DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

SITE INVESTIGATION

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FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

FEBRUARY 2022

It recommended that the report of this practical training provided

By

Meor Muhammad Fairiel Bin Meor Sharul Halizan

2019261302

Entitled

SITE INVESTIGATION

Be accepted in partial fulfillment of the requirement for obtaining the Diploma In Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at DCS Consolidated Construction Sdn. Bhd. for a duration of 20 weeks starting from 23 August 2021 and ended on 7 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfilment of the requirements for obtaining the Diploma in Building.

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Name : Meor Muhammad Fairiel Bin Meor Sharul Halizan

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ACKNOWLEDGEMENT

Firstly, thank to Allah s.w.t and his Messenger, Prophet Muhammad s.a.w for author to finish his 20 weeks of practical training successfully. Next, author want to extend my greatest gratitude and appreciation to DCS Consolidated Construction Sdn. Bhd. for giving me the opportunity to undergo my practical training at their company. Throughout weeks of my practical training, author have gained much experience that will absolutely contributing in extending my knowledge regarding my course outcome as well as my personal development. I would like to thanks personally to Encik Muhammad Muhaimin Bin Ahmad Muzaini as author have been conducting his training under his supervision. The author also would like to give my gratitude to other fellow technician and staff for all the knowledge and time that they has spent and sacrifice to teach me a lot of useful knowledge.

Apart from that, author would like to personally thanks to Ts. Mohd Najb as he were his supervision lecturer throughout his practical training. He has cleared the confusion the author had along my practical training and guided him on ways and how to completing the report with excellence. Then, author would like to thanks to all of his friends from the practical internship placement and other groups that has helped and motivating him on going forward despite many challenges. Lastly, author want to thank his parent who always prayed for my success and their sacrifices.

ABSTRACT

To maintain integrity and honesty of work by contractor and to ensure whether a proposed construction projects is safe to proceed to ensure safety and to understand the site location or condition and equipment needed for the project, a testing before construction work begins is vital. Therefore, this report will discuss about the pre-construction testing that is required before begin the construction work. Many new knowledge was discover while undergoing practical training with the company in many ways such as questionnaires interview, observation, document reviews and hands on training. The objective of the report is to to identify method of laboratory testing for site investigation, to identify on-site testing for site investigation and to identify the problem and solution at site regarding site investigation. The laboratory testing are more to soil investigation work in which purpose to investigate the condition of the soil at the site location. Meanwhile, on site testing are testing that needs to be carry out on site, as the information can only be gain as the conducted on site. Problem and solution at site regarding site investigation discussed about the the issue that encountered on site while conducting the test. Testing before starting construction work is a fundamental step, which held prior to any construction activity on site. The obtained data will assist in designing phase therefore a good quality, economic and safe structure can be built accordingly to the what site location needed.

Contents

List of figures

List of Table

CHAPTER 1.0

INTRODUCTION

1.0 Background of study

Before any construction begins, an investigation regarding the terrain and properties of the construction site and material is vital to ensure safety and quality construction outcome. Therefore, various types of testing and investigation must be done before begin any construction work to avoid any bad implications and to understand the condition of the site location. It's also important as it assist to determine whether a certain equipment or materials is required to make sure the long term safety of the constructed building or road.

Regardless whether the proposed construction works is high profile projects or a small project, site investigation is required to investigate the quality of the construction material and the condition of the construction site (Watts & Davis, 2016). The data obtained upon testing and investigation then could be use in developing an appropriate design and required material to ensure longtime safety of the proposed project (Watts & Davis, 2016).

The data obtain from the investigation is also would be use by related parties such as consultant and contractors for designing process, and deciding whether is it possible to build the proposed project at the desired location sites (Monawar, A., 2021). As for reference, the result of soil investigation will have an impact on the proposed project design, development, expense, and risk (Kunkolienkar, 2016).

Testing in construction could be divides into two categories, which are the laboratories testing and on site testing. Laboratories testing is more into soil investigation work, which concludes the Atterberg limit test, hydrometer test, linear shrinkage, particle size distribution and moisture content. However, it does not limit

to only soil investigation work, sometimes when on site testing requires deeper investigation and requires certain equipment which can includes testing for asphalt, and concrete (Shield Engineering, 2020). Meanwhile, on site test are test that are only can be done on site such as Mackintosh Probe, In situ California bearing ratio, field density test, and plate bearing test.

Testing before starting construction work is a fundamental step, which held prior to any construction activity on site. The main purpose of conducting various test is gain data needed in the designing the foundation of any given loads on the proposed constructed building (Monawar, A., 2021). The obtained data will assist in designing phase therefore a good quality, economic and safe structure can be built accordingly to the what site location needed (Monawar, A., 2021).

1.2 Objectives

There are two objectives to be achieved as undergo the Practical training which are as follows

1.2.1 To identify method of laboratory testing for site investigation.

1.2.2 To identify on-site testing for site investigation.

1.2.3 To identify the problem and solution at site regarding site investigation.

1.3 Scope of Studies

The scope of studies of practical training report are regarding of both on site and laboratories testing before and after construction work. The laboratories testing, which are more to soil investigation work, which includes the purpose, and how to conduct various testing such as hydrometer test, particle size distribution, Atterberg limit test, and Proctor test. Meanwhile on-site testing concludes the importance, equipment needed and how to conduct the on-site testing. Undergoing the practical training, I learned that the purpose of the testing in construction is to maintain integrity in construction regardless before or after

construction is finish. What it means by maintaining integrity is to make sure the contractor did the proposed construction work according to the specification in the bill quantities. Apart from that, it is to ensure long-term safety as the result of the test will determine whether the proposed construction project is safe to proceed or what needs to be done in order to carry out the project such as piling or else. It also determine whether a certain work needed in regards of failed test.

