STRUCTURE GEOTECHNICAL REPORT

Proposed SN 064-0045 (EB)
Proposed SN 064-0046 (WB)

Existing SNs 064-0027 & 064-0028

I-24 over Country Club Road
FAI Route 24
Section 64-3HB(BR-1)
Massac County

PTB 178 - Item 19
Contract No. 78502
Job No. D-99-001-16

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Project Description and Scope

This project involves the complete replacement of dual bridges carrying I-24 over Country Club Road in Massac County. The project site is located on the border of Sections 20 and 29, Range 5E, Township 15S, in the 3rd Principal Meridian about 2 miles north of US Route 45. A *Location Map* is presented in Exhibit A.

There are existing dual bridges at this location, SN 064-0027 and SN 064-0028, which were constructed in 1970. They are three span structures with continuous steel beams and concrete deck slab supported on wall piers and open abutments. The piers are supported on creosoted timber piles while the abutments are supported on concrete piles. The existing plans call for 22 ton capacity of the timber piles at an estimated 20-28 foot length and a 30 ton capacity of the concrete piles at an estimated 45 foot length. See *Existing Structure Pile Data* in Exhibit E for as-built information. Concrete slope walls are present within the outer spans of the bridges. The bridges measure 130'-6" back to back abutments and 44'-0" out to out, with a 26.56 degree left ahead skew.

Per the preliminary Type, Size & Location Plan (TSL), the proposed dual structures are 3 span bridges with W33 rolled beams supported on integral abutments and encased pile bent piers. The proposed structures will have a back-to-back abutment length of 143'-0", out-to-out width of 45'-2" and 26°-33'-26" left ahead skew. The roadway will be on a horizontal tangent alignment and on a crest vertical curve. The proposed abutments will be constructed on existing embankments, with the profile raised by over six inches. Traffic will be maintained utilizing cross overs during construction. The new abutment foundations will be located to avoid conflict with the existing concrete piles. The new structures are to be designed following LRFD Bridge Design Specifications.

See *Preliminary TSL* attached in Exhibit B for further information about the proposed structures.

Field Exploration

Subsurface Exploration and Testing

The site is located in a rural area northeast of Metropolis surrounded by open fields. There is a residence off Hillebrand Lane located just southwest of the bridges. The structures cross over Country Club Road, which is approximately 32 feet wide. A grassy median separates the two structures. Aerial power lines run along Country Club Road and cross I-24 just north of the bridges.

The subsurface investigation consisted of five borings (1-S (2016), 2-S (2016), 3-S (2016), 4-S (2016), and 5-S (2016)) drilled by IDOT District 9 personnel in March and April of 2016. The original 1968 borings (1S, 2S, 3S, 4S, 5S, 6S, 7S, and 8S) were also provided. 1-S was drilled near the intersection of the I-24 and Country Club Road centerlines; 2-S was drilled near the centerline of Country Club Road just north of SN 064-0046; 3-S was drilled in the west shoulder of Country Club Road just south of SN 064-0045; 4-S was drilled in the north shoulder of the west approach for SN 064-0046; 5-S was drilled in the southeast embankment cone of SN 064-0046. Boring locations can be found in Exhibit B.

Beginning at the ground surface, standard penetration tests (SPT) were conducted every 2.5 feet according to AASHTO T 206, using a Hollow Stem Auger. Boring depths range from 61 to 106 feet and were terminated in a very dense sand layer.

Subsurface Conditions

While drilling, groundwater was encountered at an elevation between 329.6 and 345.9 for all 2016 borings except for Boring 3-S, which did not encounter water.

Boring 1-S: Starting at ground surface, the boring data depicts stiff red and grey clay and sandy clay loam to an elevation of 402.1, with Q_u values from 1.2 to 1.4 tsf, SPT (N) values ranging from 8 to 28 blows per foot, and moisture contents ranging between 16% and 24%. Stiff to very stiff tan and brown clay and silty clay is present down to elevation 394.6, with Q_u values from 1.6 to 3.1 tsf, SPT (N) values ranging from 6 to 9 blows per foot, and moisture contents ranging between 22% and 25%. Loose to very soft white and brown lenses of sand, silt and clay is present down to elevation 386.6, with Q_u values from 0.2 to 0.3 tsf, SPT (N) values ranging from 5 to 9 blows per foot, and moisture contents ranging between 13% and 24%. Medium to very dense light grey and brown sand, silty sand, sandy loam and silt with clay and silty clay seams is present down to elevation 372.1, with SPT (N) values ranging from 22 to 86 blows per foot and moisture contents ranging between 0% and 20%. Medium dense light grey and brown silt to silty loam is present down to elevation 354.6, with Q_u values from 0 to 0.6 tsf, SPT (N) values ranging from 14 to 16 blows per foot, and moisture contents ranging between 0% and 19%. Very dense white and brown fine to medium sand is present down to elevation 344.6, with SPT (N) values ranging from 73 to 83 blows per foot and no moisture content readings. Loose white and brown fine sand is present down to elevation 339.6, with an SPT (N) value of 9 blows per foot and no moisture content readings. Very dense light grey and brown fine to medium sand is present down to elevation 328.1, with SPT (N) values ranging from 31 to 100 blows per foot, and no moisture content readings.

Boring 2-S: Starting at ground surface, the boring data depicts very stiff red brown and grey clay to an elevation of 386.8, with Q_u values from 2.1 to 3.3 tsf, SPT (N) values ranging from 7 to 10 blows per foot, and moisture contents ranging between 29% and 36%. Medium to very dense, white and brown sand and silty sand with clay layers is present down to elevation 371.8, with SPT (N) values ranging from 14 to 100 blows per foot, and moisture contents ranging between 0% and 29%. Soft grey, brown and white silty clay and silty loam with sand and clay seams is present down to elevation 348.8, with Q_u values from 0.4 to 0.5 tsf, SPT (N) values ranging from 10 to 12 blows per foot, and moisture contents ranging between 18% and 27%. Very dense, white sand is present down to elevation 344.3, with an SPT (N) value of 76 blows per foot, and moisture content of 5%. Soft to medium brown and grey silty clay with sand seams is present down to elevation 339.3, with a Q_u value of 0.5 tsf, an SPT (N) value of 5 blows per foot, and a moisture content of 27%. Medium to stiff grey and mottled brown silty clay and clay with sand seams is present down to elevation 318.8, with Q_u values from 0.8 to 1.6 tsf, SPT (N) values ranging from 1 to 6 blows per foot, and moisture contents ranging between 26% and 28%. Very dense brown fine to medium sand is present down to elevation 307.8, with SPT (N) values ranging from 91 to 100 blows per foot, and no moisture content readings.

Boring 3-S: Starting at ground surface, the boring data depicts medium dense reddish brown sand with some clay to an elevation of 404.2, with an SPT (N) value of 20 blows per foot and no moisture content. Stiff to very stiff brown, tan and grey clay, silty clay and silty clay loam is present down to elevation 394.2, with Q_u values from 1.1 to 3.9 tsf, SPT (N) values ranging from 5 to 16 blows per foot, and moisture contents ranging between 25% and 30%. Soft to medium grey and brown silty clay with sand seams is present down to elevation 386.7, with Q_u values from 0.3 to 0.8tsf, SPT (N) values ranging from 7 to 10 blows per foot, and moisture contents ranging between 16% and 23%. Dense to very dense white and brown sand with layers of clayey sand is present down to elevation 371.7, with SPT (N) values ranging from 43 to 84 blows per foot, and no moisture content. Soft to medium grey and brown silty loam with clay lenses is present down to elevation 354.2, with Q_u values from 0.5 to 0.6 tsf, SPT (N) values ranging from 5 to 11 blows per foot, and moisture contents ranging between 22% and 26%. Very dense brown sand is present down to elevation 347.7, with SPT (N) values of 100 blows per foot, and no moisture content.

Boring 4-S: Starting at ground surface, the boring data depicts medium dense red gravel with clay binder to an elevation of 422.8, with an SPT (N) value of 10 blows per foot, and moisture content of 11%. Stiff brown mottled grey silty clay to clay is present down to elevation 412.8, with Q_u values from 1.4 to 1.6 tsf, SPT (N) values ranging from 6 to 11 blows per foot, and moisture contents ranging between 20% and 25%. Medium red sandy clay loam to sandy clay is present down to elevation 407.8, with Q_u values of 0.8 tsf, SPT (N) values ranging from 23 to 30 blows per foot, and moisture contents ranging between 19% and 21%. Dense red brown silty sand to sand loam is present down to elevation 405.3, with an SPT (N) value of 48 blows per foot, and moisture content of 18%. Medium to very stiff grey and brown silty clay and clay with silt and sand lenses is present down to elevation 395.3, with Q_u values from 0.8 to 3.7 tsf, SPT (N) values ranging from 7 to 10 blows per foot, and moisture contents ranging between 22% and 26%. Soft grey and brown sandy clay loam is present down to elevation 382.8, with Q_u values from 0.3 to 0.4 tsf, SPT (N) values ranging from 8 to 17 blows per foot, and moisture contents ranging between 15% and 25%. Medium to very dense white, grey and brown sand and silty sand with clay lenses is present down to elevation 367.8, with SPT (N) values ranging from 21 to 100 blows per foot, and moisture contents ranging between 3% and 11%. Medium dense grey to white silt is present down to elevation 357.8, with SPT (N) values ranging from 17 to 22 blows per foot, and moisture contents ranging between 0% and 14%. Soft to medium grey silty loam to silty clay loam is present down to elevation 352.8, with a Q_u value of 0.5 tsf, an SPT (N) value of 11 blows per foot, and moisture content of 23%. Very dense white and brown sand is present down to elevation 341.3, with SPT (N) values ranging from 93 to 100 blows per foot, and no moisture content.

Boring 5-S: Starting at ground surface, the boring data depicts stiff to very stiff brown mottled grey clay to silty clay to an elevation of 412.4, with Q_u values from 1.0 to 2.3 tsf, SPT (N) values ranging from 6 to 11 blows per foot, and moisture contents ranging between 18% and 26%. Medium to dense red brown gravel with clay binder is present down to elevation 407.4, with SPT (N) values ranging from 28 to 30 blows per foot, and no moisture content. Stiff to hard red, grey and brown clay and fine sand lenses is present down to elevation 371.9, with Q_u values from 1.2 to 3.5 tsf, SPT (N) values ranging from 5 to 10 blows per foot, and moisture contents ranging between 29% and 39%. Very dense brown and white sand is present down to elevation 367.4, with an SPT (N) value of 84 blows per foot, and no moisture content. Soft to medium grey silt to

silty clay loam is present down to elevation 347.4, with Q_u values from 0.3 to 0.7 tsf, SPT (N) values ranging from 6 to 14 blows per foot, and moisture contents ranging between 15% and 24%. Very dense brown sand with clay layers is present down to elevation 337.4, with an SPT (N) value of 61 blows per foot, and no moisture content. Stiff grey and brown clay with sand seams is present down to elevation 327.9, with a Q_u value of 1.2 tsf, an SPT (N) value of 5 blows per foot, and a moisture content of 23%. Very dense brown sand is present down to elevation 320.9, with SPT (N) values ranging from 68 to 76 blows per foot, and no moisture content.

Further descriptions of the soil conditions encountered in the borings are presented in the *Soil Borings* attached in Exhibit D and the *Subsurface Data Profile* in Exhibit C.

Geotechnical Evaluations

Settlement

Per the preliminary TSL, it is estimated the profile will be raised between 0.54 to 0.61 feet at the abutments. The proposed abutments will be located behind the existing abutments on existing embankments, resulting in calculated settlement of less than 0.4 inches. Since the settlement is negligible, downdrag forces are not significant and no pre-coring will be required.

Slope Stability

Preliminary stability analyses using Bishop's method were performed for both abutments on SN 064-0045 and SN 064-0046. According to AASHTO LRFD 11.6.2.3, the required resistance factor for slope stability is 0.65 which is equivalent to factor of safety of 1.54. For SN 064-0045, the west abutment is 21'-9" high 2H:1V (at right angles) end slope model with rendered factor of safety 2.55. The east abutment used 21'-11" high 2H:1V (at right angles) end slope model which rendered factor of safety of 3.57. The Seismic slope stability was also analyzed and yielded factors of safety of 1.56 and 1.90 at west and east abutments respectively. For SN 064-0046, the west abutment is 21'-10" high 2H:1V (at right angles) end slope model with rendered factor of safety 1.80. The east abutment used 21'-10" high 2H:1V (at right angles) end slope model which rendered factor of safety of 4.10. The Seismic slope stability was also analyzed and yielded factors of safety of 1.00 and 2.19 at west and east abutments respectively. As per AASHTO LRFD 11.6.5.3, minimum required factor of safety under the effect of seismic loads is 1. The horizontal coefficient was calculated according to FHWA-NHI-11-032, which assumes permanent displacement of 1 to 2 inches. The horizontal coefficient for all of the abutments is 0.26g. Slope stability analyses are presented in Exhibit H. No stability problems are expected.

Seismic Considerations

Based on the method described in the IDOT Design Guide LRFD Soil Site Class Definition, Soil Site Class D controls. The Design Spectral Acceleration at 1.0 sec (S_{D1}) is 0.496g and at 0.2 sec (S_{Ds}) is 1.141g. These values are based on a 1000 year design return period earthquake. According to AASHTO LRFD 3.10.6 the Seismic Performance Zone is 3 based on the 1.0 second Design Spectral Acceleration.

Liquefaction analysis was performed by IDOT District 9 using the IDOT Liquefaction Analysis spreadsheet for each boring at the proposed bridge location. Liquefiable layers were only noted below the 60 foot depth limitation defined in the Liquefaction Analysis Design Guide, therefore liquefaction is not a concern at this location. See Exhibit F.

Approach Slab

Due to the profile raise, the approach slabs will rest on fill material where bearing capacities above the required 2 ksf should be expected.

Mining Activity

A review of the Illinois State Geological Survey (ISGS) "Directory of Coal Mines in Illinois" for Massac County indicates that no mining activity has been present at the project location. The nearest underground coal mine is located 10.2 miles northeast of the bridge location.

Foundation Recommendations

Following is the summary of preliminary factored vertical loads for the AASHTO LRFD Strength I load combination provided by ESCA Consultants, Inc., for both bridges. The Extreme Event I load combination was estimated to be 75% of Strength I.

Strength I Load Combination

West Abutment	800 kips
Pier 1	1500 kips
Pier 2	1500 kips
East Abutment	800 kips

Abutments

Due to IDOT's strong desire for a jointless structure, integral abutments will be provided for both of these bridges. Per IDOT ABD Memoranda 12.3, all pile types are permissible for an effective expansion length of 73.71' determined for eastbound SN 064-0045 and an effective expansion length of 71.50' for the westbound SN 064-0046. However, MS 12"x0.179" piles are not recommended due to their thin walls and the stiff soil layers. Unless the abutment type is changed, spread footings and drilled shafts are not allowed for integral abutments as per the IDOT Bridge Manual.

Driven pile foundation design does not include a seismic case since no liquefiable soils are present. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance. Pile size calculations are presented in Exhibit G and summarized in Tables 1 thru 4. The estimated lengths include a 2 foot embedment into the abutment cap and are based on top of pile elevations of 422.66 at the west abutment and 422.81 at the east abutment for SN 064-0045, and 422.77 at the west abutment and 422.71 at the east abutment for SN 064-0046. R_n values in tables represent the maximum nominal required bearing. Per IDOT Bridge Manual 3.10.1.6, the suggested upper limit for pile length is 50 ft for HP 8's, 75 ft for HP 10's and 100 ft for HP 12's.
Since limited borings were drilled near the eastbound structure in 2016, borings 1S and 4S from 1968 were used for the SN 064-0045 abutments. These two borings yield capacities within the expected load limits, but do not produce as high of capacities as the 2016 borings due to their limited depths. If higher capacities are required for these locations, data can be extrapolated from the nearest 2016 boring.

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
West Abutment SN 064-0045 Strength Limit State	MS 12"x.25"	149	82	15	407.8	0
		155	85	17	405.8	0
		162	89	20	402.8	0
		183	101	22	400.8	0
		213	117	25	397.8	0
		217	119	30	392.8	0
		331	182	32	390.8	0
		355	195	35	387.8	0
	MS 14"x.25"	176	97	15	407.8	0
		182	100	17	405.8	0
		190	105	20	402.8	0
		218	120	22	400.8	0
		254	140	30	392.8	0
		409	225	32	390.8	0
		416	229	35	387.8	0
	MS 14"x.312"	176	97	15	407.8	0
		182	100	17	405.8	0
		190	105	20	402.8	0
		218	120	22	400.8	0
		254	140	30	392.8	0
		409	225	32	390.8	0
		516	284	35	387.8	0
	HP 10x42	91	50	22	400.8	0
		103	57	30	392.8	0
		140	77	32	390.8	0
		162	89	35	387.8	0
		175	96	37	385.8	0
	HP 12x53	81	44	17	405.8	0
		87	48	20	402.8	0
		115	63	22	400.8	0
		126	69	30	392.8	0
		178	98	32	390.8	0
		193	106	35	387.8	0
		210	116	37	385.8	0
	HP 12x63	81	45	17	405.8	0
		88	48	20	402.8	0
		116	64	22	400.8	0
		127	70	30	392.8	0
		180	99	32	390.8	0
		198	109	35	387.8	0
		216	119	37	385.8	0
	HP 14x73	94	52	12	410.8	0
		98	54	17	405.8	0
		106	58	20	402.8	0
		144	79	22	400.8	0
		151	83	30	392.8	0
		222	122	32	390.8	0
		234	129	35	387.8	0
		256	141	37	385.8	0

Table 1

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
West Abutment SN 064-0045 Strength Limit State	HP 14x89	99	54	17	405.8	0
		107	59	20	402.8	0
		146	80	22	400.8	0
		153	84	30	392.8	0
		226	124	32	390.8	0
		239	132	35	387.8	0
		262	144	37	385.8	0

Table 1 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0045 Strength Limit State	MS 12”x.25”	89	49	16	406.9	0
		103	57	19	403.9	0
		120	66	21	401.9	0
		144	79	24	398.9	0
		165	91	26	396.9	0
		177	97	29	393.9	0
		191	105	31	391.9	0
		206	113	34	388.9	0
		219	120	36	386.9	0
		236	130	41	381.9	0
		355	195	44	378.9	0
	MS 14”x.25”	87	48	14	408.9	0
		109	60	16	406.9	0
		124	68	19	403.9	0
		144	79	21	401.9	0
		173	95	24	398.9	0
		198	109	26	396.9	0
		210	116	29	393.9	0
		227	125	31	391.9	0
		244	134	34	388.9	0
		259	142	36	386.9	0
		278	153	41	381.9	0
		416	229	44	378.9	0
	MS 14”x.312”	87	48	14	408.9	0
		109	60	16	406.9	0
		124	68	19	403.9	0
		144	79	21	401.9	0
		173	95	24	398.9	0
		198	109	26	396.9	0
		210	116	29	393.9	0
		227	125	31	391.9	0
		244	134	34	388.9	0
		259	142	36	386.9	0
		278	153	41	381.9	0
		516	284	44	378.9	0

Table 2

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0045 Strength Limit State	HP 10x42	77	43	19	403.9	0
		89	49	21	401.9	0
		109	60	24	398.9	0
		123	68	26	396.9	0
		128	70	29	393.9	0
		136	75	31	391.9	0
		147	81	34	388.9	0
		154	85	36	386.9	0
		159	88	41	381.9	0
		248	137	44	378.9	0
	HP 12x53	83	46	16	406.9	0
		98	54	19	403.9	0
		113	62	21	401.9	0
		138	76	24	398.9	0
		156	86	26	396.9	0
		159	87	29	393.9	0
		169	93	31	391.9	0
		181	100	34	388.9	0
		190	104	36	386.9	0
		195	107	41	381.9	0
		298	164	44	378.9	0
	HP 12x63	85	47	16	406.9	0
		99	55	19	403.9	0
		114	63	21	401.9	0
		140	77	24	398.9	0
		158	87	26	396.9	0
		161	88	29	393.9	0
		171	94	31	391.9	0
		183	101	34	388.9	0
		191	105	36	386.9	0
		196	108	41	381.9	0
		307	169	44	378.9	0
	HP 14x73	77	42	14	408.9	0
		100	55	16	406.9	0
		123	67	19	403.9	0
		141	78	21	401.9	0
		170	94	24	398.9	0
		195	107	26	396.9	0
		195	108	29	393.9	0
		207	114	31	391.9	0
		222	122	34	388.9	0
		230	127	36	386.9	0
		234	129	41	381.9	0
		363	200	44	378.9	0

Table 2 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0045 Strength Limit State	HP 14x89	79	43	14	408.9	0
		102	56	16	406.9	0
		124	68	19	403.9	0
		143	79	21	401.9	0
		173	95	24	398.9	0
		198	109	26	396.9	0
		198	109	29	393.9	0
		210	115	31	391.9	0
		224	123	34	388.9	0
		233	128	36	386.9	0
		237	130	41	381.9	0
		374	206	44	378.9	0

Table 2 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
West Abutment SN 064-0046 Strength Limit State	MS 12”x.25”	95	52	18	404.8	0
		111	61	20	402.8	0
		132	73	23	399.8	0
		151	83	28	394.8	0
		154	85	30	392.8	0
		157	86	33	389.8	0
		160	88	35	387.8	0
		243	133	40	382.8	0
		355	195	45	377.8	0
	MS 14”x.25”	112	62	18	404.8	0
		132	73	20	402.8	0
		158	87	23	399.8	0
		176	97	28	394.8	0
		180	99	30	392.8	0
		183	101	33	389.8	0
		188	103	35	387.8	0
		298	164	40	382.8	0
		416	229	45	377.8	0
	MS 14”x.312”	112	62	18	404.8	0
		132	73	20	402.8	0
		158	87	23	399.8	0
		176	97	28	394.8	0
		180	99	30	392.8	0
		183	101	33	389.8	0
		188	103	35	387.8	0
		298	164	40	382.8	0
		516	284	45	377.8	0

Table 3

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
West Abutment SN 064-0046 Strength Limit State	HP 10x42	86	47	28	394.8	0
		88	49	30	392.8	0
		90	50	33	389.8	0
		93	51	35	387.8	0
		121	67	40	382.8	0
		163	90	45	377.8	0
		187	103	65	357.8	0
		297	163	70	352.8	0
		335	184	75	347.8	0
	HP 12x53	82	45	20	402.8	0
		104	57	23	399.8	0
		104	57	28	394.8	0
		107	59	30	392.8	0
		109	60	33	389.8	0
		113	62	35	387.8	0
		152	84	40	382.8	0
		196	108	45	377.8	0
		225	124	65	357.8	0
		356	196	70	352.8	0
		419	230	75	347.8	0
	HP 12x63	83	46	20	402.8	0
		105	58	28	394.8	0
		108	59	30	392.8	0
		110	61	33	389.8	0
		114	63	35	387.8	0
		154	85	40	382.8	0
		202	111	45	377.8	0
		227	125	65	357.8	0
		365	201	70	352.8	0
		462	254	75	347.8	0
		497	273	80	342.8	0
	HP 14x73	77	42	18	404.8	0
		103	57	20	402.8	0
		125	69	28	394.8	0
		127	70	30	392.8	0
		130	72	33	389.8	0
		135	74	35	387.8	0
		189	104	40	382.8	0
		239	132	45	377.8	0
		269	148	65	357.8	0
		432	238	70	352.8	0
		547	301	75	347.8	0
		578	318	80	342.8	0

Table 3 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
West Abutment SN 064-0046 Strength Limit State	HP 14x89	78	43	18	404.8	0
		105	58	20	402.8	0
		126	69	28	394.8	0
		129	71	30	392.8	0
		132	72	33	389.8	0
		137	75	35	387.8	0
		191	105	40	382.8	0
		247	136	45	377.8	0
		272	149	65	357.8	0
		443	244	70	352.8	0
		560	308	75	347.8	0
		684	376	80	342.8	0

Table 3 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0046 Strength Limit State	MS 12”x.25”	139	76	15	407.8	0
		144	79	18	404.8	0
		161	89	20	402.8	0
		185	102	23	399.8	0
		199	110	25	397.8	0
		217	119	28	394.8	0
		230	126	30	392.8	0
		246	135	33	389.8	0
		258	142	35	387.8	0
		280	154	40	382.8	0
		309	170	45	377.8	0
		355	195	51	371.8	0
	MS 14”x.25”	171	94	15	407.8	0
		174	95	18	404.8	0
		193	106	20	402.8	0
		222	122	23	399.8	0
		237	130	25	397.8	0
		257	141	28	394.8	0
		272	149	30	392.8	0
		291	160	33	389.8	0
		304	167	35	387.8	0
		328	181	40	382.8	0
		365	201	45	377.8	0
		416	229	51	371.8	0

Table 4

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0046 Strength Limit State	MS 14"x.312"	171	94	15	407.8	0
		174	95	18	404.8	0
		193	106	20	402.8	0
		222	122	23	399.8	0
		237	130	25	397.8	0
		257	141	28	394.8	0
		272	149	30	392.8	0
		291	160	33	389.8	0
		304	167	35	387.8	0
		328	181	40	382.8	0
		365	201	45	377.8	0
		516	284	51	371.8	0
	HP 10x42	79	43	18	404.8	0
		91	50	20	402.8	0
		109	60	23	399.8	0
		116	64	25	397.8	0
		128	70	28	394.8	0
		135	74	30	392.8	0
		146	80	33	389.8	0
		152	84	35	387.8	0
		164	90	40	382.8	0
		188	104	45	377.8	0
		244	134	55	367.8	0
		250	138	60	362.8	0
		254	140	65	357.8	0
		260	143	70	352.8	0
		335	184	75	347.8	0
	HP 12x53	94	52	18	404.8	0
		116	64	20	402.8	0
		139	76	23	399.8	0
		146	80	25	397.8	0
		160	88	28	394.8	0
		167	92	30	392.8	0
		180	99	33	389.8	0
		188	103	35	387.8	0
		200	110	40	382.8	0
		232	127	45	377.8	0
		295	162	55	367.8	0
		302	166	60	362.8	0
		307	169	65	357.8	0
		314	173	70	352.8	0
		409	225	85	337.8	0
		419	230	95	327.8	0

Table 4 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
East Abutment SN 064-0046 Strength Limit State	HP 12x63	97	53	18	404.8	0
		117	64	20	402.8	0
		141	78	23	399.8	0
		147	81	25	397.8	0
		161	89	28	394.8	0
		169	93	30	392.8	0
		182	100	33	389.8	0
		189	104	35	387.8	0
		202	111	40	382.8	0
		234	129	45	377.8	0
		298	164	55	367.8	0
		304	167	60	362.8	0
		309	170	65	357.8	0
		317	174	70	352.8	0
		413	227	85	337.8	0
		497	273	95	327.8	0
	HP 14x73	83	46	15	407.8	0
		114	63	18	404.8	0
		141	78	20	402.8	0
		168	92	23	399.8	0
		181	99	25	397.8	0
		197	108	28	394.8	0
		204	112	30	392.8	0
		221	121	33	389.8	0
		228	125	35	387.8	0
		241	133	40	382.8	0
		281	155	45	377.8	0
		352	194	55	367.8	0
		359	197	60	362.8	0
		364	200	65	357.8	0
		374	205	70	352.8	0
		489	269	85	337.8	0
		578	318	95	327.8	0
	HP 14x89	86	47	15	407.8	0
		117	64	18	404.8	0
		144	79	20	402.8	0
		171	94	23	399.8	0
		183	101	25	397.8	0
		200	110	28	394.8	0
		207	114	30	392.8	0
		224	123	33	389.8	0
		231	127	35	387.8	0
		244	134	40	382.8	0
		285	157	45	377.8	0
		356	196	55	367.8	0
		362	199	60	362.8	0
		368	202	65	357.8	0
		378	208	70	352.8	0
		494	272	85	337.8	0
		705	388	95	327.8	0

Table 4 (continued)

Piers

There are several options for the type of foundation at the piers: Spread footing bearing on soil, pile-supported footings, encased pile bent, or drilled shaft foundation.

Spread Footing on Soil: Due to the soil layers with Qu less than 2.0 tsf for all piers and a deep bedrock elevation, it is not recommended to use spread footings.

Pile Supported: Per the preliminary TSL, pile bent piers with a single row of piles are anticipated for each pier. MS 12"x0.179" piles are not recommended due to their thin walls and the stiff soil layers. Pile size calculations are presented in Exhibit G and summarized in Tables 5 and 6. The estimated lengths include 2 ft encasement into the pier cap and are based on top of pile elevations of 423.95. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance. Tables include strength limit state. R_n values in tables represent the maximum nominal required bearing. It should be noted that the sudden increase in pile capacities in the below tables is explained by the presence of a dense sand layer.

