CHAPTER II

INTERNSHIP REPORT

2.1. INTERNSHIP COMPANY INFORMATION

2.1.1. Company Profile

Professional engineering consultancy Davy Sukamta & Partners is based in Indonesia and offers clients internationally top-notch, personalized service. It is located at Pondok Pinang Center Blok A/18, Ciputat Raya Street, Jakarta Selatan. Since its founding in 1989, this company has grown to become one of Asia Pacific's most well-known engineering consultants. They have a track record of success and have consistently drawn well-known clients. Davy Sukamta and Partners have been involved in a variety of construction projects throughout Indonesia. Some of them have collaborated with major companies such as Summarecon, The Pakubuwono, Plaza Indonesia, Hongkong Land, and others.

2.2.1. Company Management

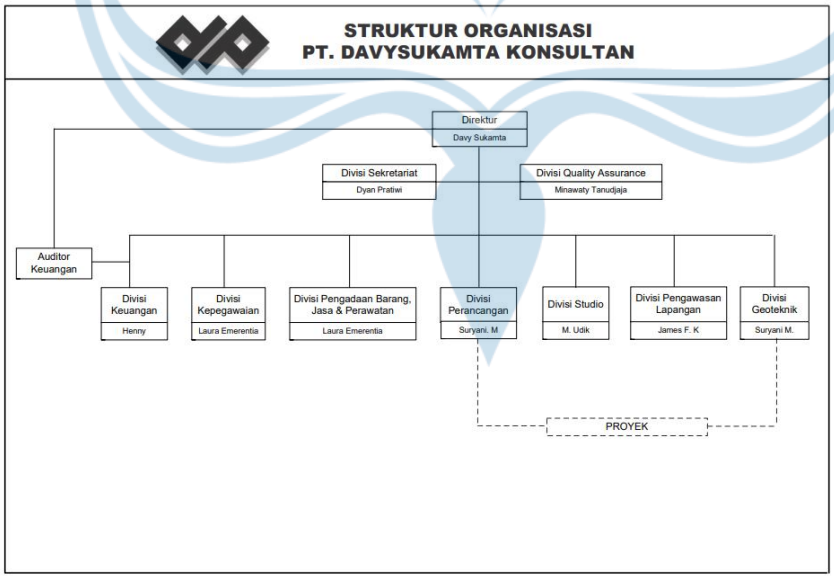


Figure 2. 1 Organizational structure of PT. Davy Sukamta Consultants

Students are joining the internship in “Divisi Perancangan” or planning division. In Davy Sukamta and Partners company, projects from architects will be analysis and designed for the superstructure by Divisi Perancangan and Divisi Geotek. Divisi Perancangan or structural planning calculates upper structure and roof design while Divisi Geotek design the substructure. After that, the projects will be drawn by Divisi Studio. In the end of the project, while the project is built, Divisi Pengawasan Lapangan or supervisor will control the project so it can be built as well as Divisi Perancangan planned.

2.2. PROJECT INFORMATION

2.1.2. Project Information

Figure 2. 2 Site Plan of MICE Project

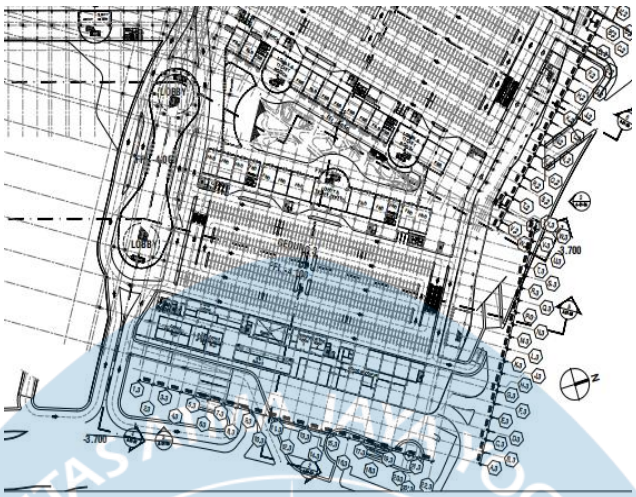


Figure 2. 3 Site Plan of building 3 MICE Project

One of the current projects from Davy Sukamta and Partners Company is the construction of a Meeting, Incentive, Conference, and Exhibition (MICE) building in Tangerang. This project consists of 3 main buildings which have almost the same design. The building that was used in this final project report is building 3. This building area is about 210 x 160 m^2. According to SNI 1726:2019, this building is included itu building type III according to the risk type.