1.4 Method of Study

i. Observation

Observations when appointed by the supervisor to assist the technician when doing on site testing and also when assist on laboratory test. After detail observation regarding the procedure of the testing, the technician will task the next point to me with more detail guidance on how to handle a certain machine or conduct the test in general. Alongside detail observation, pictures, video, and notes were also taken for revisions to sharpen the skill and remind myself on important information on how to conduct the test.

ii. Interviews and questionnaires

Direct interview by asking question to the staff or fellow colleague such supervisors, and technicians regarding the purpose, procedure, problem solution and tips of test that will be done or any question I have in mind. Different individual will have their own skills and their way on conducting a certain test based on their experience and many new information can be gain by questionnaires interview.

iii. Document reviews

Revisions to the recorded data from previous test such as reports, prelims, drawing and photo that taken when doing the testing regardless for on site testing or laboratory testing. A lot of useful information can be gain by this method as I can study the formula for certain calculation, the purpose to calculate a certain thing and many more.

Chapter 2.0

Company Background

2.1 Introduction of Company

Distinctive Civil Structure (DCS) Consolidated Construction Sdn Bhd founded by Encik Anwar Monawar since 1999, as he is the Chief Executive Officer. The company was established through the combination of experts from many engineering fields varies from oil and gas construction personnel in civil, building, mechanical and electrical.

DCS consolidated Construction Sdn Bhd is civil engineering laboratory specialist work localized at Medan Meru, 30020 Ipoh, Perak and have four other branches in other states, which are Selangor, Johor Bahru, Pahang, and Kelantan. The company is Graded G4 by the Construction Industry Development Board (CIDB) with many specializations mainly focuses on construction and civil work. The company also accredited to ISO 17025:2005 by the Laboratory Accreditation Scheme of Malaysia (SAMM) since 30 May 2018. ISO 17025 is the main international standard that specifies the general standards regarding testing and calibration laboratories' expertise.

DCS Consolidated Construction Sdn Bhd is one of Ipoh, Perak's most reliable and well-known laboratory and on site testing companies. The company has been providing quality testing for over four years, providing internal quality assurance for aggregate manufacturing, concrete manufacture, and in-place soil fill layer conformance testing. The company offers wide range of laboratory testing including soil testing, aggregate, road base and premix testing and tensile strength test. Apart from that, the company also expertise and has an excellence experience on specialist construction works such as waterproofing works, structural repair works and many more.

The company vision is to be “Malaysia’s best testing and construction firm in specialist construction works.” The company’s goal is to be the “very best” for every of their customer, employees and shareholder. The organisation has set three company objectives that serve to define its mission in order to attain that vision. The first company are to surpass client expectations by offering high-quality testing services to the businesses in which they operate at current market value. Secondly is to exceed employee expectations by creating a positive workplace culture that is both promising and pleasant. The third mission is to provide financial stability by securing a large market share with appropriate profits while implementing excellent business procedures.

2.2 Company Profile

Company Name:	DCS Consolidated Construction Sdn. Bhd
Business Address:	No. 6 & 6A, Jalan Meru Bistari A4, 30020 Ipoh, Perak\
Email:	admin@dcsconsolidated.com
Contact no. :	05 - 525 3118 / 012-349 5437 / 013-488 1388
Accreditation:	SAMM 775 (ISO 17025)
Date accreditation:	30 may 2018

Figure 2.0 DCS Consolidated Construction Sdn. Bhd.

2.3 Company Organization Chart

The company is lead by the company's CEO which is En. Anwar Monawar and all the test are verified and approved by the CEO and the company's Engineer. the test mostly are done by speacilist tehcnician and engineers.

