SCEJ (Shell Civil Engineering Journal)
https://doi.org/10.35326/scej.v7i2.3150
Vol.7 No.2, Desember 2022
www.jurnal-umbuton.ac.id/index.php/SCEJ

Analysis of Soil Tability and Foundation of Berbah Sleman SPAM Water Tank Using Plaxis with Soil Results Cone Pentrasion Test (CPT)

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ABSTRAK

Berbah is a subdistrict in the sleman regency of the special region of Yogyakarta with a total of 52565 people with this large population, so the use of clean water is very important for survival so that facilities and infrastructure to meet clean water needs must be provided in the hope that the needs of the community can be achieved. One of the facilities and infrastructure to achieve these needs requires a management place or water reservoir in the form of a water tank with a capacity based on the needs of the community. One of the tanks made in the berbah sub-district area is 10x10m with a tank height of 3.8m with a target capacity of 300 m3. Based on analysis with soil data Cone Penetration test (CPT) with 2D modeling in plaxis with water loading and gradually analyzed obtained under modeling conditions without water load, there was a decrease with t = 1 day of 1.319 with SF = 9.205 mm and when weighed for t = 30 days experienced an additional decrease of 0.008mm S = 1.327 mm and for t = 30 it was in a condition of no longer decreasing until the next With SF = 9.19. So it can be concluded that the foundation used can use the foundation from the bottom of the tank itself.

SEJARAH ARTIKEL
Diterbitkan 29 Desember 2022

KATA KUNCI
Soil; Stability; Plaxis; CPT

1. Pendahuluan

Berbah is a subdistrict in the sleman regency of the special region of Yogyakarta with a total of 52565 people with this large population, so the use of clean water is very important for survival so that facilities and infrastructure to meet clean water needs must be provided in the hope that the needs of the community can be achieved. One of the facilities and infrastructure to achieve these needs requires a management place or water reservoir in the form of a water tank with a capacity based on the needs of the community. One of the tanks made in the berbah subdistrict area is 10x10m with a tank height of 3.8 m with a target capacity of 300 m^3

In the tank structure, the condition of the structure must be calculated based on the load so that we know that the type of foundation used is using what foundation, whether using a basic foundation of a scutter plate, or using an additional shallow foundation such as a foot plate or using a pile foundation whether using piles, mini piles, or using bore piles.(Candra et al., 2018)

2. Theoretical Foundations

Land has an important role in construction work because all planned construction is necessarily supported by land. As one of the countries with the longest coastline, Indonesia has many soft soil deposits Some areas in Indonesia have very thick layers of soft soil. That is, hard soil is located deep below the ground level which causes some construction projects to require extra soil planning so that there is no significant decrease (setlement) (Fadhillah, Munawir, & Kuswanda, 2018).

Soil is the basis of a foundation planning so it is very important in determining the type of soil whether it is organic matter, loam, sandy loam, loamy sand, sand or rocks because each type of soil has different properties or behaviors to the voltage received whether due to external loads or other conditions (Suroso & Tjitradi, 2020)

Development on soft ground is a challenge in the field of construction. The properties of soft soils that have low shear strength, high compressibility, and low permeability coefficients are obstacles to be used in earthworks so that soil improvement is needed. Two commonly used soil improvement methods to speed up consolidation time are preloading and vertical drain(Apriyani et al., 2016)

The condition of this soft soil certainly needs to be improved so that it can strengthen the soil as the foundation of a building a pre-load replacement method by placing a sheet of waterproof material on the ground surface and sucking water and air on the inner side of this waterproof sheet using a vacuum pump, known as vacuum consolidation or vacuum preloading (Indraratna et al., 2015)

in the use of sondir data to analyze using plaxis 2D, it must correlate sondir data to the data needed in the input of plaxis analysis so that the data analyzed is determined based on the layers of soil to be processed. In determining the layer, it must determine the grouping based on the value of the relationship of the conus end (qc) with the Rasion frixin (FR). at this stage it can already determine the type of approximate soil with an approximate specific gravity based on the figure. 1 below:

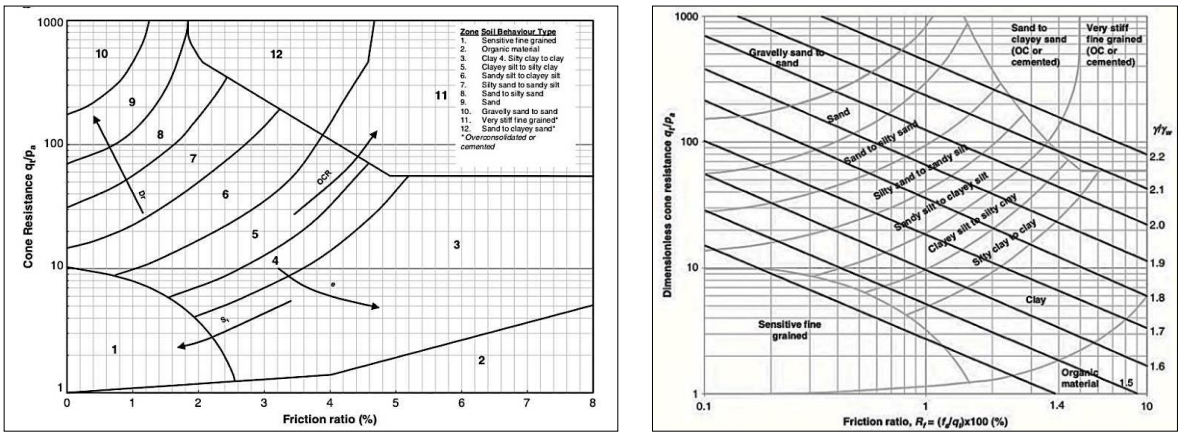


Figure 1. Soil Type and Specific gravity (Satria Warman, 2019)

