Matthew G. Bevin
Governor

COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
Frankfort, Kentucky 40622
www.transportation.ky.gov/

Greg Thomas
Secretary

February 14, 2017

CALL NO. 201
CONTRACT ID NO. 171204
ADDENDUM # 1

Subject: Mercer-Garrard Counties, 121GR17D004-STP
Letting February 24, 2017

(1) Revised - Plans - S1A, S44, S53, & S54
(2) Revised - Right-of-Way Certification - Page 77 of 249
(3) Added - Special Note - Pages 1-23 of 23

Proposal revisions are available at http://transportation.ky.gov/Construction-Procurement/.

Plan revisions are available at http://www.lynnimaging.com/kytransportation/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Rachel Mills

Rachel Mills, P.E.
Director
Division of Construction Procurement

RM:ks
Enclosures

TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS

MERCER – GARRARD COUNTY
KY 152 OVER HERRINGTON LAKE
STA. 23+18.28

LETTING DATE

CONSTRUCTION PROJECT NO.

FILE NAME: P:\STRUCT\MERCER-GARRARD, KY 152\FINAL DESIGN\PRE-BID REVISIONS\01A_TITLE SHEET.DGN

USER: cmcbroom
DATE PLOTTED: February 10, 2017

E-SHEET NAME:

MicroStation v8.11.9.655

INDEX OF SHEETS

SPECIAL NOTES

Special Notes for Drilled Shafts
Special Notes for Vibration Monitoring
Special Notes for Non-Destructive Testing
Speical Notes for Work on Herrington Lake

SPECIAL PROVISIONS

4 Welding Structural Steel
69 Embankment at Bridge End Bent Structures

STANDARD DRAWINGS

BBP-001-12	Elastomeric Bearing Pads for Prestressed Beams
BBP-002-04	Bearing Details
BGX-006-10	Stencils for Structures
BGX-012-02	Geotechnical Legend
BJE-001-13	Neoprene Expansion Dams and Armored Edges
RDP-010-09	Perforated Pipe Headwalls

SPECIFICATIONS

2012 Standard Specifications for Road and Bridge Construction.

2014 AASHTO LRFD Bridge Design Specifications with Current Interims.

REVISION	DATE

DATE: 07-2016 | CHECKED BY
DESIGNED BY: EAO | CDB
DETAILED BY: DWW | EAO

PLANS PREPARED BY :

WMB, INC. CONSULTING ENGINEERS
1950 HAGGARD COURT
LEXINGTON, KENTUCKY
(859)299-5226
40505

STATE OF KENTUCKY
EDWARD A. O'DELL II
13576
LICENSED PROFESSIONAL ENGINEER

BY: EDWARD A. O'DELL II
KY PE NO. 13576

DATE: SEPTEMBER 9, 2016

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MERCER – GARRARD

ROUTE: KY 152
CROSSING: HERRINGTON LAKE

TITLE SHEET

ITEM NUMBER
07–1116.00

PREPARED BY
WMB SINCE 1957
ENGINEERING IN EXCELLENCE

SHEET NO. S1A
DRAWING NO. 27207

REVISED 02/13/2017

TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS

MERCER – GARRARD COUNTY
KY 152 OVER HERRINGTON LAKE
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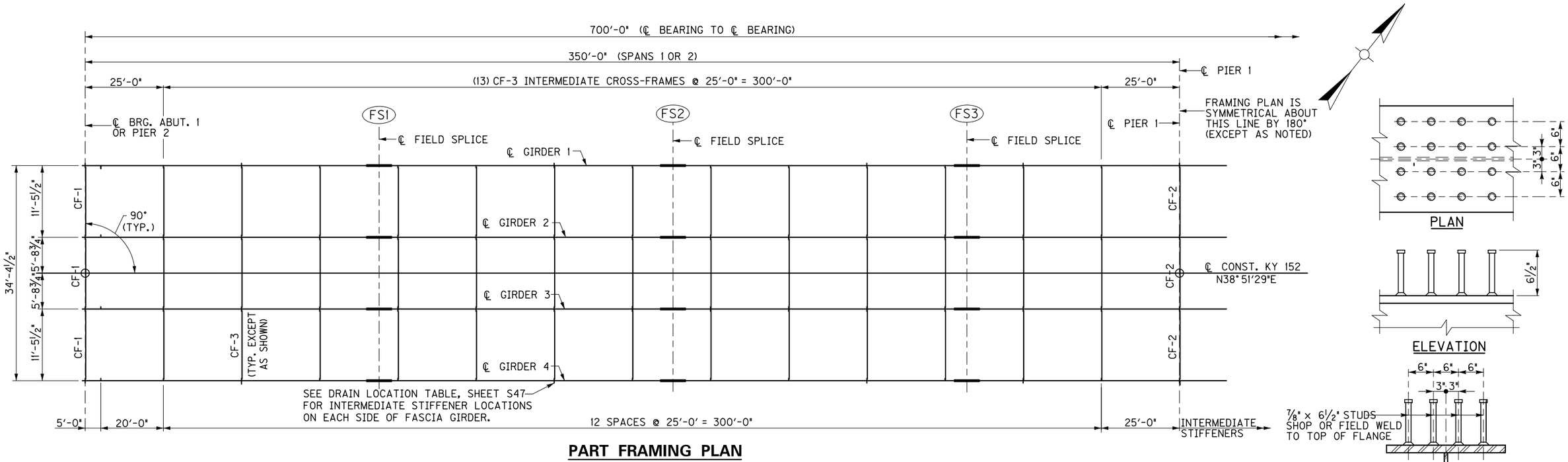
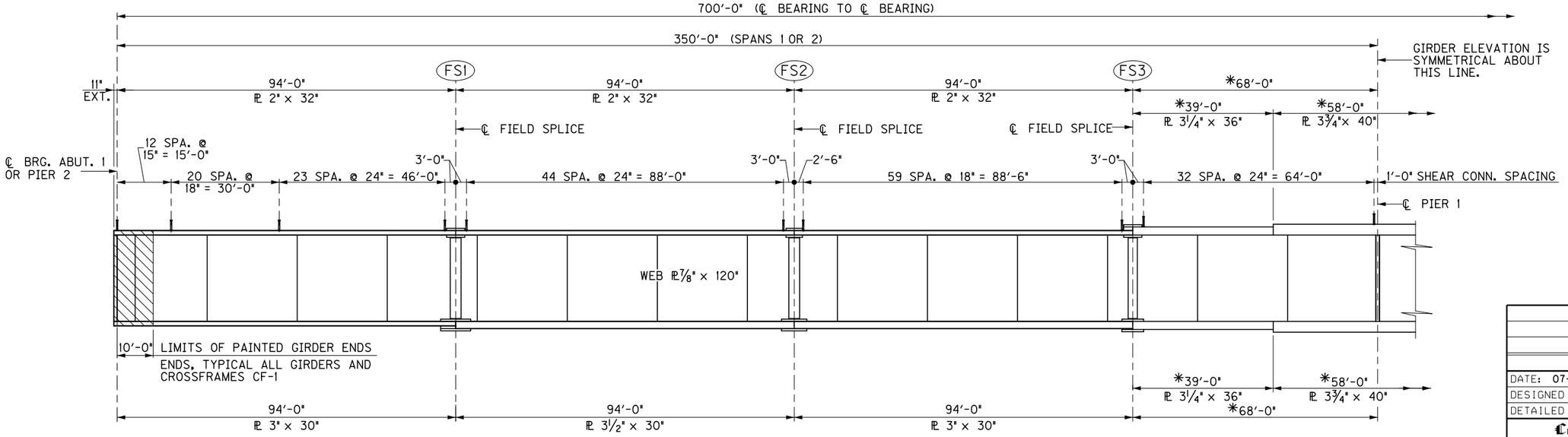


PART FRAMING PLAN

SHEAR CONNECTOR DETAIL



PART GIRDER ELEVATION

*TOP AND BOTTOM FLANGES IN THE FIELD SECTION OVER PIER 1 SHALL BE FABRICATED USING ASTM A709, GRADE HPS 70 STEEL

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DETAILED BY: CH	CDB

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

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MERCER – GARRARD

ROUTE: **KY 152**

CROSSING: **HERRINGTON LAKE**

FRAMING PLAN & GIRDER DETAILS

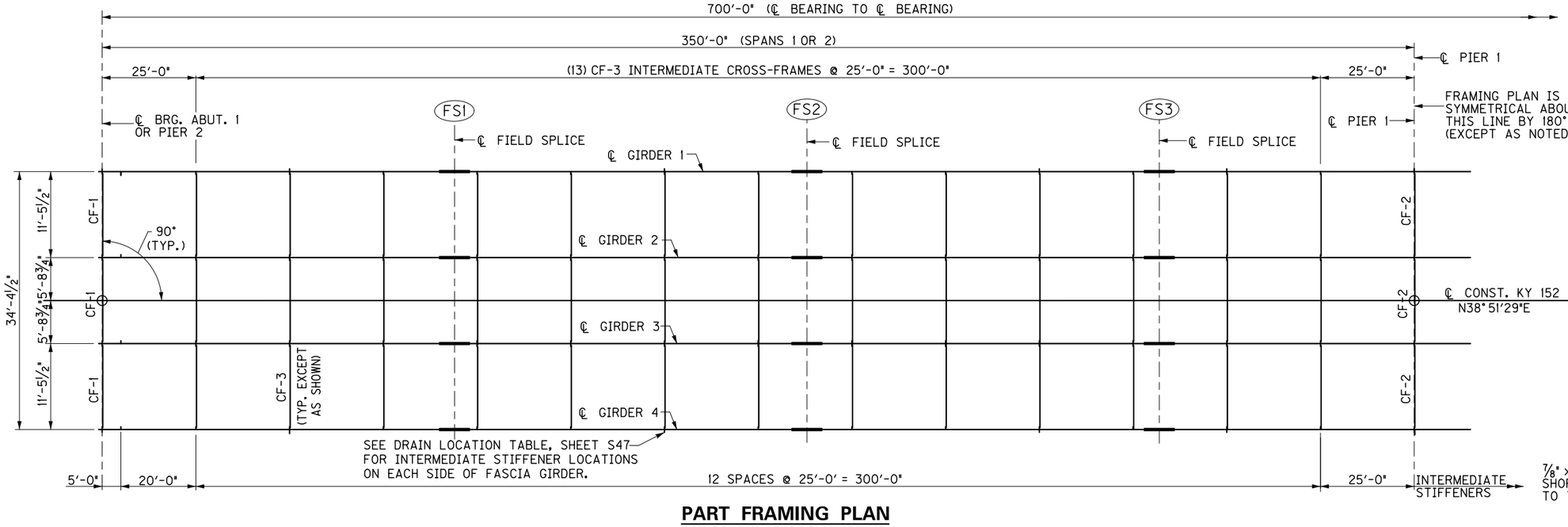
ITEM NUMBER
07–1116.00

PREPARED BY
WMB SINCE 1957
ENGINEERING IN EXCELLENCE

SHEET NO. S44

DRAWING NO. 27207

REVISED 02/13/2017



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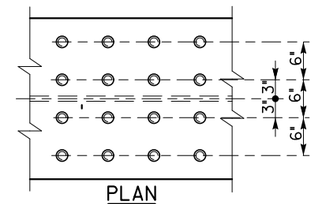
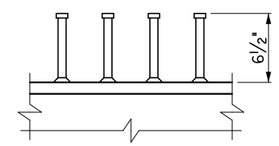
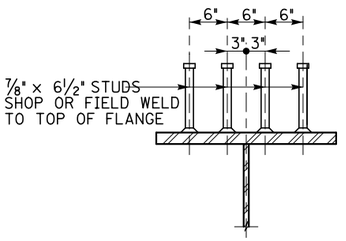


