RE-DESIGN OF FOUNDATION OF EDUTORIUM UMS BY MANUAL CALCULATIONS AND CALCULATIONS USING GEO5 SOFTWARE

Compiled as One of the Requirements of Completing the Undergraduate Program at the Department of Civil Engineering Faculty

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Surakarta, Nov 24th 2019

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Abstrak

Merancang pondasi tiang bor dengan dimensi optimal dari diameter tiang dan panjang tiang untuk mencapai stabilitas tiang terhadap sliding dan kegagalan. Dimensi bored pile adalah d = 0,40 L = 10m dengan data tanah diperoleh dari (BH-1), γb = 17,1 KN / m3 C = 20 KN / m3, =sat = 18,1. Merancang pondasi tiang bor menggunakan metode yang berbeda pada tipe tanah yang berbeda. Untuk perhitungan manual, pertama-tama kalkulasi poh kohesif tiang tunggal lebih sedikit dan tanah kohesif bersama-sama untuk mendapatkan faktor keamanan (SF). Formula yang digunakan dalam perhitungan manual berasal dari analisis dasar Terzaghi. Kemudian hitung daya dukung (Qg) untuk kelompok tiang yang bosan dilanjutkan. Pertama, hitung kelompok kohesif kelompok tumpukan tiang, dan kemudian hitung untuk kelompok tiang bosan di tanah kohesif lebih sedikit. untuk perhitungan perangkat lunak Geo5, dengan memasukkan data untuk tanah kohesif tiang tunggal dan tanah kohesif lebih sedikit untuk mendapatkan faktor keamanan. Kemudian masukan untuk kohesif tumpukan kelompok kelompok bosan dan kemudian kohesif lebih sedikit tanah. Untuk hasil dari perhitungan manual setelah menggabungkan daya dukung (Qu) tiang bor tunggal pada tanah kohesif dan tanah kohesif kurang, hasilnya didapat adalah (Qu = 1064.742 KN) dan membaginya dengan (P = 900KN) sehingga SF = 1,18. Dan untuk hasil dari perhitungan manual tiang bor kelompok pada tanah kohesif didapatkan kapasitas dukung (Qg = 3168.73KN) dan untuk tanah kohesif lebih sedikit (Qg = 4258.968), membaginya dengan (P = 900KN) sehingga SF mendapatkan SF = 3,732 untuk tanah kohesif dan SF = 4,73 untuk tanah kohesi kurang. Untuk analisis perangkat lunak Geo5 dalam bored group pile SF = 3,22 untuk tanah kohesi dan SF = 2,63 dalam tanah kohesi lebih sedikit. Aplikasi yang digunakan dalam penelitian ini adalah Geo 5 v19, AutoCAD 2010 dan Microsoft Office 2010.

Kata kunci: pondasi tiang bor pondasi kelompok tiang bor dan pondasi tiang tunggal**.**

Abstract

Designing bored pile foundation with optimum dimension of the pile diameter and pile length to attain stability of the piles against sliding and any failure. The dimensions of the bored pile were d= 0.40 L= 10m with soil data gotten from (BH- 1), γb= 17.1 KN/m3 C= 20 KN/m3 , γsat = 18.1 . Designing bored pile foundation uses different

methods on different soil types . For the manual calculations, firstly calculate for single pile cohesive less soil and cohesive soil together to get the safety factor (SF). The formulas used in manual calculations were derived from Terzaghi's foundation analysis. Then calculate the bearing capacity (Qg) for bored pile group proceeded. Firstly, calculate bored pile group cohesive soil, and then calculate for bored pile group on cohesive less soil. for Geo5 software calculations, by inputting the data for single pile cohesive soil and cohesive less soil to get the safety factor. Then input for bored group pile cohesive and then cohesive less soil .For the results from manual calculation after combining the bearing capacity (Qu) of single bored pile on cohesive soil and cohesive less soil , the result gotten is (Qu=1064.742 KN) and dividing it with (P=900KN) so the SF =1.18 . And for the results from manual calculation of group bored pile on cohesive soil the bearing capacity gotten was (Qg=3168.73KN) and for cohesive less soil (Qg=4258.968), dividing it with (P=900KN) so the SF gotten SF =3.732 for cohesive soil and SF=4.73 for cohesion less soil . For Geo5 software analysis in bored group pile SF=3.22 for cohesion soil and SF= 2.63 in cohesion less soil .The applications used in this research is Geo 5 v19, AutoCAD 2010 and Microsoft Office 2010.

Keyword: bored pile foundation bored pile group foundation and bored single pile foundation.

1. INTRODUCTION

The project which has been chosen to make the final project is under construction in Edutoerium UMS, located in Surakarta city central java. Edutorium is a meeting hall from four floors with a capacity of more than 7,000 person. Pile foundations consist of a number of piles connected by a ring of concrete called a ground beam This is similar to a strip foundation but not as wide. One method of construction is to bored pile piles into the soil using specialized percussion drivers. The other method requires the drilling of a driven pile in the soil, which is then poured with concrete and reinforced with steel. The only purpose of the Pile Foundation is to distribute the loads of the building to the ground , as the upper layer of the soil is considered poor and weak to take the weight of the building . The piles to be used at the construction site depend on the nature of the soil. The stability of the buildings is created by taking the pile to the strongest part of the soil. The friction pile gives strength due to friction that is created in the deeper layers

of the soil. When the pile is inserted into the deeper part of the soil, the soil compacts and offers greater resistance and strength to the pile. The more the pile is inserted into the soil, greater the strength piles gives to the structure on the piles.