Determination of the pile foundation as the foundation of the building if the soil under the base of the building does not have sufficient bearing capacity to carry the weight of the building the load that acts on it(Sardjono HS. dalam Vera N.Br.G. Santa et al., 2019). The influence of mesh on soil in 2D plaxis greatly affects the movement of the contour or the effectiveness of the reading to what extent the boundaries of layer separation are analyzed so that the mesh that is larger in size does not have a more det a il value to the layer area in contrast to the small mesh perger a soil is measured based on the size of the divider of the area so that the small mash is more accurate thank an with a large mash. (Wulandari et al., 2021)

The decline of the foundation greatly affects the construction on it, especially for clay soils that have a high decline over a long period of time. Foundation subsidence in fine-grained and water-saturated soils is divided into 3 components, namely: immediate decrease (Si), consolidation decrease (Sc) and secondary consolidation decrease (Terzaghi dan Peck dalam Suroso & Tjitradi, 2020) .

Immediate subsidence of clay soils:

Se : $A_1.A_2.(q_0.b)/E_s$

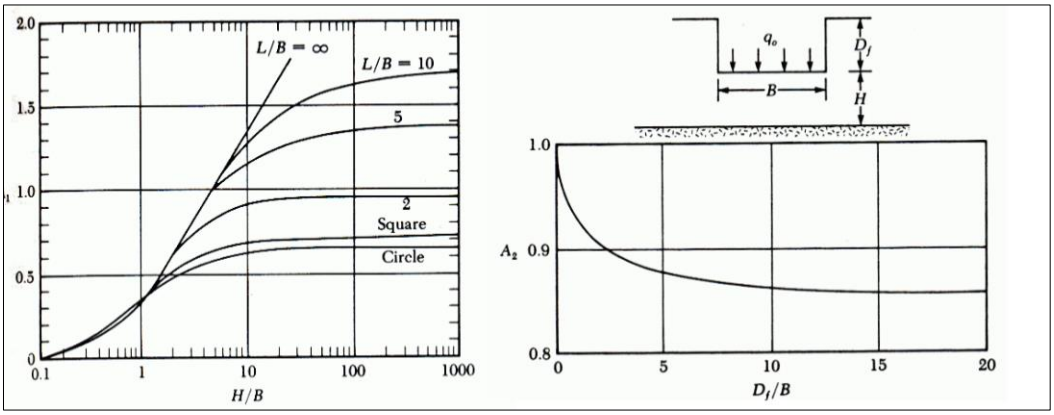


Figure 2. Decline Chart (Sugiarto, n.d)

Immediate subsidence of Sandy soils :

$$S_e = C_1 . C_2(\bar{q}) \sum_{0}^{z_2} \left(\frac{I_z}{E_s} \Delta z \right)$$

Iz = Strain influence factor

C 1 =Embedded foundation trhdap correction factor = 1-0.5[q/(q¯-q)]

C 2 =Correction factor for the calculation of the frame on the ground = 1+0.2.log(t/0.1)

T = time of year

q- = pressure due to the outer load of the foundation

q = γ . D f f

3. Method

The research method carried out is the collection of secondary data in the form of soil data and images from building models then modeled on plaxis to determine the stability of the soil, both soil subsidence and stress and safety factors of the soil being analyzed.

The research location is in merbah sleman sub-district of yogyakarta.