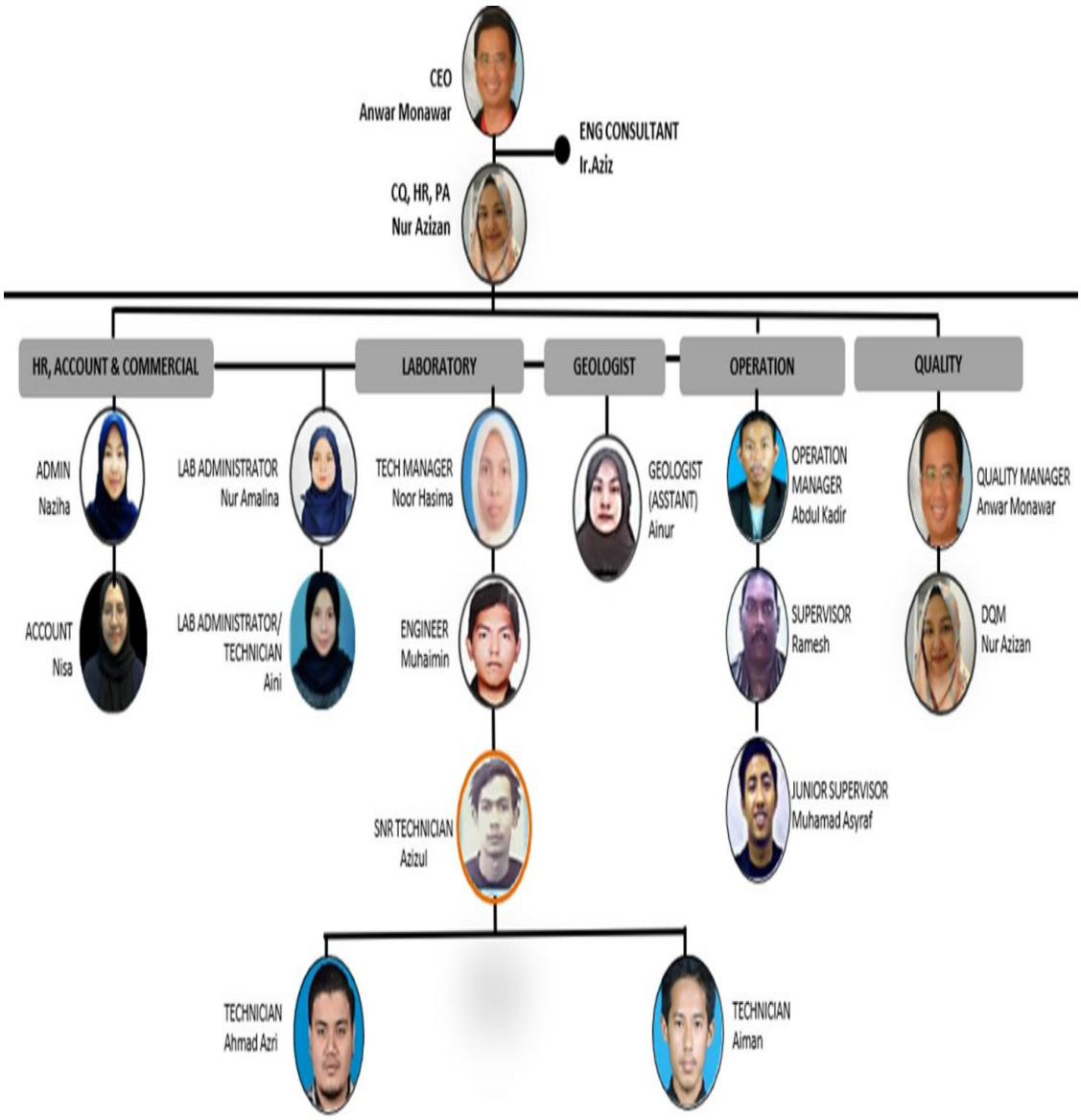


Figure 1.1 Company Organization Charts

Source: DCS Consolidated Construction SDN. BHD

2.4 List of projects

2.4.1 Completed projects

The company accomplished many excellences in the t site investigation work including soil investigation work and testing in stages of construction in which the company's offers many test, which covers, from the earthwork process and structural and road base test

Table 1 Company's Completed Projects

No.	Project Title	Type of testing	Client
1	Cadangan membibna dan menyiapkan 30 unit rumah kembar 2 tingkat di atas untuk HSD 621, PT2929 / HSD 4650, PT 2959, Mukim Tanah Rata, Cameron Highland	Soil Investigation	Jati Pemborong' Am Sdn Bhd
2	Permohonan kebenaran merancang dan pelan bangunan bagi pendirian bangunan untuk cadangan membina dan menyiapkan pembangunan perumahan di atas Lot 3667, Mukim Hulu Bernam Timur, Daerah Batang Padang, Perak	Soil Investigation	Jati Holding Sdn Bhd
3	Meroboh dan membina semula Blok pendidikan tingkatan 4 SMJK(C) Choong Huk, Mukim Bidor, Daerah Batang Padang, Perak	Mackintosh Probe	YS Low construction
4.	Membina Dewan Terbuka di Tasik Damai, Perak	Mackintosh Probe	Kualiti Ceria Enterprise
5.	Projek menggantikan Jambatan Sedia ada Hulu Perak, Perak	CBR in situ/ Soil	Gemilang Aisy Sdn Bhd

2.4.2 Ongoing Projects

All the specialist work conducted by a trained specialist and accordingly to the standard requirement as the company credited to the ISO 17025.

Table 2 Ongoing Projects

No.	Project Title	Type of testing	Client
1	Perbinaan Kompleks Perpadauan Negeri Perlis	Soil Investigation	JKR caw. Kej. Geoteknik
2	Kerja Ukur Hidrografi Untuk Pembinaan & Pembaikan Ban Paintai Di Persisir Pantai Bagan Ajam, Spu, Pulau Pinang	Soil Investigation	Soilpro Technical Services Sdn. Bhd.
3	Kerja-Kerja “Reconstruction” di Lorong Belakang Pakatan Jaya 6 & , Ipoh Perak	Cbr in situ / Crusher	Panah Mega Enterprise
4	Projek Pembaikan Cerun dan Kerja-kerja Berkaitan di Kem Pasukan Gerakan Am (PGA) Ulu Kinta, Perak	Cbr in situ / soil	Sahira Maju Construction Sdn. Bhd.
5	Proposed Earthwork At Rumah Selangorku, Mukim Bukit Raja, Daerah Petaling Shah Alam	Mackintosh Probe	Pembinaan Nescaya Sdn. Bhd.

CHAPTER 3.0

SITE INVESTIGATION CASE STUDY

3.1 Introduction to case study

The project is to construct "Kompleks Perpaduan Negeri Perlis" which a building for many government department offices, hall, and meeting room. The objective of the center is to facilitate the affairs of the surrounding population regardless for their issues involving government registration, venue for an event such as vaccination center, local event or else. Concisely overall, the building is set to serve many purpose for the resident and state of Kangar, Perlis.