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
Piers SN 064-0045 Strength Limit State	MS 12"x.25"	55	30	32	391.9	0
		59	32	35	388.9	0
		355	195	37	386.9	0
	MS 14"x.25"	65	36	32	391.9	0
		69	38	35	388.9	0
		416	229	37	386.9	0
	MS 14"x.312"	65	36	32	391.9	0
		69	38	35	388.9	0
		516	284	37	386.9	0
	HP 10x42	147	81	65	358.9	0
		240	132	70	353.9	0
		327	180	75	348.9	0
	HP 12x53	161	88	55	368.9	0
		170	93	60	363.9	0
		178	98	65	358.9	0
		288	158	70	353.9	0
		392	215	75	348.9	0
	HP 12x63	158	87	52	371.9	0
		162	89	55	368.9	0
		171	94	60	363.9	0
		179	99	65	358.9	0
		297	163	70	353.9	0
		402	221	75	348.9	0
	HP 14x73	159	87	40	383.9	0
		187	103	52	371.9	0
		192	106	55	368.9	0
		203	112	60	363.9	0
		212	117	65	358.9	0
		351	193	70	353.9	0
		476	262	75	348.9	0

Table 5

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
Piers SN 064-0045 Strength Limit State	HP 14x89	165	91	40	383.9	0
		190	104	52	371.9	0
		194	107	55	368.9	0
		205	113	60	363.9	0
		214	118	65	358.9	0
		362	199	70	353.9	0
		487	268	75	348.9	0

Table 5 (continued)

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
Piers SN 064-0046 Strength Limit State	MS 12" x .25"	158	87	37	386.9	0
		240	132	42	381.9	0
		355	195	45	378.9	0
	MS 14" x .25"	134	74	35	388.9	0
		194	107	37	386.9	0
		299	164	42	381.9	0
		416	229	45	378.9	0
	MS 14" x .312"	134	74	35	388.9	0
		194	107	37	386.9	0
		299	164	42	381.9	0
		476	262	47	376.9	0
		481	265	52	371.9	0
		486	267	55	368.9	0
		496	273	60	363.9	0
		506	278	65	358.9	0
		516	284	70	353.9	0
	HP 10x42	157	87	70	353.9	0
		199	109	80	343.9	0
		212	117	85	338.9	0
		231	127	90	333.9	0
		238	131	95	328.9	0
		335	184	105	318.9	0
	HP 12x53	167	92	52	371.9	0
		170	93	55	368.9	0
		177	98	60	363.9	0
		184	101	65	358.9	0
		190	105	70	353.9	0
		240	132	80	343.9	0
		258	142	85	338.9	0
		281	155	90	333.9	0
		288	158	95	328.9	0
		419	230	105	318.9	0

Table 6

Location	Pile Size	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.	Estimated Embedment into rock (ft)
Piers SN 064-0046 Strength Limit State	HP 12x63	168	92	52	371.9	0
		171	94	55	368.9	0
		179	98	60	363.9	0
		185	102	65	358.9	0
		192	105	70	353.9	0
		242	133	80	343.9	0
		260	143	85	338.9	0
		284	156	90	333.9	0
		291	160	95	328.9	0
		476	262	105	318.9	0
		497	273	115	308.9	0
	HP 14x73	165	91	40	383.9	0
		173	95	42	381.9	0
		199	109	52	371.9	0
		202	111	55	368.9	0
		212	116	60	363.9	0
		219	120	65	358.9	0
		226	125	70	353.9	0
		286	157	80	343.9	0
		309	170	85	338.9	0
		338	186	90	333.9	0
		344	189	95	328.9	0
		564	310	105	318.9	0
		578	318	115	308.9	0
	HP 14x89	168	93	40	383.9	0
		176	97	42	381.9	0
		201	110	52	371.9	0
		205	113	55	368.9	0
		214	118	60	363.9	0
		221	122	65	358.9	0
		229	126	70	353.9	0
		289	159	80	343.9	0
		312	172	85	338.9	0
		342	188	90	333.9	0
		347	191	95	328.9	0
		576	317	105	318.9	0
		705	388	115	308.9	0

Table 6 (continued)

Drilled Shafts: With no rock layers indicated in the borings, drilled shafts would be uneconomical at this location.

Lateral Loading Analysis

Tables 7 thru 12 provide soil parameters for the LPile program (or other approved programs) for the structural engineer to perform the lateral analysis of the foundations.

Preliminary analysis has determined that adequate lateral resistance can be provided for the piles without reaching rock strata. Per Bridge Manual 3.10.1.10, if the lateral load on a pile exceeds 3 kips then a detailed soil structure interaction analysis shall be performed.

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Medium Dense Gravel	422.8	.068	31	90	-	-
Stiff Silty Clay	412.8	.073	-	500	11	.007
Medium Sandy Clay	407.8	.069	-	100	6	.010
Dense Silty Sand	405.3	.079	39	225	-	-
Medium Silty Clay	402.8	.069	-	100	6	.010
Stiff Clay	400.3	.074	-	500	13	.007
Very Stiff Clay	395.3	.078	-	1000	22	.005
Soft Sandy Clay Loam	382.8	.063	-	30	2	.020
Medium Dense Silty Sand	377.8	.073	35	90	-	-
Very Dense Silty Sand	372.8	.085	44	225	-	-
Very Dense Sand	367.8	.080	40	225	-	-
Medium Dense Silt	357.8	.073	34	90	-	-
Medium Silty Clay Loam	352.8	.066	-	100	3	.010
Very Dense Sand	341.3	.085	44	225	-	-

Table 7 – Westbound, West Abutment (4-S)

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Very Stiff Clay	386.8	.077	-	1000	18	.005
Medium to Dense Sand	379.3	.075	35	90	-	-
Very Dense Sand	376.8	.085	44	225	-	-
Medium Dense Sand	374.3	.073	34	90	-	-
Very Dense Sand	371.8	.083	42	225	-	-
Soft Silty Clay	369.3	.064	-	30	3	.020
Soft Silty Loam	359.3	.065	-	30	3	.020
Soft Silt to Silt Loam	348.8	.064	-	30	3	.020
Very Dense Sand	344.3	.083	42	225	-	-
Soft to Medium Silty Clay	339.3	.030	-	30	3	.020
Stiff Clay	329.3	.036	-	500	10	.007
Medium Silty Clay	318.8	.033	-	100	6	.010
Very Dense Sand	307.8	.047	43	125	-	-

Table 8 – Westbound, Piers (2-S)

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Very Stiff Clay	422.4	.076	-	1000	16	.005
Stiff Clay	419.9	.073	-	500	10	.007
Stiff Silty Clay	412.4	.071	-	500	7	.007
Medium to Dense Gravel	407.4	.076	36	90	-	-
Hard Clay	404.9	.083	-	2000	38	.004
Very Stiff Clay	387.4	.077	-	1000	19	.005
Stiff Clay	382.4	.075	-	500	13	.007
Stiff Silty Clay	377.4	.072	-	500	8	.007
Very Stiff Clay	371.9	.076	-	1000	16	.005
Very Dense Sand	367.4	.084	43	225	-	-
Medium to Soft Silt Loam	347.4	.065	-	100	3	.010
Very Dense Sand	337.4	.045	41	125	-	-
Stiff Clay	327.9	.035	-	500	8	.007
Very Dense Sand	320.9	.046	41	125	-	-

Table 9 – Westbound, East Abutment (5-S)

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Medium Silty Clay	415.6	.070	-	100	7	.010
Very Stiff Clay	410.6	.077	-	1000	17	.005
Very Dense Sand	408.1	.081	40	225	-	-
Medium to Stiff Clay	400.6	.069	-	100	6	.010
Very Stiff Clay	395.6	.078	-	1000	22	.005
Medium Sandy Clay	393.1	.071	33	90	-	-
Medium Sandy Clay Loam	390.6	.068	-	100	5	.010
Medium Sand	388.1	.074	35	90	-	-
Dense to Very Dense Sand	384.6	.079	38	225	-	-

Table 10 – Eastbound, West Abutment (1S) (1968 borings)

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Medium Dense Sand	404.2	.073	34	90	-	-
Stiff Silty Clay	401.7	.072	-	500	8	.007
Stiff Clay	396.7	.071	-	500	8	.007
Very Stiff Clay	394.2	.080	-	1000	27	.005
Medium Silty Clay	391.7	.069	-	100	6	.010
Soft Silt and Clay	386.7	.064	-	30	2	.020
Very Dense Sand	376.7	.082	41	225	-	-
Dense Sand	371.7	.079	39	225	-	-
Soft to Medium Silty Loam	354.2	.066	-	30	4	.010
Very Dense Sand	347.7	.085	44	225	-	-

Table 11 – Eastbound, Piers (3-S)

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Silty Clay	414.2	.063	-	500	9	.007
Stiff Clay	411.7	.035	-	500	8	.007
Stiff Gravel	409.2	.038	-	500	13	.007
Very Stiff Clay	386.7	.036	-	1000	16	.005
Medium Sandy Clay Loam	379.2	.037	-	100	8	.010
Very Dense Sand	378.3	.048	44	125	-	-

Table 12 – Eastbound, East Abutment (4S) (1968 borings)

Construction Considerations

Stage Construction

Traffic is expected to be maintained on I-24 utilizing cross overs for the construction of both structures, while Country Club Road will be closed as necessary. No temporary soil support system will be required as each of the proposed bridges will be constructed in a single stage and there is adequate space between the structures to excavate without cutting into the other structure. The soil will generally be adequate for a 1V:1H excavation slope. However, if the intermittent very soft soil layers shown in the borings are encountered in the field, a 1.5V:1H excavation slope may be more appropriate.

Foundation Construction

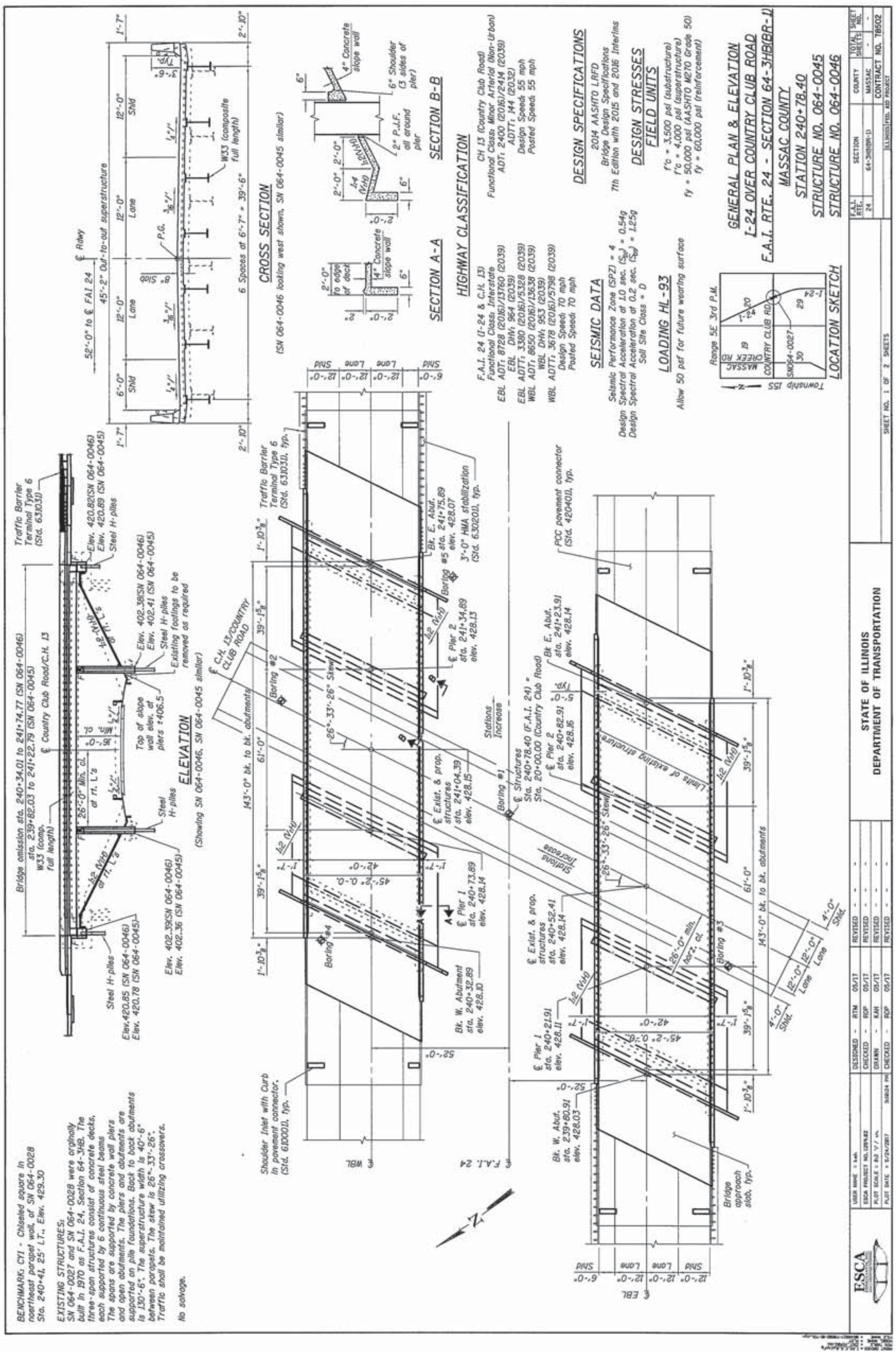
One test pile at each driven pile foundation should be provided due to the inconsistencies in the soil layers between the borings. Pile shoes are not required for steel H-piles due to the absence of rock layers. If metal shell piles are chosen, conical pile tips should be installed due to dense soil layers.

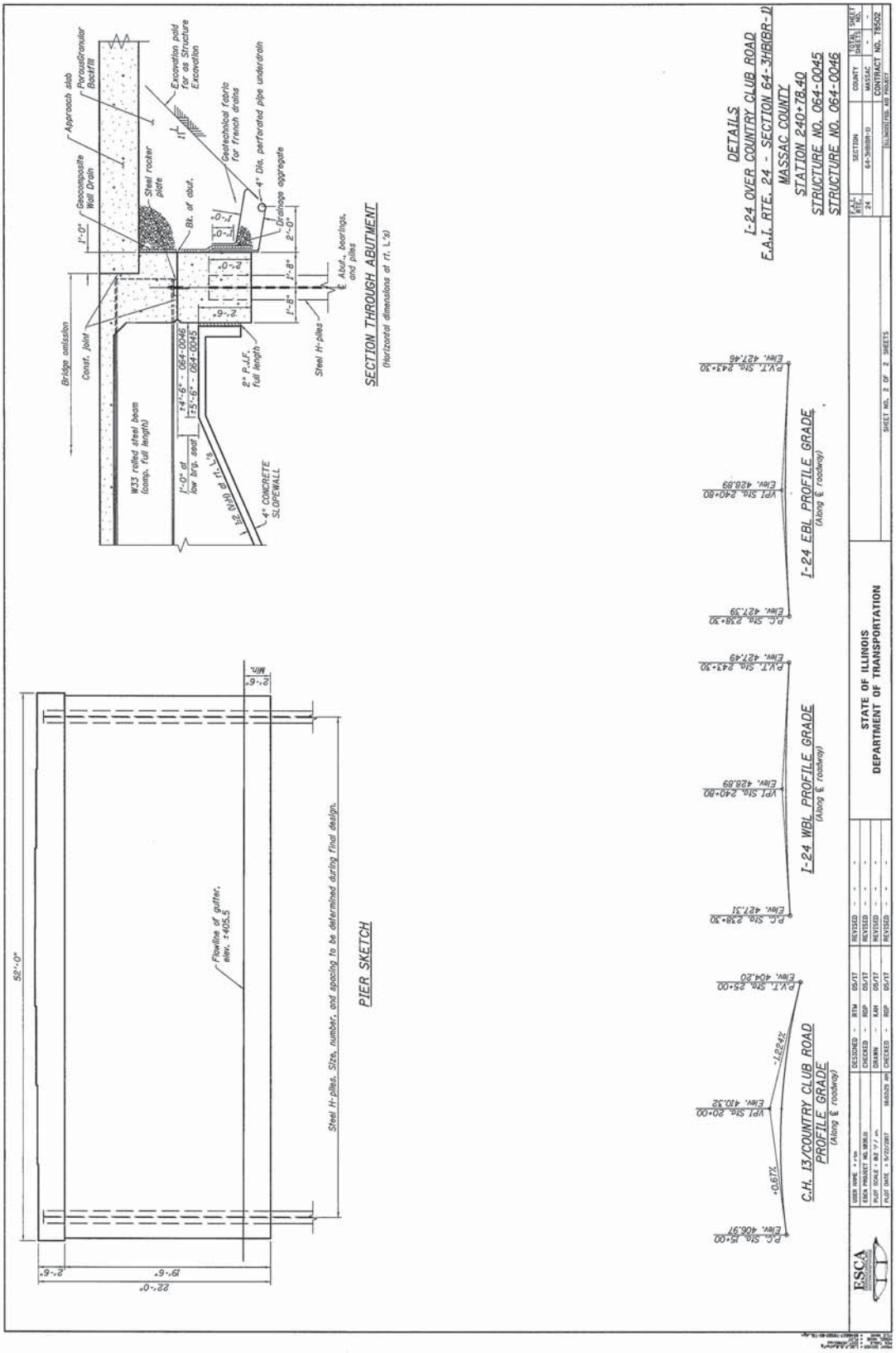
If driving metal shell piles into dense sand layers to achieve higher capacities, it is recommended to use lower energy hammers to avoid pile damage from hard driving.

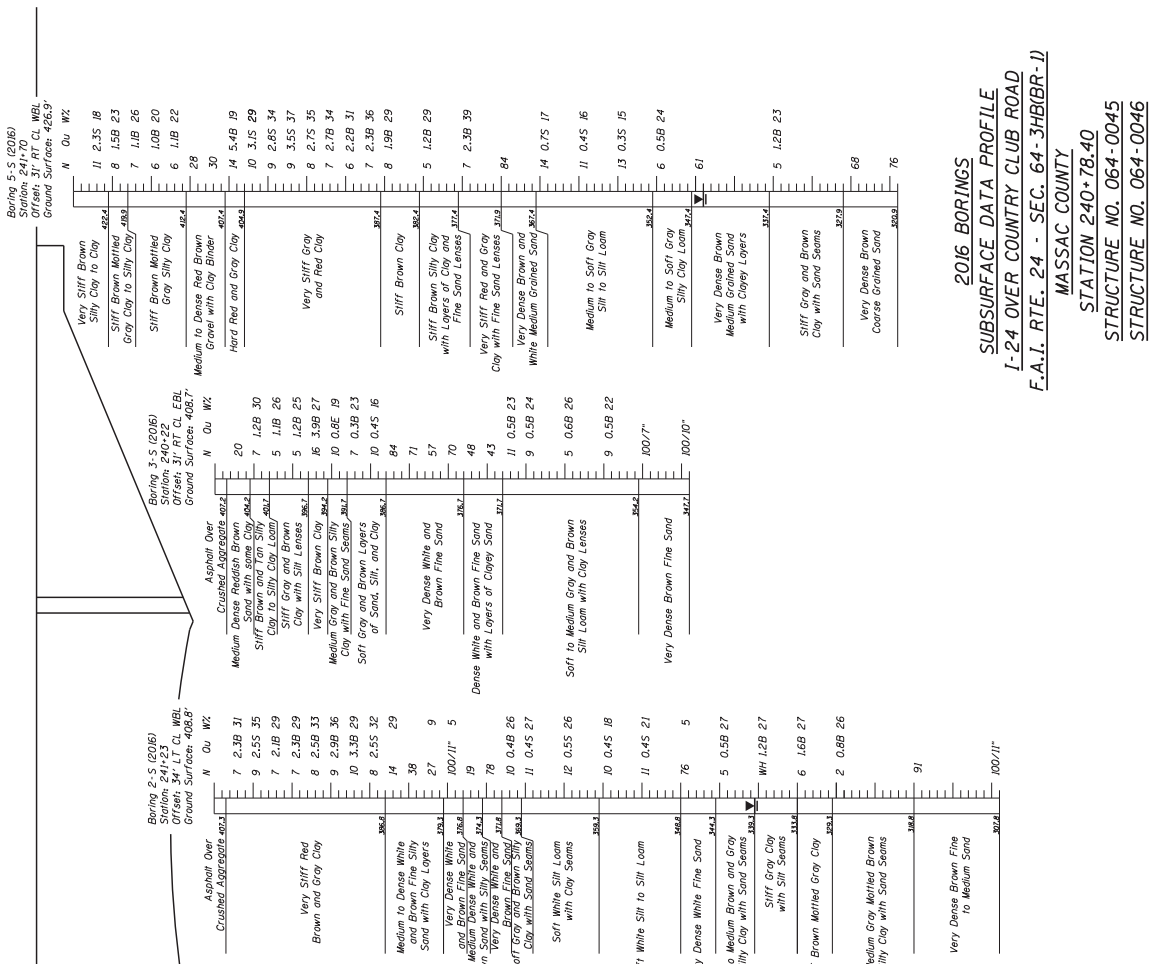
Limitations

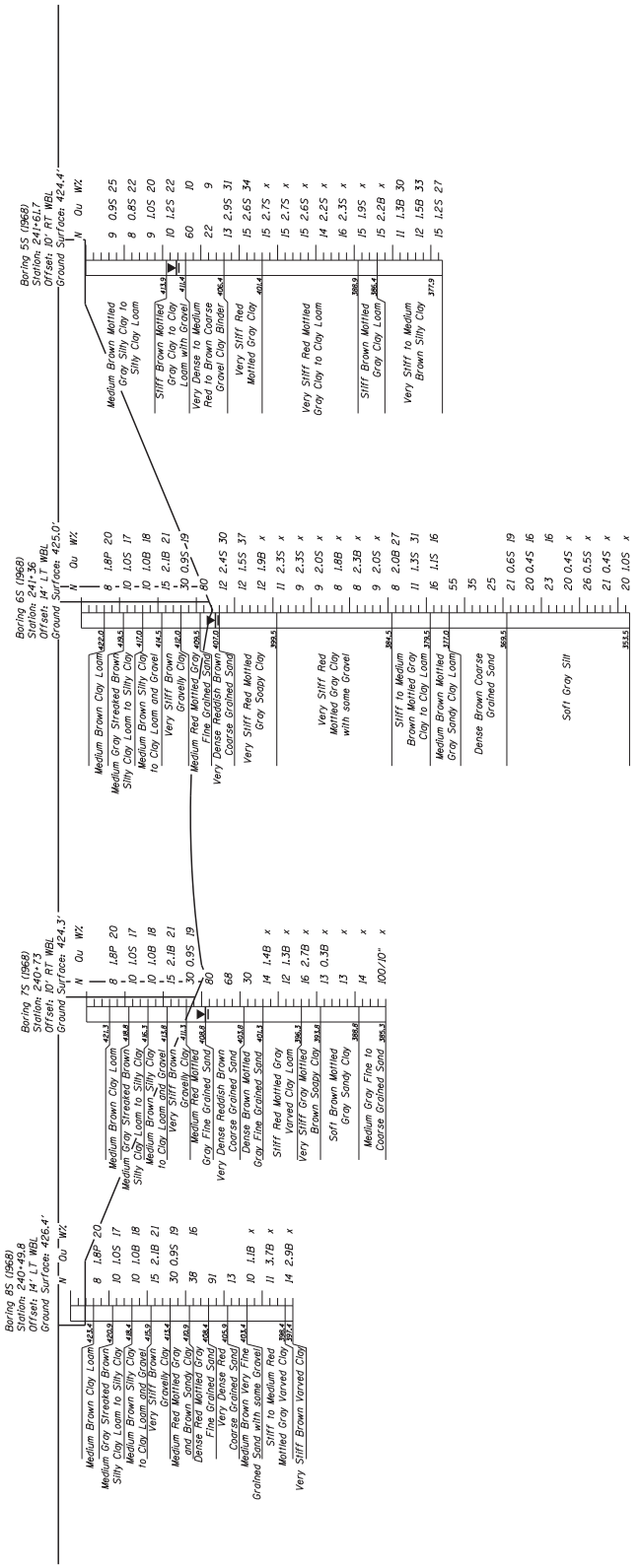
The recommendations provided herein are for the exclusive use of IDOT and ESCA Consultants, Inc. They are specific only to the project described, and are based on subsurface information obtained at boring locations within the bridge area, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. Lin Engineering, Ltd. should be contacted if conditions encountered during construction are not consistent with those described.