Figure 3. Research Location

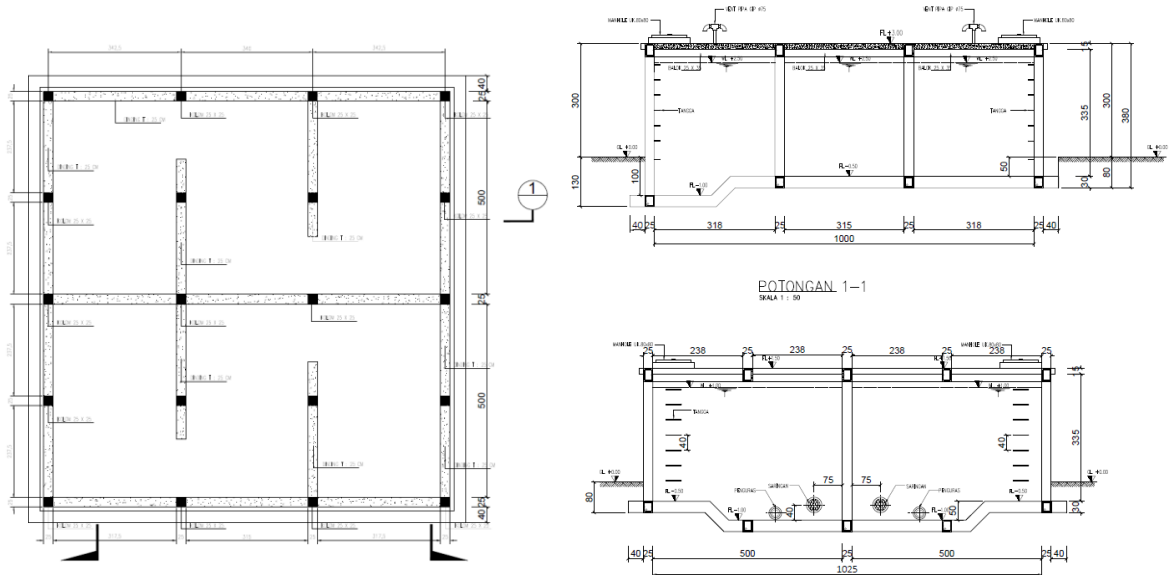


Figure 4. 2D model tank

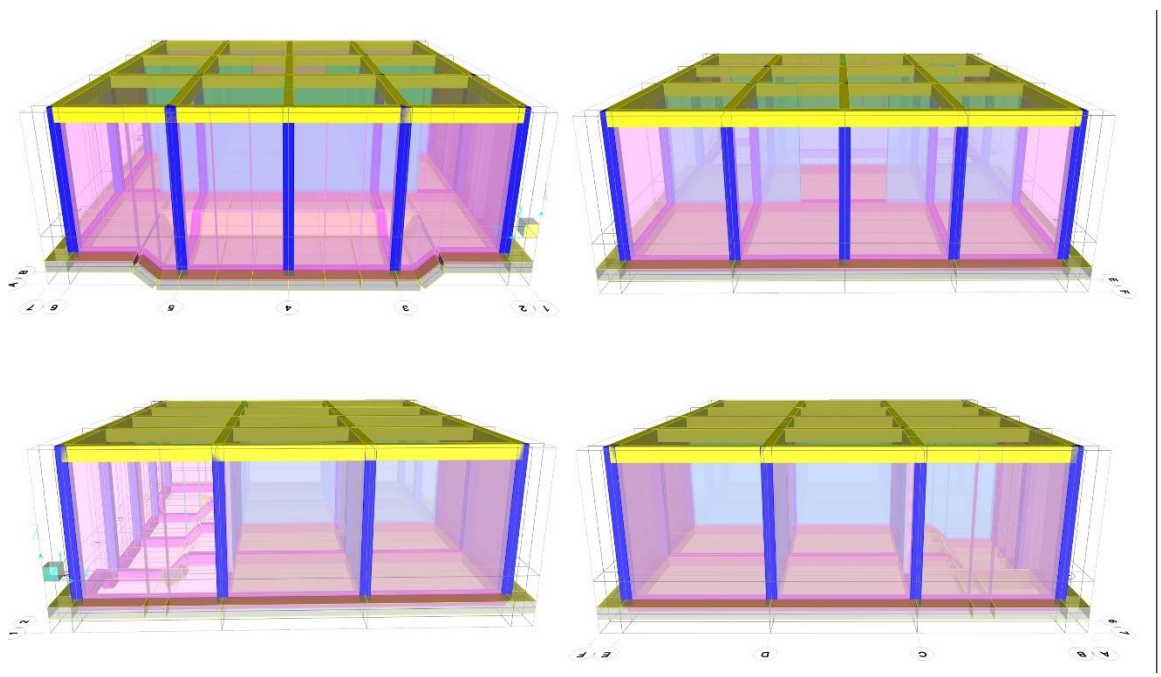
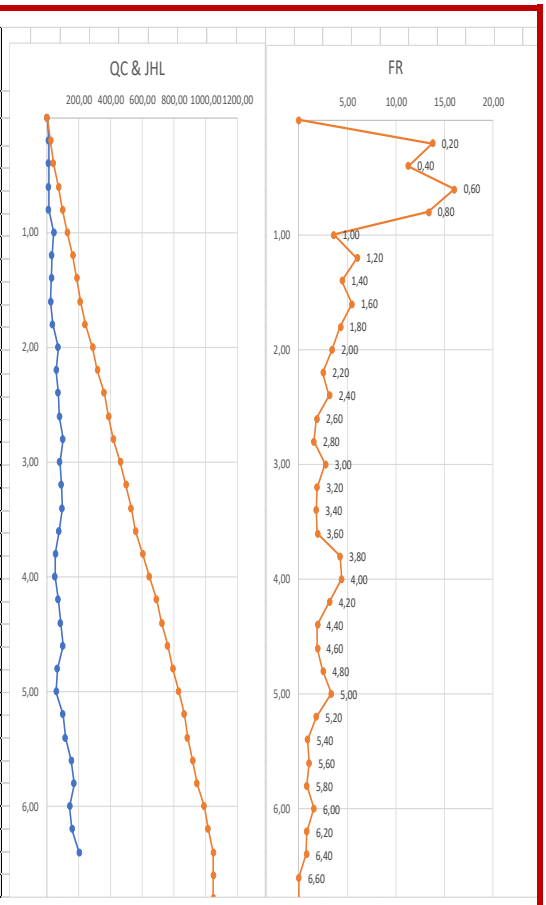


Figure 5. 3D model of tank

Soil data:

Determination of soil type based on conus end data (CPT) and Frixin ratio (FR):

