

ARKANSAS DEPARTMENT OF TRANSPORTATION



SUBSURFACE INVESTIGATION

STATE JOB NO. 012357

FEDERAL AID PROJECT NO. STPAC-0076(123)

ARKANSAS RIVER PIER PROTECTION REPAIRS (S)

STATE HIGHWAY I-30, 9 & 23 SECTION 6, 7 & 23

IN CONWAY, FRANKLIN & PULASKI COUNTY

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

Date
1/25/2020

To
Arkansas DOT
Attn: Jim Pool
From
Brad Wilder, HNTB



**PROJECT
CORRESPONDENCE**

CC

Subject
Arkansas DOT I-30
Cell Pier Protection Replacement Geotechnical Analysis

1. Project Description

The I-30 Bridge is a critical link in the Central Arkansas Freeway System through Little Rock, AR. As a navigable waterway extensive cargo shipping occurs along the Arkansas River, requiring robust pier protection measures to protect the bridge from boat collisions. To protect the existing bridge bents 40-ft diameter sheet pile cells were constructed upstream and downstream of each bent along the navigation channel. Currently, the northwestern most cell has failed and needs to be replaced.

Existing information consisting of as-built plans for the I-30 project (1968) are included in Attachment A. A boring log from a 2018 geotechnical exploration report (Boring B-68; drill date of 2015) is included in Attachment B. A recent ArDOT 2019 topographic river survey is included in Attachment C. Geotechnical calculations which include bearing capacity, eccentricity, and sliding calculations are included in Attachment D.

2. Existing Conditions

The original protection cell is a circular sheetpile structure founded on shale and filled with quarry stone. The failed cell is mostly submerged based on recent photographs. Further information on the failure mechanism is not known; however, it is possible that interior stone was lost out of the top of the cell during high water events, at the base of the cell, or after vessel collisions and this loss of stone may have caused the structure to "buckle" or "tip".

The Arkansas River in the vicinity of the I-30 bridge has experienced scouring around the pier protection cells based on recent 2015 borings and recent survey. The river bed is comprised of silty non-cohesive material ("muck") which is erodible. At the time of construction, the height of overburden above the shale was approximately 33 ft while the 2015 boring log B-68 illustrates only 3 ft of overburden. Below the silty material, a shale layer is encountered at approximate elevation 190 ft in boring B-68. The shale is part of the Jackfork Group. The shale is gray, slightly fractured, moderately weathered, with moderately fractured quartz seams. The shale encountered at boring B-68 is interbedded with sandstone from approximate elevation 179 ft to 169 ft and then the shale continues to the termination depth of the boring at elevation 72 ft (boring depth of 161.5 ft).

3. Geotechnical Analysis

3.1 Design Conditions

Design criteria for this project is AASHTO LRFD Bridge Design Specifications, 7th Edition, with 2016 Interim Revisions. All design criteria and assumptions can be found in the Pier Protection Cell Rehabilitation Design Criteria document (revision date of December 9, 2019). Design life is ten years. Hydraulic calculations are provided in a separate hydraulic memorandum (January 2020). Design assumptions included two cases:

1. Case 1: Normal water event with normal operation design force
2. Case 2: High water event with normal operation design force.

Design Loads:

- Normal Operation Design Force: 2,800 kips
- Drifting Empty Barge Design Force: 1,440 kips
- Normal Operation Design Speed: 5.9 ft/s
- Drifting Empty Barge Speed: 2.9 ft/s
- Normal Operation Design Water Surface: 231.0 ft

Drifting Empty Barge Design Water Surface: 247.2 ft (10-yr event).

3.2 Analysis

Bearing capacity resistance, sliding resistance, and eccentricity were calculated according to AASHTO LRFD. The design assumes a unit weight of 150 pcf for the cell rockfill material. The factored resistances for both Case 1 and Case 2 exceeded the factored loads. Additionally, the eccentricity is within 9/10 of the cell base as required by AASHTO LRFD. Results are provided in Appendix D.

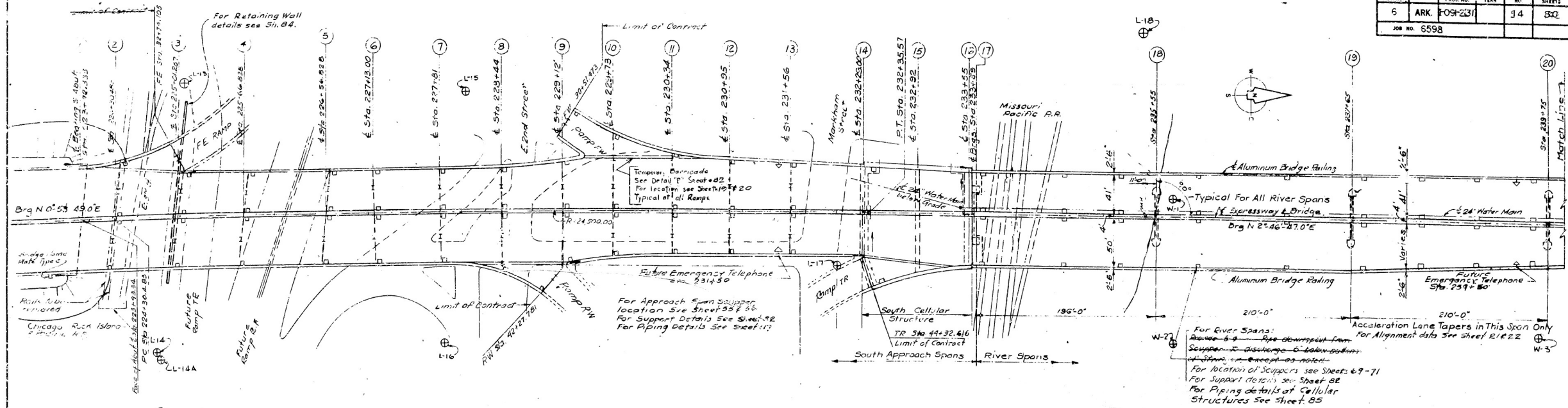
4. Construction Considerations

Sheetpiling is to be driven to refusal in shale with care taken not to damage the piles. Based on the minimal amount of overburden above the shale and depending on the ability to embed the sheetpile into the shale layer, it may be required to use additional bracing methods to support the sheetpile in a vertical position while the cell is constructed.

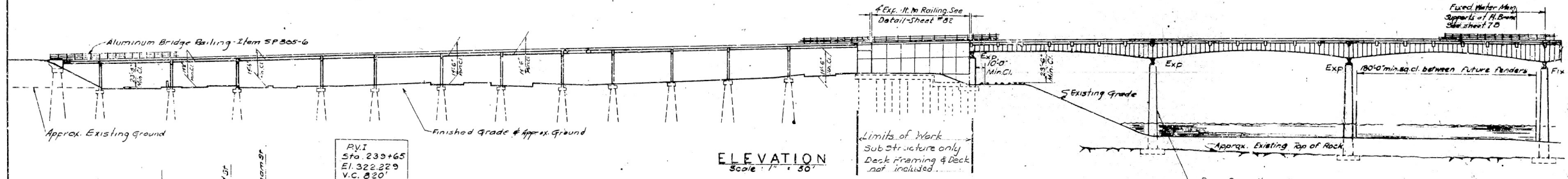
Preliminary hydraulic calculations for the rock fill gradation for the cell structure determined a d50 of 8 inches or unit weight of 26 lbf and a gradation with 100% passing 20 inches or less than 300 lb stone. The high turbulence set of rock size curves were used for an average velocity equal to 7 ft/s and a rock specific weight equal to 155 lbf/cf. See hydraulic memorandum for additional information.

ATTACHMENT A
AS-BUILT PLAN

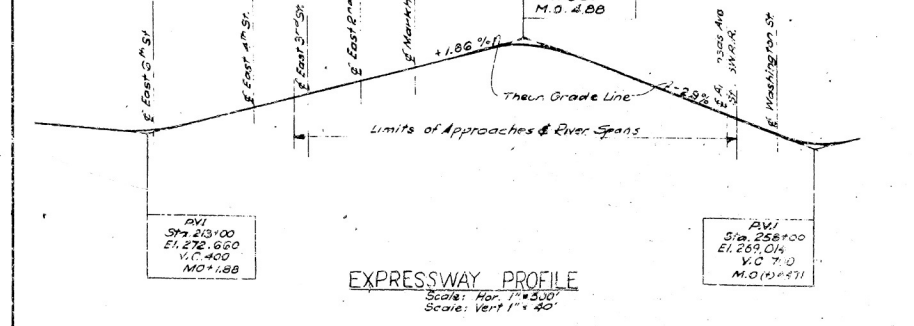
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
6	ARK.	109-231	74	82	
JOB NO. 6598					



PLAN
Scale: 1" = 30'



ELEVATION
Scale: 1" = 30'



EXPRESSWAY PROFILE
Scale: Hor. 1" = 300'
Scale: Vert. 1" = 40'

- REFERENCES**
- For Horizontal & Vertical Alignment See Sheet 4, 5, 20, 21
 - For Roadway Transitions at Ramps See Sheet 25
 - For Boring Logs See Sheet 24
 - For Bridge Abutment, Pier, and Span Locations See Sheet 19-21
 - For Lighting Details See Sheet 102
 - For Lighting Standards in Urban Areas & Conduit Locations see sheet 101
 - For Bridge Name Plate Details see sheet 121
 - For Work Markers, Signs, and Lane Transitions see sheets 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

CONTRACT 2

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK - NORTH LITTLE ROCK EXPRESSWAY 1-30

ARKANSAS RIVER BRIDGE
STRUCTURE NO. 21
GENERAL PLAN & ELEVATION I

In Charge of: J.A. Washburn
Made By: J.A.P.
Traced By: J.A.P.
Checked By: H.H.
Rev. 1-22-53

DWG. NO. SCALE DATE BROWN & BLAUVELT CONSULTING ENGINEERS

REVISIONS
 Added SP-7-30
 Revised SP-8-10
 Added Pool Elev. Note, Sheet 4

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
12-29-69	1-13-70			6	ARK.		2	6
3-18-70	3-18-70							
JOB NO. 6903						IND. TO SHTS. SPE. PROV. & QUAN.		

INDEX TO SHEETS

SHEET NO.	TITLE	DRAWING NO.
1	Title Sheet	
2	Index To Sheets, Special Provisions and Quantities	16008
3	Triangulation Control and Soil Information	16002
4	Plan and Elevations	16010
5	Structural Details	16011
6	Navigation Lighting System Details	16012

SUMMARY OF QUANTITIES

ITEM NUMBER	SP	SP	SP & 306	SP	SP	SP	SP & 101	SP	SP
ITEM	STEEL SHEET PILING (MP-102)	QUARRY RUN STONE	STRUCTURAL STEEL IN PIER PROTECTION CELL (A-36)	CLEARANCE GAGE	BITUMASTIC COATING	WET EXCAVATION	FURNISHING FIELD OFFICE	NAVIGATION LIGHTING SYSTEM	BITUPLASTIC COATING
UNIT	SQ. FT.	CU. YD.	LB.	EACH	SQ. FT.	CU. YD.	BLDG.	COMP. ITEM	SQ. FT.
JOB	-	-	-	-	-	300	1	1.00	-
CELL 1	6,938	1,622	10,292	1	9,875	-	-	-	2,500
CELL 2	6,938	1,663	10,292	1	9,875	-	-	-	2,500
CELL 3	7,438	1,851	16,973	-	10,875	-	-	-	2,500
CELL 4	7,438	1,783	16,973	-	10,875	-	-	-	2,500
CELL 5	8,437	1,617	10,218	-	9,875	-	-	-	2,500
CELL 6	8,437	1,640	10,218	-	9,875	-	-	-	2,500
TOTALS	45,626	10,176	74,966	?	61,250	300	1	1.00	15,000

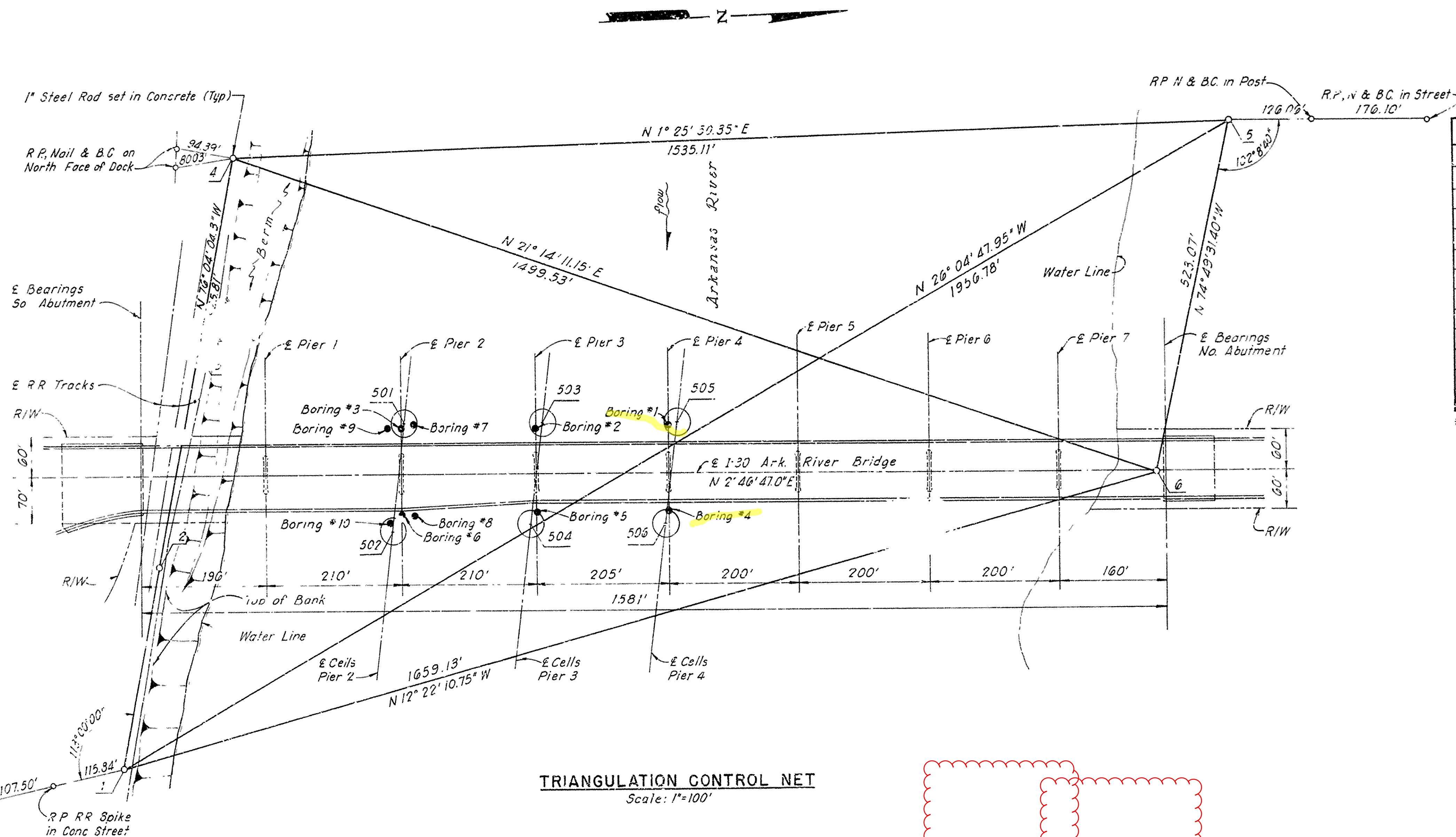
SPECIAL PROVISIONS

SPECIAL PROVISION NO.	TITLE
Job 6903	Required Contract Provisions for Work Financed by Corps of Engineers' Funds
4-1	Plant Sites and Equipment Storage Areas
Job 6903	Work Areas
6-3	Sources of Materials
6-6	Furnishing Materials from Bars, Pits or Quarries
6-7	Control of Materials
7-28	Plant Pest Control
7-29	Protection of Streams, Lakes and Reservoirs
7-30	Contractors Responsibility for Damage Claims
Job 6903	Requirements of Jurisdictional Agencies
8-2	Employment of Labor
Job 6903	Revision of Section 8 - Prosecution and Progress
8-9	Legal Holidays
8-10	Suspension or Termination of Contract.
8-11	Limitations of Subletting or Assignment of Contract
9-11	Revision of Article 9.7 - Partial Payments
100-1	Furnishing Field Offices and Laboratories
306-13	Revision of American Welding Society Bridge Specifications
Job 6903	Pier Protection Cells
Job 6903	Clearance Gages
Job 6903	Permanent Navigation Lights

Drawing No. 16008

ARKANSAS STATE HIGHWAY COMMISSION LITTLE ROCK, ARKANSAS		
I-30 BRIDGE PIER PROTECTION SYSTEM JOB 6903		
INDEX TO SHEETS, SPECIAL PROVISIONS AND QUANTITIES		
SIGNED BY J.J.M.	GARVER & GARVER, Inc. ENGINEERS LITTLE ROCK, ARKANSAS	SCALE NONE
DRAWN BY G.S.L.		SHEET NO. 2 OF 6
CHECKED BY T.B.H.		
DATE DEC. '68		

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.		3	6
						JOB NO.	6903	
TRIANG. CONTRL & SOIL. INF.								

