PRB.35488

Site # 006-01-ef443

5631 US Hwy 19E, Newland

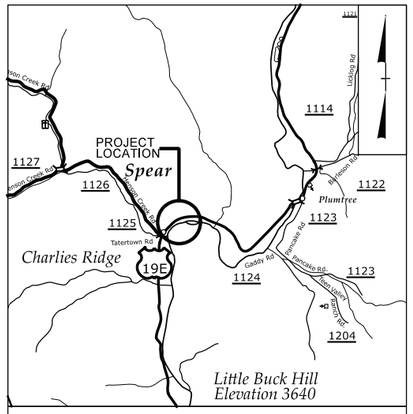
North Toe River in Avery County

WBS 51830.2.11.04

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

01/16/24

TIP PROJECT: 006-01-ef443



VICINITY MAP (NTS)

NORTH CAROLINA DEPARTMENT OF EMERGENCY MANAGEMENT

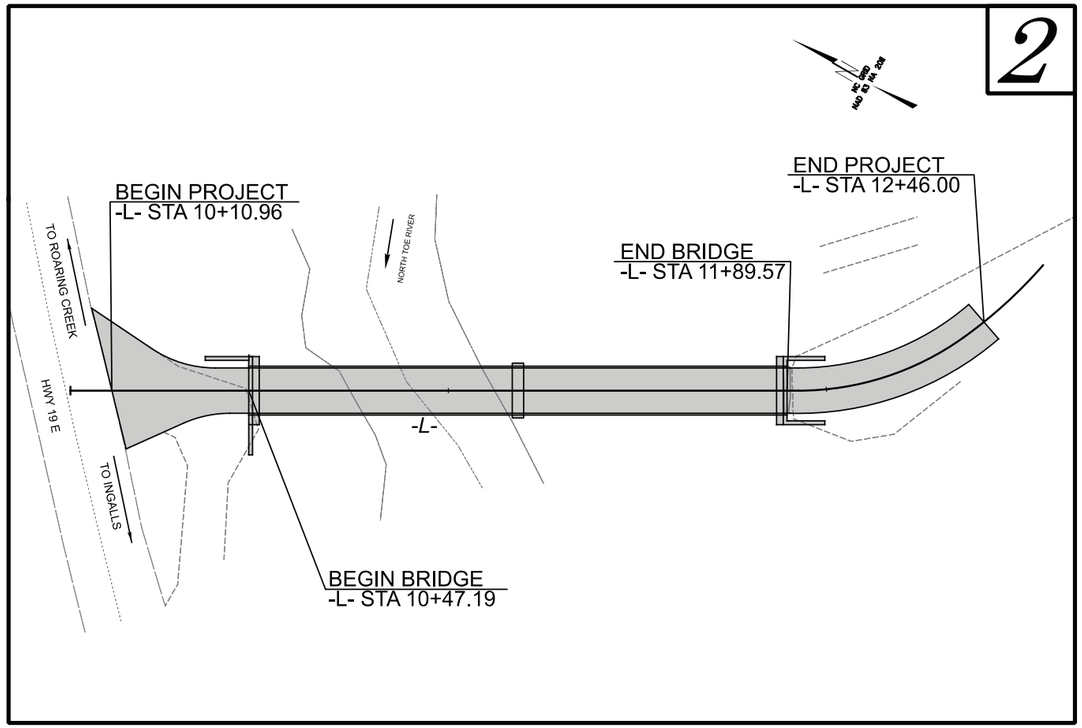
AVERY COUNTY

LOCATION: *PRIVATE BRIDGE REPLACEMENT LOCATED AT 5631 US 19E NEWLAND, NC 28657*

TYPE OF WORK: *GRADING, DRAINAGE, PAVING, AND STRUCTURE*

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	006-01-ef443	1l	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION



INDEX OF SHEETS

SHEET NUMBER	SHEET
1	TITLE SHEET
2	ROADWAY TYP.SECTION, PLAN AND PROFILE
S-1 THRU S-16	STRUCTURE PLANS
EC-1 THRU EC-4	EROSION CONTROL PLANS
RF-1	REFORESTATION DETAIL

GRAPHIC SCALES

20 10 0 20 40
PLANS

20 10 0 20 40
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

DESIGN DATA

FUNC CLASS = PRIVATE ROAD

ADT = >20 AND <2000

MIN R = 40' (<10% GRADE)
80' (>10% GRADE)

e = 0.04 MIN, 0.06 MAX (UNPAVED)
0.02 MIN, 0.06 MAX (PAVED)

MAX GRADE = 12% (UNPAVED)
25% (PAVED)

K = 2 (CREST & SAG)

PROJECT LENGTH

LENGTH OF ROADWAY PROJECT 006-01-ef443 = 0.018 MILES
LENGTH OF STRUCTURE PROJECT 006-01-ef443 = 0.027 MILES
TOTAL LENGTH OF TIP PROJECT 006-01-ef443 = 0.045 MILES

PLANS PREPARED BY:
VOLKERT
5430 Wade Park Blvd., Suite 410
Raleigh, NC 27606
Tel. 919-854-0344 Fax. 919-854-0355
NC License No. F-0765

2024 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: N/A

LETTING DATE: N/A

EMILY E MURRAY, PE
PROJECT ENGINEER

CHRISTOPHER H. LEE, PE
PROJECT DESIGN ENGINEER

CHRIS WERNER, PE
PRIVATE ROAD AND BRIDGE PROGRAM MANAGER

HYDRAULICS ENGINEER

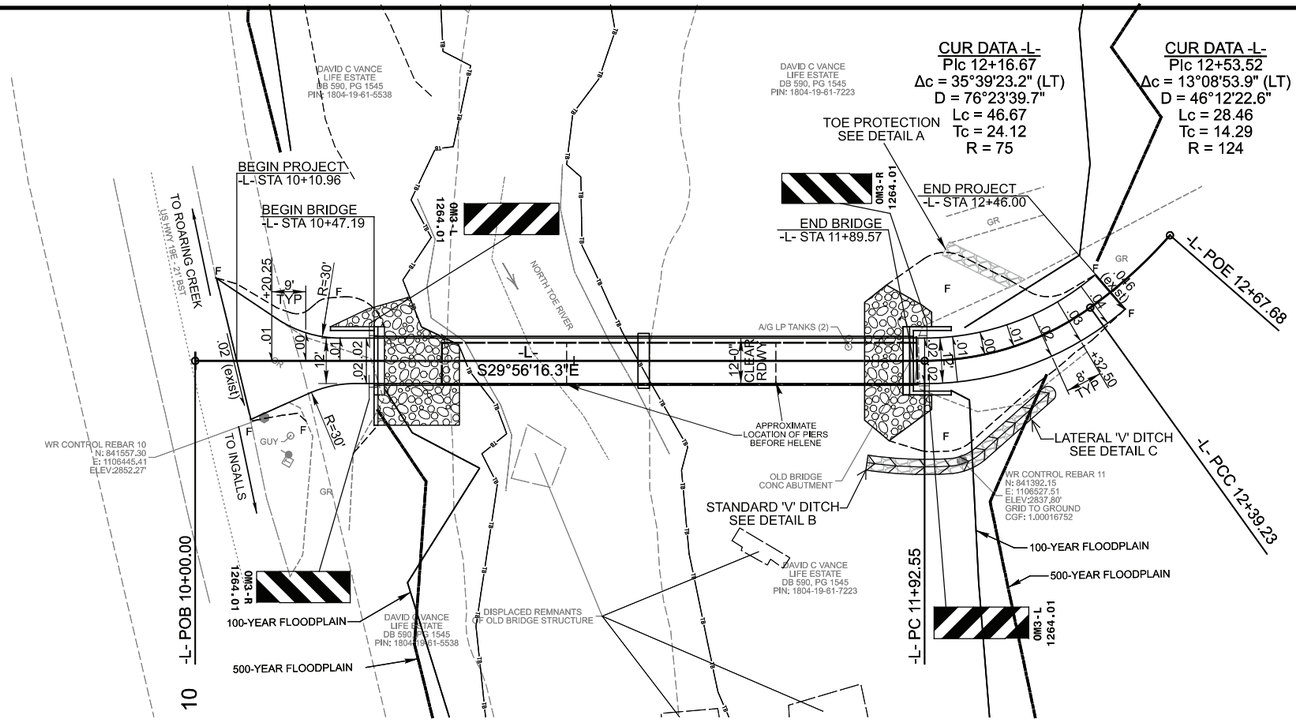
ANA M. PASSMAN *P.E.* 11/26/2025
SIGNATURE:

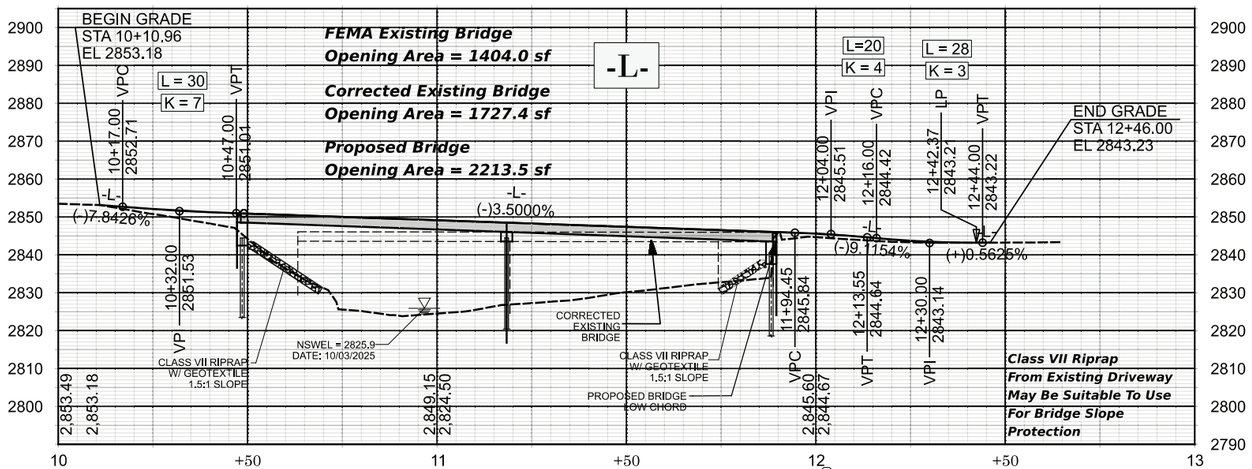
ROADWAY DESIGN ENGINEER

CHRISTOPHER H. LEE *P.E.* 11/26/2025
SIGNATURE:

EMERGENCY MANAGEMENT
NORTH CAROLINA

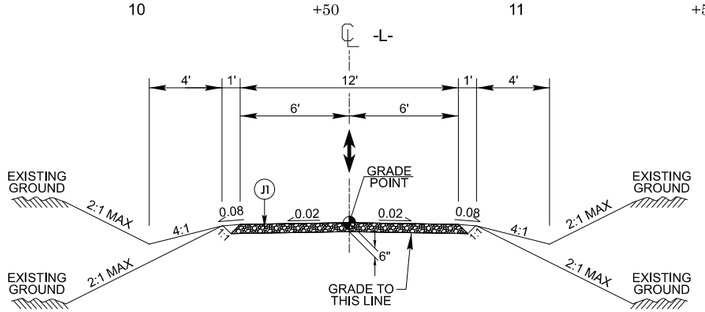
Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A



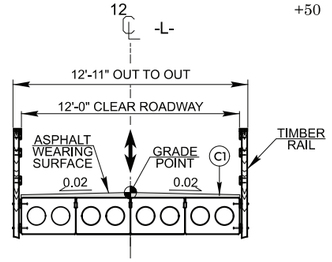


ROADWAY QUANTITIES

DESCRIPTION	QUANTITY	UNIT
BORROW EXCAVATION	135	CY
SUPPLEMENTARY CLEARING AND GRUBBING	1	ACRES
FINE GRADING	170	SY
AGGREGATE BASE COURSE	60	TON

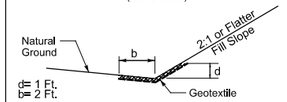


TYPICAL SECTION NO. 1
-L- STA. 10+10.96 TO 10+47.19 (BEGIN BRIDGE)
-L- STA. 11+89.57 (END BRIDGE) TO 12+46.00



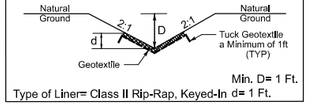
BRIDGE SKETCH NO. 1
-L- STA. 10+47.19 (BEGIN BRIDGE) TO
-L- STA. 11+89.57 (END BRIDGE)

DETAIL A
TOE PROTECTION
(Not to Scale)



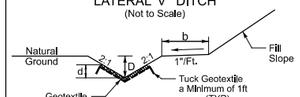
Type of Liner= Class I Rip-Rap
FROM -L- STA. 12+00 TO STA. 12+24 LT

DETAIL B
STANDARD 'V' DITCH
(Not to Scale)



Type of Liner= Class II Rip-Rap, Keyed-In d= 1 Ft.
FROM -L- STA. 11+77 TO STA. 11+93 RT

DETAIL C
LATERAL 'V' DITCH
(Not to Scale)



Type of Liner= Class II Rip-Rap, Keyed-In
FROM -L- STA. 11+93 TO STA. 12+22 RT

PAVEMENT SCHEDULE	
C1	PROP. VAR. DEPTH ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, AT AN AVERAGE RATE OF 110 LBS. PER SQ. YD. PER 1" DEPTH TO BE PLACED IN LAYERS NOT LESS THAN 1" OR GREATER THAN 1½" IN DEPTH
J1	PROP. 6' AGGREGATE BASE COURSE

PRB_006-01-ef443

SHEET NO. 2 | TOTAL SHEETS X

VOLKERT
5430 Wade Park Blvd., Suite 410
Raleigh, NC 27606
Tel. 919-854-0344 Fax. 919-854-0355
NC License No. F-0785

ROADWAY DESIGN ENGINEER
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 047089 CHRISTOPHER H. LEE
1/26/2025

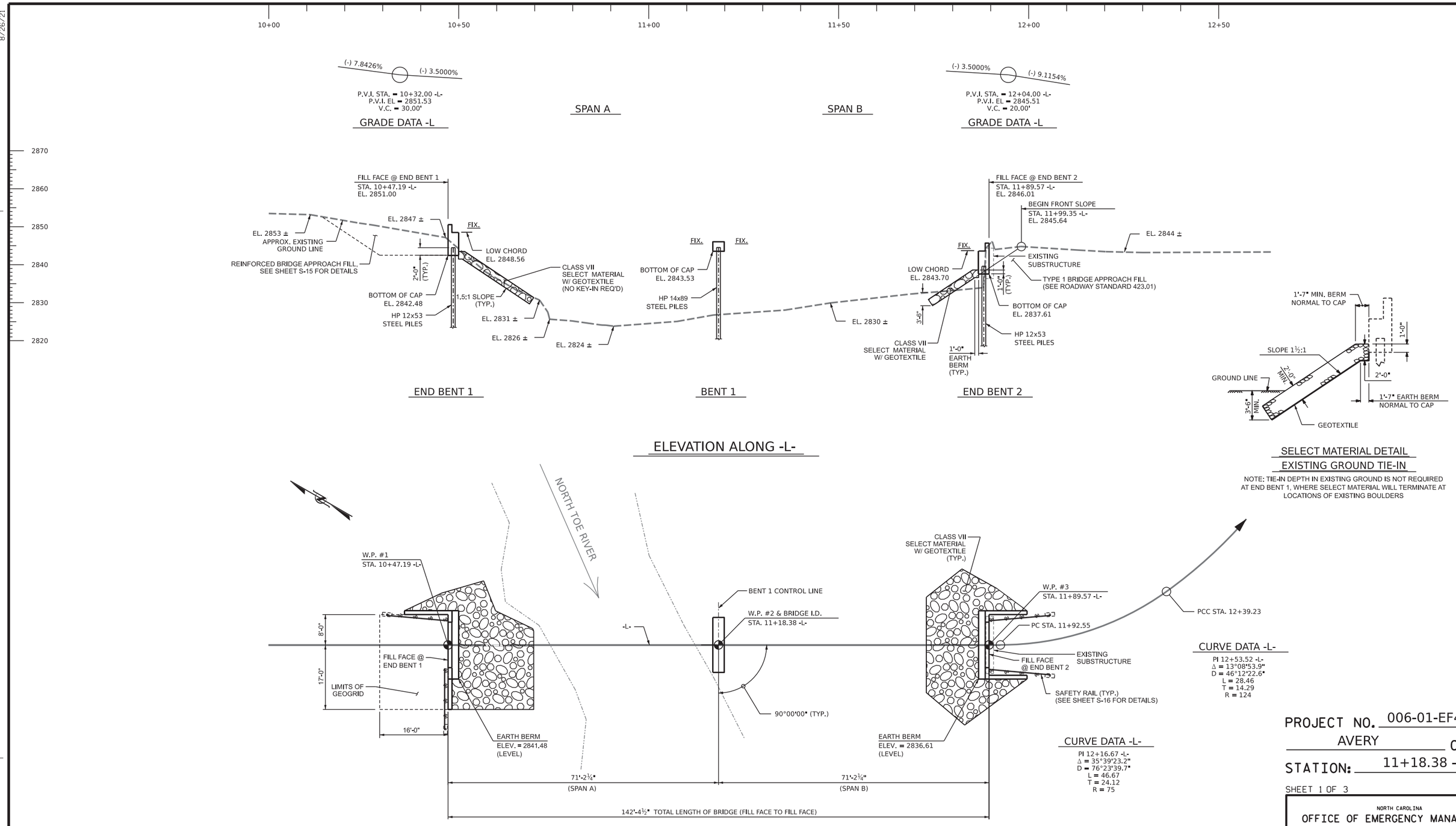
HYDRAULIC DESIGN ENGINEER
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL C26306 ANITA M. PASSMAN
11/26/2025

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

STATE OF NORTH CAROLINA
AVERY COUNTY

BRIDGE AT 5631 US 19E NEWLAND, NC 28657
AVERY COUNTY
12'-0" CLEAR ROADWAY AND 90° SKEW

8/26/21



ELEVATION ALONG -L-

SELECT MATERIAL DETAIL
EXISTING GROUND TIE-IN

NOTE: TIE-IN DEPTH IN EXISTING GROUND IS NOT REQUIRED AT END BENT 1, WHERE SELECT MATERIAL WILL TERMINATE AT LOCATIONS OF EXISTING BOULDERS

PLAN

CURVE DATA -L-
PI 12+53.52 -L-
Δ = 13°08'53.9"
D = 46°12'22.6"
L = 28.46
T = 14.29
R = 124

CURVE DATA -L-
PI 12+16.67 -L-
Δ = 35°39'23.2"
D = 76°23'39.7"
L = 46.67
T = 24.12
R = 75

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 1 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

GENERAL DRAWING

BRIDGE AT 5598 S US19E
OVER N. TOE RIVER

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

McADAMS
The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 040425 ENGINEER JEFFREY M. LOFTUS 12-01-26

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-1
1			3			TOTAL SHEETS
2			4			16

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_001_PRB00601EF443_NCEM_GD1_001.dgn
loftus

SUMMARY OF PILE INFORMATION/INSTALLATION

(Blank entries indicate item is not applicable to structure)

End Bent / Bent No, Pile(s) #(-#) (e.g., "Bent 1, Piles 1-5")	Number of Piles per Line	Factored Resistance per Pile KIPS	Pile Cut-Off (Top of Pile) Elevation FT	Estimated Pile Length per Pile FT	Scour Critical Elevation FT	Driven Piles			Predrilling for Piles **			Drilled-In Piles		
						Minimum Pile Tip (Tip No Higher Than) Elevation FT	Required Driving Resistance (RDR)* per pile KIPS	Pile Redrives Quantity EACH	Predrilling Length per Pile LIN FT	Predrilling Elevation (Elevation Not To Predrill Below) FT	Maximum Predrilling Diameter INCHES	Pile Excavation (Bottom of Hole) Elevation FT	Pile Excavation Not In Soil per Pile LIN FT	Pile Excavation In Soil per Pile LIN FT
End Bent 1, Piles 1-5	5	240	2844.48	20	2829.80							2824.80	5	15
Bent 1, Piles 1-4	4	340	2844.53	25	2823.40							2813.40	10	5
End Bent 2, Piles 1-5	5	220	2839.61	25	2824.60							2818.40	6	19
TOTAL QUANTITY:													95	190

$$^{*}RDR = \frac{Factored\ Resistance\ +\ Factored\ Drag\ Load\ +\ Factored\ Dead\ Load}{Dynamic\ Resistance\ Factor} + Nominal\ Drag\ Load\ Resistance + Nominal\ Resistance\ from\ Scourable\ Material$$

** Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.

PROJECT NO. 011.01.00403

Avery COUNTY

STATION: -L- 11+18.38

NOTES:

1. The Pile Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Hratch Antoine Agopian, #057984) on 11-18-2025.
2. Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
3. The Engineer may adjust the quantity for DPT Testing and Pipe Pile Plates when necessary.

NORTH CAROLINA PROFESSIONAL SEAL 057984 ENGINEER JEFFREY M. LOFTUS 12-04-26

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

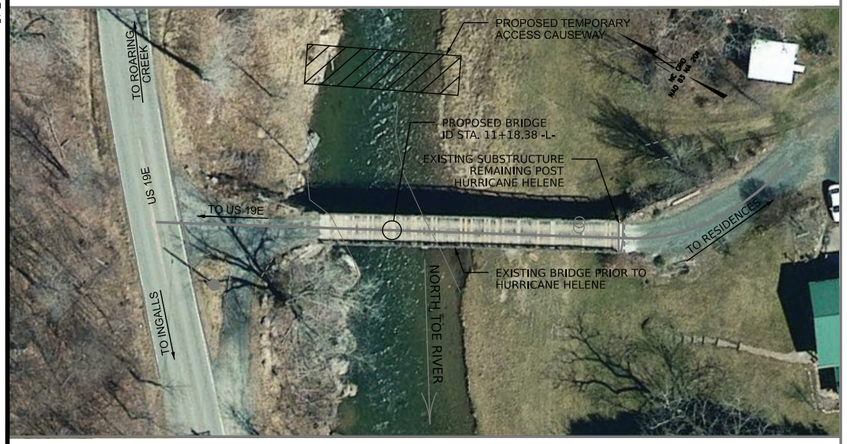
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PILE FOUNDATION TABLES

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-2
1			3			TOTAL SHEETS
2			4			16

8/26/21

BM #1, REBAR, STA. 10+18.25, OFFSET 14.98' RIGHT, ELEV. 2852.27, N 841557.30, E 1106445.41



LOCATION SKETCH

NOTES

ASSUMED LIVE LOAD = HS-20.

IMPACT ALLOWANCE = 15%.

A MOMENT DISTRIBUTION FACTOR OF 0.34 WAS USED FOR DESIGN OF THE CORED SLAB UNITS.

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH AASHTO LRFD DESIGN SPECIFICATIONS EXCEPT AS NOTED.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR CORED SLAB AND BOX BEAM POST TENSIONING, SEE SPECIAL PROVISIONS.

FOR TIMBER BRIDGE RAIL, SEE SPECIAL PROVISIONS.

FOR SAFETY RAIL, SEE SPECIAL PROVISIONS.

FOR SELECT MATERIAL, CLASS VII (2'-0" MIN. THICK), SEE SPECIAL PROVISIONS.

FOR REINFORCED BRIDGE APPROACH FILL, SEE SPECIAL PROVISIONS.

FOR TYPE 1 BRIDGE APPROACH FILL, SEE SPECIAL PROVISIONS.

FOR CONSTRUCTION, MAINTENANCE, AND REMOVAL OF TEMPORARY ACCESS, SEE SPECIAL PROVISIONS. FOR DETAILS OF CONSTRUCTION, MAINTENANCE, AND REMOVAL OF TEMPORARY ACCESS, SEE EROSION CONTROL PLANS.

FOR EROSION CONTROL, SEE EROSION CONTROL PLANS.

EXISTING BRIDGE REMNANTS SHALL BE REMOVED.

REMOVAL OF THE EXISTING BRIDGE REMNANTS AND WORK ON THE PROPOSED BRIDGE SHALL BE PERFORMED IN A MANNER THAT PREVENTS DEBRIS FROM FALLING INTO THE WATER.

IN AS MUCH AS THE PAINT SYSTEM ON THE EXISTING STRUCTURAL STEEL CONTAINS LEAD, THE CONTRACTOR'S ATTENTION IS DIRECTED TO ARTICLE 107-1 OF THE STANDARD SPECIFICATIONS. ANY COSTS RESULTING FROM COMPLIANCE WITH APPLICABLE STATE OR FEDERAL REGULATIONS PERTAINING TO HANDLING OF MATERIALS CONTAINING LEAD BASED PAINT SHALL BE INCLUDED IN THE BID PRICE FOR "REMOVAL OF EXISTING STRUCTURE."

EXCEPT AS MAY OTHERWISE BE SPECIFIED ON PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE 2024 "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES" OF THE N. C. DEPARTMENT OF TRANSPORTATION.

UNLESS OTHERWISE REQUIRED ON PLANS, CLASS A CONCRETE SHALL BE USED FOR ALL PORTIONS OF ALL STRUCTURES.

UNLESS OTHERWISE NOTED ON THE PLANS, ALL EXPOSED CORNERS ON STRUCTURES SHALL BE CHAMFERED ¾".

THE BRIDGE SHALL BE BUILT ON THE GRADE OR VERTICAL CURVE SHOWN ON PLANS.

ALL REINFORCING STEEL SHALL BE DEFORMED. DIMENSIONS RELATIVE TO PLACEMENT OF REINFORCING ARE TO CENTERS OF BARS UNLESS OTHERWISE INDICATED IN THE PLANS. DIMENSIONS ON BAR DETAILS ARE TO CENTERS OF BARS OR ARE OUT TO OUT AS INDICATED ON PLANS.

WIRE BAR SUPPORTS SHALL BE PROVIDED FOR REINFORCING STEEL WHERE INDICATED ON THE PLANS. WHEN BAR SUPPORT PIECES ARE PLACED IN CONTINUOUS LINES, THEY SHALL BE SO PLACED THAT THE ENDS OF THE SUPPORTING WIRES SHALL BE LAPPED TO LOCK LEGS ON ADJOINING PIECES.

THE TIMBER BRIDGE RAIL IS NOT DESIGNED ACCORDING TO THE MANUAL FOR ASSESSING SAFETY HARDWARE (MASH) TEST LEVELS. THE TIMBER BRIDGE RAIL WAS DESIGNED FOR LOADINGS FOR SAFETY RAIL ACCORDING TO THE 2024 NORTH CAROLINA STATE BUILDING CODE.

AT THE CONTRACTOR'S OPTION, THE EXISTING STONE MATERIAL ON THE THE END BENT 2 APPROACH CAN BE USED FOR THE CLASS VII SELECT MATERIAL PROPOSED FOR END BENT 2. CONTRACTOR SHALL VERIFY THAT THE EXISTING MATERIAL ADHERES TO CLASS VII SELECT MATERIAL QUALIFICATIONS.

ASPHALT WEARING SURFACE SHALL UTILIZE VARIABLE DEPTH ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, PLACED AT AN AVERAGE RATE OF 110 LBS. PER SQ. YD. PER 1" DEPTH, TO BE PLACED IN LAYERS NOT TO EXCEED 2" IN DEPTH.

RECOMMENDED INSPECTION AND MAINTENANCE

BRIDGE INSPECTION PERFORMED BY A CERTIFIED BRIDGE INSPECTOR IS RECOMMENDED ON THE FOLLOWING SCHEDULE:

YEARS 0-10:	INSPECT EVERY 5 YEARS
YEARS 10-20:	INSPECT EVERY 4 YEARS
YEARS 20-30:	INSPECT EVERY 3 YEARS
YEARS 30+:	INSPECT EVERY 2 YEARS

REPAIR ANY PRIORITY MAINTENANCE ITEMS NOTED DURING BRIDGE INSPECTIONS.

IF DETERIORATION IS NOTED IN INSPECTIONS, ACCELERATE SCHEDULE AND INSPECT EVERY 2 YEARS THEREAFTER.

OBSERVE BETWEEN INSPECTIONS FOR CRACKS RUST OR SPALLING IN CONCRETE OR STEEL COMPONENTS, SIGNS OF EROSION OR SCOURING AROUND ABUTMENTS AND PIERS, DECK SURFACE WEAR, DAMAGE OR DETERIORATION OF SAFETY RAIL.

REMOVE DEBRIS AND SEDIMENT FROM THE DECK AND UNDERNEATH THE BRIDGE TO PREVENT PONDING AND EROSION.

STRUCTURAL MAINTENANCE SHOULD INCLUDE TIGHTENING LOOSE BOLTS AND FASTENERS, SEALING CRACKS IN CONCRETE, PATCHING SPALLS IN CONCRETE, MILLING AND REPLACING ASPHALT ON BRIDGE DECK TAKING CARE NOT TO DAMAGE THE CORED SLAB UNITS.

MAINTAIN ASPHALT WEARING SURFACE IN GOOD CONDITION ENSURING ANY MILLING ASSOCIATED WITH REPAVING DOES NOT DAMAGE CORED SLAB UNITS.

FOUNDATION NOTES

FOR PILES, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

FILL THE BOTTOM 5 FT OF HOLES FOR PILE EXCAVATION AT END BENT NO. 1 AND END BENT NO. 2 WITH CONCRETE OR GROUT AND THE REST OF HOLES WITH CLASS II OR III SELECT MATERIAL THAT MEETS SECTION 1016 OF THE STANDARD SPECIFICATIONS.

FILL THE BOTTOM 10 FT OF HOLES FOR PILE EXCAVATION AT BENT NO. 1 WITH CONCRETE OR GROUT AND THE REST OF HOLES WITH CLASS II OR III SELECT MATERIAL THAT MEETS SECTION 1016 OF THE STANDARD SPECIFICATIONS.

SET HP12X53 PILES AT END BENT NO. 1 AND END BENT NO. 2 AND HP14X89 PILES AT BENT NO. 1 IN THE PREDRILLED HOLES AND FILL THE ANNULUS WITH CEMENTITIOUS CONCRETE/GROUT AS FOLLOWS:

1. DRY CONDITIONS: WHEN THE HOLE IS STABLE AND FREE OF STANDING WATER, PLACE CONCRETE OR GROUT FROM THE BOTTOM UP USING A TREMIE OR FLEXIBLE HOSE AND ALLOW CONCRETE OR GROUT TO FLOW FREELY AROUND THE PILE. KEEP PLACEMENT CONTINUOUS TO THE TOP OF ROCK ELEVATION.

2. WET CONDITIONS: WHEN WATER OR SLURRY IS PRESENT, USE AN APPROVED TREMIE PIPE KEPT EMBEDDED IN THE FRESH CONCRETE OR GROUT AT LEAST 5 FT. CLEAN THE BOTTOM OF EXCAVATIONS WITH A SUBMERSIBLE PUMP OR AN AIRLIFT. PLACE CONCRETE OR GROUT FROM THE BOTTOM UP TO PREVENT SEGREGATION OR WASHOUT. MAINTAIN POSITIVE HEAD OF CONCRETE OR GROUT UNTIL THE ROCK SOCKET IS COMPLETELY FILLED.

3. CASING USE: TEMPORARY CASING MAY BE USED AS REQUIRED TO MAINTAIN A CLEAN AND STABLE HOLE. CASING MAY BE TELESCOPIC OR SEGMENTAL. MAINTAIN CASING TIGHT TO PREVENT CONCRETE OR GROUT LOSS. CASING MAY BE WITHDRAWN AFTER CONCRETE OR GROUT HAS REACHED SUFFICIENT STABILITY, PROVIDED THE CONCRETE OR GROUT LEVEL IS MAINTAINED AT OR ABOVE THE BOTTOM OF THE CASING DURING WITHDRAWAL. LEAVE CASING IN PLACE IF CONCRETE OR GROUT STABILITY OR WATER CONDITIONS REQUIRE IT.

BRIDGE COORDINATES	
LATITUDE	LONGITUDE
36° - 01' - 29.0"	-82° - 01' - 19.2"

TOTAL BILL OF MATERIAL

	CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS	REMOVAL OF EXISTING STRUCTURE	CLASS A CONCRETE	REINFORCING STEEL	HP 12 X 53 STEEL PILES		HP 14 X 89 GALVANIZED STEEL PILES		PILE EXCAVATION NOT IN SOIL	PILE EXCAVATION IN SOIL	ELASTOMERIC BEARINGS	SELECT MATERIAL CLASS VII (2'-0" MIN. THICK)	GEOTEXTILE FOR DRAINAGE	3'-0" X 2'-0" PRESTRESSED CONCRETE CORED SLABS		TIMBER BRIDGE RAIL	SAFETY RAIL	REINFORCED BRIDGE APPROACH FILL, STA. 10+47.19 -L-	TYPE 1 BRIDGE APPROACH FILL, STA. 11+89.57 -L-	ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B	ASPHALT BINDER FOR PLANT MIX
	LUMP SUM	LUMP SUM	CU. YDS.	LBS.	NO.	LIN.FT.	NO.	LIN.FT.	LIN.FT.	LIN.FT.	LUMP SUM	TONS	SQ.YDS.	NO.	LIN.FT.	LIN.FT.	EACH	LUMP SUM	LUMP SUM	TON	TON
SUPERSTRUCTURE											LUMP SUM			8	560.00	284.75	4			35	3
END BENT NO. 1			19.2	2,457	5	100			25	75		87	97					LUMP SUM			
BENT NO. 1			4.2	906			4	100	40	20											
END BENT NO. 2			19.4	2,459	5	125			30	95		102	113						LUMP SUM		
TOTAL	LUMP SUM	LUMP SUM	42.8	5,822	10	225	4	100	95	190	LUMP SUM	189	210	8	560.00	284.75	4	LUMP SUM	LUMP SUM	35	3

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 3 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

GENERAL DRAWING

BRIDGE AT 5598 S US19E
OVER N. TOE RIVER

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 042425 ENGINEER JEFFREY M. LOFTUS 12-06-26

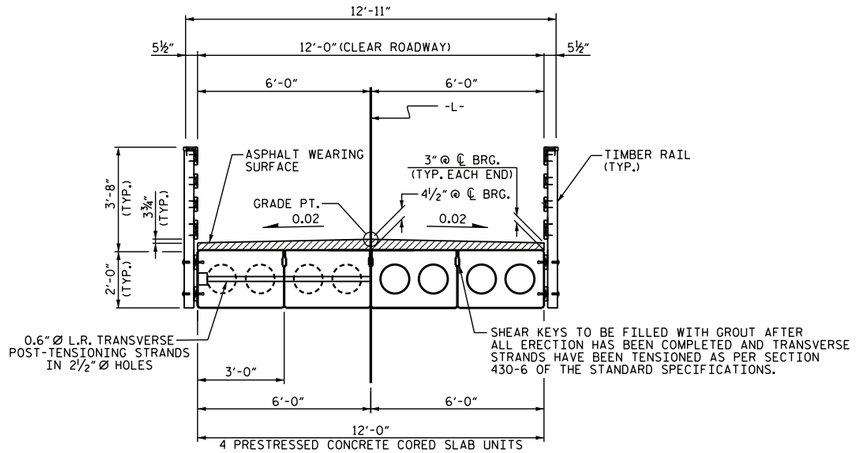
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-3
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_005_PRB00601EF443_NCEM_GD3_003.dgn
loftus

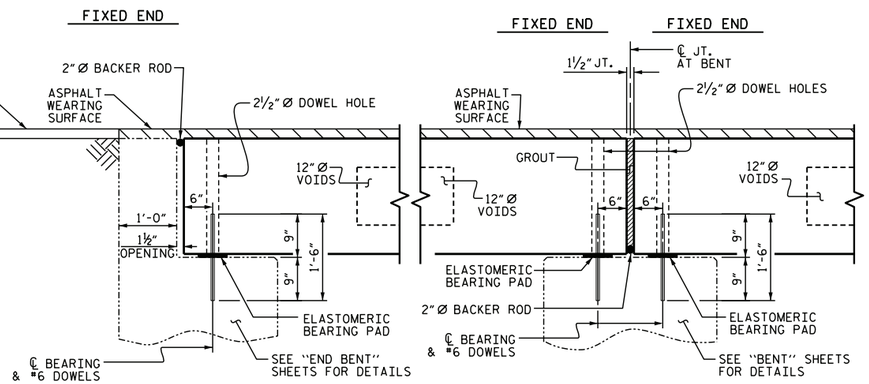
8/26/21



HALF SECTION AT INTERMEDIATE DIAPHRAGMS | HALF SECTION THROUGH VOIDS

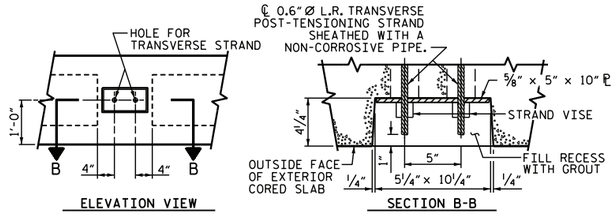
TYPICAL SECTION

THE MAXIMUM ASPHALT THICKNESS IS SHOWN. THE THICKNESS OF THE ASPHALT THICKNESS VARIES.

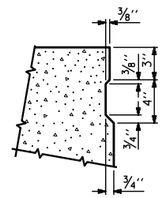


SECTION AT END BENT

SECTION AT BENT

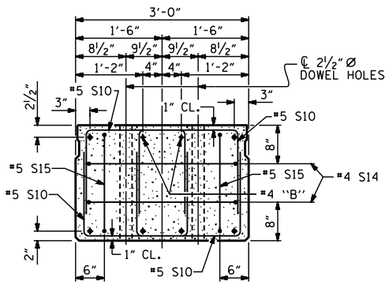


GROUTED RECESS AT END OF POST-TENSIONED STRAND•CORED SLABS



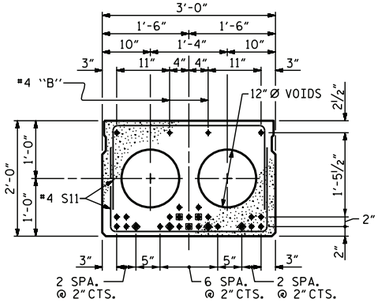
SHEAR KEY DETAIL

NOTE: OMIT SHEAR KEY ON OUTSIDE FACE OF EXTERIOR CORED SLABS.



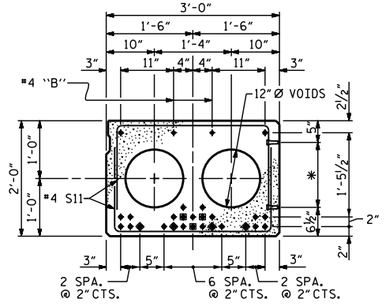
END ELEVATION

SHOWING PLACEMENT OF DOUBLE STIRRUPS AND LOCATION OF DOWEL HOLES. (STRAND LAYOUT NOT SHOWN.) INTERIOR SLAB UNIT SHOWN-EXTERIOR SLAB UNIT SIMILAR EXCEPT SHEAR KEY LOCATION.



INTERIOR SLAB SECTION

(26 STRANDS REQUIRED)



EXTERIOR SLAB SECTION

(26 STRANDS REQUIRED)
(RIGHT EXTERIOR SHOWN, LEFT EXTERIOR SLAB MIRRORED)
* (2) THREADED INSERTS CAST IN OUTSIDE FACE OF EXTERIOR UNIT

0.6'' Ø LOW RELAXATION STRAND LAYOUT

◈ BOND SHALL BE BROKEN ON THESE STRANDS FOR A DISTANCE OF 12'-0" FROM END OF CORED SLAB UNIT. SEE STANDARD SPECIFICATIONS, ARTICLE 1078-7.

◉ BOND SHALL BE BROKEN ON THESE STRANDS FOR A DISTANCE OF 8'-0" FROM END OF CORED SLAB UNIT. SEE STANDARD SPECIFICATIONS, ARTICLE 1078-7.

DEBONDING LEGEND

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 1 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

3'-0'' X 2'-0'' PRESTRESSED CONCRETE CORED SLAB UNIT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-4
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

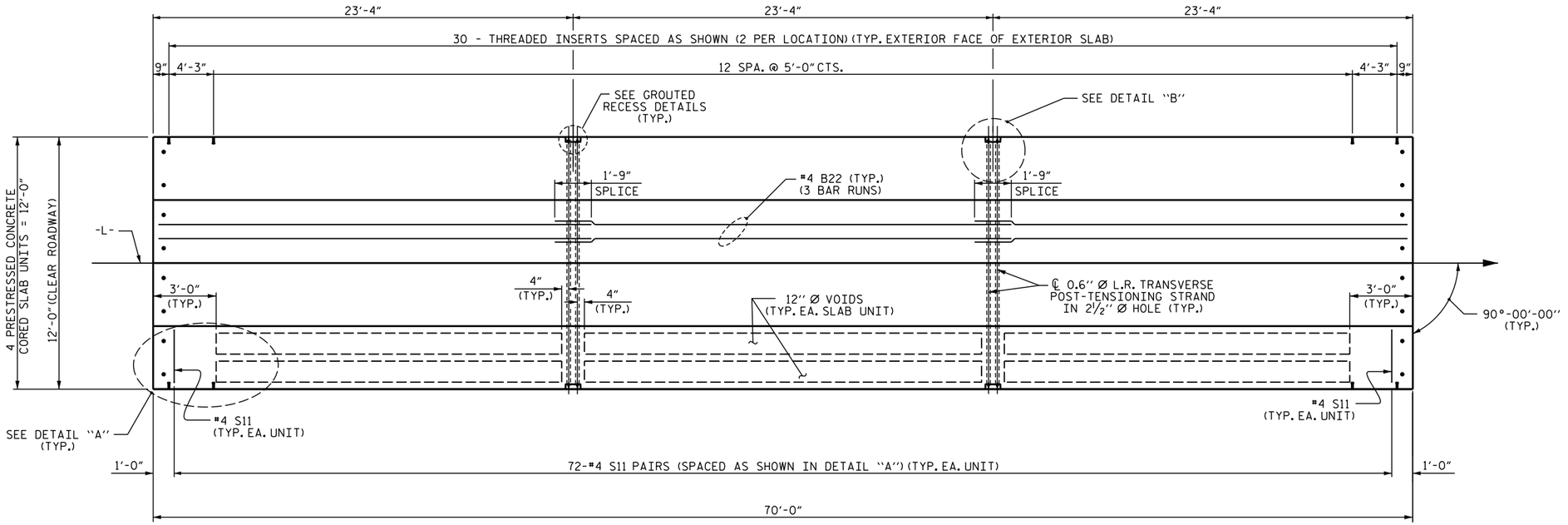
McADAMS
The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 042512 JEFFREY M. LOFTUS 12-04-26

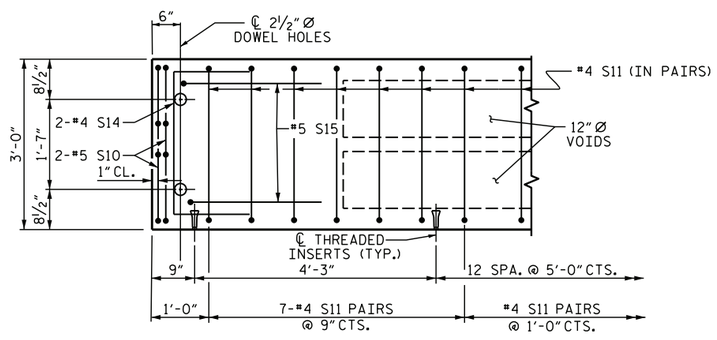
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_007_PRB00601EF443_NCEM_S01_004.dgn
loftus

8/26/21

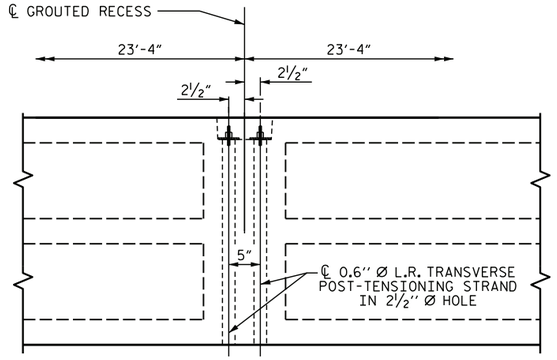


PLAN OF UNIT



DETAIL "A"

(TYPICAL EACH END OF UNIT)
NOTE: EXTERIOR UNIT SHOWN - INTERIOR UNIT SIMILAR EXCEPT OMIT THREADED INSERTS.
NOTE: #4 S11 BARS CAN BE SHIFTED SLIGHTLY TO AVOID THREADED INSERTS



DETAIL "B"

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 2 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

PLAN OF 70' UNIT 24'-10" CLEAR ROADWAY 90° SKEW

SPANS A & B

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-5
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

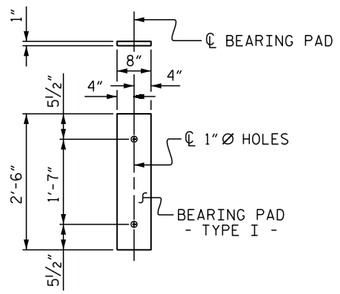
McADAMS
The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 049425 ENGINEER JEFFREY M. LOFTUS 12-01-26

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - Final Drawings\401_009_PRB00601EF443_NCEM_S02_005.dgn
loftus

8/26/21

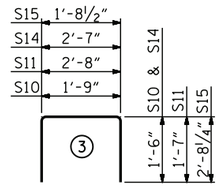


FIXED END
(TYPE I - 16 REQ'D)

ELASTOMERIC BEARING DETAILS

ELASTOMER IN ALL BEARINGS SHALL BE 60 DUROMETER HARDNESS.

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT

BILL OF MATERIAL FOR ONE 70' CORED SLAB UNIT

				EXTERIOR UNIT		INTERIOR UNIT	
BAR	NUMBER	SIZE	TYPE	LENGTH	WEIGHT	LENGTH	WEIGHT
B22	6	#4	STR	24'-6"	98	24'-6"	98
S10	8	#5	3	4'-9"	40	4'-9"	40
S11	144	#4	3	5'-10"	561	5'-10"	561
S14	4	#4	3	5'-7"	15	5'-7"	15
S15	4	#5	3	7'-1"	30	7'-1"	30
REINFORCING STEEL			LBS.		744		744
7000 P.S.I. CONCRETE			CU. YDS.		11.8		11.8
0.6"Ø L.R. STRANDS			No.		24		24

GRADE 270 STRANDS

	0.6"Ø L.R.
AREA (SQUARE INCHES)	0.217
ULTIMATE STRENGTH (LBS. PER STRAND)	58,600
APPLIED PRESTRESS (LBS. PER STRAND)	43,950

CONCRETE RELEASE STRENGTH

UNIT	PSI
70' UNITS	5500

CORED SLABS REQUIRED

	NUMBER	LENGTH	TOTAL LENGTH
70' UNIT			
EXTERIOR C.S.	4	70'-0"	280'-0"
INTERIOR C.S.	4	70'-0"	280'-0"
TOTAL	8		560'-0"

DEAD LOAD DEFLECTION AND CAMBER

	3'-0" x 2'-0"
70' CORED SLAB UNIT	0.6"Ø L.R. STRAND
CAMBER (SLAB ALONE IN PLACE)	2" ↑
DEFLECTION DUE TO SUPERIMPOSED DEAD LOAD**	⅜" ↓
FINAL CAMBER	1⅝" ↑

** INCLUDES FUTURE WEARING SURFACE

TIMBER BRIDGE RAIL

	TOTAL LENGTH
TIMBER BRIDGE RAIL	284'-9"

NOTES

ALL PRESTRESSING STRANDS SHALL BE 7-WIRE LOW RELAXATION GRADE 270 STRANDS AND SHALL CONFORM TO AASHTO M203 EXCEPT FOR SAMPLING REQUIREMENTS WHICH SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.

ALL REINFORCING STEEL CAST WITH THE CORED SLAB SECTIONS SHALL BE GRADE 60 AND SHALL BE INCLUDED IN THE UNIT PRICE BID FOR PRESTRESSED CONCRETE CORED SLABS.

RECESSES FOR TRANSVERSE STRANDS SHALL BE GROUTED AFTER THE TENSIONING OF THE STRANDS.

THE 2½"* DOWEL HOLES AT FIXED ENDS OF SLAB SECTIONS SHALL BE FILLED WITH NON-SHRINK GROUT.

THE BACKER RODS SHALL CONFORM TO THE REQUIREMENTS OF TYPE W BOND BREAKER. SEE SECTION 1028 OF THE STANDARD SPECIFICATIONS.

WHEN CORED SLABS ARE CAST, AN INTERNAL HOLD-DOWN SYSTEM SHALL BE EMPLOYED TO PREVENT VOIDS FROM RISING OR MOVING SIDEWAYS. AT LEAST SIX WEEKS PRIOR TO CASTING CORED SLABS. THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER FOR REVIEW AND COMMENT, DETAILED DRAWINGS OF THE PROPOSED HOLD-DOWN SYSTEM.IN ADDITION TO STRUCTURAL DETAILS, LOCATION AND SPACING OF THE HOLD-DOWNS SHALL BE INDICATED.

THE TRANSFER OF LOAD FROM THE ANCHORAGES TO THE CORED SLAB UNIT SHALL BE DONE WHEN THE CONCRETE HAS REACHED A COMPRESSIVE STRENGTH OF NOT LESS THAN THE REQUIRED STRENGTH SHOWN IN THE "CONCRETE RELEASE STRENGTH"TABLE.

PRESTRESSING STRANDS SHALL BE CUT FLUSH WITH THE CORED SLAB UNIT ENDS.

APPLY EPOXY PROTECTIVE COATING TO CORED SLAB UNIT ENDS.

FLAME CUTTING OF THE TRANSVERSE POST TENSIONING STRAND IS NOT ALLOWED.

MAINTAIN A SYMMETRIC TENSION FORCE BETWEEN EACH PAIR OF TRANSVERSE POST TENSIONING STRANDS IN THE DIAPHRAGM.

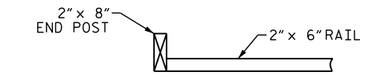
THE #4 S11 STIRRUPS MAY BE SHIFTED AS NECESSARY TO MAINTAIN 1" CLEAR TO THE GROUTED RECESS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

THE THREADED INSERTS IN THE EXTERIOR UNITS SHALL BE SPACED AS SHOWN AND GALVANIZED IN ACCORDANCE WITH SECITON 1076 OF THE STANDARD SPECIFICATIONS. STAINLESS STEEL THREADED INSERTS MAY BE USED AS AN ALTERNATIVE.

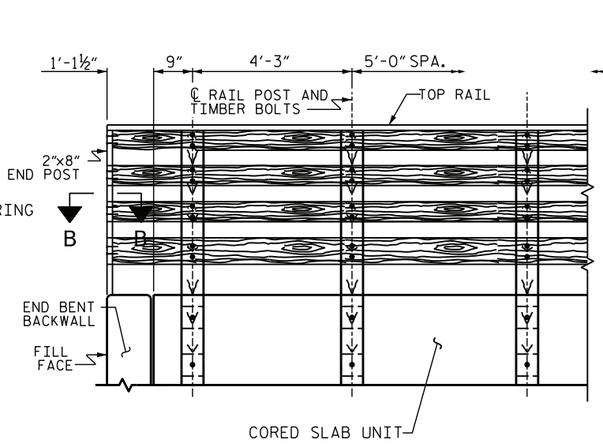
THE COST OF THE THREADED INSERTS SHALL BE INCLUDED IN THE PRICE BID FOR THE PRECAST UNITS.

THREADED INSERTS SHALL HAVE A MINIMUM FACTORED WORKING LOAD OF 4000 LBS.

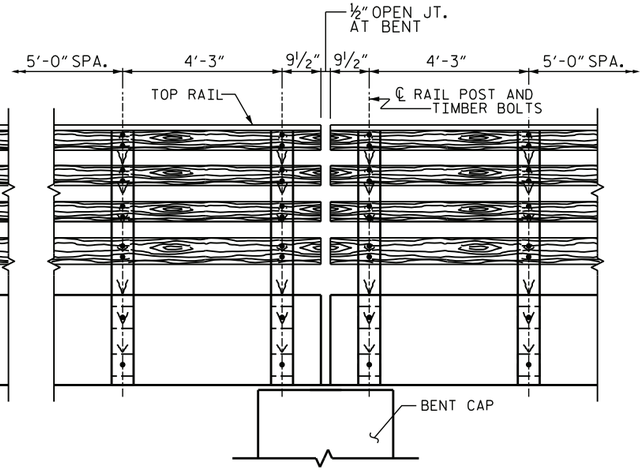


END POST CONNECTION

RAIL POST DETAIL



RAIL DETAIL AT END BENTS
(SPAN A SHOWN, SPAN B SIMILAR BUT MIRRORED)



RAIL DETAIL AT BENTS
(SPAN A SHOWN, SPAN B SIMILAR BUT MIRRORED)

PROJECT NO. 006-01-EF443
AVERY COUNTY
STATION: 11+18.38 -L-

SHEET 3 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

3'-0" X 2'-0"
PRESTRESSED CONCRETE
CORED SLAB UNIT

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-6
1			3			TOTAL SHEETS
2			4			16

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL SEAL 042425 ENGINEER JEFFREY M. LOFTUS 12-01-25

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

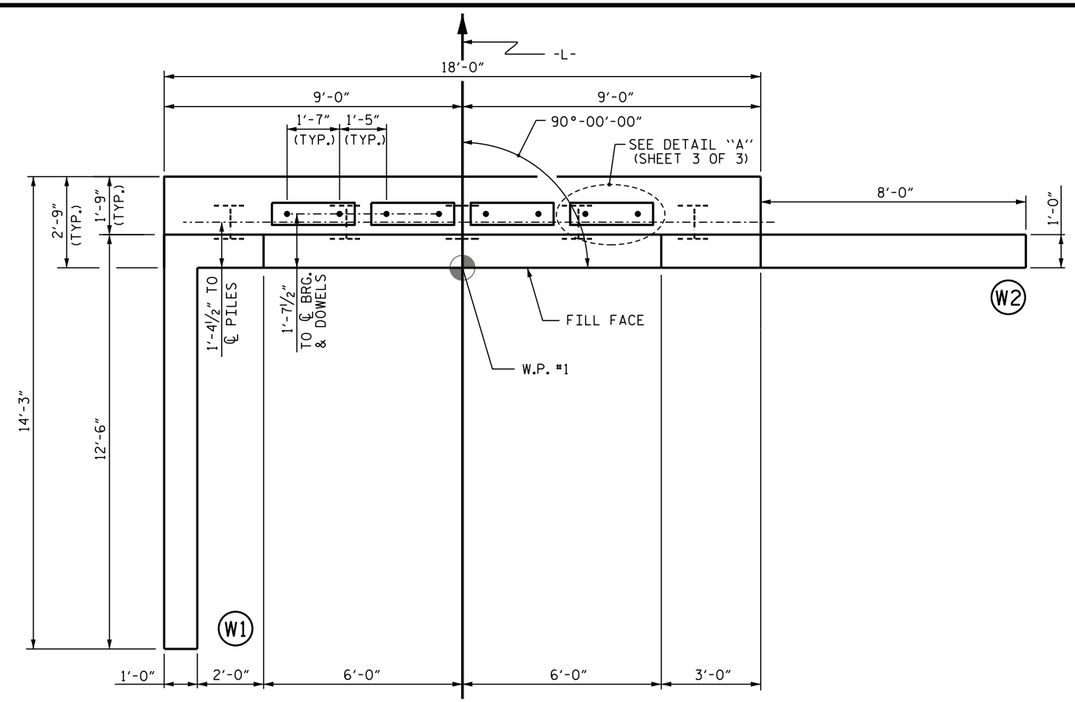
www.mcadamsco.com

McADAMS

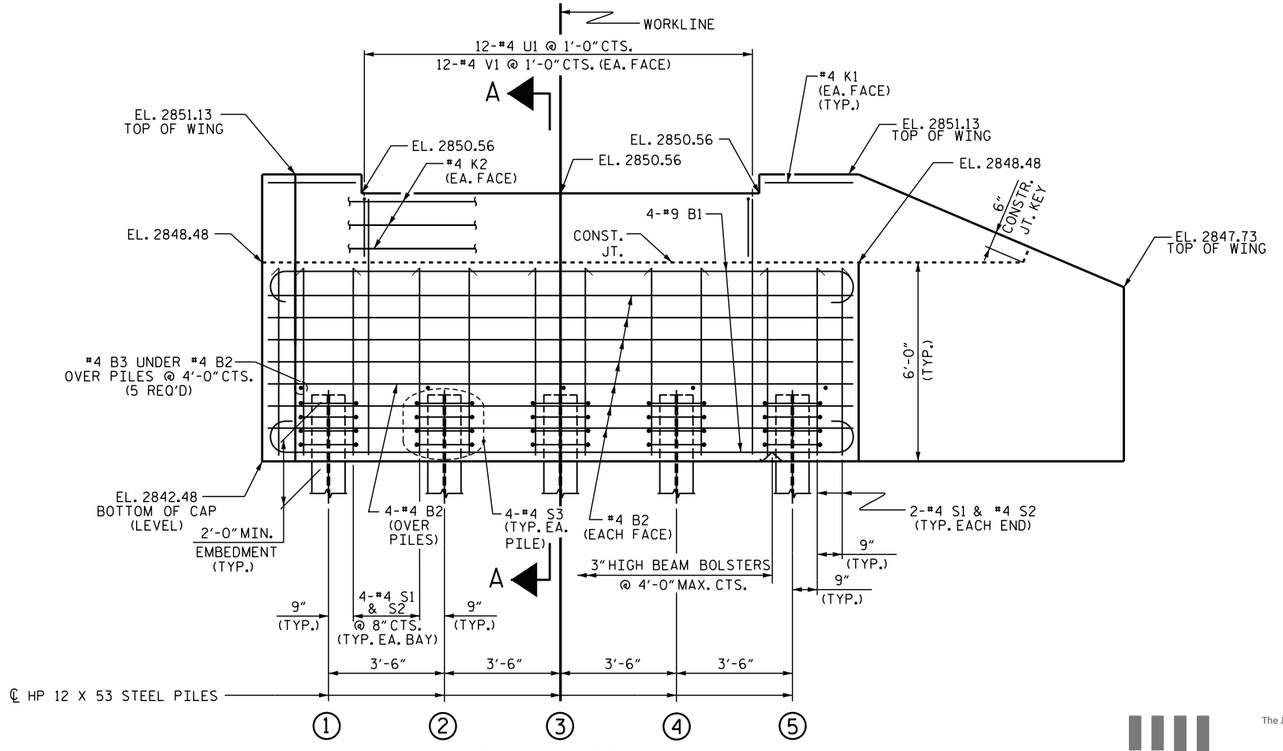
DRAWN BY :	J. LOFTUS	DATE :	11/2025
CHECKED BY :	P. JACOB	DATE :	11/2025
DESIGN ENGINEER OF RECORD:	J. LOFTUS	DATE :	12/2025

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_011_PRB00601EF443_NCEM_S03_006.dgn
loftus

8/26/21



PLAN



ELEVATION

WING REINFORCEMENT NOT SHOWN FOR CLARITY.
FOR SECTION A-A, SEE SHEET 3 OF 3.
CONCRETE COLLARS FOR STEEL PILES NOT SHOWN IN PLAN AND ELEVATION VIEWS FOR CLARITY.
SEE "CORROSION PROTECTION FOR STEEL PILES DETAIL", SHEET 3 OF 3.

NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR DOWELS.

FOR PILE SPLICE DETAILS, SEE SHEET 3 OF 3.

FOR WING DETAILS, SEE SHEET 2 OF 3.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 1 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No. 1

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_013_PRB00601EF443_NCEM_EB101_007.dgn
loftus

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

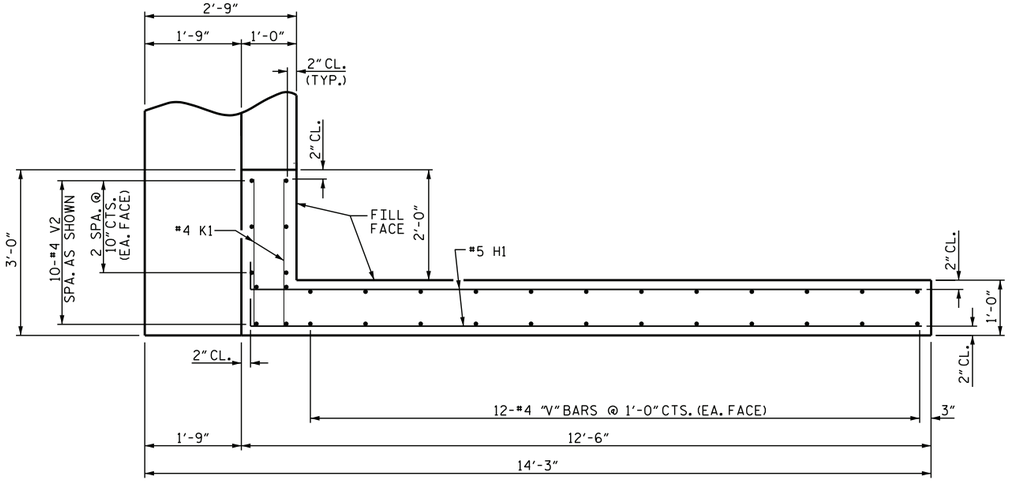
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 040425 ENGINEER JEFFREY M. LOFTUS 12-01-26

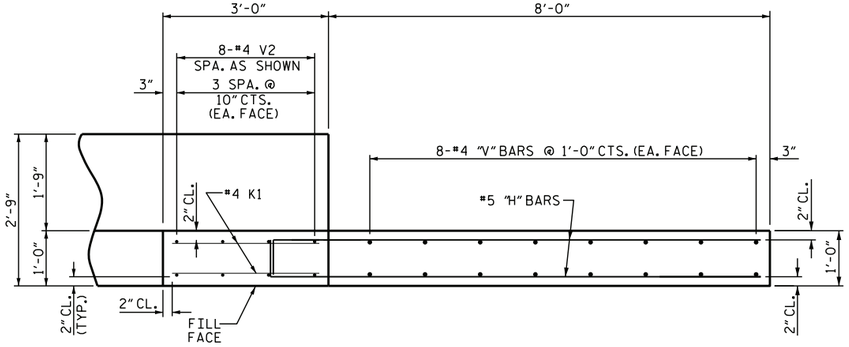
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-7
1			3			TOTAL SHEETS
2			4			16

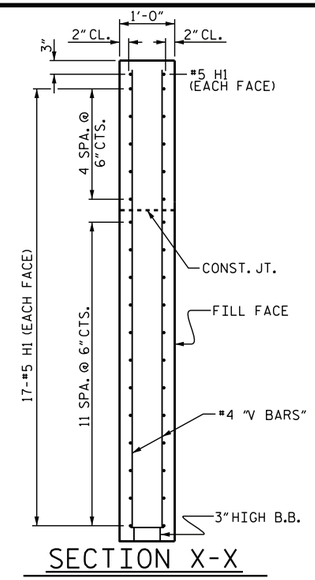
8/26/21



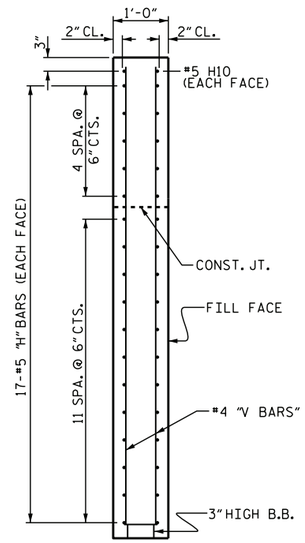
PLAN OF WING (W1)



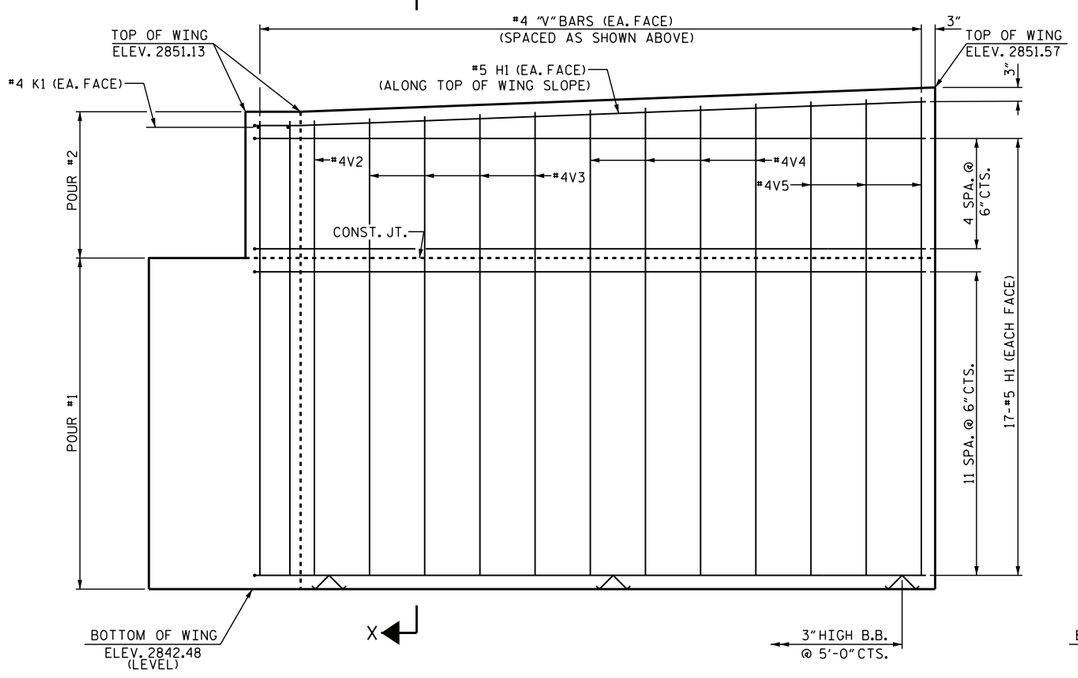
PLAN OF WING (W2)



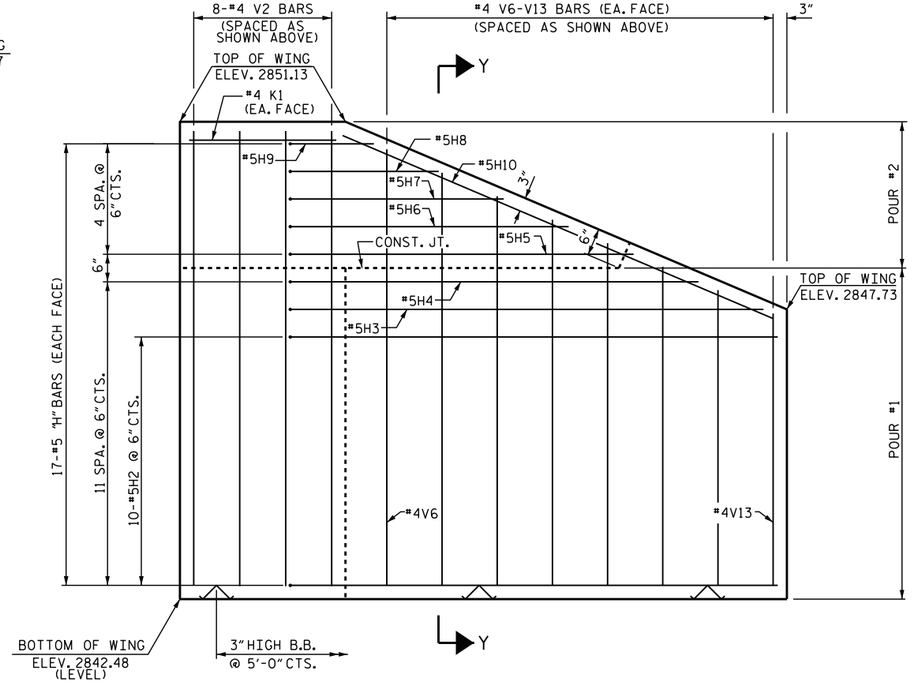
SECTION X-X



SECTION Y-Y



ELEVATION OF WING (W1)



ELEVATION OF WING (W2)

WING DETAILS

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 2 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No.1
WING DETAILS

DRAWN BY :	J. LOFTUS	DATE :	11/2025
CHECKED BY :	P. JACOB	DATE :	11/2025
DESIGN ENGINEER OF RECORD:	J. LOFTUS	DATE :	12/2025

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_015_PRB00601EF443_NCEM_EB102_008.dgn
loftus

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

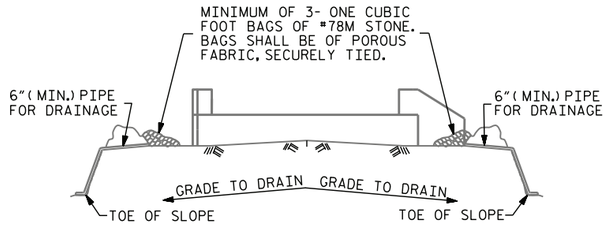
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 040425 ENGINEER JEFFREY M. LOFTUS 12-26-25

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-8
1			3			TOTAL SHEETS
2			4			16

8/26/21

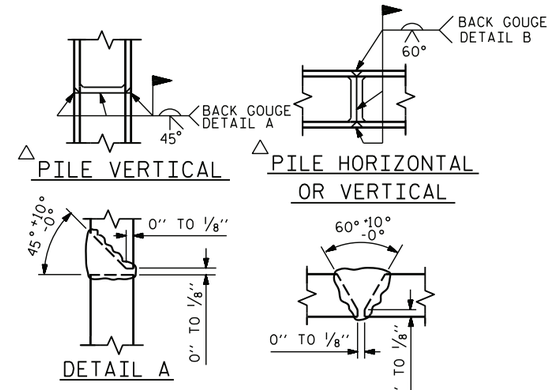


BAGGED STONE AND PIPE SHALL BE PLACED IMMEDIATELY AFTER COMPLETION OF END BENT EXCAVATION. PIPE MAY BE EITHER CONCRETE, CORRUGATED STEEL, CORRUGATED ALUMINUM ALLOY, OR CORRUGATED PLASTIC. PERFORATED PIPE WILL NOT BE ALLOWED.

BAGGED STONE SHALL REMAIN IN PLACE UNTIL THE ENGINEER DIRECTS THAT IT BE REMOVED. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF SILT ACCUMULATIONS AT BAGGED STONE WHEN SO DIRECTED BY THE ENGINEER. BAGS SHALL BE REMOVED AND REPLACED WHENEVER THE ENGINEER DETERMINES THAT THEY HAVE DETERIORATED AND LOST THEIR EFFECTIVENESS.

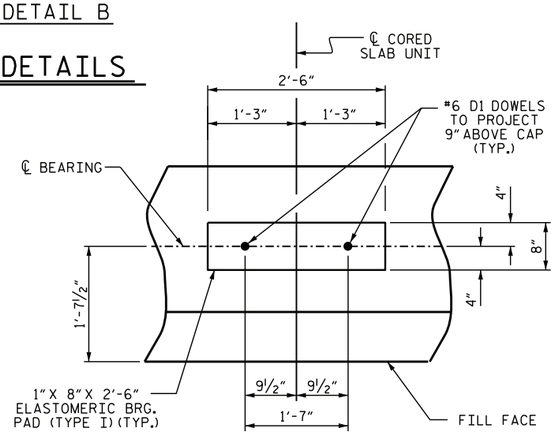
NO SEPARATE PAYMENT WILL BE MADE FOR THIS WORK AND THE ENTIRE COST OF THIS WORK SHALL BE INCLUDED IN THE UNIT CONTRACT PRICE BID FOR THE SEVERAL PAY ITEMS.

TEMPORARY DRAINAGE AT END BENT

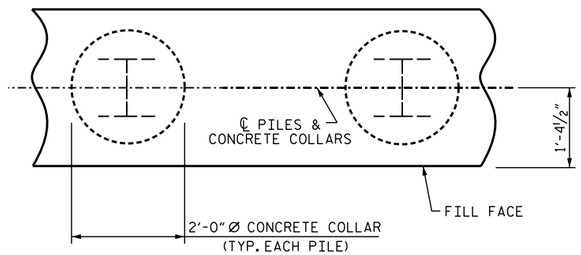


△ POSITION OF PILE DURING WELDING.

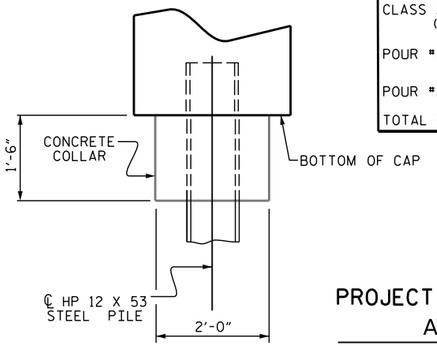
PILE SPLICE DETAILS



DETAIL "A"

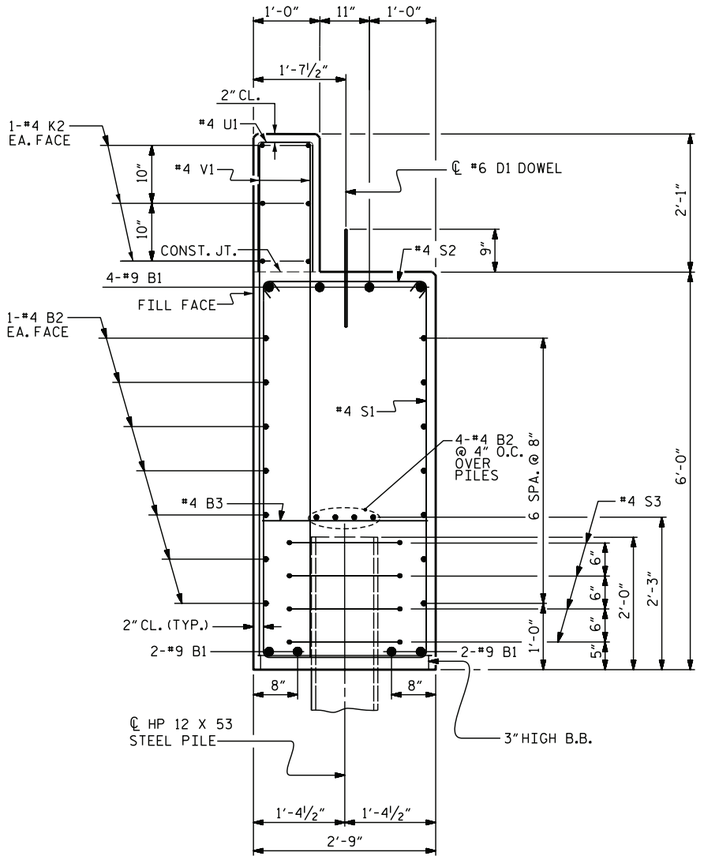


PLAN



ELEVATION

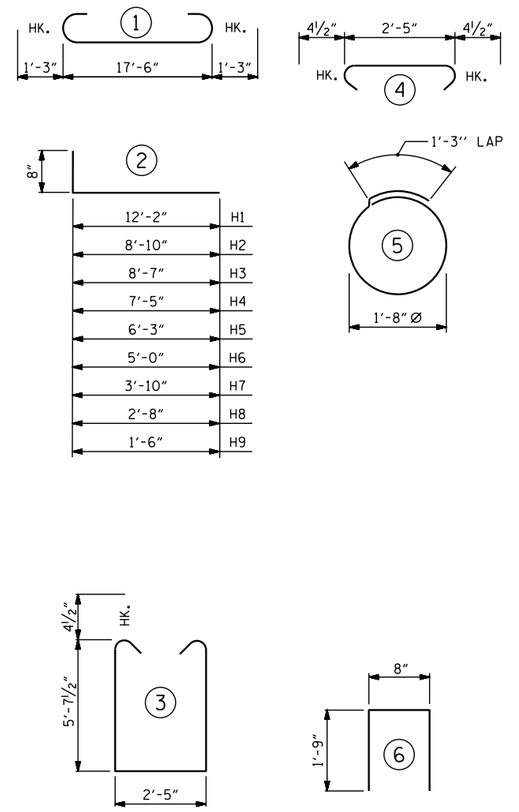
CORROSION PROTECTION FOR STEEL PILES DETAIL



SECTION A-A

(CONCRETE COLLAR NOT SHOWN FOR CLARITY. SEE "CORROSION PROTECTION FOR STEEL PILES DETAIL.")