No.	Kedalaman	Pembacaan Perlawanan Conus	Pembacaan Perlawanan Conus +	Perlawanan Geser	Conus	Gesek Lokal	Gesek/20cm	Tf	FR
	m	Cw	Tw	Kw	qc	Sf	Fs*20cm	Tf	%
	m	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm	kg/cm	%
1,00									
2,00	0,20	8,00	19,00	11,00	8,00	1,100	22,00	22,00	13,75
3,00	0,40	8,00	17,00	9,00	8,00	0,900	18,00	40,00	11,25
4,00	0,60	10,00	26,00	16,00	10,00	1,600	32,00	72,00	16,00
5,00	0,80	9,00	21,00	12,00	9,00	1,200	24,00	96,00	13,33
6,00	1,00	42,00	57,00	15,00	42,00	1,500	30,00	126,00	3,57
7,00	1,20	30,00	48,00	18,00	30,00	1,800	36,00	162,00	6,00
8,00	1,40	27,00	39,00	12,00	27,00	1,200	24,00	186,00	4,44
9,00	1,60	22,00	34,00	12,00	22,00	1,200	24,00	210,00	5,45
10,00	1,80	35,00	50,00	15,00	35,00	1,500	30,00	240,00	4,29
11,00	2,00	70,00	94,00	24,00	70,00	2,400	48,00	288,00	3,43
12,00	2,20	56,00	70,00	14,00	56,00	1,400	28,00	316,00	2,50
13,00	2,40	70,00	92,00	22,00	70,00	2,200	44,00	360,00	3,14
14,00	2,60	76,00	90,00	14,00	76,00	1,400	28,00	388,00	1,84
15,00	2,80	98,00	113,00	15,00	98,00	1,500	30,00	418,00	1,53
16,00	3,00	80,00	102,00	22,00	80,00	2,200	44,00	462,00	2,75
17,00	3,20	90,00	107,00	17,00	90,00	1,700	34,00	496,00	1,89
18,00	3,40	95,00	112,00	17,00	95,00	1,700	34,00	530,00	1,79
19,00	3,60	73,00	87,00	14,00	73,00	1,400	28,00	558,00	1,92
20,00	3,80	52,00	74,00	22,00	52,00	2,200	44,00	602,00	4,23
21,00	4,00	50,00	72,00	22,00	50,00	2,200	44,00	646,00	4,40
22,00	4,20	70,00	92,00	22,00	70,00	2,200	44,00	690,00	3,14
23,00	4,40	84,00	100,00	16,00	84,00	1,600	32,00	722,00	1,90
24,00	4,60	100,00	119,00	19,00	100,00	1,900	38,00	760,00	1,90
25,00	4,80	64,00	80,00	16,00	64,00	1,600	32,00	792,00	2,50
26,00	5,00	57,00	76,00	19,00	57,00	1,900	38,00	830,00	3,33
27,00	5,20	100,00	118,00	18,00	100,00	1,800	36,00	866,00	1,80
28,00	5,40	114,00	124,00	10,00	114,00	1,000	20,00	886,00	0,88
29,00	5,60	152,00	168,00	16,00	152,00	1,600	32,00	918,00	1,05
30,00	5,80	170,00	184,00	14,00	170,00	1,400	28,00	946,00	0,82
31,00	6,00	142,00	164,00	22,00	142,00	2,200	44,00	990,00	1,55
32,00	6,20	157,00	170,00	13,00	157,00	1,300	26,00	1016,00	0,83
33,00	6,40	202,00	218,00	16,00	202,00	1,600	32,00	1048,00	0,79



Lapisan	Kedalaman	Z1	Z2	qc	fs	FR	Jenis Tanah			No. tanah	Kohesi Cu	Sudut Geser	Berat Jenis	E_{50}^{ref}	E_{oed}^{ref}	E_{ur}^{ref}	Jenis Tipe
	m	m	m	kg/cm2	kg/cm2	%					kN/m^2	ø	kN/m^3	kN/m^2	kN/m^2	kN/m^2	
LP. 1	0 - 0,8	0	0,8	7,00	0,96	13,71	organic material	Bahan Organik	Organik	2	25,90	-	15	2800,00	3500,00	8400,00	Undrained
LP. 2	0,8 - 1,8	0,8	1,8	27,50	1,40	5,09	Clay	Lempung	Kaku	3	101,75	-	19,5	11000,00	13750,00	33000,00	Undrained
LP. 3	1,8 - 2	1,8	2	52,50	1,95	3,71	Clayey silt to silty clay	Lempung lanau hingga Lempung berlumpur	Keras	5	194,25	-	20,5	21000,00	26250,00	63000,00	Undrained
LP. 4	2 - 5,2	2	5,2	75,59	1,84	2,44	silty sand to sandy silt	pasir berlumpur hingga lanau berpasir	Padat Sedangan	7	1,00	36,02	20,5	30235,29	37794,12	90705,88	Drained
LP. 5	5,2 - 5,4	5,2	5,4	107,00	1,40	1,31	sand to silty sand	pasir menjadi pasir berlumpur	Padat	8	1,00	37,21	20,5	62800,00	78500,00	188400,00	Drained
LP. 6	5,4 - 6,4	5,4	6,4	156,17	1,52	0,97	sand	pasir	Padat	9	1,00	38,69	20,5	82466,67	103083,33	247400,00	Drained
LP. 7	6,4 - 0	6,4	0	0,00	0,00		-	-			0,00	-		0,00	0,00	0,00	Undrained
LP. 8	0 - 0	0	0	0,00	0,00		-	-			0,00	-		0,00	0,00	0,00	Undrained
LP. 9	0 - 0	0	0	0,00	0,00		-	-			0,00	-		0,00	0,00	0,00	Undrained
LP. 10	0 - 0	0	0	0,00	0,00		-	-			0,00	-		0,00	0,00	0,00	Undrained