2.2.2 Project Management

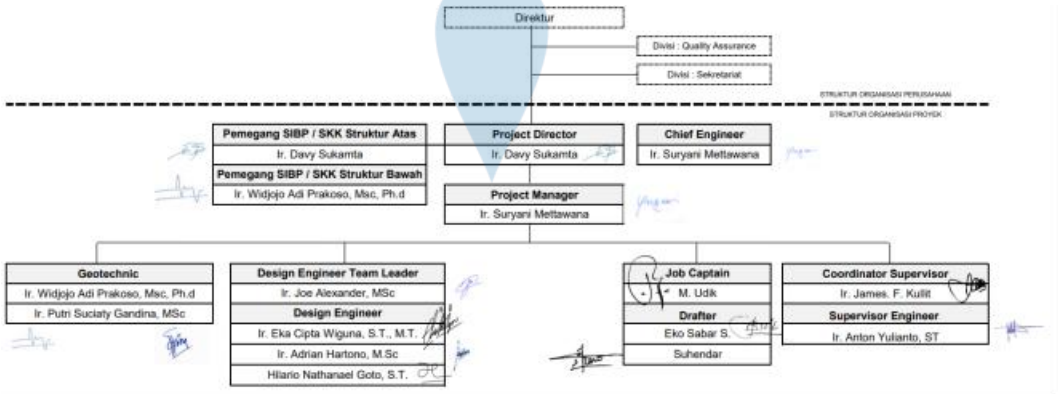


Figure 2. 4 Organizational Structure of MICE Management

Here is the project organizational structure of MICE management from Davy Sukamta and Partners members. Each of them has their own duties in this

project. In this project, students who intern in this company help the design engineer to do their jobs.

2.3. INTERNSHIP

Students who intern at Davy Sukamta and Partners started their internship on September 11th 2023 until January 11th 2024. In this internship, we are directly involved in various project teams, helping engineers. Students are given the opportunity to learn more by joining several teams so that students can learn from several building case studies and solve several problems. Details of the internship activity is written below:

Table 2. 1 Internship Activities Logbook

Numb	Date	Project	Assignment
1	11/09/2023 - 18/09/2023	Kompetisi Debat Mahasiswa Indonesia	Represent UAJY in National Debating Championship by Puspresnas Kemendikbud
2	19/09/2023	Hall 3, MICE, PIK 2	Project and Company Introduction
3	20/09/2023		Grouping column based on their types from mezzanine floor, 3rd floor, and roof floor
4	20/09/2023		
5	21/09/2023		Grouping column based on their types from 2nd floor
6	22/09/2023		Arrange column schedule
7	25/09/2023	Puri Indah Hotel	Stairs Introduction
8	26/09/2023		SAP2000 learning
9	27/09/2023		

10	28/09/2023		Stairs modeling with SAP2000
11	29/09/2023		
12	02/10/2023		
13	03/10/2023 - 12/10/2023	Nation Building 2023	Required Event for Djarum Beasiswa Plus Awardee
14	13/10/2023	Learning	Confinement Column
15	16/10/2023	Study Case	Confinement Column Calculation
16	17/10/2023		
		Learning	ETABS
17	18/10/2023		
18	19/10/2023	Puri Indah Hotel, Jakarta Barat	Site Visit : D-wall installation
19	20/10/2023	Hall 3, MICE, PIK 2	Prelimination Study Modelling with ETABS
20	23/10/2023		Column reinforcement check with ETABS
21	24/10/2023		Beam Reinforcement Introduction
22	25/10/2023		Beam Reinforcement Design (Grid : H3)
23	26/10/2023		Beam Reinforcement Design (Grid : F3)
24	27/10/2023		Beam Reinforcement Design (Grid : 2.3, roof floor and 3rd floor)
25	30/10/2023		Beam Reinforcement Design (Grid : 20.3)
26	31/10/2023		Beam Reinforcement Design (Grid : L3, M3, 10.3,