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

FOR END BENT 1

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	8	#9	1	20'-0"	544
B2	18	#4	STR	17'-8"	212
B3	5	#4	STR	2'-5"	8
D1	8	#6	STR	1'-6"	18
H1	36	#5	2	12'-10"	482
H2	20	#5	2	9'-6"	198
H3	2	#5	2	9'-3"	19
H4	2	#5	2	8'-1"	17
H5	2	#5	2	6'-11"	14
H6	2	#5	2	5'-8"	12
H7	4	#5	2	4'-6"	19
H8	4	#5	2	3'-4"	14
H9	4	#5	2	2'-2"	9
H10	4	#5	STR	8'-5"	35
K1	4	#4	STR	2'-8"	7
K2	6	#4	STR	17'-8"	71
S1	20	#4	3	14'-5"	193
S2	20	#4	4	3'-2"	42
S3	20	#4	5	6'-6"	87
U1	12	#4	6	4'-2"	33
V1	24	#4	STR	7'-8"	123
V2	20	#4	STR	8'-2"	109
V3	8	#4	STR	8'-3"	44
V4	8	#4	STR	8'-5"	45
V5	6	#4	STR	8'-7"	34
V6	2	#4	STR	7'-10"	10
V7	2	#4	STR	7'-5"	10
V8	2	#4	STR	7'-0"	9
V9	2	#4	STR	6'-7"	9
V10	2	#4	STR	6'-2"	8
V11	2	#4	STR	5'-9"	8
V12	2	#4	STR	5'-4"	7
V13	2	#4	STR	4'-11"	7

REINFORCING STEEL (END BENT 1) 2,457 LBS.

CLASS A CONCRETE BREAKDOWN (FOR END BENT 1)

POUR #1 CAP, LOWER PART OF WINGS & COLLARS	16.1 C.Y.
POUR #2 BACKWALL & WINGS	3.1 C.Y.
TOTAL CLASS A CONCRETE	19.2 C.Y.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 3 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No. 1 DETAILS

DRAWN BY :	J. LOFTUS	DATE :	11/2025
CHECKED BY :	P. JACOB	DATE :	11/2025
DESIGN ENGINEER OF RECORD:	J. LOFTUS	DATE :	12/2025

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

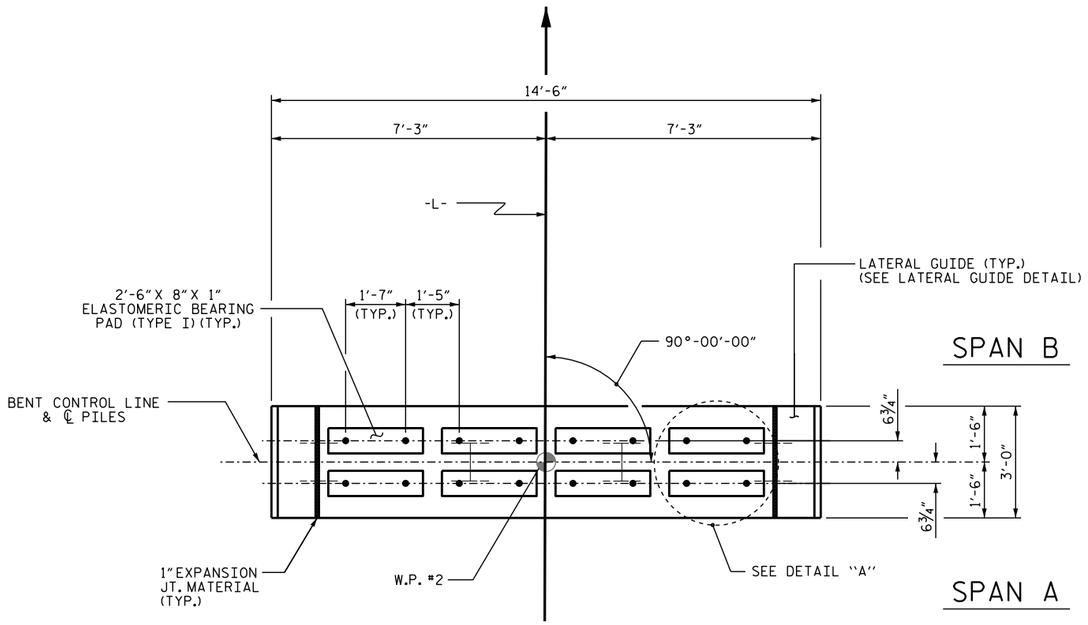
NORTH CAROLINA PROFESSIONAL SEAL 049425 ENGINEER JEFFREY M. LOFTUS 12-04-26

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

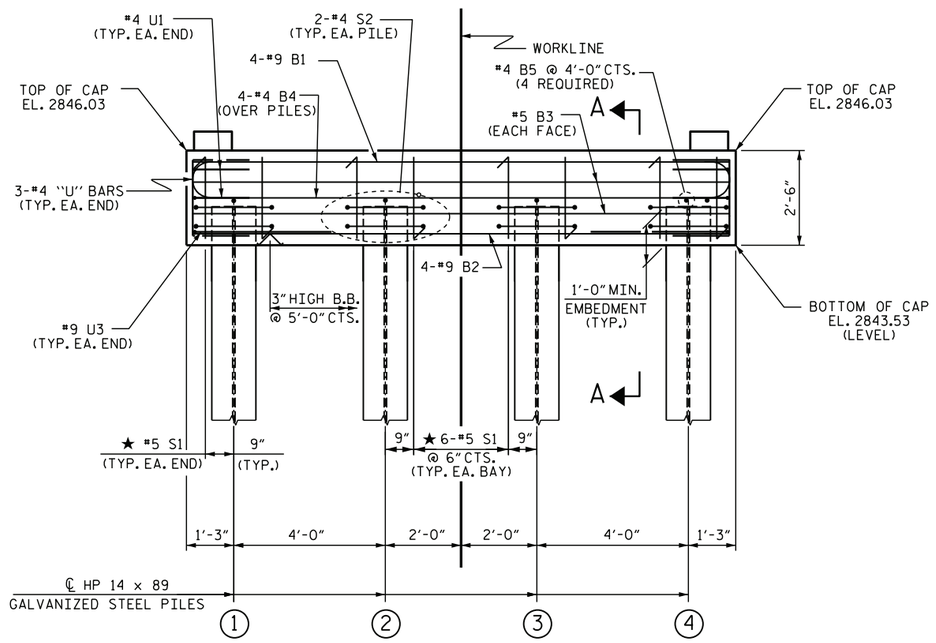
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-9
1			3			TOTAL SHEETS
2			4			16

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - Final Drawings\401_017_PRB00601EF443_NCEM_EB103_009.dgn
loftus

8/26/21

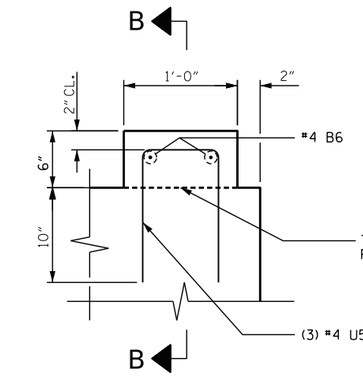


PLAN

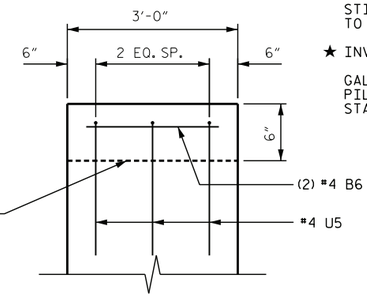


ELEVATION

FOR SECTION A-A, SEE SHEET 2 OF 2



LATERAL GUIDE ELEVATION



SECTION B-B

NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR DOWELS.

★ INVERT ALTERNATE STIRRUPS.

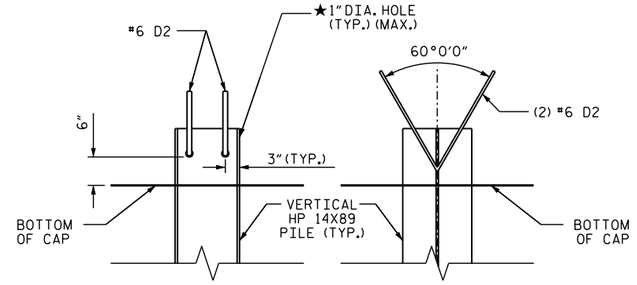
GALVANIZE THE FULL LENGTH OF EACH INTERIOR BENT PILE IN ACCORDANCE WITH SECTION 1076 OF THE STANDARD SPECIFICATIONS.

LATERAL GUIDE DETAIL

NOTE: LATERAL GUIDES MAY BE CAST IN SECONDARY POUR

DETAIL "A"

(DIMENSIONS ARE TYPICAL EACH BEARING)



HP-PILE ANCHORAGE DETAIL

★ HOLE DIAMETER SHALL BE A MINIMUM OF 1" AND A MAXIMUM OF 1½". DRILL OR FLAME CUT THE HOLES, GRIND AREA. AROUND HOLES TO REMOVE BURRS, TIE OR WEDGE TIGHTLY THE REINFORCING AGAINST THE TOP OF THE HOLE

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 1 OF 2

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

BENT No. 1

DRAWN BY :	J. LOFTUS	DATE :	11/2025
CHECKED BY :	P. JACOB	DATE :	11/2025
DESIGN ENGINEER OF RECORD:	J. LOFTUS	DATE :	12/2025

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - Final Drawings\401_019_PRB00601EF443_NCEM_B101_010.dgn
loftus

McAdams

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

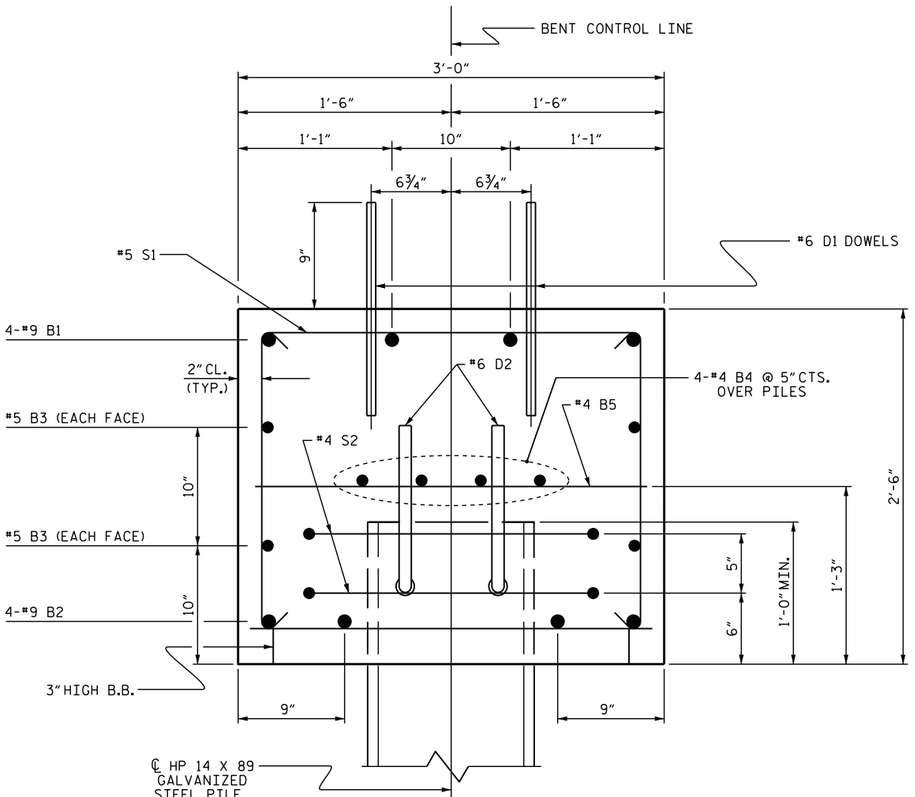
www.mcadamsco.com

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

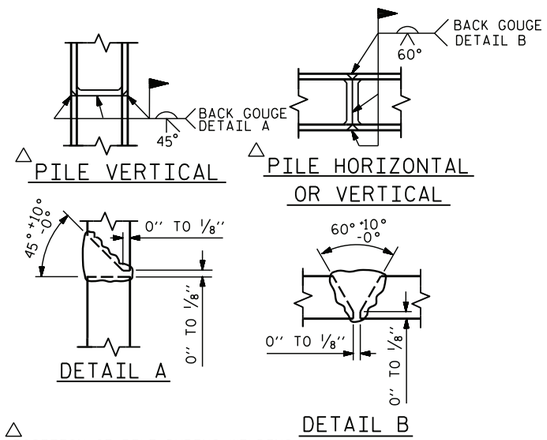
NORTH CAROLINA PROFESSIONAL SEAL 042425 ENGINEER JEFFREY M. LOFTUS 12-06-26

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-10
1			3			TOTAL SHEETS
2			4			16

8/26/21



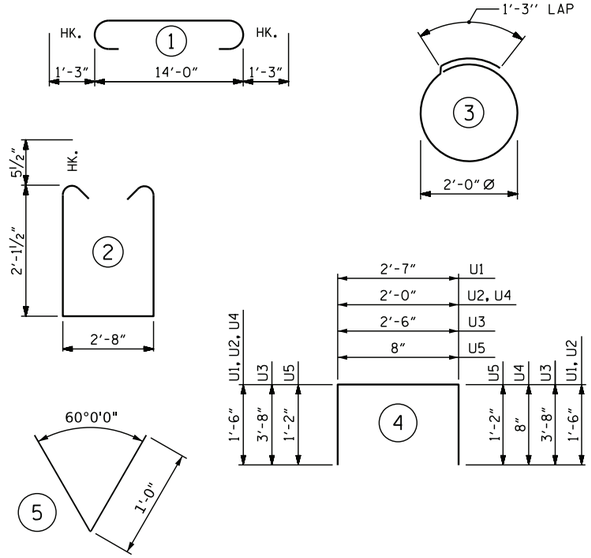
SECTION A-A



△ POSITION OF PILE DURING WELDING.

PILE SPLICE DETAILS

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

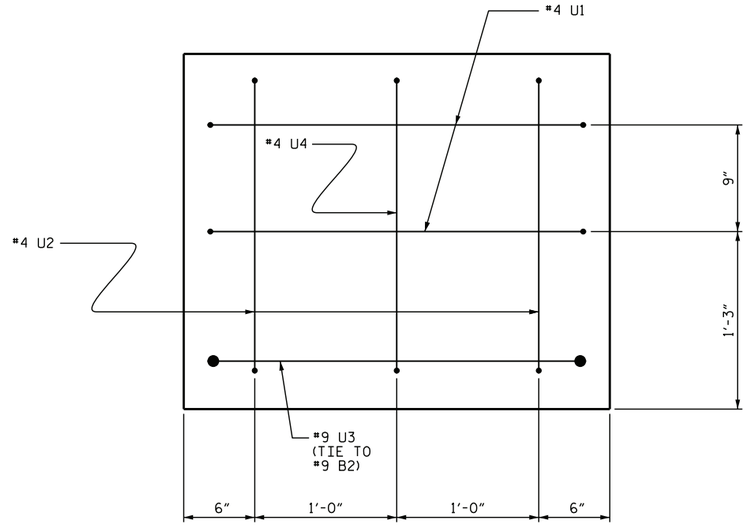
BILL OF MATERIAL
FOR ONE BENT

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	4	#9	1	16'-6"	224
B2	4	#9	STR	14'-2"	193
B3	4	#5	STR	14'-2"	59
B4	4	#4	STR	14'-2"	38
B5	5	#4	STR	2'-8"	7
B6	4	#4	STR	2'-8"	7
D1	16	#6	STR	1'-6"	36
D2	8	#6	5	2'-0"	24
S1	20	#5	2	7'-10"	163
S2	8	#4	3	7'-7"	42
U1	4	#4	4	5'-7"	15
U2	4	#4	4	5'-0"	13
U3	2	#9	4	9'-10"	67
U4	2	#4	4	4'-2"	6
U5	6	#4	4	3'-0"	12

REINFORCING STEEL (FOR ONE BENT) 906 LBS

CLASS A CONCRETE BREAKDOWN (FOR ONE BENT)

TOTAL CLASS A CONCRETE 4.2 C.Y.



END OF CAP VIEW
(TYPICAL BOTH ENDS)

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 2 OF 2

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

BENT No.1 DETAILS

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 049425 ENGINEER JEFFREY M. LOFTUS 01-06-26

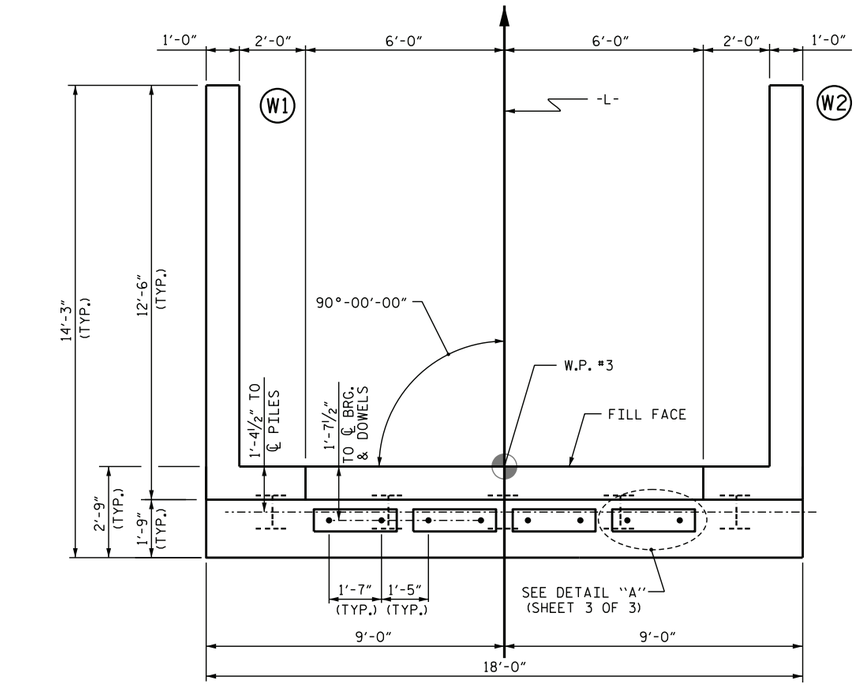
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-11
1			3			TOTAL SHEETS
2			4			16

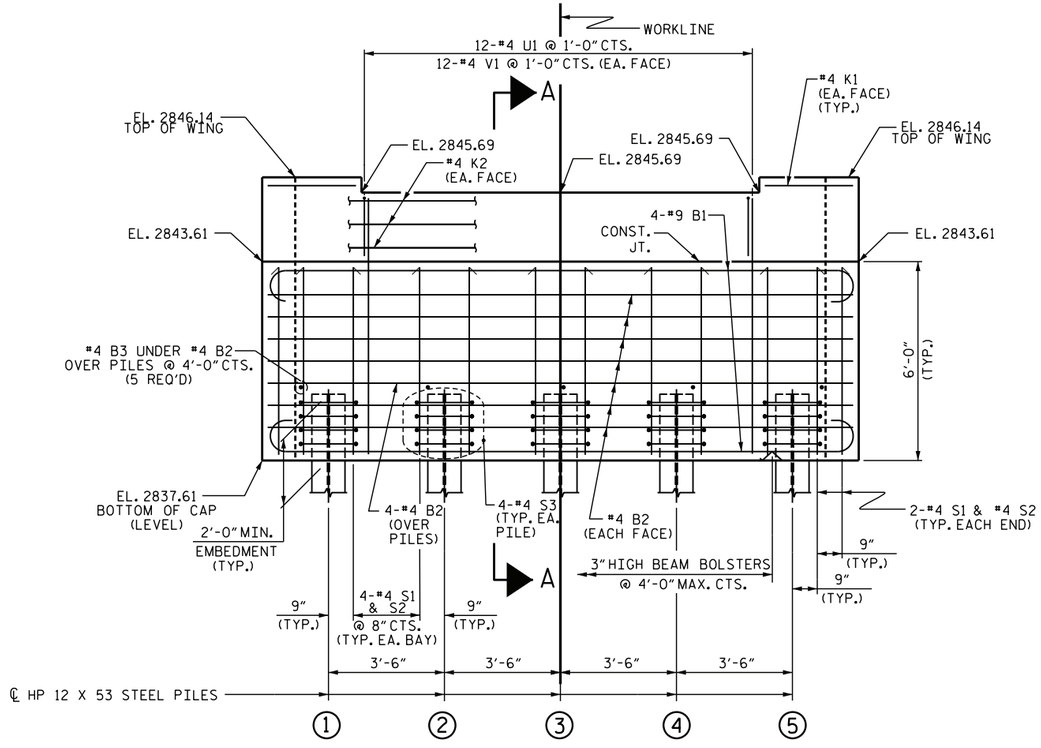
DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

12/30/2025
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_021_PRB00601EF443_NCEM_B102_011.dgn
loftus

8/26/21



PLAN



ELEVATION

WING REINFORCEMENT NOT SHOWN FOR CLARITY.
FOR SECTION A-A, SEE SHEET 3 OF 3.
CONCRETE COLLARS FOR STEEL PILES NOT SHOWN IN PLAN AND ELEVATION VIEWS FOR CLARITY.
SEE "CORROSION PROTECTION FOR STEEL PILES DETAIL", SHEET 3 OF 3.

NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR DOWELS.

FOR PILE SPLICE DETAILS, SEE SHEET 3 OF 3.

FOR WING DETAILS, SEE SHEET 2 OF 3.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 1 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No. 2

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-12
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

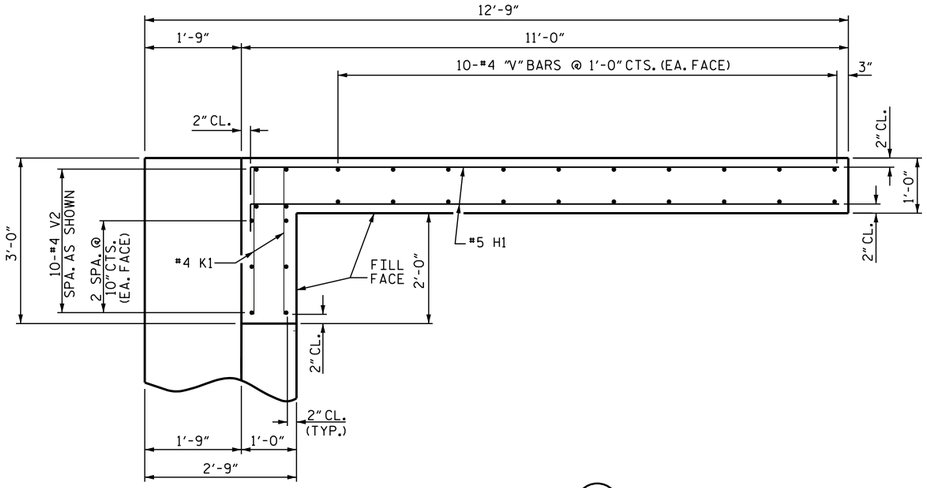
www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 040425 ENGINEER JEFFREY M. LOFTUS 12-01-26

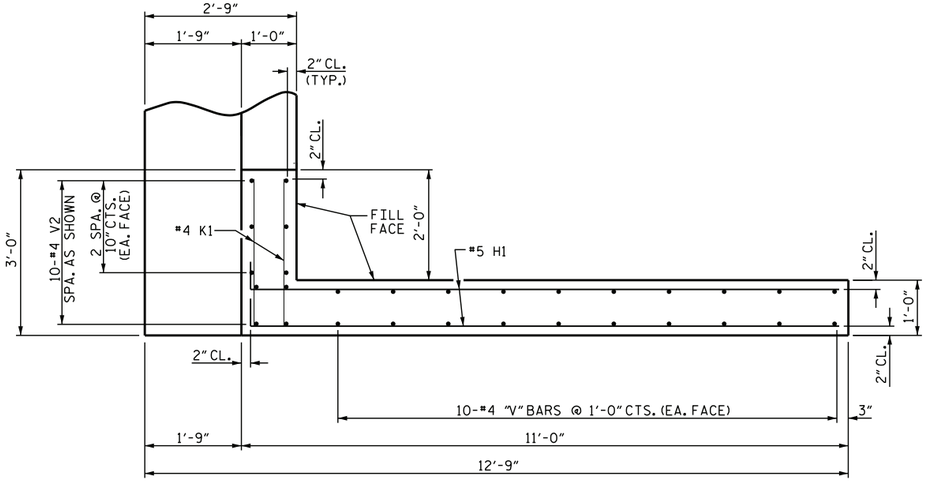
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_023_PRB00601EF443_NCEM_EB201_012.dgn
loftus

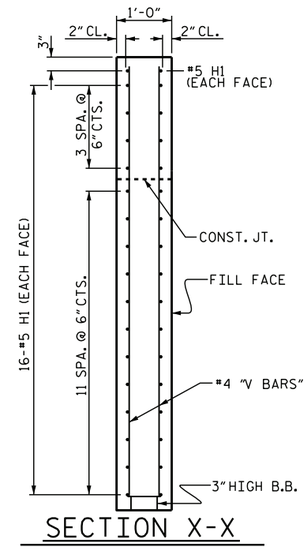
8/26/21



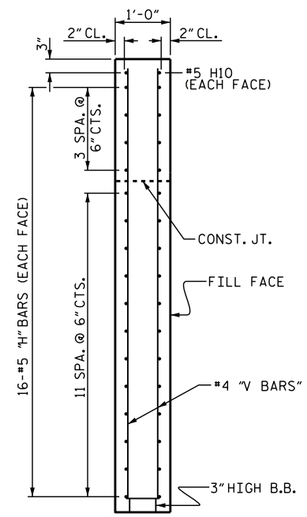
PLAN OF WING (W1)



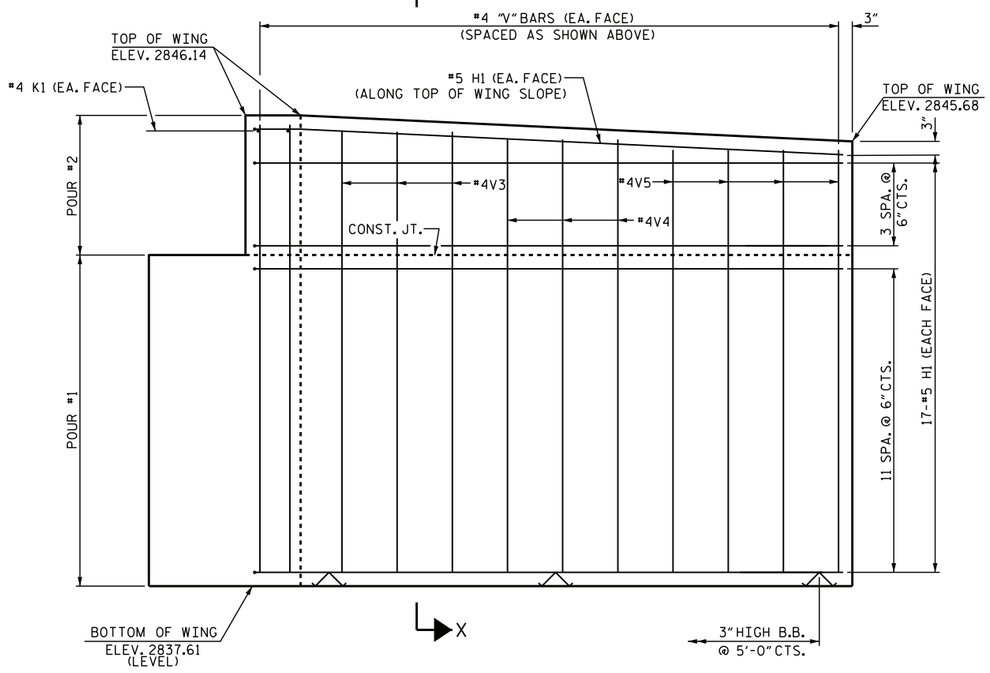
PLAN OF WING (W2)



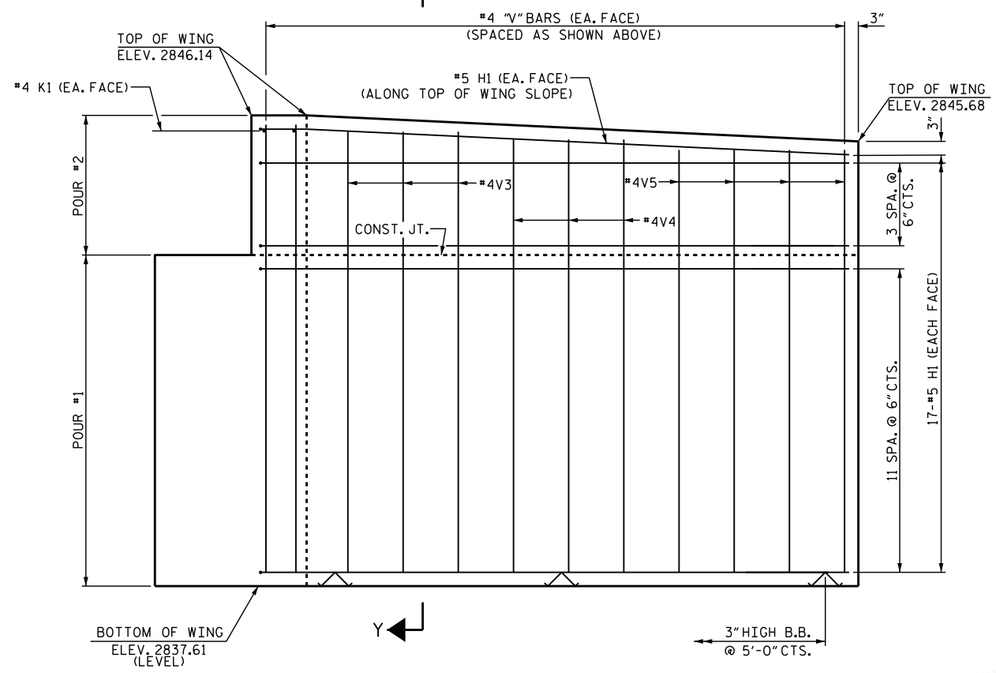
SECTION X-X



SECTION Y-Y



ELEVATION OF WING (W1)



ELEVATION OF WING (W2)

WING DETAILS

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 2 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No.2
WING DETAILS

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 042425 ENGINEER JEFFREY M. LOFTUS 25-06-26

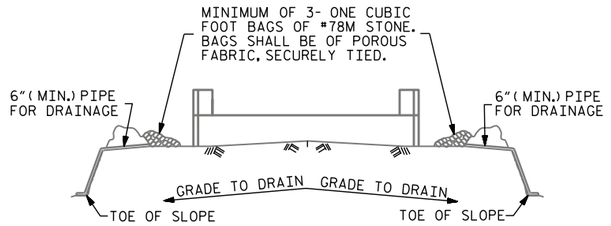
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-13
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - Final Drawings\401_025_PRB00601EF443_NCEM_EB202_013.dgn
loftus

8/26/21

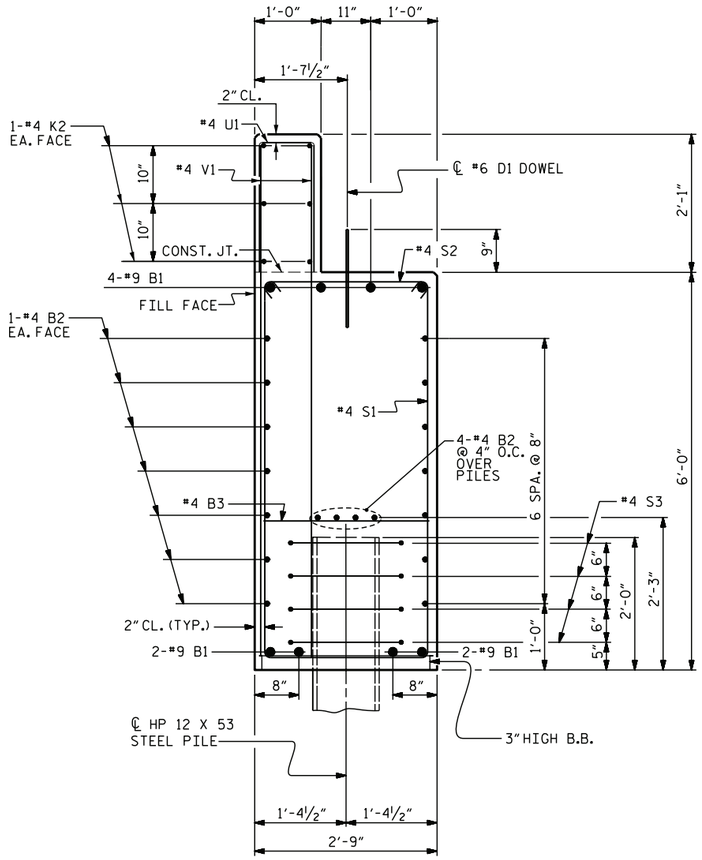


BAGGED STONE AND PIPE SHALL BE PLACED IMMEDIATELY AFTER COMPLETION OF END BENT EXCAVATION. PIPE MAY BE EITHER CONCRETE, CORRUGATED STEEL, CORRUGATED ALUMINUM ALLOY, OR CORRUGATED PLASTIC. PERFORATED PIPE WILL NOT BE ALLOWED.

BAGGED STONE SHALL REMAIN IN PLACE UNTIL THE ENGINEER DIRECTS THAT IT BE REMOVED. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF SILT ACCUMULATIONS AT BAGGED STONE WHEN SO DIRECTED BY THE ENGINEER. BAGS SHALL BE REMOVED AND REPLACED WHENEVER THE ENGINEER DETERMINES THAT THEY HAVE DETERIORATED AND LOST THEIR EFFECTIVENESS.

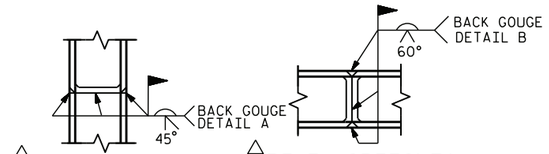
NO SEPARATE PAYMENT WILL BE MADE FOR THIS WORK AND THE ENTIRE COST OF THIS WORK SHALL BE INCLUDED IN THE UNIT CONTRACT PRICE BID FOR THE SEVERAL PAY ITEMS.

TEMPORARY DRAINAGE AT END BENT



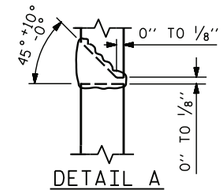
SECTION A-A

(CONCRETE COLLAR NOT SHOWN FOR CLARITY. SEE "CORROSION PROTECTION FOR STEEL PILES DETAIL.")

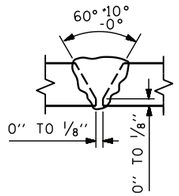


△ PILE VERTICAL

△ PILE HORIZONTAL OR VERTICAL



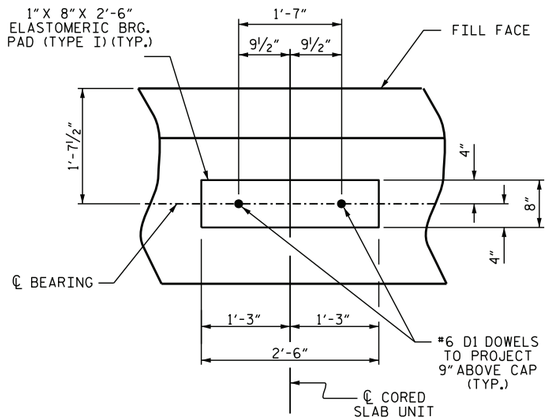
DETAIL A



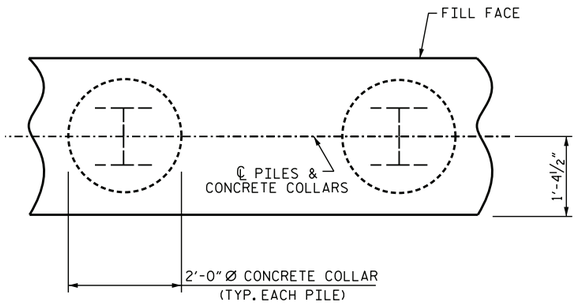
DETAIL B

△ POSITION OF PILE DURING WELDING.

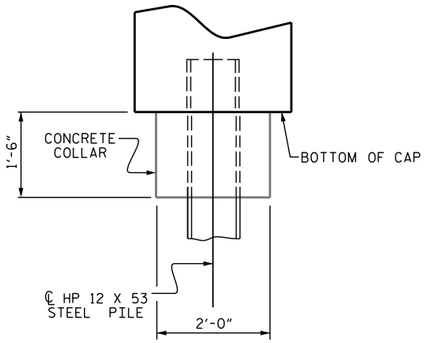
PILE SPLICE DETAILS



DETAIL "A"



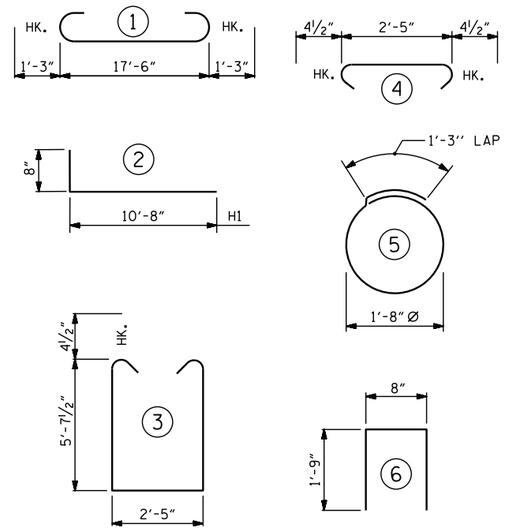
PLAN



ELEVATION

CORROSION PROTECTION FOR STEEL PILES DETAIL

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL
FOR END BENT 2

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	8	#9	1	20'-0"	544
B2	18	#4	STR	17'-8"	212
B3	5	#4	STR	2'-5"	8
D1	8	#6	STR	1'-6"	18
H1	68	#5	2	11'-4"	804
K1	4	#4	STR	2'-8"	7
K2	6	#4	STR	17'-8"	71
S1	20	#4	3	14'-5"	193
S2	20	#4	4	3'-2"	42
S3	20	#4	5	6'-6"	87
U1	12	#4	6	4'-2"	33
V1	24	#4	STR	7'-8"	123
V2	20	#4	STR	8'-1"	108
V3	12	#4	STR	8'-0"	64
V4	12	#4	STR	7'-10"	63
V5	16	#4	STR	7'-8"	82

REINFORCING STEEL (END BENT 2) 2,459 LBS.

CLASS A CONCRETE BREAKDOWN (FOR END BENT 2)

POUR #1	CAP, LOWER PART OF WINGS & COLLARS	16.2 C.Y.
POUR #2	BACKWALL & WINGS	3.2 C.Y.
TOTAL CLASS A CONCRETE		19.4 C.Y.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

SHEET 3 OF 3

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SUBSTRUCTURE

END BENT No. 2 DETAILS

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-14
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

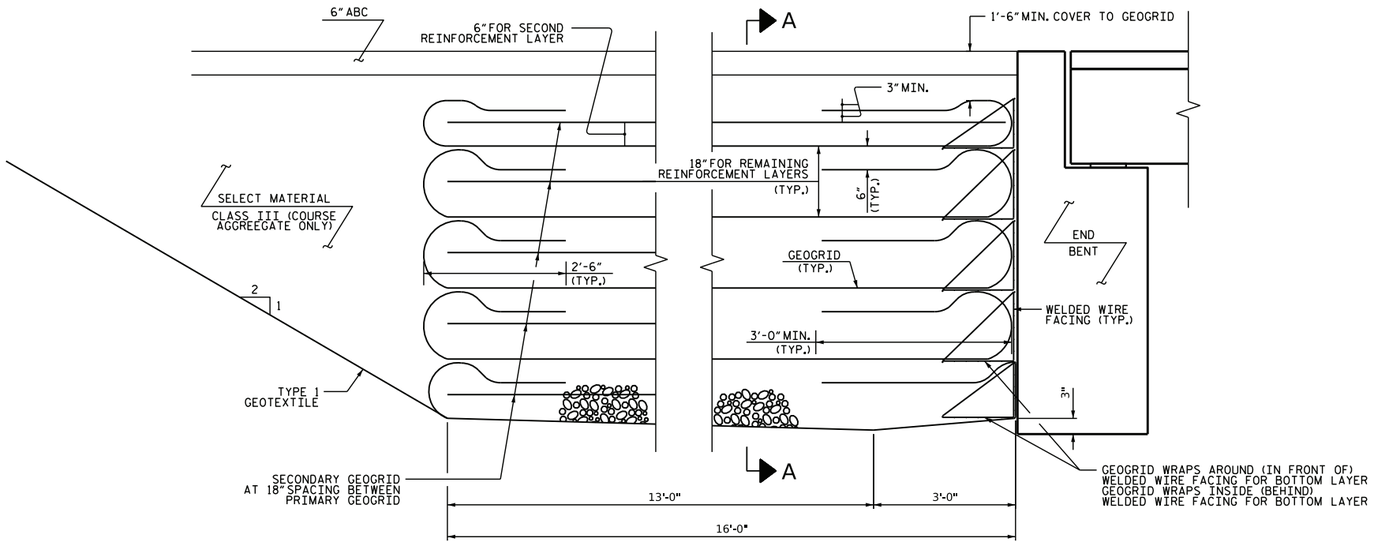
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 049425 ENGINEER JEFFREY M. LOFTUS 01-06-26

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_027_PRB00601EF443_NCEM_EB203_014.dgn
loftus

8/26/21



SHOWING SECONDARY GEOGRID SHOWING WELDED WIRE FACING

REINFORCED APPROACH FILL DETAIL

NOTES

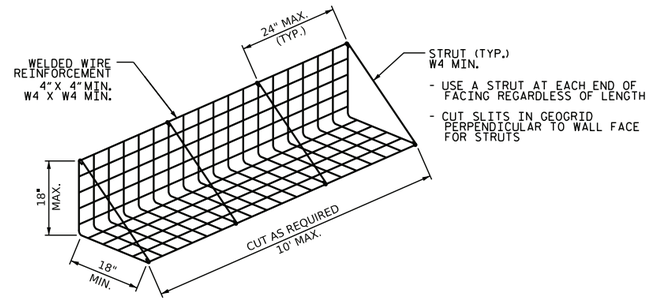
GEOGRID IN THIS APPLICATION MUST COME FROM NCDOT'S LIST OF GEOTECHNICAL QUALIFIED PRODUCTS FOR GEOSYNTHETIC REINFORCEMENT.

THESE PLANS DETAIL THE USE OF UNIAXIAL GEOGRID PLACED BEHIND THE END BENT AND WINGWALL IN AN OVERLAPPING FASHION. AT THE CONTRACTOR'S OPTION AND AT NO EXTRA COST TO THE OWNER, BI-AXIAL GEOGRID MAY BE USED TO PROVIDE REINFORCEMENT. BI-AXIAL GEOGRID MUST ALSO COME FROM NCDOT'S LIST OF GEOTECHNICAL QUALIFIED PRODUCTS FOR GEOSYNTHETIC REINFORCEMENT.

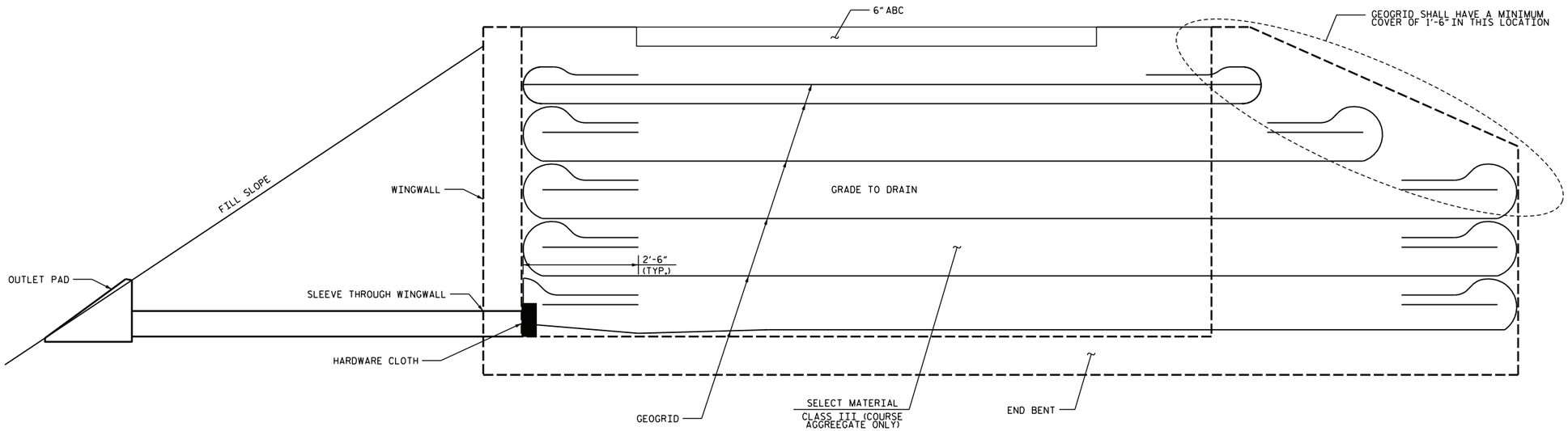
TYPE 1 SEPARATION GEOTEXTILE SHALL EXTEND ALONG EXCAVATION SLOPE AND TO THE END BENT/WINGWALL FILL FACE.

THE PRIMARY GEOGRID FOR THIS APPLICATION SHALL HAVE A LONG TERM DESIGN STRENGTH OF 1000 LBS/FT AND A DESIGN LIFE OF 100 YEARS.

THE CONTRACTOR MAY USE WELDED WIRE FACING OR SECONDARY GEOSYNTHETIC AT THE TERMINATION OF THE PRIMARY GEOGRID.



WELDED WIRE FACING



SECTION A-A

SHOWING SECONDARY GEOGRID AS PIMARY GRID TERMINATION.
WELDED WIRE FACING MAY BE USED AS WELL.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

END BENT No.1
REINFORCED
APPROACH FILL

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-15
1			3			TOTAL SHEETS
2			4			16

DRAWN BY : J. LOFTUS DATE : 11/2025
CHECKED BY : P. JACOB DATE : 11/2025
DESIGN ENGINEER OF RECORD: J. LOFTUS DATE : 12/2025

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 049425 ENGINEER JEFFREY M. LOFTUS 01-01-26

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_029_PRB00601EF443_NCEM_AF01_015.dgn
loftus

8/26/21

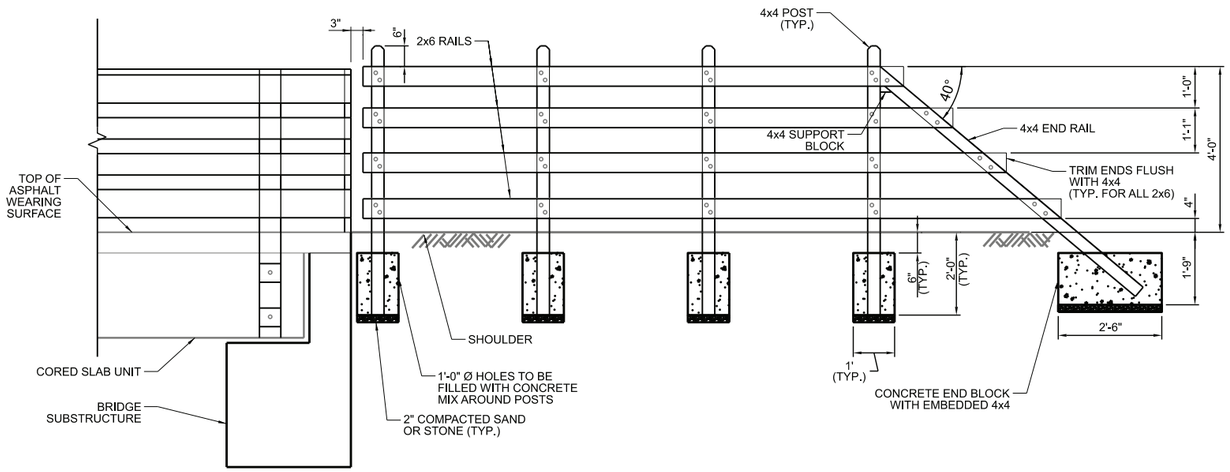
NOTES:

ALL TREATED LUMBER FOR THE SAFETY RAIL SHALL MEET THE REQUIREMENTS OF SECTION 1082 OF THE 2024 NCDOT STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES.

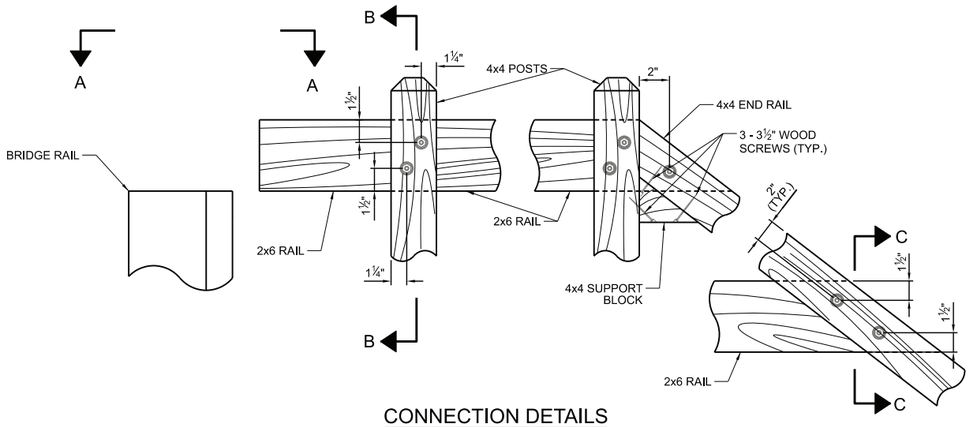
ALL SCREWS, BOLTS, NUTS AND WASHERS ARE TO BE HOT DIPPED GALVANIZED.

THE LOCATION OF POST FOOTINGS AND END BLOCKS ARE TO BE FIELD VERIFIED. DEVIATIONS FROM PLAN DIMENSIONS ARE TO BE APPROVED BY THE ENGINEER.

CONTRACTOR TO CONFIRM ANY POTENTIAL CONFLICTS WITH CONCRETE POST SUPPORTS AND WINGWALLS. ADJUST ANGLE OF APPROACH RAIL ROTATION AS NECESSARY.

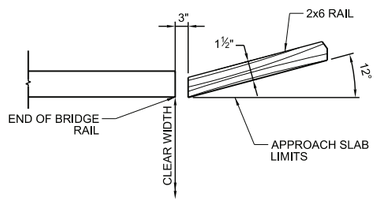


TYPICAL SAFETY RAIL ELEVATION

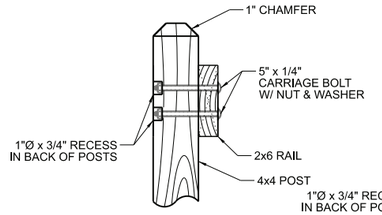


CONNECTION DETAILS

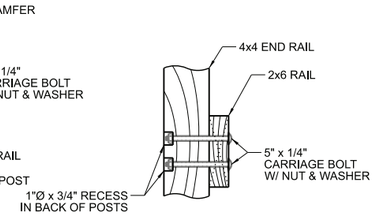
(OUTSIDE VIEW)



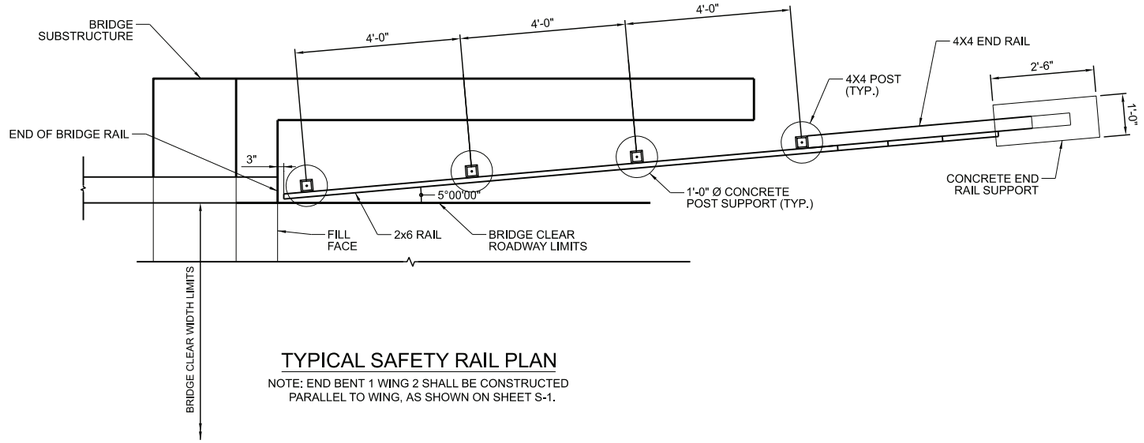
SECTION A-A



SECTION B-B



SECTION C-C



TYPICAL SAFETY RAIL PLAN

NOTE: END BENT 1 WING 2 SHALL BE CONSTRUCTED PARALLEL TO WING, AS SHOWN ON SHEET S-1.

PROJECT NO. 006-01-EF443

AVERY COUNTY

STATION: 11+18.38 -L-

NORTH CAROLINA
OFFICE OF EMERGENCY MANAGEMENT

SAFETY RAIL DETAILS

DRAWN BY :	J. LOFTUS	DATE :	11/2025			
CHECKED BY :	P. JACOB	DATE :	11/2025			
DESIGN ENGINEER OF RECORD:	J. LOFTUS	DATE :	12/2025			

The John R. McAdams Company, Inc.
621 Hillsborough Street
Suite 500
Raleigh, NC 27603

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

NORTH CAROLINA PROFESSIONAL SEAL 042425 ENGINEER JEFFREY M. LOFTUS 12-04-25

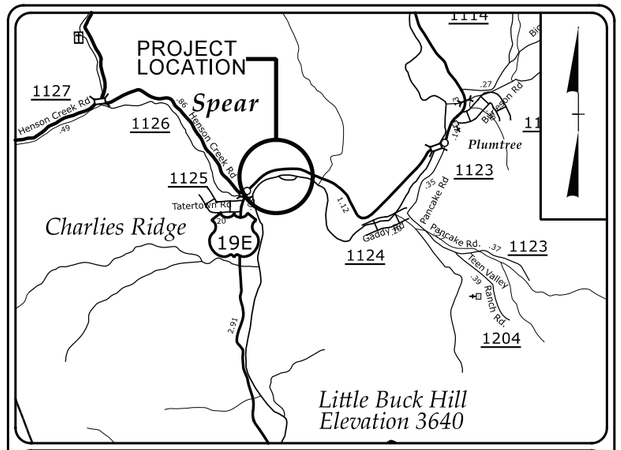
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-16
1			3			TOTAL SHEETS
2			4			16

1/6/2026
X:\Projects\NCD\NCD25009\NCD25009_01\04-Production\Transportation\Structures\03 - CADD\02 - FinalDrawings\401_031_PRB00601EF443_NCEM_SR01_016.dgn
loftus

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

TIP PROJECT: 006-01-ef443



VICINITY MAP
NOT TO SCALE

STATE OF NORTH CAROLINA
DIVISION OF EMERGENCY MANAGEMENT

PLAN FOR PROPOSED
EROSION CONTROL

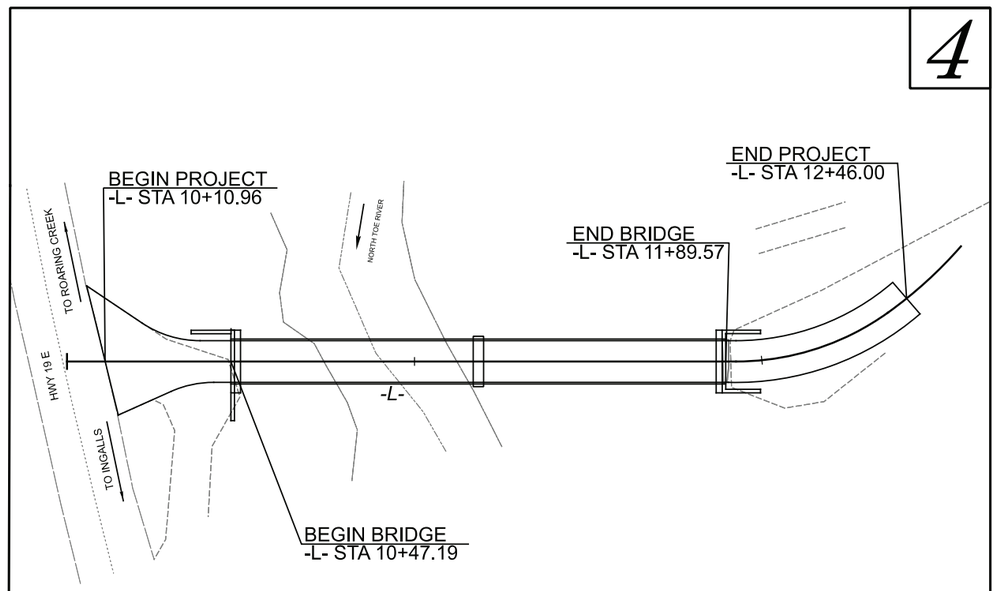
AVERY COUNTY

LOCATION: *PRIVATE BRIDGE REPLACEMENT LOCATED AT 5631 US 19E NEWFOUND, NC 28657*

TYPE OF WORK: *GRADING, PAVING, AND STRUCTURE*

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	006-01-ef443	EC-1	5

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION



NC GRID
NAD 83 NA 2011

ENVIRONMENTALLY SENSITIVE AREA(S) EXIST ON THIS PROJECT

Refer To E. C. Special Provisions for Special Considerations.

THIS PROJECT CONTAINS EROSION CONTROL PLANS FOR CLEARING AND GRUBBING PHASE OF CONSTRUCTION.

GRAPHIC SCALE

40 20 0 40 80
PLANS

THESE EROSION AND SEDIMENT CONTROL PLANS COMPLY WITH THE REGULATIONS SET FORTH BY THE NCG-010000 GENERAL STORMWATER CONSTRUCTION PERMIT ISSUED BY THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES.

VOLKERT
5430 Wade Park Blvd., Suite 410
Raleigh, NC 27606
Tel. 919-854-0344 Fax. 919-854-0355
NC License No. F-0765

Prepared In the Office of:
VOLKERT
5430 WADE PARK BLVD., SUITE 410
RALEIGH, NC 27606

Designed by:
ZACHARY THORNTON ***4365***
NAME *LEVEL III CERTIFICATION NO.*

EMERGENCY MANAGEMENT
N★C
NORTH CAROLINA

11/18/2025
PRS 006-01
ef443_EC_TSH_EC1.dgn
hsochen.jan

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

PROJECT REFERENCE NO.	SHEET NO.
006-01-ef443	EC-2

DIVISION OF HIGHWAYS
STATE OF NORTH CAROLINA

EROSION & SEDIMENT CONTROL LEGEND

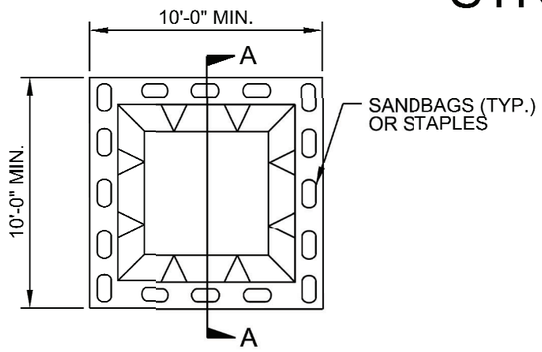
Std. #	Description	Symbol
1605.01	Temporary Silt Fence	
1606.01	Special Sediment Control Fence	
1622.01	Temporary Berms and Slope Drains	
1630.02	Silt Basin Type B	
1630.03	Temporary Silt Ditch	TSD
1630.04	Stilling Basin	
1630.05	Temporary Diversion	TD
1630.06	Special Stilling Basin	
1630.07	Skimmer Basin	
1630.08	Tiered Skimmer Basin	
1630.09	Earthen Dam with Skimmer	
	Infiltration Basin	
	Rock Inlet Sediment Trap:	
1632.01	Type A	A
1632.02	Type B	B
1632.03	Type C	C

Std. #	Description	Symbol
1633.01	Temporary Rock Silt Check Type A	
1633.02	Temporary Rock Silt Check Type B	
1633.03	Temporary Rock Silt Check Type A with Excelsior Matting and Flocculant	
1634.01	Temporary Rock Sediment Dam Type A	
1634.02	Temporary Rock Sediment Dam Type B	
1635.01	Rock Pipe Inlet Sediment Trap Type A	A
1635.02	Rock Pipe Inlet Sediment Trap Type B	B
1636.01	Excelsior Wattle Check	
1636.01	Excelsior Wattle Check with Flocculant	
1636.01	Coir Fiber Wattle Check	
1636.01	Coir Fiber Wattle Check with Flocculant	
1636.02	Silt Fence Excelsior Wattle Break	EW
	Silt Fence Coir Fiber Wattle Break	CFW
1636.03	Excelsior Wattle Barrier	EW EW EW
1636.03	Coir Fiber Wattle Barrier	CFW CFW CFW

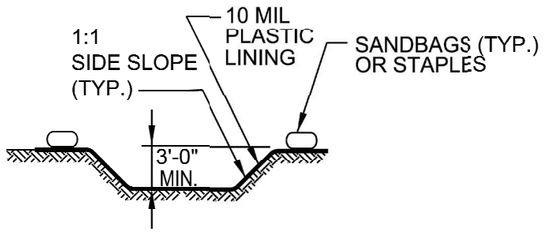
Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

PROJECT REFERENCE NO.	SHEET NO.
006-01-ef443	EC-3
R/W SHEET NO.	

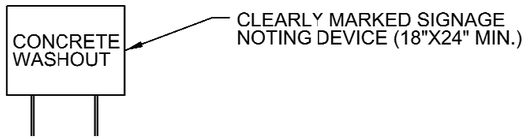
ONSITE CONCRETE WASHOUT STRUCTURE WITH LINER



PLAN



SECTION A-A



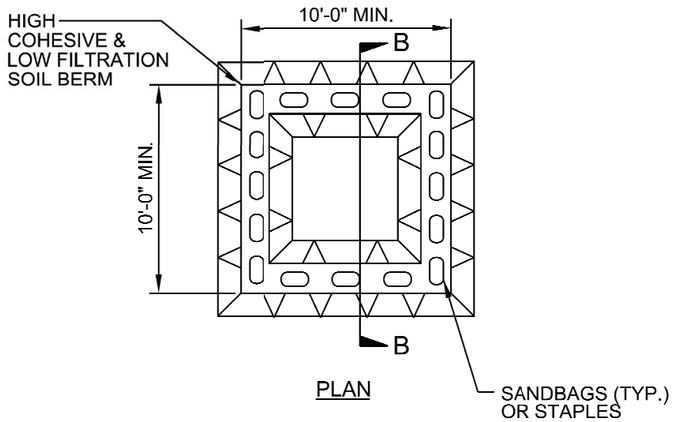
NOTES:
1. ACTUAL LOCATION DETERMINED IN FIELD

2. THE CONCRETE WASHOUT STRUCTURES SHALL BE MAINTAINED WHEN THE LIQUID AND/OR SOLID REACHES 75% OF THE STRUCTURES CAPACITY TO PROVIDE ADEQUATE HOLDING CAPACITY WITH A MINIMUM 12 INCHES OF FREEBOARD.

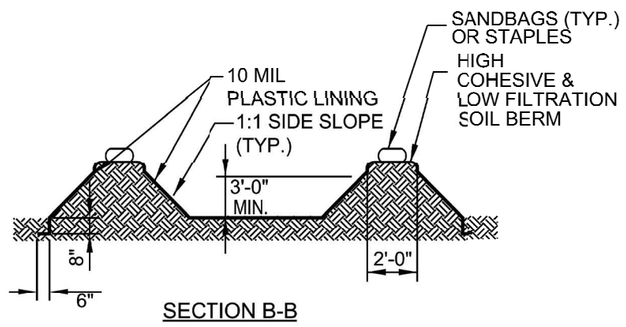
3.CONCRETE WASHOUT STRUCTURE NEEDS TO BE CLEARLY MARKED WITH SIGNAGE NOTING DEVICE.

BELOW GRADE WASHOUT STRUCTURE

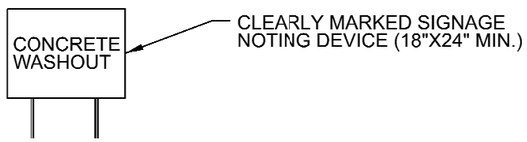
NOT TO SCALE



PLAN



SECTION B-B



NOTES:
1. ACTUAL LOCATION DETERMINED IN FIELD

2. THE CONCRETE WASHOUT STRUCTURES SHALL BE MAINTAINED WHEN THE LIQUID AND/OR SOLID REACHES 75% OF THE STRUCTURES CAPACITY TO PROVIDE ADEQUATE HOLDING CAPACITY WITH A MINIMUM 12 INCHES OF FREEBOARD.

3.CONCRETE WASHOUT STRUCTURE NEEDS TO BE CLEARLY MARKED WITH SIGNAGE NOTING DEVICE.

ABOVE GRADE WASHOUT STRUCTURE

NOT TO SCALE

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

PROJECT REFERENCE NO.	SHEET NO.
006-01-ef443	EC-3A

DIVISION OF HIGHWAYS
STATE OF NORTH CAROLINA

SOIL STABILIZATION TIMEFRAMES

SITE DESCRIPTION	STABILIZATION TIME	TIMEFRAME EXCEPTIONS
PERIMETER DIKES, SWALES, DITCHES AND SLOPES	7 DAYS	NONE
HIGH QUALITY WATER (HQW) ZONES	7 DAYS	NONE
SLOPES STEEPER THAN 3:1	7 DAYS	IF SLOPES ARE 10' OR LESS IN LENGTH AND ARE NOT STEEPER THAN 2:1, 14 DAYS ARE ALLOWED.
SLOPES 3:1 TO 4:1	14 DAYS	7 DAYS FOR SLOPES GREATER THAN 50' IN LENGTH WITH SLOPES STEEPER THAN 4:1. 7 DAYS FOR PERIMETER DIKES, SWALES, DITCHES PERIMETER SLOPES, AND HQW ZONES
ALL OTHER AREAS WITH SLOPES FLATTER THAN 4:1	14 DAYS	7 DAYS FOR PERIMETER DIKES, SWALES, DITCHES PERIMETER SLOPES, AND HQW ZONES

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

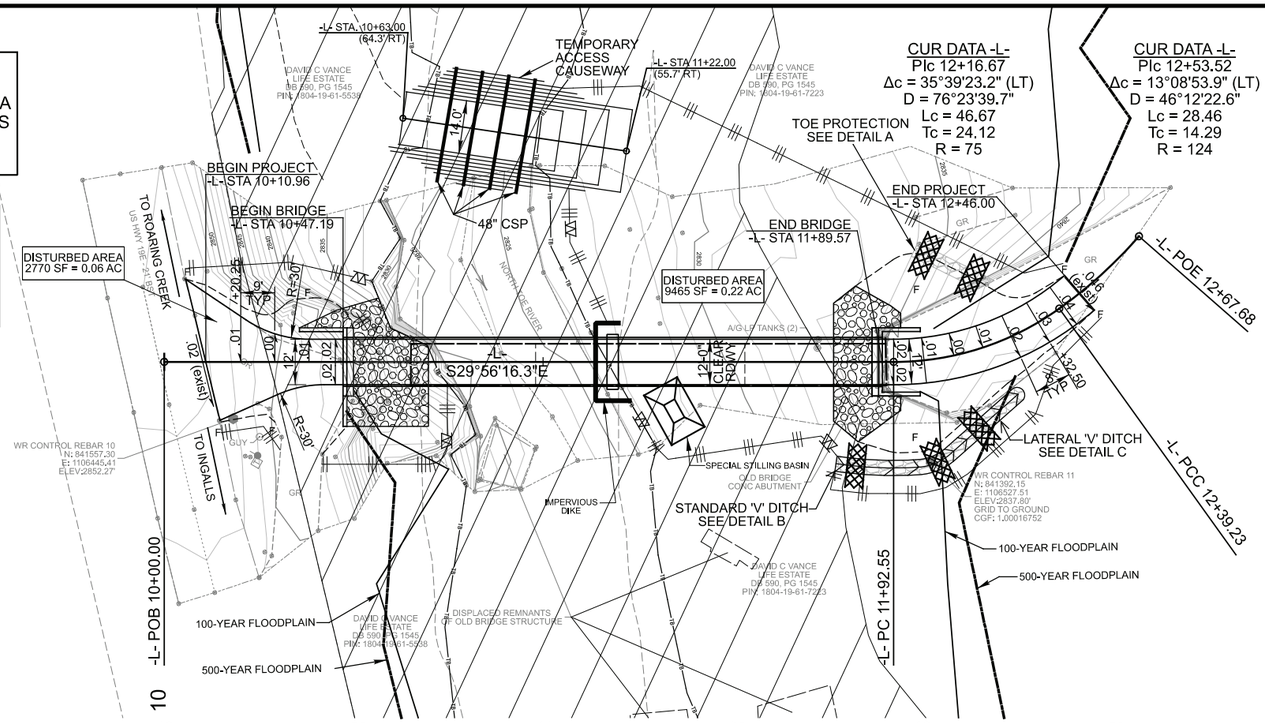
ENVIRONMENTALLY SENSITIVE AREA
SEE PROJECT SPECIAL PROVISIONS

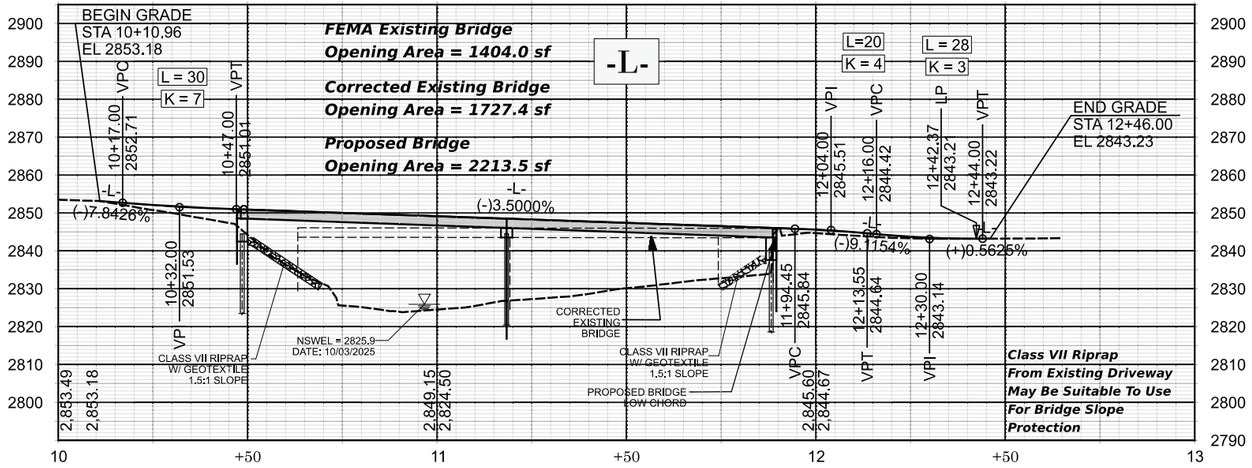
TROUT STREAM
BUFFER ZONE WITHIN ESA BUFFER
(NOT SHOWN FOR CLARITY)

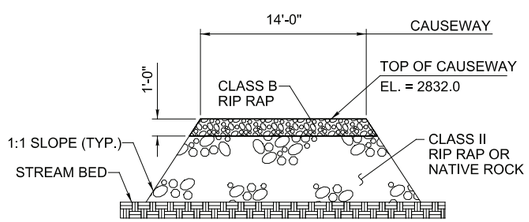
EROSION CONTROL QUANTITIES

TRNS-PORT ITEM DESCRIPTION	QUANTITY	UNIT
GEOTEXTILE FOR DRAINAGE	170	SY
TEMPORARY SILT FENCE	550	LF
EROSION CONTROL STONE, CLASS B	55	TON
SEDIMENT CONTROL STONE	155	TON
TEMPORARY MULCHING	0.50	ACR
SEED FOR TEMPORARY SEEDING	100.00	LB
FERTILIZER FOR TEMPORARY SEEDING	0.50	TON
TEMPORARY SLOPE DRAINS	200	LF
SAFETY FENCE	200	LF
SILT EXCAVATION	80	CY
MATTING FOR EROSION CONTROL	6250	SY
COIR FIBER MAT	100	SY
1/4" HARDWARE CLOTH	410	LF
SPECIAL STILLING BASINS	3	EA
SEEDING AND MULCHING	0.50	ACR
MOWING	0.50	ACR
SEED FOR REPAIR SEEDING	50.00	LB
FERTILIZER FOR REPAIR SEEDING	0.25	TON
SEED FOR SUPPLEMENTAL SEEDING	50.00	LB
FERTILIZER TOPDRESSING	0.50	TON
IMPERVIOUS DIKE	36	LF
SPECIALIZED HAND MOWING	10	MHR
RESPONSE FOR EROSION CONTROL	13	EA
REFORESTATION	0.10	ACR
CONCRETE WASHOUT STRUCTURE	1	EA
GENERIC EROSION CONTROL ITEM - PREFABRICATED CONCRETE WASHOUT	2	EA

NOTE:
UTILIZE TEMPORARY SEDIMENT BASIN OR SPECIAL STILLING BASIN(S) AS STILLING BASIN WHERE APPLICABLE.

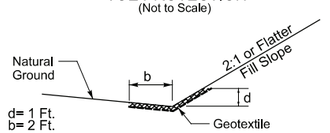






DETAIL OF CAUSEWAY
(NTS)

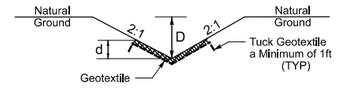
DETAIL A
TOE PROTECTION
(Not to Scale)



Type of Liner= Class I Rip-Rap

FROM -L- STA. 12+00 TO STA. 12+24 LT

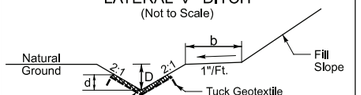
DETAIL B
STANDARD 'V' DITCH
(Not to Scale)



Min. D= 1 Ft.
Type of Liner= Class II Rip-Rap, Keyed-In d= 1 Ft.

