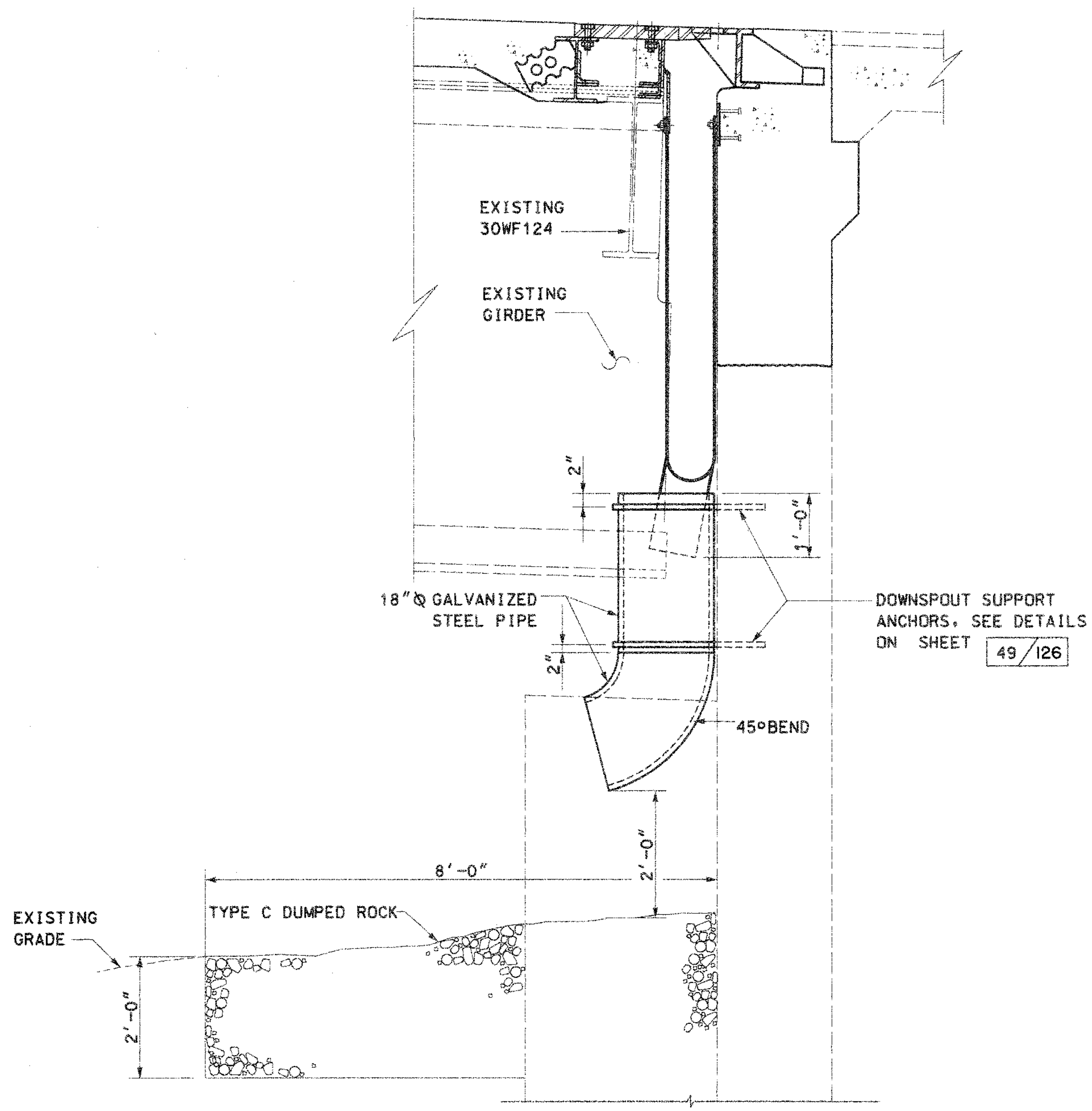
LUC-280



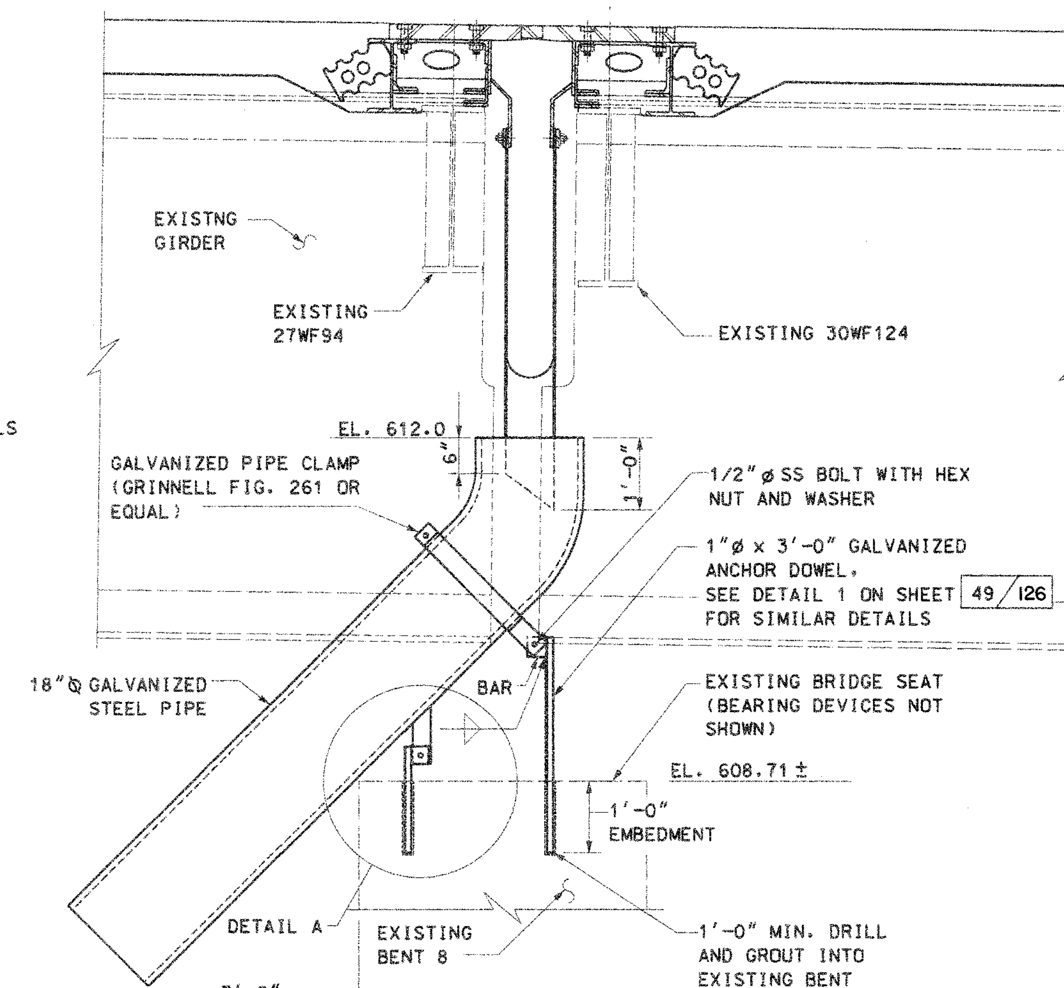
TROUGH ELEVATION @ NORTH ABUTMENT



TROUGH ELEVATION @ BENT 8
(LOOKING NORTH)



SECTION B



SECTION A

NOTES

SEE SHEET 10/126 FOR GENERAL NOTES.

SEE SHEET 49/126 FOR DETAIL A.

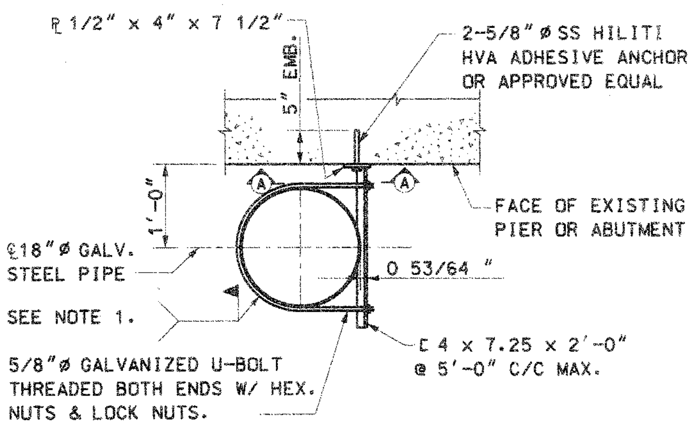
SEE SHEET 50/126 FOR TYPICAL ELASTOMERIC TROUGH DETAILS.

DESIGNED RWM | CHECKED MAK | DRAWN KEK | REVISED | REVIEWED RK/77 | DATE 14-Feb-96 | STRUCTURE FILE NUMBER 4805917

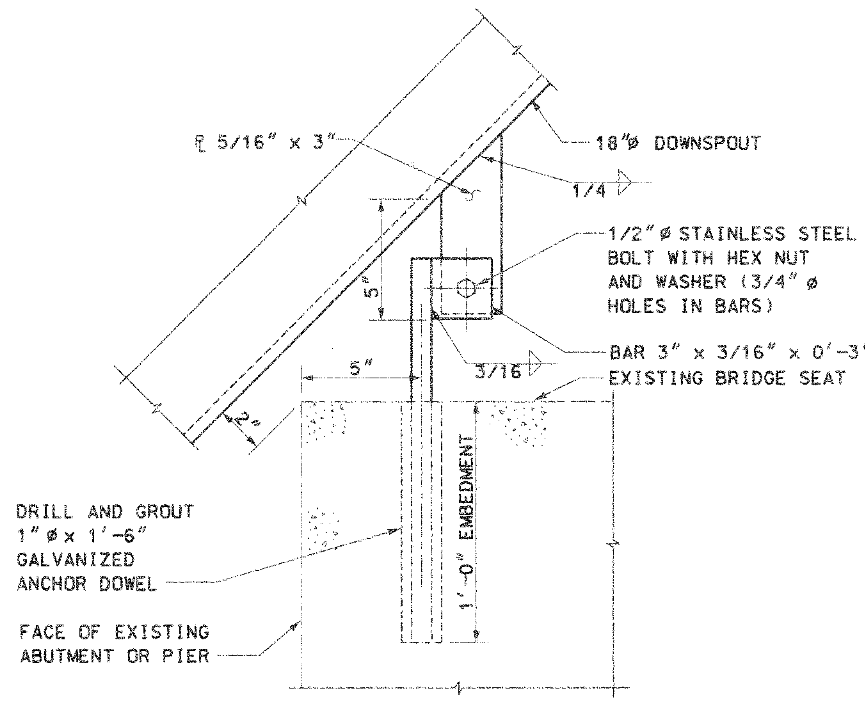
FINGER JOINT TROUGH DETAILS 2-BENT 8 & NORTH ABUTMENT

BRIDGE NO. LUC-280-0346

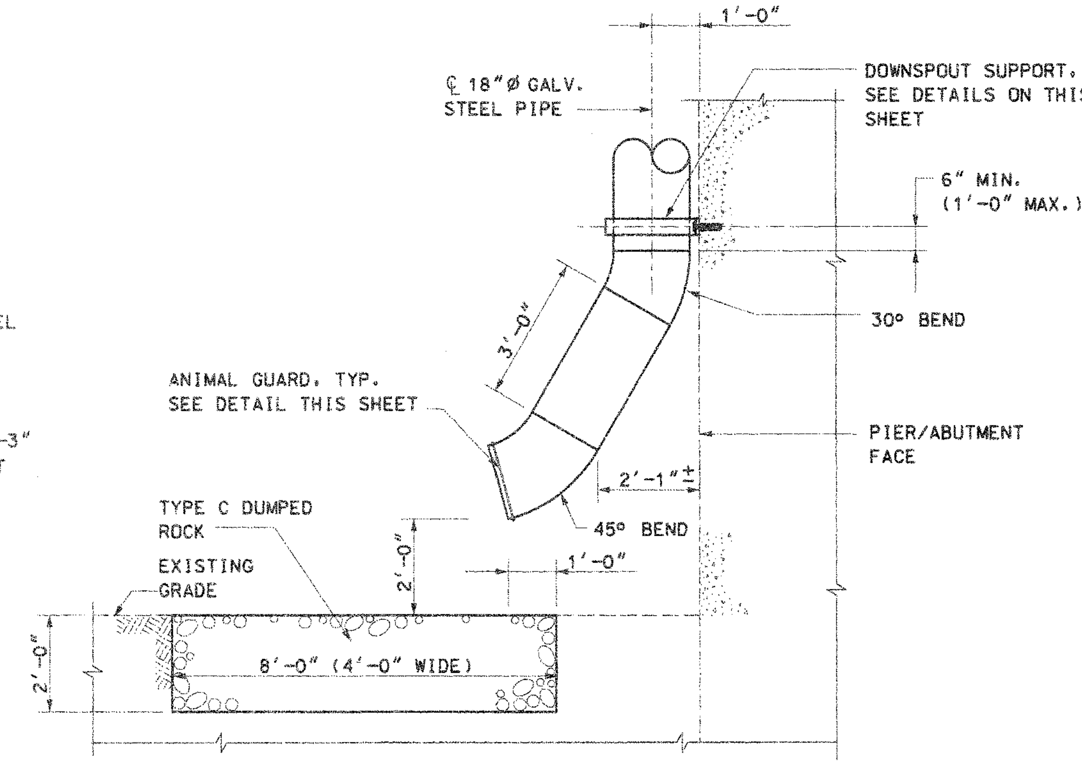
LUC-280



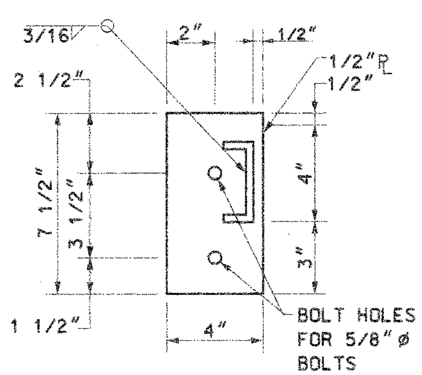
DOWNSPOUT SUPPORT DETAIL



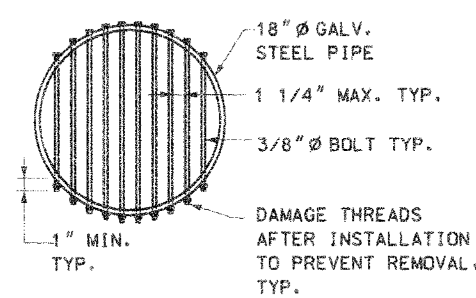
DETAIL A



TYPICAL DOWNSPOUT OUTLET DETAIL



SECTION (A)



ANIMAL GUARD DETAIL

NOTES

1. SEE SHEET 10/126 FOR GENERAL NOTES.
2. TACK WELD U-BOLT AFTER DOWNSPOUT INSTALLATION (TYP.)

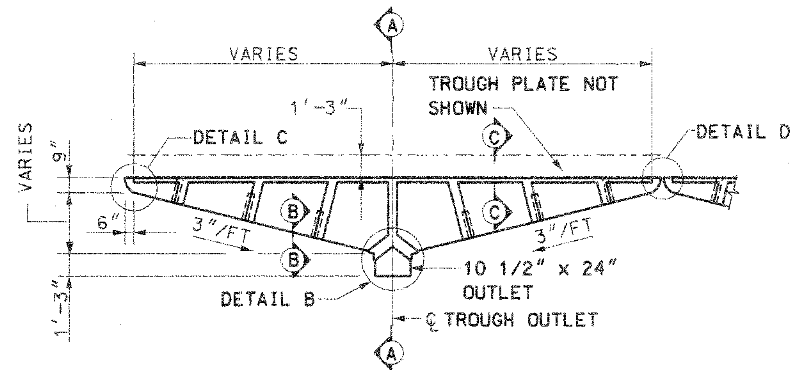
LEGEND

GALV. = GALVANIZED

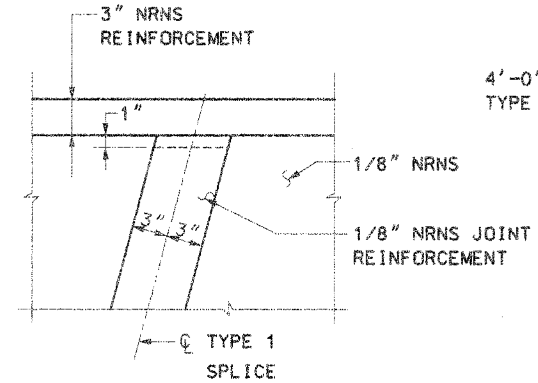
DESIGNED RWM | CHECKED MAK | DRAWN KEK | REVISED | REVIEWED RH/71 | DATE 14-Feb-96 | STRUCTURE FILE NUMBER 4805917

FINGER JOINT TROUGH DETAILS 3 - TYPICAL DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

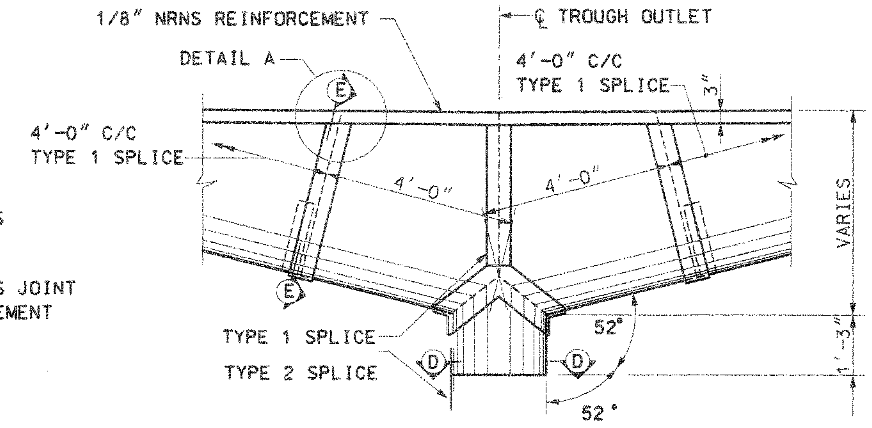
LUC-280



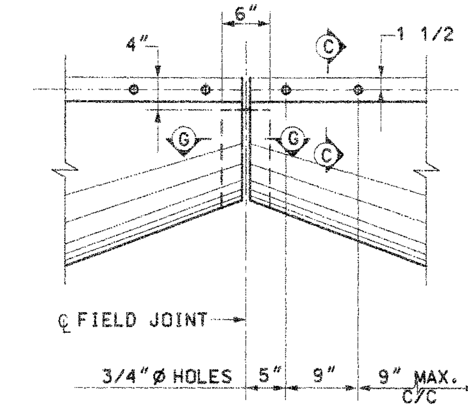
TYPICAL ELEVATION
ELASTOMERIC TROUGH



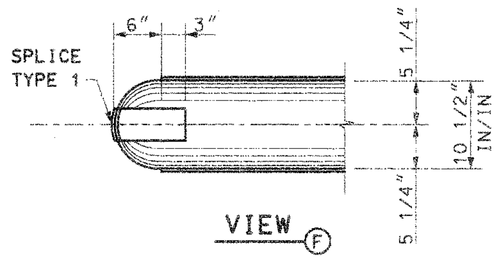
DETAIL A



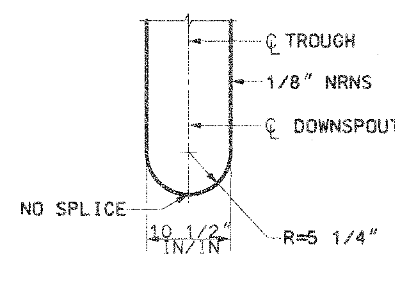
DETAIL B



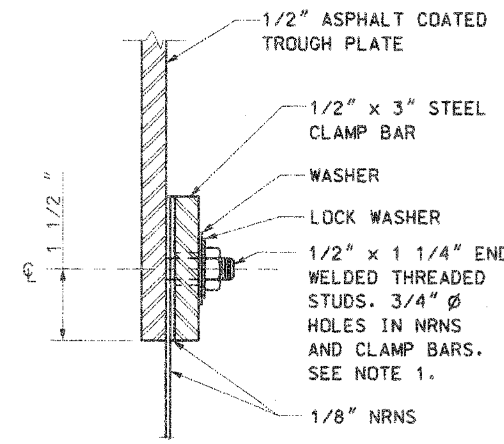
DETAIL D
(TROUGH JOINTS)



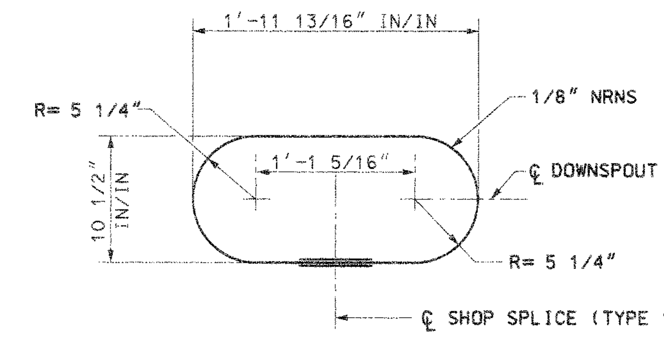
VIEW (F)



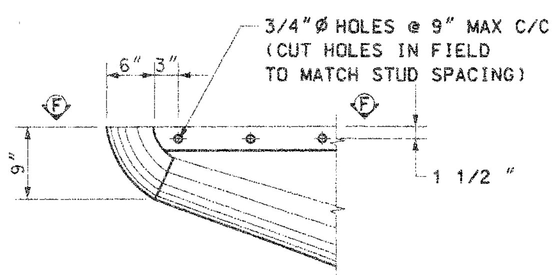
SECTION (B)



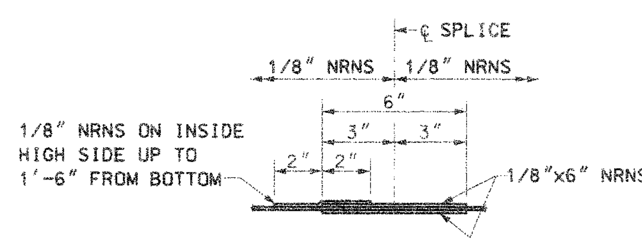
SECTION (C)



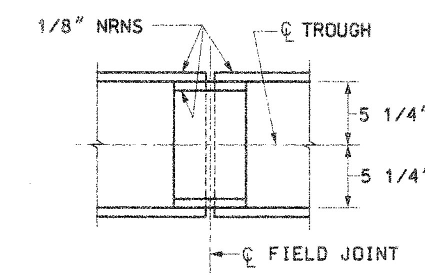
SECTION (D)



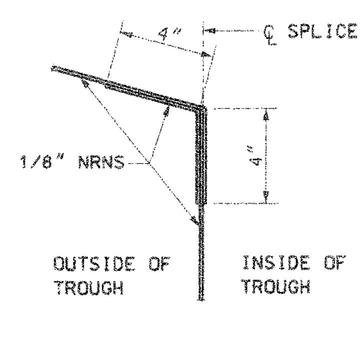
DETAIL C



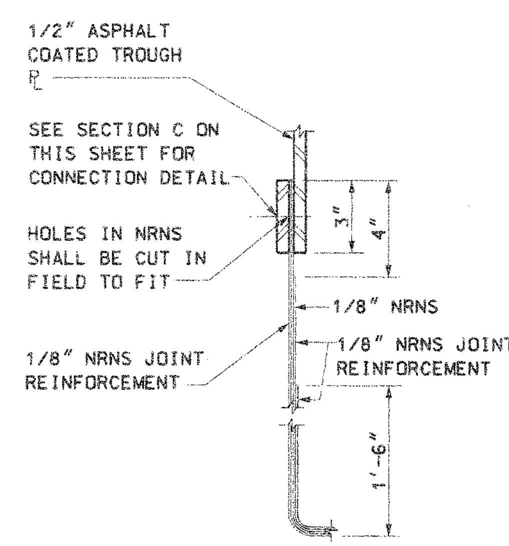
TYPICAL SHOP SPLICE (TYPE 1)



SECTION (G)



TYPICAL SHOP SPLICE (TYPE 2)



SECTION (E)

NOTES

1. 1/2" x 1 1/4" GALVANIZED STEEL END WELDED THREADED STUDS WITH HEX NUTS, FLAT WASHERS, AND LOCK WASHERS. PROVIDE 3/4"⌀ HOLES IN CLAMP BARS AND 5/8"⌀ HOLES IN WASHERS. ALL METAL FASTENER ITEMS SHALL BE FURNISHED BY THE DECK JOINT FABRICATOR. SEE ELASTOMERIC TROUGH NOTE IN GENERAL NOTES FOR OTHER REQUIREMENTS.
2. SEE SHEETS 47/126 & 48/126, FOR SECTION A.
3. WORK THIS SHEET WITH SHEETS 47/126, 48/126, & 49/126.

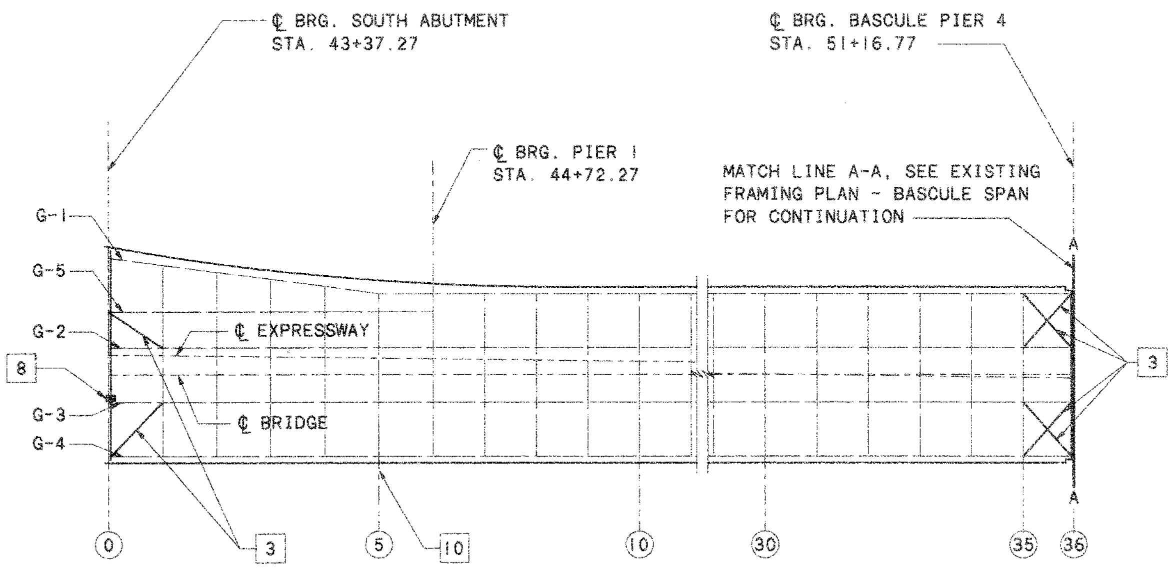
LEGEND

R = RADIUS
NRNS = NYLON REINFORCED NEOPRENE SHEET
IN/IN = INSIDE FACE TO INSIDE FACE DIMENSION

DESIGNED RMW | DRAWN KEK | REVISED RK77 | DATE 14-Feb-96
CHECKED MAK | REVISED | STRUCTURE FILE NUMBER 4805917

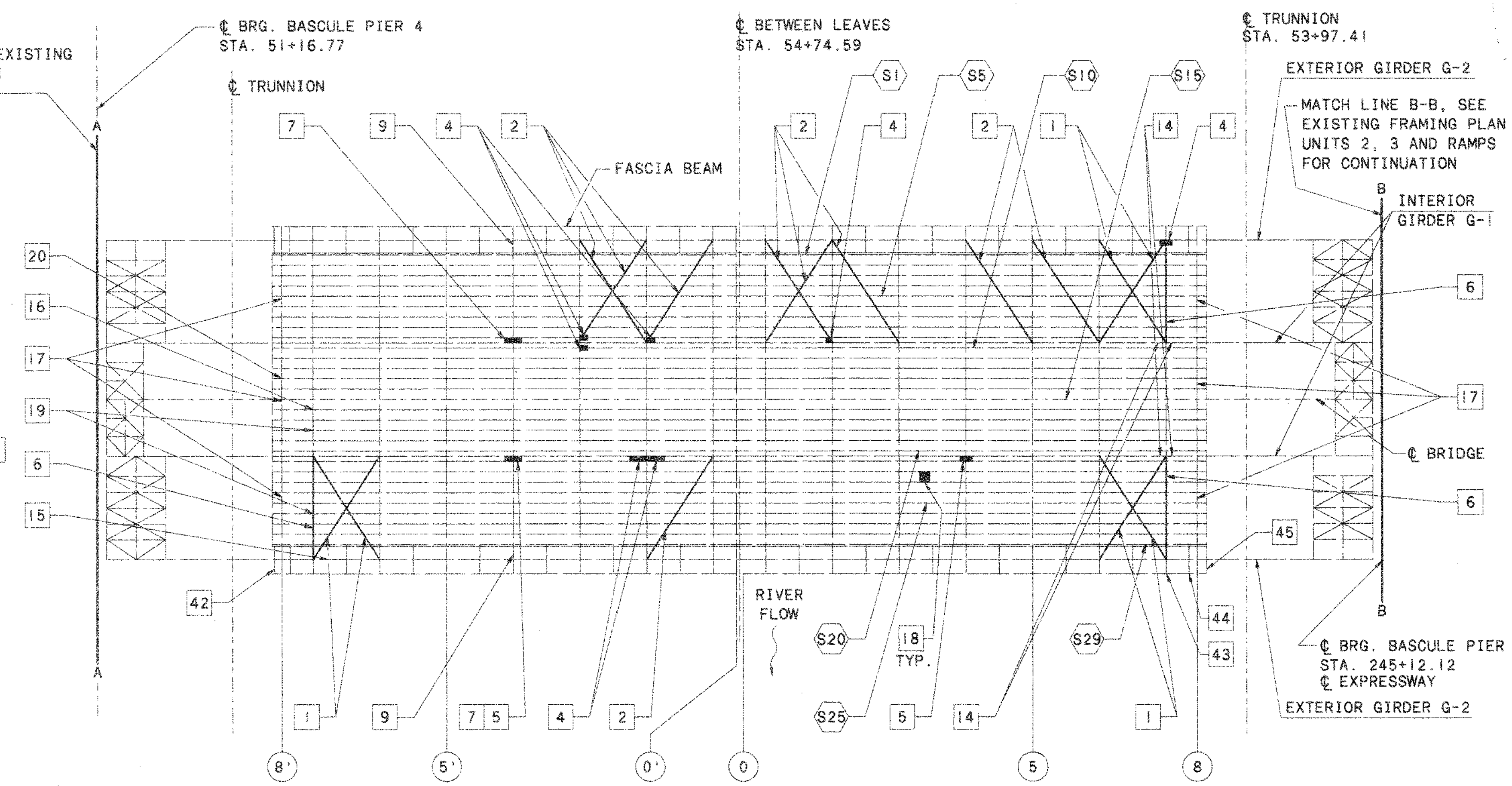
FINGER JOINT TROUGH DETAILS 4 - TYPICAL DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280



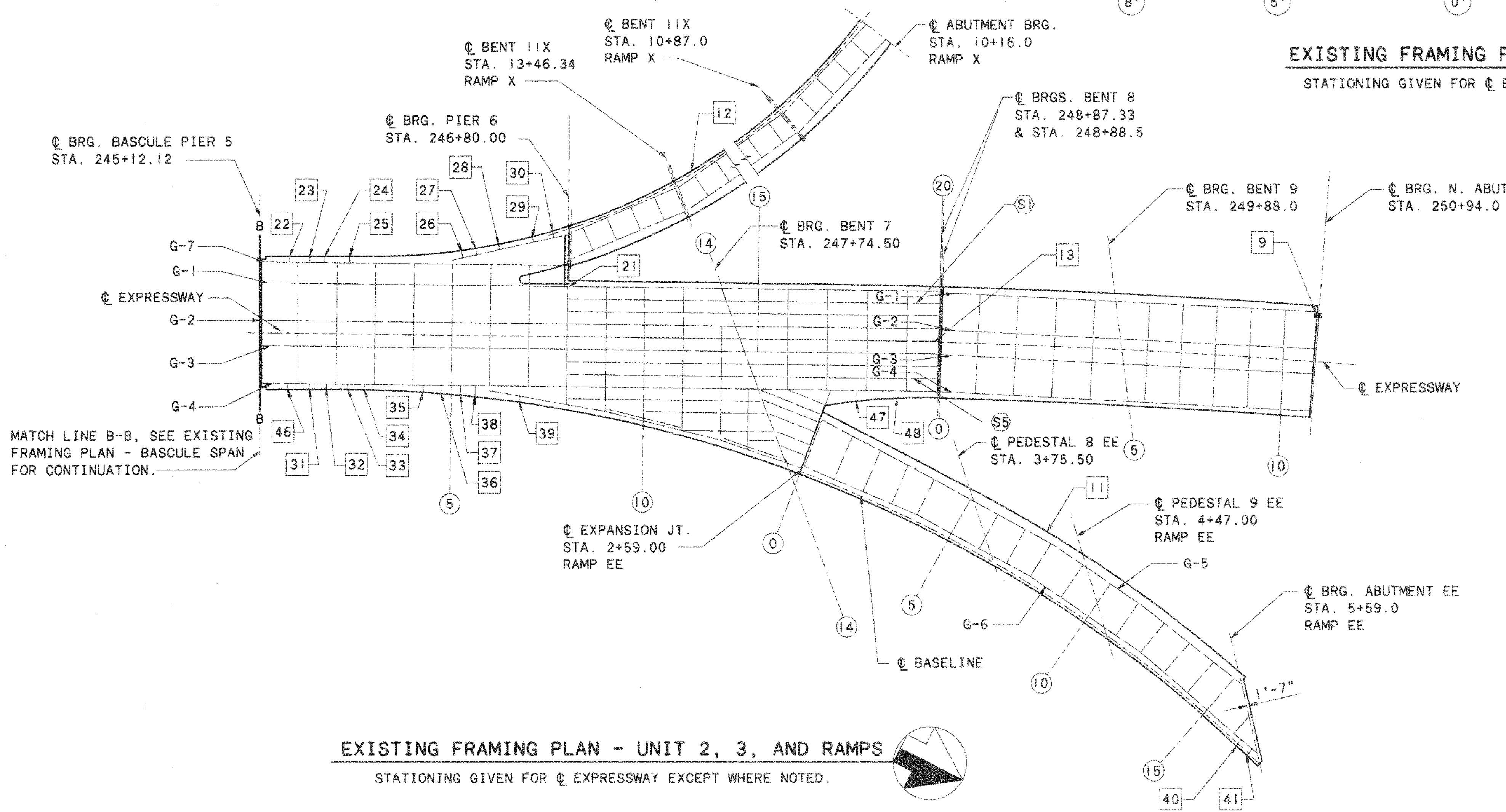
EXISTING FRAMING PLAN - UNIT 1

STATIONING GIVEN FOR ℄ BRIDGE



EXISTING FRAMING PLAN - BASCULE PLAN

STATIONING GIVEN FOR ℄ BRIDGE EXCEPT WHERE NOTED.



EXISTING FRAMING PLAN - UNIT 2, 3, AND RAMPS

STATIONING GIVEN FOR ℄ EXPRESSWAY EXCEPT WHERE NOTED.

NOTES

SEE SHEET 6/126 FOR GENERAL NOTES.

NOT ALL FRAMING MEMBERS ARE SHOWN.

LEGEND

(#) - FLOORBEAM NUMBER (NUMBERED CONSECUTIVELY BETWEEN LIMITS SHOWN)

⟨#⟩ - STRINGER NUMBER (NUMBERED CONSECUTIVELY BETWEEN LIMITS SHOWN)

[#] - CODED NOTE. SEE SHEET 62/126 FOR DESCRIPTION OF PROPOSED REHABILITATION.

ENGINEERS ARCHITECTS

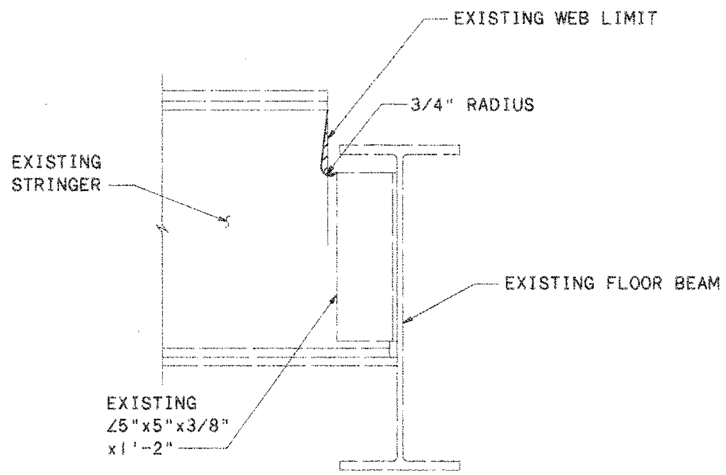
DESIGNED	DRAWN	REVIEWED	DATE
RWM	RFJ	RKM	14-Feb-96
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MAK		4805917	

STRUCTURAL STEEL REHABILITATION DETAILS I - FRAMING PLAN

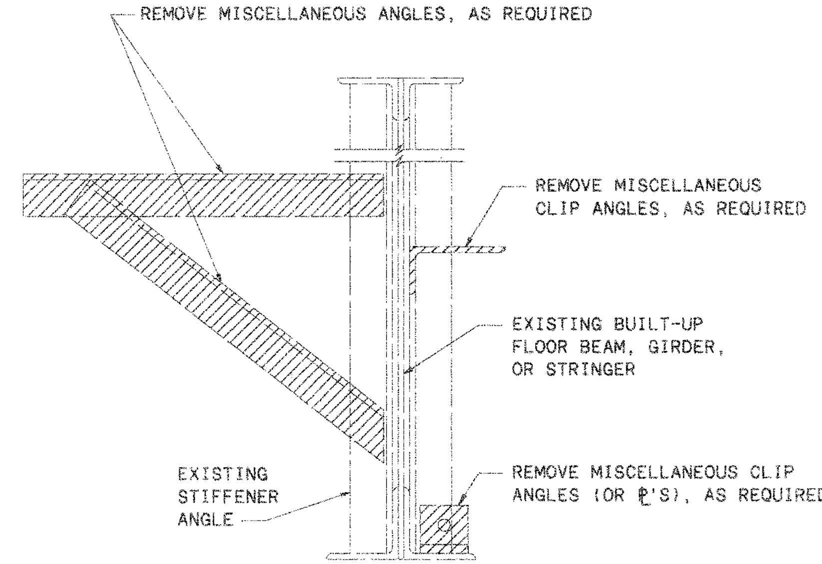
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

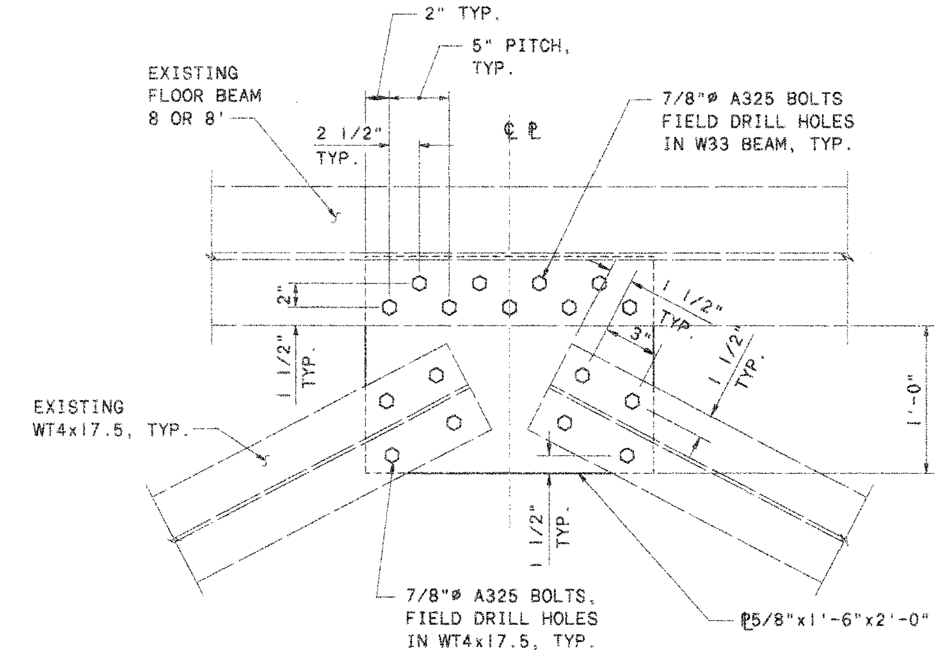
N:\PROJECTS\PP1491\CADD\FRMREHAB 2-23-95



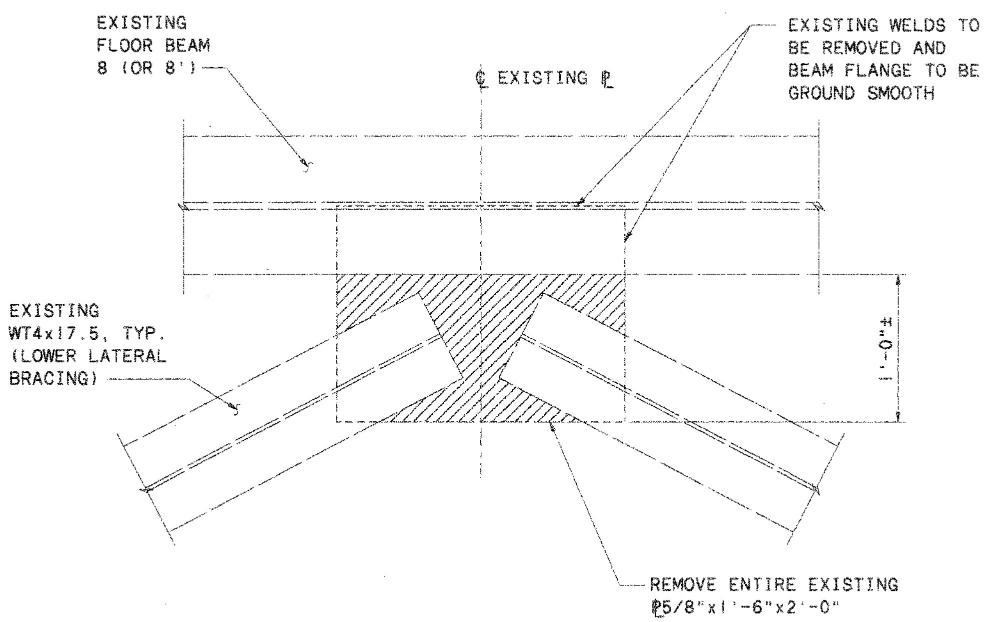
STRINGER COPE ROUNDING DETAIL 13



MISCELLANEOUS ANGLE REMOVAL DETAIL



GUSSET PLATE PLAN DETAIL 17
(PROPOSED)



WELDED GUSSET PLATE DETAIL 17
(REMOVAL)

NOTES

SEE SHEET 6/126 FOR GENERAL NOTES.

SEE SHEET 61/126 FOR LOCATIONS OF REHABILITATION DETAILS AS INDICATED IN LEGEND BELOW.

LEGEND

(hatched) - REMOVAL

1 - REPLACE LOWER LATERAL BRACING ST7WF21.5 WITH WT7X21.5. SEE DETAIL ON SHEET 63/126.

2 - REPLACE LOWER LATERAL BRACING ST7WF19 WITH WT7X19. SEE DETAIL ON SHEET 63/126.

3 - REPLACE LOWER LATERAL BRACING ST7WF15 WITH WT7X15. SEE DETAIL ON SHEET 63/126.

4 - REPLACE LOWER GUSSET PLATE. SEE DETAIL ON SHEET 63/126.

5 - REPLACE UPPER GUSSET PLATE. SEE DETAIL ON SHEET 63/126.

6 - REPLACE LOWER LATERAL BRACING STRUTS. SEE DETAIL ON SHEET 63/126.

7 - REPLACE PC18WF64 WITH PARTIALLY CLIPPED W24X76. SEE DETAIL ON SHEET 63/126.

8 - REPLACE SPLICE PLATE AS SHOWN ON DETAIL ON SHEET 63/126.

9 - REPLACE PC16WF58 (OR PC18WF64) WITH PARTIALLY CLIPPED W24X76. SEE DETAIL ON SHEET 63/126.

10 - REMOVE MISCELLANEOUS CLIP ANGLE WELDED TO FLOOR BEAM 5. SEE DETAIL ON THIS SHEET.

11 - REMOVE MISCELLANEOUS ANGLE WELDED TO BOTTOM OF WEB OF FASCIA. SEE DETAIL ON THIS SHEET.

12 - REMOVE MISCELLANEOUS ANGLE WELDED TO BOTTOM FLANGE OF FASCIA. SEE DETAIL ON THIS SHEET.

13 - COPE EXISTING STRINGER. SEE DETAIL ON THIS SHEET.

14 - REMOVE MISCELLANEOUS ANGLE WELDED TO FACE OF GIRDER G-1. SEE DETAIL ON THIS SHEET.

15 - REMOVE MISCELLANEOUS ANGLE WELDED TO GIRDER G-2. SEE DETAIL ON THIS SHEET.

16 - REMOVE MISCELLANEOUS CLIP ANGLES WELDED TO FLOOR BEAM 7', TYPICAL AT 8 LOCATIONS ALONG BEAM. SEE DETAIL ON THIS SHEET.

17 - REPLACE GUSSET PLATE PER ITEM 513 - STRUCT. STL., MISC. - WELDED GUSSET PLATE REPLACEMENT. SEE DETAILS ON THIS SHEET.

18 - REMOVE MISCELLANEOUS CLIP ANGLES WELDED TO LOWER FLANGES OF STRINGERS S22 AND S23, TYPICAL BETWEEN EACH FLOOR BEAM OF ENTIRE BASCULE SPAN BETWEEN PIERS 4 AND 5. SEE DETAIL ON THIS SHEET.

19 - REMOVE MISCELLANEOUS ANGLES WELDED TO FLOOR BEAM 7' VERTICAL STIFFENERS, 4 LOCATIONS BETWEEN INTERIOR GIRDERS G-1 AND ALSO 4 LOCATIONS BETWEEN EXTERIOR GIRDER G-2 AND INTERIOR GIRDER G-1. SEE DETAIL ON THIS SHEET.

20 - REMOVE MISCELLANEOUS PLATE WELDED TO LOWER FLANGE OF FLOOR BEAM 8'. SEE DETAIL ON THIS SHEET.

21 - REPLACE LOWER GUSSET PLATE. SEE DETAIL ON SHEET 63/126.

22 THROUGH 45 ADD WEB PLATES TO SIDEWALK STRINGERS. SEE SIDEWALK STRINGER REPAIR DETAILS AND ACCOMPANYING TABLE ON SHEET 64/126.

46 THROUGH 48 REPLACE SIDEWALK STRINGERS AS PER DETAILS ON SHEET 64/126.

DESIGNED	DRAWN	REVIEWED	DATE
RWM	RFJ	RK(?)	14-Feb-96
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MAK		4805917	

STRUCTURAL STEEL REHABILITATION DETAILS 2 - FATIGUE PRONE DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

62/126

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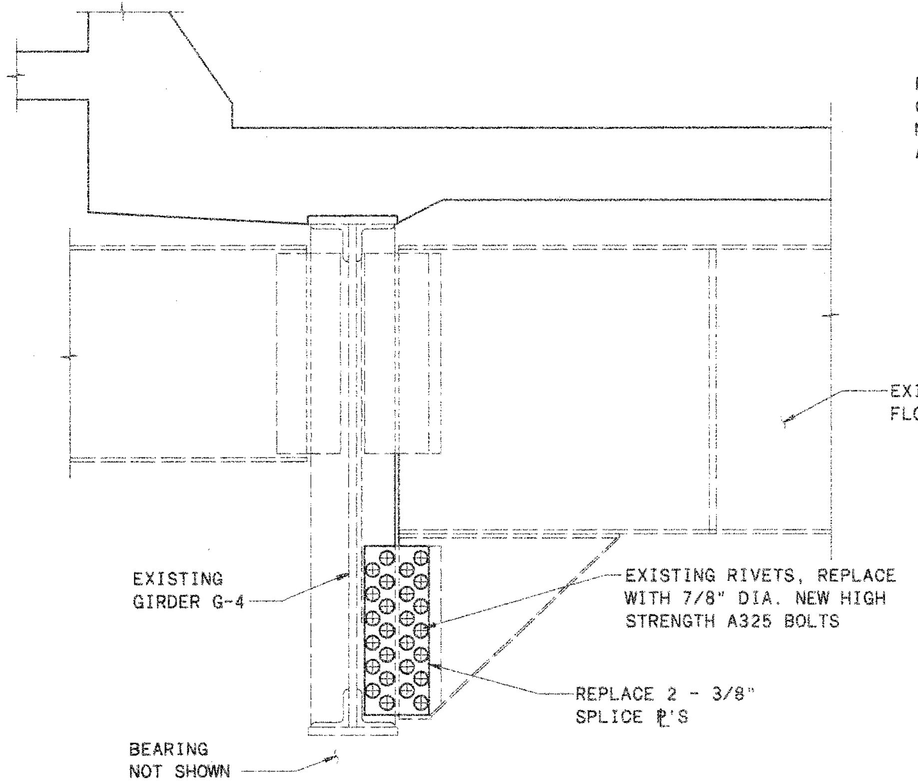
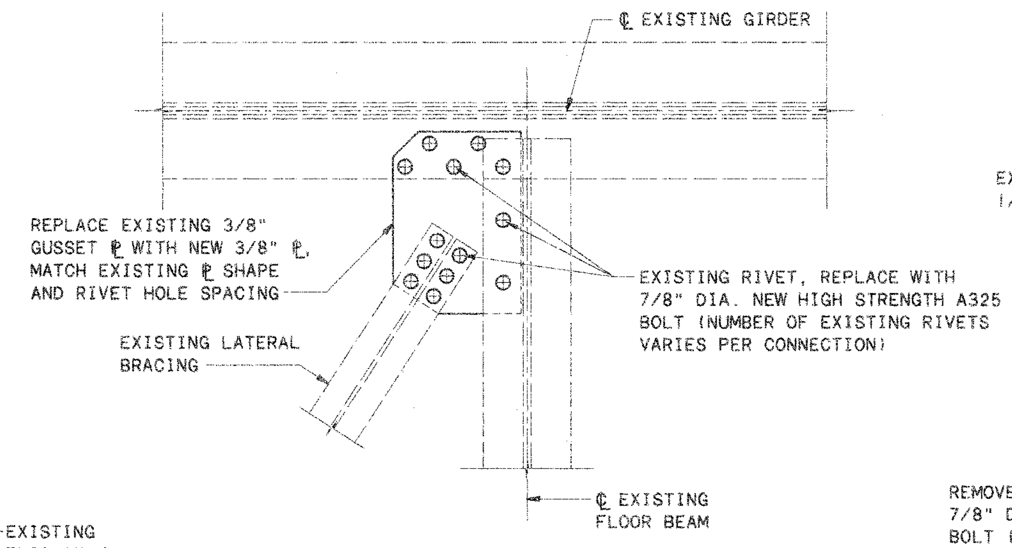
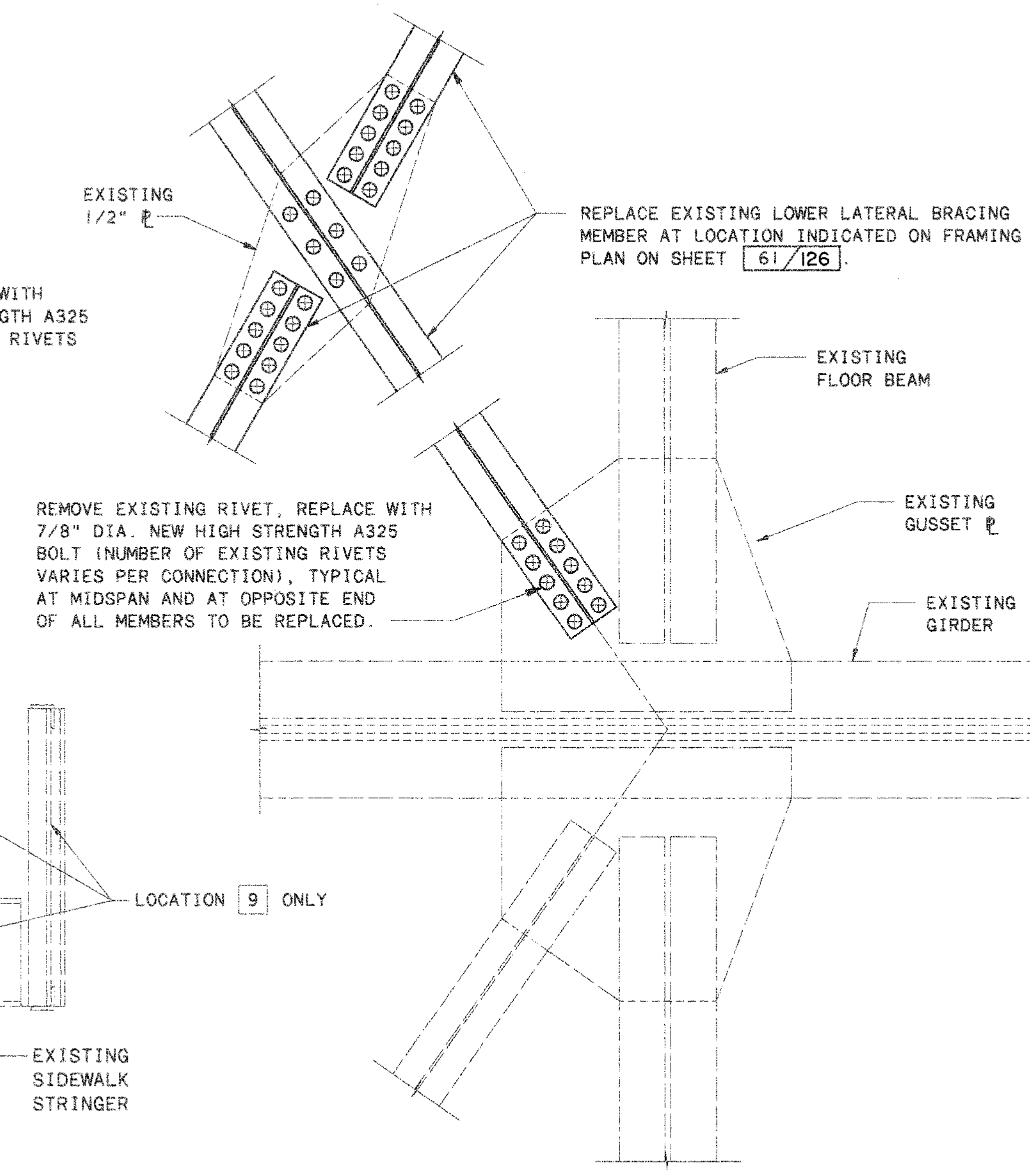


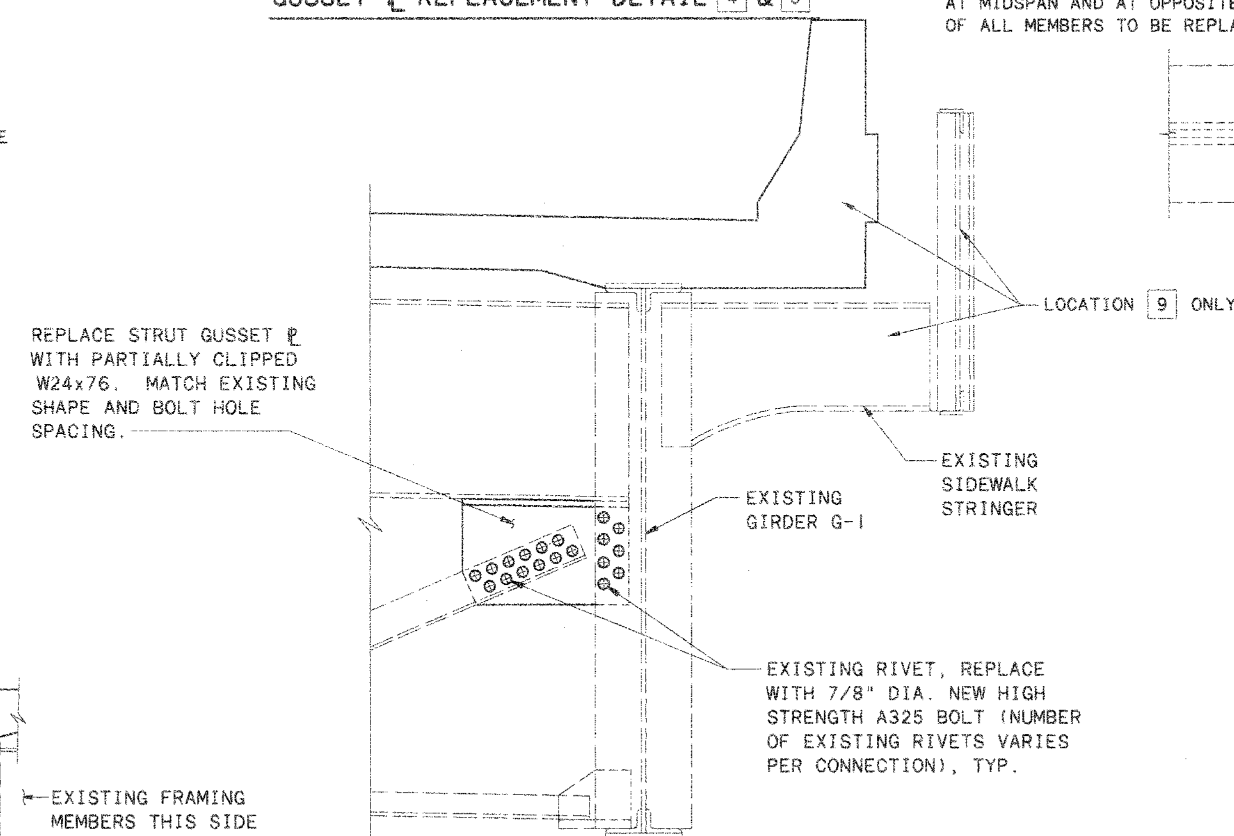
SPLICE PLATE DETAIL 8



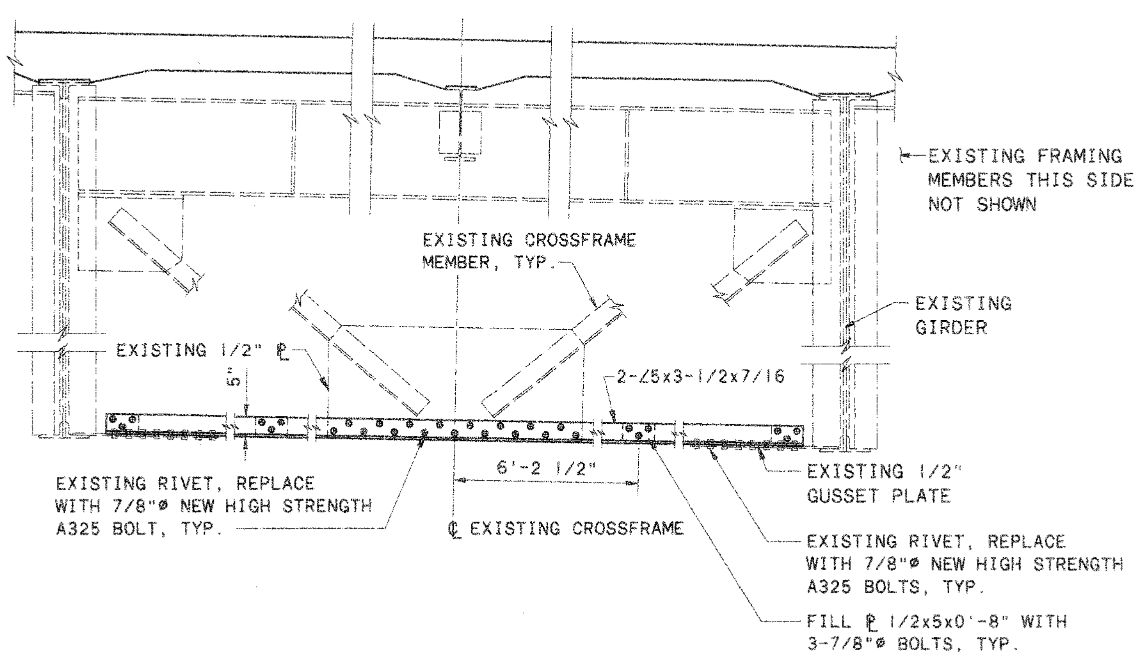
GUSSET PL REPLACEMENT DETAIL 4 & 5



LOWER LATERAL BRACING DETAIL 1 2 3



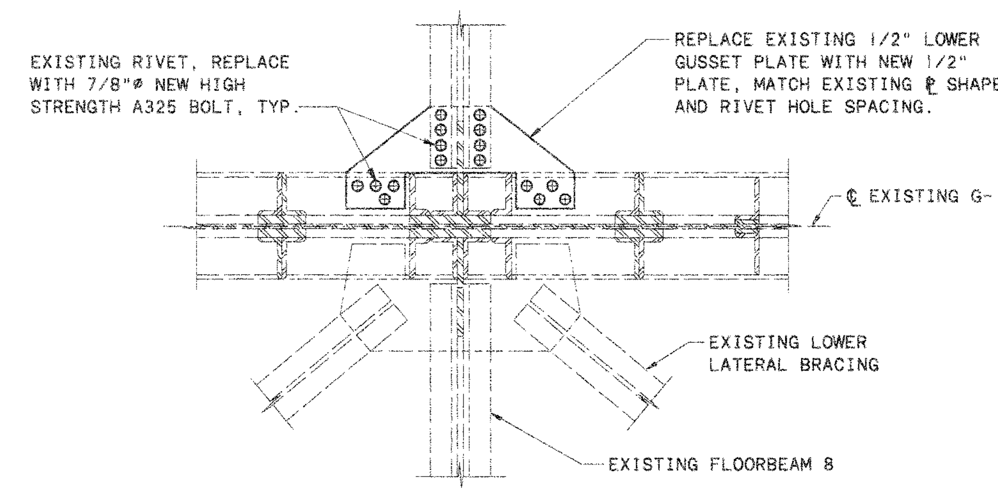
STRUT GUSSET DETAIL 9 & 7
(9 SHOWN, 7 SIMILAR)