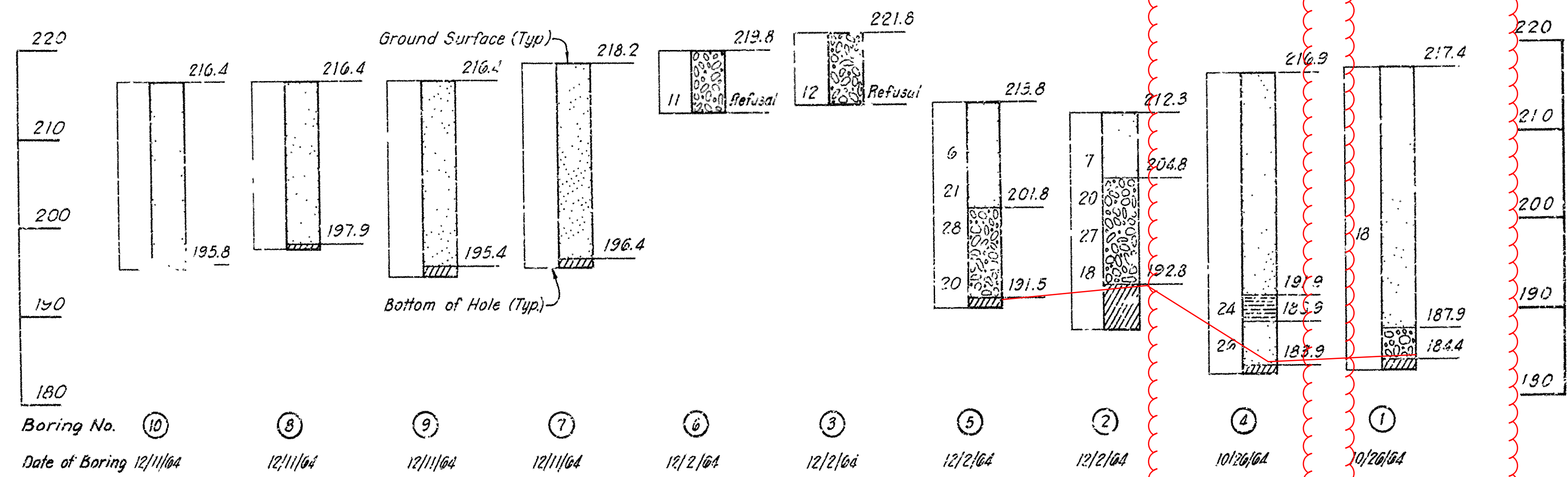


POINT	DESCRIPTION	NORTHING	EASTING	ELEV.*
1	Triangulation Pt.	392.6218	1432.8537	270.46
2	Construction Control	966.0550	1136.8360	270.67
3	Construction Control	1044.1664	821.9599	268.26
4	Triangulation Pt.	1115.5315	534.2797	265.18
5	Triangulation Pt.	2650.1627	572.6068	247.49
6	Triangulation Pt.	2513.2365	1077.4392	-
501	Center of Cell #1	1360.3463	940.9060	-
502	Center of Cell #2	1332.7933	1100.7578	-
503	Center of Cell #3	1576.2029	951.3864	-
504	Center of Cell #4	1550.1902	1102.3025	-
505	Center of Cell #5	1787.0279	961.6227	-
506	Center of Cell #6	1761.0152	1112.5387	-

* Triangulation Points with elevations may be used for T.B.M.'s

- NOTES:
- Elevations are feet above sea level 0.00 as established by the U.S.C. & G.S. T.B.M.'s were established from U.S.C. & G.S. Disc K-118 located on the west side of the C.R.I. & P.R.R. Bridge, South Abutment, Elevation 271.938
 - Although angles, linear measurements & coordinates in the Triangulation Net are shown to greater accuracy, survey data & coordinates should be regarded as accurate to within 1 to 3,000 only.
 - Soil information shown was furnished from borings by the Corps of Engineers. Ground surface indicated was of the day of boring. Waste material in Pier 2 footing excavation was a probable cause for early refusal on Borings 3 & 6. Soil data are shown for information only. The information should be regarded as approximate. The State will not be responsible for any variation in these soil characteristics and extent of some differing from tabulation.

TRIANGULATION CONTROL NET
Scale: 1"=100'



BORING LEGEND
UNIFIED SOIL CLASSIFICATION

- Gravel, Poorly Graded, Gravel-Sand Mixtures Little or no Fines
- Sand, Poorly Graded Gravely Sands
- Silty Sandy Sand Mixtures
- Hole

LOG OF SOIL BORINGS
Scale: 1"=10' Vertical

NOTE:
Numbers to left of logs indicate blows per foot. Blows per foot were determined with a standard split spoon sampler (1 3/8" I.D., 2" O.D.) and a 140 lb driving hammer with a 30" drop.

Drawing No. 16009

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS

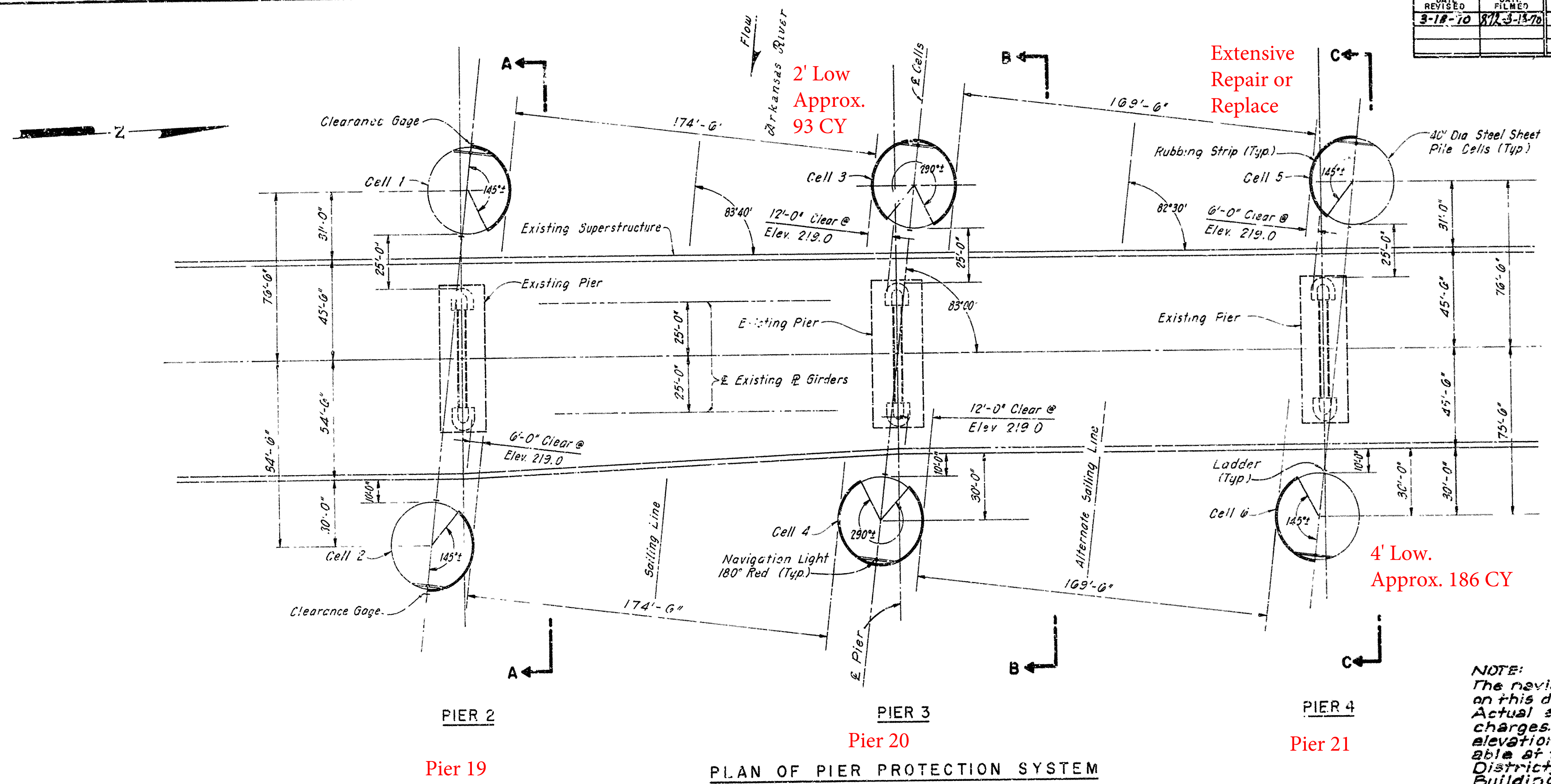
I-30 BRIDGE
PIER PROTECTION SYSTEM
JOB 6903

TRIANGULATION CONTROL
AND SOIL INFORMATION

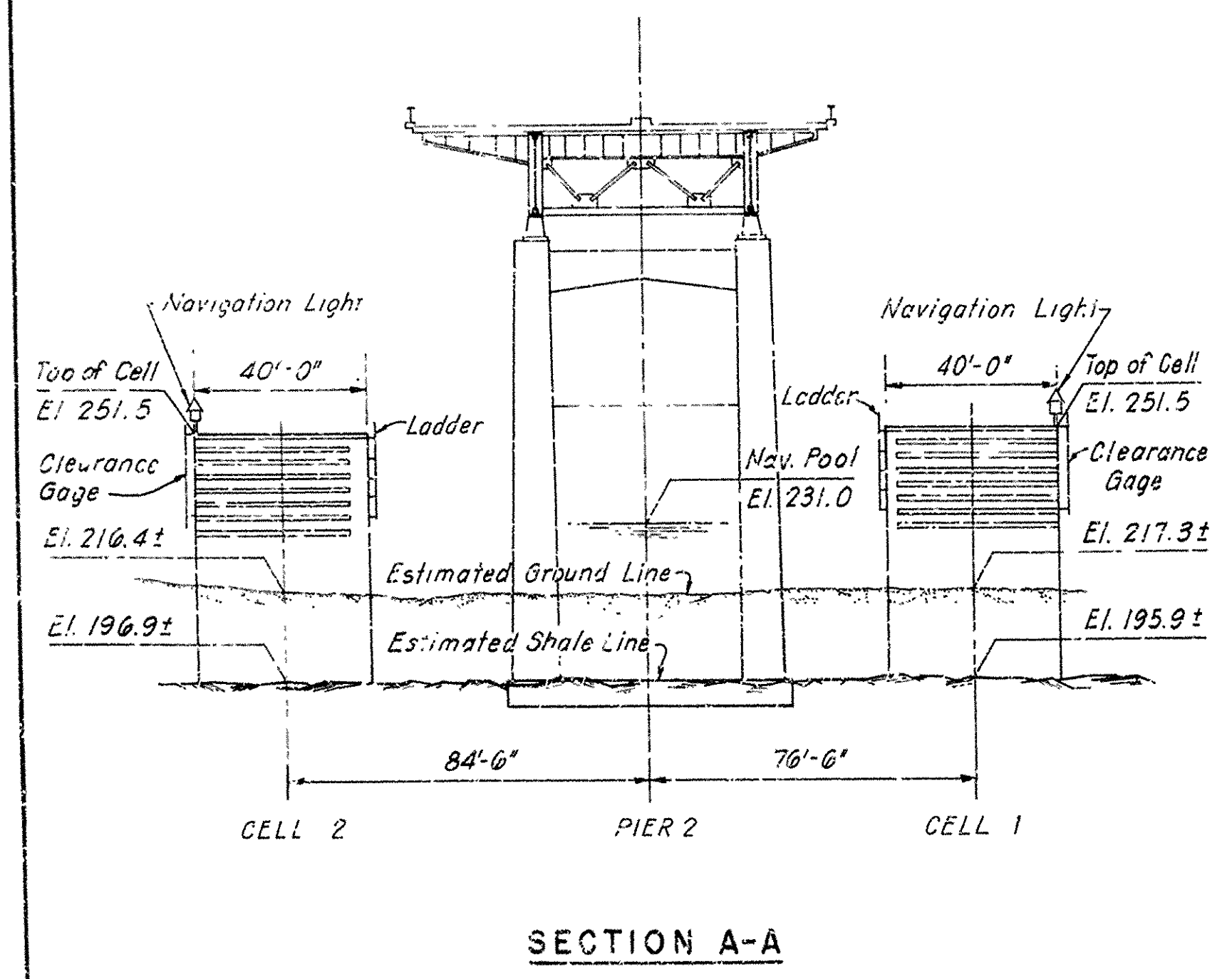
DESIGNED BY: J.M.	SCALE: NONE
DRAWN BY: GSL	SHEET NO. 3 of 6
CHECKED BY: TBH	
DATE: DEC. '68	

GARVER & GARVER, Inc.
ENGINEERS
LITTLE ROCK, ARKANSAS

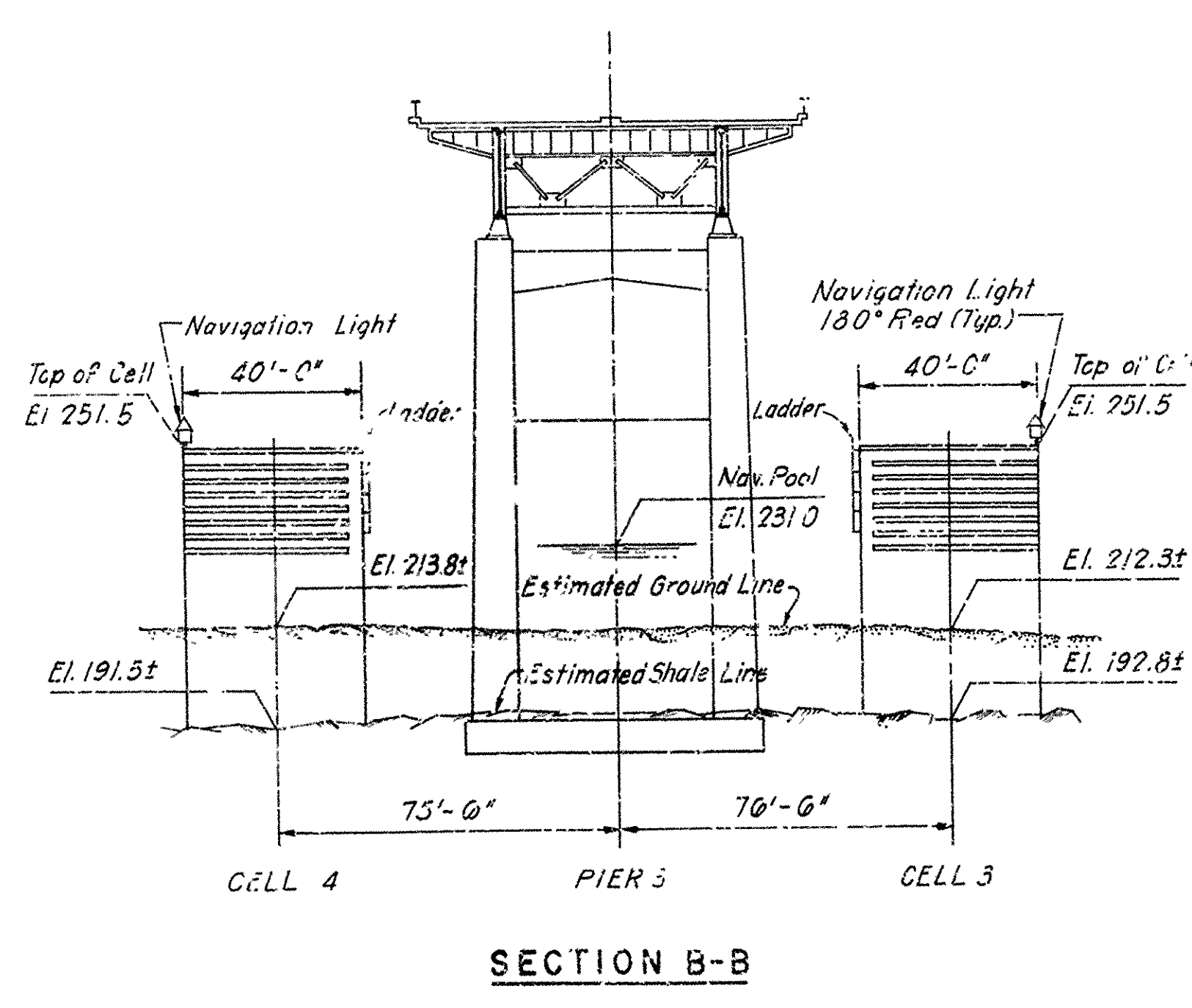
DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
3-18-70	8/23-70			6	ARK.		4	6
						JOB NO.	6903	
PLAN AND ELEVATIONS								



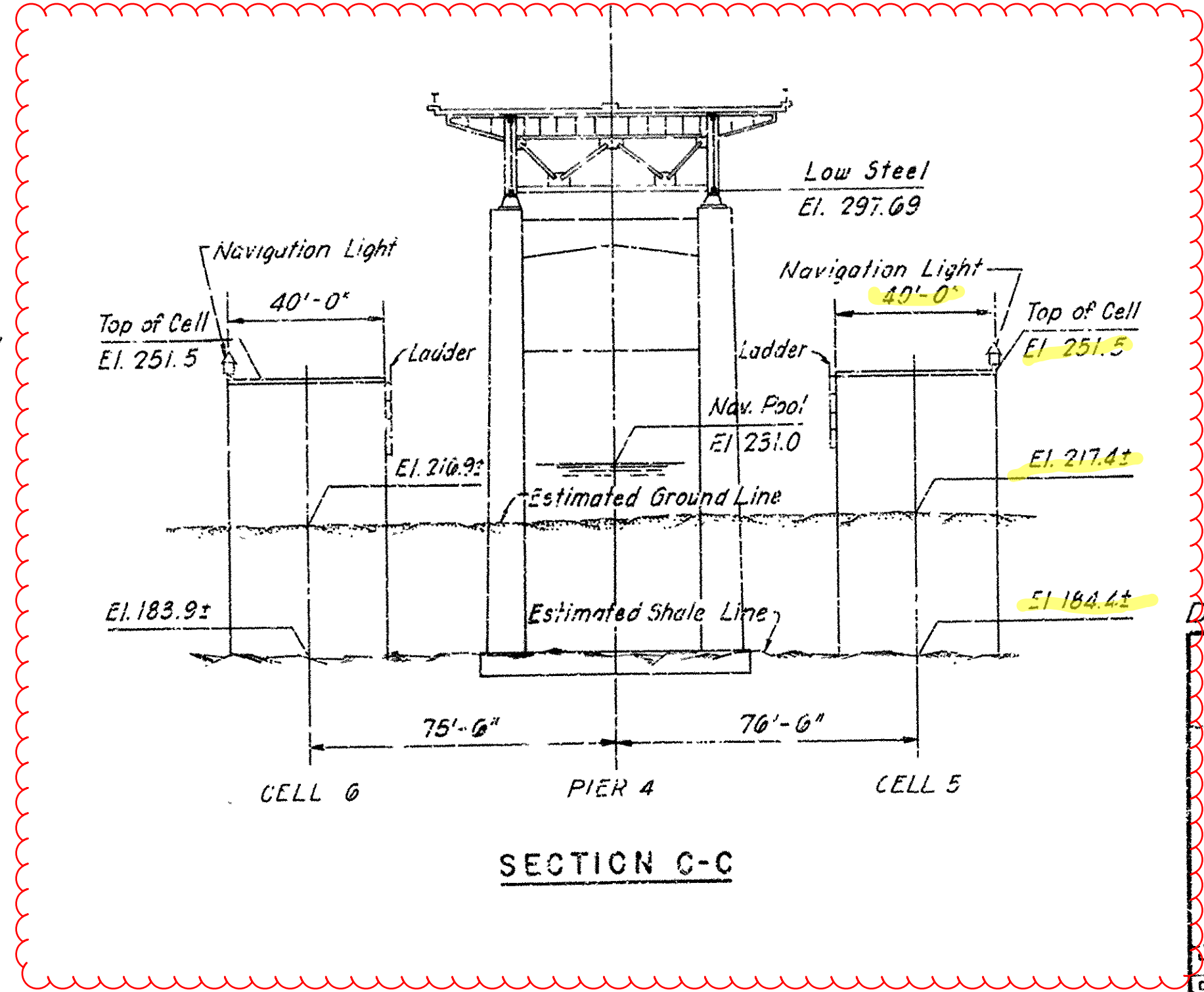
NOTE:
The navigation pool elevation of 231.0 shown on this drawing is normal low flow elevation. Actual elevations will depend on river discharges. Information on water surface elevations for various discharges is available at the office of the Little Rock District, Corps of Engineers, Federal Building, Little Rock, Arkansas.