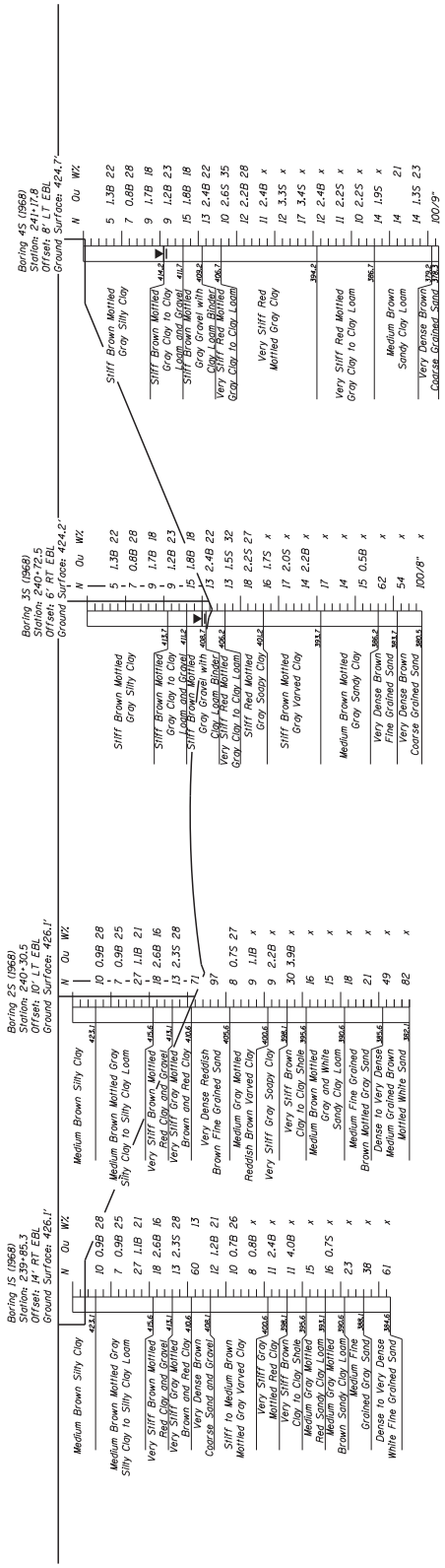

Round Knob
Midway
Structure Location
Country Club Rd
Metropolis
Fort Massac
State Park
Massac
Forest Nature
Preserve
Ohio River
S.N. 064-0045 &
S.N. 064-0046
I-24 Over Country
Club Road
Massac County


GENERAL PLAN & ELEVATION
I-24 OVER COUNTRY CLUB ROAD
F.A.I. RTE. 24 - SECTION 64-3HB(BR-1)
MASSAC COUNTY
STATION 240+78.40
STRUCTURE NO. 064-0045
STRUCTURE NO. 064-0046
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION


DETAILS
I-24 OVER COUNTRY CLUB ROAD
F.A.I. RTE. 24 - SECTION 64-3HBR(R-1)
MASSAC COUNTY
STATION 240+78.40
STRUCTURE NO. 064-0045
STRUCTURE NO. 064-0046
SECTION THROUGH ABUTMENT
(horizontal dimensions at rt. L's)
Approach slab
Porous Granular Backfill
Geocomposite Wall Drain
Steel rocker plate
Bk. of abut.
Excavation paid for as Structure Excavation
Geotechnical fabric for French drains
4" Dia. perforated pipe underdrain
Drainage aggregate
Bridge antiskid
Const. joint
W33 rolled steel beam (comp. rail length)
1'-0" of low brg. seat
2" P.J.F. full length
4" CONCRETE SLOPEWALL
Steel H-piles
Abut. bearings and piles
PIER SKETCH
Flowline of gutter, elev. =405.5
Steel H-piles. Size, number, and spacing to be determined during final design.
I-24 EBL PROFILE GRADE
(Along ℄ roadway)
I-24 WBL PROFILE GRADE
(Along ℄ roadway)
C.H. 13/COUNTRY CLUB ROAD
PROFILE GRADE
(Along ℄ roadway)
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
ESCA


Boring 4-S (2016)
Station: 240+32
Offset: 34' LT CL WBL
Ground Surface: 427.3'
N Qu W%
Asphalt Over Crushed Aggregate 424.8
Medium Dense Gravel with Clay Binder 422.6
Stiff Brown Mottled Gray Silty Clay to Clay 418.8
Medium Red Sandy Clay Loam to Sandy Clay 417.8
Dense Red Brown Silty Sand to Sandy Loam 415.3
Medium Gray and Brown Silty Clay with Silt Lenses 414.8
Stiff Gray and Brown Clay with Silt and Sand Lenses 413.3
Very Stiff Gray Clay with Scattered Silt Lenses 395.3
Soft Gray and Brown Sandy Clay Loam 388.8
Medium Dense Gray and Brown Fine Silty Sand with Clay Lenses 382.8
Very Dense White and Brown Fine Silty Sand 377.8
Very Dense White and Brown Fine Sand 372.8
Medium Dense Gray to White Silt 357.8
Medium to Soft Gray Silt Loam to Silty Clay Loam 352.8
Very Dense White and Brown Fine Sand 341.3
Boring 1-S (2016)
Station: 240+80
Offset: 52' RT CL WBL
Ground Surface: 403.1'
N Qu W%
Asphalt Over Crushed Aggregate 401.6
Stiff Red and Gray Clay 394.6
Stiff Gray and Red Sandy Clay Loam with some Gravel 392.1
Stiff Tan and Brown Silty Clay to Clay 387.1
Very Stiff Tan and Brown Clay 384.6
Loose or Very Soft White and Brown Alternating Lenses of Fine Sand, Silt, and Clay 378.6
Very Dense Light Gray and Brown Fine Silty Sand to Sand Loam 367.1
Medium to Dense Light Gray and Brown Fine Sand with Silt and Clay Seams 355.6
Very Dense White and Brown Fine Sand with Silt Seams 347.1
Very Dense White and Brown Fine Sand with Seams of Silty Clay 337.1
Medium Dense Light Gray and Brown Silt to Silt Loam 314.6
Very Dense White and Brown Fine to Medium Sand 291.3
Loose White and Brown Fine Sand 278.6
Very Dense Light Gray and Brown Fine to Medium Sand 247.1
Boring 2-S (2016)
Station: 241+23
Offset: 34' LT CL WBL
Ground Surface: 408.8'
N Qu W%
Asphalt Over Crushed Aggregate 407.3
Very Stiff Red Brown and Gray Clay 386.8
Medium to Dense White and Brown Fine Silty Sand with Clay Layers 379.3
Very Dense White and Brown Fine Sand 376.8
Medium Dense White and Brown Fine Sand with Silty Seams 374.3
Very Dense White and Brown Fine Sand 372.8
Soft Gray and Brown Silty Clay with Sand Seams 368.3
Soft White Silt Loam with Clay Seams 359.3
Soft White Silt to Silt Loam 346.8
Very Dense White Fine Sand 344.3
Soft to Medium Brown and Gray Silty Clay with Sand Seams 333.3
Stiff Gray Clay with Silt Seams 311.6
Stiff Brown Mottled Gray Clay 279.3
Medium Gray Mottled Brown Silty Clay with Sand Seams 198.8
Very Dense Brown Fine to Medium Sand 307.8
Boring 3-S (2016)
Station: 240+22
Offset: 31' RT CL EBL
Ground Surface: 408.7'
N Qu W%
Asphalt Over Crushed Aggregate 407.2
Medium Dense Reddish Brown Sand with some Clay 404.2
Stiff Brown and Tan Silty Clay to Silty Clay Loam 401.7
Stiff Gray and Brown Clay with Silt Lenses 386.7
Very Stiff Brown Clay 384.2
Medium Gray and Brown Silty Clay with Fine Sand Seams 381.7
Soft Gray and Brown Layers of Sand, Silt, and Clay 376.7
Very Dense White and Brown Fine Sand 371.7
Soft to Medium Gray and Brown Silt Loam with Clay Lenses 354.2
Very Dense Brown Fine Sand 341.7
Boring 5-S (2016)
Station: 241+70
Offset: 31' RT CL WBL
Ground Surface: 426.9'
N Qu W%
Very Stiff Brown Silty Clay to Clay 422.4
Stiff Brown Mottled Gray Clay to Silty Clay 418.9
Stiff Brown Mottled Gray Silty Clay 416.4
Medium to Dense Red Brown Gravel with Clay Binder 401.4
Hard Red and Gray Clay 394.9
Very Stiff Gray and Red Clay 357.4
Stiff Brown Silty Clay with Layers of Clay and Fine Sand Lenses 337.4
Very Stiff Red and Gray Clay with Fine Sand Lenses 327.9
Very Dense Brown and White Medium Grained Sand 307.4
Medium to Soft Gray Silt to Silt Loam 282.4
Medium to Soft Gray Silty Clay Loam 267.4
Very Dense Brown Medium Grained Sand with Clayey Layers 257.4
Stiff Gray and Brown Clay with Sand Seams 237.9
Very Dense Brown Coarse Grained Sand 230.9
2016 BORINGS
SUBSURFACE DATA PROFILE
I-24 OVER COUNTRY CLUB ROAD
F.A.I. RTE. 24 - SEC. 64-3HB(BR-1)
MASSAC COUNTY
STATION 240+78.40
STRUCTURE NO. 064-0045
STRUCTURE NO. 064-0046


Boring 8S (1968)
Station: 240+49.8
Offset: 14' LT WBL
Ground Surface: 426.4'
Boring 7S (1968)
Station: 240+73
Offset: 10' RT WBL
Ground Surface: 424.3'
Boring 6S (1968)
Station: 241+36
Offset: 14' LT WBL
Ground Surface: 425.0'
Boring 5S (1968)
Station: 241+61.7
Offset: 10' RT WBL
Ground Surface: 424.4'
1968 BORINGS (WB)
SUBSURFACE DATA PROFILE
I-24 OVER COUNTRY CLUB ROAD
F.A.I. RTE. 24 - SEC. 64-3HB(BR-1)
MASSAC COUNTY
STATION 240+78.40
STRUCTURE NO. 064-0046



1968 BORINGS (EB)
SUBSURFACE DATA PROFILE
I-24 OVER COUNTRY CLUB ROAD
F.A.I. RTE. 24 - SEC. 64-3HB(BR-1)
MASSAC COUNTY
STATION 240+78.40
STRUCTURE NO. 064-0045

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log
Sheet 1 of 2

FAI 24 Over FAS 962 (Country Club Road)
Route: FAI 24 Structure Number: 064-0027/28 Date: 3/25/2016
Section 64-3 HB Bored By: R Moberly
County: Massac Location: 2 miles North of US 45 Checked By: R Moberly

Boring No 1-S (2016)
Station 240+80
Offset 52' RT CL WBL
Ground Surface 409.1 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 329.6
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description
				Asphalt over crushed aggregate
407.6				
				Stiff, moist, red and grey, Clay A7-6
	1			
	4	1.4B	24	
	4			
404.6				
5.0	4			Stiff, moist, grey and red, Sandy Clay Loam with some gravel
	14	1.2S	16	
	14			
402.1				
	1			Stiff, moist, tan and brown, Silty Clay to Clay A7-6
	3	1.9B	24	
	3			
10.0	1			
	3	1.6B	25	
	3			
397.1				
	1			Very stiff, moist, tan and brown, Clay A7-6
	3	3.1B	22	
	6			
394.6				
15.0	2			Loose or very soft, moist, white and brown, alternating lenses of Fine Sand, Silt and Clay 55% Sand, 26% Silt, 19% Clay
	4	0.2S	20	
	5			
	1			
	2	0.3S	24	
	3			
20.0	2			
	4	0.2S	13	
	5			
386.6	4			
	13		20	Very dense, damp to moist, light grey and brown, Fine Silty Sand to Sand Loam 80% Sand, 16% Silt, 4% Clay
	49			
25.0	11			

DEPTH	BLOWS	Qu tsf	W%	Description
	40			Very dense, damp to moist, light grey and brown, Fine Silty Sand to Sand Loam 80% Sand, 16% Silt, 4% Clay
	46			
382.1				
	4			
	14		6	Medium to dense, moist, light grey and brown, Fine Sand with Silt and Clay Seams 57% Sand, 36% Silt, 7% Clay
	12			
30.0	4			
	11			
	35			
376.6	3			
	16		11	Very dense, damp to moist, white to brown, Fine Sand with some layers and seams of Silty Clay 77% Sand, 19% Silt, 4% Clay
	48			
35.0	2			
	6		5	
	16			
372.1				
	4			Medium dense, moist, light grey and brown, Silt to Silt Loam A-4 5% Sand, 84% Silt, 11% Clay
	6	0.6S	19	
	9			
40.0	2			
	6			
	9			
45.0	2			
	6	0.6S	16	
	10			
50.0	2			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 2

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 3/25/2016

Boring No: 1-S (2016)
Station: 240+80
Offset: 52' RT CL WBL
Ground Surface: 409.1 Ft

	DEPTH	BLOWS	Qu tsf	W%
Medium dense, moist, light grey and brown, Silt to Silt Loam A-4 5% Sand, 84% Silt, 11% Clay		6 8		
	354.6			
Very dense, damp to moist, white and brown, Fine to Medium Sand	55.0	11 45 38		
	344.6			
Loose, moist, white and brown, Fine Sand	65.0	2 3 6		
	339.6			
Very dense, damp to moist, light grey and brown, Fine to Medium Sand	70.0	29 100/6.5"		
	75.0			
Very dense, damp to moist, light grey and brown, Fine to Medium Sand				
	80.0	21 17		
	328.1	14		
Bottom of hole = 81.0 feet Free water observed at 79.5 feet Elevation referenced to BM at NE Corner SN 064-0028; Elevation = 429.3 feet Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) To convert "N" values to "N60" multiply by 1.25				
	85.0			
	90.0			
	95.0			
	100.0			

I-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAI 24 Over FAS 962 (Country Club Road) — Sheet 1 of 3

Route: FAI 24 — Structure Number: 064-0027/28 — Date: 3/28/2016

Section 64-3 HB — Bored By: R Moberly

County: Massac — Location: 2 miles North of US 45 — Checked By: R Moberly

Boring No 2-S (2016)
Station 241+23
Offset 34' LT CL WBL
Ground Surface 408.8 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 339.3
At Completion
At: Hrs: washed

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
Asphalt over crushed aggregate				Medium to dense, moist, white	8		
407.3				and brown, Fine Silty Sand with	30		
Very stiff, moist, red brown and				Clay layers			
grey, Clay A7-6	1			72% Sand, 24% Silt, 4% Clay	5		
	3	2.3B	31		8		9
	4				19		
				379.3			
5.0	1			Very dense, damp, white and	30.0 6		
	4	2.5S	35	brown, Fine Sand	100/11"		5
	5			83% Sand, 15% Silt, 2% Clay			
				376.8			
	1			Medium dense, moist, white and	6		
	3	2.1B	29	brown, Fine Sand with silty seams	12		
	4				7		
				374.3			
10.0	1			Very dense, damp, white and	35.0 10		
	3	2.3B	29	brown, Fine Sand	35		
	4				43		
				371.8			
	1			Soft, very moist, grey and brown,	1		
	4	2.5B	33	Silty Clay A-6 with Sand seams	2	0.4B	26
	4				8		
				369.3			
15.0	1			Soft, very moist, white, Silt Loam	40.0 2		
	4	2.9B	36	A-4 with Clay seams	5	0.4S	27
	5			7% Sand, 78% Silt, 15% Clay	6		
	1						
	4	3.3B	29				
	6						
20.0	2				45.0 2		
	3	2.5S	32		5	0.5S	26
	5				7		
386.8							
Medium to dense, moist, white	2						
and brown, Fine Silty Sand with	5		29				
Clay layers	9						
72% Sand, 24% Silt, 4% Clay				359.3			
25.0	2				50.0 2		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 3

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 3/28/2016

Boring No: 2-S (2016)
Station: 241+23
Offset: 34' LT CL WBL
Ground Surface: 408.8 Ft

	DEPTH	BLOWS	Qu tsf	W%
Soft, moist to very moist, white, Silt to Silt Loam A-4 10% Sand, 81% Silt, 9% Clay		4 6	0.4S	18
	55.0	1		
		5 6	0.4S	21
348.8	60.0	3		
Very dense, damp. white, Fine Sand 90% Sand, 8% Silt, 2% Clay		29 47		5
344.3				
Soft to medium, very moist, brown and grey, Silty Clay A-6 with Sand seams	65.0	1 2 3	0.5B	27
339.3				
Stiff, moist to very moist, grey, Clay A7-6 with Silt seams	70.0	WH WH WH	1.2B	27
333.8	75.0	1		

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, brown mottled grey, Clay A7-6		2 4	1.6B	28
329.3				
Medium, very moist, grey mottled brown, Silty Clay A-6 with Sand seams	80.0	WH		
		1 1	0.8B	26
	85.0			
318.8	90.0	3		
Very dense, moist, brown, Fine to Medium Sand		29 62		
	95.0			
Sand blow-in, washed 4'				
	100.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 3 of 3

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 3/28/2016

Boring No: 2-S (2016)
Station: 241+23
Offset: 34' LT CL WBL
Ground Surface: 408.8 Ft

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
Very dense, moist, brown, Fine to Medium Sand 307.8	100/11"						
Bottom of hole = 101.0 feet							
Free water observed at 69.5 feet							
105.0				130.0			
Elevation referenced to BM at NE corner SN 062-0028; Elevation = 429.3 feet							
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)							
To convert "N" values to "N60" multiply by 1.25							
110.0				135.0			
Wash-out procudures were used from 95.5 to 99.5 feet							
115.0				140.0			
120.0				145.0			
125.0				150.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAI 24 Over FAS 962 (Country Club Road) — Sheet 1 of 2

Route: FAI 24 — Structure Number: 064-0027/28 — Date: 3/29/2016

Section 64-3 HB — Bored By: R Moberly

County: Massac — Location: 2 miles North of US 45 — Checked By: R Moberly

Boring No 3-S (2016)
Station 240+22
Offset 31' Rt CL EBL
Ground Surface 408.7 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description
				Asphalt over crushed aggregate
				407.2
				Medium dense, moist, reddish brown, Sand with some clay
	6			
	11			
	9			
				404.2
5.0	2			Stiff, moist, brown and tan, Silty Clay to Silty Clay Loam A-6
	3	1.2B	30	
	4			
				401.7
	1			Stiff, moist to very moist, grey and brown, Clay A7-6 with Silt lenses
	2	1.1B	26	
	3			
10.0	1			
	2	1.2B	25	
	3			
				396.7
	1			Very stiff, damp, brown, Clay A7-6
	4	3.9B	27	
	12			
				394.2
15.0	2			Medium, very moist, grey and brown, Silty Clay A-6 with many Fine Sand seams
	4	0.8E	19	
	6			
				391.7
	1			Soft, very moist, grey and brown, layers of Sand, Silt and Clay 64% Sand, 20% Silt, 16% Clay
	3	0.3B	23	
	4			
20.0	2			
	4	0.4S	16	
	6			
				386.7
	5			Very dense, damp, white and brown, Fine Sand
	26			
	58			
25.0	14			

DEPTH	BLOWS	Qu tsf	W%	Description
	36			Very dense, damp, white and brown, Fine Sand
	35			
	9			
	27			
	30			
30.0	16			
	34			
	36			
				376.7
	12			Dense, damp, white and brown, Fine Sand with occasional layers of clayey Sand
	14			
	34			
35.0	14			
	27			
	16			
				371.7
	2			Soft to medium, moist, grey and brown, Silt Loam A-4 with Clay lenses
	4	0.5B	23	11% Sand, 78% Silt, 14% Clay
	7			
40.0	2			
	3	0.5B	24	
	6			
45.0	3			
	2	0.6B	26	
	3			
50.0	2			

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 2

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 3/29/2016

Boring No: 3-S (2016)
Station: 240+22
Offset: 31' Rt CL EBL
Ground Surface: 408.7 Ft

	DEPTH	BLOWS	Qu tsf	W%
Soft to medium, moist, grey and brown, Silt Loam A-4 with Clay lenses		4 5	0.5B	22
	354.2			
Very Dense, damp, brown, Fine Sand	55.0	15 100/7"		
	60.0	20 100/10"		
	347.7			
Bottom of hole = 60.9 feet No free water observed	65.0			
Elevation referenced to BM at NE corner SN 064-0028; Elevation = 429.3 feet Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) To convert "N" values to "N60" multiply by 1.25	70.0			
	75.0			
	80.0			
	85.0			
	90.0			
	95.0			
	100.0			

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log
Sheet 1 of 2

FAI 24 Over FAS 962 (Country Club Road)

Route: FAI 24 Structure Number: 064-0027/28 Date: 4/5/2016
Section 64-3 HB Bored By: R Moberly
County: Massac Location: 2 miles North of US 45 Checked By: R Moberly

Boring No 4-S (2016)
Station 240+32
Offset 19' Lt CL WBL
Ground Surface 427.3 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling
At Completion 330.8
At: 72 Hrs: 335.3 feet

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
Asphalt over crushed aggregate				Stiff, moist, grey and brown, Clay	3	1.8B	22
				A7-6 with Silt and Sand lenses	5		
				400.3			
424.8	6			Very stiff, moist, grey, Clay A7-6	2		
Medium dense, moist, red, Gravel	4		11	with scattered Silt lenses	4	2.7B	23
with Clay binder	6				6		
422.8							
Stiff, moist, brown mottled grey, 5.0	1			30.0	2		
Silty Clay to Clay A7-6	3	1.4B	25		4	3.7B	26
	3				6		
				395.3			
	1			Soft, very moist, grey and brown,	2		
	4	1.5B	22	Sandy Clay Loam A-4	4	0.3S	20
	5				6		
10.0	2			35.0	1		
	3	1.6B	20		3	0.3S	25
	5				5		
	1				2		
	4	1.6B	24		4	0.3S	15
	7				6		
412.8							
Medium, moist to very moist, red, 15.0	5			40.0	1		
Sandy Clay Loam to Sandy Clay	11	0.8S	21		7	0.4S	20
A-4	12				10		
	4						
	12	0.8E	19				
	18						
407.8				382.8			
Dense, moist, red brown, Silty 20.0	6			Medium dense, moist, grey and 45.0	6		
Sand to Sand Loam	24		18	brown, Fine Silty Sand with Clay	9		11
79% Sand, 7% Silt, 14% Clay	24			lenses	12		
				60% Sand, 32% Silt, 8% Clay			
405.3							
Medium, very moist, grey and	2						
brown, Silty Clay A-6 with Silt	3	0.8S	25				
lenses	4						
402.8				377.8			
25.0	2			50.0	7		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 2

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 4/5/2016

Boring No: 4-S (2016)
Station: 240+32
Offset: 19' Lt CL WBL
Ground Surface: 427.3 Ft

	DEPTH	BLOWS	Qu tsf	W%
Very dense, damp to moist, white and brown, Fine Silty Sand 73% Sand, 23% Silt, 4% Clay		100/11"		6
372.8				
Very dense, damp, white and brown, Fine Sand 88% Sand, 9% Silt, 3% Clay	55.0	12		
		29		3
		25		
367.8				
Medium dense, moist, grey to white, Silt 4% Sand, 88% Silt, 8% Clay	60.0	3		
		10		14
		12		
	65.0	2		
		7		
		10		
357.8				
Medium to soft, moist, grey, Silt Loam to Silty Clay Loam A-4	70.0	2		
		4	0.5B	23
		7		
352.8				
	75.0	7		

	DEPTH	BLOWS	Qu tsf	W%
Very dense, damp, white and brown, Fine Sand		31		
		62		
	80.0	21		
		100/6"		
	85.0	12		
		37		
341.3		60		
Bottom of sampling = 86.0 feet				
No free water encountered				
Boring was advanced to 99.5 feet to observe free water. Noted at 96.5 feet at completion, and boring remained open for 72 hours.	90.0			
Elevation referenced to BM at NE corner of SN 064-0028; Elevation = 429.3 feet				
Borehole advanced with hollow stem auger (8" O.D., 3.25" I.D.)				
To convert "N" values to "N60" multiply by 1.25	95.0			
	100.0			

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log
Sheet 1 of 3

FAI 24 Over FAS 962 (Country Club Road)
Route: FAI 24 Structure Number: 064-0028 Date: 4/14/2016
Section 64-3 HB Bored By: R Moberly
County: Massac Location: 2 miles North of US 45 Checked By: R Moberly

Boring No 5-S (2016)
Station 241+70
Offset 31' Rt CL WBL
Ground Surface 426.9 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 345.9
At Completion
At: Hrs: (washed)

DEPTH	BLOWS	Qu tsf	W%	Description
				Very stiff, moist, brown, Silty Clay to Clay A-6
	2			
	5	2.3S	18	
	6			
422.4				
5.0	1			Stiff, moist, brown mottled grey, Clay to Silty Clay A7-6
	4	1.5B	23	
	4			
419.9				
	1			Stiff, moist to very moist, brown mottled grey, Silty Clay A-6
	3	1.1B	26	
	4			
10.0	1			
	3	1.0B	20	
	3			
	1			
	3	1.1B	22	
	3			
412.4				
15.0	5			Medium to dense, moist, red brown, Gravel with Clay binder
	13			
	15			
	5			
	14			
	16			
407.4				
20.0	2			Hard, damp to moist, red and grey, Clay A7-6
	6	5.4B	19	
	8			
404.9				
	1			Very stiff, moist, grey and red, Clay A7-6
	4	3.1S	29	
	6			
25.0	1			

DEPTH	BLOWS	Qu tsf	W%	Description
	4	2.8S	34	Very stiff, moist, grey and red, Clay A7-6
	5			
	1			
	4	3.5S	37	
	5			
30.0	1			
	3	2.7S	35	
	5			
	1			
	3	2.7B	34	
	4			
35.0	1			
	3	2.2B	31	
	3			
	1			
	3	2.3B	36	
	4			
387.4				
40.0	1			Stiff, moist, brown, Clay A7-6
	3	1.9B	29	
	5			
382.4				
45.0	1			Stiff, moist, brown, Silty Clay A-6 with layers of Clay A7-6 and Fine Sand lenses
	2	1.2B	29	
	3			
377.4				
50.0	1			

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 3

Route: FAI 24
Section: 64-3 HB
County: Massac
Date: 4/14/2016

Boring No: 5-S (2016)
Station: 241+70
Offset: 31' Rt CL WBL
Ground Surface: 426.9 Ft

	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, red and grey, Clay A7-6 with Fine Sand lenses		3 4	2.3B	39
	371.9	55.0	2	
Very dense, damp, brown and white, Medium grained Sand		24 60		
	367.4			
Medium to soft, moist to very moist, grey, Silt to Silt Loam A-4 3% Sand, 84% Silt, 13% Clay	60.0	2		
		6 8	0.7S	17
	65.0	2		
		4 7	0.4S	16
	70.0	2		
		6 7	0.3S	15
	352.4			
	75.0	1		

	DEPTH	BLOWS	Qu tsf	W%
Medium to soft, very moist, grey, Silty Clay Loam A-4		2 4	0.5B	24
	347.4			
Very dense, moist to very moist, brown, medium grained Sand with clayey layers	80.0	24 45 16		
	337.4			
Stiff, moist to very moist, grey and brown, Clay A7-6 with Sand seams	90.0	1		
		2 3	1.2B	23
	95.0			
Sand blow-in, washed 4'	327.9			
Very dense, moist, brown, Coarse grained Sand	100.0	12		

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAI 24
Section: 64-3 HB
County: Massac

Sheet 3 of 3
Date: 4/14/2016

Boring No: 5-S (2016)
Station: 241+70
Offset: 31' Rt CL WBL
Ground Surface: 426.9 Ft

DEPTH	BLOWS	Qu tsf	W%
	21		
Very dense, moist, brown, Coarse grained Sand	47		
105.0	14		
	24		
320.9	52		
110.0			
115.0			
120.0			
125.0			

DEPTH	BLOWS	Qu tsf	W%
130.0			
135.0			
140.0			
145.0			
150.0			

Bottom of hole = 106.0 feet

Free water observed at 81.0 feet

Elevation referenced to BM at NE corner SN 064-0028; Elevation = 429.3 feet

Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)

To convert "N" values to "N60" multiply by 1.25

Washout procedures were used from 99.5 to 104.5 feet

-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ORM NO. B. D. 137 REV. 9-60 Sh. of S

BRIDGE FOUNDATION BORING LOG

PROJECT -
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 1S
Station 239+85.3
Offset 14' RT EBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4=20+00 TR 115

Date JUNE, 1968
Bored By JOEL CONGIARDO
Checked By GARY PULLEY

Surface Water El. NONE
Groundwater El. at Completion NONE
After - Hours -

Elevation	N	Qu t/s.f.	w (%)	Description
426.1				round Surface
				MEDIUM VERY MOIST BROWN SILTY CLAY A-6(10)
423.1				
	10	0.9B	28	MEDIUM MOIST BROWN MOTTLED GREY SILTY CLAY TO SILTY CLAY LOAM A-6(9-10)
-5				
	7	0.9B	25	
	27	1.1B	21	
-10				
415.6				
	18	2.6B	16	VERY STIFF MOIST BROWN MOTTLED RED CLAY & GRAVEL
413.1				
	13	2.3S	28	VERY STIFF MOIST GREY MOTTLED BROWN & RED CLAY A7-6(20)+
-15				
410.6				
	60	-	13	VERY DENSE BROWN COARSE SAND AND GRAVEL
408.1				
	12	1.2B	21	STIFF TO MEDIUM MOIST BROWN MOTTLED GREY VARVED CLAY A-6(10-11)
-20				
	10	0.7B	26	

Elevation	N	Qu t/s.f.	Description
			SEE PREVIOUS COLUMN
	8	0.8B	
-25			
400.6			
	11	2.4B	VERY STIFF MOIST GREY MOTTLED RED CLAY A7-6(20)+
398.1			
	11	4.0B	VERY STIFF MOIST BROWN CLAY TO CLAY SHALE
-30			
395.6			
	15	-	MEDIUM DAMP GREY MOTTLED RED SANDY CLAY LOAM A-4(3)
393.1			
	16	0.7S	MEDIUM DAMP GREY MOTTLED BROWN SANDY CLAY LOAM A-4(4)
-35			
390.6			
	23	-	MEDIUM DAMP FINE GRAINED GREY SAND
388.1			
	38	-	DENSE TO VERY DENSE DAMP WHITE FINE GRAINED SAND
-40			
384.6	61	-	
			BOTTOM OF HOLE = 41.5 FEET
-45			

-Standard Penetration Test- ows per foot to drive 2" D. Split Spoon Sampler 12" with 0# hammer falling 30".

Qu - Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight - %.