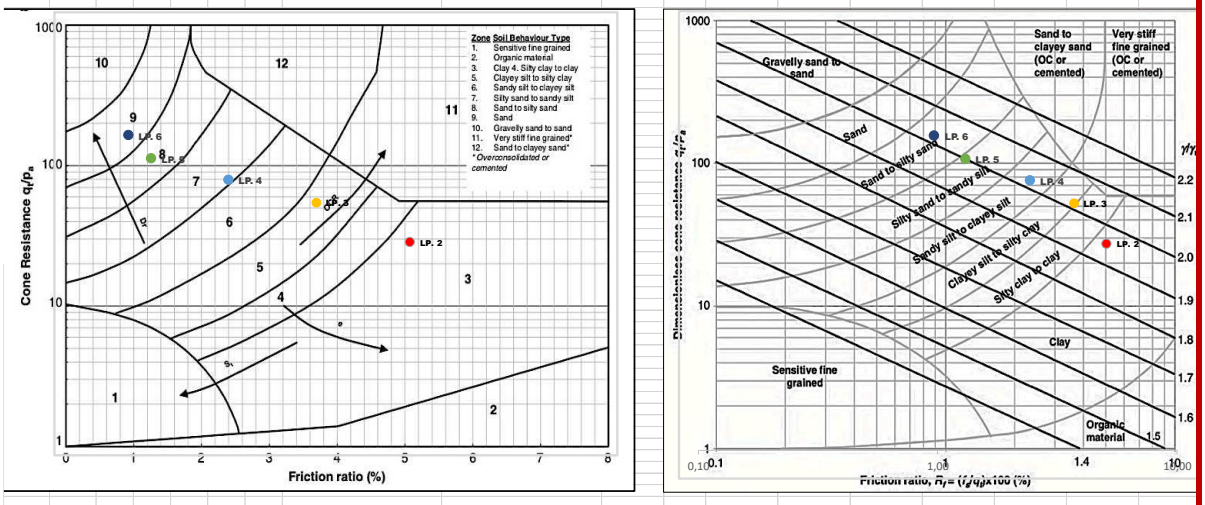


Figure 6. determination of inlay type and specific gravity of soil

Load and modeling in Plaxis

The load on the tank is the weight and load of working water as well as the load of people for operations. And the load on the bottom of the tank is 3.85 tons/m$^{2.}$