2. METHOD

At this research (design pile foundation by using Geo 5) to determine the dimension of the pile foundation that data taken from the Edutorium Muhammadiyah UMS, will be analyzed the soil's condition and to design of a pile foundation using the program Geo 5.The research is needed the data of soil in the Edutorium Muhammadiyah UMS such as soil. density (γ), specific gravity (Gs), Cu, and the friction angle (Φ). The data can be shown. The soil density = 16KN/$m^{3,}$ Cu= Convert Cu from qc, Friction angle (Φ)= 0° and P load=900 KN. the location of the Edutorium UMS project can be seen in Fig.1. The flowchart of the research can be seen in Figure
.2.

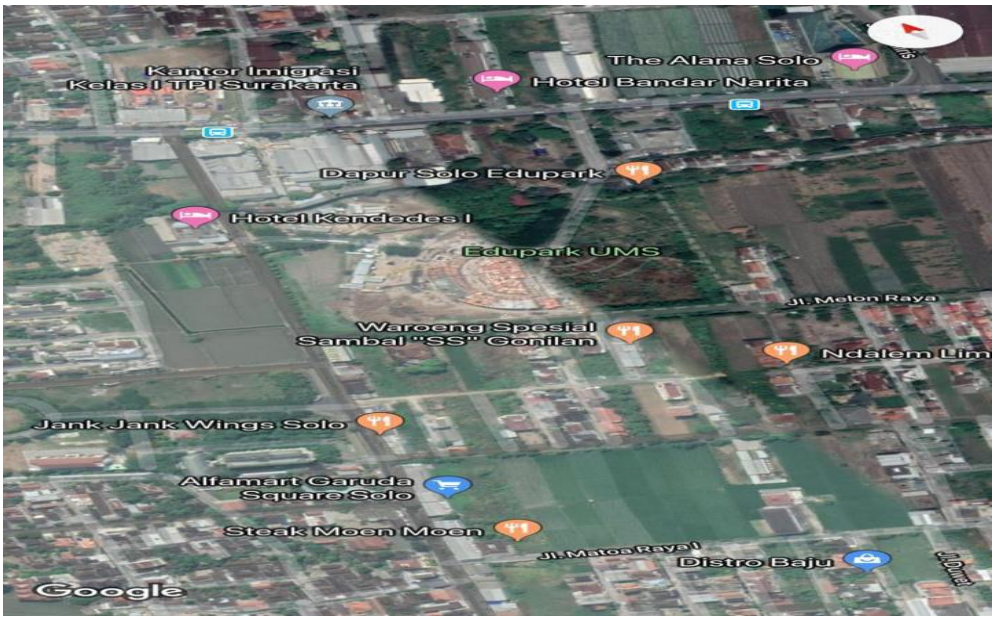


Figure 1. Edutorium UMS Location

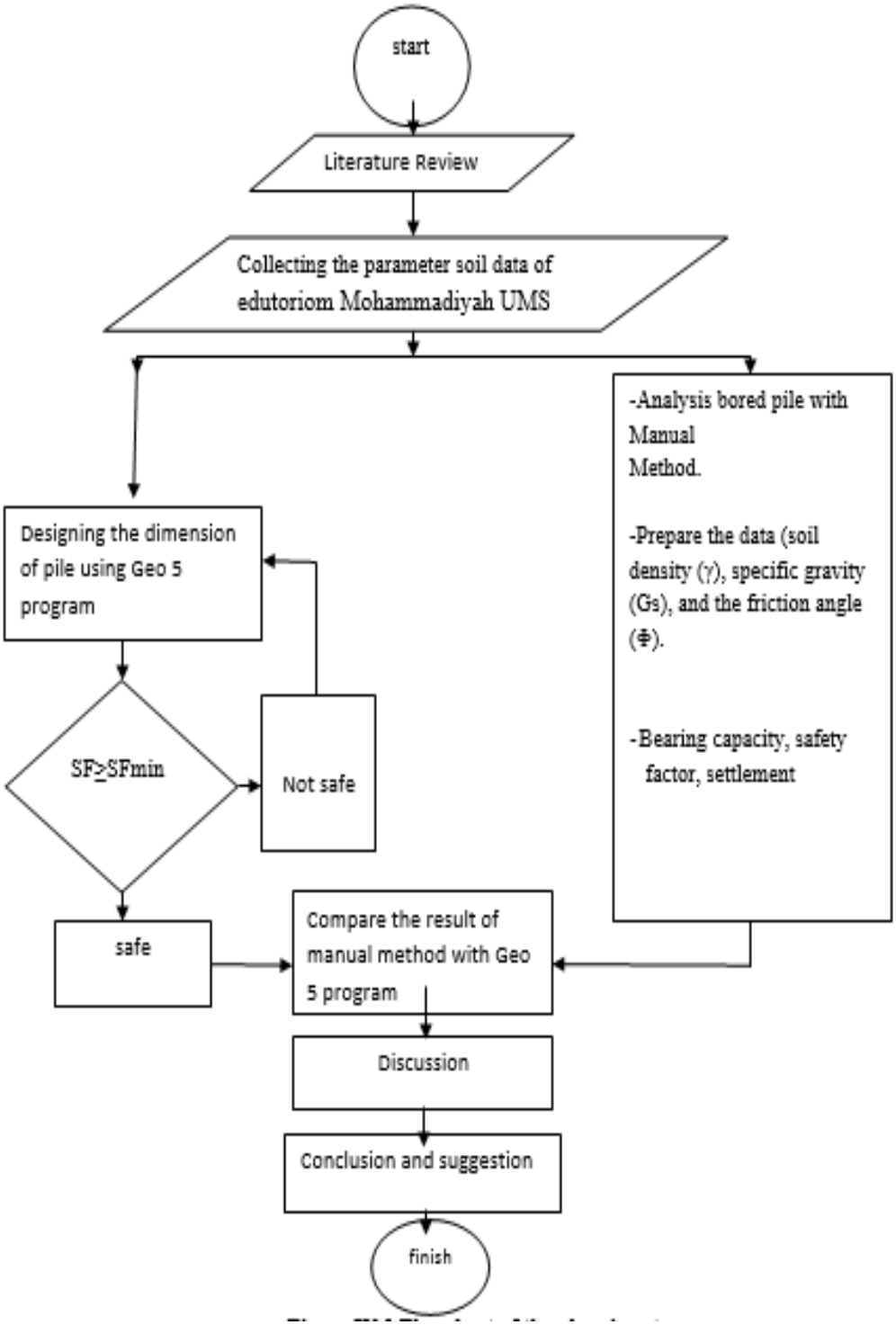


Figure 2. Flowchart

3. RESULTS AND DISCUSSION

3.1 Project Data

The soil data was gotten from two bore holes (BH-1 , BH-2) during soil investigation . Two zones were selected for soil investigation (zone 1, zone 2) . the data for this final project was from BH-1 with ground water level =1m from the ground. The bearing capacity used = 246.630 T was the biggest in zone 4.the length of pile in zone 4 point 712 was 10m .