PLAN



ELEVATION



SECTION

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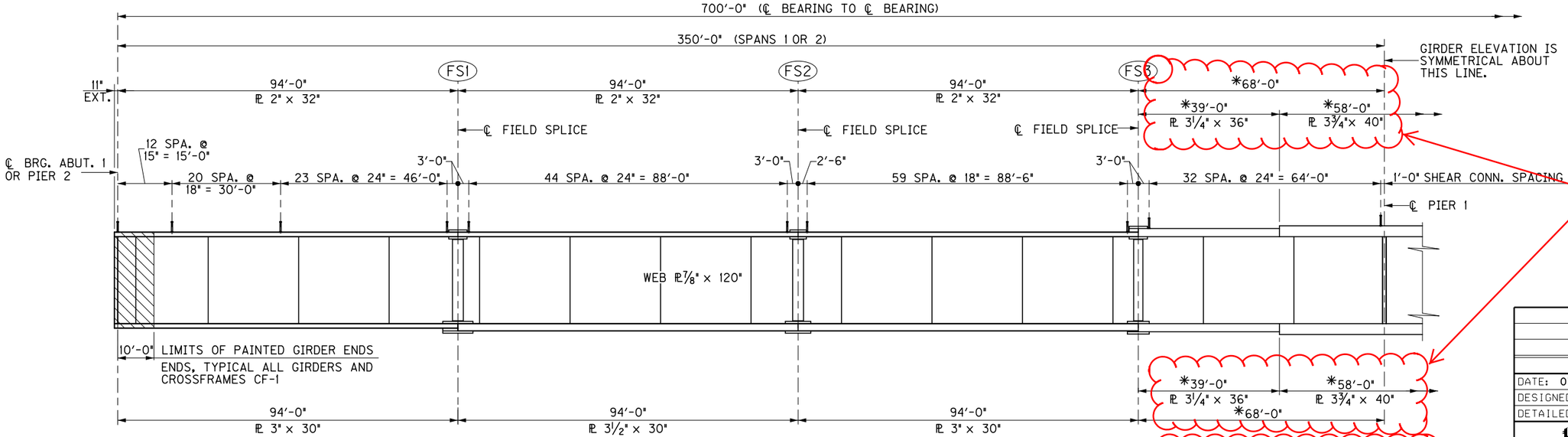

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FRAMING PLAN & GIRDER DETAILS

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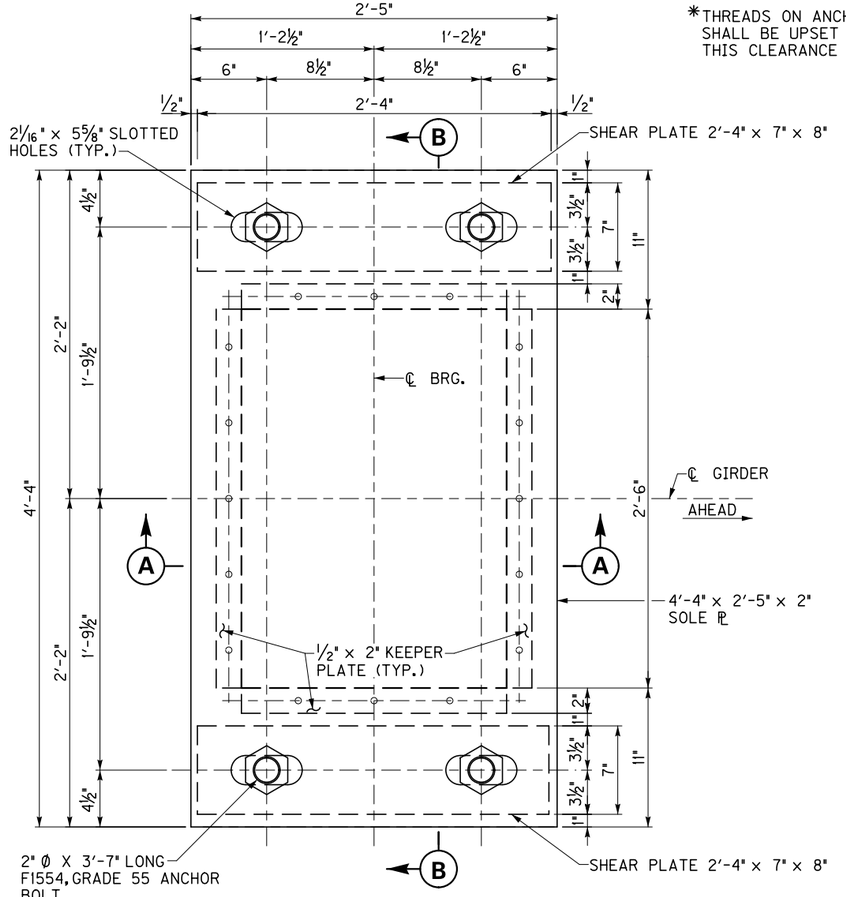
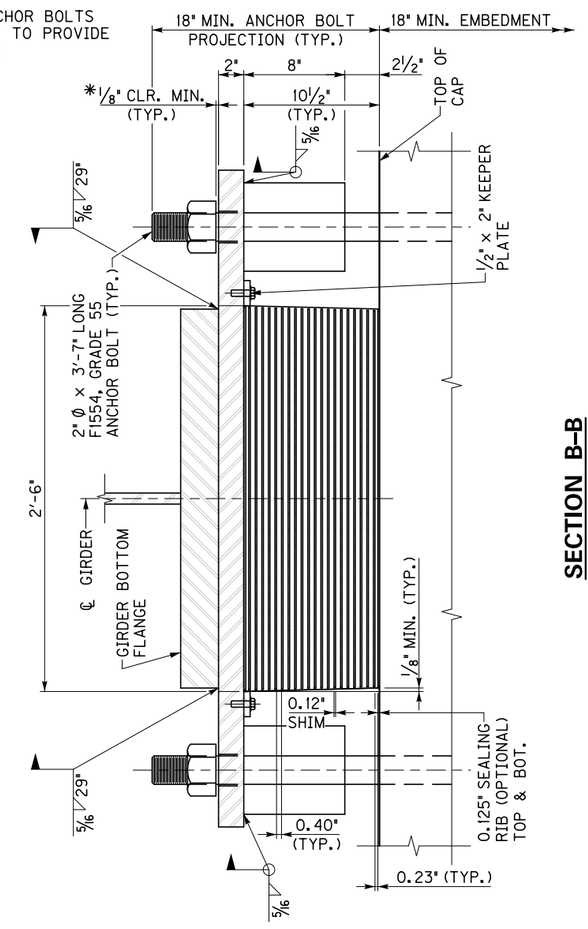


PLAN – BEARING DETAIL

(SHOWING ABUTMENT 1, PIER 2 SIMILAR)

*THREADS ON ANCHOR BOLTS SHALL BE UPSET TO PROVIDE THIS CLEARANCE



SECTION B–B

ELASTOMERIC BEARING PAD NOTES:

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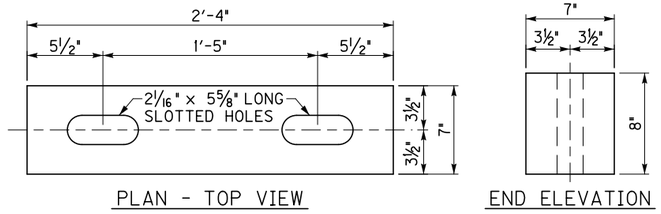
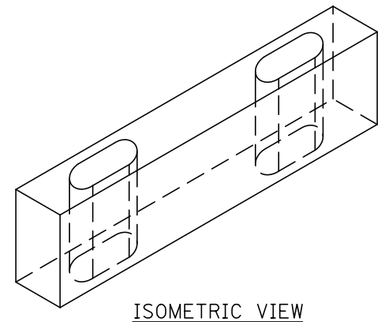


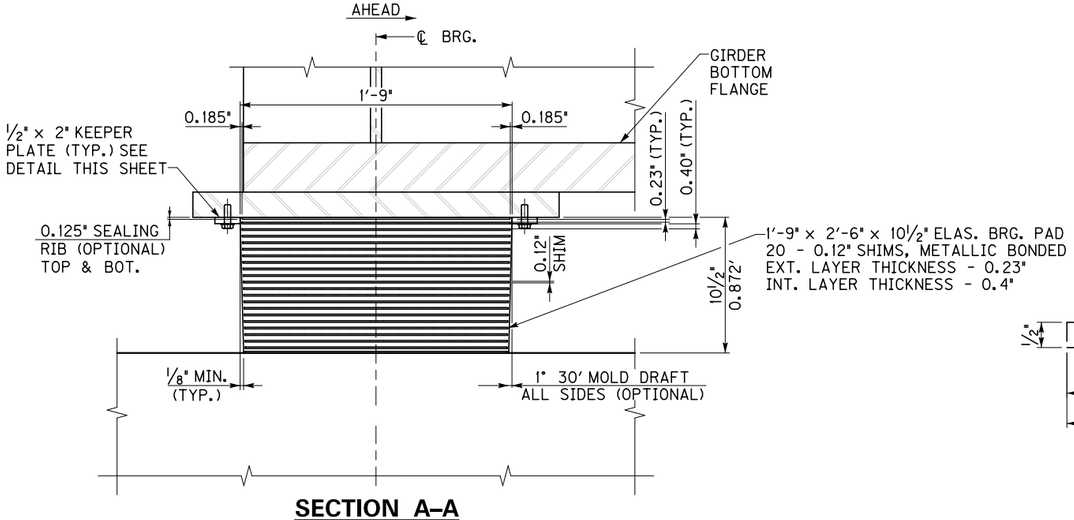
PLAN - TOP VIEW

END ELEVATION



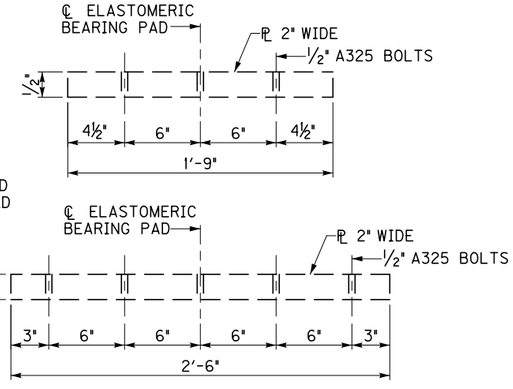
ISOMETRIC VIEW

SHEAR PLATE DETAILS



SECTION A–A

(FOR ABUTMENT 1 & PIER 2 (SPAN 2)
(4 REQUIRED EACH LOCATION)



KEEPER PLATES

NOTE:
½" DIAMETER A325 BOLTS FOR KEEPER PLATES SHALL BE DRILLED, TAPPED AND THREADED 1" INTO SOLE PLATES (TYP. ALL BEARINGS)