SECTION A-A



SECTION B-B



SECTION C-C

Drawing No. 16010

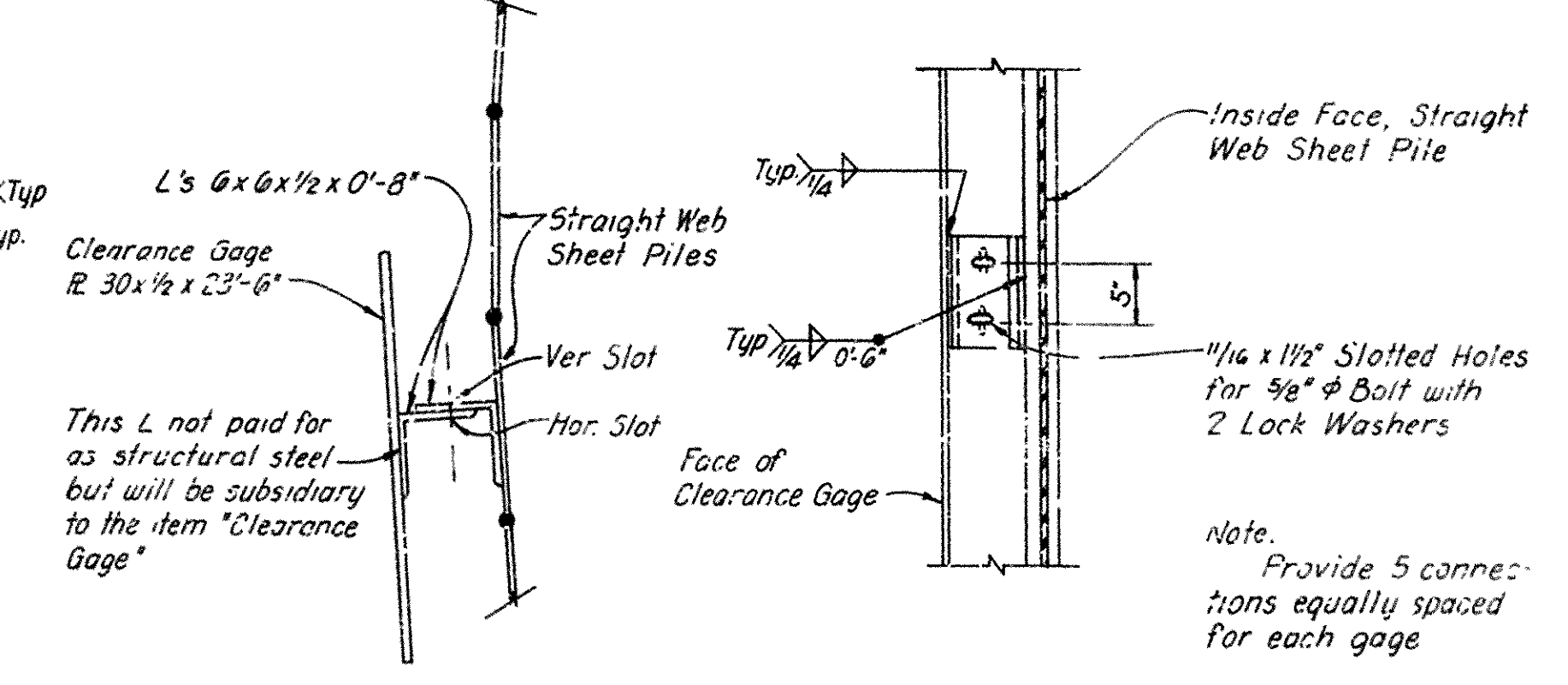
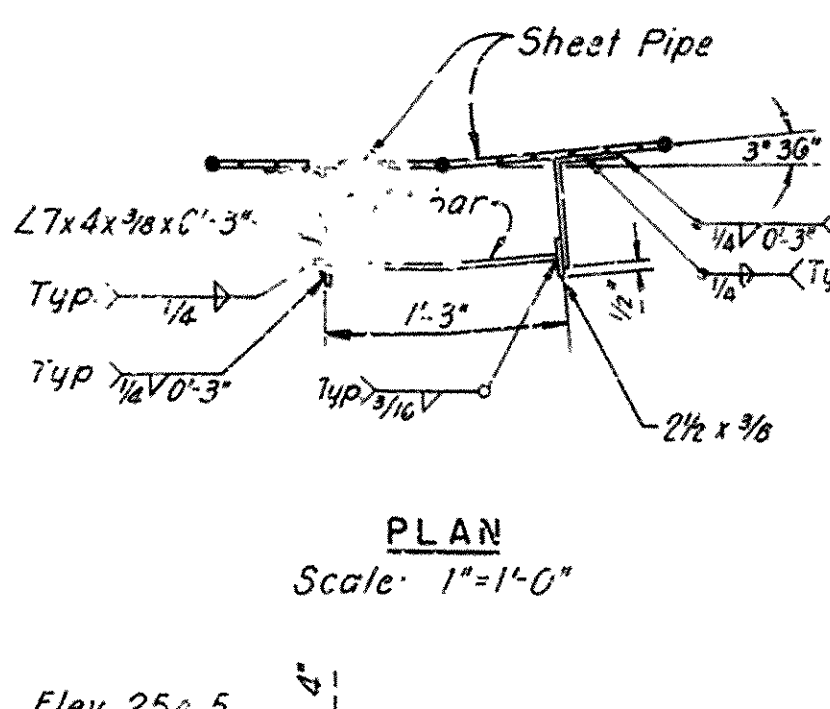
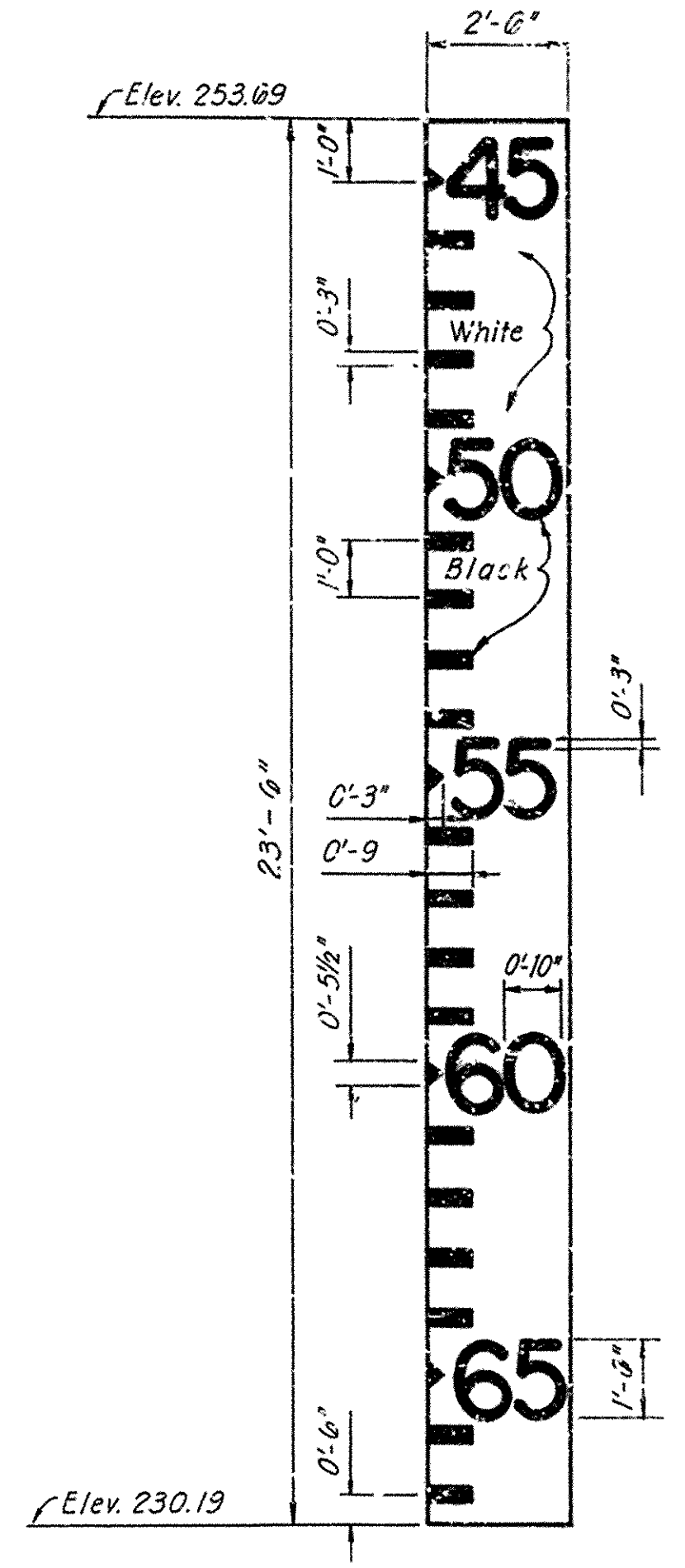
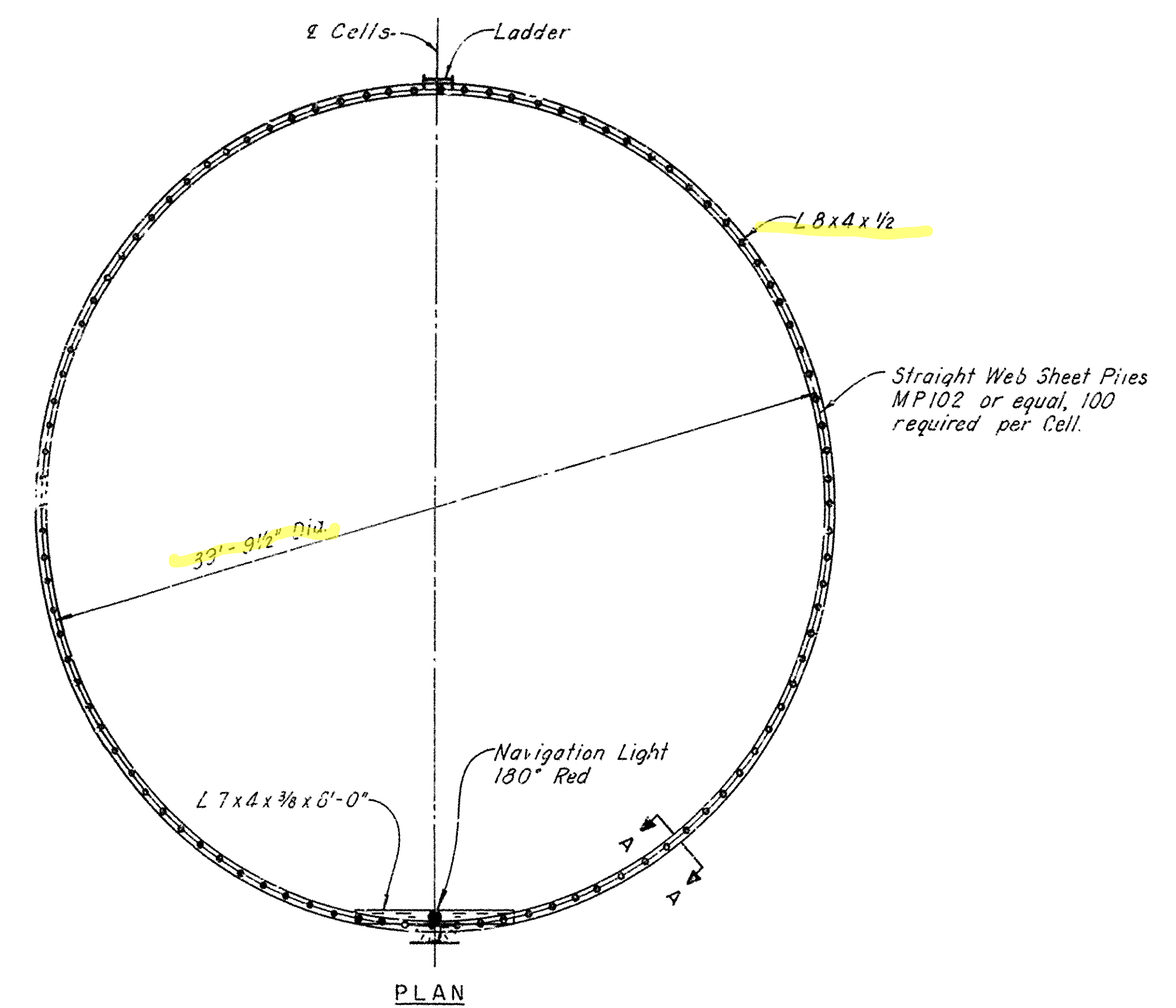
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS

I-30 BRIDGE
PIER PROTECTION SYSTEM
JOB 6903

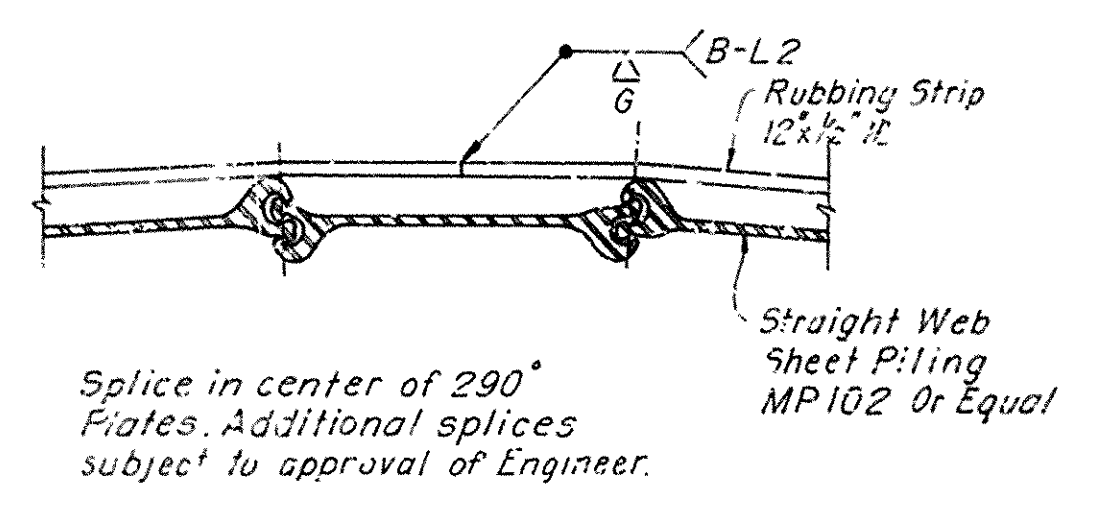
PLAN AND ELEVATIONS

DESIGNED BY: JJM	GARVER & GARVEK, Inc. ENGINEERS LITTLE ROCK, ARKANSAS	SCALE: NONE
DRAWN BY: GSL		SHEET NO. 4 OF 6
CHECKED BY: TBH		
DATE: DEC. '68		

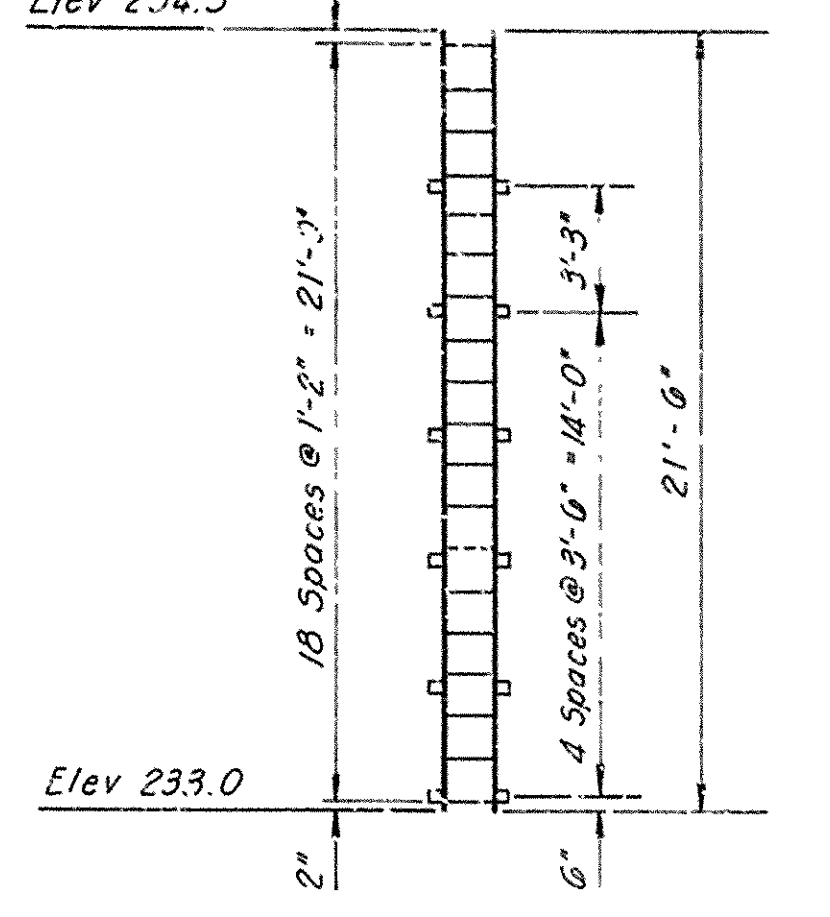
DATE REVISION	DATE FILMED	DATE REVISION	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.		5	6
				JOB NO.		6903		
STRUCTURAL DETAILS								