FROM -L- STA. 11+77 TO STA. 11+93 RT

DETAIL C
LATERAL 'V' DITCH
(Not to Scale)



Min. D= 1 Ft.
d= 1 Ft.
Type of Liner= Class II Rip-Rap, Keyed-In b= 2 Ft.

FROM -L- STA. 11+93 TO STA. 12+22 RT

PRB_006-01-ef443
SHEET NO. EC-04
CONST.04

VOLKERT
5430 Wade Park Blvd., Suite 410
Raleigh, NC 27606
Tel. 919-854-0344 Fax. 919-854-0355
NC License No. F-0765

STATE OF NORTH CAROLINA
AVERY COUNTY

BRIDGE AT 5631 US 19E NEWLAND, NC 28657
AVERY COUNTY
12'-0" CLEAR ROADWAY AND 90° SKEW

Docusign Envelope ID: 3DF3F782-88C1-42E8-BE25-DE43F0D86E0A

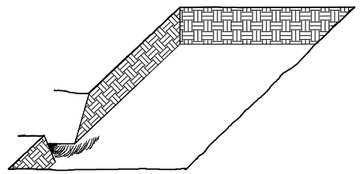
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	006-01-ef443	RF-1	1
STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION	

PLANTING DETAILS

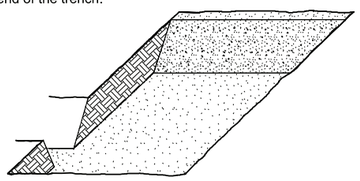
SEEDLING / LINER BAREROOT PLANTING DETAIL

HEALING IN

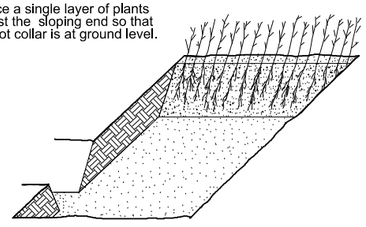
1. Locate a healing-in site in a shady, well protected area.
2. Excavate a flat bottom trench 12 inches deep and provide drainage.



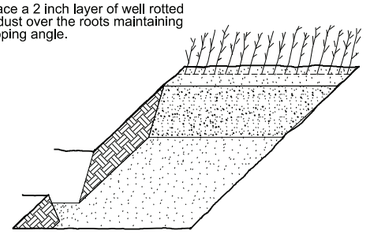
3. Backfill the trench with 2 inches well rotted sawdust. Place a 2 inch layer of well rotted sawdust at a sloping angle at one end of the trench.



4. Place a single layer of plants against the sloping end so that the root collar is at ground level.

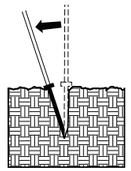


5. Place a 2 inch layer of well rotted sawdust over the roots maintaining a sloping angle.

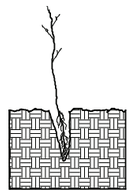


6. Repeat layers of plants and sawdust as necessary and water thoroughly.

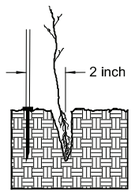
DIBBLE PLANTING METHOD
USING THE KBC PLANTING BAR



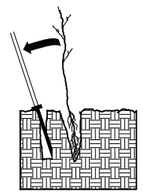
1. Insert planting bar as shown and pull handle toward planter.



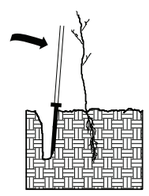
2. Remove planting bar and place seedling at correct depth.



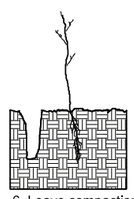
3. Insert planting bar 2 inches toward planter from seedling.



4. Pull handle of bar toward planter, firming soil at bottom.



5. Push handle forward firming soil at top.



6. Leave compaction hole open. Water thoroughly.

PLANTING NOTES:

PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 12 inches long, 4 inches wide and 1 inch thick at center.

ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 10 inches below the root collar.

REFORESTATION

☐ TREE REFORESTATION SHALL BE PLANTED 6 FT. TO 10 FT. ON CENTER, RANDOM SPACING, AVERAGING 8 FT. ON CENTER, APPROXIMATELY 680 PLANTS PER ACRE.

REFORESTATION

MIXTURE, TYPE, SIZE, AND FURNISH SHALL CONFORM TO THE FOLLOWING:

34% LIRIODENDRON TULIPIFERA	TULIP POPLAR	12 in - 18 in BR
33% PLATANUS OCCIDENTALIS	AMERICAN SYCAMORE	12 in - 18 in BR
33% BETULA NIGRA	RIVER BIRCH	12 in - 18 in BR

REFORESTATION DETAIL SHEET

N.C.D.O.T. - ROADSIDE ENVIRONMENTAL UNIT

FOUNDATION RECOMMENDATIONS

Prepared for NCDOT by: ESP Associates, Inc.

STATE NO.: PRB 006.01.ef443
TIP NO.: N/A
COUNTY: Avery
STATION: 11+18.38 -L-

DESCRIPTION: Bridge at 5631 US 19E over North Toe River in Newland, NC

	INITIALS	DATE
DESIGN	HAA	11/18/2025
CHECK	MML	11/18/2025
APPROVAL		

SIGNATURE

BENT	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
End Bent 1	10+47.19	Abutment on Five HP12x53 Drilled-In Steel Piles	240 kips/pile	Bottom of Cap Elev = 2842.48 ft Estimated Pile Lengths (P1 thru P5) = 20 ft Point of Fixity = 2828.8 ft Minimum Tip Elevation = 2824.8 ft
Bent 1	11+18.38	Pile Cap on Four HP14x89 Drilled-In Steel Piles	340 kips/pile	Bottom of Cap Elev = 2843.53 ft Estimated Pile Lengths (P1 thru P4) = 25 ft Point of Fixity = 2822.4 ft Minimum Tip Elevation = 2813.4 ft
End Bent 2	11+89.57	Abutment on Five HP12x53 Drilled-In Steel Piles	220 kips/pile	Bottom of Cap Elev = 2837.61 ft Estimated Pile Lengths (P1 thru P5) = 25 ft Point of Fixity = 2823.6 ft Minimum Tip Elevation = 2819.6 ft

FOUNDATION RECOMMENDATIONS

Prepared for NCDOT by: ESP Associates, Inc.

NOTES ON PLANS

1. FOR PILES, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.
2. FILL THE BOTTOM 5 FT OF HOLES FOR PILE EXCAVATION AT END BENT NO. 1 AND END BENT NO. 2 WITH CONCRETE OR GROUT AND THE REST OF HOLES WITH CLASS II OR III SELECT MATERIAL THAT MEETS SECTION 1016 OF THE STANDARD SPECIFICATIONS.
3. FILL THE BOTTOM 10 FT OF HOLES FOR PILE EXCAVATION AT BENT NO. 1 WITH CONCRETE OR GROUT AND THE REST OF HOLES WITH CLASS II OR III SELECT MATERIAL THAT MEETS SECTION 1016 OF THE STANDARD SPECIFICATIONS.
4. SET HP12X53 PILES AT END BENT NO. 1 AND END BENT NO. 2 AND HP14X89 PILES AT BENT NO. 1 IN THE PREDRILLED HOLES AND FILL THE ANNULUS WITH CEMENTITIOUS CONCRETE/GROUT AS FOLLOWS:
    a. DRY CONDITIONS: WHEN THE HOLE IS STABLE AND FREE OF STANDING WATER, PLACE CONCRETE OR GROUT FROM THE BOTTOM UP USING A TREMIE OR FLEXIBLE HOSE AND ALLOW CONCRETE OR GROUT TO FLOW FREELY AROUND THE PILE. KEEP PLACEMENT CONTINUOUS TO THE TOP OF ROCK ELEVATION.
    b. WET CONDITIONS: WHEN WATER OR SLURRY IS PRESENT, USE AN APPROVED TREMIE PIPE KEPT EMBEDDED IN THE FRESH CONCRETE OR GROUT AT LEAST 5 FT. CLEAN THE BOTTOM OF EXCAVATIONS WITH A SUBMERSIBLE PUMP OR AN AIRLIFT. PLACE CONCRETE OR GROUT FROM THE BOTTOM UP TO PREVENT SEGREGATION OR WASHOUT. MAINTAIN POSITIVE HEAD OF CONCRETE OR GROUT UNTIL THE ROCK SOCKET IS COMPLETELY FILLED.
    c. CASING USE: TEMPORARY CASING MAY BE USED AS REQUIRED TO MAINTAIN A CLEAN AND STABLE HOLE. CASING MAY BE TELESCOPIC OR SEGMENTAL. MAINTAIN CASING TIGHT TO PREVENT CONCRETE OR GROUT LOSS. CASING MAY BE WITHDRAWN AFTER CONCRETE OR GROUT HAS REACHED SUFFICIENT STABILITY, PROVIDED THE CONCRETE OR GROUT LEVEL IS MAINTAINED AT OR ABOVE THE BOTTOM OF THE CASING DURING WITHDRAWAL. LEAVE CASING IN PLACE IF CONCRETE OR GROUT STABILITY OR WATER CONDITIONS REQUIRE IT.

FOUNDATION RECOMMENDATIONS

Prepared for NCDOT by: ESP Associates, Inc.

COMMENTS

1. PILES ARE NUMBERED FROM LEFT TO RIGHT, LOOKING UP-STATION AT END BENT NO. 1, BENT NO. 1, AND END BENT NO. 2.
2. ESTIMATED PILE LENGTHS ARE ROUNDED UP TO NEAREST 5 FT.
3. BENT NO. 1 PILES SHALL BE INSTALLED IN A RIVER ENVIRONMENT. PREDRILL HOLES TO A MINIMUM DEPTH OF 10.0 FT BELOW GRADE TO ACHIEVE THE REQUIRED EMBEDMENT IN NON-SCOURABLE MATERIAL.
4. CONTRACTOR SHALL PREVENT CONCRETE OR GROUT LOSS AND WATER CONTAMINATION DURING PLACEMENT. PROVIDE SILT CONTROL AND COMPLY WITH ALL PERMIT REQUIREMENTS FOR IN-WATER WORK.
5. MINIMUM DIAMETER OF PILE PREDRILL HOLES FOR END BENT NO. 1 AND END BENT NO. 2 HP 12X53 PILES SHALL BE 18 IN. PROVIDE CENTRALIZERS TO MAINTAIN 1.5 IN. CONCRETE OR GROUT COVER AROUND THE PILE. SPACE CENTRALIZERS A MAXIMUM OF 10 FT ON CENTER AND LOCATE ONE IN THE LOWER THIRD, ONE AT MID-LENGTH, AND ONE NEAR THE TOP OF PILE.
6. MINIMUM DIAMETER OF PILE PREDRILL HOLES FOR BENT NO. 1 HP 14X89 PILES SHALL BE 24 IN. PROVIDE CENTRALIZERS TO MAINTAIN 1.5 IN. CONCRETE OR GROUT COVER AROUND THE PILE. SPACE CENTRALIZERS A MAXIMUM OF 10 FT ON CENTER AND LOCATE ONE IN THE LOWER THIRD, ONE AT MID-LENGTH, AND ONE NEAR THE TOP OF PILE.
7. FACTORED RESISTANCE OF PILES AT END BENT NO. 1 AND END BENT NO. 2 IS OBTAINED BY SOCKETING PILES 5 FT INTO HARD ROCK. TOP OF HARD ROCK ELEVATIONS ENCOUNTERED DURING THE FIELD EXPLORATION AT END BENT NO. 1 AND END BENT NO.2 WAS ELEV. 2,829.8 FT AND ELEV. 2,824.6 FT, RESPECTIVELY.
8. FACTORED RESISTANCE OF PILES AT BENT NO. 1 IS OBTAINED BY SOCKETING PILES 10 FT INTO HARD ROCK. TOP OF HARD ROCK ELEVATION ENCOUNTERED DURING THE FIELD EXPLORATION AT BENT NO. 1 WAS 2,823.4 FT.
9. ESTIMATED PILE EXCAVATION IN SOIL AND IN ROCK AT ALL SUBSTRUCTURE LOCATIONS ASSUME HALF THE DRILLING IN WEATHERED ROCK TO BE CONSIDERED AS ROCK PER THE REVISED NCDOT GUIDELINES.
10. PROVIDE REINFORCED APPROACH FILL AT END BENT NO. 1 PER SPECIAL DETAIL S-15. END BENT NO. 2 SHALL USE STANDARD TYPE I REINFORCED BRIDGE APPROACH FILL.
11. PRIMARY GEOGRID REINFORCEMENT SHALL BE SELECTED FROM THE NCDOT GEOTECHNICAL QUALIFIED PRODUCTS LIST AND SHALL PROVIDE A LONG-TERM DESIGN STRENGTH (LTDS) OF NOT LESS THAN 1,000 LB/FT IN BOTH THE MACHINE DIRECTION (MD) AND CROSS-MACHINE DIRECTION (CD) AT THE 90 DEGREE WINGWALL AT END BENT 1. THE GEOGRID SHALL MEET ALL NCDOT REQUIREMENTS FOR CREEP, DURABILITY, AND INSTALLATION DAMAGE, FOR A 100-YEAR DESIGN LIFE. THE CONTRACTOR SHALL SUBMIT MANUFACTURER CERTIFICATION AND PRODUCT DATA CONFIRMING COMPLIANCE WITH THESE REQUIREMENTS.
12. PROVIDE STAGGERED SECONDARY GEOTEXTILE LAYERS BETWEEN PRIMARY GEOGRID LAYERS TO SUPPORT AND CONTAIN THE LOCAL FACING. PLACE SECONDARY GEOTEXTILES MIDWAY BETWEEN PRIMARY GEOGRID ELEVATIONS AND EXTEND THEM TO THE FACE WITH A MINIMUM

EMBEDMENT OF 2.5 FT INTO THE REINFORCED ZONE. SECONDARY GEOTEXTILES SHALL BE TYPE 1 GEOTEXTILE FROM THE NCDOT QUALIFIED PRODUCTS LIST. ALTERNATIVELY, WELDED WIRE FACING CAN BE UTILIZED FOR LOCAL FACE STABILITY. SEE SPECIAL DETAIL S-15.

13. SUBMIT CENTRALIZER DETAILS, CASING METHOD, CONCRETE OR GROUT MIX DESIGN, AND CONCRETING OR GROUTING PROCEDURE FOR APPROVAL PRIOR TO INSTALLATION.
14. MAINTAIN PILE PLUMBNESS AND LOCATION WITHIN SPECIFIED TOLERANCES. RECORD FINAL EMBEDMENT DEPTHS, CONCRETE OR GROUT QUANTITIES, AND TEST RESULTS FOR SUBMITTAL TO THE ENGINEER.

SUMMARY OF PILE INFORMATION/INSTALLATION

(Blank entries indicate item is not applicable to structure)

End Bent / Bent No, Pile(s) #(-#) (e.g., "Bent 1, Piles 1-5")	Number of Piles per Line	Factored Resistance per Pile KIPS	Pile Cut-Off (Top of Pile) Elevation FT	Estimated Pile Length per Pile FT	Scour Critical Elevation FT	Driven Piles			Predrilling for Piles **			Drilled-In Piles		
						Minimum Pile Tip (Tip No Higher Than) Elevation FT	Required Driving Resistance (RDR)* per pile KIPS	Pile Redrives Quantity EACH	Predrilling Length per Pile LIN FT	Predrilling Elevation (Elevation Not To Predrill Below) FT	Maximum Predrilling Diameter INCHES	Pile Excavation (Bottom of Hole) Elevation FT	Pile Excavation Not In Soil per Pile LIN FT	Pile Excavation In Soil per Pile LIN FT
End Bent 1, Piles 1-5	5	240	2844.48	20	2829.80							2824.80	5	15
Bent 1, Piles 1-4	4	340	2844.53	25	2823.40							2813.40	10	5
End Bent 2, Piles 1-5	5	220	2839.61	25	2824.60							2818.40	6	19
TOTAL QUANTITY:													95	190

$$^{*}RDR = \frac{Factored\ Resistance\ + Factored\ Drag\ Load\ +\ Factored\ Dead\ Load}{Dynamic\ Resistance\ Factor} + Nominal\ Drag\ Load\ Resistance + \ Nominal\ Resistance\ from\ Scourable\ Material$$

** Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.

PROJECT NO. 011.01.00403

Avery COUNTY

STATION: -L- 11+18.38

NOTES:

1. The Pile Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Hratch Antoine Agopian, #057984) on 11-18-2025.
2. Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
3. The Engineer may adjust the quantity for DPT Testing and Pipe Pile Plates when necessary.

NORTH CAROLINA PROFESSIONAL SEAL PE # ENGINEER PE SEAL NAME

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PILE FOUNDATION TABLES

REVISIONS							SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:		
1			3				TOTAL SHEETS
2			4				

General Information & Loading

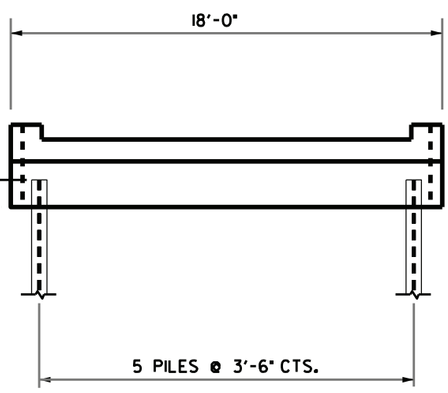
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HIGHWAY BUILDING
P. O. BOX 25201
RALEIGH, NORTH CAROLINA 27611

SUBJECT FACTORED LOADS — PROJECT PRB 006.01.ef443
FACTORED LOADS — AVERY COUNTY
PREPARED BY JML — DATE 11-2025 — STATION 11+18.38 -L-
CHECKED BY PLJ — DATE 11-2025 — STR NO SI — SHEET 1 OF 2

END BENT #1
SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE: HP 12x53
PILE ORIENTATION: STRONG AXIS IN LONGITUDINAL

AVG. PILE CUTOFF ELEV = 2844.48 FT
AVG. BOC ELEV = 2042.48 FT

FACTORED AXIAL PILE LOAD = 120 KIPS
FACTORED LONGITUDINAL PILE LOAD = 13 KIPS
FACTORED TRANSVERSE PILE LOAD = 2 KIPS

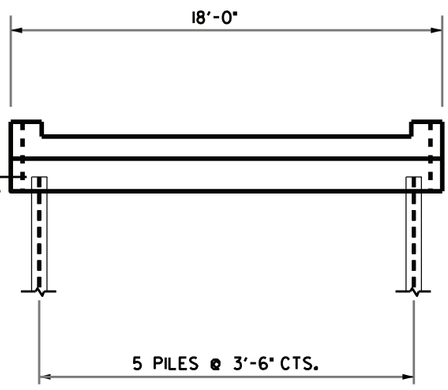


END BENT SKETCH
NO SCALE

END BENT #2
SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP 12x53
PILE ORIENTATION: STRONG AXIS IN LONGITUDINAL

AVG. PILE CUTOFF ELEV = 2839.61 FT
AVG. BOC ELEV = 2837.61 FT

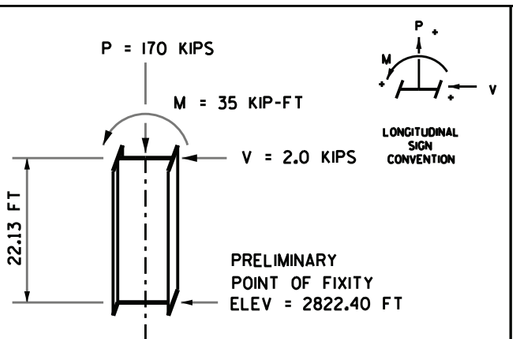
FACTORED AXIAL PILE LOAD = 110 KIPS
FACTORED LONGITUDINAL PILE LOAD = 10 KIPS
FACTORED TRANSVERSE PILE LOAD = 2 KIPS



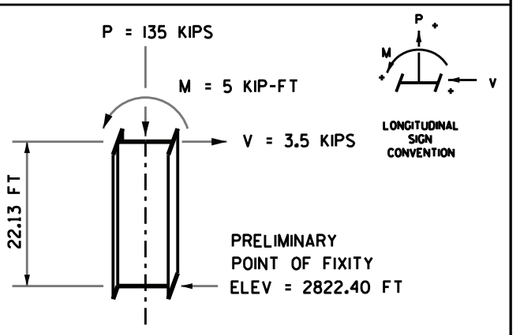
END BENT SKETCH
NO SCALE

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HIGHWAY BUILDING
P. O. BOX 25201
RALEIGH, NORTH CAROLINA 27611

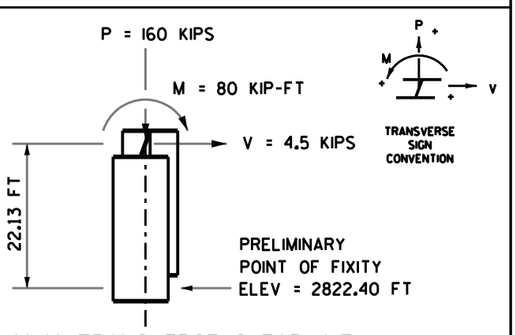
SUBJECT CONTROLLING PILE FACTORED LOADS
PROJECT PRB 006.01.ef443 AVERY COUNTY
PREPARED BY JML DATE 11-2025
CHECKED BY PLJ DATE 11-2025
STATION 11+18.38 -L-
STR NO SI SHEET 2 OF 2



MAXIMUM AXIAL LOAD WITH LONGITUDINAL SHEAR & MOMENT



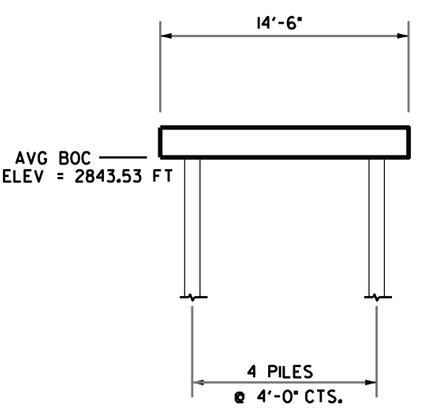
MAXIMUM LONGITUDINAL SHEAR WITH AXIAL LOAD & LONGITUDINAL MOMENT



MAXIMUM TRANSVERSE SHEAR WITH AXIAL LOAD & TRANSVERSE MOMENT

BENT #1

SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP14x89
1'-0" PILE EMBEDMENT INTO CAP



NO SCALE

Rock Mass Rating

1. End Bent 1 will be supported on steel piles in drilled-in rock. Hence, boring (EB1) is chosen to determine rock mass modulus.

2. The bedrock consists Biotite Gneiss with interlayered Schist. The rock quality was typically good with stratum RQD's in the range of 75% and 96% recovery.

3. AASHTO LRFD (2020) Sec. C10.6.3.2.1 was followed to determine the Rock Mass Rating (RMR). Additional information was collected from Sabatini et al. (2002) as per suggestion from Sec. C10.6.3.2.1 of AASHTO LRFD (2020).

RMR Rating - END BENT 1:

SL.	Rock Parameter/Category	Value/Condition		Rating
1	Strength of intact rock (q_u, MPa)[1]	30 to 160 MPa	(Use 100 MPa/14500 psi)	7
2	RQD(%)[1]	75%		17
3	Spacing of joints (m)[1]	0.3 to 1 m	(Estimate)	20
4	Condition of joints[1]	Slightly rough to slickensided; Separation ~1 mm		10
5	Ground water condition[1]	Wet		7
6	Rating adjustment for joint orientation[1]	Very Favorable (Foundations)		0
			RMR Rating =	**61**
			Description[1]:	**Good Rock**

[1] *Table 40 - CSIR classification of jointed rock mass, Sabatini et al. (2002)*

4. **Determination of Rock Mass Modulus and Intact Elastic Modulus**

5a. **Based on RMR**

Rock Mass Rating (RMR) =	61		(For Granite)
Rock mass modulus (E_m) =	3190	Ksi	Bieniawski (1978) & Serafim and Pereira (1983)
Intact elastic modulus (E_i) =	4769	Ksi	Mitri et al. (1994)
	13600	Ksi	Nicholson and Bieniawski (1990)

5b. **Based on Geological Strength Index (GSI)**

The bedrock is considered to be very thin to medium foliated, hard and slightly weathered to fresh.

Geological Strength Index (GSI) =	63	(Good)	AASHTO (2020) Figure 10.4.6.4.1 (Typically GSI ~ RMR - 5)
Unconfined Compressive Strength (q_u) =	100	MPa	(Best Guess Estimate)
Rock mass modulus (E_m) =	3065	Ksi	AASHTO (2020) Table 10.4.6.5-1
use rock mass modulus (Em) =	**3000**	Ksi	

References:

[1]Table 40, CSIR classification of jointed rock mass, Sabatini et al. (2002)
[2]Table 19, Report 651, National Cooperative Highway Research Program
[3]Table 10.5.5.2.2-1, AASHTO LRFD Bridge Design Specifications (2020), 8th Edition
[4]Section 10.6.2.6.2, AASHTO LRFD Bridge Design Specifications (2020), 8th Edition

Rock Mass Rating

1. Bent 1 and End Bent 2 will be supported on steel piles in drilled-in rock. Hence, boring (EB2) is chosen to determine rock mass modulus for both substructures.

2. The bedrock consists Biotite Gneiss with interlayered Schist. The rock quality was typically good with stratum RQD's in the range of 61% and 98% recovery.

3. AASHTO LRFD (2020) Sec. C10.6.3.2.1 was followed to determine the Rock Mass Rating (RMR). Additional information was collected from Sabatini et al. (2002) as per suggestion from Sec. C10.6.3.2.1 of AASHTO LRFD (2020).

RMR Rating - END BENT 1:

SL.	Rock Parameter/Category	Value/Condition		Rating
1	Strength of intact rock (q_u, MPa)[1]	30 to 160 MPa	(Use 100 MPa/14500 psi)	7
2	RQD(%)[1]	61%		13
3	Spacing of joints (m)[1]	0.3 to 1 m	(Estimate)	20
4	Condition of joints[1]	Slightly rough to slickensided; Separation ~1 mm		8
5	Ground water condition[1]	Wet		7
6	Rating adjustment for joint orientation[1]	Very Favorable (Foundations)		0
			RMR Rating =	**55**
			Description[1]:	**Fair Rock**

[1] *Table 40 - CSIR classification of jointed rock mass, Sabatini et al. (2002)*

4. **Determination of Rock Mass Modulus and Intact Elastic Modulus**

5a. **Based on RMR**

Rock Mass Rating (RMR) =	55		(For Granite)
Rock mass modulus (E_m) =	1450	Ksi	Bieniawski (1978) & Serafim and Pereira (1983)
Intact elastic modulus (E_i) =	2510	Ksi	Mitri et al. (1994)
	7841	Ksi	Nicholson and Bieniawski (1990)

5b. **Based on Geological Strength Index (GSI)**

The bedrock is considered to be very thin to medium foliated, hard and slightly weathered to fresh.

Geological Strength Index (GSI) =	51	(Good)	AASHTO (2020) Figure 10.4.6.4.1 (Typically GSI ~ RMR - 5)
Unconfined Compressive Strength (q_u) =	100	MPa	(Best Guess Estimate)
Rock mass modulus (E_m) =	1536	Ksi	AASHTO (2020) Table 10.4.6.5-1
use rock mass modulus (Em) =	**1500**	Ksi	

References:

[1]Table 40, CSIR classification of jointed rock mass, Sabatini et al. (2002)
[2]Table 19, Report 651, National Cooperative Highway Research Program
[3]Table 10.5.5.2.2-1, AASHTO LRFD Bridge Design Specifications (2020), 8th Edition
[4]Section 10.6.2.6.2, AASHTO LRFD Bridge Design Specifications (2020), 8th Edition

REFERENCES (CONTINUED)

Table 40 - CSIR classification of jointed rock mass, Sabatini et al. (2002)

Table 40. CSIR classification of jointed rock mass.

A. CLASSIFICATION PARAMETERS AND THEIR RATINGS

PARAMETER			RANGES OF VALUES						
1	Strength of intact rock material	Point load strength index	>8 MPa	4 to 8 Mpa	2 to 4 MPa	1 to 2 MPa	For this low range – uniaxial compressive test is preferred		
		Uniaxial compressive strength	>200 MPa	100 to 200 MPa	50 to 100 MPa	25 to 50 MPa	10 to 25 MPa	3 to 10 MPa	1 to 3 MPa
	Relative Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% to 100%	75% to 90%	50% to 75%	25% to 50%	<25%		
	Relative Rating		20	17	13	8	3		
3	Spacing of joints		>3 m	1 to 3m	0.3 to 1 m	50 to 300 mm	<50mm		
	Relative Rating		30	25	20	10	5		
4	Condition of joints		Very rough surfaces Not continuous No separation Hard joint wall rock	Slightly rough surfaces Separation <1mm Hard joint wall rock	Slightly rough surfaces Separation <1mm Soft joint wall rock	Slickensided surfaces or Gouge <5 mm thick or Joints open 1 to 5 mm Continuous joints	Soft gouge >5 mm thick or Joints open >5 mm Continuous joints		
	Relative Rating		25	20	12	6	0		
5	Ground water	Inflow per 10 m tunnel length	None		<25 liters/min	25 to 125 liters/min	>125 liters/min		
		Ratio= joint water pressure/major principal stress	0		0.0 to 0.2	0.2 to 0.5	>0.5		
		General Conditions	Completely Dry		Moist only (interstitial water)	Water under moderate pressure	Severe water problems		
	Relative Rating		10		7	4	0		

B. RATING ADJUSTMENT FOR JOINT ORIENTATIONS

Strike and dip orientations of joints		Very favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Ratings	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

C. ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS

RMR Rating	100 to 81	80 to 61	60 to 41	40 to 21	<20
Class No.	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

Table 19, Report 651, National Cooperative Highway Research Program

Table 19. Approximate relationship between rock mass quality and material constants used in defining nonlinear strength (Hoek and Brown, 1988; AASHTO, 2008, Table 10.4.6.4-4).

Rock quality	Constants	Rock type				
		A = Carbonate rocks with well developed crystal cleavage— *dolomite, limestone, and marble* B = Lithified argillaceous rocks—*mudstone, siltstone, shale, and slate (normal to cleavage)* C = Arenaceous rocks with strong crystals and poorly developed crystal cleavage—*sandstone and quartzite* D = Fine grained polymineralic igneous crystalline rocks— *andesite, dolerite, diabase, and rhyolite* E = Coarse-grained polymineralic igneous and metamorphic crystalline rocks—*amphibolite, gabbro, gneiss, granite, norite, quartz-diorite*				
		A	B	C	D	E
INTACT ROCK SAMPLES Laboratory size specimens free from discontinuities. CSIR rating: *RMR* = 100	m s	7.00 1.00	10.00 1.00	15.00 1.00	17.00 1.00	25.00 1.00
VERY GOOD QUALITY ROCK MASS Tightly interlocking undisturbed rock with unweathered joints at 3–10 ft. CSIR rating: *RMR* = 85	m s	2.40 0.082	3.43 0.082	5.14 0.082	5.82 0.082	8.567 0.082
GOOD QUALITY ROCK MASS Fresh to slightly weathered rock, slightly disturbed with joints at 3–10 ft. CSIR rating: *RMR* = 65	m s	0.575 0.00293	0.821 0.00293	1.231 0.00293	1.395 0.00293	2.052 0.00293
FAIR QUALITY ROCK MASS Several sets of moderately weathered joints spaced at 1–3 ft. CSIR rating: *RMR* = 44	m s	0.128 0.00009	0.183 0.00009	0.275 0.00009	0.311 0.00009	0.458 0.00009
POOR QUALITY ROCK MASS Numerous weathered joints at 2 to 12 in; some gouge. Clean compacted waste rock. CSIR rating: *RMR* = 23	m s	0.029 3×10^{-4}	0.041 3×10^{-4}	0.061 3×10^{-4}	0.069 3×10^{-4}	0.102 3×10^{-4}
VERY POOR QUALITY ROCK MASS Numerous heavily weathered joints spaced < 2 in with gouge. Waste rock with fines. CSIR rating: *RMR* = 3	m s	0.007 1×10^{-7}	0.010 1×10^{-7}	0.015 1×10^{-7}	0.017 1×10^{-7}	0.025 1×10^{-7}

REFERENCES (CONTINUED)

Table 10.5.5.2.2-1, AASHTO LRFD Bridge Design Specifications (2017), 8th Edition

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Table C10.6.2.6.1-1, AASHTO LRFD Bridge Design Specifications (2017), 8th Edition

Table C10.6.2.6.1-1—Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982)

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120–200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60–80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30–50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16–24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16–24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16–24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense Medium dense to dense Loose	12–20 8–14 4–12	14 10 6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense Medium dense to dense Loose	8–12 4–8 2–6	8 6 3
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense Medium dense to dense Loose	6–12 2–6 1–2	8 4 1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard Medium stiff to stiff Soft	4–8 2–6 1–2	6 3 1

REFERENCES (CONTINUED)

Table 5-7 (Modified after NAVFAC 1986b), Geotechnical Engineering Circular No 6, FHWA-SA-02-054

TABLE 5-7: PRESUMPTIVE VALUES OF ALLOWABLE BEARING PRESSURES FOR SPREAD FOUNDATIONS ON ROCK (MODIFIED AFTER NAVFAC, 1986b)

Type of Bearing Material	Consistency In Place	Allowable Bearing Pressure (MPa)	
		Range	Recommended Value for Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Hard, sound rock	5.8 to 9.6	7.7
Foliated metamorphic rock: Slate, schist (sound condition allows minor cracks)	Medium-hard, sound rock	2.9 to 3.8	3.4
Sedimentary rock; hard cemented shales, siltstone, sandstone, limestone without cavities	Medium-hard, sound rock	1.4 to 2.4	1.9
Weathered or broken bedrock of any kind except highly argillaceous rock (shale). RQD less than 25	Soft rock	0.8 to 1.2	1
Compaction shale or other highly argillaceous rock in sound condition	Soft rock	0.8 to 1.2	1

Chapter 18 Soils and Foundations - 2018 North Carolina Building Code

TABLE 1806.2PRESUMPTIVE LOAD-BEARING VALUES

CLASS OF MATERIALS	VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (psf/ft below natural grade)	LATERAL SLIDING RESISTANCE	
			Coefficient of friction[a]	Cohesion (psf)[b]
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and/or gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	—	130

For SI: 1 pound per square foot = 0.0479kPa, 1 pound per square foot per foot = 0.157 kPa/m.

a. Coefficient to be multiplied by the dead load.

b. Cohesion value to be multiplied by the contact area, as limited by Section 1806.3.2.

REFERENCES (CONTINUED)

Detaermination of Rock Mass Modulus and Intact Elastic Modulus

RMR>50

Bieniawski (1978) studied seven projects and suggested the following correlation for estimating rock mass deformation modulus E_m from RMR:

$$E_m = 2\text{RMR} - 100 \quad \text{(GPa)}$$

Mitri et al. (1994):

$$\frac{E_m}{E_r} = \frac{1 - \cos(\pi \times \text{RMR}/100)}{2}$$

Nicholson and Bieniawski (1990):

$$\frac{E_m}{E_r} = \frac{0.0028\text{RMR}^2 + 0.9e^{\text{RMR}/22.82}}{100}$$

RMR<50

by Serafim and Pereira (1983):

$$E_m = 10^{(\text{RMR}-10)/40} \quad \text{(GPa)}$$

Table 10.4.6.4-1, AASHTO LRFD Bridge Design Specifications (2017), 8th Edition

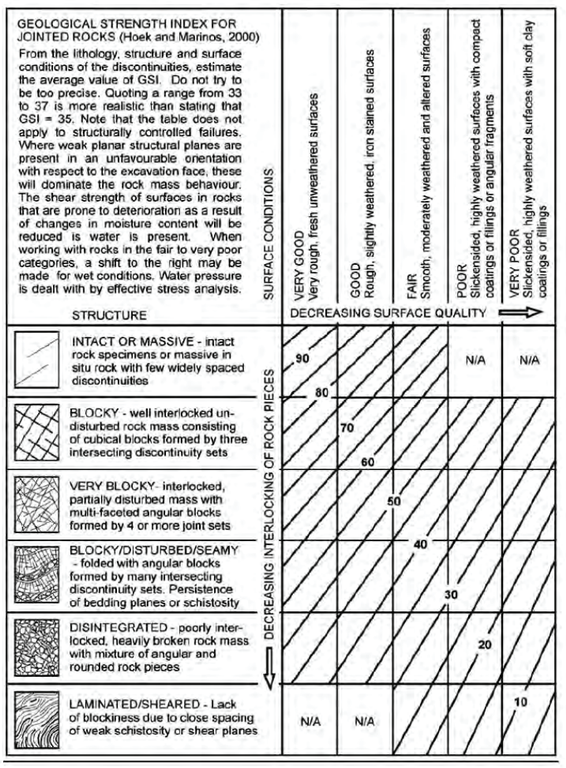


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

REFERENCES (CONTINUED)

Table 10.4.6.5-1, AASHTO LRFD Bridge Design Specifications (2017), 8th Edition

Table 10.4.6.5-1—Estimation of E_m Based on GSI

Expression	Notes/Remarks	Reference
$E_m\,(GPa) = \sqrt{\frac{q_u}{100}}\,10^{\frac{GSI-10}{40}}$ for $q_u \le 100$ MPa $E_m\,(GPa) = 10^{\frac{GSI-10}{40}}$ for $q_u > 100$ MPa	Accounts for rocks with $q_u < 100$ MPa; notes q_u in MPa	Hoek and Brown (1997); Hoek et al. (2002)
$E_m = \frac{E_R}{100}\,e^{GSI/21.7}$	Reduction factor on intact modulus, based on *GSI*	Yang (2006)
Notes: E_r = modulus of intact rock, E_m = equivalent rock mass modulus, *GSI* = geological strength index, q_u = uniaxial compressive strength, and 1 MPa = 20.9 ksf.		

Table C3.11.5.3-1, AASHTO LRFD Bridge Design Specifications (2017), 8th Edition

Table C3.11.5.3-1—Friction Angle for Dissimilar Materials (U.S. Department of the Navy, 1982a)

Interface Materials	Friction Angle, δ (degrees)	Coefficient of Friction, tan δ (dim.)
Mass concrete on the following foundation materials:		
• Clean sound rock	35	0.70
• Clean gravel, gravel-sand mixtures, coarse sand	29 to 31	0.55 to 0.60
• Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	24 to 29	0.45 to 0.55
• Clean fine sand, silty or clayey fine to medium sand	19 to 24	0.34 to 0.45
• Fine sandy silt, nonplastic silt	17 to 19	0.31 to 0.34
• Very stiff and hard residual or preconsolidated clay	22 to 26	0.40 to 0.49
• Medium stiff and stiff clay and silty clay	17 to 19	0.31 to 0.34
Masonry on foundation materials has same friction factors.		
Steel sheet piles against the following soils:		
• Clean gravel, gravel-sand mixtures, well-graded rock fill with spalls	22	0.40
• Clean sand, silty sand-gravel mixture, single-size hard rock fill	17	0.31
• Silty sand, gravel or sand mixed with silt or clay	14	0.25
• Fine sandy silt, nonplastic silt	11	0.19
Formed or precast concrete or concrete sheet piling against the following soils:		
• Clean gravel, gravel-sand mixture, well-graded rock fill with spalls	22 to 26	0.40 to 0.49
• Clean sand, silty sand-gravel mixture, single-size hard rock fill	17 to 22	0.31 to 0.40
• Silty sand, gravel or sand mixed with silt or clay	17	0.31
• Fine sandy silt, nonplastic silt	14	0.25
Various structural materials:		
• Masonry on masonry, igneous and metamorphic rocks:		
○ dressed soft rock on dressed soft rock	35	0.70
○ dressed hard rock on dressed soft rock	33	0.65
○ dressed hard rock on dressed hard rock	29	0.55
• Masonry on wood in direction of cross grain	26	0.49
• Steel on steel at sheet pile interlocks	17	0.31

PILE STRUCTURAL AXIAL COMPRESSION

Design Approach and Assumptions

1. Factored resistance of piles at End Bent No. 1 and Bent No. 1 is obtained by drilling and socketing the pile 5 to 10 ft into the the parent rock.
2. Per AASHTO (2017) Section 10.7.3.2.3, the nominal resistance of piles driven to point bearing on hard rock/refusal is controlled by the structural limit state. Geotechnical resistance is not controlling. Pile structural estimate shown here should be verified by the structural engineer of record.

Factored Structural Capacity

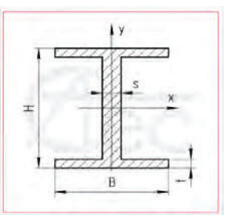
$P_R = \varphi_c P_n$

$P_n = F_y * A$

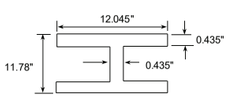
φ_c= 0.9 (AASHTO Section 6.5.4.2)

For axial resistance of steel members in compression and not subject to damage due to severe driving conditions - drilled-in (AASHTO Article 6.5.4.2). We assume 0.1" of surficial steel is lost during the lifetime of the structure.

F_y= 50 ksi



The subsurface conditions indicate that the piles will be subjected to a corrosive environment. Although the pile is known to be galvanized, we assume a reduction in the pile surface area.



HP 12x53

Actual Section:

Depth of Section, H=	11.78	in.
Flange Width, B =	12.045	in.
Flange Thickness, t =	0.435	in.
Web Thickness, s =	0.435	in.
I_x =	384	in^4
I_y =	127	in^4

BASIC FORMULAS

$I_x = [B*H^3 - (B - s)*(H - 2t)^3] / 12;$

$I_y = [2t*B^3 + (H - 2t)*s^3] / 12;$

$A = 2Bt + (H - 2t)*s;$

Reduced section area, $A_{reduced}$

Depth of Section=	11.6	in.
Flange Width =	11.8	in.
Flange Thickness =	0.235	in.
Web Thickness =	0.235	in.
Reduced I_x =	206	in^4
Reduced I_y =	65	in^4

A = 2(12.045)(0.435) + (11.78-2*0.435)(0.435)= 15.11 in^2

$A_{reduced}$ = 2(12.045-0.2)(0.435-0.2) + (11.78-2*(0.435-0.2))(0.435-0.2)= 8.16 in^2

Elastic Settlement of the Piles (Max Loads)

Bent 1 — Elastic compression of the piles, S_e

$S_e = P_u L/(A_s E_s)$

P_u=	45	kips	*(Factored Strength Maximum Loading)*
L=	40	ft	
A_s=	8.16	$in.^2$	
E_s=	29000	ksi	
S_e=	0.09	in.	

$P_n = F_y A$ = 755 kips

$P_R = (f_c F_y) A_{reduced}$ = 408 kips

LRFD Pile Axial Compression Resistance

P_R= **367 kips**

References:

Design Properties - Steel H Piling

Section Number	Weight Per Foot lb	Area of Selection A in.^{2}	Depth of Section d in.	Flange Width b_f in.	Flange Thickness t_f in.	Web Thickness t_w in.	Axis X-X I_x in.^{4}	Axis X-X S_x in.^{3}	Axis X-X r_x in.	Axis Y-Y I_y in.^{4}	Axis Y-Y S_y in.^{3}	Axis Y-Y r_y in.	Surface Area ft^2/ft
HP14X	117	34.4	14.21	14.885	0.805	0.805	1220	172	5.96	443	59.5	3.59	7.11
	102	30	14.01	14.735	0.705	0.705	1050	150	5.92	380	51.4	3.56	7.06
	89	26.1	13.83	14.695	0.615	0.615	904	131	5.88	326	44.3	3.53	7.02
	73	21.4	13.61	14.585	0.505	0.505	729	107	5.84	261	35.8	3.49	6.96
HP12X	84	24.6	12.28	12.295	0.685	0.685	650	106	5.14	213	34.6	2.94	5.97
	74	21.8	12.13	12.215	0.61	0.605	569	93.8	5.11	186	30.4	2.92	5.91
	63	18.4	11.94	12.125	0.515	0.515	472	79.1	5.06	153	25.3	2.88	5.86
	53	15.5	11.78	12.045	0.435	0.435	393	66.8	5.03	127	21.1	2.86	5.82
HP10X	57	16.8	9.99	10.225	0.565	0.565	294	58.8	4.18	101	19.7	2.45	4.91
	42	12.4	9.7	10.075	0.42	0.415	210	43.4	4.13	71.7	14.2	2.41	4.83
HP8X	36	10.6	8.02	8.155	0.445	0.445	119	29.8	3.36	40.3	9.88	1.95	3.92

PILE STRUCTURAL AXIAL COMPRESSION

Design Approach and Assumptions

1. Factored resistance of piles at End Bent No. 2 and Bent No. 2 is obtained by drilling and socketing the pile 5 to 10 ft into the the parent rock.
2. Per AASHTO (2017) Section 10.7.3.2.3, the nominal resistance of piles driven to point bearing on hard rock/refusal is controlled by the structural limit state. Geotechnical resistance is not controlling. Pile structural estimate shown here should be verified by the structural engineer of record.

Factored Structural Capacity

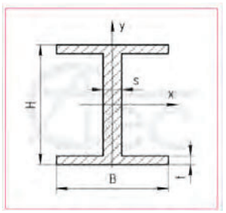
$P_R = \varphi_c P_n$

$P_n = F_y * A$

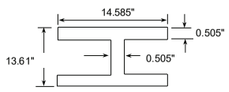
φ_c= 0.9 (AASHTO Section 6.5.4.2)

For axial resistance of steel members in compression and not subject to damage due to severe driving conditions where use of pile tip is necessary (AASHTO Article 6.5.4.2). We assume 0.1" of surficial steel is lost during the lifetime of the structure.

F_y= 50 ksi



The subsurface conditions indicate that the piles will be subjected to a corrosive environment. Although the pile is known to be galvanized, we assume a reduction in the pile surface area.



HP 14x73

Actual Section:

Depth of Section, H=	13.61	in.
Flange Width, B =	14.585	in.
Flange Thickness, t =	0.505	in.
Web Thickness, s =	0.505	in.
I_x =	717	in^4
I_y =	261	in^4

BASIC FORMULAS

$I_x = (BH^3 - (B - s)*(H - 2t)^3) / 12$

$I_y = (2t*B^3 + (H - 2t)*s^3) / 12$

$A = 2Bt + (H - 2t)*s$

Reduced section area, $A_{reduced}$

Depth of Section=	13.4	in.
Flange Width =	14.4	in.
Flange Thickness =	0.305	in.
Web Thickness =	0.305	in.
Reduced I_x =	430	in^4
Reduced I_y =	151	in^4

A = 2(13.61)(0.505) + (14.585-2*0.505)(0.505)= 20.60 in^2

$A_{reduced}$ = 2(13.61-0.2)(0.505-0.2) + (14.585-2*(0.505-0.2))(0.505-0.2)= 12.44 in^2

$P_n = F_y A$ = 1030 kips

$P_R = (f_c F_y) A_{reduced}$ = 622 kips

LRFD Pile Axial Compression Resistance

P_R= **560 kips**

Elastic Settlement of the Piles (Max Loads)

Bent 2 Elastic compression of the piles, S_e

$S_e = P_u L/(A_s E_s)$

P_u=	170 kips	*(Factored Strength Maximum Loading)*
L=	25 ft	
A_s=	12.44 in^2	
E_s=	29000 ksi	
S_e=	0.14 in.	

References:

Design Properties - Steel H Piling

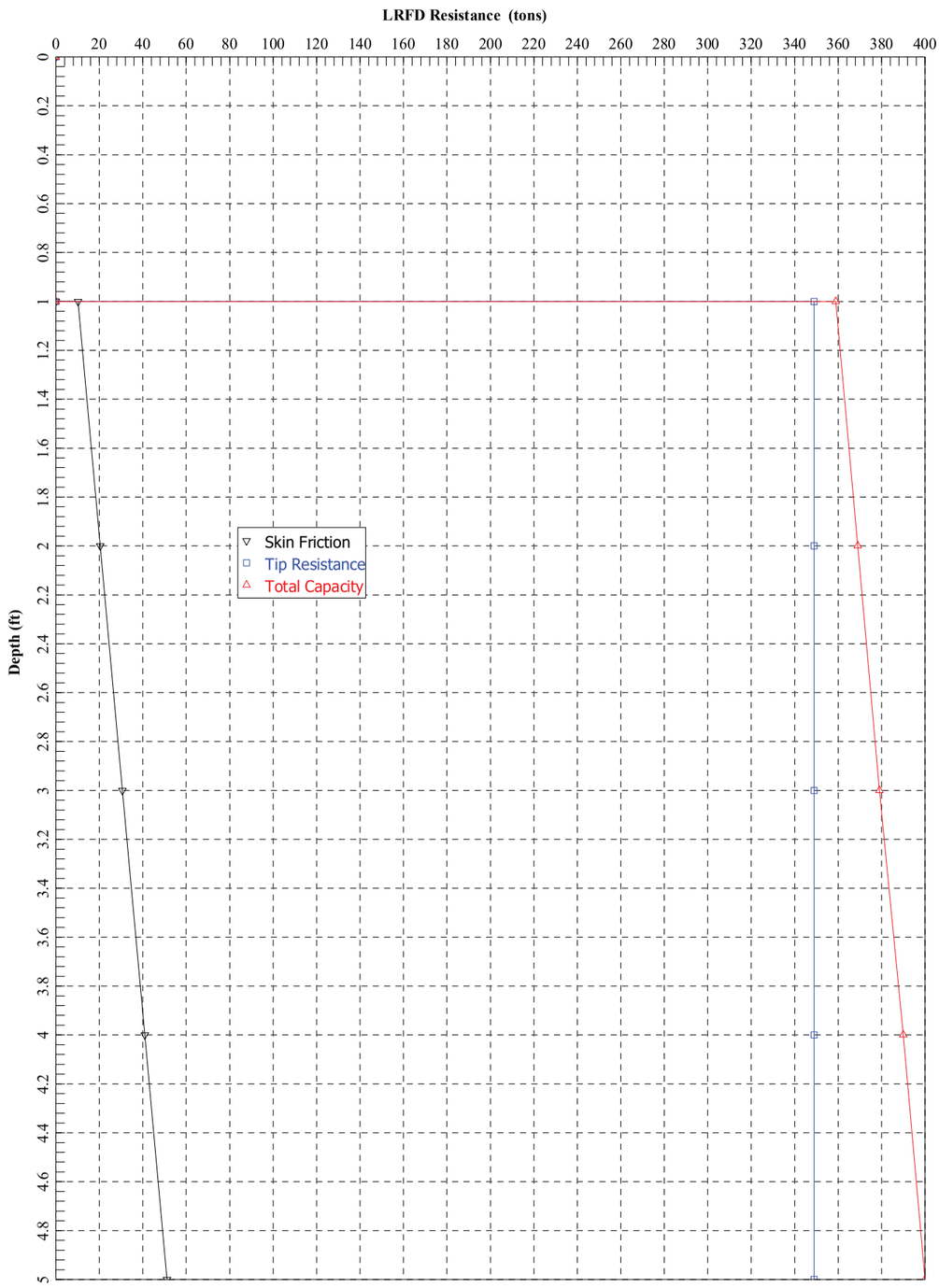
Section Number	Weight Per Foot lb	Area of Selection A $in.^2$	Depth of Section d in.	Flange Width b_f in.	Flange Thickness t_f in.	Web Thickness t_w in.	Axis X-X I_x $in.^4$	Axis X-X S_x $in.^3$	Axis X-X r_x in.	Axis Y-Y I_y $in.^4$	Axis Y-Y S_y $in.^3$	Axis Y-Y r_y in.	Surface Area ft²/ft
HP14X	117	34.4	14.21	14.885	0.805	0.805	1220	172	5.96	443	59.5	3.59	7.11
	102	30	14.01	14.735	0.705	0.705	1050	150	5.92	380	51.4	3.56	7.06
	89	26.1	13.83	14.695	0.615	0.615	904	131	5.88	326	44.3	3.53	7.02
	73	21.4	13.61	14.585	0.505	0.505	729	107	5.84	261	35.8	3.49	6.96
HP12X	84	24.6	12.28	12.295	0.685	0.685	650	106	5.14	213	34.6	2.94	5.97
	74	21.8	12.13	12.215	0.61	0.605	569	93.8	5.11	186	30.4	2.92	5.91
	63	18.4	11.94	12.125	0.515	0.515	472	79.1	5.06	153	25.3	2.88	5.86
	53	15.5	11.78	12.045	0.435	0.435	393	66.8	5.03	127	21.1	2.86	5.82
HP10X	57	16.8	9.99	10.225	0.565	0.565	294	58.8	4.18	101	19.7	2.45	4.91
	42	12.4	9.7	10.075	0.42	0.415	210	43.4	4.13	71.7	14.2	2.41	4.83
HP8X	36	10.6	8.02	8.155	0.445	0.445	119	29.8	3.36	40.3	9.88	1.95	3.92

Axial Resistance Analysis

```
======================================================================

                 SHAFT Version 2023.9.05

                     License ID : 378625567
                  License Type : (Single User)

               VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                   © 1987-2024 by Ensoft, Inc.
                      All Rights Reserved

               This software is licensed for exclusive use by:
                         ESP Associates, PA
                         Fort Mill, SC, USA

======================================================================


This model was prepared by:
hagopian


Path to file locations      : M:\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\2 - Axial\
Name of input data file     : EB1.sf9d
Name of output file         : EB1.sf9o
Name of plot output file    : EB1.sf9p
Name of runtime file        : EB1.sf9r


----------------------------------------------------------------------
                       Time and Date of Analysis
----------------------------------------------------------------------

          Date:  November 17, 2025     Time:  14:21:30

New Pile


PROPOSED DEPTH =       5.0 FT
----------------


NUMBER OF LAYERS =    1
------------------


WATER TABLE DEPTH =       0.0 FT.
--------------------



SOIL INFORMATION
---------------

LAYER NO  1----STRONG ROCK

   AT THE TOP

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 5.000E-01
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 7.500E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 0.000E+00
   DEPTH, FT                                        = 0.000E+00


   AT THE BOTTOM

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 5.000E-01
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 7.500E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 0.000E+00
   DEPTH, FT                                        = 5.000E+01
```

```
  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 5.000E-01
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 5.000E-01



INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER     =    1.500  FT.
 MAXIMUM SHAFT DIAMETER     =    1.500  FT.
 RATIO BASE/SHAFT DIAMETER  =    0.000  FT.
 ANGLE OF BELL              =    0.000  DEG.
 IGNORED TOP PORTION        =    0.000  FT.
 IGNORED BOTTOM PORTION     =    0.000  FT.
 ELASTIC MODULUS, Ec        = 3.605E+06 LB/SQ IN




COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM           =    1.500  FT.
 DIAMETER OF BASE           =    1.500  FT.
 END OF STEM TO BASE        =    0.000  FT.
 ANGLE OF BELL              =    0.000  DEG.
 IGNORED TOP PORTION        =    0.000  FT.
 IGNORED BOTTOM PORTION     =    0.000  FT.
 AREA OF ONE PERCENT STEEL  =    2.545  SQ.IN.
 ELASTIC MODULUS, Ec        = 3.605E+06 LB/SQ IN
 VOLUME OF UNDERREAM        =    0.000  CU.YDS.
 SHAFT LENGTH               =    5.000  FT.


PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
 (FT)   (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     0.07    20.43   697.48   717.91    10.22   348.74    358.95
 2.0     0.13    40.87   697.48   738.34    20.43   348.74    369.17
 3.0     0.20    61.30   697.48   758.77    30.65   348.74    379.39
 4.0     0.26    81.73   697.48   779.21    40.87   348.74    389.60
 5.0     0.33   102.17   697.48   799.64    51.08   348.74    399.82



AXIAL LOAD VS SETTLEMENT CURVES
-------------------------------

                LOAD SETTLEMENT RELATIONSHIP
          ------------------------------------------

               TOP  LOAD     TOP MOVEMENT
                  TONS            IN.
```

8.5892E+01	1.4476E-02
1.2884E+02	2.1713E-02
1.9326E+02	3.2570E-02
2.8989E+02	4.8855E-02
4.3483E+02	7.3282E-02
6.5224E+02	1.0992E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01
7.9964E+02	1.3476E-01

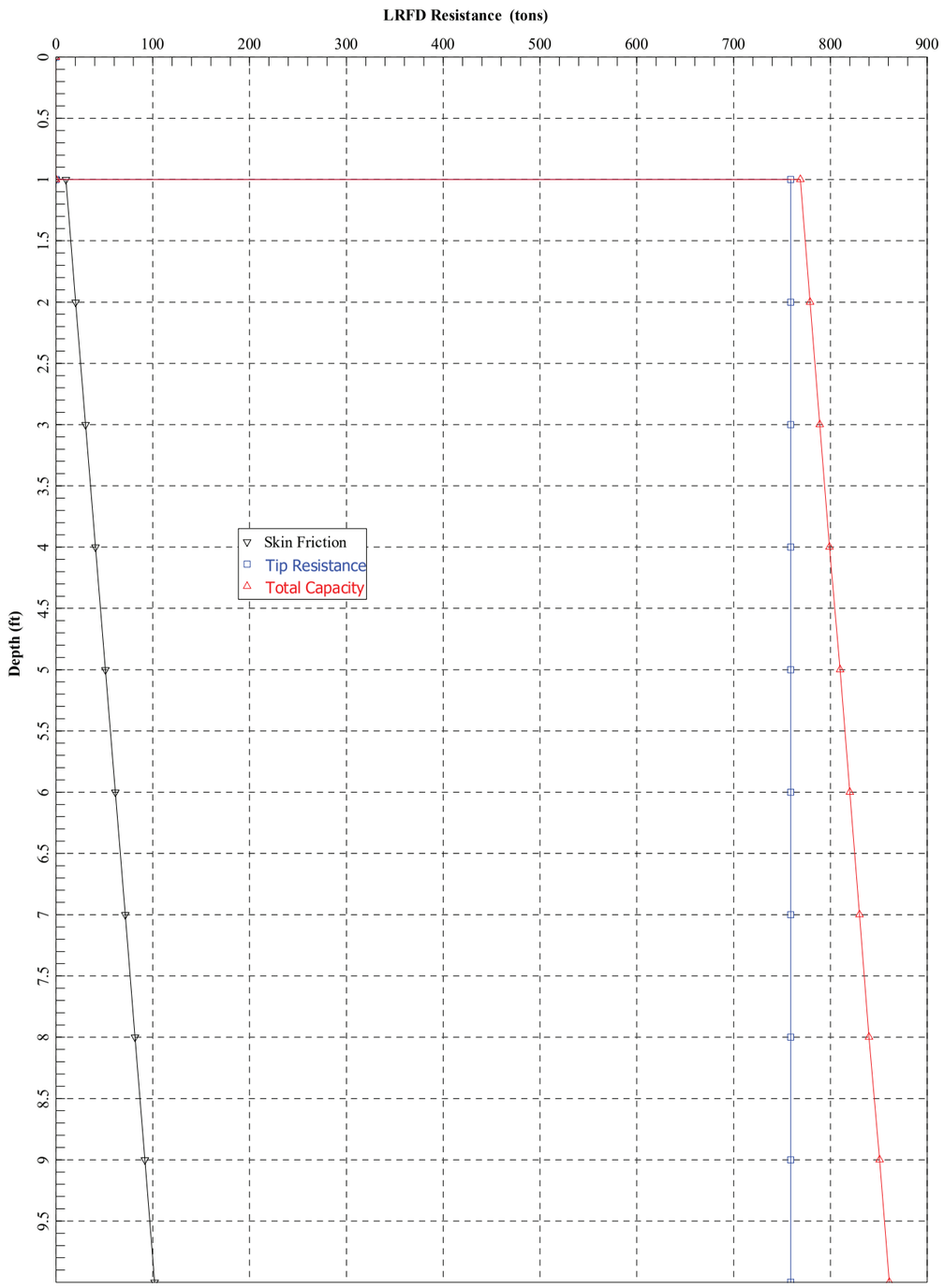

LRFD Resistance (tons)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Depth (ft)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8
5
Skin Friction
Tip Resistance
Total Capacity

```
======================================================================

                 SHAFT Version 2023.9.05

                     License ID : 378625567
                  License Type : (Single User)

               VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                   © 1987-2024 by Ensoft, Inc.
                      All Rights Reserved

               This software is licensed for exclusive use by:
                         ESP Associates, PA
                         Fort Mill, SC, USA

======================================================================


This model was prepared by:
hagopian


Path to file locations      : M:\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\2 - Axial\
Name of input data file     : B1.sf9d
Name of output file         : B1.sf9o
Name of plot output file    : B1.sf9p
Name of runtime file        : B1.sf9r


----------------------------------------------------------------------
                       Time and Date of Analysis
----------------------------------------------------------------------

          Date:  November 17, 2025     Time:  14:23:23

New Pile


PROPOSED DEPTH =      10.0 FT
----------------


NUMBER OF LAYERS =    1
------------------


WATER TABLE DEPTH =       0.0 FT.
--------------------



SOIL INFORMATION
---------------

LAYER NO  1----STRONG ROCK

   AT THE TOP

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 2.000E+00
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 6.100E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 1.500E+02
   DEPTH, FT                                        = 0.000E+00


   AT THE BOTTOM

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 2.000E+00
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 6.100E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 1.500E+02
   DEPTH, FT                                        = 5.000E+01
```

```
  LRFD RESISTANCE FACTOR (SIDE FRICTION)           = 5.000E-01
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)          = 5.000E-01



INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER    =    2.000  FT.
 MAXIMUM SHAFT DIAMETER    =    2.000  FT.
 RATIO BASE/SHAFT DIAMETER =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 ELASTIC MODULUS, Ec       = 3.605E+06 LB/SQ IN




COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM          =    2.000  FT.
 DIAMETER OF BASE          =    2.000  FT.
 END OF STEM TO BASE       =    0.000  FT.
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    0.000  FT.
 IGNORED BOTTOM PORTION    =    0.000  FT.
 AREA OF ONE PERCENT STEEL =    4.524  SQ.IN.
 ELASTIC MODULUS, Ec       = 3.605E+06 LB/SQ IN
 VOLUME OF UNDERREAM       =    0.000  CU.YDS.
 SHAFT LENGTH              =   10.000  FT.


PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
 (FT)   (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     0.12    20.43  1517.23  1537.66    10.22   758.61    768.83
 2.0     0.23    40.87  1517.23  1558.10    20.43   758.61    779.05
 3.0     0.35    61.30  1517.23  1578.53    30.65   758.61    789.26
 4.0     0.47    81.73  1517.23  1598.96    40.87   758.61    799.48
 5.0     0.58   102.17  1517.23  1619.40    51.08   758.61    809.70
 6.0     0.70   122.60  1517.23  1639.83    61.30   758.61    819.91
 7.0     0.81   143.03  1517.23  1660.26    71.52   758.61    830.13
 8.0     0.93   163.47  1517.23  1680.69    81.73   758.61    840.35
 9.0     1.05   183.90  1517.23  1701.13    91.95   758.61    850.56
10.0     1.16   204.33  1517.23  1721.56   102.17   758.61    860.78



AXIAL LOAD VS SETTLEMENT CURVES
-------------------------------
```

LOAD SETTLEMENT RELATIONSHIP

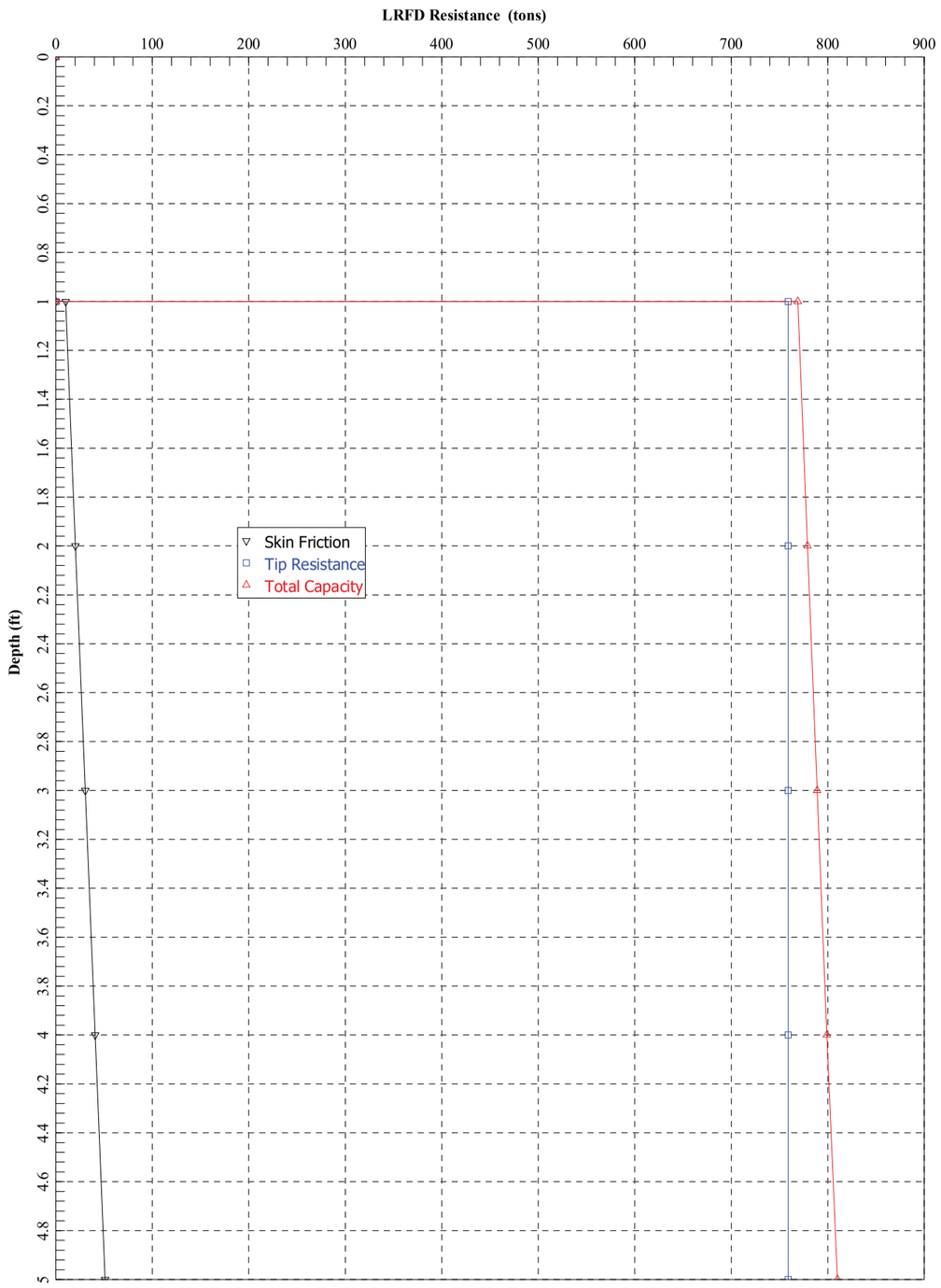
TOP LOAD TONS	TOP MOVEMENT IN.
4.8583E+01	1.5950E-02
7.2874E+01	2.3925E-02
1.0931E+02	3.5888E-02
1.6397E+02	5.3832E-02
2.4595E+02	8.0748E-02
3.6892E+02	1.2112E-01
5.5339E+02	1.8168E-01
8.3008E+02	2.7252E-01
1.2451E+03	4.0878E-01
1.7216E+03	5.6521E-01
1.7216E+03	5.6521E-01
1.7216E+03	5.6521E-01
1.7216E+03	5.6521E-01
1.7216E+03	5.6521E-01
1.7216E+03	5.6521E-01


LRFD Resistance (tons)
0
100
200
300
400
500
600
700
800
900
Depth (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
Skin Friction
Tip Resistance
Total Capacity

```
======================================================================

                 SHAFT Version 2023.9.05

                     License ID : 378625567
                  License Type : (Single User)

               VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                   © 1987-2024 by Ensoft, Inc.
                      All Rights Reserved

               This software is licensed for exclusive use by:
                         ESP Associates, PA
                         Fort Mill, SC, USA

======================================================================


This model was prepared by:
hagopian


Path to file locations      : M:\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\2 - Axial\
Name of input data file     : EB2.sf9d
Name of output file         : EB2.sf9o
Name of plot output file    : EB2.sf9p
Name of runtime file        : EB2.sf9r


----------------------------------------------------------------------
                       Time and Date of Analysis
----------------------------------------------------------------------

          Date:  November 17, 2025     Time:  14:24:37

New Pile


PROPOSED DEPTH =       5.0 FT
----------------


NUMBER OF LAYERS =    1
------------------


WATER TABLE DEPTH =       0.0 FT.
--------------------



SOIL INFORMATION
---------------

LAYER NO  1----STRONG ROCK

   AT THE TOP

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 2.000E+00
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 6.100E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 1.500E+02
   DEPTH, FT                                        = 0.000E+00


   AT THE BOTTOM

   DIAMETER OF SOCKET, FT                           = 1.500E+00
   SPACING OF DISCONTINUITIES,FT                    = 2.000E+00
   THICKNESS OF INDIVIDUAL DISCONTINUITIES,FT       = 1.000E-02
   UNIAXIAL COMPRESSION STRENGTH OF ROCK,LB/SQ FT   = 2.088E+06
   UNIAXIAL COMPRESSION STRENGTH OF CONCRETE,LB/SQ FT= 8.354E+04
   ELASTIC MODULUS FOR THE INTACT ROCK, LB/SQ IN.   = 3.605E+06
   ROCK QUALITY DESIGNATION (RQD) %                 = 6.100E+01
   SOIL UNIT WEIGHT, LB/CU FT                       = 1.500E+02
   DEPTH, FT                                        = 5.000E+01
```

```
  LRFD RESISTANCE FACTOR (SIDE FRICTION)            = 5.000E-01
  LRFD RESISTANCE FACTOR (TIP RESISTANCE)           = 5.000E-01



INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER     =    1.500  FT.
 MAXIMUM SHAFT DIAMETER     =    1.500  FT.
 RATIO BASE/SHAFT DIAMETER  =    0.000  FT.
 ANGLE OF BELL              =    0.000  DEG.
 IGNORED TOP PORTION        =    0.000  FT.
 IGNORED BOTTOM PORTION     =    0.000  FT.
 ELASTIC MODULUS, Ec        = 3.605E+06 LB/SQ IN




COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM           =    1.500  FT.
 DIAMETER OF BASE           =    1.500  FT.
 END OF STEM TO BASE        =    0.000  FT.
 ANGLE OF BELL              =    0.000  DEG.
 IGNORED TOP PORTION        =    0.000  FT.
 IGNORED BOTTOM PORTION     =    0.000  FT.
 AREA OF ONE PERCENT STEEL  =    2.545  SQ.IN.
 ELASTIC MODULUS, Ec        = 3.605E+06 LB/SQ IN
 VOLUME OF UNDERREAM        =    0.000  CU.YDS.
 SHAFT LENGTH               =    5.000  FT.


PREDICTED RESULTS
-----------------

QS      = ULTIMATE SIDE RESISTANCE;
QB      = ULTIMATE BASE RESISTANCE;
WT      = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU      = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR
          TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH  VOLUME     QS      QB      QU     LRFD QS  LRFD QB   LRFD QU
 (FT)   (CU.YDS) (TONS)   (TONS)  (TONS)   (TONS)   (TONS)    (TONS)
 1.0     0.07    20.43  1517.23  1537.66    10.22   758.61    768.83
 2.0     0.13    40.87  1517.23  1558.10    20.43   758.61    779.05
 3.0     0.20    61.30  1517.23  1578.53    30.65   758.61    789.26
 4.0     0.26    81.73  1517.23  1598.96    40.87   758.61    799.48
 5.0     0.33   102.17  1517.23  1619.40    51.08   758.61    809.70



AXIAL LOAD VS SETTLEMENT CURVES
-------------------------------

                LOAD SETTLEMENT RELATIONSHIP
          ------------------------------------------

               TOP  LOAD     TOP MOVEMENT
                  TONS            IN.
```

4.4356E+01	9.0422E-03
6.6534E+01	1.3563E-02
9.9802E+01	2.0345E-02
1.4970E+02	3.0518E-02
2.2455E+02	4.5776E-02
3.3683E+02	6.8664E-02
5.0525E+02	1.0300E-01
7.5787E+02	1.5450E-01
1.1368E+03	2.3174E-01
1.6194E+03	3.3012E-01
1.6194E+03	3.3012E-01
1.6194E+03	3.3012E-01
1.6194E+03	3.3012E-01
1.6194E+03	3.3012E-01


LRFD Resistance (tons)
0
100
200
300
400
500
600
700
800
900
Depth (ft)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8
5
Skin Friction
Tip Resistance
Total Capacity

Lateral Resistance Analysis

==

                          LPile for Version 2022-12.012

                           License ID : 162969677
                      License Type : (Single User License)

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
                          © 1985-2024 by Ensoft, Inc.
                              All Rights Reserved

                This software is licensed for exclusive use by:
                               ESP Associates, PA
                               Fort Mill, SC, USA

==

This model was prepared by:
hagopian

Files Used for Analysis

Path to file locations:
\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\1 - Lateral\

Name of input data file:
END BENT 1 Longitudinal Strong Axis.lp12d

Name of output report file:
END BENT 1 Longitudinal Strong Axis.lp12o

Name of plot output file:
END BENT 1 Longitudinal Strong Axis.lp12p

Name of runtime message file:
END BENT 1 Longitudinal Strong Axis.lp12r

Date and Time of Analysis

Date: November 17, 2025   Time: 9:45:25

Problem Title

Project Name: 5631 US HWY 19E

Job Number: 25-01592-B

Client: Volkert, Inc.