Before the construction work for the proposed project can begins, few pre construction testing will be done for convenience of the consultant and other related parties for designing, costing and other process. The various test that required by the JKR Perlis was soil investigation work which includes the laboratory test, mackintosh probe test, and Field density test. The total cost for all the testing was settle on grand total of RM 146, 507.41

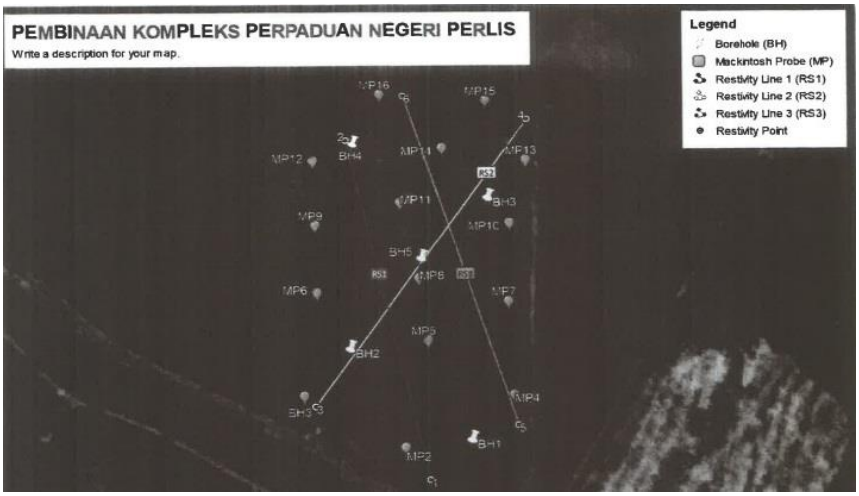


Figure 2.0 Site point location

Source: DCS Consolidated Construction SDN. BHD

The first test conducted was the soil investigation work which the process of the obtaining the soil sample for 5 points to be brought to the lab for few laboratory test which includes the Atterberg limit test, moisture content, hydrometer test, proctor soil test, and sieve analysis. Then, after the process of obtaining sample done, the mackintosh probe begins to investigate the soil bearing capacity at the proposed location for the use of the consultant for designing process. Lastly, after sometime which some construction begin such as site clearance and landfilling done, field density test is conducted to determine the increased compaction or density that has been attained on the soil layer.

Figure 3.1 Site location

The first test, which are the soil investigation work starts 21 September and the reports of the soil investigation and mackintosh probe test, is due by the JKR on 31 October 2021. The project expected to finish sometime around the next year or possibly the end of year 2021. There were about eight numbers of worker involves for the soil investigation work including the on-site geologist, machine operator and site supervisor.

3.2 Method of Laboratory Testing For Site Investigation

After the collected sample brought to the lab, the geologist will create a bore log for the disturbed sample to write the description of the soil sample for the convenience of the technician at the lab. There are many types laboratory test but the type of testing that conducted is depend on the lab schedule provides by the client which is for this particular project JKR Perlis.

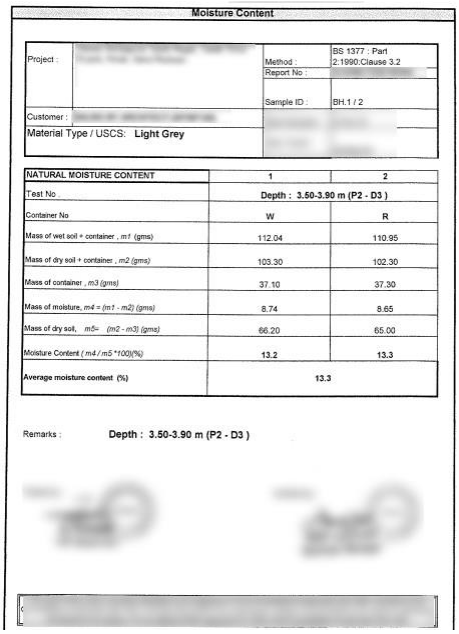
For this particular project, the JKR Perlis demand for moisture content, sieve analysis, Atterberg limit test and hydrometer test. The test is to investigate the characteristic of the soil, which conclude the water content, amount of silt, and clay, which can influence the cost and material use for the construction process. All the test may have took at least 6 days for each borehole, which usually consist of 10 to 12 sample depends on the depth to the hard layer at the certain points. There are five borehole for this project, which means there 60 sample to be test.

3.2.1 Moisture Content Test

This is usually the first test conducted in the lab, as it is the simplest test among other test. The purpose of the test is to investigate the percentage of moisture content of the soil sample. The method used for the test is the over dry method which is the common method. The apparatus of the test are weighting scale, metal dish, and an oven.

The first step are weight in the empty metal dish, then put around 100g wet soil sample into the dish and weight in it. After that, put it in the oven under a temperature of 110 degree Celsius for 24 hours as shown in figure 3.2. After a day, weight in the dry sample and then calculate the moisture content percentage using the appropriate formula as shown in figure 3.3.