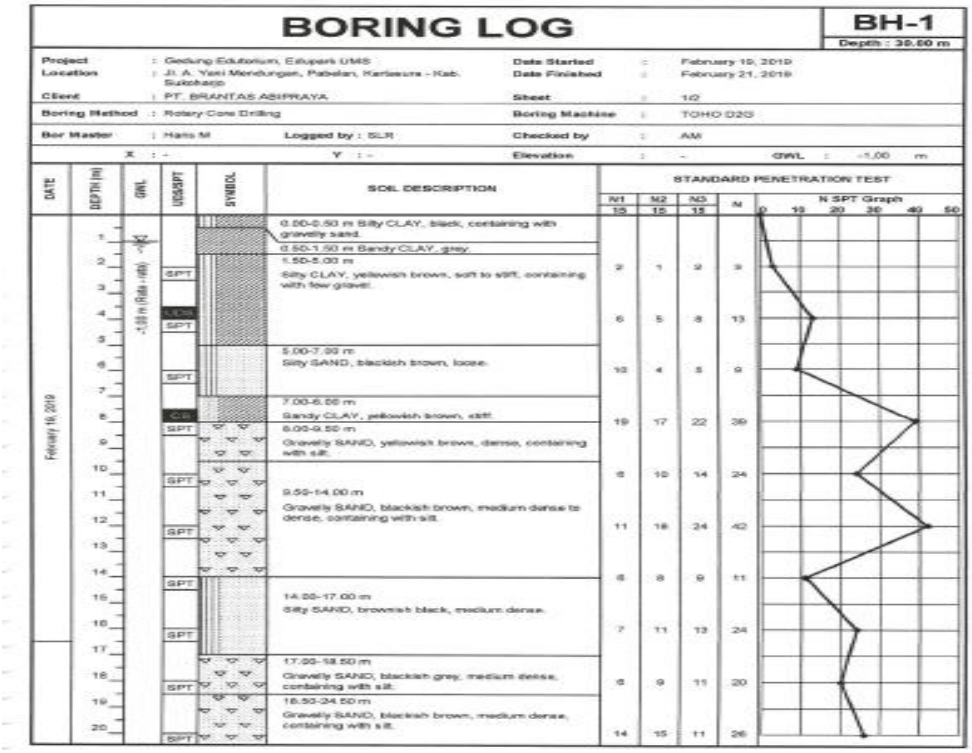


Figure 3. Boring Log BH-1

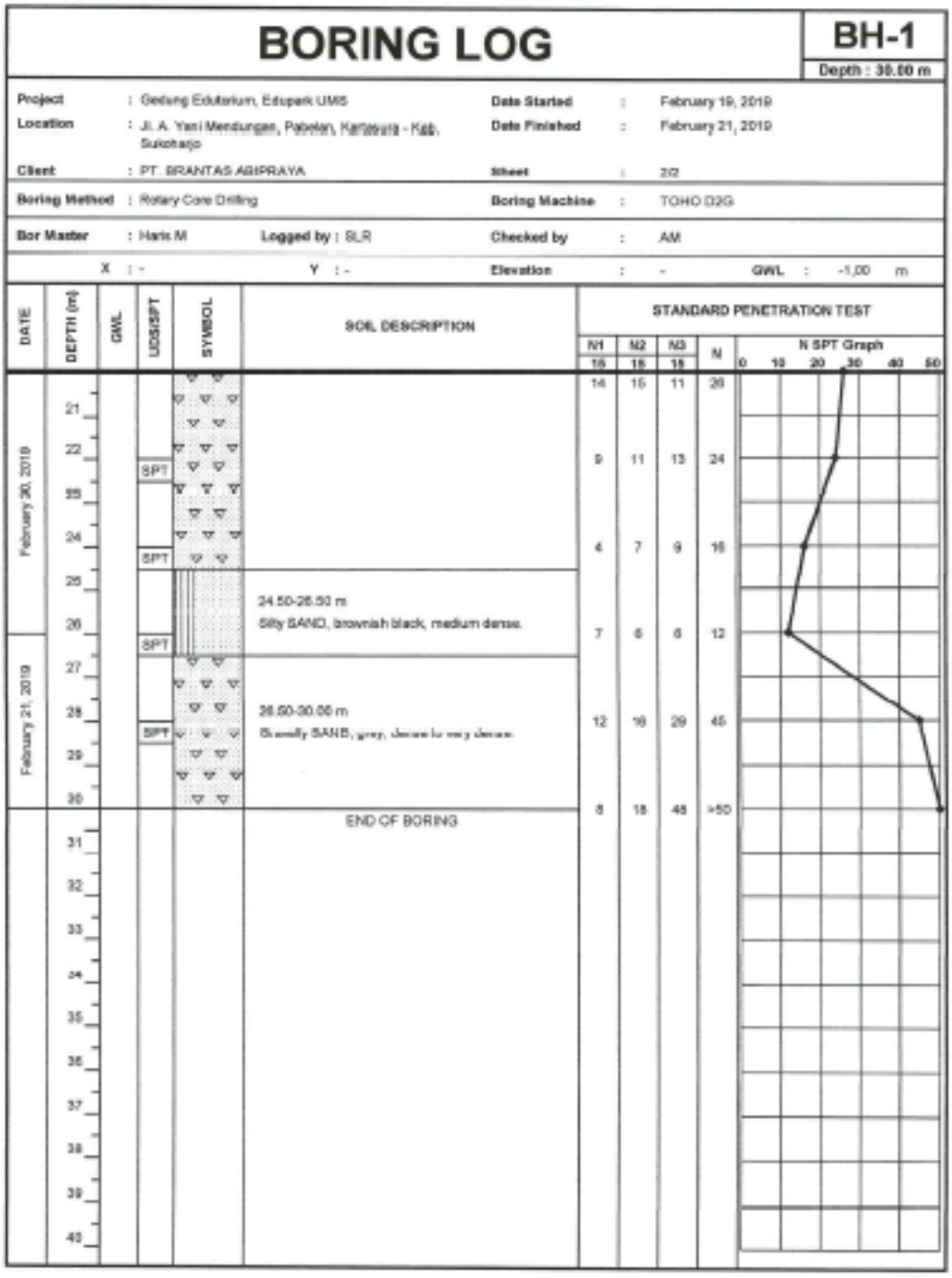


Figure 4. Boring Log BH-1