Engineer: ESP Associates/PB/HAA

Description: END BENT 1, Longitudinal, Strong Axis

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:

```
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed                =          500
 - Deflection tolerance for convergence                =   1.0000E-05 in
 - Maximum allowable deflection                        =     100.0000 in
 - Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats



---------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Number of pile sections defined                       =            1
Total length of pile                                  =       19.700 ft
Depth of ground surface below top of pile             =       0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           12.0000
  2            19.700           12.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a AISC strong axis steel pile
   Length of section                                  =    19.700000 ft
   AISC Section Type                                  = HP


   AISC Section Name                                  = HP12X53


   Pile width                                         =    12.000000 in



---------------------------------------------------------------------------
                       Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 2 layers

Layer 1 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =       0.0000 ft
   Distance from top of pile to bottom of layer       =    12.700000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
```

```
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 2 is massive rock, p-y criteria by Liang et al., 2009

   Distance from top of pile to top of layer          =    12.700000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =    57.400000 pcf
   Effective unit weight at bottom of layer           =    57.400000 pcf
   Uniaxial compressive strength at top of layer      =       14500. psi
   Uniaxial compressive strength at bottom of layer   =       14500. psi
   Poisson's ratio at top of layer                    =     0.200000
   Poisson's ratio at bottom of layer                 =     0.200000
   Option 1: Intact rock modulus at top of layer      =       0.0000 psi
             Intact rock modulus at bottom of layer   =       0.0000 psi
   Option 1: Geologic Strength Index for layer        =    63.000000
   Option 2: Rock mass modulus at top of layer        =     4060000. psi
             Rock mass modulus at bottom of layer     =     4060000. psi
   Option 2 will use the input value of rock mass modulus to compute the p-y curve
            in massive rock.
   The rock type is (metamorphic) gneiss, Hoek-Brown Material Constant mi = 28


 (Depth of the lowest soil layer extends 30.300 ft below the pile tip)


**** Warning - Possible Input Data Error ****

Values entered for effective unit weights of soil were outside the limits of
20 pcf to 140 pcf.

The minimum input value, in layer   1, for effective unit weight = .10 pcf

This data may be erroneous. Please check your data.


--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial     Rock Mass    Geologic      Elastic     Int. Rock
Hoek-Brown
 Num.           Name             Depth       Unit Wt.       qu         Modulus     Strength     Subgrade      Modulus
Material     Poisson's
          (p-y Curve Type)         ft           pcf          psi          psi         Index      Mod. pci        psi
Index, mi      Ratio
-----   --------------------   ----------   ----------   ----------   ----------   ----------   ----------   ----------
----------   ----------
  1           Elastic               0.00      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade            12.7000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  2           Massive             12.7000      57.4000       14500.     4060000.      63.0000       --          0.00
28.0000       0.2000
               Rock               50.0000      57.4000       14500.                   63.0000       --          0.00
28.0000       0.2000


--------------------------------------------------------------------------------
                               Static Loading Type
--------------------------------------------------------------------------------

Static loading criteria were used when computing p-y curves for all analyses.



--------------------------------------------------------------------------------
               Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified = 1

Load    Load         Condition              Condition            Axial Thrust      Compute Top y     Run Analysis
 No.    Type             1                      2                 Force, lbs      vs. Pile Length
-----   ----   --------------------   ----------------------   ----------------   ---------------    ------------
   1     2     V =       13000. lbs   S =       0.0000 in/in           120000.          No               Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
```

Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	19.700000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.500000 sq. in.
Moment of Inertia	=	393.000000 in^4
Elastic Bending Stiffness	=	11397000. kip-in^2
Plastic Modulus, Z	=	74.000000in^3
Plastic Moment Capacity = Fy Z	=	3700.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	775.000 kips
Nominal Axial Tensile Capacity	=	-775.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	120.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 120.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000554	61.7167449	11142283.	55.0661913	8.8358087	
0.00001108	123.4334898	11142283.	30.4830957	9.7740489	
0.00001662	185.1502347	11142283.	22.2887304	10.7122892	
0.00002216	246.8669796	11142283.	18.1915478	11.6505294	
0.00002769	308.5837244	11142283.	15.7332383	12.5887696	
0.00003323	370.3004693	11142283.	14.0943652	13.5270099	
0.00003877	432.0172142	11142283.	12.9237416	14.4652501	
0.00004431	493.7339591	11142283.	12.0457739	15.4034903	
0.00004985	555.4507040	11142283.	11.3629101	16.3417306	
0.00005539	617.1674489	11142283.	10.8166191	17.2799708	
0.00006093	678.8841938	11142283.	10.3696538	18.2182110	
0.00006647	740.6009387	11142283.	9.9971826	19.1564513	
0.00007201	802.3176836	11142283.	9.6820147	20.0946915	
0.00007755	864.0344285	11142283.	9.4118708	21.0329317	
0.00008308	925.7511733	11142283.	9.1777461	21.9711719	
0.00008862	987.4679182	11142283.	8.9728870	22.9094122	
0.00009416	1049.	11142283.	8.7921289	23.8476524	
0.00009970	1111.	11142283.	8.6314551	24.7858927	
0.0001052	1173.	11142283.	8.4876943	25.7241329	
0.0001108	1234.	11142283.	8.3583096	26.6623731	
0.0001163	1296.	11142283.	8.2412472	27.6006133	
0.0001219	1358.	11142283.	8.1348269	28.5388536	
0.0001274	1419.	11142283.	8.0376605	29.4770937	

0.0001329	1481.	11142283.	7.9485913	30.4153340	
0.0001385	1543.	11142283.	7.8666477	31.3535742	
0.0001440	1605.	11142283.	7.7910074	32.2918145	
0.0001496	1666.	11142283.	7.7209700	33.2300547	
0.0001551	1728.	11142283.	7.6559354	34.1682950	
0.0001606	1790.	11142283.	7.5953859	35.1065351	
0.0001662	1852.	11142283.	7.5388730	36.0447754	
0.0001717	1913.	11142283.	7.4860062	36.9830156	
0.0001772	1975.	11142283.	7.4364435	37.9212558	
0.0001828	2037.	11142283.	7.3898846	38.8594961	
0.0001883	2098.	11142283.	7.3460645	39.7977363	
0.0001939	2160.	11142283.	7.3047483	40.7359765	
0.0001994	2222.	11142283.	7.2657275	41.6742168	
0.0002049	2284.	11142283.	7.2288160	42.6124569	
0.0002105	2345.	11142283.	7.1938471	43.5506972	
0.0002160	2407.	11142283.	7.1606716	44.4889374	
0.0002271	2530.	11142283.	7.0991754	46.3654179	
0.0002382	2654.	11142283.	7.0433998	48.2418984	
0.0002493	2776.	11137951.	6.9942651	50.0000000	Y
0.0002603	2863.	10998031.	7.0028375	50.0000000	Y
0.0002714	2905.	10703226.	7.0779426	50.0000000	Y
0.0002825	2942.	10413209.	7.1548238	50.0000000	Y
0.0002936	2975.	10135520.	7.2301177	50.0000000	Y
0.0003046	3007.	9869320.	7.3145608	50.0000000	Y
0.0003157	3036.	9614736.	7.3559177	50.0000000	Y
0.0003268	3062.	9371140.	7.4265160	50.0000000	Y
0.0003379	3088.	9137970.	7.4985429	50.0000000	Y
0.0003490	3111.	8914720.	7.5681174	50.0000000	Y
0.0003600	3133.	8700928.	7.6323378	50.0000000	Y
0.0003711	3153.	8496171.	7.6976282	50.0000000	Y
0.0003822	3172.	8300060.	7.7705856	50.0000000	Y
0.0003933	3190.	8111898.	7.8219134	50.0000000	Y
0.0004043	3207.	7931481.	7.8883463	50.0000000	Y
0.0004154	3223.	7758267.	7.9448115	50.0000000	Y
0.0004265	3238.	7592064.	7.9996332	50.0000000	Y
0.0004376	3252.	7432163.	8.0530866	50.0000000	Y
0.0004487	3266.	7278534.	8.1050131	50.0000000	Y
0.0004597	3278.	7130806.	8.1554903	50.0000000	Y
0.0004708	3290.	6988641.	8.2045877	50.0000000	Y
0.0004819	3302.	6851619.	8.2524532	50.0000000	Y
0.0004930	3313.	6719612.	8.2990290	50.0000000	Y
0.0005040	3323.	6592362.	8.3443638	50.0000000	Y
0.0005151	3332.	6469267.	8.3873214	50.0000000	Y
0.0005262	3341.	6349069.	8.4243030	50.0000000	Y
0.0005373	3349.	6233156.	8.4604663	50.0000000	Y
0.0005484	3357.	6121194.	8.4959585	50.0000000	Y
0.0005594	3364.	6012341.	8.5277194	50.0000000	Y
0.0005705	3370.	5906122.	8.5541899	50.0000000	Y
0.0005816	3375.	5803620.	8.5801768	50.0000000	Y
0.0005927	3381.	5704496.	8.6059321	50.0000000	Y
0.0006037	3385.	5607107.	8.6238111	50.0000000	Y
0.0006148	3389.	5512245.	8.6373979	50.0000000	Y
0.0006259	3393.	5420448.	8.6513446	50.0000000	Y
0.0006370	3395.	5330584.	8.6585012	50.0000000	Y
0.0006481	3397.	5242181.	8.6585911	50.0000000	Y
0.0006591	3399.	5156721.	8.6692205	50.0000000	Y
0.0007034	3405.	4840478.	8.6584306	50.0000000	Y
0.0007478	3410.	4560304.	8.6585911	50.0000000	Y
0.0007921	3414.	4310474.	8.6577302	50.0000000	Y
0.0008364	3418.	4086341.	8.6586456	50.0000000	Y
0.0008807	3421.	3884174.	8.6585417	50.0000000	Y
0.0009250	3423.	3700941.	8.6583462	50.0000000	Y
0.0009693	3426.	3534090.	8.6588403	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	120.0000000000	3426.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction

factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	0.00
2	12.7000	12.7000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 13000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 120000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.4646	-1109871.	13000.	0.00	24687.	1.11E+10	-0.557	1.4184	0.00
0.1970	0.4643	-1079107.	12999.	-2.32E-04	24217.	1.11E+10	-0.557	2.8368	0.00
0.3940	0.4635	-1048282.	12997.	-4.58E-04	23746.	1.11E+10	-0.556	2.8368	0.00
0.5910	0.4621	-1017396.	12996.	-6.77E-04	23275.	1.11E+10	-0.555	2.8368	0.00
0.7880	0.4603	-986452.	12995.	-8.90E-04	22802.	1.11E+10	-0.552	2.8368	0.00
0.9850	0.4579	-955452.	12993.	-0.00110	22329.	1.11E+10	-0.549	2.8368	0.00
1.1820	0.4551	-924398.	12992.	-0.00130	21855.	1.11E+10	-0.546	2.8368	0.00
1.3790	0.4518	-893290.	12991.	-0.00149	21380.	1.11E+10	-0.542	2.8368	0.00
1.5760	0.4480	-862133.	12990.	-0.00167	20904.	1.11E+10	-0.538	2.8368	0.00
1.7730	0.4439	-830926.	12988.	-0.00185	20428.	1.11E+10	-0.533	2.8368	0.00
1.9700	0.4393	-799672.	12987.	-0.00203	19951.	1.11E+10	-0.527	2.8368	0.00
2.1670	0.4343	-768373.	12986.	-0.00219	19473.	1.11E+10	-0.521	2.8368	0.00
2.3640	0.4289	-737031.	12985.	-0.00235	18994.	1.11E+10	-0.515	2.8368	0.00
2.5610	0.4232	-705647.	12983.	-0.00251	18515.	1.11E+10	-0.508	2.8368	0.00
2.7580	0.4171	-674224.	12982.	-0.00265	18035.	1.11E+10	-0.500	2.8368	0.00
2.9550	0.4106	-642763.	12981.	-0.00279	17555.	1.11E+10	-0.493	2.8368	0.00
3.1520	0.4039	-611265.	12980.	-0.00292	17074.	1.11E+10	-0.485	2.8368	0.00
3.3490	0.3968	-579734.	12979.	-0.00305	16593.	1.11E+10	-0.476	2.8368	0.00
3.5460	0.3894	-548171.	12978.	-0.00317	16111.	1.11E+10	-0.467	2.8368	0.00
3.7430	0.3818	-516577.	12977.	-0.00328	15629.	1.11E+10	-0.458	2.8368	0.00
3.9400	0.3739	-484955.	12975.	-0.00339	15146.	1.11E+10	-0.449	2.8368	0.00
4.1370	0.3658	-453306.	12974.	-0.00349	14663.	1.11E+10	-0.439	2.8368	0.00
4.3340	0.3574	-421632.	12973.	-0.00358	14179.	1.11E+10	-0.429	2.8368	0.00
4.5310	0.3488	-389935.	12972.	-0.00367	13695.	1.11E+10	-0.419	2.8368	0.00
4.7280	0.3401	-358217.	12971.	-0.00375	13211.	1.11E+10	-0.408	2.8368	0.00
4.9250	0.3311	-326480.	12970.	-0.00382	12726.	1.11E+10	-0.397	2.8368	0.00
5.1220	0.3220	-294725.	12970.	-0.00389	12242.	1.11E+10	-0.386	2.8368	0.00
5.3190	0.3127	-262955.	12969.	-0.00395	11757.	1.11E+10	-0.375	2.8368	0.00
5.5160	0.3033	-231171.	12968.	-0.00400	11271.	1.11E+10	-0.364	2.8368	0.00
5.7130	0.2938	-199375.	12967.	-0.00404	10786.	1.11E+10	-0.353	2.8368	0.00
5.9100	0.2842	-167569.	12966.	-0.00408	10300.	1.11E+10	-0.341	2.8368	0.00
6.1070	0.2745	-135755.	12965.	-0.00411	9815.	1.11E+10	-0.329	2.8368	0.00
6.3040	0.2648	-103935.	12965.	-0.00414	9329.	1.11E+10	-0.318	2.8368	0.00
6.5010	0.2550	-72110.	12964.	-0.00416	8843.	1.11E+10	-0.306	2.8368	0.00
6.6980	0.2451	-40283.	12963.	-0.00417	8357.	1.11E+10	-0.294	2.8368	0.00
6.8950	0.2352	-8454.	12962.	-0.00418	7871.	1.11E+10	-0.282	2.8368	0.00
7.0920	0.2254	23373.	12962.	-0.00417	8099.	1.11E+10	-0.270	2.8368	0.00

7.2890	0.2155	55197.	12961.	-0.00417	8585.	1.11E+10	-0.259	2.8368	0.00
7.4860	0.2057	87017.	12961.	-0.00415	9070.	1.11E+10	-0.247	2.8368	0.00
7.6830	0.1959	118830.	12960.	-0.00413	9556.	1.11E+10	-0.235	2.8368	0.00
7.8800	0.1862	150634.	12959.	-0.00410	10042.	1.11E+10	-0.223	2.8368	0.00
8.0770	0.1765	182428.	12959.	-0.00407	10527.	1.11E+10	-0.212	2.8368	0.00
8.2740	0.1669	214210.	12958.	-0.00402	11012.	1.11E+10	-0.200	2.8368	0.00
8.4710	0.1575	245978.	12958.	-0.00397	11497.	1.11E+10	-0.189	2.8368	0.00
8.6680	0.1481	277730.	12958.	-0.00392	11982.	1.11E+10	-0.178	2.8368	0.00
8.8650	0.1389	309465.	12957.	-0.00386	12467.	1.11E+10	-0.167	2.8368	0.00
9.0620	0.1299	341179.	12957.	-0.00379	12951.	1.11E+10	-0.156	2.8368	0.00
9.2590	0.1210	372873.	12956.	-0.00371	13435.	1.11E+10	-0.145	2.8368	0.00
9.4560	0.1124	404543.	12956.	-0.00363	13918.	1.11E+10	-0.135	2.8368	0.00
9.6530	0.1039	436188.	12956.	-0.00354	14401.	1.11E+10	-0.125	2.8368	0.00
9.8500	0.09562	467806.	12955.	-0.00344	14884.	1.11E+10	-0.115	2.8368	0.00
10.0470	0.08760	499395.	12955.	-0.00334	15366.	1.11E+10	-0.105	2.8368	0.00
10.2440	0.07982	530954.	12955.	-0.00323	15848.	1.11E+10	-0.09579	2.8368	0.00
10.4410	0.07232	562480.	12955.	-0.00312	16329.	1.11E+10	-0.08678	2.8368	0.00
10.6380	0.06509	593972.	12955.	-0.00299	16810.	1.11E+10	-0.07811	2.8368	0.00
10.8350	0.05816	625428.	12954.	-0.00286	17290.	1.11E+10	-0.06979	2.8368	0.00
11.0320	0.05155	656845.	12954.	-0.00273	17770.	1.11E+10	-0.06186	2.8368	0.00
11.2290	0.04526	688223.	12954.	-0.00259	18249.	1.11E+10	-0.05432	2.8368	0.00
11.4260	0.03932	719559.	12954.	-0.00244	18728.	1.11E+10	-0.04719	2.8368	0.00
11.6230	0.03375	750852.	12954.	-0.00228	19205.	1.11E+10	-0.04049	2.8368	0.00
11.8200	0.02854	782099.	12954.	-0.00212	19682.	1.11E+10	-0.03425	2.8368	0.00
12.0170	0.02373	813298.	12954.	-0.00195	20159.	1.11E+10	-0.02848	2.8368	0.00
12.2140	0.01933	844449.	12954.	-0.00177	20634.	1.11E+10	-0.02320	2.8368	0.00
12.4110	0.01535	875549.	12954.	-0.00159	21109.	1.11E+10	-0.01842	2.8368	0.00
12.6080	0.01181	906596.	12954.	-0.00140	21583.	1.11E+10	-0.01418	2.8368	0.00
12.8050	0.00873	937588.	2998.	-0.00121	22056.	1.11E+10	-8422.	2280605.	0.00
13.0020	0.00612	921455.	-14804.	-0.00101	21810.	1.11E+10	-6639.	2565912.	0.00
13.1990	0.00396	868167.	-28320.	-8.18E-04	20996.	1.11E+10	-4796.	2860009.	0.00
13.3960	0.00225	788024.	-37526.	-6.43E-04	19773.	1.11E+10	-2993.	3147312.	0.00
13.5930	9.27E-04	691109.	-42643.	-4.86E-04	18293.	1.11E+10	-1337.	3410614.	0.00
13.7900	-4.80E-05	586681.	-44137.	-3.50E-04	16699.	1.11E+10	73.3853	3610841.	0.00
13.9870	-7.28E-04	482628.	-42792.	-2.37E-04	15110.	1.11E+10	1064.	3453902.	0.00
14.1840	-0.00117	384494.	-39574.	-1.45E-04	13612.	1.11E+10	1658.	3360066.	0.00
14.3810	-0.00141	295604.	-35277.	-7.25E-05	12255.	1.11E+10	1977.	3309913.	0.00
14.5780	-0.00151	217746.	-30456.	-1.80E-05	11066.	1.11E+10	2101.	3290677.	0.00
14.7750	-0.00150	151617.	-25507.	2.12E-05	10057.	1.11E+10	2086.	3293382.	0.00
14.9720	-0.00141	97136.	-20708.	4.76E-05	9225.	1.11E+10	1974.	3311365.	0.00
15.1690	-0.00127	53681.	-16250.	6.36E-05	8561.	1.11E+10	1798.	3339471.	0.00
15.3660	-0.00111	20269.	-12255.	7.14E-05	8051.	1.11E+10	1582.	3373622.	0.00
15.5630	-9.35E-04	-4302.	-8790.	7.31E-05	7808.	1.11E+10	1349.	3410579.	0.00
15.7600	-7.63E-04	-21334.	-5880.	7.04E-05	8068.	1.11E+10	1113.	3447809.	0.00
15.9570	-6.02E-04	-32144.	-3516.	6.47E-05	8233.	1.11E+10	887.3471	3483406.	0.00
16.1540	-4.57E-04	-37994.	-1663.	5.73E-05	8322.	1.11E+10	680.1541	3516021.	0.00
16.3510	-3.31E-04	-40040.	-271.698	4.90E-05	8353.	1.11E+10	497.0310	3544804.	0.00
16.5480	-2.26E-04	-39306.	718.6120	4.06E-05	8342.	1.11E+10	340.7947	3569324.	0.00
16.7450	-1.40E-04	-36666.	1372.	3.25E-05	8302.	1.11E+10	212.0781	3589496.	0.00
16.9420	-7.20E-05	-32837.	1753.	2.51E-05	8243.	1.11E+10	109.8461	3605493.	0.00
17.1390	-2.08E-05	-28393.	1920.	1.86E-05	8175.	1.11E+10	31.8955	3617671.	0.00
17.3360	1.61E-05	-23769.	1929.	1.31E-05	8105.	1.11E+10	-24.641	3618791.	0.00
17.5330	4.11E-05	-19282.	1825.	8.54E-06	8036.	1.11E+10	-62.833	3612848.	0.00
17.7300	5.65E-05	-15144.	1649.	4.89E-06	7973.	1.11E+10	-86.200	3609222.	0.00
17.9270	6.42E-05	-11487.	1431.	2.06E-06	7917.	1.11E+10	-97.984	3607404.	0.00
18.1240	6.62E-05	-8377.	1196.	-4.72E-08	7870.	1.11E+10	-101.007	3606949.	0.00
18.3210	6.40E-05	-5831.	961.4601	-1.55E-06	7831.	1.11E+10	-97.646	3607486.	0.00
18.5180	5.89E-05	-3831.	739.8540	-2.58E-06	7800.	1.11E+10	-89.838	3608712.	0.00
18.7150	5.18E-05	-2332.	540.1699	-3.23E-06	7778.	1.11E+10	-79.100	3610388.	0.00
18.9120	4.36E-05	-1275.	367.9883	-3.62E-06	7761.	1.11E+10	-66.570	3612339.	0.00
19.1090	3.47E-05	-589.803	226.5960	-3.81E-06	7751.	1.11E+10	-53.051	3614439.	0.00
19.3060	2.55E-05	-201.269	117.7145	-3.90E-06	7745.	1.11E+10	-39.065	3616607.	0.00
19.5030	1.63E-05	-31.037	42.0989	-3.92E-06	7742.	1.11E+10	-24.908	3618797.	0.00
19.7000	6.99E-06	0.00	0.00	-3.93E-06	7742.	1.11E+10	-10.709	1810495.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.46455495 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1109871. inch-lbs
Maximum shear force              =        -44137. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    13.79000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              3
```

Summary of Pile-head Responses for Conventional Analyses

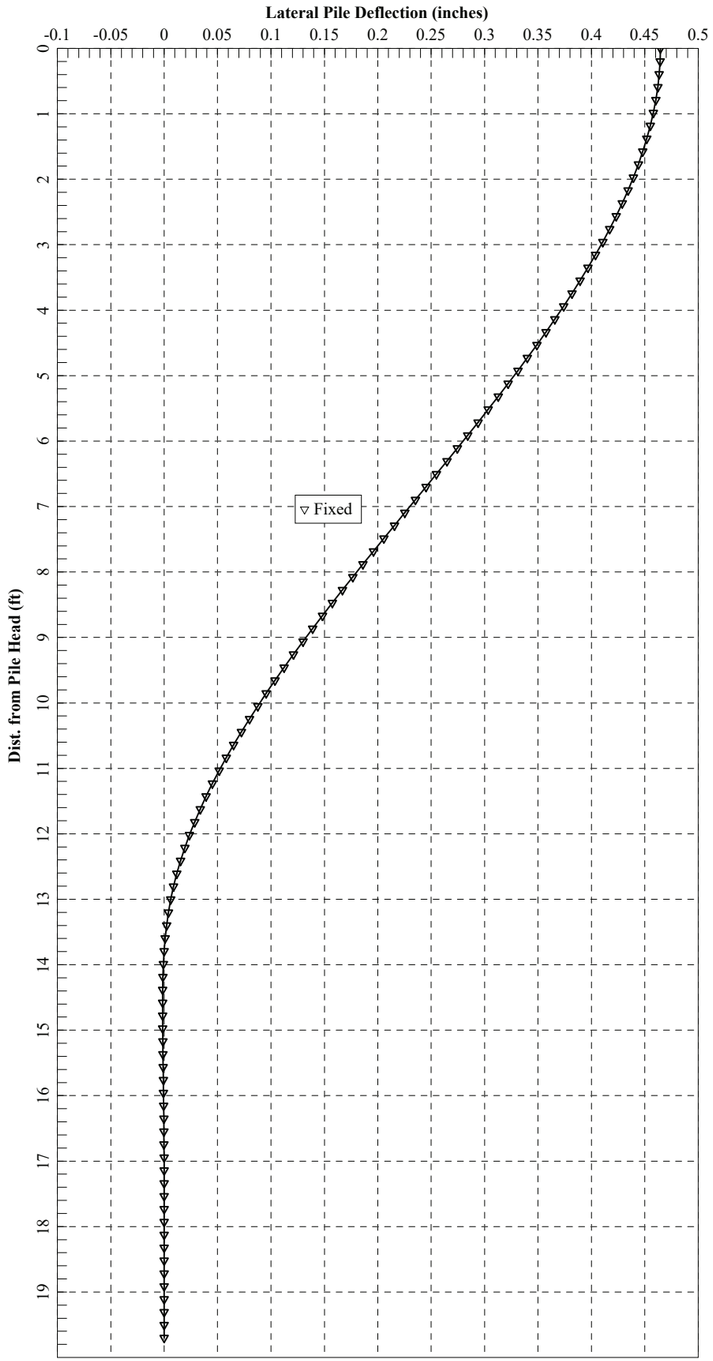
Definitions of Pile-head Loading Conditions:

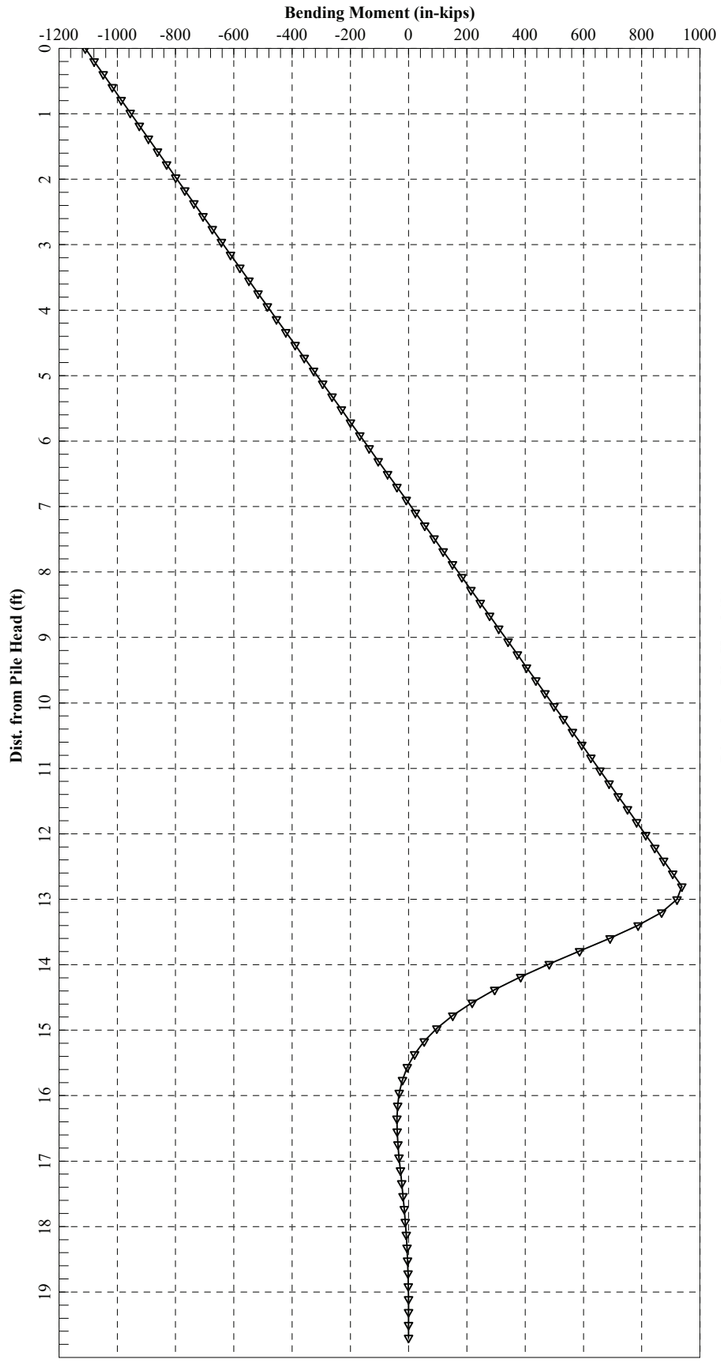
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

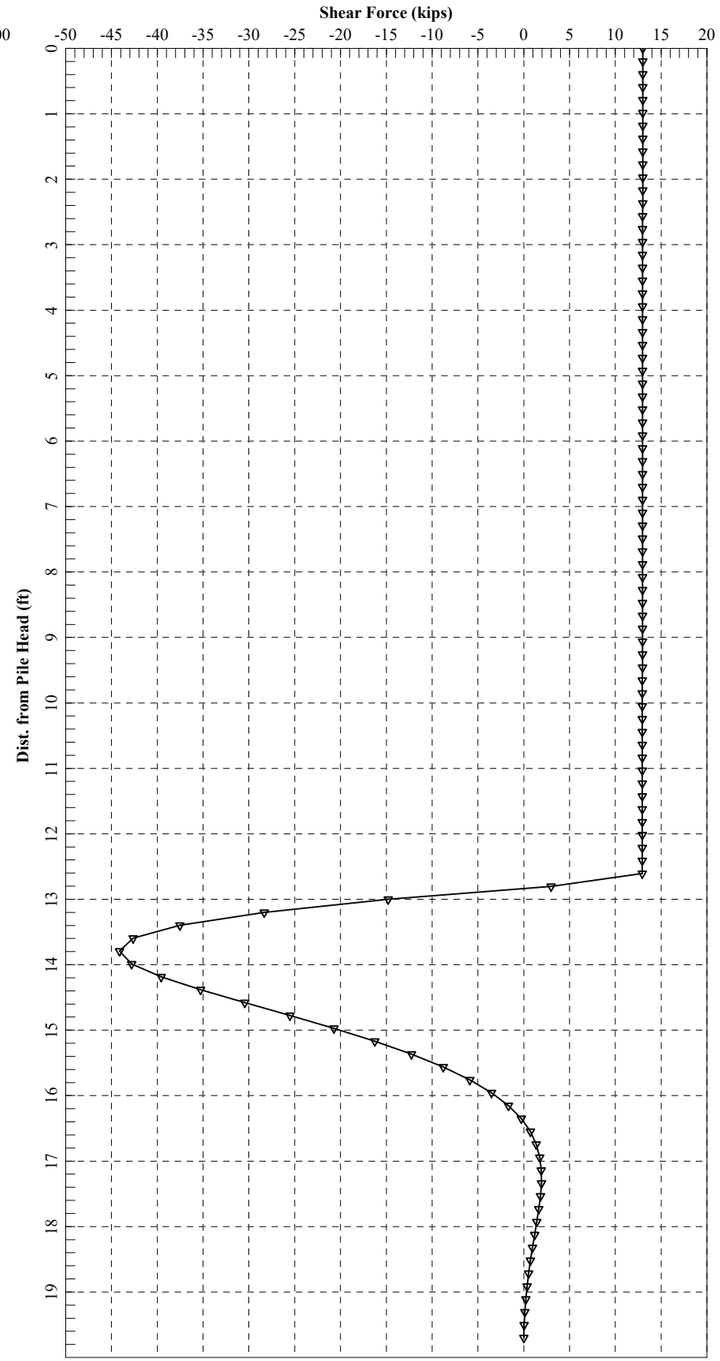
Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	13000.	S, rad	0.00	120000.	0.4646	0.00	-44137.	-1109871.

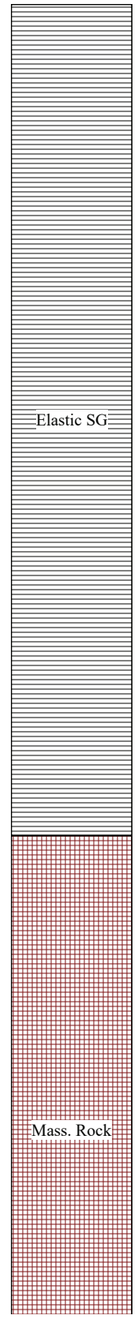
Maximum pile-head deflection = 0.4645549514 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1 -0.05 0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Fixed


Bending Moment (in-kips)
-1200 -1000 -800 -600 -400 -200 0 200 400 600 800 1000
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19


Shear Force (kips)
-50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19


Elastic SG
Mass. Rock

```
================================================================================

                            LPile for Version 2022-12.012

                             License ID : 162969677
                        License Type : (Single User License)

                    Analysis of Individual Piles and Drilled Shafts
                   Subjected to Lateral Loading Using the p-y Method
                              © 1985-2024 by Ensoft, Inc.
                                  All Rights Reserved

                   This software is licensed for exclusive use by:
                                 ESP Associates, PA
                                 Fort Mill, SC, USA

================================================================================


This model was prepared by:
hagopian



--------------------------------------------------------------------------------
                               Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\1 - Lateral\

Name of input data file:
END BENT 1 Transverse Weak Axis.lp12d

Name of output report file:
END BENT 1 Transverse Weak Axis.lp12o

Name of plot output file:
END BENT 1 Transverse Weak Axis.lp12p

Name of runtime message file:
END BENT 1 Transverse Weak Axis.lp12r



--------------------------------------------------------------------------------
                               Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 17, 2025           Time:   9:49:19



--------------------------------------------------------------------------------
                                    Problem Title
--------------------------------------------------------------------------------

Project Name: 5631 US HWY 19E


Job Number: 25-01592-B


Client: Volkert, Inc.


Engineer: ESP Associates/PB/HAA


Description: END BENT 1, Transverse, Weak Axis




--------------------------------------------------------------------------------
                             Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
```

```
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed                =          500
 - Deflection tolerance for convergence                =   1.0000E-05 in
 - Maximum allowable deflection                        =     100.0000 in
 - Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats



---------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Number of pile sections defined                       =            1
Total length of pile                                  =       19.700 ft
Depth of ground surface below top of pile             =       0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           11.8000
  2            19.700           11.8000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a AISC weak axis steel pile
   Length of section                                  =    19.700000 ft
   AISC Section Type                                  = HP


   AISC Section Name                                  = HP12X53


   Pile width                                         =    11.800000 in



---------------------------------------------------------------------------
                       Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 2 layers

Layer 1 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =       0.0000 ft
   Distance from top of pile to bottom of layer       =    12.700000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
```

```
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 2 is massive rock, p-y criteria by Liang et al., 2009

   Distance from top of pile to top of layer          =    12.700000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =    57.400000 pcf
   Effective unit weight at bottom of layer           =    57.400000 pcf
   Uniaxial compressive strength at top of layer      =       14500. psi
   Uniaxial compressive strength at bottom of layer   =       14500. psi
   Poisson's ratio at top of layer                    =     0.200000
   Poisson's ratio at bottom of layer                 =     0.200000
   Option 1: Intact rock modulus at top of layer      =       0.0000 psi
             Intact rock modulus at bottom of layer   =       0.0000 psi
   Option 1: Geologic Strength Index for layer        =    63.000000
   Option 2: Rock mass modulus at top of layer        =     4060000. psi
             Rock mass modulus at bottom of layer     =     4060000. psi
   Option 2 will use the input value of rock mass modulus to compute the p-y curve
            in massive rock.
   The rock type is (metamorphic) gneiss, Hoek-Brown Material Constant mi = 28


 (Depth of the lowest soil layer extends 30.300 ft below the pile tip)


**** Warning - Possible Input Data Error ****

Values entered for effective unit weights of soil were outside the limits of
20 pcf to 140 pcf.

The minimum input value, in layer   1, for effective unit weight = .10 pcf

This data may be erroneous. Please check your data.


--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial     Rock Mass    Geologic      Elastic     Int. Rock
Hoek-Brown
 Num.           Name             Depth       Unit Wt.       qu         Modulus     Strength     Subgrade      Modulus
Material     Poisson's
          (p-y Curve Type)        ft           pcf          psi          psi         Index      Mod. pci        psi
Index, mi      Ratio
-----   --------------------   ----------   ----------   ----------   ----------   ----------   ----------   ----------
----------   ----------
  1           Elastic               0.00      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade            12.7000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  2           Massive             12.7000      57.4000       14500.     4060000.      63.0000       --          0.00
28.0000       0.2000
               Rock               50.0000      57.4000       14500.                   63.0000       --          0.00
28.0000       0.2000


--------------------------------------------------------------------------------
                               Static Loading Type
--------------------------------------------------------------------------------

Static loading criteria were used when computing p-y curves for all analyses.



--------------------------------------------------------------------------------
               Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified = 1

Load    Load         Condition              Condition            Axial Thrust      Compute Top y     Run Analysis
 No.    Type             1                      2                 Force, lbs      vs. Pile Length
-----   ----   --------------------   ----------------------   ----------------   ---------------    ------------
   1     2     V =        2000. lbs   S =       0.0000 in/in           120000.         No               Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
```

Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel AISC Weak Axis:

Length of Section	=	19.700000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.500000 sq. in.
Moment of Inertia	=	127.000000 in^4
Elastic Bending Stiffness	=	3683000. kip-in^2
Plastic Modulus, Z	=	32.200000in^3
Plastic Moment Capacity = Fy Z	=	1610.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	775.000 kips
Nominal Axial Tensile Capacity	=	-775.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	120.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 120.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000563	20.4755914	3635033.	54.3467548	8.8678831	
0.00001127	40.9511829	3635033.	30.1733774	9.8381975	
0.00001690	61.4267743	3635033.	22.1155849	10.8085120	
0.00002253	81.9023657	3635033.	18.0866887	11.7788266	
0.00002816	102.3779572	3635033.	15.6693510	12.7491410	
0.00003380	122.8535486	3635033.	14.0577925	13.7194556	
0.00003943	143.3291401	3635033.	12.9066793	14.6897701	
0.00004506	163.8047315	3635033.	12.0433444	15.6600846	
0.00005070	184.2803229	3635033.	11.3718616	16.6303991	
0.00005633	204.7559144	3635033.	10.8346755	17.6007137	
0.00006196	225.2315058	3635033.	10.3951595	18.5710282	
0.00006759	245.7070972	3635033.	10.0288962	19.5413427	
0.00007323	266.1826887	3635033.	9.7189811	20.5116572	
0.00007886	286.6582801	3635033.	9.4533396	21.4819717	
0.00008449	307.1338716	3635033.	9.2231170	22.4522862	
0.00009013	327.6094630	3635033.	9.0216722	23.4226007	
0.00009576	348.0850544	3635033.	8.8439268	24.3929153	
0.0001014	368.5606459	3635033.	8.6859308	25.3632298	
0.0001070	389.0362373	3635033.	8.5445660	26.3335443	
0.0001127	409.5118287	3635033.	8.4173377	27.3038588	
0.0001183	429.9874202	3635033.	8.3022264	28.2741733	
0.0001239	450.4630116	3635033.	8.1975798	29.2444878	
0.0001296	470.9386031	3635033.	8.1020328	30.2148023	

0.0001352	491.4141945	3635033.	8.0144481	31.1851168	
0.0001408	511.8897859	3635033.	7.9338702	32.1554314	
0.0001465	532.3653774	3635033.	7.8594906	33.1257459	
0.0001521	552.8409688	3635033.	7.7906205	34.0960604	
0.0001577	573.3165602	3635033.	7.7266698	35.0663749	
0.0001634	593.7921517	3635033.	7.6671295	36.0366894	
0.0001690	614.2677431	3635033.	7.6115585	37.0070039	
0.0001746	634.7433346	3635033.	7.5595727	37.9773184	
0.0001803	655.2189260	3635033.	7.5108361	38.9476330	
0.0001859	675.6945174	3635033.	7.4650532	39.9179475	
0.0001915	696.1701089	3635033.	7.4219634	40.8882620	
0.0001971	716.6457003	3635033.	7.3813359	41.8585765	
0.0002028	737.1212917	3635033.	7.3429654	42.8288910	
0.0002084	757.5968832	3635033.	7.3066690	43.7992055	
0.0002140	778.0724746	3635033.	7.2722830	44.7695200	
0.0002197	798.5480661	3635033.	7.2396604	45.7398346	
0.0002309	839.4992489	3635033.	7.1791891	47.6804636	
0.0002422	880.4504318	3635033.	7.1243431	49.6210926	
0.0002535	920.0010231	3629508.	7.0764965	50.0000000	Y
0.0002647	957.0506208	3615006.	7.0364592	50.0000000	Y
0.0002760	991.8853453	3593663.	7.0030080	50.0000000	Y
0.0002873	1025.	3567235.	6.9750966	50.0000000	Y
0.0002985	1056.	3537167.	6.9518209	50.0000000	Y
0.0003098	1086.	3504454.	6.9324881	50.0000000	Y
0.0003211	1114.	3469570.	6.9166750	50.0000000	Y
0.0003323	1141.	3433570.	6.9051644	50.0000000	Y
0.0003436	1167.	3396250.	6.8929773	50.0000000	Y
0.0003549	1191.	3354868.	6.8862373	50.0000000	Y
0.0003661	1212.	3310614.	6.8745974	50.0000000	Y
0.0003774	1232.	3263779.	6.8635946	50.0000000	Y
0.0003887	1250.	3215508.	6.8535377	50.0000000	Y
0.0003999	1266.	3166335.	6.8442123	50.0000000	Y
0.0004112	1282.	3116687.	6.8350968	50.0000000	Y
0.0004225	1296.	3066929.	6.8262298	50.0000000	Y
0.0004337	1309.	3017369.	6.8183190	50.0000000	Y
0.0004450	1321.	2968203.	6.8109290	50.0000000	Y
0.0004563	1332.	2919436.	6.8041278	50.0000000	Y
0.0004675	1343.	2871500.	6.7923237	50.0000000	Y
0.0004788	1352.	2824485.	6.7842861	50.0000000	Y
0.0004901	1361.	2777905.	6.7787419	50.0000000	Y
0.0005013	1370.	2732474.	6.7685870	50.0000000	Y
0.0005126	1378.	2688105.	6.7612865	50.0000000	Y
0.0005239	1385.	2644528.	6.7568788	50.0000000	Y
0.0005351	1392.	2602026.	6.7462658	50.0000000	Y
0.0005464	1399.	2560581.	6.7415059	50.0000000	Y
0.0005577	1405.	2519984.	6.7321390	50.0000000	Y
0.0005689	1411.	2480460.	6.7272706	50.0000000	Y
0.0005802	1417.	2441881.	6.7185836	50.0000000	Y
0.0005914	1422.	2404312.	6.7141558	50.0000000	Y
0.0006027	1427.	2367607.	6.7055031	50.0000000	Y
0.0006140	1432.	2331933.	6.7020904	50.0000000	Y
0.0006252	1436.	2297040.	6.6928122	50.0000000	Y
0.0006365	1440.	2263089.	6.6866850	50.0000000	Y
0.0006478	1445.	2230044.	6.6804409	50.0000000	Y
0.0006590	1448.	2197777.	6.6747490	50.0000000	Y
0.0006703	1452.	2166221.	6.6721226	50.0000000	Y
0.0007154	1465.	2048200.	6.6471070	50.0000000	Y
0.0007604	1476.	1941125.	6.6254235	50.0000000	Y
0.0008055	1485.	1844009.	6.6058427	50.0000000	Y
0.0008506	1493.	1755615.	6.5874720	50.0000000	Y
0.0008956	1500.	1674922.	6.5703921	50.0000000	Y
0.0009407	1506.	1600982.	6.5557180	50.0000000	Y
0.0009857	1511.	1533027.	6.5383137	50.0000000	Y
0.0010308	1516.	1470517.	6.5236462	50.0000000	Y
0.0010759	1520.	1412673.	6.5124801	50.0000000	Y
0.0011209	1523.	1359071.	6.4966917	50.0000000	Y
0.0011660	1527.	1309360.	6.4865843	50.0000000	Y
0.0012111	1530.	1262997.	6.4725008	50.0000000	Y
0.0012561	1532.	1219827.	6.4641440	50.0000000	Y
0.0013012	1535.	1179391.	6.4506951	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	120.0000000000	1535.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	0.00
2	12.7000	12.7000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 2000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 120000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2183	-175681.	2000.	0.00	15903.	3.64E+09	-0.258	1.3948	0.00
0.1970	0.2182	-170937.	1999.	-1.13E-04	15683.	3.64E+09	-0.257	2.7895	0.00
0.3940	0.2178	-166163.	1999.	-2.22E-04	15461.	3.64E+09	-0.257	2.7895	0.00
0.5910	0.2171	-161361.	1998.	-3.29E-04	15238.	3.64E+09	-0.256	2.7895	0.00
0.7880	0.2162	-156530.	1998.	-4.32E-04	15014.	3.64E+09	-0.255	2.7895	0.00
0.9850	0.2151	-151671.	1997.	-5.32E-04	14788.	3.64E+09	-0.254	2.7895	0.00
1.1820	0.2137	-146786.	1996.	-6.29E-04	14561.	3.64E+09	-0.252	2.7895	0.00
1.3790	0.2121	-141875.	1996.	-7.23E-04	14333.	3.64E+09	-0.250	2.7895	0.00
1.5760	0.2103	-136939.	1995.	-8.14E-04	14104.	3.64E+09	-0.248	2.7895	0.00
1.7730	0.2082	-131980.	1995.	-9.01E-04	13873.	3.64E+09	-0.246	2.7895	0.00
1.9700	0.2060	-126997.	1994.	-9.86E-04	13642.	3.64E+09	-0.243	2.7895	0.00
2.1670	0.2036	-121993.	1993.	-0.00107	13409.	3.64E+09	-0.240	2.7895	0.00
2.3640	0.2010	-116967.	1993.	-0.00114	13176.	3.64E+09	-0.237	2.7895	0.00
2.5610	0.1982	-111921.	1992.	-0.00122	12941.	3.64E+09	-0.234	2.7895	0.00
2.7580	0.1952	-106856.	1992.	-0.00129	12706.	3.64E+09	-0.230	2.7895	0.00
2.9550	0.1921	-101772.	1991.	-0.00136	12470.	3.64E+09	-0.227	2.7895	0.00
3.1520	0.1888	-96671.	1991.	-0.00142	12233.	3.64E+09	-0.223	2.7895	0.00
3.3490	0.1853	-91553.	1990.	-0.00148	11995.	3.64E+09	-0.219	2.7895	0.00
3.5460	0.1818	-86420.	1990.	-0.00154	11757.	3.64E+09	-0.214	2.7895	0.00
3.7430	0.1781	-81272.	1989.	-0.00160	11518.	3.64E+09	-0.210	2.7895	0.00
3.9400	0.1742	-76110.	1989.	-0.00165	11278.	3.64E+09	-0.206	2.7895	0.00
4.1370	0.1703	-70935.	1988.	-0.00169	11037.	3.64E+09	-0.201	2.7895	0.00
4.3340	0.1662	-65748.	1988.	-0.00174	10796.	3.64E+09	-0.196	2.7895	0.00
4.5310	0.1620	-60550.	1987.	-0.00178	10555.	3.64E+09	-0.191	2.7895	0.00
4.7280	0.1578	-55342.	1987.	-0.00182	10313.	3.64E+09	-0.186	2.7895	0.00
4.9250	0.1535	-50125.	1986.	-0.00185	10071.	3.64E+09	-0.181	2.7895	0.00
5.1220	0.1490	-44899.	1986.	-0.00188	9828.	3.64E+09	-0.176	2.7895	0.00
5.3190	0.1445	-39666.	1986.	-0.00191	9585.	3.64E+09	-0.171	2.7895	0.00
5.5160	0.1400	-34427.	1985.	-0.00193	9341.	3.64E+09	-0.165	2.7895	0.00
5.7130	0.1354	-29183.	1985.	-0.00196	9098.	3.64E+09	-0.160	2.7895	0.00

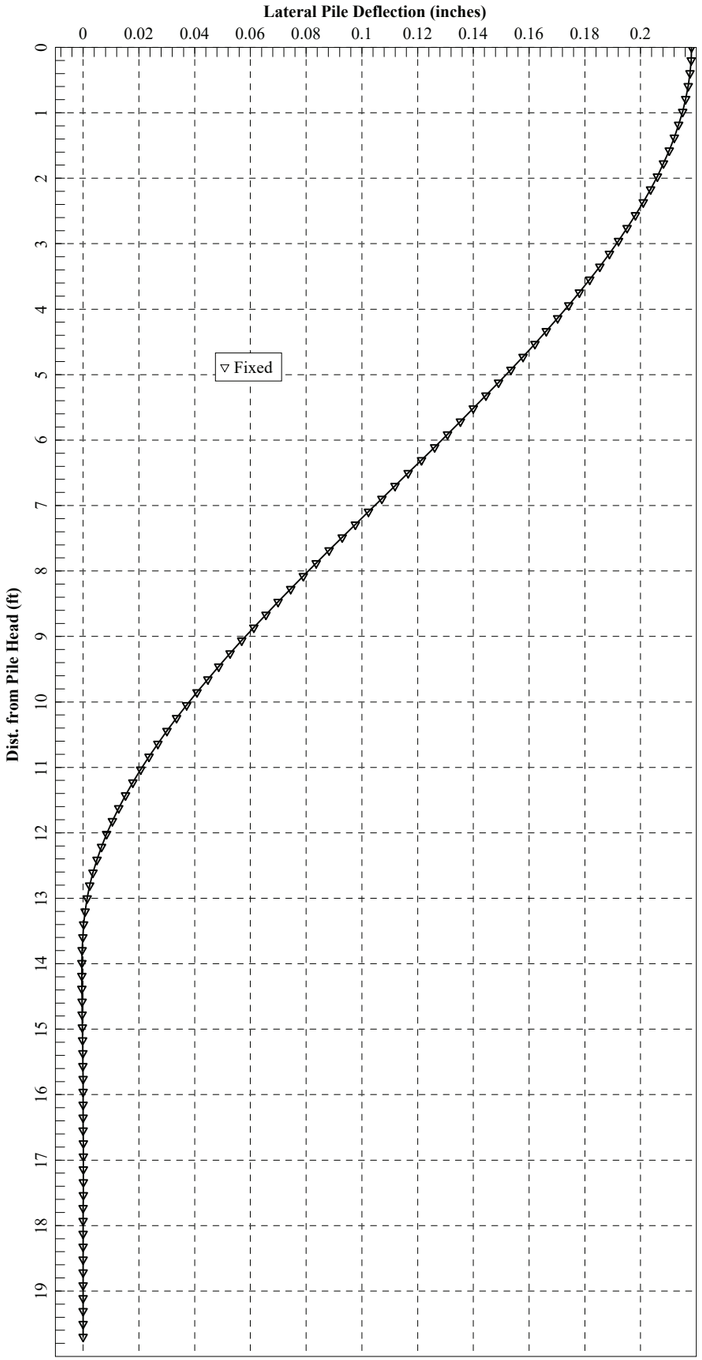
5.9100	0.1308	-23934.	1984.	-0.00197	8854.	3.64E+09	-0.154	2.7895	0.00
6.1070	0.1261	-18681.	1984.	-0.00199	8610.	3.64E+09	-0.149	2.7895	0.00
6.3040	0.1214	-13426.	1984.	-0.00200	8366.	3.64E+09	-0.143	2.7895	0.00
6.5010	0.1166	-8169.	1983.	-0.00200	8121.	3.64E+09	-0.138	2.7895	0.00
6.6980	0.1119	-2911.	1983.	-0.00201	7877.	3.64E+09	-0.132	2.7895	0.00
6.8950	0.1071	2346.	1983.	-0.00201	7851.	3.64E+09	-0.126	2.7895	0.00
7.0920	0.1024	7602.	1982.	-0.00200	8095.	3.64E+09	-0.121	2.7895	0.00
7.2890	0.09766	12856.	1982.	-0.00200	8339.	3.64E+09	-0.115	2.7895	0.00
7.4860	0.09295	18108.	1982.	-0.00199	8583.	3.64E+09	-0.110	2.7895	0.00
7.6830	0.08826	23355.	1982.	-0.00197	8827.	3.64E+09	-0.104	2.7895	0.00
7.8800	0.08361	28597.	1981.	-0.00196	9070.	3.64E+09	-0.09866	2.7895	0.00
8.0770	0.07901	33834.	1981.	-0.00194	9314.	3.64E+09	-0.09323	2.7895	0.00
8.2740	0.07445	39063.	1981.	-0.00191	9557.	3.64E+09	-0.08786	2.7895	0.00
8.4710	0.06996	44285.	1981.	-0.00189	9799.	3.64E+09	-0.08255	2.7895	0.00
8.6680	0.06553	49499.	1981.	-0.00186	10041.	3.64E+09	-0.07733	2.7895	0.00
8.8650	0.06119	54703.	1980.	-0.00182	10283.	3.64E+09	-0.07220	2.7895	0.00
9.0620	0.05692	59896.	1980.	-0.00178	10525.	3.64E+09	-0.06717	2.7895	0.00
9.2590	0.05275	65078.	1980.	-0.00174	10765.	3.64E+09	-0.06224	2.7895	0.00
9.4560	0.04867	70247.	1980.	-0.00170	11005.	3.64E+09	-0.05743	2.7895	0.00
9.6530	0.04471	75404.	1980.	-0.00165	11245.	3.64E+09	-0.05276	2.7895	0.00
9.8500	0.04086	80546.	1980.	-0.00160	11484.	3.64E+09	-0.04821	2.7895	0.00
10.0470	0.03713	85673.	1980.	-0.00155	11722.	3.64E+09	-0.04382	2.7895	0.00
10.2440	0.03354	90784.	1980.	-0.00149	11959.	3.64E+09	-0.03958	2.7895	0.00
10.4410	0.03009	95878.	1979.	-0.00143	12196.	3.64E+09	-0.03550	2.7895	0.00
10.6380	0.02678	100954.	1979.	-0.00137	12432.	3.64E+09	-0.03160	2.7895	0.00
10.8350	0.02363	106011.	1979.	-0.00130	12667.	3.64E+09	-0.02788	2.7895	0.00
11.0320	0.02064	111048.	1979.	-0.00123	12901.	3.64E+09	-0.02435	2.7895	0.00
11.2290	0.01782	116065.	1979.	-0.00115	13134.	3.64E+09	-0.02103	2.7895	0.00
11.4260	0.01518	121061.	1979.	-0.00108	13366.	3.64E+09	-0.01791	2.7895	0.00
11.6230	0.01273	126034.	1979.	-9.97E-04	13597.	3.64E+09	-0.01502	2.7895	0.00
11.8200	0.01047	130983.	1979.	-9.13E-04	13827.	3.64E+09	-0.01235	2.7895	0.00
12.0170	0.00841	135909.	1979.	-8.26E-04	14056.	3.64E+09	-0.00993	2.7895	0.00
12.2140	0.00656	140809.	1979.	-7.36E-04	14283.	3.64E+09	-0.00774	2.7895	0.00
12.4110	0.00493	145683.	1979.	-6.43E-04	14510.	3.64E+09	-0.00582	2.7895	0.00
12.6080	0.00352	150530.	1979.	-5.47E-04	14735.	3.64E+09	-0.00415	2.7895	0.00
12.8050	0.00234	155350.	-791.323	-4.47E-04	14959.	3.64E+09	-2344.	2364580.	0.00
13.0020	0.00140	147043.	-5295.	-3.49E-04	14573.	3.64E+09	-1467.	2468396.	0.00
13.1990	6.92E-04	130512.	-7913.	-2.59E-04	13805.	3.64E+09	-747.749	2553368.	0.00
13.3960	1.81E-04	109778.	-9033.	-1.81E-04	12842.	3.64E+09	-199.947	2618005.	0.00
13.5930	-1.62E-04	87907.	-9056.	-1.16E-04	11826.	3.64E+09	180.0389	2620372.	0.00
13.7900	-3.70E-04	67025.	-8363.	-6.61E-05	10856.	3.64E+09	406.2380	2593790.	0.00
13.9870	-4.75E-04	48402.	-7270.	-2.86E-05	9991.	3.64E+09	518.5597	2580639.	0.00
14.1840	-5.05E-04	32667.	-6006.	-2.22E-06	9260.	3.64E+09	550.9097	2576901.	0.00
14.3810	-4.86E-04	20005.	-4729.	1.49E-05	8671.	3.64E+09	529.7867	2579440.	0.00
14.5780	-4.35E-04	10301.	-3540.	2.48E-05	8220.	3.64E+09	475.7376	2585832.	0.00
14.7750	-3.68E-04	3253.	-2500.	2.92E-05	7893.	3.64E+09	404.3638	2594239.	0.00
14.9720	-2.97E-04	-1536.	-1635.	2.97E-05	7813.	3.64E+09	327.0966	2603319.	0.00
15.1690	-2.28E-04	-4497.	-951.156	2.78E-05	7951.	3.64E+09	251.8659	2612144.	0.00
15.3660	-1.66E-04	-6049.	-436.288	2.43E-05	8023.	3.64E+09	183.7252	2620125.	0.00
15.5630	-1.13E-04	-6573.	-70.845	2.02E-05	8047.	3.64E+09	125.4479	2626940.	0.00
15.7600	-7.01E-05	-6396.	169.7330	1.60E-05	8039.	3.64E+09	78.0868	2632470.	0.00
15.9570	-3.72E-05	-5780.	311.0583	1.21E-05	8010.	3.64E+09	41.4778	2636739.	0.00
16.1540	-1.31E-05	-4932.	377.4261	8.57E-06	7971.	3.64E+09	14.6710	2639861.	0.00
16.3510	3.33E-06	-4000.	390.3701	5.67E-06	7928.	3.64E+09	-3.720	2641134.	0.00
16.5480	1.36E-05	-3089.	367.9601	3.36E-06	7885.	3.64E+09	-15.239	2639798.	0.00
16.7450	1.92E-05	-2263.	324.5922	1.62E-06	7847.	3.64E+09	-21.451	2639079.	0.00
16.9420	2.13E-05	-1555.	271.1276	3.78E-07	7814.	3.64E+09	-23.781	2638812.	0.00
17.1390	2.10E-05	-980.927	215.3065	-4.47E-07	7788.	3.64E+09	-23.445	2638853.	0.00
17.3360	1.92E-05	-537.236	162.2691	-9.40E-07	7767.	3.64E+09	-21.426	2639089.	0.00
17.5330	1.66E-05	-213.185	115.0928	-1.18E-06	7752.	3.64E+09	-18.486	2639431.	0.00
17.7300	1.36E-05	7.5953	75.3005	-1.25E-06	7742.	3.64E+09	-15.179	2639815.	0.00
17.9270	1.06E-05	143.5451	43.3109	-1.20E-06	7749.	3.64E+09	-11.885	2640196.	0.00
18.1240	7.91E-06	213.0512	18.8198	-1.09E-06	7752.	3.64E+09	-8.835	2640549.	0.00
18.3210	5.51E-06	233.1412	1.1055	-9.41E-07	7753.	3.64E+09	-6.151	2640858.	0.00
18.5180	3.46E-06	218.8121	-10.736	-7.94E-07	7752.	3.64E+09	-3.867	2641122.	0.00
18.7150	1.75E-06	182.8330	-17.620	-6.63E-07	7750.	3.64E+09	-1.958	2641341.	0.00
18.9120	3.24E-07	135.8793	-20.363	-5.60E-07	7748.	3.64E+09	-0.362	2641525.	0.00
19.1090	-8.95E-07	86.8751	-19.610	-4.87E-07	7746.	3.64E+09	0.9995	2641452.	0.00
19.3060	-1.98E-06	43.4406	-15.814	-4.45E-07	7744.	3.64E+09	2.2121	2641313.	0.00
19.5030	-3.00E-06	12.3607	-9.239	-4.27E-07	7743.	3.64E+09	3.3500	2641183.	0.00
19.7000	-4.00E-06	0.00	0.00	-4.23E-07	7742.	3.64E+09	4.4666	1320528.	0.00

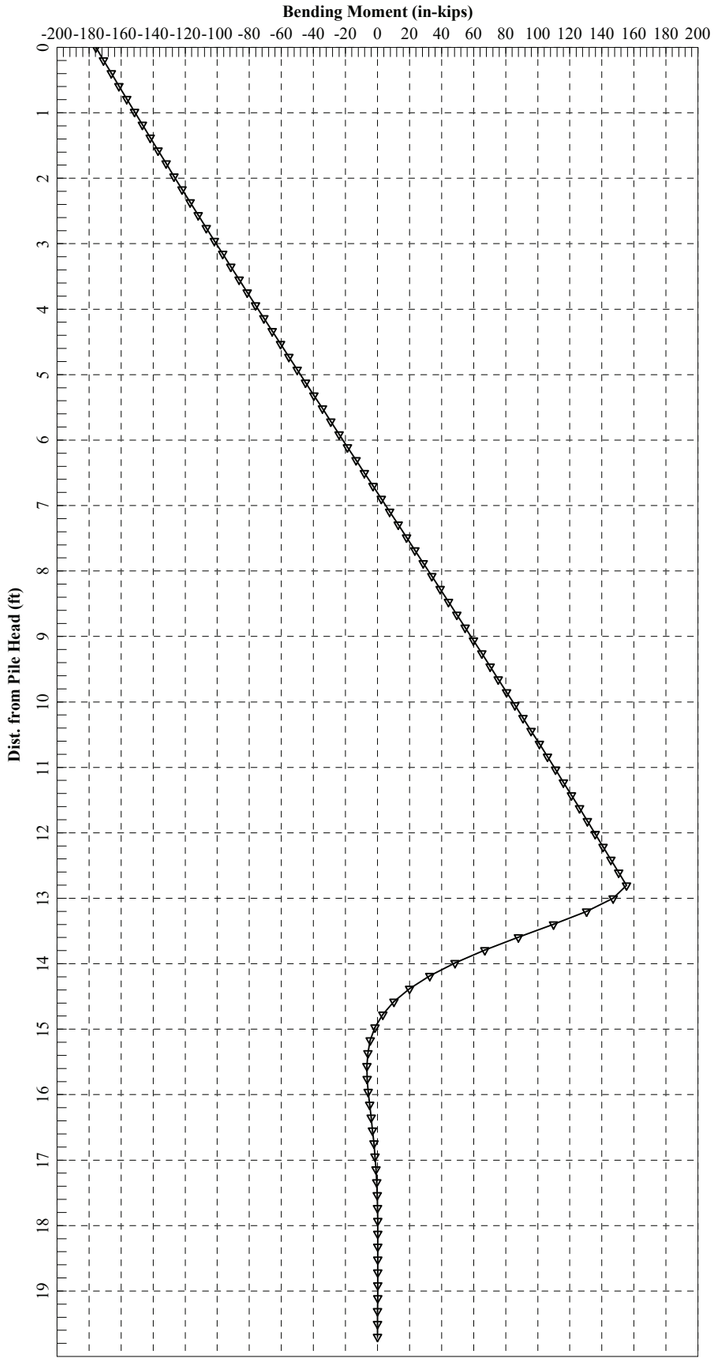
* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

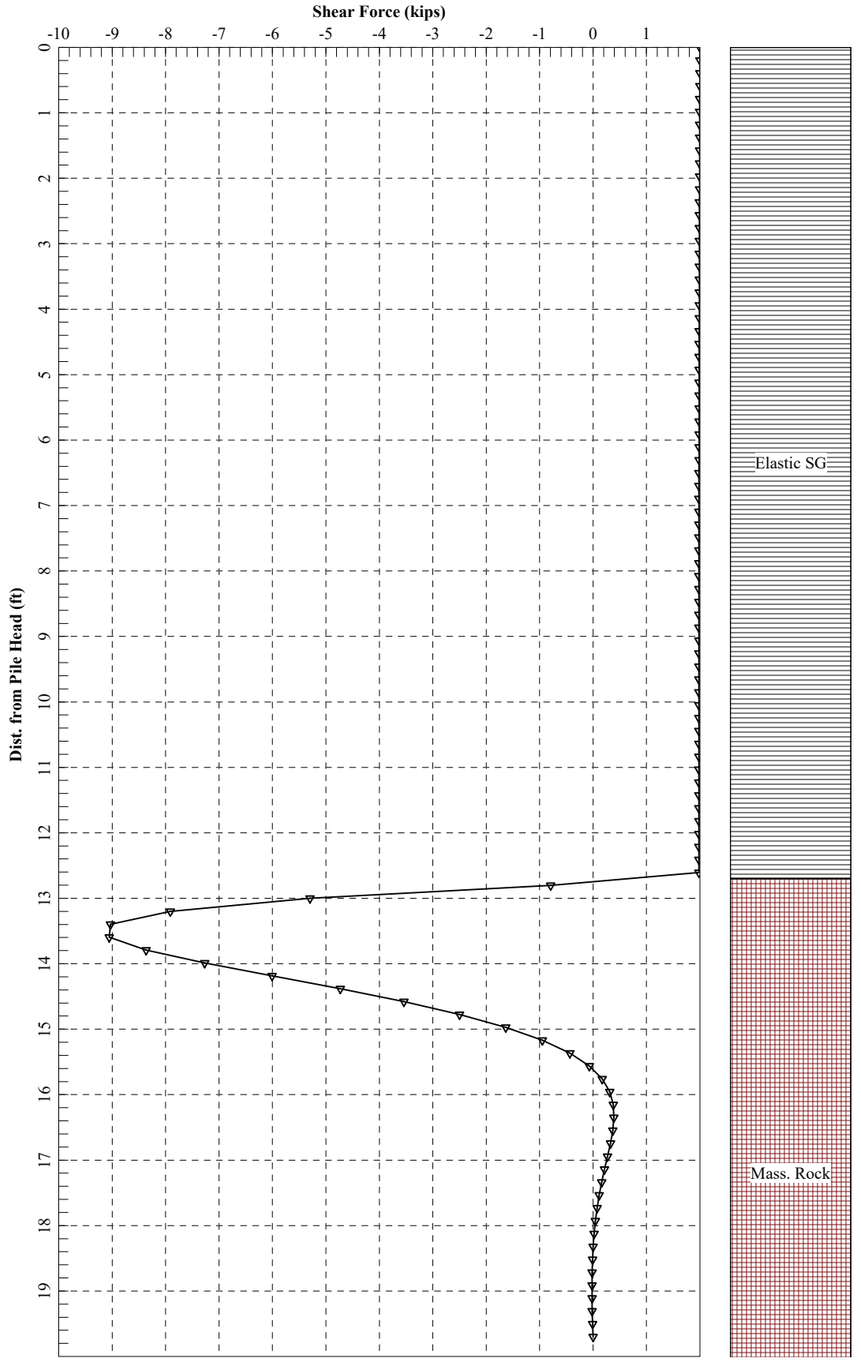
Output Summary for Load Case No. 1:

Pile-head deflection = 0.21829375 inches

```
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -175681. inch-lbs
Maximum shear force              =         -9056. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    13.59300000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              3


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load                Load                  Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs      in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  V, lb      2000.   S, rad         0.00    120000.     0.2183       0.00     -9056.   -175681.