REVISION	DATE
DATE: 07-2016	CHECKED BY
DESIGNED BY: CDB	CGM
DETAILED BY: DWW	CDB

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: MERCER – GARRARD

ROUTE: KY 152 | CROSSING: HERRINGTON LAKE

BEAR. DETAILS – ABUT. 1 & PIER 2

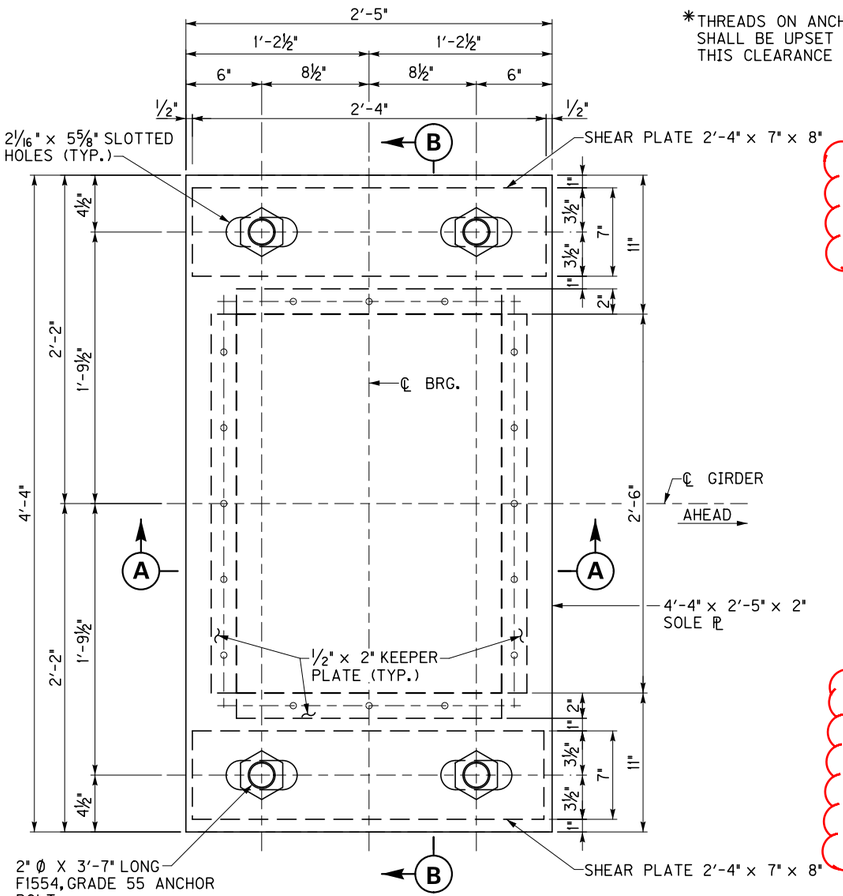
ITEM NUMBER: 07–1116.00

PREPARED BY: WM3 SINCE 1957 ENGINEERING IN EXCELLENCE

SHEET NO. S53

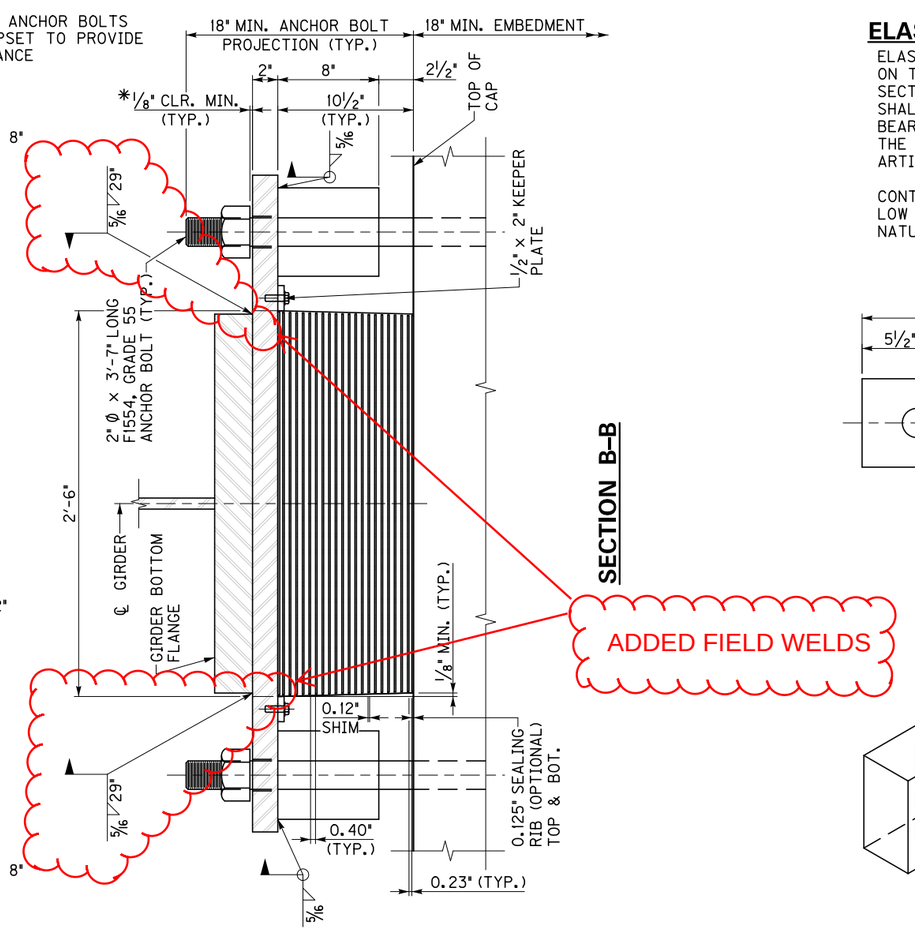
DRAWING NO. 27207

REVISED 02/13/2017



PLAN – BEARING DETAIL

(SHOWING ABUTMENT 1, PIER 2 SIMILAR)



SECTION B–B

ADDED FIELD WELDS

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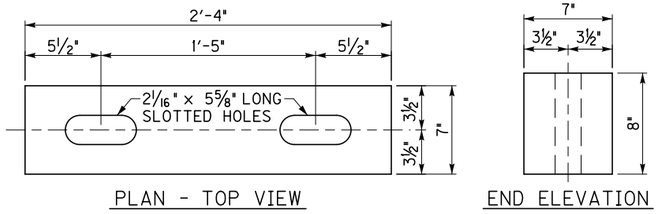
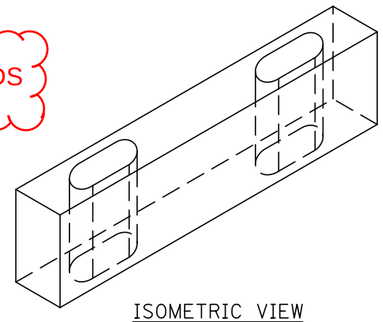


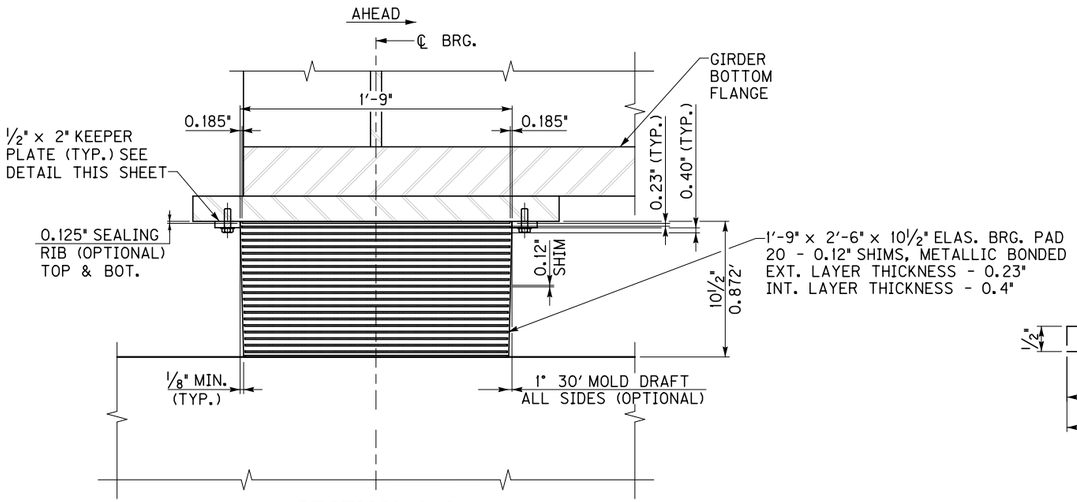
PLAN - TOP VIEW

END ELEVATION



ISOMETRIC VIEW

SHEAR PLATE DETAILS



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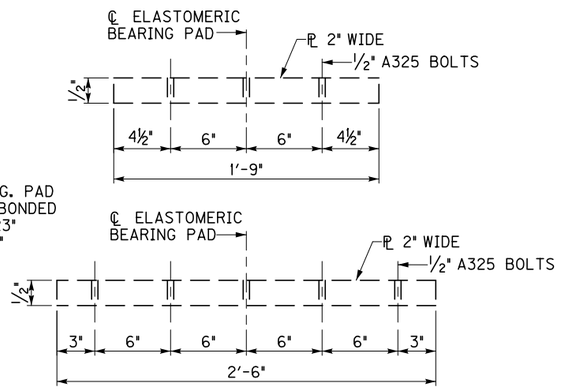

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Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: MERCER – GARRARD

ROUTE: KY 152 | CROSSING: HERRINGTON LAKE

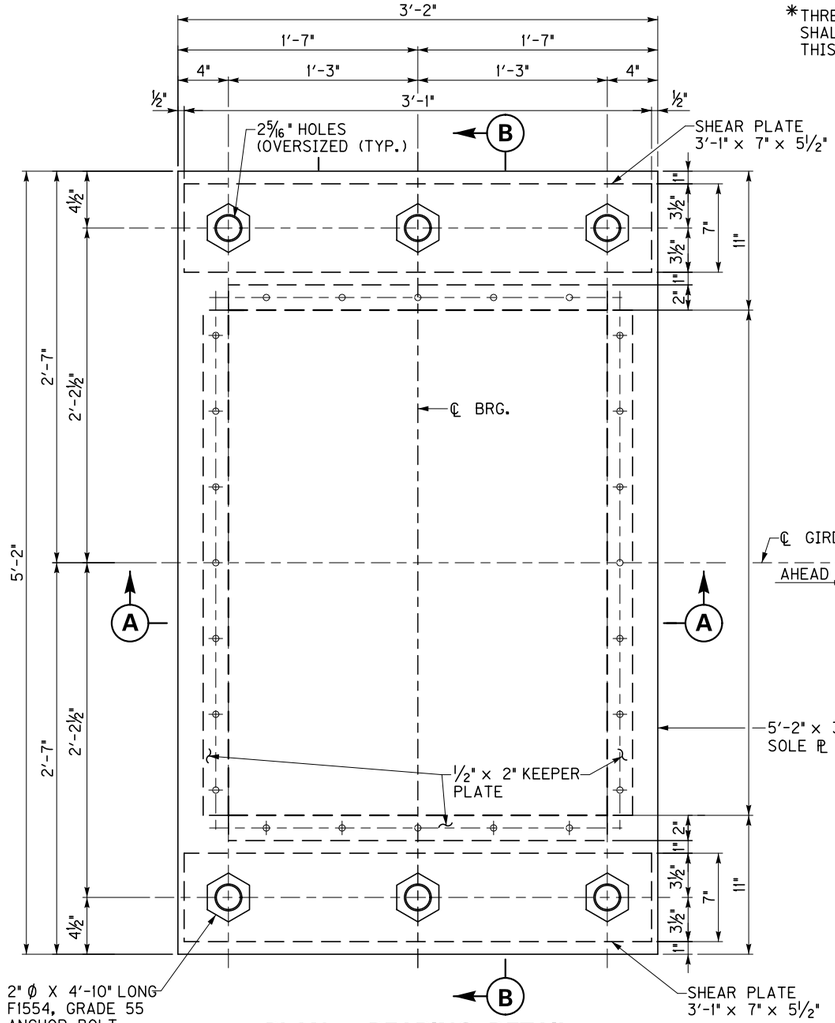
BEAR. DETAILS – ABUT. 1 & PIER 2

ITEM NUMBER: 07–1116.00

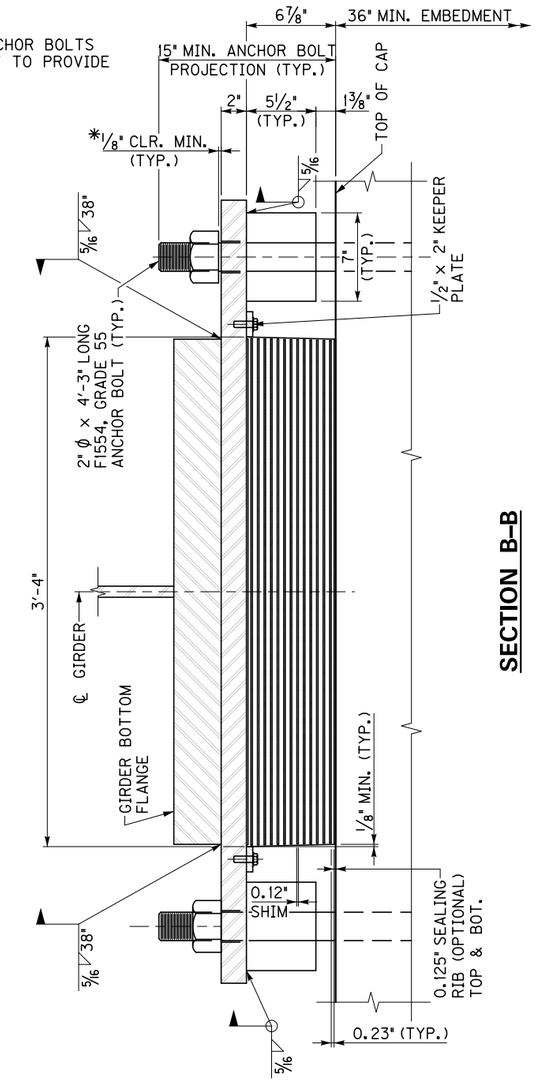
PREPARED BY: WMB SINCE 1957 ENGINEERING IN EXCELLENCE