Figure 3.2 Drying sample in oven



Moisture Content

Project :	[redacted]	Method :	BS 1377 : Part 2:1990:Clause 3.2
		Report No :	[redacted]
		Sample ID :	BH.1 / 2
Customer :	[redacted]		
Material Type / USCS:	Light Grey		

NATURAL MOISTURE CONTENT	1	2
Test No	Depth : 3.50-3.90 m (P2 - D3)	
Container No	W	R
Mass of wet soil + container , m1 (gms)	112.04	110.95
Mass of dry soil + container , m2 (gms)	103.30	102.30
Mass of container , m3 (gms)	37.10	37.30
Mass of moisture, m4 = (m1 - m2) (gms)	8.74	8.65
Mass of dry soil, m5= (m2 - m3) (gms)	66.20	65.00
Moisture Content (m4 / m5 *100)(%)	13.2	13.3
Average moisture content (%)	13.3	

Remarks : Depth : 3.50-3.90 m (P2 - D3)

Figure 3.3 moisture content form

Source: DCS Consolidated Construction Sdn. Bhd.

3.2.2. Hydrometer Test

Silt and clay are the finest particle between gravel and sand. The particle size are so small that it can passed the finest sieve sizes, which are 63 micron. The objective of the hydrometer test is to investigate the amount of silt and clay contain in certain depth of the collected soil test.

The first step of test starts with soak the sample with distilled water for 3 hour to makes the silt and clay soluble in distilled water. Sodium Hexametaphosphate can be add to act as dispersion agent to prevent clay and soil from clumping together and shorten the time to 1 hour as shown in figure 3.4. Next, after hard soil and clay mixture is soften, pour it into 63-micron sieve size to distinguish the fine sand and gravel or any other particle from the soil sample and add more distilled water and stir the soil sample.

Figure 3.4 soaking sample with Sodium Hexametaphosphate

The dissolve water is collected in a tray underneath the 63-micron sieve size and will be pour into a measuring cylinder up 1000ml as shown in figure 3.5. Meanwhile, the particle that are retained from the 63-micron sieve size will be pour into a metal can to be dried in the over under 110 degree Celsius for 24 hours to conduct sieve analysis.

Figure 3.5 pouring dissolve silt and clay into measuring cylinder

Then, immerse the measuring cylinder into the water tank and record the reading of the hydrometer after a period of half a minute, 1 minutes, 2 minutes, 4 minutes and 1440 minutes as shown in figure 3.6. The specific gravity reading supposedly to decrease over time as the silt and clay fall down into the bottom of measuring cylinder as shown in figure 3.7.

Figure 3.6 taking hydrometer reading

Figure 3.7 Hydrometer test reading

3.2.3. Sieve Analysis Test

The distinguished particle from previous hydrometer test was pour into a metal can, to be dry in the over under 110 degree Celsius for 24 hours to conduct sieve analysis. The purpose of this test are to investigate the percentage of gravel, silt and clay. The purpose of sieving the sample with 63-micron size sieve is because only silt and clay passes the size. Therefore, the gravel and sand particle will be distinguish

from the silt and clay and the percentage of the particles can be calculate by conducting test.

Figure 3.8 Arranged sieve pan

The particle of gravel and sand are sieves starting with sieve size from 5.0 mm to 63 micron as shown in figure 3.8. The starting size are depends on the sizes of the gravel that can be seen by eyes. Usually, the sizes for soil investigation work are relatively small therefore, it starts with 5.0 mm. the procedure are simple as it starts stack each sizes sieve from big to smallest. Then, pour the dried sample onto the top pan and shake it carefully and uniformly. Upon the shaking, each particle size will falls down into the lowest sieve and retained at the sieve size that it could not passed. Record the weight of each sieve size.

Later than, the percentage of retained and passing particle can be calculate alongside the percentage of gravel, sand, silt and clay. The particle that retained from the top sieve to the sieve size 2.0 mm are gravels, meanwhile the 1.18 mm to the 63 micron are sand particle. Any particles that passes 63 Micron sieve size are silt and clay. From the data collected from both hydrometer and sieve, analysis the Particle Size Distribution graph can be produce as shown in figure 3.9.

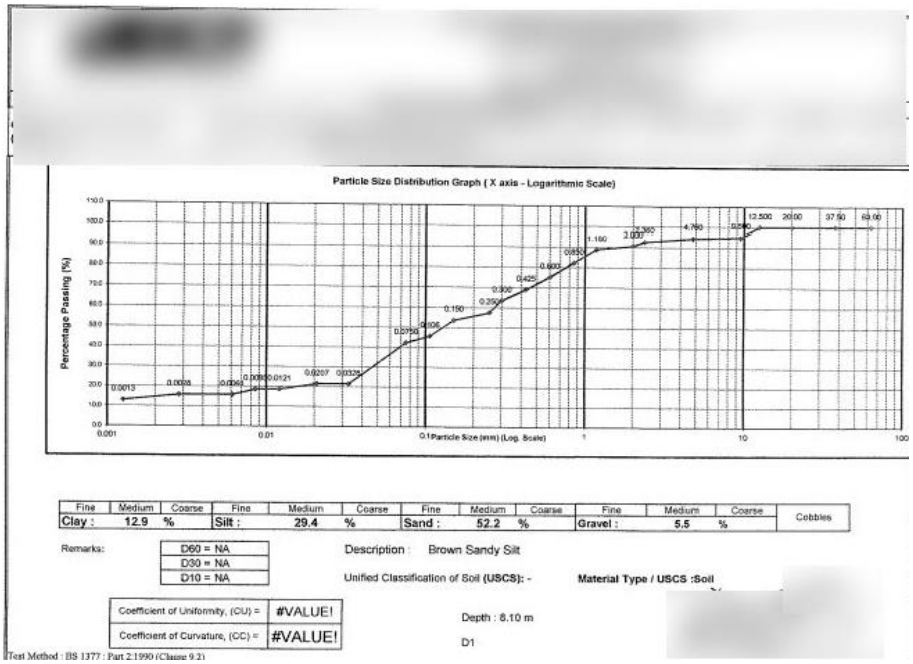


Figure 3.9 Particle size distribution graph

Source: DCS Consolidated Construction SDN. BHD.