LOWER LATERAL BRACING STRUT DETAIL 6

LEGEND

- DETAIL NUMBER, WORK THIS SHEET WITH SHEETS 61/126 AND 62/126



GUSSET PL REPLACEMENT DETAIL 22

[redacted] ENGINEERS ARCHITECTS

DESIGNED RWM | DRAWN GTC | REVIEWED RKM | DATE 14-Feb-96
CHECKED MAK | REVISED | STRUCTURE FILE NUMBER 4805917

STRUCTURAL STEEL REHAB. DETAILS 3 - LOWER LATERAL BRACING
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

63/126

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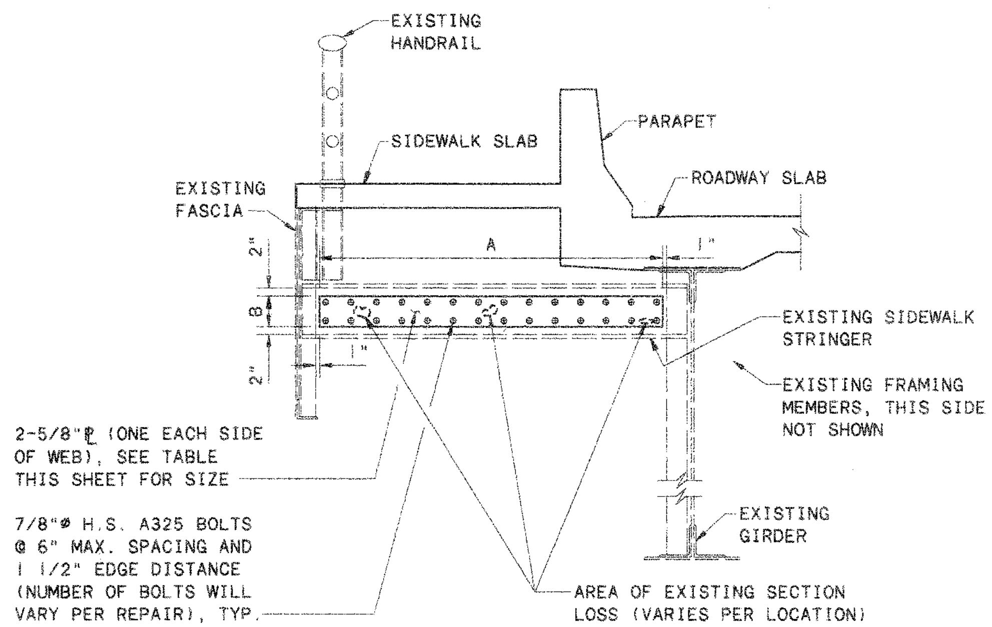
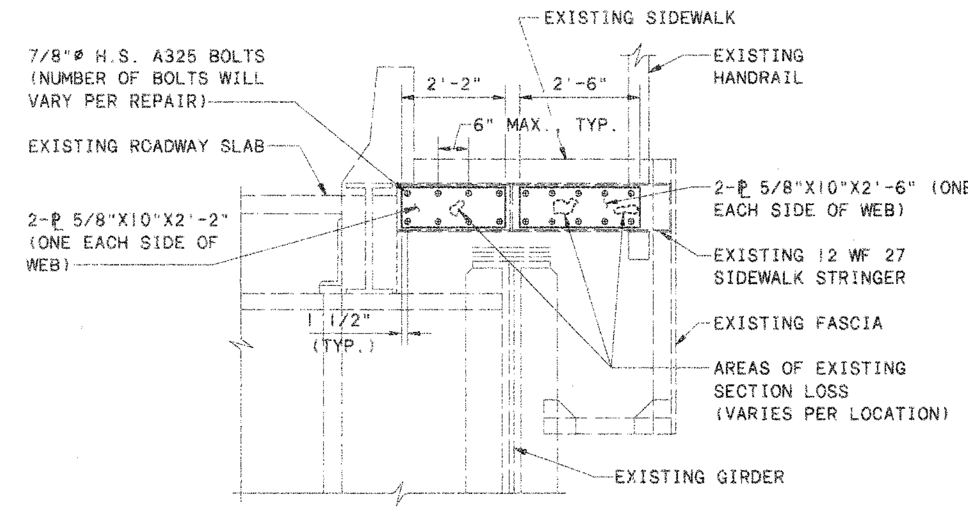
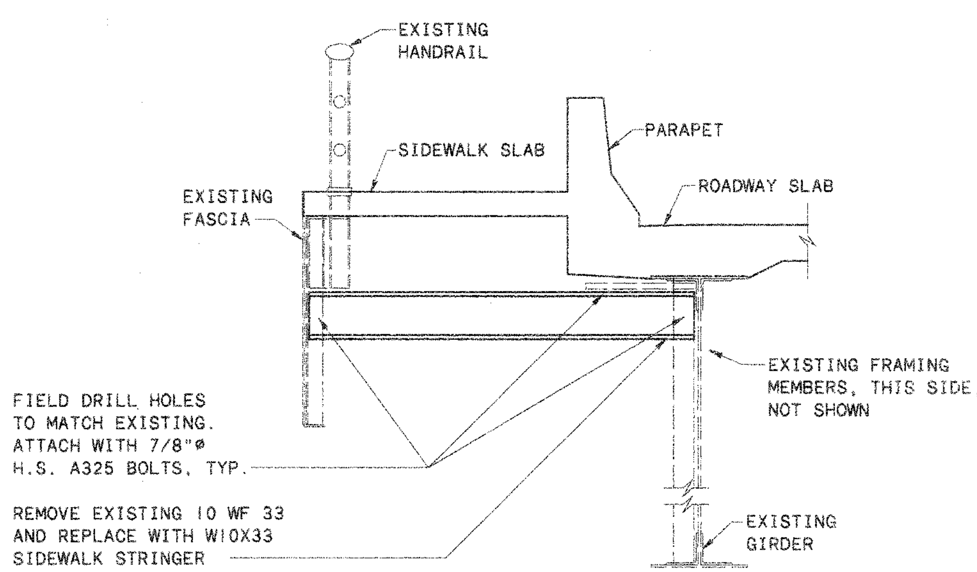


SIDEWALK STRINGER REPAIR
DETAIL 22 THROUGH 41
(UNIT 2 AND RAMP E-E)

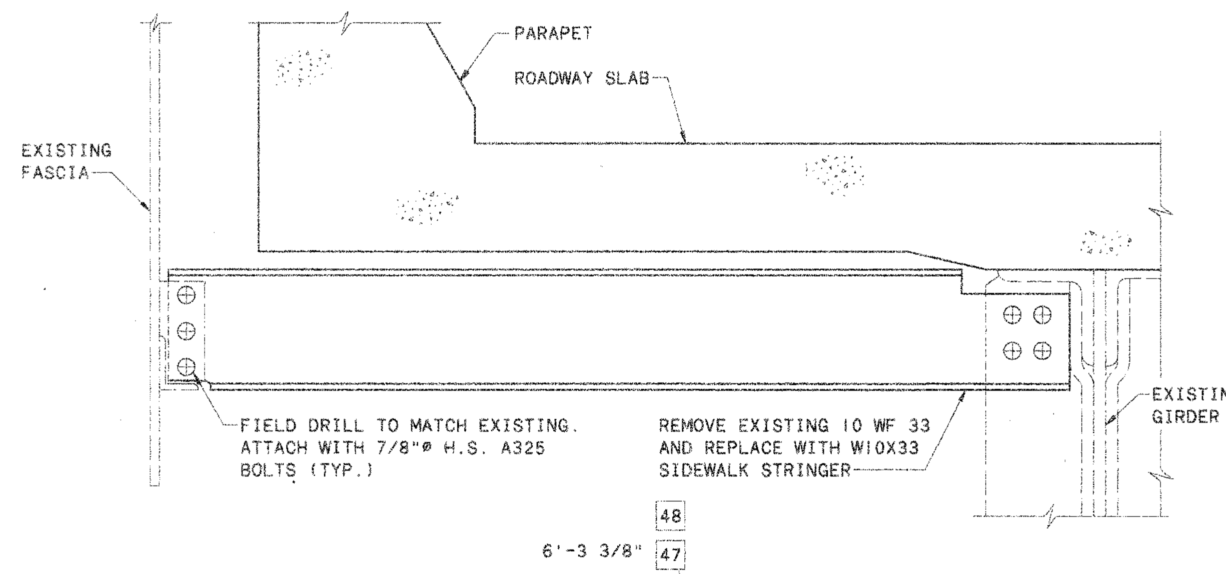


SIDEWALK STRINGER REPAIR
DETAIL 42 THROUGH 45
(BASCULE SPAN)

TABLE FOR DETAILS 22 THROUGH 41		
DETAIL NUMBER	PLATE DIMENSIONS A	B
22	6'-8"	7 5/8"
23	7'-0"	7 5/8"
24	7'-0"	7 5/8"
25	7'-2"	7 5/8"
26	7'-4"	7 5/8"
27	7'-0"	7 5/8"
28	7'-0"	7 5/8"
29	7'-0"	7 5/8"
30	7'-0"	7 5/8"
31	5'-8"	7 5/8"
32	5'-8"	7 5/8"
33	6'-6"	7 5/8"
34	6'-6"	7 5/8"
35	7'-4"	7 5/8"
36	7'-6"	7 5/8"
37	8'-6"	7 5/8"
38	9'-2"	7 5/8"
39	7'-2"	7 5/8"
40	3'-2"	6"
41	2'-8"	1'-2"



SIDEWALK STRINGER REPAIR
DETAIL 46
(UNITS 2)



SIDEWALK STRINGER REPLACEMENT DETAIL 47 AND 48
(UNITS 2)

NOTES

SEE SHEET 6/126 FOR GENERAL NOTES.

SEE SHEET 61/126 FOR LOCATIONS OF REPAIRS AND REPLACEMENT OF SIDEWALK STRINGERS.

LEGEND

- REHABILITATION NUMBER, SEE SHEET 62/126.

ENGINEERS ARCHITECTS

DESIGNED RWM | DRAWN WHW | REVIEWED RK17 | DATE 14-Feb-96
CHECKED MAK | REVISED | STRUCTURE FILE NUMBER 4805917

STRUCTURAL STEEL REHAB. DETAILS 4 - SIDEWALK STRINGER DETAILS
BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

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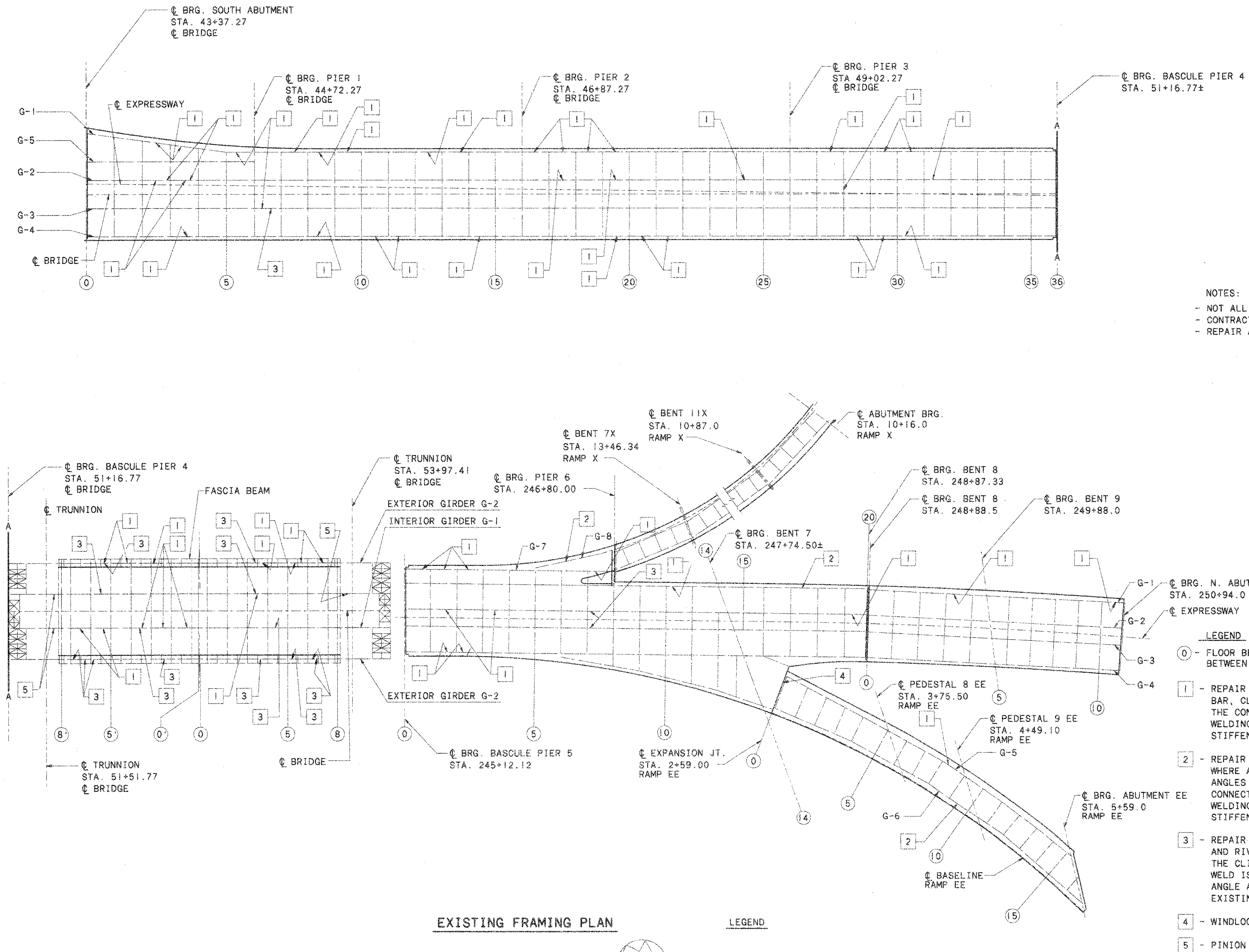

EXISTING FRAMING PLAN

LEGEND

NOTES:
- NOT ALL FRAMING MEMBERS SHOWN FOR CLARITY.
- CONTRACTOR SHALL VERIFY LOCATIONS OF REPAIRS.
- REPAIR AREAS ARE LOCATED ON ARROWHEAD SIDE.

LEGEND

(0) - FLOOR BEAM NUMBER (NUMBERED CONSECUTIVELY BETWEEN LIMITS SHOWN)

[1] - REPAIR SHALL CONSIST OF REPLACING BENT 3/4"⌀ BAR, CLIP ANGLES AND RIVETS ASSOCIATED WITH THE CONNECTION ON THE CLIP ANGLE TO GIRDER AND WELDING BAR TO NEW ANGLE AND EXISTING STIFFENERS.

[2] - REPAIR SHALL CONSIST OF ADDING 3/4"⌀ BAR WHERE A BAR IS MISSING AND REPLACING CLIP ANGLES AND RIVETS ASSOCIATED WITH THE CONNECTION OF THE CLIP ANGLE TO GIRDER AND WELDING BAR TO NEW ANGLE AND EXISTING STIFFENERS.

[3] - REPAIR SHALL CONSIST OF REPLACING CLIP ANGLES AND RIVETS ASSOCIATED WITH THE CONNECTION OF THE CLIP ANGLE TO GIRDER WHERE THE EXISTING WELD IS BROKEN. WELD EXISTING BAR TO NEW ANGLE AND REPAIR ANY BROKEN TACK WELDS BETWEEN EXISTING BAR AND EXISTING STIFFENERS.

[4] - WINDLOCK REPAIR

[5] - PINION SUPPORT REHABILITATION

WORK THIS SHEET WITH SHEET [66/126].

[redacted] ENGINEERS ARCHITECTS

DESIGNED	DRAWN	REVIEWED	DATE
RWM	WHW	RKM	14-Feb-96
CHECKED	REVISED	STRUCTURE FILE NUMBER	
MAK		4805917	

STRUCTURAL STEEL REHABILITATION DETAILS 5 LOCATION PLAN

BRIDGE NO. LUC-280-0346
OVER MAUMEE RIVER

LUC-280

65/126

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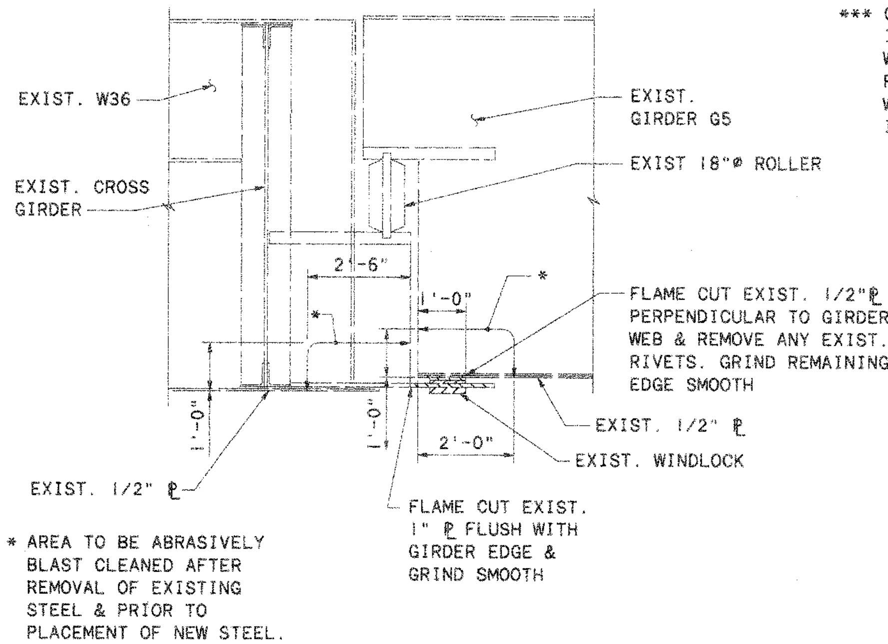
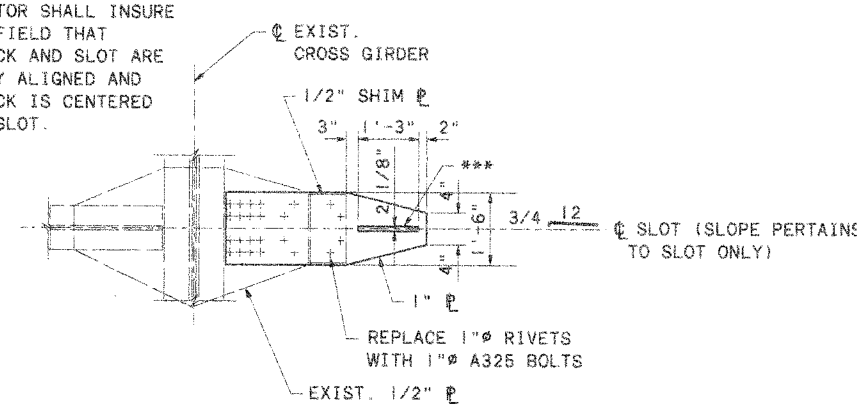
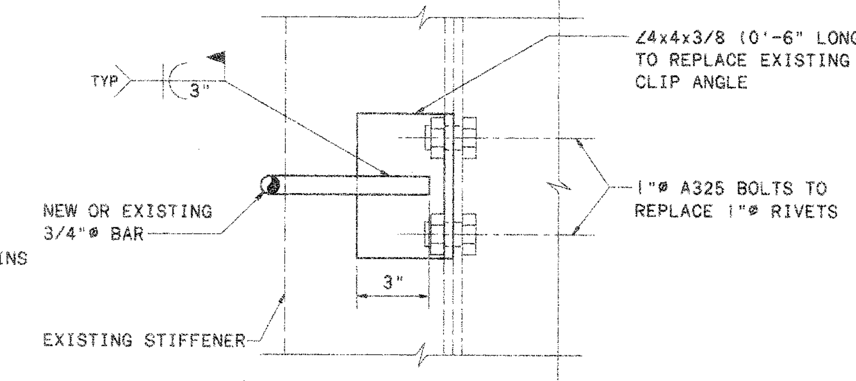


WIND LOCK REMOVAL

*** CONTRACTOR SHALL INSURE IN THE FIELD THAT WIND LOCK AND SLOT ARE PROPERLY ALIGNED AND WIND LOCK IS CENTERED INSIDE SLOT.

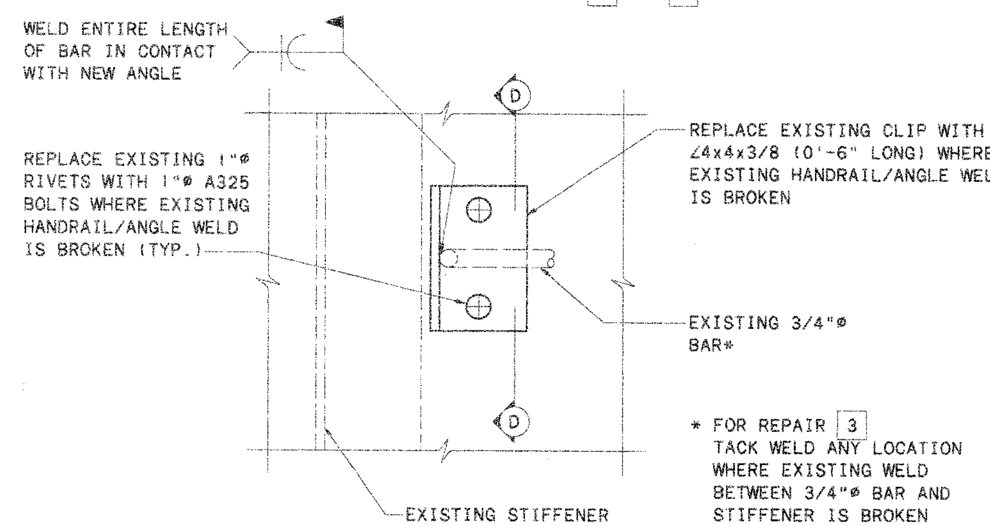


VIEW (A)



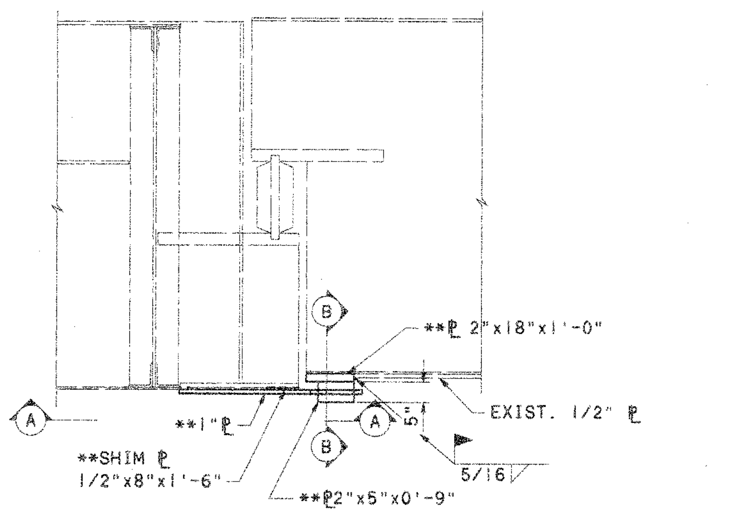
SECTION (D)

TYPICAL FOR REPAIR 1, 2 AND 3



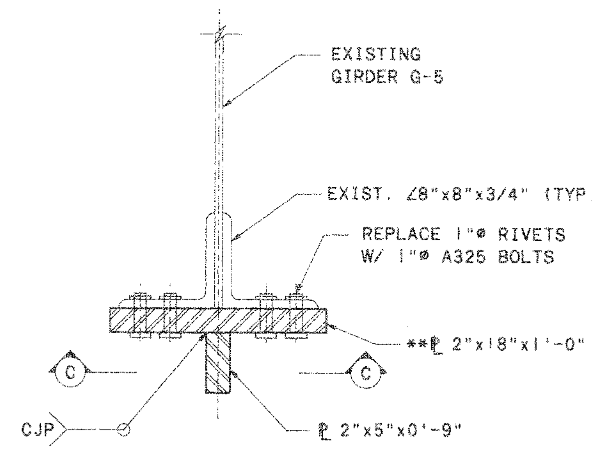
HANDRAIL REPLACEMENT DETAIL

TYPICAL FOR REPAIR 3

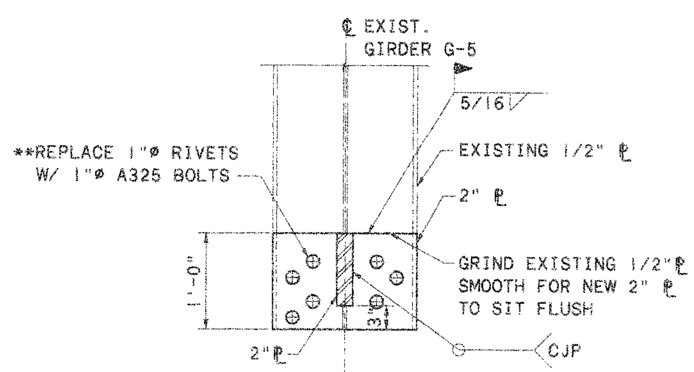


WIND LOCK DETAIL

**BOLT HOLES IN PROPOSED STEEL SHALL BE FIELD DRILLED TO MATCH EXIST. BOLT PATTERNS

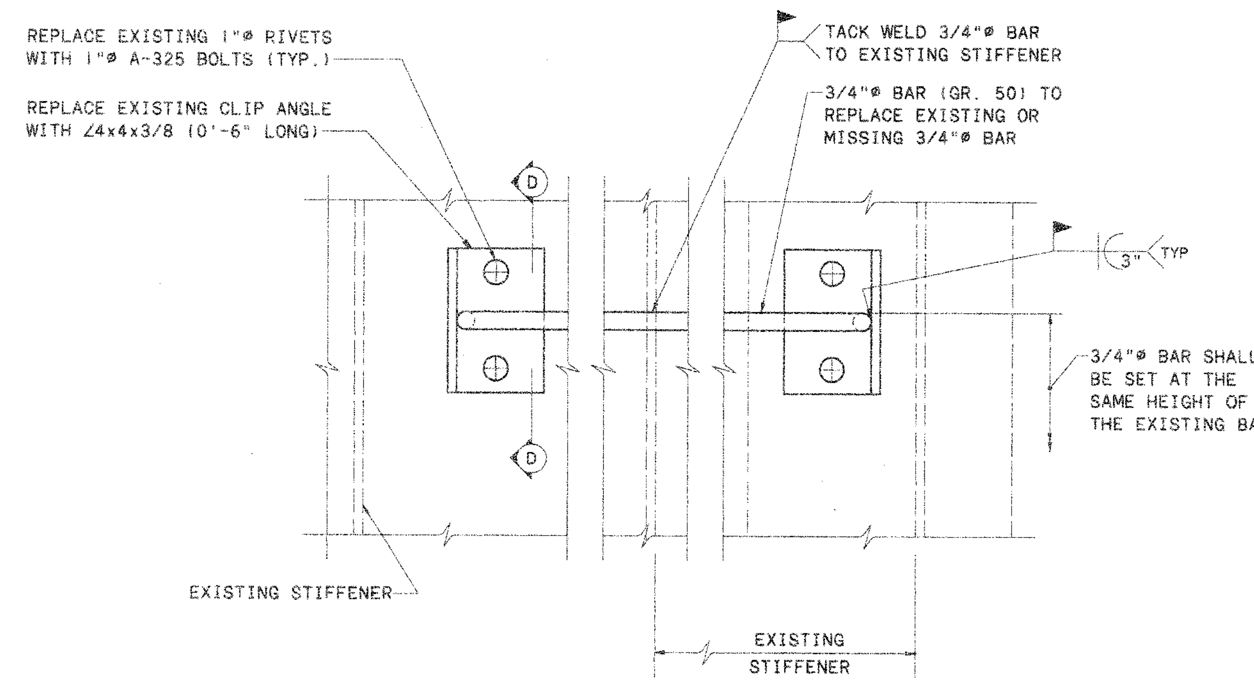


SECTION (B)



SECTION (C)

WORK THIS SHEET WITH SHEET 65/126 FOR LOCATIONS OF REPAIRS.



HANDRAIL REPLACEMENT DETAIL

TYPICAL FOR REPAIR 1 AND 2

ENGINEERS ARCHITECTS

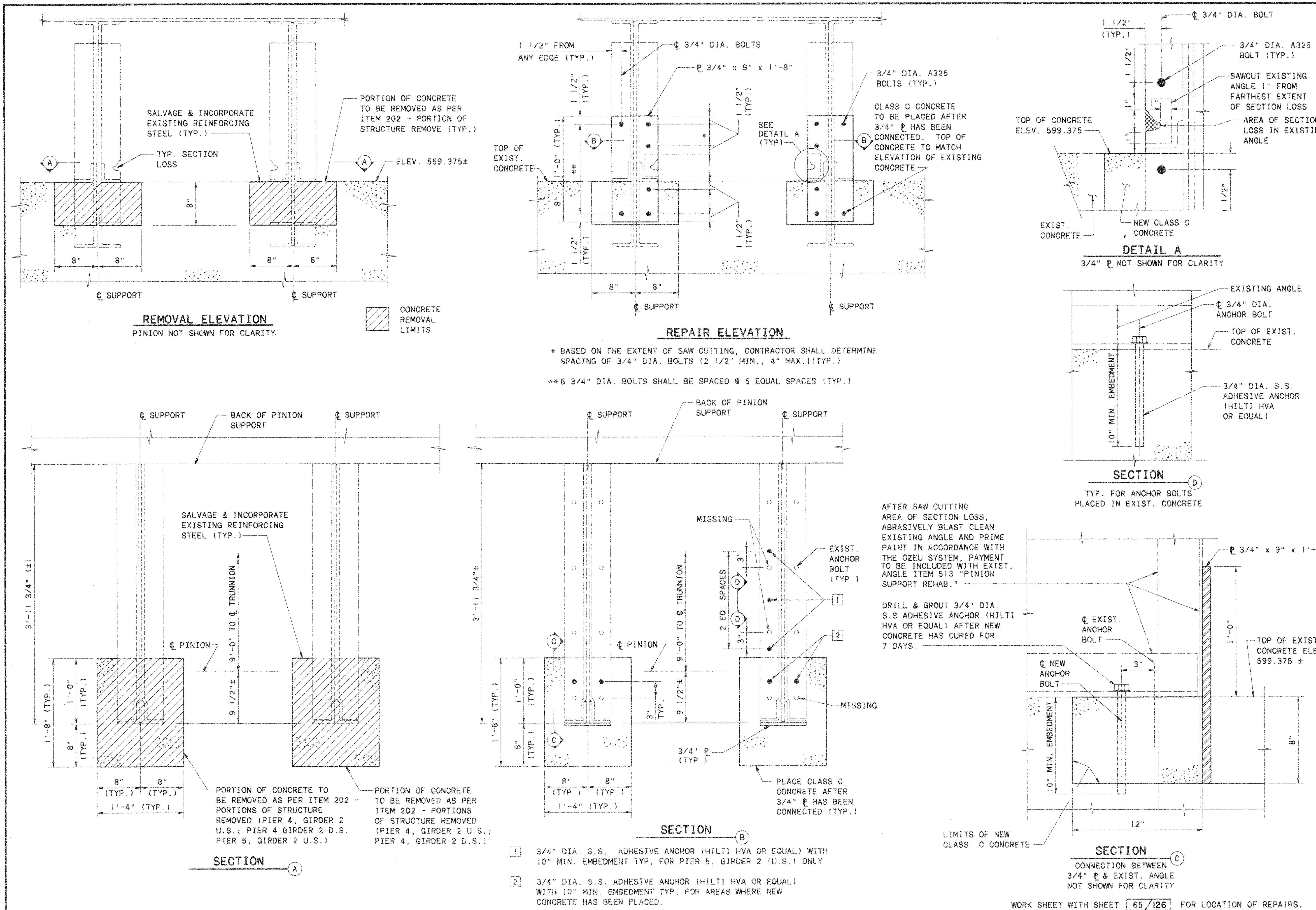
DESIGNED	DRAWN	REVIEWED	DATE
JAP	RFJ	RKM	14-Feb-96
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RWM		4805917	

STRUCTURAL STEEL REHAB. DETAILS 6 - WIND LOCK AND HANRAIL

BRIDGE NO. LUC-280-0346 OVER MAUMEE RIVER

LUC-280

N:\PROJECTS\PR14512\CADD\DETAILS2 8-7-95 9:21:04 am



WORK SHEET WITH SHEET 65/126 FOR LOCATION OF REPAIRS.

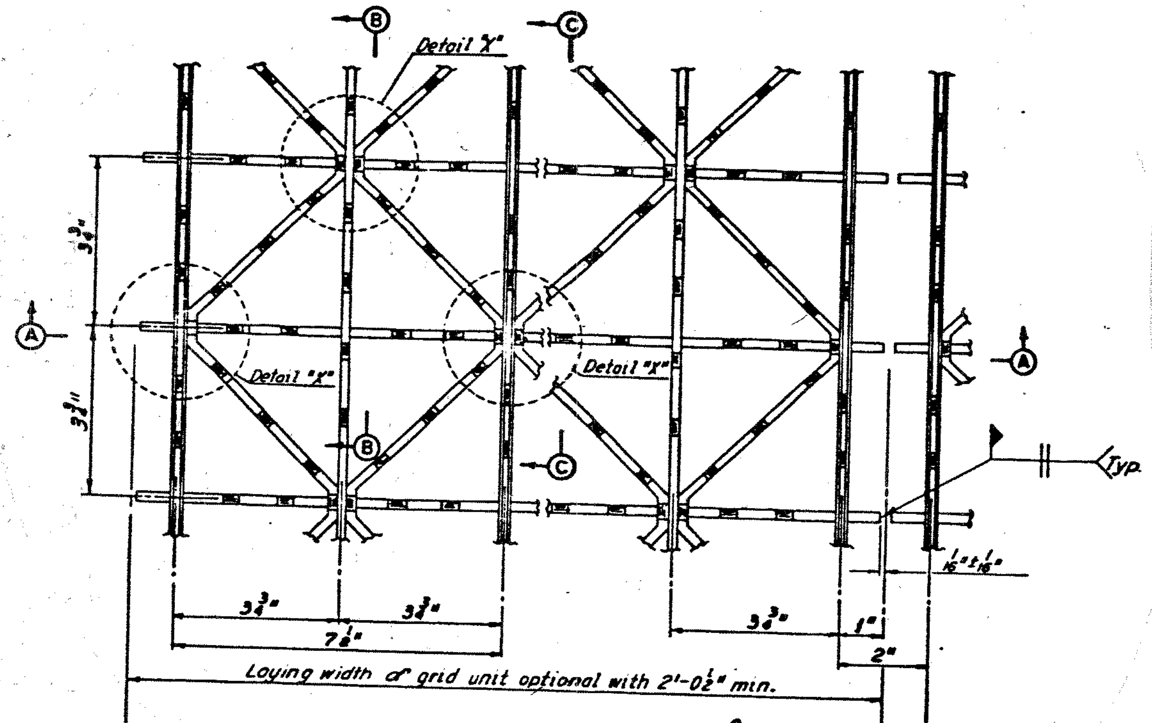
STRUCTURAL STEEL REHABILITATION DETAILS 5-PINION SUPPORTS

BRIDGE NO. LUC-280-0346 OVER MAUMEE RIVER

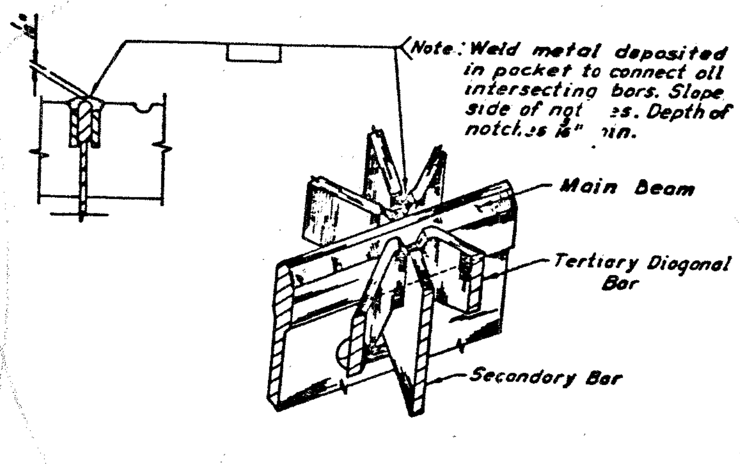
DESIGNED JAP · CHECKED MAK · DRAWN GTC · REVIEWED RH77 · DATE 14-Feb-96 · STRUCTURE FILE NUMBER 4805917

LUC-280

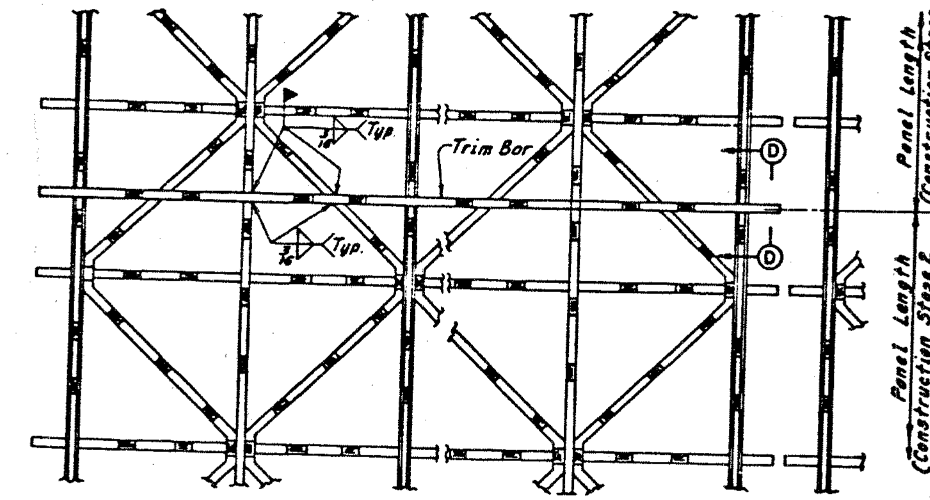
67/126



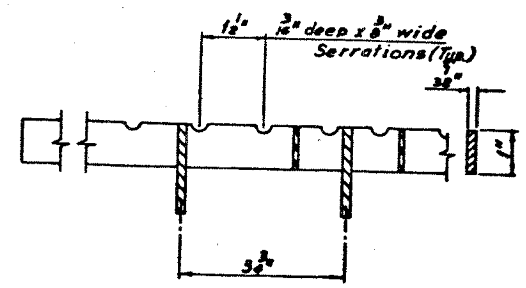
PLAN



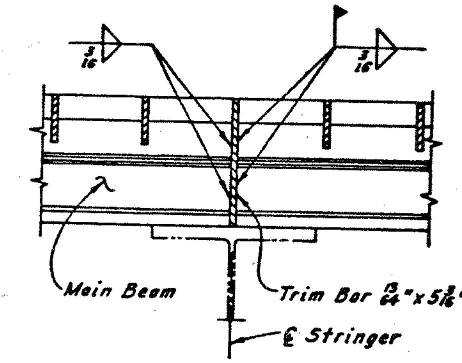
DETAIL "X"



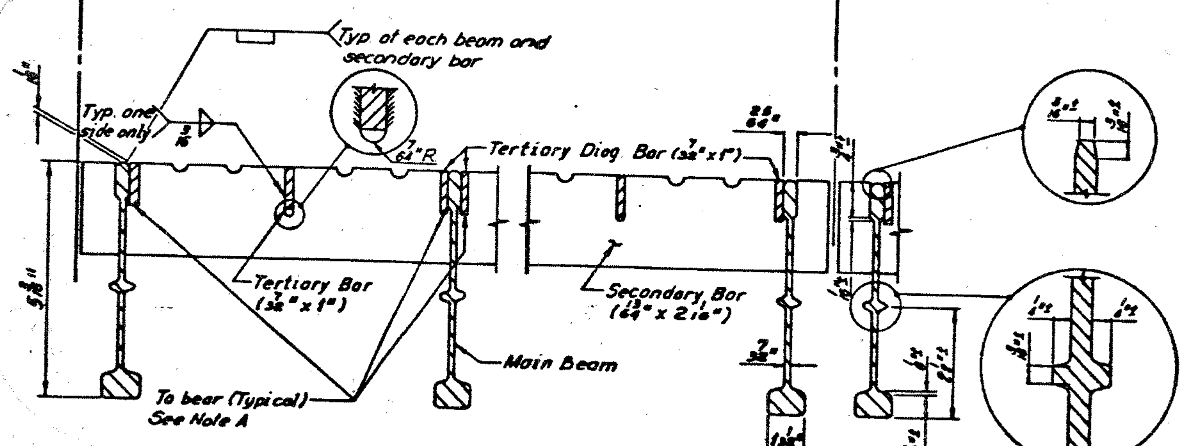
PLAN AT TRIM BAR



SECTION B-B

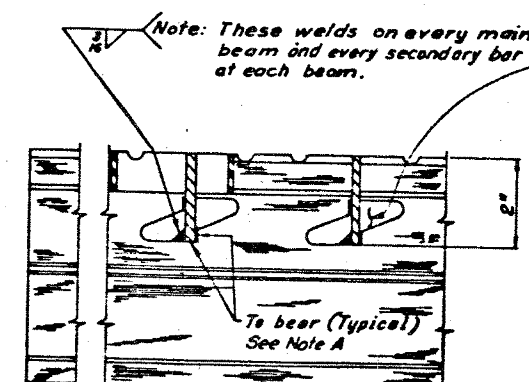


SECTION D-D
(Typical at Main Beam)



SECTION A-A

Final dimensions including all fillet dimensions shall be submitted to the Director for approval. Calculations shall be included with this submittal showing that the minimum specified section moduli are provided.



SECTION C-C

Slot in main beam as required for installation of slotted secondary bar. Configuration of slot in main beam shall be subject to the approval of the Director.

METAL FORM STRIPS

Metal form strips, where required, shall be No 20 gauge or thicker of such width and fit as to make reasonable mortar tight joints. The metal form strips shall be A-366 steel.

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NOTE:
This sheet is from the original set of plans, and is for information only.

Note:
5" Open Steel Grid Floor shall be A-588 steel, except as noted for the metal form strips, and shall weigh not more than 20 lbs. per square foot and not less than 18 lbs. per square foot with main beams placed transverse to traffic. The minimum gross section modulus of the main beams shall be as follows:

1.221 inches cubed (Top)
2.114 inches cubed (Bottom)

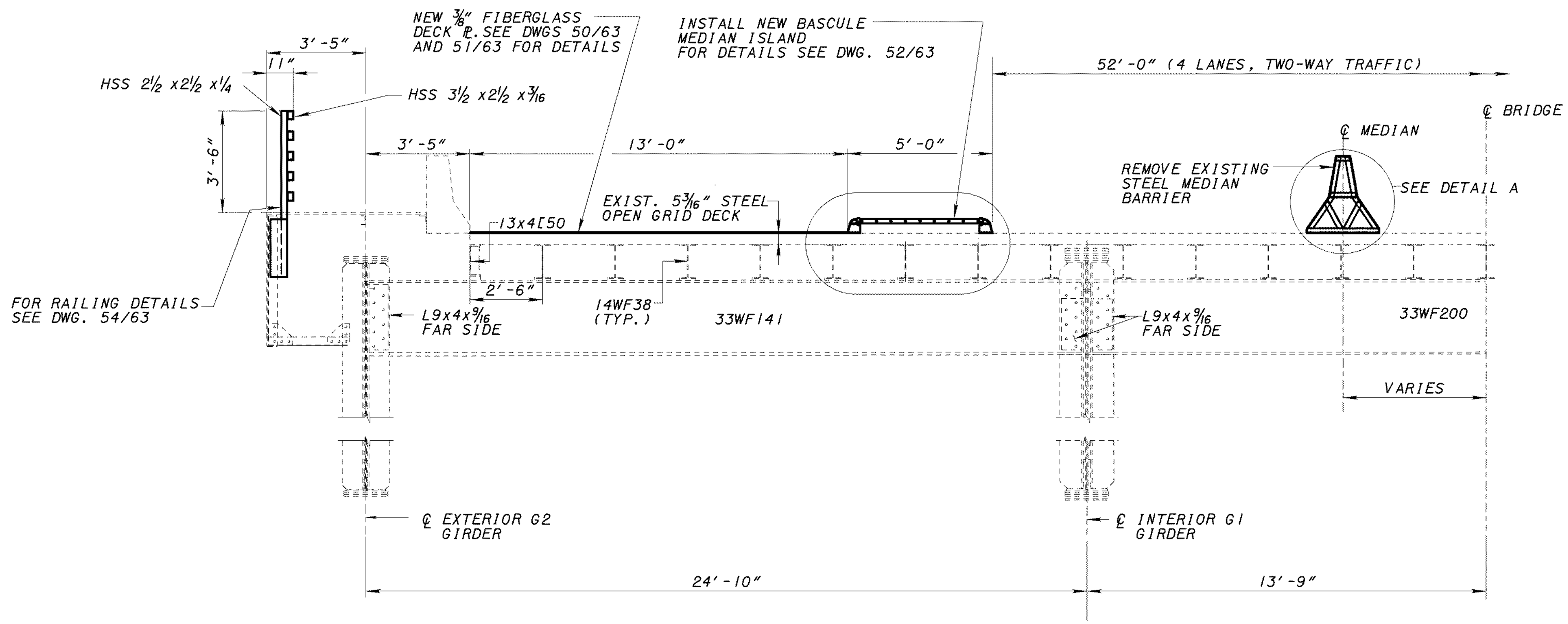
68A
126

HOWARD NEEDLES TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
CLEVELAND
HNTB

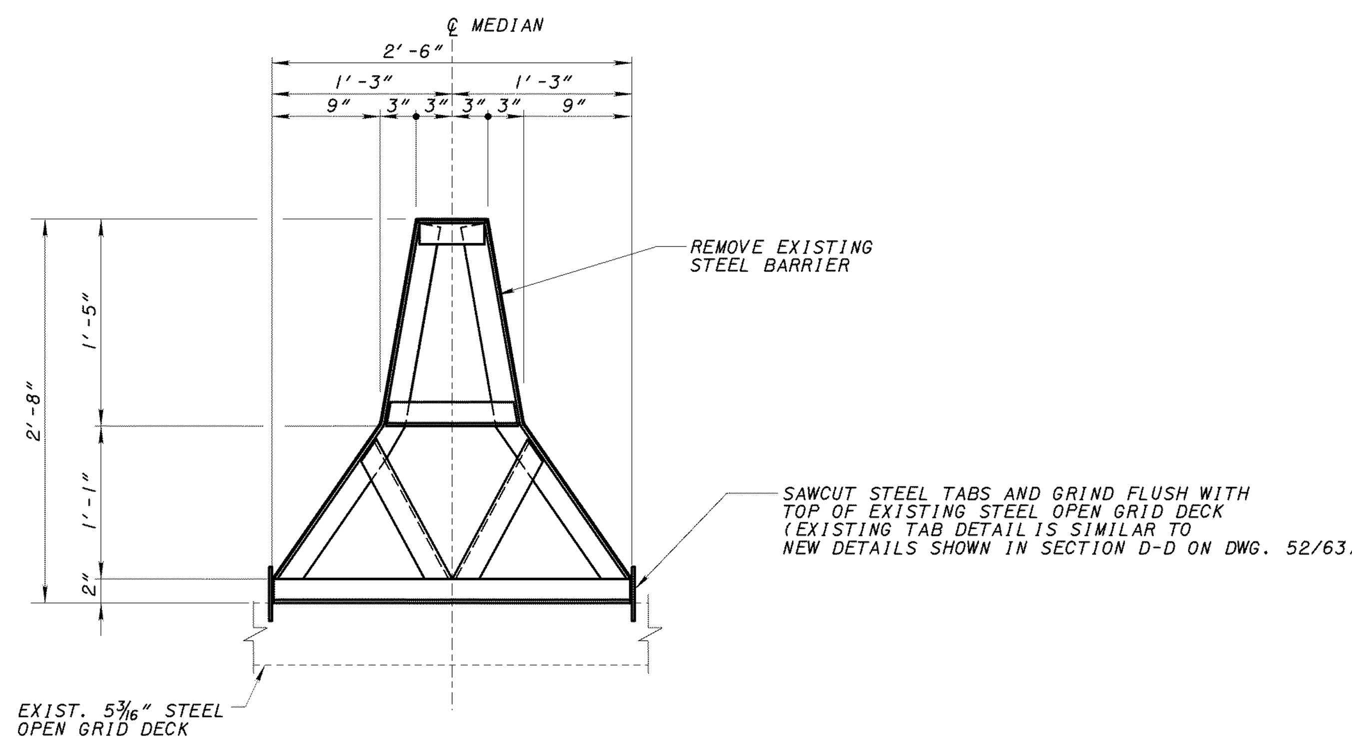
5" OPEN STEEL GRID
FLOOR DETAILS
MAUMEE RIVER BRIDGE — BASCULE SPAN
BR. NO. LUC.-280-0346

LUCAS COUNTY OHIO

DRAWN	TRACED	CHECKED	REVIEWED	REVISED	SHEET
DLR	DLR	RMW	AJ		13/17



SECTION A-A



DETAIL A

NOTES:

1. FOR LOCATION OF SECTION A-A SEE DWG. NO. 48/63.
2. THE COST OF REMOVING AND DISPOSING OF EXISTING STEEL BARRIER INCLUDING FLAME CUTTING STEEL TABS SHALL BE INCLUDED IN THE PRICE BID FOR ITEM 202 REMOVAL MISC.: STEEL MEDIAN BARRIER (BASCULE SPAN).

DESIGN AGENCY
BERGMANN associates
6711 Monroe St., Bldg. 2
Sylvania, OH 43560

DESIGNED	DRAWN	REVIEWED	DATE
HP	LK	JAH	3/16/06
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JA		4805917	

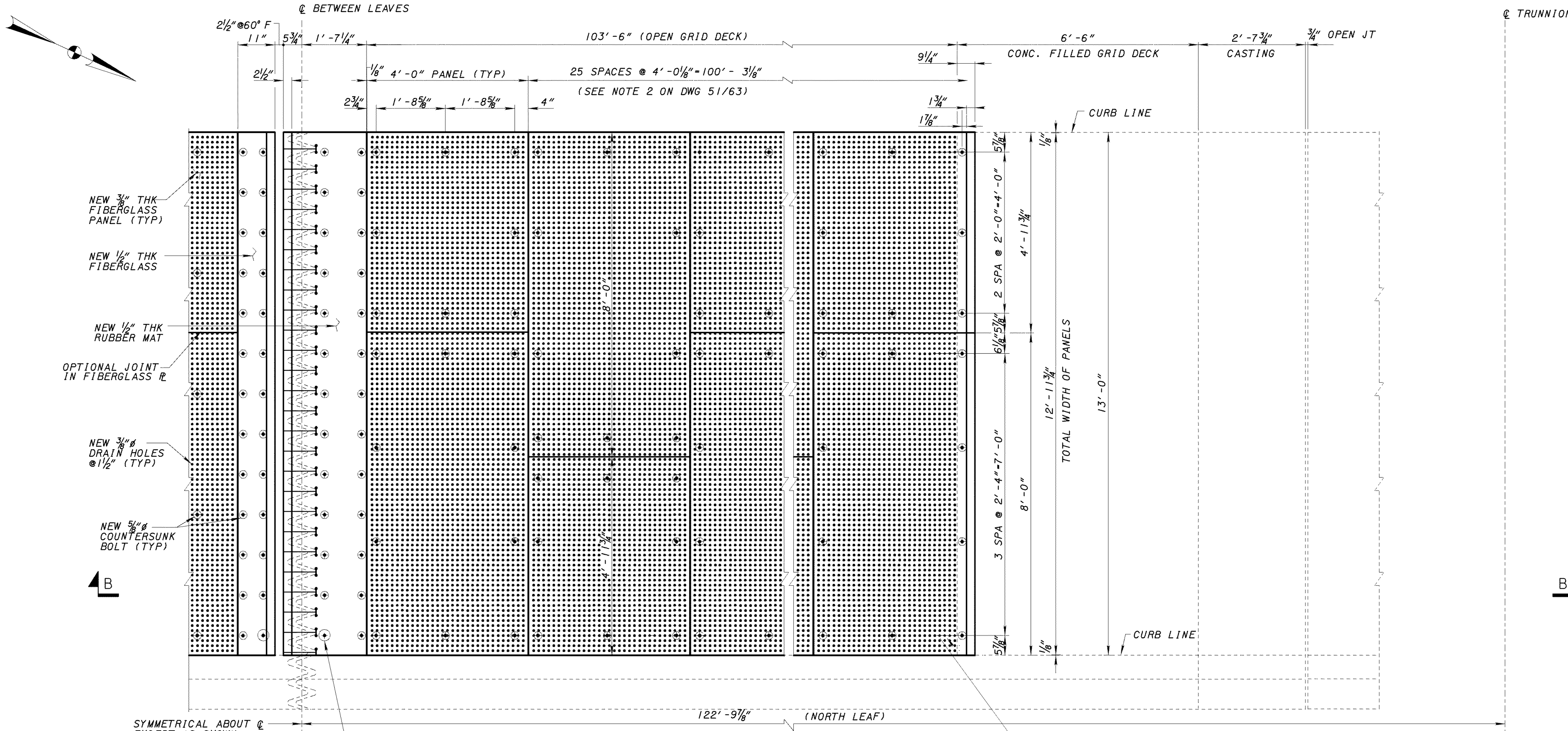
DECK SECTION
CRAIG MEMORIAL BRIDGE NO. LUC-65-0538 OVER MAUMEE RIVER

LUC-280-2.34 TRENCH RECLAMATION

49/63

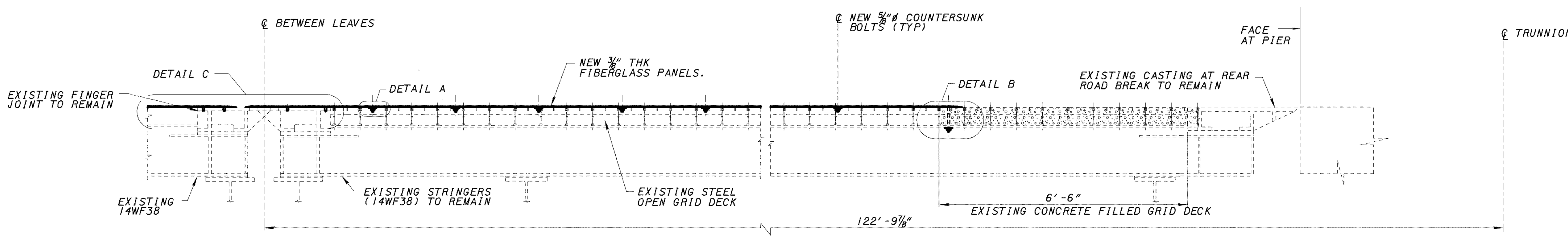
508/555

$DATE$ $TIME$ $FILE$



MULTI- USE TRAIL - PARTIAL PLAN

(SEE NOTE 4 FOR BOLT SPACING ADJUSTMENTS)



SECTION B-B

NOTES:

1. FOR DETAILS A, B AND C SEE DWG. NO. 51/63
2. FOR FIBERGLASS PLATE CONNECTION DETAILS SEE DWG. NO. 51/63.
3. HOLES IN FIBERGLASS PLATE FOR ⅝" DIA. COUNTERSUNK BOLTS SHALL BE FIELD DRILLED AND ALIGNED WITH LOCATION OF TAB HOLES.
4. THE CONTRACTOR SHALL ADJUST HOLE SPACING BASED ON LOCATION OF WELDED TABS IN OPEN GRID DECK. SEE FIBERGLASS DECK PLATE CONNECTION.