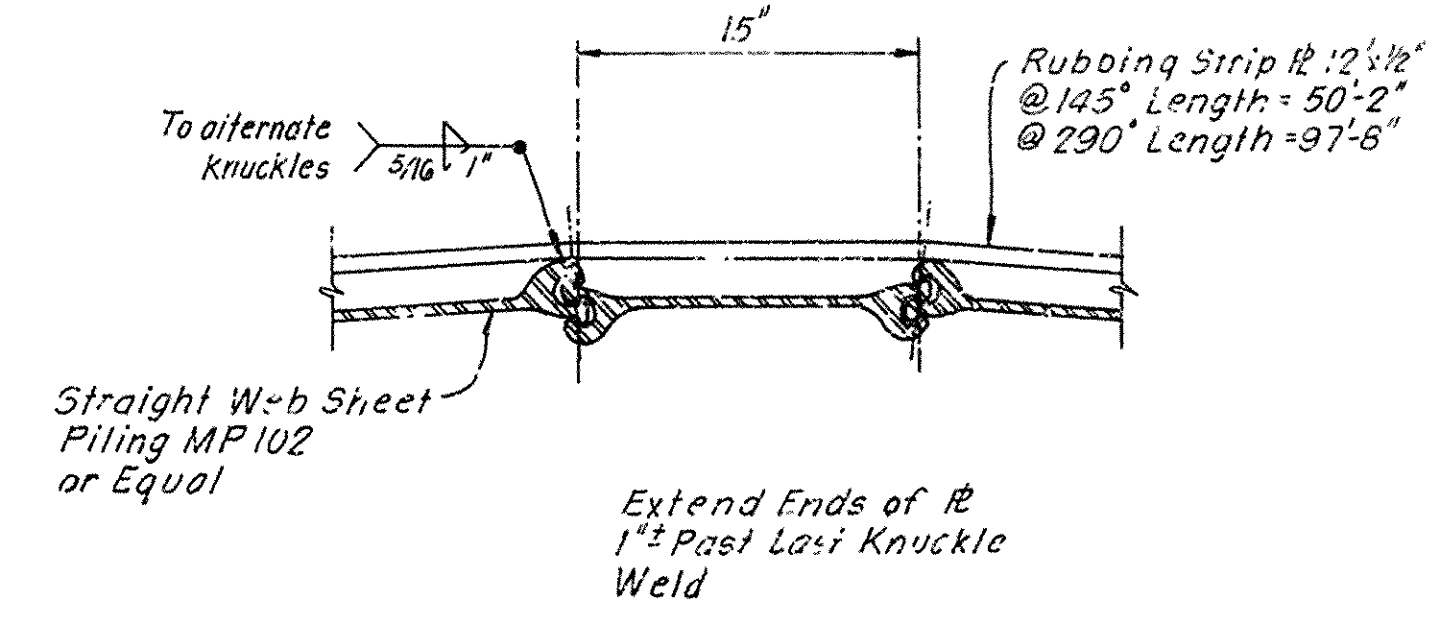
PLAN PARTIAL ELEVATION
CLEARANCE GAGE CONNECTION DETAILS
Scale: 1" = 1'-0"



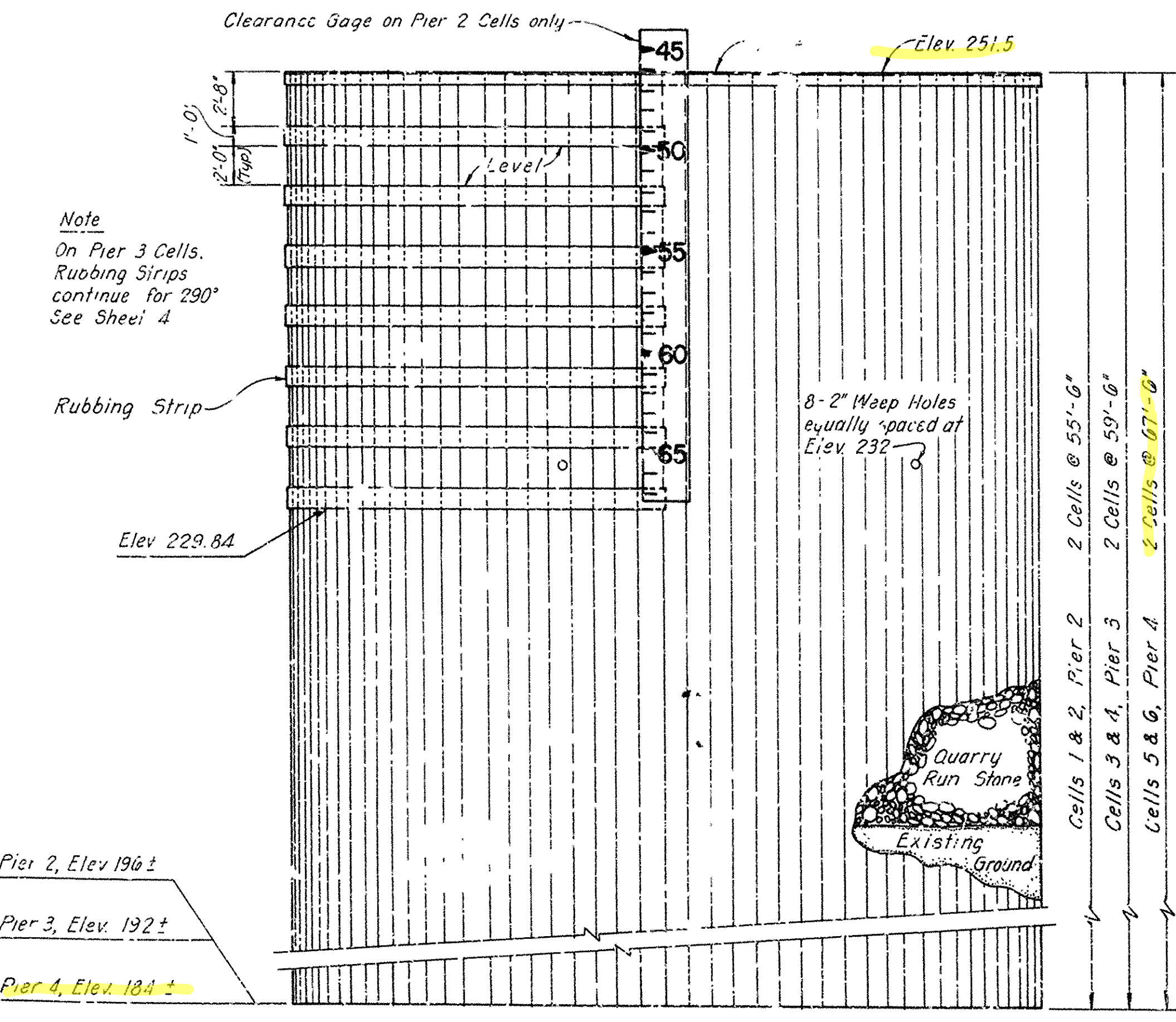
RUBBING STRIP SPLICE DETAIL
No Scale



ELEVATION
LADDER DETAILS
Scale: 3/16" = 1'-0"



RUBBING STRIP CONNECTION DETAIL
No Scale



ELEVATION
PIER PROTECTION CELLS
Scale: 3/16" = 1'-0"

Pier 2, Elev 196 ±
Pier 3, Elev. 192 ±
Pier 4, Elev. 184 ±

- Notes:
- All Structural Steel shall be ASTM A-36.
 - All Bolts shall be ASTM A307 Bolts. Minimum distances from sheared edge to center of Bolt shall be 1 1/2" from rolled edges 1 1/2".
 - Drawings show general features of design only. Shop drawings showing structural steel details shall be prepared in accordance with specifications, submitted and approval secured before fabrication is begun.
 - All welding shall conform to the American Welding Society Standard Specifications for welding Highway and Railway Bridges, current edition, and to SP80G-13.

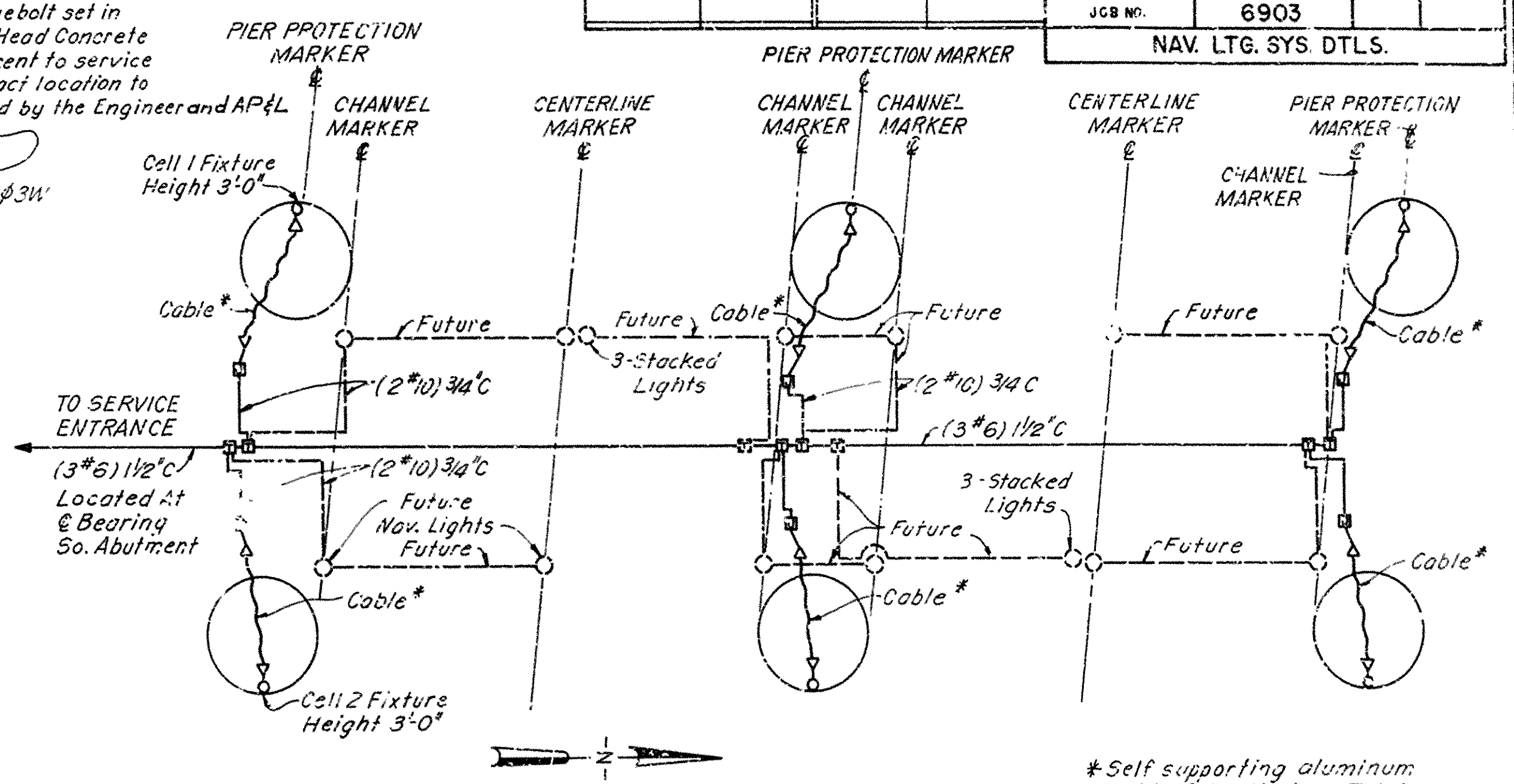
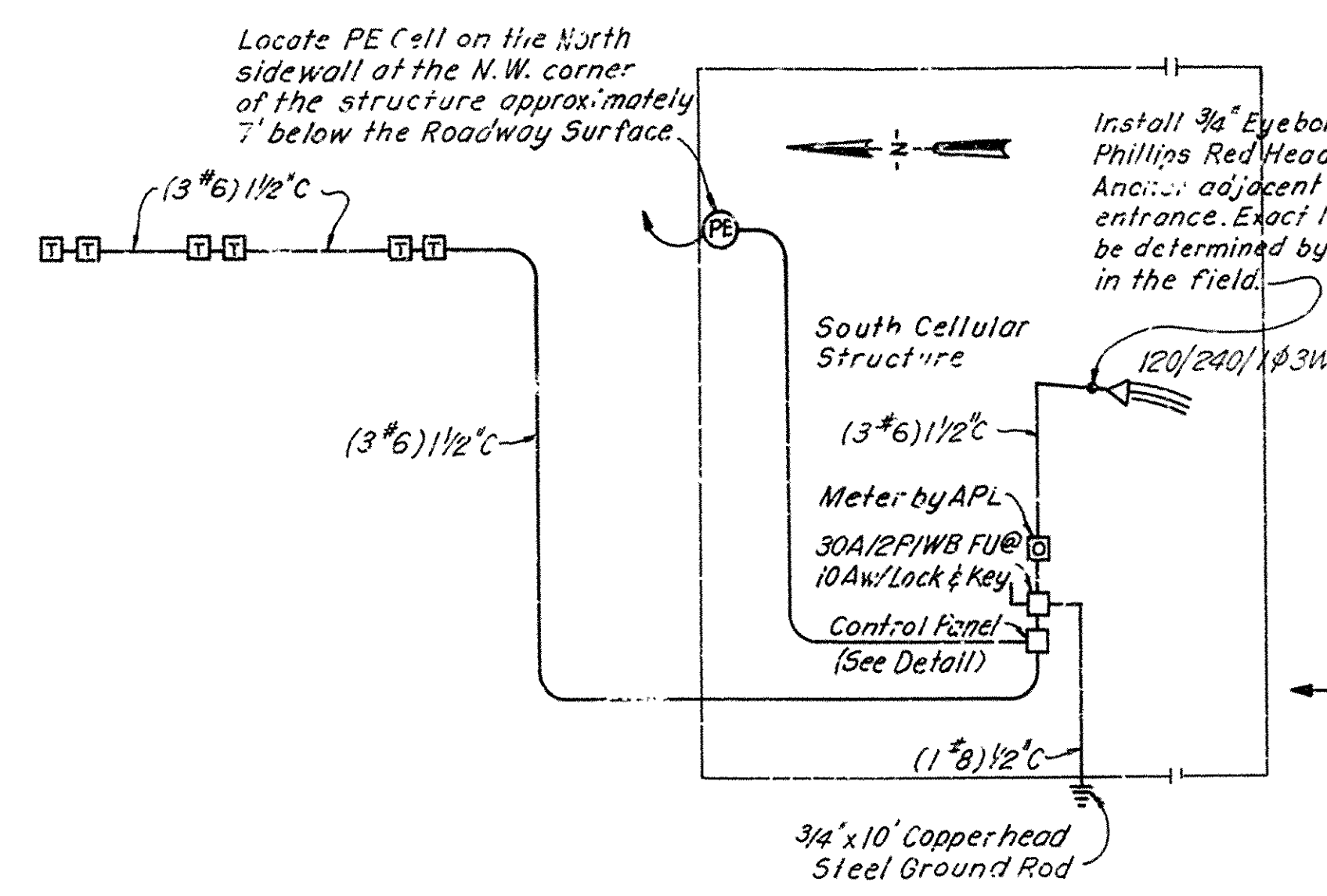
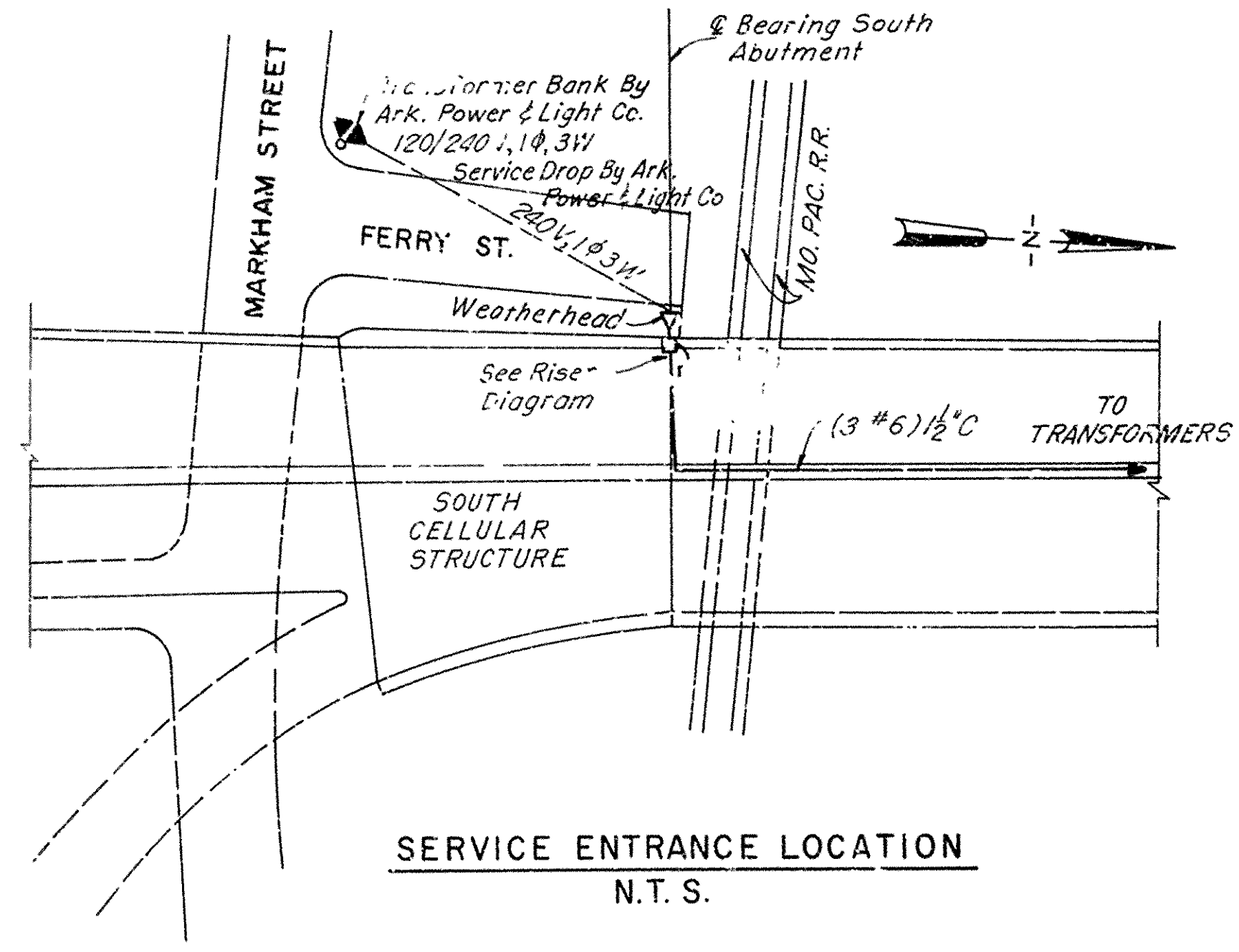
Drawing No 16011