3.2.4 Atterberg Limit Test

Atterberg limit test can be divide into to test which are the plastic limit test and the liquid limit test. The test only be conducted if the percentage of silt and clay exceeds 25%, which the information can be obtain from previous sieve analysis. The objective of the test is to ascertain the liquid limit (LL), plastic limit (PL), and the plasticity index (PI) of fine-grained cohesive soils. It is important for construction as the result could influences the value shear strength of soil and the site location. It is due to clay and silt, expands and shrinks depends on the moisture content. Therefore, the shear strength could be vary due to it.

For both liquid and plastic limit, the sample used is the dried sample that passed the 425-micron sieve size. The sample needed for both test are around 400g. The first step of liquid limit test is add small amount of water and mix it thoroughly with soil sample until a smooth consistent paste is achieve. Then spread the soil sample to Casagrande cup and make sure to squeeze it to deepest end of the cup with

pressure to avoid any air pocket. Then, neatly dividing the soil as shown in figure 3.10 and blow around 10 blows as shown in figure 3.11. Remove the soil at which the divided soil touching and place it on the empty dish as shown in figure 3.12. Record the weight of the wet soil, put it the oven under 110 degree Celsius, and calculate the moisture content the next day. The process repeated for four times with different number of blows, which are 30, and 40 blows with decreasing of amount of water as the number of blows increases.

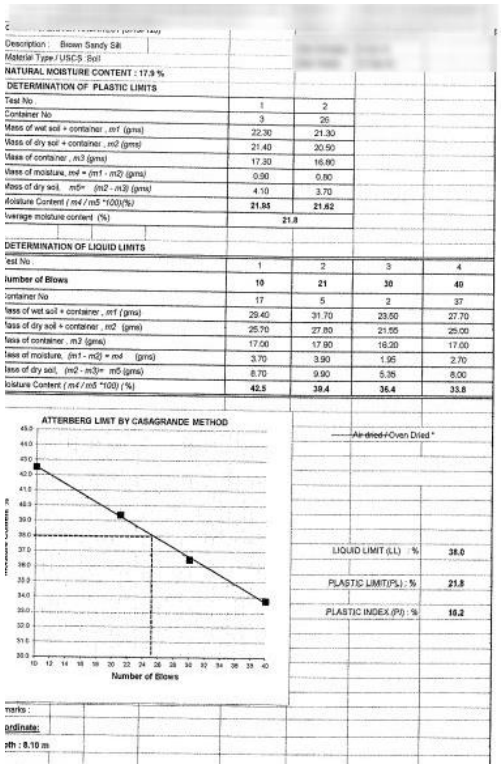
Figure 3.10 dividing soil in the Casagrande cup

Figure 3.11 conducting liquid limit test

Meanwhile, for the plastic limit test, the procedure is mostly the same except the usage of the Casagrande cup. After the soil mixed with distilled water, the soil formed into a ball. Then, a portion of the ball, taken and shaped into ellipsoidal with a 3mm diameter. When a soil breaks apart when before reaching 3mm diameter it means the soil has reached it plastic limit if not then, that means the soil have not reaches it plastic limit yet. The soil rolled until cracks can be seen on the ellipsoidal

as shown in figure 3.12. Then, weight in wet soil and put it the oven under 110 degree Celsius, and calculate the moisture content the next day. Lastly, calculate the plastic index and liquid limit of the sample, if the plastic index exceeds 55% and liquid limit exceeds 80% the soil will considered as unstable material soil as per JKR standard not suitable to be use as embankment soil. The tested soil sample for the project however passed the test as the liquid limit and plastic index are 38.0% and 16.2% respectively as shown in figure 3.15.

Figure 3.12 Atterberg limit test



Description : Brown Sandy Silt
Material Type / USCS :Soil
NATURAL MOISTURE CONTENT : 17.9 %

DETERMINATION OF PLASTIC LIMITS

Test No .	1	2
Container No	3	26
Mass of wet soil + container , m1 (gms)	22.30	21.30
Mass of dry soil + container , m2 (gms)	21.40	20.50
Mass of container , m3 (gms)	17.30	16.80
Mass of moisture, m4 = (m1 - m2) (gms)	0.90	0.80
Mass of dry soil, m5= (m2 - m3) (gms)	4.10	3.70
Moisture Content (m4 / m5 *100)(%)	21.95	21.62
Average moisture content (%)	21.8	

DETERMINATION OF LIQUID LIMITS

Test No .	1	2	3	4
Number of Blows	10	21	30	40
Container No	17	5	2	37
Mass of wet soil + container , m1 (gms)	29.40	31.70	23.50	27.70
Mass of dry soil + container , m2 (gms)	25.70	27.80	21.55	25.00
Mass of container , m3 (gms)	17.00	17.90	16.20	17.00
Mass of moisture, (m1 - m2) = m4 (gms)	3.70	3.90	1.95	2.70
Mass of dry soil, (m2 - m3)= m5 (gms)	8.70	9.90	5.35	8.00
Moisture Content (m4 / m5 *100) (%)	42.5	39.4	36.4	33.8

Air dried / Oven Dried *

LIQUID LIMIT (LL) %	38.0
PLASTIC LIMIT(PL) : %	21.8
PLASTIC INDEX (PI) : %	16.2

Marks :
Ordinate:
Depth : 8.10 m

Figure 3.13 Atterberg limit test result

Source: DCS Consolidated Construction Sdn. Bhd.