			11.3, 9.3, 12.3)
27	1/11/2023		Beam Reinforcement Design (Grid : 4.3, 6.3, 15.3, 16.3, 17.3, 18.3, 19.3)
28	2/11/2023		Beam Reinforcement Design (Grid : 3.3, 5.3, 8.3, 14.3, 1.3, J3, K3)
29	3/11/2023		Beam Reinforcement Design (Grid : R3, Q3, S3, J3)
30	6/11/2023		Change of plans → Revision. Typical Beam Reinforcement Design (Grid : 4.3 - 18.3 and J3 - R3)
31	7/11/2023		Support Beam Reinforcement Design roof floor, 3rd floor, and mezzanine floor
32	8/11/2023		Support Beam Reinforcement Design 2nd floor (Area by Grid: H3-V3 ; 1.3 - 22.3)
33	9/11/2023		Structural Drawing by Drafter check
			Stairs Design Briefing
34	10/11/2023		Stairs modeling with SAP2000 (Grid 2.3-3.3 ; S3-T3)
35	13/11/2023		Change of plans → Changes method of modeling from SAP2000
36	14/11/2023		Stairs reinforcement design
			Beam bordes and column bordes modeling check

37	15/11/2023	Blibli	Learning of slab reinforcement design and project introduction
38	16/11/2023		Grouping and reinforcement design of slab (13th-16th floor , 17th floor, 9th-11th floor)
39	17/11/2023		Comparison of volume total calculation and reinforcement total calculation between 140mm slab with D10-400 and 150mm slab D10-450
40	20/11/2023		Grouping of column design
41	21/11/2023		Confinement reinforcement of column
42	22/11/2023		Column revision (fc' divided in three phase) in ETABS modeling
43	23/11/2023		Revision longitudinal column reinforcement in ETABS
			Trial and error longitudinal column reinforcement in ETABS
44	24/11/2023		Revision confinement reinforcements of columns
45	27/11/2023		Column schedule of tower building
			Detailing sketch of column and column schedule
46	28/11/2023	Learning	Core Wall Reinforcement
47	29/11/2023	Company Event	DSP Birthday Celebration
48	30/11/2023	Blibli	Core Wall Design Briefing

49	1/12/2023		Walls revision dimension in ETABS
50	4/12/2023		Coordinate Data of Column and Walls
51	5/12/2023		Coordinate Data of Piles
52	6/12/2023		Data of forces from output ETABS for each column and walls
53	7/12/2023		Revision of walls coordinate and ETABS output
			Revision of piles coordinate based on update piles plan
54	8/11/2023		Two way slab Calculation and detailing slab sketch 9th floor - 17th floor
55	11/12/2023		Data of forces from output ETABS for each column and walls from GF model
56	12/12/2023		One way slab calculation and detailing slab sketch 9th floor - 17th floor
57	13/12/2023		Slab mapping and grouping 18th floor - 33th floor
58	14/12/2023		Slab mapping and grouping 34th floor - roof floor
59	15/12/2023		Two way slab calculation of 18th floor - 33th floor
60	18/12/2023		Two way slab calculation of 34th floor - roof floor
61	19/12/2023		Two way slab calculation of 1st floor - 8th floor
			Slab mapping and grouping 1st floor - 8th floor
62	20/12/2023		One way slab calculation 18th floor - roof floor

63	21/12/2023		Load changing in refugee floor concrete cover changing for each floor based on each requirement
64	22/12/2023		Revision of slab calculation
65	25/12/2023	Holiday	Christmas holiday
66	26/12/2023		
67	27/12/2023	Blibli	One way slab calculation 1st floor - 8th floor
68	28/12/2023		
69	29/12/2023		Slab detail sketch
70	1/1/2024	Holiday	New Year Holiday
71	2/1/2024	Blibli	Slab reinforcements mapping
72	3/1/2024		Support beam reinforceents
73	4/1/2024		
74	5/1/2024		

2.4. RELATED SUBJECT CONVERSION

2.4.1. Structural Analysis

Structural analysis is the most fundamental discipline used in the design of any building structure. Structure analysis is used in all aspects of building design, from determining dimensions to establishing reinforcement. In this case, students use ETABS to apply structural analysis concepts, then use structural analysis principles in revising and determining the longitudinal column on a column through the style interaction in a column, and also determine the column column, beam, slabs, and a stairs.

2.4.2. Applied Soil Mechanics

Because of student as an intern in PT. Davy Sukamta and Partners is focused in structural engineering, so matter about applied soil mechanics is taken by learning the soil examination results from the building that was used as the student's final project.