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value

ORM NO. B. D. 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT -
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 2 S
Station 240+30.5
Offset 10' LT EBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4=20+00 TR 115

Date JUNE 1968
Bored By JOEL CONGIARDO
Checked By GARY PULLEY

Surface Water El. NONE
Groundwater El. at Completion NONE
After ___ Hours -

Elevation		N	Qu t/s.f.	w (%)
ound Surface 426.1	0			
MEDIUM VERY MOIST BROWN SILTY CLAY A-6(10)				
423.1				
MEDIUM MOIST BROWN MOTTLED GREY SILTY CLAY TO SILTY CLAY LOAM A-6(9-10)	-5	10	0.9B	28
		7	0.9B	25
	-10	27	1.1B	21
415.6				
ERY STIFF MOIST BROWN MOTTLED ED CLAY & GRAVEL		18	2.6B	16
413.1				
ERY STIFF MOIST GREY MOTTLED ROWN & RED CLAY A7-6(20)+		13	2.3S	28
	-15			
410.6				
ERY DENSE MOIST REDDISH ROWN FINE GRAINED SAND		71	-	-
		97	-	-
	-20			
405.6				
EDIUM VERY MOIST GREY MOTTLED EDDISH BROWN VARVED CLAY -6(12)		8	0.7S	27

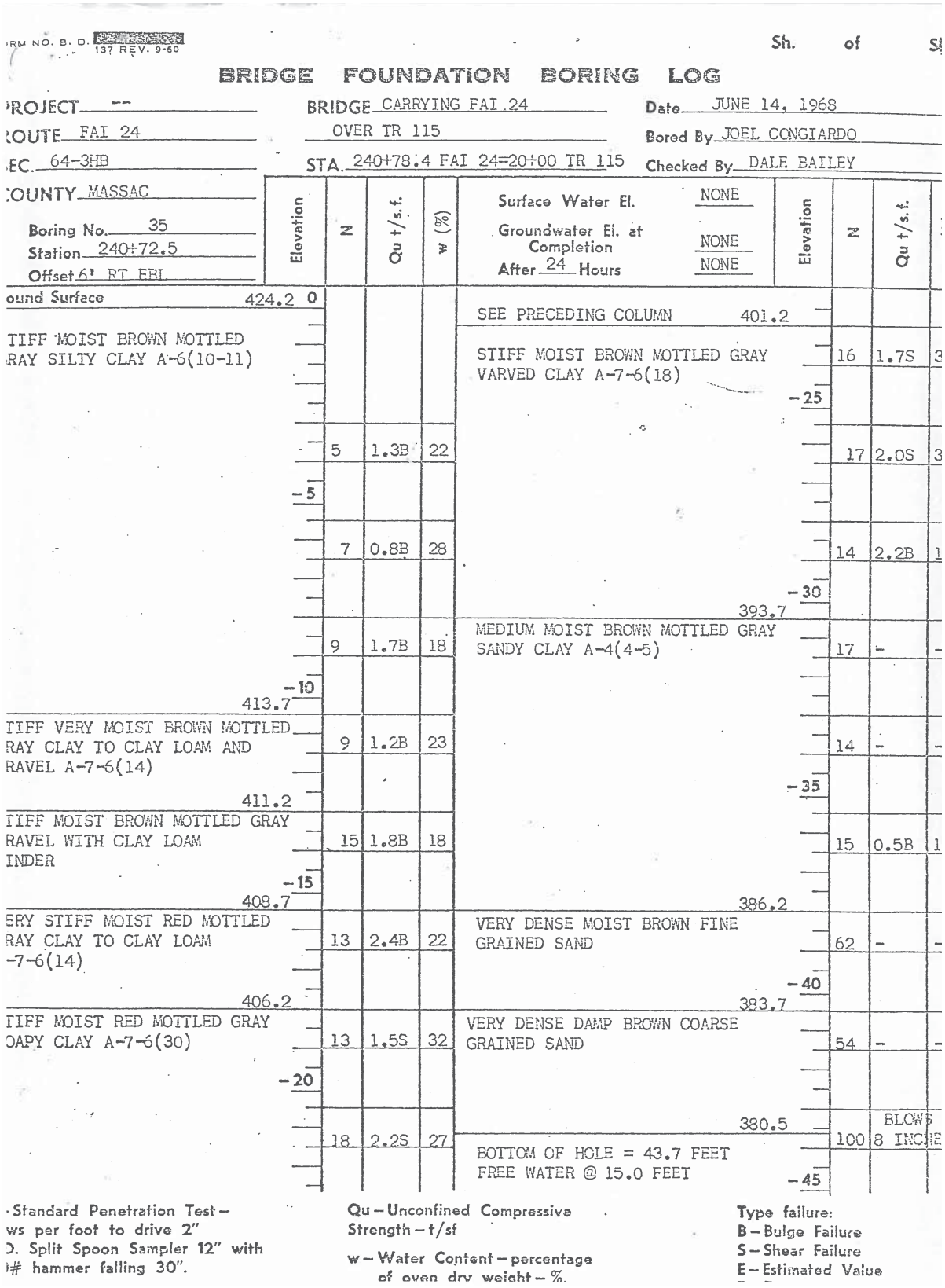
Elevation		N	Qu t/s.f.
SEE PREVIOUS COLUMN			
		9	1.1B
400.6	-25		
VERY STIFF MOIST GREY SOAPY CLAY A7-6(20)		9	2.2B
398.1			
VERY STIFF MOIST BROWN CLAY TO CLAY SHALE		30	3.9B
395.6	-30		
MEDIUM DAMP BROWN MOTTLED GREY & WHITE SANDY CLAY LOAM A-4(0)		16	-
		15	-
390.6	-35		
MEDIUM DAMP FINE GRAINED BROWN MOTTLED GREY SAND		18	-
		21	-
385.6	-40		
DENSE TO VERY DENSE DAMP MEDIUM GRAINED BROWN MOTTLED WHITE SAND		49	-
382.1		82	-
BOTTOM OF HOLE = 44.0 FEET	-45		

·Standard Penetration Test—
ws per foot to drive 2"
D. Split Spoon Sampler 12" with
)# hammer falling 30".

Qu—Unconfined Compressive Strength—t/sf

w—Water Content—percentage of oven dry weight—%.

Type failure:
B—Bulge Failure
S—Shear Failure
E—Estimated Value



FORM NO. B. D. 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT --
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 35
Station 240+72.5
Offset 6' RT EBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4 FAI 24=20+00 TR 115

Date JUNE 14, 1968
Bored By JOEL CONGIARDO
Checked By DALE BAILEY

Surface Water El. NONE
Groundwater El. at Completion NONE
After 24 Hours NONE

Elevation		N	Qu t/s.f.	w (%)
ound Surface	424.2			
	0			
TIFF MOIST BROWN MOTTLED RAY SILTY CLAY A-6(10-11)				
		5	1.3B	22
	-5			
		7	0.8B	28
		9	1.7B	18
	-10			
	413.7			
IIFF VERY MOIST BROWN MOTTLED RAY CLAY TO CLAY LOAM AND RAVEL A-7-6(14)		9	1.2B	23
	411.2			
IIFF MOIST BROWN MOTTLED GRAY RAVEL WITH CLAY LOAM INDER		15	1.8B	18
	-15			
	408.7			
ERY STIFF MOIST RED MOTTLED RAY CLAY TO CLAY LOAM -7-6(14)		13	2.4B	22
	406.2			
IIFF MOIST RED MOTTLED GRAY OAPY CLAY A-7-6(30)		13	1.5S	32
	-20			
		18	2.2S	27

Elevation		N	Qu t/s.f.
SEE PRECEDING COLUMN	401.2		
STIFF MOIST BROWN MOTTLED GRAY VARVED CLAY A-7-6(18)		16	1.7S
	-25		
		17	2.0S
		14	2.2B
	-30		
	393.7		
MEDIUM MOIST BROWN MOTTLED GRAY SANDY CLAY A-4(4-5)		17	-
		14	-
	-35		
		15	0.5B
	386.2		
VERY DENSE MOIST BROWN FINE GRAINED SAND		62	-
	-40		
	383.7		
VERY DENSE DAMP BROWN COARSE GRAINED SAND		54	-
	380.5		
BOTTOM OF HOLE = 43.7 FEET FREE WATER @ 15.0 FEET		100	BLOWS 8 INCHE
	-45		

·Standard Penetration Test—
ws per foot to drive 2"
D. Split Spoon Sampler 12" with
l# hammer falling 30".

Qu—Unconfined Compressive Strength—t/sf

w—Water Content—percentage of oven dry weight—%.

Type failure:
B—Bulge Failure
S—Shear Failure
E—Estimated Value

RM ·O. B. D [redacted] 137 REV. 9-60 Sh. of S

BRIDGE FOUNDATION BORING LOG

PROJECT -- BRIDGE CARRYING FAI 24 Date JUNE 7, 1968
ROUTE FAI 24 OVER TR 115 Bored By JOEL CONGIARDO
SEC. 64-3HB STA. 240+78.4 FAI 24=20+00 TR 115 Checked By DALE BAILEY
COUNTY MASSAC
Boring No. 4 S
Station 241+17.8
Offset 8' LEFT EBL

Surface Water El. NONE
Groundwater El. at Completion
After ___ Hours

Elevation	N	Qu t/s.f.	w (%)	
ound Surface 424.7				
0				
TIFF MOIST BROWN MOTTLED RAY SILTY CLAY A-6(10-11)				
	5	1.3B	22	
-5				
	7	0.8B	28	
	9	1.7B	18	
-10 414.2				
TIFF VERY MOIST BROWN MOTTLED RAY CLAY TO CLAY LOAM & RAVEL A-7-6(14)	9	1.2B	23	
411.7				
TIFF MOIST BROWN MOTTLED GRAY RAVEL WITH CLAY LOAM INDER	15	1.8B	18	
-15 409.2				
ERY STIFF MOIST RED MOTTLED RAY CLAY TO CLAY LOAM -7-6(14)	13	2.4B	22	
406.7				
E NEXT COLUMN	10	2.6S	35	
-20				
	12	2.2B	28	

Elevation	N	Qu t/s.f.	
VERY STIFF MOIST RED MOTTLED GRAY CLAY A-7-6(30)			
	11	2.4B	4
-25			
	12	3.3S	3
	17	3.4S	2
-30 394.2			
VERY STIFF MOIST RED MOTTLED GRAY CLAY TO CLAY LOAM A-4(8)	12	2.4B	3
	11	2.2S	3
-35			
	10	2.2S	2
396.7			
MEDIUM MOIST BROWN SANDY CLAY LOAM A-4(3)	14	1.9S	2
-40			
	14	-	2
	14	1.3S	2
-45			

Standard Penetration Test — vs per foot to drive 2" . Split Spoon Sampler 12" with # hammer falling 30".

Qu — Unconfined Compressive Strength — t/sf

w — Water Content — percentage of ... dry weight of

Type failure:
B — Bulge Failure
S — Shear Failure
E — Estimated Value

FORM NO. B. D. 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT -- BRIDGE CARRYING FAI 24 Date JUNE 7, 1968

ROUTE FAI 24 OVER TR 115 Bored By JOEL CONGIARDO

SEC. 64-3HB STA. 240+78.4 FAI 24-20+00 TR 115 Checked By DALE BAILEY

COUNTY MASSAC

Boring No. 4 S
Station 241+17.8
Offset 8' LT WBL

Surface Water El. NONE
Groundwater El. at Completion
After ___ Hours

	Elevation	N	Qu t/s.f.	w (%)
ound Surface	40			
EDIUM MOIST BROWN SANDY LAY LOAM		14	-	21
		14	1.3S	23
ERY DENSE BROWN OARSE GRAINED AND	45 / 379.2			
	378.3	100	BLOWS 9 INCHES	
OTTOM OF HOLE = 46.4 FEET				
URING DRILLING OPERATIONS T APPEARED THAT FREE WATER AS ENCOUNTERED AT 10.5 FEET				
	50 -10			
	55 -15			
	60 -20			
	65 -25			
	70 -30			
	75 -35			
	80 -40			
	85 -45			

- Standard Penetration Test –
ows per foot to drive 2"
D. Split Spoon Sampler 12" with
0# hammer falling 30".

Qu – Unconfined Compressive Strength – t/sf

w – Water Content – percentage of oven dry weight – %.

Type failure:
B – Bulge Failure
S – Shear Failure
E – Estimated Value

ORM NO. B. D. 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT -- BRIDGE CARRYING FAI 24 Date JUNE 10, 1968

ROUTE FAI 24 OVER TR 115 Bored By JOEL CONGIARDO

SEC. 64-3HB STA. 240+78.4=20+00 TR 115 Checked By DALE BAILEY

COUNTY MASSAC

Boring No. 5 S

Station 241+61.7

Offset 10' RT WBL

Surface Water El. NONE

Groundwater El. at Completion NONE

After 24 Hours 412.6

Elevation	N	Qu t/s.f.	w (%)
ound Surface 424.4 0			
MEDIUM MOIST BROWN MOTTLED GRAY SILTY CLAY TO SILTY CLAY LOAM A-6(9-11)			
	9	0.9S	25
-5			
	8	0.8S	22
	9	1.0S	20
-10 413.9			
TIFF VERY MOIST BROWN MOTTLED RAY CLAY TO CLAY LOAM -6(11) SOME GRAVEL	10	1.2S	22
411.4			
ERY DENSE TO MEDIUM MOIST ED TO BROWN COARSE GRAVEL LAY BINDER	60	-	
-15			
	22	-	9
406.4			
ERY STIFF MOIST RED MOTTLED RAY CLAY A-7-6(30)	13	2.9S	31
-20			
	15	2.6S	34

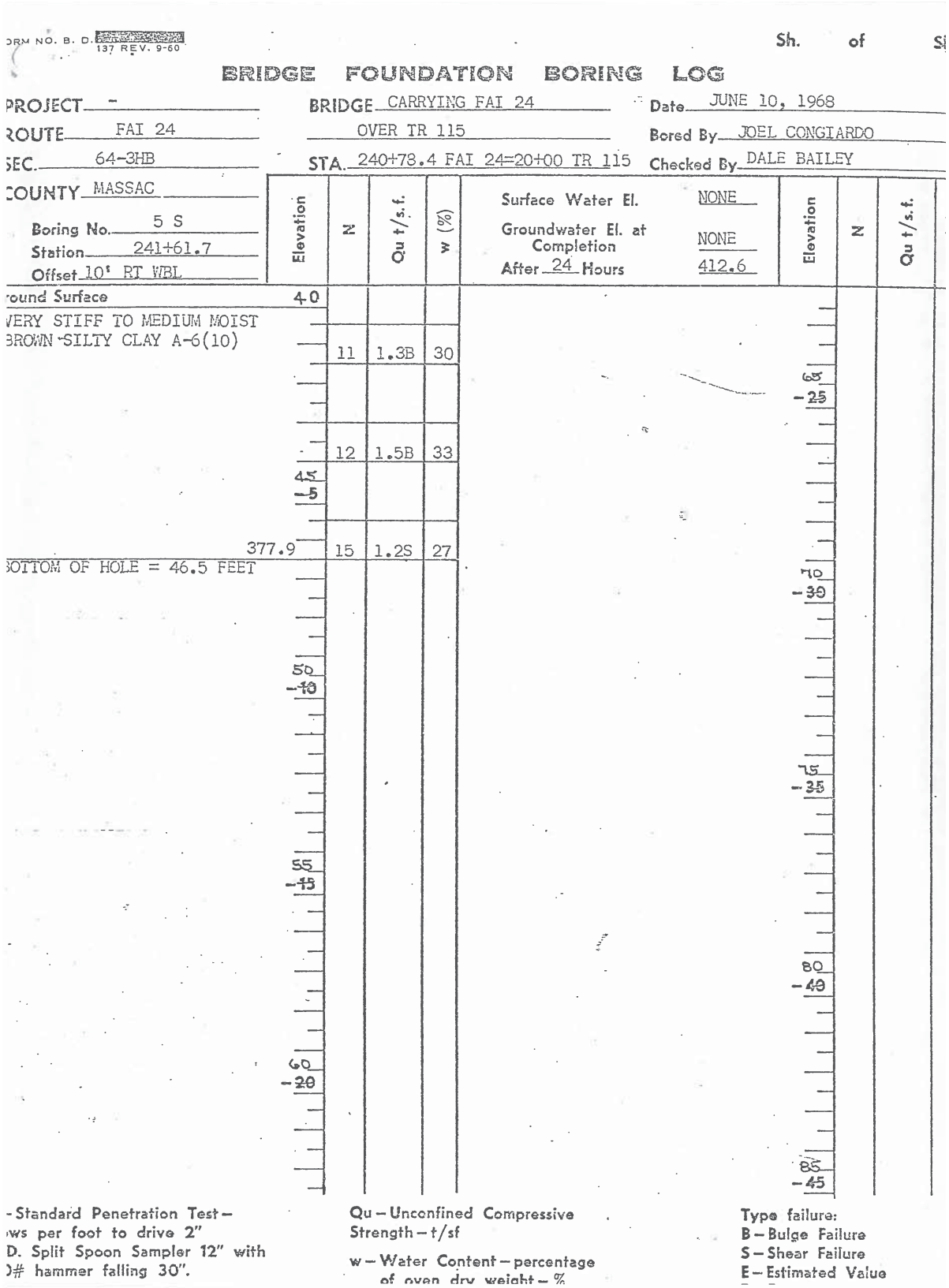
Elevation	N	Qu t/s.f.	
SEE PRECEDING COLUMN 401.4			
VERY STIFF MOIST RED MOTTLED GRAY CLAY TO CLAY LOAM A-6(10)	15	2.7S	2
-25			
	15	2.7S	3
	15	2.6S	3
-30			
	14	2.2S	2
	16	2.3S	3
-35 388.9			
TIFF MOIST BROWN MOTTLED GRAY CLAY LOAM A-4(8)	15	1.9S	2
386.4			
VERY STIFF TO MEDIUM MOIST BROWN SILTY CLAY A-6(10)	15	2.2B	2
-40			
	11	1.3B	3
	12	1.5B	3
-45			

-Standard Penetration Test—
ws per foot to drive 2"
D. Split Spoon Sampler 12" with
0# hammer falling 30".

Qu—Unconfined Compressive Strength—t/sf

w—Water Content—percentage of oven dry weight—%

Type failure:
B—Bulge Failure
S—Shear Failure
E—Estimated Value



FORM NO. B. D. [redacted] 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT -
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 5 S
Station 241+61.7
Offset 10' RT WBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4 FAI 24=20+00 TR 115

Date JUNE 10, 1968
Bored By JOEL CONGIARDO
Checked By DALE BAILEY

Surface Water El. NONE
Groundwater El. at Completion NONE
After 24 Hours 412.6

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 404			
VERY STIFF TO MEDIUM MOIST BROWN SILTY CLAY A-6(10)	11	1.3B	30
	12	1.5B	33
377.9	15	1.2S	27
BOTTOM OF HOLE = 46.5 FEET			

Elevation: 65 -25; 70 -30; 75 -35; 80 -40; 85 -45

N - Standard Penetration Test - Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140# hammer falling 30".

Qu - Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight - %

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value

R[illegible] O. B. D. [illegible] 137 REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT -- BRIDGE CARRYING FAI 24 Date JUNE 5, 1968

ROUTE FAI 24 @VER TR 115 Bored By JOEL CONGIARDO

SEC. 64-3HB STA. 240+78.4 FAI 24=20+00 TR 115 Checked By DALE BAILEY

COUNTY MASSAC

Boring No. 6 S

Station 241+36

Offset 14' LT WBL

Surface Water El. NONE

Groundwater El. at Completion

After ___ Hours

Elevation	N	Qu t/s.f.	w (%)	Description
ound Surface 425.0				
0				
422.0				
EDIUM MOIST BROWN CLAY LOAM -4(7)	8	1.8P	20	
-5				
419.5				
EDIUM MOIST GRAY STREAKED ROWN SILTY CLAY LOAM TO ILTY CLAY A-6(10)	10	1.0S	17	
417.0				
EDIUM MOIST BROWN SILTY CLAY) CLAY LOAM A-6(10) AND GRAVEL	10	1.0B	18	
-10				
414.5				
ERY STIFF MOIST BROWN GRAVELLY LAY	15	2.1B	21	
412.0				
EDIUM MOIST RED MOTTLED GRAY INE GRAINED SAND	30	0.9S	19	
-15				
409.5				
ERY DENSE MOIST REDDISH BROWN OARSE GRAINED SAND	80	-	-	
407.0				
ERY STIFF MOIST RED MOTTLED AY SOAPY CLAY A-7-6(20)	12	2.4S	30	
-20				
	12	1.5S	37	

Elevation	N	Qu t/s.f.	
			SEE PRECEDING COLUMN
	12	1.9B	3
-25			
399.5			
	11	2.3S	3
	9	2.3S	3
-30			
	9	2.0S	2
	8	1.8B	3
-35			
	8	2.3B	2
	9	2.0S	3
-40			
384.5			
	8	2.0B	2
	11	1.3S	3
-45			

VERY STIFF MOIST RED MOTTLED GRAY CLAY A-7-6(15) SOME GRAVEL MIXED

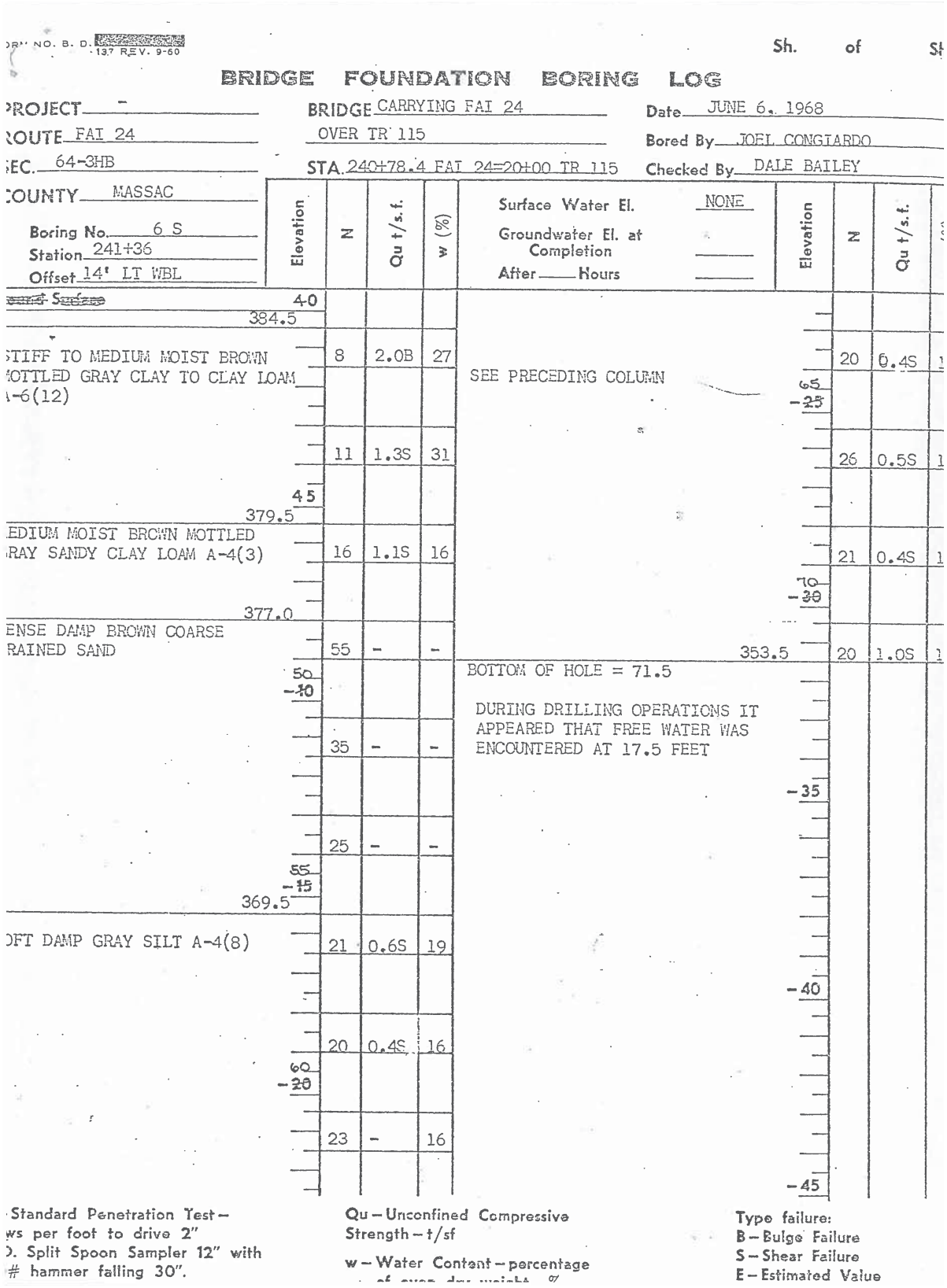
STIFF TO MEDIUM MOIST BROWN MOTTLED GRAY CLAY TO CLAY LOAM A-6(12)

Standard Penetration Test -- [illegible] per foot to drive 2" [illegible]. Split Spoon Sampler 12" with [illegible]# hammer falling 30".

Qu - Unconfined Compressive Strength - t/sf

w - Water Content - percentage

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value



DR' NO. B. D. [redacted] 137 REV. 9-60

Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT –
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 6 S
Station 241+36
Offset 14' LT WBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4 FAI 24=20+00 TR 115

Date JUNE 6, 1968
Bored By JOEL CONGIARDO
Checked By DALE BAILEY

Surface Water El. NONE
Groundwater El. at Completion
After ___ Hours

Elevation	N	Qu t/s.f.	w (%)	Description
~~Ground~~ Surface				
40 / 384.5				
	8	2.0B	27	STIFF TO MEDIUM MOIST BROWN MOTTLED GRAY CLAY TO CLAY LOAM A-6(12)
	11	1.3S	31	
45 / 379.5				
	16	1.1S	16	MEDIUM MOIST BROWN MOTTLED GRAY SANDY CLAY LOAM A-4(3)
377.0				
	55	–	–	DENSE DAMP BROWN COARSE GRAINED SAND
50 / -10				
	35	–	–	
	25	–	–	
55 / -15 / 369.5				
	21	0.6S	19	SOFT DAMP GRAY SILT A-4(8)
	20	0.4S	16	
60 / -20				
	23	–	16	

SEE PRECEDING COLUMN

Elevation	N	Qu t/s.f.
	20	0.4S
65 / -25		
	26	0.5S
	21	0.4S
70 / -30		
353.5	20	1.0S

BOTTOM OF HOLE = 71.5

DURING DRILLING OPERATIONS IT APPEARED THAT FREE WATER WAS ENCOUNTERED AT 17.5 FEET

-35
-40
-45

Standard Penetration Test – ws per foot to drive 2" O. Split Spoon Sampler 12" with # hammer falling 30".

Qu – Unconfined Compressive Strength – t/sf

w – Water Content – percentage of oven dry weight %

Type failure:
B – Bulge Failure
S – Shear Failure
E – Estimated Value

D. B. D. 137 REV. 9-60

Sh. of Sh

BRIDGE FOUNDATION BORING LOG

ROJECT --
OUTE FAI 24
EC. 64-3HB
OUNTY MASSAC
Boring No. 7 S
Station 240+73
Offset 10' RT WBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4 FAI 24=20+00 TR 115

Date JUNE 4, 1968
Bored By JOEL CONGIARDO
Checked By DALE BAILEY

Surface Water El. NONE
Groundwater El. at Completion -
After - Hours -

	Elevation	N	Qu t/s.f.	w (%)
ound Surface	424.3 0			
	421.3			
EDIUM MOIST BROWN CLAY LOAM -4(7)		8	1.8P	20
	-5 418.8			
EDIUM MOIST GRAY STREAKED ROWN SILTY CLAY LOAM TO ILTY CLAY A-6(10)		10	1.0S	17
	416.3			
EDIUM MOIST BROWN SILTY LAY TO CLAY LOAM -6(10) & GRAVEL		10	1.0B	18
	-10 413.8			
ERY STIFF MOIST BROWN RAVELLY CLAY		15	2.1B	21
	411.3			
EDIUM MOIST RED MOTTLED RAY FINE GRAINED SAND		30	0.9S	19
	-15 408.8			
ERY DENSE MOIST REDDISH ROWN COARSE GRAINED SAND		80	-	-
		68	-	-
	-20 403.8			
ENSE MOIST BROWN MOTTLED GRAY INE GRAINED SAND		30	-	-

	Elevation	N	Qu t/s.f.
SEE PRECEDING COLUMN	401.3		
STIFF MOIST RED MOTTLED GRAY VARVED CLAY LOAM		14	1.4B
	-25		
	396.3	12	1.3B
VERY STIFF MOIST GRAY MOTTLED . BROWN SOAPY CLAY A-7-6(30)		16	2.7B
	-30 393.8		
SOFT MOIST BROWN MOTTLED GRAY SANDY CLAY A-4(3)		13	0.3B
		13	-
	-35 388.8		
MEDIUM MOIST GRAY FINE TO COARSE GRAINED SAND		14	-
	385.3	100	BLOWS 10 INCH
BOTTOM OF HOLE = 39.0 FEET	-40		
DURING DRILLING OPERATIONS IT APPEARED THAT FREE WATER WAS ENCOUNTERED AT 15.5 FEET			
	-45		

- Standard Penetration Test — ws per foot to drive 2" D. Split Spoon Sampler 12" with

Qu — Unconfined Compressive Strength — t/sf

w — Water Content — percentage

Type failure:
B — Bulge Failure
S — Shear Failure

ORM NO. B. D. 137, REV. 9-60 Sh. of Sh

BRIDGE FOUNDATION BORING LOG

PROJECT
ROUTE FAI 24
SEC. 64-3HB
COUNTY MASSAC
Boring No. 8 S
Station 240+49.8
Offset 14' LT WBL

BRIDGE CARRYING FAI 24 OVER TR 115
STA. 240+78.4=20+00 TR 115

Date JUNE 1968
Bored By JOEL CONGIARDO
Checked By GARY PULLEY

Surface Water El. NONE
Groundwater El. at Completion NONE
After ____ Hours

Elevation	N	Qu t/s.f.	w (%)	Description
426.4				ound Surface
423.4				
	8	1.8P	20	EDIUM MOIST BROWN CLAY LOAM -4(7)
420.9				
	10	1.0S	17	EDIUM MOIST GREY STREAKED ROWN SILTY CLAY LOAM TO ILTY CLAY A-6(10)
418.4				
	10	1.0B	18	EDIUM MOIST BROWN SILTY CLAY O CLAY LOAM A-6(10) & GRAVEL
415.9				
	15	2.1B	21	ERY STIFF MOIST BROWN RAVELLY CLAY
413.4				
	30	0.9S	19	EDIUM MOIST RED MOTTLED GREY ND BROWN SANDY CLAY A-4(8)
410.9				
	38	-	16	ENSE MOIST RED MOTTLED GREY INE GRAINED SAND
408.4				
	91	-	-	ERY DENSE MOIST RED COARSE RAINED SAND
405.9				
	13	-	-	EDIUM MOIST BROWN VERY FINE RAINED SAND WITH SOME GRAVEL

Elevation	N	Qu t/s.f.	Description
403.4			SEE PREVIOUS COLUMN
	10	1.1B	STIFF TO MEDIUM MOIST RED MOTTLED GREY VARVED CLAY
	11	3.7B	
398.4			
397.4	14	2.9B	VERY STIFF MOIST BROWN VARVED CLAY
			BOTTOM OF HOLE = 29.0 FEET

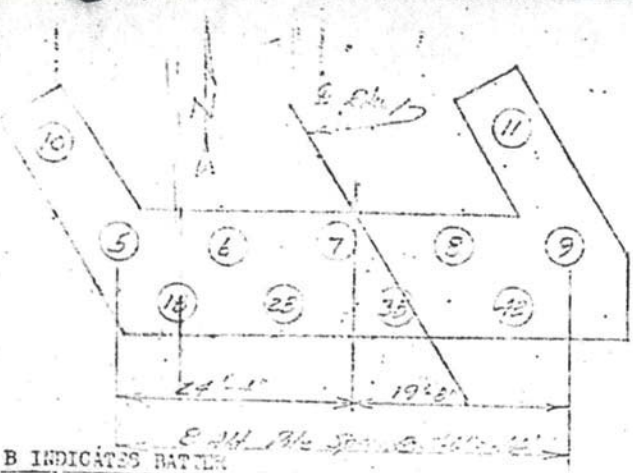
-Standard Penetration Test—
ws per foot to drive 2"
D. Split Spoon Sampler 12" with
)# hammer falling 30".