3.2 On-Site Testing For Site Investigation

Some test has to be conduct on site to investigate the desired information. For the project particularly the on-site testing that is appointed to us were the mackintosh probe test and field density test. Each test are important and has its own purpose, which could influence the cost and material to be use for the proposed construction work. Each test could takes up several days depends on the numbers of point, weather condition and many other factor.

3.2.1 Mackintosh Probe Test

The purpose of the Mackintosh Probe test are to investigate the soil bearing capacity which information is important for the consultant for the designing and calculation process. The test also will determine whether the building of proposed construction will require piling or not.

The procedure of test starts with marking the penetration rod 30 cm lines as for the interval sign as the number of blow for the rod to penetrate into ground for every 30cm recorded. The interval marking is marked along the circumference of the penetration rod with permanent marker pen therefore it not easily erased and visible from every angle. The length of each penetration rod is 1 meter. After the rammer is attach to the top of the penetration rod, then placed it straight on the desired by point and raise the hammer to a certain level until a sound of ‘click’ is produce as shown in figure 3.14 and then drop the hammer with freely with no additional force. The authority determines the location of the point, which is the representative from JKR Perlis based on the condition of site, which are away from any water or electrical lines underground.

Figure 3.14 raising mackintosh probe hammer

Figure 3.15 conducted Mackintosh Probe Test

Figure 3.16 conducted Mackintosh Probe Test

The number of blow required for every 30 cm interval recorded and another penetration rod attached to the previous penetration until it reaches the hard layer of soil. If the rod does not penetrate into the ground after 400 blows, it is considered the rod has reaches the hard layer as shown in figure 3.17, then record the length of balance distance to the nearest 30 cm marking as shown in figure 3.15 and 3.16. In some cases, if the rod does not meet hard layer after maximum 15m of penetration rod is attach, the test will stop and it means that the building for the proposed construction site will require piling and soil investigation work is needed. The depth of the required piling will be determine by conducting the standard penetration test, (SPT). The test shares the same concept but using a machines and it can penetrate into the ground up to 30m.

MACKINTOSH PROBE TEST

Project : [redacted]

Position No.	MP-1	MP-2	MP-3
Depth (m)	No of Blows	No of Blows	No of Blows
0.0 - 0.3	68	52	58
0.3 - 0.6	155	35	21
0.6 - 0.9	83	20	14
0.9 - 1.2	90	26	84
1.2 - 1.5	68	48	75
1.5 - 1.8	17	110	115
1.8 - 2.1	84	75	125
2.1 - 2.4	66	33	187
2.4 - 2.7	30	52	76
2.7 - 3.0	76	93	81
3.0 - 3.3	102	29	99
3.3 - 3.6	218	108	111
3.6 - 3.9	310	133	92
3.9 - 4.2	326	120	51
4.2 - 4.5	400	131	117
4.5 - 4.8	/60mm	125	135
4.8 - 5.1		123	186
5.1 - 5.4		246	216
5.4 - 5.7		400	400
5.7 - 6.0		/80mm	/40mm
6.0 - 6.3			
6.3 - 6.6			
6.6 - 6.9			
6.9 - 7.2			
7.2 - 7.5			
7.5 - 7.8			
7.8 - 8.1			
8.1 - 8.4			
8.4 - 8.7			
8.7 - 9.0			
9.0 - 9.3			
9.3 - 9.6			
9.6 - 9.9			
9.9 - 10.2			
10.2 - 10.5			
10.5 - 10.8			
10.8 - 11.1			
11.1 - 11.4			
11.4 - 11.7			
11.7 - 12.0			
12.0 - 12.3			
12.3 - 12.6			
12.6 - 12.9			
12.9 - 13.2			
13.2 - 13.5			
13.5 - 13.8			
13.8 -14.1			
14.1 - 14.4			
14.4 - 14.7			
14.7 - 15.0			
Final Depth:	**4.56m**	**5.78m**	**5.74m**

Figure 3.17 Mackintosh Probe result

Source: DCS Consolidated Construction SDN. BHD.

3.2.2 Field Density Test

There are many methods of field density test, the one that offered by the company are the sand replacement method which are the most common method. The

purpose of this test are to investigate compaction level of soil, sand or crusher run at the proposed site location. The test is important as the compaction of soil influence the shear strength of soil, which affected the stability and bearing capacity of soil at the proposed location. The test conducted when the construction is at earthwork process or after the site clearance, which the ground is compacted using the roller and the test conducted at every level or layers of landfill to investigate the degree of compaction at each layer to determine whether the ground is compacted enough.

The procedure is simple as it starts with placing the metal plate on an even surface and starts digging until 6 inches as show in figure 3.18. The excavated soil collected in plastic bag and labelled to avoid any loss of moisture. Then, place the cylinder cone onto the plate and aligned it properly. Then pour the sand into the cone carefully as shown in figure 3.19, the size of sand used is the dry sand that passes 600-micron sieve and retained at 300-micron sieve. The sand is use as a constant, the remaining sand in the cone is collected, and the weight is compare with the excavated soil of respective point for a certain calculation.