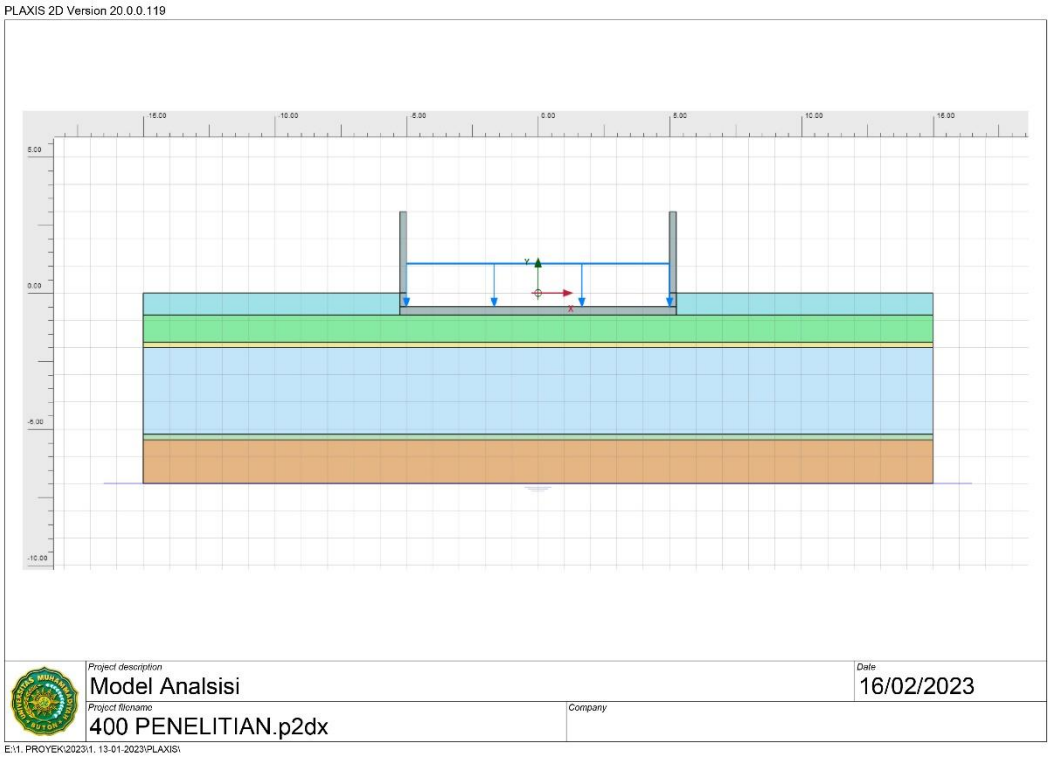


Figure 7. Model and Loading In plaxis

4. Result and Discussion

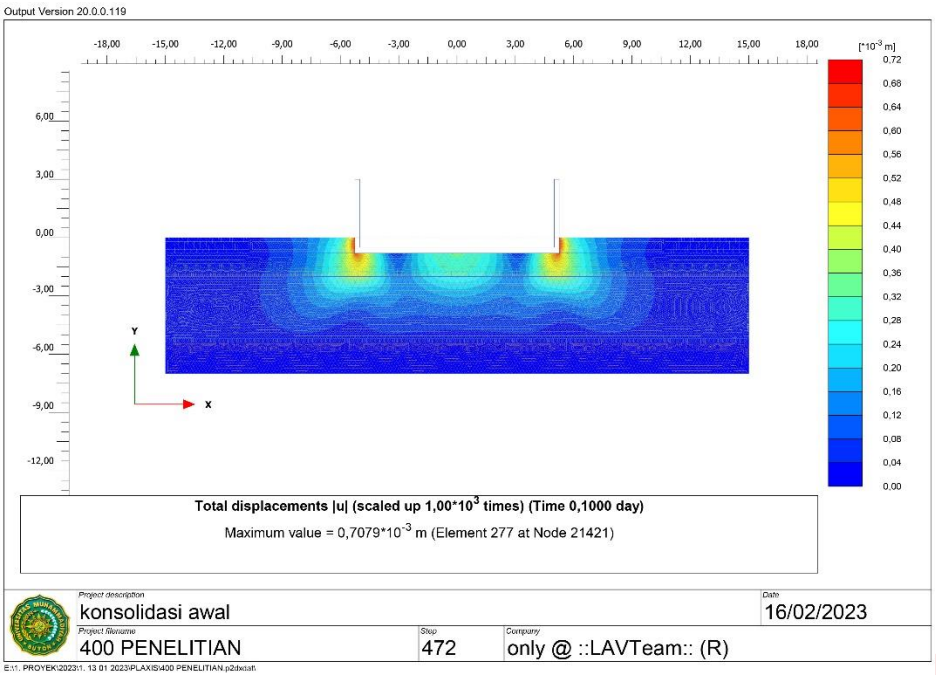


Figure 8. 0.7 mm drop with SF = 4551

In the early stages of modeling where the soil only withstands the load from the tank itself with a cosolidation time of 0.1 days, the largest land subsidence occurs at the point of 21421 with a decrease in magnitude from the initial

condition of 0.708 mm < 25 mm to meet the condition of the decrease with the result of the stability safety factor FS = 4451.

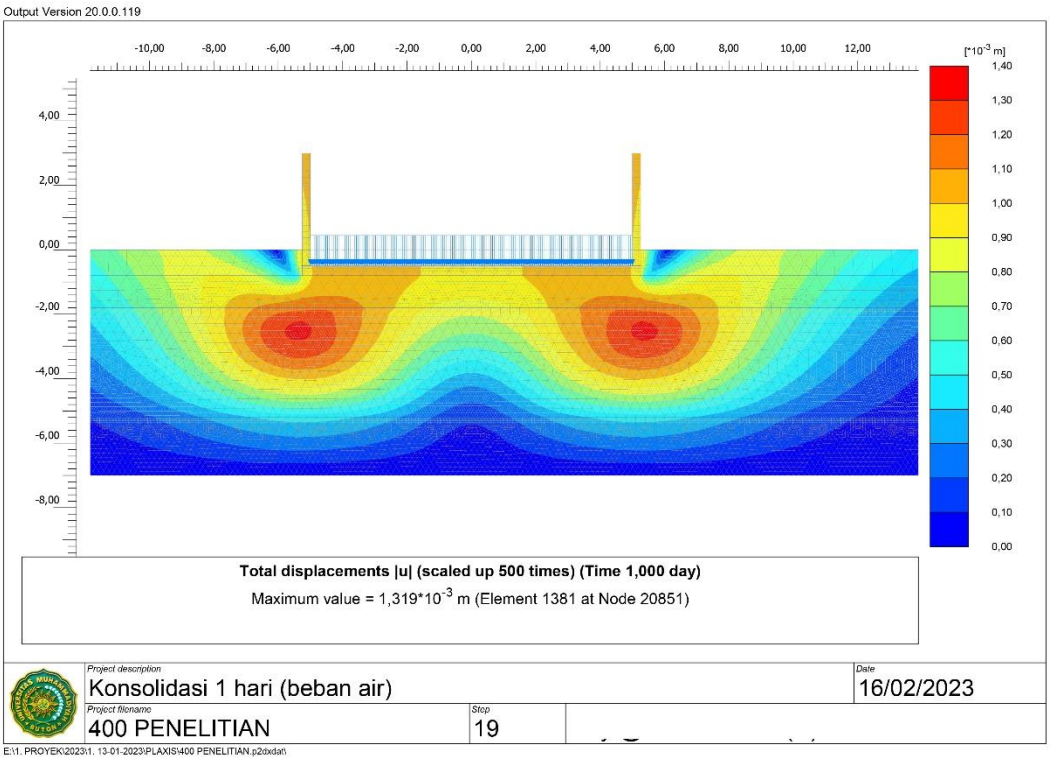


Figure 9. 1,319 mm consolidation with SF =9,205

At the loading stage in the 1-day consolidation time check, the largest land subsidence occurred at the point of 20851 with a decrease of S = 1,319 < 25 mm and the difference from the initial condition was S = 1.319-0.708 = 0.611 decrease with the result of the FS stability safety factor = 9.205.