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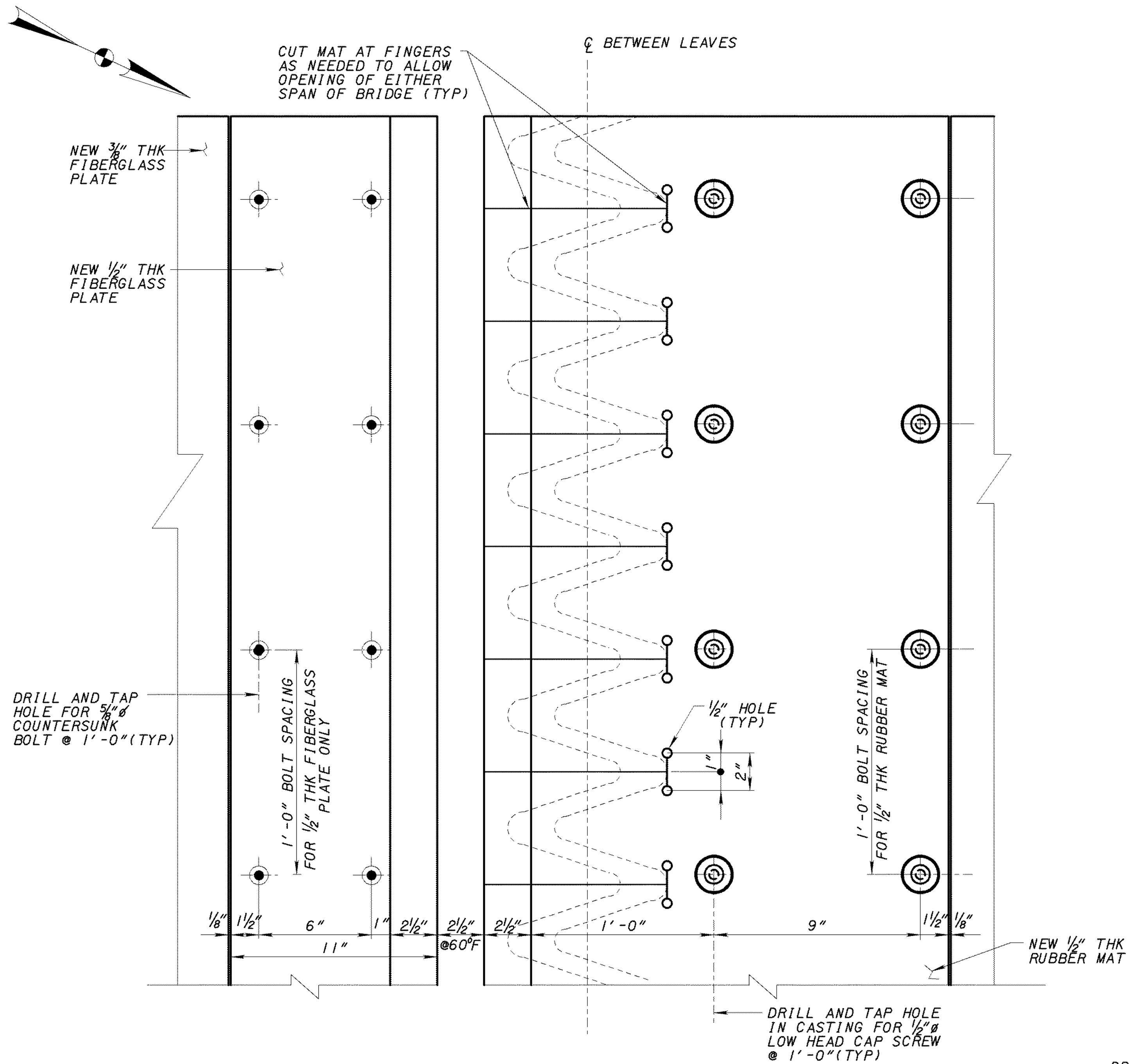
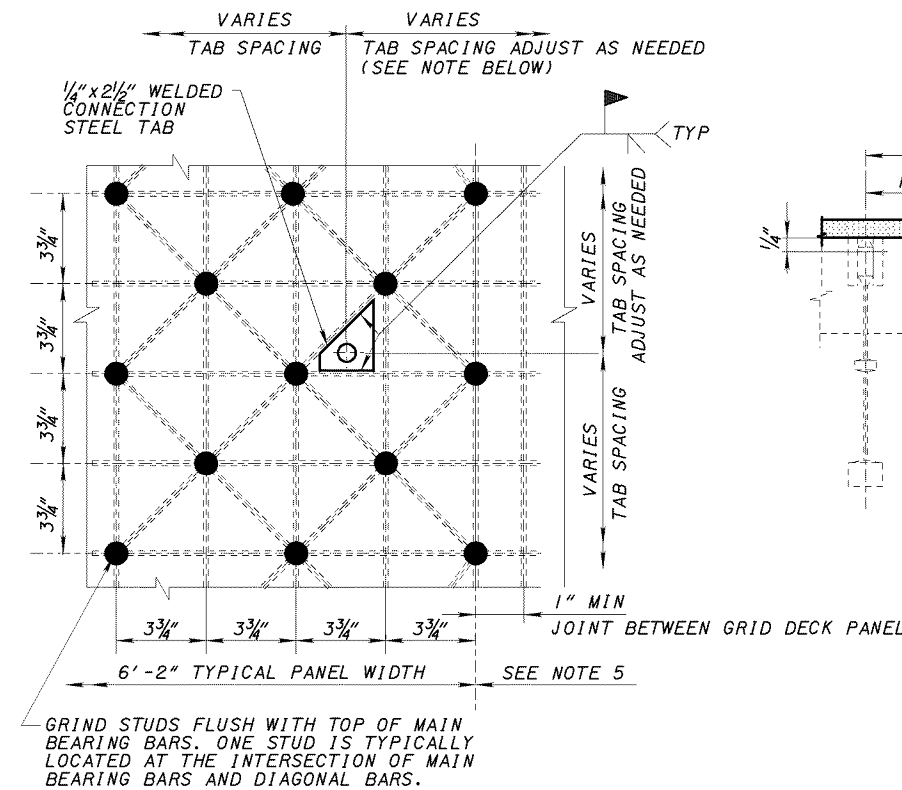
MULTI - USE TRAIL PLAN AND SECTION
CRAIG MEMORIAL BRIDGE NO. LUC-65-0538
OVER MAUMEE RIVER

LUC-280-2.34
TRENCH
RECLAMATION

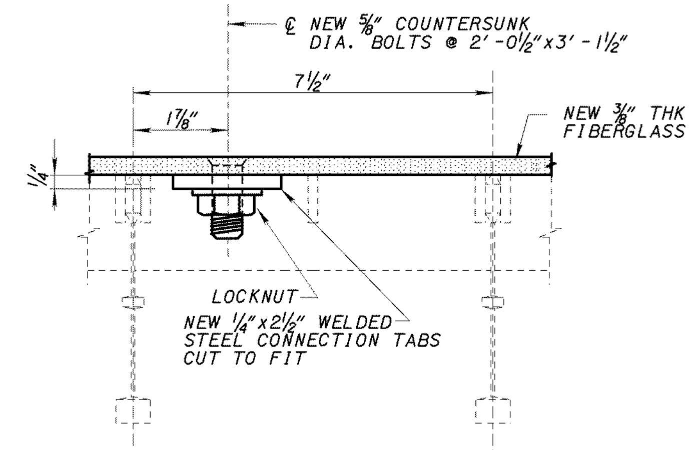
$DATE$ $TIME$ $FILE$



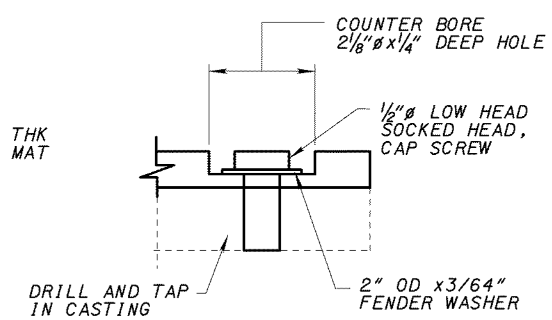
SECTION A-A



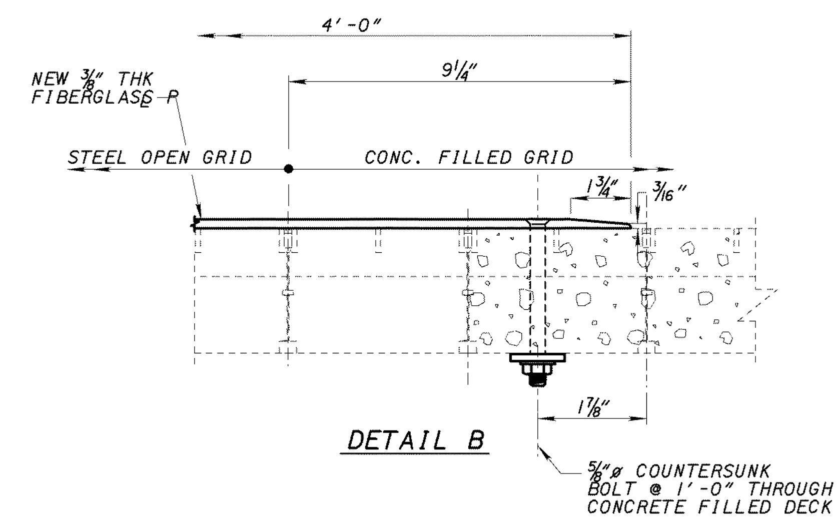
FIBERGLASS DECK PLATE CONNECTION DETAILS - PLAN



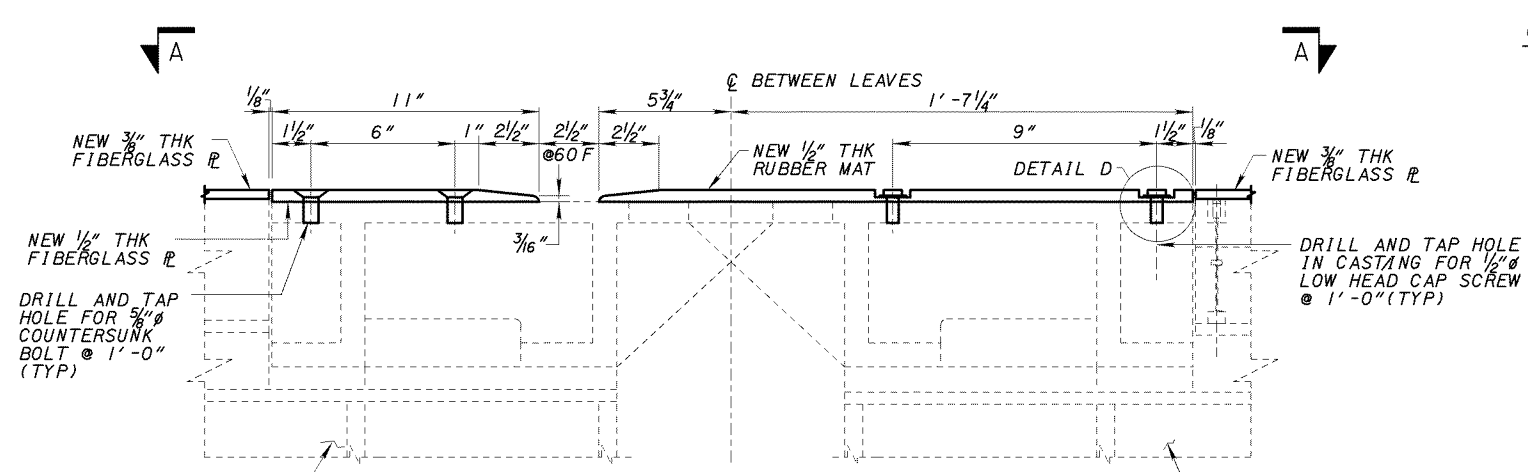
DETAIL A



CONNECTION DETAIL D



DETAIL B



DETAIL C

NOTES:

1. FOR LOCATION OF DETAILS A, B AND C SEE DWG. NO. 50/63.
2. ADJUST TABS ACCORDING TO GRID CONFIGURATION AND CONFIRM LOCATION PRIOR TO DRILLING HOLES IN FIBERGLASS PLATE. THE COST OF FURNISHING AND INSTALLING STEEL TAPS SHALL BE INCLUDED IN PRICE BID FOR ITEM 530 SPECIAL-STRUCTURE, MISC.: FIBERGLASS DECK PLATE.
3. THE COST OF DRILLING AND TAPPING HOLES IN JOINT CASTING FOR FIBERGLASS DECK SHALL BE INCLUDED IN THE PRICE BID FOR ITEM 530 SPECIAL-STRUCTURE, MISC.: FIBERGLASS DECK PLATE.
4. THE COST OF DRILLING AND TAPPING HOLES IN JOINT CASTING FOR ½ INCH THICK RUBBER MAT SHALL BE INCLUDED IN THE PRICE BID FOR ITEM 530 SPECIAL-STRUCTURE, MISC.: FINGER JOINT MODIFICATION.
5. LAY WIDTH OF GRID DECK PANELS ARE ESTIMATED BASED ON AVAILABLE PLANS. ACTUAL LAY WIDTH MAY VARY AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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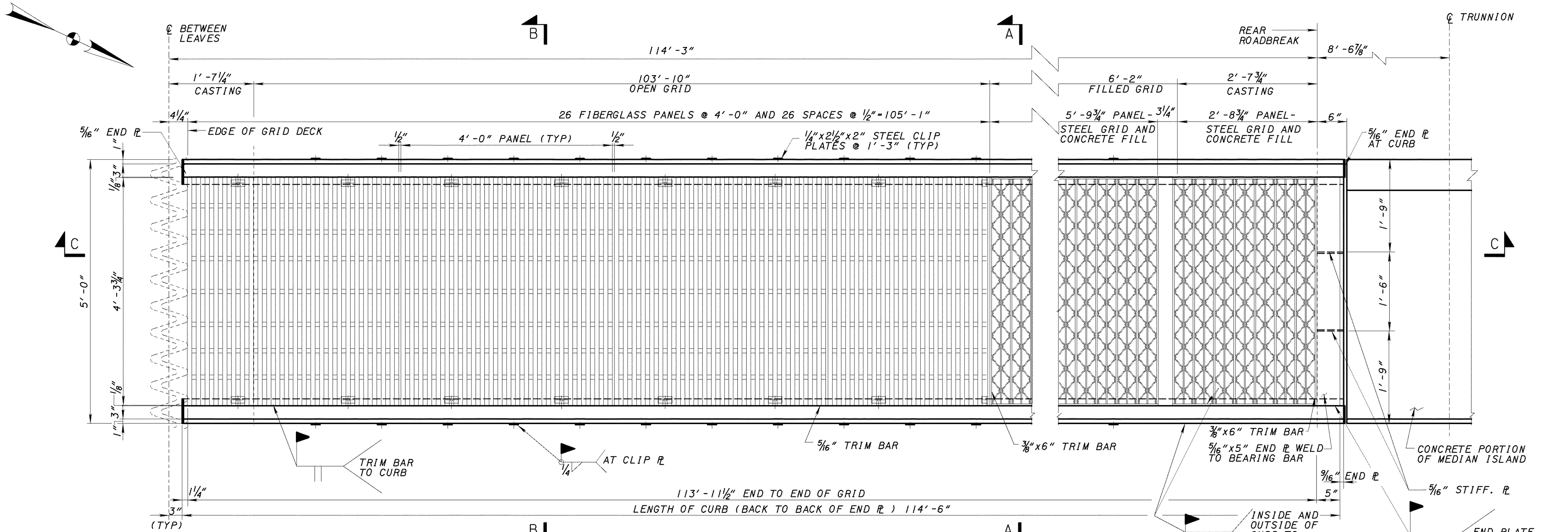
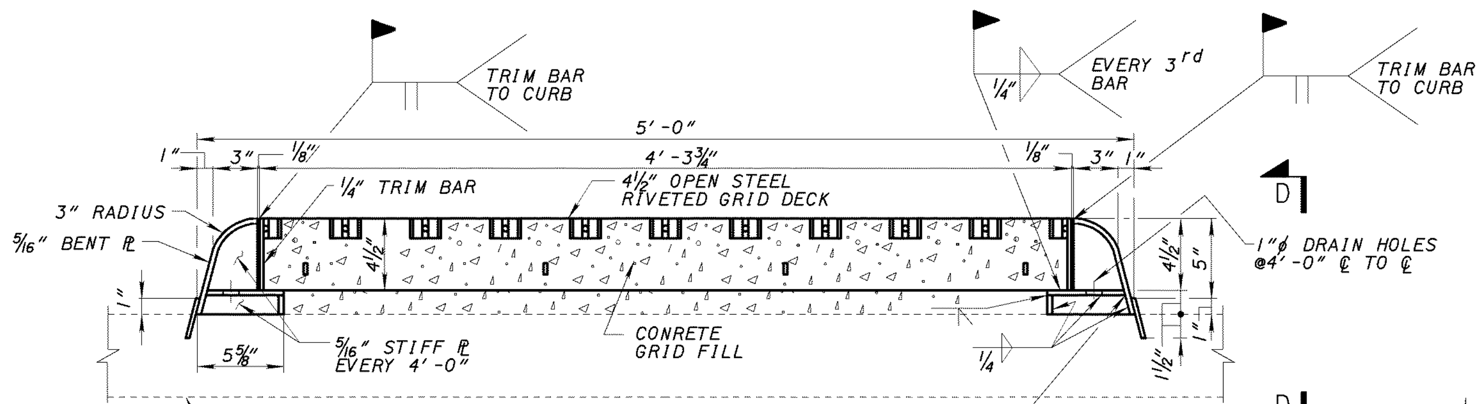
MULTI-USE TRAIL MODIFICATION- DECK DETAILS
CRAIG MEMORIAL BRIDGE NO. LUC-65-0538 OVER MAUMEE RIVER

LUC-280-2.34 TRENCH RECLAMATION

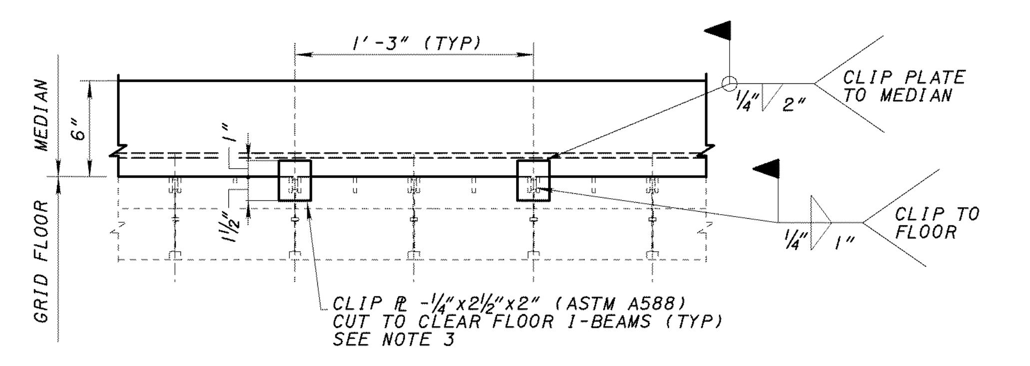


MEDIAN ISLAND PLAN

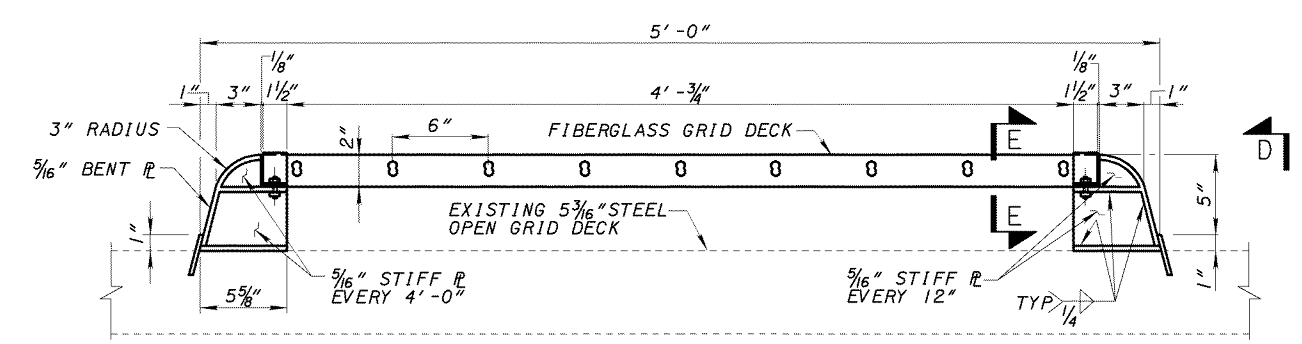
NORTH BASCULE LEAF SHOWN
SOUTH BASCULE LEAF OPPOSITE HAND



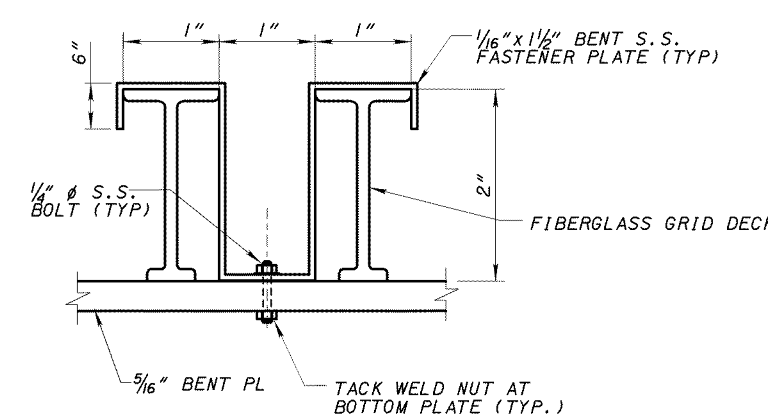
SECTION A-A



SECTION D-D



SECTION B-B



SECTION E-E

NOTES:

1. FOR SECTION C-C SEE DWG. 53/63.
2. STEEL GRID SHALL BE 4½" OPEN STEEL GRID WEIGHING 23.09 LBS/SQ FT. CONTRACTOR SHALL ADJUST BALANCE BASED ON WEIGHT OF ACTUAL GRID SELECTED.
3. FIBERGALSS OPEN GRID SHALL BE 2"x2"x6" WT FIBERGLASS GRATING.
4. REMOVE CONCRETE FILL WHERE NECESSARY IN ORDER TO PLACE MEDIAN CLIP PLATES AS REQUIRED. AFTER CLIPS ARE INSTALLED, ALL POCKETS AROUND CLIPS SHALL BE FILLED WITH GROUT.
5. STRUCTURE STEEL CURBS, GRID DECK, AND TABS SHALL BE HOT DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A123.
6. THE COST OF ALL WORK ON THIS SHEET SHALL BE INCLUDED IN THE PRICE BID FOR ITEM 530 SPECIAL STRUCTURE, MISC.: BASCULE SPAN MEDIAN ISLAND.
7. CONTRACTOR SHALL VERIFY ALL DIMENSION IN THE FIELD PRIOR FABRICATION.

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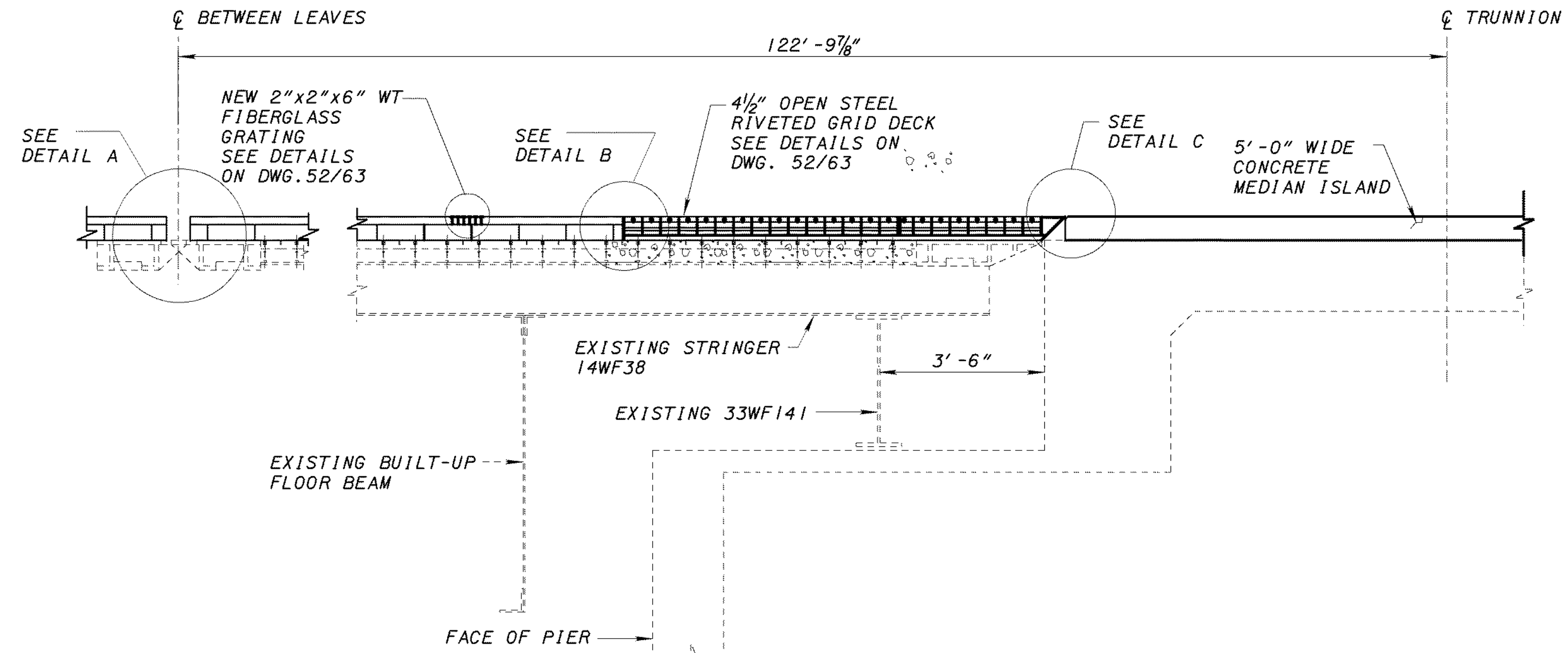
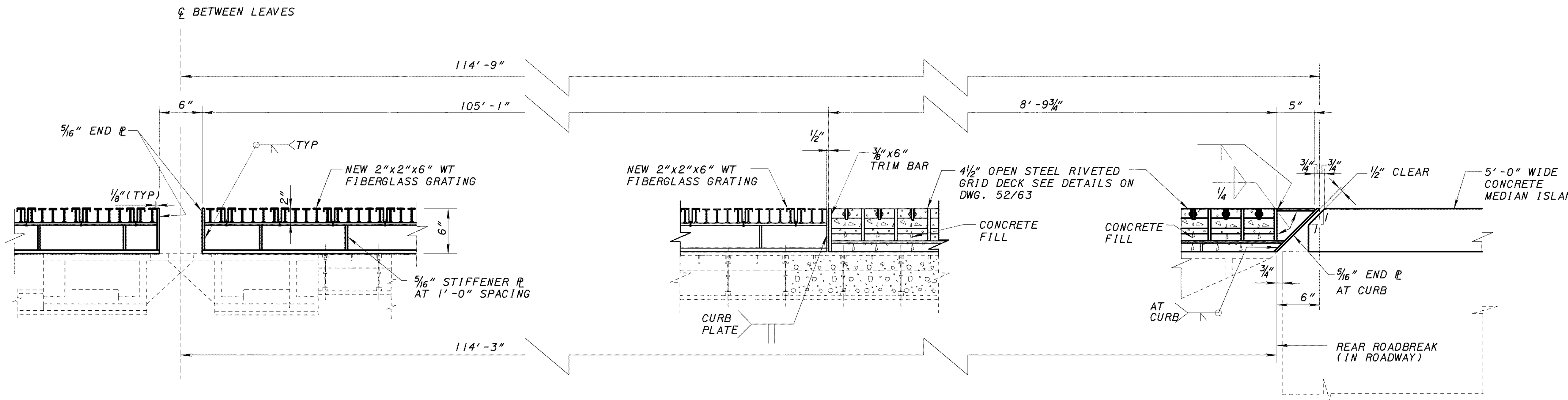
MEDIAN ISLAND - PLAN AND DETAILS
CRAIG MEMORIAL BRIDGE NO. LUC-65-0538 OVER MAUMEE RIVER

LUC-280-2.34 TRENCH RECLAMATION

$DATE$ $TIME$ $FILE$



SECTION C-C



DETAIL A

DETAIL B

DETAIL C

NOTES:

1. FOR LOCATION OF SECTION C-C, SEE DWG. 52/63
2. SEE DWG. 52/63 FOR ADDITIONAL NOTES.

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Sylvania, OH 43560

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MEDIAN ISLAND SECTION
CRAIG MEMORIAL BRIDGE NO. LUC-65-0538
OVER MAUMEE RIVER

LUC-280-2.34
TRENCH
RECLAMATION

53/63

512/555

$DATE$ $TIME$ $FILE$

Appendix 2:
Condition Photographs

Appendix 2.1:

Structural Photographs

Photo S-1 - [North shoreline] -Structure West elevation, Looking Southeast

Photo S-2 - [North shoreline] -Structure East elevation, Looking Southwest

Photo S-3 - [Span 3W] -Feature Under - Maumee River, East side Looking South

Photo S-4 - [Span 3W] -Feature Under - Maumee River, West side Looking South

Photo S-5 - [South Approach] -View off of structure, Looking South

Photo S-6 - [South Approach] -View onto structure from South Approach, Looking North

Photo S-7 - [North Approach] -View onto structure from North Approach, Looking South

Photo S-8 - [North Approach] -View off of structure, Looking North

Photo S-9 - [South Approach] -Roadway approach pavement, NB right and left lanes general view, Looking North

Photo S-10 - [South Approach] -Roadway approach slab, NB right and left general view, Looking South

Photo S-11 - [South Approach] -East sidewalk / trail approach slab, general view, Looking North

Photo S-12 - [South Approach] -Roadway approach pavement, SB lanes and shoulder general view, Looking South

Photo S-13 - [South Approach] -Roadway approach pavement, middle lanes general view, Looking South

Photo S-14 - [North Approach] -Roadway approach pavement, NB lanes, Looking North

Photo S-15 - [North Approach] -East sidewalk / trail approach pavement, general view, Looking South

Photo S-16 - [South Approach] -Approach slab HPR joint with approach pavement, SB lanes, Looking North

Photo S-17 - [South Approach] -Approach slab HPR joint with approach pavement, NB lanes, Looking Northeast

Photo S-18 - [South Approach] -Southwest bridge barrier and raised curb at SB roadway shoulder, Looking South

Photo S-19 - [South Approach] -Southwest sidewalk, barrier and pedestrian railing, Looking South

Photo S-20 - [South Approach] -Southeast roadway barrier and top railing, Looking Northeast

Photo S-21 - [South Approach] -Southeast sidewalk / trail approach timber railing and green space, Looking Northeast

Photo S-22 - [South Approach] -Southeast sidewalk / trail approach barrier and top railing, Looking Northeast

Photo S-23 - [North Approach] -Northwest guard railing, Looking South

Photo S-24 - [North Approach] -Northwest guard railing transition and barrier, Looking Southwest

Photo S-25 - [North Approach] -Northwest sidewalk at guard railing transition, settlement on north side at barrier corner up to 3", Looking South

Photo S-26 - [North Approach] -Northwest sidewalk vegetation growth throughout, Looking North

Photo S-27 - [North Approach] -Northeast guard railing approach, minor impact damage, Looking Southeast

Photo S-28 - [North Approach] -Northeast guard railing transition and barrier, minor impact damage, Looking Northeast

Photo S-29 - [South Approach] -Southwest approach slope, general view, Looking Southwest

Photo S-30 - [South Approach] -Southeast approach slope, general view, Looking South

Photo S-31 - [North Approach] -Northwest approach slope, general view, Looking North

Photo S-32 - [North Approach] -Northeast approach slope, general view, Looking North

Photo S-33 - [South Approach] -Southeast drain inlet at east side sidewalk / trail, general view, Looking Northeast

Photo S-34 - [South Approach] -Southeast drain inlet at east side sidewalk / trail is clear, detail view, Looking East

Photo S-35 - [Span 1] -Roadway deck and wearing surface, NB lanes at south end of span, Looking North

Photo S-36 - [Span 1] -Roadway deck and wearing surface, NB lanes at mid-span, Looking North

Photo S-37 - [Span 1] -Roadway deck and wearing surface, SB lanes near north end of span, Looking South

Photo S-38 - [Span 1] -Roadway deck and wearing surface, middle lanes near mid-span, Looking South

Photo S-39 - [Span 2] -Roadway deck and wearing surface, NB lanes at mid-span, Looking North

Photo S-40 - [Span 2] -Roadway deck and wearing surface, SB lanes near north end of span, Looking South

Photo S-41 - [Span 2] -Roadway deck and wearing surface, middle lanes from north end of span, Looking South

Photo S-42 - [Span 3] -Roadway deck and wearing surface, NB lanes at south end of span, Looking North

Photo S-43 - [Span 3] -Roadway deck and wearing surface, NB lanes at mid-span, Looking North

Photo S-44 - [Span 3] -Roadway deck and wearing surface, SB lanes at north end of span, Looking South

Photo S-45 - [Span 4] -Roadway deck and wearing surface, middle lanes near mid-span, Looking South

Photo S-46 - [Span 4] -Roadway deck and wearing surface, NB lanes south of mid-span, Looking North

Photo S-47 - [Span 4] -Roadway deck and wearing surface, NB lanes north of mid-span, Looking North

Photo S-48 - [Span 4] -NB right lane detail view of deck cracking, spalling and delamination along finger joint plates, Looking North

Photo S-49 - [Span 4] -Roadway deck and wearing surface, SB lanes near mid-span, Looking South

Photo S-50 - [Span 4] -Roadway deck and wearing surface, middle lanes from north end of span, Looking South

Photo S-51 - [Pier 4 Span] -Roadway deck and wearing surface, SB lanes, Looking South

Photo S-52 - [Span 5] -South leaf SB lanes general view of grid deck and roadway barrier, Looking South

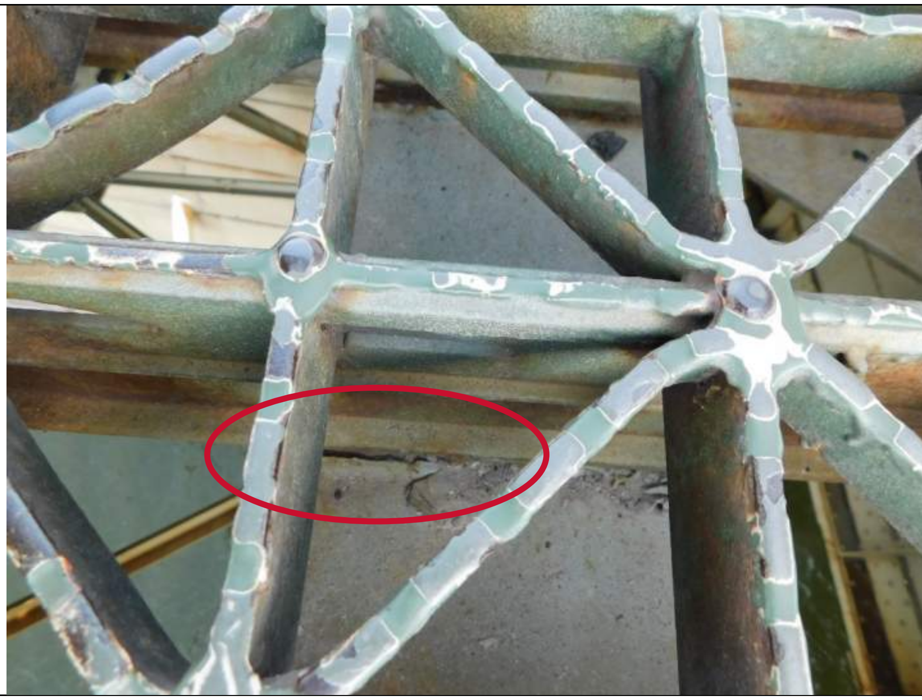


Photo S-53 - [Span 5] -Detail view of grid deck with broken weld connecting lower main bar to stringer top flange, South leaf in SB lanes near Pier 4, Looking North

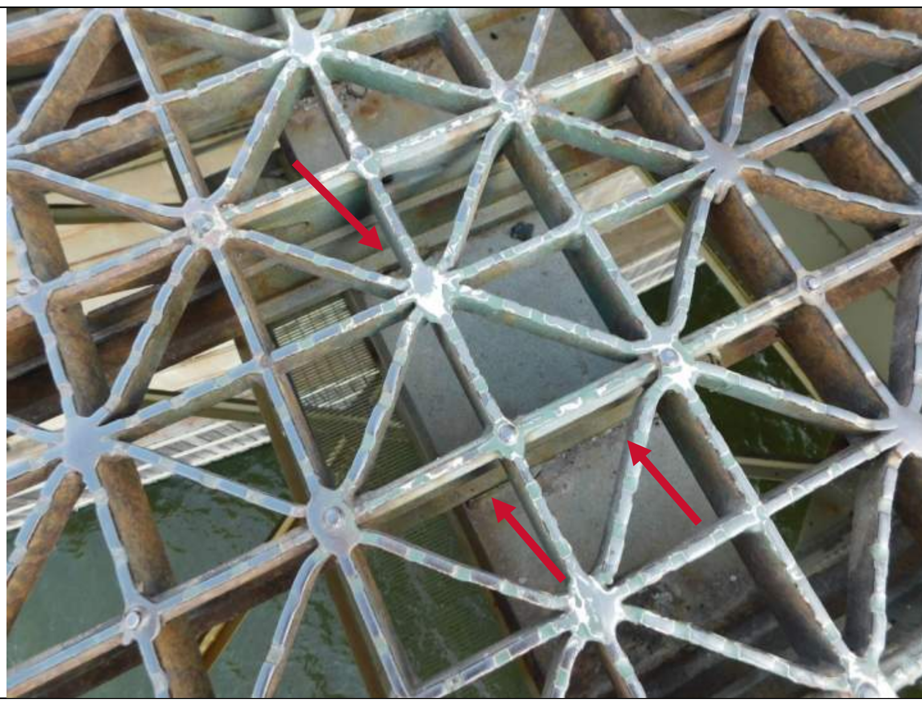


Photo S-54 - [Span 5] -Detail view of grid deck with broken weld connecting lower main bar to stringer top flange, South leaf in SB lanes near Pier 4, Looking North

Photo S-55 - [Span 5] -South leaf, general view of grating noting locations of corrosion holes with white spray chalk, Looking South

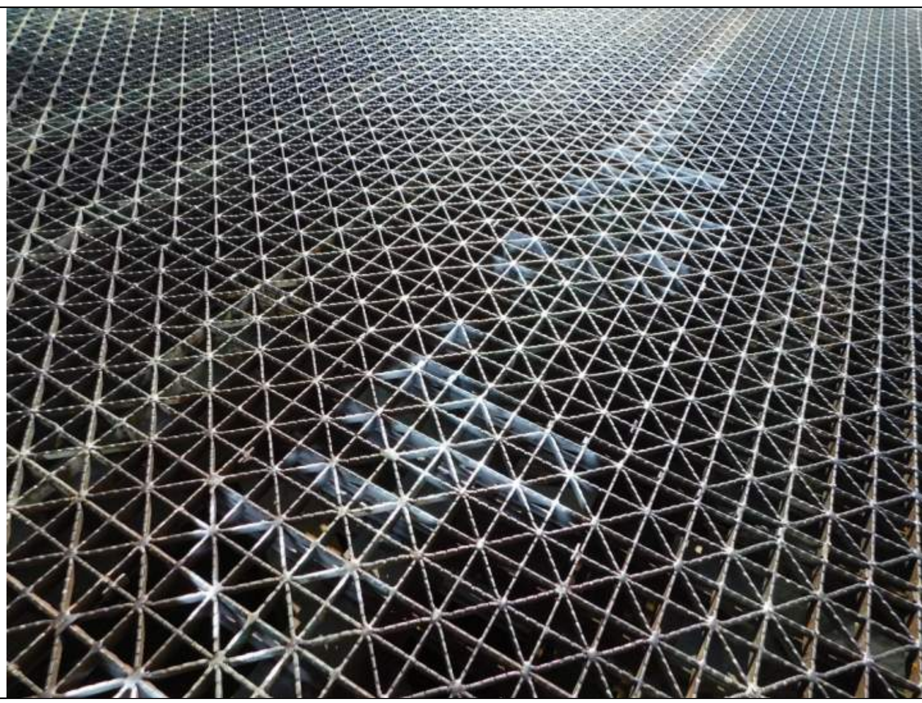


Photo S-56 - [Span 5] -South leaf, general view of grating noting locations of corrosion holes with white spray chalk, Looking South

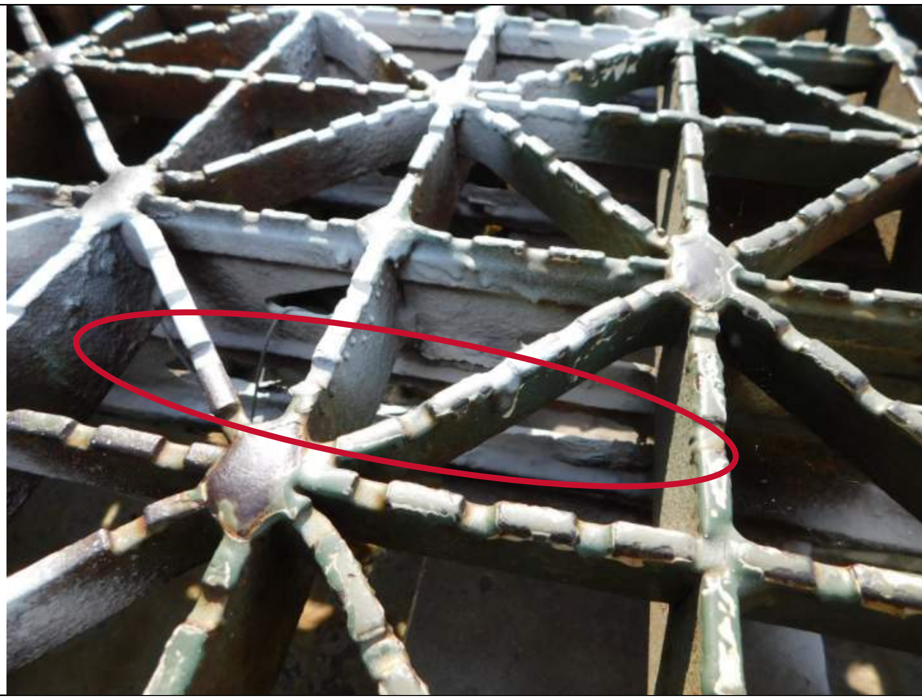


Photo S-58 - [Span 5] -Detail view of grid deck with corrosion holes in lower main bars above Stringer 16W, typical location between FB6s-7s, Looking North

Photo S-57 - [Span 5] -Detail view of grid deck with corrosion holes in lower main bars above Stringer 17W between FB5n-6n, Looking South

Photo S-59 - [Span 5] -South leaf NB lanes, raised curb and panel-covered trail segment, general view of elements in good condition, Looking North

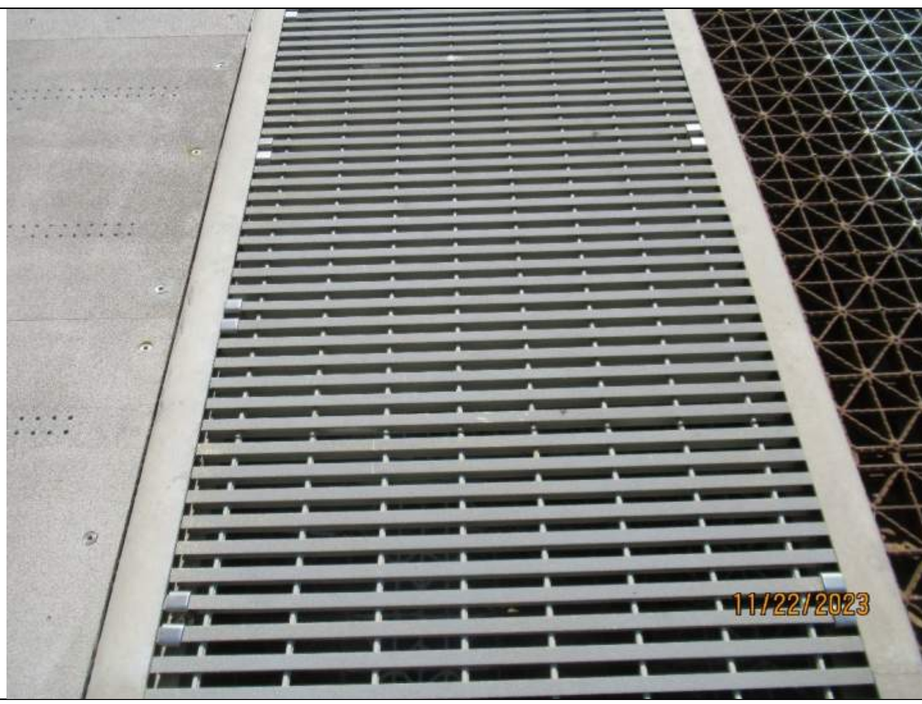


Photo S-60 - [Span 5] -South leaf NB raised curb, detail view of typical good condition, Looking North

Photo S-61 - [Span 5] -South leaf trail segment, detail view of bolted panel sections in good condition, Looking East

Photo S-62 - [Span 6] -Roadway deck and wearing surface, East trail, Looking North

Photo S-63 - [Span 7] -Roadway deck and wearing surface, East trail and flare area, Looking South

Photo S-64 - [Span 8] -Roadway deck and wearing surface, East trail, Looking South

Photo S-65 - [Span 9] -Roadway deck and wearing surface, NB right lane from Pier 8, Looking North

Photo S-66 - [Span 10] -Roadway deck and wearing surface, NB right lane from Pier 9, Looking North

Photo S-67 - [Span 10] -Roadway deck and wearing surface, NB right lane from midspan, Looking North

Photo S-68 - [Span 1] -West fascia, general view, Looking East

Photo S-69 - [Span 1] -East fascia, general view, Looking West

Photo S-70 - [Span 2] -East fascia, detail view of typical packing corrosion at sidewalk edge and fascia plate, Looking Southwest

Photo S-71 - [Span 4] -West fascia and framing, general view, Looking Southeast

Photo S-72 - [Span 4] -East fascia and framing, general view, Looking Southwest

Photo S-73 - [Span 6] -East fascia and framing, general view, Looking Southwest

Photo S-74 - [Span 7] -West fascia, general view, Looking East

Photo S-75 - [Span 7] -East fascia, general view, Looking West

Photo S-76 - [Span 8] -West fascia, general view, Looking East

Photo S-77 - [Span 8] -East fascia, general view, Looking West

Photo S-78 - [Span 9] -West fascia, general view, Looking East

Photo S-79 - [Span 9] -East fascia, general view, Looking West

Photo S-80 - [Span 10] -West fascia, general view, Looking East

Photo S-81 - [Span 10] -East fascia, general view, Looking West

Photo S-82 - [Span 1] -East roadway barrier, typical full height vertical cracking, Looking East

Photo S-83 - [Span 1] -West roadway barrier, typical vertical cracking, Looking Southwest

Photo S-84 - [Span 2] -East roadway barrier, typical full height vertical cracking, Looking East

Photo S-85 - [Span 2] -West roadway barrier, typical minor impact scrapes and vertical cracking, Looking Southwest

Photo S-86 - [Span 3] -East roadway barrier, typical full height vertical cracking, Looking East

Photo S-87 - [Span 3] -West roadway barrier, typical minor impact scrapes and vertical cracking, Looking Southwest

Photo S-88 - [Span 4] -East roadway barrier, typical full height vertical cracking, Looking Northeast

Photo S-89 - [Span 4] -West roadway barrier, typical full height vertical cracking, Looking South

Photo S-90 - [Pier 4 Span] -West roadway barrier, typical vertical cracks, Looking Southwest

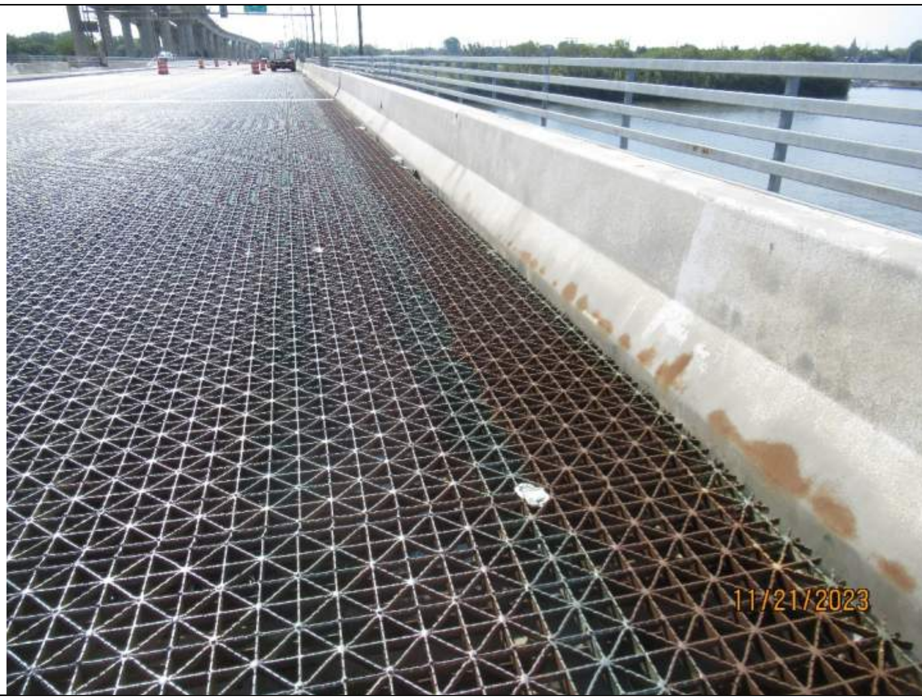


Photo S-91 - [Span 5] -North leaf, West roadway steel barrier, minor corrosion at base, peeling paint throughout, Looking South

Photo S-92 - [Span 5] -South leaf, East roadway / trail steel barrier, generally good condition with flaking and peeling paint, Looking Northeast

Photo S-93 - [Span 5] -South leaf East roadway / trail steel barrier, East side, scattered missing connection bolts for vertical plate, Looking Northwest

Photo S-94 - [Span 6] -East roadway / trail barrier, typical full height vertical cracking and isolated longitudinal cracking at lower slope, Looking North

Photo S-95 - [Span 6] -East sidewalk / trail barrier and railing, typical full height vertical cracking, Looking South

Photo S-96 - [Span 7] -East roadway / trail barrier, typical full height vertical cracking , Looking North

Photo S-97 - [Span 8] -East roadway & trail / sidewalk barriers and top railings, typical full height vertical cracking, Looking North

Photo S-98 - [Span 9] -East roadway barrier and top railing, trail / sidewalk barrier and railing in background, typical full height vertical cracking, Looking Northeast

Photo S-99 - [Span 9] -East roadway & trail / sidewalk barriers and top railings, typical full height vertical cracking, Looking North

Photo S-100 - [Span 10] -East roadway barrier and top railing, trail barrier and railing in background, typical full height vertical cracking, Looking Northeast

Photo S-101 - [Span 10] -East sidewalk / trail barrier and top railing, typical full height vertical cracking, Looking Southeast

Photo S-102 - [Span 1] -West pedestrian railing and sidewalk, typical good condition, Looking Southwest

Photo S-103 - [Span 2] -West pedestrian railing and sidewalk, typical good condition, Looking Southwest

Photo S-104 - [Span 3] -West pedestrian railing and sidewalk, typical good condition, Looking Southwest

Photo S-105 - [Span 4] -Concrete curb / median island between northbound lanes and mixed use trail, minor scrapes in coating, generally good condition, Looking Northeast

Photo S-106 - [Pier 4 Span] -West sidewalk and railings, good condition general view, Looking Southwest

Photo S-107 - [Pier 4 Span] -East sidewalk and railings, good condition general view, Looking North

Photo S-108 - [Span 5] -South leaf west sidewalk and railing, typical good condition with spots of corrosion, Looking South

Photo S-109 - [Span 5] -North leaf west sidewalk and railing, typical good condition with spots of corrosion, Looking South

Photo S-110 - [Span 5] -North leaf east sidewalk and railing, typical good condition of rail and widespread minor corrosion to sidewalk grating, Looking North

Photo S-111 - [Span 5] -North leaf east sidewalk at north end, vertical misalignment along longitudinal and transverse breaks presents minor tripping hazard, Looking South

Photo S-112 - [Pier 5 Span] -West sidewalk and railings, good condition general view, Looking South

Photo S-113 - [Span 6] -Concrete curb / median island between northbound lanes and mixed use trail, minor scrapes in coating, generally good condition, Looking Northwest

Photo S-114 - [Span 6] -East sidewalk and trail topside, barrier and railings, good condition general view, Looking North

Photo S-115 - [Span 7] -West sidewalk, barrier and railing, good condition general view, Looking North

Photo S-116 - [Span 7] -East sidewalk, railing and barrier, good condition general view, Looking North

Photo S-117 - [Span 7 & 8] -West sidewalk, barrier and railing, minor transverse and vertical cracking, Looking North

Photo S-118 - [Span 8] -West sidewalk, barrier and railing, minor transverse and vertical cracking, Looking North

Photo S-119 - [Span 9] -West sidewalk, barrier and railing, minor transverse and vertical cracking, Looking North

Photo S-120 - [Span 10] -West sidewalk, barrier and railing, minor transverse and vertical cracking, patch repairs to barrier, Looking North

Photo S-121 - [South Abutment] -Abutment reference line finger joint general view from NB lanes, Looking West

Photo S-122 - [South Abutment] -Abutment reference line finger joint, horizontal mis-alignment with fingers touching in NB lanes, Looking West

Photo S-123 - [South Abutment] -Abutment reference line sliding plate joint at West sidewalk, joint has seized and broken apart at the north header, Looking South

Photo S-124 - [South Abutment] -Abutment reference line finger joint general view in SB shoulder, Looking East

Photo S-125 - [South Abutment] -Abutment reference line finger joint general view in SB lanes, Looking East

Photo S-126 - [South Abutment] -Abutment reference line finger joint at middle lanes, view showing approach (south) fingers up to 0.75" higher than span (north) fingers, Looking South

Photo S-127 - [South Abutment] -Detail view showing approach (south) fingers up to 0.75" higher than span (north) fingers in shoulder lanes, into SB right lane, Looking West

Photo S-128 - [South Abutment] -Abutment reference line finger joint with cover at east sidewalk / trail, Looking South

Photo S-129 - [North Abutment] -Abutment reference line finger joint at NB lanes, Looking South

Photo S-130 - [North Abutment] -Abutment reference line finger joint at NB left lane and SB lane, Looking West

Photo S-131 - [North Abutment] -Abutment reference line finger joint, Span 10 side teeth are 0.25"-0.75" higher than the approach side teeth, primarily in the SB lane, Looking East

Photo S-132 - [North Abutment] -Abutment reference line finger joint with cover at east sidewalk / trail, Looking South

Photo S-133 - [Pier 4] -Expansion finger joint general view across NB roadway lanes, Looking Northwest

Photo S-134 - [Pier 4] -Expansion finger joint detail view at NB right lane, horizontal mis-alignment with fingers nearly touching, Looking West

Photo S-135 - [Pier 4] -Underside of finger joint, view of elastomeric trough and drainage downspout (b/w G2-G3), connection to pier, generally good condition, Looking North

Photo S-136 - [Pier 5] -Expansion finger joint general view across SB roadway lanes, Looking East

Photo S-137 - [Pier 5] -West sidewalk expansion joint with minor debris, general view, Looking South

Photo S-138 - [Span 5] -Bascule span center finger joint, general view across SB lanes, Looking East

Photo S-139 - [Span 5] -Bascule span center finger joint, detail view of horizontal mis-alignment with fingers in contact, Looking East

Photo S-140 - [Span 5] -Bascule span center finger joint, detail view of horizontal mis-alignment with fingers in contact, Looking East

Photo S-141 - [Span 5] -Bascule span center finger joint, detail view at West sidewalk, Looking South

Photo S-142 - [Span 5] -South leaf rear break joint, good condition general view, Looking East

Photo S-143 - [Span 5] -South leaf rear break joint at East sidewalk, diamond plating at longitudinal break is uplifted and presents a minor tripping hazard, Looking Northwest

Photo S-144 - [Pier 5] -North rear break joint at Girder 1W longitudinal break, slight rubbing/wear between break edge angles and girder cap vertical plates, Looking South

Photo S-145 - [Pier 8] -Expansion finger joint general view across roadway lanes, Looking East

Photo S-146 - [Pier 8] -Expansion joint at East sidewalk / trail, diamond plating cover pushed upward in the middle, Looking South

Photo S-147 - [Span 1] -Typical clogged roadway drain next to west barrier, 3rd drain from abutment, Looking South

Photo S-148 - [Span 3] -Typical clogged roadway drain next to west barrier, 2nd drain south of Pier 3, Looking West

Photo S-149 - [Span 4] -Typical roadway drain next to barrier, clear and good condition, SB lanes near mid-span shown, Looking West

Photo S-150 - [Span 1] -Downspouts at South abutment and east side of span are disconnected at the abutment, Looking Southwest

Photo S-151 - [Span 7] -Drainage downspouts, piping and supports along Girder 5W (west flare exterior girder), generally good condition, Looking Southwest

Photo S-152 - [Pier 8] -Drainage troughs are not connected to downspouts at pier and downspouts have missing segments, Looking South

Photo S-153 - [Span 2] -Deck underside, general view between Floorbeams 6S & 7S, Stringers 3S & 4S, Looking South

Photo S-154 - [Span 2] -Deck underside, detail view between Floorbeams 6S & 7S, Girder 2W and Stringer 3W, Looking West

Photo S-155 - [Span 2] -Deck underside, close up view of typical 0.01-0.02" map cracking / shrinkage cracking between Floorbeams 6S & 7S, Girder 2W and Stringer 3W, Looking West

Photo S-156 - [Span 2] -Deck underside, between Floorbeam 9S-10S and Stringers 5W-6W, minor pop-out spalls in deck (below trail-roadway barrier), Looking South

Photo S-157 - [Span 2] -Deck underside, between Floorbeam 14S-15S and Stringers 5W-6W, typical minor map cracking and honeycombing, Looking South

Photo S-158 - [Span 3] -Deck underside, general view between Floorbeam 20S-21S, Girders 2W-4W, Looking North

Photo S-159 - [Span 6] -Deck underside, detail view between Floorbeam 2S-3S, Stringers 2W-3W, typical minor map cracking / shrinkage cracking, scattered throughout, Looking South

Photo S-160 - [Span 7] -Deck underside, between Girders 2W-3W south of FB14S, isolated patch repair in deck, Looking North

Photo S-161 - [Span 8] -Deck underside, between Stringers 1W-2W and Floorbeams 17S-18S, typical random / map cracking, Looking North

Photo S-162 - [Span 1] -Span framing and underside general view, Looking North

Photo S-163 - [Span 3] -Span framing and underside general view, Looking South

Photo S-164 - [Span 4] -Span framing and underside general view, Looking Southeast

Photo S-165 - [Span 5] -Span framing and underside general view, South leaf, Girders 2W-4W, Looking South