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS

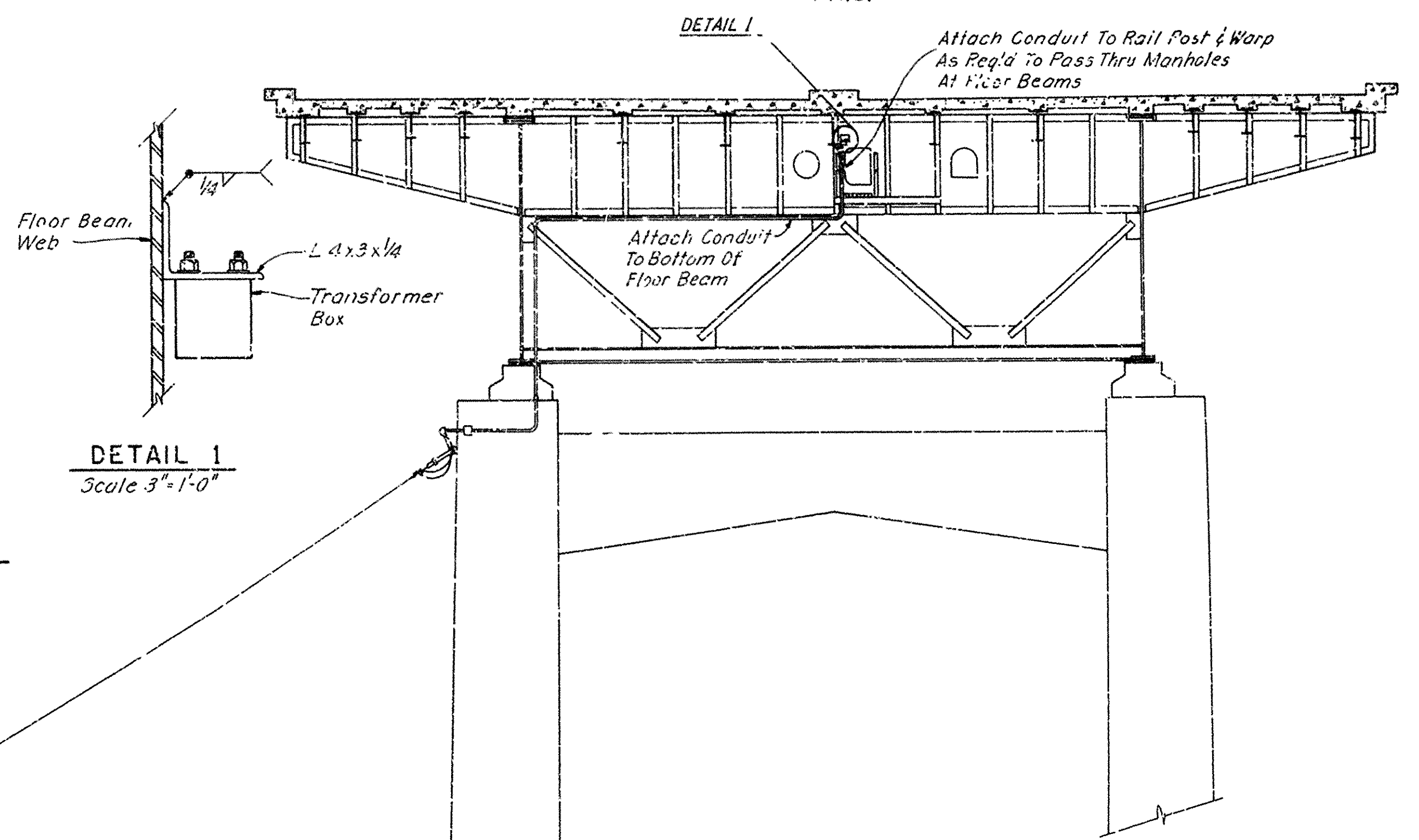
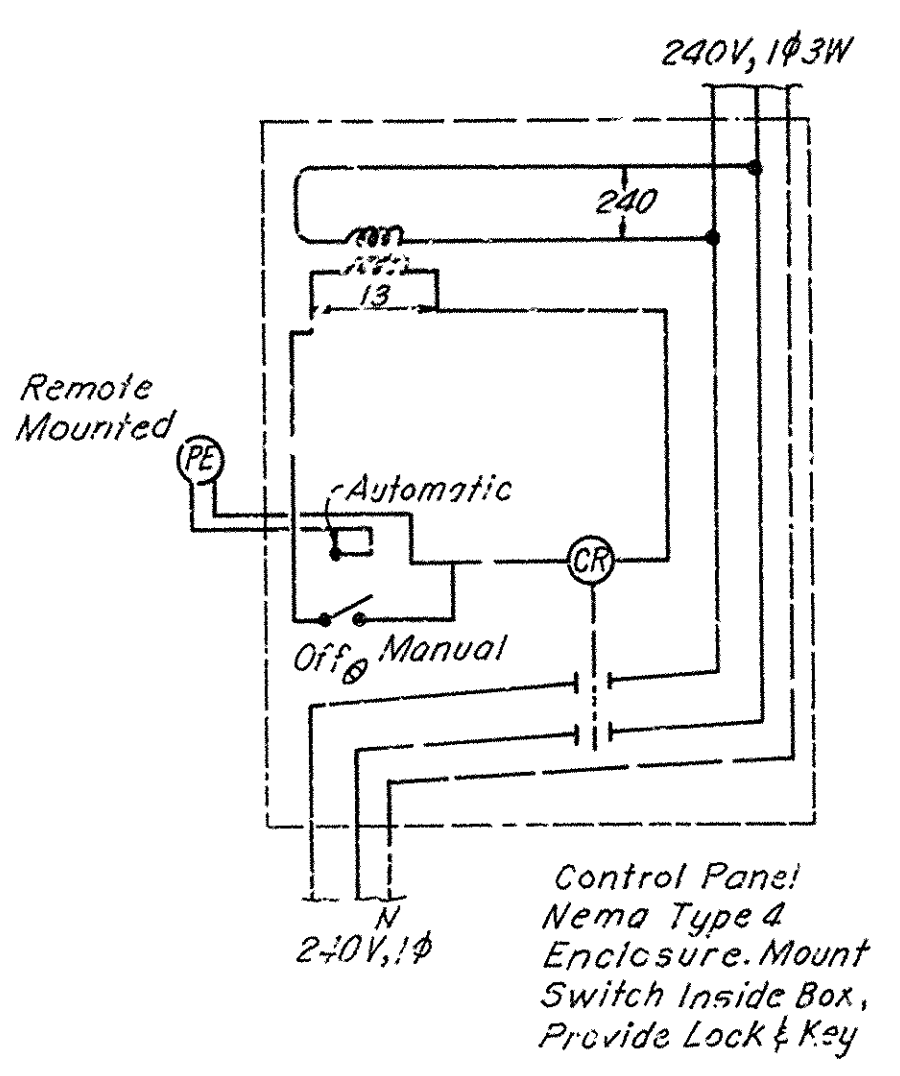
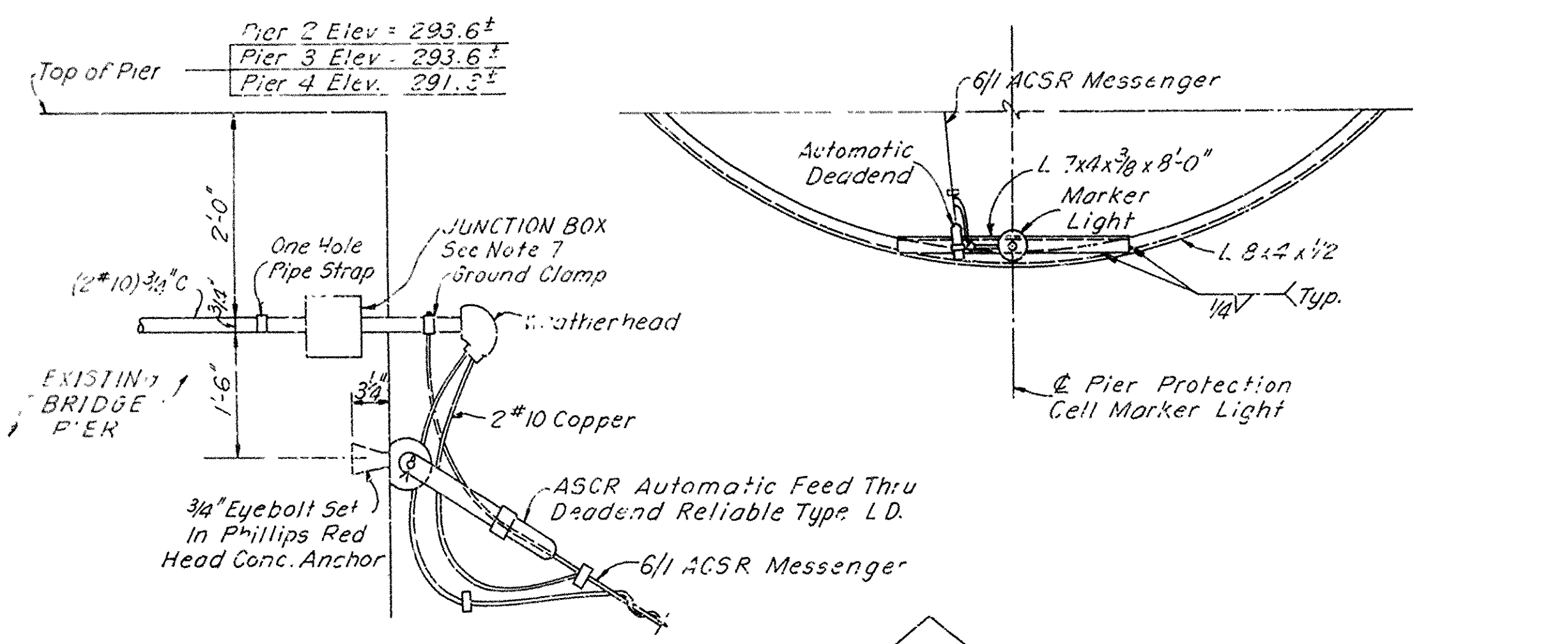
I-30 BRIDGE
PIER PROTECTION SYSTEM
JOB 6903
STRUCTURAL DETAILS

DESIGNED BY J J M	GARVER & GARVER, Inc. ENGINEERS LITTLE ROCK, ARKANSAS	SCALE: AS SHOWN
DRAWN BY G S L		SHEET NO. 5 OF 5
CHECKED BY T B H		
DATE DE 1968		

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.		6	6
							JCB NO. 6903	
NAV. LTG. SYS. DTLS.								



* Self supporting aluminum cable Polyethylene Triplex, ACSR Messenger; 2#6, & 6/1 ACSR, Kaiser "Pauquina" or equal



GENERAL NOTES

1. FIXTURE #1 - Pier Protection Marker 180° Red Lens, Wallace Tiernan FA-231, w/FA-229 Pedestal, Four Place Lamp Changer w/ Disconnect Switch.
2. TRANSFORMER - Remote Mounted 240/13 Volts Single Phase Size For Two Or Three Marker Lights As Indicated.
3. Ground Wire Installed Throughout System, Bond All Fixtures, Transformers And Housings, Conduits, Supports, etc.
4. Provide Copper Conductor, 600V Rubber Or Polyethylene Insulation. Service Drop To Light Fixtures From Bridge To Be Aluminum. Provide Approved Connectors For Aluminum To Copper Connectors.
5. Coordinate Main Service Connection With Arkansas Power And Light. Verify Location Of Service Entrance And Method Of Connection.
6. PE Cell To Be Wallace-Tiernan Sun Switch, 12V.
7. Provide ESNA Connectors For Junction Box Connections.
8. Installation Shall Conform To The Requirements Of The National Electrical Code.
9. Provide junction boxes or pull boxes as required to suit the project conditions and conform with the National Electrical Code.

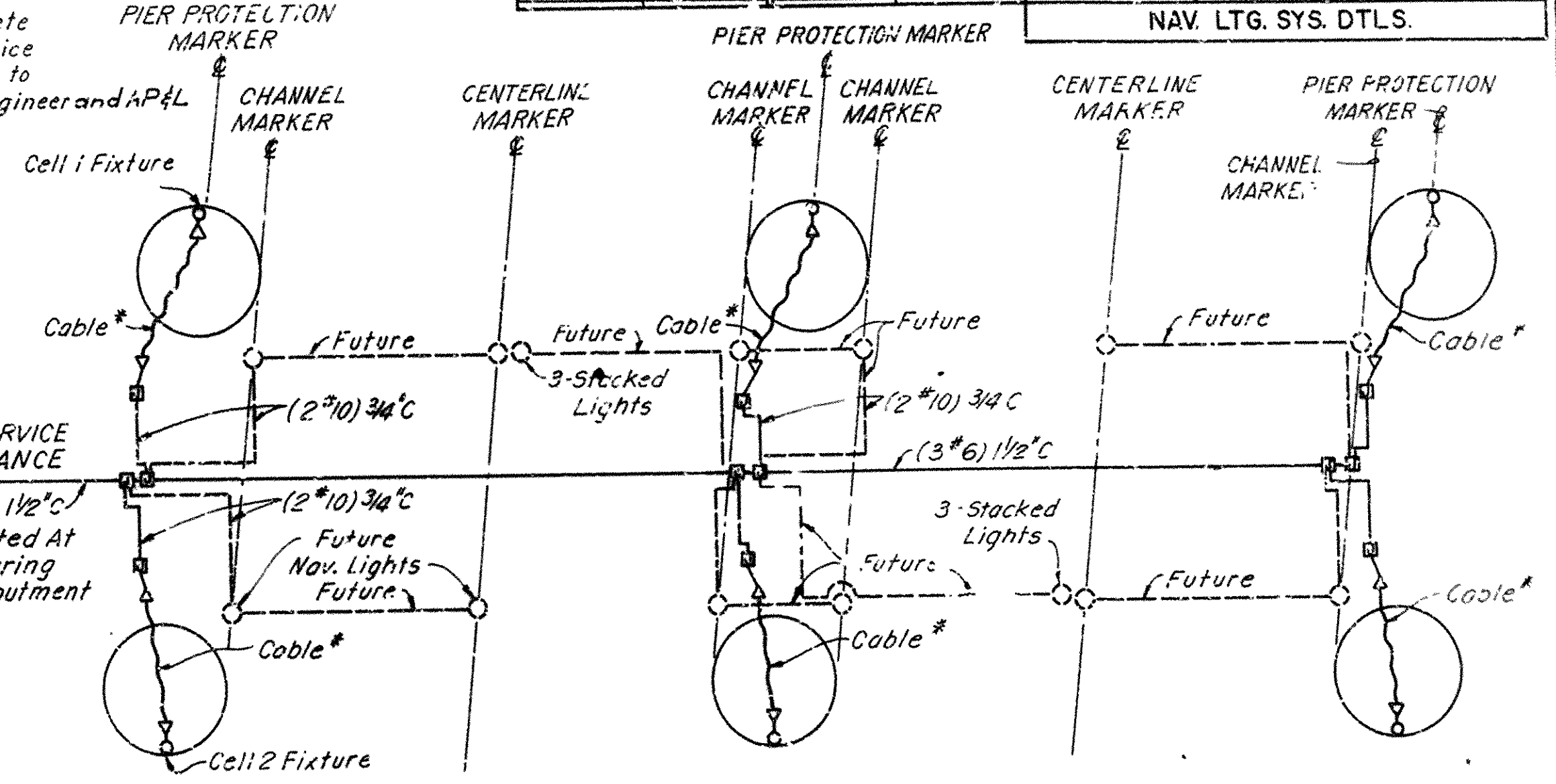
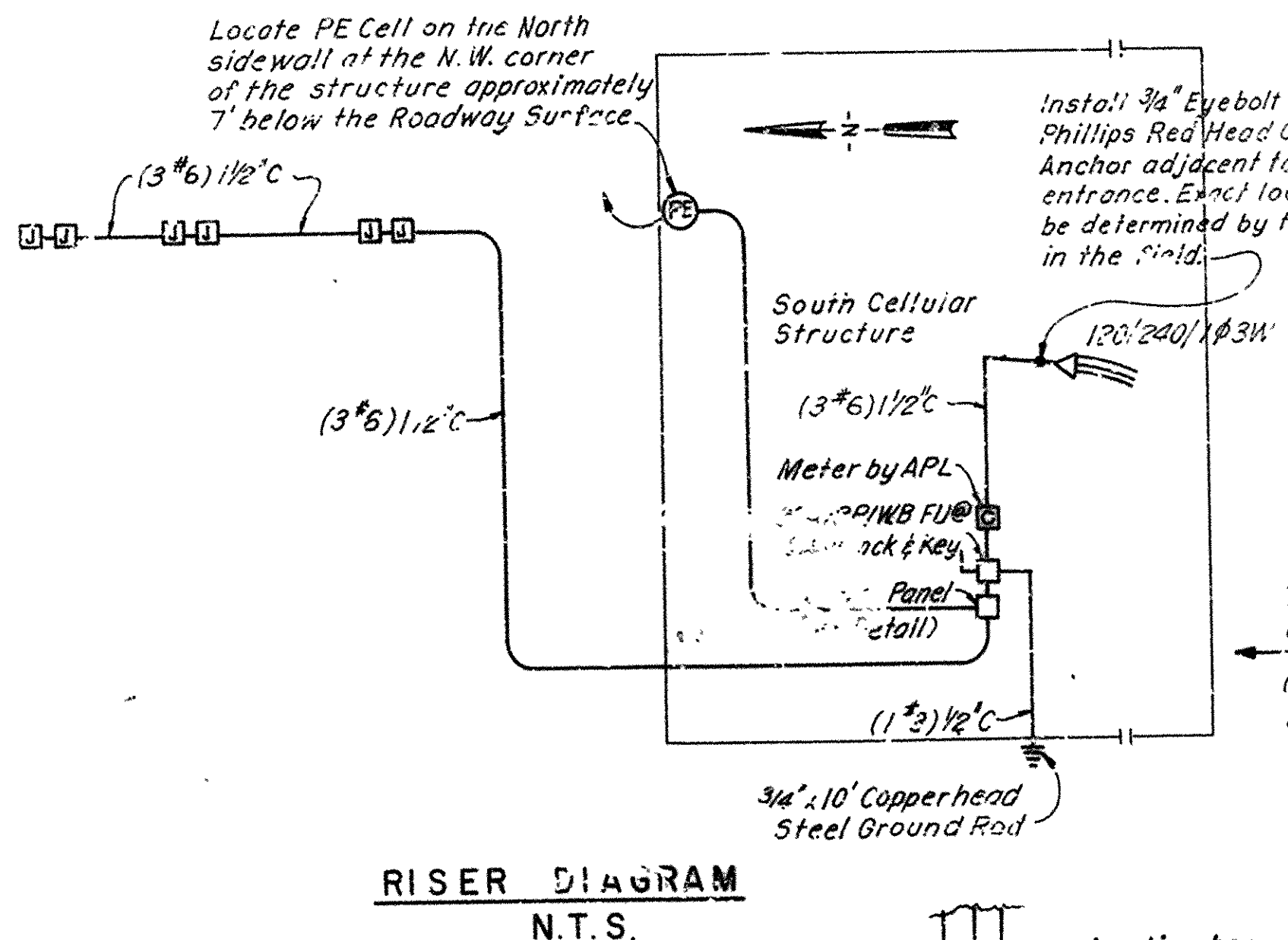
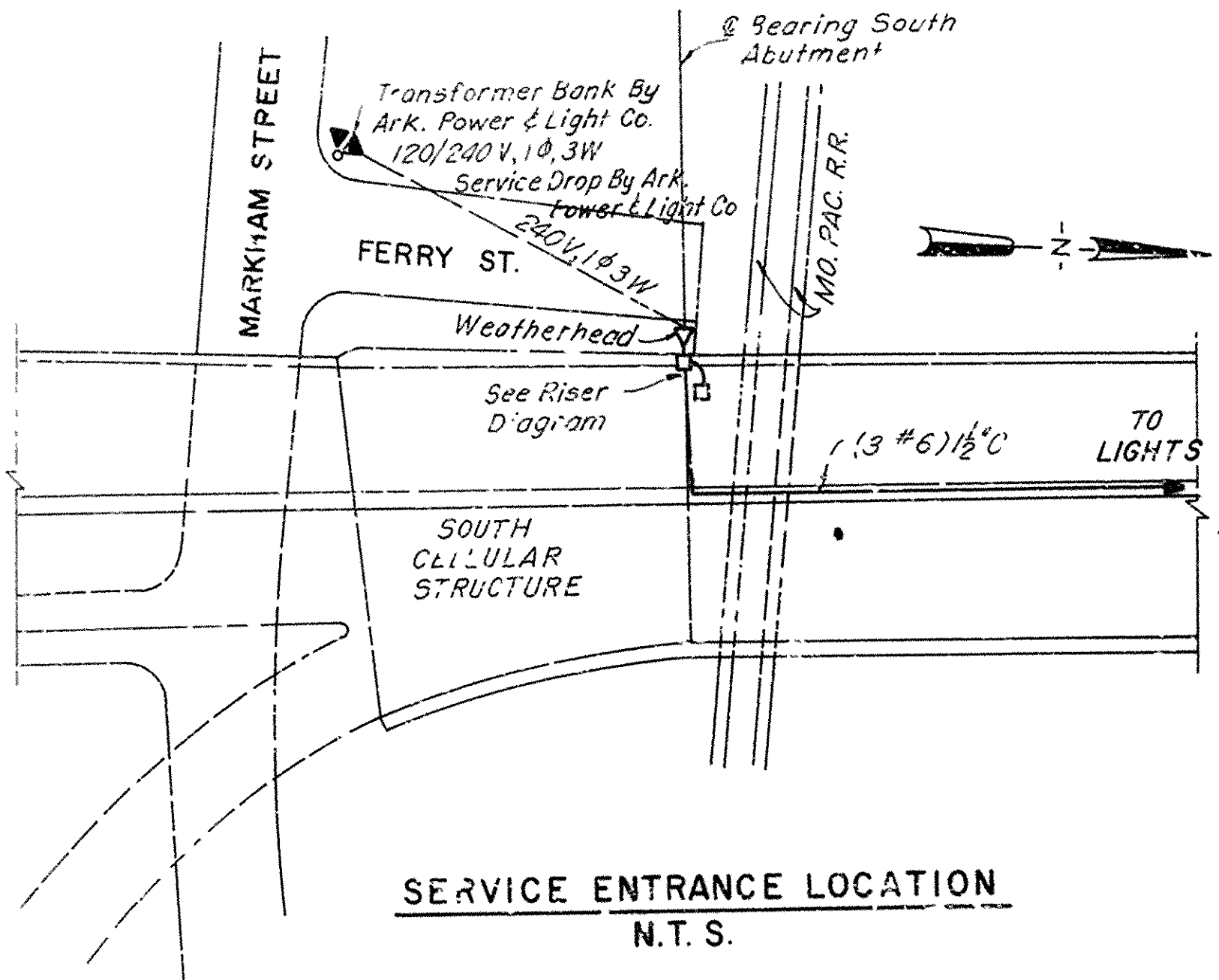
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DRAWING NO. 16012