Soil investigation is carried out to determine the profile and characteristics of the land on which the building will be built. The goal of this investigation is to provide information to project participants in order to determine the most cost-effective and safe foundation design. Two tests are being conducted in this building: field testing and laboratory testing.

The field test includes sondir, SPT, boring, and sampling. The ASTM D-3441 standard is used in the sondir test to determine the level of soil resistance to conical pressure and total adhesion. The boring test, on the other hand, employs the ASTM D-1452 standard to visually identify soil types and structure. The SPT test then employs the ASTM D-1586 standard to calculate soil strength by calculating the amount of impact required by the hammer standard to penetrate as deep as 30 cm into the soil layer. Lastly, undisturbed soil sampling based on the ASTM D-1587 standard is intended for laboratory test.

There are several soil parameters that are obtained from laboratory test. The first is the water content based on ASTM D-2216 to determine the moisture conditions of the original soil sample, the specific gravity based on ASTM D-854 to determine the relative soil weight to the water content, the unit weight based on ASTM C-29 to determine weight per unit of volume, the grain size distribution based on ASTM D-422 and ASTM-D-1140 to determine the size and arrangement of soil grains, The Atterberg Limits (LL/PL) test according to ASTM D-4318 to classify soil based on liquid and plastic boundary properties and to evaluate soil consistency, the strength test according to ASTM D-2850 and the Triaxial-Act-Triaxial CU according to AsSTMD-4767 to obtain angle of gliding resistance and soil cohesion, and the consolidation test according to ASTMd-2435 to identify and behave soil compression properties under working stress.

A. FIELD TEST

1. Cone Penetrometer Test (CPT)

A soil investigations were conducted on this project, including 1 drilling point in 90m depth, 3 drilling points in 65m depth, 5 drilling points in 60m depth, 5 drilling points in 50m depth, and 8 light CPT points to meet the requirements of SNI 8460: 2017. PT Testana Indoteknika conducted this soil investigation in 2023.

The topographic conditions of the building site area on the project land range from El. +2,100 to El. +3,695. The topographic elevation of +3,000 is used as the reference existing land surface level, with the existing road area at an average elevation of +3,000. For reference, the elevation of El. 0.000 architecture is defined as elevation + 6,700 topographic maps.

Overall, preliminary soil stratification at the project location can be simplified as follows:

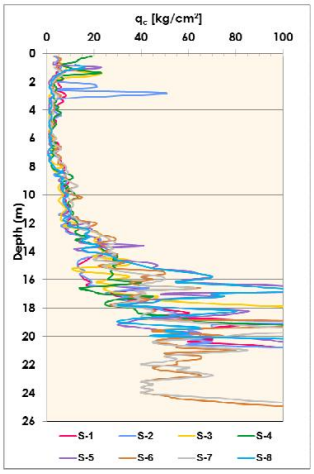
0 ~ 13m : very soft silt clay, $N_{SPT\text{-}ave} \cong 0 \sim 2$

13 ~ 36m : Stiff silt clay until very stiff silt clay , $N_{SPT\text{-}ave} \cong 13 \sim 19$

36 ~ 60m : very stiff silt clay, $N_{SPT\text{-}ave} \cong 18$

60 ~ 90m : very stiff silt clay, $N_{SPT\text{-}ave} \cong 20$

During technical drilling, the groundwater level was reported to be 1m to 2m below the ground surface. For the design, the normal groundwater level is taken at a depth of 1m from the ground surface, or architectural El. +2.00. According to the Employer, the flood barrier at the project site is reported to be at El.+2.160, approximately 0.84m below the existing ground level reference.



Gambar 1. Hasil Pengujian Sondir Mekanis

Figure 2. 5 CPT Result

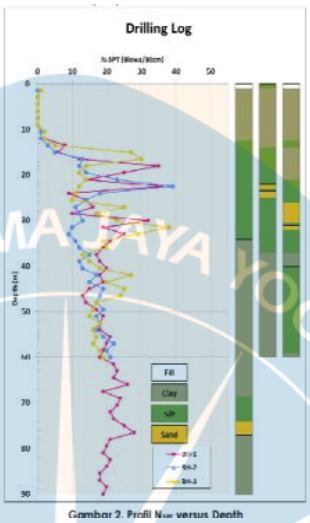
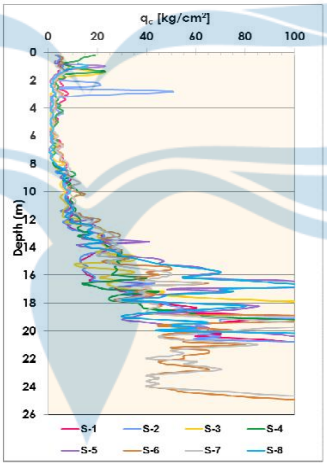