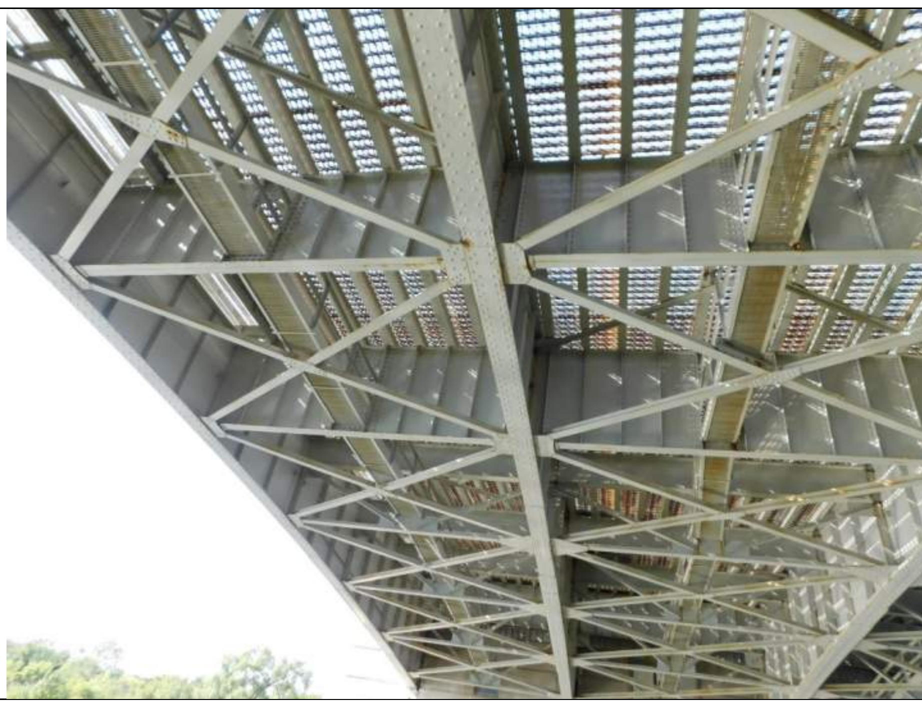


Photo S-166 - [Span 5] -Span framing and underside general view, North leaf, Girders 1W-3W, Looking North

Photo S-167 - [Span 6] -Span framing and underside general view, Looking Northeast

Photo S-168 - [Span 7] -Span framing and underside general view, Looking South

Photo S-169 - [Span 7] -Span framing and underside general view, Looking Southwest

Photo S-170 - [Span 8] -Span framing and underside general view, Looking Northwest

Photo S-171 - [Span 9] -Span framing and underside general view, Looking North

Photo S-172 - [Span 10] -Span framing and underside general view, Looking Northwest

Photo S-173 - [Span 1] -Interior framing between Girders 2W-3W at FB6S, paint in typically good condition throughout, Looking South

Photo S-174 - [Span 1] -Girder 4W West face at FB0S, scattered section loss up to 0.125" deep across web and bottom flange, floorbeam connection, similar at floorbeam, Looking Southeast

Photo S-175 - [Span 2] -Girder 4W East web, scattered painted over section loss up to 0.125" deep across lower third of web, Looking Southwest

Photo S-176 - [Span 2] -Girder 4W East bottom flange, cleaned packing corrosion with section loss to the plate, Looking West

Photo S-177 - [Span 3] -Girder 1W West bottom flange, warping of cover plates due to packing corrosion and isolated section loss to BF angle, Looking Northeast

Photo S-178 - [Span 3] -Girder 4W East bottom flange, warping of cover plates due to packing corrosion, general view, Looking Northwest

Photo S-179 - [Span 3] -Girder 4W East bottom flange, warping of cover plates due to packing corrosion, detail view FB18-19, Looking Northwest

Photo S-180 - [Span 4] -Girder 4W East lower web between FB28S-29S exhibits typical scattered painted over section loss to lower web up to 0.125" deep, Looking Southwest

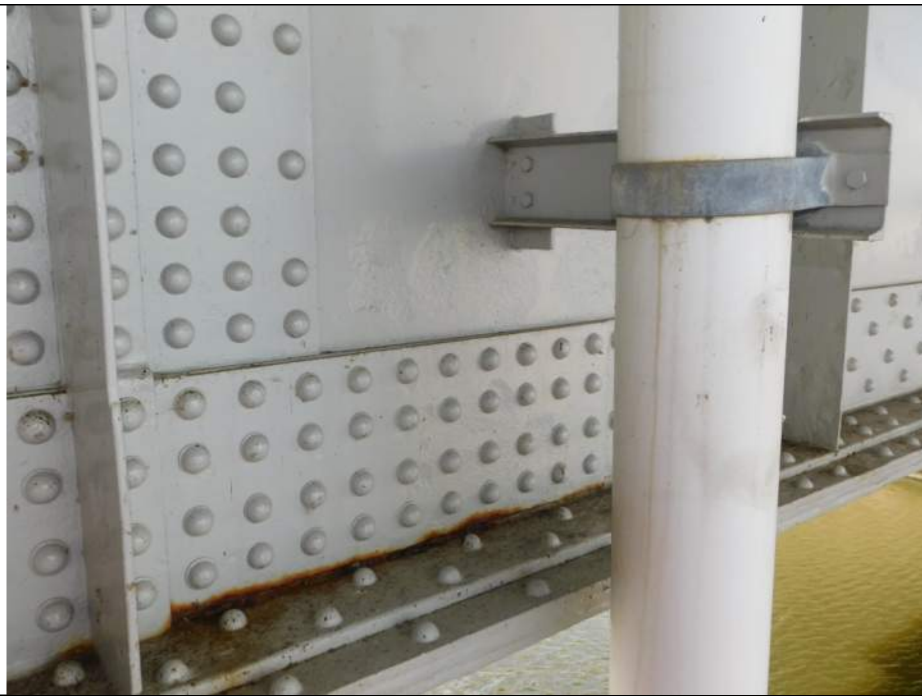


Photo S-181 - [Span 4] -Girder 4W East lower web between FB29S-30S exhibits minor localized corrosion along edge of thickener plate and localized section loss to web at drainage location, Looking Northwest

Photo S-182 - [Span 4] -Girder 4W East lower web between FB30S-31S exhibits a 2" diameter hole in the base of the vertical stiffener, Looking Northwest

Photo S-183 - [Span 8] -Girder 1W West bottom flange, warping of cover plates due to packing corrosion, general view, Looking Southeast

Photo S-184 - [Span 9] -Girder 1W west bearing stiffener angles at Pier 8 exhibit up to 1.25" thick packing corrosion and warping between the outstanding legs, Looking East

Photo S-185 - [Span 9] -Girder 4W east bottom flange cover plate warping due to up to 1" thick pack rust between plates, Looking Southwest

Photo S-186 - [Span 1] -Floorbeam 0S at the South Abutment widespread painted over deep section loss to the web and flanges, area next to Girder 3W, Looking South

Photo S-187 - [Span 1] -Floorbeam 0S at the South Abutment widespread painted over deep section loss to the web and flanges, area next to Girder 2W, Looking South

Photo S-188 - [Span 4] -Floorbeam 36S at Pier 4 between Girders 1W and 2W, painted over section loss at lower web with a small hole, Looking Northeast

Photo S-189 - [Span 4] -Floorbeam 36S at Pier 4 between Girders 3W and 4W, painted over section loss at lower web with two small holes, Looking Northeast

Photo S-190 - [Span 6] -Floorbeam 0S at Pier 5 between Girders 2W and 3W, painted over section loss at lower web with holes, Looking South

Photo S-191 - [Span 8] -Floorbeam 20S south bottom flange, pack rust and warping of flange angle at the lower diagonal connection plate, Looking North

Photo S-192 - [Span 8] -Floorbeam 20S, south lower web and bottom flange between G2W-G3W, typical scattered web section loss and localized section loss at bottom flange, Looking North

Photo S-193 - [Span 8] -Floorbeam 20S, south top flange angle horizontal leg with heavy section loss for 3 ft lengths on either side of Stringer 3W, Looking North

Photo S-194 - [Span 9] -Floorbeam 0S, North face between Stringer 3W and Girder 3W, rust staining and active corrosion across top flange, Looking South

Photo S-195 - [Span 10] -Floorbeam 11S, South face east half between G2W-3W, typical section loss throughout web, Looking North

Photo S-196 - [Span 10] -Floorbeam 11S, North face bottom flange active corrosion and section loss at east half between G2W-3W, Looking East

Photo S-197 - [Span 2] -Floorbeam 6S, East exterior, North face, typical painted over section loss up to 0.125" deep across lower web, Looking South

Photo S-198 - [Span 3] -Floorbeam 20S, East exterior, South face, typical painted over section loss up to 0.125" deep across lower web, additional similar loss in middle web, Looking North

Photo S-199 - [Span 3] -Floorbeam 20S, West exterior, North face, typical painted over section loss up to 0.125" deep across lower web, additional similar loss in middle web, Looking South

Photo S-200 - [Span 6] -Floorbeam 6S, East exterior, South face, typical painted over section loss up to 0.125" deep across the east half of the web, Looking North

Photo S-201 - [Span 2] -Stringer 6W at connection to Floorbeam 15S, typical welded bottom flange connection plate, stringer, and connections in typical good condition, Looking Northeast

Photo S-202 - [Span 9] -Stringer 3W at connection to Floorbeam 3S, typical welded bottom flange connection plate, connection, and components in good condition, Looking South

Photo S-203 - [Span 10] -Stringer 3W at the North Abutment exhibits a 2” diameter hole in the lower web at the connection to Floorbeam 11S, Looking North

Photo S-204 - [Span 4] -Sidewalk framing member with section loss and a 2" diameter hole in the web below deck curb location, between Floorbeams 35S-36S at west sidewalk, Looking Southeast

Photo S-205 - [Span 4] -Sidewalk framing member with section loss below deck curb location, minor web buckling and pinhole, between Floorbeams 34S-35S at east sidewalk, Looking Northwest

Photo S-206 - [Span 6] -Reinforcement repair to sidewalk framing member, typical, at east sidewalk between Floorbeams 1S and 2S, Looking North

Photo S-207 - [Span 2] -General view of diagonal and transverse bracing between Girders 3W and 4W at Floorbeam 14S, Looking South

Photo S-208 - [Span 4] -Lower-Level diagonal bracing connection to G2W below FB36S exhibits painted over section loss and several small holes in the flange, Looking Northeast

Photo S-209 - [Span 8] -General view of diagonal and transverse bracing between Girders 3W and 4W from FB19S, Looking South

Photo S-210 - [Span 5, South Leaf] -Girder 2W, east side between FB1s-FB2s, typical section loss and small holes in base of stiffener, Looking Southwest

Photo S-211 - [Span 5, South Leaf] -Girder 3W, east BF between FB1s-FB2s, small holes in bases of vertical stiffeners, Looking Northwest

Photo S-212 - [Span 5, South Leaf] -Girder 3W, east lower web below FB5s, detail view of typical section loss up to 1/4" deep, Looking Southwest

Photo S-213 - [Span 5, North Leaf] -Girder 2W, west face below FB7n, typical widespread section loss to web, splice plates, rivets, stiffeners and bottom flange angle, Looking East

Photo S-214 - [Span 5, North Leaf] -Girder 3W, west face between FB5n-FB6n, typical scattered section loss to web and built-up components, Looking East

Photo S-215 - [Span 5, North Leaf] -Girder 3W, bottom flange at FB2n, one missing bolt at repaired diagonal bracing connection plate, Looking Northwest

Photo S-216 - [Span 5, South Leaf] -Floorbeam 7s between G2W-G3W, typical section loss scattered throughout web, Looking South

Photo S-217 - [Span 5, South Leaf] -Floorbeam 7s, north side at Stringer 6W, 3" diameter hole in top of web stiffener, Looking South

Photo S-218 - [Span 5, South Leaf] -Floorbeam 6s between G1W-G2W, typical section loss to lower web, typical section loss to K-bracing connection plate below, Looking South

Photo S-219 - [Span 5, South Leaf] -Floorbeam 6s, south face between G3W-G4W, typical section loss throughout lower web and two holes up to 1/4" dia, Looking Northwest

Photo S-220 - [Span 5, South Leaf] -Floorbeam 5s north face at G3W, detail view of typical web section loss with spots up to 1/4" deep, Looking Southwest

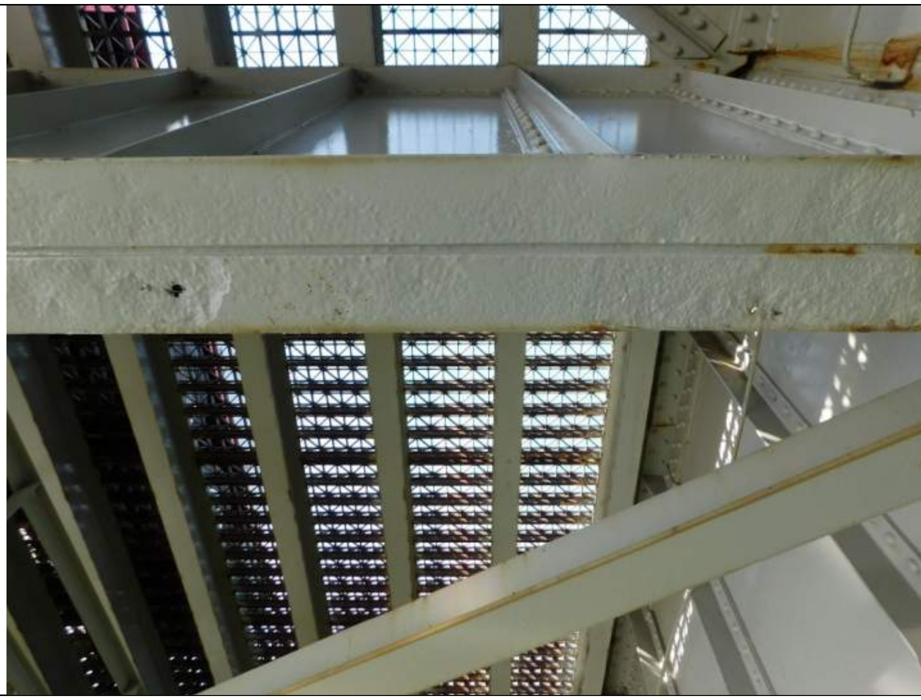


Photo S-221 - [Span 5, South Leaf] -Floorbeam 3s between G1W-G2W, small holes and section loss in bottom flange near G2W, Looking North

Photo S-222 - [Span 5, South Leaf] -Floorbeam 3s, north BF with 1" dia hole next to bracing connection at G3W, note 100% SL at end of bracing member, Looking Southeast

Photo S-223 - [Span 5, South Leaf] -Floorbeam 3s between G3W-G4W, north BF with 2"x1" hole below catwalk, Looking Southeast

Photo S-224 - [Span 5, South Leaf] -Floorbeam 2n, south face between G3W-G4W, holes in bottom of web stiffeners up to 4" x 1", Looking Northwest

Photo S-225 - [Span 5, South Leaf] -Floorbeam 2s, north face between G3W-G4W, holes in bottom of web stiffeners up to 6" dia. and web reinforcement repair, Looking Northwest

Photo S-226 - [Span 5, North Leaf] -Floorbeams 0n+0s at center break joint between G1W-G2W, typical section loss across lower webs and minor debris accumulation, Looking West

Photo S-227 - [Span 5, North Leaf] -Floorbeam 1n at east side G2W, typical packing corrosion with warping at connection angle, Looking South

Photo S-228 - [Span 5, North Leaf] -Floorbeam 3n south face at west side G2W, typical section loss scattered throughout web and packing corrosion at connection angle, Looking North

Photo S-229 - [Span 5, North Leaf] -Floorbeam 3n at east side G2W, typical section loss, minor debris, and small holes at base of web stiffener, Looking North

Photo S-230 - [Span 5, North Leaf] -Floorbeam 3n between G3W-G4W, south BF with 1" dia hole and holes in stiffener bases, Looking Northeast

Photo S-231 - [Span 5, North Leaf] -Floorbeam 6n at G2W, typical lower web and bottom flange section loss including rivet head section loss, pack rust at connection and repaired upper diagonal connection, Looking North

Photo S-232 - [Span 5, North Leaf] -Floorbeam 7n between G1W-G2W, packing corrosion with warping to bottom of web plate along north face, Looking East

Photo S-233 - [Span 5, North Leaf] -Floorbeam 7n between G1W-2W, typical web and bottom flange section loss, debris at bottom flange, repairs to bases of web stiffeners, Looking South

Photo S-234 - [Span 5, North Leaf] -Stringers 7W-8W and grid deck lower main bars, between FB6n-FB7n, general view of typical good condition, Looking North

Photo S-235 - [Span 5, North Leaf] -Stringers 10W+11W at mid-panel, holes in web up to 3" diameter, Looking West

Photo S-236 - [Span 5, South Leaf] -Stringer 26W between FB4s-FB5s at mid-panel, 6" x 3" hole in web, Looking East

Photo S-237 - [Span 5, South Leaf] -Upper diagonal bracing at FB7s north side to G3W east side, connection angle fully cracked/broken, Looking Southwest

Photo S-238 - [Span 5, South Leaf] -Upper diagonal bracing at FB6s south side to G2W west side, connection angle fully cracked/broken, Looking Northeast

Photo S-239 - [Span 5, South Leaf] -Upper diagonal bracing at FB6s south side to G3W west side, connection angle fully cracked/broken, Looking Northwest

Photo S-240 - [Span 5, South Leaf] -Upper diagonal bracing at FB6s north side to G2W west side, connection angle fully cracked/broken, Looking Southeast

Photo S-241 - [Span 5, South Leaf] -Upper diagonal bracing at FB6s north side to G2W east side, connection angle fully cracked/broken, Looking Southwest

Photo S-242 - [Span 5, South Leaf] -K-bracing below FB4s between G2W-G3W, 1" dia hole in connection plate, Looking South (note typical PR and SL to FB web & connection)

Photo S-243 - [Span 5, North Leaf] -Upper diagonal bracing at FB2n south side to G2W west side, 5" L crack in connection angle, Looking Northeast

Photo S-244 - [Span 5, North Leaf] -Lower diagonal bracing connection plate with 4" x 1" hole, at south side FB2n and G4W west side connection, Looking North

Photo S-245 - [Span 5, North Leaf] -K-bracing below FB7n between G1W-G2W, typical section loss throughout connection plate, Looking North

Photo S-246 - [Span 5, North Leaf] -K-bracing below FB7n between G2W-G3W, typical section loss and packing corrosion throughout members, including large hole in angle, Looking West

Photo S-247 - [Span 5, South Leaf] -East sidewalk support and fascia girder, typical section loss and corrosion hole in support angle and stiffener across from FB7s, Looking South

Photo S-248 - [Span 5, South Leaf] -East sidewalk support beams with reinforcement repairs over corrosion holes in webs at FB7s, Looking South

Photo S-249 - [Span 5, South Leaf] -East sidewalk and railing support beams with scattered corrosion holes in webs between FB7s-FB5s, Looking North

Photo S-250 - [Span 5, North Leaf] -West sidewalk support beam and post at FB7n, holes in beam web and base of post, Looking North

Photo S-251 - [Span 5, North Leaf] -Upper T-section support below center catwalk (G2W-G3W) between FB1n-FB2n at diagonal bracing connection exhibits a 31" L x 1" H corrosion hole in the web with pack rust throughout, Looking Northwest

Photo S-252 - [Span 5, North Leaf] -Upper T-section support below center catwalk (G2W-G3W) between FB2n-FB3n at diagonal bracing connection exhibits a pack rust throughout and small edge holes, Looking Northwest

Photo S-253 - [Span 5, North Leaf] -Middle catwalk, west support channel exhibits several large holes in the web between FB5n-FB6n, Looking East

Photo S-254 - [South Abutment] -Bearing 4W, typical minor rust stains and bleeding corrosion, Looking South

Photo S-255 - [Pier 1] -Bearings 3W and 4W, typical minor tilt to north in contraction, good condition, Looking East

Photo S-256 - [Pier 2] -Bearing 3W general view, typical good condition of fixed bearings, Looking North

Photo S-257 - [Pier 3] -Bearing 4W general view, typical minor tilt to south in contraction, good condition, Looking Northeast

Photo S-258 - [Pier 4] -Bearing 2W at South side of Bascule Pier 4, general view of bearing generally plumb, Looking East

Photo S-259 - [Pier 4] -Bearing 4W at South side of Bascule Pier 4, general view of bearing generally plumb, Looking East

Photo S-260 - [Pier 5] -Bearing 2W at North side of Bascule Pier 5, general view of bearing tilted South in expansion, Looking West

Photo S-261 - [Pier 5] -Bearing 3W at North side of Bascule Pier 5, general view of bearing tilted South in expansion, Looking East

Photo S-262 - [Pier 5] -Bearing 5W at North side of Bascule Pier 5, general view of bearing tilted South in expansion, Looking West

Photo S-263 - [Pier 6] -Bearing 5W, West exterior girder bearing at pier, moderate blister and bleeding corrosion around masonry plate and at lower rocker, Looking North

Photo S-264 - [Pier 6] -Bearing 7W, East flare girder bearing at pier, general view in good condition, Looking North

Photo S-265 - [Pier 7] -Bearing 1W, rocker bearing in good condition and generally plumb, Looking Northwest

Photo S-266 - [Pier 8] -Bearings 2W, 3W, 4W (Span 8 side), minor to moderate blistering and bleeding corrosion, debris across pier top, Looking East

Photo S-267 - [Pier 8] -Bearing 3W (Span 9 side), moderate blistering and bleeding corrosion with staining throughout, generally plumb, Looking Southeast

Photo S-268 - [Pier 9] -Bearing 1W, fixed bearing in good condition, typical for Pier 9 fixed bearings, Looking North

Photo S-269 - [North Abutment] -Bearings 2W and 3W, typical minor rust stains and bleeding corrosion to rockers and masonry plates, Looking North

Photo S-270 - [Span 5, South Leaf] -Stringers, floorbeams, bracing and catwalk between G2W-G3W and FB5s-6s-7s, general view of paint in good condition, Looking North

Photo S-271 - [Span 9] -Girders 2W & 3W, Floorbeams 0s-1s-2s, Stringer 3W and secondary framing, general view of paint in good condition, Looking South

Photo S-272 - [South Abutment] -Abutment stem and back wall general view, Looking South

Photo S-273 - [South Abutment] -Abutment stem and back wall view between Girders 1W-3W, Looking South

Photo S-274 - [South Abutment] -Abutment stem and back wall view between Girders 3W-5W, Looking South

Photo S-275 - [South Abutment] -Abutment backwall at Girder 3W, cracking throughout and minor delamination and shallow spalls, Looking South

Photo S-276 - [South Abutment] -Abutment West wingwall, Looking Southeast

Photo S-277 - [South Abutment] -Abutment East wingwall, Looking Southwest

Photo S-278 - [North Abutment] -Abutment columns and back wall general view, Looking North

Photo S-279 - [North Abutment] -Abutment columns and back wall view between Girders 1W and 2W, Looking North

Photo S-280 - [North Abutment] -Abutment columns and back wall view between Girders 3W and 4W, Looking North

Photo S-281 - [North Abutment] -Abutment backwall and cheek at West wingwall, cracks propagating from corner where walls meet, general view, Looking Northeast

Photo S-282 - [North Abutment] -West side of backwall at West wingwall, vertical cracking at wall corner, Looking North

Photo S-283 - [North Abutment] -Abutment West wingwall, Looking North

Photo S-284 - [North Abutment] -Abutment East wingwall, Looking North

Photo S-285 - [Pier 1] -Pier South face, general view, Looking North

Photo S-286 - [Pier 1] -Pier North face, general view, Looking South

Photo S-287 - [Pier 1] -Pier north side at east end, detail view of vertical cracking, Looking Southwest

Photo S-288 - [Pier 2] -Pier South face, general view, Looking North

Photo S-289 - [Pier 2] -Pier North face, general view, Looking South

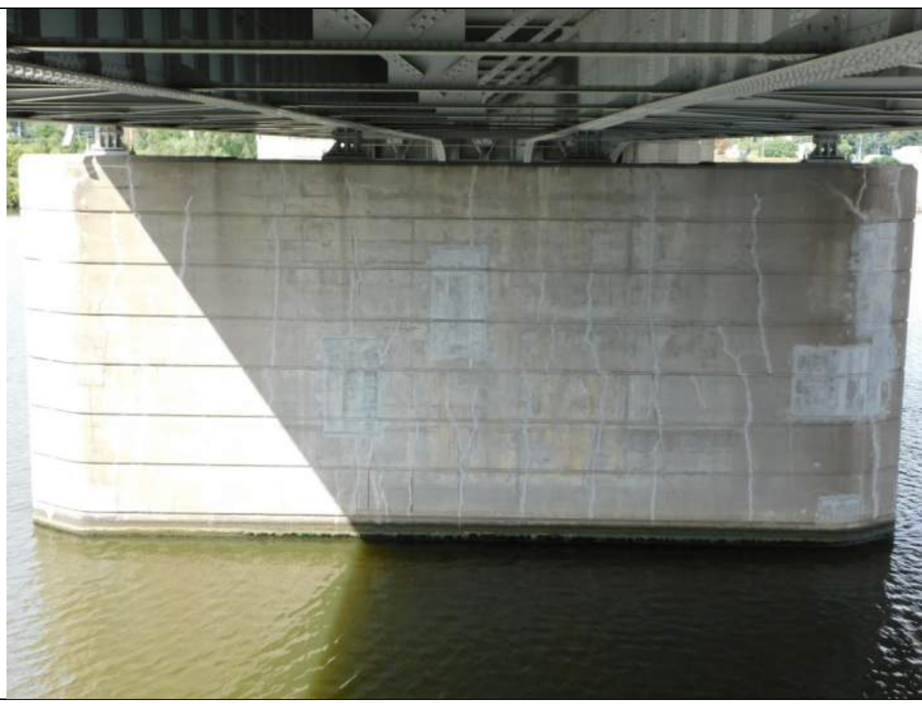


Photo S-290 - [Pier 3] -Pier South face, general view, Looking North

Photo S-291 - [Pier 3] -Pier North face, general view, Looking South

Photo S-292 - [Pier 3] -Pier south side at east end, detail view of shrinkage cracking and dampness throughout repair areas, Looking North

Photo S-293 - [Pier 4] -Pier South face, general view, Looking North

Photo S-294 - [Pier 4] -Pier North face, general view, Looking South

Photo S-295 - [Pier 4] -Pier South face, detail view of widespread patch and crack repairs, cracking in and around repair areas, Looking Northwest

Photo S-296 - [Pier 4] -Pier South face, detail view of widespread patch and crack repairs, cracking in and around repair areas, Looking Northeast

Photo S-297 - [Pier 4] -Hole in pier wall with temporary repair, south wall of pier at Girder 3W, Looking North

Photo S-298 - [Pier 4] -Detail view of repairs and cracking across west half of north face, Looking South

Photo S-299 - [Pier 4] -Detail view of repairs and cracking across east half of north face, Looking South

Photo S-300 - [Pier 5] -Pier South face, general view, Looking North

Photo S-301 - [Pier 5] -Pier North face, general view, Looking South

Photo S-302 - [Pier 5] -Detail view of repairs and cracking across west half of south face, Looking North

Photo S-303 - [Pier 5] -Detail view of repairs and cracking across east half of south face, Looking North

Photo S-304 - [Pier 5] -Pier North face, detail view of widespread patch repairs with scattered cracking, Looking Southwest

Photo S-305 - [Pier 6] -Pier South face, general view, Looking North

Photo S-306 - [Pier 6] -Pier North face, general view, Looking South

Photo S-307 - [Pier 6] -Pier South face, detail view of west side patch and crack repairs throughout with scattered cracking, Looking North

Photo S-308 - [Pier 7] -Pier South face, general view, Looking North

Photo S-309 - [Pier 7] -Pier North face, general view, Looking South

Photo S-310 - [Pier 8] -Pier South face, general view, Looking North

Photo S-311 - [Pier 8] -Pier North face, general view, Looking South

Photo S-312 - [Pier 8] -Pier North face below Bearing 1W, corner spall with exposed rebar, Looking South

Photo S-313 - [Pier 9] -Pier South face, general view, Looking North

Photo S-314 - [Pier 9] -Pier North face, general view, Looking South

Photo S-315 - [Span 1] -West side light pole at Floorbeam 0S / South Abutment, holes in base of pole across 75% of the perimeter, Looking Southeast

Photo S-316 - [Span 1] -East side light pole at Floorbeam 4S, holes in base of pole at west and north sides up to 6" W x 4" H, Looking West

Photo S-317 - [Span 2] -West side light pole, missing access cover above pedestrian railing, typically good condition otherwise, Looking West

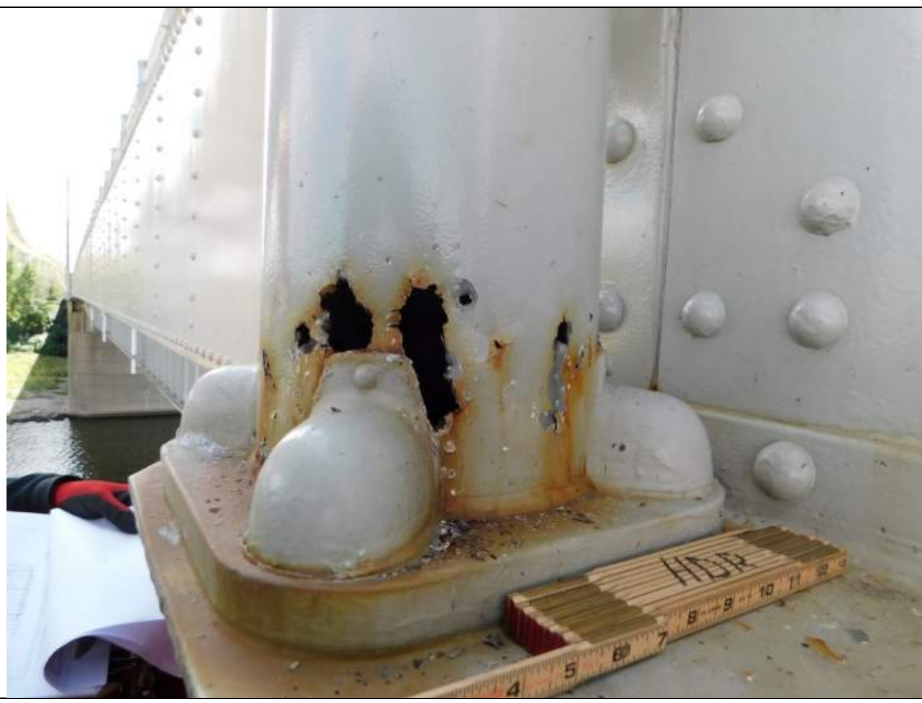


Photo S-318 - [Span 3] -East side light pole at Floorbeam 18S, holes in base of pole around north half, open hand hole cover above, Looking South

Photo S-319 - [Span 3] -East side light pole at Floorbeam 25S, holes in base of pole around 75% of perimeter, general view, Looking North

Photo S-320 - [Span 3] -East side light pole at Floorbeam 25S, holes in base of pole around 75% of perimeter, detail view, Looking North

Photo S-321 - [Span 5] -East side navigational lights, good condition, lights not functional, Looking West

Photo S-322 - [Span 5] -West side, north navigational light, cracked glass at bottom light, lights not functional, Looking North

Photo S-323 - [Span 5] -West side navigational lights, north light not functional, south light functional, Looking North

Photo S-324 - [Span 5] -Pier 5 channel side navigational light at center of pier functional, typical for channel lights along both Piers 4 & 5, Looking North

Photo S-325 - [Span 4] -Overhead Sign Gantry, general view of east side support framing / attachment to fascia and G4W, Looking Southwest

Photo S-326 - [Span 4] -Overhead Sign Gantry, South elevation east half, detail view, components in good condition, Looking North

Photo S-327 - [Span 4] -Overhead Sign Gantry, North elevation west half, detail view, components in good condition, Looking South

Photo S-328 - [Span 4] -Overhead Sign Gantry, general north elevation view from east side, Looking Southwest

Photo S-329 - [Span 6] -Sign gantry support connection at East fascia, south post base exhibits two corrosion holes in the east plate up to 4" x 2", Looking West

Photo S-330 - [Span 6] -Sign gantry support connections at West fascia, posts and bases in good condition, Looking East

Photo S-331 - [Span 2] -Electrical junction box and conduit above Floorbeam 11S East exterior, holes in box and conduit, Looking North

Photo S-332 - [Span 3] -Electrical junction box above Floorbeam 18S East exterior, holes in box, Looking South

Photo S-333 - [Span 5] -Abandoned conduit along east side of G3W between FB3n-FB4n, above floorbeam top flanges, general view, Looking West

Photo S-334 - [Span 6] -Electrical conduit exhibits 100% SL and a broken support angle at connection to East exterior FB0S with exposed wiring, Looking Southeast

Photo S-335 - [Pier 6] -Three conduits at north face of pier are disconnected with exposed wiring, Looking South

Photo S-336 - [Pier 6] -Three disconnected conduits at north face of pier are supported by rope at upper and lower diagonals, Looking South

Photo S-337 - [Span 4] -Swing gate operational support and housing attached to G4W, east side lower framing, minor bleeding corrosion and painted over edge section loss throughout, Looking Northeast

Photo S-338 - [Span 6] -Swing gate operational support and housing attached to G4W, east side lower framing, painted over section loss and small holes in east channel, Looking East

Photo S-339 - [Span 10] -Security fencing along Floorbeam 6S is in good condition, including connections to floorbeams, girders, bracing members, view between G1W-G2W, Looking Northwest

Photo S-340 - [Pier 4 Interior] -Basement Level (Level F), Room 4W, water and silt accumulation across floor, Looking South

Photo S-341 - [Pier 4 Interior] -Basement Level (Level F), Room 2W, vertical cracking in North wall with heavy efflorescence, Looking North

Photo S-342 - [Pier 5 Interior] -Basement Level (Level F), Room 1W, diagonal cracking in interior wall above doorway between north and south sides of west exterior room, Looking North

Photo S-343 - [Pier 4 Interior] -Counterweight Pit (Level E), general view of interior, Looking East

Photo S-344 - [Pier 5 Interior] -Counterweight Pit (Level E), upper North wall diagonal cracking throughout between girder live load bearing cut-outs, Looking North

Photo S-345 - [Pier 4 Interior] -Machinery level (Level D) channel side wall between Girders 3W and 4W, wide vertical crack behind drainage pipe, Looking North

Photo S-346 - [Pier 4 Interior] -Girder 4W at roadway span underside (Level C), view of cracking and small spalls to deck underside above counterweight, Looking West

Photo S-347 - [Pier 4 Interior] -Roadway span underside (Level C) above Girder 4W, view of cracking and small spalls to deck underside above counterweight, Looking Southeast

Photo S-348 - [Pier 5 Interior] -Roadway span underside (Level C), view of 4 ft x 3 ft spall to deck underside above counterweight at G1W, Looking Northwest

Photo S-349 - [Pier 4 Interior] -Trunnion Tower 1W general view of lower portion of paired tower legs, Looking Northwest

Photo S-350 - [Pier 4 Interior] -Trunnion Tower 4W general view of upper portion of paired tower legs and bascule girder, Looking Northeast

Photo S-351 - [Pier 4 Interior] -Trunnion Tower 3W West leg interior at base, active section loss and corrosion hole in diaphragm, Looking Northeast

Photo S-352 - [Pier 4 Interior] -Tower 4W West leg at base, exterior of East plate, painted over section loss throughout, Looking Northwest

Photo S-353 - [Pier 4 Interior] -Tower 4W East leg at mid-height, North column with scattered painted over section loss throughout, Looking Northeast

Photo S-354 - [Pier 4 Interior] -Tower 4W East leg at machinery level, section loss and hole in North column North channel, Looking Southwest

Photo S-355 - [Pier 4 Interior] -Tower 4W East leg North column at trunnion pin access catwalk location, North side framing exhibits 100% edge section loss, Looking South

Photo S-356 - [Pier 4 Interior] -Girder 4W, West bottom flange and stiffener bases exhibit localized section loss, Looking Southeast

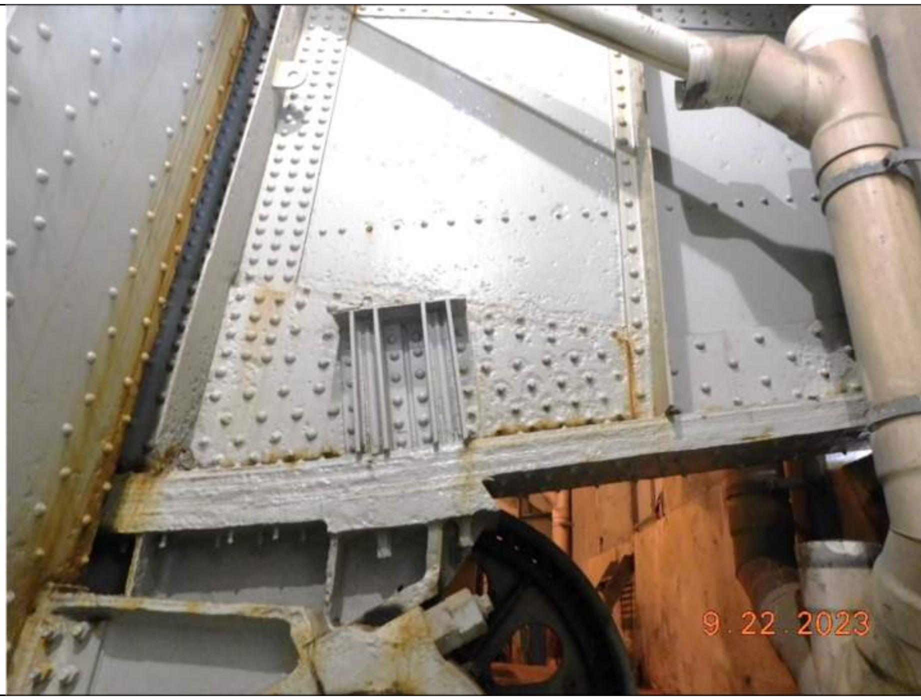


Photo S-357 - [Pier 4 Interior] -Girder 3W, East face between pier wall and trunnion tower, widespread painted over heavy section loss to web, plates, bottom flanges, rivets and bolts, Looking West

Photo S-358 - [Pier 5 Interior] -Girder 3W, West face behind the trunnion bearing, typical localized minor corrosion to plate edge above bottom flange, Looking East

Photo S-359 - [Pier 5 Interior] -Girder 3W, East face between pier wall and trunnion tower, typical painted over section loss to web plate and minor corrosion along bottom flange, Looking West

Photo S-360 - [Pier 4 Interior] -Counterweight undersides at girder tails, general view of lower portions at G2W, G3W, Looking East

Photo S-361 - [Pier 4 Interior] -Counterweight top at east side (G4W) with moderate corrosion and minor spalling deterioration across the top of the block, Looking Southeast

Photo S-362 - [Pier 5 Interior] -Counterweight top at east side (G4W) with moderate corrosion and minor spalling deterioration across the top of the block, Looking North

Photo S-363 - [Pier 5 Interior] -Counterweight pockets and blocks detail view, between G3W-G4W, Looking Northeast

Photo S-364 - [Pier 5 Interior] -Upper catwalks between G1W and G2W in good condition, Looking North

Photo S-365 - [Pier 4 Interior] -Machinery level railing is broken at the east side of G3W, Looking North

Photo S-366 - [Pier 5 Interior] -Machinery level railing is broken at the west side of G3W, Looking West

Photo S-367 - [Pier 5 Interior] -Level F, base of stairs in East exterior room, heavy corrosion, section loss, hole in channel web, Looking East

Photo S-368 - [Pier 5 Interior] -Level F, mid-level of stairs in East exterior room, 100% section loss to post and railing, Looking South

Photo S-369 - [Pier 5 Interior] -Level E, East exterior room, packing corrosion at railing and stairs connections to floor, Looking South

Photo S-370 - [Pier 4 Interior] -Basement Level, Room 1W, access staircase with moderate degradation of galvanizing and minor spot corrosion, Looking South

Photo S-371 - [Control House Exterior] -North side and access from roadway level, general view, Looking South

Photo S-372 - [Control House Exterior] -Roof general view, Looking North

Photo S-373 - [Control House Exterior] -Mechanical cage general view, Looking North

Photo S-374 - [Control House Exterior] -East windows general view, Looking North

Appendix 2.2:

Mechanical Photographs

Photo 1 - [North Machinery Room] - Machinery Room Layout

Photo 2 - [North Machinery Room] – Note surface corrosion on motor shafts and hubs.

Photo 3 - [North Machinery Room] – Note surface corrosion and paint failure on motor housing and shims.

Photo 4 - [North Machinery Room] – Note surface corrosion on base of motor support and use of finger shims.

Photo 5 - [North Machinery Room] - Oil in chain housing is contaminated with dirt and debris.

Photo 6 - [North Machinery Room] – Note oil leak from chain housing.

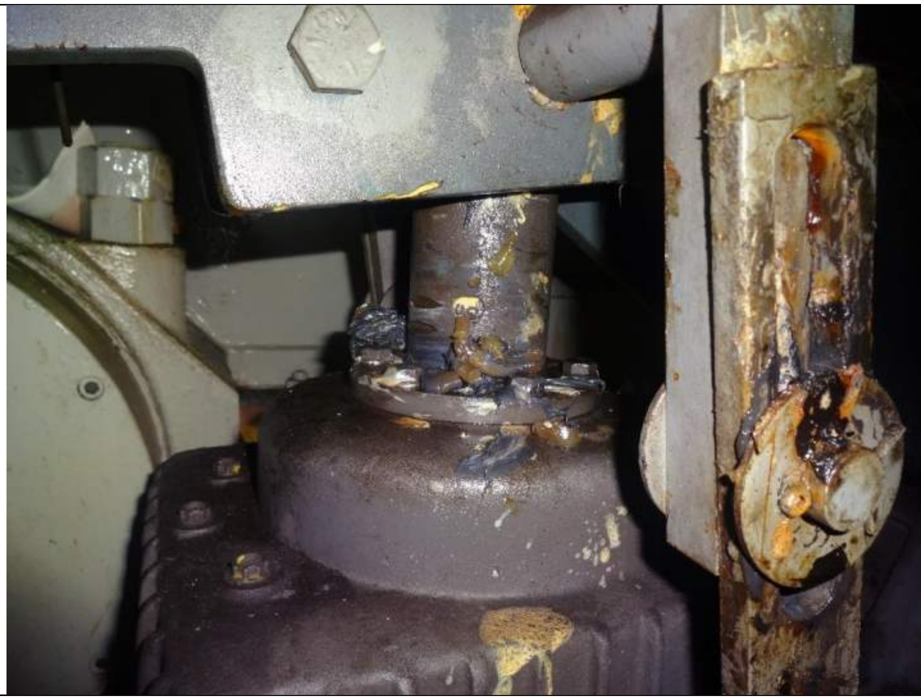


Photo 7 - [North Machinery Room] – Note oil purge from top of thruster on motor brake.

Photo 8 - [North Machinery Room] - Scoring and rust contamination is on brake wheel surface.

Photo 9 - [North Machinery Room] – Note minor paint failure, surface corrosion, corrosion on the base, corrosion on fasteners and seized bolts on both the motor brakes on the North side.

Photo 10 - [NW Motor Brake] – Note poor brake pad contact.

Photo 11 - [NW Motor Brake] **–** Note severe corrosion and section loss on motor brake support.

Photo 12 - [SW Motor Brake] - Top 30% of the north pad on motor brake stays in contact after release.

Photo 13 - [SE Motor Brake] - Both the north and south pads stay in contact after release on motor brake, roughly 10% for the north and 25% for the south. South pad is shown.

Photo 14 - [North Machinery Room] – Note surface corrosion and paint failure on couplings along with stripped grease plugs.

Photo 15 - [NE Coupling] – Note loose nut on coupling.

Photo 16 - [SW Coupling] - Coupling has slight bulging on the O-ring that is meant to act as a seal.

Photo 17 - [North Machinery Room] - Oil is contaminated in central gear boxes.

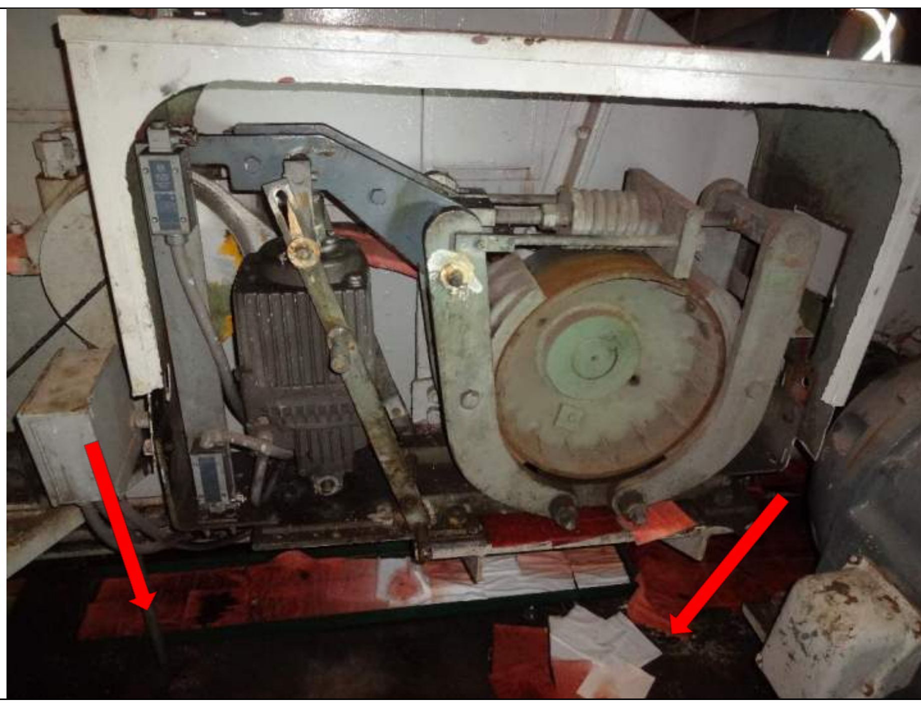


Photo 18 - [South Machinery Room] - Oil leaks outside of central gear boxes and is soaked up by using copious amounts of rags.

Photo 19 - [North Machinery Room] - Inspection hatches on central gear enclosure do not fully open due to being painted over.

Photo 20 - [North Machinery Room] – Fastener is missing on the seam of central gear enclosure.

Photo 21 - [South Machinery Room] - South side gear box severely leaks oil most likely due to overfilling. Puddles of lubricant all over floor.

Photo 22 - [NW B1 Bearing] - Pack rust is below base of B1 bearing.

Photo 23 - [NW B1 Bearing] - Severe corrosion is on the inboard side of B1 bearing.

Photo 24 - [NW Corner of North Machinery Room] – There is severe corrosion of fasteners and section loss of base for B2 & B3.

Photo 25 - [NE B1 Bearing] - Moderate surface corrosion is present on fasteners and inboard side of B1 bearing anchorage.

Photo 26 - [South Machinery Room] – Note severe scoring across all open gear faces on both sides.

Photo 27 - [SE Corner of South Machinery Room] - Moderate surface corrosion exists on opening and closing faces of teeth as well as rust build up near the edges.

Photo 28 - [NW Rack Segment] - Severe corrosion and section loss appears to be painted over on rack segment fasteners.

Photo 29 - [NW P1 Gear] – Note poorly lubricated P1 gear with contaminated lubrication that contains dirt and debris.

Photo 30 - [North Machinery Room] – Note severely corroded gear cover and failing gear cover gasket.

Photo 31 - [North Machinery Room] - Abandoned span drive machinery on North side of bridge is still being maintained.

Photo 32 - [North Machinery Room] - North side span drive machinery has corrosion on shafting and loose chain.

Photo 33 - [South Machinery Room] - South side span drive control machinery has missing foot mount on selsyn motor and a loose chain.

Photo 34 - [NW Outer Trunnion] – Note the section loss on trunnion bearing nuts that have been painted over.

Photo 35 - [NW Inner Trunnion] - Grease is purging from trunnions mixed with various debris.

Photo 36 - [SW Inner Trunnion] - Corrosion is present on collars of trunnion bearings.

Photo 37 - [NW Outboard Live Load Shoe] - Minor surface corrosion is evident on contacting surface of live load shoes as well as an 1/8” gap.

Photo 38 - [Span Lock Thruster Brake] – Note severely corroded thruster brake shaft on span lock. Linkages are also not well lubricated.

Photo 39 - [Span Lock Thruster Brake] - Span lock thruster brake lever is severely corroded and cannot be removed due to seized wingnuts.

Photo 40 - [Span Lock Motor] – Note heavy corrosion on motor shafts and keys.

Photo 41 - [Span Lock Motor] – Note heavy corrosion on SE motor foot mount.

Photo 42 - [Span Locks] - Non-lubricated motor coupling with plugs and gaskets are covered with paint.

Photo 43 - [Span Lock Reducer] - Isolated corrosion is on fasteners on reducer housing.

Photo 44 - [RLCS Instrumentation] – Note top wingnuts seized, old oil on chain, tensioner held by wire and heavy corrosion on top surface

Photo 45 - [NW Span Lock Couplings] - Couplings exhibit minor paint failure, moderate grease purging, and rusted hubs.

Photo 46 - [NW Inboard Locking Mechanism] – Note paint failure, corrosion, old grease and debris contaminating lubrication in locking mechanism.

Photo 47 - [NW Inboard Locking Mechanism] - Moderate scoring exists on rack and pinion teeth.

Photo 48 – [NW Inboard Locking Mechanism] – Severely corroded countersunk bolts and pack rust is forming on receiver plates.

Photo 49 - [NE Inboard Locking Mechanism] - Locking mechanism has pack rust starting to form on receiver plates.

Photo 50 - [NW Outboard Locking Mechanism] - Heavy scoring is present on locking mechanism teeth.

Photo 51 - [NE Outboard Locking Mechanism] - Limit switch targets have poor welds on locking mechanism.

Photo 52 - [NE Outboard Locking Mechanism] - Top cover is seized due to paint.

Photo 53 - [NE Outboard Locking Mechanism] - Heavy scoring on teeth for rack and pinion on locking mechanism.

Photo 54 - [NW Span Lock Bearings] – Note pack rust forming, paint failure, isolated corrosion on fasteners on bearings.

Photo 55 - [NW Span Lock Bearings] – Note top two bolts on bearing using mismatched hardware: one hex nut and one square nut.

Photo 56 - [NW Seated Buffer] - Seated buffers exhibit transverse misalignment with strike plate as well as some minor surface corrosion.

Photo 57 - [SW Seated Buffer] - Seated buffer exhibits minor surface corrosion and corrosion on back lever that is meant to extend rod.

Photo 58 - [SE Seated Buffer] - Seated buffer has moderate grease purge.

Photo 59 - [NW Raised Buffer] - Rollers of raised buffers are severely corroded and seized.

Photo 60 - [NW Raised Buffer] - Relief valves on North side of bridge are severely corroded on raised buffers.

Photo 61 - [North CW Pit] - Wooden counterweight bumpers exhibit isolated fastener corrosion and wood failure.

Photo 62 - [NE Traffic Gate] - Vertical traffic gates have loose guy wires.

Photo 63 - [NE Traffic Gate] – Note missing jam nut on turnbuckle.

Photo 64 - [NE Traffic Gate] - Cracked welds are at base of gate arm and isolated corrosion is present on fasteners of arm connector.

Photo 65 - [NE Traffic Gate] – Note the heavy corrosion on top of motor, hand crank shaft and limit switch fasteners.

Photo 66 - [NE Traffic Gate] - Widespread corrosion and paint failure is present across all movable components.

Photo 67 - [NE Traffic Gate] - Crank arm has misalignment possibly due to deformation.

Photo 68 - [NE Traffic Gate] - East door limit switch on vertical arm traffic gate does not extend.

Photo 69 - [NE Traffic Gate] - Cover for electrical access below gate arm is missing.

Photo 70 - [NE Traffic Gate] - Gate bumper does not contact the roadway when gate is down.

Photo 71 - [SW Traffic Gate] - Gate arm has crack at base where conduit inlet is located.

Photo 72 - [SW Traffic Gate] - Levers exhibit slight deformation and misalignment.

Photo 73 - [SE Swing Gate] – Note loose fasteners on RACO limit switch housing for swing gate.

Photo 74 - [SE Swing Gate] - Limit switches have seized rollers due to paint and make poor contact with their targets.

Photo 75 - [SE Swing Gate] - Heavy corrosion is present on access doors and hinges to access swing gate machinery.

Photo 76 - [SE Swing Gate] - Severe corrosion and section loss exist on upper bearing anchors of swing gate.

Photo 77 - [SE Swing Gate] - Heavy corrosion is on bearing and shaft inside swing gate housing.

Photo 78 - [NW Swing Gate] - Mismatched actuator bolts are being used on swing gate.

Photo 79 - [NW Swing Gate] - No protective boot is present on swing gate actuator arm.

Photo 80 - [NW Swing Gate] – Rollers, though in better condition than SE gate, are misaligned.

Photo 81 - [NW Swing Gate] – Note severe corrosion on upper bearing fasteners and shaft.

Photo 82 - [North Machinery Room] - Counterweight stacks are present throughout machinery rooms.

Appendix 2.3:

Electrical Photographs

Photo E-01: Abandoned Electrical Equipment on the South Pier. Note the Meter has been removed.

Photo E-02: Medium Voltage Transformers located in a lower level of the Control House

Photo E-03: Service Entrance Disconnect near the Medium Voltage Transformers

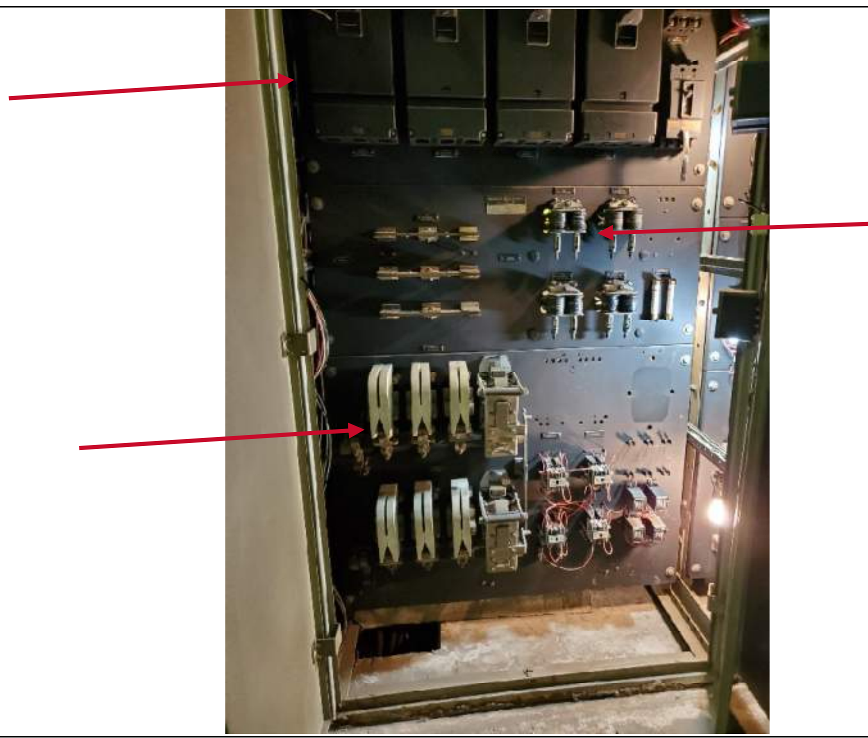


Photo E-04: South Leaf Motor Starter Cabinet – Left Section. Note the Original Contactors/Starters, Overloads and Circuit Breakers

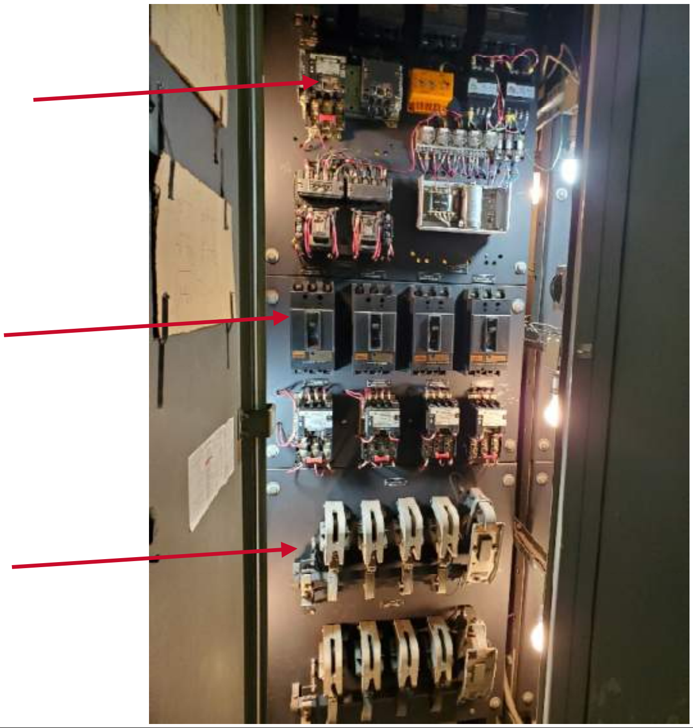


Photo E-05: South Leaf Motor Starter Cabinet – Middle Section. Note the Original Contactors/Starters, Overloads and Circuit Breakers

Photo E-06: South Leaf Motor Starter Cabinet – Right Section. Note the Original Contactors for the Secondary Stepped Resistance of the Main Drive Motors

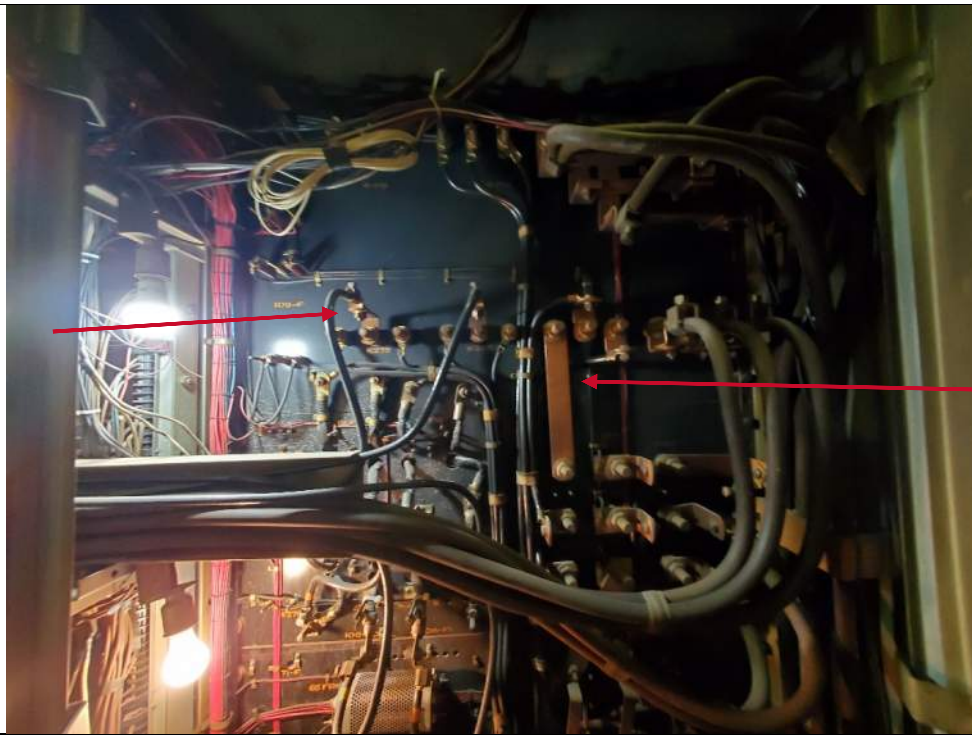


Photo E-07: Back Side of the South Leaf Motor Starter Cabinet. Note the open bus bar and terminals.