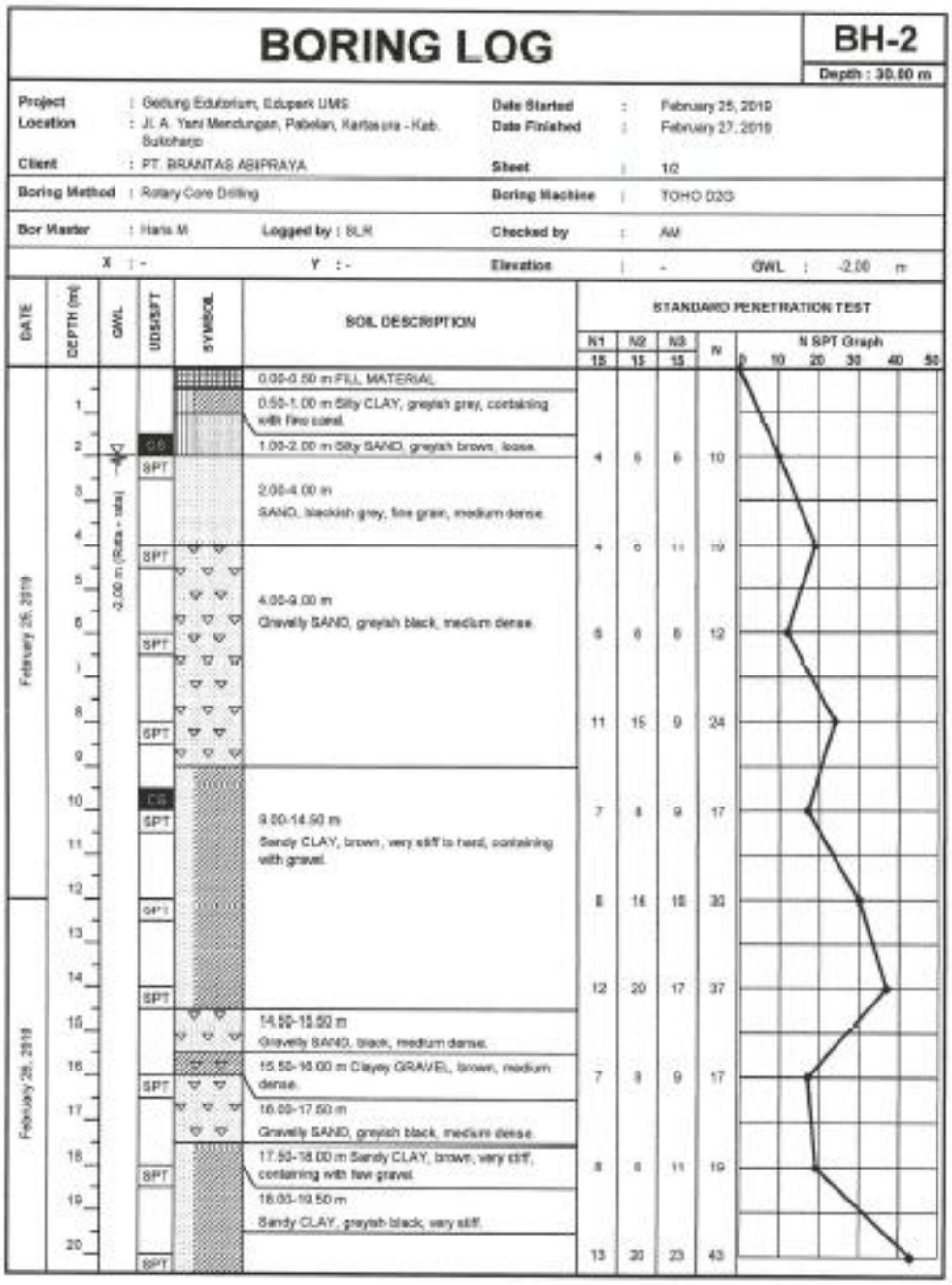


Figure 5. Boring Log BH-2

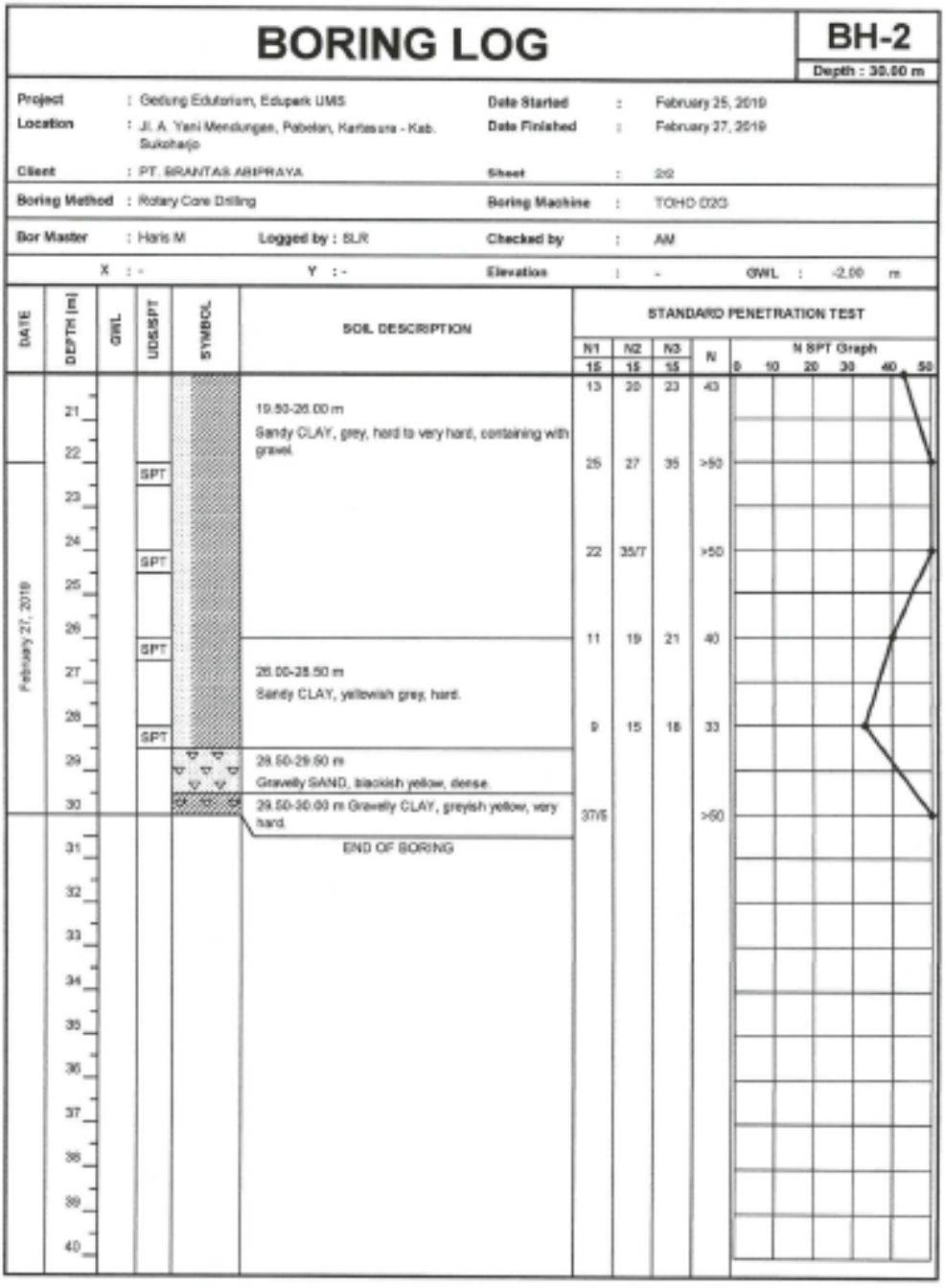
