

ANALYSIS OF AXIAL CAPACITY AND SETTLEMENT OF A SINGLE PILE

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PROJECT INFORMATION	
Project Name	
Project No.	
Project Location	
Analyzed By	
Reviewed By	

INPUT PARAMETERS	
Design Method	ASD: Allowable Stress Design
Pile Type	6: Cast-in-Drilled Hole (CIDH) Concrete Pile
Outer Pile Diameter or Width	30.00 inches
Pile Wall Thickness (for Pipe Pile)	0.00 inches
Plug Length (for Pipe Pile)	0.00 feet
Pile Gross End-Area	706.86 square inches
Pile Perimeter	94.25 inches
Embedded Pile Length	50.00 feet
Design Compression Load	400.00 kips
Design Tension Load	0.00 kips
Factor of Safety for Skin Friction	2.00
Factor of Safety for End Bearing	3.00
Ground Surface Elevation	100.00 feet
Top of Pile Elevation	97.00 feet
Design Groundwater Depth	20.00 feet

SUMMARY OF RESULTS	
Embedded Pile Length	50.00 feet
Pile Tip Elevation	47.00 feet
Ultimate Compression Capacity	1,115.9 kips
Ultimate Tension Capacity	504.9 kips
Design Compression Capacity	492.2 kips
Design Tension Capacity	252.4 kips
Pile Settlement	0.65 inch

REFERENCES:

- Brown, D.A. et al., 2007, "Design and Construction of Continuous Flight Auger (CFA) Piles", USDOT Federal Highway Administration (FHWA), Geotech. Eng. Circular No. 8, Report No. FHWA-HIF-07-03.
- Hannigan, P.J. et al., 2016, "Design and Construction of Driven Pile Foundations", USDOT FHWA, Report No. FHWA-NHI-16-009.
- Meyerhof, G.G., 1976, "Bearing Capacity and Settlement of Pile Foundations," Journal of Geotechnical Engineering Division, ASCE, 102 (GT3), pp. 195-228.
- O'Neill, M.W. and Reese, L.C., 1999, "Drilled Shafts: Construction Procedures and Design Methods", US DOT FHWA, Report No. FHWA-IF-99-025.
- U.S. Naval Facilities Engineering Command (NAVFAC) 7.02 Foundations and Earth Structures, 1986, pp. 7.02-207 to 7.02-209.

INPUT SOIL/ROCK PROFILE DATA										
Top of Soil Layer Elevation	Bottom of Soil Layer Elevation	Skin Friction Condition	Soil Type Model	Total Soil Unit Weight	SPT Blow Count	Soil Friction Angle	Soil Cohesion	Rock Unconf. Comp. Strength	Specified Unit Skin Friction	Specified Unit End Bearing
(feet)	(feet)	(P/N/Z)		γ_t (pcf)	N_{60} (blows/ft)	ϕ (degrees)	c (ksf)	q_u (ksf)	f_s (ksf)	q_p (ksf)
100.00	97.00	Z	Sand	120.00	N/A	N/A	N/A	N/A	N/A	N/A
97.00	96.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
96.00	95.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
95.00	94.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
94.00	93.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
93.00	92.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
92.00	91.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
91.00	90.00	P	Sand	120.00	15.00	N/A	N/A	N/A	N/A	N/A
90.00	89.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
89.00	88.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
88.00	87.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
87.00	86.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
86.00	85.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
85.00	84.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
84.00	83.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
83.00	82.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
82.00	81.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
81.00	80.00	P	Clay/Plastic Silt	125.00	N/A	N/A	1.50	N/A	N/A	N/A
80.00	79.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
79.00	78.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
78.00	77.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
77.00	76.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
76.00	75.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
75.00	74.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
74.00	73.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
73.00	72.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
72.00	71.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A
71.00	70.00	P	Sand	125.00	21.00	N/A	N/A	N/A	N/A	N/A