Photo E-08: 1950s Circuit Breakers

Photo E-09: Southeast Main Drive Motor

Photo E-10: Southeast Main Drive Motor Brush Wear. Note that the brush is not wearing evenly

Photo E-11: Northeast Motor Brake

Photo E-12: Motor Brake Junction Box. Note the severe corrosion on the junction box and conduit. Also note that the junction box is not properly mounted as it is only supported by conduits.

Photo E-13: Southeast Traffic Gate Actuator. Note the corrosion and the abandoned in place rotary cam limit switch.

Photo E-14: Northeast Traffic Gate. Note the corrosion within the gate

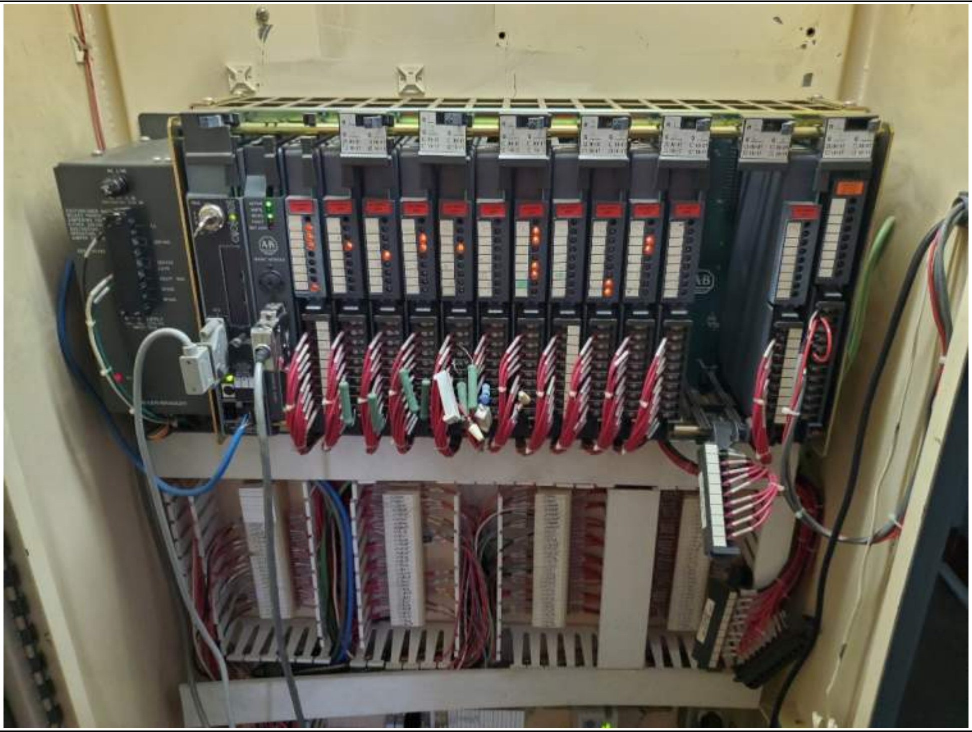


Photo E-15: PLC

Photo E-16: Control Console

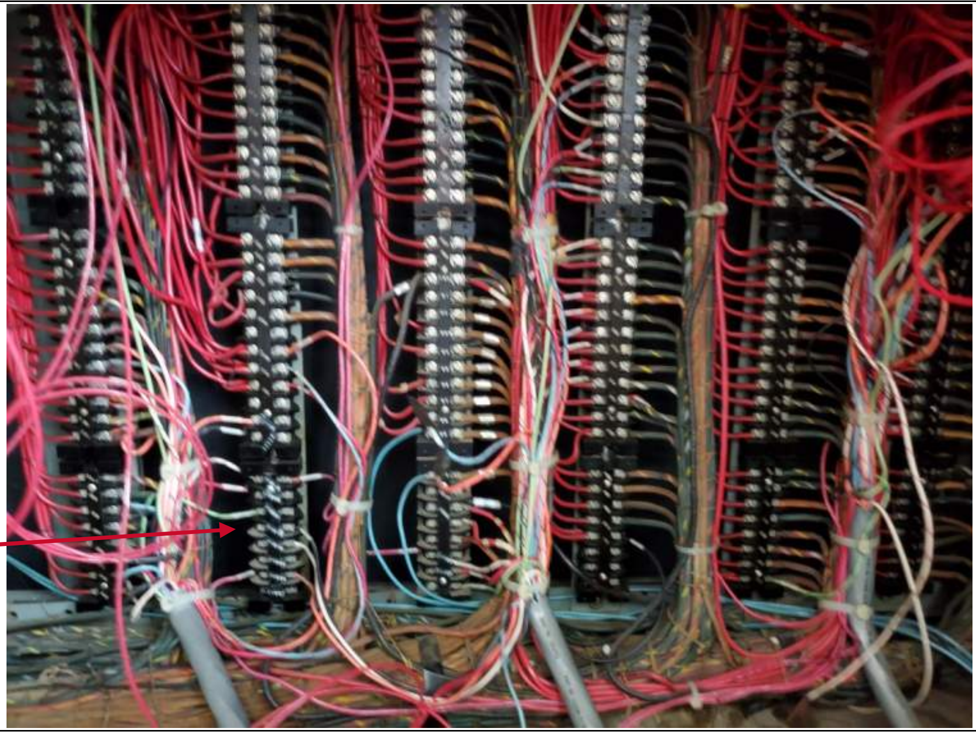


Photo E-17: Control Console Interior. Note the missing wire numbers on almost all the conductors

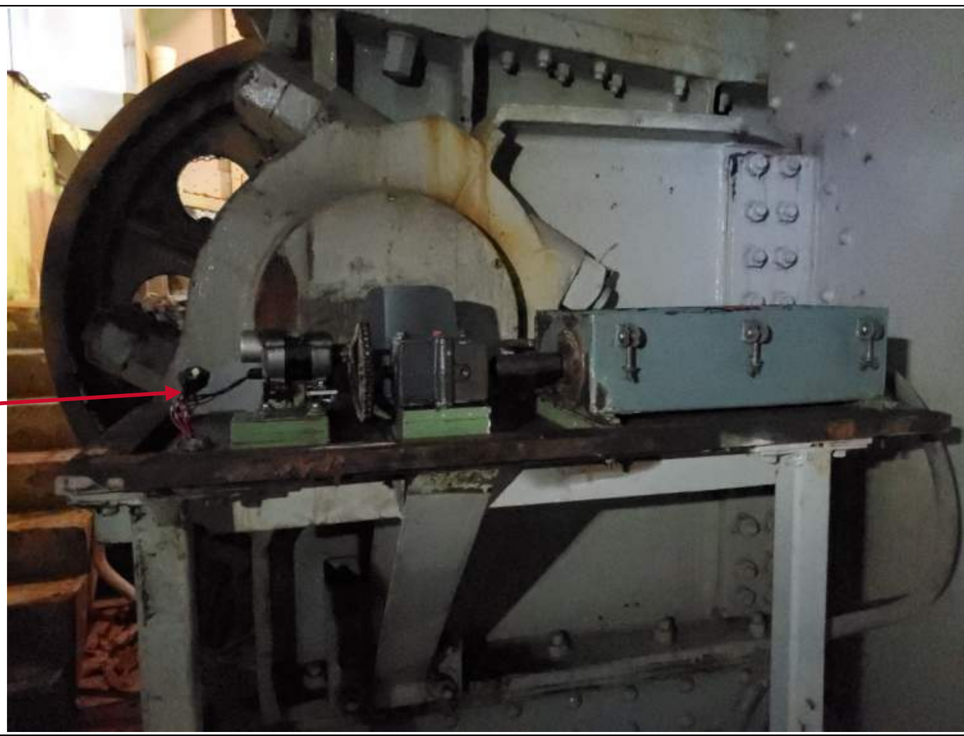


Photo E-18: North Leaf Rotary Cam Limit Switch. Note the wire nuts at the selsyn transmitter.

Photo E-19: Abandoned North Leaf Rotary Cam Limit Switch. Abandoned equipment should be removed

Photo E-20: Span Lock Proximity Switches

Photo E-21: Conduit near the Southeast Traffic Gate Actuator. Note the corrosion.

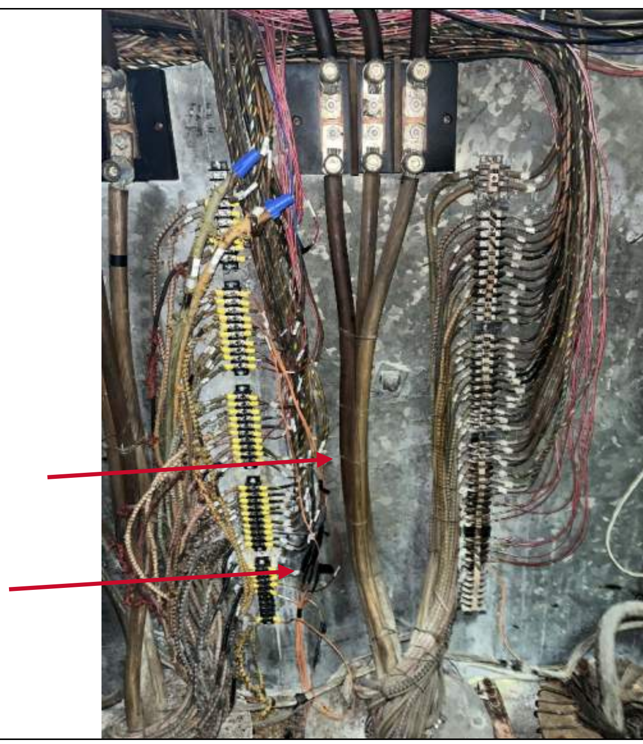


Photo E-22: South Pier Submarine Cable Termination Cabinet. Note the discolored conductors due to a previous electrical fire.

Photo E-23: Southeast Navigation Light

Appendix 3:
Structural Condition Sketches

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

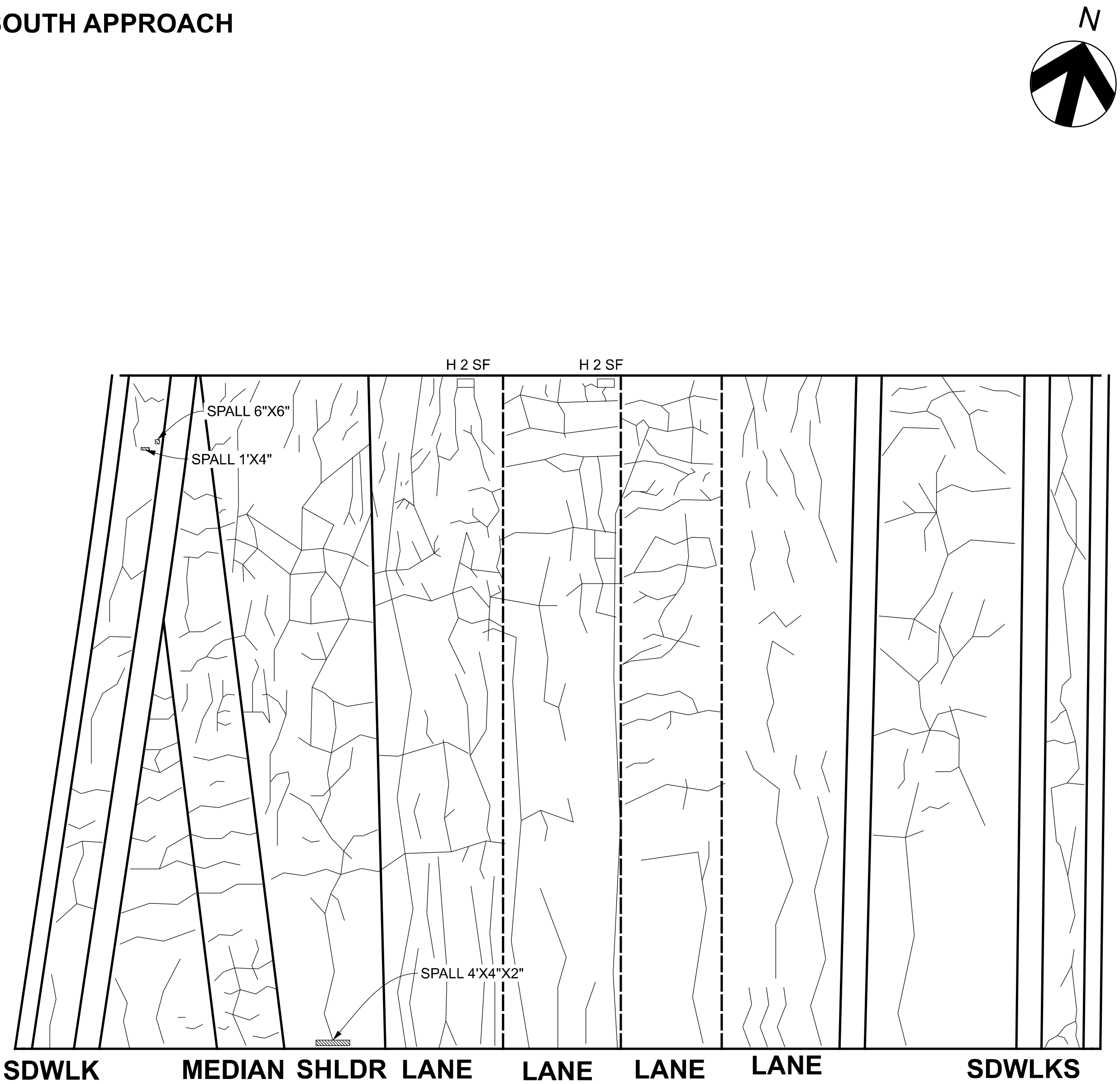
BRIDGE: Craig St. Bascule **SHEET** 1 **OF** 34

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:**

Feature Carried: Craig Street

Feature Crossed: Maumee River

SOUTH APPROACH



DETERIORATION QUANTITIES:

Cracking <1/32":	1849.43 LF
Delamination:	4 SF
Spalling:	1.9 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 2 OF 34

TEAM LEADER: Jason Fogg

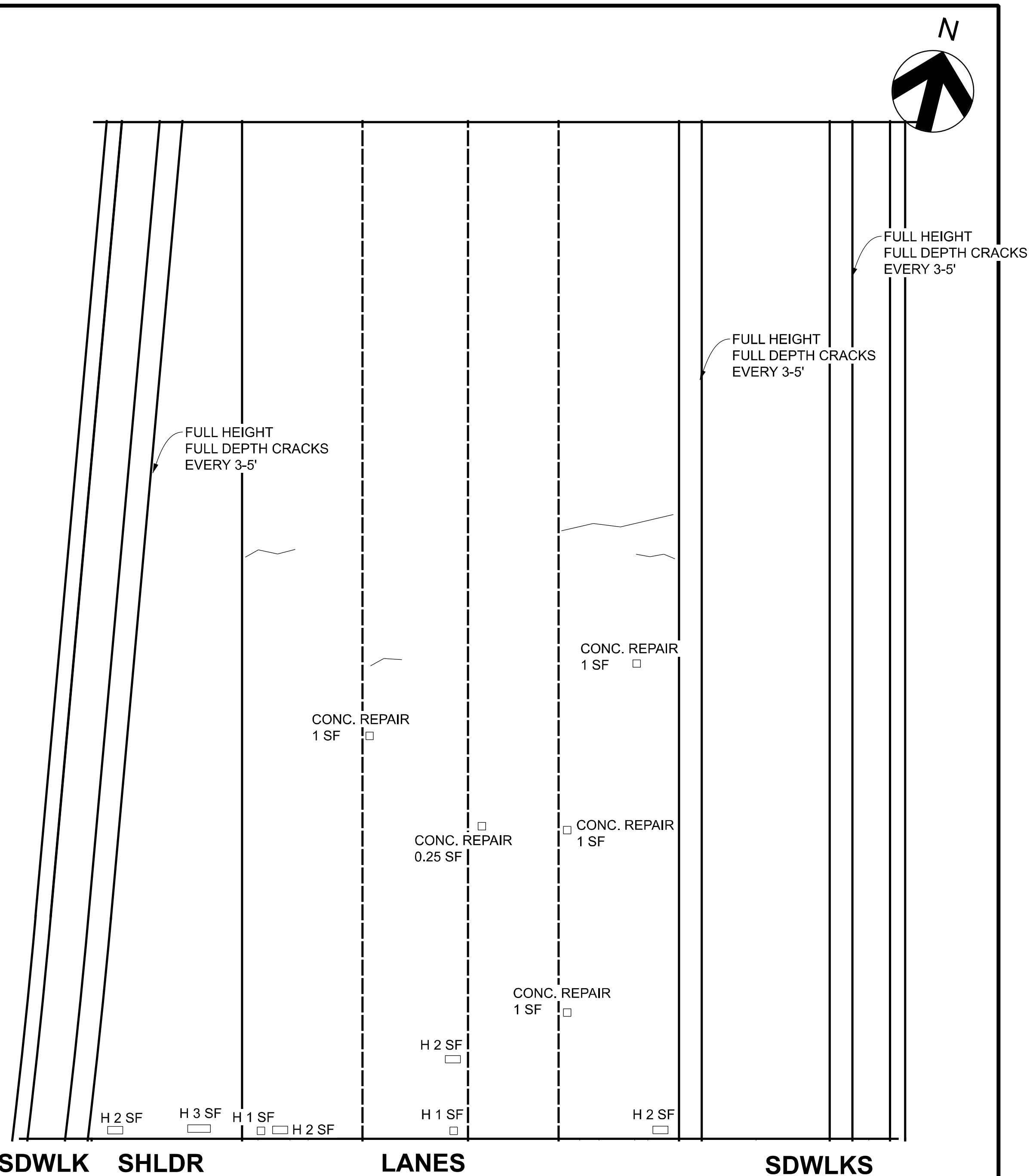
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 1



DETERIORATION QUANTITIES:
Cracking <1/32": 31.95 LF
Delamination: 13 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg

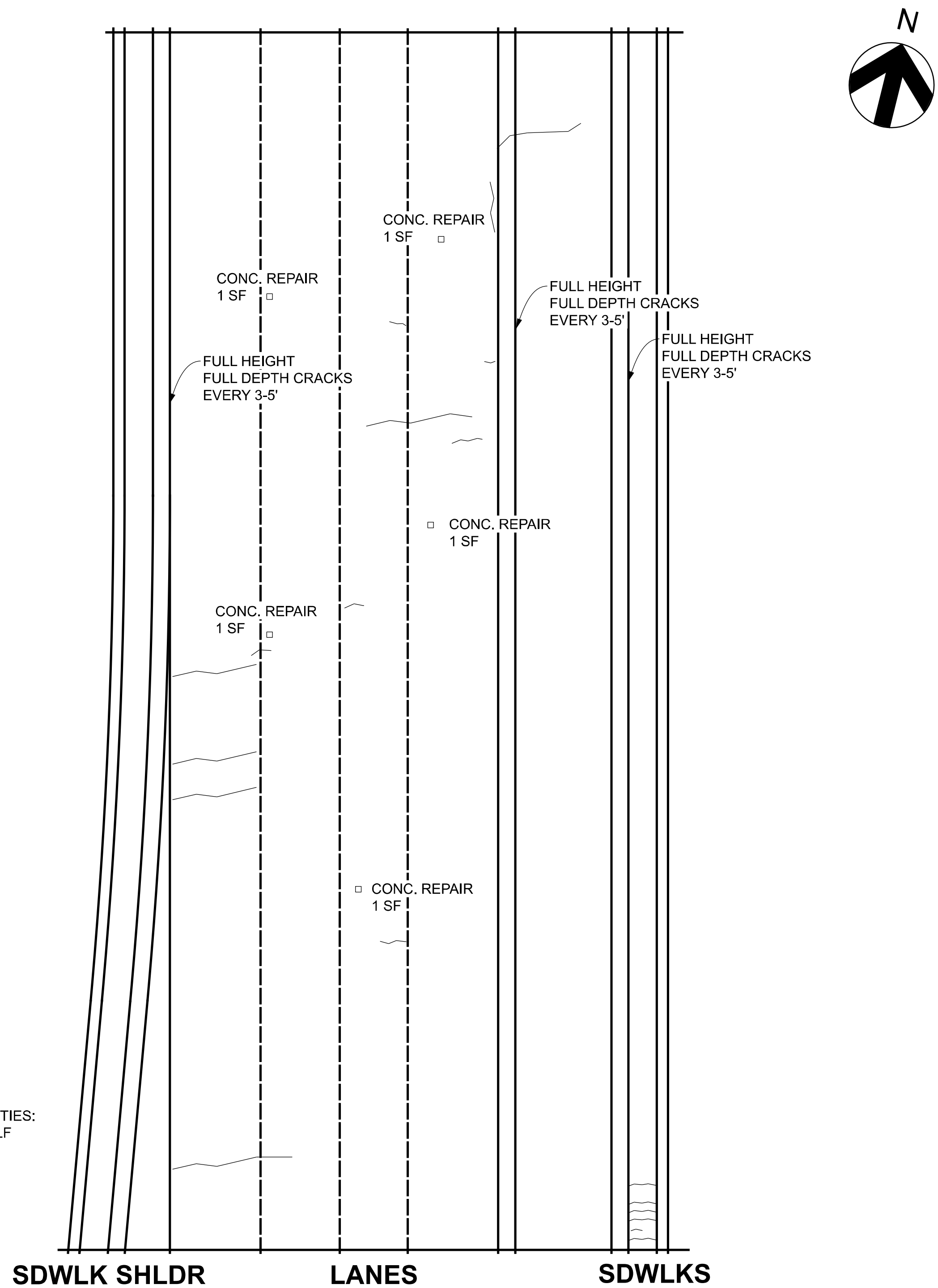
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 2



DETERIORATION QUANTITIES:
Cracking <1/32": 118.36 LF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 4 OF 34

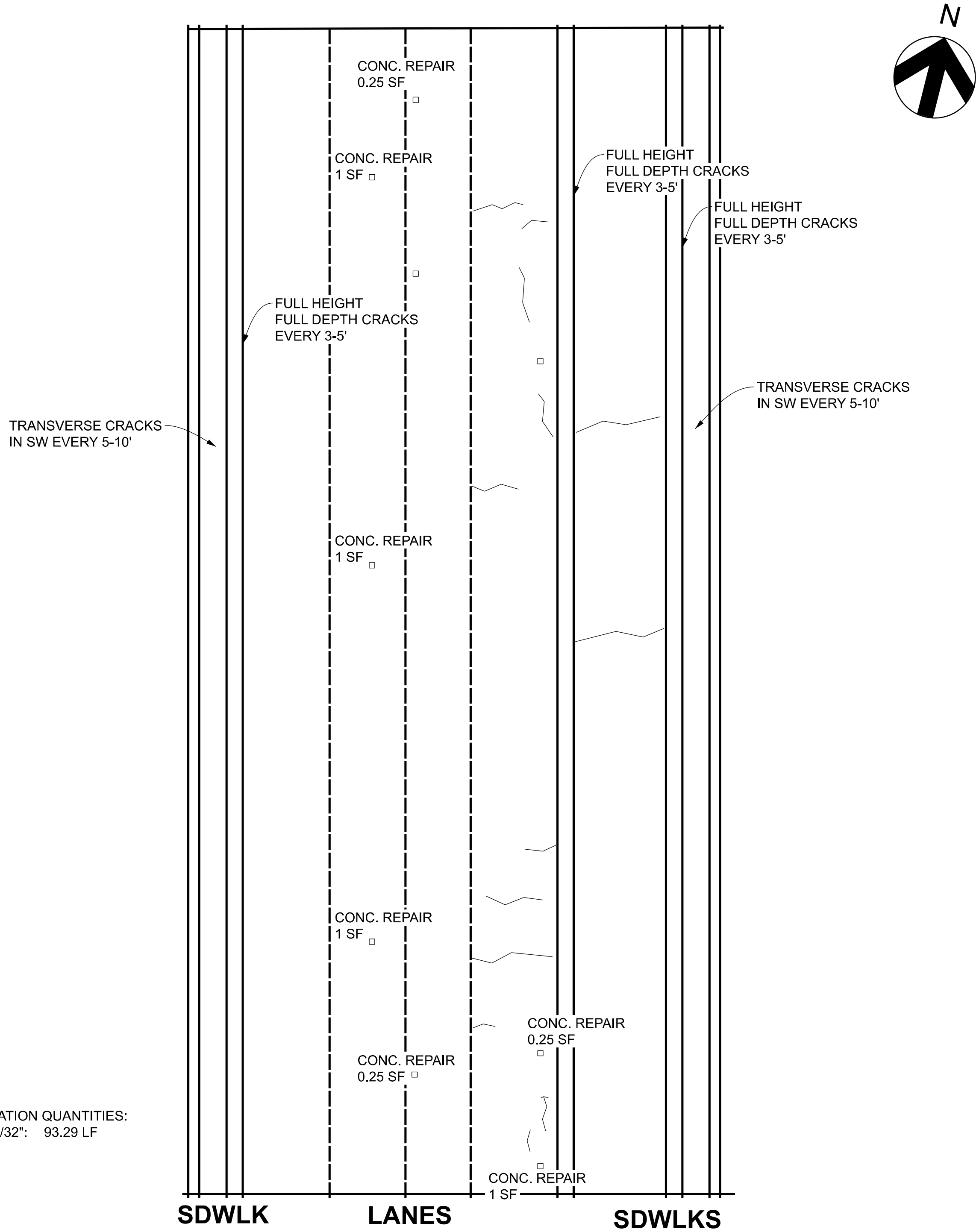
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:**

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 3



DETERIORATION QUANTITIES:
Cracking <1/32": 93.29 LF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 5 **OF** 34

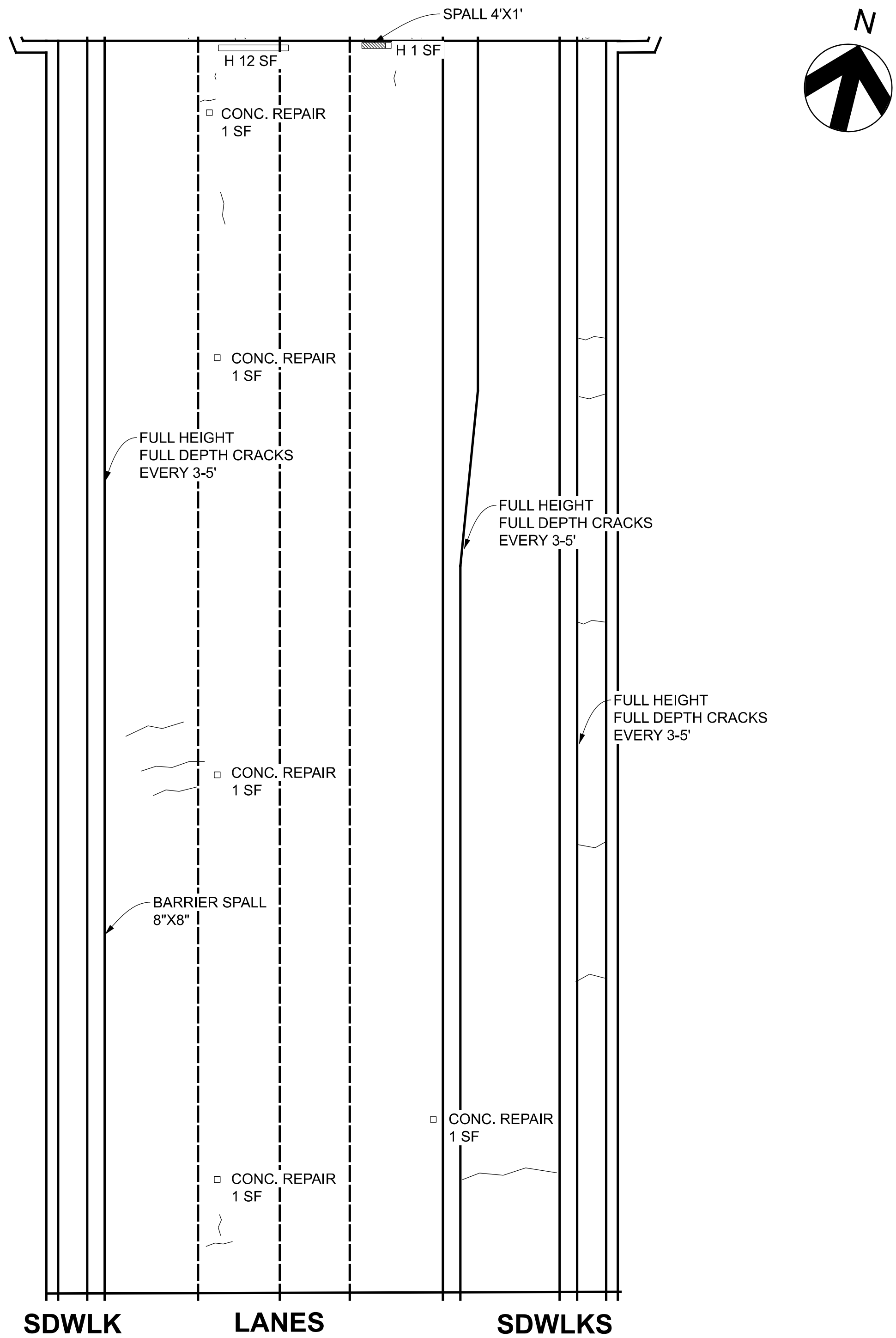
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:**

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 4



DETERIORATION QUANTITIES:

Cracking <1/32":	50.85 LF
Delamination:	13 SF
Spalling:	4 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

SHEET 6 OF 34

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg

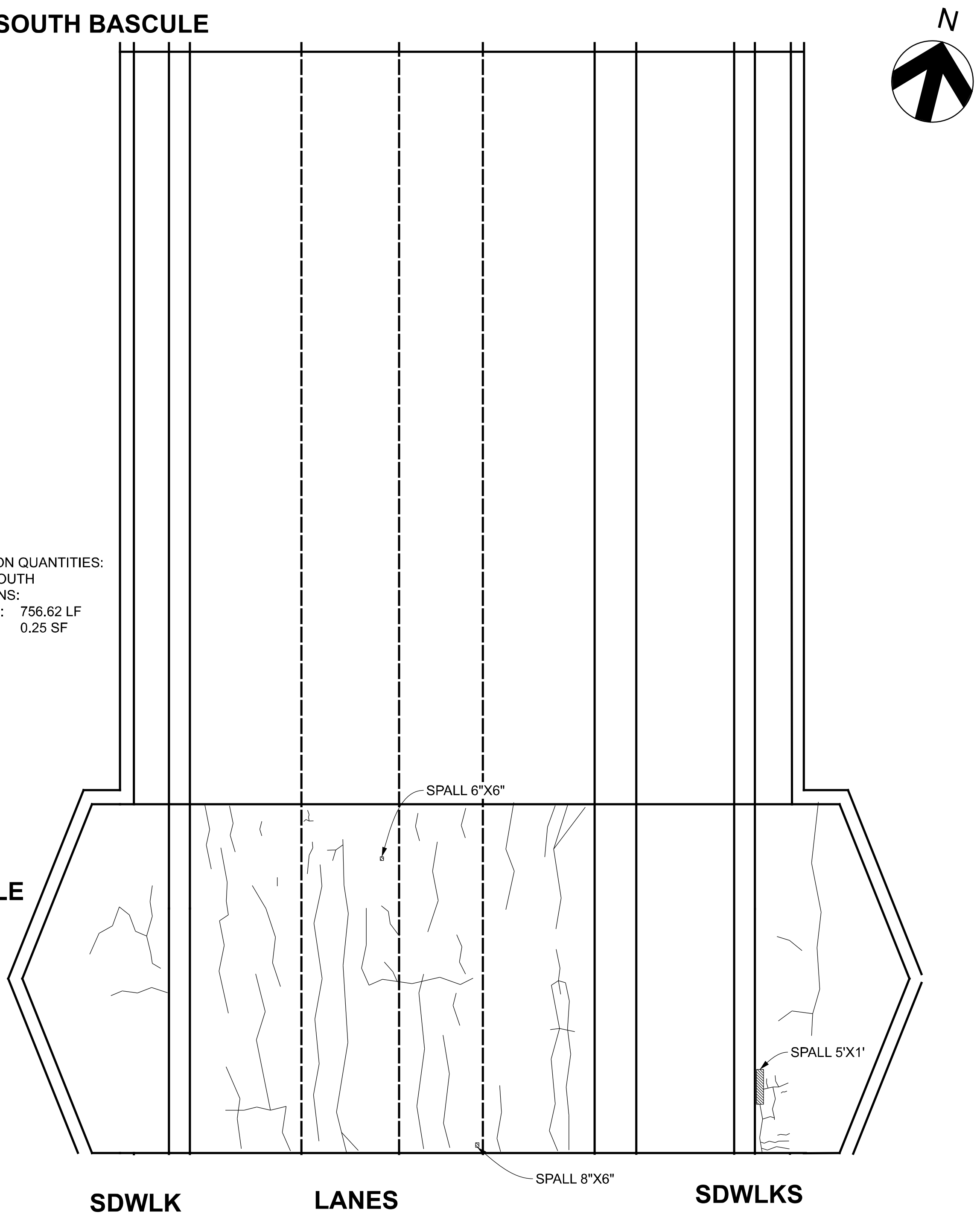
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 5 SOUTH BASCULE



DETERIORATION QUANTITIES:
NORTH AND SOUTH
BASCULE SPANS:

Cracking <1/32":	756.62 LF
Spalling:	0.25 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

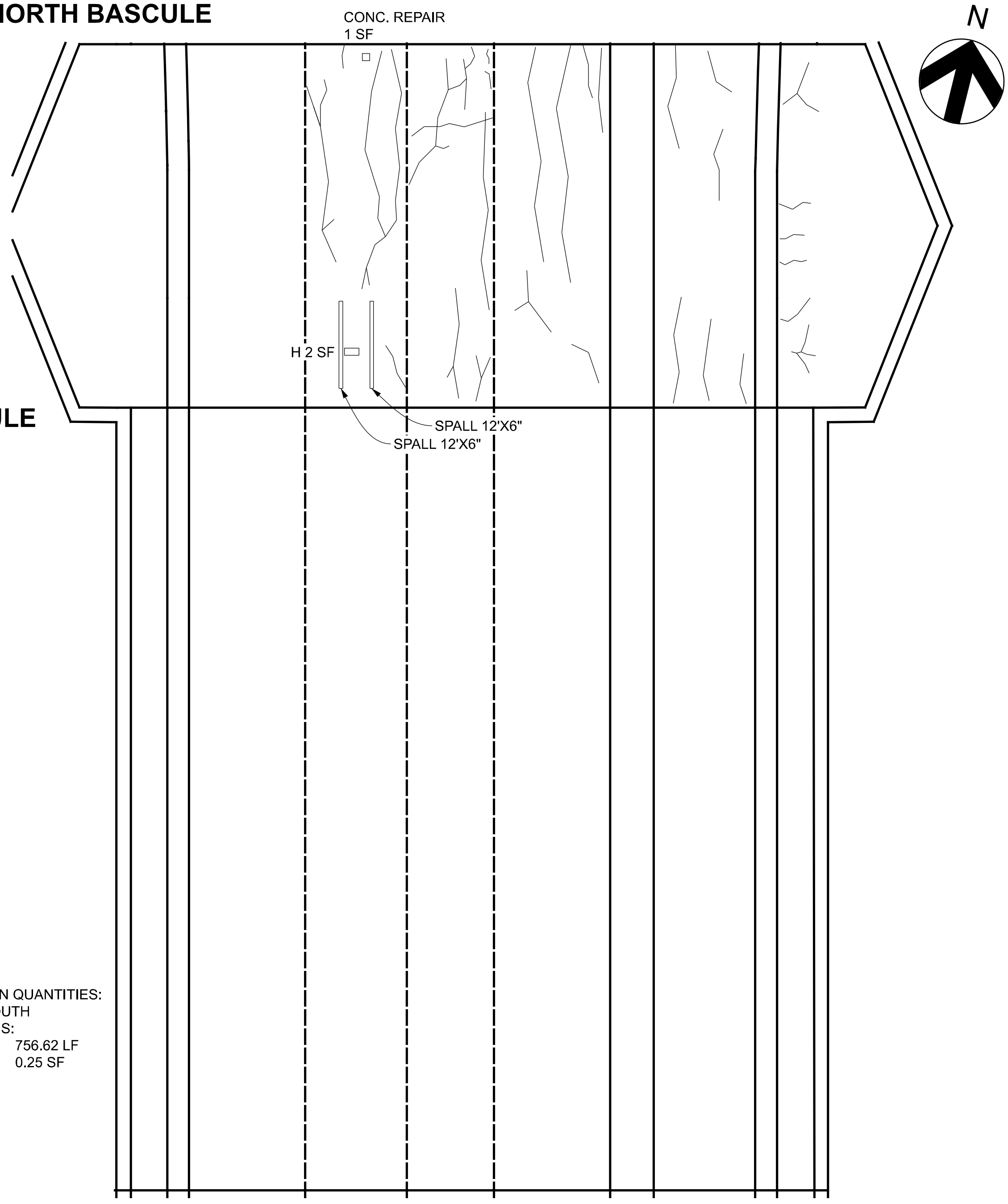
BRIDGE: Craig St. Bascule **SHEET** 7 **OF** 34

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:**

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 5 NORTH BASCULE



DETERIORATION QUANTITIES:
NORTH AND SOUTH
BASCULE SPANS:
Cracking <1/32": 756.62 LF
Spalling: 0.25 SF

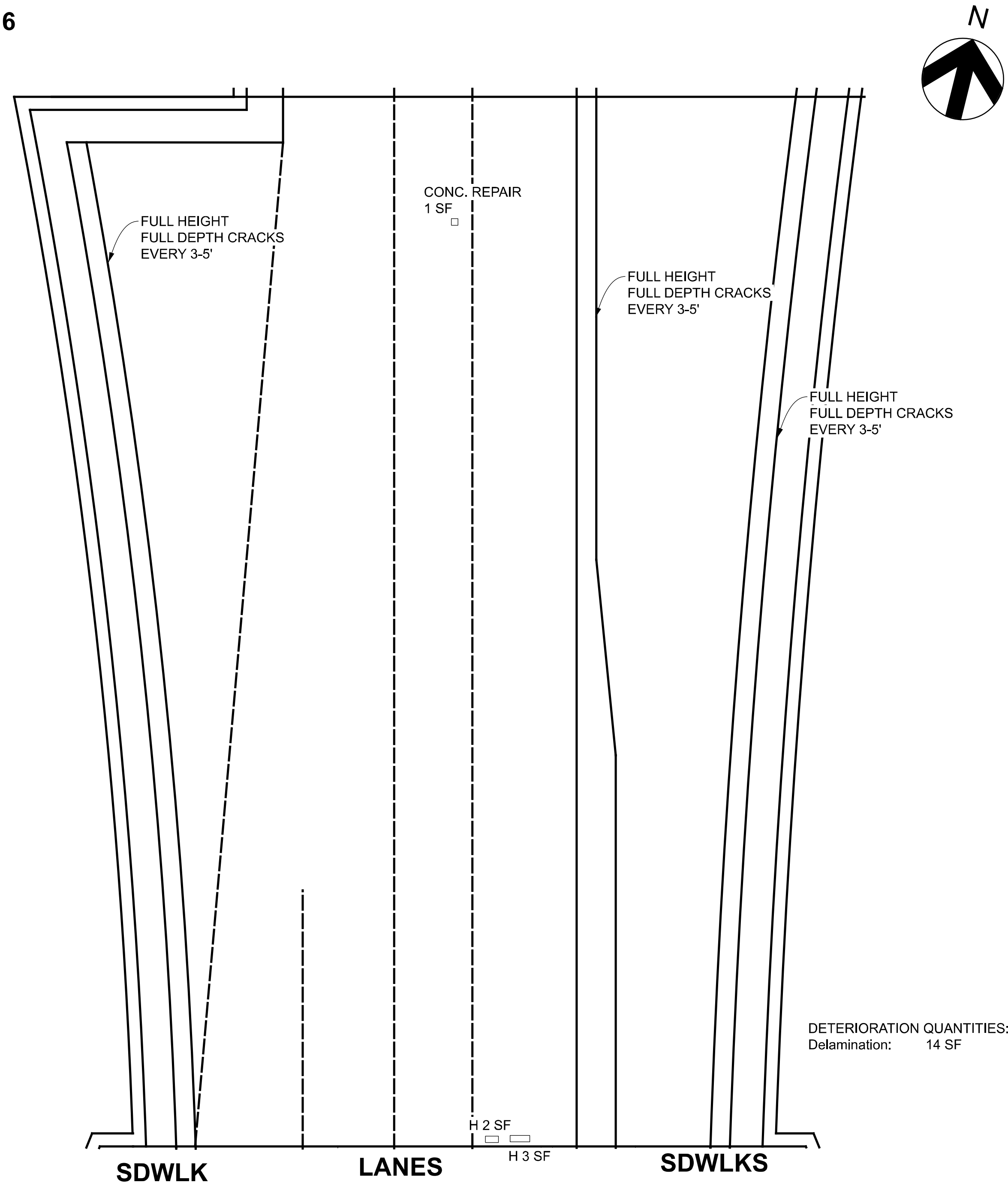
OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 8 **OF** 34

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg
ASST. TEAM LEADER: Ed Oliver
DATE:

Feature Carried: Craig Street
Feature Crossed: Maumee River

SPAN 6



DETERIORATION QUANTITIES:
Delamination: 14 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 9 OF 34

TEAM LEADER: Jason Fogg

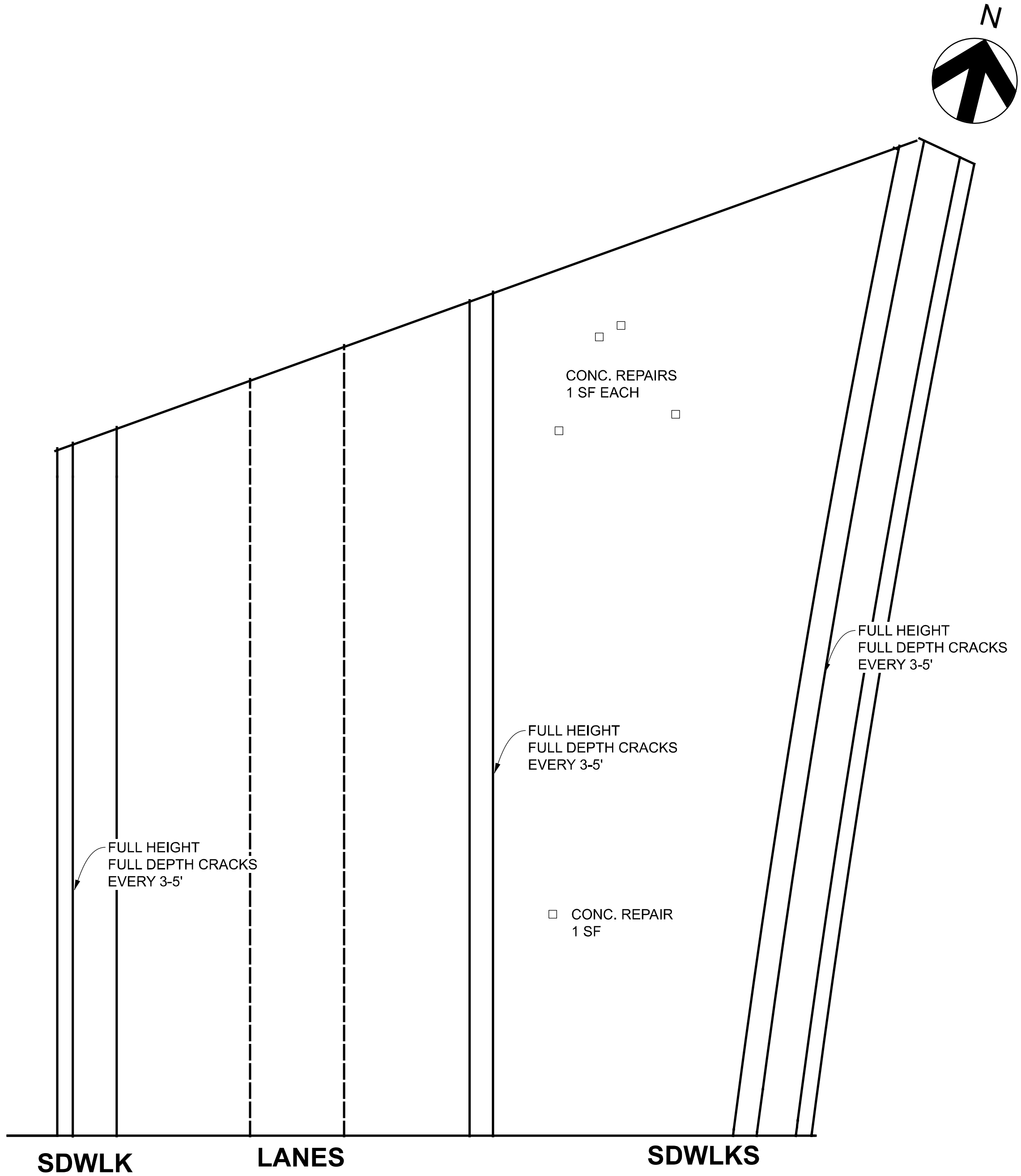
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 7



DETERIORATION QUANTITIES:

Cracking <1/32":	0 LF
Delamination:	0 SF
Spalling:	0 SF

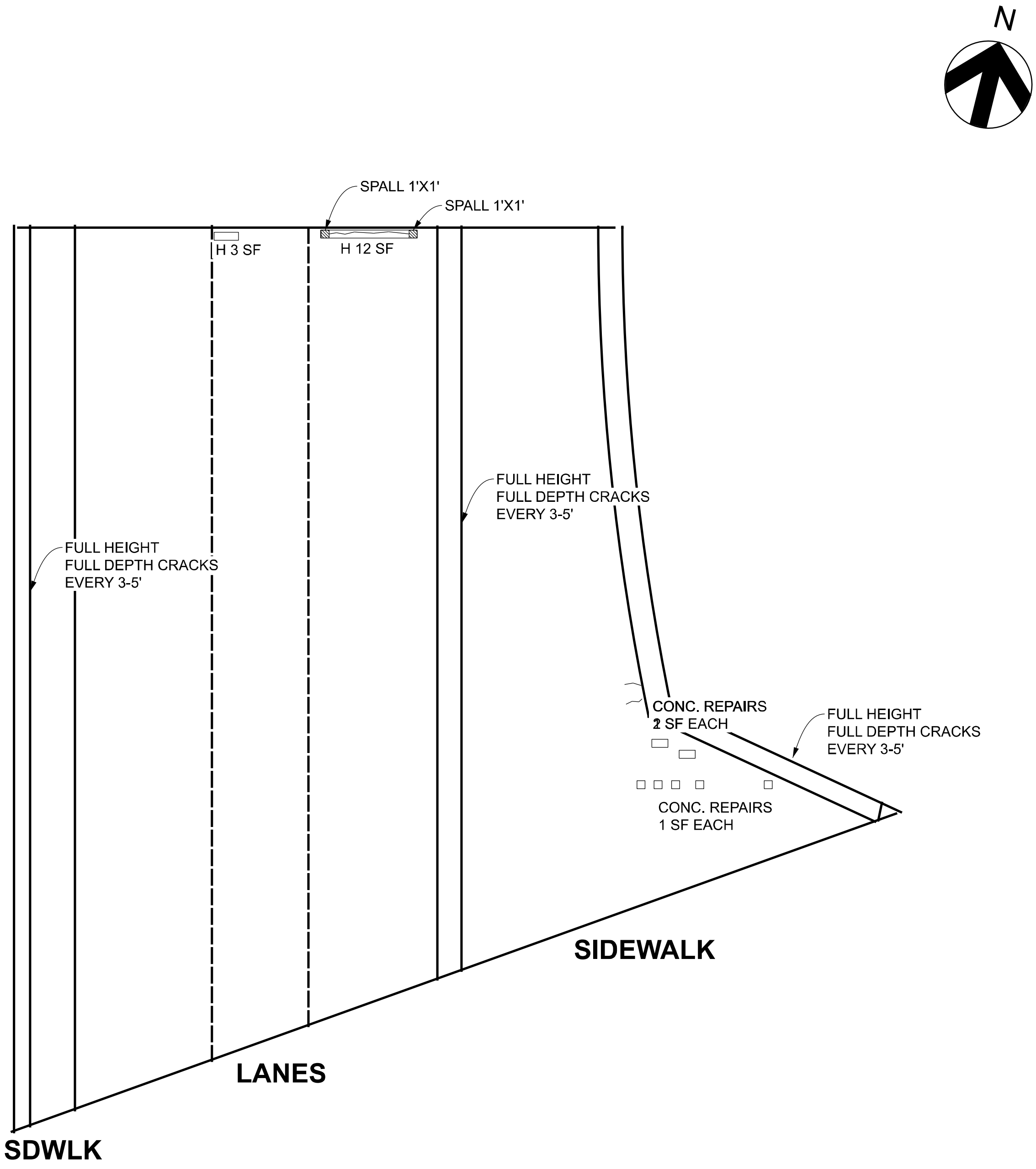
OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule
SHEET 10 **OF** 34

TEAM LEADER: Jason Fogg
ASST. TEAM LEADER: Ed Oliver
DATE:

Feature Carried: Craig Street
Feature Crossed: Maumee River

SPAN 8



DETERIORATION QUANTITIES:
Delamination: 15 SF
Spalling: 2 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 11 OF 34

TEAM LEADER: Jason Fogg

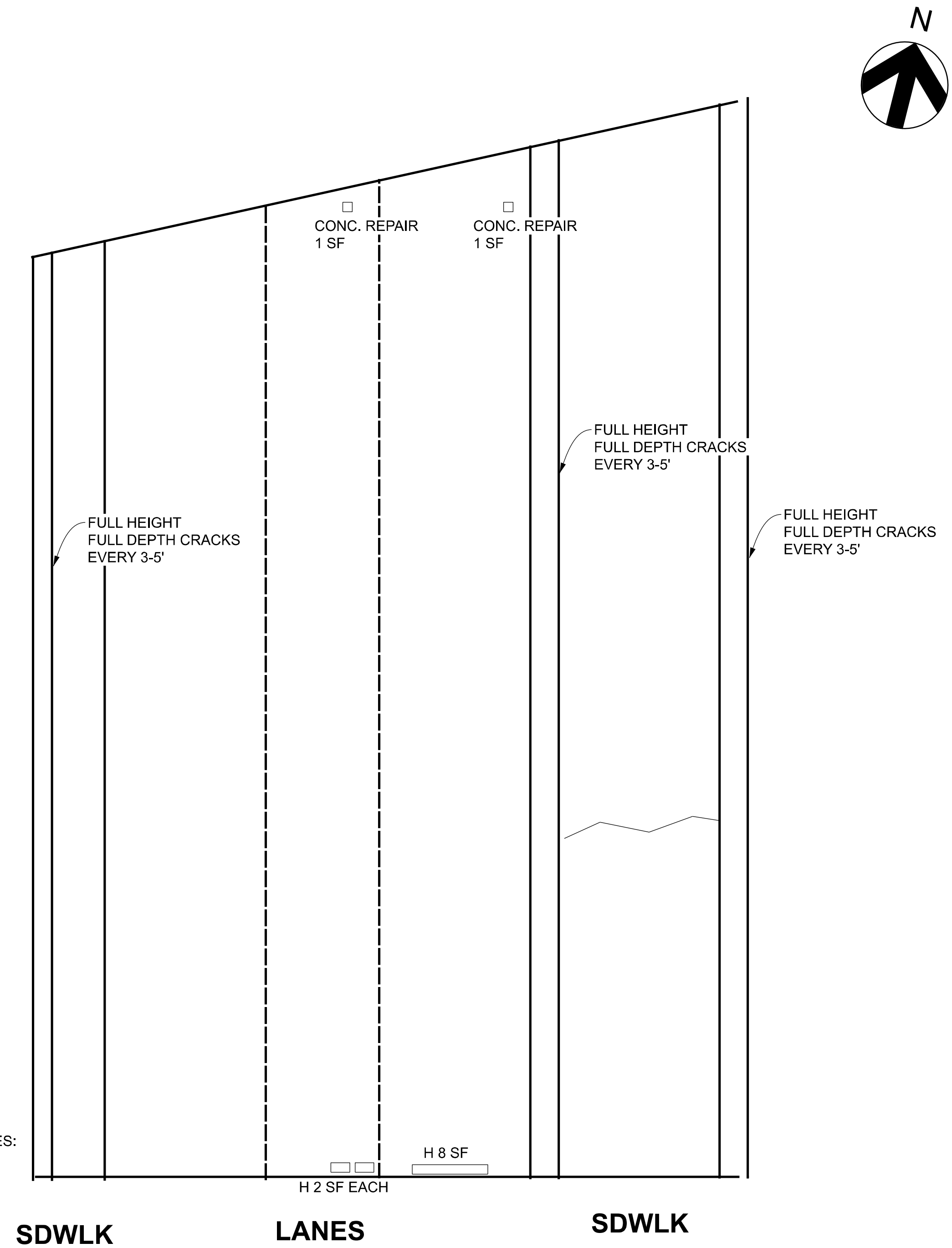
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 9



DETERIORATION QUANTITIES:
Delamination: 12 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 12 **OF** 34

TEAM LEADER: Jason Fogg

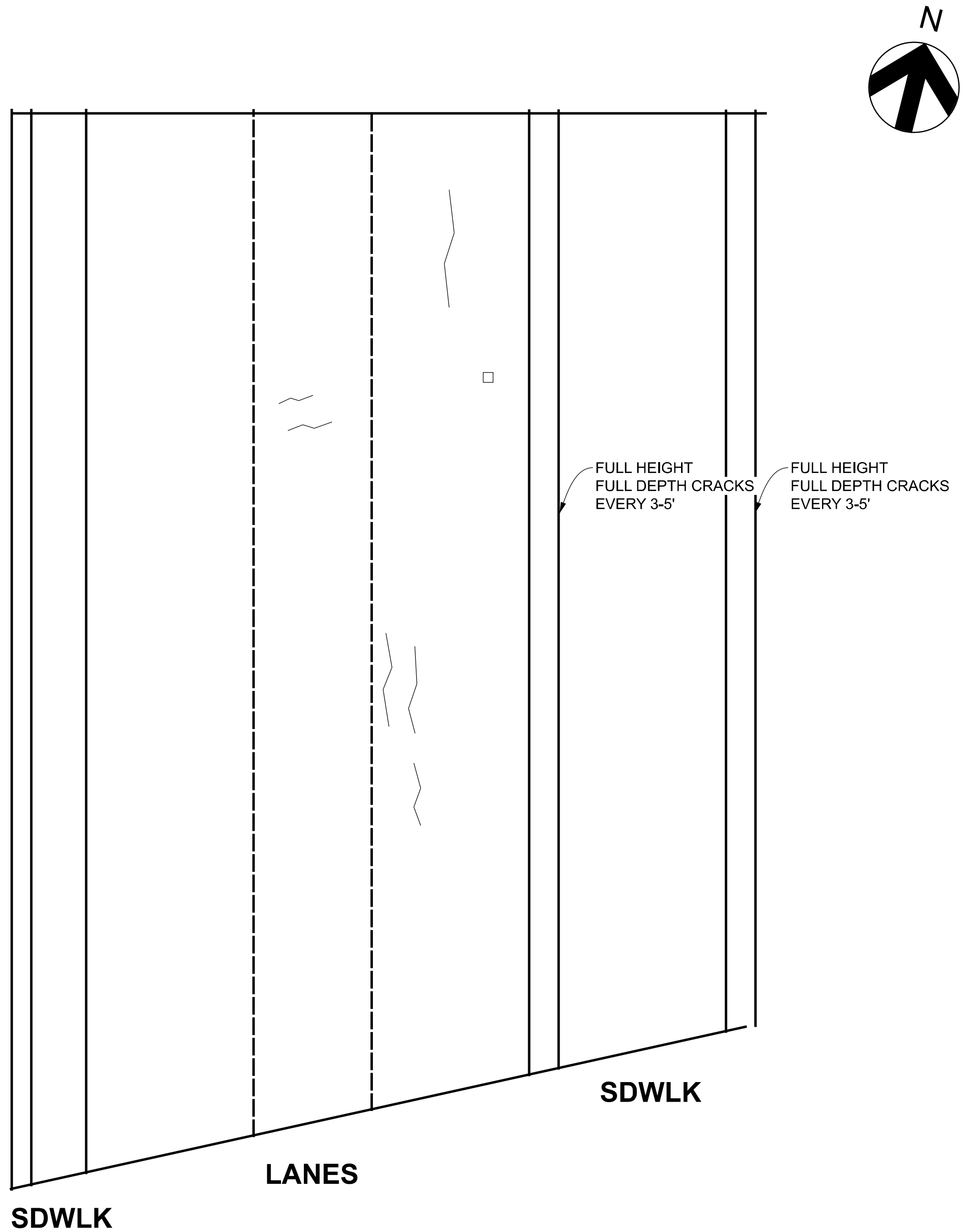
ASST. TEAM LEADER: Ed Oliver

DATE:

Feature Carried: Craig Street

Feature Crossed: Maumee River

SPAN 10



DETERIORATION QUANTITIES:
Cracking <1/32": 63.61 LF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 13 OF 34

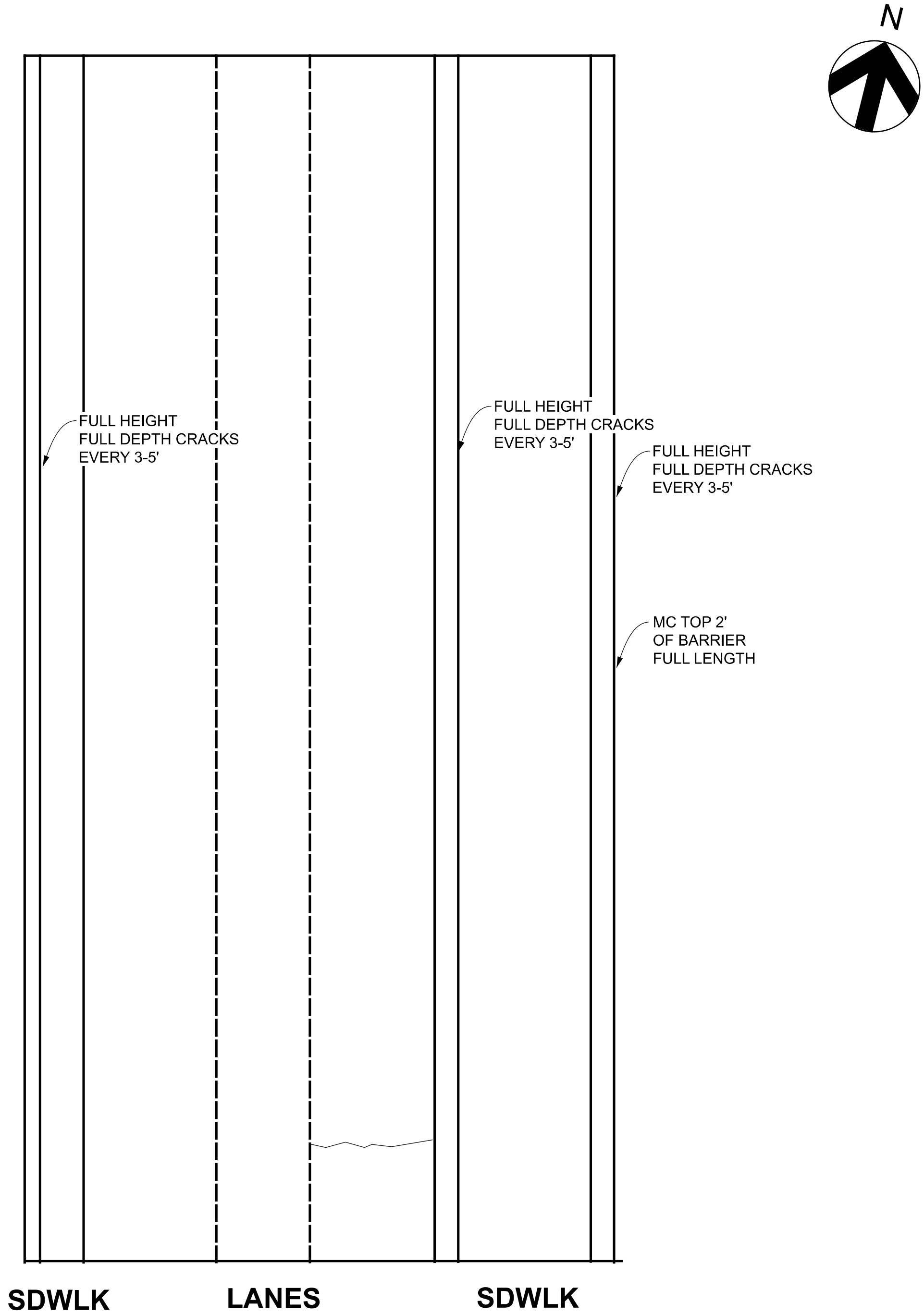
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:**