SHEET NO.: S53

DRAWING NO.: 27207



PLAN – BEARING DETAIL
(PIER 1)



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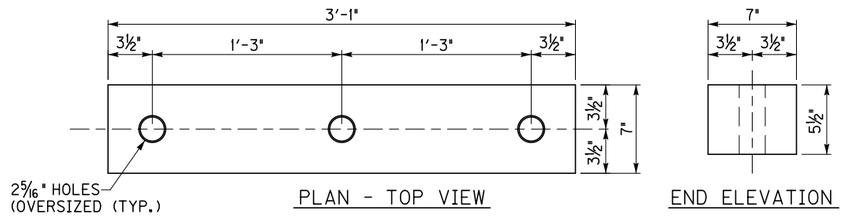
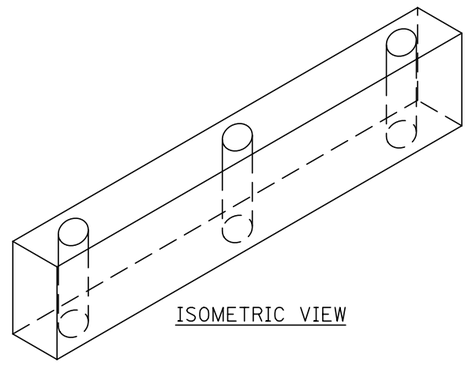
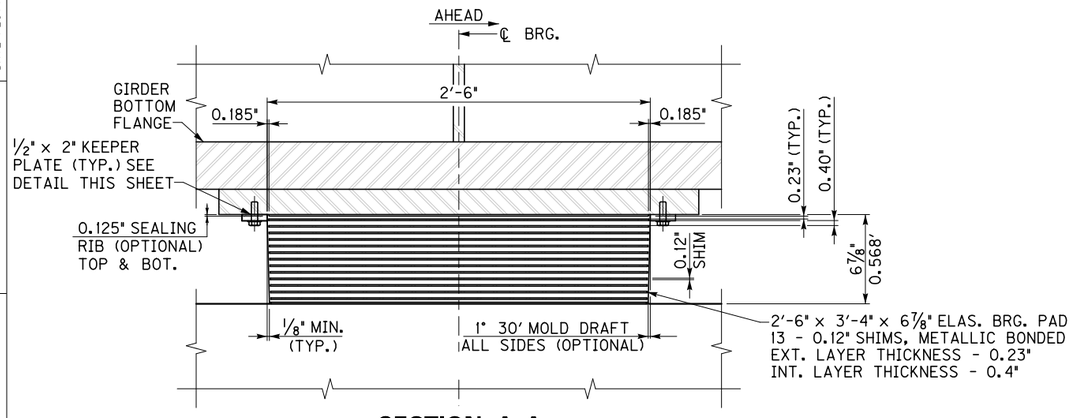
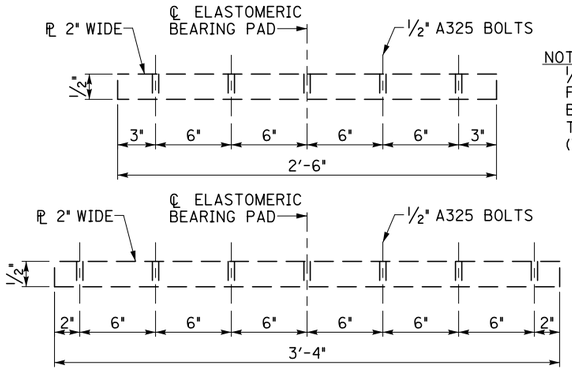




SHEAR PLATE DETAILS



SECTION A–A
PIER 1 (4 REQUIRED)



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BEARING DETAILS – PIER 1

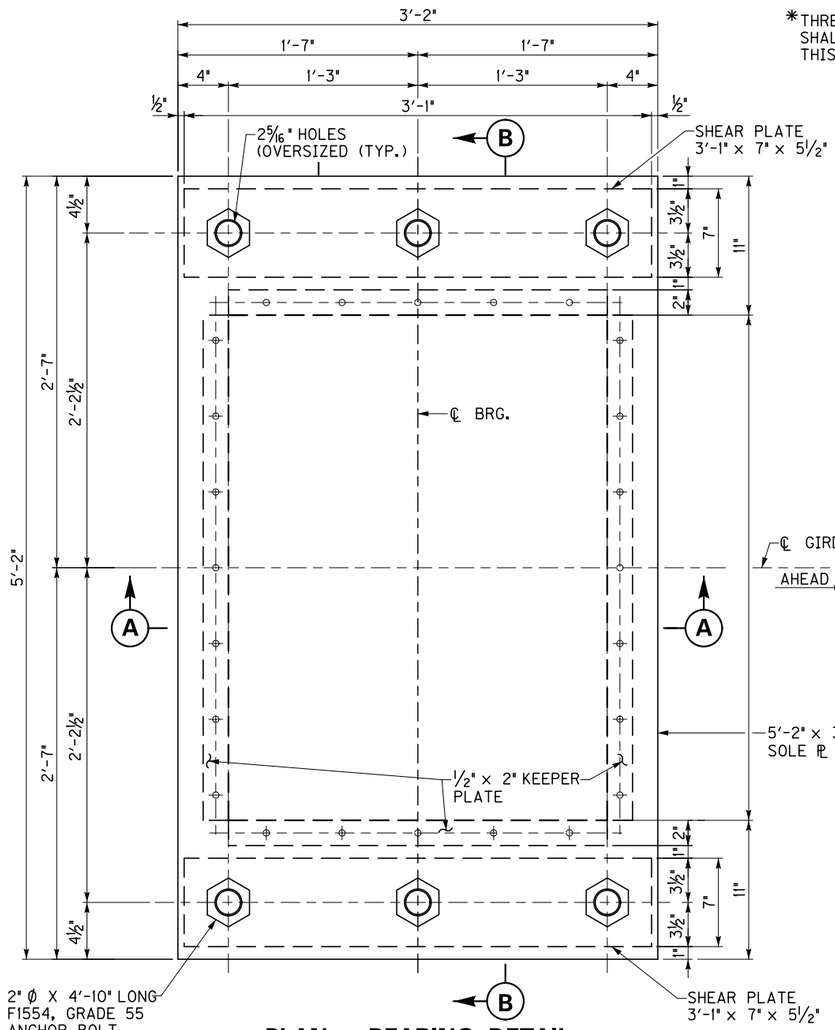
ITEM NUMBER: 07–1116.00

PREPARED BY: WMB SINCE 1957 ENGINEERING IN EXCELLENCE

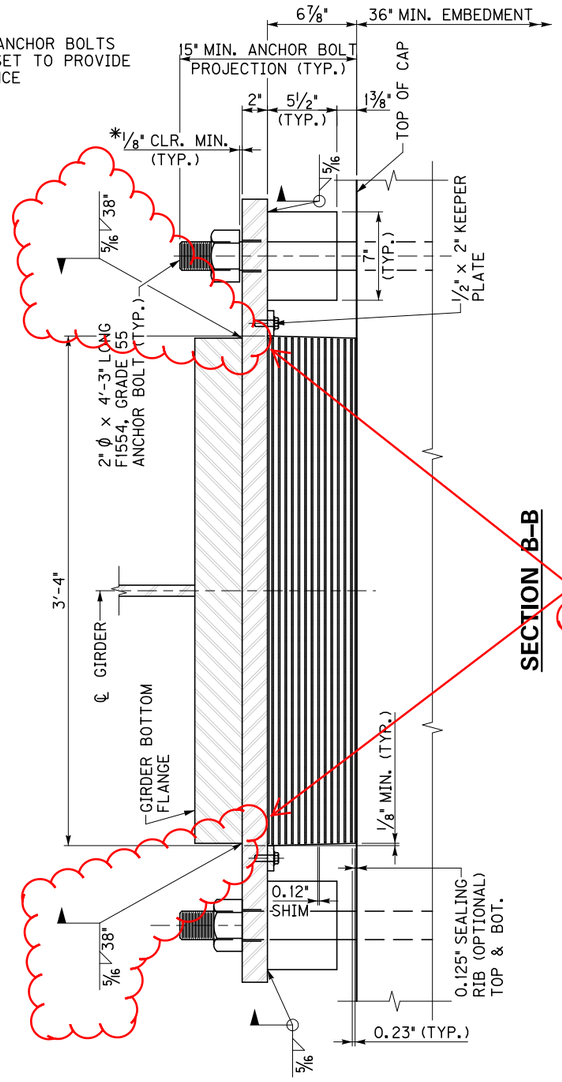
SHEET NO. S54

DRAWING NO. 27207

REVISED 02/13/2017



PLAN – BEARING DETAIL
(PIER 1)



SECTION B–B

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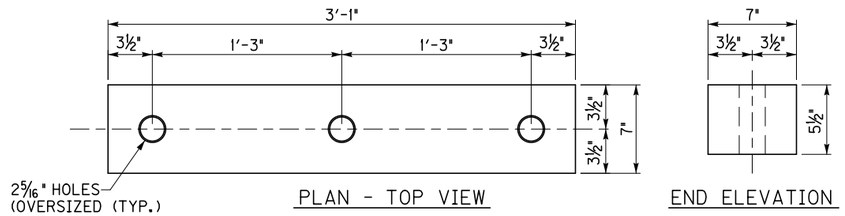
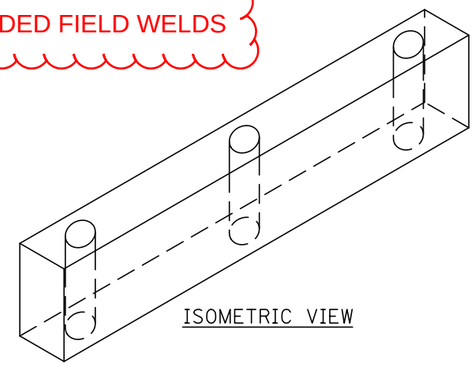
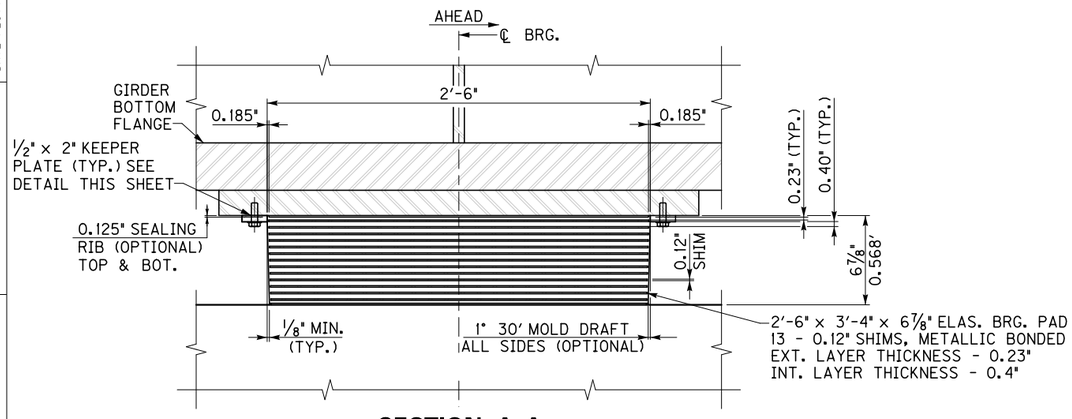
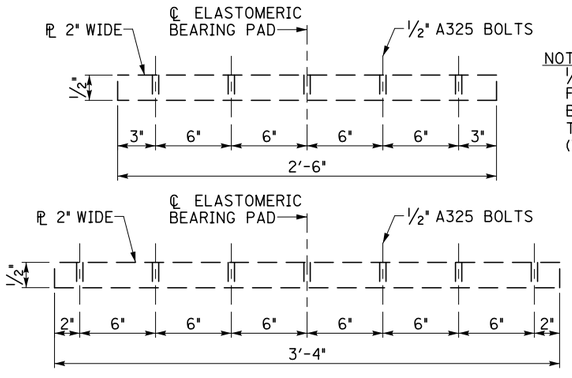