Maximum pile-head deflection = 0.2182937549 inches
Maximum pile-head rotation   = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.
```


Lateral Pile Deflection (inches)
0 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16 0.18 0.2
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
▽ Fixed


Bending Moment (in-kips)
-200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19


Shear Force (kips)
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Elastic SG
Mass. Rock

```
======================================================================

                 GROUP Version 2022.12.10

                   License ID : 164290273

                 License Type : (Single User)

                  Analysis of A Group of Piles
                Subjected to Axial and Lateral Loading

                 © 1987-2024 by Ensoft, Inc.
                      All Rights Reserved

                This software is licensed for exclusive use by:
                          ESP Associates, PA
                          Fort Mill, SC, USA

======================================================================


This model was prepared by:
Hratch Antoine Agopian, PE


----------------------------------------------------------------------
                     Time and Date of Analysis
----------------------------------------------------------------------

          Date:  November 17, 2025     Time:  10:21:18

Load Case 1: Max Transverse
Load Case 2: Max Long Shear
Load Case 3: Max Long Axial

            *****     COMPUTATION RESULTS     *****


5631 US 19E BENT 1



            *****     LOAD CASES RESULTS      *****


LOAD CASE :     1
CASE NAME : Maximum Transverse Shear Loading
LOAD TYPE : Dead, DL


* TABLE L *   COMPUTATION ON PILE CAP

* EQUIVALENT CONCENTRATED LOAD AT ORIGIN *

      VERT. LOAD, LBS    HOR. LOAD Y, LBS   HOR. LOAD Z, LBS
        6.40000E+05           18000.0            0.00000

     MOMENT X ,LBS-IN    MOMENT Y,LBS-IN    MOMENT Z,LBS-IN
            0.00000           0.00000       -4.99200E+07

* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *

       VERTICAL ,IN      HORIZONTAL Y,IN     HORIZONTAL Z,IN
          0.0403441           0.66264            0.00000

     ANGLE ROT. X,RAD    ANGLE ROT. Y,RAD    ANGLE ROT. Z,RAD
            0.00000           0.00000       -1.79682E-04

  THE GLOBAL STRUCTURAL COORDINATE SYSTEM
  ---------------------------------------

  * PILE TOP DISPLACEMENTS *

 PILE GROUP    DISP. X,IN    DISP. Y,IN    DISP. Z,IN    ROT. X,RAD    ROT. Y,RAD    ROT. Z,RAD
```

1	0.040344	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
2	0.048969	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
3	0.057594	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
4	0.066218	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
MINIMUM	0.040344	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
Pile N.	1	1	1	1	1	1
MAXIMUM	0.066218	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
Pile N.	4	1	1	1	1	1

* PILE TOP REACTIONS *

PILE GROUP	FOR. X,LBS	FOR. Y,LBS	FOR. Z,LBS	MOM X,LBS-IN	MOM Y,LBS-IN	MOM Z,LBS-IN
1	1.2115E+05	4625.7	0.0000	0.0000	0.0000	5.9630E+05
2	1.4705E+05	4541.9	0.0000	0.0000	0.0000	5.9475E+05
3	1.7295E+05	4458.1	0.0000	0.0000	0.0000	5.9320E+05
4	1.9885E+05	4374.3	0.0000	0.0000	0.0000	5.9164E+05
MINIMUM	1.2115E+05	4374.3	0.0000	0.0000	0.0000	5.9164E+05
Pile N.	1	4	1	1	1	4
MAXIMUM	1.9885E+05	4625.7	0.0000	0.0000	0.0000	5.9630E+05
Pile N.	4	1	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

* PILE TOP DISPLACEMENTS *

PILE GROUP	DISP. x,IN	DISP. y,IN	DISP. z,IN	ROT. x,RAD	ROT. y,RAD	ROT. z,RAD
1	0.040344	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
2	0.048969	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
3	0.057594	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
4	0.066218	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
MINIMUM	0.040344	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
Pile N.	1	1	1	1	1	1
MAXIMUM	0.066218	0.6626	0.0000	0.0000	0.0000	-1.7968E-04
Pile N.	4	1	1	1	1	1

* PILE TOP REACTIONS *

PILE GROUP	AXIAL,LBS	LAT. y,LBS	LAT. z,LBS	MOM x,LBS-IN	MOM y,LBS-IN	MOM z,LBS-IN
1	1.2115E+05	4625.7	0.0000	0.0000	0.0000	5.9630E+05
2	1.4705E+05	4541.9	0.0000	0.0000	0.0000	5.9475E+05
3	1.7295E+05	4458.1	0.0000	0.0000	0.0000	5.9320E+05
4	1.9885E+05	4374.3	0.0000	0.0000	0.0000	5.9164E+05
MINIMUM	1.2115E+05	4374.3	0.0000	0.0000	0.0000	5.9164E+05
Pile N.	1	4	1	1	1	4
MAXIMUM	1.9885E+05	4625.7	0.0000	0.0000	0.0000	5.9630E+05
Pile N.	4	1	1	1	1	1

PILE GROUP	STRESS,LBS/IN**2
1	4641.8
2	5634.1
3	6626.4
4	7618.7
MINIMUM	4641.8
Pile N.	1
MAXIMUM	7618.7
Pile N.	4

* EFFECTS FOR LATERALLY LOADED PILE *

* MINIMUM VALUES AND LOCATIONS *

PILE	DISPL. FLEX. RIG. y-DIR	DISPL. z-DIR	MOMENT z-DIR	MOMENT y-DIR	SHEAR y-DIR	SHEAR z-DIR	SOIL REACT y-DIR	SOIL REACT z-DIR	TOTAL STRESS y-DIR
	IN	IN	LBS-IN	LBS-IN	LBS	LBS	LBS/IN	LBS/IN	LBS/IN**2
LBS-IN**2	LBS-IN**2								
******	**********	**********	**********	**********	**********	**********	**********	**********	**********
**********	**********								
1	-4.0652E-04	0.0000	-5.9630E+05	0.0000	-1.7190E+04	0.0000	-495.37	0.0000	267.80
9.4476E+09	2.5085E+10								

```
     x(FT)      23.200      0.0000      0.0000      0.0000      21.694      0.0000      23.200      0.0000      20.187
  3.9169      0.0000
       2  -4.0543E-04      0.0000 -5.9475E+05      0.0000 -1.7145E+04      0.0000     -494.06      0.0000      325.05
9.4476E+09  2.5085E+10
     x(FT)      23.200      0.0000      0.0000      0.0000      21.694      0.0000      23.200      0.0000      20.187
  5.4234      0.0000
       3  -4.0434E-04      0.0000 -5.9320E+05      0.0000 -1.7101E+04      0.0000     -492.75      0.0000      382.30
9.4476E+09  2.5085E+10
     x(FT)      23.200      0.0000      0.0000      0.0000      21.694      0.0000      23.200      0.0000      20.187
  3.9169      0.0000
       4  -4.0324E-04      0.0000 -5.9164E+05      0.0000 -1.7056E+04      0.0000     -491.44      0.0000      439.55
9.4476E+09  2.5085E+10
     x(FT)      23.200      0.0000      0.0000      0.0000      21.694      0.0000      23.200      0.0000      20.187
  4.2182      0.0000

     Min. -4.0652E-04      0.0000 -5.9630E+05      0.0000 -1.7190E+04      0.0000     -495.37      0.0000      267.80
9.4476E+09  2.5085E+10
   Pile N.       1           1           1           1           1           1           1           1           1
   1           1
```

* MAXIMUM VALUES AND LOCATIONS *

```
    PILE     DISPL.      DISPL.      MOMENT      MOMENT       SHEAR       SHEAR    SOIL REACT  SOIL REACT     TOTAL
FLEX. RIG.  FLEX. RIG.
             y-DIR       z-DIR       z-DIR       y-DIR       y-DIR       z-DIR       y-DIR       z-DIR      STRESS
 z-DIR       y-DIR
               IN          IN        LBS-IN      LBS-IN         LBS         LBS      LBS/IN      LBS/IN    LBS/IN**2
LBS-IN**2   LBS-IN**2
    ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
**********  **********
       1       0.6626      0.0000  6.0368E+05      0.0000      4625.7      0.0000      2312.2      0.0000      4641.8
7.6727E+10  9.0329E+10
     x(FT)      0.0000      0.0000      20.187      0.0000      0.0000      0.0000      20.187      0.0000      0.0000
  24.104      20.187
       2       0.6626      0.0000  6.0206E+05      0.0000      4541.9      0.0000      2301.4      0.0000      5634.1
7.6727E+10  9.0329E+10
     x(FT)      0.0000      0.0000      20.187      0.0000      0.0000      0.0000      20.187      0.0000      0.0000
  23.501      20.187
       3       0.6626      0.0000  6.0043E+05      0.0000      4458.1      0.0000      2290.6      0.0000      6626.4
7.6727E+10  9.0329E+10
     x(FT)      0.0000      0.0000      20.187      0.0000      0.0000      0.0000      20.187      0.0000      0.0000
  23.501      20.187
       4       0.6626      0.0000  5.9879E+05      0.0000      4374.3      0.0000      2279.7      0.0000      7618.7
7.6727E+10  9.0329E+10
     x(FT)      0.0000      0.0000      20.187      0.0000      0.0000      0.0000      20.187      0.0000      0.0000
  23.501      20.187

     Max.       0.6626      0.0000  6.0368E+05      0.0000      4625.7      0.0000      2312.2      0.0000      7618.7
7.6727E+10  9.0329E+10
   Pile N.       1           1           1           1           1           1           1           1           4
   1           1
```

LOAD CASE : 2
CASE NAME : Maximum Longitudinal Shear Loading
LOAD TYPE : Dead, DL

* TABLE L * COMPUTATION ON PILE CAP

* EQUIVALENT CONCENTRATED LOAD AT ORIGIN *

VERT. LOAD, LBS	HOR. LOAD Y, LBS	HOR. LOAD Z, LBS
5.40000E+05	0.00000	14000.0

MOMENT X ,LBS-IN	MOMENT Y,LBS-IN	MOMENT Z,LBS-IN
1.00800E+06	2.40000E+05	-3.88800E+07

* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0449560	-1.14510E-15	0.92014

ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
3.74586E-11	5.70853E-03	-4.59746E-20

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

* PILE TOP DISPLACEMENTS *

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
2	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
3	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
4	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
MINIMUM	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
Pile N.	1	1	1	1	1	1
MAXIMUM	0.044956	-1.1451E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
Pile N.	1	1	1	1	1	1

* PILE TOP REACTIONS *

PILE GROUP	FOR. X,LBS	FOR. Y,LBS	FOR. Z,LBS	MOM X,LBS-IN	MOM Y,LBS-IN	MOM Z,LBS-IN
1	1.3500E+05	-2.9655E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
2	1.3500E+05	-2.6084E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
3	1.3500E+05	-2.1271E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
4	1.3500E+05	-1.7591E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
MINIMUM	1.3500E+05	-2.9655E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
Pile N.	1	1	1	1	1	1
MAXIMUM	1.3500E+05	-1.7591E-22	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
Pile N.	1	4	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

* PILE TOP DISPLACEMENTS *

PILE GROUP	DISP. x,IN	DISP. y,IN	DISP. z,IN	ROT. x,RAD	ROT. y,RAD	ROT. z,RAD
1	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
2	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
3	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
4	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
MINIMUM	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
Pile N.	1	1	1	1	1	1
MAXIMUM	0.044956	-1.1478E-15	0.9201	3.7459E-11	5.7085E-03	-4.5975E-20
Pile N.	1	1	1	1	1	1

* PILE TOP REACTIONS *

PILE GROUP	AXIAL,LBS	LAT. y,LBS	LAT. z,LBS	MOM x,LBS-IN	MOM y,LBS-IN	MOM z,LBS-IN
1	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
2	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
3	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
4	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
MINIMUM	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
Pile N.	1	1	1	1	1	1
MAXIMUM	1.3500E+05	-8.2664E-12	3500.0	2.0805E-03	6.0000E+04	-1.0848E-09
Pile N.	1	1	1	1	1	1

PILE GROUP	STRESS,LBS/IN**2
1	5172.4
2	5172.4
3	5172.4
4	5172.4
MINIMUM	5172.4
Pile N.	1
MAXIMUM	5172.4
Pile N.	1

* EFFECTS FOR LATERALLY LOADED PILE *

* MINIMUM VALUES AND LOCATIONS *

PILE	DISPL.	DISPL.	MOMENT	MOMENT	SHEAR	SHEAR	SOIL REACT	SOIL REACT	TOTAL
FLEX. RIG.	FLEX. RIG.								
	y-DIR	z-DIR	z-DIR	y-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS
z-DIR	y-DIR								

```
              IN          IN        LBS-IN      LBS-IN        LBS         LBS       LBS/IN      LBS/IN     LBS/IN**2
LBS-IN**2   LBS-IN**2
    ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
**********  **********
        1  -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
9.4476E+09  2.5085E+10
     x(FT)      0.0000      23.200      20.187      26.213      0.0000      21.694      20.187      23.200      20.187
  0.0000      19.584
        2  -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
9.4476E+09  2.5085E+10
     x(FT)      0.0000      23.200      20.187      26.213      0.0000      21.694      20.187      23.200      20.187
  0.0000      19.584
        3  -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
9.4476E+09  2.5085E+10
     x(FT)      0.0000      23.200      20.187      26.213      0.0000      21.694      20.187      23.200      20.187
  0.0000      19.584
        4  -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
9.4476E+09  2.5085E+10
     x(FT)      0.0000      23.200      20.187      26.213      0.0000      21.694      20.187      23.200      20.187
  0.0000      19.584

      Min. -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
9.4476E+09  2.5085E+10
   Pile N.       1           1           1           1           1           1           1           1           1
   1           1

       * MAXIMUM VALUES AND LOCATIONS *

     PILE     DISPL.      DISPL.      MOMENT      MOMENT       SHEAR       SHEAR    SOIL REACT  SOIL REACT     TOTAL
FLEX. RIG.  FLEX. RIG.
              y-DIR       z-DIR       z-DIR       y-DIR       y-DIR       z-DIR       y-DIR       z-DIR      STRESS
 z-DIR       y-DIR
               IN          IN        LBS-IN      LBS-IN         LBS         LBS      LBS/IN      LBS/IN     LBS/IN**2
LBS-IN**2   LBS-IN**2
    ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
**********  **********
        1   7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
7.6727E+10  9.0329E+10
     x(FT)      23.200      0.0000      0.0000      20.187      21.694      19.886      23.200      20.187      0.0000
  20.187      23.803
        2   7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
7.6727E+10  9.0329E+10
     x(FT)      23.200      0.0000      0.0000      20.187      21.694      19.886      23.200      20.187      0.0000
  20.187      24.104
        3   7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
7.6727E+10  9.0329E+10
     x(FT)      23.200      0.0000      0.0000      20.187      21.694      19.886      23.200      20.187      0.0000
  20.187      24.104
        4   7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
7.6727E+10  9.0329E+10
     x(FT)      23.200      0.0000      0.0000      20.187      21.694      19.886      23.200      20.187      0.0000
  20.187      23.803

      Max.   7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
7.6727E+10  9.0329E+10
   Pile N.       1           1           1           1           1           1           1           1           1
   1           1


    LOAD CASE :     3
    CASE NAME : Maxumum Axial Loading
    LOAD TYPE : Dead, DL


    * TABLE L *   COMPUTATION ON PILE CAP

    * EQUIVALENT CONCENTRATED LOAD AT ORIGIN *

          VERT. LOAD, LBS    HOR. LOAD Y, LBS   HOR. LOAD Z, LBS
            6.80000E+05            0.00000            8000.00

         MOMENT X ,LBS-IN    MOMENT Y,LBS-IN    MOMENT Z,LBS-IN
            5.76000E+05        1.68000E+06       -4.89600E+07

    * DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *

           VERTICAL ,IN      HORIZONTAL Y,IN     HORIZONTAL Z,IN
```

```
         0.0566113       -1.50634E-15            1.13212

    ANGLE ROT. X,RAD    ANGLE ROT. Y,RAD    ANGLE ROT. Z,RAD
      -6.27236E-11        7.90138E-03         1.56945E-19


 THE GLOBAL STRUCTURAL COORDINATE SYSTEM
 ---------------------------------------

 * PILE TOP DISPLACEMENTS *

PILE GROUP   DISP. X,IN   DISP. Y,IN   DISP. Z,IN   ROT. X,RAD   ROT. Y,RAD   ROT. Z,RAD
**********  ***********  ***********  ***********  ***********  ***********  ***********
    1          0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    2          0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    3          0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    4          0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19

 MINIMUM       0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
 Pile N.          1           1            1           1           1           1
 MAXIMUM       0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
 Pile N.          1           1            1           1           1           1

 * PILE TOP REACTIONS *

PILE GROUP   FOR. X,LBS   FOR. Y,LBS   FOR. Z,LBS MOM X,LBS-IN MOM Y,LBS-IN MOM Z,LBS-IN
**********  ***********  ***********  ***********  ***********  ***********  ***********
    1        1.7000E+05  -8.2394E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    2        1.7000E+05  -8.3408E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    3        1.7000E+05  -8.4498E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    4        1.7000E+05  -8.5446E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09

 MINIMUM     1.7000E+05  -8.5446E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
 Pile N.          1           4            1           1           1           1
 MAXIMUM     1.7000E+05  -8.2394E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
 Pile N.          1           1            1           1           1           1


 THE PILE COORDINATE SYSTEM (LOCAL AXES)
 ---------------------------------------

 * PILE TOP DISPLACEMENTS *

PILE GROUP   DISP. x,IN   DISP. y,IN   DISP. z,IN   ROT. x,RAD   ROT. y,RAD   ROT. z,RAD
**********  ***********  ***********  ***********  ***********  ***********  ***********
    1          0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    2          0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    3          0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    4          0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19

 MINIMUM       0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
 Pile N.          1           1            1           1           1           1
 MAXIMUM       0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
 Pile N.          1           1            1           1           1           1

 * PILE TOP REACTIONS *

PILE GROUP   AXIAL,LBS    LAT. y,LBS   LAT. z,LBS MOM x,LBS-IN MOM y,LBS-IN MOM z,LBS-IN
**********  ***********  ***********  ***********  ***********  ***********  ***********
    1        1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    2        1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    3        1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    4        1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09

 MINIMUM     1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
 Pile N.          1           1            1           1           1           1
 MAXIMUM     1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
 Pile N.          1           1            1           1           1           1

PILE GROUP   STRESS,LBS/IN**2
**********  ****************
    1             6513.4
    2             6513.4
    3             6513.4
    4             6513.4

 MINIMUM          6513.4
 Pile N.            1
 MAXIMUM          6513.4
 Pile N.            1

 * EFFECTS FOR LATERALLY LOADED PILE *
```

* MINIMUM VALUES AND LOCATIONS *

PILE	DISPL.	DISPL.	MOMENT	MOMENT	SHEAR	SHEAR	SOIL REACT	SOIL REACT	TOTAL
FLEX. RIG.	FLEX. RIG.								
	y-DIR	z-DIR	z-DIR	y-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS
z-DIR	y-DIR								
	IN	IN	LBS-IN	LBS-IN	LBS	LBS	LBS/IN	LBS/IN	LBS/IN**2
LBS-IN**2	LBS-IN**2								
******	**********	**********	**********	**********	**********	**********	**********	**********	**********
**********	**********								
1	-1.5098E-15	-7.0657E-04	-1.3869E-09	-4.5700E+04	-1.0409E-11	-2.9794E+04	-5.0298E-12	-813.28	375.78
9.4476E+09	2.5085E+10								
x(FT)	0.0000	23.200	20.187	26.213	0.0000	21.694	20.187	23.200	20.187
0.0000	16.572								
2	-1.5098E-15	-7.0657E-04	-1.3869E-09	-4.5700E+04	-1.0409E-11	-2.9794E+04	-5.0298E-12	-813.28	375.78
9.4476E+09	2.5085E+10								
x(FT)	0.0000	23.200	20.187	26.213	0.0000	21.694	20.187	23.200	20.187
0.0000	16.572								
3	-1.5098E-15	-7.0657E-04	-1.3869E-09	-4.5700E+04	-1.0409E-11	-2.9794E+04	-5.0298E-12	-813.28	375.78
9.4476E+09	2.5085E+10								
x(FT)	0.0000	23.200	20.187	26.213	0.0000	21.694	20.187	23.200	20.187
0.0000	16.572								
4	-1.5098E-15	-7.0657E-04	-1.3869E-09	-4.5700E+04	-1.0409E-11	-2.9794E+04	-5.0298E-12	-813.28	375.78
9.4476E+09	2.5085E+10								
x(FT)	0.0000	23.200	20.187	26.213	0.0000	21.694	20.187	23.200	20.187
0.0000	16.572								
Min.	-1.5098E-15	-7.0657E-04	-1.3869E-09	-4.5700E+04	-1.0409E-11	-2.9794E+04	-5.0298E-12	-813.28	375.78
9.4476E+09	2.5085E+10								
Pile N.	1	1	1	1	1	1	1	1	1
1	1								

* MAXIMUM VALUES AND LOCATIONS *

PILE	DISPL.	DISPL.	MOMENT	MOMENT	SHEAR	SHEAR	SOIL REACT	SOIL REACT	TOTAL
FLEX. RIG.	FLEX. RIG.								
	y-DIR	z-DIR	z-DIR	y-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS
z-DIR	y-DIR								
	IN	IN	LBS-IN	LBS-IN	LBS	LBS	LBS/IN	LBS/IN	LBS/IN**2
LBS-IN**2	LBS-IN**2								
******	**********	**********	**********	**********	**********	**********	**********	**********	**********
**********	**********								
1	9.5966E-19	1.1321	1.3890E-09	1.0982E+06	3.8890E-11	2007.4	1.1046E-12	3549.9	6513.4
7.6727E+10	9.0329E+10								
x(FT)	23.200	0.0000	0.0000	20.187	21.694	0.3013	23.200	20.187	0.0000
20.187	23.803								
2	9.5966E-19	1.1321	1.3890E-09	1.0982E+06	3.8890E-11	2007.4	1.1046E-12	3549.9	6513.4
7.6727E+10	9.0329E+10								
x(FT)	23.200	0.0000	0.0000	20.187	21.694	1.5065	23.200	20.187	0.0000
20.187	23.803								
3	9.5966E-19	1.1321	1.3890E-09	1.0982E+06	3.8890E-11	2007.4	1.1046E-12	3549.9	6513.4
7.6727E+10	9.0329E+10								
x(FT)	23.200	0.0000	0.0000	20.187	21.694	0.9039	23.200	20.187	0.0000
20.187	25.610								
4	9.5966E-19	1.1321	1.3890E-09	1.0982E+06	3.8890E-11	2007.4	1.1046E-12	3549.9	6513.4
7.6727E+10	9.0329E+10								
x(FT)	23.200	0.0000	0.0000	20.187	21.694	0.6026	23.200	20.187	0.0000
20.187	23.803								
Max.	9.5966E-19	1.1321	1.3890E-09	1.0982E+06	3.8890E-11	2007.4	1.1046E-12	3549.9	6513.4
7.6727E+10	9.0329E+10								
Pile N.	1	1	1	1	1	1	1	1	1
1	1								

***** SUMMARY FOR LOAD CASES AND COMBINATIONS *****

***** LOAD CASES RESULTS *****

LOAD CASE : 1

* TABLE L * COMPUTATION ON PILE CAP

* EQUIVALENT CONCENTRATED LOAD AT ORIGIN *

LOAD X,LBS	LOAD Y,LBS	LOAD Z,LBS	MOM X,LBS-IN	MOM Y,LBS-IN	MOM Z,LBS-IN
6.40000E+05	18000.0	0.00000	0.00000	0.00000	-4.99200E+07

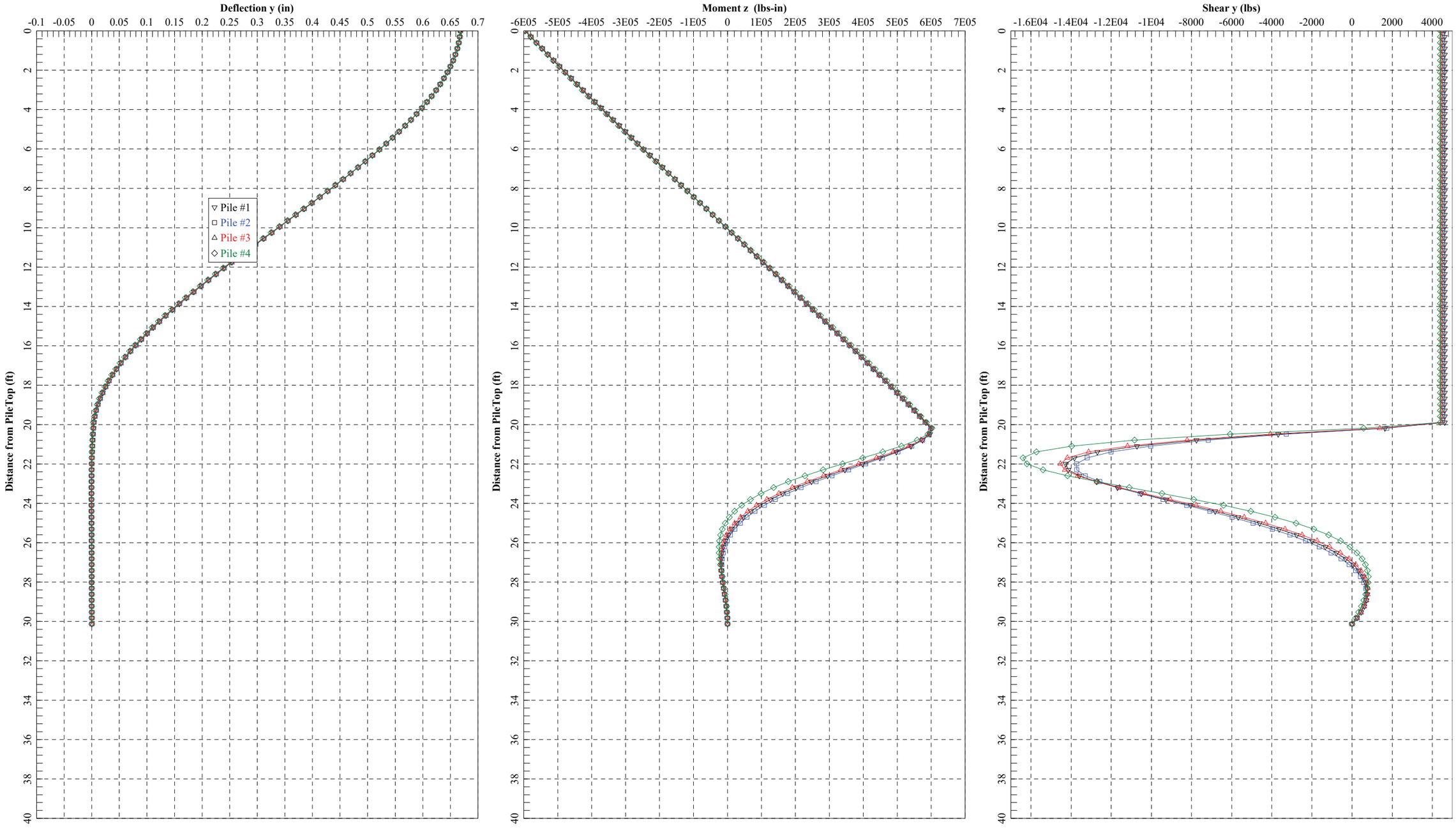
* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *

DISP X,IN	DISP Y,IN	DISP Z,IN	ROT X,RAD	ROT Y,RAD	ROT Z,RAD
0.0403441	0.66264	0.00000	0.00000	0.00000	-1.79682E-04

```
   * PILE TOP DISPLACEMENTS, GLOBAL *
              DISP. X,IN   DISP. Y,IN   DISP. Z,IN   ROT. X,RAD   ROT. Y,RAD   ROT. Z,RAD
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM       0.040344       0.6626       0.0000       0.0000       0.0000  -1.7968E-04
   Pile N.          1            1            1            1            1            1
   MAXIMUM       0.066218       0.6626       0.0000       0.0000       0.0000  -1.7968E-04
   Pile N.          4            1            1            1            1            1

   * PILE TOP REACTIONS, GLOBAL *
              FOR. X,LBS   FOR. Y,LBS   FOR. Z,LBS MOM X,LBS-IN MOM Y,LBS-IN MOM Z,LBS-IN
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM     1.2115E+05       4374.3       0.0000       0.0000       0.0000   5.9164E+05
   Pile N.          1            4            1            1            1            4
   MAXIMUM     1.9885E+05       4625.7       0.0000       0.0000       0.0000   5.9630E+05
   Pile N.          4            1            1            1            1            1

   * PILE TOP DISPLACEMENTS, LOCAL *
              DISP. x,IN   DISP. y,IN   DISP. z,IN   ROT. x,RAD   ROT. y,RAD   ROT. z,RAD
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM       0.040344       0.6626       0.0000       0.0000       0.0000  -1.7968E-04
   Pile N.          1            1            1            1            1            1
   MAXIMUM       0.066218       0.6626       0.0000       0.0000       0.0000  -1.7968E-04
   Pile N.          4            1            1            1            1            1

   * PILE TOP REACTIONS, LOCAL *
              AXIAL,LBS    LAT. y,LBS   LAT. z,LBS MOM x,LBS-IN MOM y,LBS-IN MOM z,LBS-IN
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM     1.2115E+05       4374.3       0.0000       0.0000       0.0000   5.9164E+05
   Pile N.          1            4            1            1            1            4
   MAXIMUM     1.9885E+05       4625.7       0.0000       0.0000       0.0000   5.9630E+05
   Pile N.          4            1            1            1            1            1

   * EFFECTS FOR LATERALLY LOADED PILE *

  PILE     DISPL.      DISPL.      MOMENT      MOMENT       SHEAR       SHEAR    SOIL REACT  SOIL REACT     TOTAL
            y-DIR       z-DIR       z-DIR       y-DIR       y-DIR       z-DIR       y-DIR       z-DIR      STRESS
              IN          IN        LBS-IN      LBS-IN        LBS         LBS       LBS/IN      LBS/IN    LBS/IN**2
 ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
   Min. -4.0652E-04      0.0000 -5.9630E+05      0.0000 -1.7190E+04      0.0000     -495.37      0.0000      267.80
Pile N.        1           1           1           1           1           1           1           1           1
   Max.      0.6626      0.0000  6.0368E+05      0.0000      4625.7      0.0000      2312.2      0.0000      7618.7
Pile N.        1           1           1           1           1           1           1           1           4

  LOAD CASE :     2

  * TABLE L *   COMPUTATION ON PILE CAP

  * EQUIVALENT CONCENTRATED LOAD AT ORIGIN *
       LOAD X,LBS     LOAD Y,LBS     LOAD Z,LBS    MOM X,LBS-IN   MOM Y,LBS-IN   MOM Z,LBS-IN
       5.40000E+05        0.00000        14000.0    1.00800E+06    2.40000E+05   -3.88800E+07

  * DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *
        DISP X,IN      DISP Y,IN      DISP Z,IN      ROT X,RAD      ROT Y,RAD      ROT Z,RAD
         0.0449560   -1.14510E-15        0.92014    3.74586E-11    5.70853E-03   -4.59746E-20

    * PILE TOP DISPLACEMENTS, GLOBAL *
              DISP. X,IN   DISP. Y,IN   DISP. Z,IN   ROT. X,RAD   ROT. Y,RAD   ROT. Z,RAD
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM       0.044956  -1.1451E-15       0.9201   3.7459E-11   5.7085E-03  -4.5975E-20
   Pile N.          1            1            1            1            1            1
   MAXIMUM       0.044956  -1.1451E-15       0.9201   3.7459E-11   5.7085E-03  -4.5975E-20
   Pile N.          1            1            1            1            1            1

   * PILE TOP REACTIONS, GLOBAL *
              FOR. X,LBS   FOR. Y,LBS   FOR. Z,LBS MOM X,LBS-IN MOM Y,LBS-IN MOM Z,LBS-IN
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM     1.3500E+05  -2.9655E-22       3500.0   2.0805E-03   6.0000E+04  -1.0848E-09
   Pile N.          1            1            1            1            1            1
   MAXIMUM     1.3500E+05  -1.7591E-22       3500.0   2.0805E-03   6.0000E+04  -1.0848E-09
   Pile N.          1            4            1            1            1            1

   * PILE TOP DISPLACEMENTS, LOCAL *
              DISP. x,IN   DISP. y,IN   DISP. z,IN   ROT. x,RAD   ROT. y,RAD   ROT. z,RAD
             ***********  ***********  ***********  ***********  ***********  ***********
   MINIMUM       0.044956  -1.1478E-15       0.9201   3.7459E-11   5.7085E-03  -4.5975E-20
   Pile N.          1            1            1            1            1            1
   MAXIMUM       0.044956  -1.1478E-15       0.9201   3.7459E-11   5.7085E-03  -4.5975E-20
   Pile N.          1            1            1            1            1            1

   * PILE TOP REACTIONS, LOCAL *
              AXIAL,LBS    LAT. y,LBS   LAT. z,LBS MOM x,LBS-IN MOM y,LBS-IN MOM z,LBS-IN
             ***********  ***********  ***********  ***********  ***********  ***********
```

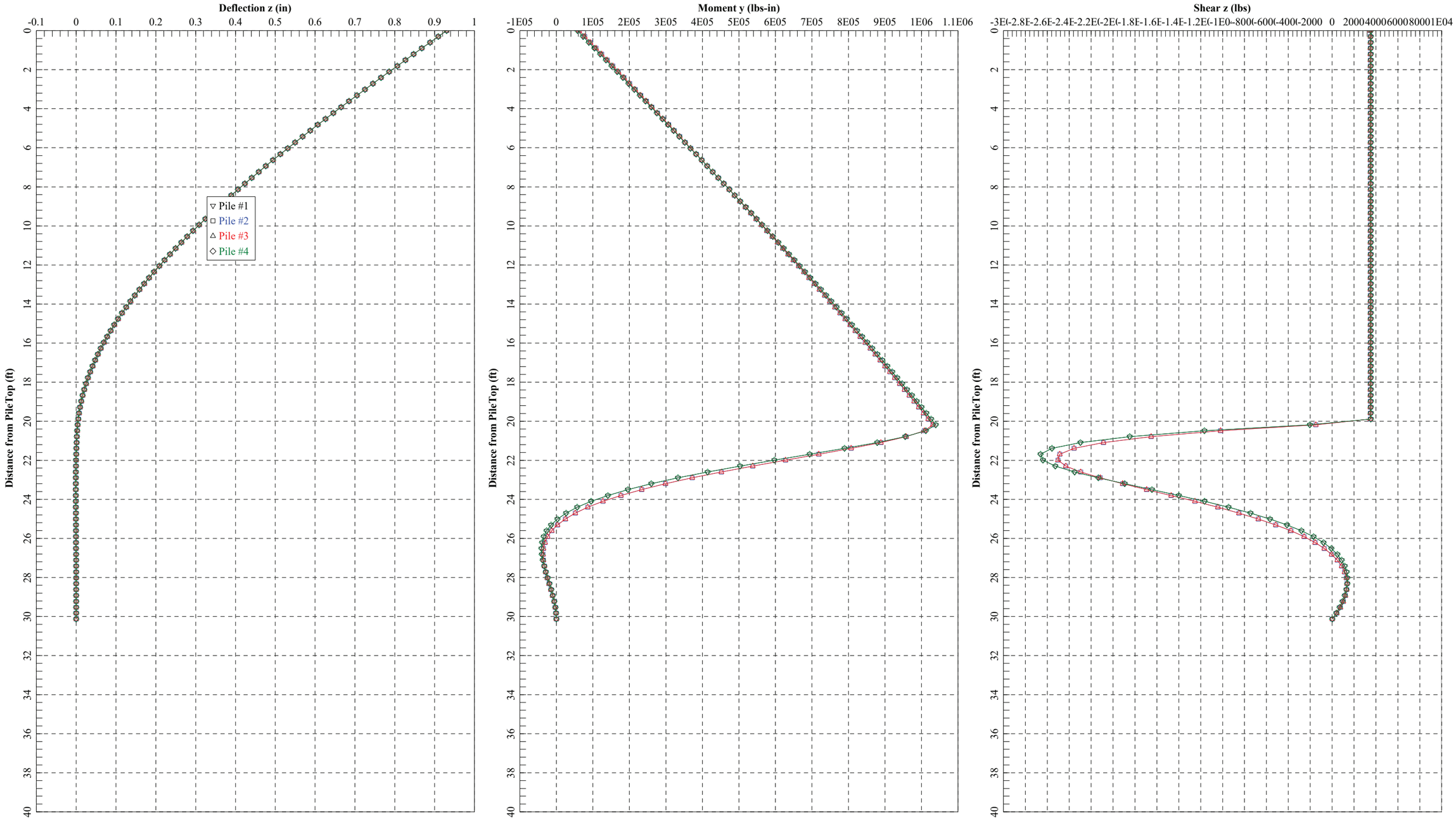
```
    MINIMUM     1.3500E+05  -8.2664E-12       3500.0   2.0805E-03   6.0000E+04  -1.0848E-09
    Pile N.          1           1             1           1            1           1
    MAXIMUM     1.3500E+05  -8.2664E-12       3500.0   2.0805E-03   6.0000E+04  -1.0848E-09
    Pile N.          1           1             1           1            1           1

    * EFFECTS FOR LATERALLY LOADED PILE *

  PILE     DISPL.      DISPL.      MOMENT      MOMENT       SHEAR       SHEAR    SOIL REACT  SOIL REACT     TOTAL
           y-DIR       z-DIR       z-DIR       y-DIR       y-DIR       z-DIR       y-DIR       z-DIR      STRESS
            IN          IN        LBS-IN      LBS-IN        LBS         LBS       LBS/IN      LBS/IN     LBS/IN**2
 ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
   Min. -1.1479E-15 -6.6171E-04 -1.0710E-09 -4.2639E+04 -8.2664E-12 -2.7953E+04 -3.9167E-12     -762.93      298.42
Pile N.       1           1           1           1           1           1           1           1           1
   Max.  7.4025E-19      0.9201  1.0847E-09  1.0334E+06  3.0031E-11      3507.2  8.5349E-13      3393.3      5172.4
Pile N.       1           1           1           1           1           1           1           1           1

  LOAD CASE :     3

  * TABLE L *   COMPUTATION ON PILE CAP

  * EQUIVALENT CONCENTRATED LOAD AT ORIGIN *
       LOAD X,LBS     LOAD Y,LBS     LOAD Z,LBS    MOM X,LBS-IN   MOM Y,LBS-IN   MOM Z,LBS-IN
       6.80000E+05        0.00000        8000.00    5.76000E+05    1.68000E+06   -4.89600E+07

  * DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN *
        DISP X,IN      DISP Y,IN      DISP Z,IN      ROT X,RAD      ROT Y,RAD      ROT Z,RAD
         0.0566113   -1.50634E-15        1.13212   -6.27236E-11    7.90138E-03    1.56945E-19

    * PILE TOP DISPLACEMENTS, GLOBAL *
                DISP. X,IN   DISP. Y,IN   DISP. Z,IN   ROT. X,RAD   ROT. Y,RAD   ROT. Z,RAD
                ***********  ***********  ***********  ***********  ***********  ***********
    MINIMUM       0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    Pile N.          1           1             1           1            1           1
    MAXIMUM       0.056611  -1.5063E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    Pile N.          1           1             1           1            1           1

    * PILE TOP REACTIONS, GLOBAL *
                 FOR. X,LBS   FOR. Y,LBS   FOR. Z,LBS MOM X,LBS-IN MOM Y,LBS-IN MOM Z,LBS-IN
                 ***********  ***********  ***********  ***********  ***********  ***********
    MINIMUM      1.7000E+05  -8.5446E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    Pile N.          1           4             1           1            1           1
    MAXIMUM      1.7000E+05  -8.2394E-21       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    Pile N.          1           1             1           1            1           1

    * PILE TOP DISPLACEMENTS, LOCAL *
                DISP. x,IN   DISP. y,IN   DISP. z,IN   ROT. x,RAD   ROT. y,RAD   ROT. z,RAD
                ***********  ***********  ***********  ***********  ***********  ***********
    MINIMUM       0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    Pile N.          1           1             1           1            1           1
    MAXIMUM       0.056611  -1.5098E-15       1.1321  -6.2724E-11   7.9014E-03   1.5694E-19
    Pile N.          1           1             1           1            1           1

    * PILE TOP REACTIONS, LOCAL *
                 AXIAL,LBS    LAT. y,LBS   LAT. z,LBS MOM x,LBS-IN MOM y,LBS-IN MOM z,LBS-IN
                 ***********  ***********  ***********  ***********  ***********  ***********
    MINIMUM      1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    Pile N.          1           1             1           1            1           1
    MAXIMUM      1.7000E+05  -1.0410E-11       2000.0  -3.4838E-03   4.2000E+05  -1.3890E-09
    Pile N.          1           1             1           1            1           1

    * EFFECTS FOR LATERALLY LOADED PILE *

  PILE     DISPL.      DISPL.      MOMENT      MOMENT       SHEAR       SHEAR    SOIL REACT  SOIL REACT     TOTAL
           y-DIR       z-DIR       z-DIR       y-DIR       y-DIR       z-DIR       y-DIR       z-DIR      STRESS
            IN          IN        LBS-IN      LBS-IN        LBS         LBS       LBS/IN      LBS/IN     LBS/IN**2
 ******  **********  **********  **********  **********  **********  **********  **********  **********  **********
   Min. -1.5098E-15 -7.0657E-04 -1.3869E-09 -4.5700E+04 -1.0409E-11 -2.9794E+04 -5.0298E-12     -813.28      375.78
Pile N.       1           1           1           1           1           1           1           1           1
   Max.  9.5966E-19      1.1321  1.3890E-09  1.0982E+06  3.8890E-11      2007.4  1.1046E-12      3549.9      6513.4
Pile N.       1           1           1           1           1           1           1           1           1
```

Transverse



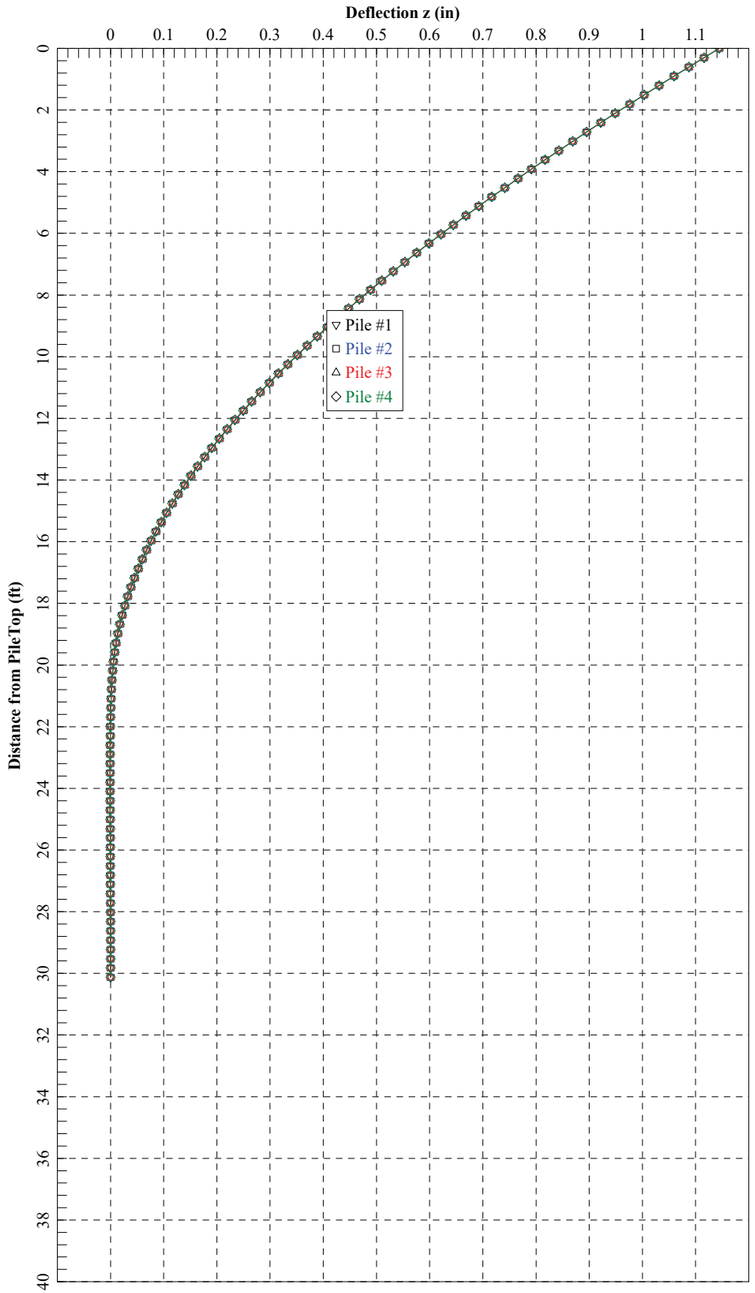
Load Case 1

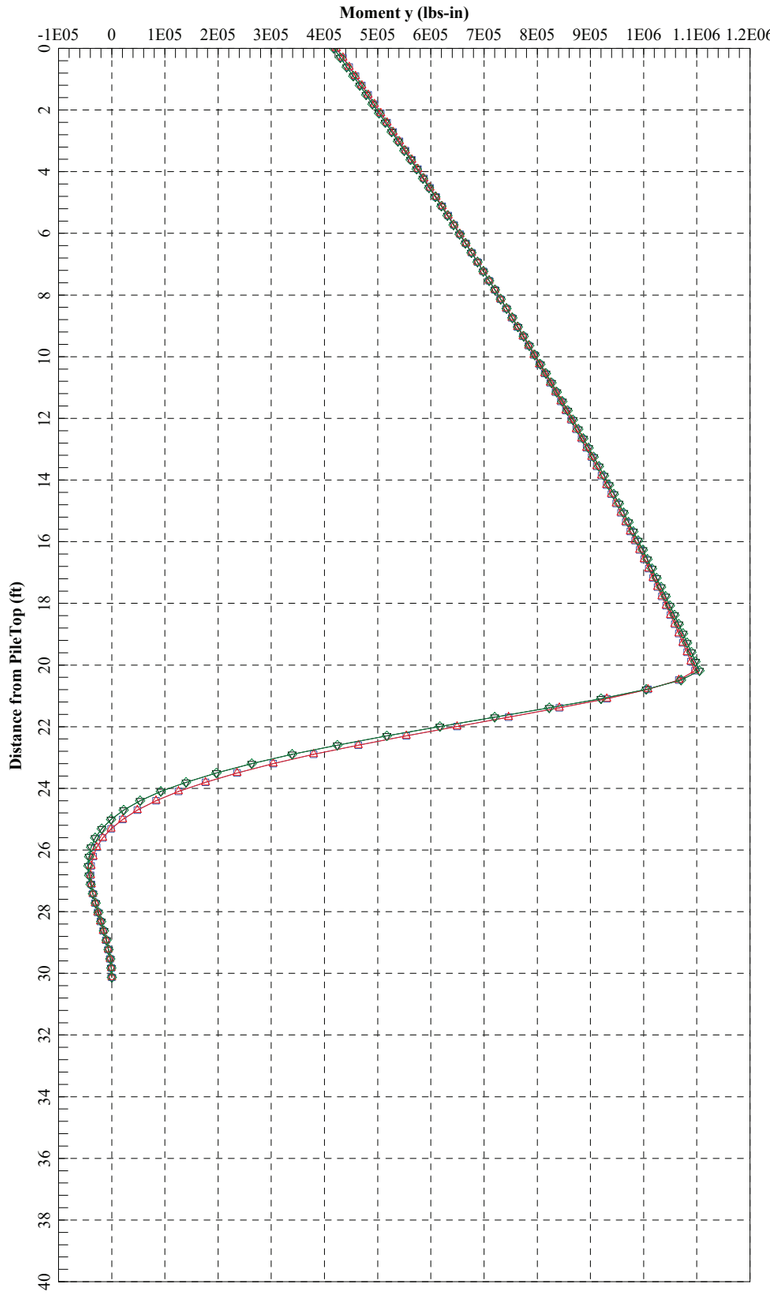
Long - Max Shear Case

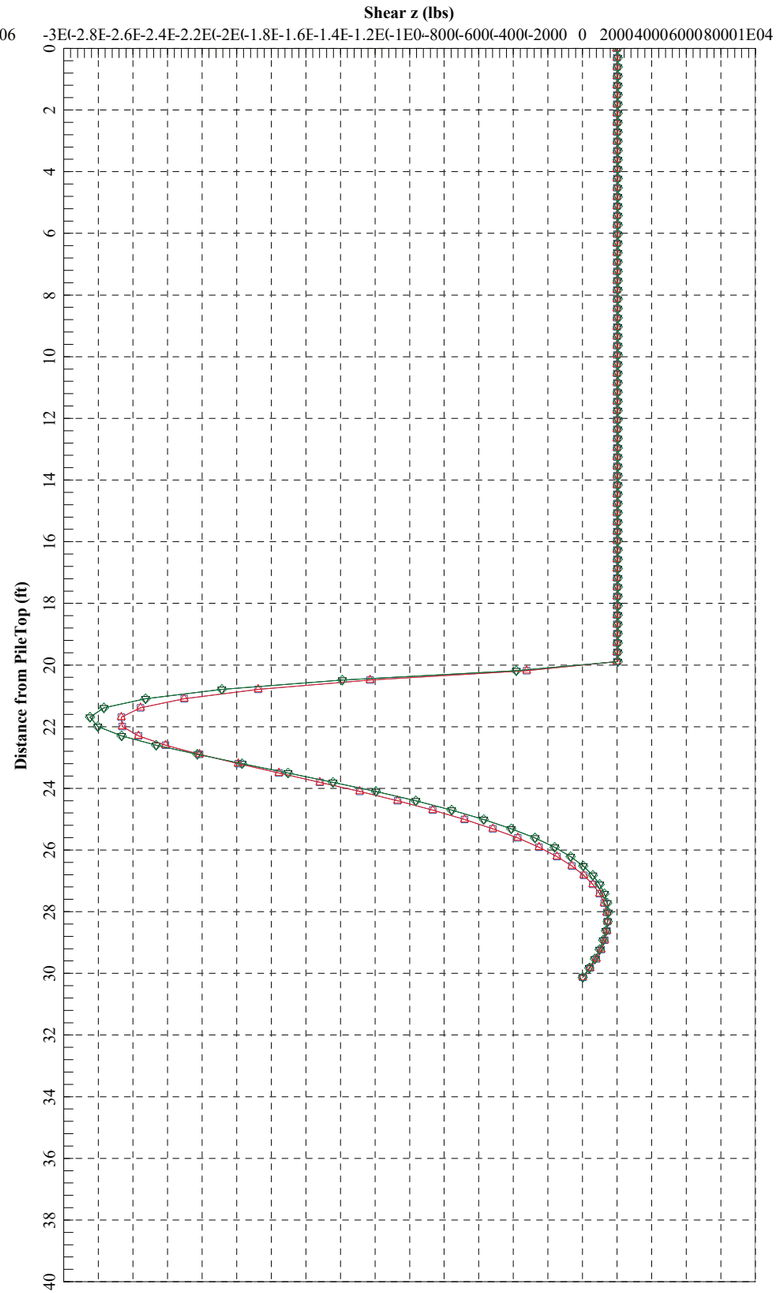


Load Case 2

Long - Max Axial Case







Load Case 3

```
================================================================================

                            LPile for Version 2022-12.012

                             License ID : 162969677
                        License Type : (Single User License)

                   Analysis of Individual Piles and Drilled Shafts
                  Subjected to Lateral Loading Using the p-y Method
                             © 1985-2024 by Ensoft, Inc.
                                 All Rights Reserved

                  This software is licensed for exclusive use by:
                                 ESP Associates, PA
                                 Fort Mill, SC, USA

================================================================================


This model was prepared by:
hagopian



--------------------------------------------------------------------------------
                               Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\1 - Lateral\

Name of input data file:
END BENT 2 Longitudinal Strong Axis.lp12d

Name of output report file:
END BENT 2 Longitudinal Strong Axis.lp12o

Name of plot output file:
END BENT 2 Longitudinal Strong Axis.lp12p

Name of runtime message file:
END BENT 2 Longitudinal Strong Axis.lp12r



--------------------------------------------------------------------------------
                               Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 17, 2025           Time:   9:52:37



--------------------------------------------------------------------------------
                                    Problem Title
--------------------------------------------------------------------------------

Project Name: 5631 US HWY 19E


Job Number: 25-01592-B


Client: Volkert, Inc.


Engineer: ESP Associates/PB/HAA


Description: END BENT 2, Longitudinal, Strong Axis




--------------------------------------------------------------------------------
                             Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
```

```
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed                =          500
 - Deflection tolerance for convergence                =   1.0000E-05 in
 - Maximum allowable deflection                        =     100.0000 in
 - Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats



---------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Number of pile sections defined                       =            1
Total length of pile                                  =       18.000 ft
Depth of ground surface below top of pile             =       0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           12.0000
  2            18.000           12.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a AISC strong axis steel pile
   Length of section                                  =    18.000000 ft
   AISC Section Type                                  = HP


   AISC Section Name                                  = HP12X53


   Pile width                                         =    12.000000 in



---------------------------------------------------------------------------
                       Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 3 layers

Layer 1 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =       0.0000 ft
   Distance from top of pile to bottom of layer       =    11.000000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
```

```
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 2 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =    11.000000 ft
   Distance from top of pile to bottom of layer       =    13.000000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 3 is massive rock, p-y criteria by Liang et al., 2009

   Distance from top of pile to top of layer          =    13.000000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =   150.000000 pcf
   Effective unit weight at bottom of layer           =   150.000000 pcf
   Uniaxial compressive strength at top of layer      =       14500. psi
   Uniaxial compressive strength at bottom of layer   =       14500. psi
   Poisson's ratio at top of layer                    =     0.200000
   Poisson's ratio at bottom of layer                 =     0.200000
   Option 1: Intact rock modulus at top of layer      =       0.0000 psi
             Intact rock modulus at bottom of layer   =       0.0000 psi
   Option 1: Geologic Strength Index for layer        =    51.000000
   Option 2: Rock mass modulus at top of layer        =     1500000. psi
             Rock mass modulus at bottom of layer     =     1500000. psi
   Option 2 will use the input value of rock mass modulus to compute the p-y curve
            in massive rock.
   The rock type is (metamorphic) gneiss, Hoek-Brown Material Constant mi = 28


 (Depth of the lowest soil layer extends 32.000 ft below the pile tip)


**** Warning - Possible Input Data Error ****

Values entered for effective unit weights of soil were outside the limits of
20 pcf to 140 pcf.

The minimum input value, in layer   1, for effective unit weight = .10 pcf

This data may be erroneous. Please check your data.


**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer   1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.


--------------------------------------------------------------------------------
                         Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial     Rock Mass    Geologic      Elastic     Int. Rock
Hoek-Brown
 Num.           Name            Depth       Unit Wt.       qu         Modulus     Strength     Subgrade      Modulus
Material     Poisson's
          (p-y Curve Type)        ft           pcf          psi          psi         Index      Mod. pci        psi
Index, mi      Ratio
-----   -------------------   ----------   ----------   ----------   ----------   ----------   ----------   ----------
----------   ----------
  1           Elastic               0.00      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade           11.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  2           Elastic            11.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade           13.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  3           Massive            13.0000     150.0000       14500.     1500000.      51.0000       --          0.00
28.0000       0.2000
              Rock               50.0000     150.0000       14500.                   51.0000       --          0.00
28.0000       0.2000
```

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 10000. lbs	S = 0.0000 in/in	110000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	18.000000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.500000 sq. in.
Moment of Inertia	=	393.000000 in^4
Elastic Bending Stiffness	=	11397000. kip-in^2
Plastic Modulus, Z	=	74.000000in^3
Plastic Moment Capacity = Fy Z	=	3700.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	775.000 kips
Nominal Axial Tensile Capacity	=	-775.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	110.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 110.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg

| | | |

0.0008435	3445.	4083720.	8.4288198	50.0000000	Y
0.0008882	3448.	3881585.	8.4287605	50.0000000	Y
0.0009329	3450.	3698388.	8.4286491	50.0000000	Y
0.0009776	3452.	3531629.	8.4285538	50.0000000	Y
0.0010223	3454.	3379086.	8.4288537	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	110.0000000000	3454.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	0.00
2	11.0000	11.0000	Yes	No	0.00	0.00
3	13.0000	13.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

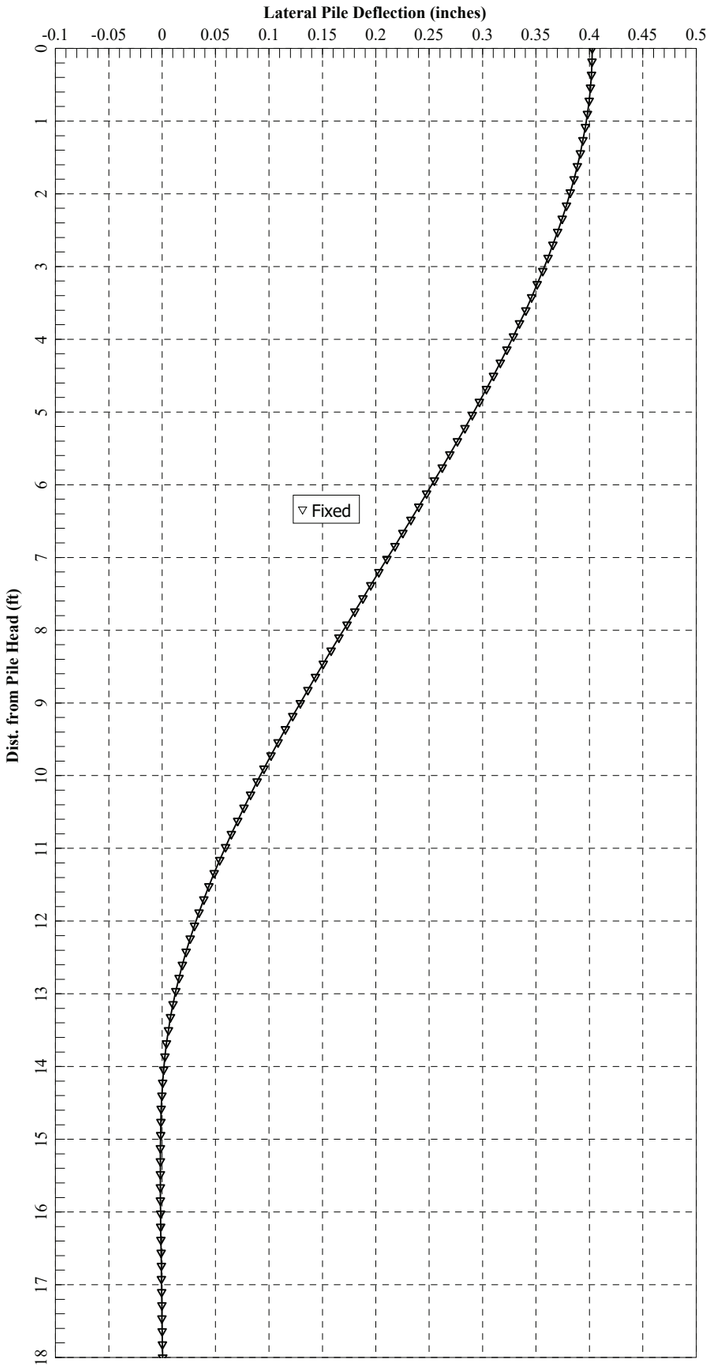
Shear force at pile head = 10000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 110000.0 lbs

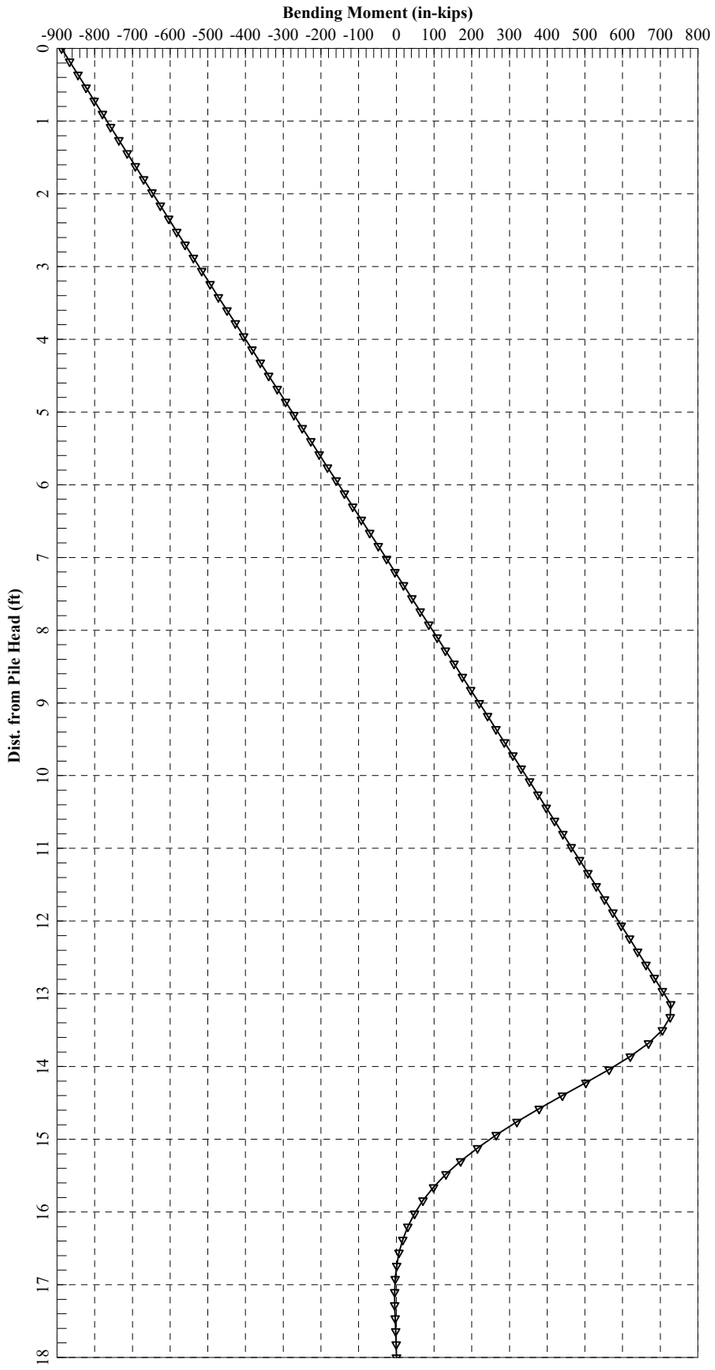
(Zero slope for this load indicates fixed-head conditions)

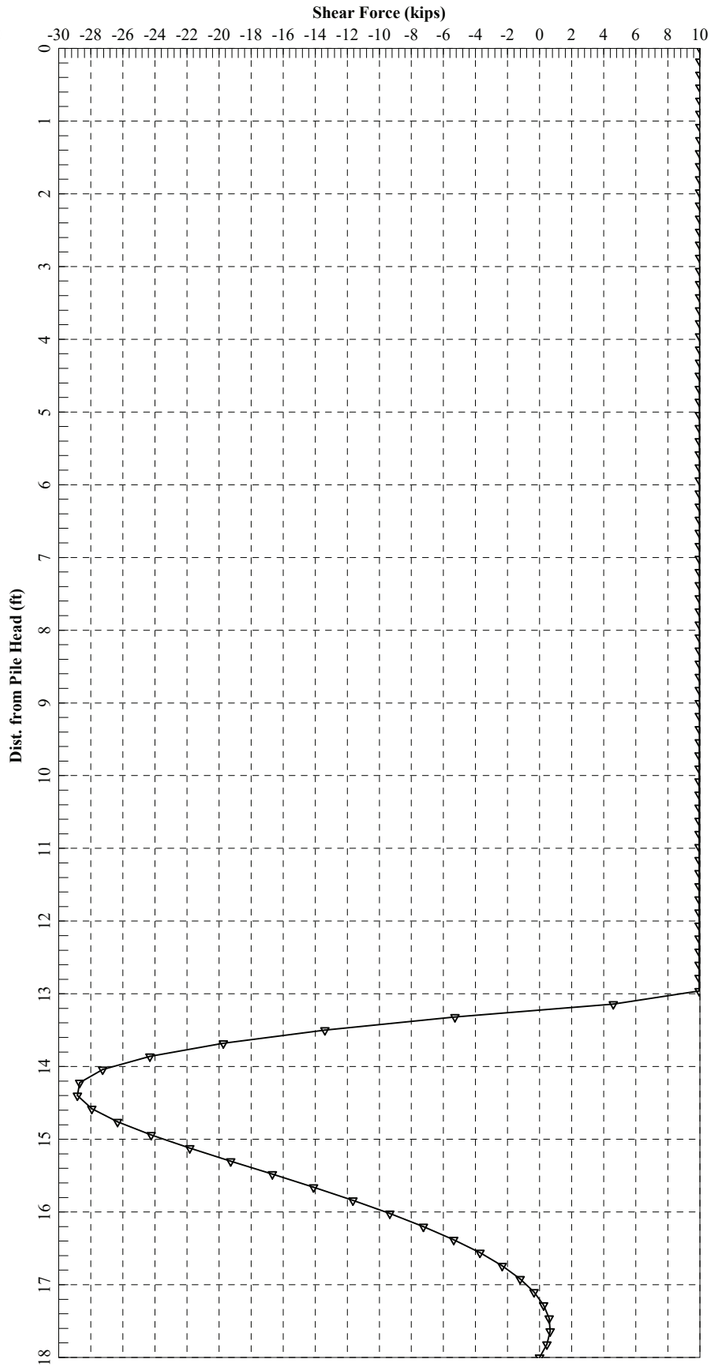
Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.4026	-887938.	10000.	0.00	20653.	1.11E+10	-0.483	1.2960	0.00
0.1800	0.4024	-866318.	9999.	-1.70E-04	20323.	1.11E+10	-0.483	2.5920	0.00
0.3600	0.4018	-844661.	9998.	-3.36E-04	19992.	1.11E+10	-0.482	2.5920	0.00
0.5400	0.4009	-822968.	9997.	-4.98E-04	19661.	1.11E+10	-0.481	2.5920	0.00
0.7200	0.3997	-801239.	9996.	-6.55E-04	19329.	1.11E+10	-0.480	2.5920	0.00
0.9000	0.3981	-779475.	9995.	-8.08E-04	18997.	1.11E+10	-0.478	2.5920	0.00
1.0800	0.3962	-757677.	9994.	-9.57E-04	18664.	1.11E+10	-0.475	2.5920	0.00
1.2600	0.3940	-735847.	9993.	-0.00110	18331.	1.11E+10	-0.473	2.5920	0.00
1.4400	0.3914	-713985.	9992.	-0.00124	17997.	1.11E+10	-0.470	2.5920	0.00
1.6200	0.3886	-692092.	9991.	-0.00138	17663.	1.11E+10	-0.466	2.5920	0.00
1.8000	0.3855	-670170.	9990.	-0.00151	17328.	1.11E+10	-0.463	2.5920	0.00

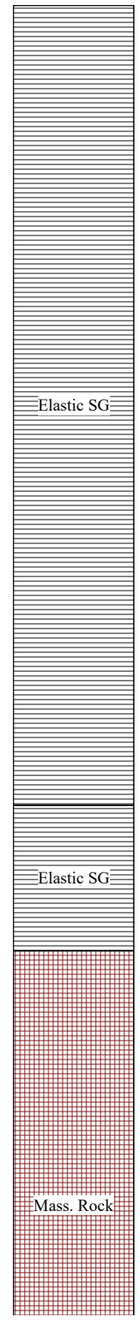
1.9800	0.3821	-648218.	9989.	-0.00164	1.11E+10	-0.458	2.5920	0.00	6993.	1.11E+10	-0.458	2.5920	0.00
2.1600	0.3784	-626240.	9988.	-0.00176	1.11E+10	-0.454	2.5920	0.00	6658.	1.11E+10	-0.454	2.5920	0.00
2.3400	0.3744	-604234.	9987.	-0.00188	1.11E+10	-0.449	2.5920	0.00	6322.	1.11E+10	-0.449	2.5920	0.00
2.5200	0.3703	-582203.	9986.	-0.00200	1.11E+10	-0.444	2.5920	0.00	5985.	1.11E+10	-0.444	2.5920	0.00
2.7000	0.3658	-560147.	9985.	-0.00211	1.11E+10	-0.439	2.5920	0.00	5649.	1.11E+10	-0.439	2.5920	0.00
2.8800	0.3612	-538067.	9984.	-0.00221	1.11E+10	-0.433	2.5920	0.00	5312.	1.11E+10	-0.433	2.5920	0.00
3.0600	0.3563	-515964.	9983.	-0.00232	1.11E+10	-0.428	2.5920	0.00	4974.	1.11E+10	-0.428	2.5920	0.00
3.2400	0.3511	-493840.	9982.	-0.00241	1.11E+10	-0.421	2.5920	0.00	4636.	1.11E+10	-0.421	2.5920	0.00
3.4200	0.3458	-471695.	9981.	-0.00251	1.11E+10	-0.415	2.5920	0.00	4298.	1.11E+10	-0.415	2.5920	0.00
3.6000	0.3403	-449530.	9980.	-0.00260	1.11E+10	-0.408	2.5920	0.00	3960.	1.11E+10	-0.408	2.5920	0.00
3.7800	0.3346	-427346.	9979.	-0.00268	1.11E+10	-0.402	2.5920	0.00	3621.	1.11E+10	-0.402	2.5920	0.00
3.9600	0.3287	-405145.	9979.	-0.00276	1.11E+10	-0.394	2.5920	0.00	3282.	1.11E+10	-0.394	2.5920	0.00
4.1400	0.3227	-382927.	9978.	-0.00284	1.11E+10	-0.387	2.5920	0.00	2943.	1.11E+10	-0.387	2.5920	0.00
4.3200	0.3165	-360692.	9977.	-0.00291	1.11E+10	-0.380	2.5920	0.00	2604.	1.11E+10	-0.380	2.5920	0.00
4.5000	0.3101	-338443.	9976.	-0.00298	1.11E+10	-0.372	2.5920	0.00	2264.	1.11E+10	-0.372	2.5920	0.00
4.6800	0.3036	-316181.	9975.	-0.00304	1.11E+10	-0.364	2.5920	0.00	1924.	1.11E+10	-0.364	2.5920	0.00
4.8600	0.2970	-293905.	9974.	-0.00310	1.11E+10	-0.356	2.5920	0.00	1584.	1.11E+10	-0.356	2.5920	0.00
5.0400	0.2902	-271617.	9974.	-0.00316	1.11E+10	-0.348	2.5920	0.00	1244.	1.11E+10	-0.348	2.5920	0.00
5.2200	0.2833	-249319.	9973.	-0.00321	1.11E+10	-0.340	2.5920	0.00	0903.	1.11E+10	-0.340	2.5920	0.00
5.4000	0.2764	-227011.	9972.	-0.00325	1.11E+10	-0.332	2.5920	0.00	0563.	1.11E+10	-0.332	2.5920	0.00
5.5800	0.2693	-204693.	9972.	-0.00329	1.11E+10	-0.323	2.5920	0.00	0222.	1.11E+10	-0.323	2.5920	0.00
5.7600	0.2621	-182368.	9971.	-0.00333	1.11E+10	-0.315	2.5920	0.00	9881.	1.11E+10	-0.315	2.5920	0.00
5.9400	0.2549	-160036.	9970.	-0.00336	1.11E+10	-0.306	2.5920	0.00	9540.	1.11E+10	-0.306	2.5920	0.00
6.1200	0.2476	-137698.	9970.	-0.00339	1.11E+10	-0.297	2.5920	0.00	9199.	1.11E+10	-0.297	2.5920	0.00
6.3000	0.2402	-115355.	9969.	-0.00342	1.11E+10	-0.288	2.5920	0.00	8858.	1.11E+10	-0.288	2.5920	0.00
6.4800	0.2328	-93008.	9968.	-0.00344	1.11E+10	-0.279	2.5920	0.00	8517.	1.11E+10	-0.279	2.5920	0.00
6.6600	0.2254	-70658.	9968.	-0.00345	1.11E+10	-0.270	2.5920	0.00	8176.	1.11E+10	-0.270	2.5920	0.00
6.8400	0.2179	-48306.	9967.	-0.00347	1.11E+10	-0.261	2.5920	0.00	7834.	1.11E+10	-0.261	2.5920	0.00
7.0200	0.2104	-25953.	9967.	-0.00347	1.11E+10	-0.252	2.5920	0.00	7493.	1.11E+10	-0.252	2.5920	0.00
7.2000	0.2029	-3600.	9966.	-0.00348	1.11E+10	-0.243	2.5920	0.00	7152.	1.11E+10	-0.243	2.5920	0.00
7.3800	0.1954	18752.	9966.	-0.00347	1.11E+10	-0.234	2.5920	0.00	7383.	1.11E+10	-0.234	2.5920	0.00
7.5600	0.1879	41102.	9965.	-0.00347	1.11E+10	-0.225	2.5920	0.00	7724.	1.11E+10	-0.225	2.5920	0.00
7.7400	0.1804	63449.	9965.	-0.00346	1.11E+10	-0.216	2.5920	0.00	8065.	1.11E+10	-0.216	2.5920	0.00
7.9200	0.1729	85792.	9964.	-0.00344	1.11E+10	-0.208	2.5920	0.00	8407.	1.11E+10	-0.208	2.5920	0.00
8.1000	0.1655	108131.	9964.	-0.00343	1.11E+10	-0.199	2.5920	0.00	8748.	1.11E+10	-0.199	2.5920	0.00
8.2800	0.1581	130463.	9963.	-0.00340	1.11E+10	-0.190	2.5920	0.00	9089.	1.11E+10	-0.190	2.5920	0.00
8.4600	0.1508	152788.	9963.	-0.00337	1.11E+10	-0.181	2.5920	0.00	9429.	1.11E+10	-0.181	2.5920	0.00
8.6400	0.1436	175106.	9962.	-0.00334	1.11E+10	-0.172	2.5920	0.00	9770.	1.11E+10	-0.172	2.5920	0.00
8.8200	0.1364	197415.	9962.	-0.00331	1.11E+10	-0.164	2.5920	0.00	0111.	1.11E+10	-0.164	2.5920	0.00
9.0000	0.1293	219714.	9962.	-0.00327	1.11E+10	-0.155	2.5920	0.00	0451.	1.11E+10	-0.155	2.5920	0.00
9.1800	0.1223	242002.	9961.	-0.00322	1.11E+10	-0.147	2.5920	0.00	0791.	1.11E+10	-0.147	2.5920	0.00
9.3600	0.1154	264278.	9961.	-0.00317	1.11E+10	-0.138	2.5920	0.00	1132.	1.11E+10	-0.138	2.5920	0.00
9.5400	0.1086	286541.	9961.	-0.00312	1.11E+10	-0.130	2.5920	0.00	1471.	1.11E+10	-0.130	2.5920	0.00
9.7200	0.1019	308791.	9961.	-0.00306	1.11E+10	-0.122	2.5920	0.00	1811.	1.11E+10	-0.122	2.5920	0.00
9.9000	0.09534	331025.	9960.	-0.00300	1.11E+10	-0.114	2.5920	0.00	2151.	1.11E+10	-0.114	2.5920	0.00
10.0800	0.08893	353244.	9960.	-0.00293	1.11E+10	-0.107	2.5920	0.00	2490.	1.11E+10	-0.107	2.5920	0.00
10.2600	0.08267	375447.	9960.	-0.00286	1.11E+10	-0.09920	2.5920	0.00	2829.	1.11E+10	-0.09920	2.5920	0.00
10.4400	0.07656	397631.	9960.	-0.00279	1.11E+10	-0.09188	2.5920	0.00	3167.	1.11E+10	-0.09188	2.5920	0.00
10.6200	0.07063	419797.	9959.	-0.00271	1.11E+10	-0.08475	2.5920	0.00	3506.	1.11E+10	-0.08475	2.5920	0.00
10.8000	0.06486	441943.	9959.	-0.00262	1.11E+10	-0.07784	2.5920	0.00	3844.	1.11E+10	-0.07784	2.5920	0.00
10.9800	0.05929	464068.	9959.	-0.00254	1.11E+10	-0.07114	2.5920	0.00	4182.	1.11E+10	-0.07114	2.5920	0.00
11.1600	0.05390	486172.	9959.	-0.00244	1.11E+10	-0.06468	2.5920	0.00	4519.	1.11E+10	-0.06468	2.5920	0.00
11.3400	0.04872	508253.	9959.	-0.00235	1.11E+10	-0.05847	2.5920	0.00	4856.	1.11E+10	-0.05847	2.5920	0.00
11.5200	0.04376	530310.	9959.	-0.00225	1.11E+10	-0.05251	2.5920	0.00	5193.	1.11E+10	-0.05251	2.5920	0.00
11.7000	0.03901	552342.	9959.	-0.00214	1.11E+10	-0.04682	2.5920	0.00	5529.	1.11E+10	-0.04682	2.5920	0.00
11.8800	0.03450	574349.	9958.	-0.00203	1.11E+10	-0.04140	2.5920	0.00	5865.	1.11E+10	-0.04140	2.5920	0.00
12.0600	0.03023	596329.	9958.	-0.00192	1.11E+10	-0.03627	2.5920	0.00	6201.	1.11E+10	-0.03627	2.5920	0.00
12.2400	0.02621	618282.	9958.	-0.00180	1.11E+10	-0.03145	2.5920	0.00	6536.	1.11E+10	-0.03145	2.5920	0.00
12.4200	0.02244	640206.	9958.	-0.00168	1.11E+10	-0.02693	2.5920	0.00	6871.	1.11E+10	-0.02693	2.5920	0.00
12.6000	0.01894	662100.	9958.	-0.00155	1.11E+10	-0.02273	2.5920	0.00	7205.	1.11E+10	-0.02273	2.5920	0.00
12.7800	0.01573	683964.	9958.	-0.00142	1.11E+10	-0.01887	2.5920	0.00	7539.	1.11E+10	-0.01887	2.5920	0.00
12.9600	0.01279	705796.	9958.	-0.00129	1.11E+10	-0.01535	2.5920	0.00	7872.	1.11E+10	-0.01535	2.5920	0.00
13.1400	0.01016	727595.	4590.	-0.00115	1.11E+10	-4970.	1057028.	0.00	8205.	1.11E+10	-4970.	1057028.	0.00
13.3200	0.00782	726171.	-5280.	-0.00101	1.11E+10	-4168.	1150551.	0.00	8183.	1.11E+10	-4168.	1150551.	0.00
13.5000	0.00580	705268.	-13391.	-8.71E-04	1.11E+10	-3343.	1245722.	0.00	7864.	1.11E+10	-3343.	1245722.	0.00
13.6800	0.00406	668734.	-19724.	-7.37E-04	1.11E+10	-2521.	1339739.	0.00	7306.	1.11E+10	-2521.	1339739.	0.00
13.8600	0.00261	620409.	-24313.	-6.12E-04	1.11E+10	-1728.	1429553.	0.00	6569.	1.11E+10	-1728.	1429553.	0.00
14.0400	0.00142	563993.	-27252.	-4.98E-04	1.11E+10	-992.863	1512196.	0.00	5707.	1.11E+10	-992.863	1512196.	0.00
14.2200	4.61E-04	502918.	-28690.	-3.94E-04	1.11E+10	-338.585	1585135.	0.00	4775.	1.11E+10	-338.585	1585135.	0.00
14.4000	-2.85E-04	440240.	-28828.	-3.03E-04	1.11E+10	210.9097	1599294.	0.00	3818.	1.11E+10	210.9097	1599294.	0.00
14.5800	-8.47E-04	378527.	-27941.	-2.23E-04	1.11E+10	609.8133	1555605.	0.00	2876.	1.11E+10	609.8133	1555605.	0.00
14.7600	-0.00125	319641.	-26329.	-1.56E-04	1.11E+10	883.1990	1526009.	0.00	1977.	1.11E+10	883.1990	1526009.	0.00
14.9400	-0.00152	264861.	-24230.	-9.91E-05	1.11E+10	1066.	1507135.	0.00	1140.	1.11E+10	1066.	1507135.	0.00
15.1200	-0.00168	215015.	-21829.	-5.26E-05	1.11E+10	1163.	1496515.	0.00	0379.	1.11E+10	1163.	1496515.	0.00
15.3000	-0.00175	170585.	-19269.	-1.52E-05	1.11E+10	1207.	1492277.	0.00	9701.	1.11E+10	1207.	1492277.	0.00
15.4800	-0.00174	131779.	-16664.	1.41E-05	1.11E+10	1205.	1492963.	0.00	9109.	1.11E+10	1205.	1492963.	0.00
15.6600	-0.00169	98590.	-14100.	3.64E-05	1.11E+10	1169.	1497411.	0.00	8602.	1.11E+10	1169.	1497411.	0.00
15.8400	-0.00159	70850.	-11644.	5.28E-05	1.11E+10	1105.	1504685.	0.00	8178.	1.11E+10	1105.	1504685.	0.00
16.0200	-0.00146	48265.	-9346.	6.44E-05	1.11E+10	1022.	1514028.	0.00	7834.	1.11E+10	1022.	1514028.	0.00
16.2000	-0.00131	30445.	-7245.	7.20E-05	1.11E+10	923.8644	1524827.	0.00	7562.	1.11E+10	923.8644	1524827.	0.00
16.3800	-0.00115	16934.	-5366.	7.66E-05	1.11E+10	815.8158	1536597.	0.00	7355.	1.11E+10	815.8158	1536597.	0.00
16.5600	-9.78E-04	7228.	-3727.	7.89E-05	1.11E+10	701.1903	1548965.	0.00	7207.	1.11E+10	701.1903	1548965.	0.00
16.7400	-8.06E-04	793.5942	-2341.	7.97E-05	1.11E+10	582.5619	1561655.	0.00	7109.	1.11E+10	582.5619	1561655.	0.00

```
   16.9200  -6.33E-04     -2923.     -1213.   7.95E-05      7141.   1.11E+10   461.7092   1574480.       0.00
   17.1000  -4.62E-04     -4485.   -347.645   7.88E-05      7165.   1.11E+10   339.7139   1587325.       0.00
   17.2800  -2.93E-04     -4462.   253.6819   7.79E-05      7165.   1.11E+10   217.0704   1600141.       0.00
   17.4600  -1.26E-04     -3426.   589.4345   7.72E-05      7149.   1.11E+10    93.8117   1612925.       0.00
   17.6400   4.03E-05     -1952.   658.1004   7.66E-05      7127.   1.11E+10    -30.232   1619478.       0.00
   17.8200   2.05E-04   -619.688   460.3692   7.64E-05      7106.   1.11E+10   -152.852   1606945.       0.00
   18.0000   3.70E-04       0.00       0.00   7.63E-05      7097.   1.11E+10   -273.416    797356.       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 1:

Pile-head deflection             =     0.40255388 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -887938. inch-lbs
Maximum shear force              =        -28828. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =    14.40000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              2


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load               Load                Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1     Load 1       2        Load 2       lbs      inches     radians      lbs      in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  V, lb     10000.   S, rad         0.00    110000.     0.4026       0.00    -28828.   -887938.


Maximum pile-head deflection = 0.4025538780 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.
```


Lateral Pile Deflection (inches)
-0.1 -0.05 0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Fixed


Bending Moment (in-kips)
-900 -800 -700 -600 -500 -400 -300 -200 -100 0 100 200 300 400 500 600 700 800
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


Shear Force (kips)
-30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


Elastic SG
Elastic SG
Mass. Rock

```
================================================================================

                            LPile for Version 2022-12.012

                             License ID : 162969677
                        License Type : (Single User License)

                    Analysis of Individual Piles and Drilled Shafts
                   Subjected to Lateral Loading Using the p-y Method
                              © 1985-2024 by Ensoft, Inc.
                                  All Rights Reserved

                   This software is licensed for exclusive use by:
                                 ESP Associates, PA
                                 Fort Mill, SC, USA

================================================================================


This model was prepared by:
hagopian



--------------------------------------------------------------------------------
                               Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Projects\2025\25-01592-B PRB 5631 US Highway 19E\Analysis\1 - Lateral\

Name of input data file:
END BENT 2 Transverse Weak Axis.lp12d

Name of output report file:
END BENT 2 Transverse Weak Axis.lp12o

Name of plot output file:
END BENT 2 Transverse Weak Axis.lp12p

Name of runtime message file:
END BENT 2 Transverse Weak Axis.lp12r



--------------------------------------------------------------------------------
                               Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 17, 2025           Time:   9:54:07



--------------------------------------------------------------------------------
                                    Problem Title
--------------------------------------------------------------------------------

Project Name: 5631 US HWY 19E


Job Number: 25-01592-B


Client: Volkert, Inc.