Feature Carried: Craig Street

Feature Crossed: Maumee River

NORTH APPROACH



DETERIORATION QUANTITIES:
Cracking <1/32": 16.6 LF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 14 OF 34

TEAM LEADER: Jason Fogg

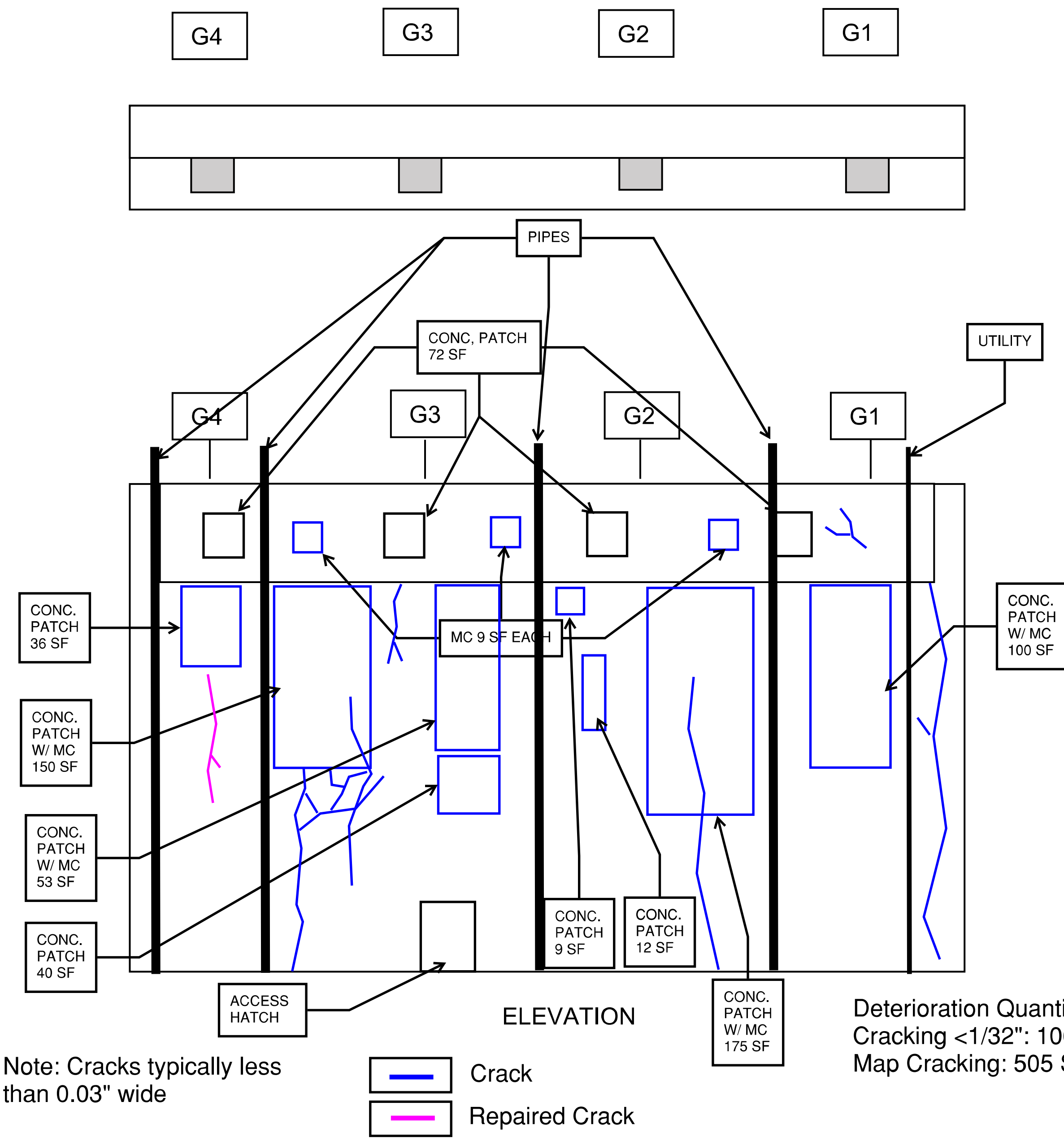
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

SOUTH ABUTMENT



Deterioration Quantities:
Cracking <1/32": 106.03 LF
Map Cracking: 505 SF

Note: Cracks typically less than 0.03" wide

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 15 OF 34

TEAM LEADER: Jason Fogg

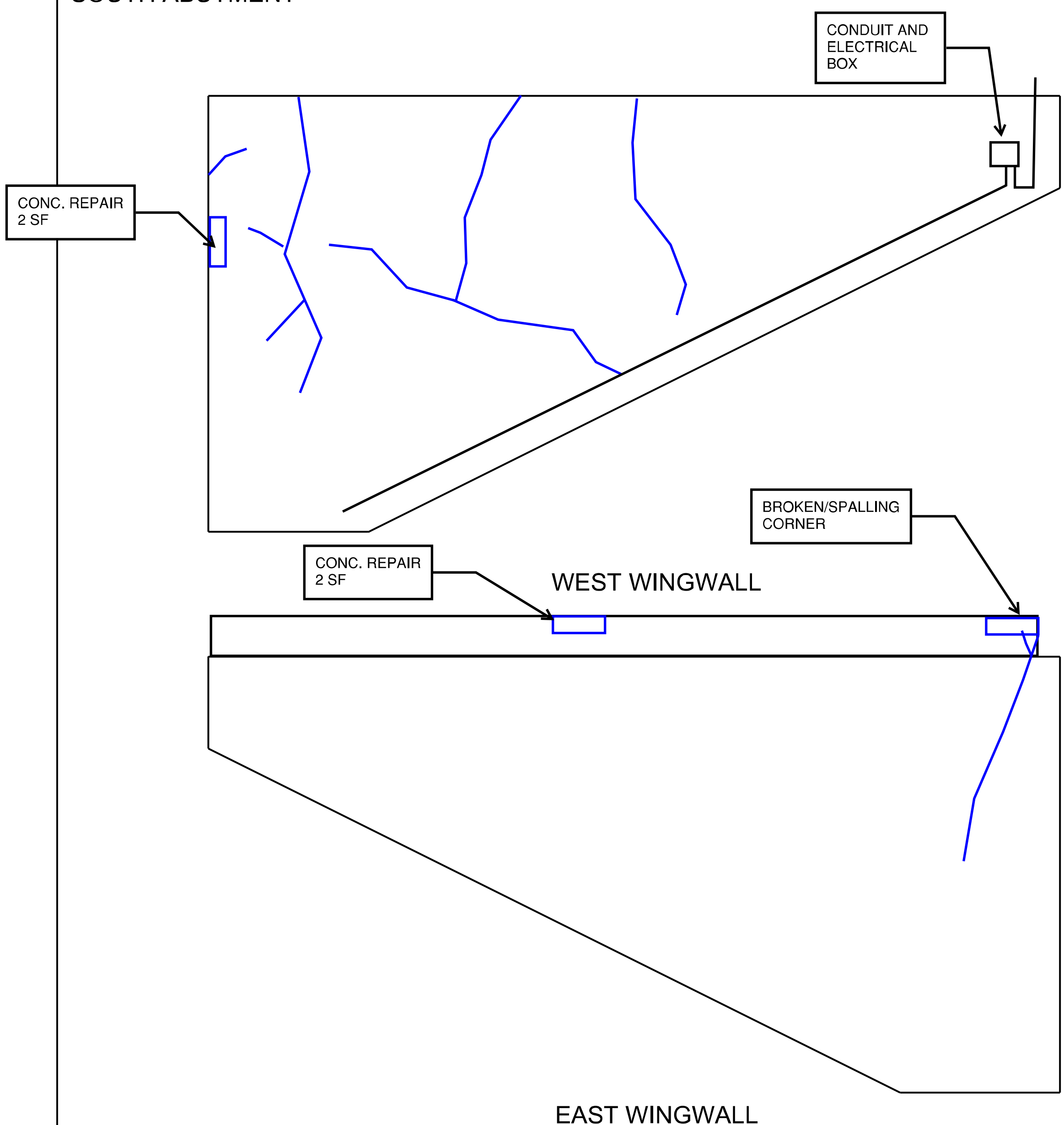
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

SOUTH ABUTMENT



Deterioration Quantities:
Cracking <1/32": 115.52 LF
Spalling: 0.5 SF

Note: Cracks typically less than 0.03" wide

BRIDGE: Craig St. Bascule

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 16 OF 34

TEAM LEADER: Jason Fogg

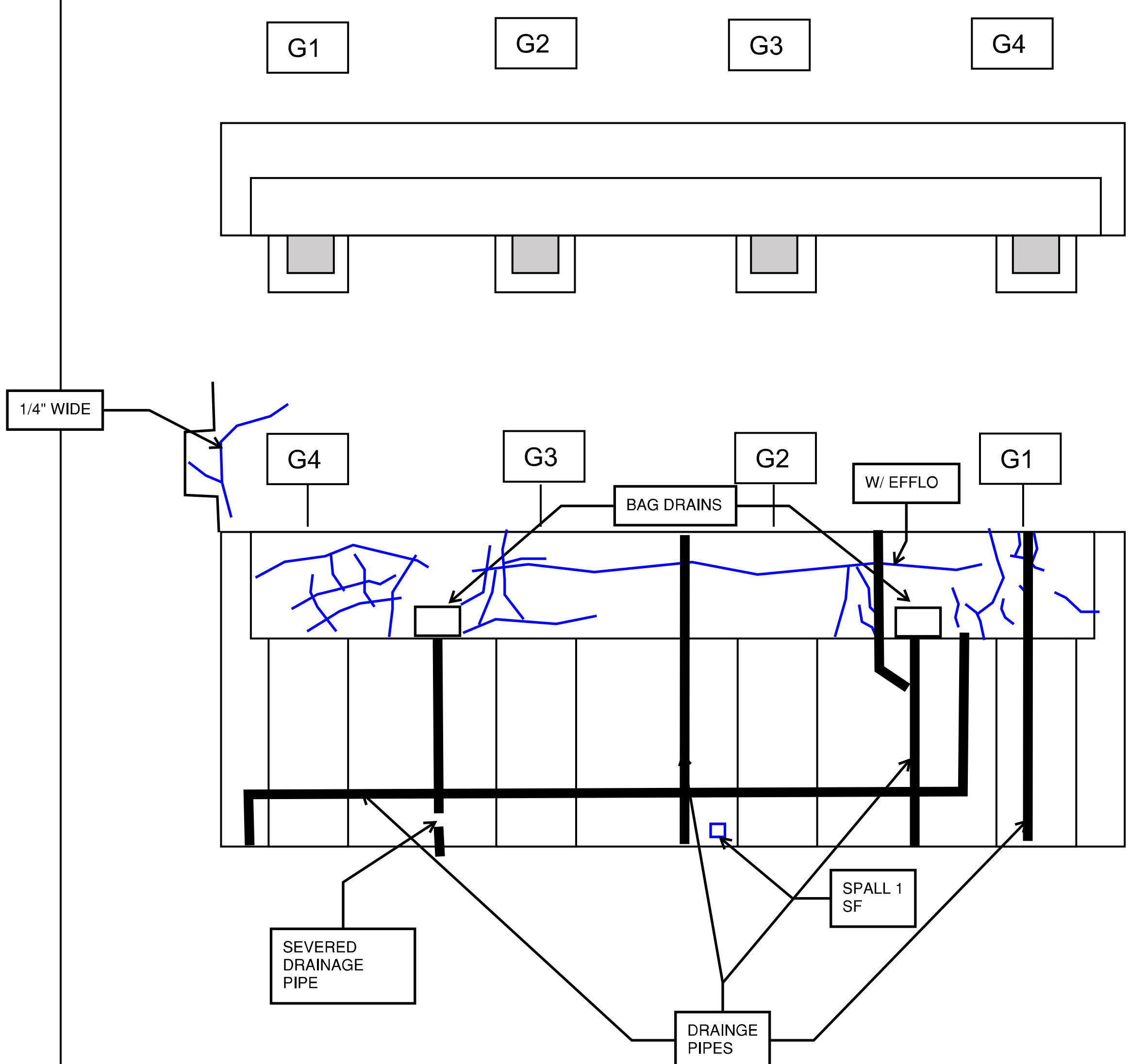
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

NORTH ABUTMENT



ELEVATION

Deterioration Quantities:
Cracking <1/32": 103.9 LF
Cracking up to or >1/8": 9.48 LF
Spalling: 1 SF

Note: Cracks typically less than 0.03" wide

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 17 OF 34

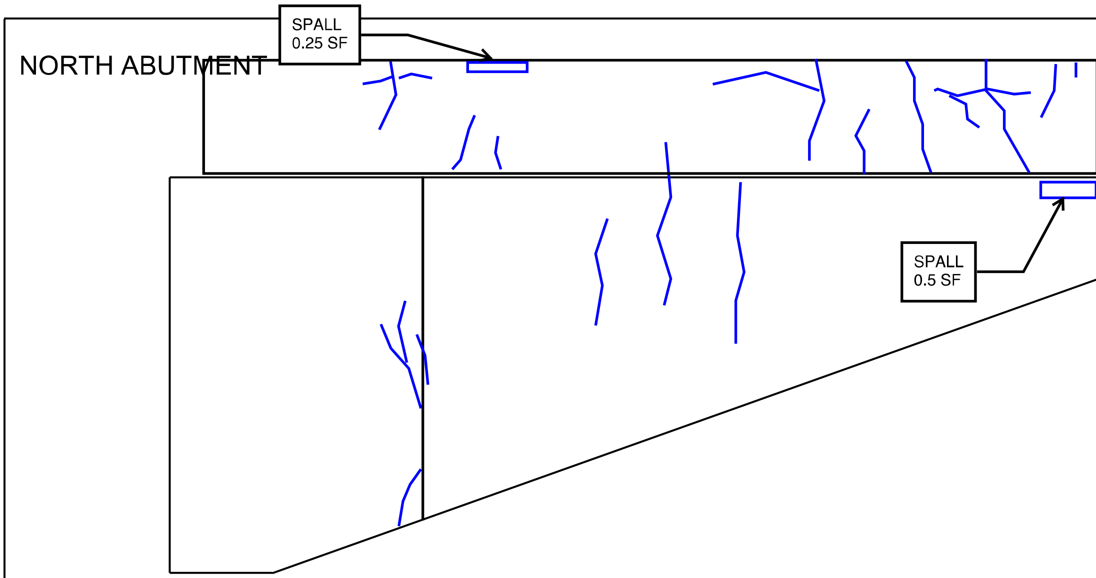
TEAM LEADER: Jason Fogg

ASST. TEAM LEADER: Ed Oliver

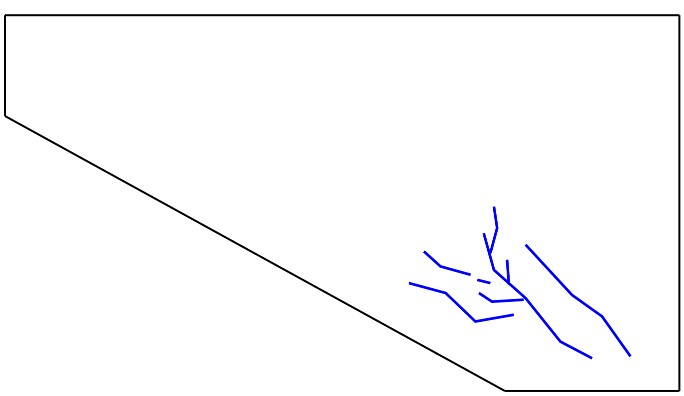
DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River



EAST WINGWALL



WEST WINGWALL

Deterioration Quantities:
Cracking <1/32": 74.83 LF
Spalling: 0.75 SF

Note: Cracks typically less than 0.03" wide

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 18 OF 34

TEAM LEADER: Jason Fogg

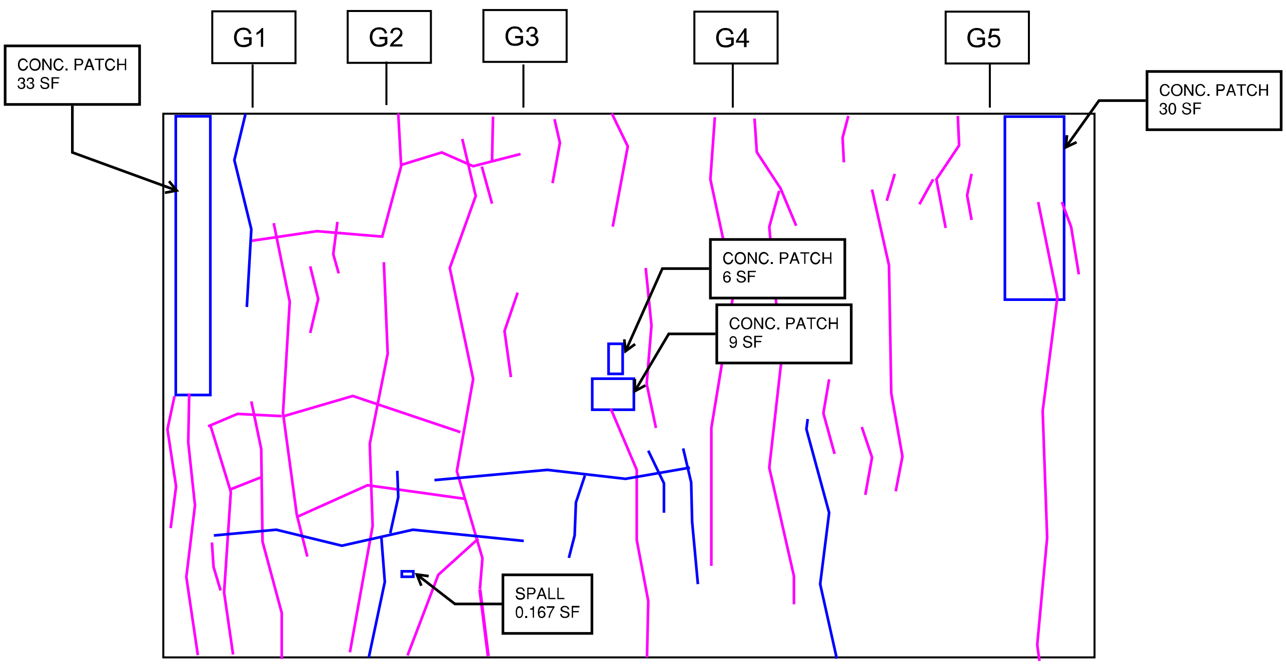
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 1



SOUTH ELEVATION

Crack

Repaired Crack

Deterioration Quantities:
Cracking < 1/32": 70.22 LF
Spalling: 0.17 SF

Note: Cracks typically less than 0.03" wide

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

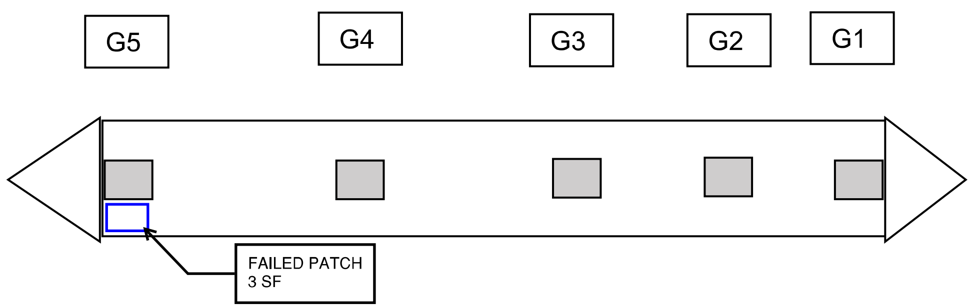
BRIDGE: Craig St. Bascule

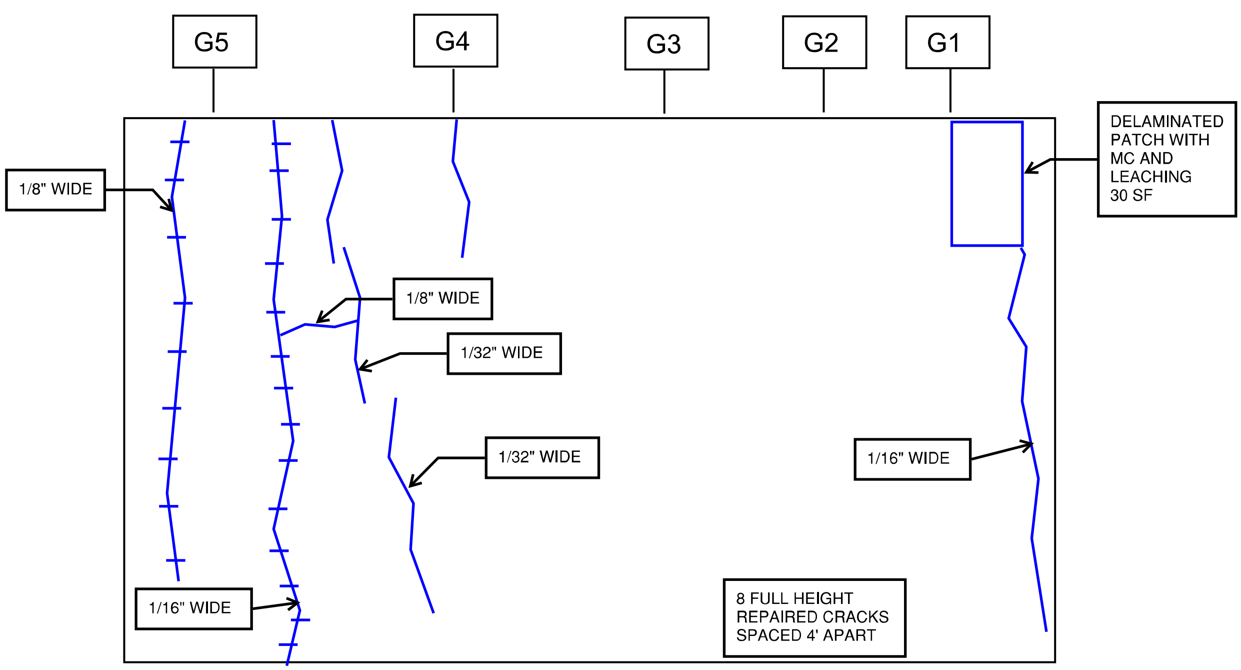
TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 1





NORTH ELEVATION

Deterioration Quantities:
Cracking < 1/32": 4 LF
Cracking up to or >1/8": 118 LF
Map Cracking: 30 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 20 OF 34

TEAM LEADER: Jason Fogg

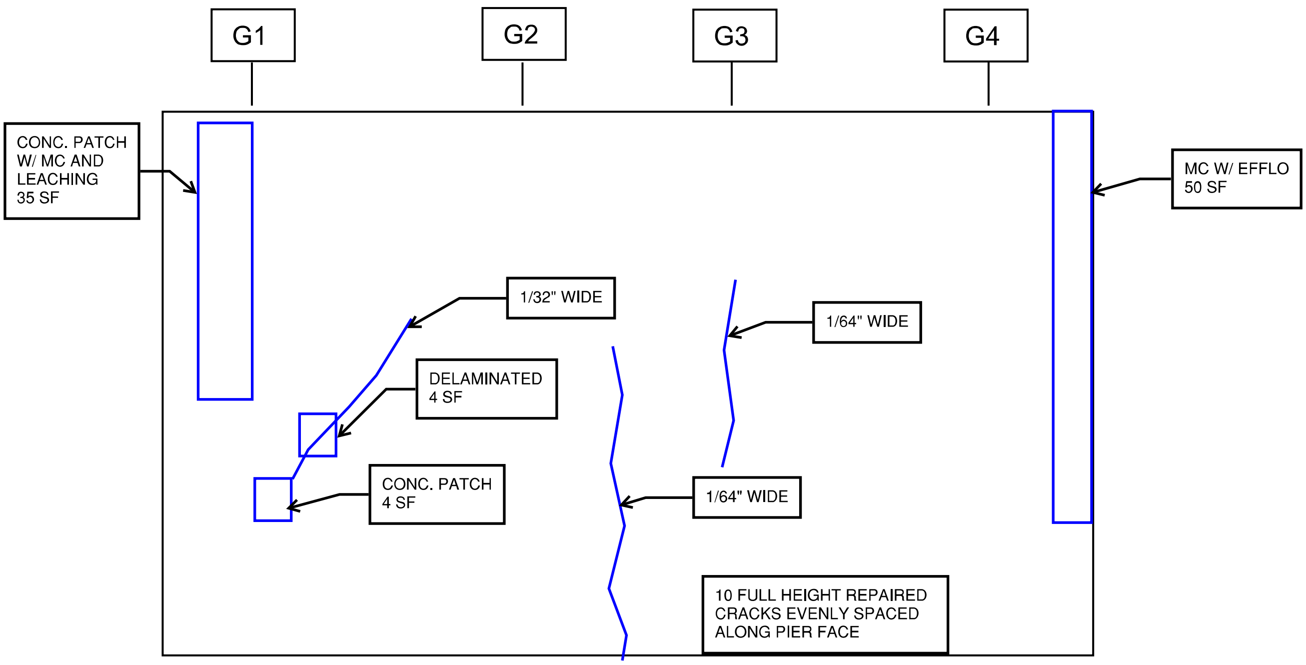
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 2



SOUTH ELEVATION

Deterioration Quantities:
Cracking < 1/32": 25 LF
Cracking up to or >1/8": 15 LF
Delamination: 4 SF
Map Cracking: 85 SF

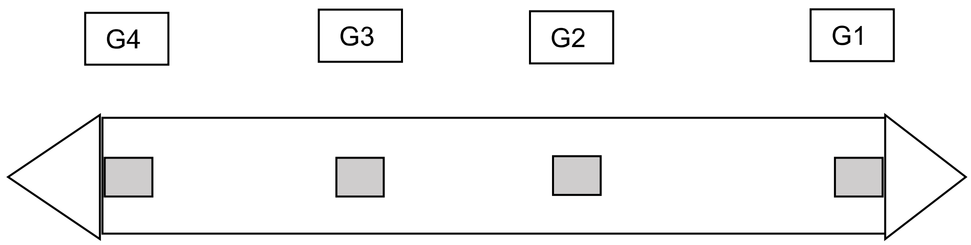
BRIDGE: Craig St. Bascule

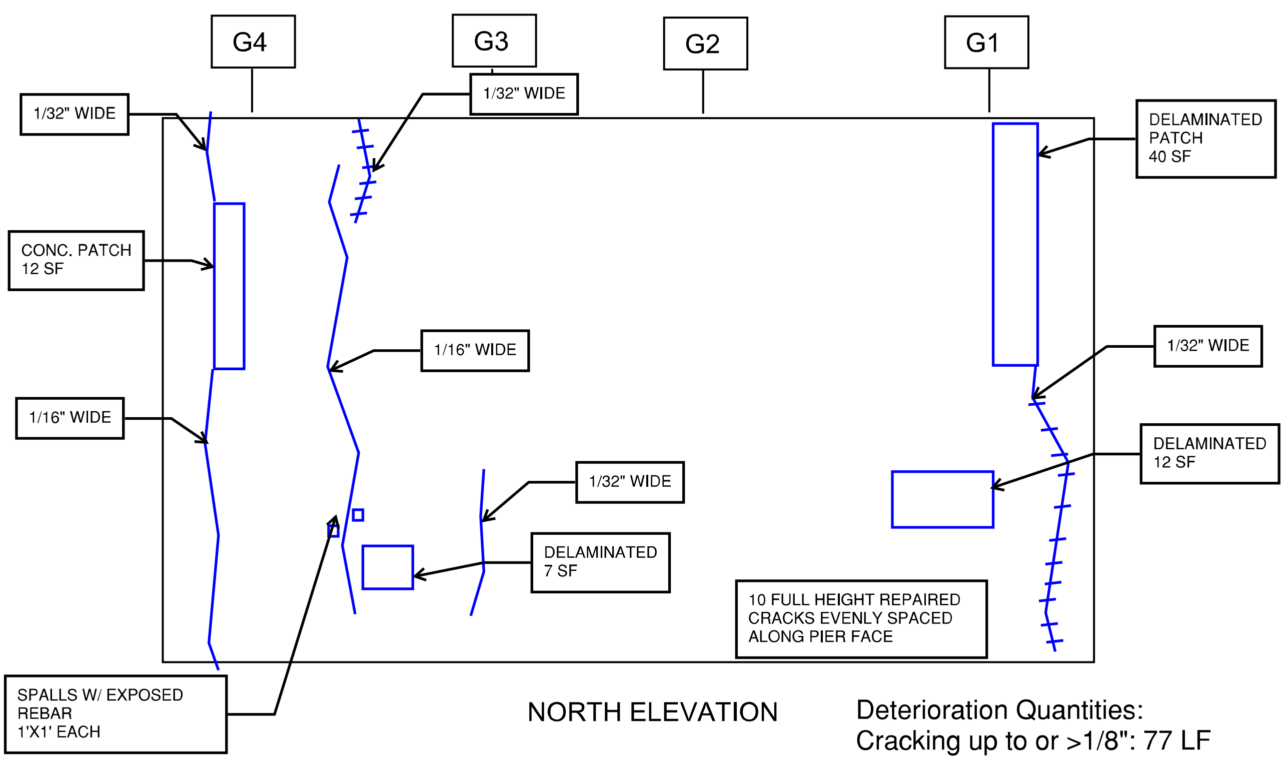
TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 2





NORTH ELEVATION

Deterioration Quantities:
Cracking up to or >1/8": 77 LF
Delamination: 59 SF
Spalling: 2 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg

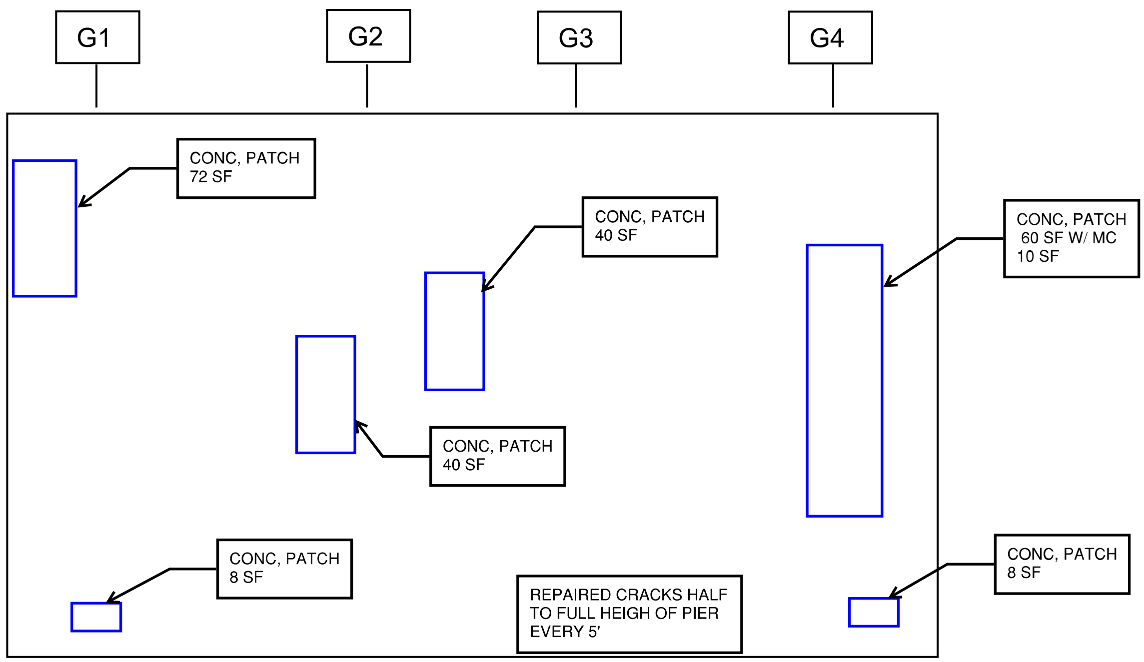
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 3



SOUTH ELEVATION

Deterioration Quantities:
Map Cracking: 10 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

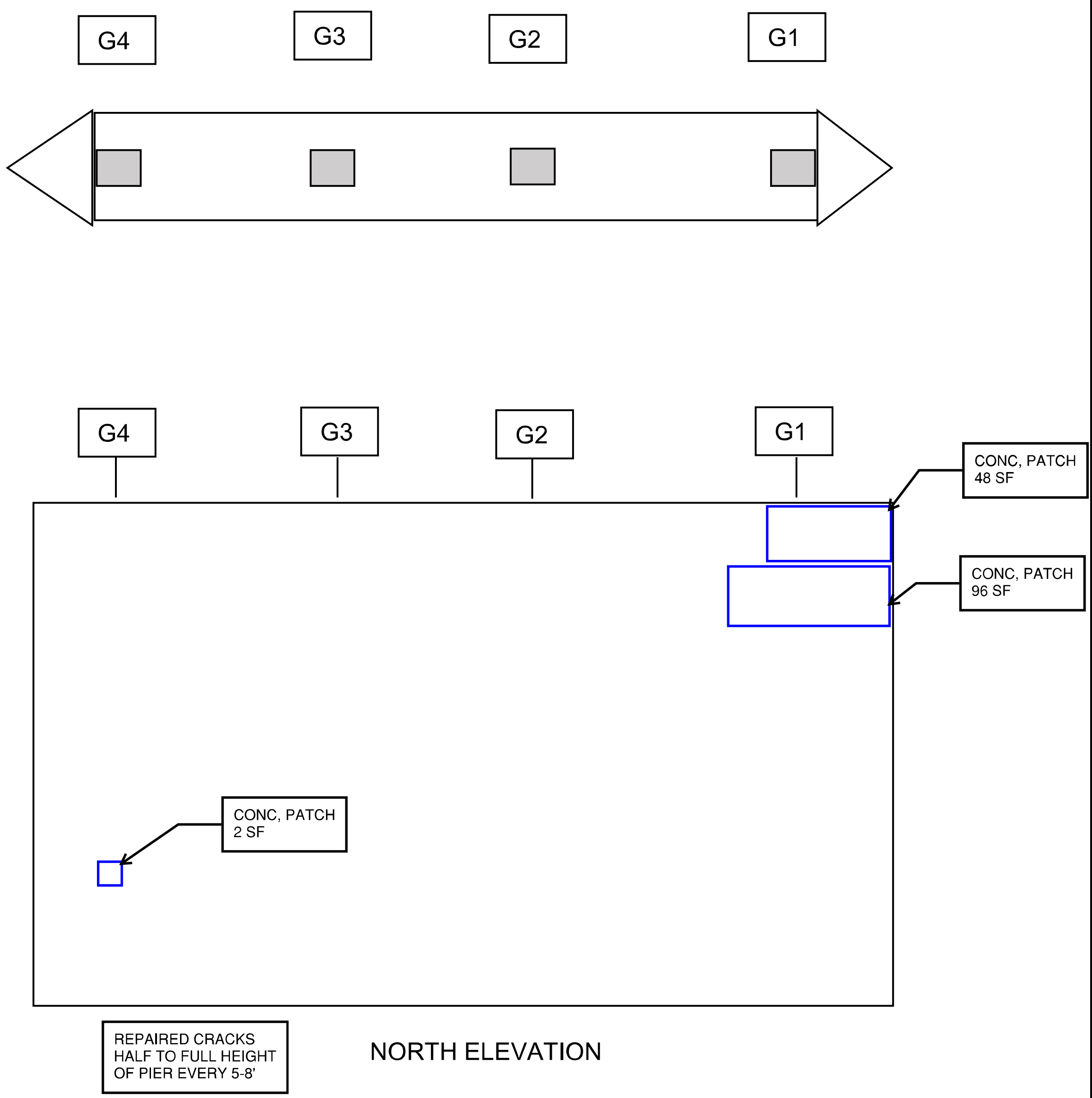
BRIDGE: Craig St. Bascule SHEET 23 OF 34

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 3



OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 24 OF 34

TEAM LEADER: Jason Fogg

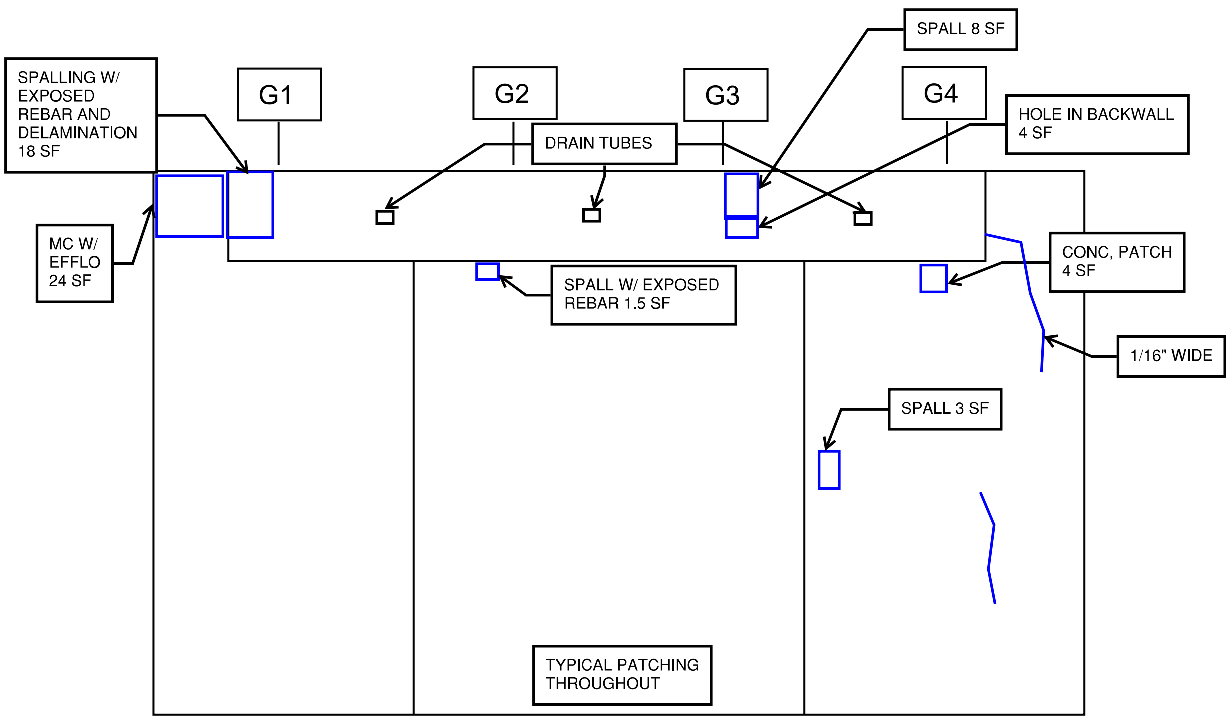
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 4



SOUTH ELEVATION

Deterioration Quantities:
Cracking <1/32": 4 LF
Cracking up to or >1/8": 10 LF
Spalling: 34.5 SF
Map Cracking: 24 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 25 OF 34

TEAM LEADER: Jason Fogg

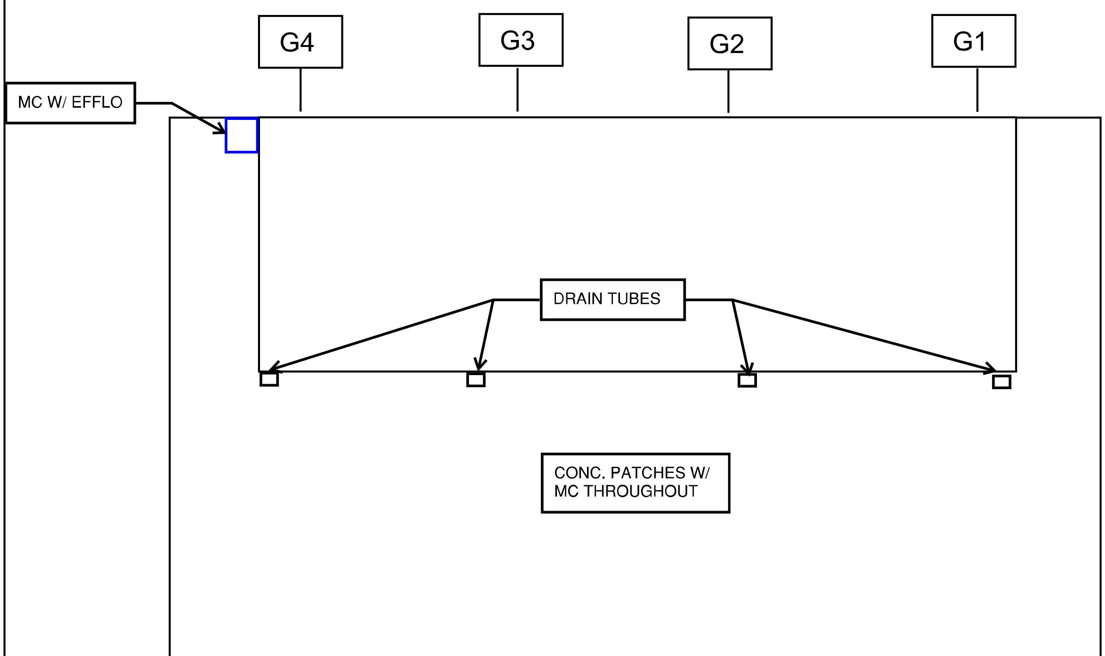
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 4



NORTH ELEVATION

Deterioration Quantities:
Map Cracking: 16 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 26 OF 34

TEAM LEADER: Jason Fogg

ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 4

WEST ELEVATION

EAST ELEVATION

BRIDGE: Craig St. Bascule

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 27 OF 34

TEAM LEADER: Jason Fogg

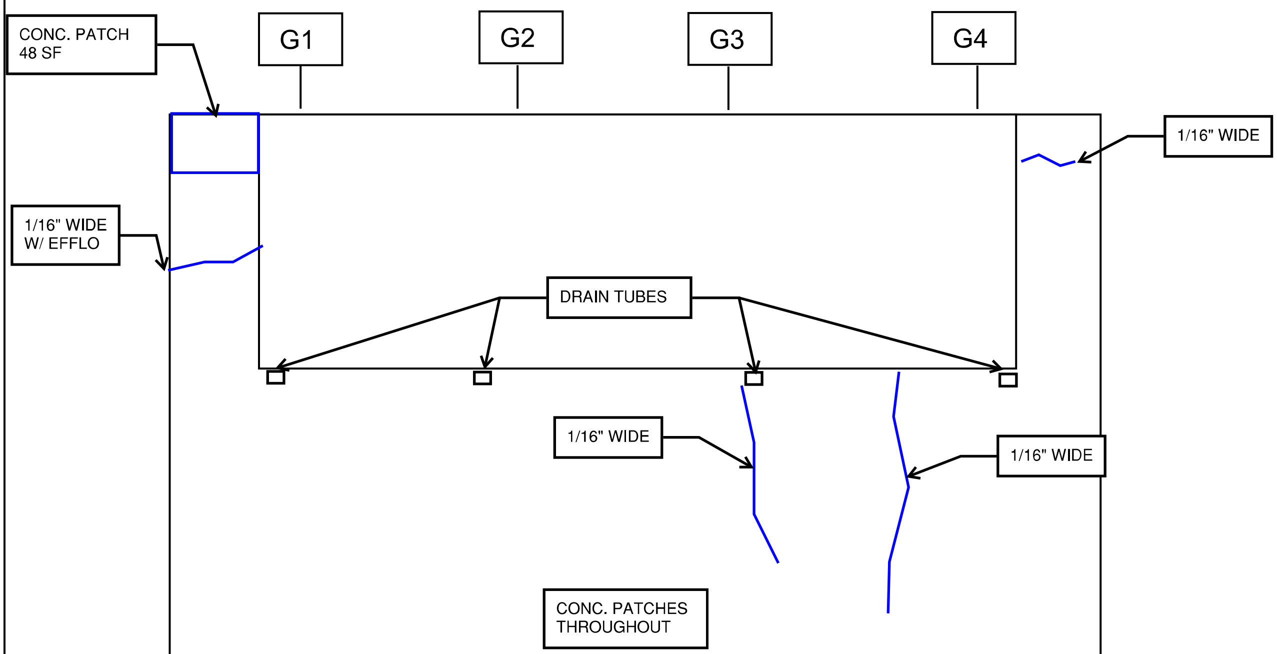
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 5



SOUTH ELEVATION

Deterioration Quantities:
Cracking up to or >1/8": 30 LF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

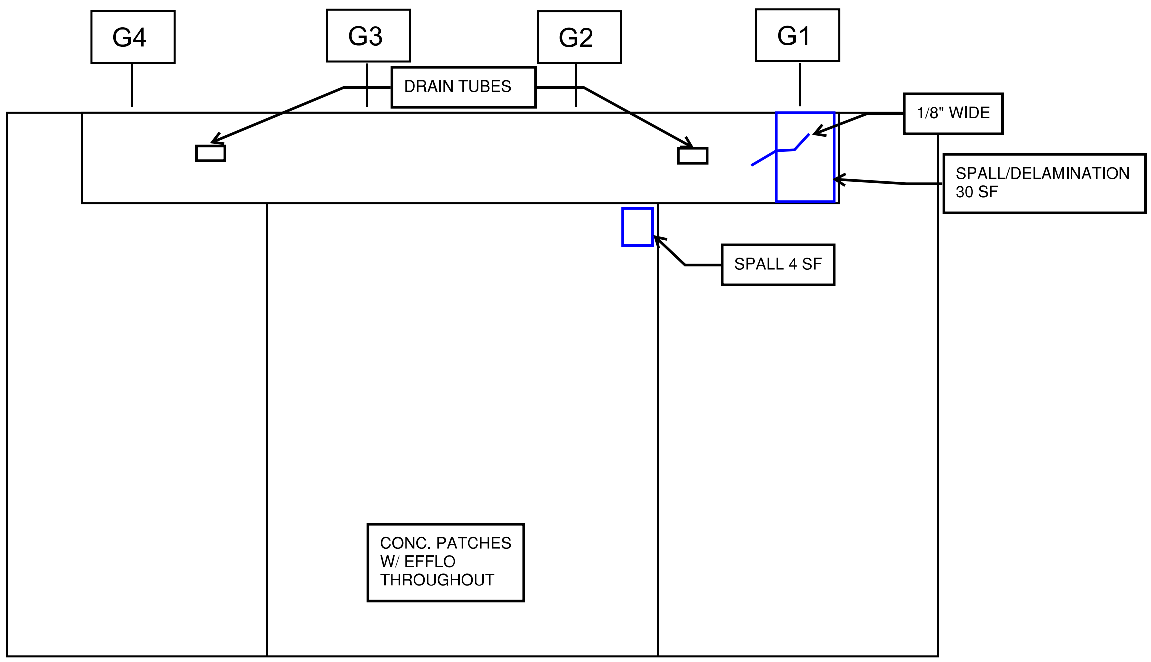
BRIDGE: Craig St. Bascule | SHEET 28 OF 34

TEAM LEADER: Jason Fogg | **ASST. TEAM LEADER:** Ed Oliver | **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 5



NORTH ELEVATION

Deterioration Quantities:
Cracking up to or >1/8": 10 LF
Spalling: 34 SF

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 5

WEST ELEVATION

EAST ELEVATION

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

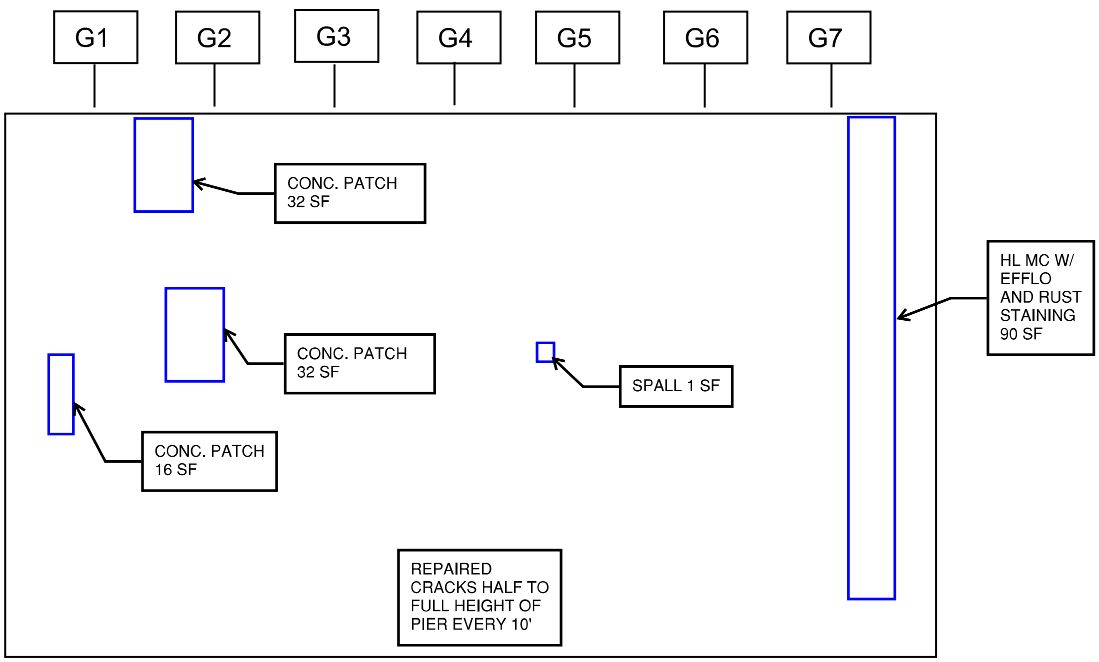
SHEET 30 OF 34

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 6



SOUTH ELEVATION

Deterioration Quantities:
Spalling: 1 SF
Map Cracking: 90 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 31 OF 34

TEAM LEADER: Jason Fogg

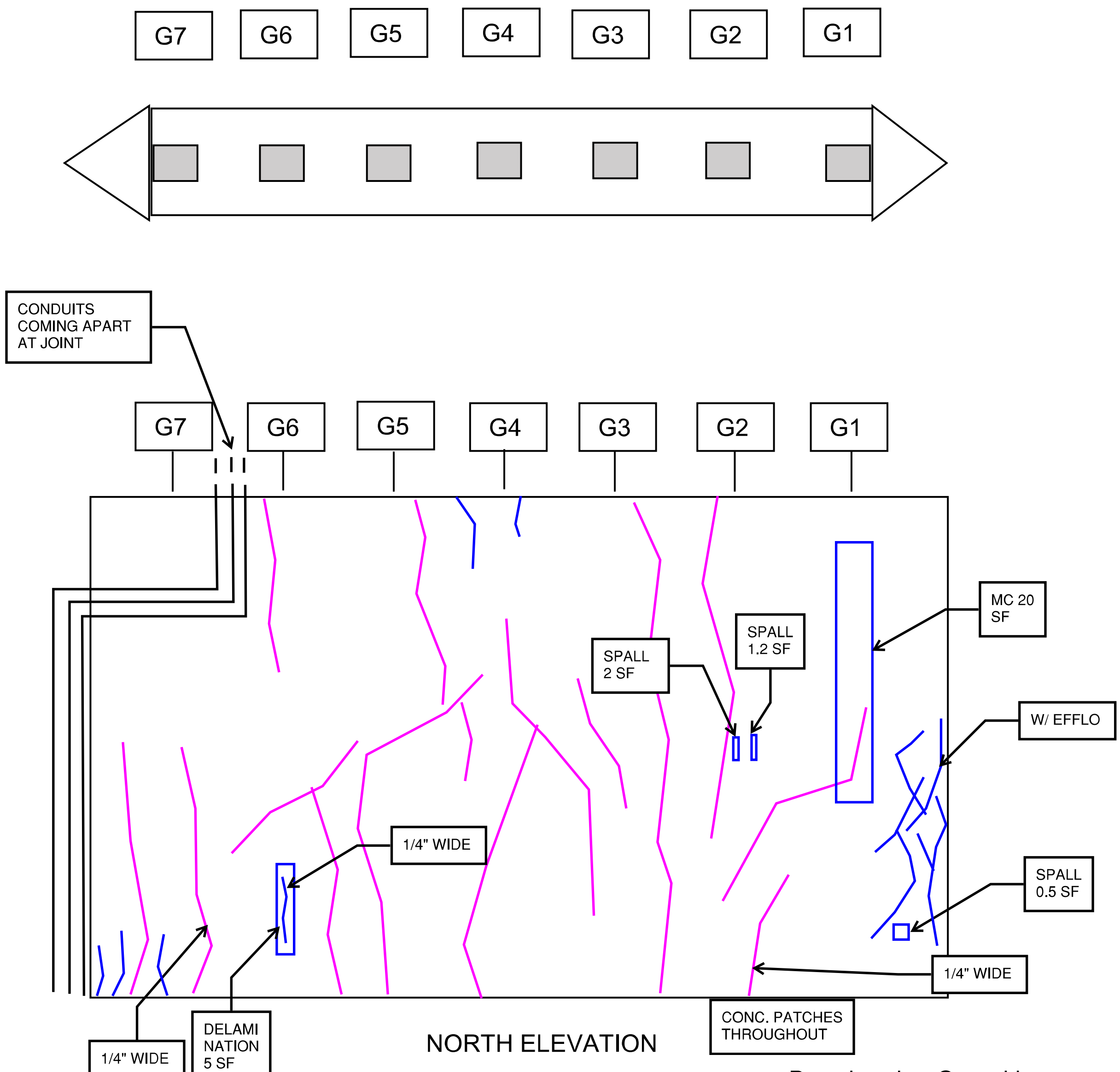
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 6



NORTH ELEVATION

Crack

Repaired Crack

Deterioration Quantities:
Cracking <1/32": 78.83
Cracking up to or >1/8": 5.28 LF
Delamination: 5 SF
Spalling: 3.7 SF
Map Cracking: 20 SF

Note: Cracks typically less than 0.03" wide

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

SHEET 32 OF 34

TEAM LEADER: Jason Fogg

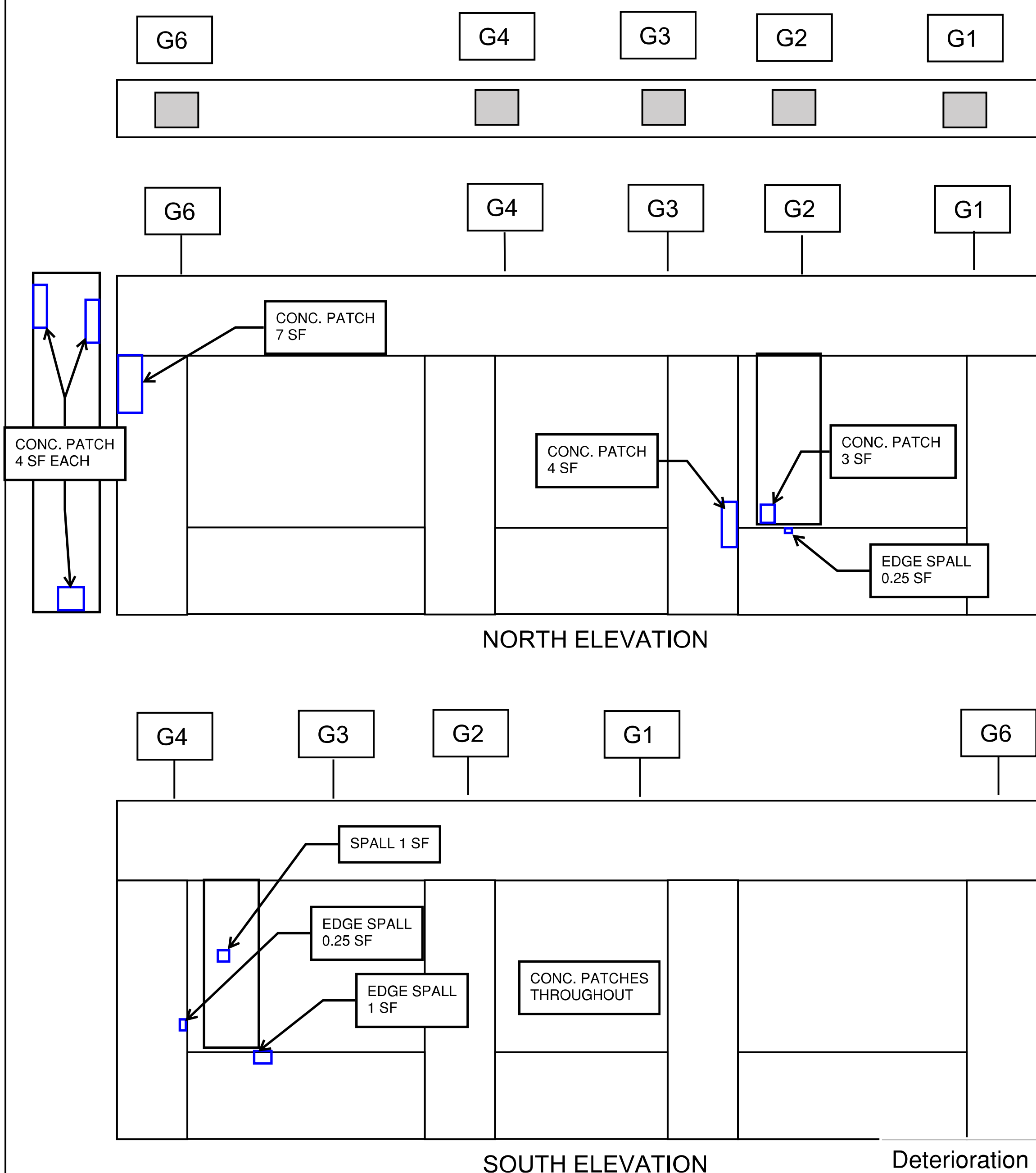
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 7



Deterioration Quantities:
Spalling: 1.25 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