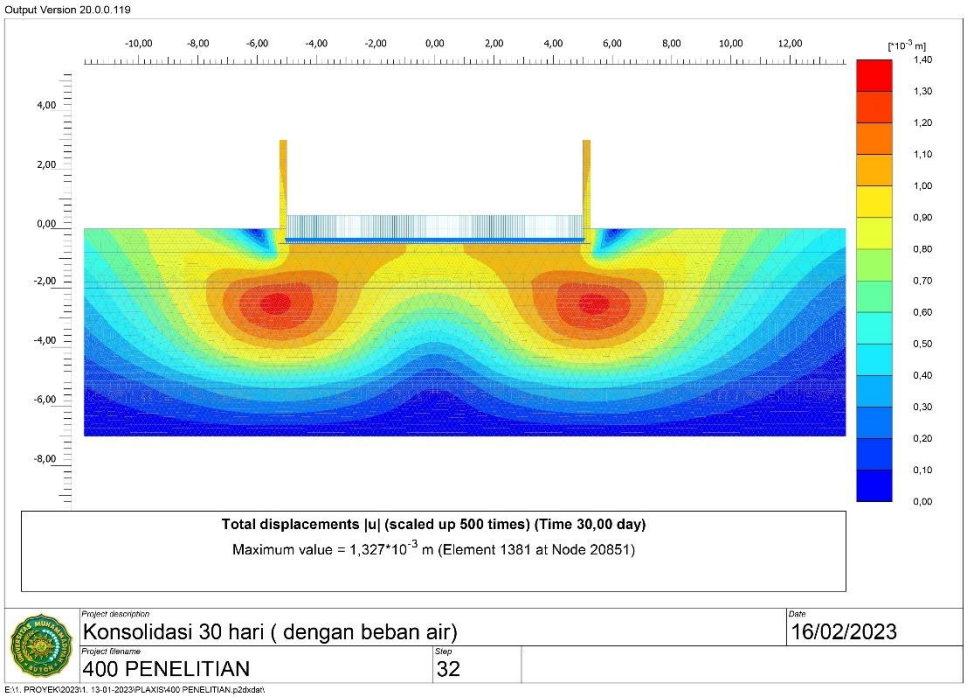


Figure 10. 1.327 mm consolidation with SF =9.19

At the loading stage in the 30-day consolidation time check, the largest land subsidence occurred at the point of 20851 with a decrease of S = 1,327 < 25 mm and a difference from the 1-day condition of S = 1,327 -1,319= 0.008mm decrease with the result of the FS stability safety factor = 9.19.

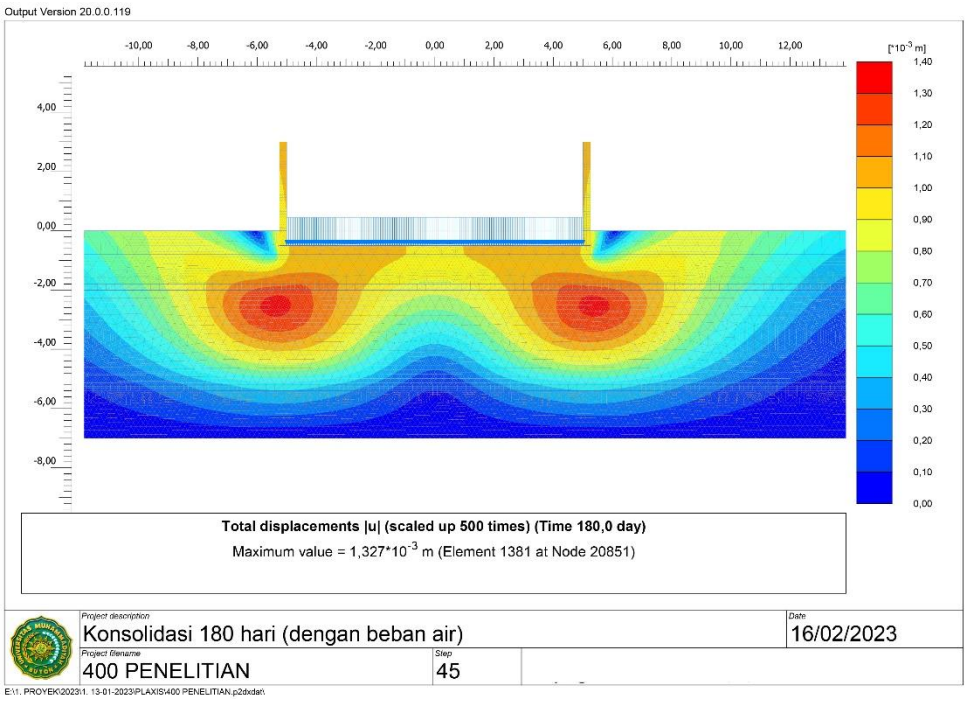


Figure 11. Consolidation of 1.327 mm with SF =9.19

At the loading stage in the 180-day consolidation time check, the largest land subsidence occurred at the point of 20851 with a decrease of S = 1,327 < 25 mm and the difference from the 30-day condition of S = 1.327 -1.327= 0 decrease with the result of the FS stability safety factor = 9.19.