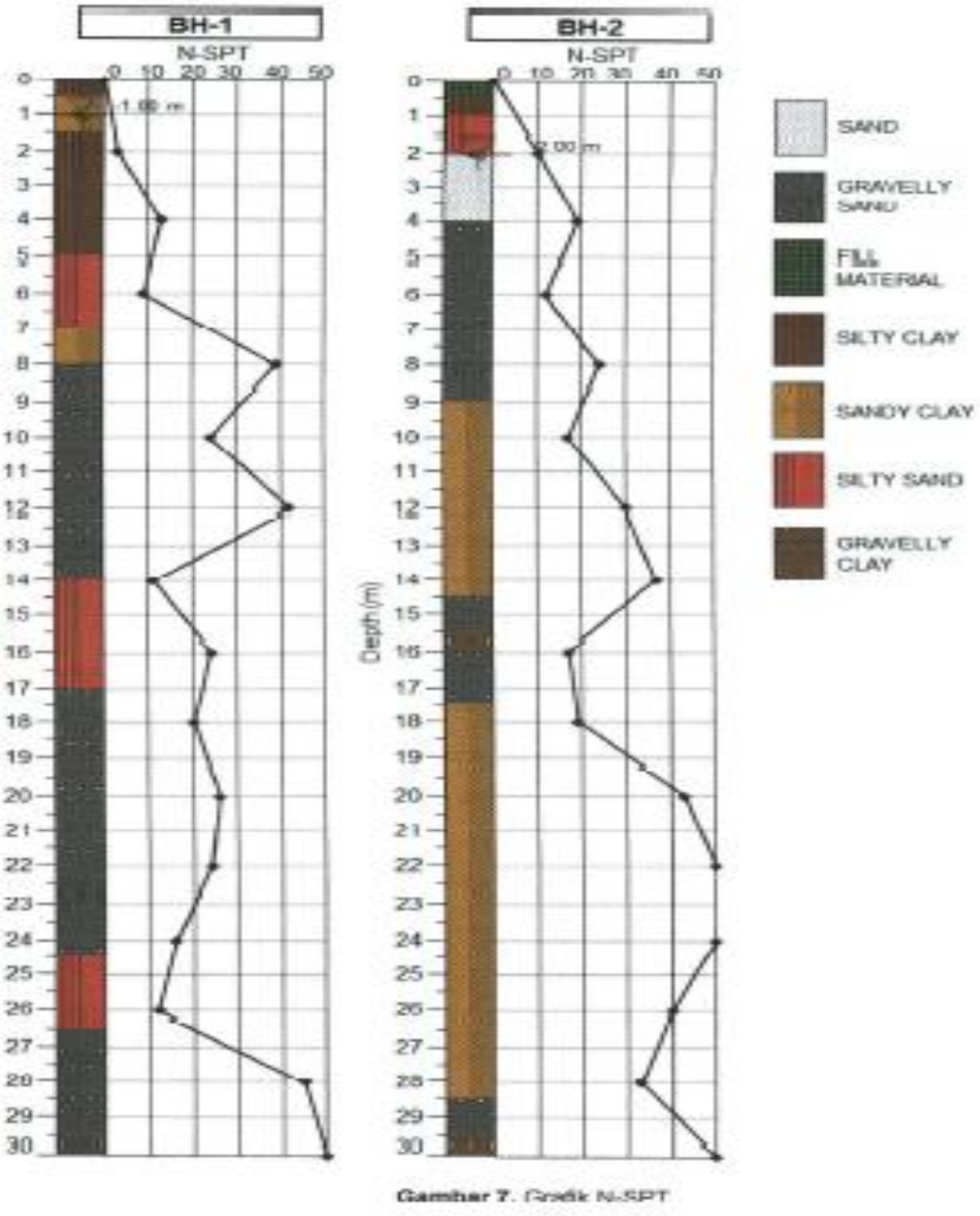


Figure 6. Boring Log BH-2



Gambar 7. Grafik N-SPT

Figure 7 Soil Test

4.3. Hasil Pengujian Laboratorium

Pengujian mekanika tanah telah dilakukan di laboratorium terhadap contoh tanah tak terganggu yang berhasil diambil dari lubang bor.