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS

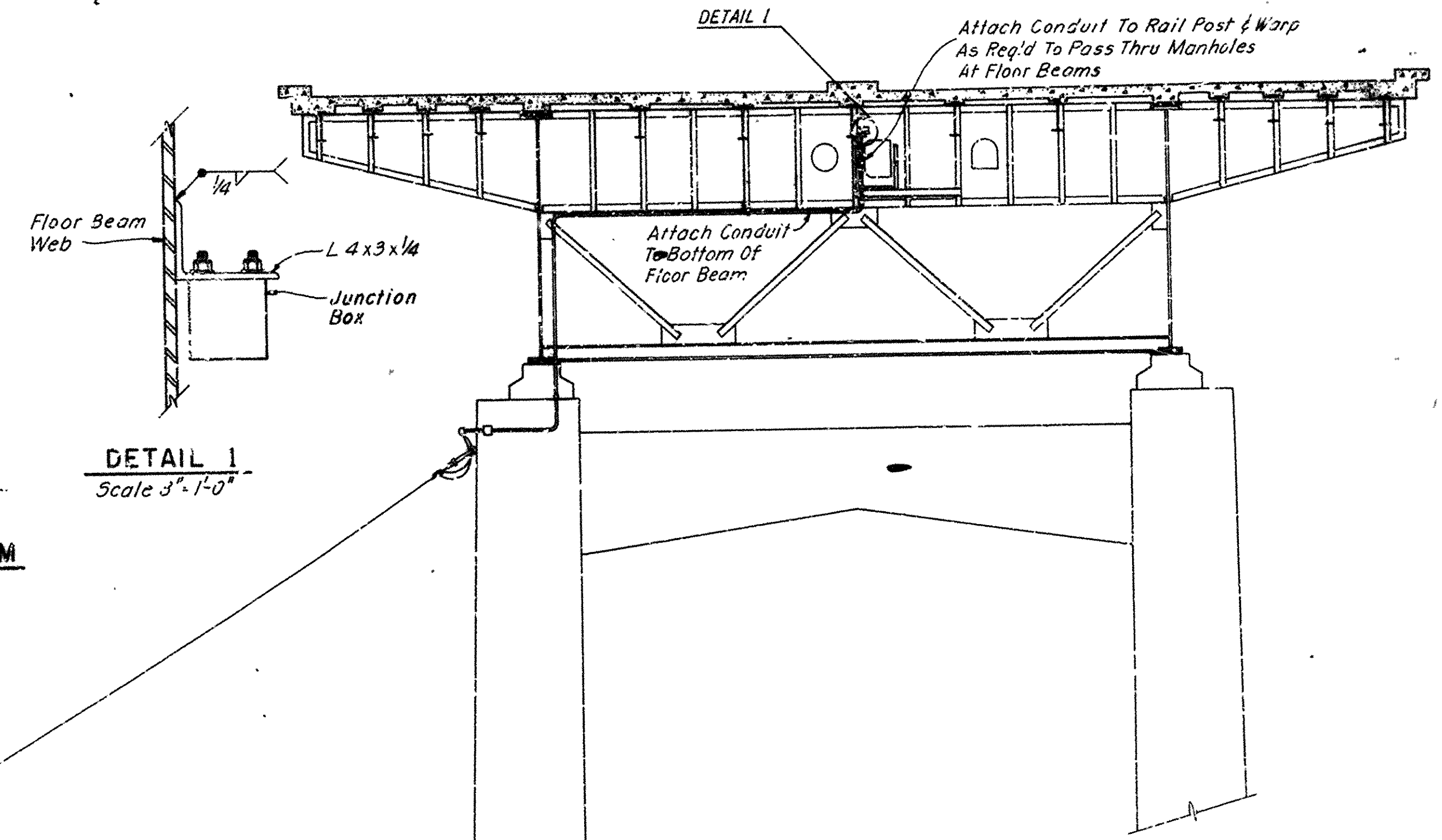
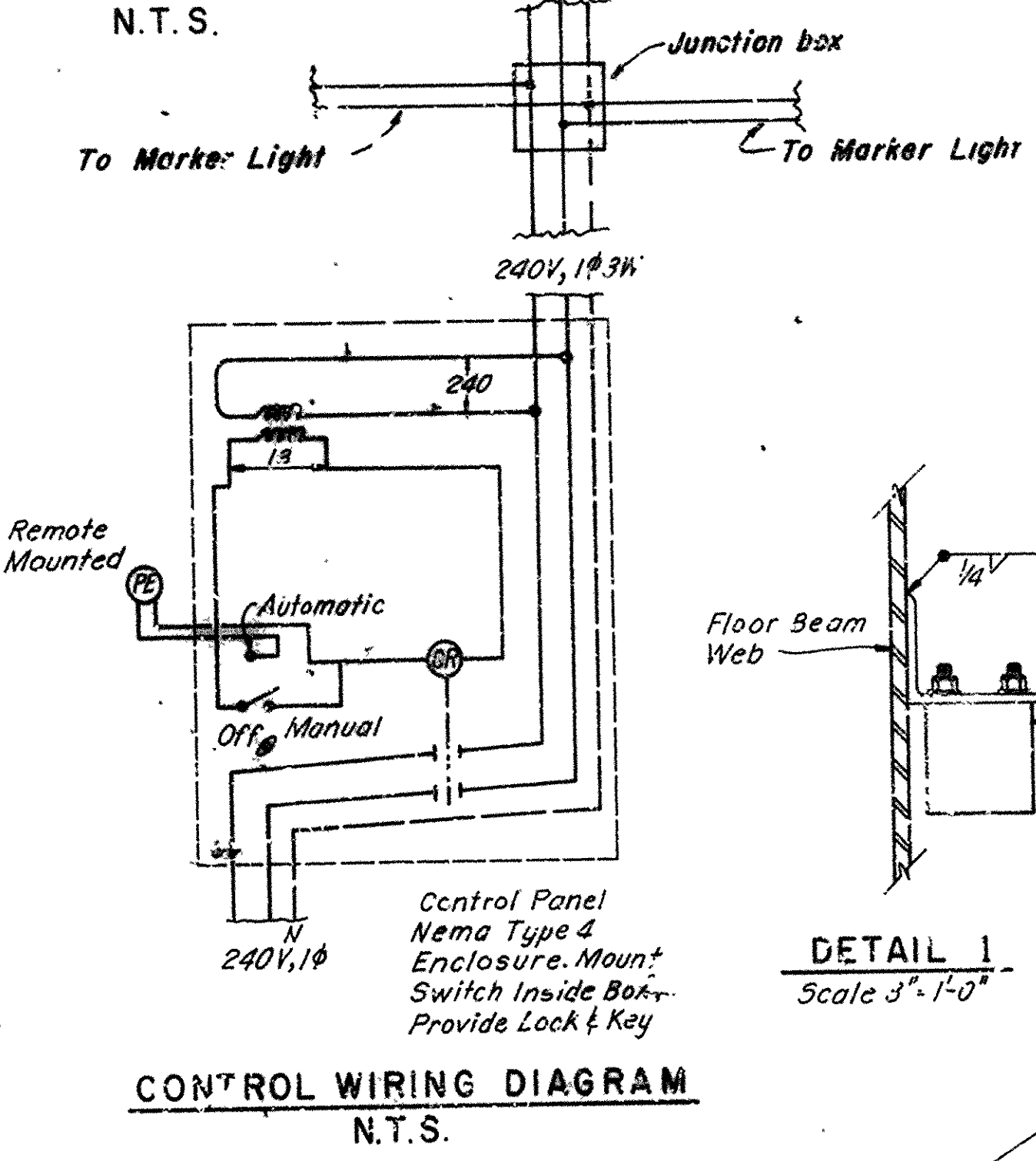
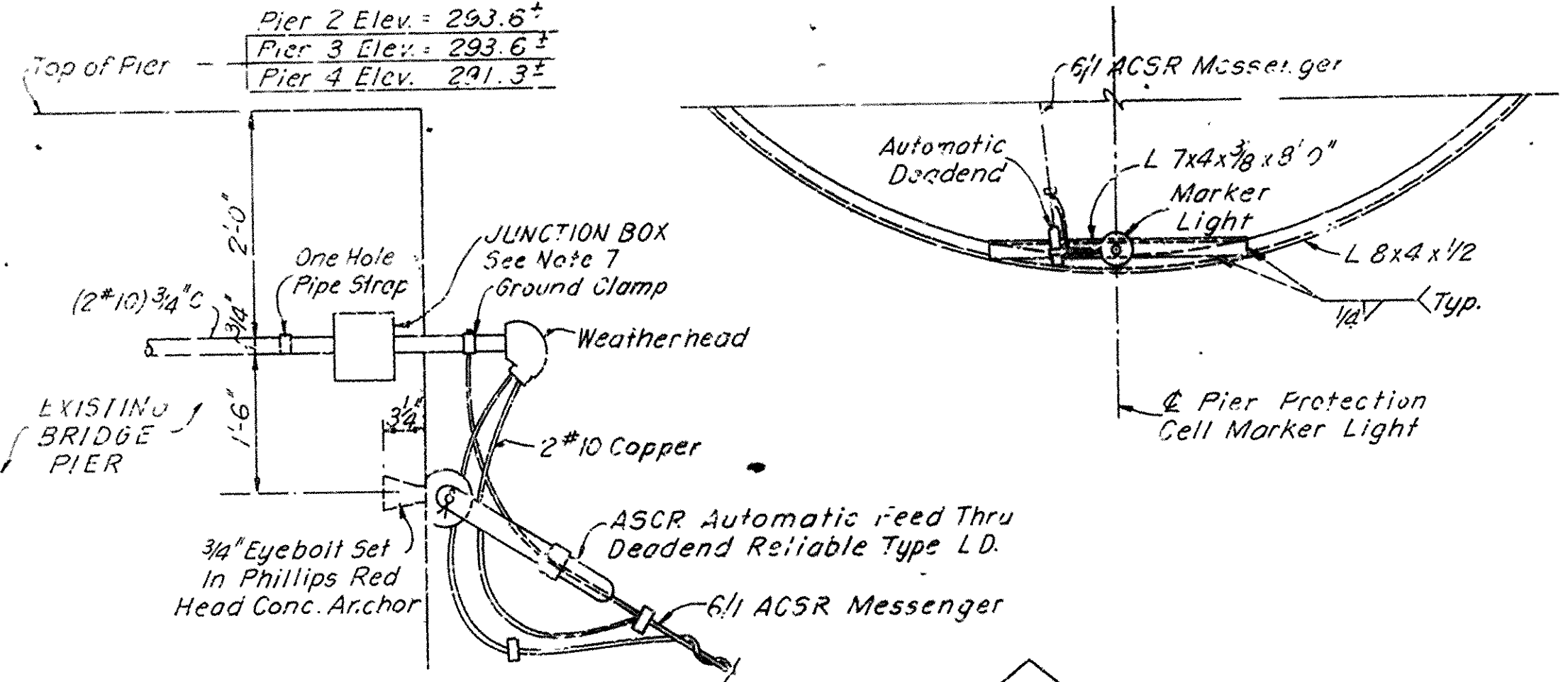
1-30 BRIDGE
PIER PROTECTION SYSTEM
JOB 6903
NAVIGATION LIGHTING
SYSTEM DETAILS

DESIGNED BY C.E.D.	DATE DEC. 68	CHECKED BY T.B.H.	DATE DEC. 68	ENGINEERS GARVER & GARVER, Inc.	LITTLE ROCK, ARKANSAS	AS NOTED SHEET NO. 6 OF 6
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DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.		6	6
				JOB NO.		6903		
NAV. LTG. SYS. DTLS.								



* Self supporting aluminum cable Polyethylene Triplex, ACSR Messenger, 2#6, & 6/1 ACSR, Kaiser "Paludina" or equal.



- GENERAL NOTES**
1. FIXTURE #1 - Pier Protection Marker 180° Red Head B & B Electromatic Corp MS 53 PM DL KI AR 180 w/ix... rough service lamp and automatic changer, or equal. A = 2'-0"
 2. TRANSFORMER - 240/13v mount in control panel. Size for P.E. cell & control relay
 3. Ground Wire installed Throughout System, Bond All Fixtures, Transformers And Housings, Conduits, Supports, etc.
 4. Provide Copper Conductor, 600V Rubber Or Polyethylene Insulation. Service Drop To Light Fixtures From Bridge To Be Aluminum. Provide Approved Connectors For Aluminum To Copper Connectors.
 5. Coordinate Main Service Connection With Arkansas Power And Light. Verify Location Of Service Entrance And Method Of Connection.
 6. PE Cell To Be Wallace-Tiernan Sun Switch, 12V. or equal.
 7. Provide ESN Connectors For Junction Box Connections.
 8. Installation Shall Conform To The Requirements Of The National Electrical Code.
 9. Provide junction boxes or pull boxes as required to suit the project conditions and conform with the National Electrical Code.