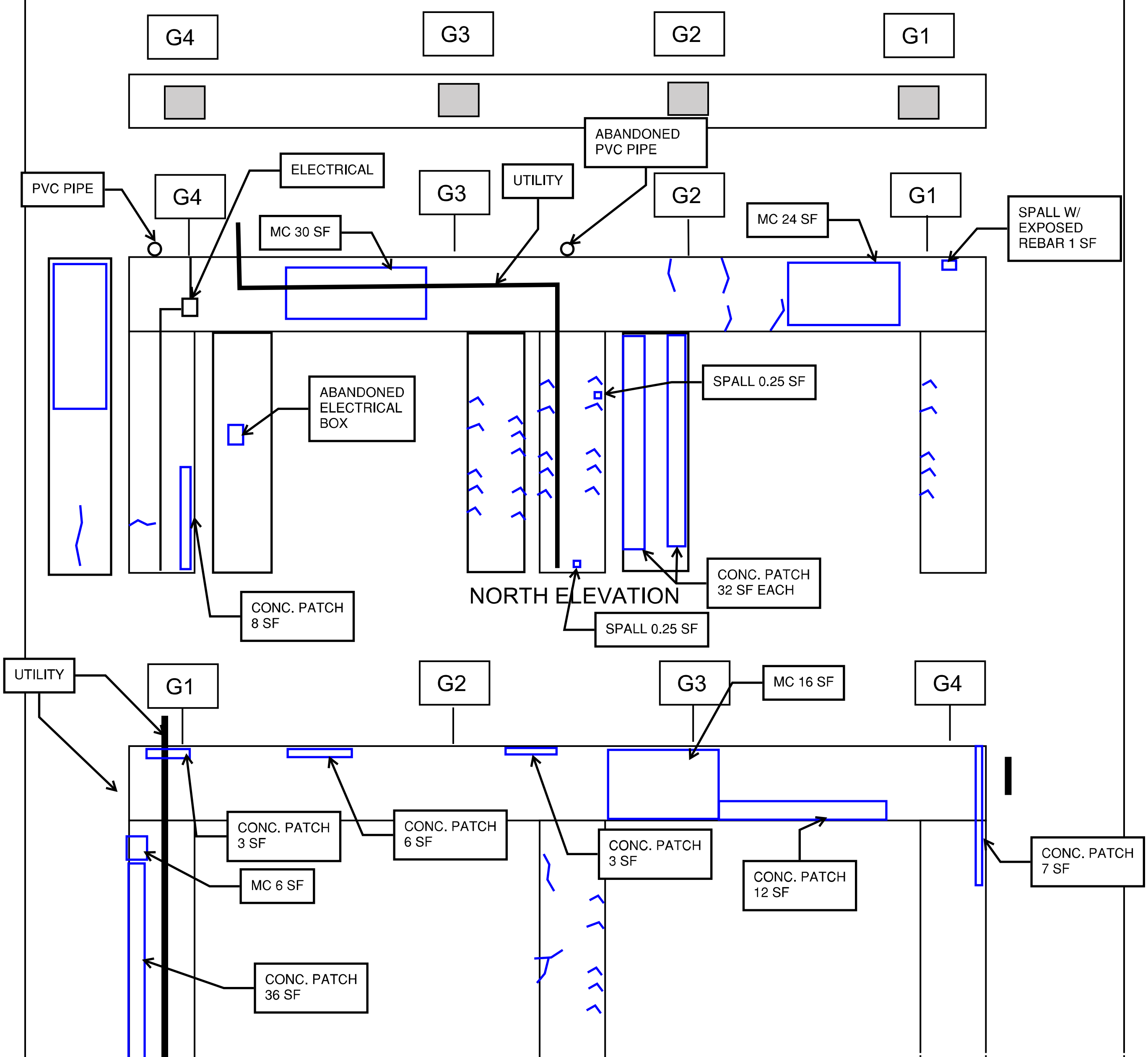
BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg **ASST. TEAM LEADER:** Ed Oliver **DATE:** 9/18/23-9/22/23

Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 8



Note: Cracks typically less than 0.03" wide

Deterioration Quantities:
Cracking < 1/32": 79.92 LF
Spalling: 1.25 SF
Map Cracking: 76 SF

OHIO DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BRIDGE: Craig St. Bascule

TEAM LEADER: Jason Fogg

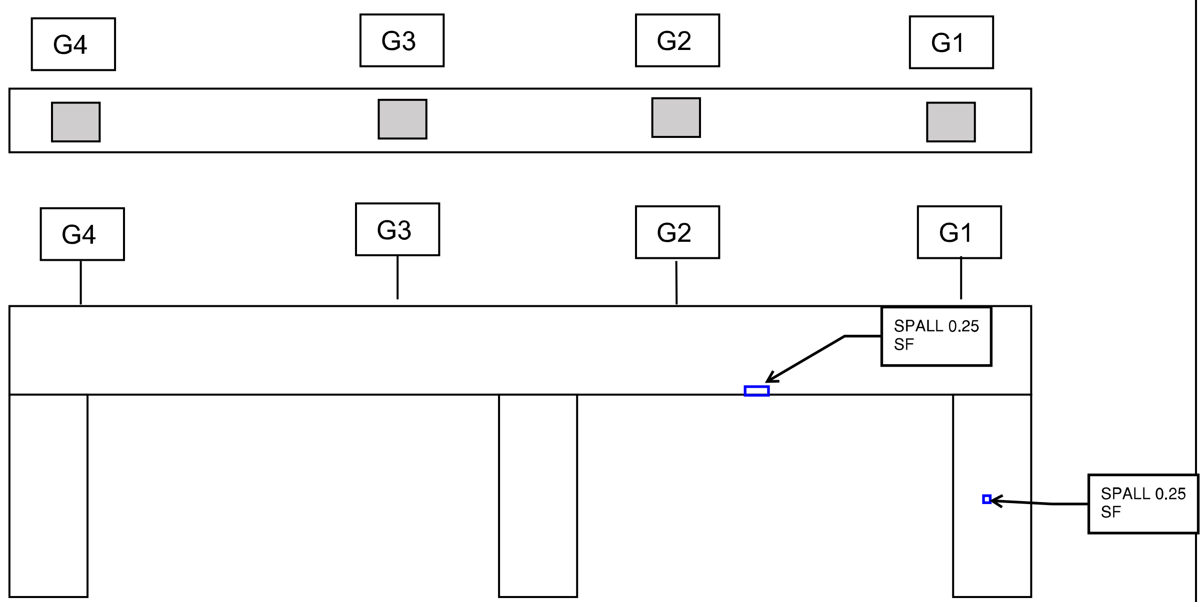
ASST. TEAM LEADER: Ed Oliver

DATE: 9/18/23-9/22/23

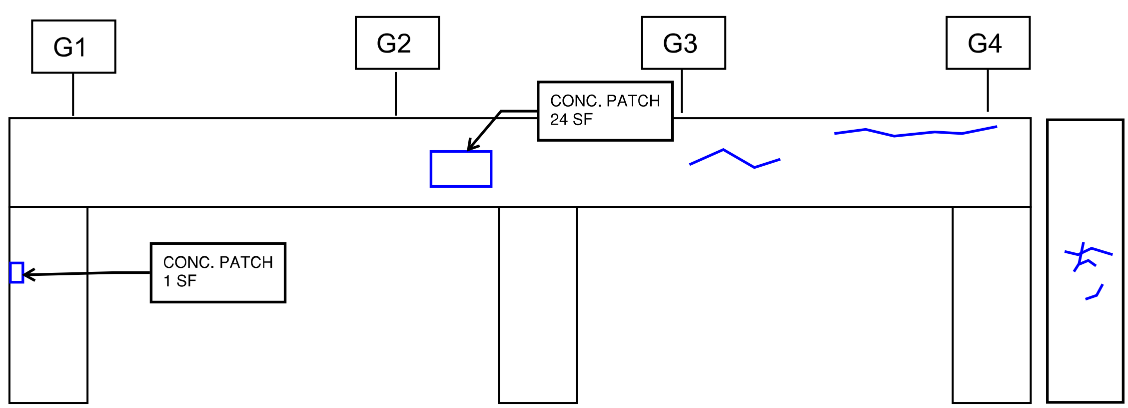
Feature Carried: Craig Street

Feature Crossed: Maumee River

PIER 9



NORTH ELEVATION



SOUTH ELEVATION

Note: Cracks typically less than 0.03" wide

Deterioration Quantities:
Cracking < 1/32": 24.71 LF
Spalling: 0.5 SF

Appendix 4:

Rocker Bearing Measurements

Bridge No.: LUC-065-0535

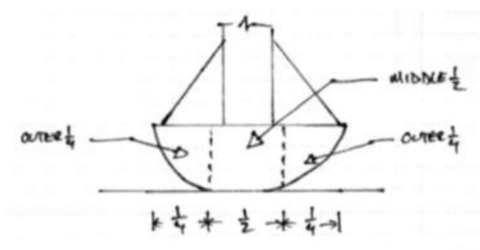
Ohio Department of Transportation
Bridge Inspection Report

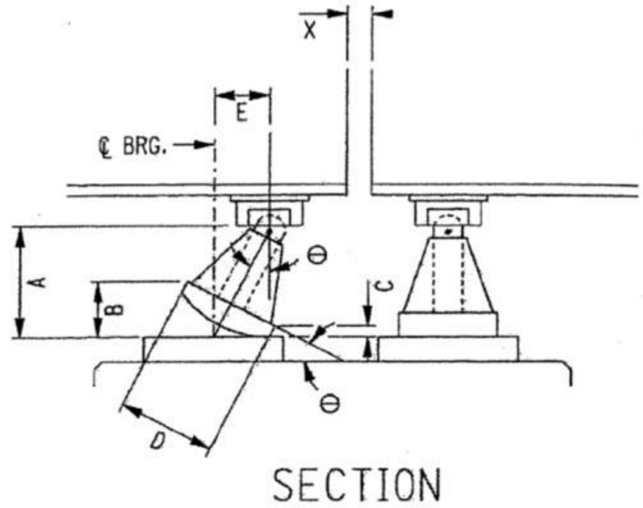
Team Leader: Jason Fogg, PE
Asst. Team Leader: Ed Oliver, PE
Feature Carried: *Craig Memorial Bascule Bridge / SR-65*
Feature Crossed: *Maumee River / Ann Arbor Railroad*
Date: 9/19/2023

Rocker Bearing Field Documentation Summary

Reference Sketch:

- **A** = Height of Rocker
- **B** = High Corner of Rocker Plate (N S E W side as shown)
- **C** = Low Corner of Rocker Plate (N S E W side as shown)
- **D** = Width of Rocker Plate
- **Θ** = Angle of Rotation (Tilt of Bearing)
- **E** = Eccentricity (Translation of Girder)
- **X** = Minimum Clear Distance





Allowable Tilt:

Allowable Tilt should be calculated as the maximum angle of the bearing in expansion or contraction so that the rocker does not bear on the outer 1/4 of the rocker surface (see sketch). **The allowable tilt for these bearings is approximately 10.5 degrees.**

Bearing Measurement Data Table:

(All Dimensions are in English Units - **Inches**)

Date	Bearing Location	Ambient Temp (F)	Steel Temp (F)	Dim. "A"	Dim. "B" (North)	Dim. "C" (South)	Dim. "D"	Tilt Direction	Calculated Dim. "Θ"	Tilt Mode
9/19/2023	Pier 5 North: Bearing 1W	72	72	14.25	3.50	2.50	10.0	South	5.74	Exp
9/19/2023	Pier 5 North: Bearing 2W	72	72	14.00	3.375	2.625	10.0	South	4.30	Exp
9/19/2023	Pier 5 North: Bearing 3W	72	72	13.50	3.50	2.625	10.0	South	5.02	Exp
9/19/2023	Pier 5 North: Bearing 4W	72	72	14.00	3.375	2.625	10.0	South	4.30	Exp
9/19/2023	Pier 5 North: Bearing 5W	72	72	14.00	3.25	2.75	10.0	South	2.87	Exp

Appendix 5:

Bridge Balance Condition Report

EXECUTIVE SUMMARY

The bridge balance for the North and South spans of the Ohio Department of Transportation Craig Memorial Bridge over the Maumee River in Toledo, Ohio was tested on September 19 and September 20, 2023, respectively. The test results are as follows:

TABLE 1: BALANCE RESULTS SUMMARY

Span	Imbalance Moment WL (Kip-Ft)	Center of Gravity Location Alpha (Degrees)	Equivalent Toe Reaction (Kips)	Span Frictional Moment (Kip-Ft)
North	873	75.5	1.78	266
South	787	61.3	3.08	382

The center of gravity location for both spans is too high when compared against the recommended location between -20 degrees and +20 degrees towards the channel relative to a horizontal line passing through the trunnions. The spans are toe heavy when fully seated, but counterweight heavy when fully open. The equivalent toe reaction for the North span is within the recommended range of 1,600 lbs to 3,000 lbs, but the toe reaction for the South span is slightly higher. The overall imbalance moment for both spans is high.

In order to reduce machinery loading and increase long term operational reliability, HDR recommends preparing detailed calculations and plans to restore the balance of the bridge to the recommended condition within a reasonable proximity. In the recommended condition, the spans will remain toe heavy in all operating positions and the maximum motor loading should be reduced.

INTRODUCTION

On September 19 and September 20, 2023, span balance testing was performed for the double leaf bascule bridge over the Maumee River in Toledo, Ohio. The dynamic strain gage testing method was utilized to determine the existing span balance by applying strain gauges to the output shafts of the enclosed differential gear reducer to measure strain throughout rotation. Leaf angle of rotation was measured using an inclinometer, and time-based measurements were recorded using a data acquisition system. The data was analyzed using a custom PTC Mathcad Prime program that yields the imbalance of the span as a vector, the angle of the vector when the span is in the fully seated position (with zero degrees indexed as horizontal from the center of rotation), and the friction of the span excluding the span drive machinery from the location of the strain gauges to the drive motors.

TEST PROCEDURE AND LIST OF EQUIPMENT

The leaf balance was determined through measuring the torque on the intermediate shafts via strain gauges through both raising and lowering of the span. See **Figure 1** for strain gauge location. The resultant data was correlated to the rotational position of the span which was measured with an inclinometer.

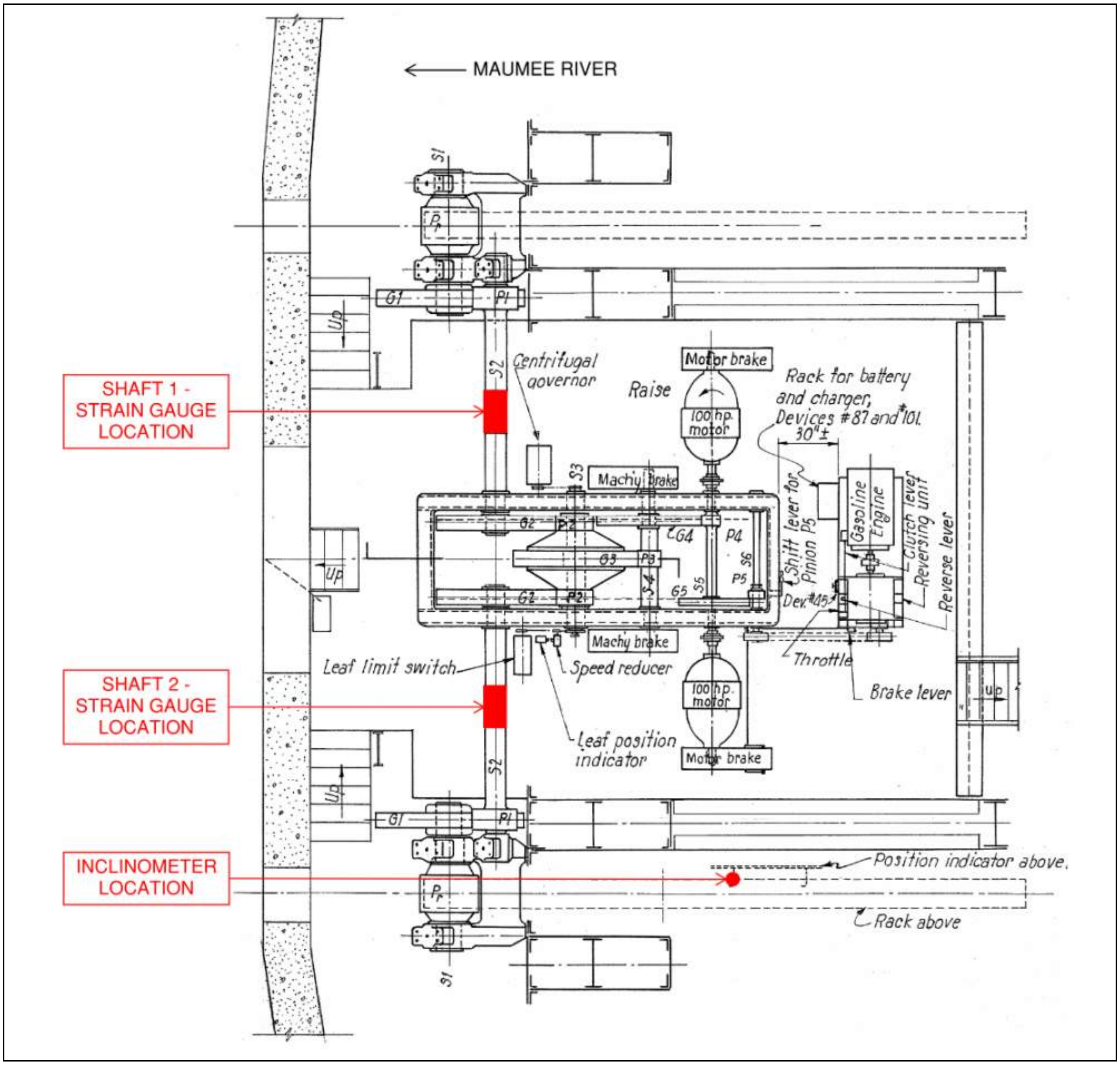


Figure 1. The strain gauges were attached to the output shafts of the differential gear reducer.

To determine the strain in each measured shaft, two pairs of strain gages were mounted 180° from each other and wired in a full Wheatstone bridge configuration. This arrangement allows the torsional strain to be measured while cancelling out the effects of bending on the shaft. A Somat brand strain gauge module was attached to the strain gauges at each shaft and the data converted to a digital signal and amplified prior to sending the data to the data acquisition system. To determine the position of the leaf relative to the strain in the shafts, a Rieker H4A2-45 inclinometer was used with a 0-10V linear output. Data was collected via a Somat eDAQ lite data acquisition system capable of recording 8 channels simultaneously, which was operated by a laptop computer.

Prior to testing, in a shop controlled environment, calibration of the equipment was verified through the placement of a known torque on a shaft of known size and read through data collecting equipment in microstrain and compared to the calculated value. The inclinometer calibration was tested through placing the inclinometer at known angles and verifying the reading.

Each bascule span is equipped with an enclosed differential gear reducer which evenly splits torque between the east and west open gearing. The torque required to open the bridge is transmitted to the bridge through contact between main pinion gears and segment rack gears mounted to the east and west bascule girders. After calibration of the strain gauges by removing torque on the shafting, each span was measured during three complete operations. In order to remove inaccuracies introduced through acceleration, stopping, and braking, data from the first 25 degrees and last 20 degrees of opening and closing was not included in determining bridge balance.

The gear ratios, inner and outer shaft diameters, and bridge length which are necessary to convert shaft strain to bridge torque were determined from the 1952 design plans for the bridge and confirmed using field measurements. The information is documented in the calculations.

RECOMMENDED BALANCE CONDITION

The result findings are compared against the recommended balance condition for the bridge. The recommended balance condition is typically specified by the original designer but has evolved over the years based on findings through industry standard practice.

The bridge design plans from 1952 specify the horizontal and vertical imbalance moments for each span. The specified imbalance moments equate to a downward reaction at the toe of each span of 1,600 lbs with the spans fully seated. The center of gravity for the North and South Spans is specified as 12.7 degrees and 8.4 degrees, respectively, towards the channel above a horizontal line passing through the trunnions.

The AASHTO Movable Bridge Design Specifications and industry standard practice recommend the center of gravity be located towards the channel at an angle no greater than 20 degrees above or below a horizontal line passing through the trunnions and an equivalent downward reaction at the toe of each span between 2,000 lbs and 3,000 lbs with the spans fully seated.

For purposes of this report the recommended balance condition will be estimated as a center of gravity located towards the channel at an angle between -20 degrees and +20 degrees relative to a horizontal line passing through the trunnions and an equivalent downward reaction at the toe of each span between 1,600 lbs and 3,000 lbs.

RESULT FINDINGS

For each span, measurements were recorded for a total of three bridge operations from the fully seated position to the fully open position and back to the fully seated position. The average of the three runs was used to determine the final imbalance condition of each span.

Testing on the North span was performed between 1PM and 2PM local time with wind speed below 7mph, fair sky conditions, and temperatures between 70-72 degrees Fahrenheit. Testing on the South span was performed between 11AM and 12PM local time with wind speed below 6mph, partly cloudy sky conditions, and temperatures between 67-73 degrees Fahrenheit.

When analyzing the data, it was noted that there were very high oscillations in the torque readings, which are attributed to the machinery and control system “bumping” the bridge to maintain speed rather than applying a more constant torque. This is common with older systems which have excessive gear wear and backlash and use drum controllers without drives to control the motors. The oscillations along with operator input on the drum controller heavily impact the consistency of the results between runs. An average of the oscillations for each degree of rotation was taken in order to determine the trend for the balance results.

Table 2 and 3 represent the results of the testing and calculations for the North and South spans. The following definitions apply in the tables:

- WL – overall span imbalance moment.
- Wx – horizontal imbalance moment in the fully seated position.
- Wy – vertical imbalance moment in the fully seated position.
- Alpha – location towards the channel of the center of gravity relative to a horizontal line through the trunnions.
- Seated Reaction – equivalent downward reaction at the toe of the span in the fully seated position.
- Friction – moment resisting motion due to friction in the bearings and gearing from the span to the location of the strain gauges.

Refer to **Appendix A** for a sample Mathcad calculation for determining the balance information in the tables and **Appendix B** for the graphs and resultant data for all three runs on each span.

TABLE 2: NORTH SPAN - BALANCE TESTING RESULTS

Run	WL (Kip-Ft)	Alpha (Degrees)	Wx (Kip-Ft)	Wy (Kip-Ft)	Seated Reaction (Kip)	Friction (Kip-Ft)
1	918	71.5	291	870	2.37	298
2	876	75.3	222	847	1.81	273
3	829	80.2	141	817	1.15	228
Average	**873**	**75.5**	**218**	**845**	**1.78**	**266**

The location of the center of gravity for the North span is greater than the recommended range. In its current condition the span is toe heavy when seated, evenly balanced when open 15.5 degrees, and counterweight heavy when fully open. The greatest imbalance and load on the machinery occurs in the fully open position so the magnitude of closing torque is greater than the magnitude of opening torque on average.

The seated reaction is within the recommended range, but the overall imbalance moment is high. The counterweight heavy imbalance in the fully open position is equivalent to a fully seated toe reaction of -6,400 lbs, which is more than twice the maximum recommended balance magnitude of about 3,000 lbs. The horizontal imbalance moment in the fully seated position is less than the magnitude of the frictional moment resisting operation, so there is no net positive seating torque developed by the bridge when seating. The horizontal imbalance moment in the fully open position is greater than the magnitude of the frictional moment resisting operation, so the brakes are necessary to hold the bridge in the fully open position against imbalance.

TABLE 3: SOUTH SPAN - BALANCE TESTING RESULTS

Run	WL (Kip-Ft)	Alpha (Degrees)	Wx (Kip-Ft)	Wy (Kip-Ft)	Seated Reaction (Kip)	Friction (Kip-Ft)
1	817	58.4	428	696	3.49	380
2	770	62.8	352	685	2.87	385
3	774	62.8	354	689	2.88	380
Average	**787**	**61.3**	**378**	**690**	**3.08**	**382**

The location of the center of gravity for the South span is greater than the recommended range. In its current condition the span is toe heavy when seated, evenly balanced when open 28.7 degrees, and counterweight heavy when fully open. The greatest imbalance and load on the machinery occurs in the fully open position so the magnitude of closing torque is greater than the magnitude of opening torque on average.

The seated reaction is greater than the recommended range and the overall imbalance moment is high. The counterweight heavy imbalance in the fully open position is equivalent to a fully seated toe reaction of -4,900 lbs, which is greater than the maximum recommended balance magnitude of about 3,000 lbs. The horizontal imbalance moment in the fully seated position is less than the magnitude of the frictional moment resisting operation, so there is no net positive seating torque developed by the bridge when seating. The horizontal imbalance moment in the fully open position is greater than the magnitude of the frictional moment resisting operation, so the brakes are necessary to hold the bridge in the fully open position against imbalance.

No issues were noted during operation for either span. The bridge operator noted that the last 20 degrees of span operation in the opening direction are typically performed by turning off the drum controller and letting the bridge “drift” while the brakes bring the bridge to a controlled stop. The operator noted that when the motors are used to fully open the bridge it is difficult to bring the bridge to a controlled stop and the brakes often slip, risking overtravel. The narrative is consistent with the high center of gravity for both spans and the counterweight heavy condition in the fully open position.

RECOMMENDATIONS

HDR recommends preparing detailed calculations and plans to restore the balance of the bridge to the recommended balance condition with a target seated imbalance between 1,600 lbs and 3,000 lbs and a center of gravity location towards the channel between -20 degrees and +20 degrees from a horizontal line through the trunnions. The plans should include details for removal and addition of counterweight between the counterweight pockets as necessary to meet the recommended balance condition. A detailed inventory of the counterweight pockets should be taken to determine the location and magnitude of existing counterweight in each pocket.

HDR also recommends providing maintenance to the brakes and readjusting to the original design brake torque settings, and cleaning and relubricating all gears and bearings to reduce friction.

Performing the above recommendations will increase long term operational reliability of the bridge through the following improvements:

- Reduce maximum power consumption and motor loading.
- Reduce maximum machinery loading and stress oscillation during operation.
- Reduce counterweight heavy span imbalance tending to open the bridge when near fully open.
- Reduce frictional moment resisting bridge operation.
- Reduce required holding torque by the brakes.

APPENDIX A

Sample Balance Calculation

Client: ODOT Project Name: ODOT - Craig Bridge

Project / Calculation Number: 10372613

Total Number of Pages (including cover sheet): 8

Prepared By: Matthew Cassera Date: November 20, 2023

Checked By: Mike Carlton Date: November 20, 2023

Description and Purpose:

The purpose of this calculation is to determine the span balance through the use of strain gage data. The strain gage data is acquired during raising and lowering of the span for shaft 1 (east) and shaft 2 (west). The calculation uses span angle and microstrain measured in the field to provide results.

Note that the bascule span is operated by 2 main pinions which drive against the segmental rack gear segments mounted to the east and west bascule girders. Both pinions are driven through one set of open gearing and a differential gear reducer.

Remarks / Conclusions:

The result of Run 1 was as follows:

WL = 918 kip-ft

alpha = 71.5 degrees

Wx = 291 kip-ft

Wy = 870 kip-ft

Friction = 298 kip-ft

Seated Reaction = 2.37 kips at the toe of the bascule span

Input Data for Leaf Design

Name of Bridge $Bridge := \text{"ODOT - Craig Bridge"}$

Location of Bridge $Location := \text{"Toledo, OH"}$

Date of Test $TestDate := \text{"September 19, 2023"}$

Outside Diameter of Measured Shaft $OD_s := 10\ in$

- Reference: Confirmed with As-Built Drawings & Field Measurements

Inside Diameter of Measured Shaft $ID_s := 1.75 \cdot in$

- Reference: Confirmed with As-Built Drawings & Field Measurements

Shear Modulus of Shaft Material $G := 11500 \cdot ksi$

- Reference: Published Value for Steel

Beginning of constant velocity readings $Bcv := 25$

- Reference: Determined from Excel Data

End of constant velocity readings $Ecv := 50$

- Reference: Determined from Excel Data

Gear ratio of measured shaft to span $GR := \frac{238}{15} \cdot \frac{54}{15} = 57$

- Reference: Confirmed with As-Built Drawings & Field Measurements

Efficiency of gearing $Eff := .98^2 \cdot .95^2 = 0.87$

- Represents 2 sets of open gearing and bearings.

Length of Span, Center of Rotation to CL Bascule Span $L_{sp} := 122\ ft + 9.875\ in$

- Reference: Confirmed with As-Built Drawings & Field Measurements

Import Data from Excel Spreadsheet

Use "READ EXCEL" Data Import function to import data. File must be formatted in the following manner:
- Column A: Angle of Span (degrees)
- Column B: Strain of Shaft 1 (micro stain)
- Column C: Strain of Shaft 2 (micro stain)

Test Run Number $Testrun := \text{“North - Run 1”}$

Data File for Raising the Span

$$DFR := \text{READEXCEL}\left(\text{“..\textbackslash XLS Files\textbackslash North\textbackslash Run 1\_Up.xlsx”}, \text{“Run 1\_Up!A1:C2248”}\right)$$

Data File for Lowering the Span

$$DFL := \text{READEXCEL}\left(\text{“..\textbackslash XLS Files\textbackslash North\textbackslash Run 1\_Down.xlsx”}, \text{“Run 1\_Down!A1:C6320”}\right)$$

Polarity Determined from Seating Data or Gear Contact

Shaft 1 (East) Polarity $S1_P := 1$

Shaft 2 (West) Polarity $S2_P := 1$

Assign the Data to Arrays

Angle of constant velocity	$\theta := Bcv..Ecv$	
Angle of raising the span in degrees	$A_{rs} := DFR^{\langle 1 \rangle}$	$Ars(n) := A_{rs_{n,1}}$
Strain for raising the span in micro strain, shaft 1 (east)	$S1_{rs} := DFR^{\langle 2 \rangle}$	$Srs1(n) := S1_{rs_{n,1}}$
Strain for raising the span in micro strain, shaft 2 (west)	$S2_{rs} := DFR^{\langle 3 \rangle}$	$Srs2(n) := S2_{rs_{n,1}}$
Angle of lowering the span in degrees	$A_{ls} := DFL^{\langle 1 \rangle}$	$Als(n) := A_{ls_{n,1}}$
Strain for lowering the span in micro strain, shaft 1 (east)	$S1_{ls} := DFL^{\langle 2 \rangle}$	$Sls1(n) := S1_{ls_{n,1}}$
Strain for lowering the span in micro strain, shaft 2 (west)	$S2_{ls} := DFL^{\langle 3 \rangle}$	$Sls2(n) := S2_{ls_{n,1}}$
Number of rows for raising the span	$Rrs := \text{rows}(DFR)$	$Rrs = 2248$
Number of rows for lowering the span	$Rls := \text{rows}(DFL)$	$Rls = 6320$

<u>Find Average Strain (per Degree raising)</u>

Average strain for raising the span:
per degree for shaft 1

```
Sr1(θ) := | xx ← 0
          | j ← 0
          | k ← 0
          | while j < Rrs
          |   | j ← j + 1
          |   | if Ars(j) ≥ θ ∧ Ars(j) < (θ + 1)
          |   |   | xx ← xx + Srs1(j)
          |   | if θ < Bcv ∨ θ > Ecv
          |   |   | xx ← 0
          |   | if Ars(j) ≥ θ ∧ Ars(j) < (θ + 1)
          |   |   | k ← k + 1
          | xx / k
```

Average strain for raising the span:
per degree for shaft 2

```
Sr2(θ) := | xx ← 0
          | j ← 0
          | k ← 0
          | while j < Rrs
          |   | j ← j + 1
          |   | if Ars(j) ≥ θ ∧ Ars(j) < (θ + 1)
          |   |   | xx ← xx + Srs2(j)
          |   | if θ < Bcv ∨ θ > Ecv
          |   |   | xx ← 0
          |   | if Ars(j) ≥ θ ∧ Ars(j) < (θ + 1)
          |   |   | k ← k + 1
          | xx / k
```

Find Average Strain (per degree lowering)

Average strain for lowering the span: per degree for shaft 1

```
Sl1(θ) := | xx ← 0
          | j ← 0
          | k ← 0
          | while j < Rls
          |   | j ← j + 1
          |   | if Als(j) ≥ θ ∧ Als(j) < (θ + 1)
          |   |   | xx ← xx + Sls1(j)
          |   | if θ < Bcv ∨ θ > Ecv
          |   |   | xx ← 0
          |   | if Als(j) ≥ θ ∧ Als(j) < (θ + 1)
          |   |   | k ← k + 1
          | xx / k
```

Average strain for lowering the span: per degree for shaft 2

```
Sl2(θ) := | xx ← 0
          | j ← 0
          | k ← 0
          | while j < Rls
          |   | j ← j + 1
          |   | if Als(j) ≥ θ ∧ Als(j) < (θ + 1)
          |   |   | xx ← xx + Sls2(j)
          |   | if θ < Bcv ∨ θ > Ecv
          |   |   | xx ← 0
          |   | if Als(j) ≥ θ ∧ Als(j) < (θ + 1)
          |   |   | k ← k + 1
          | xx / k
```

Convert Strain to Torque (per degree)

For the following equations the polar moment of inertia will be defined as the following:
$$J := \frac{\pi}{32} \cdot \left(OD_s^{\,4} - ID_s^{\,4}\right)$$

Bridge Torque from Shaft 1 (West) due to raising the leaf:
$$Trs1(\theta) := \frac{G \cdot J \cdot GR \cdot Eff \cdot S1_P}{\frac{OD_s}{2}} \cdot \frac{Sr1(\theta)}{10^6}$$

Bridge Torque from Shaft 2 (East) due to raising the leaf:
$$Trs2(\theta) := \frac{G \cdot J \cdot GR \cdot Eff \cdot S2_P}{\frac{OD_s}{2}} \cdot \frac{Sr2(\theta)}{10^6}$$

Bridge Torque from Shaft 1 due to lowering the leaf:
$$Tls1(\theta) := \frac{G \cdot J \cdot GR \cdot Eff \cdot S1_P}{\frac{OD_s}{2}} \cdot \frac{Sl1(\theta)}{10^6}$$

Bridge Torque from Shaft 2 due to lowering the leaf:
$$Tls2(\theta) := \frac{G \cdot J \cdot GR \cdot Eff \cdot S2_P}{\frac{OD_s}{2}} \cdot \frac{Sl2(\theta)}{10^6}$$

Total torque of raising the span:
$$Trs(\theta) := Trs1(\theta) + Trs2(\theta)$$

Total torque of lowering the span:
$$Tls(\theta) := Tls1(\theta) + Tls2(\theta)$$

Calculate Imbalance and Friction from Torque (per degree)

Imbalance of shaft 1:
$$Is1(\theta) := \frac{Trs1(\theta) + Tls1(\theta)}{2}$$

Imbalance of shaft 2:
$$Is2(\theta) := \frac{Trs2(\theta) + Tls2(\theta)}{2}$$

Total Imbalance of span:
$$Is(\theta) := \frac{Trs(\theta) + Tls(\theta)}{2} \qquad I_\theta := Is(\theta)$$

Friction of shaft 1:
$$Fs1(\theta) := \frac{Trs1(\theta) - Tls1(\theta)}{2}$$

Friction of shaft 2:
$$Fs2(\theta) := \frac{Trs2(\theta) - Tls2(\theta)}{2}$$

Total friction of span:
$$Fs(\theta) := \frac{Trs(\theta) - Tls(\theta)}{2}$$

Calculate WL and α from Torque

$F(WL, \alpha, \theta) := WL \cdot \cos\left(\alpha + \theta \cdot \frac{\pi}{180}\right)$

$BFC(WL, \alpha) := \sum_{\theta} \left(F(WL, \alpha, \theta) - I_{\theta}\right)^2$

Guess Values

$WL := 200 \cdot kip \cdot ft$

$\alpha := 10\ deg$

Constraints

$BFC(WL, \alpha) = 0$

Solver

$\begin{bmatrix} WL \\ \alpha \end{bmatrix} := \mathbf{Minerr}(WL, \alpha)$

$WL = 917.9\ ft \cdot kip$ $\alpha = 71.5401\ deg$

$Wx := WL \cdot \cos(\alpha)$ $Wx = 291\ ft \cdot kip$

$Wy := WL \cdot \sin(\alpha)$ $Wy = 871\ ft \cdot kip$

$alpha := \alpha \cdot \frac{180}{\pi}$ $alpha = 71.5$

$friction := \left| \frac{\sum_{\theta} Fs(\theta)}{Ecv - Bcv + 1} \right|$

Set Graphing Limits

Upper Graph Range Limit $gr1 := 200$

Lower Graph Range Limit $gr2 := -750$

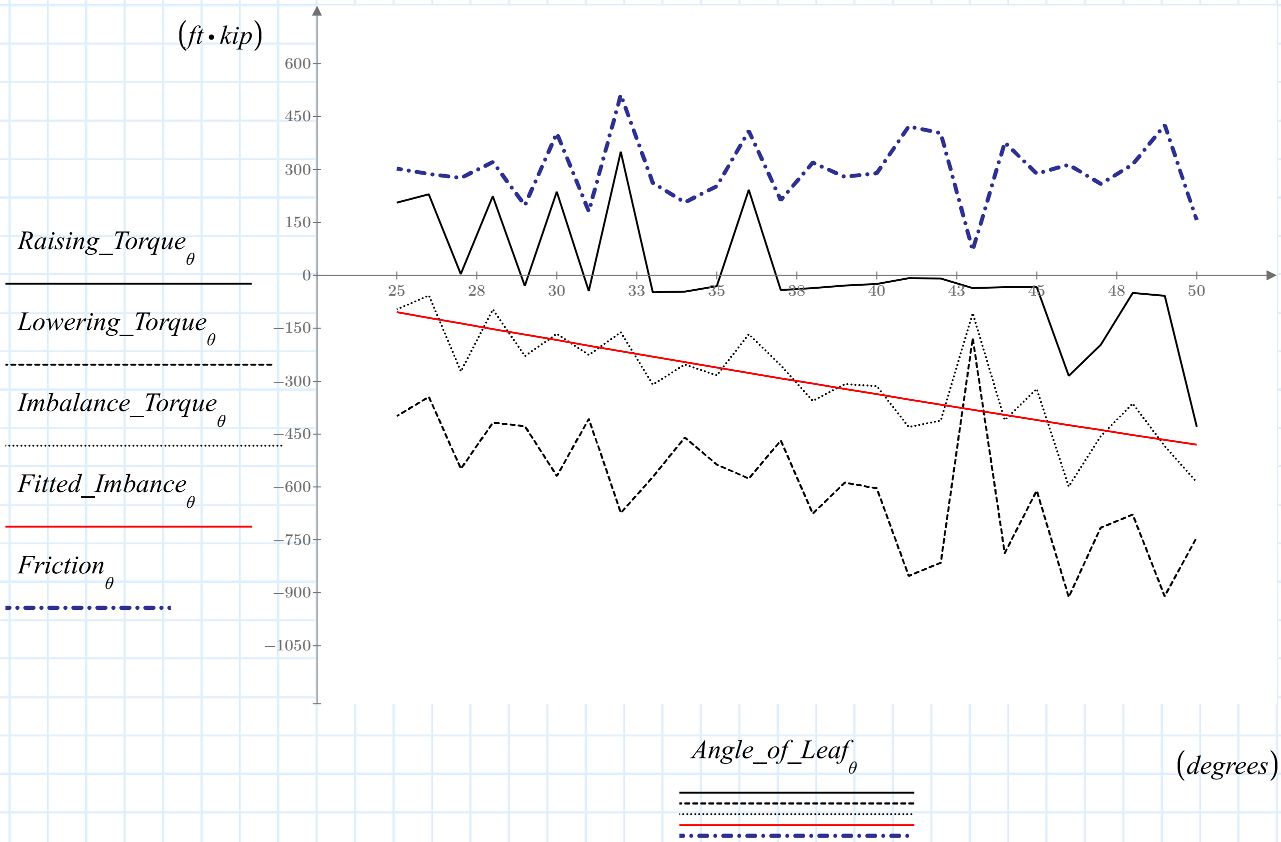
APPENDIX B

Results of Strain Gauge Analysis

Summary of Results

$Bridge = \text{"ODOT - Craig Bridge"}$ $TestDate = \text{"September 19, 2023"}$

$Location = \text{"Toledo, OH"}$ $Testrun = \text{"North - Run 1"}$



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 917.88$ ***ft·kip*** $Wx = 290.6$ ***ft·kip*** $Wy = 870.6$ ***ft·kip***

Center of Gravity Location Angle: $\alpha = 71.5$ ***deg***

Frictional Moment: $friction = 298.00$ ***ft·kip***

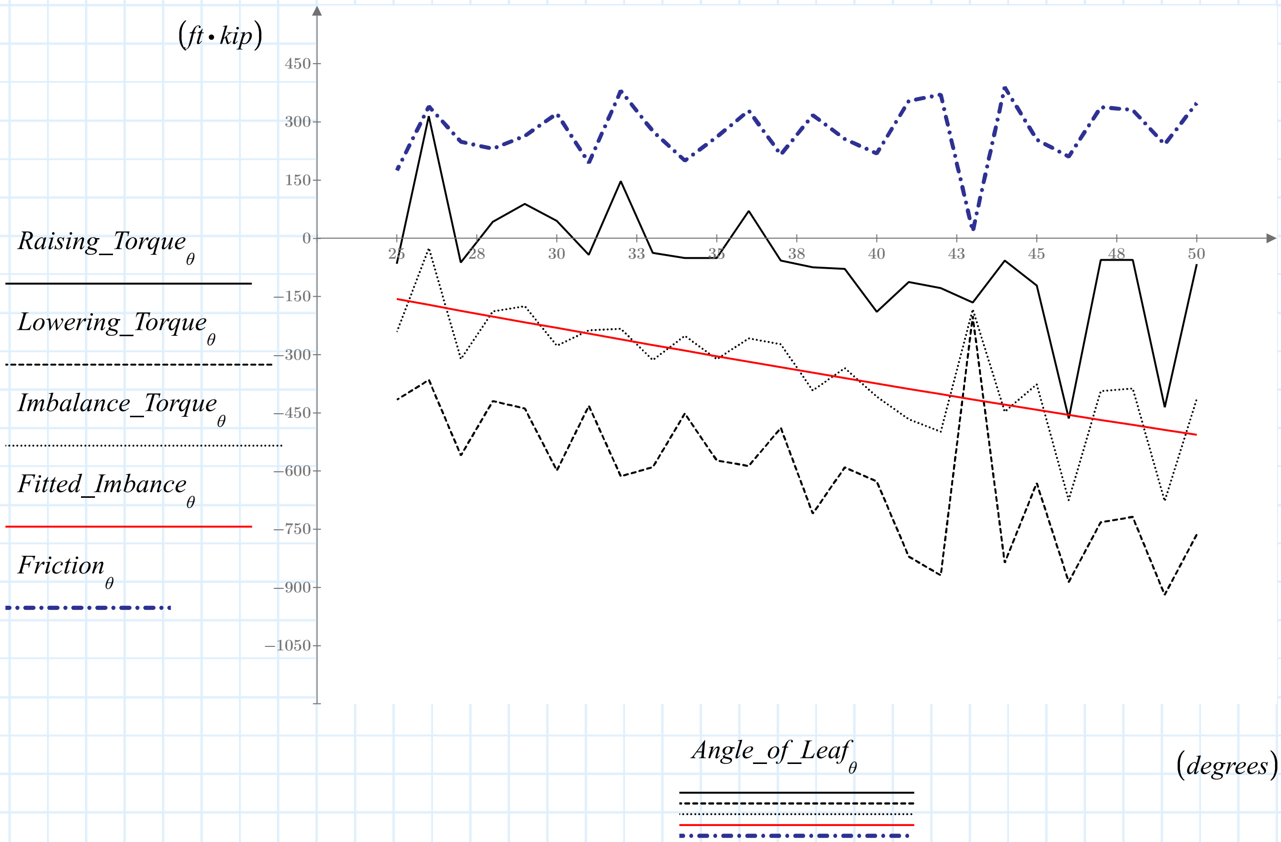
Seated Imbalance Moment: $F(WL, \alpha, 0) = 290.64$ ***ft·kip***

Seated Toe Reaction: $Tip := \dfrac{Wx}{L_{sp}} = 2.37$ ***kip***

Summary of Results

$Bridge = \text{"ODOT - Craig Bridge"}$ $TestDate = \text{"September 19, 2023"}$

$Location = \text{"Toledo, OH"}$ $Testrun = \text{"North - Run 2"}$



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 876.12$ ***ft·kip*** $Wx = 222.4$ ***ft·kip*** $Wy = 847.4$ ***ft·kip***

Center of Gravity Location Angle: $\alpha = 75.3$ ***deg***

Frictional Moment: $friction = 272.50$ ***ft·kip***

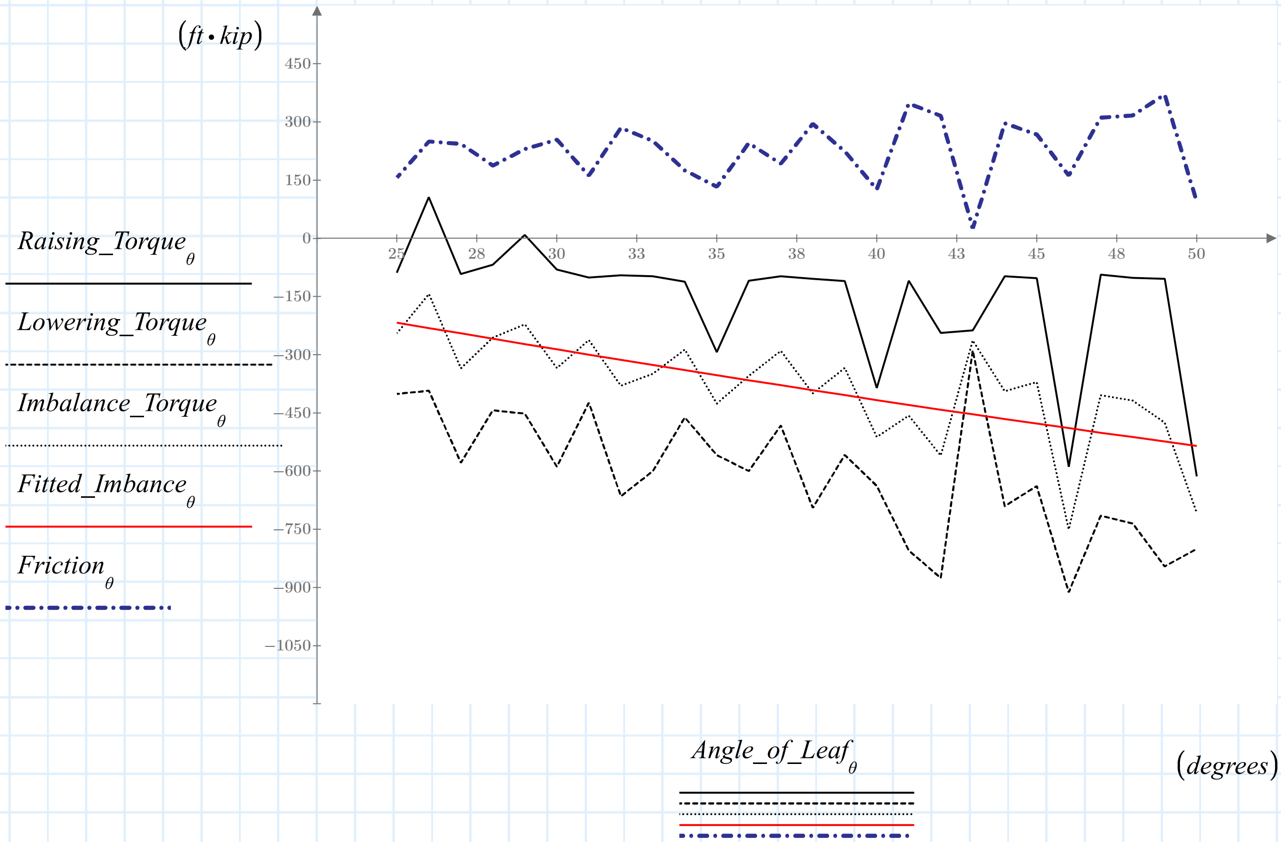
Seated Imbalance Moment: $F(WL, \alpha, 0) = 222.43$ ***ft·kip***

Seated Toe Reaction: $Tip := \frac{Wx}{L_{sp}} = 1.81$ ***kip***

Summary of Results

$Bridge = \text{"ODOT - Craig Bridge"}$ $TestDate = \text{"September 19, 2023"}$

$Location = \text{"Toledo, OH"}$ $Testrun = \text{"North - Run 3"}$



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 828.70$ ***ft·kip*** $Wx = 141.1$ ***ft·kip*** $Wy = 816.6$ ***ft·kip***

Center of Gravity Location Angle: $\alpha = 80.2$ ***deg***

Frictional Moment: $friction = 227.56$ ***ft·kip***

Seated Imbalance Moment: $F(WL, \alpha, 0) = 141.07$ ***ft·kip***

Seated Toe Reaction: $Tip := \frac{Wx}{L_{sp}} = 1.15$ ***kip***

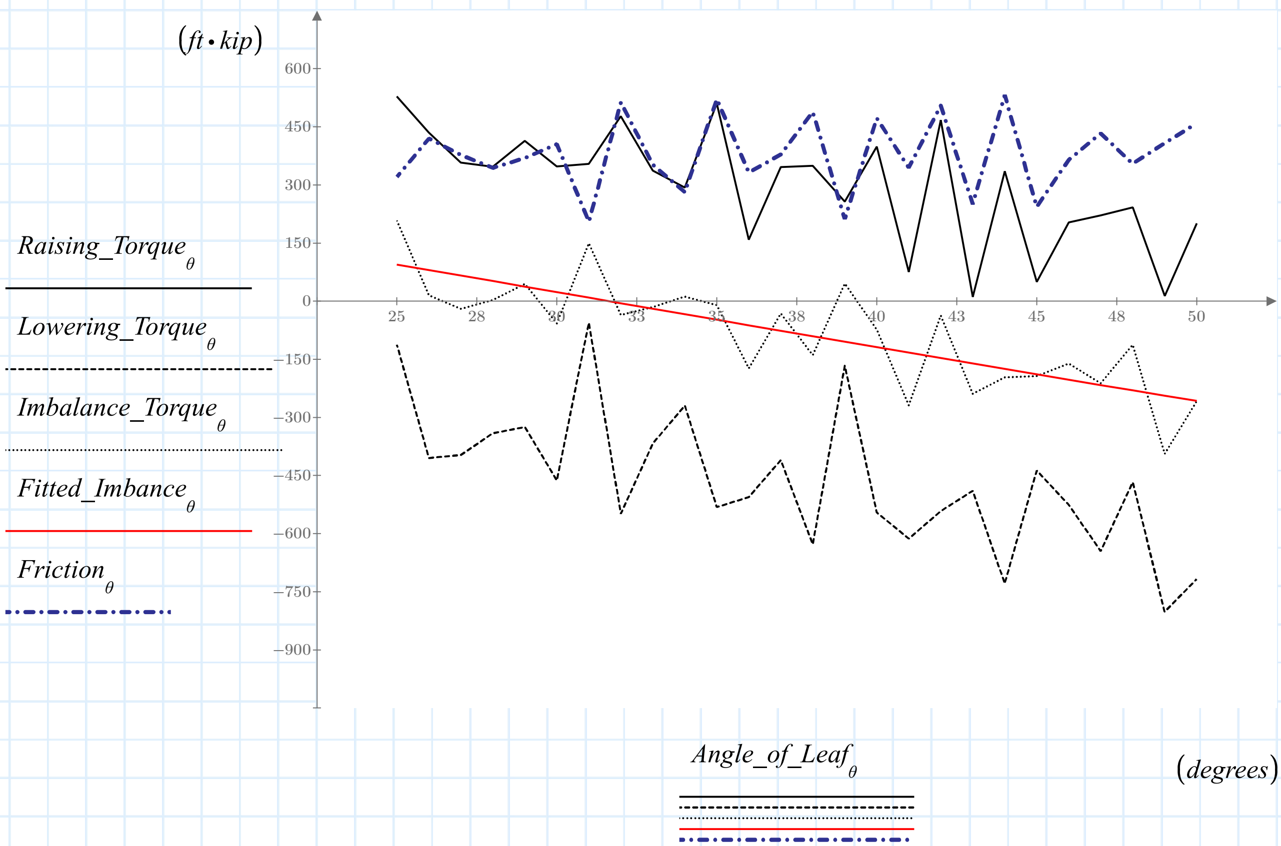
Summary of Results

$Bridge = $ "ODOT - Craig Bridge"

$TestDate = $ "September 20, 2023"

$Location = $ "Toledo, OH"

$Testrun = $ "South - Run 1"



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 817.18\ ft \cdot kip$ $Wx = 428.6\ ft \cdot kip$ $Wy = 695.7\ ft \cdot kip$

Center of Gravity Location Angle: $\alpha = 58.4\ deg$

Frictional Moment: $friction = 380.19\ ft \cdot kip$

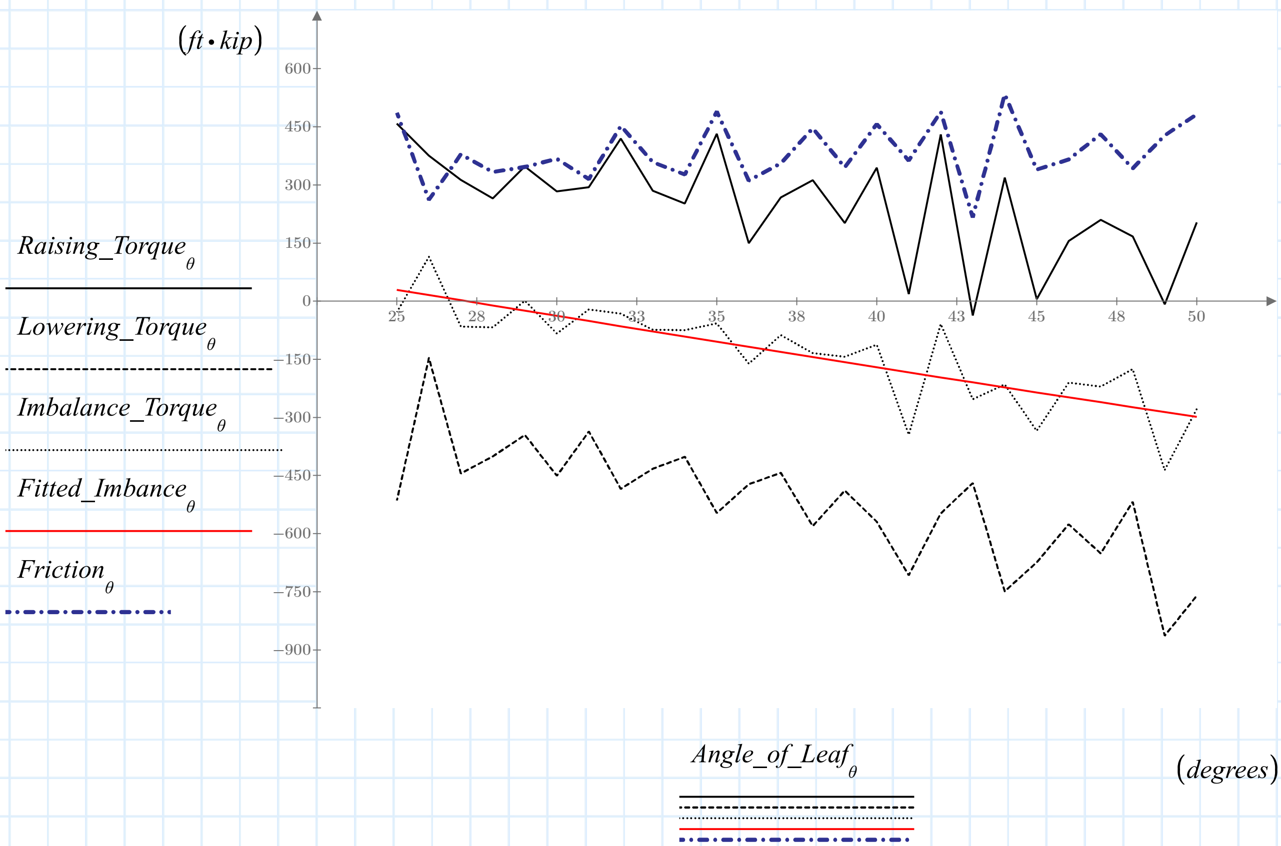
Seated Imbalance Moment: $F(WL, \alpha, 0) = 428.62\ ft \cdot kip$

Seated Toe Reaction: $Tip := \frac{Wx}{L_{sp}} = 3.49\ kip$

Summary of Results

$Bridge = \text{“ODOT - Craig Bridge”}$ $\quad$ $TestDate = \text{“September 20, 2023”}$

$Location = \text{“Toledo, OH”}$ $\quad$ $Testrun = \text{“South - Run 2”}$



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 769.88\ ft \cdot kip$ $\quad$ $Wx = 351.7\ ft \cdot kip$ $\quad$ $Wy = 684.8\ ft \cdot kip$

Center of Gravity Location Angle: $\alpha = 62.8\ deg$

Frictional Moment: $friction = 385.37\ ft \cdot kip$

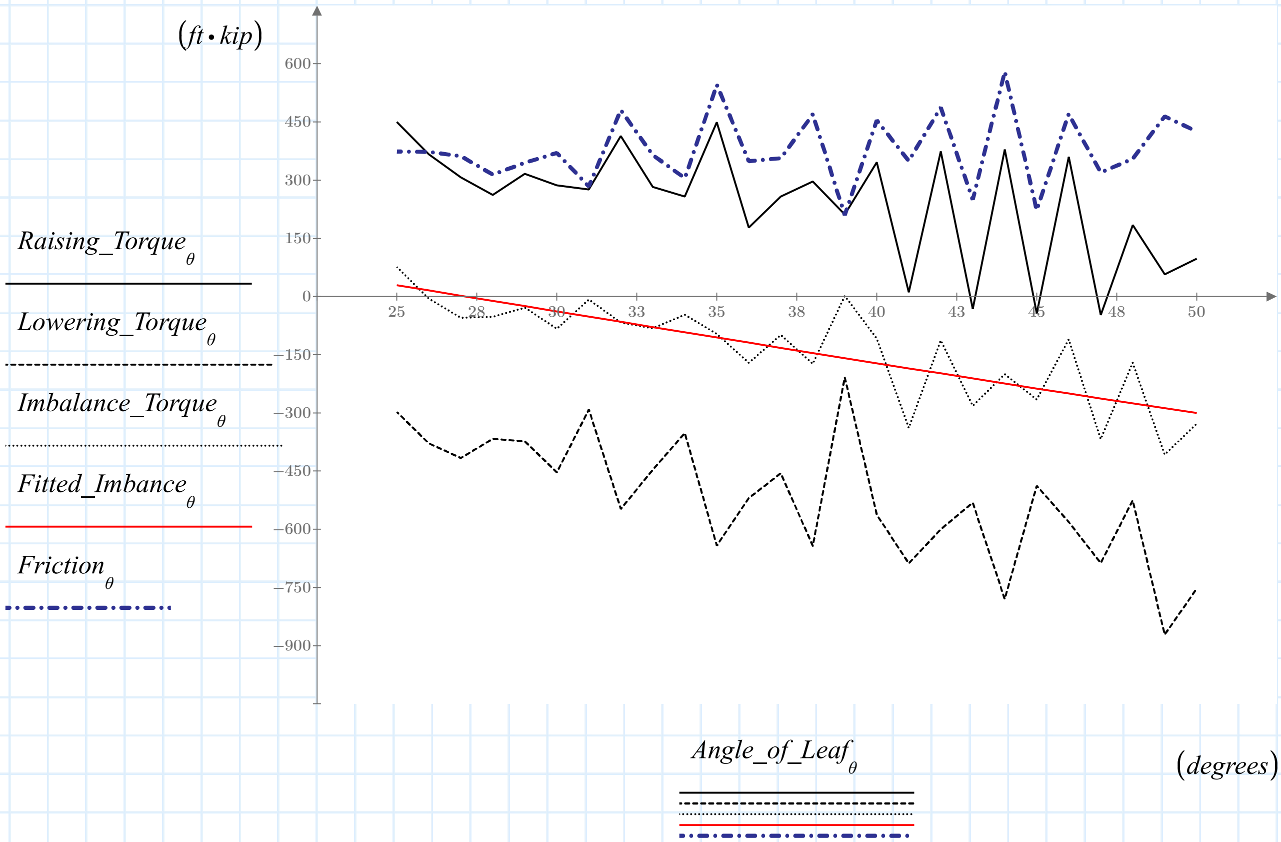
Seated Imbalance Moment: $F(WL, \alpha, 0) = 351.70\ ft \cdot kip$