Figure 2. 6 Drilling Log

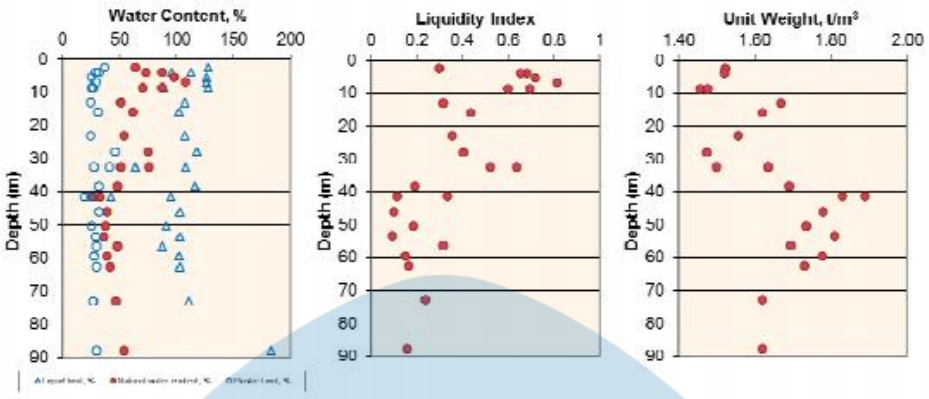


Gambar 1. Hasil Pengujian Sondir Mekanis

Figure 2. 7 CPT Result

B. LABORATORIUM TEST

1. Index Properties



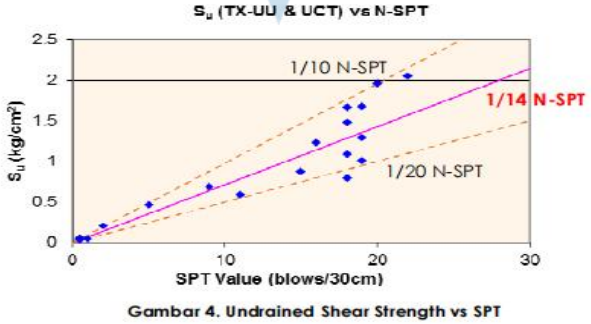
Gambar 3. Index Properties versus Kedalaman.

Figure 2. 8 Index Properties

Based on the results of index properties testing on cohesive soil samples of various depths, water content values range from 27% to 108%, with liquid limits ranging from 43% to 183% and plastic limits range from 19% to 46%. Specific gravity values are estimated between 2.58 and 2.75.

1. Direct Shear Test

The value of undrained shear strength (Su) can be correlated with the drilling result's SPT value.



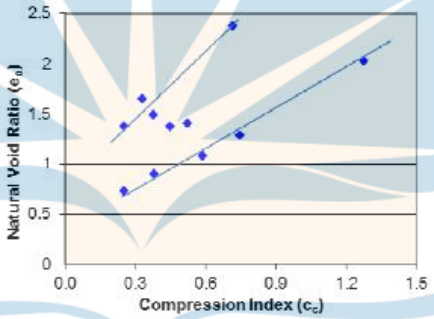
Gambar 4. Undrained Shear Strength vs SPT

Figure 2. 9 SPT Value

While the previous data is correlated with the N-SPT value found, the average Su value is approximately 1/14 N-SPT. The total cohesion value ranges between 0.06 and 0.15 kg/cm^2 based on the traxil result CU on the surface, while the effective cohesion value ranges between 0.04 and 0.09 kg/cm2. Meanwhile, the total sliding angle values range from 12 to 21 degrees, and the effective sliding angles range from 19 to 32 degrees.