DRAWING NO. 16012A

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS

130 BRIDGE
PIER PROTECTION SYSTEM
JOB 6903
NAVIGATION LIGHTING
SYSTEM DETAILS

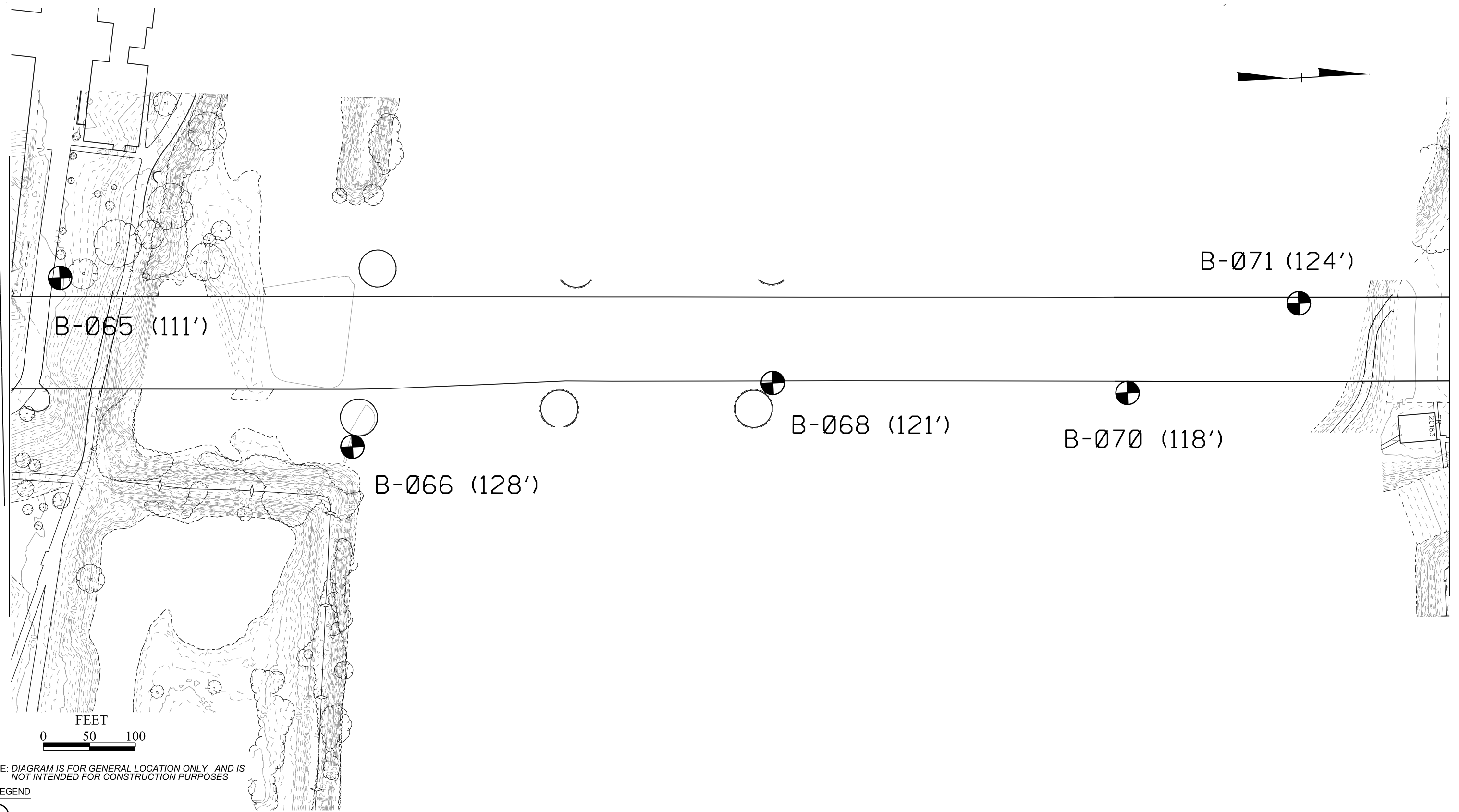
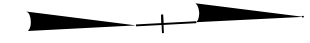
DESIGNED BY	GED	GARVER & GARVER, Inc. ENGINEERS LITTLE ROCK, ARKANSAS	SCALE	AS NOTED
DRAWN BY	JRC		SHEET NO.	6 OF 6
CHECKED BY	T&H		DATE	DEC. 68

REVISED 5/15/70 Control Circuit, Control Wiring Diagram, Typical Detail Pier Service, General Notes. J.R.F.

ATTACHMENT B
2015 BORING LOG B-68

MATCHLINE FOR EXHIBIT A-11

MATCHLINE FOR EXHIBIT A-13



NOTE: DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

LEGEND

SPT BORINGS (BORING DEPTH)

Project Manager	SPB
Drawn By:	WDF
Checked By:	SWG
Approved By:	DSL

Project No.	35159097
Scale:	AS SHOWN
File No.	CA0602_GEO_PSH12
Date:	02/16/2018

Terracon
25809 I-30 SOUTH
BRYANT, ARKANSAS 72022

FIELD EXPLORATION PLAN
ARDOT JOB NUMBER CA0602 - 30 CROSSING
PULASKI COUNTY
LITTLE ROCK, ARKANSAS

Exhibit
A-12

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing

CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
										TEST TYPE	1/50-POINT LOAD INDEX (tsf)	UNDRAINED SHEAR STRENGTH (tsf)				
	DEPTH	ELEVATION (Ft.)														

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

Advancement Method:
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

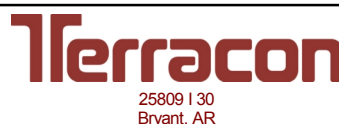
Horizontal Datum: NAD 83 (Y.X Localized)
Vertical Datum: NAVD 88
State Plane Zone: 0302 Arkansas South
Surveyed by NTB Associates

Notes:
40.5 feet from water surface to mudline.
Advanced 4-inch casing 5 feet past mudline and began rock coring.

Abandonment Method:

WATER LEVEL OBSERVATIONS

40.5' from water surface to mudline



Boring Started: 12-07-2015

Boring Completed: 12-08-2015

Drill Rig: 977, ATV, CME-850

Driller: S. Zeien

Checked by: P. McCloud

Logged by: D. Tennison

Project No.: 35159097

Exhibit: B-29


THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG 02-09-18.GPJ TERRACON2015.GDT 2/16/18

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing


CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
										TEST TYPE	150-POINT LOAD INDEX (tsf)	UNDRAINED SHEAR STRENGTH (tsf)				
		30														
	40.5	193														
	43.5	190														
	54.5	179				RUN 1	REC = 88% RQD = 60%									
		55						171		UC	171.1					

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop, Energy Transfer Ratio (ETR) = 76.3%

Advancement Method: 0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit 45.5 to 161.5 Feet: NQ Core Barrel	Horizontal Datum: NAD 83 (Y.X Localized) Vertical Datum: NAVD 88 State Plane Zone: 0302 Arkansas South Surveyed by NTB Associates	Notes:
Abandonment Method:		
WATER LEVEL OBSERVATIONS 40.5' from water surface to mudline		Boring Started: 12-07-2015 Drill Rig: 977, ATV, CME-850 Checked by: P. McCloud Project No.: 35159097
		Boring Completed: 12-08-2015 Driller: S. Zeien Logged by: D. Tennison Exhibit: B-29

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG_02-09-18.GPJ TERRACON2015.GDT 2/16/18

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing

CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES	
										TEST TYPE	150-POINT LOAD INDEX (tsf)	COMPRESSIVE STRENGTH (tsf)					UNDRAINED SHEAR STRENGTH (tsf)
	<p>SHALE WITH INTERBEDDED SANDSTONE (continued) gray, slightly fractured, moderately weathered</p> <hr/> <p>SHALE gray, slightly fractured, moderately weathered</p> <hr/> <p>SHALE gray, slightly fractured, unweathered</p>	60				RUN 2	REC = 96% RQD = 85%			PL	4.2						
		64.5															
		65							170		UC PL	8.4	40				
		70					RUN 3	REC = 97% RQD = 91%			UC PL	16.9					
		75							170		UC PL	40.9					
		80					RUN 4	REC = 94% RQD = 93%		171	UC PL	4.2	107.8				
		85							171		UC PL	4.2	44.9				

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

Advancement Method:
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

Horizontal Datum: NAD 83 (Y.X Localized)
Vertical Datum: NAVD 88

Notes:

Abandonment Method:

State Plane Zone: 0302 Arkansas South
Surveyed by: NTB Associates

WATER LEVEL OBSERVATIONS

40.5' from water surface to mudline



25809 | 30
Bryant, AR

Boring Started: 12-07-2015

Boring Completed: 12-08-2015

Drill Rig: 977, ATV, CME-850

Driller: S. Zeien

Checked by: P. McCloud

Logged by: D. Tennison

Project No.: 35159097

Exhibit: B-29

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG_02-09-18.GPJ TERRACON2015.GDT 2/16/18

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing

CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
										TEST TYPE	1/50-POINT LOAD INDEX (tsf)	COMPRESSIVE STRENGTH (tsf)				
	SHALE (continued)															
	gray, slightly fractured, unweathered	90				RUN 5	REC = 93% RQD = 93%			PL	17.7					
		95						174		UC	93.5					
	gray, slightly fractured, unweathered	100				RUN 6	REC = 100% RQD = 99%			PL	12.7					
		105						171		UC	78					
	gray, slightly fractured, unweathered, angled fractures	110				RUN 7	REC = 88% RQD = 85%			UC	159.2					
		115						171		UC	83.4					
							RUN			PL	14.8					

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

Advancement Method:
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

Horizontal Datum: NAD 83 (Y.X Localized)

Notes:

Vertical Datum: NAVD 88

Abandonment Method:

State Plane Zone: 0302 Arkansas South

Surveyed by NTB Associates

WATER LEVEL OBSERVATIONS

40.5' from water surface to mudline



25809 | 30
Bryant, AR

Boring Started: 12-07-2015

Boring Completed: 12-08-2015

Drill Rig: 977, ATV, CME-850

Driller: S. Zeien

Checked by: P. McCloud

Logged by: D. Tennison

Project No.: 35159097

Exhibit: B-29

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG_02-09-18.GPJ TERRACON2015.GDT 2/16/18

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing

CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES	
										TEST TYPE	150-POINT LOAD INDEX (tsf)	COMPRESSIVE STRENGTH (tsf)					UNDRAINED SHEAR STRENGTH (tsf)
	SHALE (continued) gray, slightly fractured, unweathered, angled fractures	120				8	REC = 95% RQD = 89%	172		PL UC	16.9	49.3					
	gray, wide fracture spacing, unweathered, angled fractures	125				RUN 9	REC = 93% RQD = 93%	172		PL UC	8.4	39.8					
	gray, wide fracture spacing, unweathered, angled fractures	130						171		UC PL	12.7	85.6					
		135					RUN 10	REC = 98% RQD = 98%	171		UC PL	12.7	85.6				
		140							173		UC	39					

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

Advancement Method:
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

Horizontal Datum: NAD 83 (Y.X Localized)

Notes:

Vertical Datum: NAVD 88

Abandonment Method:

State Plane Zone: 0302 Arkansas South

Surveyed by NTB Associates

WATER LEVEL OBSERVATIONS

40.5' from water surface to mudline



25809 | 30
Bryant, AR

Boring Started: 12-07-2015

Boring Completed: 12-08-2015

Drill Rig: 977, ATV, CME-850

Driller: S. Zeien

Checked by: P. McCloud

Logged by: D. Tennison

Project No.: 35159097

Exhibit: B-29

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG_02-09-18.GPJ TERRACON2015.GDT 2/16/18

BORING LOG NO. B-068

PROJECT: AHTD Job No. CA0602 - 30 Crossing

CLIENT: Arkansas State Highway and Transportation Dept.

SITE: Little Rock Area
Pulaski County, Arkansas

GRAPHIC LOG	LOCATION See Exhibit A-12 Latitude: 34.74983° Longitude: -92.262528° Northing: 2070540.42 Easting: 1233497.18 Surface Elev.: 233.3 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	SAMPLE ID	FIELD TEST RESULTS	TOTAL ROCK UNIT WEIGHT (pcf)	LABORATORY HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	SOIL DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES	
										TEST TYPE	150-POINT LOAD INDEX (tsf)	COMPRESSIVE STRENGTH (tsf)					UNDRAINED SHEAR STRENGTH (tsf)
	SHALE (continued) gray, wide fracture spacing, unweathered, angled fractures	145				RUN 11	REC = 98% RQD = 98%										
		150								PL	8.4						
		155					RUN 12	REC = 99% RQD = 99%									
		160					RUN 13	REC = 100% RQD = 94%	170	UC PL	14.8	39					
	Boring Terminated at 161.5 Feet	161.5															

Total depth of hole: 161.5 Feet
Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

Advancement Method:
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

Horizontal Datum: NAD 83 (Y.X Localized)

Notes:

Vertical Datum: NAVD 88

Abandonment Method:

State Plane Zone: 0302 Arkansas South

Surveyed by NTB Associates

WATER LEVEL OBSERVATIONS

40.5' from water surface to mudline



25809 | 30
Bryant, AR

Boring Started: 12-07-2015

Boring Completed: 12-08-2015

Drill Rig: 977, ATV, CME-850

Driller: S. Zeien

Checked by: P. McCloud

Logged by: D. Tennison

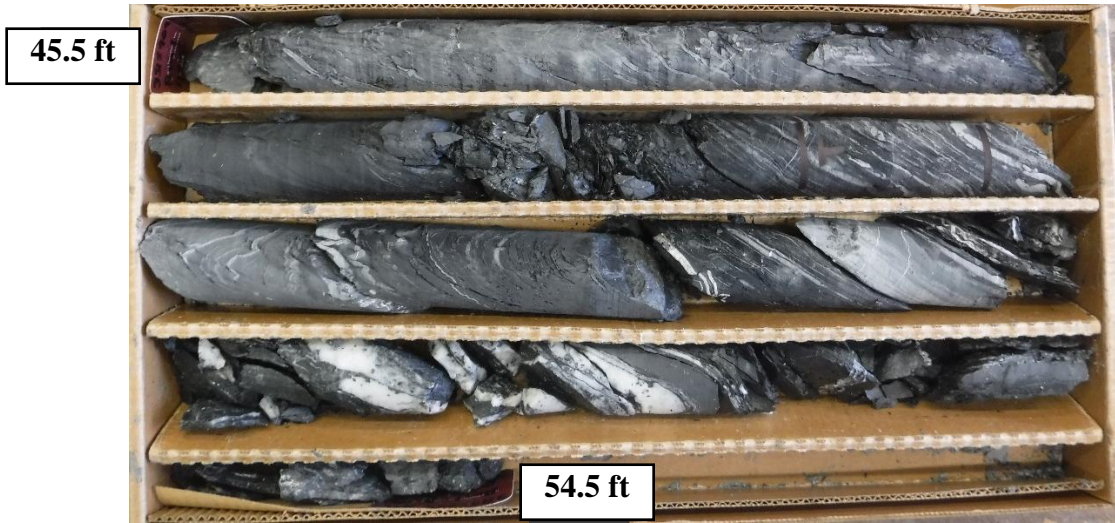
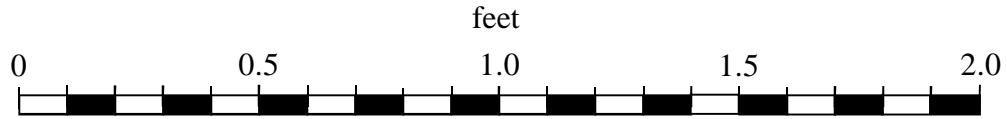
Project No.: 35159097

Exhibit: B-29

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 35159097 BORING LOG 02-09-18.GPJ TERRACON2015.GDT 2/16/18

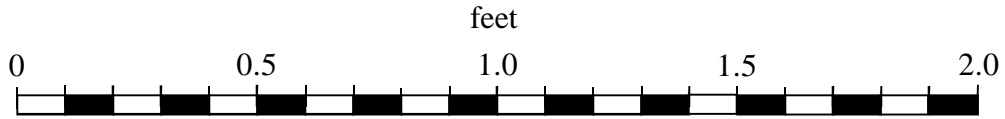
Arkansas State Highway and Transportation Department
 AHTD Job No. CA0602 – 30 Crossing
 Soil and Rock Photographs

<i>Site:</i> Little Rock, Arkansas	<i>County:</i> Pulaski	<i>Boring Location:</i> B-068
<i>Driller:</i> S. Zeien	<i>Drill Rig:</i> #972, CME-850	<i>Boring Depth:</i> 161.5 feet
<i>Terracon Project No.:</i> 35159097	<i>Boring Started:</i> 12/7/2015	<i>Boring Completed:</i> 12/8/2015



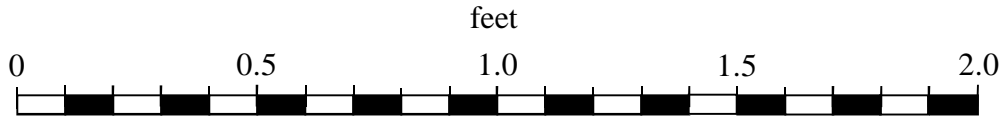
Arkansas State Highway and Transportation Department
 AHTD Job No. CA0602 – 30 Crossing
 Soil and Rock Photographs

Site: Little Rock, Arkansas	County: Pulaski	Boring Location: B-068
Driller: S. Zeien	Drill Rig: #972, CME-850	Boring Depth: 161.5 feet
Terracon Project No.: 35159097	Boring Started: 12/7/2015	Boring Completed: 12/8/2015