SHEAR PLATE DETAILS



SECTION A–A
PIER 1 (4 REQUIRED)



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ITEM NUMBER: 07–1116.00

PREPARED BY: WMB SINCE 1957 ENGINEERING IN EXCELLENCE

SHEET NO.: S54

DRAWING NO.: 27207

KENTUCKY TRANSPORTATION CABINET
Department of Highways
DIVISION OF RIGHT OF WAY & UTILITIES

TC 62-226
Rev. 01/2016
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RIGHT OF WAY CERTIFICATION

☐ Original ☒ Re-Certification — RIGHT OF WAY CERTIFICATION

ITEM #	COUNTY	PROJECT # (STATE)	PROJECT # (FEDERAL)
7-1116.00	Garrard/Mercer	FD52 084 0152 018-019	STP BRZ 5129 (015)

PROJECT DESCRIPTION

Replace Bridge and Approaches on KY 152 Over Herrington Lake at the Mercer/Garrard County Line

☐ **No Additional Right of Way Required**

Construction will be within the limits of the existing right of way. The right of way was acquired in accordance to FHWA regulations under the Uniform Relocation Assistance and Real Property Acquisitions Policy Act of 1970, as amended. No additional right of way or relocation assistance were required for this project.

☒ **Condition # 1 (Additional Right of Way Required and Cleared)**

All necessary right of way, including control of access rights when applicable, have been acquired including legal and physical possession. Trial or appeal of cases may be pending in court but legal possession has been obtained. There may be some improvements remaining on the right-of-way, but all occupants have vacated the lands and improvements, and KYTC has physical possession and the rights to remove, salvage, or demolish all improvements and enter on all land. Just Compensation has been paid or deposited with the court. All relocations have been relocated to decent, safe, and sanitary housing or that KYTC has made available to displaced persons adequate replacement housing in accordance with the provisions of the current FHWA directive.

☐ **Condition # 2 (Additional Right of Way Required with Exception)**

The right of way has not been fully acquired, the right to occupy and to use all rights-of-way required for the proper execution of the project has been acquired. Some parcels may be pending in court and on other parcels full legal possession has not been obtained, but right of entry has been obtained, the occupants of all lands and improvements have vacated, and KYTC has physical possession and right to remove, salvage, or demolish all improvements. Just Compensation has been paid or deposited with the court for most parcels. Just Compensation for all pending parcels will be paid or deposited with the court prior to AWARD of construction contract

☐ **Condition # 3 (Additional Right of Way Required with Exception)**

The acquisition or right of occupancy and use of a few remaining parcels are not complete and/or some parcels still have occupants. All remaining occupants have had replacement housing made available to them in accordance with 49 CFR 24.204. KYTC is hereby requesting authorization to advertise this project for bids and to proceed with bid letting even though the necessary right of way will not be fully acquired, and/or some occupants will not be relocated, and/or the just compensation will not be paid or deposited with the court for some parcels until after bid letting. KYTC will fully meet all the requirements outlined in 23 CFR 635.309(c)(3) and 49 CFR 24.102(j) and will expedite completion of all acquisitions, relocations, and full payments after bid letting and prior to AWARD of the construction contract or force account construction.

		EXCEPTION (S) Parcel #	ANTICIPATED DATE OF POSSESSION WITH EXPLANATION
Total Number of Parcels on Project	11		
Number of Parcels That Have Been Acquired			
Signed Deed	10		
Condemnation	1		Parcel complete deed has been signed
Signed ROE			

Notes/ Comments (Use Additional Sheet if necessary)

LPA RW Project Manager		Right of Way Supervisor	
Printed Name		Printed Name	Robin L. Sprague
Signature		Signature	
Date		Date	2/10/2017
Right of Way Director		**FHWA**	
Printed Name	Dan Log	Printed Name	
Signature		Signature	No Signature Required as per FHWA-KYTC Current Stewardship Agreement
Date	10 Feb 2017	Date	

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SPECIAL NOTE FOR NON-DESTRUCTIVE TESTING IN DRILLED SHAFTS

Garrard-Mercer Counties –KY 152 Bridge over Herrington Lake

The following sections provide the requirements for non-destructive testing (Sonar Caliper, Video Inspection, Crosshole Sonic Logging and Thermal Integrity Profiling) of the drilled shaft foundations, schedule requirements for submittals, reporting requirements and Contractor/Testing Subcontractor/Department responsibilities. The purpose of the non-destructive testing is to evaluate the integrity of the drilled shafts, to potentially detect air-, soil- or debris-filled voids or other discontinuities within and along the perimeter of the drilled shafts and to evaluate whether the shafts are within the specified geometrical tolerances.

References to the “Department” refer to the Kentucky Department of Highways and/or consultants acting on behalf of the Department.

In all cases, the Department reserves the right to request raw data, field notes and/or other available information that may be necessary to evaluate the results of testing specified in this Special Note. Upon request, provide any available information at no additional cost to the Department.

In all cases, the Department reserves the right to perform testing to obtain independent results of testing specified in this Special Note. Upon request, provide any assistance required for Department personnel to perform such testing at no additional cost to the Department.

At the request of the Engineer, personnel representing the Contractor (including testing subcontractors) and the Department may be required to attend a pre-test meeting to discuss procedures related to testing, reports, reviews, etc. This meeting will be at no additional cost to the Department.

The Department will respond to the Contractor regarding acceptability of submittals referenced in this Special Note within ten (10) business days. A “Business Day” is defined as any day except Saturdays, Sundays and Holidays, as defined in Section 101.03 of the Standard Specifications.

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1.0 Sonar Caliper Testing of Drilled Shafts

1.1 Description

Perform Sonar Caliper (SC) Testing, using the SoniCaliper™ system or other similar system approved by the Department, to evaluate verticality and whether the shafts are within the specified geometrical tolerances, to detect any void spaces along the perimeter of the shaft design diameter, and to provide a written record and rock socket profile for each shaft prior to reinforcement or concrete placement. The Contractor will be responsible for obtaining the services of a SC Testing Firm experienced with SC testing and approved by the Engineer. The Contractor will be responsible for scheduling and coordinating the testing and presentation of data to the Department.

The calipering system will use one or more radial-spaced ultrasonic transceivers to transmit and receive acoustic signals between the tool and the borehole wall.

As directed by the Engineer, perform SC Testing after rock excavation is completed to the design bottom of shaft. If karst or other features are detected, additional SC testing may be directed by the Engineer.

Sonar calipering testing may be useful but is not necessarily a reliable method to definitively identify karstic features. As such, it will be used as a tool in conjunction with video inspection and other available information and will be subject to reasonable judgement by the Engineer.

1.2 SC Testing and Evaluation of Test Results

Make submittals in accordance with the Project requirements for submittals. See Table 1 below.

Table 1 – Schedule of SC Submittals

Submittal Number	Submittal Item	Deadline	Event
1	Technical Proposal with SC Testing Firm qualifications	45 business days before	Start of Drilled Shaft Construction
2	SC Preliminary Testing Reports	24 HOURS after	Completion of testing on an individual drilled shaft
3	SC Final Testing Reports	5 business days after	Completion of testing on an individual drilled shaft
Provide all submittals and reports in .pdf format			

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1.2.1 Technical Proposal

Submit a technical proposal prepared by the SC Testing Firm that addresses the testing procedures and required qualifications and experience of the testing firm (Submittal No. 1 in Table 1.) Include at least two (2) similar deep foundation projects [or one (1) deep foundation project supplemented by at least two (2) other projects where similar sonar imaging was performed] for which the testing organization has been engaged in SC Testing. Include an example of a wire frame plot with a verticality analysis prepared according to the criteria defined below. Use personnel having the same above-referenced experience performing sonar caliper testing.

1.2.2 Testing

Perform the SC Testing using the following steps:

1. Caliper is positioned over drilled hole along with lowering assembly (provided by the SC Testing Firm).
2. Caliper is reset and calibrated at the zero degree reading.
3. Profile is taken in casing with known diameter to calibrate acoustic velocity.
4. Depth increment is set into software.
5. Caliper measures 360-degree profile.
6. Vertical and angular head position and range to shaft wall is captured.
7. Caliper is lowered at desired depth increment.
8. Steps 4 to 7 are repeated until the bottom of shaft socket is reached.

To acquire verticality information, the caliper head will be affixed to a guide cable that is weighted near the bottom of the shaft and positioned plumb.

Perform the SC Testing process on all finished excavated shafts. Provide access to the top of shaft for testing personnel and equipment. Perform the SC Testing process in accordance with generally accepted SC Testing methods. At a minimum, take caliper readings every 10 feet in casing and every 12 inches in rock strata, unless directed otherwise by the Engineer. If a feature is identified on the real time visual display, the Engineer may decrease the testing interval as necessary to improve the definition of the feature at no additional cost. Determine the top of casing elevation and calculate the station and offset of the geometric center of the top of casing, and provide this information to the Department and to the SC Testing Firm. Provide these services at no additional cost to the Department.

Employ the services of an experienced SC Testing company to record a 360-degree profile of the finished rock socket for each drilled shaft. After each rock socket is completed, use the SC Testing process to measure the gross diameter and shape of each drilled shaft for the entire shaft length in the rock socket.

1.2.3 Test Reports

Provide real-time data regarding the shaft verticality and shaft wall profile, to the Engineer on site as the SC Testing is in progress.

Within 24 hours after completing the SC Testing, perform all required filtering and analyses and submit a wire frame plot within 24 hours (Submittal No. 2 in Table 1.) Include a verticality analysis with the wire frame plot consisting of the following:

1. Station and offset of the geometrical center of the top of the shaft.
2. A clear indication of the ahead station and back station directions relative to the wire frame plot.
3. The vertical alignment vector (magnitude and direction of tilt) of the casing from the top to the bottom of casing.
4. The vertical alignment vector (magnitude and direction of tilt) from the top to bottom of the rock socket (when the rock socket is profiled);
5. The magnitude and direction of the offset of the geometric center of the rock socket relative to the geometric center of the casing at the transition between the casing and the rock socket (when the rock socket is profiled).
6. Any other information requested by the Department if necessary to evaluate the shaft tolerances specified in the Special Note for Drilled Shafts.

In addition, provide descriptions of any cavities, cracks or voids in the rock socket wall, including a general description with depth and elevation of the cavities, cracks or voids in .pdf format.

Within five (5) business days after completion of each test, submit a .pdf copy of the final report to the Department (Submittal No. 3 in Table 1), including, as a minimum, the following information:

1. Date of test;
2. Shaft No., and reference elevation,
3. Wire frame plots of the shaft from representative viewpoints,
4. A plot of shaft volume vs. depth,
5. Analysis of shaft verticality (as defined above), and
6. Description and plot of any shaft wall voids, cracks, or cavities encountered.
7. A narrative which explains all aspects of the test, results and analyses.

1.2.4 Evaluation of SC Test Results

Allow direct communication between the SC Testing Firm and the Department. If the SC Testing Firm is different than other testing firms on the project, allow direct contact between the SC and other testing firms.

The Engineer will review the “real-time” data collected by the SC Testing Firm during the testing process at each shaft.