Engineer: ESP Associates/PB/HAA


Description: END BENT 2, Transverse, Weak Axis




--------------------------------------------------------------------------------
                             Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
```

```
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed                =          500
 - Deflection tolerance for convergence                =   1.0000E-05 in
 - Maximum allowable deflection                        =     100.0000 in
 - Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats



---------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Number of pile sections defined                       =            1
Total length of pile                                  =       18.000 ft
Depth of ground surface below top of pile             =       0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           11.8000
  2            18.000           11.8000


Input Structural Properties for Pile Sections:
-----------------------------------------------

Pile Section No. 1:

   Section 1 is a AISC weak axis steel pile
   Length of section                                  =    18.000000 ft
   AISC Section Type                                  = HP


   AISC Section Name                                  = HP12X53


   Pile width                                         =    11.800000 in



---------------------------------------------------------------------------
                       Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 3 layers

Layer 1 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =       0.0000 ft
   Distance from top of pile to bottom of layer       =    11.000000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
```

```
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 2 is modelled using an elastic subgrade modulus

   Distance from top of pile to top of layer          =    11.000000 ft
   Distance from top of pile to bottom of layer       =    13.000000 ft
   Effective unit weight at top of layer              =     0.100000 pcf
   Effective unit weight at bottom of layer           =     0.100000 pcf
   Elastic subgrade at top of layer                   =     0.100000 pci
   Elastic subgrade at bottom of layer                =     0.100000 pci


Layer 3 is massive rock, p-y criteria by Liang et al., 2009

   Distance from top of pile to top of layer          =    13.000000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =   150.000000 pcf
   Effective unit weight at bottom of layer           =   150.000000 pcf
   Uniaxial compressive strength at top of layer      =       14500. psi
   Uniaxial compressive strength at bottom of layer   =       14500. psi
   Poisson's ratio at top of layer                    =     0.200000
   Poisson's ratio at bottom of layer                 =     0.200000
   Option 1: Intact rock modulus at top of layer      =       0.0000 psi
             Intact rock modulus at bottom of layer   =       0.0000 psi
   Option 1: Geologic Strength Index for layer        =    51.000000
   Option 2: Rock mass modulus at top of layer        =     1500000. psi
             Rock mass modulus at bottom of layer     =     1500000. psi
   Option 2 will use the input value of rock mass modulus to compute the p-y curve
            in massive rock.
   The rock type is (metamorphic) gneiss, Hoek-Brown Material Constant mi = 28


 (Depth of the lowest soil layer extends 32.000 ft below the pile tip)


**** Warning - Possible Input Data Error ****

Values entered for effective unit weights of soil were outside the limits of
20 pcf to 140 pcf.

The minimum input value, in layer   1, for effective unit weight = .10 pcf

This data may be erroneous. Please check your data.


