DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

WATER SUPPLY SYSTEM REPAIR WORKS

Prepared by :

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2019221058

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

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FEBRUARY 2022

It is recommended that the report of this practical training provided

By

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WATER SUPPLY SYSTEM REPAIR WORKS

Accepted as a partial fulfilment of a prerequisite for Diploma in Building

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STUDENT DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for whch the original references stated herein, prepared during a practical training session that I underwent at GLOBAL ETIKA JAYA SDN BHD for 20 weeks starting from 23th August 2021 and ended on 7th January 2022. It is submitted as one of the requirements of BGN 310 and accepted as a partial fulfillment of a prerequisite for Diploma in Building.

……..

Name	: HARIZ ZUHAIR BIN HALIM SHAH
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Date	:

ACKNOWLEDGEMENT

Hello and Assalamualaikum,

First and foremost, I cannot express enough thanks to my fellow work partners for their guidance, support and encouragement. It is a pleasure to have this learning opportunity at Global Etika Jaya Sdn Bhd for 20 weeks, it is very spectacular and remarkable. Therefore, I considered myself as a very lucky person as I was sprinkled with an opportunity to be a part of it. On the other hand, a debt of gratitude is also owed to Mr. Hasli bin Muhammad, my respective Boss for this outrageous opportunity and enlightenment towards the work given and the path that I might went in the future. He also who in spite of being extraordinarily busy with his duties, took time out to hear, advice, guide and keep me on the right path that allow me to carry out my project at their esteemed organization and extending during the training.

Moreover, I would like to express appreciation to Mrs. Nadia Izzatul Akmal binti Mohammad Isa for counsel me throughout the training by share with me her ideas, information and sprinkled me with her tips in this construction business and path, It is gainful and I considered it as valuable information that gain throughout the training. It is my honor to be given the opportunity to work here and to meet new people that beneficial to me.

Last but not least, I also would like to thank all the UiTM lectures that have taught and instructed me during my studies. Especially, Ts En Mohd Fareh bin Majid, Supervising Lecturer, Pm Ts Sr Dr Hayroman bin Ahmad, Evalution Lecturer, En Muhammd Naim bin Mahyuddin, Practical Training Coordinator and Dr Dzulkarnaen bin Ismail, Program Coordinator, I value the time, effort, encouragement and tips that they have contributed towards the successful completion of my training, this report and the valuable knowledge that have been shared over the last few semesters, Thank you.

ABSTRACT

Water Supply System is a very complex topic to elaborate, Therefore, this report will discuss about Water Supply System Repair Work based on my Company, Global Etika Jaya Sdn Bhd Site Report and Files that involved in this project which is Kerja-Kerja Pembaikan Sistem Bekalan Air di Sekolah Za'aba, Kuala Pilah, Negeri Sembilan D.K. The Objective of this report is to identify the soil condition for a safe piling construction that provide a foundation for the water tank and also will explain the installation of the piling system chosen according to the soil condition which it is one of the procedure of this project. The method will be using is installation of Micro pile which we will discuss in the report. This report will also look at the determination of the method will be using for construct of water tank.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

Water Supply System Repair Works is one of the crucial part of Development whether it is in city nor rural. Of all municipal services, provision of potable water is perhaps the most vital. People depend on water for drinking, cooking, washing, carrying away wastes, and other domestic needs. (Jerry A. Nathanson, 2010). One of the main thing that play it part is Distribution system where The basic function of a water distribution system is to transport the water from the treatment facility to the customer. In addition, distribution systems may also provide storage, as well as provide flow and pressure adequate for fire protection. (Alaska Department of Environmental Conservation, 2022) There is a lot of type of water tank there are for the Distribution System which is few of them is Overhead Tank, Elevated Water Tank, Septic Tank and Suction Tank. The difference of these all kind of tank is capacity and the type of the tank, where in this report I will discuss about Elevated Water Tank and Suction Tank. The advantages of tank chosen which is, Elevated Water Tank is an elevated water tank is basically referred to as a water storage tank elevated above the roof of a building and is constructed at a height sufficient to pressurize a water distribution system. (Ironcon (M) Sdn Bhd, 2022) which this is the perfect fit with my project that I referred which is Kerja-Kerja Pembaikan Sistem Bekalan Air di Sekolah Za'aba, Kuala Pilah, Negeri Sembilan D.K. and where Suction Tank is a tank that is maintained at low internal pressure, i.e., a partial vacuum that is less than the atmospheric pressure. It is to serve the function of a reservoir to provide a vacuum source to those instruments that need a low-pressure source to function. (Nearby Engineers, 2021)