Seated Toe Reaction: $Tip := \dfrac{Wx}{L_{sp}} = 2.86\ kip$

Summary of Results

$Bridge = \text{"ODOT - Craig Bridge"}$ $TestDate = \text{"September 20, 2023"}$

$Location = \text{"Toledo, OH"}$ $Testrun = \text{"South - Run 3"}$



Leaf imbalance = WL*cos(leaf angle + alpha)

Overall Imbalance Moment: $WL = 774.20$ ***ft·kip*** $Wx = 353.4$ ***ft·kip*** $Wy = 688.8$ ***ft·kip***

Center of Gravity Location Angle: $\alpha = 62.8$ ***deg***

Frictional Moment: $friction = 379.93$ ***ft·kip***

Seated Imbalance Moment: $F(WL, \alpha, 0) = 353.43$ ***ft·kip***

Seated Toe Reaction: $Tip := \frac{Wx}{L_{sp}} = 2.88$ ***kip***

Appendix 6:

Mechanical Layout & Clearance Measurements

hdrinc.com 600 Superior Avenue East, Suite 1700, Cleveland, OH 44114-2622
(216) 912-4240

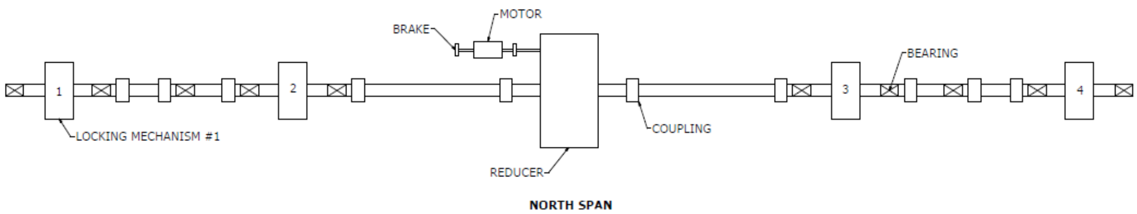


Figure 1: Span Lock Machinery

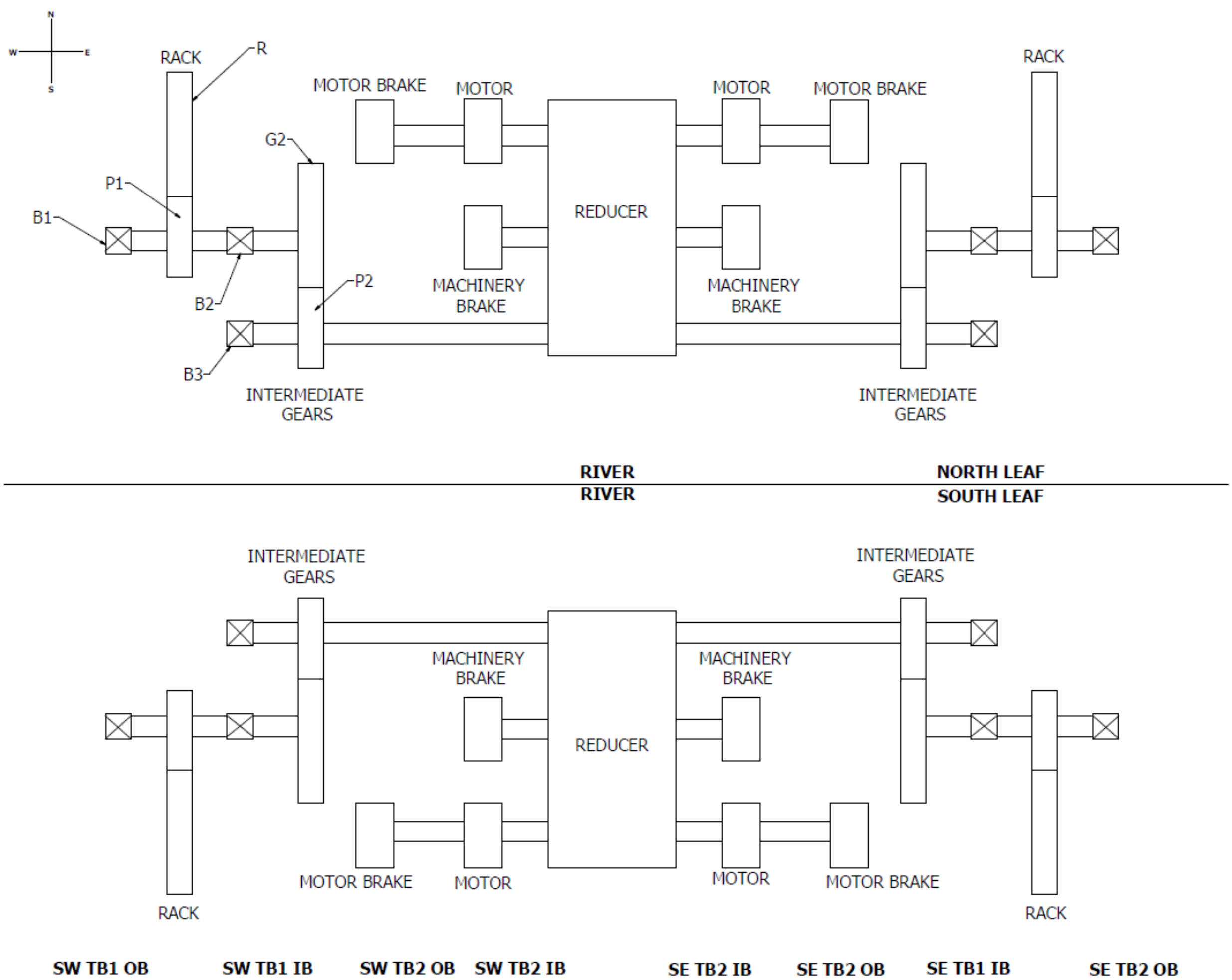


Figure 2: Bridge Machinery Layout

Craig Memorial - ODOT: September 20th, 2023

User Inputs									Calculated Reference Info		Span Measurement # of Teeth	Span Measurement Orig.	Chordal Measurements									Wear		Backlash		Tip Clearances	
LEAF	GEAR	FD=Full Depth ST=Stub Tooth SP=Special	No. Teeth	Pitch Diameter (in.)	Pres. Ang. (Deg)	Diametral Pitch	Circular Pitch (in.)	Backlash, as fabricated (in.)* **	P. Radius (in.)	Arc Tooth Thickness with No BL (in.)	Recommended	Original with No BL (in.)	Original Addendum (in.)	Addendum Used (in.)	Thickness (in.) with No BL	West Side (in.)	Calibrated West Side (in.)	Center (in.)	Calibrated Center (in.)	East Side (in.)	Calibrated East Side (in.)	Wear (in.)	Wear (%)	Theoretical installation (in.)	Current (in.) Measurement taken with span seated.	At Tooth Tip (in.) [E-left and W-right ends of tooth)	Measurement taken with span seated.
NE	R	ST	238	398.000	20	0.6	5.250	0.040	199.000	2.625	0	3.107	1.341	1.350	2.625	2.539	2.522	2.560	2.543	2.552	2.535	0.091	9.15	0.110	0.397	NM	NM
	P1	ST	15	25.067	20	0.6	5.250	0.040	12.533	2.625	2	7.751	1.405	1.375	2.620	2.564	2.620	2.556	2.612	2.568	2.624	0.001	0.14				
	G2	FD	54	72.000	20	0.75	4.189	0.025	36.000	2.0944	7	26.594	1.349	1.350	2.094	2.056	2.054	2.039	2.037	2.030	2.028	0.054	5.38	0.070	0.172	NM	NM
	P2	FD	15	20.000	20	0.75	4.189	0.025	10.000	2.0944	2	6.184	1.388	1.380	2.091	2.055	2.067	2.061	2.073	2.049	2.061	0.024	2.41				
NW	R	ST	238	398.000	20	0.6	5.250	0.040	199.000	2.625	0	3.107	1.341	1.350	2.625	2.496	2.480	2.508	2.491	2.500	2.484	0.140	14.02	0.110	0.550	NM	NM
	P1	ST	15	25.067	20	0.6	5.250	0.040	12.533	2.625	2	7.751	1.405	1.375	2.620	2.525	2.580	2.532	2.587	2.505	2.560	0.044	4.43				
	G2	FD	54	72.000	20	0.75	4.189	0.025	36.000	2.0944	7	26.594	1.349	1.350	2.094	2.029	2.027	2.044	2.042	2.050	2.048	0.055	5.45	0.070	0.235	NM	NM
	P2	FD	15	20.000	20	0.75	4.189	0.025	10.000	2.0944	2	6.184	1.388	1.380	2.091	2.067	2.079	2.036	2.048	2.016	2.028	0.040	3.95				
SE	R	ST	238	398.000	20	0.6	5.250	0.040	199.000	2.625	0	3.107	1.341	1.350	2.625	2.485	2.469	2.488	2.472	2.501	2.485	0.150	15.01	0.110	0.479	NM	NM
	P1	ST	15	25.067	20	0.6	5.250	0.040	12.533	2.625	2	7.751	1.405	1.375	2.620	2.564	2.620	2.568	2.624	2.540	2.595	0.007	0.69				
	G2	FD	54	72.000	20	0.75	4.189	0.025	36.000	2.0944	7	26.594	1.349	1.350	2.094	2.059	2.057	2.066	2.064	2.012	2.011	0.050	4.98	0.070	0.285	NM	NM
	P2	FD	15	20.000	20	0.75	4.189	0.025	10.000	2.0944	2	6.184	1.388	1.380	2.091	2.070	2.082	2.072	2.084	2.160	2.173	-0.022	-2.18				
SW	R	ST	238	398.000	20	0.6	5.250	0.040	199.000	2.625	0	3.107	1.341	1.350	2.625	2.507	2.490	2.520	2.503	2.495	2.479	0.134	13.42	0.110	0.412	NM	NM
	P1	ST	15	25.067	20	0.6	5.250	0.040	12.533	2.625	2	7.751	1.405	1.375	2.620	2.544	2.600	2.550	2.606	2.564	2.620	0.012	1.16				
	G2	FD	54	72.000	20	0.75	4.189	0.025	36.000	2.0944	7	26.594	1.349	1.350	2.000	2.005	2.004	2.015	2.014	2.016	2.015	-0.011	-1.05	0.070	0.176	NM	NM
	P2	FD	15	20.000	20	0.75	4.189	0.025	10.000	2.0944	2	6.184	1.388	1.380	2.091	2.108	2.120	2.094	2.106	2.078	2.090	-0.014	-1.45				

Table 1: Open Gearing Measurements

MAIN REDUCER OUTPUT BEARING CLEARANCE MEASUREMENTS										
Mark	**Type**	**Journal Dia. (in.)**	**Bearing Clearance**				**Met Spec?**	**Location of Measurement**	**Comments**
			RC6*		**RC9 Max**	**2023 (in.)**			
NE	Plain	9	0.004	0.011	0.034	0.008	Y	12:00	-
NW	Plain	9	0.004	0.011	0.034	-	N/A*	-	Unable to fit any gauges for measurement
SE	Plain	9	0.004	0.011	0.034	0.007	Y	3:00	-
SW	Plain	9	0.004	0.011	0.034	0.026	N	8:00	-

RC6*: Recommended fit

Table 2: Main Reducer Output Bearing Clearance

Appendix 7:
Oil Sample Testing Reports

Bureau Veritas Oil Condition Monitoring
2450 Hassell Rd, Hoffman Estates, IL
800-222-0071
LOAMS@bureauveritas.com

LOAMS Lube Oil Analysis Management System

Sample Analysis Report

Status ABNORMAL

Account Information		Sample Information		Other Sample Information	
Lab Customer ID#:	404332	Lab No.:	202310170356	PO No.:	
Company Name:	HDR, Inc.	Sample Tracking #:	S20230731035747	Work Order No.:	
Worksite:	Newark, NJ	Sampled Date:	09/21/2023	Reference No.:	9874421
Address:	1037 Raymond Blvd, Suite 1400, Newark, NJ, 07102	Received Date:	10/17/2023	Filter Age:	
		Completed Date:	10/19/2023	Make Up Oil Amount:	

Unit Information		Component Information		Fluid Information	
Unit ID	ODOT - Craig North	Component Description	GEARBOX	Fluid Manufacturer	
Unit Manufacturer		Component Manufacturer		Fluid Brand/Product	
Unit Model		Component Model		Fluid Grade	
Unit Serial		Component Serial			
Unit Worksite	Newark, NJ	Component Type	GEARBOX		

Maintenance for Lab No. : 202310170356
Evaluated By : Stephen Kullas - Data Analyst

ANALYSIS INDICATES AN ABNORMAL LEVEL OF CONTAMINATION IS PRESENT! PARTICLE COUNT level(s) are HIGH. PURIFY the oil. RESAMPLE at the next scheduled interval.

SPECTROCHEMICAL ANALYSIS IN PARTS PER MILLION

		Wear Metals										Contaminants			Additives								
LAB NO.	SAMPLE DRAWN	Iron	Chromium	Nickel	Aluminum	Lead	Copper	Tin	Silver	Titanium	Vanadium	Silicon	Sodium	Potassium	Boron	Molybdenum	Phosphorus	Zinc	Calcium	Barium	Magnesium	Antimony
0356	09/21/2023	12	<1	<1	1	18	50	2	<0.1	<1	<1	18	13	<1	94	17	400	308	30	<1	1	13

SAMPLE INFORMATION

Lab No.	Sample Drawn	Unit Time	Lube Age	UOM	Filter Chgd.	Lube Service
0356	09/21/2023	5000	5000	HR	No	S

FLUID PROPERTIES

Water (KF) ppm	Viscosity 40 °C cSt	Total Acid Number mg KOH/g	Particles >4µm	Particles >6µm
614	289.6	0.34	166485	138270

KEY: UoM - Unit of Measure Y - Yes N - No C - Changed S - Sampled > - Greater Than < - Less Than N/R - Not Reported (M) - Modified Method

This analysis is intended as an aid in predicting mechanical wear. Test results, maintenance recommendations and accuracy are affected by customer provided samples, equipment identification, maintenance history and apply only to this sample as provided. No guarantee, expressed or implied, is made against failure of this piece of equipment or a component thereof. The ultimate responsibility for the maintenance of this piece of equipment and all of its components is the responsibility of the equipment owner.

Testing performed by Bureau Veritas, an ISO/IEC 17025:2017 accredited laboratory by ANAB. Certificate and scope of accredited methods can be found at https://oil-testing.com/iso-17025-quality-program/. �: Not in scope of accreditation. For further details on outsourced testing, contact the laboratory directly. Click here for Tests and Methodologies.

FLUID PROPERTIES

Particles >14µm	Particles >21µm	Particles >38µm	Particles >70µm	ISO Code
43994	11972	379	28	25/24/23 *

LOAMS Lube Oil Analysis Management System

Bureau Veritas Oil Condition Monitoring
2450 Hassell Rd, Hoffman Estates, IL
800-222-0071
LOAMS@bureauveritas.com

Sample Analysis Report

Status ABNORMAL

Account Information		Sample Information		Other Sample Information	
Lab Customer ID#:	404332	Lab No.:	202310100590	PO No.:	
Company Name:	HDR, Inc.	Sample Tracking #:	S20230807040542	Work Order No.:	
Worksite:	Newark, NJ	Sampled Date:	09/21/2023	Reference No.:	9874387
Address:	1037 Raymond Blvd, Suite 1400, Newark, NJ, 07102	Received Date:	10/10/2023	Filter Age:	
		Completed Date:	10/12/2023	Make Up Oil Amount:	

Unit Information		Component Information		Fluid Information	
Unit ID	ODOT - Craig South	Component Description	GEARBOX	Fluid Manufacturer	
Unit Manufacturer		Component Manufacturer		Fluid Brand/Product	
Unit Model		Component Model		Fluid Grade	
Unit Serial		Component Serial			
Unit Worksite	Newark, NJ	Component Type	GEARBOX		

Maintenance for Lab No. : 202310100590
Evaluated By : Stephen Kullas - Data Analyst

ANALYSIS INDICATES AN ABNORMAL LEVEL OF CONTAMINATION IS PRESENT! PARTICLE COUNT level(s) are HIGH. PURIFY the oil. RESAMPLE at the next scheduled interval.

SPECTROCHEMICAL ANALYSIS IN PARTS PER MILLION

		Wear Metals										Contaminants			Additives							
LAB NO.	SAMPLE DRAWN	Iron	Chromium	Nickel	Aluminum	Lead	Copper	Tin	Silver	Titanium	Vanadium	Silicon	Sodium	Potassium	Boron	Molybdenum	Phosphorus	Zinc	Calcium	Barium	Magnesium	Antimony
0590	09/21/2023	25	<1	<1	1	46	78	4	<0.1	<1	<1	15	5	1	22	16	486	407	24	1	1	24

SAMPLE INFORMATION

Lab No.	Sample Drawn	Unit Time	Lube Age	UOM	Filter Chgd.	Lube Service
0590	09/21/2023	5000	5000	HR	No	S

FLUID PROPERTIES

Water (KF) ppm	Viscosity 40 °C cSt	Total Acid Number mg KOH/g	Particles >4µm	Particles >6µm
255	296.1	0.79	172831	143423

KEY: UoM - Unit of Measure Y - Yes N - No C - Changed S - Sampled > - Greater Than < - Less Than N/R - Not Reported (M) - Modified Method

This analysis is intended as an aid in predicting mechanical wear. Test results, maintenance recommendations and accuracy are affected by customer provided samples, equipment identification, maintenance history and apply only to this sample as provided. No guarantee, expressed or implied, is made against failure of this piece of equipment or a component thereof. The ultimate responsibility for the maintenance of this piece of equipment and all of its components is the responsibility of the equipment owner.

Testing performed by Bureau Veritas, an ISO/IEC 17025:2017 accredited laboratory by ANAB. Certificate and scope of accredited methods can be found at https://oil-testing.com/iso-17025-quality-program/. �: Not in scope of accreditation. For further details on outsourced testing, contact the laboratory directly. Click here for Tests and Methodologies.

FLUID PROPERTIES				
Particles >14µm	Particles >21µm	Particles >38µm	Particles >70µm	ISO Code
46496	14608	1102	145	25/24/23 *

Appendix 8:

Electrical Measurements

Insulation Resistance Tests

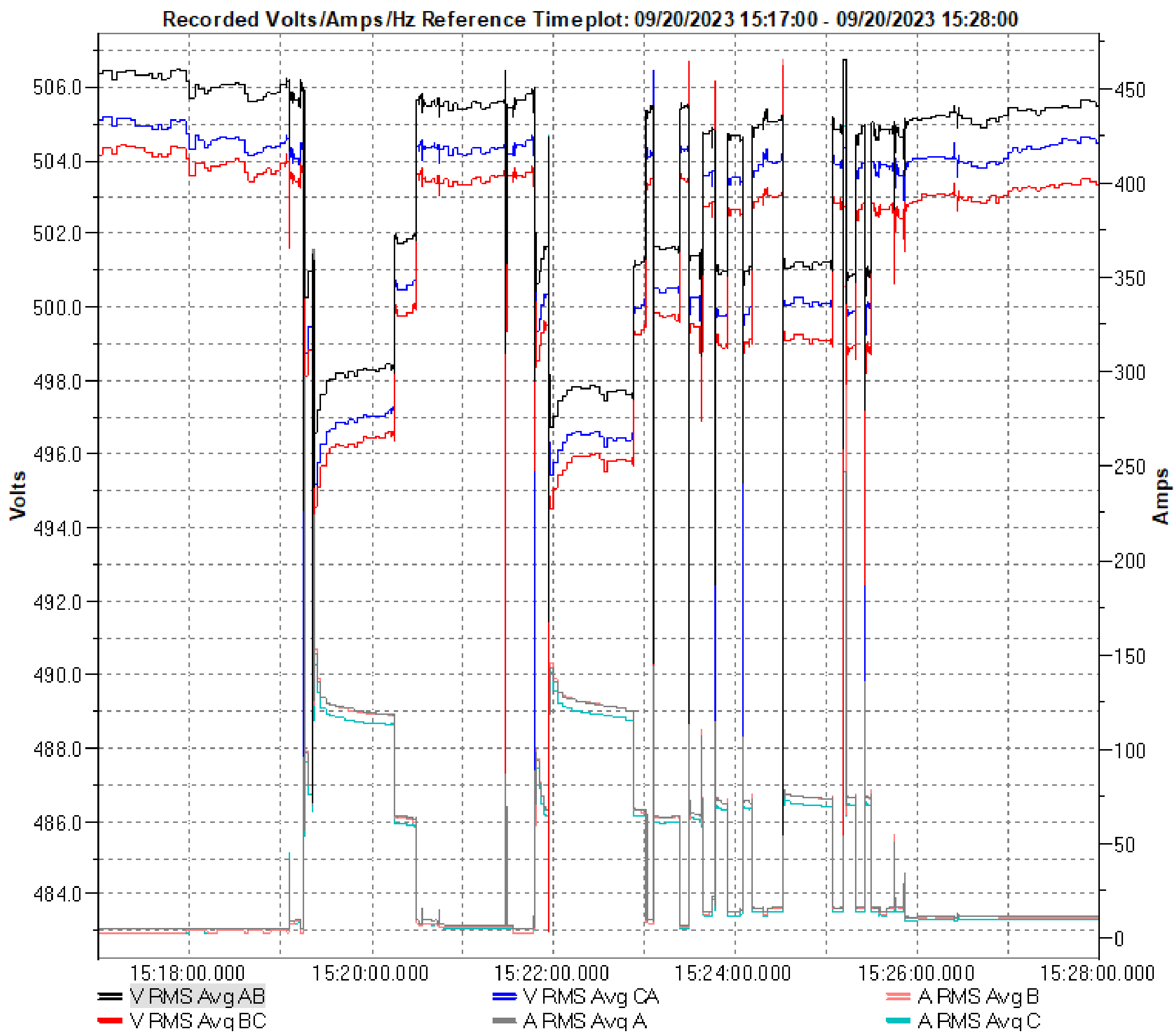
Notes:

Gates, Brakes and Locks measurements taken from motor starter cabinet. Main Drive Motor measurements taken from disconnect.

Device	Phase A to Ground (M-ohms)
NE Main Drive Motor	0.7
NW Main Drive Motor	4.4
SE Main Drive Motor	4.3
SW Main Drive Motor	4.7
North Brake A	10.3
North Brake B	24.6
North Brake C	13.6
North Brake D	14.9
South Brake A	13.9
South Brake B	23.7
South Brake C	61.3
South Brake D	21.7
Lock Motor	10.7
North On-Coming Gate	N/A
North Off-Going Gate	5.7
South On-Coming Gate	N/A
South Off-Going Gate	123

Motor Measurements

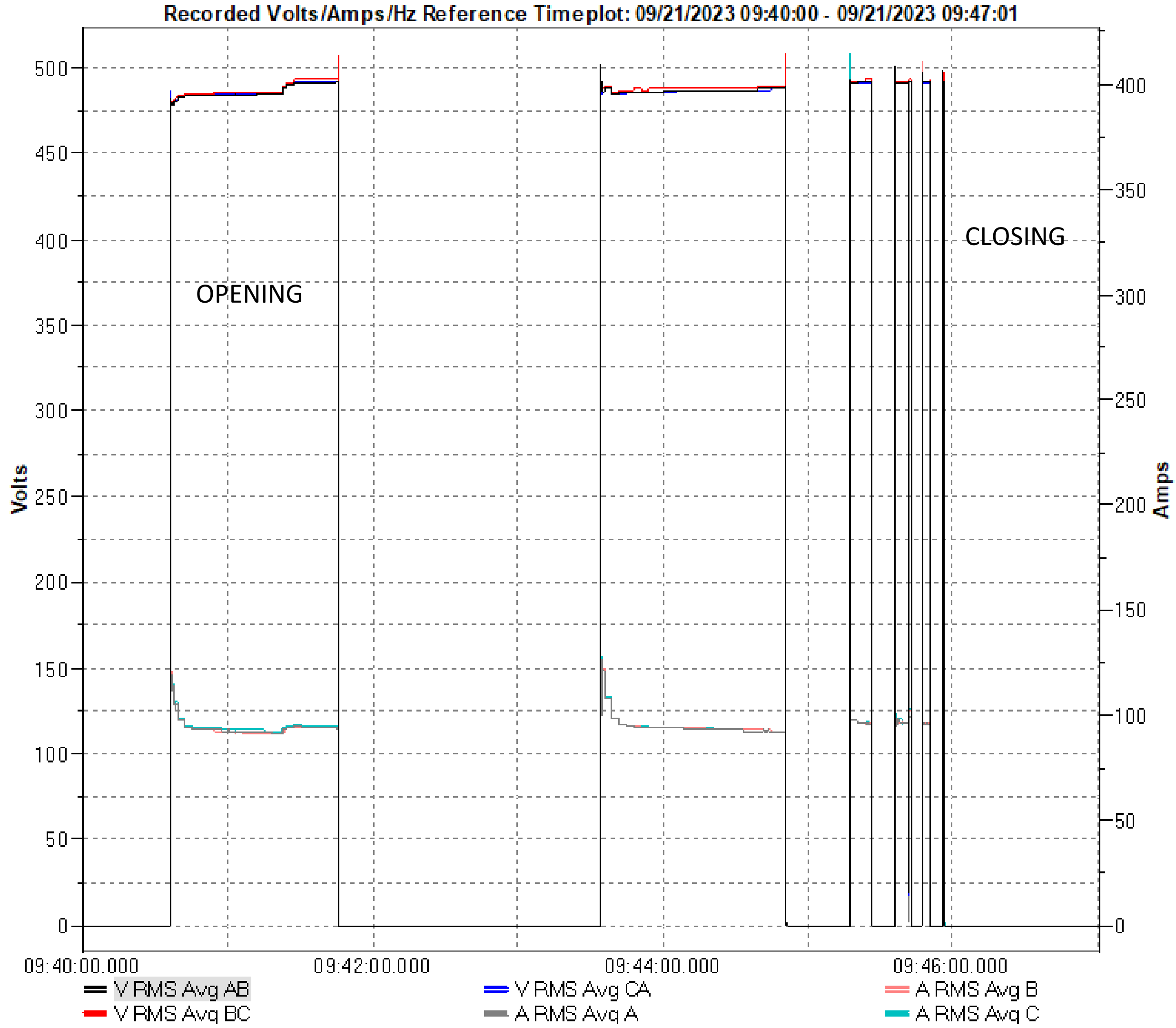
Lift Performed Under Utility Service



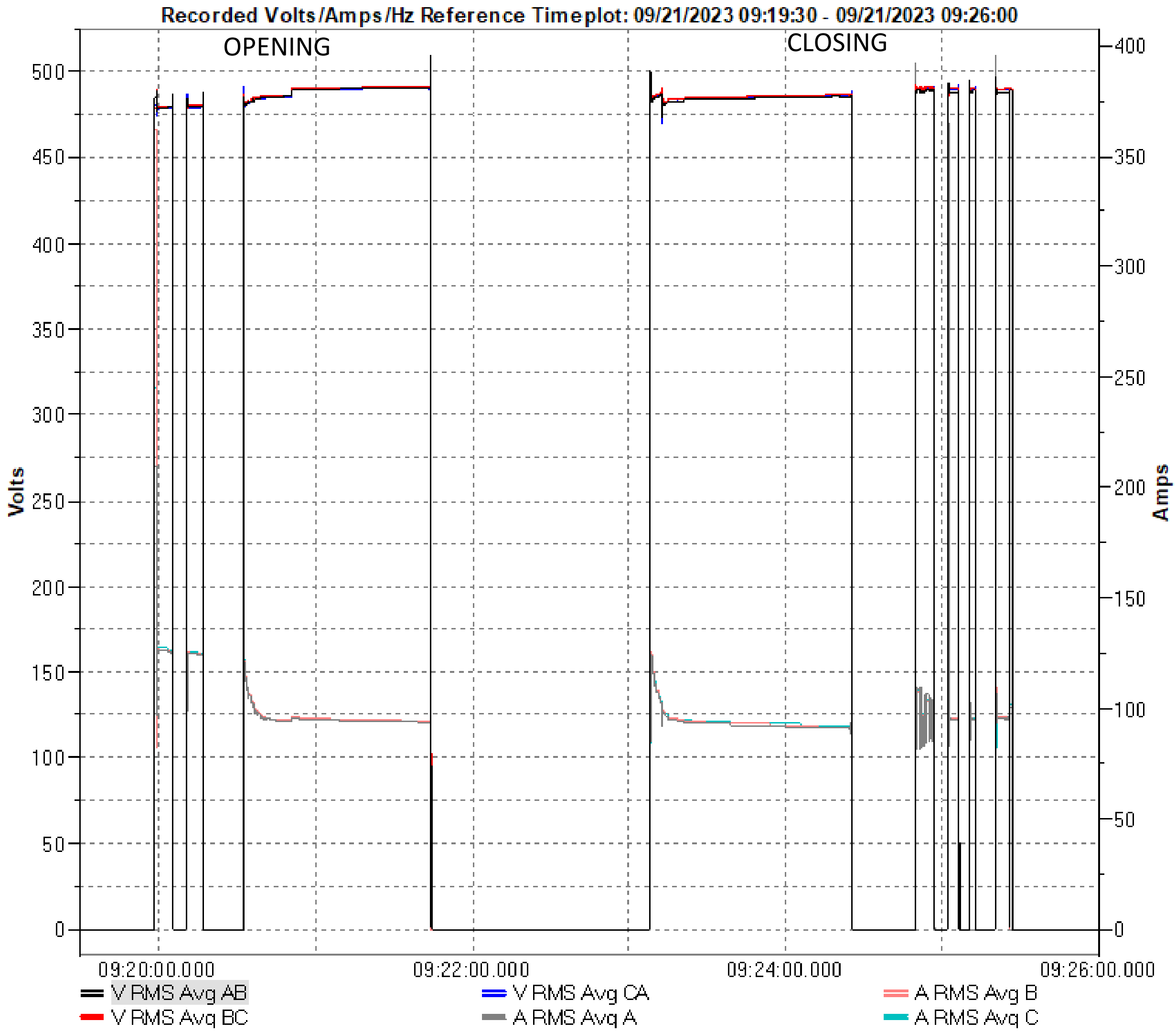
At the time of inspection with the bridge at standby, utility voltage from the main transformer was observed to be 506.71V RMS. During the bridge opening, the lowest observed voltage was 482.87V RMS.

$$\text{Utility Voltage Drop} = 100 - \left(\frac{482.87}{506.71} \times 100\right) = 4.70\%$$

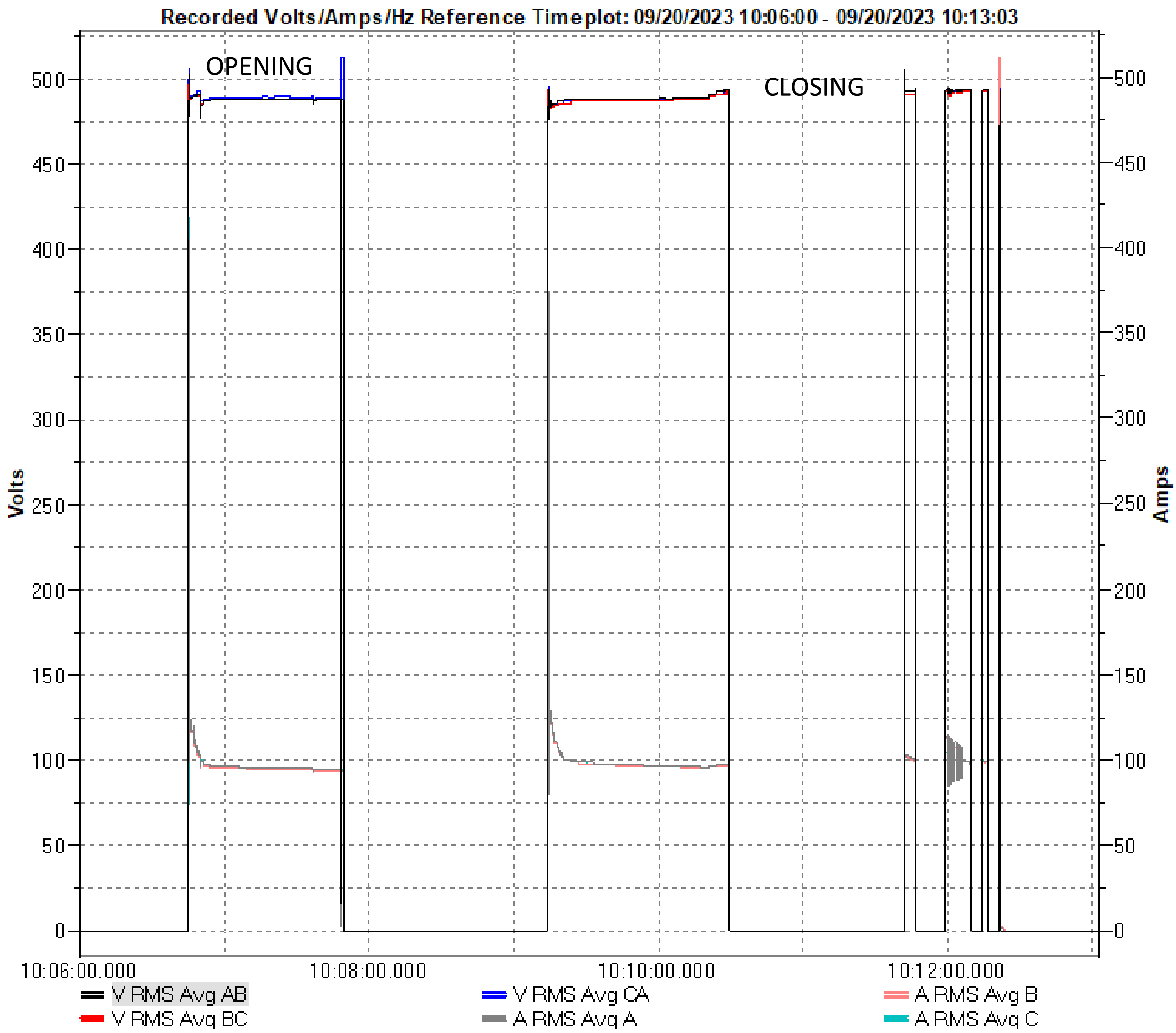
SE Main Motor Lift Characteristic



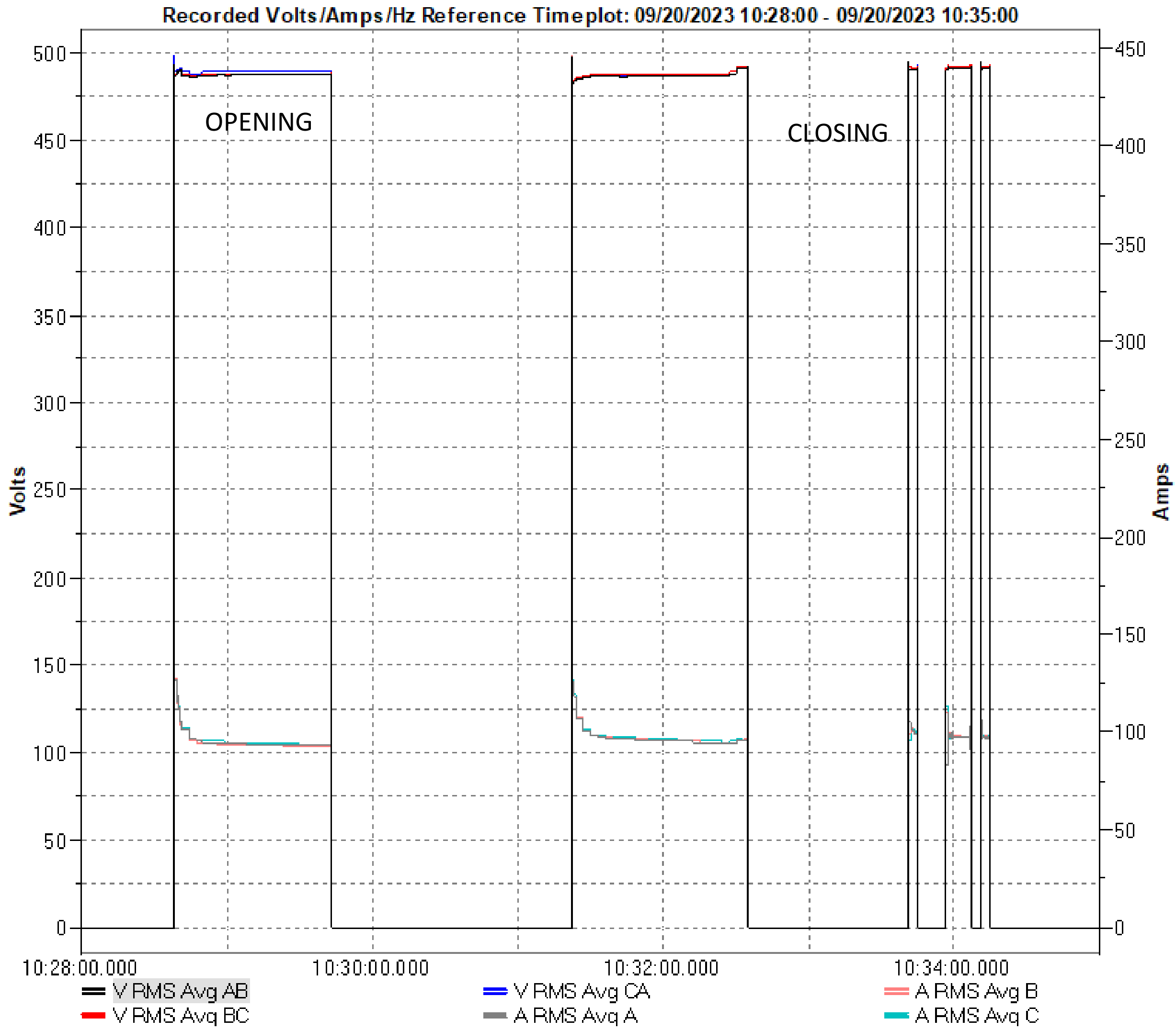
SW Main Motor Lift Characteristic



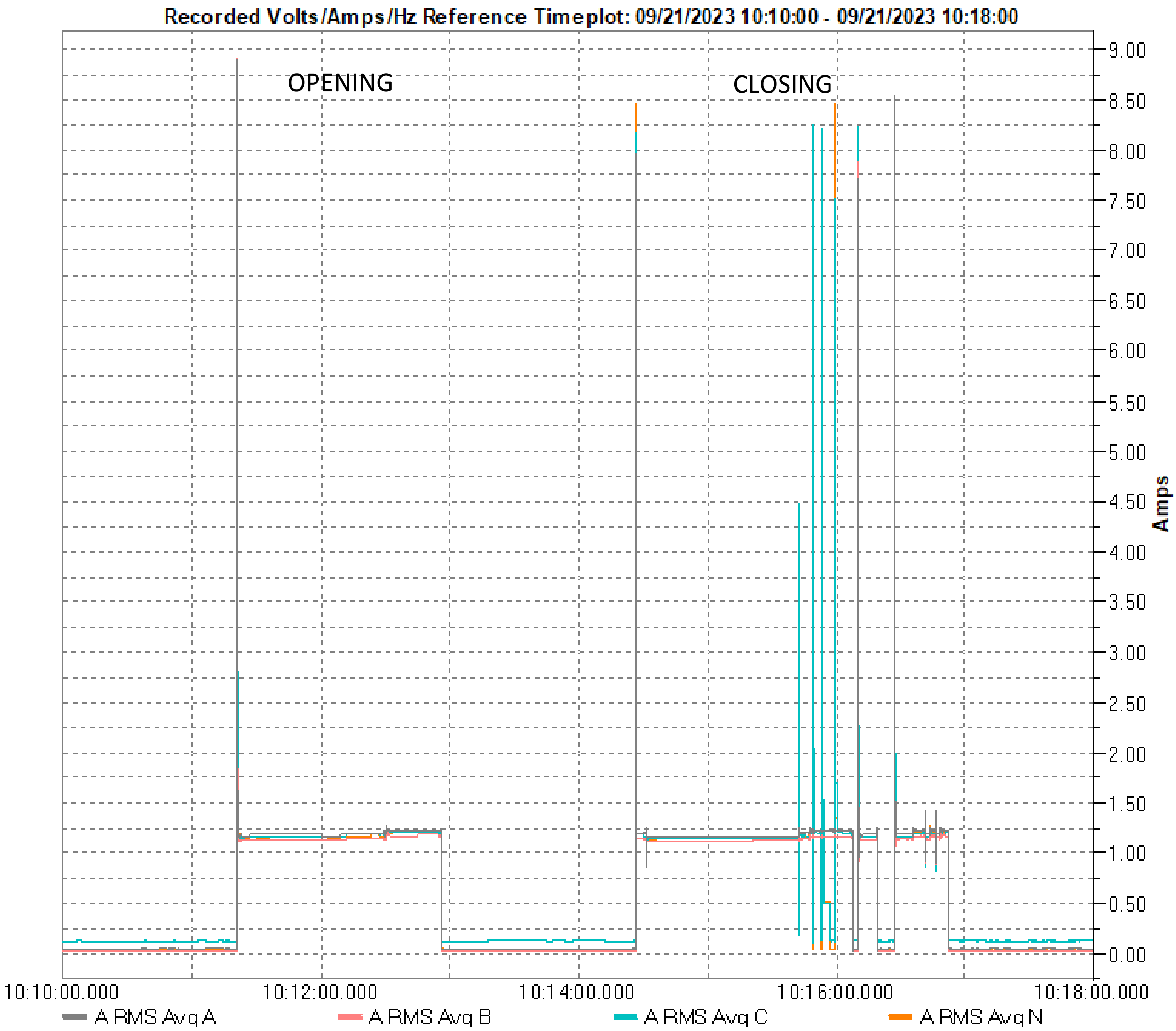
NE Main Motor Lift Characteristic



NW Main Motor Lift Characteristic



South Brakes (Single Phase)



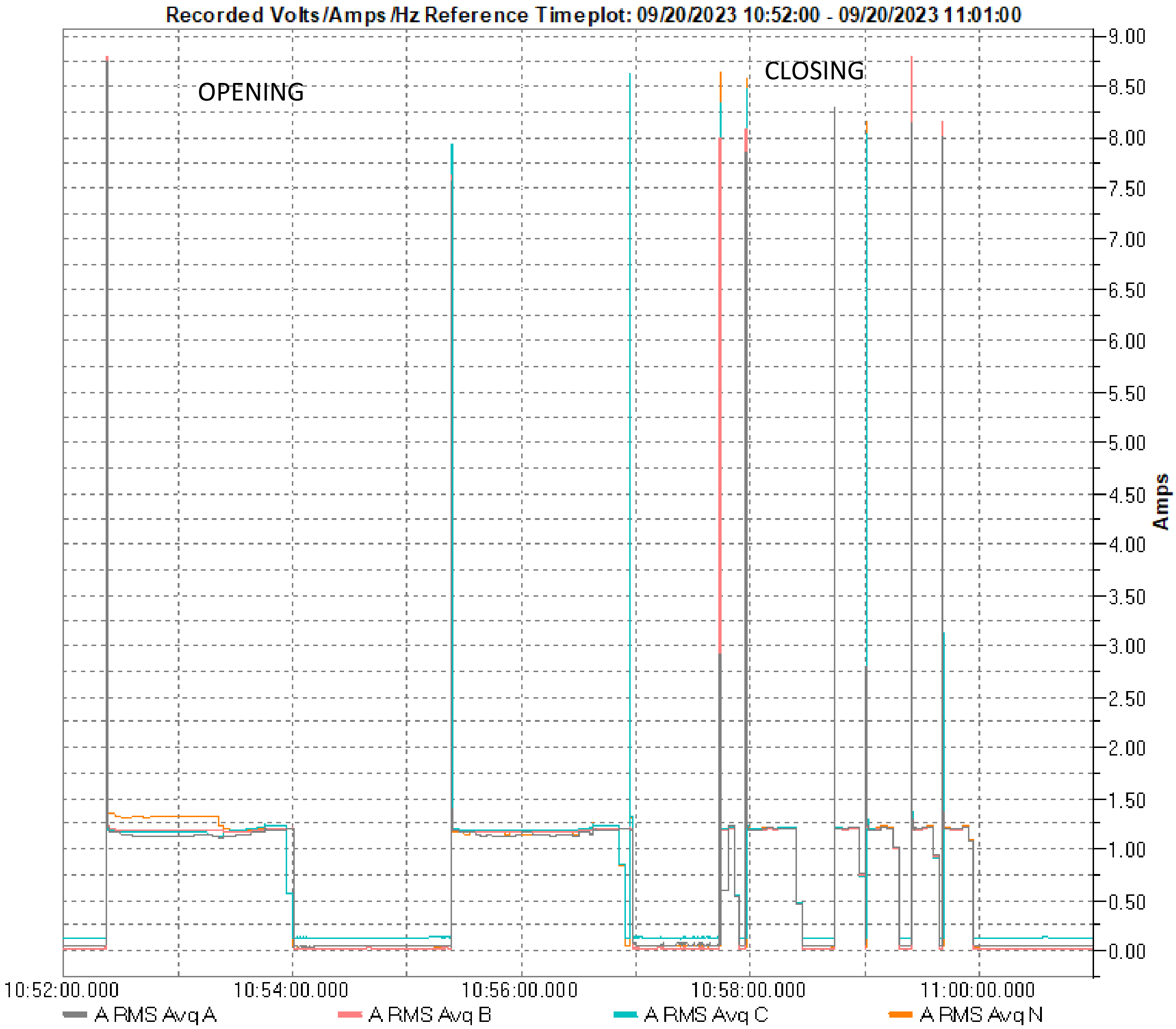
Notes:

1. Voltage not shown for clarity. Voltage for all brakes was consistent.
2. Due to across the line starting, only single-phase current was recorded. It is assumed that all phases are similar and consistent for each brake.

Legend:

- South Brake A – Phase A
- South Brake B – Phase B
- South Brake C – Phase C
- South Brake D – Phase N

North Brakes (Single Phase)



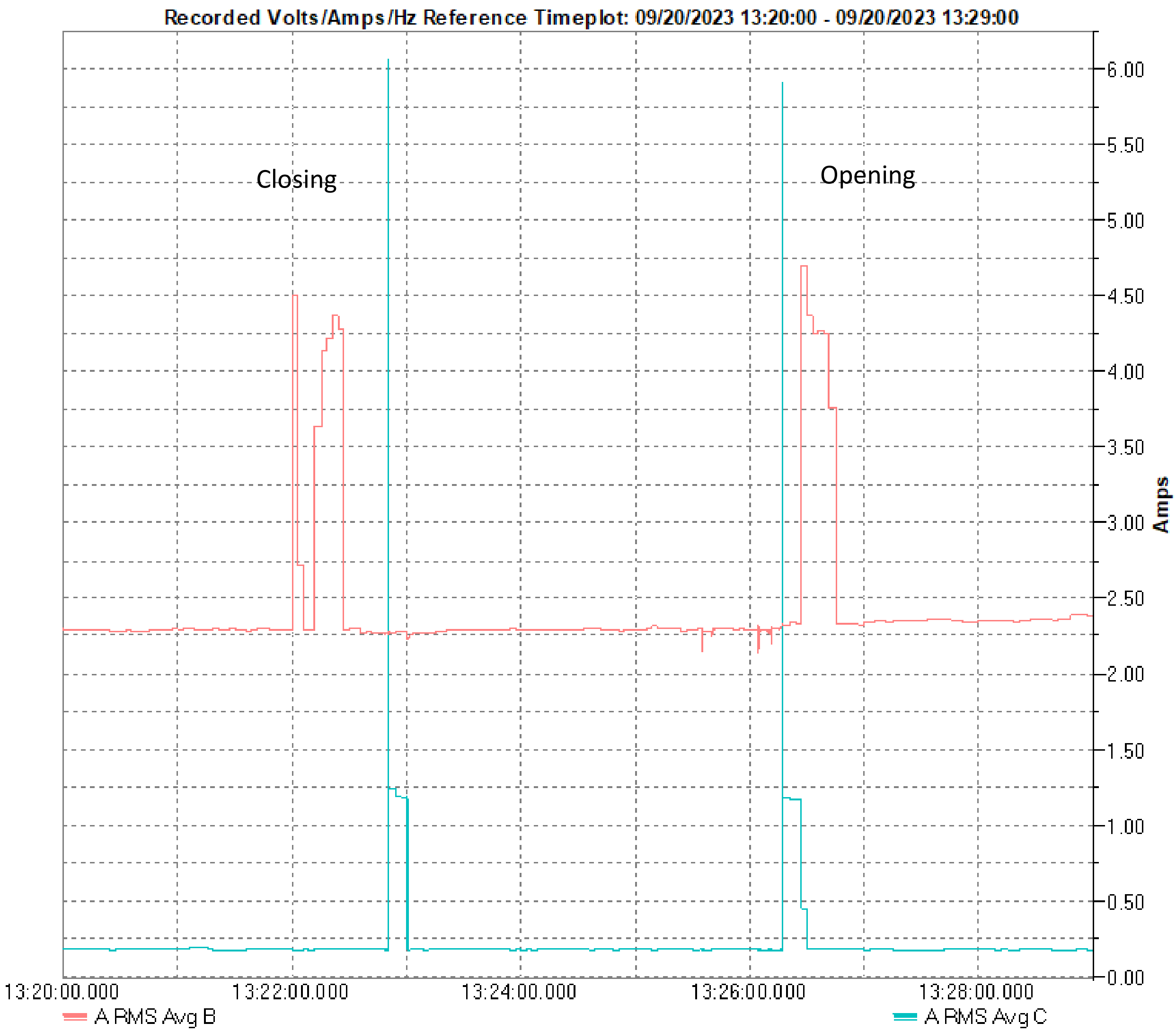
Notes:

1. Voltage not shown for clarity. Voltage for all brakes was consistent.
2. Due to across the line starting, only single-phase current was recorded. It is assumed that all phases are similar and consistent for each brake.

Legend:

- North Brake A – Phase A
- North Brake B – Phase B
- North Brake C – Phase C
- North Brake D – Phase N

North Gates (Single Phase)



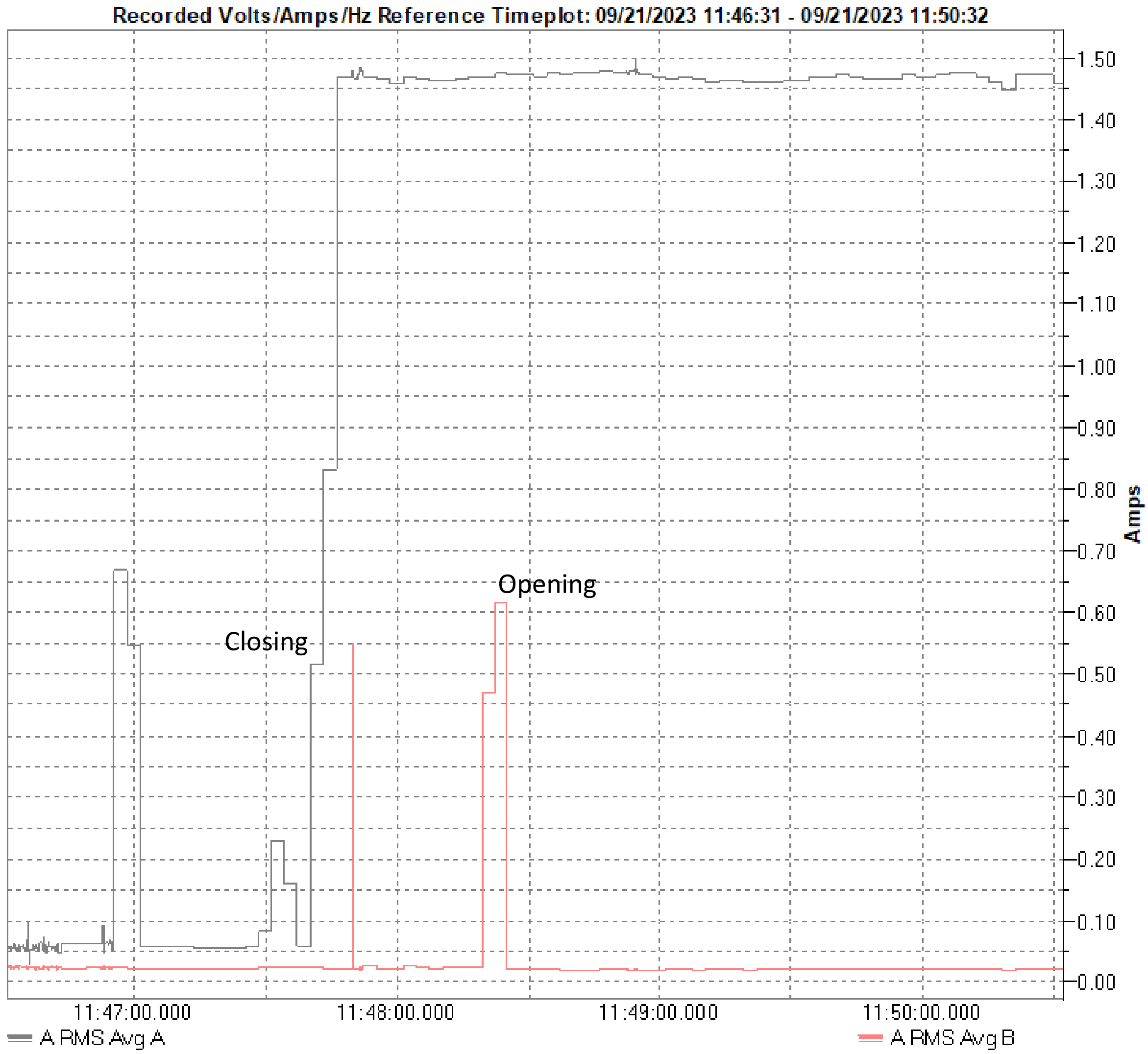
Notes:

1. Voltage not shown for clarity. Voltage for all Gates was consistent.
2. Due to across the line starting, only single-phase current was recorded. It is assumed that all phases are similar and consistent for each brake.

Legend:

- On-Coming Gate – Phase B
    - Note Gates is Controlled via VFD and Transformer. Constant current measured is transformer losses.
- Off-Going Gate – Phase C

South Gates (Single Phase)



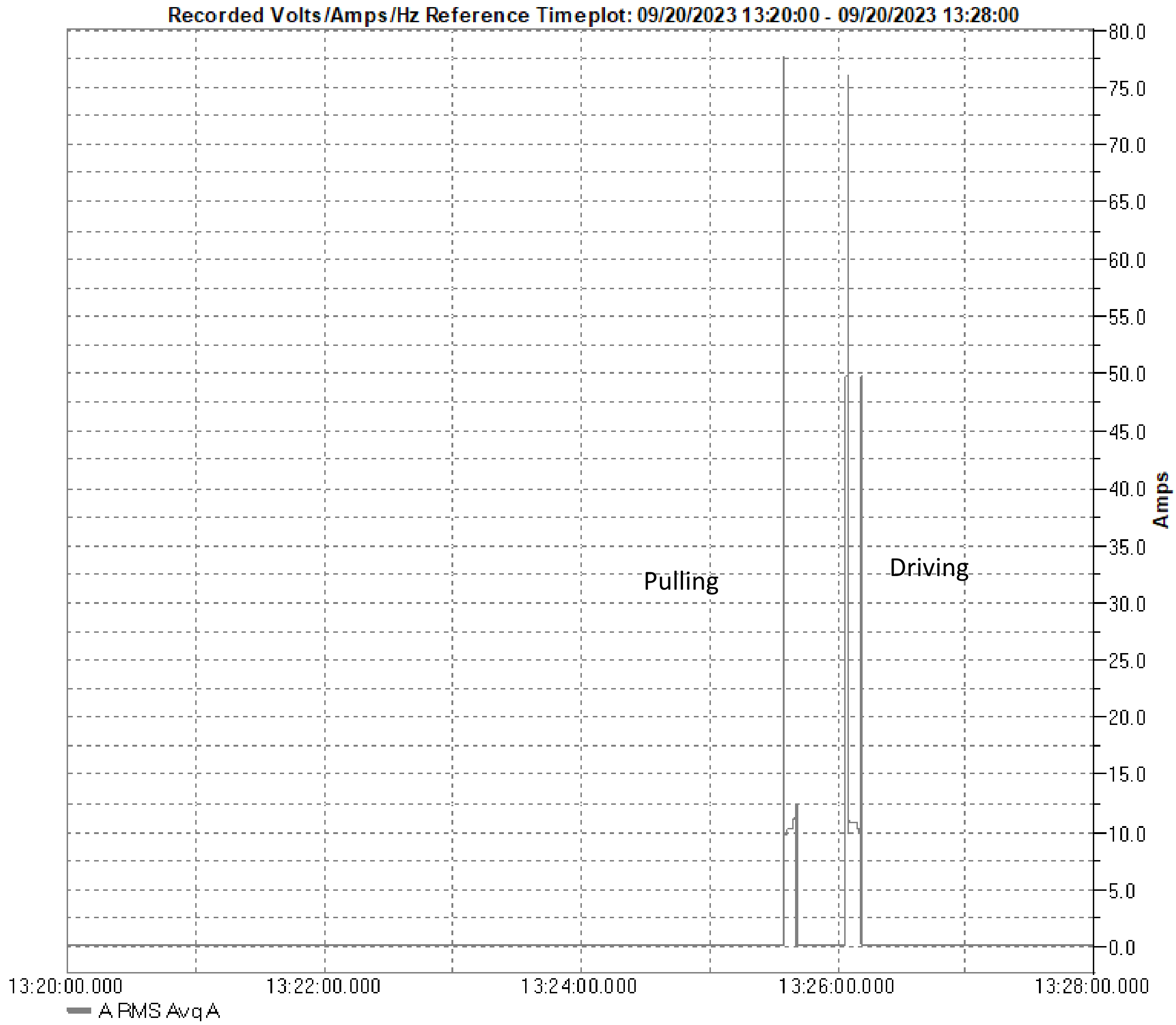
Notes:

1. Voltage not shown for clarity. Voltage for all Gates was consistent.
2. Due to across the line starting, only single-phase current was recorded. It is assumed that all phases are similar and consistent for each brake.

Legend:

- On-Coming Gate – Phase A
    - Note Gates is Controlled via VFD and Transformer. Constant current measured is transformer losses.
- Off-Going Gate – Phase C

Span Lock (Single Phase)



Notes:

1. Voltage not shown for clarity. Voltage for all Gates was consistent.
2. Due to across the line starting, only single-phase current was recorded. It is assumed that all phases are similar and consistent for each brake.