**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer   1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.


--------------------------------------------------------------------------------
                         Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial     Rock Mass    Geologic      Elastic     Int. Rock
Hoek-Brown
 Num.           Name            Depth       Unit Wt.       qu         Modulus     Strength     Subgrade      Modulus
Material     Poisson's
          (p-y Curve Type)        ft           pcf          psi          psi         Index      Mod. pci        psi
Index, mi      Ratio
-----   -------------------   ----------   ----------   ----------   ----------   ----------   ----------   ----------
----------   ----------
  1           Elastic               0.00      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade           11.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  2           Elastic            11.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
              Subgrade           13.0000      0.10000       --           --           --          0.10000      0.00
  0.00         0.00
  3           Massive            13.0000     150.0000       14500.     1500000.      51.0000       --          0.00
28.0000       0.2000
              Rock               50.0000     150.0000       14500.                   51.0000       --          0.00
28.0000       0.2000
```

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 2000. lbs	S = 0.0000 in/in	110000.	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel AISC Weak Axis:

Length of Section	=	18.000000 ft
Flange Width	=	12.000000 in
Section Depth	=	11.800000 in
Flange Thickness	=	0.435000 in
Web Thickness	=	0.435000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.500000 sq. in.
Moment of Inertia	=	127.000000 in^4
Elastic Bending Stiffness	=	3683000. kip-in^2
Plastic Modulus, Z	=	32.200000in^3
Plastic Moment Capacity = Fy Z	=	1610.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	775.000 kips
Nominal Axial Tensile Capacity	=	-775.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	110.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 110.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg

0.00000568	20.65036669		36350331.		49.94277207	8	.2180347		
0.00001136	41.30073390		36350331.		27.97138600	9	.1966317		
0.00001704	61.95111008		36350331.		20.64759070	10	.1752285		
0.00002272	82.60146770		36350331.		16.98569300	11	.1538255		
0.00002840	103.2518347		36350331.		14.78855440	12	.1324224		
0.00003409	123.9022016		36350331.		13.32379530	13	.1110193		
0.00003977	144.5525685		36350331.		12.27753890	14	.0896163		
0.00004545	165.2029355		36350331.		11.49284650	15	.0682132		
0.00005113	185.8533024		36350331.		10.88253020	16	.0468101		
0.00005681	206.5036693		36350331.		10.39427720	17	.0254070		
0.00006249	227.1540362		36350331.		9.99479750	18	.0040039		
0.00006817	247.8044032		36350331.		9.66189770	19	.9826009		
0.00007385	268.4547701		36350331.		9.38021320	20	.9611978		
0.00007953	289.1051370		36350331.		9.13876940	21	.9397947		
0.00008521	309.7555040		36350331.		8.92951810	22	.9183916		
0.00009089	330.4058709		36350331.		8.74642320	23	.8969886		
0.00009658	351.0562378		36350331.		8.58486890	24	.8755855		
0.00010226	371.7066048		36350331.		8.44126510	25	.8541824		
0.00010794	392.3569717		36350331.		8.31277750	26	.8327793		
0.00011362	413.0073386		36350331.		8.19713860	27	.8113762		
0.00011930	433.6577056		36350331.		8.09251300	28	.7899732		
0.00012498	454.3080725		36350331.		7.99739870	29	.7685701		
0.00013067	474.9584394		36350331.		7.91055530	30	.7471670		
0.00013635	495.6088064		36350331.		7.83094880	31	.7257639		
0.00014203	516.2591733		36350331.		7.75771090	32	.7043608		
0.00014771	536.9095402		36350331.		7.69010660	33	.6829578		
0.00015340	557.5599071		36350331.		7.62751010	34	.6615547		
0.00015908	578.2102741		36350331.		7.56938470	35	.6401516		
0.00016476	598.8606410		36350331.		7.51526800	36	.6187485		
0.00017044	619.5110079		36350331.		7.46475910	37	.5973455		
0.00017613	640.1613749		36350331.		7.41750880	38	.5759424		
0.00018181	660.8117418		36350331.		7.37321160	39	.5545393		
0.00018750	681.4621087		36350331.		7.33159920	40	.5331362		
0.00019320	702.1124757		36350331.		7.29243450	41	.5117332		
0.00019888	722.7628426		36350331.		7.25550780	42	.4903301		
0.00020457	743.4132095		36350331.		7.22063260	43	.4689270		
0.00021026	764.0635765		36350331.		7.18764250	44	.4475239		
0.00021595	784.7139434		36350331.		7.15633870	45	.4261208		
0.00022164	805.3643103		36350331.		7.12673770	46	.4047178		
0.00022733	846.6650442		36350331.		7.07177490	47	.3619116		
0.00024431	887.9657780		36350331.		7.02192490	49	.3191054		
0.00025562	928.2258679		36309621.		6.97806870	50	.2761208		
0.00026702	965.9587320		36177731.		6.94166710	50	.2331362		
0.00027841	1001.		35976171.		6.91153960	50	.1901516		
0.00030111	1067.		35431711.		6.86620360	50	.1471670		
0.00031250	1097.		35107971.		6.84972000	50	.1257747		
0.00032389	1126.		34767471.		6.83824630	50	.1043824		
0.00033528	1153.		34410081.		6.82576450	50	.0829901		
0.00033465	1179.		34017571.		6.81907790	50	.0615978		
0.00035790	1202.		33585561.		6.80765370	50	.0402055		
0.00036930	1223.		33122151.		6.79765850	50	.0188132		
0.00038060	1242.		32636711.		6.78867380	50	.9974209		
0.00039200	1260.		32139531.		6.77987860	50	.9760286		
0.00040330	1276.		31635401.		6.77129390	50	.9546363		
0.00041470	1291.		31128361.		6.76288800	50	.9332440		
0.00042610	1305.		30621831.		6.75463130	50	.9118517		
0.00043740	1317.		30117061.		6.74663090	50	.8904594		
0.00044880	1329.		29616831.		6.73894660	50	.8690671		
0.00046020	1340.		29124151.		6.73269900	50	.8476748		
0.00047150	1350.		28640711.		6.72686650	50	.8262825		
0.00048290	1360.		28161531.		6.71625520	50	.8048902		
0.00049420	1369.		27693101.		6.70948060	50	.7834979		
0.00050560	1377.		27236371.		6.70476800	50	.7621056		
0.00051700	1385.		26787871.		6.69507280	50	.7407133		
0.00052830	1392.		26349981.		6.68944490	50	.7193210		
0.00053970	1399.		25921761.		6.68153390	50	.6979287		
0.00055110	1405.		25509381.		6.67540470	50	.6765364		
0.00056240	1411.		25096731.		6.66851240	50	.6551441		
0.00057380	1417.		24701891.		6.66247260	50	.6337518		
0.00058510	1423.		24312611.		6.65600820	50	.6123595		
0.00059650	1428.		23937261.		6.65058870	50	.5909672		
0.00060790	1433.		23568031.		6.64393230	50	.5695749		
0.00061920	1437.		23210781.		6.63961270	50	.5481826		
0.00063060	1442.		22861401.		6.63222790	50	.5267903		
0.00064190	1446.		22521171.		6.62945060	50	.5053980		
0.00065330	1450.		22189061.		6.62118730	50	.4840057		
0.00066470	1453.		21867081.		6.61562700	50	.4626134		
0.00067600	1457.		21557171.		6.61218630	50	.4412211		
0.00068740	1460.		21259361.		6.60989960	50	.4198288		
0.00069870	1470.		20969361.		6.57087600	50	.3984365		
0.00071240	1480.		19301441.		6.55279060	50	.3770442		
0.00081240	1489.		18331181.		6.55279060	50	.3556519		

0.0008578	1497.	1744912.	6.5358326	50.0000000	Y
0.0009033	1503.	1664433.	6.5198891	50.0000000	Y
0.0009487	1509.	1590697.	6.5060396	50.0000000	Y
0.0009942	1514.	1523066.	6.4939524	50.0000000	Y
0.0010396	1518.	1460625.	6.4775597	50.0000000	Y
0.0010851	1522.	1403054.	6.4664189	50.0000000	Y
0.0011305	1526.	1349759.	6.4531008	50.0000000	Y
0.0011760	1529.	1300206.	6.4428124	50.0000000	Y
0.0012214	1532.	1254110.	6.4307639	50.0000000	Y
0.0012668	1534.	1211077.	6.4224921	50.0000000	Y
0.0013123	1537.	1170948.	6.4104601	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	110.0000000000	1537.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	0.00
2	11.0000	11.0000	Yes	No	0.00	0.00
3	13.0000	13.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 2000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 110000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2438	-182068.	2000.	0.00	15555.	3.64E+09	-0.288	1.2744	0.00
0.1800	0.2437	-177736.	1999.	-1.07E-04	15354.	3.64E+09	-0.288	2.5488	0.00
0.3600	0.2434	-173380.	1999.	-2.11E-04	15151.	3.64E+09	-0.287	2.5488	0.00
0.5400	0.2428	-169001.	1998.	-3.13E-04	14948.	3.64E+09	-0.287	2.5488	0.00
0.7200	0.2420	-164599.	1998.	-4.12E-04	14744.	3.64E+09	-0.286	2.5488	0.00

0.9000	0.2410	-160176.	1997.	-5.09E-04	1.64E+09	-0.284	2.5488	0.00	4538.	1.64E+09	-0.284	2.5488	0.00
1.0000	0.2398	-155731.	1996.	-6.02E-04	1.64E+09	-0.283	2.5488	0.00	4332.	1.64E+09	-0.283	2.5488	0.00
1.2600	0.2384	-151266.	1996.	-6.94E-04	1.64E+09	-0.281	2.5488	0.00	4124.	1.64E+09	-0.281	2.5488	0.00
1.4400	0.2368	-146780.	1995.	-7.82E-04	1.64E+09	-0.279	2.5488	0.00	3916.	1.64E+09	-0.279	2.5488	0.00
1.6200	0.2350	-142275.	1994.	-8.68E-04	1.64E+09	-0.277	2.5488	0.00	3706.	1.64E+09	-0.277	2.5488	0.00
1.8000	0.2331	-137752.	1994.	-9.51E-04	1.64E+09	-0.275	2.5488	0.00	3496.	1.64E+09	-0.275	2.5488	0.00
1.9800	0.2309	-133210.	1993.	-0.00103	1.64E+09	-0.273	2.5488	0.00	3285.	1.64E+09	-0.273	2.5488	0.00
2.1600	0.2286	-128650.	1993.	-0.00111	1.64E+09	-0.270	2.5488	0.00	3073.	1.64E+09	-0.270	2.5488	0.00
2.3400	0.2261	-124074.	1992.	-0.00118	1.64E+09	-0.267	2.5488	0.00	2861.	1.64E+09	-0.267	2.5488	0.00
2.5200	0.2235	-119481.	1992.	-0.00126	1.64E+09	-0.264	2.5488	0.00	2647.	1.64E+09	-0.264	2.5488	0.00
2.7000	0.2207	-114873.	1991.	-0.00133	1.64E+09	-0.260	2.5488	0.00	2433.	1.64E+09	-0.260	2.5488	0.00
2.8800	0.2178	-110250.	1990.	-0.00139	1.64E+09	-0.257	2.5488	0.00	2219.	1.64E+09	-0.257	2.5488	0.00
3.0600	0.2147	-105612.	1990.	-0.00146	1.64E+09	-0.253	2.5488	0.00	2003.	1.64E+09	-0.253	2.5488	0.00
3.2400	0.2115	-100961.	1989.	-0.00152	1.64E+09	-0.250	2.5488	0.00	1787.	1.64E+09	-0.250	2.5488	0.00
3.4200	0.2081	-96296.	1989.	-0.00158	1.64E+09	-0.246	2.5488	0.00	1570.	1.64E+09	-0.246	2.5488	0.00
3.6000	0.2047	-91620.	1988.	-0.00163	1.64E+09	-0.242	2.5488	0.00	1353.	1.64E+09	-0.242	2.5488	0.00
3.7800	0.2011	-86931.	1988.	-0.00169	1.64E+09	-0.237	2.5488	0.00	1135.	1.64E+09	-0.237	2.5488	0.00
3.9600	0.1974	-82231.	1987.	-0.00174	1.64E+09	-0.233	2.5488	0.00	0917.	1.64E+09	-0.233	2.5488	0.00
4.1400	0.1936	-77521.	1987.	-0.00178	1.64E+09	-0.228	2.5488	0.00	0698.	1.64E+09	-0.228	2.5488	0.00
4.3200	0.1897	-72800.	1986.	-0.00183	1.64E+09	-0.224	2.5488	0.00	0479.	1.64E+09	-0.224	2.5488	0.00
4.5000	0.1857	-68071.	1986.	-0.00187	1.64E+09	-0.219	2.5488	0.00	0259.	1.64E+09	-0.219	2.5488	0.00
4.6800	0.1816	-63333.	1985.	-0.00191	1.64E+09	-0.214	2.5488	0.00	0039.	1.64E+09	-0.214	2.5488	0.00
4.8600	0.1774	-58587.	1985.	-0.00195	1.64E+09	-0.209	2.5488	0.00	9819.	1.64E+09	-0.209	2.5488	0.00
5.0400	0.1732	-53834.	1984.	-0.00198	1.64E+09	-0.204	2.5488	0.00	9598.	1.64E+09	-0.204	2.5488	0.00
5.2200	0.1689	-49074.	1984.	-0.00201	1.64E+09	-0.199	2.5488	0.00	9377.	1.64E+09	-0.199	2.5488	0.00
5.4000	0.1645	-44308.	1983.	-0.00204	1.64E+09	-0.194	2.5488	0.00	9155.	1.64E+09	-0.194	2.5488	0.00
5.5800	0.1601	-39536.	1983.	-0.00206	1.64E+09	-0.189	2.5488	0.00	8934.	1.64E+09	-0.189	2.5488	0.00
5.7600	0.1556	-34760.	1983.	-0.00208	1.64E+09	-0.184	2.5488	0.00	8712.	1.64E+09	-0.184	2.5488	0.00
5.9400	0.1511	-29980.	1982.	-0.00210	1.64E+09	-0.178	2.5488	0.00	8490.	1.64E+09	-0.178	2.5488	0.00
6.1200	0.1465	-25197.	1982.	-0.00212	1.64E+09	-0.173	2.5488	0.00	8267.	1.64E+09	-0.173	2.5488	0.00
6.3000	0.1419	-20411.	1982.	-0.00213	1.64E+09	-0.167	2.5488	0.00	8045.	1.64E+09	-0.167	2.5488	0.00
6.4800	0.1373	-15622.	1981.	-0.00214	1.64E+09	-0.162	2.5488	0.00	7823.	1.64E+09	-0.162	2.5488	0.00
6.6600	0.1326	-10833.	1981.	-0.00215	1.64E+09	-0.157	2.5488	0.00	7600.	1.64E+09	-0.157	2.5488	0.00
6.8400	0.1280	-6042.	1981.	-0.00216	1.64E+09	-0.151	2.5488	0.00	7377.	1.64E+09	-0.151	2.5488	0.00
7.0200	0.1233	-1251.	1980.	-0.00216	1.64E+09	-0.146	2.5488	0.00	7155.	1.64E+09	-0.146	2.5488	0.00
7.2000	0.1186	3539.	1980.	-0.00216	1.64E+09	-0.140	2.5488	0.00	7261.	1.64E+09	-0.140	2.5488	0.00
7.3800	0.1140	8328.	1980.	-0.00216	1.64E+09	-0.135	2.5488	0.00	7484.	1.64E+09	-0.135	2.5488	0.00
7.5600	0.1093	13115.	1979.	-0.00215	1.64E+09	-0.129	2.5488	0.00	7706.	1.64E+09	-0.129	2.5488	0.00
7.7400	0.1047	17900.	1979.	-0.00214	1.64E+09	-0.124	2.5488	0.00	7928.	1.64E+09	-0.124	2.5488	0.00
7.9200	0.1001	22682.	1979.	-0.00213	1.64E+09	-0.118	2.5488	0.00	8150.	1.64E+09	-0.118	2.5488	0.00
8.1000	0.09551	27460.	1979.	-0.00211	1.64E+09	-0.113	2.5488	0.00	8372.	1.64E+09	-0.113	2.5488	0.00
8.2800	0.09097	32233.	1978.	-0.00210	1.64E+09	-0.107	2.5488	0.00	8594.	1.64E+09	-0.107	2.5488	0.00
8.4600	0.08646	37002.	1978.	-0.00207	1.64E+09	-0.102	2.5488	0.00	8816.	1.64E+09	-0.102	2.5488	0.00
8.6400	0.08200	41764.	1978.	-0.00205	1.64E+09	-0.09676	2.5488	0.00	9037.	1.64E+09	-0.09676	2.5488	0.00
8.8200	0.07760	46521.	1978.	-0.00202	1.64E+09	-0.09157	2.5488	0.00	9258.	1.64E+09	-0.09157	2.5488	0.00
9.0000	0.07326	51270.	1977.	-0.00200	1.64E+09	-0.08644	2.5488	0.00	9479.	1.64E+09	-0.08644	2.5488	0.00
9.1800	0.06898	56012.	1977.	-0.00196	1.64E+09	-0.08139	2.5488	0.00	9699.	1.64E+09	-0.08139	2.5488	0.00
9.3600	0.06477	60746.	1977.	-0.00193	1.64E+09	-0.07643	2.5488	0.00	9919.	1.64E+09	-0.07643	2.5488	0.00
9.5400	0.06064	65470.	1977.	-0.00189	1.64E+09	-0.07156	2.5488	0.00	0138.	1.64E+09	-0.07156	2.5488	0.00
9.7200	0.05660	70185.	1977.	-0.00185	1.64E+09	-0.06679	2.5488	0.00	0357.	1.64E+09	-0.06679	2.5488	0.00
9.9000	0.05264	74890.	1977.	-0.00181	1.64E+09	-0.06212	2.5488	0.00	0576.	1.64E+09	-0.06212	2.5488	0.00
10.0800	0.04879	79584.	1977.	-0.00176	1.64E+09	-0.05757	2.5488	0.00	0794.	1.64E+09	-0.05757	2.5488	0.00
10.2600	0.04503	84266.	1976.	-0.00171	1.64E+09	-0.05313	2.5488	0.00	1012.	1.64E+09	-0.05313	2.5488	0.00
10.4400	0.04138	88936.	1976.	-0.00166	1.64E+09	-0.04883	2.5488	0.00	1228.	1.64E+09	-0.04883	2.5488	0.00
10.6200	0.03785	93594.	1976.	-0.00161	1.64E+09	-0.04466	2.5488	0.00	1445.	1.64E+09	-0.04466	2.5488	0.00
10.8000	0.03443	98238.	1976.	-0.00155	1.64E+09	-0.04063	2.5488	0.00	1661.	1.64E+09	-0.04063	2.5488	0.00
10.9800	0.03115	102868.	1976.	-0.00149	1.64E+09	-0.03675	2.5488	0.00	1876.	1.64E+09	-0.03675	2.5488	0.00
11.1600	0.02799	107483.	1976.	-0.00143	1.64E+09	-0.03303	2.5488	0.00	2090.	1.64E+09	-0.03303	2.5488	0.00
11.3400	0.02497	112083.	1976.	-0.00136	1.64E+09	-0.02947	2.5488	0.00	2304.	1.64E+09	-0.02947	2.5488	0.00
11.5200	0.02210	116667.	1976.	-0.00130	1.64E+09	-0.02608	2.5488	0.00	2517.	1.64E+09	-0.02608	2.5488	0.00
11.7000	0.01938	121235.	1976.	-0.00123	1.64E+09	-0.02286	2.5488	0.00	2729.	1.64E+09	-0.02286	2.5488	0.00
11.8800	0.01681	125785.	1976.	-0.00115	1.64E+09	-0.01983	2.5488	0.00	2940.	1.64E+09	-0.01983	2.5488	0.00
12.0600	0.01440	130317.	1976.	-0.00108	1.64E+09	-0.01699	2.5488	0.00	3151.	1.64E+09	-0.01699	2.5488	0.00
12.2400	0.01216	134831.	1976.	-9.97E-04	1.64E+09	-0.01435	2.5488	0.00	3361.	1.64E+09	-0.01435	2.5488	0.00
12.4200	0.01009	139326.	1976.	-9.15E-04	1.64E+09	-0.01191	2.5488	0.00	3569.	1.64E+09	-0.01191	2.5488	0.00
12.6000	0.00821	143801.	1976.	-8.31E-04	1.64E+09	-0.00968	2.5488	0.00	3777.	1.64E+09	-0.00968	2.5488	0.00
12.7800	0.00650	148256.	1976.	-7.44E-04	1.64E+09	-0.00767	2.5488	0.00	3984.	1.64E+09	-0.00767	2.5488	0.00
12.9600	0.00499	152689.	1976.	-6.55E-04	1.64E+09	-0.00589	2.5488	0.00	4190.	1.64E+09	-0.00589	2.5488	0.00
13.1400	0.00367	157101.	74.7850	-5.63E-04	1.64E+09	-1760.	1034642.	0.00	4395.	1.64E+09	-1760.	1034642.	0.00
13.3200	0.00256	153280.	-3203.	-4.71E-04	1.64E+09	-1275.	1076079.	0.00	4218.	1.64E+09	-1275.	1076079.	0.00
13.5000	0.00164	143489.	-5492.	-3.83E-04	1.64E+09	-844.984	1112515.	0.00	3763.	1.64E+09	-844.984	1112515.	0.00
13.6800	9.06E-04	129735.	-6923.	-3.01E-04	1.64E+09	-479.652	1143242.	0.00	3124.	1.64E+09	-479.652	1143242.	0.00
13.8600	3.38E-04	113725.	-7639.	-2.29E-04	1.64E+09	-182.995	1168001.	0.00	2380.	1.64E+09	-182.995	1168001.	0.00
14.0400	-8.34E-05	96845.	-7787.	-1.67E-04	1.64E+09	45.5607	1179404.	0.00	1596.	1.64E+09	45.5607	1179404.	0.00
14.2200	-3.81E-04	80164.	-7516.	-1.14E-04	1.64E+09	205.7148	1166268.	0.00	0821.	1.64E+09	205.7148	1166268.	0.00
14.4000	-5.76E-04	64431.	-6960.	-7.10E-05	1.64E+09	308.5993	1157929.	0.00	0090.	1.64E+09	308.5993	1157929.	0.00
14.5800	-6.88E-04	50129.	-6230.	-3.69E-05	1.64E+09	367.1394	1153271.	0.00	9426.	1.64E+09	367.1394	1153271.	0.00
14.7600	-7.35E-04	37533.	-5411.	-1.09E-05	1.64E+09	391.9270	1151389.	0.00	8840.	1.64E+09	391.9270	1151389.	0.00
14.9400	-7.35E-04	26760.	-4564.	8.20E-06	1.64E+09	391.6868	1151542.	0.00	8340.	1.64E+09	391.6868	1151542.	0.00
15.1200	-7.00E-04	17811.	-3738.	2.14E-05	1.64E+09	373.5971	1153128.	0.00	7924.	1.64E+09	373.5971	1153128.	0.00
15.3000	-6.42E-04	10603.	-2963.	2.99E-05	1.64E+09	343.5163	1155660.	0.00	7589.	1.64E+09	343.5163	1155660.	0.00
15.4800	-5.71E-04	4995.	-2262.	3.45E-05	1.64E+09	306.1510	1158752.	0.00	7329.	1.64E+09	306.1510	1158752.	0.00
15.6600	-4.93E-04	815.5761	-1645.	3.62E-05	1.64E+09	265.1920	1162103.	0.00	7135.	1.64E+09	265.1920	1162103.	0.00

15.8400	-4.14E-04	-2127.	-1117.	3.59E-05	7196.	3.64E+09	223.4337	1165491.	0.00
16.0200	-3.38E-04	-4027.	-678.122	3.40E-05	7284.	3.64E+09	182.8863	1168755.	0.00
16.2000	-2.67E-04	-5073.	-324.129	3.13E-05	7332.	3.64E+09	144.8853	1171793.	0.00
16.3800	-2.03E-04	-5442.	-48.638	2.82E-05	7350.	3.64E+09	110.1994	1174549.	0.00
16.5600	-1.45E-04	-5296.	155.8445	2.50E-05	7343.	3.64E+09	79.1357	1177001.	0.00
16.7400	-9.46E-05	-4780.	297.0828	2.20E-05	7319.	3.64E+09	51.6405	1179157.	0.00
16.9200	-5.01E-05	-4023.	382.4396	1.94E-05	7284.	3.64E+09	27.3936	1181046.	0.00
17.1000	-1.08E-05	-3138.	418.3920	1.73E-05	7243.	3.64E+09	5.8957	1182709.	0.00
17.2800	2.45E-05	-2224.	410.2560	1.57E-05	7200.	3.64E+09	-13.429	1182133.	0.00
17.4600	5.70E-05	-1373.	362.1070	1.46E-05	7161.	3.64E+09	-31.153	1180782.	0.00
17.6400	8.77E-05	-666.573	276.7528	1.40E-05	7128.	3.64E+09	-47.878	1179517.	0.00
17.8200	1.18E-04	-183.759	155.8126	1.38E-05	7105.	3.64E+09	-64.103	1178300.	0.00
18.0000	1.47E-04	0.00	0.00	1.37E-05	7097.	3.64E+09	-80.168	588551.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.24383704 inches
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -182068. inch-lbs
Maximum shear force = -7787. lbs
Depth of maximum bending moment = 0.000000 feet below pile head
Depth of maximum shear force = 14.04000000 feet below pile head
Number of iterations = 6
Number of zero deflection points = 2

Summary of Pile-head Responses for Conventional Analyses

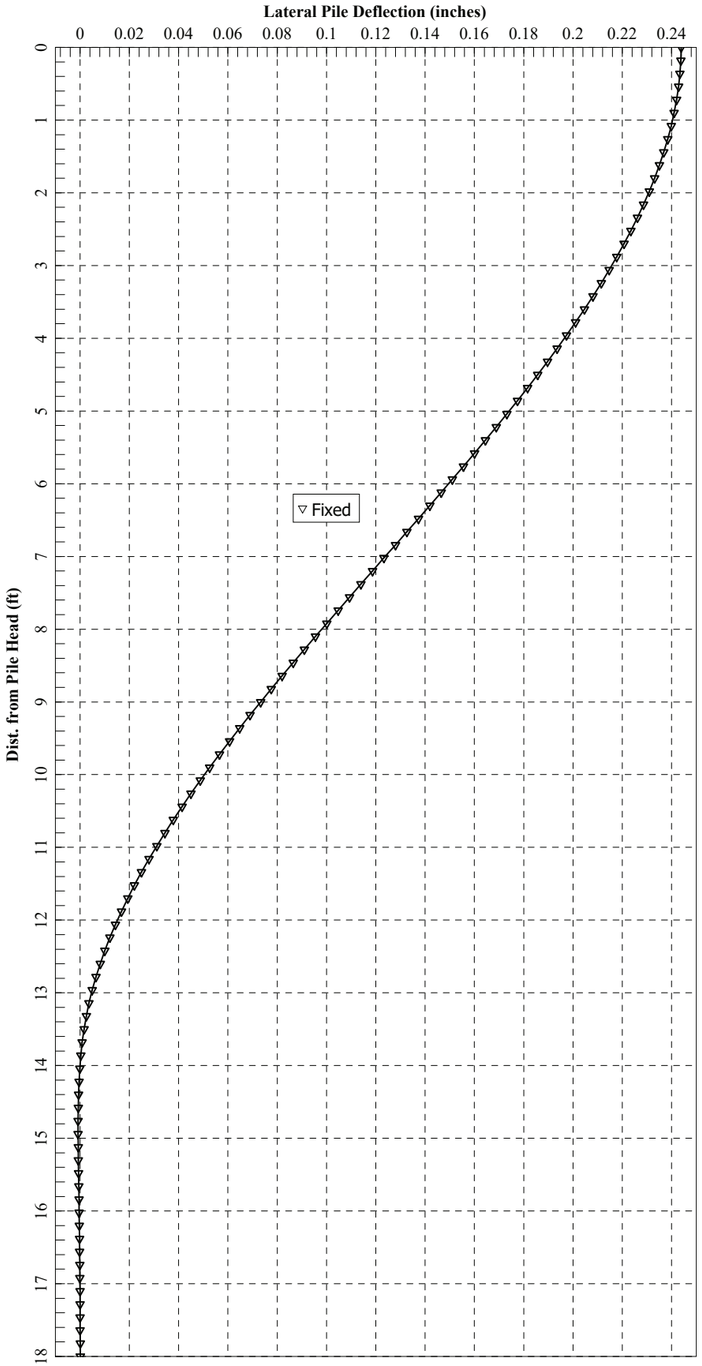
Definitions of Pile-head Loading Conditions:

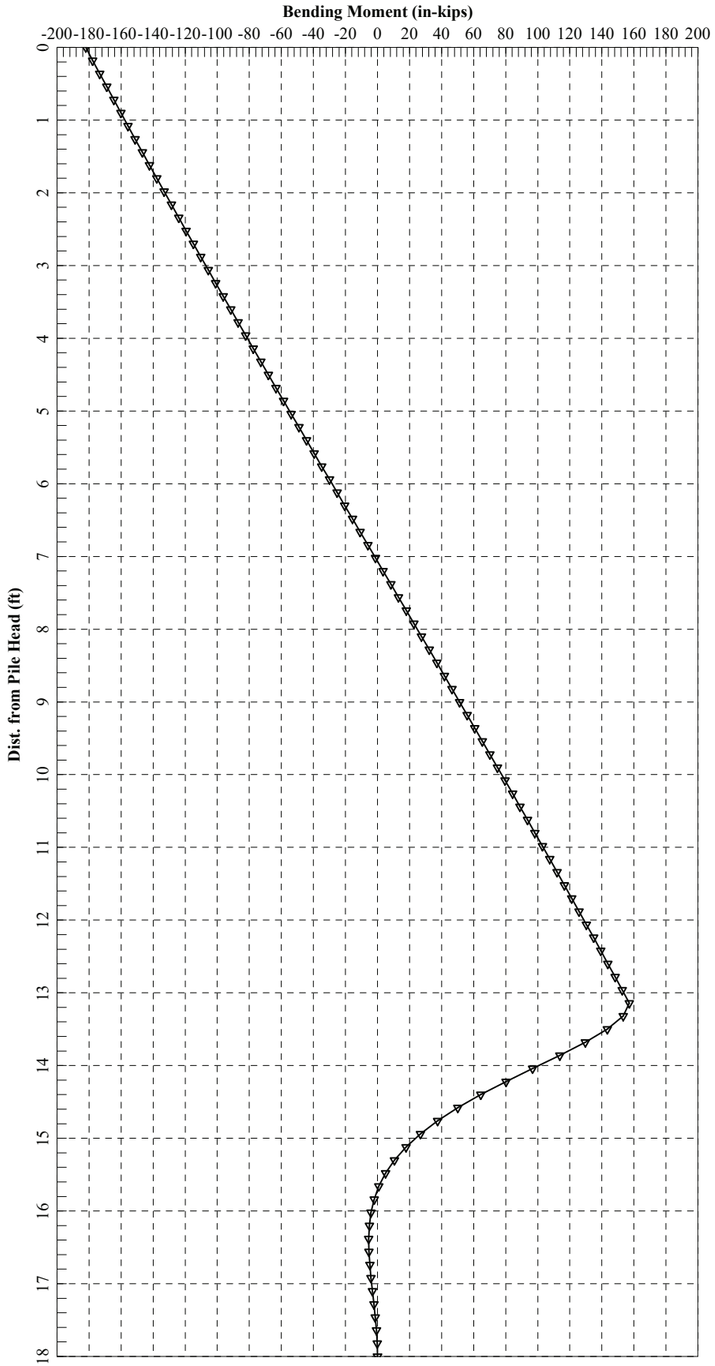
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

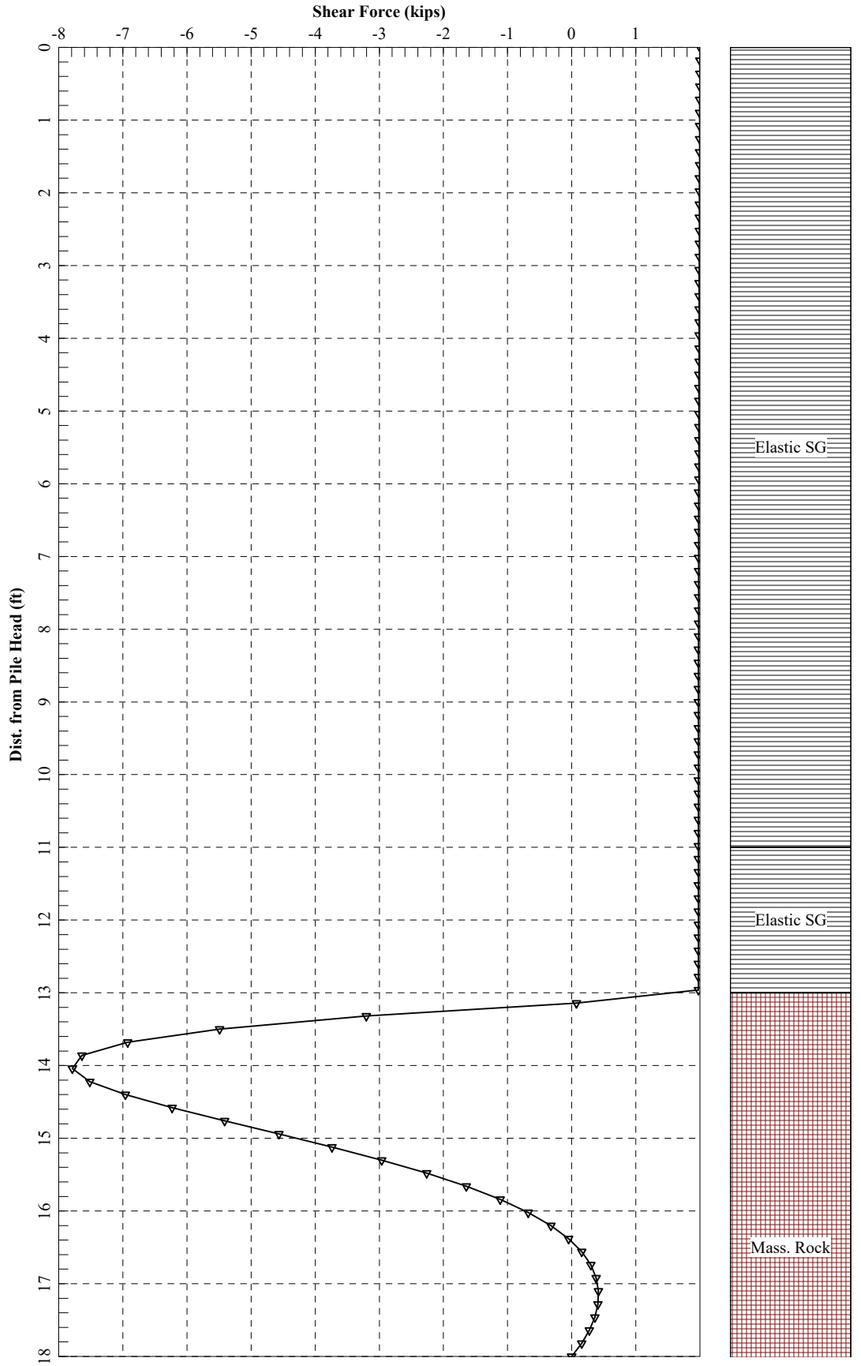
Load Case No.	Load Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	2000.	S, rad	0.00	110000.	0.2438	0.00	-7787.	-182068.

Maximum pile-head deflection = 0.2438370438 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

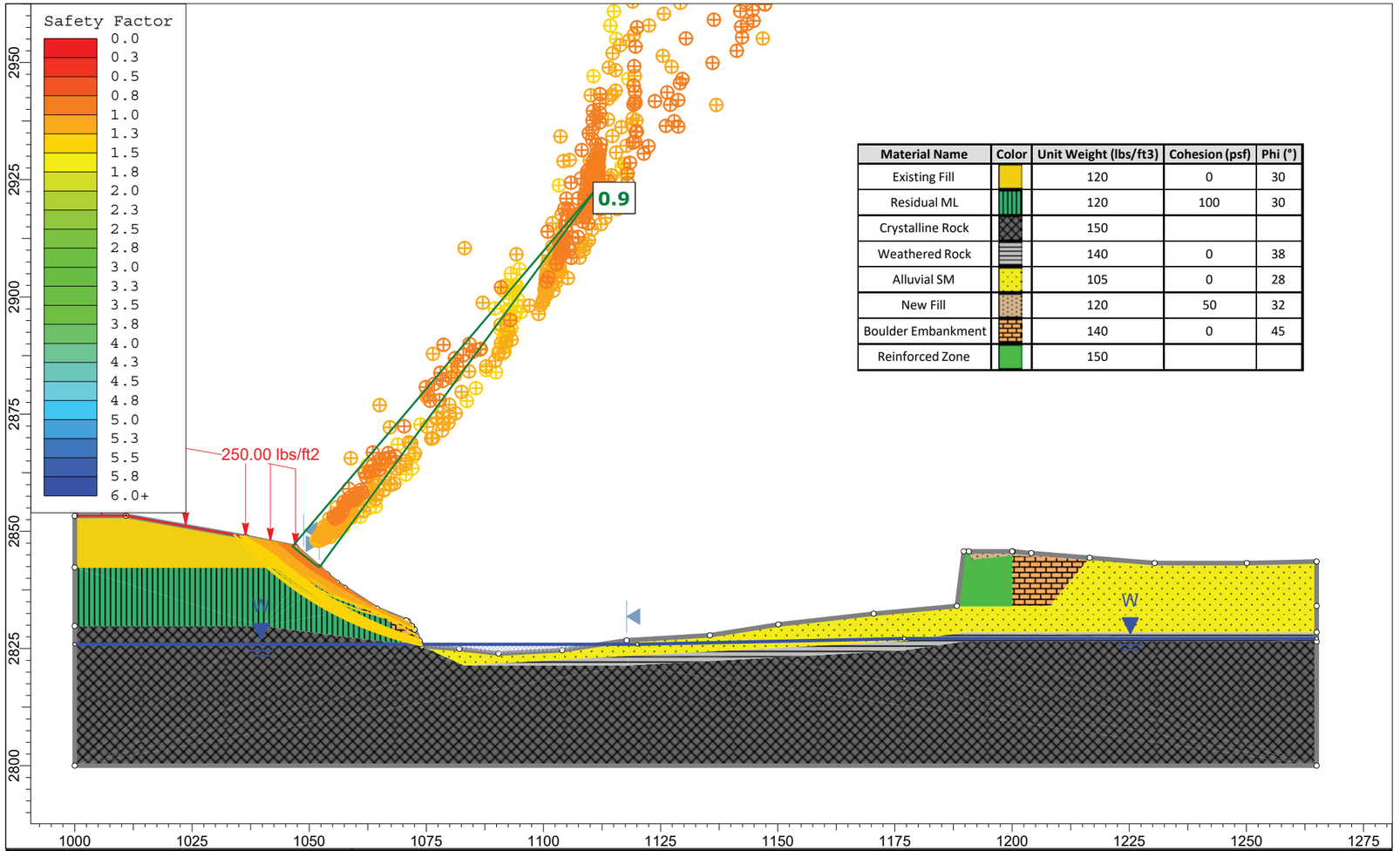
The analysis ended normally.


Lateral Pile Deflection (inches)
0 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16 0.18 0.2 0.22 0.24
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Fixed


Bending Moment (in-kips)
-200 -180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


Shear Force (kips)
-8 -7 -6 -5 -4 -3 -2 -1 0 1
Dist. from Pile Head (ft)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Elastic SG
Elastic SG
Mass. Rock

Slope Stability

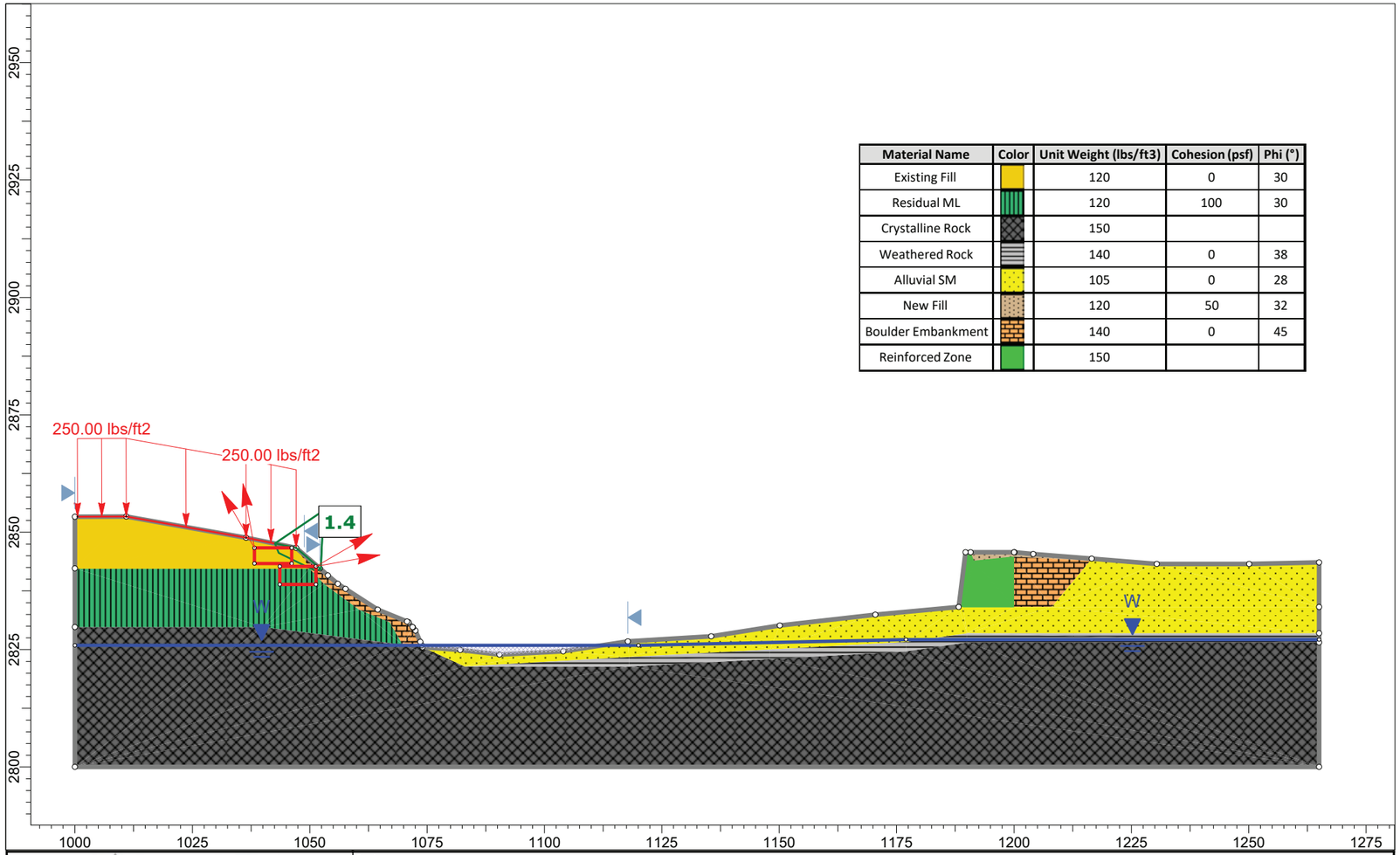


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
New Fill		120	50	32
Boulder Embankment		140	0	45
Reinforced Zone		150		

SLIDEINTERPRET 9.038

Project	PRB 5631 US 19E		
Group	Existing Conditions	*Scenario*	EB1 Circular
Drawn By	VA	*Company*	ESP Associates, Inc.
Date	11/18/2025	*File Name*	25-01592-B_5631 US 19E Slope Stability - NEW.slmd

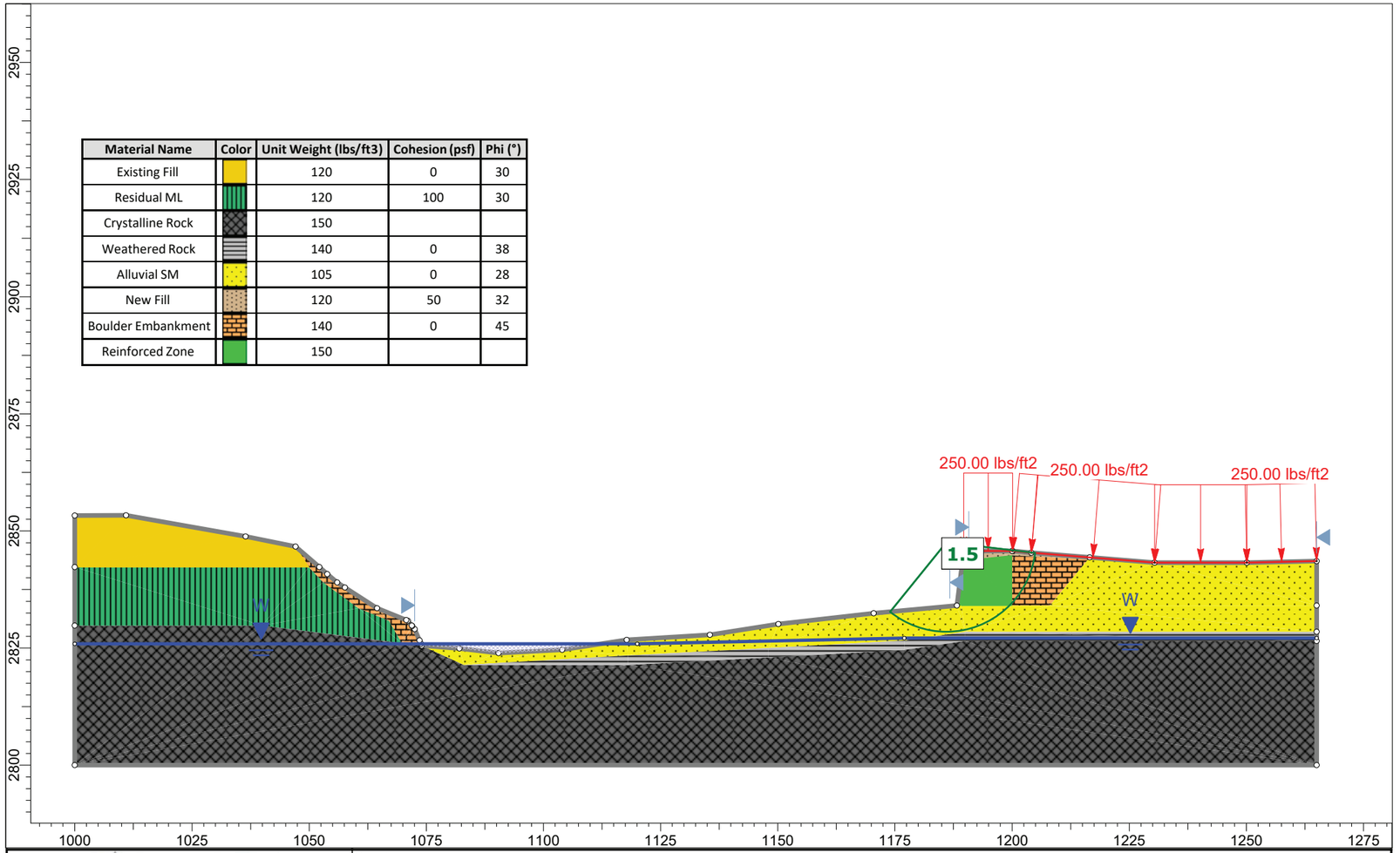
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
New Fill		120	50	32
Boulder Embankment		140	0	45
Reinforced Zone		150		



ESP	Project	PRB 5631 US 19E	
	Group	Existing Conditions	Scenario: EB1 Block
	Drawn By	VA	Company: ESP Associates, Inc.
	Date	11/18/2025	File Name: 25-01592-B_5631 US 19E Slope Stability - NEW.slmd

SLIDEINTERPRET 9.038

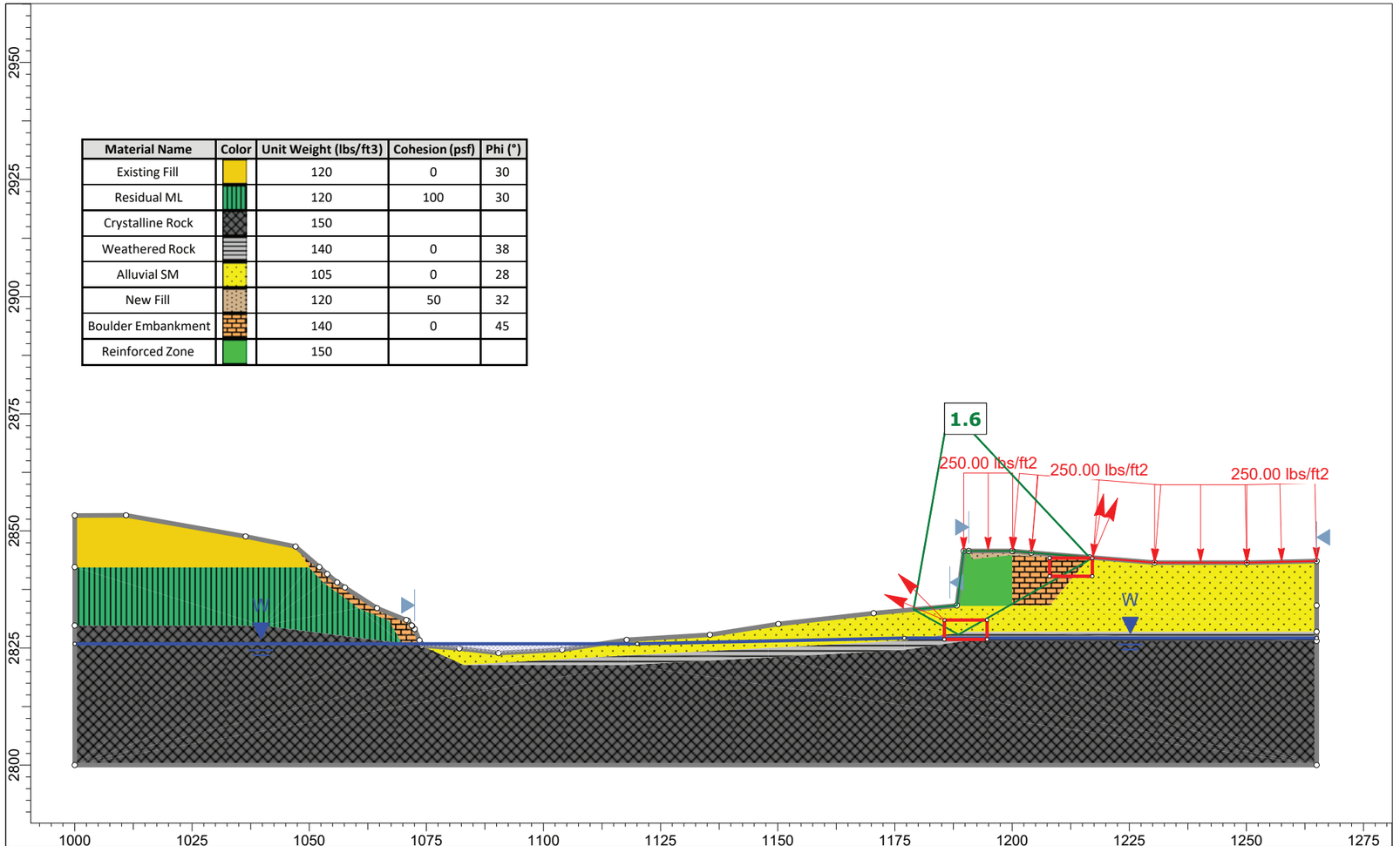
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
New Fill		120	50	32
Boulder Embankment		140	0	45
Reinforced Zone		150		



SLIDEINTERPRET 9.038

Project	PRB 5631 US 19E		
Group	Existing Conditions	Scenario	EB2 Circular
Drawn By	VA	Company	ESP Associates, Inc.
Date	11/18/2025	File Name	25-01592-B_5631 US 19E Slope Stability - NEW.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
New Fill		120	50	32
Boulder Embankment		140	0	45
Reinforced Zone		150		

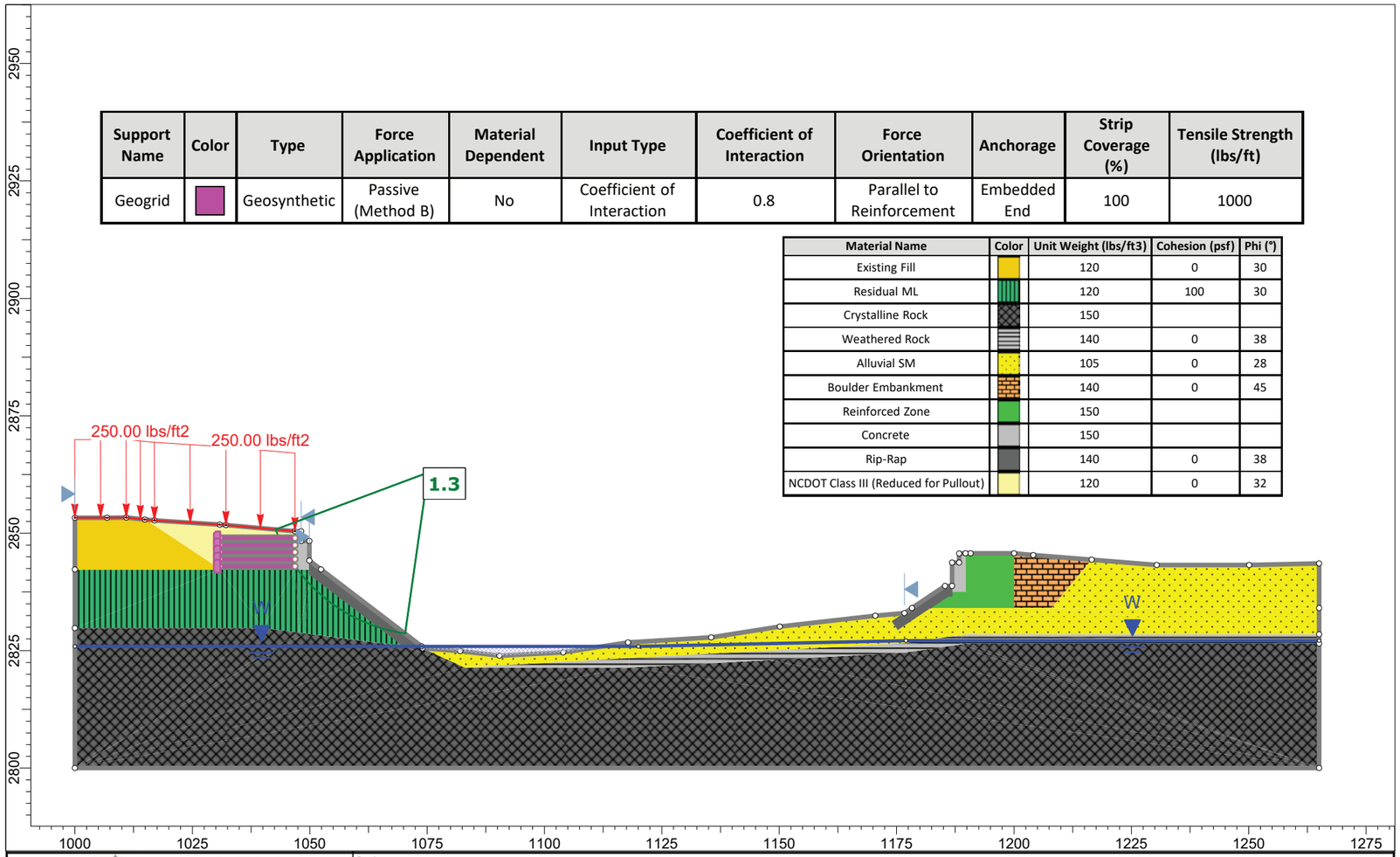


SLIDEINTERPRET 9.038

Project	PRB 5631 US 19E		
Group	Existing Conditions	Scenario	EB2 Block
Drawn By	VA	Company	ESP Associates, Inc.
Date	11/18/2025	File Name	25-01592-B_5631 US 19E Slope Stability - NEW.slmd

Support Name	Color	Type	Force Application	Material Dependent	Input Type	Coefficient of Interaction	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Geogrid		Geosynthetic	Passive (Method B)	No	Coefficient of Interaction	0.8	Parallel to Reinforcement	Embedded End	100	1000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
Boulder Embankment		140	0	45
Reinforced Zone		150		
Concrete		150		
Rip-Rap		140	0	38
NCDOT Class III (Reduced for Pullout)		120	0	32

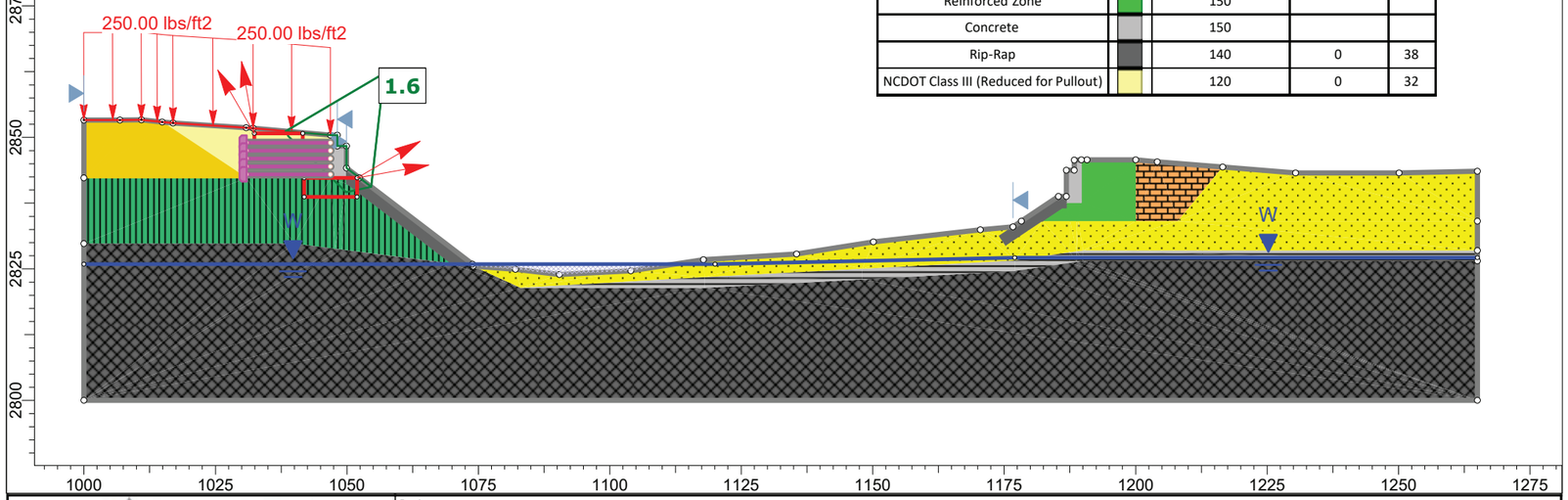


SLIDEINTERPRET 9.038

Project	PRB 5631 US 19E		
Group	Proposed Conditions	Scenario	EB1 Circular
Drawn By	VA	Company	ESP Associates, Inc.
Date	11/18/2025	File Name	25-01592-B_5631 US 19E Slope Stability - NEW.slmd

Support Name	Color	Type	Force Application	Material Dependent	Input Type	Coefficient of Interaction	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Geogrid		Geosynthetic	Passive (Method B)	No	Coefficient of Interaction	0.8	Parallel to Reinforcement	Embedded End	100	1000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (°)
Existing Fill		120	0	30
Residual ML		120	100	30
Crystalline Rock		150		
Weathered Rock		140	0	38
Alluvial SM		105	0	28
Boulder Embankment		140	0	45
Reinforced Zone		150		
Concrete		150		
Rip-Rap		140	0	38
NCDOT Class III (Reduced for Pullout)		120	0	32



SLIDEINTERPRET 9.038

Project	PRB 5631 US 19E		
Group	Proposed Conditions	Scenario	EB1 Block
Drawn By	VA	Company	ESP Associates, Inc.
Date	11/18/2025	File Name	25-01592-B_5631 US 19E Slope Stability - NEW.slmd

REFERENCE: N/A

PROJECT: PRB_006-01-EF443

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	PRB_006-01-EF443	1	10

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *AVERY*

PROJECT DESCRIPTION *BRIDGE AT 5631 US 19E OVER NORTH TOE RIVER IN NEWLAND, NC*

SITE DESCRIPTION *BRIDGE STRUCTURE AT -L- STA. 11+18.38*

CONTENTS

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	LEGEND (SOIL & ROCK)
2A	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4-9	BORE LOGS & CORE PHOTOGRAPHS
10	SITE PHOTOGRAPHS

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

NOTES:
1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
2. BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PERSONNEL

P. BARRERA

V. AYALA

M.S. ULMER

H.A. AGOPIAN

BRIDGER

INVESTIGATED BY *ESP Associates, Inc.*

DRAWN BY *P. BARRERA*

CHECKED BY *H.A. AGOPIAN*

SUBMITTED BY *ESP Associates, Inc.*

DATE *NOVEMBER 2025*

ESP ASSOCIATES, INC.
P.O. BOX 7030
CHARLOTTE, NC 28241
WWW.ESPASSOCIATES.COM

NORTH CAROLINA PROFESSIONAL SEAL 057984 ENGINEER HRATCH ANTOINE AGOPIAN

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
PRB_006-01-EF443	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,
VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6			
SYMBOL														
% PASSING #10	50 MX													
#40	30 MX		50 MX	51 MN										
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
MATERIAL PASSING #40 LL	—		—	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PI	6 MX		NP	10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	NO MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	< 4 4 TO 10 10 TO 30 30 TO 50 > 50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30	< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL — SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LL < 31
MODERATELY COMPRESSIBLE	LL = 31 - 50
HIGHLY COMPRESSIBLE	LL > 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	> 10%	> 20%	HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT / DPT DMT / VST PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING WITH CORE
- SPT N-VALUE

RECOMMENDATION SYMBOLS

- UNDERCUT
- SHALLOW UNDERCUT
- UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
- UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK
- UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [X] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [X] CASING [ ] W/ ADVANCER
- [X] TRICONE 2 15/16 " STEEL TEETH
- [ ] TRICONE _____ " TUNG.-CARB.
- [X] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -N Q2

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FOOT
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: FILE "25-0274-Volkert NCDOT Program Mgmt.-5600 US HWY 19E-ORD-2023.dgn" WAS USED TO DETERMINE GROUND ELEVATION FOR ALL BORINGS ELEVATION: FEET

NOTES:

F.I.A.D = FILLED IMMEDIATELY AFTER DRILLING

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
PRB_006-01-EF443	2A

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

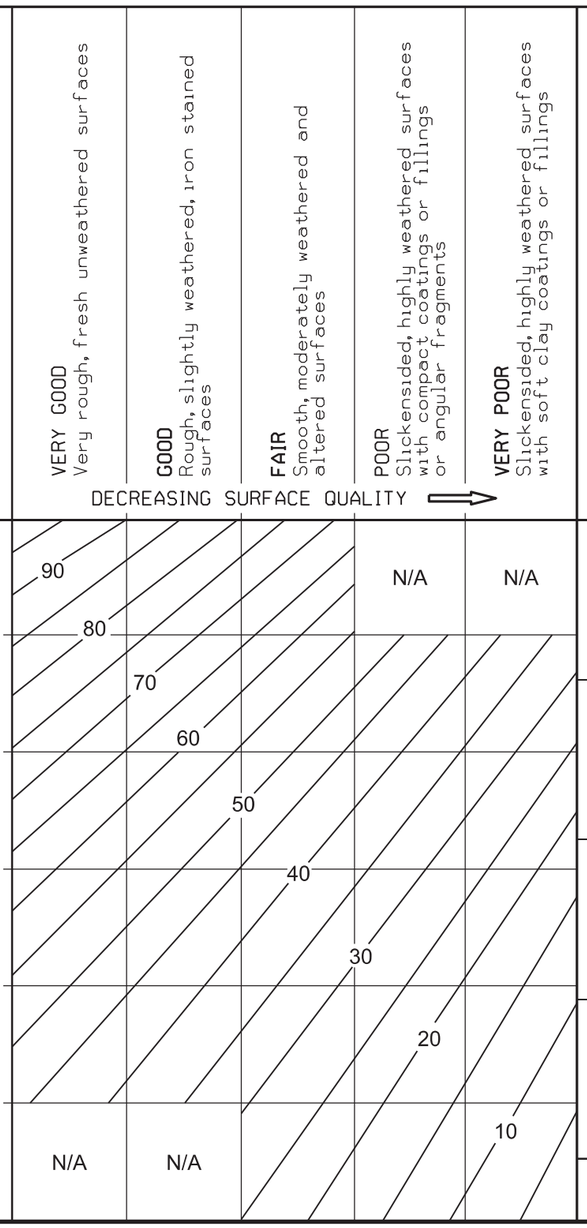
AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)

From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.

STRUCTURE

- INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities
- BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets
- VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
- BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity
- DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
- LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes

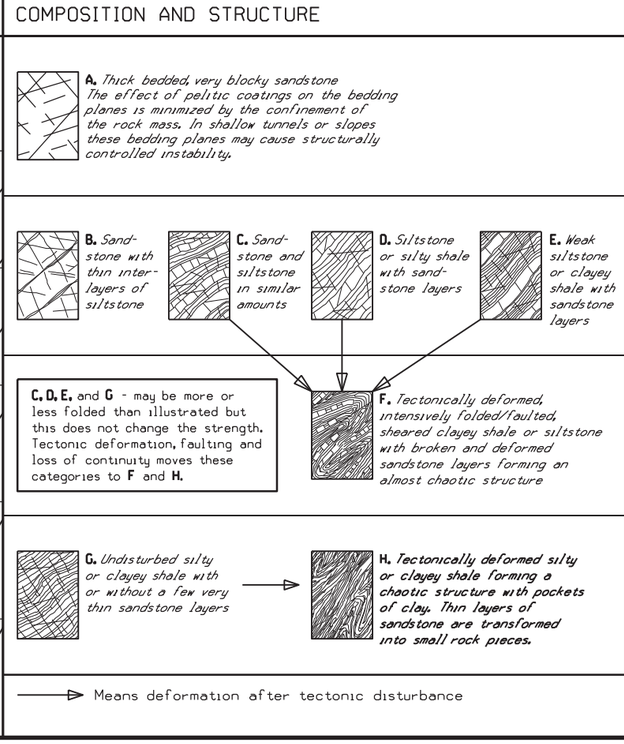


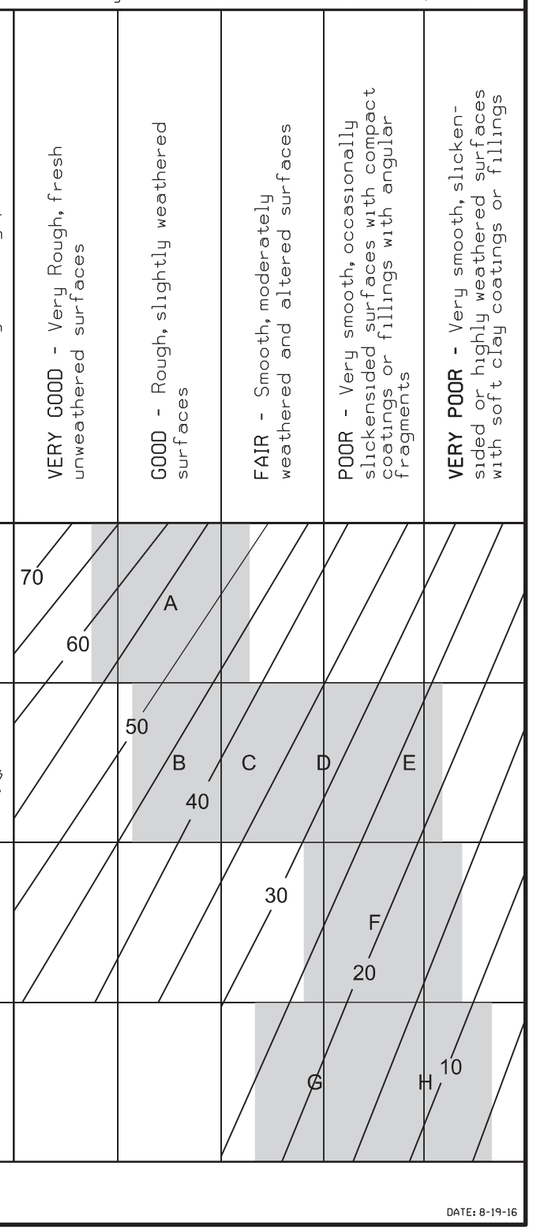
AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos. P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

COMPOSITION AND STRUCTURE





DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
PRB_006-01-EF443	3

SITE PLAN

0 20 40
FEET

DAVID C VANCE
LIFE ESTATE
DB 590, PG 1545
PIN: 1804-19-61-5538

DAVID C VANCE
LIFE ESTATE
DB 590, PG 1545
PIN: 1804-19-61-7223

CUR DATA -L-
PIc 12+16.67
Δc = 35°39'23.2" (LT)
D = 76°23'39.7"
Lc = 46.67
Tc = 24.12
R = 75

BEGIN PROJECT
-L- STA 10+10.96

END PROJECT
-L- STA 12+46.00

US HWY 19E - 21' BST

BEGIN BRIDGE
-L- STA 10+47.19

END BRIDGE
-L- STA 11+89.57

R=30'

.02

.02

12'

12'-0"
CLEAR
RDWY

-L-
S29°56'16.3"E

NORTH TOE RIVER

B-1

B-2

B-3

EB2

EB1

A/C LP TANKS (2)

GUY

GR

GR

GR

R=30'

WR CONTROL REBAR 10
N: 841557.30
E: 1106445.41
ELEV:2852.27'

WR CONTROL REBAR 11
N: 841392.15
E: 1106527.51
ELEV:2837.80'
GRID TO GROUND
CGF: 1.00016752

OLD BRIDGE
CONC ABUTMENT

-L- START 10+00.00

-L- PC 11+92.55

10

DAVID C VANCE
LIFE ESTATE
DB 590, PG 1545
PIN: 1804-19-61-5538

DISPLACED REMNANTS
OF OLD BRIDGE STRUCTURE

DAVID C VANCE
LIFE ESTATE
DB 590, PG 1545
PIN: 1804-19-61-7223

GEOTECHNICAL BORING REPORT
BORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.	
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River				**GROUND WTR (ft)**
BORING NO. EB1	**STATION** 10+40	**OFFSET** 11 ft RT	**ALIGNMENT** -L-	**0 HR.** 10.6
COLLAR ELEV. 2,848.3 ft	**TOTAL DEPTH** 30.0 ft	**NORTHING** 841,540	**EASTING** 1,106,460	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** Mud Rotary w/ Core	**HAMMER TYPE** Automatic	
DRILLER Eister, G.	**START DATE** 10/14/25	**COMP. DATE** 10/14/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2850										2,848.3 GROUND SURFACE	0.0
	2,847.3	1.0	4	3	2	5		M		**ROADWAY EMBANKMENT** Brown with White and Orange, Loose, Clayey Coarse to Fine SAND (A-2-6), Trace Roots	
2845	2,844.8	3.5	2	2	2	4		M		2,845.3	3.0
	2,842.3	6.0	2	2	2	4		M		Brown and Gray, Soft to Medium Stiff, Coarse to Fine Sandy CLAY (A-6), Trace Rock Fragments 2,842.3	6.0
2840	2,839.8	8.5	1	2	2	4		W7		**RESIDUAL** Brown and Orange, Soft to Medium Stiff, Coarse to Fine Sandy SILT (A-4), Trace Roots, Mica, and Rock Fragments Note: Hard Drilling From 18.0'-18.5'.	
2835	2,834.8	13.5	4	12	9	21		W			
2830	2,829.8	18.5	60/0.0			60/0.0				2,829.8 **CRYSTALLINE ROCK** Gray with White and Brown, Moderately Weathered to Fresh, Moderately Hard to Hard BIOTITE GNEISS interlayered with SCHIST, Closed to Wide Fracture Spacing, Variably Foliated	18.5
2825											
2820										2,818.3 Boring Terminated at Elevation 2,818.3 ft in Crystalline Rock: BIOTITE GNEISS	30.0

NCDOT BORE SINGLE 25-01592-B_PRB 5631 US 19E.GPJ NC_DOT.GDT 10/29/25

GEOTECHNICAL BORING REPORT
CORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River			**GROUND WTR (ft)**
BORING NO. EB1	**STATION** 10+40	**OFFSET** 11 ft RT	**ALIGNMENT** -L-	**0 HR.** 10.6
COLLAR ELEV. 2,848.3 ft	**TOTAL DEPTH** 30.0 ft	**NORTHING** 841,540	**EASTING** 1,106,460	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** Mud Rotary w/ Core	**HAMMER TYPE** Automatic
DRILLER Eister, G.	**START DATE** 10/14/25	**COMP. DATE** 10/14/25	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 11.5 ft		

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2829.8											Begin Coring @ 18.5 ft	
	2,829.8	18.5	1.5	1:21/0.5	(1.2)	(0.3)		(11.0)	(8.6)		2,829.8 **CRYSTALLINE ROCK** Gray with White and Brown, Moderately Weathered to Fresh, Moderately Hard to Hard BIOTITE GNEISS interlayered with SCHIST, Closed to Wide Fracture Spacing, Variably Foliated GSI = 60-70	18.5
	2,828.3	20.0		*N=60/0.0*	80%	20%		96%	75%			
			5.0	1:21/0.5	(5.0)	(4.3)						
2825				4:27/1.0	100%	86%						
				1:57/1.0								
				1:02/1.0								
	2,823.3	25.0		1:02/1.0								
				1:00/1.0								
			5.0	1:17/1.0	(4.8)	(4.0)						
2820				1:42/1.0	96%	80%						
				1:08/1.0								
				1:05/1.0								
				1:06/1.0								
	2,818.3	30.0		1:08/1.0							2,818.3 Boring Terminated at Elevation 2,818.3 ft in Crystalline Rock: BIOTITE GNEISS	30.0

NCDOT CORE SINGLE 25-01592-B_PRB 5631 US 19E.GPJ NC_DOT.GDT 10/29/25

CORE PHOTOGRAPH

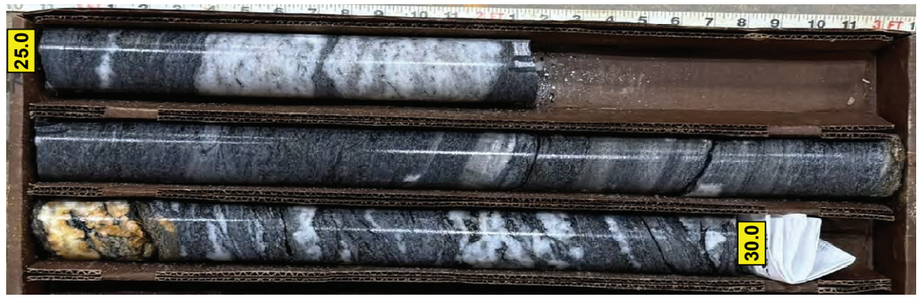
Project Description: PRB_006-01-EF443

Site Description: Private Road Bridge Replacement (PRB Site #006-01-EF443) at 5631 US 19E Avery County, North Carolina

EB1

Box 1 and 2: 18.5 Feet to 25.0 Feet

Box 2 and 2: 25.0 Feet to 30.0 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.	
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River				**GROUND WTR (ft)**
BORING NO. EB2	**STATION** 11+77	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,833.1 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 841,433	**EASTING** 1,106,548	**24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** Mud Rotary w/ Core	**HAMMER TYPE** Automatic	
DRILLER Eister, G.	**START DATE** 10/14/25	**COMP. DATE** 10/14/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2835										2,833.1 GROUND SURFACE	0.0
	2,832.1	1.0	2	2	2	4				**ALLUVIAL** Brown and Gray, Very Loose to Loose, Silty Coarse to Fine SAND (A-2-4), Trace Roots	
2830	2,829.6	3.5	1	4	4	8					
	2,827.1	6.0	14	86/0.4		100/0.9				2,826.6	6.5
2825	2,824.6	8.5	60/0.0			60/0.0				**WEATHERED ROCK** MICA SCHIST Brown with White	
										2,824.6 **CRYSTALLINE ROCK** Gray with White and Brown, Moderately Weathered to Fresh, Moderately Hard to Hard, BIOTITE GNEISS interlayered with SCHIST, Close to Moderately Close Fracture Spacing, Variably Foliated	8.5
2820											
2815										2,813.1	20.0
										Boring Terminated at Elevation 2,813.1 ft in Crystalline Rock: BIOTITE GNEISS	

GEOTECHNICAL BORING REPORT
CORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River			**GROUND WTR (ft)**
BORING NO. EB2	**STATION** 11+77	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,833.1 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 841,433	**EASTING** 1,106,548	**24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** Mud Rotary w/ Core	**HAMMER TYPE** Automatic
DRILLER Eister, G.	**START DATE** 10/14/25	**COMP. DATE** 10/14/25	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 11.5 ft		

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2824.6											Begin Coring @ 8.5 ft	
	2,824.6	8.5	1.5	1:19/0.5	(1.5)	(0.5)		(11.3)	(7.0)		2,824.6 **CRYSTALLINE ROCK** Gray with White and Brown, Moderately Weathered to Fresh, Moderately Hard to Hard, BIOTITE GNEISS interlayered with SCHIST, Close to Moderately Close Fracture Spacing, Variably Foliated GSI=50-60	8.5
	2,823.1	10.0	5.0	*N=60/0.0*	100%	33%		98%	61%			
2820				1:19/0.5								
				1:37/1.0	(4.8)	(2.5)						
				1:23/1.0	96%	50%						
	2,818.1	15.0		1:17/1.0								
				1:02/1.0								
			5.0	1:01/1.0								
				1:03/1.0	(5.0)	(4.0)						
2815				1:09/1.0	100%	80%						
				0:52/1.0								
				0:51/1.0								
	2,813.1	20.0		0:58/1.0							2,813.1	20.0
				1:02/1.0							Boring Terminated at Elevation 2,813.1 ft in Crystalline Rock: BIOTITE GNEISS	

CORE PHOTOGRAPH

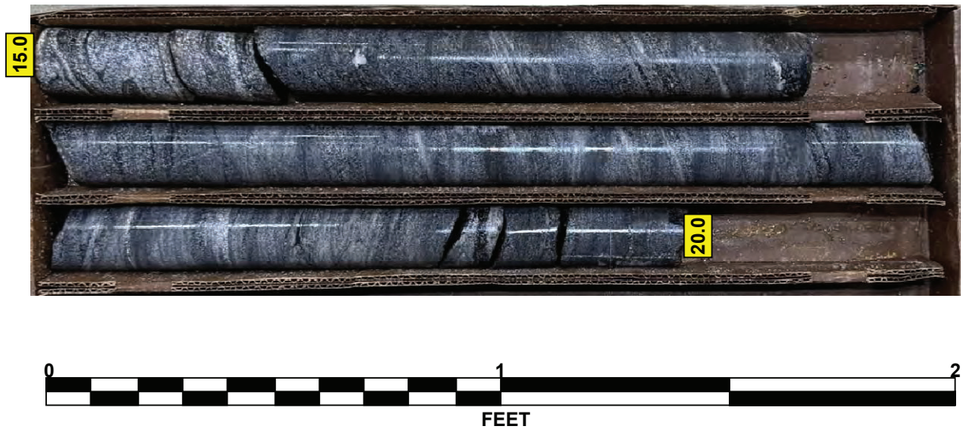
Project Description: PRB_006-01-EF443

Site Description: Private Road Bridge Replacement (PRB Site #006-01-EF443) at 5631 US 19E Avery County, North Carolina

EB2

Box 1 and 2: 8.5 Feet to 15.0 Feet

Box 2 and 2: 15.0 Feet to 20.0 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.	
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River				**GROUND WTR (ft)**
BORING NO. B-1	**STATION** 11+18	**OFFSET** 8 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 2,826.9 ft	**TOTAL DEPTH** 3.5 ft	**NORTHING** 841,483	**EASTING** 1,106,515	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Eister, G.	**START DATE** 10/15/25	**COMP. DATE** 10/15/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2830										ELEV. (ft) DEPTH (ft)
										2,826.9 GROUND SURFACE 0.0
2825								W		**ALLUVIAL** Brown, Coarse to Fine SAND with Abundant Cobbles and Pebbles
										2,823.4 3.5
										Boring Terminated by Auger Refusal at Elevation 2,823.4 ft

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.	
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River				**GROUND WTR (ft)**
BORING NO. B-2	**STATION** 11+48	**OFFSET** 8 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 2,830.5 ft	**TOTAL DEPTH** 5.5 ft	**NORTHING** 841,456	**EASTING** 1,106,530	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Eister, G.	**START DATE** 10/15/25	**COMP. DATE** 10/15/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2835										
										2,830.5 GROUND SURFACE 0.0
2830								M		**ALLUVIAL** Brown, Silty Coarse to Fine SAND (A-2-4)
										2,825.0 5.5
2825										Boring Terminated by Auger Refusal at Elevation 2,825.0 ft

NCDOT BORE DOUBLE 25-01592-B_PRB 5631 US 19E.GPJ NC_DOT.GDT 10/29/25

GEOTECHNICAL BORING REPORT
BORE LOG

WBS PRB_006-01-EF443	**TIP** 0	**COUNTY** AVERY	**GEOLOGIST** Barrera, P.	
SITE DESCRIPTION Bridge at 5631 US 19E over North Toe River				**GROUND WTR (ft)**
BORING NO. B-3	**STATION** 11+90	**OFFSET** 24 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 2,833.5 ft	**TOTAL DEPTH** 5.0 ft	**NORTHING** 841,428	**EASTING** 1,106,565	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE BRI5104 CME-45C 96% 04/17/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER Eister, G.	**START DATE** 10/15/25	**COMP. DATE** 10/15/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
2835										2,833.5 GROUND SURFACE 0.0
										ALLUVIAL
2830								M		Brown and Gray, Silty SAND (A-2-4)
										2,828.5 5.0
										Boring Terminated by Auger Refusal at Elevation 2,828.5 ft

NCDOT BORE DOUBLE 25-01592-B_PRB 5631 US 19E.GPJ NC_DOT.GDT 10/29/25

SITE PHOTOGRAPHS

Project Description: PRB_006-01-EF443

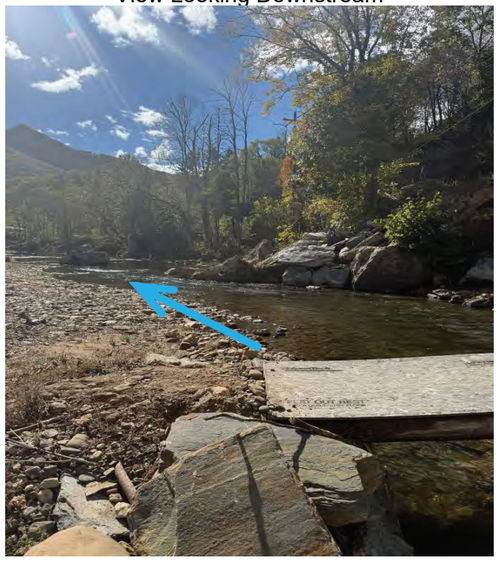
Site Description: Private Road Bridge Replacement (PRB Site 006-01-EF443) at 5631 US 19E
Avery County, North Carolina

View Looking Upstation

View Looking Upstream

View Looking Downstation

View Looking Downstream



PRB.35488

Site # 006-01-07045
85 Kay Jay Lane, Newland
Horse Creek in Avery County
WBS 51830.2.11.09

North Carolina Emergency Management – Private Roads and Bridges

Site Information Form

Site Number: 006-01-07045

Site Address: 85 Kay Jay Lane, Newland, NC

GPS Coordinates: 36.1073, -81.9957

County: Avery

Bridge Type: Steel I-beam with timber decking

Span Length: 40 feet

Bridge Width: 12'-0" out-to out, 11'-1" clear width

Substructure Type: Concrete Cap on Drilled in Piles

Geotechnical Information: See Standard Bridge Plans for Notes

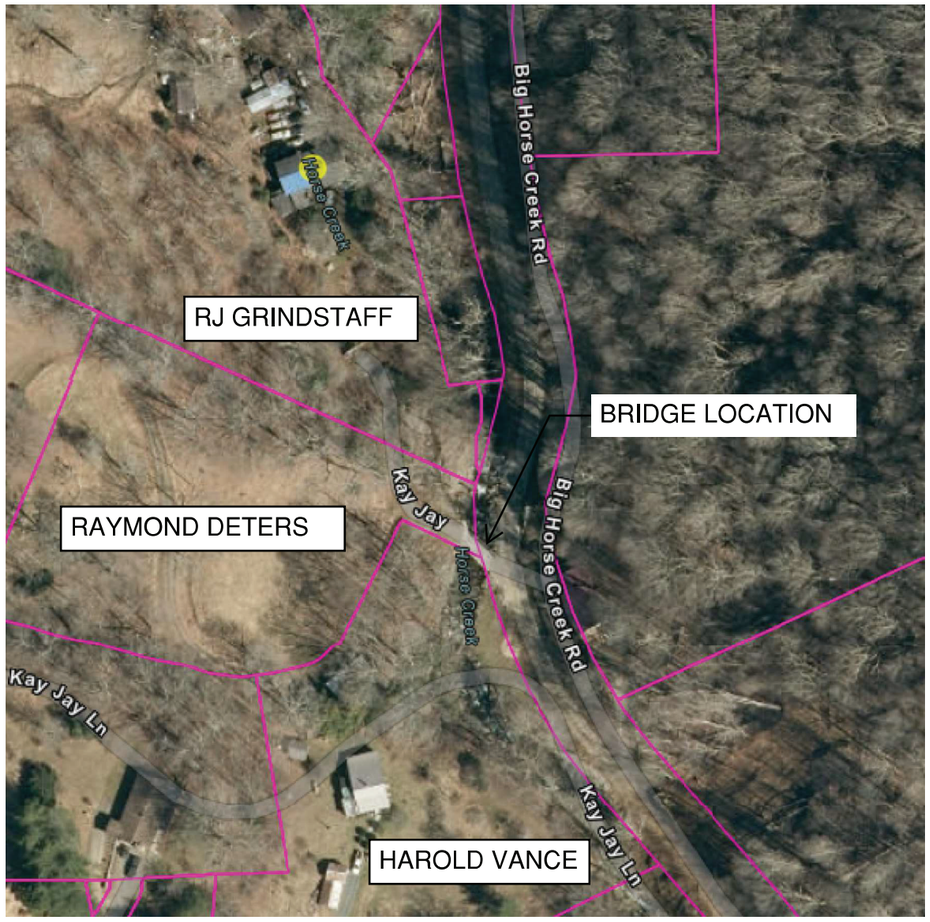
Additional Notes:

Timber bridge railing not required.

Wing walls not required.

The existing bridge is in place and must be removed prior to the start of construction.

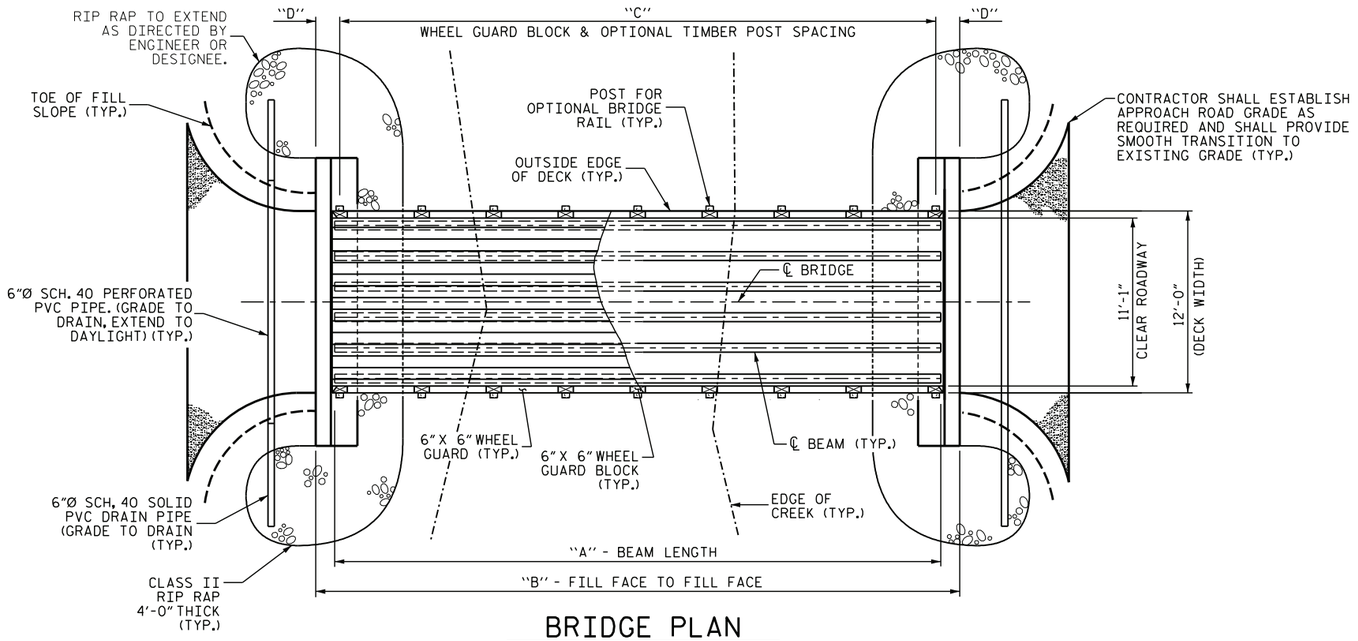
The stream contains no debris or obstructions requiring removal.



SITE ID: 006-01-07045

SITE ADDRESS: 85 KAY JAY LANE
NEWLAND, NC 28657

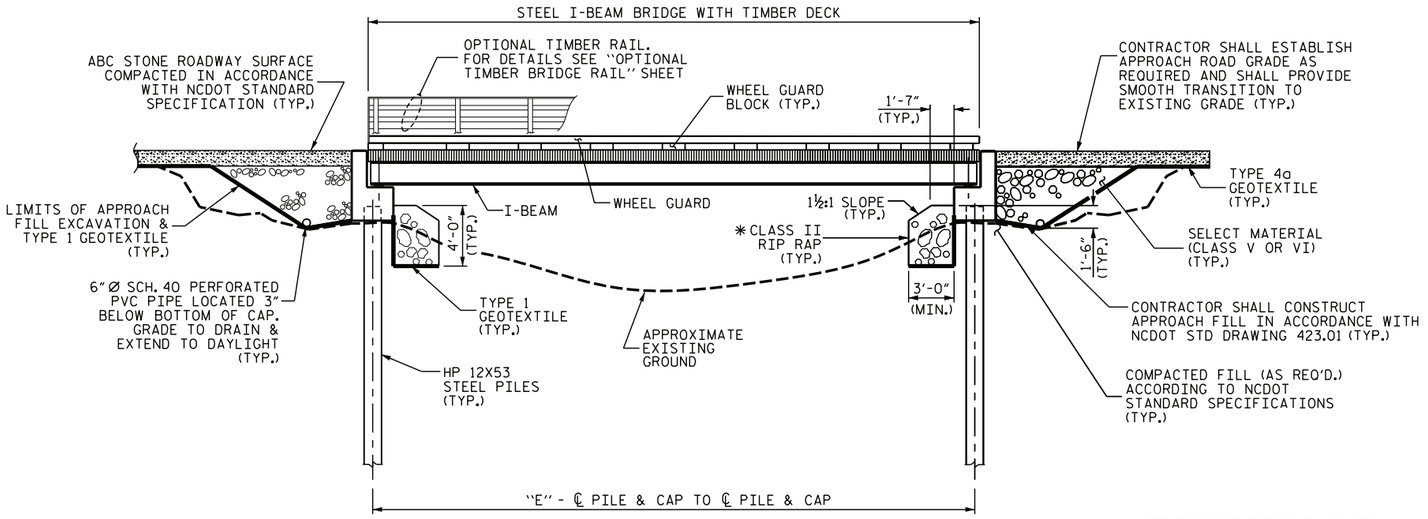
Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



BRIDGE PLAN

(FOUNDATION TYPE NOT SHOWN FOR CLARITY)

DIMENSIONS TABLE					
SPAN	A	B	C	D	E
20'-0"	20'-0"	22'-6"	5 SPA. @ 3'-8"	2'-1"	19'-9"
30'-0"	30'-0"	32'-6"	7 SPA. @ 4'-0"	2'-3"	29'-9"
40'-0"	40'-0"	42'-6"	9 SPA. @ 4'-3"	2'-1½"	39'-9"
50'-0"	50'-0"	52'-6"	11 SPA. @ 4'-4"	2'-5"	49'-9"



BRIDGE ELEVATION

(SHOWING DRIVEN 12X53 STEEL PILES FOUNDATION)

*SEE BSR FOR RIP RAP LIMITS

NOTES

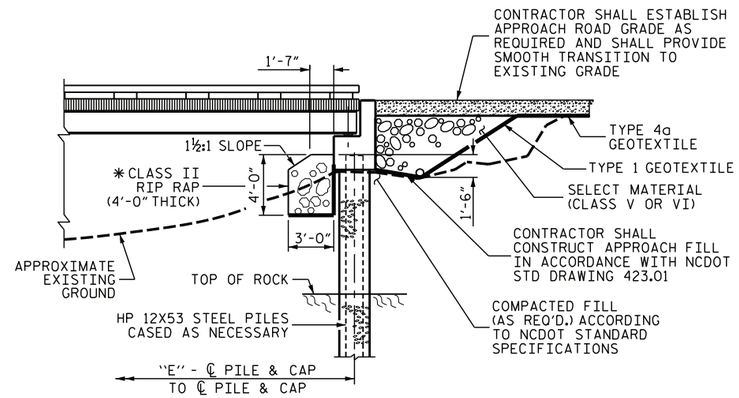
FOR OPTIONAL TIMBER BRIDGE RAIL DETAILS, SEE "OPTIONAL TIMBER BRIDGE RAIL" SHEET.

CONTRACTOR SHALL LOCATE THE EXPANSION BEARING ON THE "UPHILL" END OF THE BRIDGE. THERE WILL BE ONLY ONE EXPANSION BEARING PER BRIDGE.

CONTRACTOR SHALL PROVIDE EROSION CONTROL MEASURES, AS REQUIRED ACCORDING TO NCDOT STANDARD SPECIFICATIONS AND THE CONTRACT DOCUMENTS.

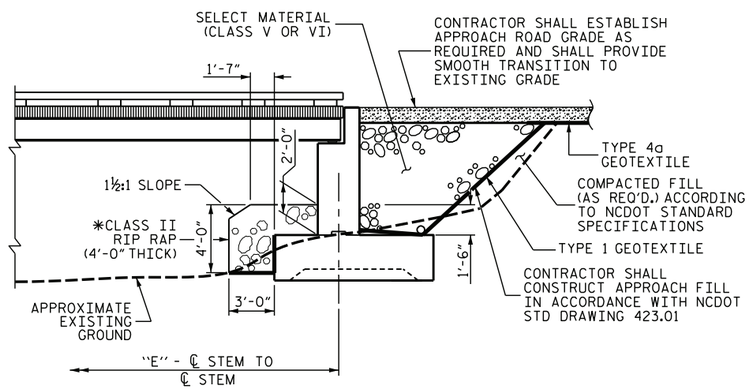
THE CONTRACTOR SHALL SET THE LOW-CHORD ELEVATION OF THE BRIDGE BASED ON EXISTING SITE CONDITIONS AND IN COORDINATION WITH THE ENGINEER, SUCH THAT THE NEW CROSSING PROVIDES CONVEYANCE GREATER THAN OR EQUAL TO THE ORIGINAL DESTROYED CROSSING. THE CONTRACTOR SHALL REFER TO THE BSR WHEN SETTING THE LOW-CHORD ELEVATION OF THE BRIDGE. NO CONSTRUCTION ACTIVITIES SHALL COMMENCE UNTIL ALL PARTIES HAVE AGREED UPON THE LOW-CHORD ELEVATION AND THE DATED PERMIT APPLICATION IS APPROVED.

TIMBER DECKING SHALL BE 2X8 BOARDS. 4X6 TIMBER DECKING (6"DIMENSION HORIZONTAL) MAY BE USED IN LIEU OF 2X8 DECKING; SEE OPTIONAL TYPICAL SECTION ON SHEET S-03 FOR DETAILS.



BRIDGE PARTIAL ELEVATION

(SHOWING DRILLED-IN 12X53 STEEL PILES FOUNDATION)



BRIDGE PARTIAL ELEVATION

(SHOWING SPREAD FOOTING FOUNDATION)

DocuSigned by: Gwen Wilson F172D6ADE683420...
ENGINEER GWENDOLEN F. WILSON
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

GENERAL DRAWING

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

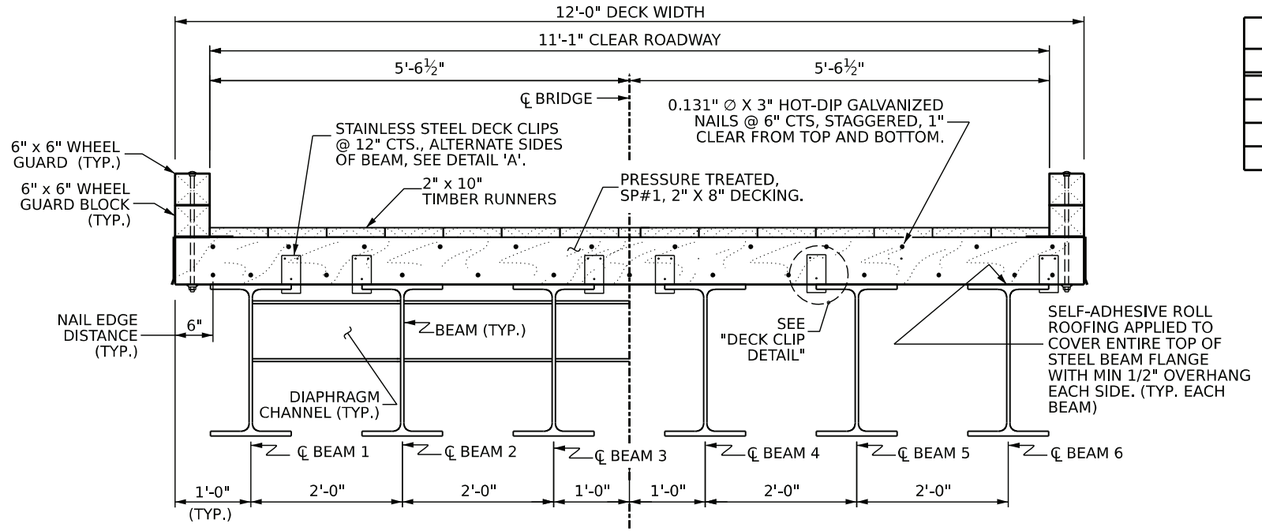
DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-01
1			3			TOTAL SHEETS
2			4			13

wGruther
CON: jmt-pw-bentley.com
TIME: 4/7/2025

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F

C:\Users\wdrutcher\OneDrive - JMT\Documents\Projects\2025\25-00529\25-00529-00\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\002-S2_Typical Sections.dgn
wdrutcher
DGN: dwr://jmt-pw.bentley.com/jmt-pw-01/Documents/Projects/2025/25-00529/25-00529-00/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/002-S2_Typical Sections.dgn
TIME: 4/7/2026



TYPICAL SECTION

MATERIALS TABLE

SPAN	BEAM	DIAPHRAGM CHANNEL	DECK PLANK	DECKING SQ. FT.
20'-0"	W16X36	C12X20.7	2X8	244
30'-0"	W21X48	C12X20.7	2X8	364
40'-0"	W24X76	C12X20.7	2X8	484
50'-0"	W24X104	C12X20.7	2X8	604

NOTES

FOR TIMBER BRIDGE DECK SYSTEM DETAILS, SEE "PLAN OF SPAN" SHEET.

FOR OPTIONAL TIMBER RAILS, SEE "OPTIONAL TIMBER BRIDGE RAIL" SHEET.