AXIAL PILE CAPACITY CALCULATIONS										
Embedded Pile Length	Ultimate Unit Skin Friction	Ultimate Unit End Bearing	Cum. Ultimate Skin Friction	Ultimate End Bearing	Ultimate Comp. Capacity	Ultimate Tension Capacity	Design Skin Friction	Design End Bearing	Design Tension Capacity	Design Comp. Capacity
D_z (feet)	f_s (ksf)	q_p (ksf)	$Q_{s,ult}$ (kips)	$Q_{p,ult}$ (kips)	$Q_{c,ult}$ (kips)	$Q_{t,ult}$ (kips)	$Q_{s,all}$ (kips)	$Q_{p,all}$ (kips)	$Q_{t,all}$ (kips)	$Q_{c,all}$ (kips)
0.00										
1.00	0.50	18.00	3.96	88.36	92.32	2.77	1.98	29.45	1.39	31.43
2.00	0.65	18.00	9.05	88.36	97.41	6.33	4.52	29.45	3.17	33.98
3.00	0.78	18.00	15.18	88.36	103.54	10.63	7.59	29.45	5.31	37.04
4.00	0.90	18.00	22.26	88.36	110.62	15.58	11.13	29.45	7.79	40.58
5.00	1.02	18.00	30.25	88.36	118.61	21.18	15.13	29.45	10.59	44.58
6.00	1.13	18.00	39.12	88.36	127.47	27.38	19.56	29.45	13.69	49.01
7.00	1.24	18.00	48.82	88.36	137.18	34.18	24.41	29.45	17.09	53.86
8.00	0.83	13.50	55.30	66.27	121.57	38.71	27.65	22.09	19.36	49.74
9.00	0.83	13.50	61.78	66.27	128.05	43.25	30.89	22.09	21.62	52.98
10.00	0.83	13.50	68.26	66.27	134.53	47.78	34.13	22.09	23.89	56.22
11.00	0.83	13.50	74.74	66.27	141.01	52.32	37.37	22.09	26.16	59.46
12.00	0.83	13.50	81.22	66.27	147.49	56.85	40.61	22.09	28.43	62.70
13.00	0.83	13.50	87.70	66.27	153.97	61.39	43.85	22.09	30.69	65.94
14.00	0.83	13.50	94.18	66.27	160.45	65.93	47.09	22.09	32.96	69.18
15.00	0.83	13.50	100.66	66.27	166.93	70.46	50.33	22.09	35.23	72.42
16.00	0.83	13.50	107.14	66.27	173.41	75.00	53.57	22.09	37.50	75.66
17.00	0.83	13.50	113.62	66.27	179.89	79.53	56.81	22.09	39.77	78.90
18.00	2.21	25.20	130.94	123.70	254.64	91.66	65.47	41.23	45.83	106.70
19.00	2.22	25.20	148.40	123.70	272.10	103.88	74.20	41.23	51.94	115.43
20.00	2.24	25.20	166.00	123.70	289.70	116.20	83.00	41.23	58.10	124.23
21.00	2.26	25.20	183.73	123.70	307.43	128.61	91.86	41.23	64.30	133.10
22.00	2.27	25.20	201.57	123.70	325.27	141.10	100.79	41.23	70.55	142.02
23.00	2.29	25.20	219.53	123.70	343.23	153.67	109.77	41.23	76.84	151.00
24.00	2.30	25.20	237.60	123.70	361.30	166.32	118.80	41.23	83.16	160.03
25.00	2.31	25.20	255.76	123.70	379.46	179.03	127.88	41.23	89.52	169.11
26.00	2.32	25.20	274.01	123.70	397.71	191.81	137.01	41.23	95.90	178.24
27.00	2.33	25.20	292.35	123.70	416.05	204.64	146.17	41.23	102.32	187.41

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(feet)	(feet)	(P/N/Z)		γ_t (pcf)	N_{60} (blows/ft)	ϕ (degrees)	c (ksf)	q_u (ksf)	f_s (ksf)	q_p (ksf)
70.00	69.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
69.00	68.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
68.00	67.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
67.00	66.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
66.00	65.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
65.00	64.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
64.00	63.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
63.00	62.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
62.00	61.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
61.00	60.00	P	Sand	125.00	35.00	N/A	N/A	N/A	N/A	N/A
60.00	59.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
59.00	58.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
58.00	57.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
57.00	56.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
56.00	55.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
55.00	54.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
54.00	53.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
53.00	52.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
52.00	51.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
51.00	50.00	P	Sand	125.00	48.00	N/A	N/A	N/A	N/A	N/A
50.00	49.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
49.00	48.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
48.00	47.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
47.00	46.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
46.00	45.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
45.00	44.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
44.00	43.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A
43.00	42.00	P	Sand	125.00	67.00	N/A	N/A	N/A	N/A	N/A