2. Consolidation Test

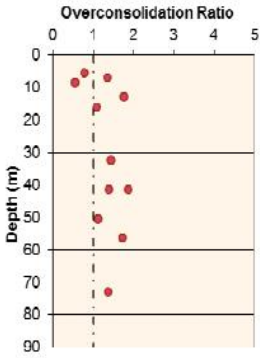
Consolidation tests were conducted to obtain preconsolidation pressure and compression index values.The values of preconsolidation pressure range from 0.30 kg/cm^2 to 7.00 kg/ cm^2, with compression index values ranging from 0.252 to 1.274. When compression Index values are correlated with natural void ratio values, correlation is found as below:



Gambar 5. Korelasi Compression Index dengan Void Ratio

Figure 2. 10 Compression index

The value of preconsolidation pressure obtained can be used to estimate the value of the Overconsolidation ratio (OCR) by dividing the pre-consolidated pressure value by the effective overburden stress. As for the estimated value of the OCR compared to the depth of the as below:



Gambar 6. Overconsolidation Ratio vs Kedalaman

Figure 2. 11 Consolidation result

Based on the consolidation test results, the loose soil found on the surface is still consolidated and should be treated cautiously.

2.4.3. Foundation Engineering

Because of student as an intern in PT. Davy Sukamta and Partners is focused in structural engineering, so material about foundation engineering is taken by learning the soil examination results and the foundation estimation from the building that was used as the student's final project.

1. Axial Bearing Capacity

The ultimate compressive axial bearing capacity of a single pile, both ultimate cover resistance and ultimate end resistance, is calculated using the method of DeCourt (1995). From this method, the ultimate pile cover resistance (Qs-ult) and ultimate pile tip resistance (Qt-ult) are calculated. From these two values, the ultimate compressive axial bearing capacity (Qult) and allowable compressive axial bearing capacity (Qall) of a single pile can be obtained as follows:

$Q_{ult} = Q_{s\text{-}ult} + Q_{t\text{-}ult}$

$Q_{all} = (Q_{\text{-}ult} - W_p) / FK - NSF$

Where FK is the global safety factor that is 2.5, and Wp is the self weight of the foundation.

Assuming that the 13m top pile segment experiences negative skin friction, for a spun pile dia.600mm with a total length of 30m and an effective length of 27m, the ultimate blanket resistance, Qs ult, is 2,300kN and the end blanket resistance, Qt-ult, is 850kN, resulting in an ultimate total resistance, Qult, of 3,150kN. With approximately 300kN of negative skin friction, a net Qult of 2,850kN is achieved. Using the pile's own weight and a global safety factor of 2.5,

the permitted bearing capacity, Qall, is 1,109kN, with the design Qall = 1,100kN. To determine the number of piles for the compressive axial load requirements, an efficiency of 85% is used for pile groups up to a maximum.

For the purposes of the pile loading test, negative skin friction is not taken into account, so that the capacity for the pile loading test is 1,400kN.

2. Lateral Bearing Capacity

The lateral bearing capacity of a single pile when subjected to a lateral load at the pile head is calculated using the p-y method. Reese et al. (1974) developed this method, which was then applied to the LPILE 2022 auxiliary program used in the analysis. Dr. Lymon C. Reese founded Ensoft, Inc., which developed this program. The clamping conditions and lateral loads acting on the pile head can be modeled to obtain pile behavior, particularly the distribution of lateral deflection, bending moment, and shear along the pile.

The amount of lateral deflection that occurs determines a single pile's lateral bearing capacity, as opposed to its axial bearing capacity. The allowable lateral bearing capacity of a single pile is defined as the amount of lateral force at the pile's head that causes a lateral deformation of 12mm during a design or nominal earthquake, or 25mm during a strong earthquake.From the lateral pile compression test data that has been carried out, a back-calculated analysis is made to produce soil parameters (spring, stiffness). The condition of the pile during the test is a single pile with a free head with static loading, while for production piles the pile will be in group pile condition with a fixed cap and analyzed with cyclic loading.

For piles in a group, the analysis is carried out by reducing the p-y curves according to the average lateral efficiency for the entire foundation system, with the pile head clamped in accordance with the final conditions. Lateral deflection curves, moment distribution, and shear force distribution along the pile due to design lateral loads are shown in the following figures, where a p-y curve reduction factor of 70% has been used to model the pile in accordance with the results of the pile group efficiency analysis for lateral loading, namely the entire building foundation system.