FOR BEAM AND DIAPHRAGM DETAILS, SEE "FRAMING PLAN & BEAM DETAILS" SHEET.

TREAT ALL DRILLED OR NEWLY EXPOSED HOLES IN TIMBER MEMBERS BY PUMPING WITH BITUMINOUS ASPHALT-BASED ROOFING CEMENT, OR APPROVED PRESERVATIVE SYSTEM BEFORE INSTALLING HARDWARE.

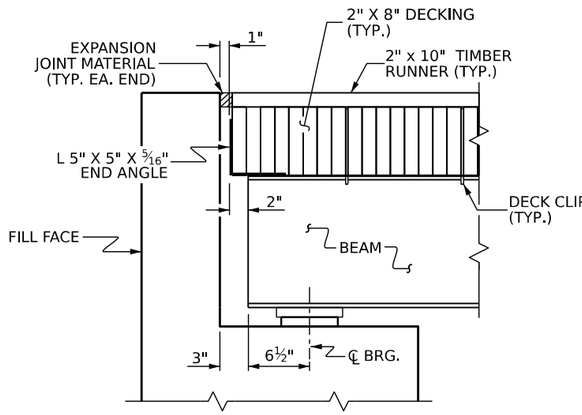
SEE "PLAN OF SPAN" SHEET FOR NUMBER OF WHEEL GUARDS AND WHEEL GUARD SPACING.

STAINLESS STEEL DECK CLIPS SHALL BE FABRICATED FROM 12-GAUGE STEEL.

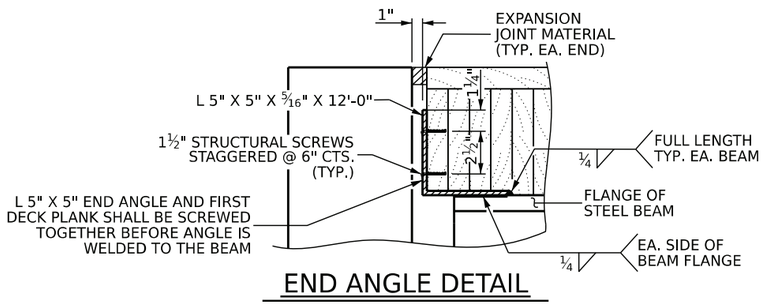
THE 2"X10" TIMBER RUNNERS SHALL BE LAID OUT SYMMETRICALLY ABOUT THE CENTERLINE OF THE BRIDGE. ANY REQUIRED WIDTH ADJUSTMENT SHALL BE MADE AT THE CENTER RUNNER.

PLACE 2X10 WEARING SURFACE BOARDS PARALLEL TO TRAFFIC WITH A UNIFORM ¼" CLEAR LONGITUDINAL GAP BETWEEN ADJACENT BOARDS. DO NOT BUTT BOARDS TIGHT. THIS GAP SHALL BE MAINTAINED TO FACILITATE SURFACE DRAINAGE AND PREVENT MOISTURE ENTRAPMENT AT THE INTERFACE OF THE STRUCTURAL DECK.

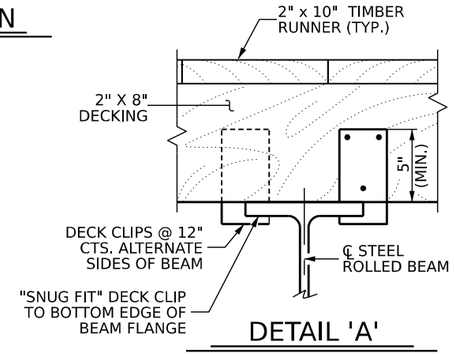
INSTALL 2X10 WEARING SURFACE BOARDS WITH GROWTH RINGS CURVING DOWNWARD TO PROMOTE DRAINAGE.



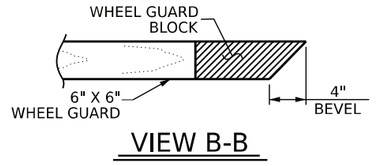
SECTION AT END BENT



END ANGLE DETAIL



DETAIL 'A'

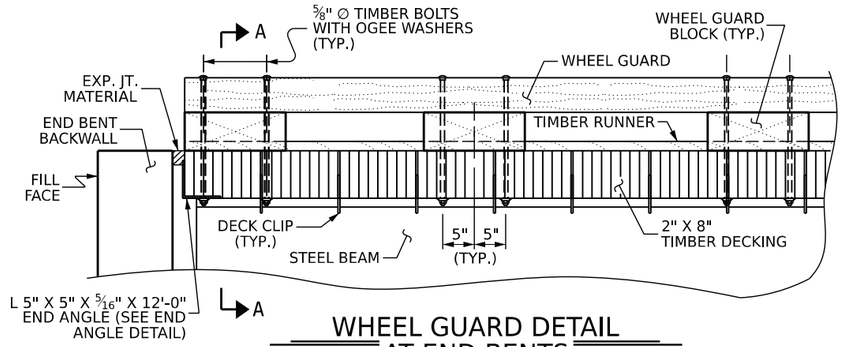


VIEW B-B

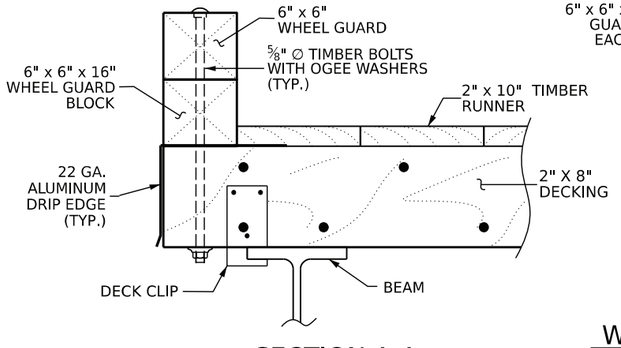
DECK CLIP DIMENSIONS

SPAN	BEAM	*A
20'-0"	W16X36	½"
30'-0"	W21X48	½"
40'-0"	W24X76	¾"
50'-0"	W24X104	13/16"

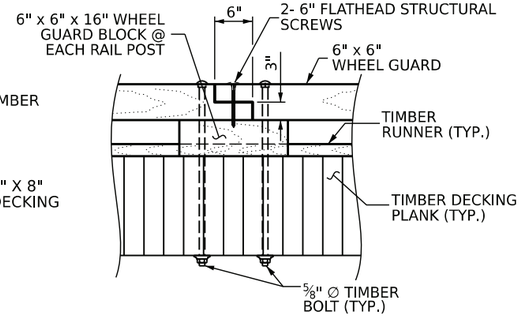
* DIMENSION A IS FOR INFORMATION ONLY. IT IS BASED ON THE FLANGE THICKNESS PLUS A 1/16" TOLERANCE. THE CONTRACTOR SHALL VERIFY THIS DIMENSION WITH DECK CLIP SUPPLIER. THE DECK CLIP SHALL HAVE A SNUG FIT TO THE BEAM FLANGE.



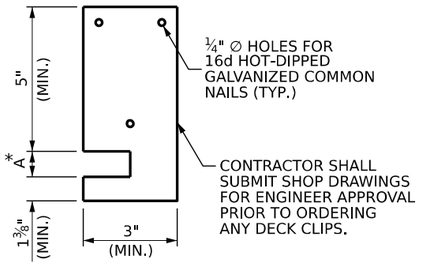
WHEEL GUARD DETAIL AT END BENTS



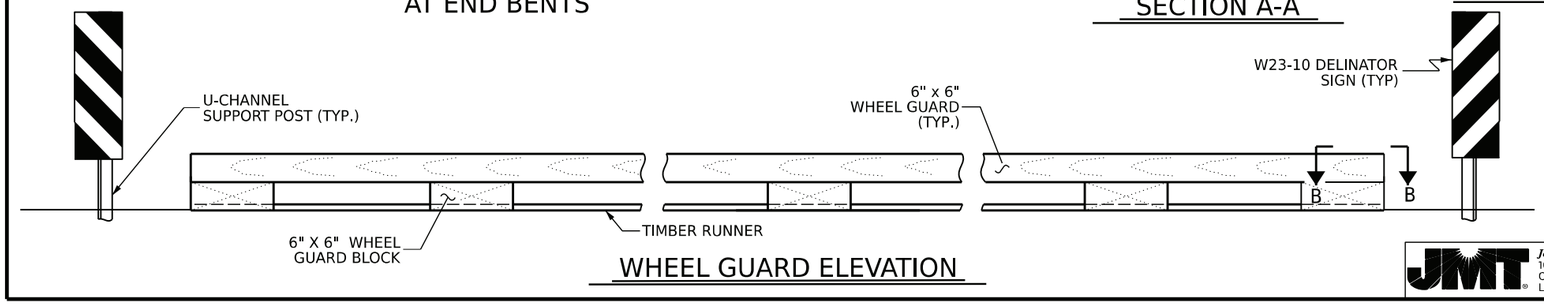
SECTION A-A



WHEEL GUARD SPLICE DETAIL



DECK CLIP DETAIL



WHEEL GUARD ELEVATION

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D8ADE683420...
ENGINEER
NOELEN F. WILSON
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
2X8 TIMBER DECK

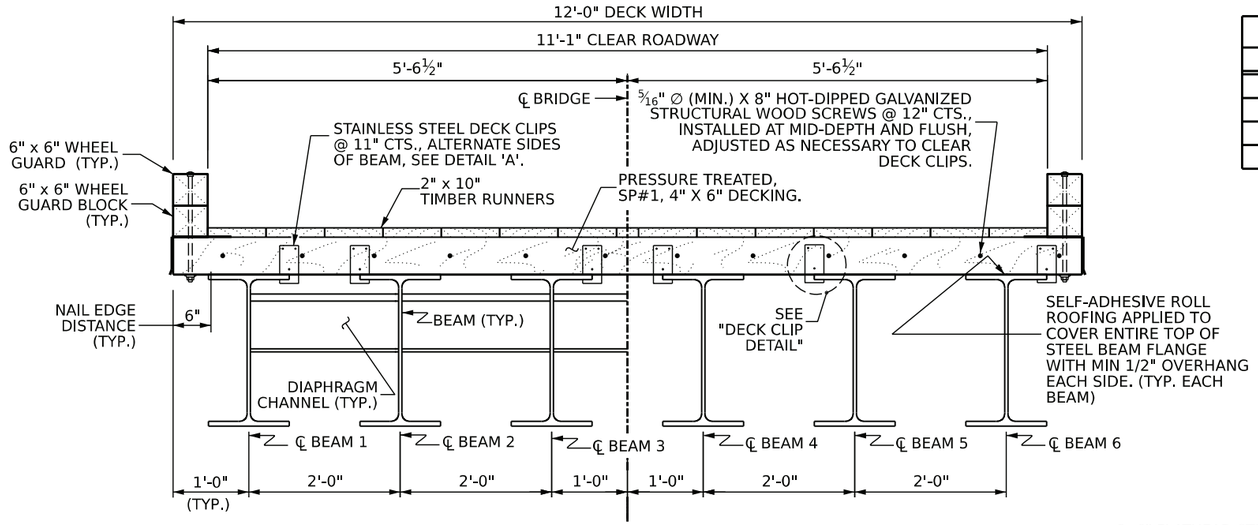
TYPICAL SECTION & RAIL DETAILS

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-02
1			3			TOTAL SHEETS
2			4			13

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



TYPICAL SECTION

MATERIALS TABLE				
SPAN	BEAM	DIAPHRAGM CHANNEL	DECK PLANK	DECKING SQ. FT.
20'-0"	W16X36	C12X20.7	4X6	244
30'-0"	W21X48	C12X20.7	4X6	364
40'-0"	W24X76	C12X20.7	4X6	484
50'-0"	W24X104	C12X20.7	4X6	604

NOTES

FOR TIMBER BRIDGE DECK SYSTEM DETAILS, SEE "PLAN OF SPAN" SHEET.

FOR OPTIONAL TIMBER RAILS, SEE "OPTIONAL TIMBER BRIDGE RAIL" SHEET.

FOR BEAM AND DIAPHRAGM DETAILS, SEE "FRAMING PLAN & BEAM DETAILS" SHEET.

TREAT ALL DRILLED OR NEWLY EXPOSED HOLES IN TIMBER MEMBERS BY PUMPING WITH BITUMINOUS ASPHALT-BASED ROOFING CEMENT, OR APPROVED PRESERVATIVE SYSTEM BEFORE INSTALLING HARDWARE.

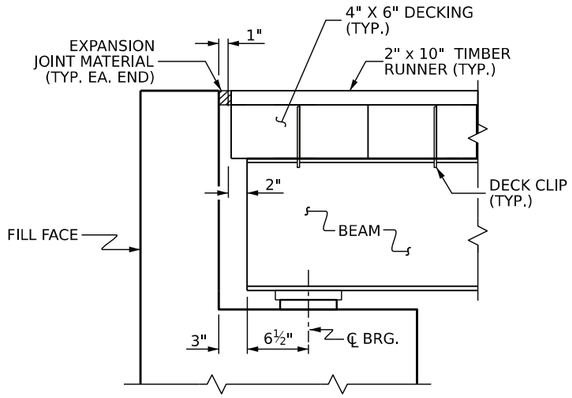
SEE "PLAN OF SPAN" SHEET FOR NUMBER OF WHEEL GUARDS AND WHEEL GUARD SPACING.

STAINLESS STEEL DECK CLIPS SHALL BE FABRICATED FROM 12 GAUGE STEEL.

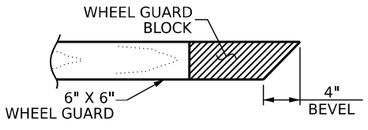
THE 2"X10" TIMBER RUNNERS SHALL BE LAID OUT SYMMETRICALLY ABOUT THE CENTERLINE OF THE BRIDGE. ANY REQUIRED WIDTH ADJUSTMENT SHALL BE MADE AT THE CENTER RUNNER.

PLACE 2X10 WEARING SURFACE BOARDS PARALLEL TO TRAFFIC WITH A UNIFORM ¼" CLEAR LONGITUDINAL GAP BETWEEN ADJACENT BOARDS. DO NOT BUTT BOARDS TIGHT. THIS GAP SHALL BE MAINTAINED TO FACILITATE SURFACE DRAINAGE AND PREVENT MOISTURE ENTRAPMENT AT THE INTERFACE OF THE STRUCTURAL DECK.

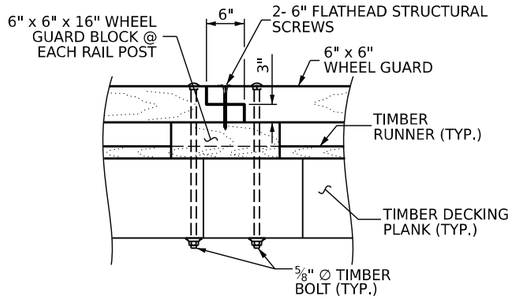
INSTALL 2X10 WEARING SURFACE BOARDS WITH GROWTH RINGS CURVING DOWNWARD TO PROMOTE DRAINAGE.



SECTION AT END BENT



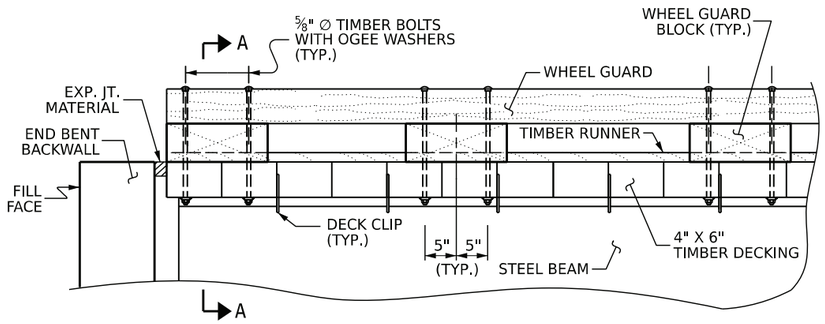
VIEW B-B



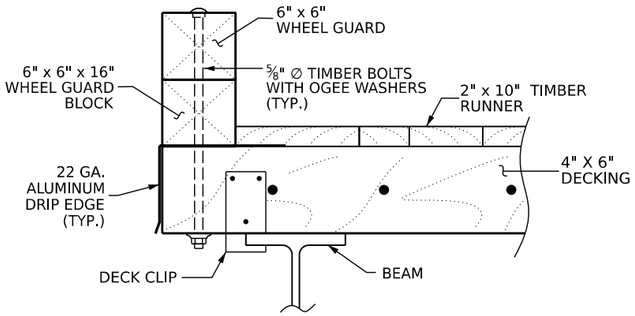
WHEEL GUARD SPLICE DETAIL

DECK CLIP DIMENSIONS		
SPAN	BEAM	*A
20'-0"	W16X36	½"
30'-0"	W21X48	½"
40'-0"	W24X76	¾"
50'-0"	W24X104	13/16"

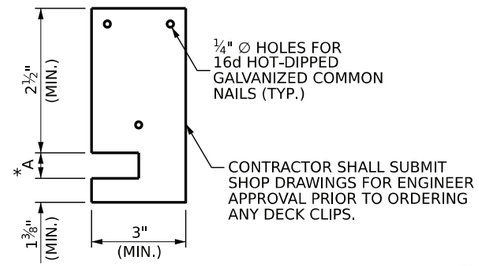
* DIMENSION A IS FOR INFORMATION ONLY. IT IS BASED ON THE FLANGE THICKNESS PLUS A 1/16" TOLERANCE. THE CONTRACTOR SHALL VERIFY THIS DIMENSION WITH DECK CLIP SUPPLIER. THE DECK CLIP SHALL HAVE A SNUG FIT TO THE BEAM FLANGE.



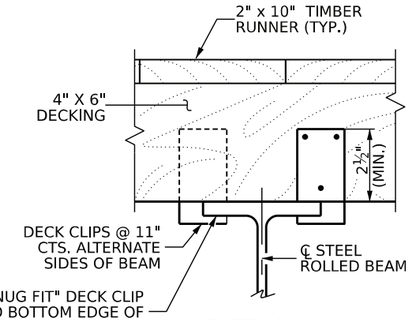
WHEEL GUARD DETAIL AT END BENTS



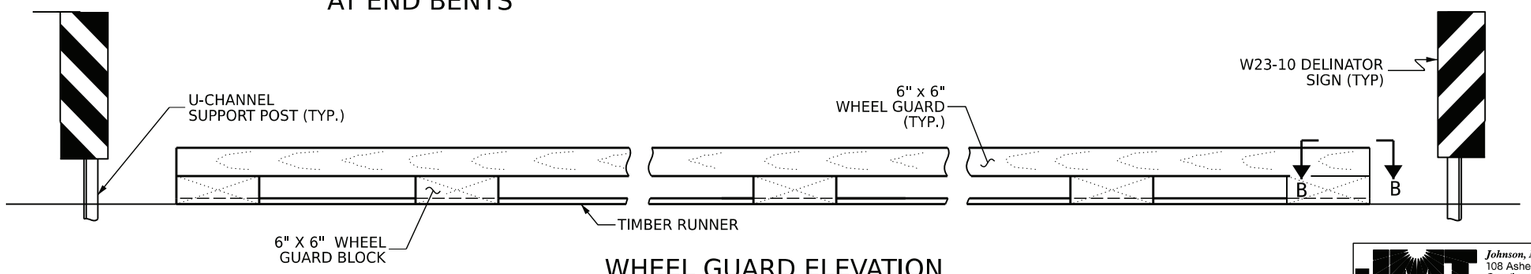
SECTION A-A



DECK CLIP DETAIL



DETAIL 'A'



WHEEL GUARD ELEVATION

DocuSigned by: Gwen Wilson F1720D6ADE683420... ENGINEER ENDOLEN F. WILSON 04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
4X6 TIMBER DECK

OPTIONAL TYPICAL SECTION & RAIL DETAILS

JMT Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC. 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

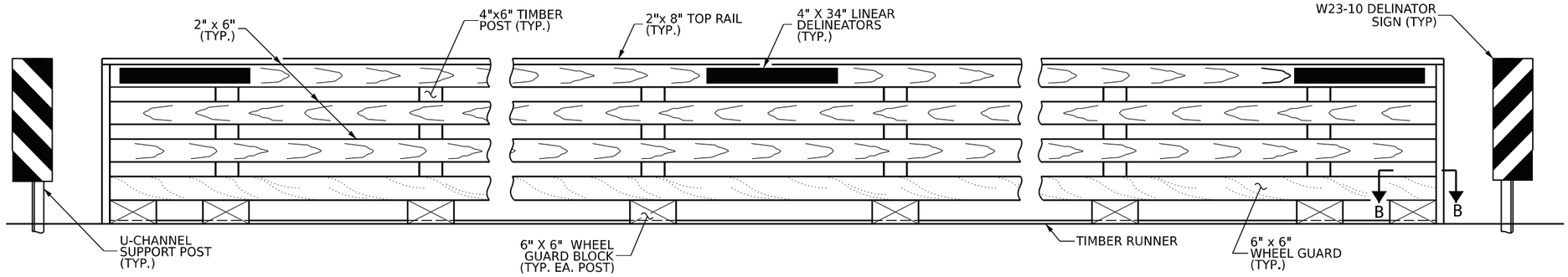
REVISIONS

NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-03
TOTAL SHEETS 13

w:\Structures\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\r003-53_Optional Typical Section.dgn
DGN: pw://jmt-pwbentley.com:jmt-pw-01/Documents/Projects/2025/25-00529/25-00529-001/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/r003-53_Optional Typical Section.dgn
USER: bc
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



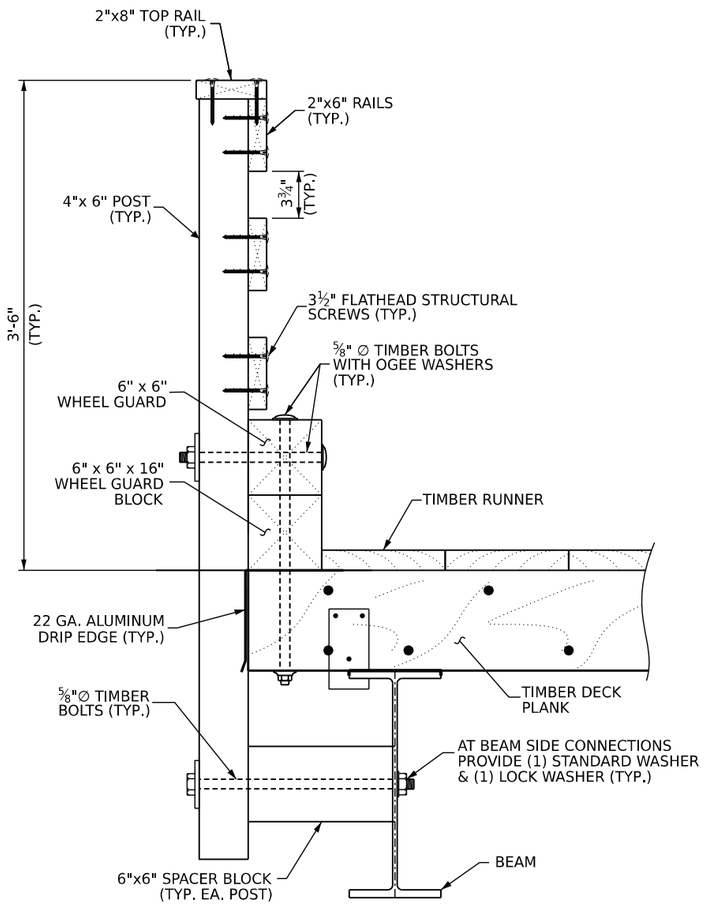
ELEVATION OF OPTIONAL BRIDGE RAIL

OPTIONAL BRIDGE RAIL NOTES

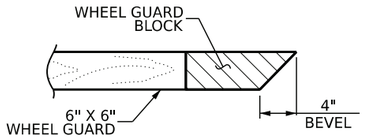
BRIDGE RAILS SHALL BE CONTINUOUS FROM END POST TO END POST WITH NO GAPS. RAIL LUMBER LENGTHS SHALL BE ATTACHED TO A MINIMUM OF THREE POSTS.

TREAT ALL DRILLED OR NEWLY EXPOSED HOLES IN TIMBER MEMBERS BY PUMPING WITH BITUMINOUS ASPHALT-BASED ROOFING CEMENT, OR APPROVED PRESERVATIVE SYSTEM BEFORE INSTALLING HARDWARE.

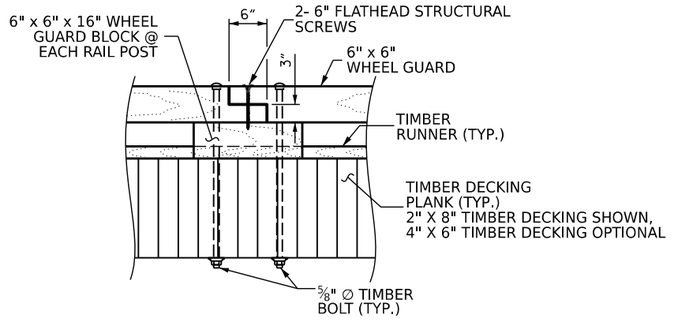
SEE ''PLAN OF SPAN'' SHEET FOR NUMBER OF POSTS AND POST SPACING.



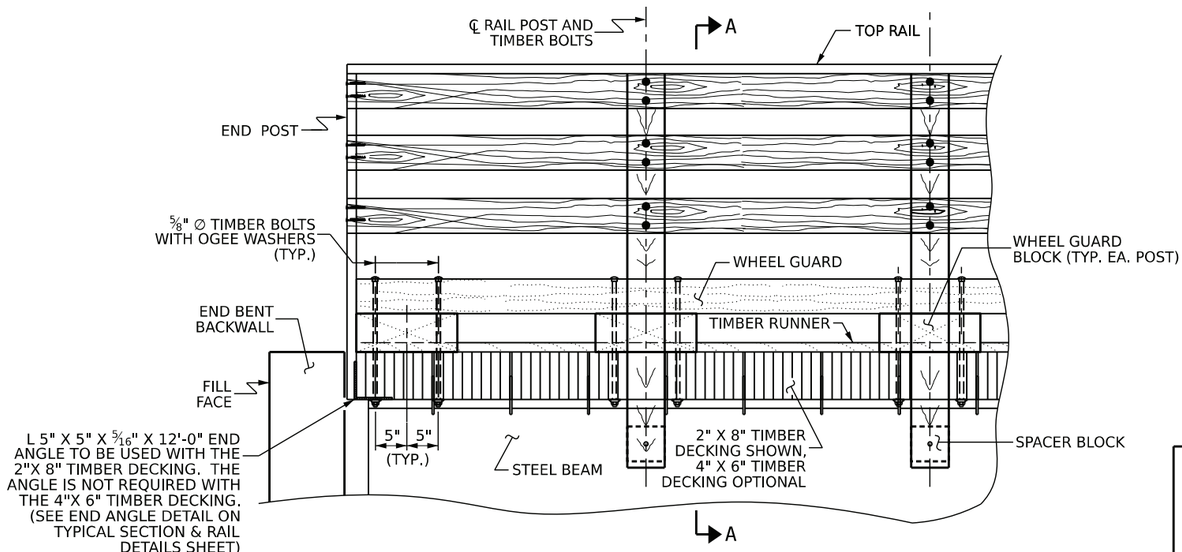
SECTION A-A



VIEW B-B



WHEEL GUARD SPLICE DETAIL



OPTIONAL RAIL DETAIL AT END BENTS

DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
JOOLEN F. WILL
NORTH CAROLINA
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

OPTIONAL TIMBER BRIDGE RAIL

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-04
TOTAL SHEETS 13

wdcrutcher
DGN: dwr://jmt-pw.bentley.com/jmt-pw-01/Documents/Projects/2025/25-00529/25-00529-00/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/004-54 Optional Bridge Raildgn
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F

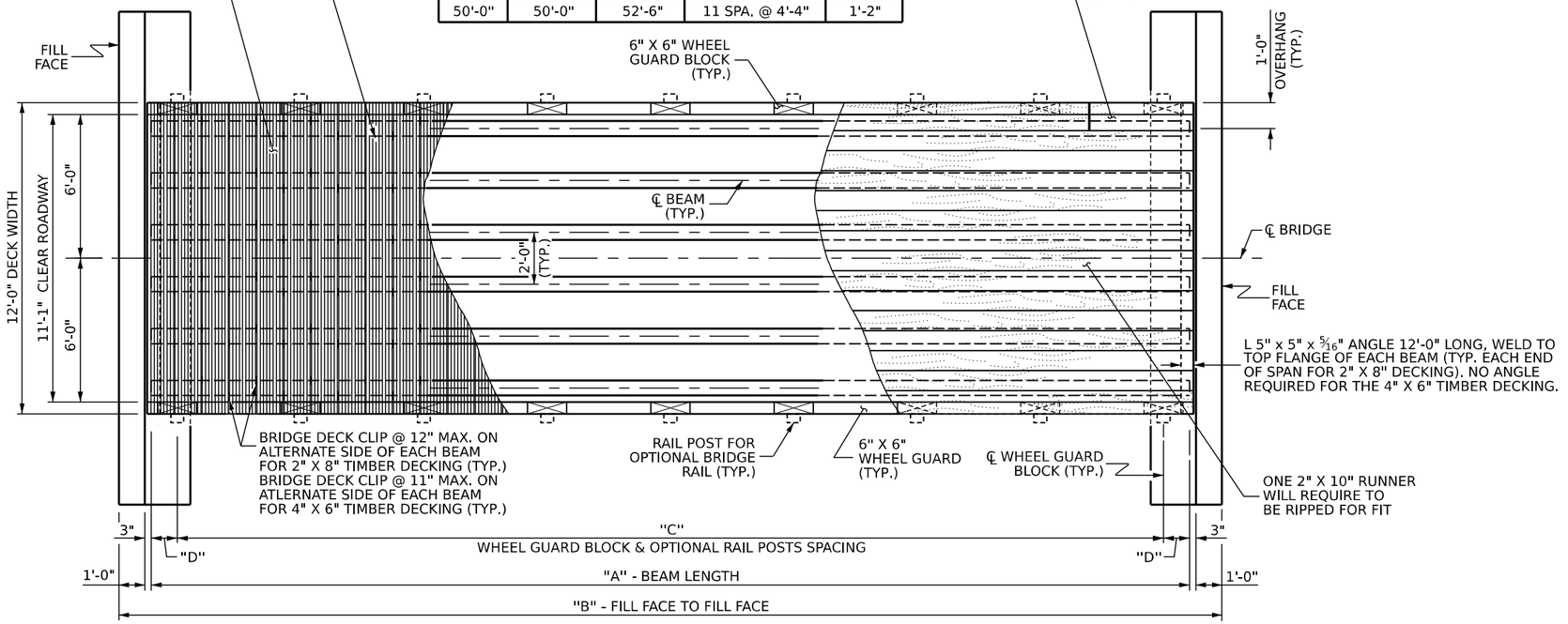
wgcrutcher
DGN: Dwn:/jmt-pw.bentley.com/jmt-pw-01/Documents/Projects/2025/25-00529/25-00529-001/Design/Structures/NC PRB-Steel Beam with Timber Deck Plans/2 Standard Drawings/20-TO FT - 12 FT DECK WIDTH/r005-S5_Plan of Spandgn
TIME: 4/7/2026

RIP ONE DECK BOARD (CLOSURE BOARD) AS NECESSARY TO PROVIDE A TIGHT, UNIFORM FIT.

PRESSURE TREATED (PT), SP#1, 2" X 8" DECKING SHOWN (8 BOARD CLUSTERS) 4" X 6" DECKING (2 BOARD CLUSTERS) MAY BE USED IN LIEU.

DIMENSIONS TABLE

SPAN	A	B	C	D
20'-0"	20'-0"	22'-6"	5 SPA. @ 3'-8"	10"
30'-0"	30'-0"	32'-6"	7 SPA. @ 4'-0"	1'-0"
40'-0"	40'-0"	42'-6"	9 SPA. @ 4'-3"	10½"
50'-0"	50'-0"	52'-6"	11 SPA. @ 4'-4"	1'-2"



END BENT 1

END BENT 2

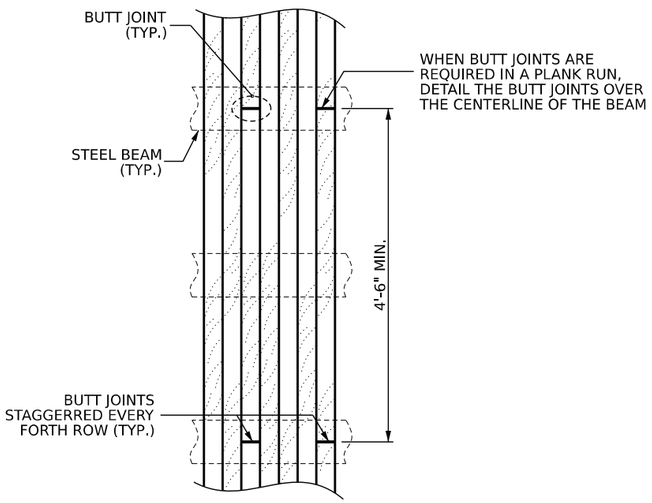
DECK LAYOUT

2" X 8" TIMBER DECKING SHOWN. 4" X 6" TIMBER DECKING (6" DIMENSION HORIZONTAL) MAY BE USED IN LIEU OF 2" X 8" DECKING.

NOTES

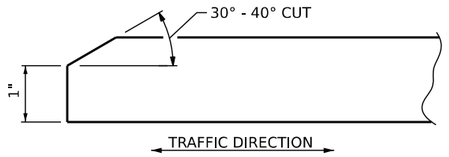
FOR ADDITIONAL NOTES, SEE "TYPICAL SECTION & RAIL DETAILS" SHEET, "OPTIONAL TYPICAL SECTION & RAIL DETAILS", AND "GENERAL NOTES" SHEET.

COUNTERSINK FLATHEAD STRUCTURAL TIMBER SCREW HEADS TO BE FLUSH WITH TIMBER SURFACE.



DECKING BOARD BUTT JOINT DETAIL

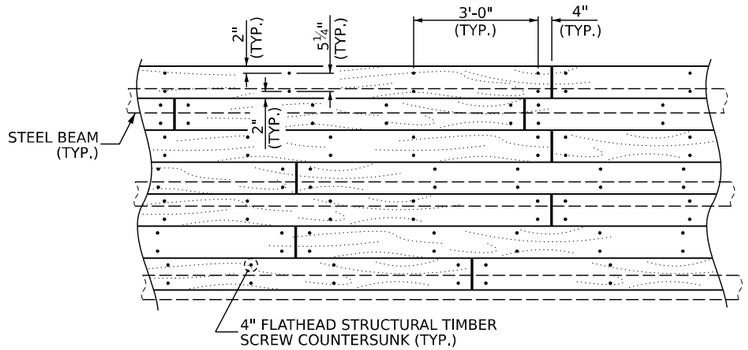
BUTT JOINTS SHALL BE OVER THE CENTERLINE OF A BEAM. JOINTS SHALL BE STAGGERED EVERY FOURTH DECK BOARD. NONE ALLOWED AT THE EXTERIOR BEAMS.



SIDE VIEW

TIMBER RUNNER BEVEL DETAIL

(TYP. AT EACH END OF BRIDGE)



TIMBER RUNNER BUTT JOINT DETAIL

DocuSigned by: Gwen Wilson F172D6ADE683420... NC PE SEAL 042618 ENGINEER GWENDOLEN F. WILSON
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

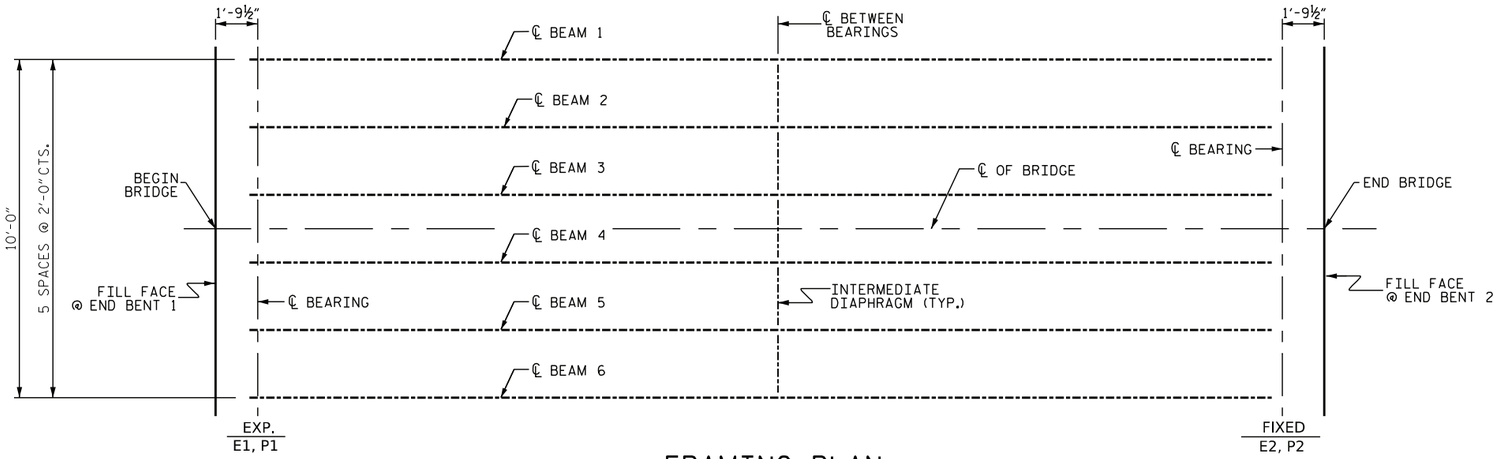
PLAN OF SPAN

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

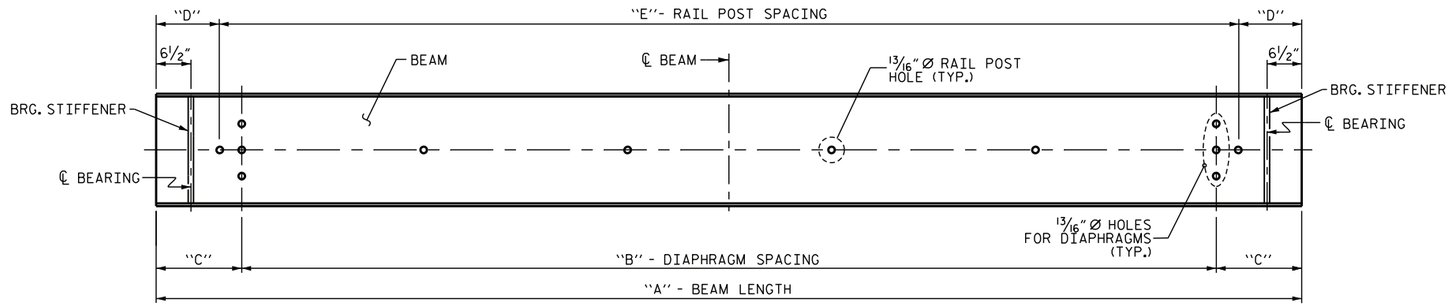
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-05
1			3			TOTAL SHEETS
2			4			13

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



FRAMING PLAN

EXPANSION BEARING SHALL BE PLACED ON THE "UPHILL" END OF THE BRIDGE.

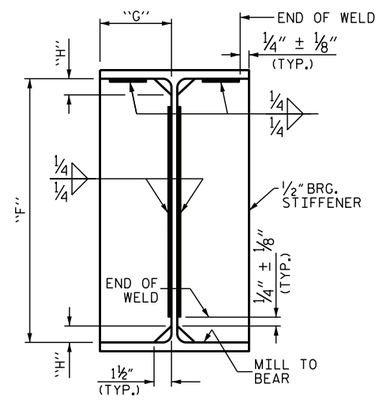


BEAM FLANGE ELEVATION

SHOWING DIAPHRAGM HOLES FOR ALL BEAMS, AND RAIL POST HOLES FOR EXTERIOR BEAMS.

BEAM DIMENSION TABLE

SPAN	BEAM	CHANNEL	A	B	C	D	E
20'-0"	W16X36	C12X20.7	20'-0"	2 SPA. @ 7'-0"	3'-0"	10"	5 SPA. @ 3'-8"
30'-0"	W21X48	C12X20.7	30'-0"	2 SPA @ 12'-0"	3'-0"	1'-0"	7 SPA. @ 4'-0"
40'-0"	W24X76	C12X20.7	40'-0"	2 SPA. @ 17'-0"	3'-0"	10½"	9 SPA. @ 4'-3"
50'-0"	W24X104	C12X20.7	50'-0"	2 SPA. @ 22'-0"	3'-0"	1'-2"	11 SPA. @ 4'-4"



SECTION VIEW - BRG. STIFFENER

NOTES

NO SALVAGED BEAMS SHALL BE USED, UNLESS OTHERWISE NOTED ON THE PLANS.

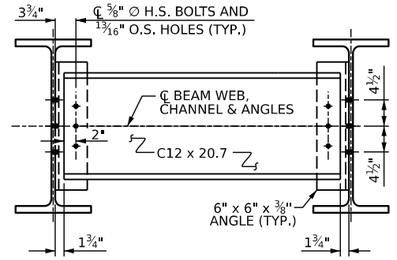
NO SHOP CAMBER REQUIRED, TURN NATURAL MILL CAMBER UP.

ALL STRUCTURAL STEEL FIELD CONNECTIONS SHALL BE ⅝" DIA. GALVANIZED HIGH STRENGTH BOLTS UNLESS OTHERWISE NOTED.

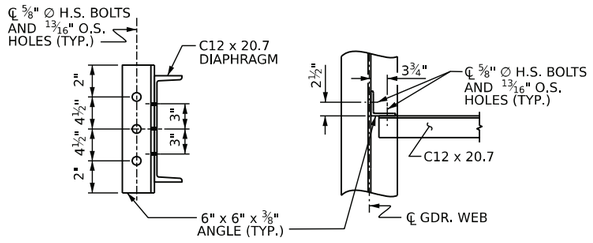
BEAMS SHALL BE PLACED PARALLEL TO THE CHORD.

CONTRACTORS OPTION TO WELD CONNECTOR TO BEAM PRIOR TO SHOP COATING.

SEE "GENERAL NOTES" SHEET FOR COATING.



DIAPHRAGM DETAILS



ANGLE DETAILS

STIFFENER DIMENSION

BEAM	F	G	H
W16X36	1'-3"	3⅜"	2"
W21X48	1'-7¾"	3⅞"	2"
W24X76	1'-10⁹⁄₁₆"	4¼"	2⁷⁄₁₆"
W24X104	1'-10⁹⁄₁₆"	6⅛"	2¾"

DocuSigned by: Gwen Wilson F172D6ADE683420... — ENGINEER — KENDOLEN F. WILSON — 04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

FRAMING PLAN & BEAM DETAILS

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

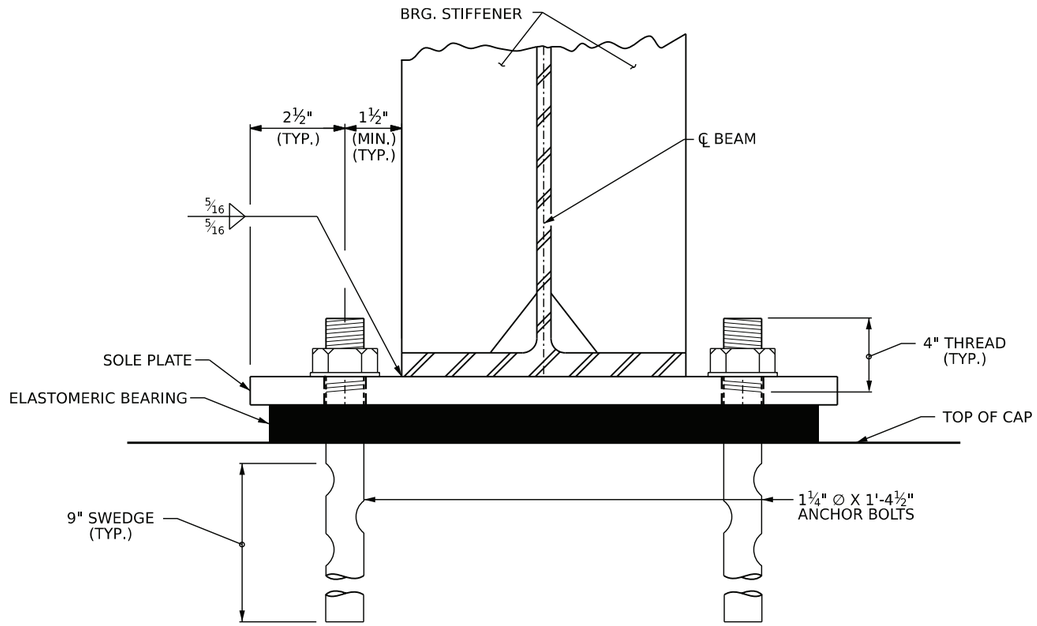
DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-06
TOTAL SHEETS 13

w:\cru\cfr
DGN: Dwg / jmt-pw.bentley.com:jmt-pw-01/Documents/Projects/2025/25-00529/25-00529-001/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/006-S6_Framing Plan.dgn
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



SECTION AT BEARING

END VIEW

NOTES

ELASTOMER IN ALL BEARINGS SHALL BE 50 DUROMETER HARDNESS IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.

AT ALL SUPPORTS, NUTS FOR ANCHOR BOLTS ARE TO BE TIGHTENED FINGER TIGHT AND THEN BACKED OFF ½ TURN. THE THREAD OF THE NUT AND BOLT SHALL THEN BE BURRED WITH A SHARP POINTED TOOL.

SOLE PLATES, ANCHOR BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.

ALL BEARING PLATES SHALL BE AASHTO M270 GRADE 36.

ANCHOR BOLTS SHALL MEET THE REQUIREMENTS OF ASTM A449. NUTS SHALL MEET THE REQUIREMENTS OF AASHTO M291-DH OR AASHTO M292-2H. WASHERS SHALL MEET THE REQUIREMENTS OF AASHTO M293. SHOP DRAWINGS ARE NOT REQUIRED FOR ANCHOR BOLTS, NUTS, AND WASHERS. SHOP INSPECTION IS REQUIRED.

AT THE APPROVAL OF THE ENGINEER, SOLE PLATES AT THE EXPANSION END MAY BE FIELD WELDED.

WHEN FIELD WELDING THE SOLE PLATE TO THE GIRDER FLANGE, USE TEMPERATURE INDICATING WAX PENS, OR OTHER SUITABLE MEANS, TO ENSURE THAT THE TEMPERATURE OF THE SOLE PLATE DOES NOT EXCEED 300° F. TEMPERATURES ABOVE THIS MAY DAMAGE THE ELASTOMER.

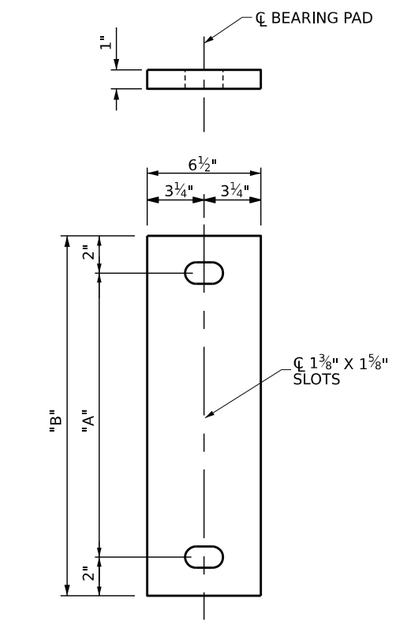
ALL SURFACES OF BEARING PLATES SHALL BE SMOOTH AND STRAIGHT.

AT NO ADDITIONAL COST, THE CONTRACTOR MAY USE ADHESIVELY ANCHORED ANCHOR BOLTS IN PLACE OF CAST-IN-PLACE ANCHORS. LEVEL 1 FIELD TESTING IS REQUIRED, AND THE YIELD LOAD OF THE ANCHOR BOLT IS 30 KIPS. FOR ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS, SEE STANDARD SPECIFICATIONS.

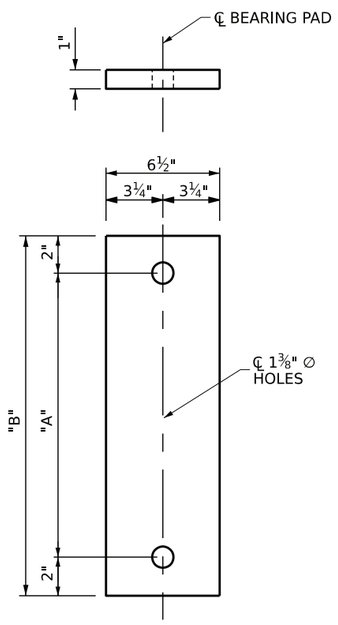
ADHESIVELY ANCHORED ANCHOR BOLTS SHALL BE THREADED FULL LENGTH.

DIMENSIONS TABLE

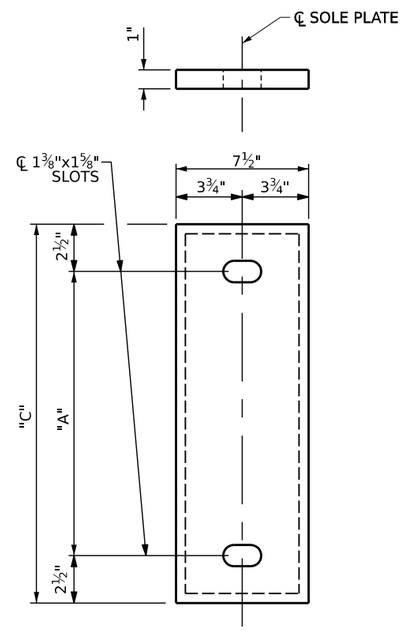
SPAN	BEAM	FLANGE WIDTH	TYPE	A	B	C
20'-0"	W16X36	7"	I	11"	1'-3"	1'-4"
30'-0"	W21X48	8⅛"	II	1'-1"	1'-5"	1'-6"
40'-0"	W24X76	9"	II	1'-1"	1'-5"	1'-6"
50'-0"	W24X104	12¾"	III	1'-4"	1'-8"	1'-9"



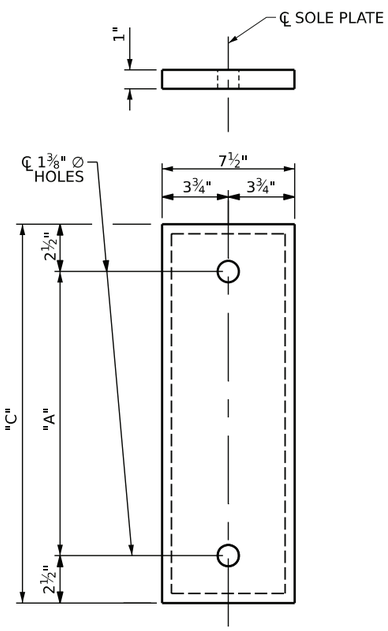
E1 ELASTOMERIC BEARING DETAILS
(6 REQ'D)
EXPANSION



E2 ELASTOMERIC BEARING DETAILS
(6 REQ'D)
FIXED



P1 SOLE PLATE DETAILS
(6 REQ'D)
EXPANSION



P2 SOLE PLATE DETAILS
(6 REQ'D)
FIXED

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
GWENDOLEN F. WILSON
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

BEARING DETAILS

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

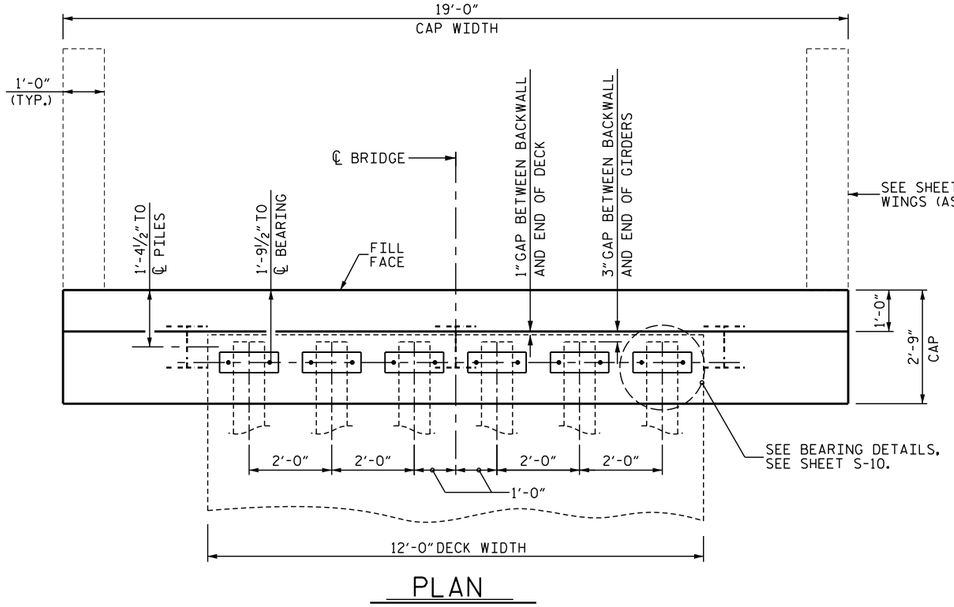
DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

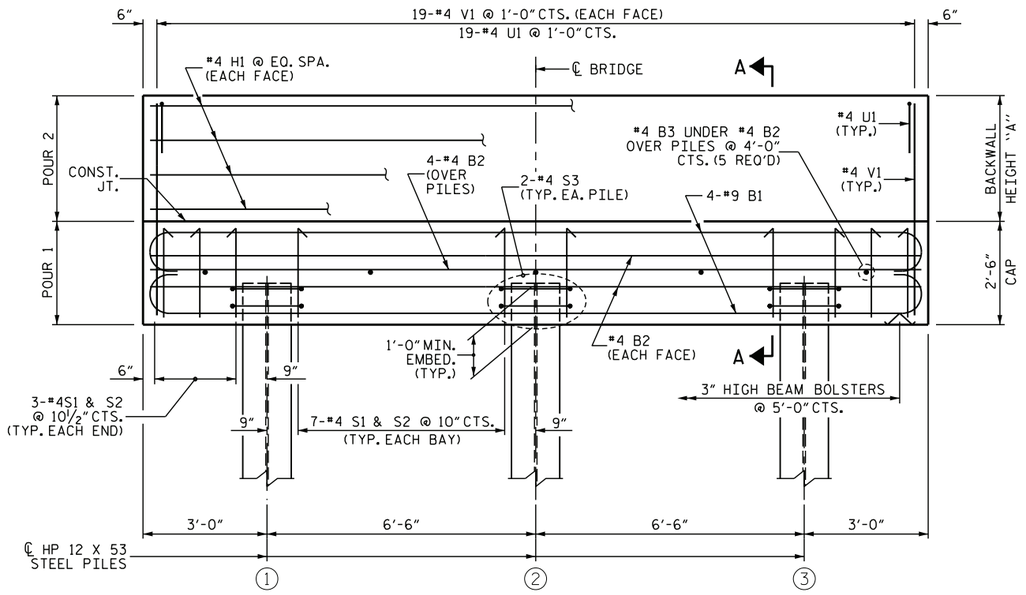
SHEET NO. S-07
TOTAL SHEETS 13

wdcrutcher
DGN: ..\jmt-pw.bentley.com_jmt-pw-01\Documents\Projects\2025\25-00529\25-00529-001\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\007-ST_Bearing Details.dgn
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



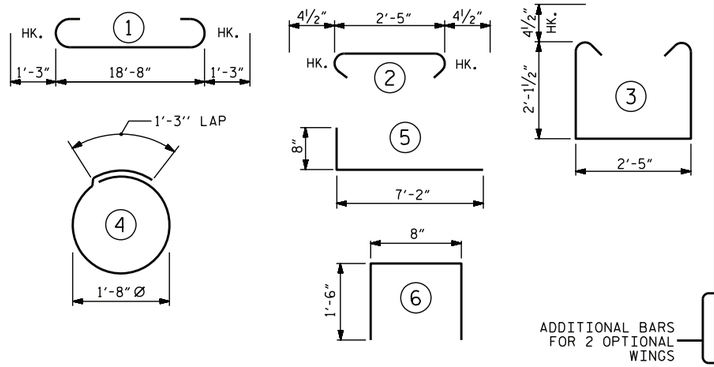
PLAN



ELEVATION

(OPTIONAL WINGS NOT SHOWN FOR CLARITY)

BAR TYPES



ADDITIONAL BARS FOR 2 OPTIONAL WINGS

ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL

FOR ONE END BENT

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	8	#9	1	21'-2"	576
B2	8	#4	STR	18'-8"	100
B3	5	#4	STR	2'-5"	8
H1	8	#4	STR	18'-8"	100
S1	20	#4	3	7'-5"	99
S2	20	#4	2	3'-2"	42
S3	6	#4	4	6'-6"	26
U1	19	#4	6	3'-8"	47
V1	38	#4	STR	4'-4"	110
H2	28	#4	5	7'-10"	147
V2	56	#4	STR	3'-2"	118

	W/O WINGS	WITH WINGS
REINFORCING STEEL (FOR ONE END BENT) (LBS.) ✳	1,108	1,373
CLASS A CONCRETE (FOR ONE END BENT) (C.Y.)		
POUR 1	4.8	6.0
POUR 2 ✳	1.7	2.8
TOTAL	6.5	8.8

✳ REINFORCING AND CONCRETE QUANTITIES ARE BASED ON THE SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. CONTRACTOR SHALL ADJUST FOR 4X6 DECKING OR INCREASED BACKWALL HEIGHT.

BACKWALL HEIGHT

SPAN	BEAM	A (2X8 DECKING)	A (4X6 DECKING)
20'-0"	W16X36	2'-2⅝"	1'-10⅞"
30'-0"	W21X48	2'-7⅜"	2'-3⅝"
40'-0"	W24X76	2'-10⅝"	2'-6⅞"
50'-0"	W24X104	2'-10¾"	2'-7"

DIMENSION "A" (BACKWALL HEIGHT) VARIES BASED ON DECKING TYPE. USE VALUES CORRESPONDING TO SELECTED DECKING OPTION.

GENERAL NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR ANCHOR BOLTS.

CONTRACTOR SHALL SLOPE TOP OF CAP TO MATCH LONGITUDINAL GRADE OF THE BRIDGE. SLOPES SHALL MATCH ON BOTH END BENT 1 AND END BENT 2 CAPS.

WINGS MAY BE REQUIRED AT THE DIRECTION OF THE ENGINEER OR DESIGNEE.

FOR OPTIONAL WINGS FOR END BENT, SEE SHEET S-10.

FOR BEARING DETAILS, SEE SHEET S-10.

FOR PILE SPLICE DETAILS, SEE SHEET S-10.

"V" BARS BASED ON SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. ADJUST LENGTH TO MAINTAIN REQUIRED MIN. CLEARANCE AT BOTTOM OF CAP AND TOP OF BACKWALL.

FOUNDATION NOTES

DRIVEN PILES

INSTALL PILES IN ACCORDANCE WITH SECTION 450 OF THE STANDARD SPECIFICATIONS.

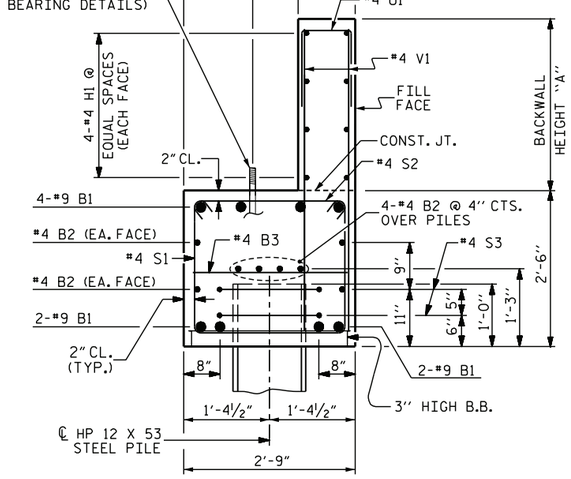
DO NOT INSTALL PILES UNTIL FILL HAS BEEN PLACED.

DRIVE PILES TO A MINIMUM PENETRATION OF AT LEAST 10 FEET INTO NATURAL GROUND OR CHANNEL BOTTOM.

DRIVE ALL PILES TO "REFUSAL" BELOW MINIMUM PENETRATION.

PREDRILLING OR SPUDDING MAY BE REQUIRED TO ACHIEVE THE MINIMUM PILE PENETRATION.

SUBMIT THE PROPOSED PILE DRIVING METHODS AND EQUIPMENT FOR ACCEPTANCE BY THE ENGINEER.



SECTION A-A

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
LYNDOLEN F. WILS
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

END BENT
DRIVEN PILES

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

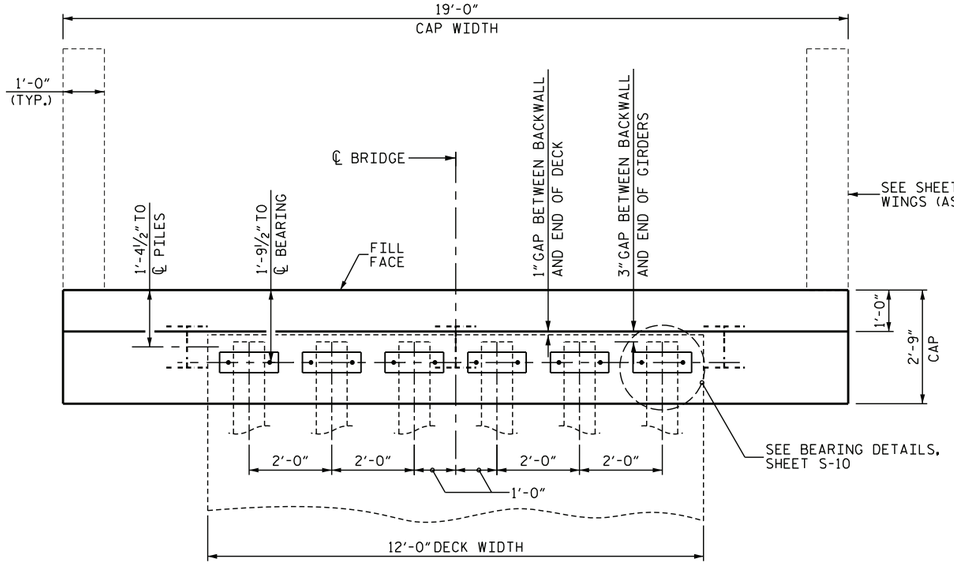
REVISIONS					
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-08
TOTAL SHEETS 13

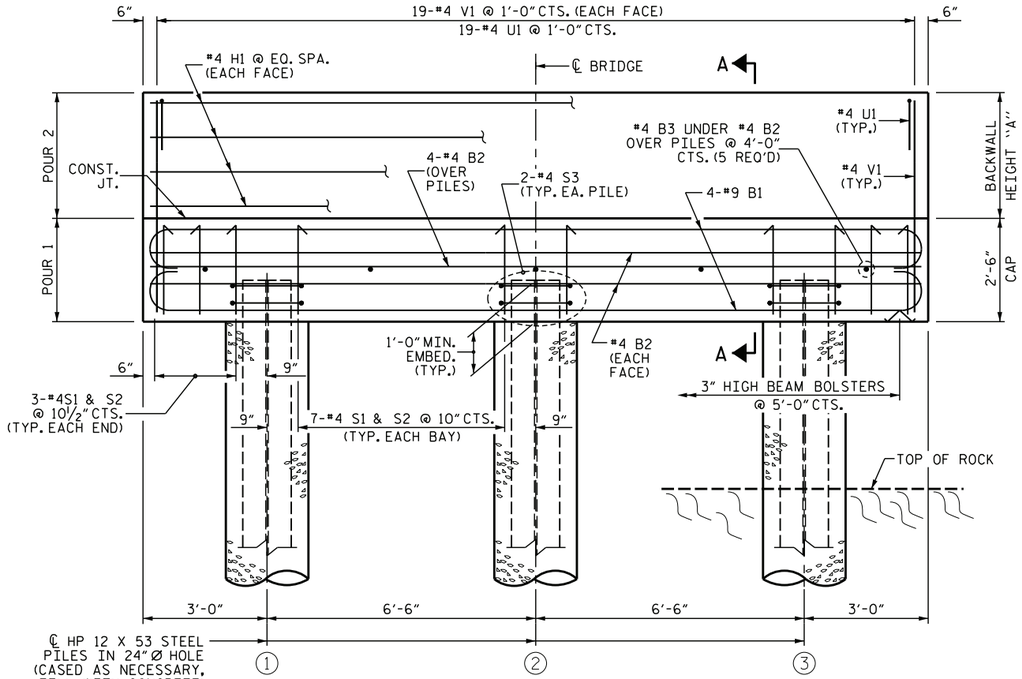
w:\Structural\Documents\Projects\2025\25-00529-00\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\008-S8_End Bent_Driven Piles.dgn
DGN: Dan / JMT_pw:bentley.com:JMT-pw-01\Documents\Projects\2025\25-00529\25-00529-00\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\008-S8_End Bent_Driven Piles.dgn
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F

w:\Drafter
DGN: ..\..\jmt-pw-be1\ffy.com\jmt-pw-01\Documents\Projects\2025\25-00529\25-00529-001\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-TO FT - 12 FT DECK WIDTH\009-S9_End Bent_Drilled-in Piles.dgn
TIME: 4/1/2026



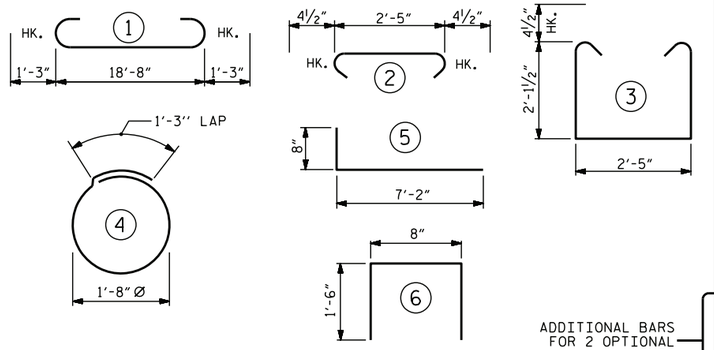
PLAN



ELEVATION

(OPTIONAL WINGS NOT SHOWN FOR CLARITY)

BAR TYPES



ADDITIONAL BARS FOR 2 OPTIONAL WINGS

ALL BAR DIMENSIONS ARE OUT TO OUT.

BILL OF MATERIAL
FOR ONE END BENT

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	8	#9	1	21'-2"	576
B2	8	#4	STR	18'-8"	100
B3	5	#4	STR	2'-5"	8
H1	8	#4	STR	18'-8"	100
S1	20	#4	3	7'-5"	99
S2	20	#4	2	3'-2"	42
S3	6	#4	4	6'-6"	26
U1	19	#4	6	3'-8"	47
V1	38	#4	STR	4'-4"	110
H2	28	#4	5	7'-10"	147
V2	56	#4	STR	3'-2"	118

	W/O WINGS	WITH WINGS
REINFORCING STEEL (FOR ONE END BENT) (LBS.) ✳	1,108	1,373
CLASS A CONCRETE (FOR ONE END BENT) (C.Y.)		
POUR 1	4.8	6.0
POUR 2 ✳	1.7	2.8
TOTAL	6.5	8.8

✳ REINFORCING AND CONCRETE QUANTITIES ARE BASED ON THE SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. CONTRACTOR SHALL ADJUST FOR 4X6 DECKING OR INCREASED BACKWALL HEIGHT.

BACKWALL HEIGHT

SPAN	BEAM	A (2X8 DECKING)	A (4X6 DECKING)
20'-0"	W16X36	2'-2⅝"	1'-10⅞"
30'-0"	W21X48	2'-7⅜"	2'-3⅝"
40'-0"	W24X76	2'-10⅝"	2'-6⅞"
50'-0"	W24X104	2'-10¾"	2'-7"

DIMENSION "A" (BACKWALL HEIGHT) VARIES BASED ON DECKING TYPE. USE VALUES CORRESPONDING TO SELECTED DECKING OPTION.

GENERAL NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR ANCHOR BOLTS.

CONTRACTOR SHALL SLOPE TOP OF CAP TO MATCH LONGITUDINAL GRADE OF THE BRIDGE. SLOPES SHALL MATCH ON BOTH END BENT 1 AND END BENT 2 CAPS.

WINGS MAY BE REQUIRED AT THE DIRECTION OF THE ENGINEER OR DESIGNEE.

FOR OPTIONAL WINGS FOR END BENT, SEE SHEET S-10.

FOR BEARING DETAILS, SEE SHEET S-10.

FOR PILE SPLICE DETAILS, SEE SHEET S-10.

"V" BARS BASED ON SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. ADJUST LENGTH TO MAINTAIN REQUIRED MIN. CLEARANCE AT BOTTOM OF CAP AND TOP OF BACKWALL.

FOUNDATION NOTES
DRILLED-IN PILES

ROCK QUALITY DESIGNATION (RQD)
GEOLOGICAL STRENGTH INDEX (GSI)

INSTALL DRILLED-IN PILES IN ACCORDANCE WITH SECTION 450 OF THE STANDARD SPECIFICATIONS.

MINIMUM PILE PENETRATION OF 10-FT INTO NATURAL GROUND OR CHANNEL BOTTOM IS REQUIRED.

MINIMUM ROCK SOCKET DEPTHS, UNLESS OTHERWISE INDICATED ON PROJECT SPECIFIC DATA SHEET:

4' MINIMUM (RQD >70, GSI >50)
6' MINIMUM (RQD 30-70, GSI 30-50)
8' MINIMUM (RQD <30, GSI <30)

REFER TO BORING LOGS FOR RQD AND GSI DATA.

PILES SHALL BE SEATED IN THE BOTTOM OF THE EXCAVATION. PILE DRIVING IS NOT REQUIRED.

BACKFILL WITH CONCRETE ONLY. DO NOT PROCEED WITH CONSTRUCTION ACTIVITIES UNTIL THE 28 DAY STRENGTH IS ACHIEVED.

SECTION A-A

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
NOONEY
MIDDLEN F. WIL...
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

END BENT
DRILLED-IN PILES

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

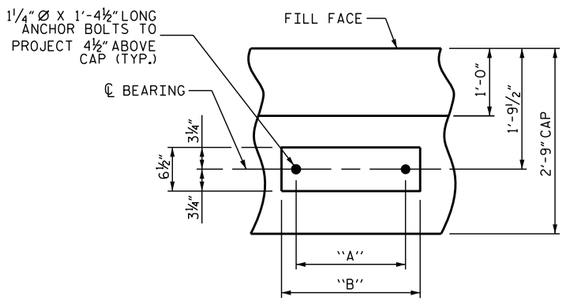
DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS

NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO. S-09
TOTAL SHEETS 13

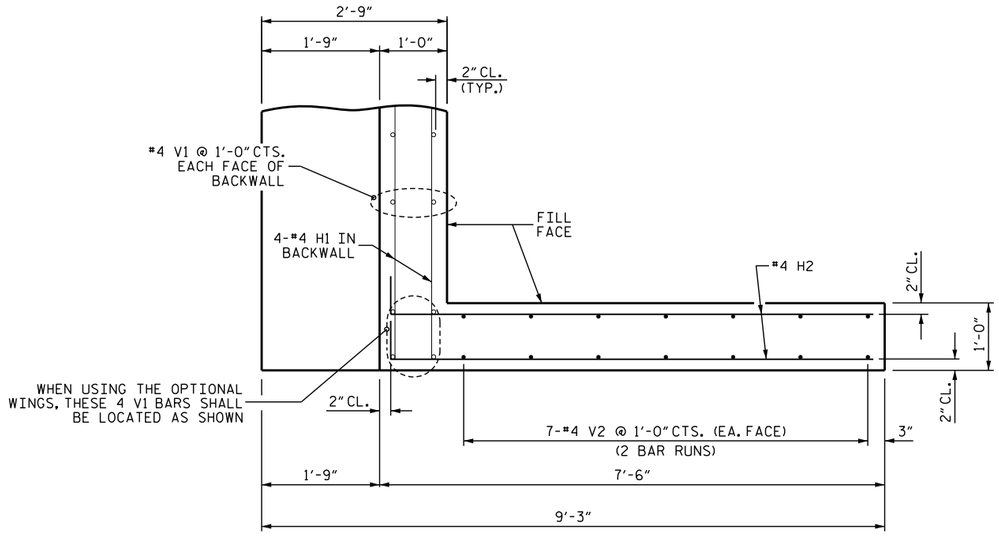
Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



BEARING DETAIL

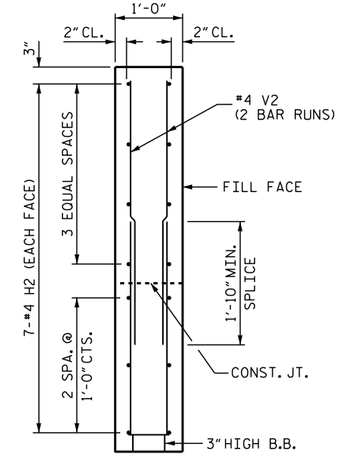
(TYP. EACH BEARING LOCATION)

REFER TO DIMENSIONS TABLE ON SHEET S-07 FOR DIMENSIONS A AND B.



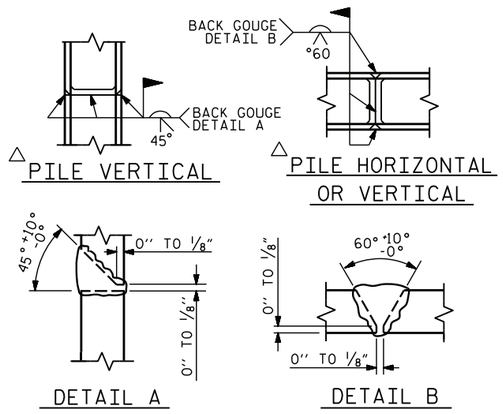
ELEVATION OF WING

(OPTIONAL)



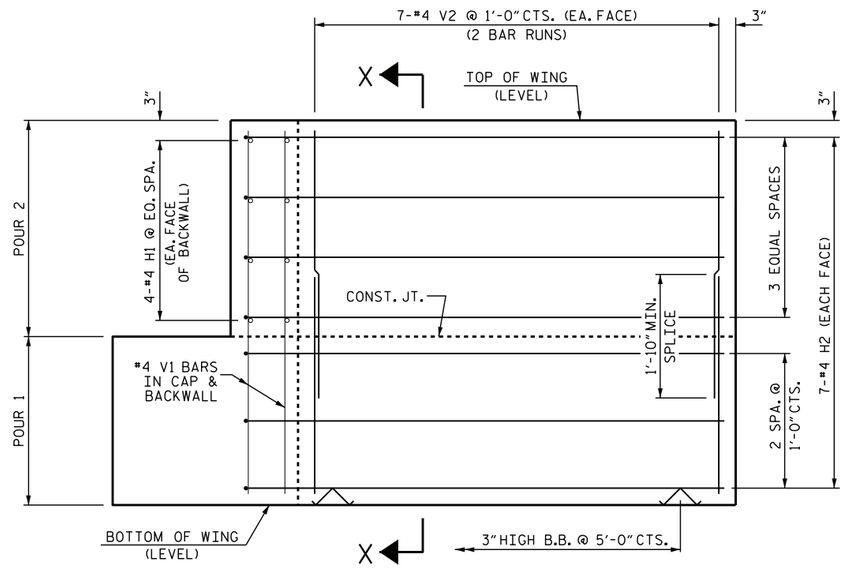
SECTION X-X

(OPTIONAL)



PILE SPLICE DETAILS

△ POSITION OF PILE DURING WELDING.



PLAN OF WING

(OPTIONAL)

RIGHT SIDE WING SHOWN, LEFT SIDE WING SIMILAR.

WING HEIGHT DEPENDENT ON BACKWALL HEIGHT.

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
NOTARY PUBLIC
ADOLEN F. WIL...
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

SHEET 2 OF 2

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

OPTIONAL WINGS FOR DRIVEN OR DRILLED-IN PILES

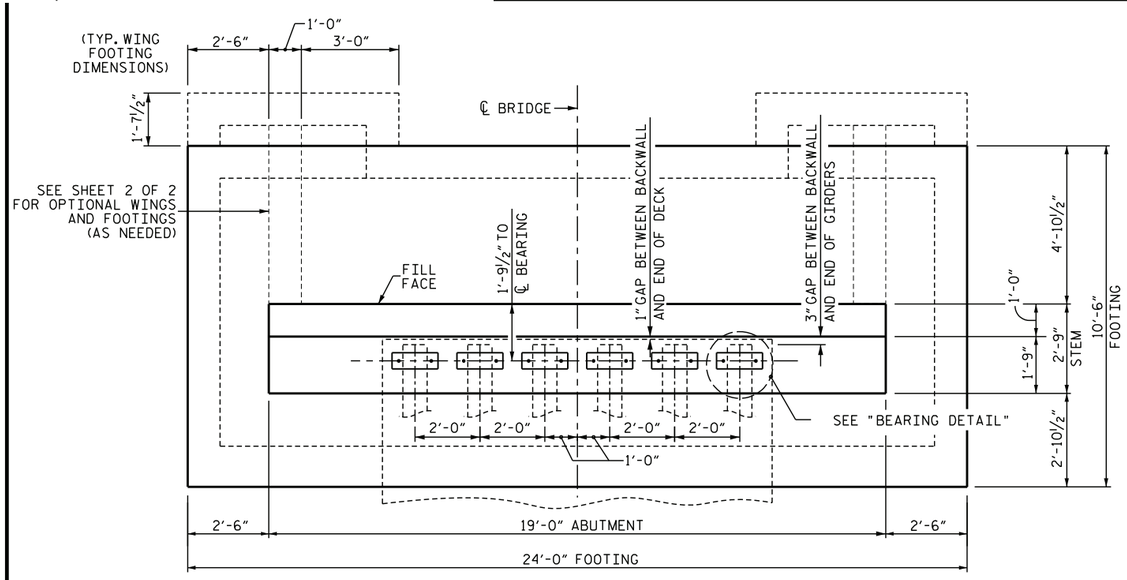
Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

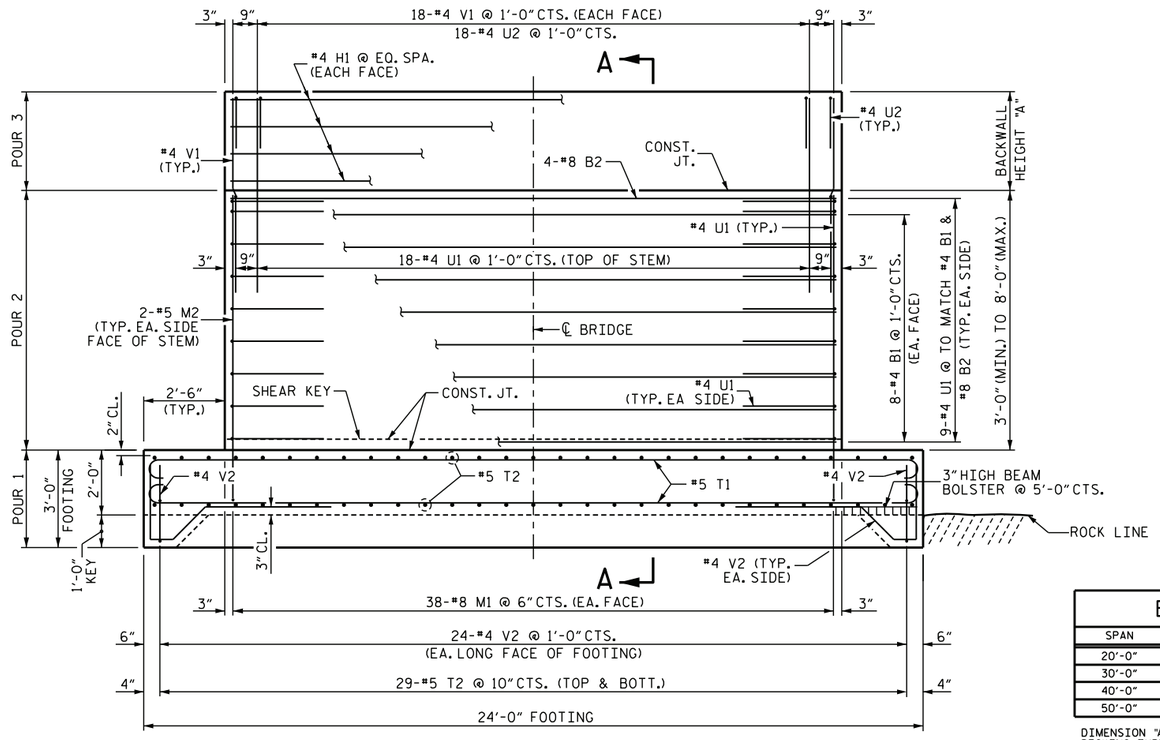
REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-10
1			3			TOTAL SHEETS
2			4			13

w:\Civil\dot
DGN: dw:/jmt-pw.bentley.com/jmt~pw~01/Documents/Projects/2025/25-00529/25-00529-001/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/010-S10_Optional Wings_Plts.dgn
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F



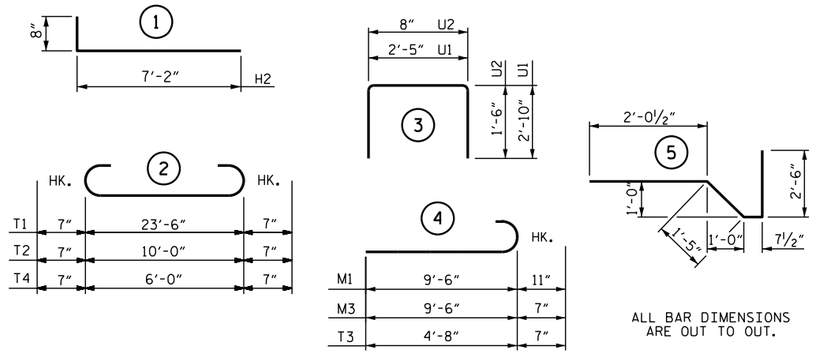
PLAN



ELEVATION

(OPTIONAL WINGS NOT SHOWN FOR CLARITY)

BAR TYPES



ALL BAR DIMENSIONS ARE OUT TO OUT.

GENERAL NOTES

U1 BARS IN STEM MAY BE SHIFTED AS NECESSARY TO CLEAR ANCHOR BOLTS.

CONTRACTOR SHALL SLOPE TOP OF CAP TO MATCH LONGITUDINAL GRADE OF THE BRIDGE. SLOPES SHALL MATCH ON BOTH END BENT 1 AND END BENT 2 CAPS.

WINGS MAY BE REQUIRED AT THE DIRECTION OF THE ENGINEER OR DESIGNEE.

FOR OPTIONAL WINGS FOR END BENT, SEE SHEET 2 OF 2.

FOR SECTION A-A, SEE SHEET 2 OF 2.

THE FINAL STEM WALL HEIGHT SHALL BE DETERMINED IN THE FIELD BASED ON EXISTING ROCK ELEVATIONS. THE STEM WALL HEIGHT SHALL NOT BE LESS THAN 3'-0"OR GREATER THAN 8'-0.

END BENT REINFORCEMENT AND DETAILS ARE BASED ON A MAXIMUM STEM WALL HEIGHT OF 8'-0"AND THE SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. CONTRACTOR SHALL ADJUST REINFORCEMENT FOR FIELD-VERIFIED STEM WALL HEIGHTS AND BACKWALL HEIGHTS WHILE MAINTAINING BAR SIZES, SPACING, SPLICE LENGTHS, AND OVERALL CONFIGURATION SHOWN.

FOUNDATION NOTES

SPREAD FOOTING

FOUNDATION EXCAVATIONS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH SECTION 410 OF THE SPECIFICATIONS.

A GEOTECHNICAL ENGINEER LICENSED IN THE STATE OF NORTH CAROLINA SHALL OBSERVE THE BEARING SURFACE AND CONFIRM THE FOOTING IS CONSTRUCTED ON ROCK. THE ENGINEER SHALL PROVIDE A LETTER VERIFYING ACCEPTANCE OF THE BEARING SURFACE.

CLEAN ALL ROCK OF LOOSE MATERIAL AND CUT TO A FIRM SURFACE, AS DIRECTED BY THE ENGINEER AND FILL WITH CONCRETE, MORTAR OR GROUT. LEAVE ROCK SURFACE IN A ROUGH CONDITION.

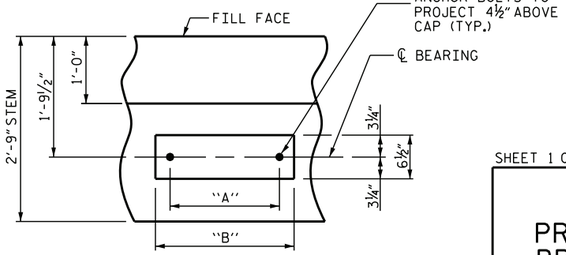
BEARING SURFACE MUST RESIST A MAXIMUM APPLIED BEARING PRESSURE OF 5.0 KSF.

KEY IN FOOTINGS AT LEAST 1 FT INTO ROCK.

BACKWALL HEIGHT

SPAN	BEAM	A (2X8 DECKING)	A (4X6 DECKING)
20'-0"	W16X36	2'-2⅜"	1'-10⅞"
30'-0"	W21X48	2'-7⅜"	2'-3⅜"
40'-0"	W24X76	2'-10⅝"	2'-6⅞"
50'-0"	W24X104	2'-10¾"	2'-7"

DIMENSION "A" (BACKWALL HEIGHT) VARIES BASED ON DECKING TYPE. USE VALUES CORRESPONDING TO SELECTED DECKING OPTION.



BEARING DETAIL

(TYP. EACH BEARING LOCATION)
REFER TO DIMENSIONS TABLE ON SHEET S-07 FOR DIMENSIONS A AND B.

**BILL OF MATERIAL FOR ONE END BENT

BAR	NO.	SIZE	TYPE	LENGTH	WEIGHT
B1	16	#4	STR	18'-8"	200
B2	4	#8	STR	18'-8"	199
H1	8	#4	STR	18'-8"	100
M1	76	#8	4	10'-5"	2,114
M2	4	#5	STR	7'-6"	31
T1	26	#5	2	24'-8"	669
T2	58	#5	2	11'-2"	676
U1	38	#4	3	8'-1"	205
U2	20	#4	3	3'-8"	49
V1	40	#4	STR	6'-0"	160
V2	70	#4	5	6'-7"	308
H2	52	#4	1	7'-10"	272
M3	40	#5	4	10'-1"	421
M4	40	#5	STR	5'-4"	223
T3	32	#5	4	5'-3"	175
T4	8	#5	2	7'-2"	60
V2	22	#4	5	6'-7"	97

ADDITIONAL BARS FOR 2 OPTIONAL WINGS WITH FOOTINGS

REINFORCING STEEL (W/O WINGS)	4711 LBS.
REINFORCING STEEL (WITH WINGS)	5959 LBS.

CLASS A CONCRETE BREAKDOWN		
POUR #1	FOOTING	22.5 C.Y.
POUR #2	END BENT STEM	15.5 C.Y.
POUR #3	BACKWALL	1.6 C.Y.
	WINGWALLS (OPTIONAL)	7.5 C.Y.
TOTAL CLASS A CONCRETE (W/O WINGS)		39.6 C.Y.
TOTAL CLASS A CONCRETE (WITH WINGS)		47.1 CY

**THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT THE QUANTITIES AND REINFORCING BARS SHOWN IN THE BILL OF MATERIAL ARE BASED ON AN 8'-0" MAXIMUM STEM WALL HEIGHT AND THE SHORTEST BACKWALL HEIGHT USING 2X8 DECKING. THE CONTRACTOR IS RESPONSIBLE FOR THE FINAL QUANTITIES BASED ON THE ACTUAL STEM WALL AND BACKWALL HEIGHTS.

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
NOOLEN F. WIL...
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

SHEET 1 OF 2

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

END BENT
SPREAD FOOTING

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

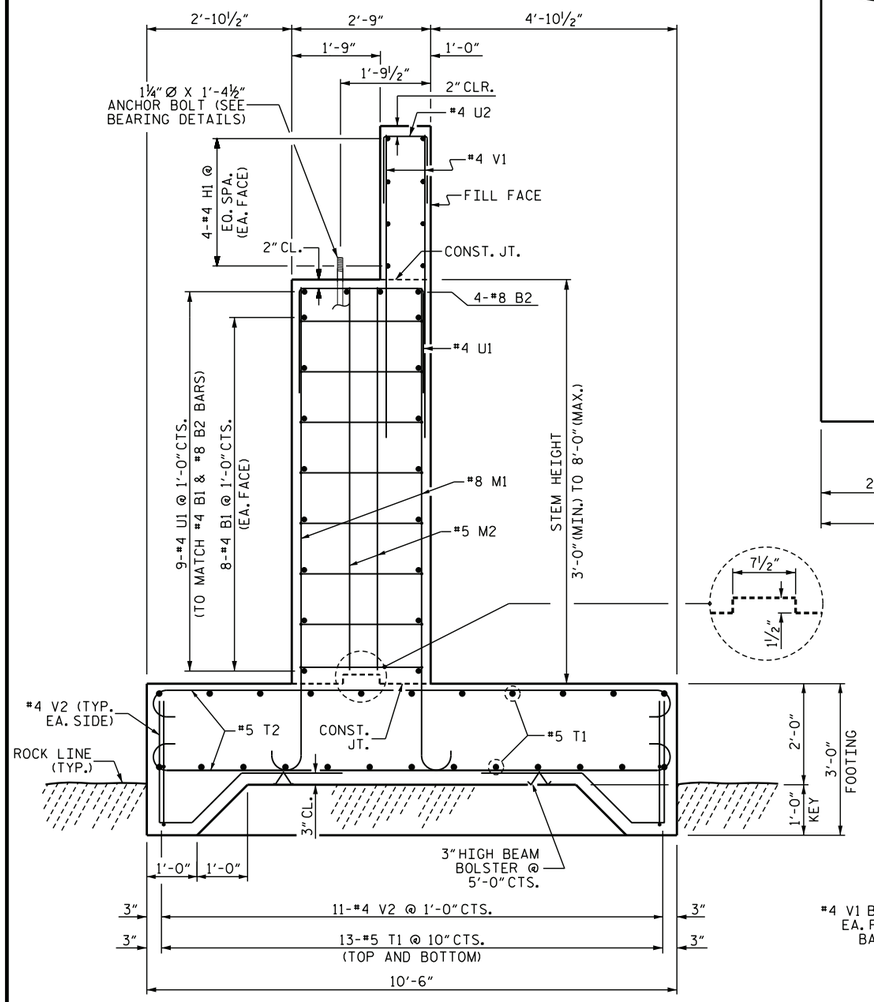
DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-11
1			3			TOTAL SHEETS
2			4			13

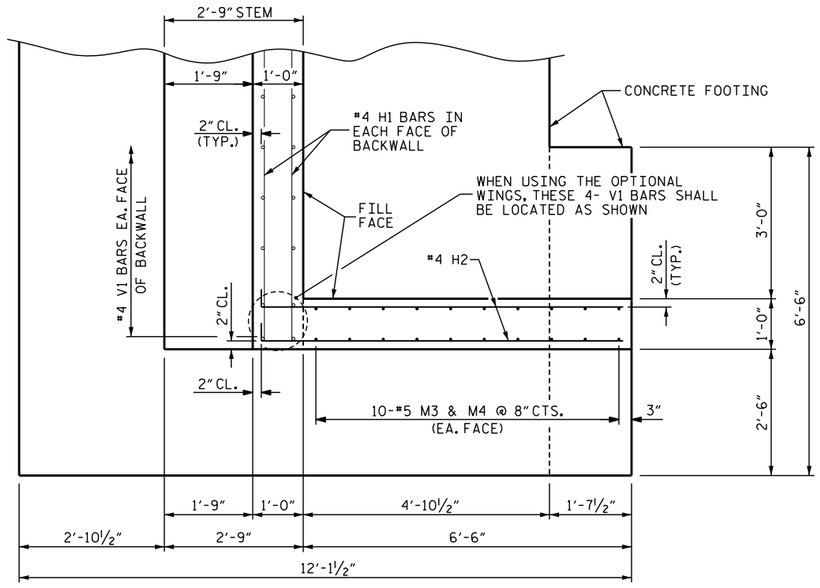
wdcrutcher
DGN: pw://jmt-pw.bentley.com/jmt-pw-01/Documents/Projects/2025/25-009529/25-009529-000/Design/Structures/NC PRB-Steel Beam with Timber Deck Stonoras/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/SH-SIL_End Bent_Spread Footing
TIME: 4/7/2026

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F

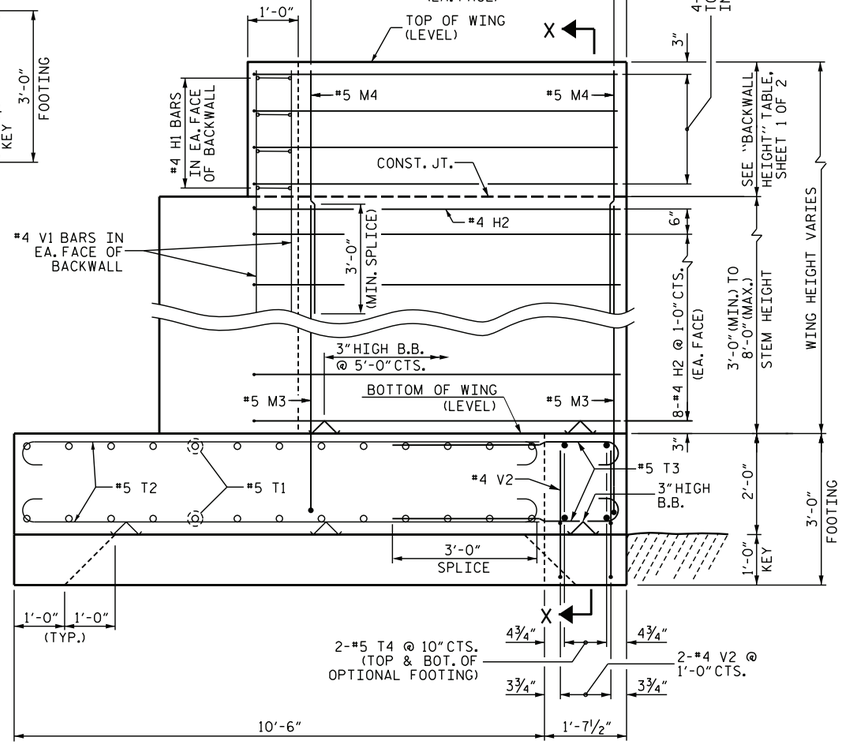
w:\structher
DGN: Dwr:\\jmt-pw.bentley.com:jmt-pw-01\Documents\Projects\2025\25-00529\25-00529-001\Design\Structures\NC PRB-Steel Beam with Timber Deck Standards\Single Lane Steel Beam with Timber Deck Plans\2 Standard Drawings\20-70 FT - 12 FT DECK WIDTH\012-S12_Optional Wings_Footings.dgn
TIME: 4/7/2026



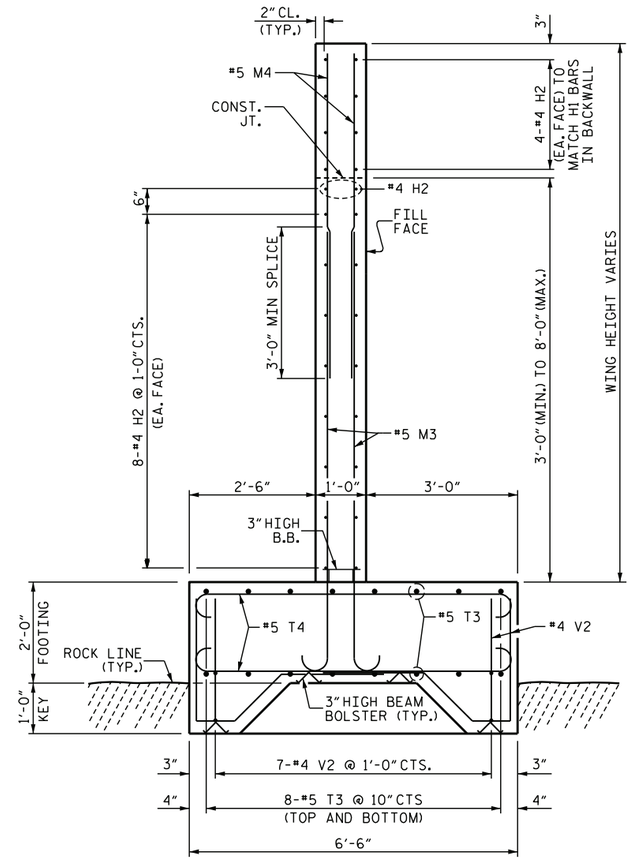
SECTION A-A



PLAN OF WING
(OPTIONAL)



ELEVATION OF WING
(OPTIONAL)



SECTION X-X
(OPTIONAL)

DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
GWENDOLEN F. WILSON
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

SHEET 2 OF 2

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

OPTIONAL WINGS & FOOTINGS

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC. 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-12
1			3			TOTAL SHEETS
2			4			13

Docusign Envelope ID: BEA3BB0A-B894-4AB5-B432-C851E7E2C10F

w:\cruncher
DGN: Dwn:/jmt-jw.bentley.com/jmt-jw-0/Documents/Projects/2025/25-00529/25-00529-001/Design/Structures/NC PRB-Steel Beam with Timber Deck Standards/Single Lane Steel Beam with Timber Deck Plans/2 Standard Drawings/20-70 FT - 12 FT DECK WIDTH/015-S15_General Notes.dgn
TIME: 4/7/2026

STRUCTURAL STEEL / HARDWARE NOTES:

ALL STRUCTURAL STEEL SHALL BE AASHTO M270 GRADE 50 AND PAINTED IN ACCORDANCE WITH SYSTEM 1 OF THE STRUCTURAL STEEL COATING PROGRAM AND ARTICLE 442-8 OF THE STANDARD SPECIFICATIONS UNLESS OTHERWISE NOTED ON THE PLANS.

COATING APPLICATION FOR ALL STRUCTURAL STEEL SHALL NOT BE PERFORMED UNTIL SHOP FABRICATION INCLUDING CUTTING, DRILLING AND WELDING HAS BEEN COMPLETED.

ALL HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH SECTION 1076 OF THE STANDARD SPECIFICATION, UNLESS OTHERWISE NOTED ON THE PLANS.

DO NOT DRIVE LAG/STRUCTURAL SCREWS WITH A HAMMER, SCREW OR TORQUE LAG/STRUCTURAL SCREWS.

SCREWS SHALL BE OF SUFFICIENT LENGTH TO PROVIDE FULL THREAD ENGAGEMENT INTO RECEIVING MEMBERS.

REPAIR ANY DAMAGED GALVANIZED SURFACES IN ACCORDANCE WITH STANDARD SPECIFICATION ARTICLE 1076-7.

REPAIR ANY DAMAGED PAINTED SURFACES IN ACCORDANCE WITH SECTION 442 OF THE STANDARD SPECIFICATIONS.

STRUCTURAL WOOD SCREWS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH SECTION 1076 OF THE STANDARD SPECIFICATION.

TIMBER / LUMBER NOTES:

ALL TIMBER AND LUMBER MEMBERS SHALL BE TREATED NO. 1 SOUTHERN PINE AND CONFORM TO SECTION 1082 OF THE STANDARD SPECIFICATIONS.

ALL TIMBER DIMENSIONS SHOWN ON THE PLANS ARE NOMINAL DIMENSIONS. DESIGN IS BASED ON ACTUAL DRESSED DIMENSIONS.

PRE-DRILL HOLES IN TIMBER MEMBERS RECEIVING BOLTS TO ELIMINATE SPLITTING. PRE-DRILL HOLES FOR SCREWS AS NECESSARY TO PREVENT SPLITTING IN TIMBER MEMBERS.

DESIGN LOADS:

LIVE LOAD:

TRUCK LOAD:

THIS BRIDGE WAS DESIGNED FOR:

HS20
GVWR = 72,000 LBS
NUMBER OF AXLES: 3
AXLE WEIGHTS:
GAWR FRONT = 8,000 LBS
GAWR INTERMEDIATE = 32,000 LBS
GAWR REAR = 32,000 LBS

EV2
GVWR = 57,500 LBS
NUMBER OF AXLES: 2
AXLE WEIGHTS:
GAWR FRONT = 24,000 LBS
GAWR REAR = 33,500 LBS

EV3
GVWR = 86,000 LBS
NUMBER OF AXLES: 3
AXLE WEIGHTS:
GAWR FRONT = 24,000 LBS
GAWR INTERMEDIATE = 31,000 LBS
GAWR REAR = 31,000 LBS

LIVE LOAD FACTORS:

HS-20 = 1.30
EV2 = 1.3
EV3 = 1.3

LIVE LOAD FACTORS LOAD RATING:

HS-20 = 1.35
EV2 = 1.0
EV3 = 1.0

MULTIPLE PRESENCE FACTOR:

MPF = 1.0

LANE LOAD:

NO LANE LOAD WAS APPLIED.

IMPACT:

DYNAMIC IMPACT FOR WOOD/TIMBER COMPONENTS IS ZERO. DYNAMIC IMPACT FACTOR FOR ALL OTHER COMPONENTS IS 33%.

DEAD LOADS:

WEARING SURFACES SHALL NOT BE ALLOWED.

WEIGHT OF TIMBER = 40 PCF.

DESIGN ASSUMPTIONS/PARAMETERS:

SUPERSTRUCTURE WILL BE SIX LINES OF I-BEAMS.

BRIDGE IS SINGLE SPAN.

BRIDGE WIDTH = 12'-0" OUT TO OUT.

REF.#	DESIGN VEHICLES SCHEMATIC
HS-20	8K, 32K, 32K; 14', 14', 28'; 72K 36 TON
EV2	24K, 33.5K; 15'; 57.5K 28.75 TON
EV3	24K, 31K, 31K; 15', 4', 19'; 86K 43 TONS

GENERAL NOTES:

THIS BRIDGE IS DESIGNED IN ACCORDANCE WITH THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT) "STRUCTURES MANAGEMENT UNIT MANUAL", DATED 6/15/23, 2024 NCDOT IN-KIND TIMBER BRIDGE REPLACEMENT PROGRAM, AND THE AASHTO "LRFD BRIDGE DESIGN SPECIFICATIONS", 9th EDITION.

THESE DRAWINGS ARE INTENDED ONLY FOR USAGE IN THE INSTALLATION OF SINGLE SPAN I-BEAM BRIDGES FOR PRIVATE DRIVEWAYS IN COUNTIES AS LISTED IN THE CONTRACT DOCUMENTS BY NORTH CAROLINA OFFICE OF EMERGENCY MANAGEMENT IN RESPONSE TO THE DAMAGE CAUSED BY HURRICANE HELENE.

BRIDGE CONSTRUCTION, WORKMANSHIP, AND MATERIALS SHALL BE IN ACCORDANCE WITH THE NCDOT "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES", 2024 EDITION.

THIS BRIDGE IS LOCATED IN SEISMIC ZONE 1.

IT IS ASSUMED THAT THERE ARE NO UTILITY CONFLICTS. THE CONTRACTOR SHALL INVESTIGATE THE PRESENCE OF UTILITIES BEFORE COMMENCING WORK.

FOR SUBMITTAL OF WORKING DRAWINGS, SEE SPECIAL PROVISIONS.

FOR FALSEWORK AND FORMWORK, SEE SPECIAL PROVISIONS.

FOR CRANE SAFETY, SEE SPECIAL PROVISIONS.

FOR GROUT FOR STRUCTURES, SEE SPECIAL PROVISIONS.

FOR ASBESTOS ASSESSMENT, SEE SPECIAL PROVISIONS.

ALL DIMENSIONS SHOWN ARE HORIZONTAL OR VERTICAL, UNLESS OTHERWISE NOTED.

CONTRACTOR SHALL SET BRIDGE ELEVATIONS SUCH THAT WATER WILL DRAIN AND NOT POND ON THE BRIDGE DECK AND MINIMUM LONGITUDINAL GRADE SHALL BE 0.5% AND MAXIMUM GRADE SHALL BE 6%.

FOR PILE-SUPPORTED END BENTS, PLACE APPROACH EMBANKMENT (CORE MATERIAL) PRIOR TO PILE INSTALLATION.

THIS BRIDGE HAS BEEN DESIGNED FOR ADTT < 100.

EROSION AND SEDIMENT CONTROL MEASURES SHOWN ON SHEET EC-01 ARE FOR GENERAL GUIDANCE ONLY AND REPRESENT MINIMUM REQUIREMENTS. THE CONTRACTOR SHALL PROVIDE, INSTALL, AND MAINTAIN ALL REQUIRED EROSION AND SEDIMENT CONTROL MEASURES IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS, CONTRACT DOCUMENTS, AND APPLICABLE REGULATIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MODIFYING THESE MEASURES AND PROVIDING ANY ADDITIONAL DEVICES NECESSARY TO ACCOUNT FOR ACTUAL SITE CONDITIONS, INCLUDING GROUNDWATER CONDITIONS AND WEATHER EVENTS, AND TO PREVENT SEDIMENT FROM LEAVING THE PROJECT SITE.

ALL REFERENCES WITHIN THESE PLANS TO "STANDARD SPECIFICATIONS" OR "NCDOT SPECIFICATIONS" SHALL BE GOVERNED BY THE NCDOT "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES" DATED JANUARY 2024.

TRAFFIC CONTROL SHALL BE PROVIDED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, INCLUDING THE SPECIAL PROVISIONS, AND IN CONFORMANCE WITH THE NCDOT STANDARD SPECIFICATIONS, NCDOT ROADWAY STANDARD DRAWINGS, AND THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD). THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING, INSTALLING, AND MAINTAINING ALL TRAFFIC CONTROL DEVICES NECESSARY TO SAFELY CONDUCT THE WORK AND PROTECT THE TRAVELING PUBLIC.

MATERIAL PROPERTIES:

CONCRETE: MINIMUM COMPRESSIVE STRENGTH, f'c = 3,000 psi (CLASS A)

STRUCTURAL STEEL: AASHTO M270, GRADE 50.

WELDS: SMAW, 70 KSI ELECTRODES PER NCDOT STANDARD SPECIFICATIONS.

ANCHOR BOLTS: ASTM F1554, GRADE 55.

BOLTS SHALL CONFORM TO ASTM F3125, GRADE A325. PROVIDE GALVANIZED NUTS AND WASHERS COMPATIBLE WITH THE BOLTS.

TIMBER: ALL TIMBER & DIMENSIONAL LUMBER SHALL BE NO. 1 VISUALLY GRADED, SOUTHERN PINE WITH REFERENCE DESIGN VALUES OF: Fbo = 1.35 ksi AND Fvo = 0.175 ksi OR GREATER.

ELASTOMER IN ALL BEARINGS SHALL BE 50 DUROMETER HARDNESS WITH A SHEAR MODULUS OF 0.110 KSI.

NORTH CAROLINA
DocuSigned by:
Gwen Wilson
F172D6ADE683420...
ENGINEER
GWENDOLEN F. WILSON, P.E.
04/07/2026

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

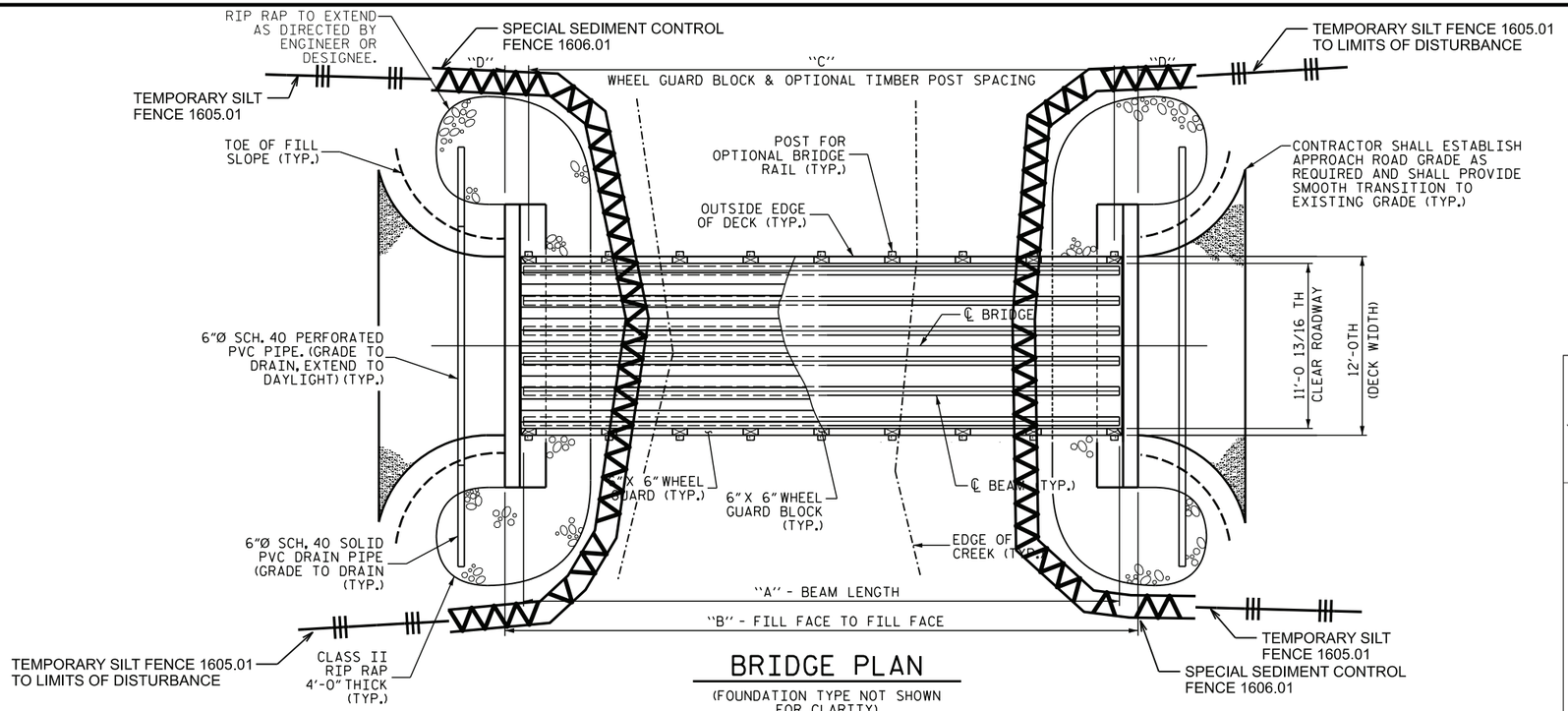
SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

GENERAL NOTES

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	S-13
1			3			TOTAL SHEETS
2			4			13

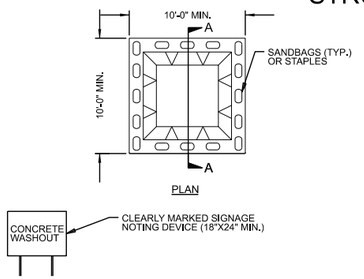


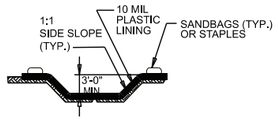
BRIDGE PLAN

(FOUNDATION TYPE NOT SHOWN FOR CLARITY)

DIMENSIONS TABLE					
SPAN	A	B	C	D	E
20'-0"	20'-0"	22'-6"	5 SPA. @ 3'-8"	2'-1"	19'-9"
30'-0"	30'-0"	32'-6"	7 SPA. @ 4'-0"	2'-3"	29'-9"
40'-0"	40'-0"	42'-6"	9 SPA. @ 4'-3"	2'-1 1/2"	39'-9"
50'-0"	50'-0"	52'-6"	11 SPA. @ 4'-4"	2'-5"	49'-9"

ONSITE CONCRETE WASHOUT STRUCTURE WITH LINER



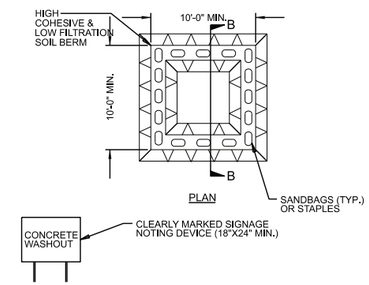


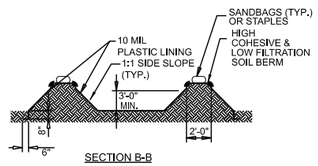
NOTES:
1. ACTUAL LOCATION DETERMINED IN FIELD

2. THE CONCRETE WASHOUT STRUCTURES SHALL BE MAINTAINED WHEN THE LIQUID AND/OR SOLID REACHES 75% OF THE STRUCTURES CAPACITY TO PROVIDE ADEQUATE HOLDING CAPACITY WITH A MINIMUM 12 INCHES OF FREEBOARD.

3.CONCRETE WASHOUT STRUCTURE NEEDS TO BE CLEARLY MARKED WITH SIGNAGE NOTING DEVICE.

BELOW GRADE WASHOUT STRUCTURE
NOT TO SCALE





NOTES:
1. ACTUAL LOCATION DETERMINED IN FIELD

2. THE CONCRETE WASHOUT STRUCTURES SHALL BE MAINTAINED WHEN THE LIQUID AND/OR SOLID REACH 75% OF THE STRUCTURES CAPACITY TO PROVIDE ADEQUATE HOLDING CAPACITY WITH A MINIMUM 12 INCHES OF FREEBOARD.

3.CONCRETE WASHOUT STRUCTURE NEEDS TO BE CLEARLY MARKED WITH SIGNAGE NOTING DEVICE.

ABOVE GRADE WASHOUT STRUCTURE
NOT TO SCALE

ESC LEGEND

Special Sediment Control Fence

Temporary Silt Fence

NOTES

FOR OPTIONAL TIMBER BRIDGE RAIL DETAILS, SEE "OPTIONAL TIMBER BRIDGE RAIL" SHEET.

CONTRACTOR SHALL LOCATE THE EXPANSION BEARING ON THE "UPHILL" END OF THE BRIDGE. THERE WILL BE ONLY ONE EXPANSION BEARING PER BRIDGE.

CONTRACTOR SHALL PROVIDE EROSION CONTROL MEASURES, AS REQUIRED ACCORDING TO NCDOT STANDARD SPECIFICATIONS AND THE CONTRACT DOCUMENTS.

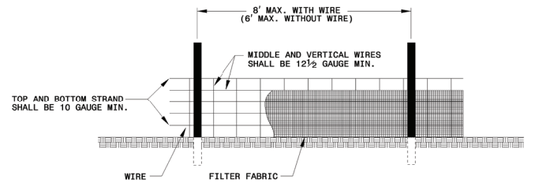
THE CONTRACTOR SHALL SET THE LOW-CHORD ELEVATION OF THE BRIDGE BASED ON EXISTING SITE CONDITIONS AND IN COORDINATION WITH THE ENGINEER, SUCH THAT THE NEW CROSSING PROVIDES CONVEYANCE GREATER THAN OR EQUAL TO THE ORIGINAL DESTROYED CROSSING. THE CONTRACTOR SHALL REFER TO THE BSR WHEN SETTING THE LOW-CHORD ELEVATION OF THE BRIDGE. NO CONSTRUCTION ACTIVITIES SHALL COMMENCE UNTIL ALL PARTIES HAVE AGREED UPON THE LOW-CHORD ELEVATION AND THE DATED PERMIT APPLICATION IS APPROVED.

TIMBER DECKING SHALL BE 2X8 BOARDS. 4X6 TIMBER DECKING (6" DIMENSION HORIZONTAL) MAY BE USED IN LIEU OF 2X8 DECKING; SEE OPTIONAL TYPICAL SECTION ON SHEET S-03 FOR DETAILS.

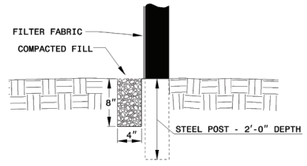
STATE OF NORTH CAROLINA DEPT. OF TRANSPORTATION DIVISION OF HIGHWAYS RALEIGH, N.C. 7-06

ENGLISH STANDARD DRAWING FOR **TEMPORARY SILT FENCE**

SHEET 1 OF 1 **1605.01**



NOTES
USE WIRE A MINIMUM OF 32" IN WIDTH AND WITH A MINIMUM OF 6 LINE WIRES WITH 12" STAY SPACING.
USE FILTER FABRIC A MINIMUM OF 36" IN WIDTH AND FASTEN ADEQUATELY TO THE WIRE AS DIRECTED BY THE ENGINEER.
PROVIDE 5'-0" STEEL POST OF THE SELF-FASTENER ANGLE STEEL TYPE. ANGLE STEEL TYPE.



STATE OF NORTH CAROLINA DEPT. OF TRANSPORTATION DIVISION OF HIGHWAYS RALEIGH, N.C. 7-06

ENGLISH STANDARD DRAWING FOR **SPECIAL SEDIMENT CONTROL FENCE**

SHEET 1 OF 1 **1606.01**

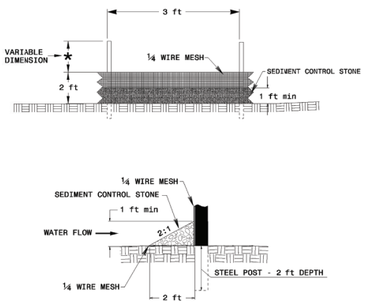
GENERAL NOTES:

USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL.

USE HARDWARE CLOTH 24 GAUGE WIRE MESH WITH ¼ INCH MESH OPENINGS.

INSTALL 5 FT. SELF FASTENER ANGLE STEEL POST 2 FT. DEEP MINIMUM.

SPACE POST A MAXIMUM OF 3 FT.



Signed by: Matthew D Foster
7B1932BFAFC8472...
4/2/2026 | 6:30:17 PM EDT

NORTH CAROLINA PROFESSIONAL SEAL 20646 ENGINEER MATTHEW D. FOSTER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA OFFICE OF
EMERGENCY MANAGEMENT

PRIVATE DRIVEWAY BRIDGE STANDARDS

SINGLE LANE STEEL BEAM BRIDGE
TIMBER DECK

EROSION CONTROL

Johnson, Mirmiran, & Thompson Inc.
108 Asheville Commerce Parkway
Candler, NC, 28715
License No: C-3097

DWN. BY: BC DATE: 04/2026
CHKD. BY: GFW DATE: 04/2026
DES. EGR. OF RECORD: GFW DATE: 04/2026

REVISIONS						SHEET NO.
NO.	BY:	DATE:	NO.	BY:	DATE:	EC-01
1			3			TOTAL SHEETS
2			4			13

$$$$USERNAME$$$$
DGN: $$DGN$$
TIME: $$$$$$CSTTIME$$$$$$

FOR INFORMATION ONLY

GEOTECHNICAL BORING REPORT
BORE LOG

SHEET

WBS 006-01-07045	**TIP** N/A	**COUNTY** AVERY	**GEOLOGIST** J, Baskin	
SITE DESCRIPTION 85 Kay Jay Lane for Bridge over Big Horse Creek				**GROUND WTR (ft)**
BORING NO. EB1	**STATION** N/A	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** 5.0
COLLAR ELEV. 0.0 ft	**TOTAL DEPTH** 19.3 ft	**NORTHING** 870,940	**EASTING** 1,115,336	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R7348 CME-750X 87% 12/20/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER S. Davis	**START DATE** 02/12/26	**COMP. DATE** 02/12/26	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
										0.0 GROUND SURFACE	0.0
0	0.0	0.0	1	14	16	30		M		-2.0 **ARTIFICIAL FILL** Brown, Fine to Coarse Sandy Silty CLAY (A-6) with Trace Roots and Gravel	2.0
-5	-3.5	3.5	2	2	1	3				**ALLUVIAL** Dark Gray, Silty Clayey Fine to Coarse SAND (A-2-4) with Trace Gravel	
-10	-8.5	8.5	25	31	36	67		M		-7.0 **RESIDUAL** Black-Green, Clayey Silty Fine to Coarse SAND (A-2-4) with Trace Rock Fragments	7.0
-15	-13.5	13.5	100/0.5			100/0.5				-12.0 **WEATHERED ROCK** Red-Tan BIOTITE HORNBLENDE GNEISS	12.0
	-18.5	18.5								-18.5	18.5
	-19.3	19.3	60/0.1			60/0.1				-19.3 **CRYSTALLINE ROCK** White-Gray BIOTITE HORNBLENDE GNEISS	19.3
			60/0.1							Boring Terminated with Standard Penetration Test Refusal at Elevation -19.3 ft in CRYSTALLINE ROCK (GNEISS)	

Notes:
1. Surficial Organic Soil: 0.0'-0.2'

DRAFT

FOR INFORMATION ONLY

GEOTECHNICAL BORING REPORT
BORE LOG

SHEET

WBS 006-01-07045	**TIP** N/A	**COUNTY** AVERY	**GEOLOGIST** J, Baskin	
SITE DESCRIPTION 85 Kay Jay Lane for Bridge over Big Horse Creek				**GROUND WTR (ft)**
BORING NO. EB2	**STATION** N/A	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** 8.5
COLLAR ELEV. 0.0 ft	**TOTAL DEPTH** 10.0 ft	**NORTHING** 870,995	**EASTING** 1,115,300	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R7348 CME-750X 87% 12/20/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER S. Davis	**START DATE** 02/12/26	**COMP. DATE** 02/12/26	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
0										0.0 GROUND SURFACE	0.0
	0.0	0.0	6	12	5	17		M		**ARTIFICIAL FILL**	
										-2.0 Silty Fine to Coarse SAND (A-2-4) with Trace Gravel	2.0
	-3.5	3.5	2	2	4	6		M		Red-Tan, Fine to Coarse Sandy Silty CLAY (A-6)	
-5										-7.0	7.0
	-8.5	8.5	20	19	28	47		M		**RESIDUAL** Blue-Green, Clayey Silty Fine to Coarse SAND (A-2-4) with Trace Rock Fragments	
-10										-10.0 Boring Terminated at Elevation -10.0 ft in RESIDUAL (SAND)	10.0

Note:
Boring terminated at 10.0' due to crooked hole. Offset to EB2(A)

DRAFT

FOR INFORMATION ONLY

SHEET

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 006-01-07045	**TIP** N/A	**COUNTY** AVERY	**GEOLOGIST** J, Baskin	
SITE DESCRIPTION 85 Kay Jay Lane for Bridge over Big Horse Creek				**GROUND WTR (ft)**
BORING NO. EB2(A)	**STATION** N/A	**OFFSET** N/A	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 0.0 ft	**TOTAL DEPTH** 12.2 ft	**NORTHING** 870,995	**EASTING** 1,115,302	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R7348 CME-750X 87% 12/20/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER S. Davis	**START DATE** 02/12/26	**COMP. DATE** 02/12/26	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
0										0.0 GROUND SURFACE	0.0
								M		-2.0 **ARTIFICIAL FILL** Silty Fine to Coarse SAND (A-2-4) with Trace Gravel	2.0
-5								M		Red-Tan, Fine to Coarse Sandy Silty CLAY (A-6) -7.0	7.0
-10								M		**RESIDUAL** Black-Green, Clayey Silty Fine to Coarse SAND (A-2-4) with Trace Rock Fragments -12.1	12.1
	-12.1	12.1	60/0.1			60/0.1				-12.2 **CRYSTALLINE ROCK** HORNBLENDE GNEISS	12.2

Boring Terminated with Standard Penetration Test Refusal at Elevation -12.2 ft in CRYSTALLINE ROCK (HORNBLENDE GNEISS)

Note:
1. Auger probe to 12.1 feet.
2. Auger refusal at 12.1 feet.

DRAFT