Tabel 2. Ringkasan Hasil Laboratorium

Location	Sample no.	Depth	Water Content (w_n)	Unit Weight (γ_n)	Specific Gravity (G_s)	Grain Size Analysis				Atterberg Limit				Consolidation				Triaxial UU		Direct Shear	
						Clay	Silt	Sand	Gravel	W_L	W_P	I_P	Classification	Pc	e_o	Cv	Cc	Φ	C	Φ	C
		(m)	(%)	(t/m^3)		(%)	(%)	(%)	(%)	(%)	(%)	(%)		kN/m^2	-	cm^2/sec	-	(°)	(kN/m^2)	(°)	(kN/m^2)
Jl. A. Yani Mendungan, Pabelan, Kartasura - Kab. Sukoharjo	BH-1	3.50-4.00	33,62	1,71	2,50	21	35	43	1	-	-	-	-	145,00	0,9848	1,14E-02	0,1457	12,9	20,0	-	-
		7.50-8.00	34,80	1,81	2,64	19	55	25	1	36	26	11	ML	156,00	1,0000	1,23E-02	0,1661	13,1	46,8	-	-
	BH-2	1.50-2.00	22,50	2,01	2,72	23	19	58	0	-	-	-	-	113,50	0,6148	4,89E+00	0,0791	36,1	48,8	-	-
		9.50-10.00	49,29	1,67	2,70	30	52	18	0	50	33	17	ML	105,50	1,3875	5,49E+00	0,3443	-	-	23,54	17,566

Figure 8. Soil Test

3.2 Analysis

3.2.1 Manual calculations

The ultimate bearing capacity which was 1064.742 KN. The safety factor was gotten by dividing the ultimate bearing capacity with the applied load on pile which was 900 KN. The safety factor gotten was 1.18 which is less than the minimum safety factor.

And for calculate the bearing capacity of pile group for cohesion soil, get 3168.73 KN. and when calculated the bearing capacity of pile group cohesion less soil, get 4258.968 KN. after that dividing by the load(900KN). it can get a safe of safety factor for the cohesion soil SF= 3.732. And for the cohesion less soil SF=4.73. And it can be shown that both of the safety factors are greater than the minimum required safety ≥ 2 (OK).

3.2.2 Geo 5 Software Calculations

The result of safety factor for single pile can be shown in figure 9 for single pile

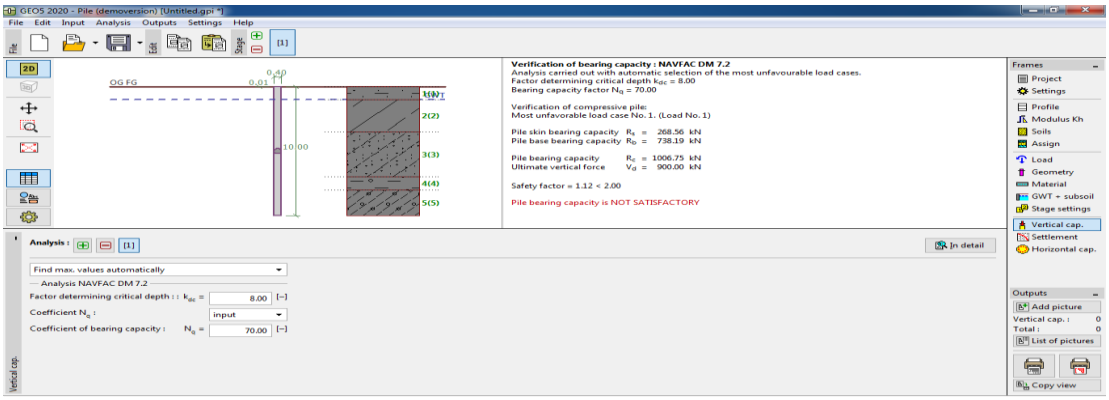


Figure 9. Bering Capacity Result of Single Pile by GEO5 Software Calculation

Pile group in cohesion soil results by geo5 software calculation shown in figure 10