The results of the analysis of a single pile that receives a lateral load to determine the permitted lateral capacity are given in the figure and table above. The production pile is a 0.6m diameter pile with an effective length (Leff) of 27m. The permitted lateral capacity is 73kN for earthquake conditions without omega and 108kN for earthquake conditions with Ω. When the pile head conditions are free and the stair load is applied to a single pile, the pile loading test capacity is 75kN at 200% load and 37.5kN at 100% load.

Table 2. 2 Resume

Spun pile (m)	L_{eff} (m)	Kondisi	$\delta_{h\text{-}maks}$ (mm)	H (kN)	Mmaks (kN.m)	Keterangan
0.6	27 (cut 2m)	Fixed, Kelompok, Siklik	**12**	73	208	H_{ijin}, gempa tanpa Ω
			25	108	343	H_{ijin}, gempa dengan Ω
		Free, Tunggal, Statik	3	**25**	41	test pile, 100% H
			25	**75**	170	test pile, 200% H

Note : $\delta_{h\text{-}maks}$ = maximum deflection ; H = lateral load on pile caps ; M_{maks} = maximum moments.

2.4.4. Construction Materials Technology

Because there is no materials about construction materials in the consultant company, including in Davy Sukamta and Partners company, so author's try to calculate the mix design to fulfill the conversion duty in this report.

Step 1 - Slump

1.10 Slump

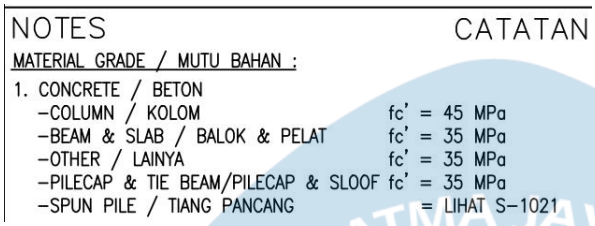
Slump beton minimum adalah sbb:

a. Pondasi mat untuk Tower = 150mm. Setting time dan slump retention time beton harus disesuaikan dengan metode pengecoran.
b. Pile cap, basement slab = 130 mm
c. Dinding beton dan kolom = 160 mm
d. Pelat dan balok = 130 mm

Slump harus ditentukan menurut ASTM C143. Tambahkan retarder secukupnya agar tidak terjadi setting sebelum pengecoran dan perataan selesai. Juga tambahkan retarder untuk menghindari retak akibat plastic settlement.

Figure 2. 12 Slump standard of MICE project

In this building slump is determined by the company according to ASTM C143. Based on data above, students will calculate the mix design of a column which is 160 mm. Based on SNI 7656: 2012, this slump is included in the 150-175mm category. Another data from company that have determined is fc' as below:



NOTES CATATAN

MATERIAL GRADE / MUTU BAHAN :

1. CONCRETE / BETON
   - -COLUMN / KOLOM fc' = 45 MPa
   - -BEAM & SLAB / BALOK & PELAT fc' = 35 MPa
   - -OTHER / LAINYA fc' = 35 MPa
   - -PILECAP & TIE BEAM/PILECAP & SLOOF fc' = 35 MPa
   - -SPUN PILE / TIANG PANCANG = LIHAT S-1021

Figure 2. 13 Notes of material grade of MICE project

So, in this case the fc' of the mix design is 45 Mpa.

Step 2 - Nominal size

According to SNI 7657:2023 5.3.1.2 maximum nominal of aggregate can not be more than:

a) 1/5 of the smallest dimension between walls bekisting
b) 1/3 of slab thickness
c) 3/4 of minimum spacing between reinforcements

The maximum number can be chosen from the smallest result so that it will give more strengths to the water-cement ratio.

The chosen nominal is assumed as 19 mm.

Step 3 - Estimated water mixing requirements and air content

Tabel 2 Perkiraan kebutuhan air pencampur dan kadar udara untuk berbagai slump dan ukuran nominal agregat maksimum batu pecah