The Engineer will evaluate the wire frame plot, including verticality analysis, and determine if the construction tolerances have been met and inform the Contractor. If the casing is not within the specified tolerances, adjust the casing at no cost to the Department. Perform additional SC Testing from the bottom of casing to the top of the casing at no cost to the Department. Continue adjustment and testing at no cost to the Department until the construction tolerances have been met.

If discontinuities or features noted by the testing firm in the shaft excavation are deemed sufficient by the Engineer to potentially cause concrete loss or soil intrusion during concrete placement, or loss of nominal resistance, the Engineer will meet with the Contractor to discuss stabilization.

Continue with placement of reinforcement and concrete in the shaft only after receiving written approval from the Engineer to do so, based on evaluation of the SC and other applicable test results.

2.0 Video Inspection

2.1 Description

Perform video inspection (i.e. testing) of steel casings and rock sockets using a video camera lowered into the shaft. Furnish all equipment necessary to conduct the video camera inspection. Provide methods and equipment for controlling the camera subject to acceptance by the Department and achievement of a satisfactory color video record.

The Contractor will be responsible for obtaining the services of a Video Inspection Firm experienced with video inspection of drilled shafts and accepted by the Engineer. The Contractor will be responsible for scheduling and coordinating the testing and presentation of information to the Department.

As directed by the Engineer, perform video inspection after rock excavation is completed to the design bottom of shaft. If karst or other features are detected, additional video inspection may be directed by the Engineer.

Video inspection may be useful, but is not necessarily a reliable method to definitively identify karstic features. As such, it will be used as a tool in conjunction with other available information and will be subject to reasonable judgement by the Engineer.

The Department reserves the right to perform independent video inspection using its equipment at any time. Provide any required assistance (e.g. access, etc.) to Department personnel for these independent inspections.

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2.2 Video Inspection and Evaluation of Results

Make submittals in accordance with the Project requirements for submittals. See Table 2 below.

Table 2 – Schedule of Video Inspection Submittals

Submittal Number	Submittal Item	Deadline	Event
1	Technical Proposal with Video Inspection Firm qualifications	45 business days before	Start of Drilled Shaft Construction
2	Video Inspection Electronic Files	24 HOURS after	Completion of testing on an individual drilled shaft
3	Video Inspection Final Report	5 business days after	Completion of testing on an individual drilled shaft
Provide all submittals and reports (except electronic video files) in .pdf format			

2.2.1 Technical Proposal

Submit a technical proposal prepared by the Video Inspection Firm that addresses the testing procedures and required qualifications and experience of the testing firm (Submittal No. 1 in Table 2.) and personnel. Include at least two (2) similar deep foundation projects where imaging of geological features in bedrock was performed [or one (1) deep foundation project supplemented by at least two (2) other projects where similar imaging of geological features in bedrock was performed] for which the organization has been engaged in Video Inspection. Use personnel having the same above-referenced experience performing video imaging.

Include layout drawings showing the relative position of all components of the video inspection system, including type and size of barge or other work area and a statement indicating the power source. Provide a written description of the operating procedure in a step-by-step sequence.

2.2.2 Testing

Thoroughly clean each excavated shaft, including the rock socket, of all loose fragments, sediment and turbidity prior to inspection. Flocculate each finished wet shaft excavation to increase the visibility in the water, prior to using the underwater video camera. Use a commercially available flocculant per the manufacturer's recommendations. Include flocculating time and delays into the project schedule and bid prices at the time of bidding. **The Department will not grant contract time extensions or provide additional compensation due to the flocculation time.**

Provide a color camera and lighting equipment which are capable of operating in dry or submerged conditions encountered during the inspection and capable of performing side-looking and down-looking video scans. Provide means and methods to evaluate and include the following with the submitted video images.

- Depth of the camera to the nearest 0.5 ft. at all times.
- Horizontal orientation of the camera. This can be as simple as distinctive visual markings (e.g. different colors) using equally-spaced weighted tapes or weighted ropes at no fewer than four (4) locations along the sidewalls of the shaft socket and casing. If visual markers are not used, provide a calibrated system to measure the camera orientation to the nearest 15 degrees.
- For features along the sidewalls, provide a system that can measure the size of the observed features to a precision of +/- 6 inches (0.5 ft.) in both the vertical and radial (i.e. along the perimeter) directions.
- For features along the shaft bottoms, provide a system that can measure the size of the observed features to a precision of +/- 6 inches (0.5 ft.) in both the directions and that measure distance of features from the sidewall to the nearest 12 inches (1 ft.) and quadrant in which the feature is located.

Operate the camera such that optimum clarity of detail can be obtained and all surface areas of the shaft, including the rock socket wall and bottom, casing/bedrock interface, and casing can be observed. Digitally record images of all surfaces. Based on the results of the video inspection and other applicable information (sonar calipering reports, construction records, etc.) associated with a rock socket, the Engineer will direct whether or not the excavation is acceptable.

2.2.3 Test Reports

Share real-time images with the Engineer on site as the video inspection is in progress.

Electronically store files associated with the video inspection and properly label the files as to test date, pier number, shaft number, station & offset, along with project and contractor identification. Furnish electronic files in Windows Media (.wmv) format, unless another format is accepted by the Department. Submit these files within 24 hours after completion of testing on an individual shaft. Upload the files on an ftp site to allow for immediate access by relevant personnel, unless another method is accepted by the Department. These files will immediately become property of the Department.

Within five (5) business days after completion of each test, submit a .pdf copy of the final written report to the Department (Submittal No. 3 in Table 2), including, as a minimum, the following information:

1. Date of test,
2. Shaft No., and reference elevation,
3. Descriptions of any cavities, cracks or voids in the rock socket wall and bottom, including a general description with depth, elevation and size of the cavities, cracks or voids, condition of the casing/bedrock interface, casing irregularities, etc. in .pdf format,
4. A narrative which explains all aspects of the test, results and analyses.

2.2.4 Evaluation of Video Inspection Results

Allow direct communication between the Video Inspection Firm and the Department. If the Video Inspection Firm is different than other testing firms on the project, allow direct communication between the Video Inspection and other testing firms.

The Engineer will review the “real-time” data collected by the Video Inspection Firm during the testing process at each shaft.

If discontinuities or features noted by the video inspection firm in the shaft excavation are deemed sufficient by the Engineer to potentially cause concrete loss or soil intrusion during concrete placement, or loss of nominal resistance, the Engineer will meet with the Contractor to discuss stabilization.

Continue with placement of reinforcement and concrete in the shaft only after receiving written approval from the Engineer to do so, based on evaluation of the Video Inspection and other applicable test results.

3.0 Crosshole Sonic Logging

3.1 Description

Crosshole Sonic Logging (CSL) is a nondestructive method to test the integrity of drilled shafts in accordance with ASTM D6760. It is the responsibility of the Contractor to supply all equipment and materials necessary to perform this testing and for obtaining the services of a CSL Testing Firm, which is experienced with CSL testing in accordance with Section 3.4.1 of this note and approved by the Department, to perform the testing.

The Contractor will be responsible for providing:

1. access tubes to be used for CSL testing of the drilled shafts;
2. watertight shoes, watertight caps, and non-shrink grout;
3. suitable working space and access to every shaft;
4. any other equipment, materials, or assistance necessary to accomplish the testing.

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3.2 Materials

3.2.1 Access Tubes

1. Provide access tubes meeting the requirements below:
   a. 2 inch ID schedule 40 steel pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S;
   b. contains round, regular internal diameters free of defects or obstructions, including any at pipe joints;
   c. capable of permitting the free, unobstructed passage of a 1.5-inch-diameter source and receiver probes; and
   d. watertight and free from corrosion with clean internal and external faces to ensure passage of the probes and a good bond between the concrete and the tubes.
2. Provide watertight shoes on the bottom and removable watertight caps on the top of the tubes.
3. The Engineer will accept access tubes based on visual inspection and certification and the steel pipe meets the requirements above.

3.2.2 Grout

Provide non-shrink grout to fill the access tubes and any cored holes at the completion of the CSL tests. Use grout conforming to Section 601.03.03 of the Standard Specifications.

3.3 Execution

3.3.1 Access Tube Installation

1. Install access tubes generally evenly-spaced and as shown below:
   - Abutment 1 6 tubes
   - Pier 1 8 tubes
   - Pier 2 6 tubes
2. Securely attach the CSL tubes that are along the inside periphery to the spiral reinforcement. Wire-tie the tubes a minimum of every 3 ft. so they will stay in position during placement of reinforcement and concrete. Place the tubes so they will be parallel with each other and as near to vertical as possible in the finished shaft. Even moderate bending of the tubes will result in large regional variations in the data.
3. Place the tubes from 6 inches above the shaft tip to at least 3 ft. above the top of rebar cage, at least 3 ft. above water level, at least to the top of concrete, and at least 3 ft. above the top of casing. Under no circumstances may the tubes be allowed to come to rest on the bottom of the excavation.
4. Ensure that any joints in the tubes are watertight.

5. Tubes may be extended with mechanical couplings. Do not use duct tape or other wrapping material to seal the joints. Welding of joints is prohibited.
6. During placement of the reinforcement cage, exercise care so that the tubes will not be damaged to the extent that would prevent a 1.5 inch diameter probe from passing through them.
7. After placing the reinforcing cage and before beginning concrete placement, **fill the tubes with clean potable water** and cap or seal the tube tops to keep debris out of the tubes. Replace the watertight caps immediately after filling the tubes with water.
8. Immediately before placing concrete, use a weighted tape to investigate all tubes to make sure that there are no bends, crimps, obstructions or other impediments to the free passage of the testing probes. Additionally, check to ensure there are no water leaks.
9. During removal of the caps from the tubes, exercise care so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and concrete.
10. Immediately after concrete placement, recheck each access tube to ensure that the water level is at the top of the tube. (This is due to the potential for air bubbles entrapped in the tube to rise during the pour and lower the water level in the tube.)
11. After concrete placement and before the beginning of CSL testing, inspect the access tubes and report any access tubes that the 1.5 inch diameter test probe cannot pass through to the Engineer. The Engineer will make an evaluation to determine if the CSL testing can be successfully performed without the tube(s); the Engineer may require the contractor to, at its own expense, replace one or more tubes with 2-inch-diameter holes cored through the concrete for the entire length of the shaft, excluding the bottom 6 inches. Unless directed otherwise by the Engineer, locate core holes approximately 6 inches inside the reinforcement such that it does not damage the reinforcement. For each core hole drilled, record a log with descriptions of inclusions and voids in the cored holes and submit a copy of the log and photographs to the Engineer. Preserve the cores, identify as to location and make available for inspection by the Engineer.

3.3.2 Grouting

After completion of the CSL and TIP testing, evaluation of results and upon being directed by the Engineer, remove the water from the access tubes and any cored holes, completely fill the tubes and holes with approved grout. After grouting, cut the tubes flush with the tops of the drilled shafts.

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3.4 CSL Testing and Evaluation of Test Results

Make submittals in accordance with the Project requirements for submittals. See Table 3 below.

Table 3 – Schedule of CSL Submittals

Submittal Number	Submittal Item	Deadline	Event
1	Technical Proposal with CSL Testing Firm qualifications	45 business days before	Start of Drilled Shaft Construction
2	CSL Testing Reports	5 business days after	Completion of testing on an individual drilled shaft
Provide all submittals and reports in .pdf format			

3.4.1 Technical Proposal

Submit a technical proposal prepared by the CSL Testing Firm that addresses the testing procedures and required qualifications and experience of the testing firm. Include at least three (3) similar deep foundation projects for which the testing organization has been engaged in CSL Testing. Use personnel having a minimum of three (3) similar deep foundation projects experience in CSL Testing and interpretation.

3.4.2 Testing

1. Provide access to the top of the shaft for testing personnel and equipment.
2. Perform CSL testing in accordance with ASTM D 6760.
3. Perform CSL testing on all completed shafts, after the shaft concrete has cured at least 72 hours and has obtained a minimum strength of 2500 psi.
4. Obtain logs as shown in the table below unless directed otherwise by the Engineer.