Qu—Unconfined Compressive Strength—t/sf

w—Water Content—percentage of oven dry weight—%.

Type failure:
B—Bulge Failure
S—Shear Failure
E—Estimated Value

PILING DIAGRAM SHEET NO. 1 OF 5



COUNTY Massac
SECTION 64-3HB
ROUTE FAI 24
DISTRICT 9
CONTRACT NO. 28060
JOB NO. C-89-107-70
PROJECT I-24-1(48)34

LOCATION

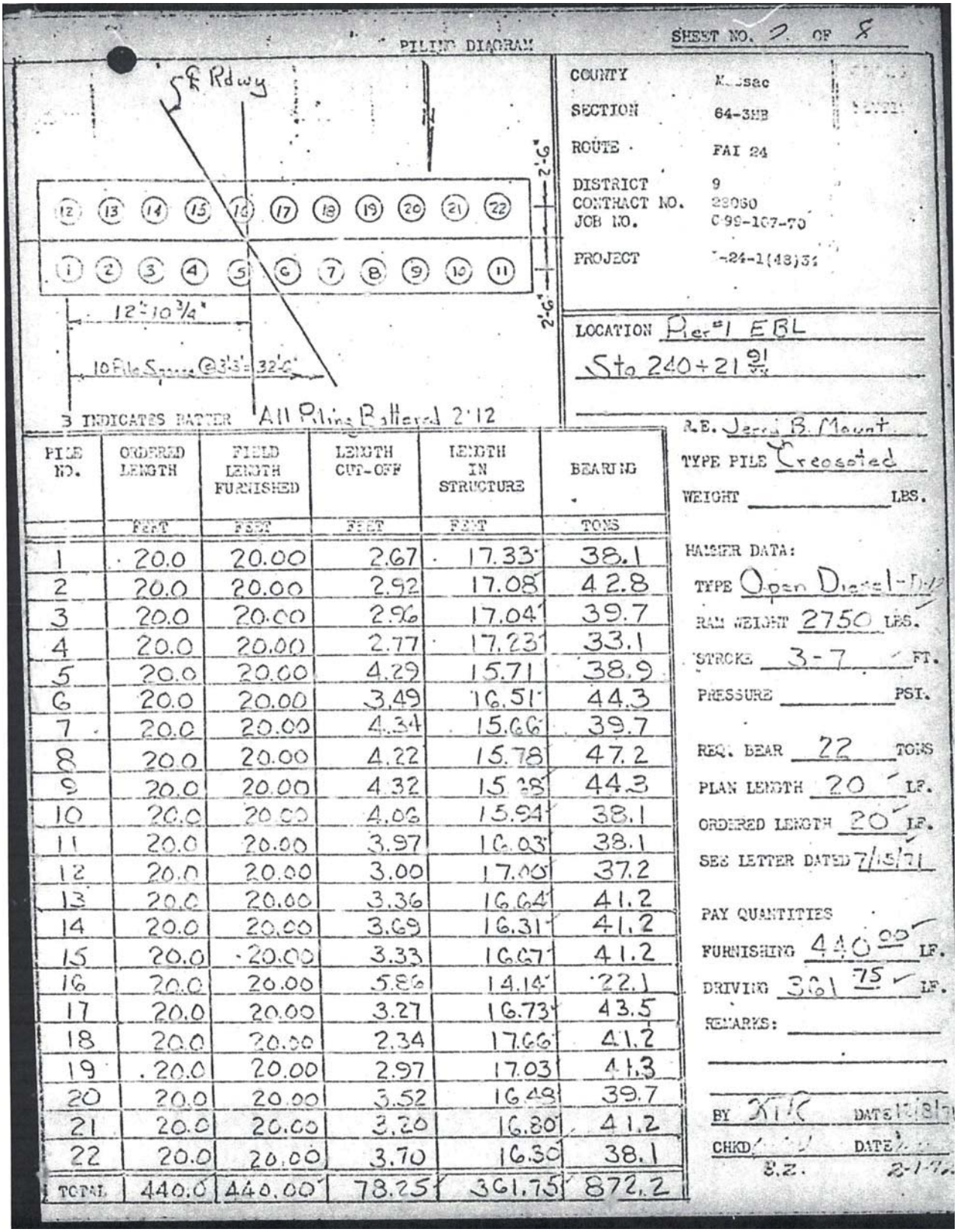
R.E.
TYPE PILE
WEIGHT 36 LBS.

HAMMER DATA:
TYPE
RAM WEIGHT LBS.
STROKE FT.
PRESSURE PSI.
REQ. BEAR 50 Tons CP TONS
PLAN LENGTH LF.
ORDERED LENGTH LF.
SEE LETTER DATED

PAY QUANTITIES
FURNISHING LF.
DRIVING LF.
REMARKS:
BY DATE
CHKD DATE

PILE NO.	ORDERED LENGTH FEET	FIELD LENGTH FURNISHED FEET	LENGTH CUT-OFF FEET	LENGTH IN STRUCTURE FEET	BEARING TONS
			2 9"		
			2 4 2"		
			5 3 2"		
			0 9 4"		
			* 0 5 6"		
			0 2 1"		
			3 11"		
			0 3 6"		
			2 5 2"		
			0 5 2"		
TOTAL					

* Piling #5 driven 4' below cut-off.



PILING DIAGRAM

SHEET NO. 2 OF 8

Sft Rdwy

(12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22)

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

12'-10 3/4"

10 Pile Spaces @ 3'-3" = 32'-6"

2'-6"

2'-6"

3 INDICATES BATTER All Piling Battered 2:12

COUNTY Nueces

SECTION 64-3NB

ROUTE FAI 24

DISTRICT 9
CONTRACT NO. 23060
JOB NO. C 99-107-70

PROJECT F-24-1(48)3

LOCATION Pier #1 EBL
Sta 240+21 91/99

R.E. Jerry B. Mount

TYPE PILE Creosoted

WEIGHT _____ LBS.

HAMMER DATA:

TYPE Open Diesel-Delmag

RAM WEIGHT 2750 LBS.

STROKE 3-7 FT.

PRESSURE _____ PSI.

REQ. BEAR 22 TONS

PLAN LENGTH 20 LF.

ORDERED LENGTH 20 LF.

SEE LETTER DATED 7/15/71

PAY QUANTITIES

FURNISHING 440 00 LF.

DRIVING 361 75 LF.

REMARKS: _____

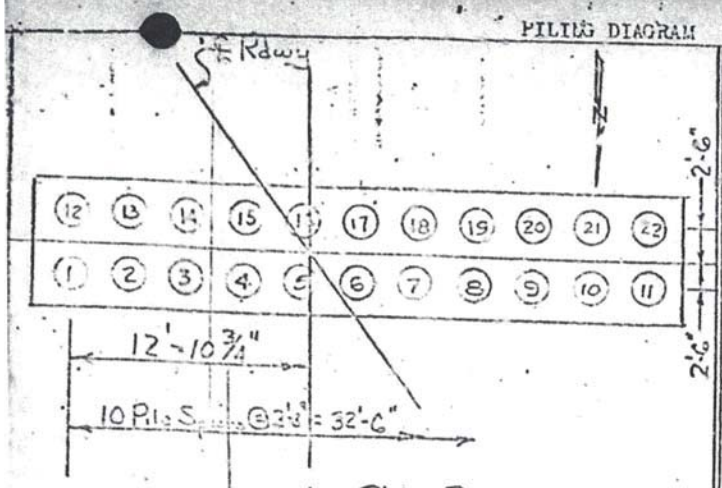
BY KJK DATE 12/8/71

CHKD B.Z. DATE 2-1-72

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1	20.0	20.00	2.67	17.33	38.1
2	20.0	20.00	2.92	17.08	42.8
3	20.0	20.00	2.96	17.04	39.7
4	20.0	20.00	2.77	17.23	33.1
5	20.0	20.00	4.29	15.71	38.9
6	20.0	20.00	3.49	16.51	44.3
7	20.0	20.00	4.34	15.66	39.7
8	20.0	20.00	4.22	15.78	47.2
9	20.0	20.00	4.32	15.68	44.3
10	20.0	20.00	4.06	15.94	38.1
11	20.0	20.00	3.97	16.03	38.1
12	20.0	20.00	3.00	17.00	37.2
13	20.0	20.00	3.36	16.64	41.2
14	20.0	20.00	3.69	16.31	41.2
15	20.0	20.00	3.33	16.67	41.2
16	20.0	20.00	5.86	14.14	22.1
17	20.0	20.00	3.27	16.73	43.5
18	20.0	20.00	2.34	17.66	41.2
19	20.0	20.00	2.97	17.03	41.3
20	20.0	20.00	3.52	16.48	39.7
21	20.0	20.00	3.20	16.80	41.2
22	20.0	20.00	3.70	16.30	38.1
TOTAL	440.0	440.00	78.25	361.75	872.2

PILING DIAGRAM

SHEET NO. 5 OF 8



B INDICATES BATTER All Piling Battered 2:12

COUNTY Massac
SECTION 64-3H3
ROUTE FAI 24
DISTRICT 9
CONTRACT NO. 22060
JOB NO. C-99-107-70
PROJECT I-24-1(18)34

LOCATION Pier #2 EBL
Sta 240+82.91

PILE NO.	ORDERED LENGTH FEET	FIELD LENGTH FURNISHED FEET	LENGTH, CUT-OFF FEET	LENGTH IN STRUCTURE FEET	BEARING TONS
1	20.0	20.0	0.54	19.46'	34.8
2	20.0	20.0	0.62	19.38'	33.1
3	20.0	20.0	1.24	18.76'	33.1
4	20.0	20.0	2.55	17.45'	34.2
5	20.0	20.0	3.39	16.61'	38.6
6	20.0	20.0	0.64	19.36'	27.5
7	20.0	20.0	2.85	17.15'	33.9
8	20.0	20.0	0.95	19.05'	29.3
9	20.0	20.0	1.85	18.15'	39.7
10	20.0	20.0	1.53	18.47'	42.3
11	20.0	20.0	2.00	18.00'	40.5
12	20.0	20.0	1.34	18.66'	26.8
13	20.0	20.0	0.46	19.54'	22.1
14	20.0	20.0	1.04	18.96'	29.7
15*	20.0	20.0	-0.33	20.33'	24.4
16	20.0	20.0	0.05	19.95'	26.0
17*	20.0	20.0	-0.30	20.30'	22.9
18	20.0	20.0	0.65	19.35'	28.2
19	20.0	20.0	0.37	19.63'	33.8
20	20.0	20.0	1.15	18.85'	30.3
21	20.0	20.0	0.43	19.57'	26.8
22*	20.0'	20.0	-0.23	20.23'	23.7
TOTAL	440.0	440.0'	*23.65'	417.91'	682.2

R.E. Jerry Mount
TYPE PILE Creosoted
WEIGHT _____ LBS.

HAMMER DATA:
TYPE Open Diesel D-12
RAM WEIGHT 2750 LBS.
STROKE 3-7 FT.
PRESSURE _____ PSI.

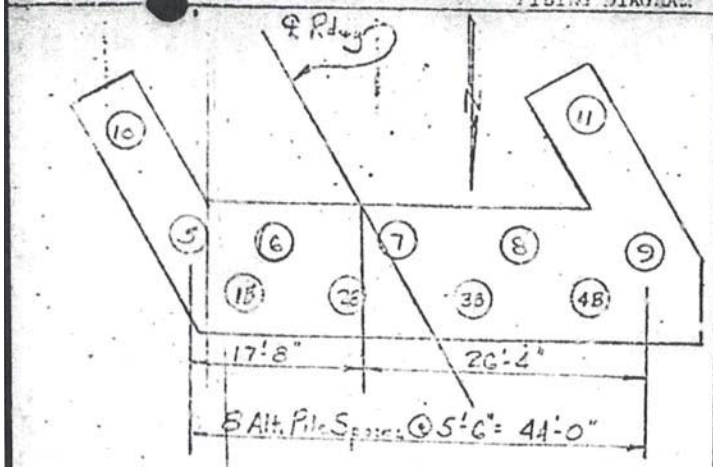
REQ. BEAR 22 TONS
PLAN LENGTH 20' LF
ORDERED LENGTH 20' LF.
SEE LETTER DATED 7/15/71

PAY QUANTITIES
FURNISHING 440.00' LF.
DRIVING 417.81 LF.

REMARKS: * Piling #15 #17 & #22 driven below cut-off elev.
BY [illegible] DATE 12/8/[illegible]
CHKD [illegible] DATE [illegible]
RGZ - 2-1-72

PILING DIAGRAM

SHEET NO. 1 OF 8



B INDICATES BATTER

COUNTY	Massac
SECTION	64-3H2
ROUTE	FAI 24
DISTRICT	9
CONTRACT NO.	28060
JOB NO.	C-99-107-70
PROJECT	I-24-1(48)34

LOCATION East Abut. ERL
Sta 241+17.00

R.E. Jerry B. Mount

TYPE PILE Metal Shell

WEIGHT _____ LBS.

HAMMER DATA:

TYPE Open Diesel D-22

RAM WEIGHT 2750 LBS.

STROKE 3-7 FT.

PRESSURE _____ PSI.

REQ. BEAR 30 TONS

PLAN LENGTH 45 LF.

ORDERED LENGTH 38 LF.

SEE LETTER DATED 8/19/71

PAY QUANTITIES

FURNISHING 380.00 LF.

DRIVING 371.14 LF.

REMARKS: _____

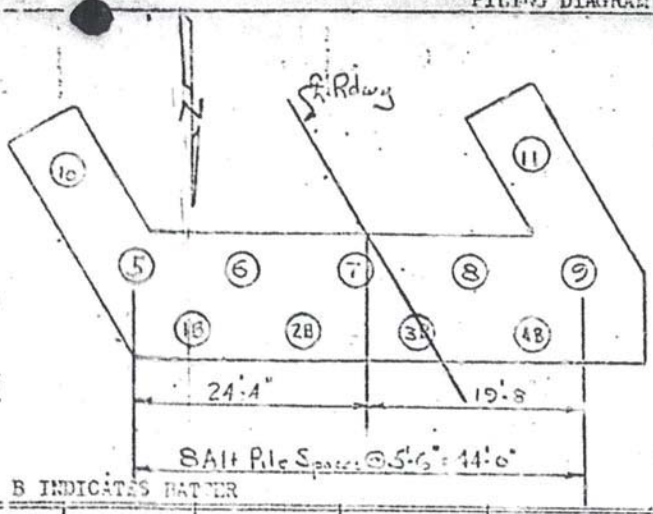
BY [illegible] DATE 12/1/71

CHKD [illegible] DATE 12-20-71

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1B	37.0	38.0	0.93	37.07	45.7
2B	38.0	38.0	0.94	37.06	47.9
3B	38.0	38.0	1.28	36.72	38.1
4B	38.0	38.0	0.88	37.12	41.2
5	Test	Pile			
6	38.0	38.0	0.92	37.08	44.3
7	38.0	38.0	0.19	37.81	49.9
8	38.0	38.0	0.83	37.17	40.5
9	38.0	38.0	0.41	37.59	39.7
10	38.0	38.0	1.23	36.77	42.3
11	38.0	38.0	1.25	36.75	46.4
TOTAL	380.0	380.0	8.86	371.14	436.5

PILING DIAGRAM

SHEET NO. 5 OF 9



B INDICATES BATTER

COUNTY Massac
SECTION 64-3HB
ROUTE FAI 24
DISTRICT 9
CONTRACT NO. 2S060
JOB NO. C-99-107-70
PROJECT I-24-1(48)34

LOCATION East Abut WBL
Sta 241+69.64

R.E. Jerry B. Mount
TYPE PILE Metal Shell
WEIGHT _____ LBS.

HAMMER DATA:
TYPE Open Diesel-D-12
RAM WEIGHT 2750 LBS.
STROKE 3-7 FT.
PRESSURE _____ PSI.

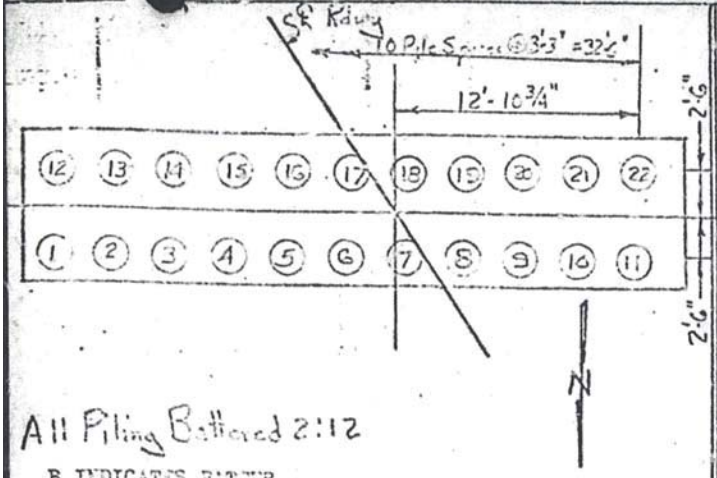
REQ. BEAR 30 TONS
PLAN LENGTH 45 LF.
ORDERED LENGTH 38 LF.
SEE LETTER DATED 8/19/71

PAY QUANTITIES
FURNISHING 418.00 LF.
DRIVING 410.63 LF.
REMARKS: * Pile #7 driven .51 ft below cut-off elev.
BY BLP DATE 12/13/71
CHKD BGZ DATE 2-1-72

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1B	38.0	38.00	1.30	36.70	40.5
2B	38.0	38.00	0.65	37.35	37.2
3B	38.0	38.00	0.37	37.63	36.4
4B	38.0	38.00	0.90	37.10	38.1
5	38.0	38.00	0.65	37.35	37.2
6	38.0	38.00	0.05	37.95	39.7
*7	38.0	38.00	- 0.51	38.51	38.1
8	38.0	38.00	0.55	37.45	39.7
9	38.0	38.00	1.33	36.67	41.2
10	38.0	38.00	1.65	36.35	39.7
11	38.0	38.00	0.42	37.57	41.2
TOTAL	418.0	418.00	* 7.98	410.63	429.0

PILING DIAGRAM

SHEET NO. 6 OF 8



All Piling Battered 2:12

B INDICATES BATTER

COUNTY Massac
SECTION 64-3HB
ROUTE FAI 24
DISTRICT 9
CONTRACT NO. 28060
JOB NO. C-99-107-70
PROJECT I-24-1(48)54

LOCATION Pier #1 WBL
Sta 240+73 89

R.E. Jerry B Mount
TYPE PILE Precasted
WEIGHT _____ LBS.

HAMMER DATA:
TYPE Open Diesel D-12
RAM WEIGHT 2750 LBS.
STROKE 3-7 FT.
PRESSURE _____ PSI.

REQ. BEAR 22 TONS
PLAN LENGTH 20 LF.
ORDERED LENGTH 21 LF.
SEE LETTER DATED 7/15/71

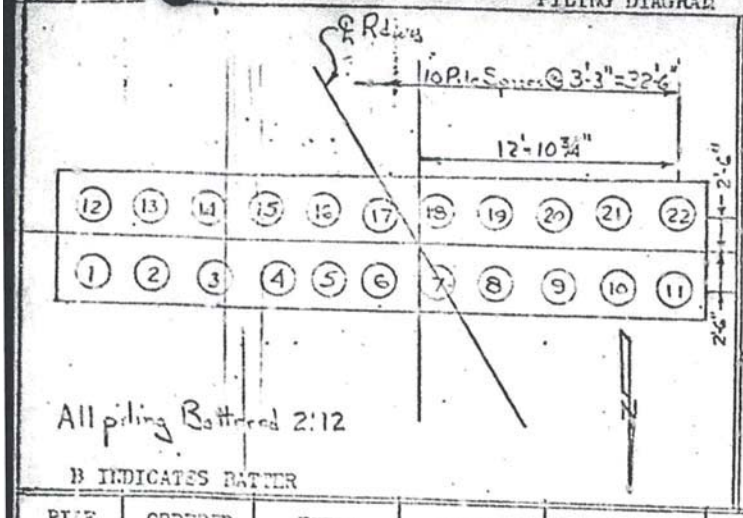
PAY QUANTITIES
FURNISHING 462 00 LF.
DRIVING 381 10 LF.
REMARKS:

BY JTK DATE 12/9/71
CHKD BGZ DATE 1-31-72

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1	21.0	21.0	5.03	15.97	41.2
2	21.0	21.0	4.10	16.90	38.1
3	21.0	21.0	2.46	18.54	55.1
4	21.0	21.0	3.88	17.12	35.0
5	21.0	21.0	4.35	16.65	32.8
6	21.0	21.0	4.22	16.78	31.0
7	21.0	21.0	3.05	17.95	29.7
8	21.0	21.0	4.30	16.70	32.1
9	21.0	21.0	3.18	17.82	32.1
10	21.0	21.0	3.86	17.14	36.4
11	21.0	21.0	4.73	16.27	33.1
12	21.0	21.0	4.70	16.30	35.0
13	21.0	21.0	2.95	18.05	31.0
14	21.0	21.0	4.30	16.70	36.4
15	21.0	21.0	2.35	18.65	39.7
16	21.0	21.0	3.27	17.73	37.2
17	21.0	21.0	4.22	16.78	32.1
18	21.0	21.0	3.70	17.30	34.8
19	21.0	21.0	3.73	17.27	36.4
20	21.0	21.0	2.76	18.24	37.2
21	21.0	21.0	2.16	18.84	38.1
22	21.0	21.0	3.60	17.40	32.1
TOTAL	462.0	462.0	80.90	381.10	786.6

PILING DIAGRAM

SHEET NO. 7 OF 8



COUNTY Massac
SECTION 64-3HB
ROUTE FAI 24
DISTRICT 9
CONTRACT NO. 28060
JOB NO. C-99-107-70
PROJECT I-24-1(48)34

LOCATION Pier #2 WBL
Sta 241+34 BS

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1	24.0	25.0	0.97	24.03	34.2
2	24.0	25.0	0.96	24.04	28.4
3	24.0	25.0	1.88	23.12	31.0
4	24.0	25.0	1.69	23.31	30.3
5	24.0	25.0	1.80	23.20	31.0
6	24.0	25.0	1.94	23.06	23.6
7	24.0	25.0	2.67	22.33	33.1
8	24.0	25.0	2.76	22.24	33.9
9	24.0	25.0	2.97	22.03	38.6
10	24.0	25.0	2.93	22.07	33.1
11	24.0	25.0	3.92	21.08	33.9
12	24.0	25.0	0.77	24.25	22.9
13	24.0	25.0	0.68	24.32	29.3
14	24.0	25.0	0.90	24.10	25.6
15	24.0	25.0	0.53	24.47	27.5
16	24.0	25.0	0.68	24.32	25.6
17	24.0	25.0	2.56	22.44	29.8
18	24.0	25.0	0.70	24.30	25.0
19	24.0	25.0	1.47	23.53	33.9
20	24.0	25.0	0.92	24.08	25.6
21	24.0	25.0	1.12	23.88	27.5
22	24.0	25.0	0.23	24.77	29.3
TOTAL	528.0	550.0	35.05	514.95	653.1

R.E. Jerry R. Mount
TYPE PILE Prestressed Conc.
WEIGHT _____ LBS.

HAMMER DATA:
TYPE Open Diesel
RAM WEIGHT 2750 LBS.
STROKE 3-7 FT.
PRESSURE _____ PSI.

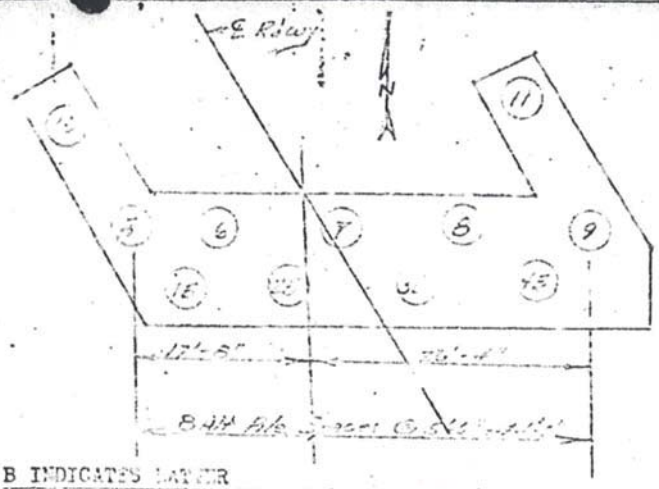
REQ. BEAR 22 TONS
PLAN LENGTH 28' LF.
ORDERED LENGTH 24' LF.
SEE LETTER DATED 7/5/71

PAY QUANTITIES
FURNISHING 550.00 LF.
DRIVING 514.95 LF.
REMARKS: _____

BY [illegible] DATE [illegible]
CHKD [illegible] DATE [illegible]
B.Z. 2-1-72

PILING DIAGRAM

SHEET NO. 8 OF 8



B INDICATES LAYER

COUNTY	Massac
SECTION	64-3HB
ROUTE	FAI 24
DISTRICT	9
CONTRACT NO.	23089
JOB NO.	C-99-107-70
PROJECT	I-24-1(43)31

LOCATION

PILE NO.	ORDERED LENGTH	FIELD LENGTH FURNISHED	LENGTH CUT-OFF	LENGTH IN STRUCTURE	BEARING
	FEET	FEET	FEET	FEET	TONS
1	35	35	1 84	33 05	55 L
2	35	35	1 83	33 17	53 L
3	35	35	2 85	32 15	51 L
4	35	35	2 85	32 15	51 L
5					
6					
7	35	35	2 85	32 15	51 L
8	35	35	2 85	32 15	55 L
9	35	35	2 85	32 15	51 L
10	35	35	2 85	32 15	51 L
11	35	35	2 85	32 15	51 L
TOTAL	385 00	385 00	28 85	356 15	490 L

R.E.

TYPE PILE

WEIGHT LBS.

HAMMER DATA:

TYPE 1

RAM WEIGHT LBS.

STROKE FT.

PRESSURE PSI.

REQ. BEAR TONS

PLAN LENGTH LF.

ORDERED LENGTH LF.

SEE LETTER DATED

PAY QUANTITIES

FURNISHING 385 LF.

DRIVING LF.