Figure 3.18 FDT test

Figure 3.19 pouring sand into cone

The collected sample brought to the lab for further investigate which are moisture content and some calculation to investigate to degree of compaction of the collected sample at point location. To investigate to degree of compaction, the value maximum dry density and optimum dry density needed. However, to obtain the information of those data, the proctor or soil compaction test must be carry out on lab, therefore; approximately 15kg of soil must be brought to the lab for the test. The specific requirement set by the JKR is depends on the purposed construction work which for soil and sand, 90% for landfill or embankment and 95% for road construction. Meanwhile for crusher run is 95% regardless of proposed construction. For the project, which is done both for road around the proposed 'Kompleks' and for landfill, all the points passes test as the degree of compaction exceeds the specification requirement which is more than 100.8% averagely as shown in figure 3.20.

[redacted]			Customer	[redacted]	
			Rpt. No.		
			JobSheet No.		
			Date tested		
Section	Laboratory		Tested by		
Stage of Works /~~Layer~~	177.0		Opt. Moisture Content	14.0	
Depth excavated	150mm		max. Dry Density	1.756	
Type of material*	SOIL		Bulk density of Sand, $\rho_s = (m_s / V)$ kg/m³	1.317	
* pouring Cylinder	Small		* Color of Sand	White	*Delete as appropriate

Test Number		**P1**	**P2**	**P2**	**P2**
Chaninage / offset dist. from centreline					
Mass of wet soil from hole (m_w)	g	2094	2031	1860	2031
Mass of sand before pouring (m_1)	g	3000	3000	3000	3000
Mass of sand in cone (m_2)	g	406	406	406	406
mass of sand after pouring (m_4)	g	1232	1338	1420	1375
mass of sand in hole ($m_b = m_1 - m_4 - m_2$)	g	1362	1256	1174	1219
ratio (m_w / m_b)		1.537	1.617	1.584	1.666
Bulk density, $\rho = (m_w / m_b) \times \rho_s$	Mg/m³	**2.024**	**2.129**	**2.086**	**2.195**
Moisture content container no.		**P1**	**Z4**	**AT**	**P2**
mass of wet soil + Container (M2)	g	505.3	393.1	511.1	262.4
mass of dry soil + Container (M3)	g	457.5	359.8	464.0	242.8
Mass of container (M1)	g	125.3	95.7	122.5	101.4
Mass of moisture (M2 - M3)	g	47.8	33.3	47.1	19.6
Mass of dry soil (M3 - M1)	g	332.2	264.1	341.5	141.4
moisture content, w = (M2 - M3) / (M3 - M1) x 100	%	**14.4**	**12.6**	**13.8**	**13.9**
Dry density, $\rho_d = 100\rho / (100 + w)$	Mg/m³	**1.770**	**1.891**	**1.833**	**1.927**
Degree of compaction	%	**100.8**	**107.7**	**104.4**	**109.8**
Specification requirement	%	95	95	95	95

Figure 3.20 FDT test result

Source: DCS Consolidated Construction SDN. BHD.

3.3 The Problem and Solution at Site Regarding Site Investigation

Upon the experience of months in internship with the company, many challenges has been face in each test conducted on site. One of the common is when conducting the mackintosh probe test. The issues that always arise is lifting handle could not grip to the penetration rod as shown in figure 3.21 and the penetration rod is stuck into ground as strength of manpower is not enough to pull it out using the lifting handle.

Figure 3.21 gap in lifting handle

Hence, to solve the penetration rod is stuck into ground, as strength of manpower is not enough to pull it out using the lifting handle, one of the senior technician or now current company supervisors has created a modified jet as shown

in figure 3.21 and figure 3.22. The modified jet created from a pickup truck air jet used to lift heavy vehicles. The air jet modified to have a slot to place the lifting handle as shown in figure 3.23. Next up, to solve the second issue, which are, lifting handle could not grip to the penetration rod is by simply fill the gap with little rocks to increase the diameter so the lifting handle could grip to it. Another method is wrap the penetration rod with anything from the environment such as water host, leaves or else as shown in figure 3.23 to increase the diameter of the rod so the lifting handle could grip to it.

Figure 3.22 pulling out penetration rod using modified jet

Figure 3.23 wrapping penetration rod with water host

CHAPTER 4.0

CONCLUSION

As a conclusion, each test has its own purpose and each one are vital and must be carry out in stages of construction. To maintain the integrity of contractor and ensure safety in a long term the testing are required and the result of the test must meets the standard requirement by the authority or clients. Both test which are laboratory and on site test are important as each sets to investigate different information, which can be useful to know the condition and what is required at the construction site in order to carry out the proposed project.

The laboratory test are important as it more to soil investigation work which to understand the plasticity of soil and percentage of gravel, sand, silt and clay and many other information which could affect the cost of construction, material of construction such as the length of piling needed for proposed construction project. Meanwhile, on site testing such as field density test, and California bearing ratio are important as it helps to make sure the integrity of the contractor by making sure the compaction level of the soil, sand and crusher run at of the ground at the proposed construction site is compacted properly as it will affect the result of construction. Meanwhile the mackintosh probe test is investigate the soil bearing capacity of the soil which the result is important for the consultant for designing and calculation process which contribute to the cost of construction as if the hard layer soil at the proposed construction site meets at 15m deep into the ground it will require piling.

Upon carrying the test on site many problem has to come as nothing come close to perfect in this worlds, therefore many solution to many issue founded while carrying testing on site was discovered while undergo the internship process. The knowledge of solution the problem are not been taught theoricaly in classes as the solution discovered by experience and creativity of critical thinking such as how to pulled out the penetration rod out of the ground if the it stuck or else.

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