Substructure Unit	Tubes	Perimeter Logs	Major Diagonal Logs	Minor Diagonal Logs
Abutment 1	6	6	3	6
Pier 1	8	8	4	16
Pier 2	6	6	3	6

5. If during testing, it is apparent the tube debonding has occurred, the Contractor may consider flooding the top of the shaft and retesting immediately; it is possible that water may flow into gaps between the tubes and concrete and provide continuity for the sonic waves.

6. If the CSL testing firm believes that additional testing is required (such as Angled CSL, Crosshole Tomography, Singlehole Sonic Logging, or Sonic Echo/Impulse Response, etc.), contact the Engineer immediately. The Department will determine if additional testing is required. If the additional testing indicates that any drilled shaft on which additional testing was required is acceptable, the Department will pay for the direct cost of additional testing by change order. If the additional testing or evaluation of cores indicates that the concrete for any drilled shaft concrete is unacceptable, the additional testing will be at the expense of the Contractor.

3.4.3 Test Reports

1. Submit a test report prepared by the CSL Testing Firm within 5 business days of completion of testing which, as a minimum, contains:
   a. Date of test;
   b. Plan Shaft No. and Reference Elevation and notation of water level in the tubes at the time of testing;
   c. Schematic showing a plan view of the access tube locations;
   d. CSL logs with reference elevations;
   e. CSL logs presented for each tube pair tested with any discontinuity zones indicated on the logs and discussed in the report as appropriate;
   f. Analyses of **both** pulse first arrival time (FAT) versus depth **and** velocity versus depth;
   g. Include nested signal peak (i.e. “waterfall”) diagrams as a function of time plotted vs. depth. Clearly indicate the FAT picks used to obtain velocity vs. depth.
   h. Analyses of pulse energy/amplitude versus depth.
   i. Tables which indicate tube pairs, vertical extents, and magnitude (FAT % delay and/or energy decrease) of flaw and defect zones, as defined in Section 3.4.5 of this Special Note.
   j. A narrative portion of the report will be used to present items a thru i.

2. Plot data to a scale that will allow adequate evaluation of data variations. The Department reserves the right to request scale adjustments.
3. Complete all reports using English units.

3.4.4. Evaluation of CSL Test Results

1. Allow direct communication between the CSL Testing Firm and the Department. If the CSL Testing Firm is different than other testing firms on the project, allow direct communication between the CSL and other testing firms.
2. The Department will review the CSL test results in the test report to evaluate whether or not the drilled shaft integrity is acceptable. Within 10 business

days after receiving a test report, the Engineer will report to the Contractor whether the construction is acceptable or additional analyses are needed. The Department will also use the results of other non-destructive and materials testing, construction records, etc. to evaluate the condition of the shafts.

3. Perform CSL testing on the first shaft constructed and continue with drilling operations on subsequent shafts in accordance with Section 4.12 of the Special Note for Drilled Shafts.
4. Continue with construction of the structure above the drilled shafts only after receiving written approval from the Engineer to do so, based on evaluation of the TIP and CSL test results and other applicable test results, construction records, etc.
5. If the CSL records are inconclusive (e.g. records do not clearly indicate discontinuity, good conditions or missing data), the Department may require additional testing, such as Angled CSL, or Singlehole Sonic Logging or concrete cores to sample the concrete in question to verify shaft conditions. If core samples are needed, obtain cores with a minimum diameter of 2 inches using a double tube core barrel at a minimum of 4 locations selected by the Department, unless directed otherwise by the Engineer. Unless directed otherwise by the Engineer, locate core holes approximately 6 inches inside the reinforcement such that they do not damage the reinforcement. For each core hole drilled, record a log with descriptions of inclusions and voids in the cored holes and submit a copy of the log to the Engineer. Place the cores in core boxes as shown in Exhibit 10 of the KYTC Geotechnical Guidance Manual properly marked showing the shaft depth at each interval of core recovery. Transport the cores and logs to the Geotechnical Branch in Frankfort for inspection and testing unless directed otherwise by the Engineer. Only after being directed by the Engineer grout the core holes in accordance with Section 3.3.2 above.
6. If the additional testing or evaluation of cores indicate that concrete for any drilled shaft on which additional testing or coring was required is acceptable, the Department will pay for the direct cost of additional testing and concrete coring and grouting by change order. If the additional testing or evaluation of cores indicates that the concrete for any drilled shaft concrete is unacceptable, the additional testing and concrete coring and grouting will be at the expense of the Contractor.
7. If discontinuities are found, an independent structural and/or geotechnical consultant hired by the Contractor will perform structural and/or geotechnical evaluation at the expense of the Contractor. Use consultants who are prequalified by KYTC in applicable areas. Alternatively, the Engineer may require the Department's designer to perform the referenced evaluations and the Department may require the cost of these evaluations to be borne by the Contractor. Based on the design criteria established for the structure and the evaluation, the Engineer will assess the effects of the defects on the structural performance of the drilled shaft. If the results of the analyses indicate that there is conclusive evidence that the discontinuity

will result in inadequate or unsafe performance under the design loads, as defined by the design criteria for the structure, the Engineer will reject the shaft.

8. If any shaft is rejected, provide a plan for remedial action to the Department for approval. Any modifications to the foundation shafts and/or other substructure elements caused by the remedial action will require calculations and working drawings by consultant(s) hired by the contractor (or the Department's designer), at the expense of the Contractor, which will be subject to review by the Department. Begin remediation operations only after receiving approval from the Engineer for the proposed remediation. All remedial action will be at no cost to the Department and with no extension of contract time.

3.4.5. Evaluation Criteria

The Department will generally use the criteria below for evaluation of the shafts but may vary the criteria based on other available information (e.g. TIP results, construction records, etc.)

Satisfactory	Good (G)	FAT increase 0 to 10% **and** Energy Reduction < 6 dB
Anomaly	Questionable (Q)	FAT increase 11 to 20% **and** Energy Reduction of < 9 dB
Flaw	Poor/Flaw (P/F)	FAT increase 21 to 30% **or** Energy Reduction of 9 to 12 dB
Defect	Poor/Defect (P/D)	FAT increase >31% **or** Energy Reduction > 12 dB

- Flaws must be addressed if they affect more than 50% of the profiles.
- Defects must be addressed if they affect more than one profile (i.e. the result of complete investigation from bottom to top between two tubes) at the same depth.
- "Addressing" a Flaw or Defect may include an evaluation by tomography if the concern is localized (e.g. not across the full section), and/or, depending on the depth to the concern, additional measures like core drilling, repair or replacement, repeat tests after a longer waiting time or testing by other methods (gamma-gamma, low strain, high strain).
- Flaws or Defects covering the entire cross section define a full layer concern requiring repair.
- Anomalies will require evaluation and may need to be addressed based on the results of the evaluation.

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Continue with placement of reinforcement and concrete above the top of shaft only after receiving written approval from the Engineer to do so, based on evaluation of the CSL and other applicable test results.

4.0 Thermal Integrity Profiling

4.1 Description

Thermal Integrity Profiling (TIP) will be used as part of the program to test the integrity of drilled shafts. The Contractor will be responsible for supplying all equipment and materials necessary to perform this testing, and obtaining the services of a TIP Testing Firm, experienced with TIP testing and approved by the Engineer, to perform the testing using embedded thermal sensors in accordance with ASTM D7949 (Method B).

Installation of sensors/instrumentation to the reinforcing cage is incidental to the applicable contract unit bid price for Drilled Shaft, Common or Drilled Shaft, Solid Rock. Ensuring that the TIP instrumentation is operational and provides the required information is the responsibility of the TIP Testing Firm. Overseeing the installation of the TIP testing instrumentation and properly training the Contractor in the installation of the TIP testing instrumentation is the responsibility of the TIP Testing Firm and is incidental to applicable unit bid price for TIP Testing.

The Contractor will be responsible for providing:

1. suitable working space and access to every shaft;
2. other equipment, materials, or assistance necessary to accomplish the testing.

4.2 Materials

Provide materials in accordance with ASTM D7949 (Method B).

4.3 Execution

4.3.1 Training of Contractor Personnel

A TIP Testing Firm representative meeting the specified experience requirements will be required to be on site during installation of instrumentation, the shaft pour, and at least through the first 24 hours of data collection for the first shafts constructed at each of Abutment 1, Pier 1, and Pier 2. (This does not mean that it is necessary for the representative to be on site continuously during the first 24 hours of data collection after completion of concrete placement. However, the representative must visit the site to ensure that the instrumentation is functional and properly acquiring data 24 hours after completion of concrete placement before departing the project vicinity.) At the request

of the Contractor the Engineer may waive the requirement for the representative to be on site during the above-referenced activities for Abutment 1 or Pier 2 if satisfactory performance of the Contractor's personnel is observed. However, due to the conditions at Pier 1, it will be necessary for the TIP Testing firm representative to meet all of the requirements above for the first shaft constructed at Pier 1, regardless of the number of shafts at other locations that have been completed at that time. Unsatisfactory performance by Contractor personnel may result in the Engineer requiring the TIP Testing Firm representative to be on site for additional shafts. Additionally, this representative will be required to train applicable Contractor supervisory and/or engineering personnel with regard to instrumentation installation, data collection, and other applicable tasks as deemed necessary by the Tip Testing Firm and/or the Engineer. Department personnel may also participate in this training at the discretion of the Engineer. Submit written documentation prepared by the Tip Testing Firm representative which documents the training and includes the names of all personnel who have been trained. If the Contractor's personnel changes it will be necessary for the representative to train new personnel.

4.3.2 Embedded Thermal Sensor Installation

Install embedded thermal sensor cable in accordance with ASTM D7949 (Method B), the manufacturer's recommendations, and procedures outlined by the TIP Testing Firm representative at plan view access locations which are approximately evenly-spaced and as shown below:

- Abutment 1 6 embedded thermal sensor access locations per shaft
- Pier 1 8 embedded thermal sensor access locations per shaft
- Pier 2 6 embedded thermal sensor access locations per shaft

Attach the embedded thermal sensor cables to the longitudinal reinforcement of the shaft in accordance with procedures outlined by the TIP Testing Firm representative. Securely attach the cables to the reinforcement at a location on the reinforcement that is 90^{o} to the line connecting the reinforcement to the center of the shaft approximately halfway between nodes, working from the bottom of the cage to the top before tightening cable ties. Attach each cable to a recording apparatus securely suspended (on a protruding rebar, casing, template, etc.) well above the top of the concrete. If the cable is routed with a bend at any location, take extra precautions on securing the cable on either side of each such node. If reinforcement cage splicing is necessary, take extra precautions to ensure that the sensor cables are properly spliced.

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4.4 TIP Testing and Evaluation of Test Results

Make submittals in accordance with the Project requirements for submittals. See Table 4 below.

Table 4 – Schedule of TIP Submittals

Submittal Number	Submittal Item	Deadline	Event
1	Technical Proposal with TIP Testing Firm qualifications	45 business days before	Start of Drilled Shaft Construction
2	TIP Testing Reports	5 business days after	Completion of testing on an individual drilled shaft
Provide all submittals and reports in .pdf format			

4.4.1 Technical Proposal

Submit a technical proposal prepared by the TIP Testing Firm that addresses the testing procedures and required qualifications and experience of the testing firm. It is acceptable for the TIP and CSL Testing Firm to be the same firm, provided they meet requirements for both TIP (this Section) and CSL (Section 3.4.1) Testing Firms. Include at least three (3) similar deep foundation projects for which the testing organization has been engaged in TIP testing and data interpretation, including at least one (1) project involving embedded thermal sensors. At the discretion of the Department, documented participation in the development of ASTM Standard Test Method D7949-14 and/or documented participation in applicable research may be counted as one (1) tip project for the purposes of this qualification. At the discretion of the Department, experience on at least two (2) similar projects using other forms of deep foundation integrity testing (e.g. Crosshole Sonic Logging, Sonic Echo, Impulse Response, Gamma-Gamma, etc.) and interpretation may be substituted for one (1) TIP project. If used, integrity testing experience on other projects must be different projects than used to satisfy the actual TIP Testing project experience. Use personnel with experience in TIP Testing and interpretation as described immediately above.