AXIAL PILE CAPACITY CALCULATIONS										
Embedded Pile Length	Ultimate Unit Skin Friction	Ultimate Unit End Bearing	Cum. Ultimate Skin Friction	Ultimate End Bearing	Ultimate Comp. Capacity	Ultimate Tension Capacity	Design Skin Friction	Design End Bearing	Design Tension Capacity	Design Comp. Capacity
D_z (feet)	f_s (ksf)	q_p (ksf)	$Q_{s,ult}$ (kips)	$Q_{p,ult}$ (kips)	$Q_{c,ult}$ (kips)	$Q_{t,ult}$ (kips)	$Q_{s,all}$ (kips)	$Q_{p,all}$ (kips)	$Q_{t,all}$ (kips)	$Q_{c,all}$ (kips)
28.00	2.34	42.00	310.76	206.17	516.93	217.53	155.38	68.72	108.77	224.10
29.00	2.35	42.00	329.24	206.17	535.41	230.47	164.62	68.72	115.23	233.34
30.00	2.36	42.00	347.78	206.17	553.95	243.45	173.89	68.72	121.72	242.61
31.00	2.37	42.00	366.38	206.17	572.55	256.47	183.19	68.72	128.23	251.91
32.00	2.37	42.00	385.03	206.17	591.20	269.52	192.51	68.72	134.76	261.24
33.00	2.38	42.00	403.72	206.17	609.88	282.60	201.86	68.72	141.30	270.58
34.00	2.38	42.00	422.44	206.17	628.61	295.71	211.22	68.72	147.85	279.94
35.00	2.39	42.00	441.19	206.17	647.35	308.83	220.59	68.72	154.42	289.32
36.00	2.39	42.00	459.96	206.17	666.12	321.97	229.98	68.72	160.98	298.70
37.00	2.39	42.00	478.74	206.17	684.91	335.12	239.37	68.72	167.56	308.09
38.00	2.39	57.60	497.53	282.74	780.28	348.27	248.77	94.25	174.14	313.01
39.00	2.39	57.60	516.32	282.74	799.07	361.43	258.16	94.25	180.71	352.41
40.00	2.39	57.60	535.11	282.74	817.86	374.58	267.56	94.25	187.29	361.80
41.00	2.39	57.60	553.89	282.74	836.63	387.72	276.94	94.25	193.86	371.19
42.00	2.39	57.60	572.64	282.74	855.38	400.85	286.32	94.25	200.42	380.57
43.00	2.38	57.60	591.37	282.74	874.12	413.96	295.69	94.25	206.98	389.93
44.00	2.38	57.60	610.07	282.74	892.81	427.05	305.04	94.25	213.52	399.28
45.00	2.38	57.60	628.73	282.74	911.48	440.11	314.37	94.25	220.06	408.61
46.00	2.37	57.60	647.35	282.74	930.09	453.14	323.67	94.25	226.57	417.92
47.00	2.36	57.60	665.92	282.74	948.66	466.14	332.96	94.25	233.07	427.21
48.00	2.36	80.40	684.43	394.66	1079.09	479.10	342.21	131.55	239.55	473.77
49.00	2.35	80.40	702.88	394.66	1097.54	492.01	351.44	131.55	246.01	482.99
50.00	2.34	80.40	721.26	394.66	1115.92	504.88	360.63	131.55	252.44	492.18
51.00	2.33	80.40	739.56	394.66	1134.23	517.69	369.78	131.55	258.85	501.34
52.00	2.32	80.40	757.79	394.66	1152.45	530.45	378.89	131.55	265.23	510.45
53.00	2.31	80.40	775.92	394.66	1170.59	543.15	387.96	131.55	271.57	519.52
54.00	2.30	80.40	793.97	394.66	1188.63	555.78	396.99	131.55	277.89	528.54
55.00	2.29	80.40	811.92	394.66	1206.58	568.34	405.96	131.55	284.17	537.51

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DESIGN CAPACITY VERSUS PILE DEPTH