REMARKS:

BY DATE

CHKD T.B.M DATE 1-25-1

. Form BD-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(46)34
Route FAI 24
Section 64-3HB
County Massac
Station of Structure 240+78.40
C-99-107-70

Station location at which pile was driven W.Abut.EBL 1'2" Lt CL Pdwy. Sta. 239+37.10
Elev. from which pile was driven 419.31

Type & Weight of Hammer 2750 Del Mag D-12 Diesel Powered
Length of Fall *
Type of Pile Steel BBP36
Required Bearing ** 50 Tons
Elev. Top Pile 419.87
Elev. Tip of Pile 379.67
Elev. Cutoff 420.16
Estimated Plan Length --
Ordered Length
West Acutment, Eastbound Lane - 43 L.F.

Formula Used: $P = \frac{2W}{S+0.1}$

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	Length of Fall	Remarks
398.67	21.49	8		--	3	Date Driven: 11-11-71
397.67	22.49	7		--	3	R.E. - Jerry Mount
396.67	23.49	8		--	3	Witnessed: Bob Zieba
395.67	24.49	10		--	3	Hoist No. 58663
394.67	25.49	11		--	3	
393.67	26.49	12		--	3	
392.67	27.49	13		--	3	
391.67	28.49	13	54	--	3	
390.67	29.49	14		--	3	
389.67	30.49	14		--	3	
388.67	31.49	16		14.9	4	
387.67	32.49	17		13.8	4	
386.67	33.49	22		17.0	4	
385.67	34.49	24		18.3	4	
384.67	35.49	27		20.2	4	
383.67	36.49	55		43.2	5	
382.67	37.49	60	54	45.9	5	
381.67	38.49	60		45.9	5	
380.67	39.49	72		72.2	7	
379.67	40.49	90		82.4	7	
						** Plans call for using concrete piling at an estimated length of 45 L.F. Due to concrete piling being unable to penetrate sandstone layer which was located approx. 8ft. below footing elevation steel piling was used with a required bearing of 50 tons.

cc: Carl E. Thurman, Jr.
Jerry Mount
Bob Zieba
File

Form [illegible]-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(48)34
Route FAI 24
Section 64-3HB
County Massac
Station of Structure 240+78.40

Type & Weight of Hammer 2750 DEL MAG D-12 Diesel Powered
Length of Fall *
Type of Pile Concrete
Required Bearing 30
Elev. Top Pile 432.80
Elev. Tip of Pile 387.70
Elev. Cutoff 420.23
Estimated Plan Length 45 L.F.
Ordered Length

Station location at which pile was driven Station 240+39.14 W.Abut.6'-8" Rt.C.L.Rdwy.WBL
Elev. from which pile was driven 419.04

West Abut. W.B.Lane 35 L.F.
West " E.B.Lane 35 L.F.

Formula: $P = \frac{2WE}{S+0.1}$

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	* Length of Pile	Remarks
396.70	23.53	10		--	3	Date Driven: 8-31-71
395.70	24.53	13		--	3	R.E.-Jerry Mount
394.70	25.53	14		--	3	Witnessed -Bob Zieba
393.70	26.53	13		--	3	
392.70	27.53	14		11.5	4	
391.70	28.53	16		12.9	4	
390.70	29.53	19		15.0	4	
389.70	30.53	25		18.9	4	
388.70	31.53	30		22.0	4	
387.70	32.53	110	49	Refusal	7+	

Note: Test pile data listed above is for 2nd test pile in West Abutment of Westbound lane. Prior to driving, precoring was done to elevation 400.8. Abutment is located in cut section.

cc: Carl E. Thunman, Jr.
Jerry Mount
Bob Zieba
File

Form BD-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(48)34
Route FAI 24
Section 64-2HB
County Massac
Station of Structure 240+78.40

Type & Weight of Hammer 27.0 lb.
Del Mag D-12 Diesel Powered
Length of Fall *
Type of Pile Concrete
Required Bearing 30
Elev. Top Pile 456.23
Elev. Tip of Pile 411.03
Elev. Cutoff 420.23
Estimated Plan Length 45
Ordered Length *

Station location at which pile was driven 240+30.14 W.Abut. 17'8" Rt.C.L.Rdwy.W.B.L.
Elev. from which pile was driven 419.0
Formula Used: $P = \frac{2WH}{S+0.1}$

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	Remarks
					* ~~No driving data prior to refusal was obtained~~ as the test pile for the West Abutment of the Westbound Lane was scheduled to be logged beginning at the 10 ft. mark on the piling. Refusal was not at an elevation of 9.2 ft below cut-off elevation and at that point driving was continued for 110+ blows at a fall of seven (7)+ ft.
					*Due to piling not being driven to elevation of ten (10) ft. below footing elevation & borings 8S & 1S showing soft material laying below fine gravel sand layers, an additional test pile will be driven in the West Abut. of the Westbound Lane. Prior to driving additional test pile, precoring will be done to elevation 401.0+.
					Resident Engineer: Jerry Mount
					Witnessed: Bob Zieba
					Date Driven: 8-27-71

cc: Carl E. Thumman, Jr.
Jerry Mount
Bob G. Zieba
File

BD-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(48)34
Route FAI 24
Section 64-3HB
County Massac
Station of Structure 240+78.40

Type & Weight of Hammer 2750#
Del Mag D-12 Diesel Powered
Length of Fall 8
Type of Pile Concrete
Required Bearing 30
Elev. Top Pile 422.94
Elev. Tip of Pile 377.94
Elev. Cutoff 420.24
Estimated Plan Length 45
Ordered Length
East Abutment - Eastbound Lane - 38 L.F.
" " Westbound " 38 "

Station location at which pile was driven Sta. 241+17.6 19'Lt C.L. E.Abut.E.B. Lane
Elev. from which pile was driven 419.0

Formula: $P = \frac{2WH}{S+0.1}$

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	*Length of Fall	Remarks
401.94	18.30	25		23.7	5	Date Driven: 8-17-71
400.94	19.30	23		22.1	5	R.E. Jerry Mount
399.94	20.30	27		25.2	5	Witnessed: Bob Zieba
398.94	21.30	25		23.7	5	
397.94	22.30	28		26.0	5	
396.94	23.30	30		27.6	5	
395.94	24.30	28	53	26.0	5	
394.94	25.30	36		31.8	5	
393.94	26.30	30		27.6	5	
392.94	27.30	35		31.0	5	
391.94	28.30	35		31.0	5	
390.94	29.30	36		31.8	5	
389.94	30.30	35		31.0	5	
388.94	31.30	40		34.3	5	
387.94	32.30	42		35.7	5	
386.94	33.30	41		35.0	5	
385.94	34.30	42		35.0	5	
384.94	35.30	43	50	40.4	5	
383.94	36.30	45		37.6	5	
382.94	37.30	50		48.5	6	
381.94	38.30	50		48.5	6	
380.94	39.30	50		48.5	6	
379.94	40.30	60		55.1	6	
378.94	41.30	60		55.1	6	
377.94	42.30	80		77.0	7	

cc: Carl E. Thunman, Jr.
Jerry Mount, Bob Zieba & File

Form BD-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(48)34
Route FAI 24
Section 64-3HE
County Massac
Station of Structure 240+78.40

Type & Weight of Hammer 2750 Del Mag D-12 Diesel Powered
Length of Fall *
Type of Pile Timber
Required Bearing 22
Elev. Top Pile 423.07
Elev. Tip of Pile 382.47
Elev. Cutoff 404.64
Estimated Plan Length 28
Ordered Length
Pier #1 W.B.Lane - 21 l.f.
Pier #2 W.B.Lane - 24 l.f.
R.E. - Jerry Mount

Station location at which pile was driven 20' Rt.CL Rdwy.WB Lane Sta.241+34.89
Elev. from which pile was driven

Formula Used: P = 2WH / S +0.1

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	*Length of Fall	Remarks
395.97	8.67	10		--	3	Date Driven: 7-7-71
394.97	9.67	12		--	3	Witnessed: Bob Zieba
393.97	10.67	12		--	3	Ill. Stamp - IHD-15
392.97	11.67	12		--	3	
391.97	12.67	15		--	3	
390.97	13.67	16	57	--	3	
389.97	14.67	16		12.9	4	
388.97	15.67	18		14.3	4	
387.97	16.67	19		15.0	4	
386.97	17.67	19		18.8	4	
385.97	18.67	22		21.2	5	
384.97	19.67	26	52	24.4	5	
383.97	20.67	26		24.4	5	
382.97	21.67	31		28.2	5	
382.47	22.17			Refusal	7+	

cc: Carl E. Thunman, Jr.
Jerry Mount
Bob Zieba
File

Form BD-757

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

Test Pile Driving Record

Project I-24-1(48)34
Route FAI 24
Section 64-3HB
County Massac
Station of Structure 240+78.40

Station location at which pile was driven 20'Lt.CL Rdwy EB Lane,Sta.240+21.91
Elev. from which pile was driven

Formula Used: $P = \frac{2WH}{S+0.1}$

Type & Weight of Hammer 2750 Del Mag D-12 Diesel Powered
Length of Fall *
Type of Pile Timber
Required Bearing 22
Elev. Top Pile 423.17
Elev. Tip of Pile 387.47
Elev. Cutoff 405.16
Estimated Plan Length 20
Ordered Length
Pier No. 1 E.B. Lane - 20 L.F.
Pier No. 2 E B. Lane-20 L.F.

Elev. Tip of Pile	Feet Below Cut Off	Blows Per Foot	Blows Per Minute	Bearing In Tons	*Length of Fall	Remarks
395.47	9.69	12		--	3	
394.47	10.69	12		--	3	
393.47	11.69	15		--	3	
392.47	12.69	15		--	3	
391.47	13.69	17	53	--	3	
390.47	14.69	19		16.8	5	
389.47	15.69	20		19.7	5	
388.47	16.69	33		29.7	5	
387.47	17.69	100		Refusal	7+	

cc: Carl E. Thunman, Jr.
Jerry B. Mount
Bob Zieba
File

Illinois Department of Transportation

Memorandum

To:	Carrie Nelsen	Attn: Dave Piche
From:	Rob Graeff	By: Rich Moberly
Subject:	*Boring Logs	
Date:	May 17, 2016	

FAI 24 over FAS 962 (Country Club Road)
Structures 064-0027/0028
Massac County

Foundation boring logs have been obtained this year for the above listed structure and are attached. Also included to supplement the designer are boring logs obtained in 1968 for the original construction of the embankment and structures.

Liquefaction Analysis

Liquefaction calculations indicate no liquefiable soils at this structure location except well below the depth that will achieve a minimum Nominal Bearing capacity of 500 kips for a 14" diameter metal shell pile.

It should be noted that boring logs obtained in 1968 indicate a much higher elevation for ground water. A review of historical data and those logs indicate a layer of trapped water in a shallow gravel layer was incorrectly labeled as ground water.

Slope Stability

At the time of this report, a preliminary TSL is not available. Therefore, we are unable to provide any slope stability calculations for the proposed endslope configuration. This office should be contacted to complete the slope stability calculations when a proposed endslope configuration is determined.

Attachments
RM:rm

cc: Soils File

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/24/10

REFERENCE BORING NUMBER ========== 1-S (2016)
ELEVATION OF BORING GROUND SURFACE ========== 469.10 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 79.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 76.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.526
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.948

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = 661 FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 34.9
Ground Motion Prediction Equations = NMSZ
PGA = 0.526

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
406.1	3	8	1.4	90	20	40	24	0.125	0.375	15.128	23.154	0.259	0.125	0.375	0.375	1.500	0.369	0.996	0.341	N.L. (1)
403.6	5.5	26	1.2	50	20	40	16	0.124	0.685	55.172	71.207	0.496	0.124	0.685	0.685	1.500	0.705	0.992	0.339	N.L. (1)
401.1	8	6	1.9	90	20	40	24	0.129	1.008	9.317	16.181	0.172	0.129	1.008	1.008	1.223	0.200	0.987	0.338	N.L. (1)
398.6	10.5	6	1.6	90	20	40	25	0.127	1.325	9.185	16.022	0.170	0.127	1.325	1.325	1.135	0.183	0.981	0.335	N.L. (1)
396.1	13	9	3.1	90	20	40	22	0.135	1.663	13.322	20.986	0.228	0.135	1.663	1.663	1.076	0.233	0.973	0.333	N.L. (1)
393.6	15.5	9	0.2	45			20	0.104	1.923	12.997	20.597	0.223	0.104	1.923	1.923	1.030	0.218	0.963	0.329	N.L. (1)
391.1	18	5	0.3	45			24	0.108	2.193	6.980	13.376	0.144	0.108	2.193	2.193	0.992	0.136	0.951	0.325	N.L. (1)
388.6	20.5	9	0.2	45			13	0.104	2.453	12.121	19.545	0.210	0.104	2.453	2.453	0.958	0.191	0.936	0.320	N.L. (1)
386.1	23	62		20			20	0.141	2.805	93.321	104.350	0.754	0.141	2.805	2.805	0.894	0.639	0.920	0.314	N.L. (1)
383.6	25.5	86		20				0.145	3.168	######	135.632	0.990	0.145	3.168	3.168	0.852	0.799	0.900	0.308	N.L. (1)
381.1	28	26		45			6	0.129	3.490	32.541	44.050	0.222	0.129	3.490	3.490	0.819	0.172	0.878	0.300	N.L. (1)
378.6	30.5	46		43				0.137	3.833	59.265	76.118	0.535	0.137	3.833	3.833	0.789	0.400	0.855	0.292	N.L. (1)
376.1	33	64		23			11	0.141	4.185	78.450	90.378	0.647	0.141	4.185	4.185	0.762	0.467	0.830	0.284	N.L. (1)
373.6	35.5	22		23			5	0.127	4.503	22.773	29.116	0.416	0.127	4.503	4.503	0.768	0.303	0.805	0.275	N.L. (1)
371.1	38	15	0.6	95	2	24	19	0.116	4.793	14.365	22.238	0.245	0.116	4.793	4.793	0.778	0.181	0.779	0.266	N.L. (1)
368.6	40.5	15		95	2	24		0.123	5.100	13.829	21.595	0.236	0.123	5.100	5.100	0.766	0.172	0.755	0.258	N.L. (1)
363.6	45.5	16	0.6	95	2	24	16	0.116	5.680	13.787	21.544	0.236	0.116	5.680	5.680	0.741	0.166	0.713	0.244	N.L. (1)
358.6	50.5	14		95	2	24		0.122	6.290	11.283	18.539	0.198	0.122	6.290	6.290	0.734	0.138	0.681	0.233	N.L. (1)
353.6	55.5	83		20				0.145	7.015	73.298	82.735	0.587	0.145	7.015	7.015	0.620	0.345	0.658	0.225	N.L. (1)
348.6	60.5	73		20				0.143	7.730	60.087	68.475	0.473	0.143	7.730	7.730	0.596	0.268	0.643	0.220	N.L. (1)
343.6	65.5	9		20				0.117	8.315	5.934	10.020	0.113	0.117	8.315	8.315	0.729	0.078	0.618	0.211	N.L. (1)
338.6	70.5	100		20				0.147	9.050	72.989	82.403	0.585	0.085	8.740	8.771	0.567	0.315	0.611	0.210	N.L. (3)
328.6	80.5	91		20				0.071	9.760	18.374	23.448	0.264	0.071	9.450	10.105	0.624	0.156	0.597	0.218	0.716 (D)

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

5/11/2016 — 1-S (2016).xls

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/24/10

REFERENCE BORING NUMBER ========== 2-S (2016)
ELEVATION OF BORING GROUND SURFACE ========== 408.80 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 69.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 60.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.526
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.948

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = 621 FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 34.9
Ground Motion Prediction Equations = NMSZ
PGA = 0.526

	BORING DATA							CONDITIONS DURING DRILLING						CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
405.8	3	7	2.3	90	20	40	31	0.132	0.396	12.947	20.537	0.222	0.132	0.396	0.396	1.500	0.316	0.994	0.340	N.L. (1)
403.3	5.5	9	2.5	90	20	40	36	0.133	0.729	15.187	23.224	0.260	0.133	0.729	0.729	1.399	0.346	0.989	0.338	N.L. (1)
400.8	8	7	2.1	90	20	40	29	0.130	1.054	10.731	17.877	0.190	0.130	1.054	1.054	1.217	0.220	0.981	0.335	N.L. (1)
398.3	10.5	7	2.3	90	20	40	29	0.132	1.384	10.556	17.667	0.188	0.132	1.384	1.384	1.127	0.201	0.972	0.332	N.L. (1)
395.8	13	8	2.5	90	20	40	33	0.133	1.716	11.693	19.032	0.204	0.133	1.716	1.716	1.063	0.205	0.960	0.328	N.L. (1)
393.3	15.5	9	2.9	90	20	40	36	0.134	2.051	12.634	20.160	0.217	0.134	2.051	2.051	1.010	0.208	0.947	0.324	N.L. (1)
390.8	18	10	3.3	90	20	40	29	0.136	2.391	13.399	21.079	0.229	0.136	2.391	2.391	0.964	0.210	0.930	0.318	N.L. (1)
388.3	20.5	8	2.5	90	20	40	32	0.133	2.724	10.220	17.264	0.184	0.133	2.724	2.724	0.933	0.163	0.911	0.311	N.L. (1)
385.8	23	14		28			29	0.122	3.029	17.383	24.346	0.280	0.122	3.029	3.029	0.892	0.236	0.889	0.304	N.L. (1)
383.3	25.5	38		28				0.134	3.364	52.247	64.027	0.436	0.134	3.364	3.364	0.831	0.344	0.864	0.295	N.L. (1)
380.8	28	27		26			9	0.130	3.689	32.746	41.832	0.177	0.130	3.689	3.689	0.801	0.135	0.838	0.286	N.L. (1)
378.3	30.5	100		17			5	0.147	4.056	######	134.965	0.985	0.147	4.056	4.056	0.771	0.720	0.810	0.277	N.L. (1)
375.8	33	19		28				0.126	4.371	19.668	26.946	0.337	0.126	4.371	4.371	0.783	0.250	0.782	0.267	N.L. (1)
373.3	35.5	78		17				0.144	4.731	88.744	97.089	0.698	0.144	4.731	4.731	0.725	0.480	0.754	0.258	N.L. (1)
370.8	38	10	0.4	60	14	35	26	0.111	5.009	9.303	16.164	0.172	0.111	5.009	5.009	0.793	0.129	0.728	0.249	N.L. (1)
368.3	40.5	11	0.4	99	4	26	27	0.111	5.286	9.900	16.880	0.180	0.111	5.286	5.286	0.778	0.132	0.704	0.241	N.L. (1)
363.3	45.5	12	0.5	93	4	26	26	0.114	5.856	10.123	17.148	0.182	0.114	5.856	5.856	0.755	0.131	0.664	0.227	N.L. (1)
358.3	50.5	10	0.4	90	2	24	18	0.111	6.411	7.950	14.540	0.155	0.111	6.411	6.411	0.750	0.111	0.635	0.217	N.L. (1)
353.3	55.5	11	0.4	90	2	24	21	0.111	6.966	8.262	14.914	0.159	0.111	6.966	6.966	0.732	0.111	0.616	0.211	N.L. (1)
348.3	60.5	76		10			6	0.143	7.681	62.856	65.084	0.445	0.081	7.371	7.402	0.607	0.256	0.603	0.207	N.L. (3)
343.3	65.5	5	0.5	65	15	36	27	0.114	8.251	3.316	8.979	0.104	0.052	7.631	7.974	0.750	0.074	0.582	0.208	N.L. (2)
338.3	70.5	1	1.2	90	21	46	27	0.061	8.556	0.645	5.774	0.078	0.061	7.936	8.591	0.763	0.056	0.575	0.213	N.L. (2)
333.3	75.5	6	1.6	99	21	40	28	0.065	8.881	3.763	9.516	0.109	0.065	8.261	9.228	0.733	0.076	0.568	0.217	N.L. (2)
328.3	80.5	2	0.6	60	15	36	26	0.057	9.166	1.226	6.471	0.083	0.057	8.546	9.825	0.747	0.059	0.561	0.221	N.L. (2)
318.3	90.5	91		16				0.082	9.986	61.611	63.813	0.434	0.082	9.366	11.269	0.552	0.227	0.547	0.225	N.L. (3)
308.3	100.5	100		10				0.083	10.816	62.025	64.236	0.438	0.083	10.196	12.723	0.534	0.222	0.533	0.228	N.L. (3)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR $w_c/LL \leq 0.85$
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

5/11/2016 — 2-S (2016), Trial 2.xls

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ========== 3-S (2016)
ELEVATION OF BORING GROUND SURFACE ========== 408.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 61.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 61.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.526
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/cut Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.948

AVG. SHEAR WAVE VELOCITY (top 40')
$V_{s,40'}$ = 679 FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 34.9
Ground Motion Prediction Equations = NMSZ
PGA = 0.526

	BORING DATA							CONDITIONS DURING DRILLING						CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
405.7	3	20		30				0.126	0.378	43.549	54.976	0.355	0.126	0.378	0.378	1.500	0.505	0.997	0.341	N.L. (1)
403.2	5.5	7	1.2	75	14	35	30	0.124	0.688	11.671	19.005	0.203	0.124	0.688	0.688	1.382	0.267	0.994	0.340	N.L. (1)
400.7	8	5	1.1	90	20	40	26	0.123	0.996	7.791	14.349	0.154	0.123	0.996	0.996	1.216	0.177	0.989	0.338	N.L. (1)
398.2	10.5	5	1.2	90	20	40	25	0.124	1.306	7.693	14.231	0.152	0.124	1.306	1.306	1.133	0.164	0.984	0.336	N.L. (1)
395.7	13	16	3.9	90	20	40	27	0.138	1.651	25.434	35.520	-0.399	0.138	1.651	1.651	1.103	-0.418	0.977	0.334	N.L. (1)
393.2	15.5	10	0.8	40	14	35	19	0.119	1.948	14.409	22.291	0.246	0.119	1.948	1.948	1.026	0.240	0.969	0.331	N.L. (1)
390.7	18	7	0.3	36	2	12	23	0.108	2.218	9.720	16.664	0.177	0.108	2.218	2.218	0.988	0.166	0.959	0.328	N.L. (1)
388.2	20.5	16	0.4	36	2	12	16	0.111	2.496	13.353	21.023	0.229	0.111	2.496	2.496	0.952	0.206	0.946	0.324	N.L. (1)
385.7	23	64		20				0.145	2.858	######	138.756	1.013	0.145	2.858	2.858	0.887	0.853	0.932	0.318	N.L. (1)
383.2	25.5	71		10				0.142	3.213	######	111.744	0.810	0.142	3.213	3.213	0.847	0.650	0.914	0.313	N.L. (1)
380.7	28	57		20				0.139	3.561	76.331	86.010	0.613	0.139	3.561	3.561	0.813	0.472	0.895	0.306	N.L. (1)
378.2	30.5	76		20				0.142	3.916	89.027	99.714	0.718	0.142	3.916	3.916	0.782	0.533	0.873	0.299	N.L. (1)
375.7	33	48		30				0.137	4.258	58.206	71.895	0.501	0.137	4.258	4.258	0.757	0.360	0.850	0.291	N.L. (1)
373.2	35.5	43		30				0.136	4.598	49.098	61.381	0.413	0.136	4.598	4.598	0.734	0.288	0.826	0.283	N.L. (1)
370.7	38	11	0.5	65	2	24	25	0.114	4.883	10.406	17.487	0.186	0.114	4.883	4.883	0.793	0.140	0.802	0.274	N.L. (1)
368.2	40.5	9	0.5	80	2	24	24	0.114	5.168	8.224	14.869	0.159	0.114	5.168	5.168	0.792	0.119	0.779	0.266	N.L. (1)
363.2	45.5	6	0.6	89	2	24	26	0.116	5.748	4.273	10.128	0.114	0.116	5.748	5.748	0.793	0.086	0.736	0.252	N.L. (1)
358.2	50.5	9	0.6	89	2	24	22	0.114	6.318	7.230	13.676	0.147	0.114	6.318	6.318	0.757	0.106	0.703	0.240	N.L. (1)
353.2	55.5	100		15				0.147	7.053	87.961	94.689	0.680	0.147	7.053	7.053	0.618	0.399	0.679	0.232	N.L. (1)
348.2	60.5	100		15				0.147	7.788	81.848	88.283	0.631	0.147	7.788	7.788	0.594	0.355	0.663	0.227	N.L. (1)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

5/11/2016

3-S (2016).xls

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ========== 4-S (2016)
ELEVATION OF BORING GROUND SURFACE ========== 427.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 96.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 92.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.526
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 6 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V_{s,40'}$ = **578** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 34.9
Ground Motion Prediction Equations = NMSZ
PGA = **0.526**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
424.3	3	10		36			11	0.118	0.354	19.607	27.338	0.348	0.118	0.354	0.354	1.500	0.495	0.992	0.339	N.L. (1)
421.8	5.5	6	1.4	65	15	38	25	0.125	0.667	10.061	17.074	0.182	0.125	0.667	0.667	1.376	0.237	0.983	0.336	N.L. (1)
419.3	8	9	1.5	65	15	36	22	0.126	0.982	14.323	22.187	0.245	0.126	0.982	0.982	1.267	0.294	0.971	0.332	N.L. (1)
416.8	10.5	6	1.6	65	15	36	20	0.127	1.299	12.329	19.795	0.213	0.127	1.299	1.299	1.154	0.233	0.958	0.327	N.L. (1)
414.3	13	11	1.6	65	15	26	24	0.127	1.617	16.811	25.174	0.295	0.127	1.617	1.617	1.093	0.306	0.941	0.322	N.L. (1)
411.8	15.5	23	0.8	35	1	15	21	0.119	1.914	37.533	50.039	0.303	0.119	1.914	1.914	1.042	0.300	0.922	0.315	N.L. (1)
409.3	18	30	0.8	35	1	15	19	0.119	2.212	49.080	63.896	0.435	0.119	2.212	2.212	0.983	0.406	0.899	0.308	N.L. (1)
406.8	20.5	48		21			18	0.137	2.554	74.877	85.112	0.606	0.137	2.554	2.554	0.928	0.533	0.874	0.299	N.L. (1)
404.3	23	7	0.6	75	14	35	25	0.119	2.852	8.838	15.606	0.166	0.119	2.852	2.852	0.924	0.146	0.846	0.289	N.L. (1)
401.8	25.5	8	1.8	75	20	40	22	0.128	3.172	9.620	16.544	0.176	0.128	3.172	3.172	0.896	0.150	0.816	0.279	N.L. (1)
399.3	28	10	2.7	90	20	40	23	0.134	3.507	11.432	18.719	0.200	0.134	3.507	3.507	0.866	0.164	0.785	0.268	N.L. (1)
396.8	30.5	19	3.2	90	20	40	26	0.138	3.852	10.869	18.043	0.192	0.138	3.852	3.852	0.845	0.154	0.754	0.258	N.L. (1)
394.3	33	10	0.3	60	1	15	20	0.108	4.122	10.471	17.565	0.187	0.108	4.122	4.122	0.831	0.147	0.724	0.247	N.L. (1)
391.8	35.5	6	0.3	60	1	15	25	0.108	4.392	8.079	14.694	0.157	0.108	4.392	4.392	0.827	0.123	0.695	0.238	N.L. (1)
389.3	38	10	0.3	60	1	15	15	0.108	4.662	9.751	16.701	0.178	0.108	4.662	4.662	0.806	0.136	0.670	0.229	N.L. (1)
386.8	40.5	17	0.4	60	1	15	20	0.111	4.939	16.097	24.316	0.279	0.111	4.939	4.939	0.762	0.202	0.647	0.221	N.L. (1)
381.8	45.5	21		40			11	0.127	5.574	18.676	27.411	0.350	0.127	5.574	5.574	0.720	0.239	0.611	0.209	N.L. (1)
376.8	50.5	100		27			6	0.147	6.309	95.039	111.901	0.811	0.147	6.309	6.309	0.646	0.497	0.586	0.201	N.L. (1)
371.8	55.5	54		12			8	0.139	7.004	46.412	49.431	0.297	0.139	7.004	7.004	0.620	0.174	0.570	0.195	N.L. (1)
366.8	60.5	22		90	2	14	14	0.127	7.639	15.470	23.564	0.266	0.127	7.639	7.639	0.667	0.168	0.560	0.191	N.L. (1)
361.8	65.5	17		90	2	14		0.124	8.259	11.267	18.520	0.198	0.124	8.259	8.259	0.679	0.127	0.544	0.186	N.L. (1)
356.8	70.5	11	0.5	65	9	28	23	0.114	8.829	6.926	13.311	0.144	0.114	8.829	8.829	0.698	0.095	0.537	0.183	N.L. (1)
351.8	75.5	98		29				0.146	9.559	65.068	73.852	0.517	0.146	9.559	9.559	0.547	0.268	0.530	0.181	N.L. (1)
346.8	80.5	100		29				0.147	10.294	66.081	74.945	0.526	0.147	10.294	10.294	0.531	0.265	0.522	0.179	N.L. (1)
341.8	85.5	97		29				0.147	11.029	60.627	69.058	0.478	0.147	11.029	11.029	0.517	0.234	0.515	0.176	N.L. (1)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