Include a proposed method to perform confirmatory TIP testing [such as using a thermal probe in accordance with ASTM D7949 (Method A)] in the event that thermal sensor damage/defects (to the extent that a complete analysis of the shaft cannot be performed using the data from the embedded thermal sensors) are detected after concrete placement has been completed. Such testing would be at no additional cost to the Department.

4.4.2 Testing

1. Provide access to the top of the shaft for testing personnel and equipment.
2. Perform TIP testing in accordance with generally accepted TIP testing methods and in accordance with ASTM D7949.
3. Perform TIP testing on all completed shafts, unless directed otherwise by the Engineer. As a minimum, obtain data in 15 minute increments for a duration of 48 hours after completion of concrete placement or three (3) hours after the peak average shaft temperature has been reached, whichever is longer. The Department will consider reducing the 48 hour minimum for subsequent shafts at a given abutment or pier location if the Contractor submits a written request prepared by the TIP testing consultant with adequate justification for doing so.
4. Perform TIP testing using the embedded thermal sensor array, and in accordance with the ASTM Test Method D7949 (Method B).
5. Immediately report potential local discontinuities indicated by locally low temperatures relative to the average temperature at that depth, or average temperatures significantly lower than the average temperatures at other depths to the Department.
6. Place a weight on the bottom of a thermal sensor cable and lower the cable into the lake water outside of the casing to obtain a profile of ambient water temperature vs. depth. Unless directed otherwise by the Engineer, obtain this temperature profile immediately before, during, or immediately after testing each shaft. If this is performed during or immediately after concrete placement, ensure that the distance between the cable and the casing is sufficient to prevent the concrete from influencing these measurements. The Engineer may waive this requirement for some shafts if similar results are being obtained.
7. If thermal sensor damage/defects (to the extent that a complete analysis of the shaft cannot be performed using the data from the embedded thermal sensors) are detected after concrete placement has been completed, perform any confirmatory TIP testing as proposed according to Section 4.4.1 of this Special Note and accepted by the Department. Perform this testing at no additional cost to the Department. At the request of the Department, propose corrective methods to prevent repetitive occurrences of such damage/defects.

4.4.3 Test Reports

1. Submit a test report prepared by the TIP Testing Firm within five (5) business days of completion of testing which, as a minimum, contains:
   a. Date of test;
   b. Plan Shaft No. and Reference Elevation;
   c. Schematic showing a plan view of the embedded thermal sensor cable locations;
   d. The overall average temperature plotted as a function of time over the entire data collection period, with a clear indication of the selected time of

peak temperature. The "overall average temperature" averages all embedded thermal sensor cables and the entire length of the shaft (resulting in only one temperature value plotted at any given time). This temperature is proportional to the average radius computed from the actual total concrete volume installed (assuming a consistent concrete mix throughout). Radius at any point can then be determined from the temperature at that point compared to the overall average temperature;

e. Graphical displays of temperature measurements (including each individual cable and the average of the cables) versus depth at 12, 24, 36, and 48 hours after completion of concrete placement, and at least one plot within the last six (6) hours of the data collection period. Upon request, provide these graphical displays at other times;
f. At both the time associated with peak temperature and one-half the time to peak temperature, provide graphical displays of temperature (including each individual cable and the average of the cables) vs. depth, radius vs. depth, 3-D interpretations of temperature and radius, and at least one shaft slice at representative depths corresponding to water, overburden and rock socket, as applicable. Upon request, provide any of these graphical figures at other times and/or depths at no additional cost to the Department.
g. Indication of unusual temperatures, particularly significantly cooler local deviations of the average at any depth from the overall average over the entire length;
h. Plotted profile of ambient water temperature (outside the casing) vs. depth;
i. Variations in temperature between sensors (at each depth) which may correspond to variations in cage alignment (where concrete volume is known, the cage alignment or offset from center should be noted);
j. Where shaft specific construction information is available (e.g. elevations of the top of shaft, bottom of casing, bottom of shaft, etc.), these values should be noted on all pertinent graphical displays;
k. Drilled shaft radius calculations and the shaft quality, based upon the collected data, as well other available data, such as, as shaft alignment and wall profile from the SC Testing, top/bottom shaft/concrete elevations and concrete volume records collected during construction of the drilled shaft; and
l. A narrative portion of the report which addresses items a through k above.

2. When drastic changes in boundary conditions exist (air to water, water to soil, varying soil strata, varying temperatures in the water column, etc.) a single temperature to radius relationship will not accurately estimate the shaft radius. In such cases, apply algorithms in the software to account for these changes

in boundary conditions, normalize temperatures, and remove fluctuations not caused by changes in cross section.

3. Plot data to a scale that will allow adequate evaluation of data variations. The Department reserves the right to request scale adjustments.
4. Complete all reports using English units.

4.4.4 Evaluation of TIP Test Results

1. Allow direct communication between the TIP Testing Firm and the Department. If the TIP Testing Firm is different than other testing firms on the project, allow direct contact between the TIP and other testing firms
2. The Department will review the TIP test results in the test report to evaluate whether or not the drilled shaft integrity is acceptable. Within 10 business days after receiving a test report, the Engineer will report to the Contractor whether the construction is acceptable or additional more detailed analyses are needed. The Department will also use the results of other non-destructive and materials testing, construction records, etc. to evaluate the condition of the shafts.
3. Perform TIP testing on the first shaft constructed and continue with drilling operations on subsequent shafts in accordance with Section 4.12 of the Special Note for Drilled Shafts.
4. Continue with construction of the structure above the drilled shafts only after receiving written approval from the Engineer to do so, based on evaluation of the TIP and CSL test results and other applicable test results, construction records, etc.
5. If the TIP and the CSL records are inconclusive, the Engineer may require additional testing (such as Angled CSL, Crosshole Tomography, Singlehole Sonic Logging, or Sonic Echo/Impulse Response, etc.) or concrete cores to sample the concrete in question to verify shaft conditions. If either the TIP or CSL records are inconclusive, the Engineer may elect to require additional testing, based on the results of the conclusive TIP or CSL records. If core samples are needed, obtain cores with a minimum diameter of 2 inches, double tube core barrel at a minimum of four locations specified by the Department, unless directed otherwise by the Engineer. Unless directed otherwise by the Engineer, locate core holes approximately 6 inches inside the reinforcement such that they do not damage the reinforcement. For each core hole drilled, record a log with descriptions of inclusions and voids in the cored holes and submit a copy of the log to the Engineer. Place the cores in crates properly marked showing the shaft depth at each interval of core recovery. Transport the cores and logs to the Geotechnical Branch in Frankfort for inspection and testing unless directed otherwise by the Engineer. Grout the core holes in accordance with Section 3.3.2 above.
6. If the additional testing or evaluation of cores indicate that concrete for any drilled shaft on which additional testing or coring was required is acceptable,

the Department will pay for the direct cost of additional testing and concrete coring and grouting by change order. If the additional testing or if evaluation of cores indicate that the concrete for any drilled shaft concrete is unacceptable, the additional testing and concrete coring and grouting will be at the expense of the Contractor.

7. If discontinuities are found, an independent structural and/or geotechnical consultant hired by the Contractor may be required to perform structural and/or geotechnical evaluation at the expense of the Contractor. Use consultants who are prequalified by KYTC in applicable areas. Alternatively, the Engineer may require the Department's designer to perform the referenced evaluations and the cost of these evaluations may be borne by the Contractor. Based on the design criteria established for the structure and the evaluation, the Department will assess the effects of the defects on the structural performance of the drilled shaft. If the results of the analyses indicate that there is conclusive evidence that the discontinuity will result in inadequate or unsafe performance under the design loads, as defined by the design criteria for the structure, the Engineer will reject the shaft.
8. If any shaft is rejected, provide a plan for remedial action to the Department for approval. Any modifications to the foundation shafts and/or other substructure elements caused by the remedial action will require calculations and working drawings by independent consultant(s) hired by the Contractor, at the expense of the Contractor. The calculations and working drawings will be reviewed by the Engineer and/or the Department's designer. Begin remediation operations only after receiving acceptance from the Engineer for the proposed remediation. All remedial action will be at no cost to the Department and with no extension of contract time.

Continue with placement of reinforcement and concrete above the top of shaft only after receiving written approval from the Engineer to do so, based on evaluation of the TIP and other applicable test results.

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5.0 Measurement and Payment

5.1 Method of Measurement Sonar Calipering

The Department will pay for the authorized and accepted quantities of "Sonar Calipering" at the contract unit price per test for production shafts. This will constitute full compensation for all costs associated with providing access for testing personnel and equipment, performing the SC Testing, and reporting the results to the Engineer. Payment for the SC Testing will be at the contract unit price per SC Test. Payment for each test required by the Engineer will be the same regardless of whether the testing is performed after casing installation and overburden excavation or after rock excavation. Any additional testing required to verify verticality after casing adjustments will be at the expense of the Contractor.

5.2 Method of Measurement Video Inspection

The Department will pay for the authorized and accepted quantities of "Drilled Shaft Video Inspection" at the contract unit price per inspection. This will constitute full compensation for all costs associated with providing access for testing personnel and equipment, flocculating and flushing turbid water from the shaft, performing the video inspection, and reporting the results to the Engineer.

5.3 Method of Measurement CSL Testing

The Department will pay for the authorized and accepted quantities of "CSL Testing" at the contract unit price per each shaft tested. This will constitute full compensation for all costs associated with providing access for testing personnel and equipment, performing the CSL Testing in a single shaft, and reporting the results to the Engineer.

Installation of CSL Access Tubing is incidental to the applicable contract unit bid price for Drilled Shaft, Common, and Drilled Shaft, Solid Rock. This will constitute all costs and delays associated with installing the CSL Access Tubing in a single shaft, including but not limited to providing and installing access tubing, providing and installing all required bracing for access tubes, providing and placing grout in access tubes.

The Department will pay for the direct cost of additional testing and concrete coring, authorized by the Engineer, required to investigate shafts with inconclusive CSL records if evaluation of the additional testing or cores indicates that concrete for that drilled shaft is acceptable using a change order. This will constitute full compensation for all costs and delays associated with performing additional tests, obtaining and delivering concrete cores to the Geotechnical Branch, and grouting core holes.

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5.4 Method of Measurement TIP Testing

The Department will pay for the authorized and accepted quantities of "TIP Testing" at the contract unit price per each shaft tested. This will constitute full compensation for all costs associated with providing access for testing personnel and equipment, performing the TIP Testing in a single shaft, and reporting the results to the Engineer.

Installation of embedded thermal sensors is incidental to the applicable contract unit bid price for Drilled Shaft, Common, and Drilled Shaft, Solid Rock. This will constitute all costs and delays associated with installing the embedded thermal sensors.

The Department will pay for the cost of additional testing and concrete coring, authorized by the Engineer, required to investigate shafts with complex or inconclusive TIP records if evaluation of the additional testing or cores indicates that concrete for that drilled shaft is acceptable using a change order. This will constitute full compensation for all costs and delays associated with performing additional tests, obtaining and delivering concrete cores to the Geotechnical Branch.

5.5 Payment

The Department will pay for the completed and accepted quantities under the following. The Pay Unit of "Each" refers to each individual shaft.

Code	Pay Item	Pay Unit
24741EC	Sonar Caliper Testing - Pier 1	Each
24741EC	Sonar Caliper Testing - Pier 2	Each
24876EC	Drilled Shaft Video Insp. – Abut 1	Each
24876EC	Drilled Shaft Video Insp. – Pier 1	Each
24876EC	Drilled Shaft Video Insp. – Pier 2	Each
21322NC	CSL Testing (6 tubes) - Abut 1	Each
24875EC	CSL Testing (8 tubes) - Pier 1	Each
21322NC	CSL Testing (6 tubes) – Pier 2	Each
24874EC	TIP Testing - Abut 1	Each
24874EC	TIP Testing - Pier 1	Each
24874EC	TIP Testing - Pier 2	Each

The Department will consider payment as full compensation for all work required under this Section.