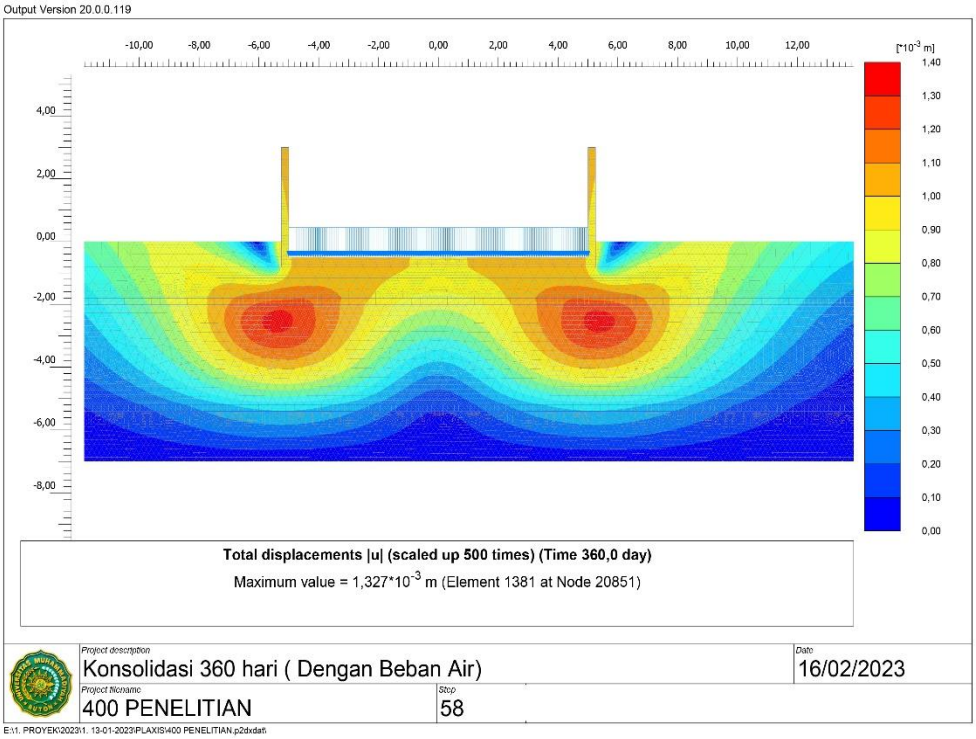


Figure 12. Consolidation of 1.327 mm with SF =9.19

At the loading stage in the 180-day consolidation time check, the largest land subsidence occurred at the point of 20851 with a decrease of S = 1,327 < 25 mm and the difference from the 30-day condition of S = 1.327 -1.327= 0 decrease with the result of the FS stability safety factor = 9.19.

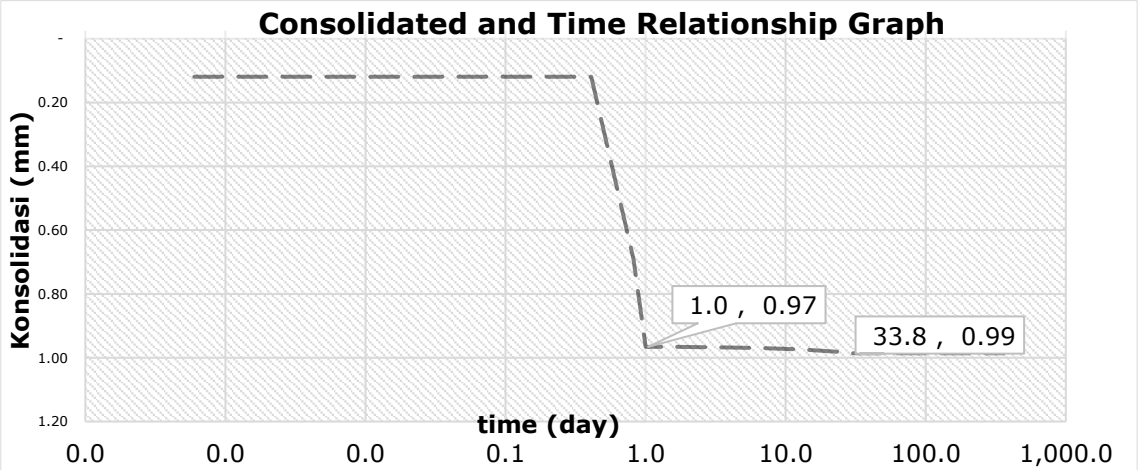


Figure 13. Consolidation chart against time

The data graph explains that the instantaneous consolidation time occurs at the 0 to 1 day stage then the consolidation until the maximum condition occurs in 30 days then the consolidation does not occur again

5. Conclusion

Based on the analysis of soil stability on the foundation from stage 0 to 360 days the soil condition is in a stable state with the greatest decrease in total which is at t_{max} = 30 days of 1.327 mm < 25 mm with a safety stability of 9.19 < 1.5 so that the foundation used is enough to use the foundation from the bottom of the tank without any soil strengthening.

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