5/11/2016

4-S (2016).xls

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 5/24/10

REFERENCE BORING NUMBER ========== 5-S (2016)
ELEVATION OF BORING GROUND SURFACE ========== 426.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 61.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 61.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.526
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s\,40}$ = **525** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 34.9
Ground Motion Prediction Equations = NMSZ
PGA = **0.526**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
423.9	3	11	2.3	80	15	36	16	0.132	0.396	21.507	30.809	0.537	0.132	0.396	0.396	1.500	**0.764**	0.986	**0.337**	N.L. (1)
421.4	5.5	8	1.5	90	20	40	23	0.126	0.711	13.408	21.089	0.229	0.126	0.711	0.711	1.389	**0.302**	0.972	**0.332**	N.L. (1)
418.9	8	7	1.1	80	15	36	26	0.123	1.019	10.836	18.004	0.192	0.123	1.019	1.019	1.229	**0.224**	0.954	**0.326**	N.L. (1)
416.4	10.5	6	1	80	15	36	20	0.122	1.324	9.188	16.026	0.171	0.122	1.324	1.324	1.135	**0.184**	0.934	**0.319**	N.L. (1)
413.9	13	6	1.1	80	15	36	22	0.123	1.631	8.948	15.738	0.168	0.123	1.631	1.631	1.073	**0.170**	0.909	**0.311**	N.L. (1)
411.4	15.5	28		30				0.130	1.956	47.074	59.045	0.393	0.130	1.956	1.956	1.033	**0.384**	0.881	**0.301**	N.L. (1)
408.9	18	30		30				0.131	2.284	48.184	60.326	0.404	0.131	2.284	2.284	0.971	**0.372**	0.851	**0.291**	N.L. (1)
406.4	20.5	14	5.4	90	20	40	19	0.143	2.641	18.598	27.317	0.347	0.143	2.641	2.641	0.928	**0.306**	0.817	**0.279**	N.L. (1)
403.9	23	10	3.1	90	20	40	29	0.135	2.979	12.336	19.803	0.213	0.135	2.979	2.979	0.905	**0.183**	0.782	**0.268**	N.L. (1)
401.4	25.5	9	2.8	90	20	40	34	0.134	3.314	10.560	17.672	0.188	0.134	3.314	3.314	0.883	**0.157**	0.747	**0.255**	N.L. (1)
398.9	28	9	3.5	90	20	40	37	0.137	3.656	10.041	17.049	0.181	0.137	3.656	3.656	0.861	**0.148**	0.713	**0.244**	N.L. (1)
396.4	30.5	8	2.7	90	20	40	35	0.134	3.991	8.510	15.212	0.162	0.134	3.991	3.991	0.846	**0.130**	0.680	**0.233**	N.L. (1)
393.9	33	7	2.7	90	20	40	34	0.134	4.326	7.111	13.534	0.146	0.134	4.326	4.326	0.835	**0.115**	0.650	**0.222**	N.L. (1)
391.4	35.5	6	2.2	90	20	40	31	0.131	4.654	5.838	12.006	0.131	0.131	4.654	4.654	0.825	**0.103**	0.623	**0.213**	N.L. (1)
388.9	38	7	2.3	90	20	40	36	0.132	4.984	6.534	12.840	0.139	0.132	4.984	4.984	0.808	**0.107**	0.600	**0.205**	N.L. (1)
386.4	40.5	8	1.9	90	20	40	29	0.129	5.306	7.182	13.618	0.146	0.129	5.306	5.306	0.792	**0.110**	0.581	**0.198**	N.L. (1)
381.4	45.5	5	1.2	85	18	36	29	0.124	5.926	4.183	10.020	0.113	0.124	5.926	5.926	0.788	**0.085**	0.551	**0.188**	N.L. (1)
376.4	50.5	7	2.3	85	18	36	39	0.132	6.586	5.458	11.550	0.127	0.132	6.586	6.586	0.761	**0.092**	0.531	**0.181**	N.L. (1)
371.4	55.5	84		20				0.145	7.311	71.953	81.283	0.576	0.145	7.311	7.311	0.609	**0.333**	0.518	**0.177**	N.L. (1)
366.4	60.5	14	0.7	97	2	24	17	0.117	7.896	9.596	16.515	0.176	0.117	7.896	7.896	0.699	**0.116**	0.511	**0.175**	N.L. (1)
361.4	65.5	11	0.4	97	2	24	16	0.111	8.451	7.163	13.595	0.146	0.111	8.451	8.451	0.704	**0.098**	0.498	**0.170**	N.L. (1)
356.4	70.5	13	0.3	97	2	24	15	0.108	8.991	8.070	14.684	0.157	0.108	8.991	8.991	0.686	**0.102**	0.491	**0.168**	N.L. (1)
351.4	75.5	6	0.5	70	5	24	24	0.114	9.561	3.552	9.262	0.107	0.114	9.561	9.561	0.711	**0.072**	0.484	**0.166**	N.L. (1)
346.4	80.5	61		20				0.140	10.261	37.994	44.627	0.232	0.140	10.261	10.261	0.532	**0.117**	0.477	**0.163**	N.L. (1)
336.4	90.5	5	1.2	85	15	36	23	0.061	10.871	2.675	8.211	0.098	0.061	10.871	11.464	0.698	**0.065**	0.463	**0.167**	N.L. (2)
326.4	100.5	68						0.079	11.661	37.327	37.327	-0.029	0.079	11.661	12.878	0.506	**-0.014**	0.449	**0.170**	N.L. (3)
321.4	105.5	76						0.080	12.061	38.880	38.880	0.078	0.080	12.061	13.590	0.499	**0.037**	0.442	**0.170**	N.L. (3)

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

5/11/2016 — 5-S (2016).xls

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*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: FAI_64_over_FAS long:  88.686 W., lat: 37.191 N.
 Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08  See USGS OFR 2008-1128. dM=0.2 below
Return period: 975   yrs. Exceedance PGA =0.5365   g. Weight * Computed_Rate_Ex 0.102E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.02924
#This deaggregation corresponds to Mean Hazard w/all GMPEs
DIST(KM) MAG(MW) ALL_EPS EPSILON>2  1<EPS<2 0<EPS<1 -1<EPS<0 -2<EPS<-1 EPS<-2
    9.8    4.61    0.647    0.253    0.304    0.090    0.000    0.000    0.000
   10.6    4.80    1.574    0.509    0.793    0.272    0.000    0.000    0.000
   11.7    5.03    1.649    0.452    0.839    0.358    0.000    0.000    0.000
   12.5    5.21    0.837    0.205    0.443    0.189    0.000    0.000    0.000
   13.4    5.40    1.664    0.359    0.857    0.429    0.018    0.000    0.000
   14.4    5.62    1.126    0.196    0.531    0.366    0.033    0.000    0.000
   37.3    5.62    0.064    0.064    0.000    0.000    0.000    0.000    0.000
   15.0    5.81    1.227    0.170    0.573    0.436    0.048    0.000    0.000
   37.7    5.81    0.096    0.095    0.001    0.000    0.000    0.000    0.000
   14.3    6.01    1.227    0.107    0.506    0.505    0.108    0.000    0.000
   36.8    6.02    0.153    0.119    0.034    0.000    0.000    0.000    0.000
   15.0    6.21    1.494    0.108    0.590    0.643    0.154    0.000    0.000
   37.2    6.22    0.198    0.126    0.072    0.000    0.000    0.000    0.000
   15.5    6.42    1.221    0.072    0.423    0.559    0.168    0.000    0.000
   38.2    6.42    0.201    0.091    0.110    0.000    0.000    0.000    0.000
   60.6    6.43    0.056    0.056    0.000    0.000    0.000    0.000    0.000
   12.2    6.59    0.606    0.022    0.134    0.319    0.130    0.001    0.000
   30.8    6.60    0.403    0.079    0.238    0.085    0.000    0.000    0.000
   12.5    6.78    0.937    0.032    0.191    0.478    0.232    0.003    0.000
   31.0    6.78    0.675    0.099    0.375    0.201    0.000    0.000    0.000
   61.4    6.79    0.096    0.085    0.011    0.000    0.000    0.000    0.000
   16.7    7.00    1.036    0.040    0.241    0.539    0.211    0.004    0.000
   38.2    7.00    0.273    0.042    0.189    0.043    0.000    0.000    0.000
   60.9    7.01    0.093    0.061    0.032    0.000    0.000    0.000    0.000
   17.5    7.19    0.607    0.022    0.134    0.317    0.130    0.004    0.000
   38.3    7.19    0.171    0.021    0.105    0.045    0.000    0.000    0.000
   61.5    7.19    0.067    0.035    0.032    0.000    0.000    0.000    0.000
   17.0    7.37    0.556    0.019    0.112    0.275    0.144    0.006    0.000
   34.8    7.43   21.984    1.419    7.288   12.406    0.870    0.000    0.000
   58.3    7.43    0.408    0.086    0.282    0.041    0.000    0.000    0.000
   34.9    7.70   41.586    2.004   10.829   22.983    5.770    0.000    0.000
   57.9    7.70    0.839    0.095    0.445    0.298    0.000    0.000    0.000
   35.0    8.00   15.436    0.601    3.408    7.207    4.182    0.038    0.000
   57.9    8.00    0.396    0.030    0.150    0.194    0.022    0.000    0.000

Summary statistics for above PSHA PGA  deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%):  100.0
 Mean src-site R=   32.0 km; M= 7.35; eps0=  -0.05. Mean calculated for all sources.
Modal src-site R=   34.9 km; M= 7.70; eps0=  -0.18 from peak (R,M) bin
 MODE R*=  35.0km; M*= 7.70; EPS.INTERVAL: 0 to 1 sigma  % CONTRIB.= 22.983

Principal sources (faults, subduction, random seismicity having > 3% contribution)
Source Category:                % contr.  R(km)    M   epsilon0 (mean values).
New Madrid SZ no clustering       80.19    35.4   7.68   -0.14
CEUS gridded                      19.81    18.5   6.01    0.30
Individual fault hazard details if its contribution to mean hazard > 2%:
Fault ID                        % contr.   Rcd(km)  M   epsilon0 Site-to-src azimuth(d)
New Madrid FZ, midwest             5.41    45.1   7.70    0.29     -88.1
New Madrid FZ, central            59.91    34.4   7.68   -0.18     -98.1
New Madrid FZ, mideast             9.15    32.6   7.68   -0.27    -115.8
New Madrid FZ, east                4.17    35.0   7.68   -0.15    -140.0
#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs  *********#
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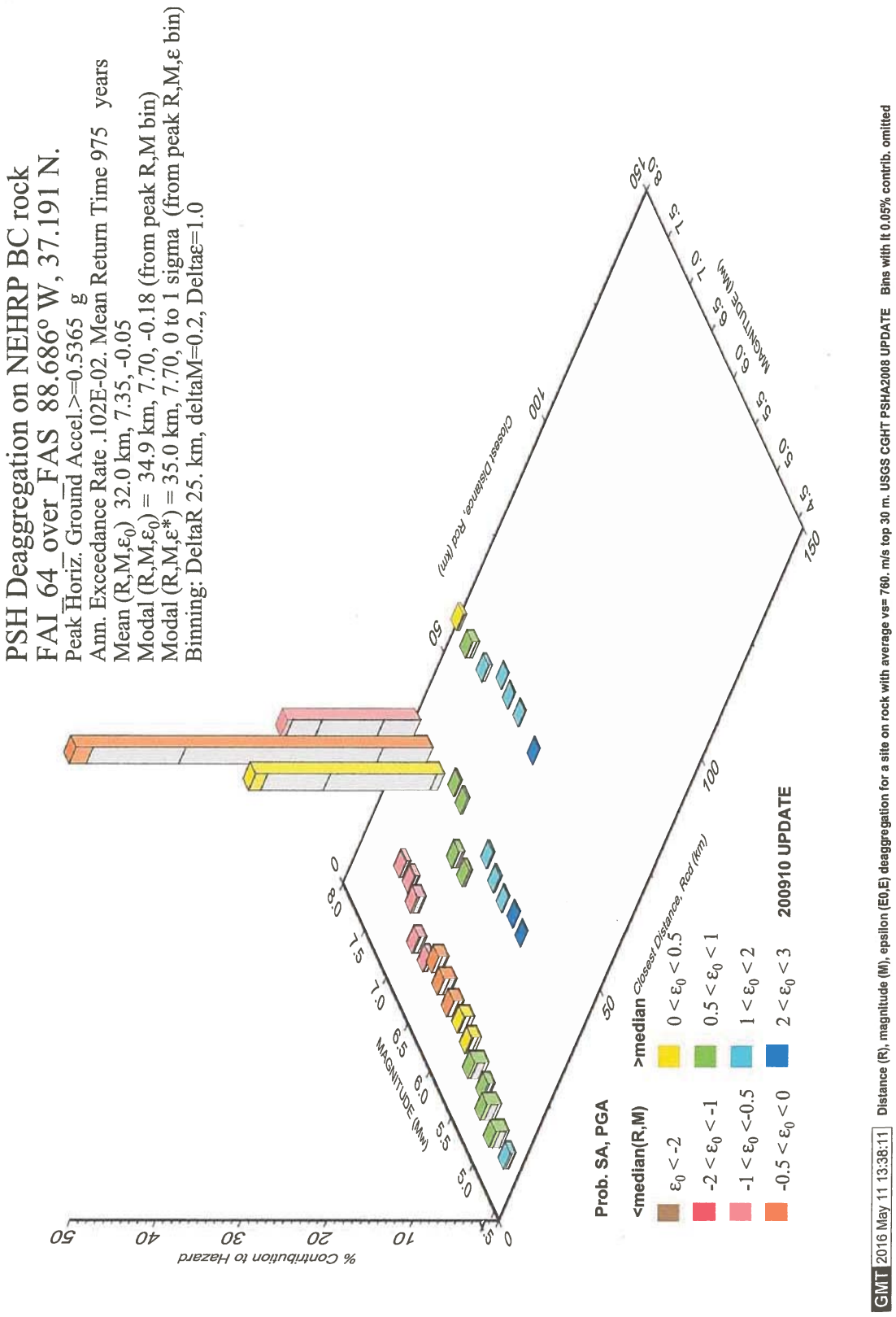
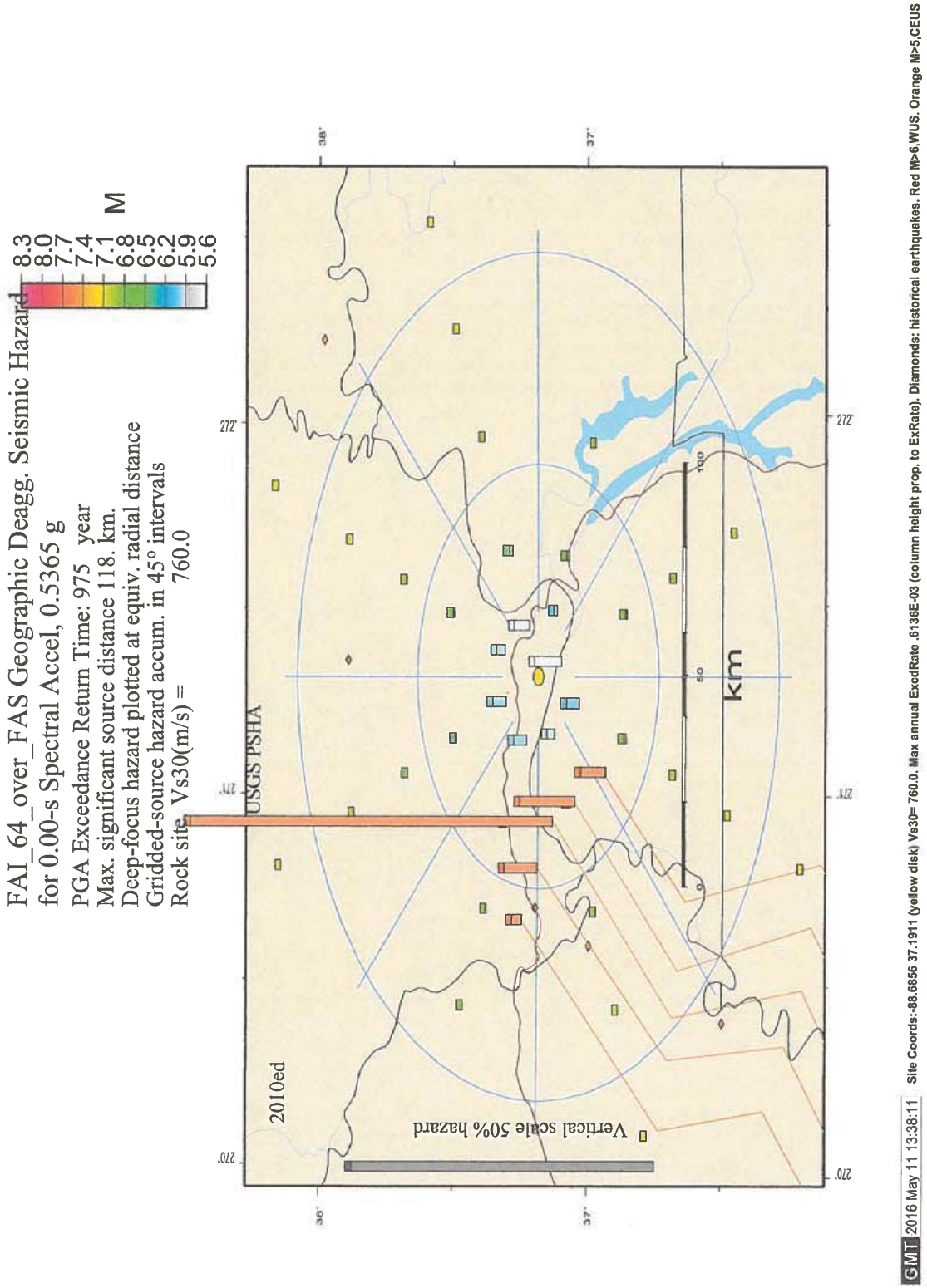
http://geohazards.usgs.gov/deaggint/2008/out/FAI_64_over_FAS_2016.05.11_13.38.08.txt 5/11/2016


PSH Deaggregation on NEHRP BC rock
FAI_64_over_FAS 88.686° W, 37.191 N.
Peak Horiz. Ground Accel.>=0.5365 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 years
Mean (R,M,ε0) 32.0 km, 7.35, -0.05
Modal (R,M,ε0) = 34.9 km, 7.70, -0.18 (from peak R,M bin)
Modal (R,M,ε*) = 35.0 km, 7.70, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0
% Contribution to Hazard
MAGNITUDE (Mw)
Closest Distance, Rcd (km)
Prob. SA, PGA
<median(R,M)
ε0 < -2
-2 < ε0 < -1
-1 < ε0 <-0.5
-0.5 < ε0 < 0
>median Closest Distance, Rcd (km)
0 < ε0 < 0.5
0.5 < ε0 < 1
1 < ε0 < 2
2 < ε0 < 3
200910 UPDATE
GMT 2016 May 11 13:38:11
Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted


FAI_64_over_FAS Geographic Deagg. Seismic Hazard
for 0.00-s Spectral Accel, 0.5365 g
PGA Exceedance Return Time: 975 year
Max. significant source distance 118. km.
Deep-focus hazard plotted at equiv. radial distance
Gridded-source hazard accum. in 45° intervals
Rock site Vs30(m/s) = 760.0
M
8.3
8.0
7.7
7.4
7.1
6.8
6.5
6.2
5.9
5.6
USGS PSHA
2010ed
Vertical scale 50% hazard
km
GMT 2016 May 11 13:38:11
Site Coords:-88.6856 37.1911 (yellow disk) Vs30= 760.0. Max annual ExcdRate .6136E-03 (column height prop. to ExRate). Diamonds: historical earthquakes. Red M>6,WUS. Orange M>5,CEUS

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==========
REFERENCE BORING ========== 1-S (2016)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 423.95 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 402.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1500 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 237.62 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 89.11 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
418 KIPS	**372** KIPS	**205** KIPS	**84** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
402.10	0.30	1.20			1.0		27.2	1.4		***4.3***	4	0	0	2	22
399.60	2.50	1.90			11.2	26.2	34.2	16.3	2.9	***20.2***	20	0	0	11	24
397.10	2.50	1.60			10.0	22.0	64.8	14.6	2.4	***37.0***	37	0	0	20	27
394.60	2.50	3.10	9		15.5	42.7	***40.4***	22.7	4.7	55.4	40	0	0	22	29
392.10	2.50	0.20			1.6	2.8	***43.4***	2.4	0.3	57.9	43	0	0	24	32
389.60	2.50	0.30			2.4	4.1	***44.4***	3.5	0.5	61.2	44	0	0	24	34
386.60	3.00	0.20			2.0	2.8	157.6	2.9	0.3	***76.3***	76	0	0	42	37
384.60	2.00		62	Very Fine Silty Sand	10.5	113.9	212.2	15.4	12.5	***96.5***	96	0	0	53	39
382.10	2.50		86	Very Fine Silty Sand	23.7	158.0	141.6	34.6	17.3	***120.8***	121	0	0	66	42
379.60	2.50		26	Fine Sand	4.4	63.7	195.0	6.5	7.0	***132.6***	133	0	0	73	44
376.60	3.00		46	Fine Sand	11.9	112.7	251.0	17.4	12.3	***154.9***	155	0	0	85	47
374.60	2.00		64	Fine Sand	13.8	156.8	***161.9***	20.2	17.2	163.8	162	0	0	89	49
372.10	2.50		22	Fine Sand	3.7	53.9	***120.0***	5.5	5.9	164.2	120	0	0	66	52
369.60	2.50	0.60			4.6	8.3	***153.0***	6.7	0.9	174.0	153	0	0	84	54
364.60	5.00		15	Medium Sand	5.4	36.7	***130.0***	7.9	4.0	178.8	130	0	0	71	59
359.60	5.00	0.60			9.1	8.3	***165.1***	13.3	0.9	195.0	165	0	0	91	64
354.60	5.00		14	Medium Sand	5.1	34.3	339.2	7.4	3.8	***220.9***	221	0	0	121	69
349.60	5.00		83	Fine Sand	53.7	203.3	368.4	78.6	22.3	***296.8***	297	0	0	163	74
344.60	5.00		73	Fine Sand	43.6	178.8	***255.2***	63.7	19.6	343.3	255	0	0	140	79
339.60	5.00		9	Fine Sand	3.1	22.0	481.2	4.5	2.4	***372.2***	372	0	0	205	84
329.60	10.00		100	Fine Sand	142.0	245.0	***454.2***	207.6	26.8	561.3	~~454~~	~~0~~	~~0~~	~~250~~	~~94~~
328.10	1.50		31	Fine Sand		75.9			8.3						

Printed 6/20/2017 Page 1 of 1 BBS 147 (11/01/16)

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== WB, Piers
REFERENCE BORING ========== 2-S (2016)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 423.95 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 402.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1500 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 237.62 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 89.11 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
418 KIPS	**288** KIPS	**158** KIPS	**95** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
401.80	0.60	2.50			3.2		32.1	4.7		***7.9***	8	0	0	4	22
399.30	2.50	2.10			11.9	28.9	46.8	17.4	3.2	***25.6***	26	0	0	14	25
396.80	2.50	2.30			12.6	31.7	62.2	18.5	3.5	***44.3***	44	0	0	24	27
394.30	2.50	2.50			13.4	34.5	81.1	19.5	3.8	***64.5***	64	0	0	35	30
391.80	2.50	2.90			14.8	40.0	101.4	21.7	4.4	***86.7***	87	0	0	48	32
389.30	2.50	3.30	10		16.3	45.5	***106.6***	23.8	5.0	109.3	107	0	0	59	35
386.80	2.50	2.50			13.4	34.5	***111.2***	19.5	3.8	127.9	111	0	0	61	37
384.30	2.50		14	Very Fine Silty Sand	2.2	25.7	157.5	3.2	2.8	***135.9***	136	0	0	75	40
381.80	2.50		38	Very Fine Silty Sand	6.2	69.8	143.5	9.0	7.6	***142.7***	143	0	0	78	42
379.30	2.50		27	Very Fine Silty Sand	4.2	49.6	343.0	6.1	5.4	***170.2***	170	0	0	94	45
376.80	2.50		100	Fine Sand	35.5	245.0	***180.1***	51.9	26.8	200.4	180	0	0	99	47
374.30	2.50		19	Fine Sand	3.2	46.5	327.9	4.7	5.1	***220.9***	221	0	0	121	50
371.80	2.50		78	Fine Sand	24.3	191.1	***166.6***	35.6	20.9	236.1	167	0	0	92	52
369.30	2.50	0.40			3.1	5.5	***169.7***	4.6	0.6	240.7	170	0	0	93	55
364.30	5.00	0.40			6.3	5.5	***177.4***	9.2	0.6	250.1	177	0	0	98	60
359.30	5.00	0.50			7.7	6.9	***183.8***	11.3	0.8	261.3	184	0	0	101	65
354.30	5.00	0.40			6.3	5.5	***190.1***	9.2	0.6	270.5	190	0	0	105	70
348.80	5.50	0.40			6.9	5.5	377.7	10.1	0.6	***300.4***	300	0	0	165	75
344.30	4.50		76	Fine Sand	42.0	186.2	***240.3***	61.3	20.4	342.1	240	0	0	132	80
339.30	5.00	0.50			7.7	6.9	***257.7***	11.3	0.8	354.4	258	0	0	142	85
333.80	5.50	1.20			17.9	16.5	***281.1***	26.1	1.8	381.2	281	0	0	155	90
329.30	4.50	1.60			17.9	22.0	***288.0***	26.2	2.4	406.2	288	0	0	158	95
318.80	10.50	0.80			24.6	11.0	524.5	36.0	1.2	***465.4***	~~465~~	~~0~~	~~0~~	~~256~~	~~105~~
308.80	10.00		91	Fine Sand	123.7	222.9	670.3	180.9	24.4	***648.7***	~~649~~	~~0~~	~~0~~	~~357~~	~~115~~
307.80	1.00		100	Fine Sand		245.0			26.8						

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Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== EB, Piers
REFERENCE BORING ========== 3-S (2016)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 423.95 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 402.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1500 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 237.62 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 89.11 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**392** KIPS	**215** KIPS	*** Below Boring

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
401.70	0.70	1.20			2.3		17.4	3.3		***5.0***	5	0	0	3	22
399.20	2.50	1.10			7.6	15.2	26.4	11.1	1.7	***16.2***	16	0	0	9	25
396.70	2.50	1.20			8.1	16.5	71.7	11.9	1.8	***32.2***	32	0	0	18	27
394.20	2.50	3.90	16		18.4	53.7	***47.5***	27.0	5.9	54.5	47	0	0	26	30
391.70	2.50	0.80			5.9	11.0	***46.4***	8.6	1.2	62.3	46	0	0	26	32
389.20	2.50	0.30			2.4	4.1	***50.2***	3.5	0.5	66.0	50	0	0	28	35
386.70	2.50	0.40			3.1	5.5	253.6	4.6	0.6	***92.5***	92	0	0	51	37
384.20	2.50		84	Fine Sand	27.4	205.8	249.2	40.0	22.5	***129.0***	129	0	0	71	40
381.70	2.50		71	Fine Sand	20.8	173.9	235.6	30.4	19.0	***155.6***	156	0	0	86	42
379.20	2.50		57	Fine Sand	14.3	139.6	281.7	20.9	15.3	***180.0***	180	0	0	99	45
376.70	2.50		70	Fine Sand	20.3	171.5	248.1	29.6	18.8	***203.7***	204	0	0	112	47
374.20	2.50		48	Fine Sand	10.7	117.6	246.5	15.6	12.9	***218.0***	218	0	0	120	50
371.70	2.50		43	Fine Sand	8.8	105.3	***156.9***	12.9	11.5	220.1	157	0	0	86	52
369.20	2.50	0.50			3.9	6.9	***160.8***	5.7	0.8	225.8	161	0	0	88	55
364.20	5.00	0.50			7.7	6.9	***169.9***	11.3	0.8	237.2	170	0	0	93	60
359.20	5.00	0.60			9.1	8.3	***177.6***	13.3	0.9	250.4	178	0	0	98	65
354.20	5.00	0.50			7.7	6.9	423.5	11.3	0.8	***287.8***	288	0	0	158	70
349.20	5.00		100	Fine Sand	71.0	245.0	494.5	103.8	26.8	***391.6***	392	0	0	215	75
347.70	1.50		100	Fine Sand		245.0			26.8						