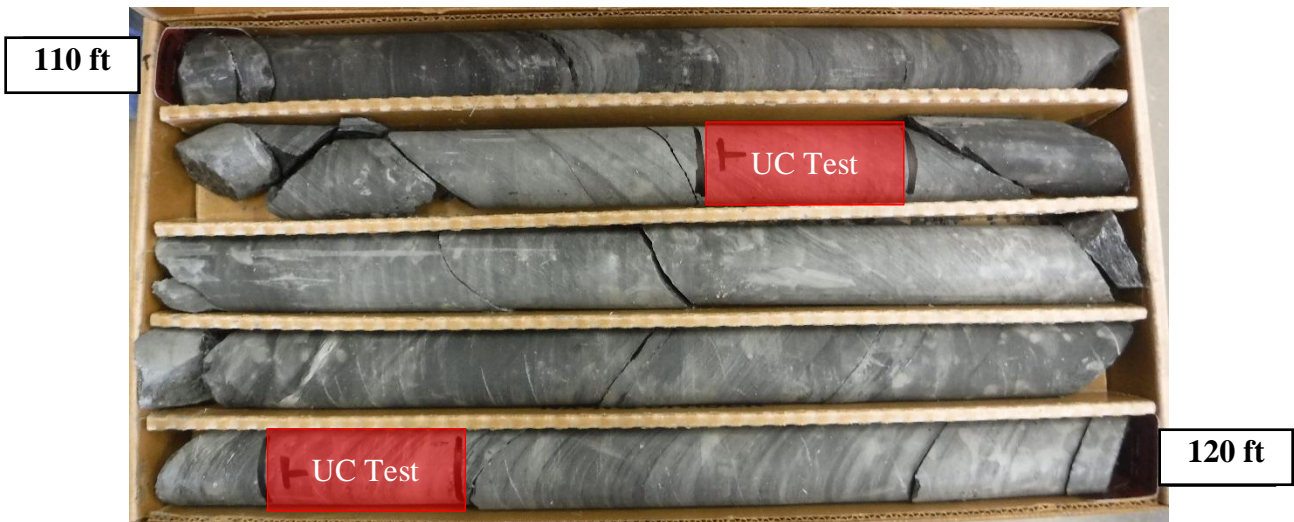
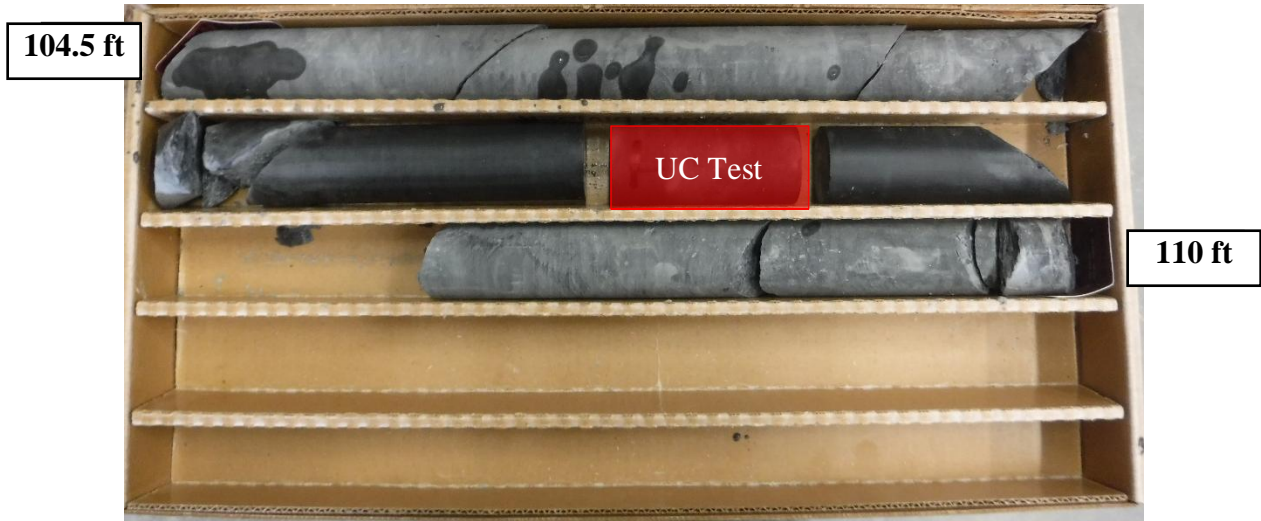
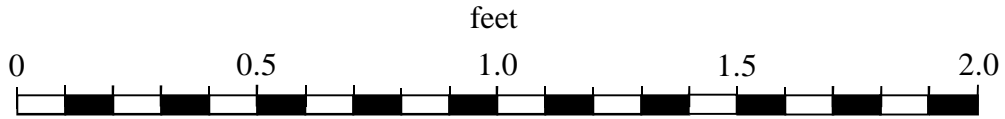
Arkansas State Highway and Transportation Department
 AHTD Job No. CA0602 – 30 Crossing
 Soil and Rock Photographs

Site: Little Rock, Arkansas	County: Pulaski	Boring Location: B-068
Driller: S. Zeien	Drill Rig: #972, CME-850	Boring Depth: 161.5 feet
Terracon Project No.: 35159097	Boring Started: 12/7/2015	Boring Completed: 12/8/2015



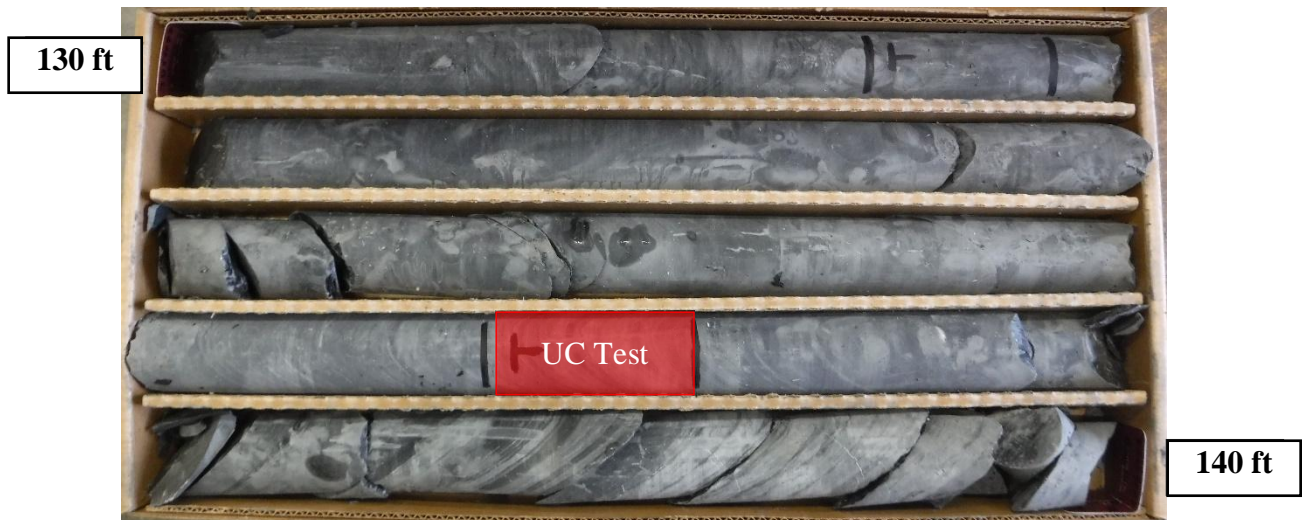
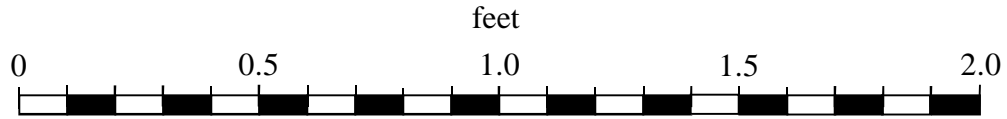
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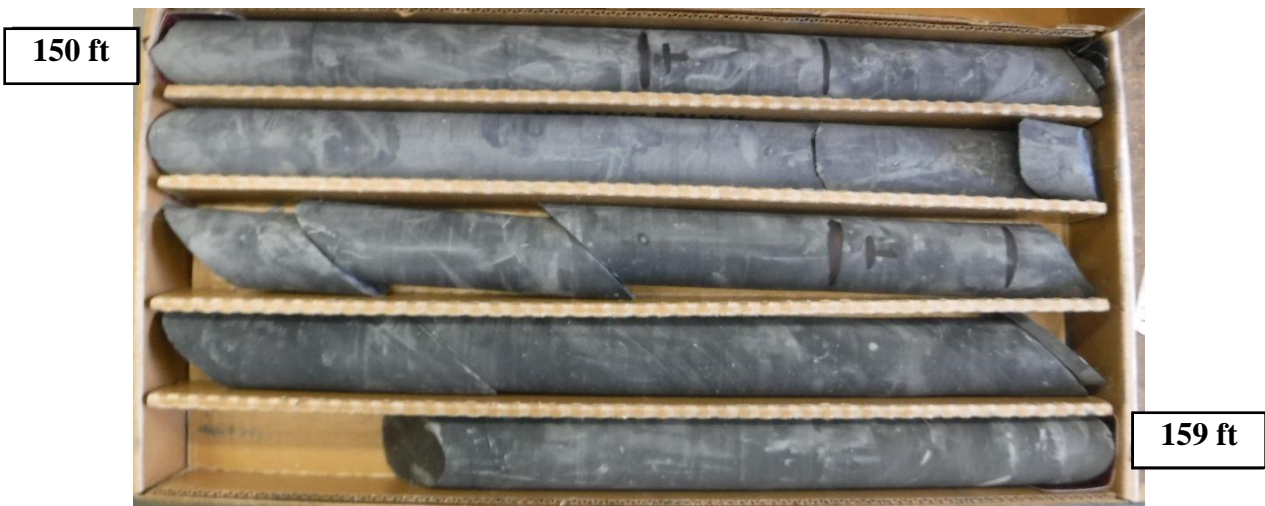
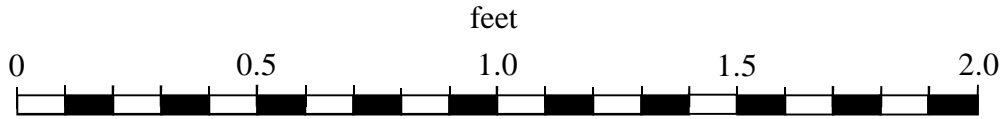
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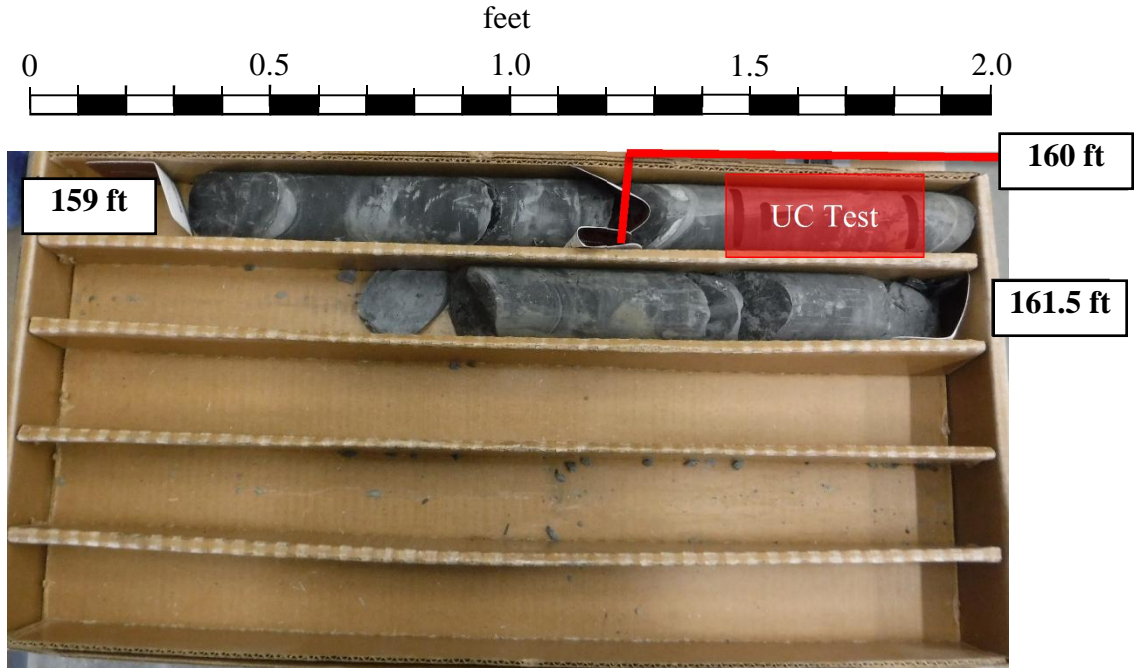
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<i>Site:</i> Little Rock, Arkansas	<i>County:</i> Pulaski	<i>Boring Location:</i> B-068
<i>Driller:</i> S. Zeien	<i>Drill Rig:</i> #972, CME-850	<i>Boring Depth:</i> 161.5 feet
<i>Terracon Project No.:</i> 35159097	<i>Boring Started:</i> 12/7/2015	<i>Boring Completed:</i> 12/8/2015



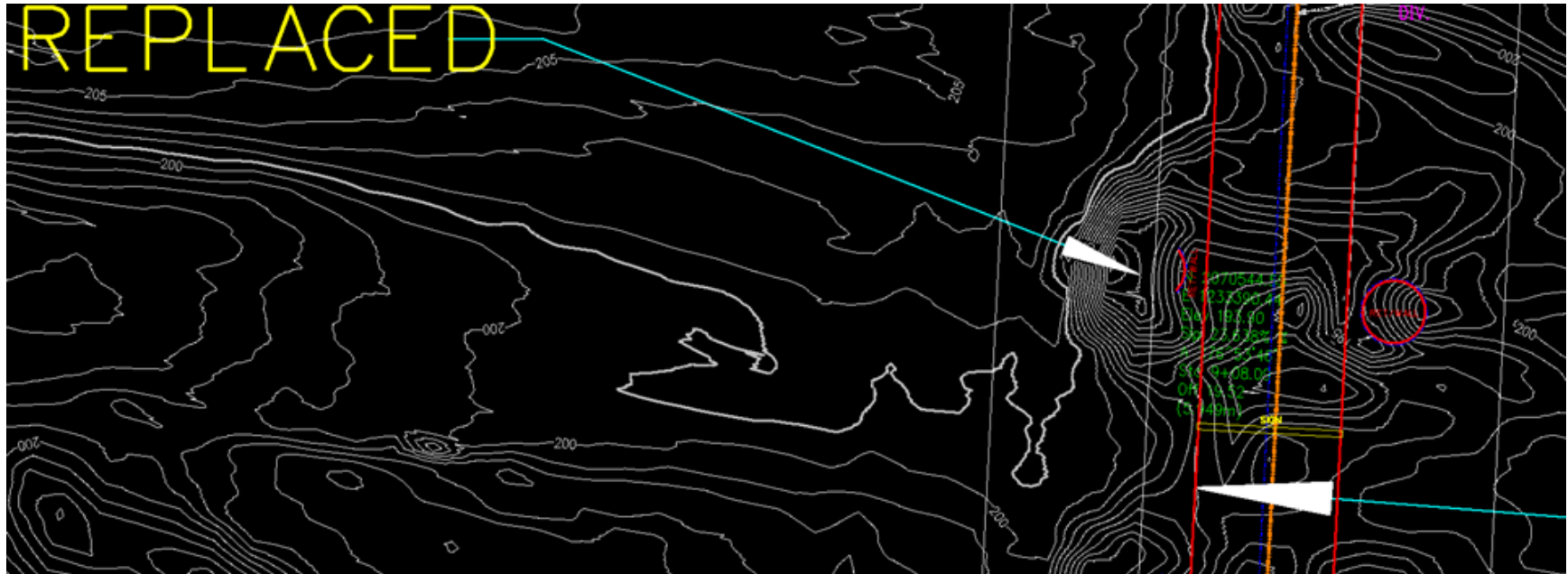
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<i>Site:</i> Little Rock, Arkansas	<i>County:</i> Pulaski	<i>Boring Location:</i> B-068
<i>Driller:</i> S. Zeien	<i>Drill Rig:</i> #972, CME-850	<i>Boring Depth:</i> 161.5 feet
<i>Terracon Project No.:</i> 35159097	<i>Boring Started:</i> 12/7/2015	<i>Boring Completed:</i> 12/8/2015



ATTACHMENT C
SURVEY CONTOUR PLOT (ArDOT 2019)

Survey Contour Plot (ARDOT 2019)



ATTACHMENT D
GEO TECHNICAL ANALYSIS



For: ArDOT Pier Protection I-30 Cell Replacement
 Made By: BDW
 Date: 1/9/2020

Job Number: 63136
 Check By: JMS
 Date: 1/22/2020

BackCheck By: BDW
 Date: 1/23/2020

PIER GEOMETRY AND DESIGN CONDITIONS

Top of Cell Elevation	251.5 ft	As-Built Plans
Shale Elevation	190 ft	Boring B-68 (2015 date)
Normal Water Level Surface	231 ft	Case 1: Design Criteria
10-year event water surface	247.2 ft	Case 2: Design Criteria
Normal Operation Design Force	2800 kips	Design Criteria; force applied 5ft above normal water level
Drifting Empty Barge Design Force	1440 kips	Design Criteria
Rock Fill Unit Weight	150 pcf	As-Built plans used 150 pcf "quarry stone"
Presumptive Shale Bearing Resistance	20 ksf	AASHTO Table C10.6.2.6.1-1
100 Year Water Force (WA)	170 kips	Based on water velocity of 12 ft/sec provided in Vessel Collision Study
Cell Diameter	40 ft	As-Built Plans
Total Cell Height	61.5 ft	
Area	1257 ft ²	

AASHTO Table 3.4.1-1 and 3.4.1-2

Load Factors	Max	
	DC	1.25
	CV	1.0
WA	1.0	Dead Loads Vessel collision force Water load and stream pressure

Resistance Factors	AASHTO Table 10.5.5.2.2-1	
	0.45	Bearing Resistance
	0.9	Sliding Resistance

CASE 1: Normal Water Event with Normal Operation Design Force

Submerged Height	41 ft
Height above water	20.5 ft
Submerged Weight	4,513,338 lb
Weight above water	3,864,159 lb
Total Weight	8,377,497 lb

eccentricity 15.6 ft Allowable e = 18 ft
 $e = (\text{Sum of Overturning Moments}) / \text{Total Weight}$

Bearing Capacity FOS at service limit 3.0

LRFD BEARING CAPACITY AT STRENGTH LIMIT STATE

Nominal Load	6666.6 lb/ft ²
Factored Load	8333.25 lb/ft ²
Nominal Resistance	20000 lb/ft ²
Factored Resistance	9000 lb/ft ²

SLIDING AASHTO 10.6.3.4

Nominal Load	2,970,410 lb
Factored Load	2,970,410 lb
Nominal Resistance	4,691,398 lb
Factored Resistance	4,222,258 lb

CASE 2: 10 yr High Water Event with Drifting Empty Barge Design Force

Submerged Height	57.2 ft
Height above water	4.3 ft
Submerged Weight	6,296,656 lb
Weight above water	810,531 lb
Total Weight	7,107,187 lb

eccentricity 12.5 ft

Bearing Capacity FOS at service limit 3.5

LRFD BEARING CAPACITY AT STRENGTH LIMIT STATE

Nominal Load	5655.72 lb/ft ²
Factored Load	7069.65 lb/ft ²
Nominal Resistance	20000 lb/ft ²
Factored Resistance	9000 lb/ft ²

SLIDING

Nominal Load	1,610,410 lb
Factored Load	1,610,410 lb
Nominal Resistance	3,980,025 lb
Factored Resistance	3,582,022 lb

AASHTO 11.6.3.3 Eccentricity limit for foundation on rock, the location of the resultant should be within nine-tenths of the base width. Eccentricity must be less than 18 ft for a 40-ft diameter cell
 Eccentricity calc is conservative as Water Force (WA) is from 100-yr velocity
 Water force assumes uniform water velocity for height of river and is based on 100-yr velocity