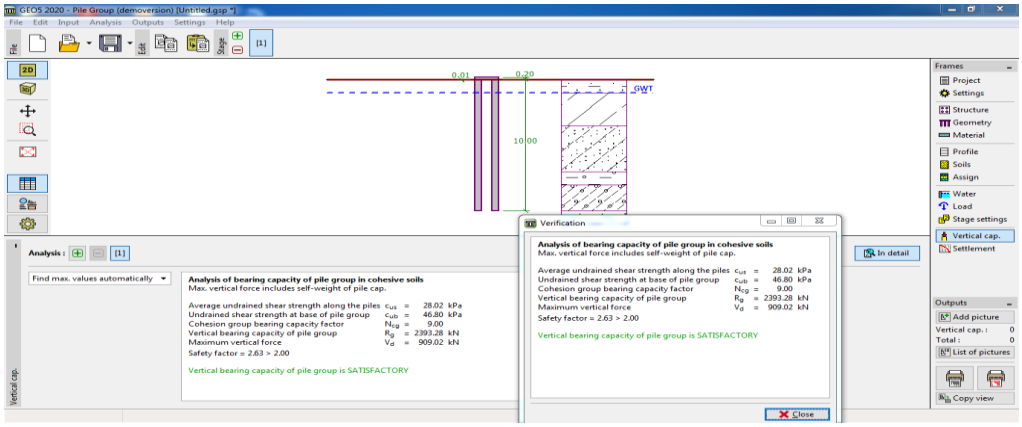


Figure 10 Bering Capacity Result of Pile Group on cohesion soil by GEO5 Software Calculation

Pile group in cohesion less soil results by geo5 software calculation shown in figure 11.

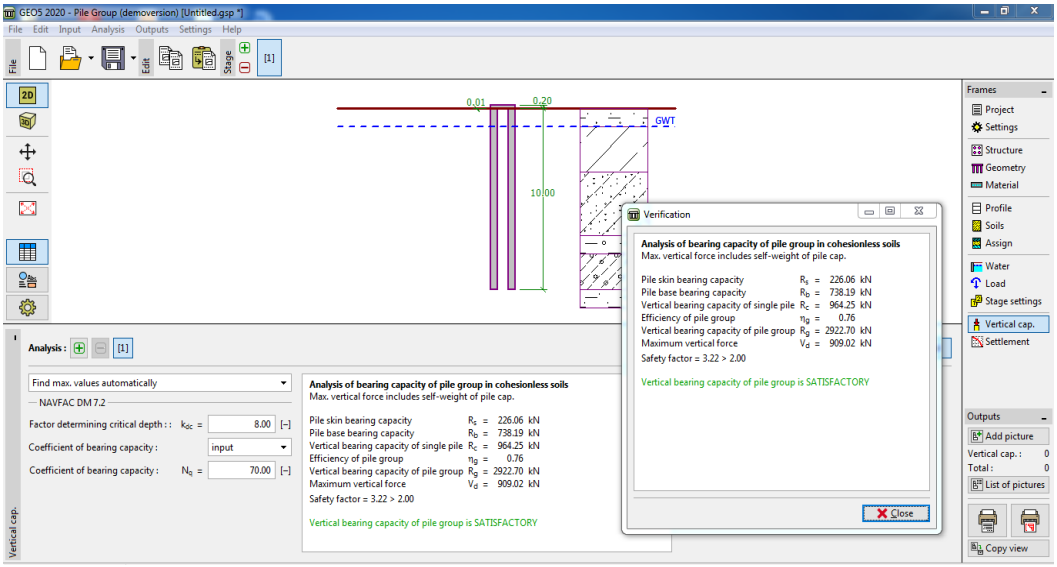


Figure 11 Bering Capacity Result of Pile Group on cohesion less soil by GEO5 Software Calculation

3.3 Results

Table 1. Result of manual calculation of pile group:

Type of soil	Units	Results
Cohesion soil	Q_g (KN)	3168.73
	SF	3.732
Cohesion less soil	Q_g (KN)	4258.968
	SF	4.73

Table 2. Result of Geo5 calculation of pile group

Type of soil	Units	Results
Cohesion soil	Q_g (Rd) (KN)	2922.70
	SF	3.22
Cohesion less soil	Q_g (Rd) (KN)	2393
	SF	2.63

After observing the data result on Table 1 and Table 2. It can conclude that the final result of manual calculation using manual method gives us a slightly different safety factor than geo5 software. This means that there are a lot of variables in the manual calculations than geo5 software. The geo5 program gave us a relatively smaller safety factor than from manual calculations which was basically not safe. While using the geo5 software, it is easier to adjust to the optimum dimensions of the pile in order to get the desired safety factor.

4. CONCLOSION

This final project is basically concerned about the comparison of the safety factors from both the manual and geo5 software calculations. From the analysis of the data from both calculations, we can conclude with the following;

1. It is safer to use both manual and software results because there a lot of variables that might be covered in the software but manual calculations would cover them.
2. The dimensions of the safer piles can be easily adjusted while using geo5 software making it less time consuming as time being the most valuable asset in any project.

3. The software gave a smaller safety factor than manual calculations. As it can be seen from the manual calculations gave us a safety factor of 3.732 for cohesive soil and a safety factor of 4.73 for cohesive less soil on pile group. Whereas the software gave us a safety factor of 3.22 for cohesive soil and a safety factor of 2.63 for cohesive less soil on pile group. This means that the Geo5 software gives a challenge of not being over confident about the safety of the piles so that precautions can be taken. This is because, if the safety factor is over 3.0, it gives a lot of confidence that the piles are safe which can lead to a lot of complications if they are not.

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