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LIN ENGINEERING, LTD.
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Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== WB, W. Abut.
REFERENCE BORING ========== 4-S (2016)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 422.85 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 420.85 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 800 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 126.73 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 47.52 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
418 KIPS	**356** KIPS	**196** KIPS	**70** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
420.30	0.55	1.40			2.0		22.7	2.9		***5.2***	5	0	0	3	3
417.80	2.50	1.50			9.5	20.7	33.6	13.9	2.3	***19.3***	19	0	0	11	5
415.30	2.50	1.60			10.0	22.0	43.6	14.6	2.4	***33.9***	34	0	0	19	8
412.80	2.50	1.60			10.0	22.0	***42.5***	14.6	2.4	47.2	43	0	0	23	10
410.30	2.50	0.80			5.9	11.0	***48.4***	8.6	1.2	55.8	48	0	0	27	13
407.80	2.50	0.80			5.9	11.0	131.4	8.6	1.2	***72.8***	73	0	0	40	15
405.30	2.50		48	Very Fine Silty Sand	8.6	88.2	***62.8***	12.6	9.7	77.0	63	0	0	35	18
402.80	2.50	0.80			5.9	11.0	***82.5***	8.6	1.2	87.0	82	0	0	45	20
400.30	2.50	1.80			10.8	24.8	105.7	15.8	2.7	***104.2***	104	0	0	57	23
397.80	2.50	2.70			14.1	37.2	133.5	20.6	4.1	***126.3***	126	0	0	69	25
395.30	2.50	3.70	10		17.7	51.0	***104.4***	25.9	5.6	147.0	104	0	0	57	28
392.80	2.50	0.30			2.4	4.1	***106.8***	3.5	0.5	150.5	107	0	0	59	30
390.30	2.50	0.30			2.4	4.1	***109.2***	3.5	0.5	154.1	109	0	0	60	33
387.80	2.50	0.30			2.4	4.1	***113.0***	3.5	0.5	157.7	113	0	0	62	35
382.80	5.00	0.40			6.3	5.5	***152.3***	9.2	0.6	170.5	152	0	0	84	40
377.80	5.00		21	Very Fine Silty Sand	6.5	38.6	304.0	9.5	4.2	***195.9***	196	0	0	108	45
372.80	5.00		100	Very Fine Silty Sand	60.2	183.7	312.7	88.1	20.1	***278.3***	278	0	0	153	50
367.80	5.00		54	Fine Sand	26.1	132.3	***246.9***	38.1	14.5	306.4	247	0	0	136	55
362.80	5.00		22	Very Fine Silty Sand	6.8	40.4	***244.6***	9.9	4.4	315.3	245	0	0	135	60
357.80	5.00		17	Very Fine Silty Sand	5.3	31.2	***225.5***	7.7	3.4	320.3	225	0	0	124	65
352.80	5.00	0.50			7.7	6.9	454.1	11.3	0.8	***355.8***	356	0	0	196	70
347.80	5.00		93	Fine Sand	63.9	227.8	535.2	93.4	24.9	***451.1***	~~451~~	~~0~~	~~0~~	~~248~~	~~75~~
342.80	5.00		100	Fine Sand	71.0	245.0	598.8	103.8	26.8	***554.1***	~~554~~	~~0~~	~~0~~	~~305~~	~~80~~
341.30	1.50		97	Fine Sand		237.6			26.0						

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Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== WB, E. Abut.
REFERENCE BORING ========== 5-S (2016)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 422.82 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 420.82 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 800 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 126.73 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 47.52 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring.
418 KIPS	**314** KIPS	**173** KIPS	**70** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
419.90	0.92	1.50			3.5		18.7	5.1		***6.8***	7	0	0	4	3
417.40	2.50	1.10			7.6	15.2	24.9	11.1	1.7	***17.8***	18	0	0	10	5
414.90	2.50	1.00			7.0	13.8	33.3	10.3	1.5	***28.2***	28	0	0	16	8
412.40	2.50	1.10			7.6	15.2	94.4	11.1	1.7	***45.2***	45	0	0	25	10
409.90	2.50		28	Sandy Gravel	7.1	68.6	106.3	10.4	7.5	***56.1***	56	0	0	31	13
407.40	2.50		30	Sandy Gravel	8.0	73.5	115.2	11.6	8.0	***67.8***	68	0	0	37	15
404.90	2.50	5.40	14		20.6	74.4	104.1	30.1	8.1	***94.5***	94	0	0	52	18
402.40	2.50	3.10	10		15.5	42.7	***115.5***	22.7	4.7	116.7	116	0	0	64	20
399.90	2.50	2.80			14.4	38.6	139.6	21.1	4.2	***138.9***	139	0	0	76	23
397.40	2.50	3.50	9		17.0	48.2	***145.6***	24.8	5.3	162.5	146	0	0	80	25
394.90	2.50	2.70			14.1	37.2	***159.7***	20.6	4.1	183.1	160	0	0	88	28
392.40	2.50	2.70			14.1	37.2	***166.8***	20.6	4.1	203.0	167	0	0	92	30
389.90	2.50	2.20			12.3	30.3	***180.5***	17.9	3.3	221.0	180	0	0	99	33
387.40	2.50	2.30			12.6	31.7	***187.6***	18.5	3.5	238.9	188	0	0	103	35
382.40	5.00	1.90			22.3	26.2	***200.3***	32.7	2.9	270.5	200	0	0	110	40
377.40	5.00	1.20			16.3	16.5	***231.7***	23.8	1.8	295.9	232	0	0	127	45
371.90	5.50	2.30			27.8	31.7	433.6	40.6	3.5	***355.6***	356	0	0	196	51
367.40	4.50		84	Medium Sand	57.8	205.8	***295.3***	84.6	22.5	418.7	295	0	0	162	55
362.40	5.00	0.70			10.4	9.6	***301.6***	15.3	1.1	433.5	302	0	0	166	60
357.40	5.00	0.40			6.3	5.5	***306.5***	9.2	0.6	442.6	307	0	0	169	65
352.40	5.00	0.30			4.8	4.1	***314.1***	7.0	0.5	449.9	314	0	0	173	70
347.40	5.00	0.50			7.7	6.9	***464.4***	11.3	0.8	476.8	~~464~~	~~0~~	~~0~~	~~255~~	~~75~~
337.40	10.00		61	Medium Sand	77.9	149.4	***409.4***	113.9	16.4	576.2	409	0	0	225	85
327.90	9.50	1.20			30.9	16.5	***590.3***	45.1	1.8	637.8	~~590~~	~~0~~	~~0~~	~~325~~	~~95~~
322.40	5.50		68	Clean Coarse Sand	59.0	166.6	***668.9***	86.3	18.2	726.2	~~669~~	~~0~~	~~0~~	~~368~~	~~100~~
320.90	1.50		76	Clean Coarse Sand		186.2			20.4						

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Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== EB, W. Abut.
REFERENCE BORING ========== 1S (1968)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 422.78 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 420.78 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 800 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 126.73 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 47.52 KIPS

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**210** KIPS	**116** KIPS	*** Below Boring

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
420.60	0.18	0.90			0.5		12.9	0.7		***2.0***	2	0	0	1	2
418.10	2.50	0.90			6.5	12.4	22.1	9.5	1.4	***11.8***	12	0	0	6	5
415.60	2.50	1.10			7.6	15.2	50.4	11.1	1.7	***25.2***	25	0	0	14	7
413.10	2.50	2.60			13.7	35.8	59.9	20.1	3.9	***44.8***	45	0	0	25	10
410.60	2.50	2.30			12.6	31.7	187.9	18.5	3.5	***75.9***	76	0	0	42	12
408.10	2.50		60	Clean Coarse Sand	22.0	147.0	***79.4***	32.1	16.1	93.7	79	0	0	44	15
405.60	2.50	1.20			8.1	16.5	***80.6***	11.9	1.8	104.8	81	0	0	44	17
403.10	2.50	0.70			5.2	9.6	***87.2***	7.6	1.1	112.6	87	0	0	48	20
400.60	2.50	0.80			5.9	11.0	***115.1***	8.6	1.2	123.6	115	0	0	63	22
398.10	2.50	2.40			13.0	33.1	150.2	19.0	3.6	***145.0***	145	0	0	80	25
395.60	2.50	4.00	11		18.8	55.1	***141.4***	27.5	6.0	169.5	141	0	0	78	27
393.10	2.50		15	Very Fine Silty Sand	2.3	27.6	***125.8***	3.4	3.0	170.9	126	0	0	69	30
390.60	2.50	0.70			5.2	9.6	***177.7***	7.6	1.1	183.6	178	0	0	98	32
388.10	2.50		23	Fine Sand	3.9	56.3	218.4	5.7	6.2	***193.4***	193	0	0	106	35
385.60	2.50		38	Fine Sand	7.2	93.1	281.9	10.5	10.2	***210.0***	210	0	0	116	37
384.60	1.00		61	Fine Sand		149.4			16.4						

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LIN ENGINEERING, LTD.
Consulting Engineers

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== EB, E. Abut.
REFERENCE BORING ========== 4S (1968)
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 422.89 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 420.89 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 800 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 50.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 126.73 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 47.52 KIPS

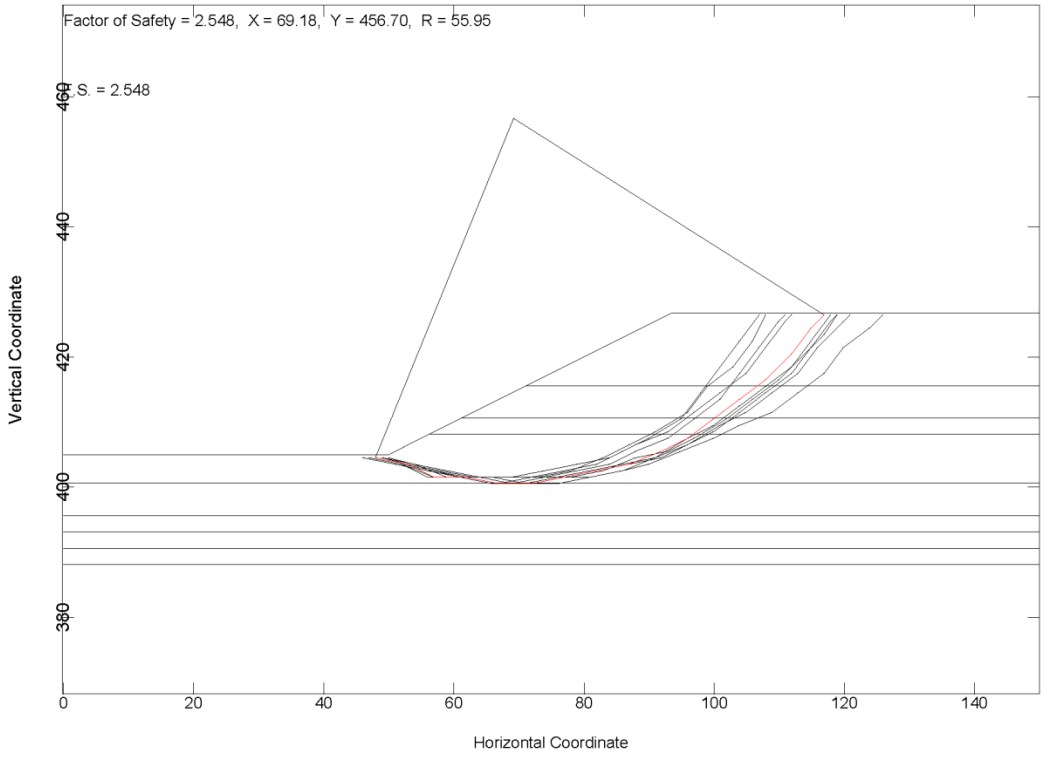
MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**298** KIPS	**164** KIPS	*** Below Boring

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
419.20	1.69	1.30			5.8		16.9	8.5		***9.7***	10	0	0	5	4
416.70	2.50	0.80			5.9	11.0	35.1	8.6	1.2	***19.7***	20	0	0	11	6
414.20	2.50	1.70			10.4	23.4	38.6	15.2	2.6	***34.1***	34	0	0	19	9
411.70	2.50	1.20			8.1	16.5	55.0	11.9	1.8	***46.9***	47	0	0	26	11
409.20	2.50	1.80			10.8	24.8	74.1	15.8	2.7	***63.5***	64	0	0	35	14
406.70	2.50	2.40			13.0	33.1	89.8	19.0	3.6	***82.8***	83	0	0	46	16
404.20	2.50	2.60			13.7	35.8	***98.0***	20.1	3.9	102.3	98	0	0	54	19
401.70	2.50	2.20			12.3	30.3	***113.0***	17.9	3.3	120.5	113	0	0	62	21
399.20	2.50	2.40			13.0	33.1	***138.4***	19.0	3.6	140.9	138	0	0	76	24
396.70	2.50	3.30	12		16.3	45.5	***156.1***	23.8	5.0	164.8	156	0	0	86	26
394.20	2.50	3.40	17		16.6	46.9	***158.9***	24.3	5.1	187.6	159	0	0	87	29
391.70	2.50	2.40			13.0	33.1	***169.2***	19.0	3.6	206.3	169	0	0	93	31
389.20	2.50	2.20			12.3	30.3	***181.4***	17.9	3.3	224.3	181	0	0	100	34
386.70	2.50	2.20			12.3	30.3	***189.6***	17.9	3.3	241.7	190	0	0	104	36
384.20	2.50	1.90			11.2	26.2	***200.3***	16.3	2.9	258.0	200	0	0	110	39
381.70	2.50		14	Very Fine Silty Sand	2.2	25.7	***194.6***	3.2	2.8	260.3	195	0	0	107	41
379.20	2.50	1.30			8.6	17.9	430.3	12.6	2.0	***297.8***	298	0	0	164	44
378.30	0.90		100	Clean Coarse Sand		245.0			26.8						

EB W. Abutment



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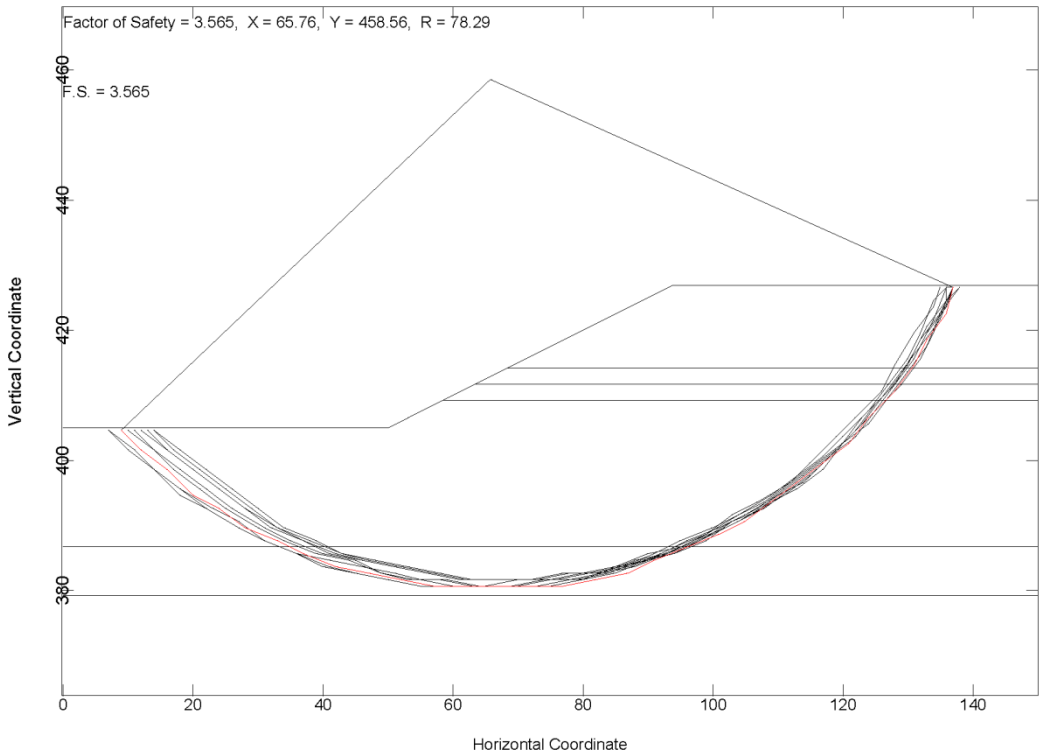

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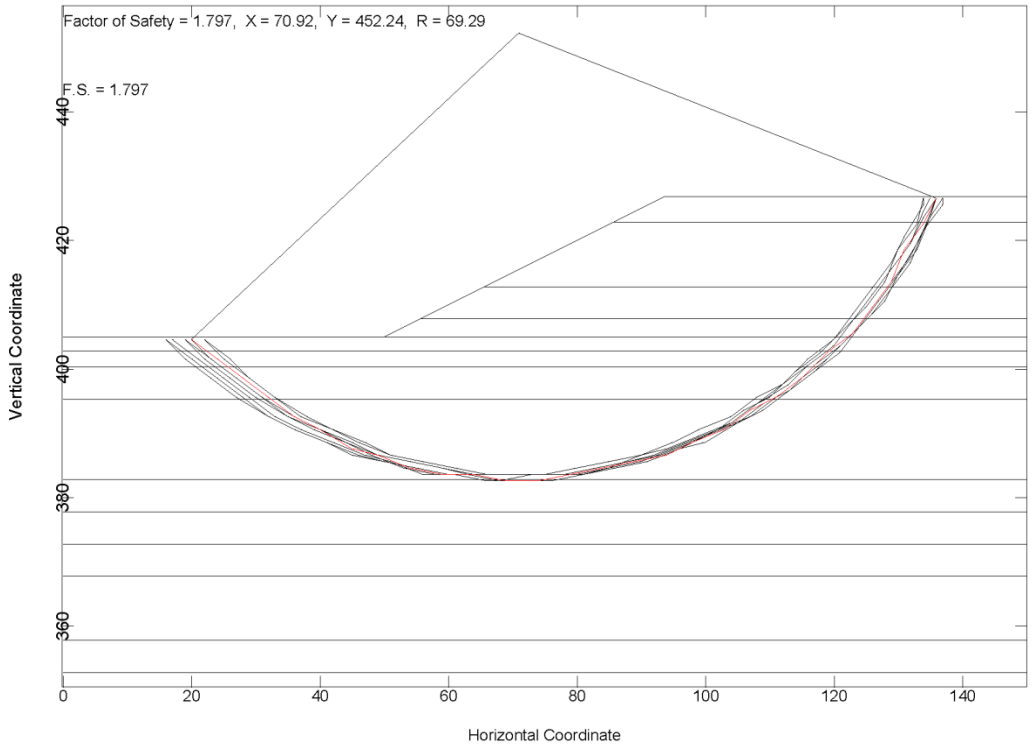

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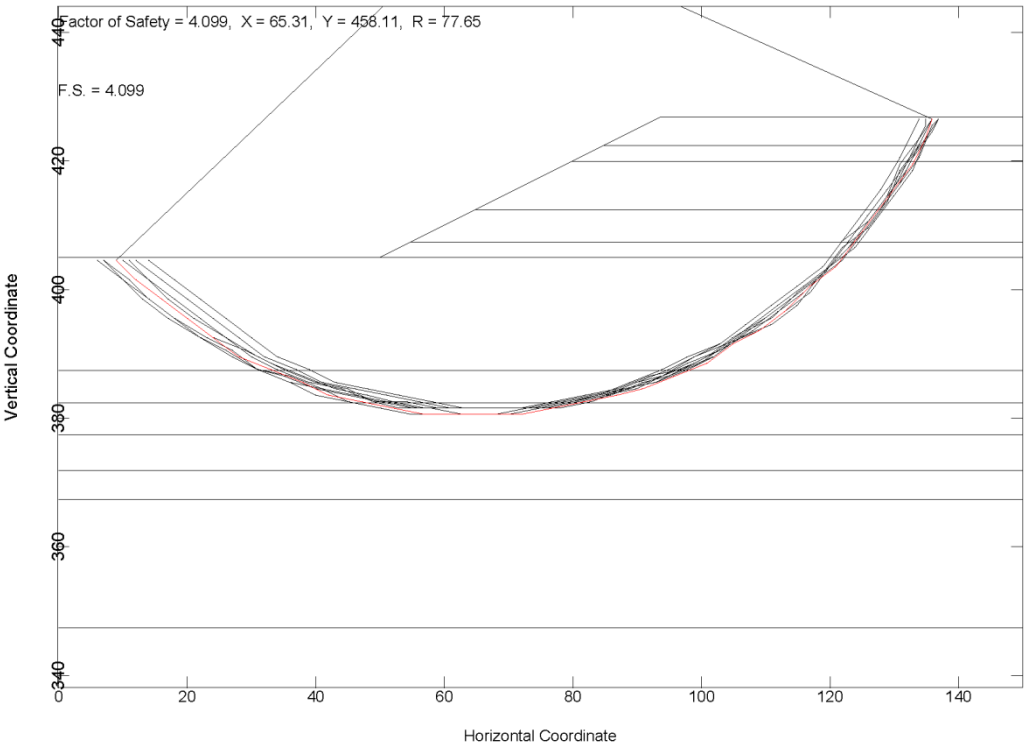

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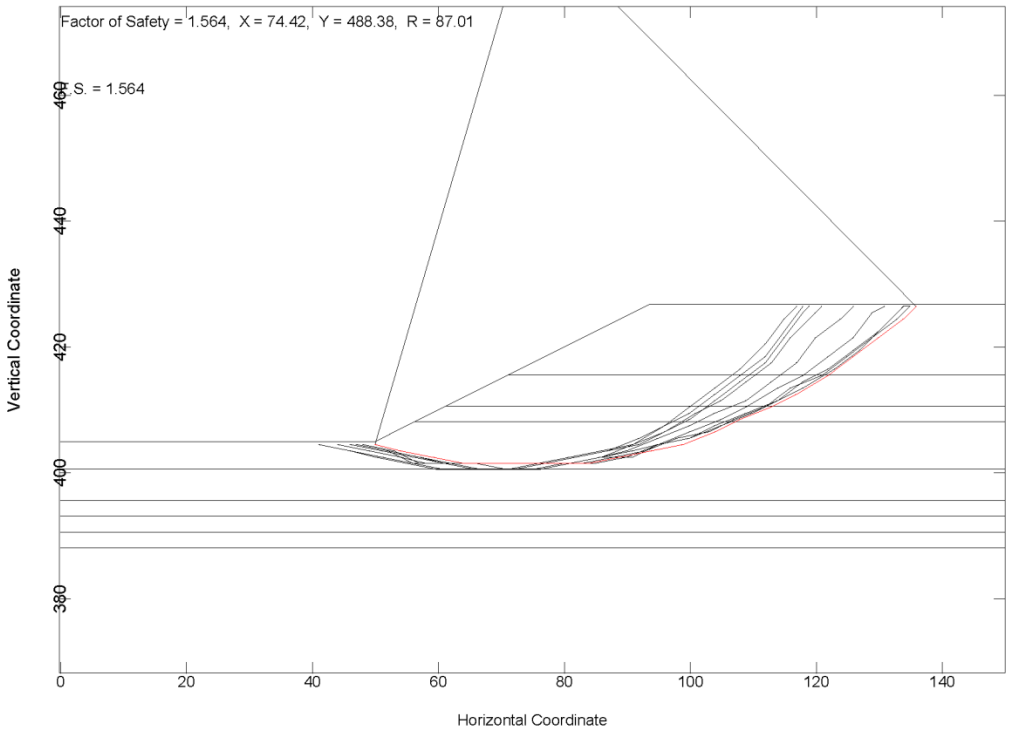

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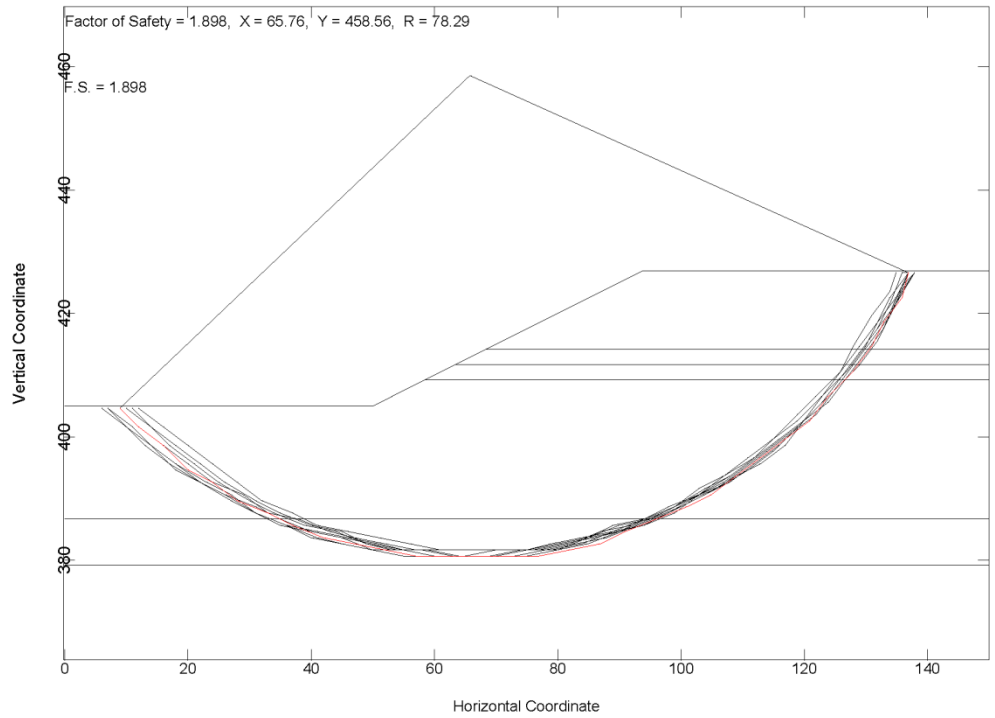

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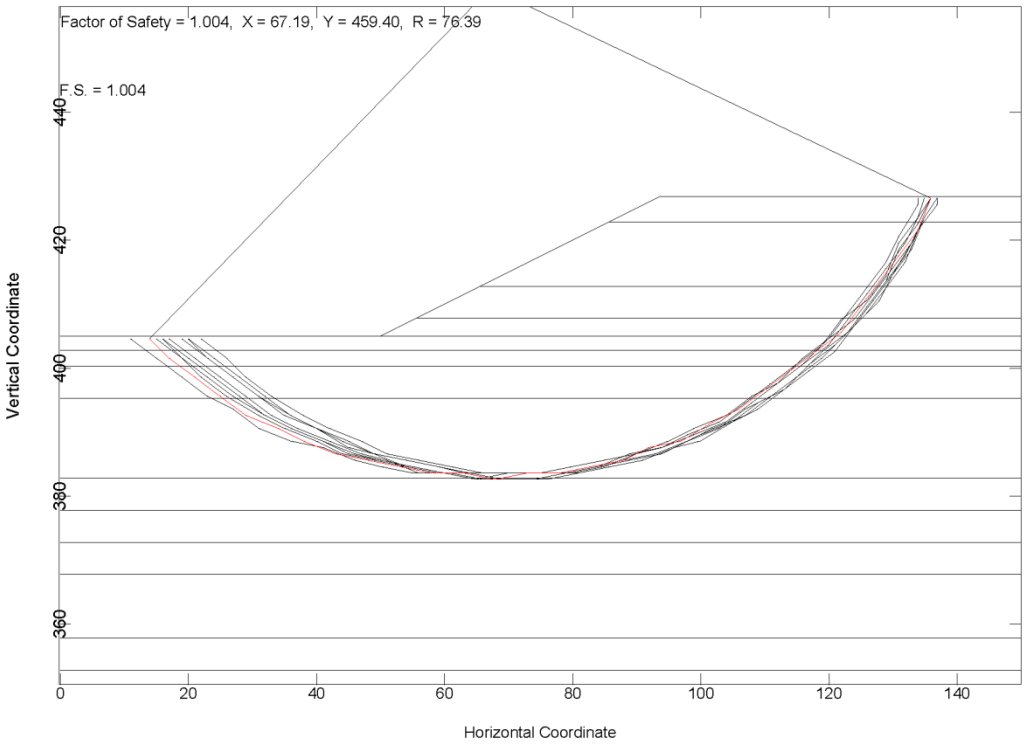

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