Slump (mm)	Air (kg/m³) untuk ukuran nominal agregat maksimum batu pecah							
	9,5 mm*	12,7 mm*	19 mm*	25 mm*	37,5 mm*	50 mm†*	75 mm†‡	150 mm†‡
Beton tanpa tambahan udara								
25-50	207	199	190	179	166	154	130	113
75-100	228	216	205	193	181	169	145	124
150-175	243	228	216	202	190	178	160	-
> 175*	-	-	-	-	-	-	-	-
banyaknya udara dalam beton (%)	3	2,5	2	1,5	1	0,5	0,3	0,2
Beton dengan tambahan udara								
25-50	181	175	168	160	150	142	122	107
75-100	202	193	184	175	165	157	133	119
150-175	216	205	197	184	174	166	154	-
> 175*	-	-	-	-	-	-	-	-
Jumlah kadar udara yang disarankan untuk tingkat pemaparan sebagai berikut : ringan (%)	4,5	4,0	3,5	3,0	2,5	2,0	1,5**††	1,0**††
sedang (%)	6,0	5,5	5,0	4,5	4,5	4,0	3,5**††	3,0**††
berat ‡‡ (%)	7,5	7,0	6,0	6,0	5,5	5,0	4,5**††	4,0**††

Figure 2. 14 SNI Table of estimated mixing requirments

So, based on SNI 7656:2012 in table above, the estimated mixing water requirements is 216 kg/m^3 with air content about 2%.

Step 4 - Water cement ratio

Based on SNI 7656:2012 in table below:

Kekuatan beton umur 28 hari, MPa*	Rasio air-semen (berat)	
	Beton tanpa tambahan udara	Beton dengan tambahan udara
40	0,42	-
35	0,47	0,39
30	0,54	0,45
25	0,61	0,52
20	0,69	0,60
15	0,79	0,70

Figure 2. 15 SNI Table of water cement ratio

We can interpolate the water cement ratio.

$X_1 = 35$ $Y_1 = 0.47$

$X = 40$ $Y = 0.42$

$X_2 = 45$ $Y_2 = ?$

$$= \frac{X - X1}{X2 - x1} = \frac{Y - Y1}{Y2 - Y1}$$

$$= \frac{40 - 35}{45 - 35} = \frac{0.42 - 0.47}{Y2 - 0.47}$$

$$= \frac{-5}{10} = \frac{-0.05}{Y2 - 0.47}$$

$= -5(Y_2 - 0.47) = -0.05(10)$

$= -5Y_2 + 2.35 = -0.5$

$= -5Y_2 = -0.5 - 2.35$

$$= Y_2 = \frac{-2.85}{-5}$$

$= Y_2 = 0.57$

So the water cement ratio of the concrete is 0.57

Step 5 - W_{cement}

$W_{water} = 216$ kg/m^3

w/c = 0.57

$$W_{cement} = \frac{216}{0.57} = 378.94 \text{ kg/m}^3$$

Step 6 - Coarse aggregate

Ukuran nominal agregat maksimum (mm)	Volume agregat kasar kering oven* per satuan volume beton untuk berbagai modulus kehalusan† dari agregat halus			
	2,40	2,60	2,80	3,00
9,5	0,50	0,48	0,46	0,44
12,5	0,59	0,57	0,55	0,53
19	0,66	0,64	0,62	0,60
25	0,71	0,69	0,67	0,65
37,5	0,75	0,73	0,71	0,69
50	0,78	0,76	0,74	0,72
75	0,82	0,80	0,78	0,76
150	0,87	0,85	0,83	0,81

*Volume berdasarkan berat kering oven sesuai SNI 03-4804-1998

Figure 2. 16 SNI Table of coarse aggregate

According to SNI 7656:2012 Table 5, for fine aggregate with fineness modulus that is assumed as 3 and coarse aggregate maximum nominal size 19mm, the number that can be obtained is 0.6 m for every m^3 of concrete.

Therefore, W_{dried} = 0.6 x oven dry density that assumed as 2220.4 kg/m^3

So 0.6 x 2220.4 = 1332.24 kg/m^3

Step 7 - Preliminary estimate weight of concrete

According to SNI 7656:2012 table 6, the fine aggregate content will be calculated as below:

Ukuran nominal maksimum agregat (mm)	Perkiraan awal berat beton, kg/m^3*	
	Beton tanpa tambahan udara	Beton dengan tambahan udara
9,5	2280	2200
12,5	2310	2230
19	2345	2275
25	2380	2290
37,5	2410	2350
50	2445	2345
75	2490	2405
150	2530	2435

Figure 2. 17 SNI table of weigth estimation

From table above the weight of concrete is 2345 kg/m^3

Absolute weigth

$= W_{concrete} - W_{water} - W_{cement} - W_{coarse}$

$= 2345\ kg/m^3 - 205\ kg/m^3 - 378.94\ kg/m^3 - 1332.24\ kg/m^3$

$= 428.82\ kg/m^3$