Meanwhile, to deeply understand how does water supply system repair works be construct or build, to be more specific is to learn how to making soil test before constructing piles

that will eventually will be having foundation underneath it. In addition, in this report will also I will explain the method statement for installation of pile that will be chosen according to the soil condition and the safest pile that will be using. The reason to select which pile that will be used is because it need to be considerate in choosing pile like be sufficiently important to influence this choice very materially, if not decisively, as for instance, the type of structure, whether temporary or permanent, whether located upon leased or owned ground, the structural loadings and other design requirements, existing foreign underground structures and utilities, air and underground rights, the possible future development of adjoining properties and consequent need of protecting your foundation against subsidence that might result from eventual nearby construction, the possible need of similar protection to existing structures against your own building activities, the working space available and means of access, danger of earthquakes exposure to and protection against high water, financial limitation and time limit. (A. M. Bouillon, 1934). Besides, choosing type of water tank also will make a big decision for the safety of people around there, how useful, durable, and strong it is when mother nature things happen all of the sudden, so the performance of elevated water tanks during earthquakes is of much interest to engineers, not only because of the importance of these tanks in controlling fires, but also because the simple structure of an elevated tank is relatively easy to analyze and hence, the study of tanks can be informative as to the behavior of structures during earthquakes. If a closed tank is completely full or completely empty, it is essentially a one-mass structure, If, as is usual, the tank has free water surface there will be sloshing of the water during an earthquake and this makes the tank essentially a two-mass structure. Therefore, an understanding of the earthquake damage, or survival, of elevated water tank requires and understanding of the dynamic forces associated with the sloshing water. (Bulletin of the Seismological Society of America ,1963)

There are many reason of choosing type of piles and water tank in theoretically. However, this report is aiming for water supply system repair works.

1.2 Objective

1. To identify the soil condition for a safe piling construction that provide a foundation for the water tank.
2. To explain the installation of the piling system chosen according to the soil condition.
3. To determine the method of construction of water tank.

1.3 Scope of Study

This study carried out at Sekolah Menengah Kebangsaan Za'aba at Kuala Pilah, Negeri Sembilan D.K. at it is focusing on Method for installation of Micro pile where it is intended to describe the technical procedures that will be adopted during of the execution of the installation of Micro Pile and the material that been used is Ordinary Portland Cement or equivalent, Reinforcement Bar T16 and Helical Link R8. The plant and Machinery that been used in this studies is Drilling Rig which to drill or bore hole for micro pile installation, Grout Mixing which is to prepare and mix cement grout, Grout Pump is where to pump and grout micro pile from grouting plant, Air Compressor is to run high pressure operated hammer and air flush drilled materials and lastly is Water Pump which it is to supply water or for wash boring. This Project which is Kerja-Kerja Pembaikan Sistem Bekalan Air di Sekolah Menengah Kebangsaan Za'aba Kuala Pilah is costed around RM1,699,800.00 where the Payment have been made by date to date and which this Project's quantity of labors is 6 labors.

The objective of this study are to identify the soil condition for a safe piling construction that provide a foundation for water tank which they start to do soil

investigation every day before they start to digging, Site investigation is the process by which geological, geotechnical, and other relevant information

which might affect the construction or performance of a civil engineering or building project is acquired. Soil and rock are created by many processes out of a wide variety of materials. Because deposition is irregular, soils and rocks are notoriously variable, and often have properties which are undesirable from the point of view of a proposed structure. Unfortunately, the decision to develop a particular site cannot often be made on the basis of its complete suitability from the engineering viewpoint; geotechnical problems therefore occur and require geotechnical parameters for their solution. Site investigation will often be carried out by specialists in the field of soil mechanics. Soil, in the engineering sense, is the relatively soft and uncemented material which overlies the rock of the outer part of the Earth's crust. Specialists in the mechanical behaviour of soil are normally civil engineers and in the UK they will often have some postgraduate geotechnical education: such people are termed 'soils engineers' or 'geotechnical engineers'. Geologists with an interest in the relevance of geology to civil engineering or building construction are called 'engineering geologists'. Next is to explain the installation of the piling system chosen according to the soil condition which they chosen the right specific type of pile which is Micro Pile where it is very suitable for this kind of project because it is the usual type when any project held regarding Elevated Water Tank. Lastly, to Determine the method of construct the water tank. In which, they chose Elevated Water Tank and Suction Tank which the capacity of the elevated water tank is 70,000 Gallons and Suction tank is 24,000 Gallons. In, Conclusion, all further explanation relating the above method were explained as below.

1.4 Method of Study

- Observation

The observation is a way of collecting data through observing. The observation is about to identify the soil condition for a safe piling construction that provide a foundation for the water tank. The average time taken for this observation approximately around 1-2 hours but only for Soil investigation test where the more test been held, the longer it takes to proceed with the digging. Overall, it took 3-4 weeks for the soil investigation test. Meanwhile, for the installation of micro pile usually it takes 10-12 days to make 1 pile because it requires skill and need to be done. This make it took around 3-4 weeks to complete all the finishes process. The observation of the wall construction process had been recorded by smartphone and some notes that lasted for 20 weeks.

- Interviews

The interview is one of the method to collect the construction data by doing the structured or semi structured interview with the trusted person for the project. The have been done while doing the observation and while doing the work at the site. I made an interview with the Project Engineer of this project, where he explained to me more deeply and made me understand the flow of work and how they execute it because we cannot understand the project while referring on only our observation and document review, This interview made me more keen to understand the process of the objective that I have chosen.

- Document Reviews

The documents review that have been used to collect all the data for the construction is company profile, construction drawing, standard operating procedures (SOP), progress report and the pictures that taken by other workers. Especially the drawing plan because we can see more thing the drawing and this document review took me about 2-3 hours in a week to collect all the information I needed.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Figure 1 Company Logo

Our Company has been established on 10th November 2005. Previously known as Glokal Etika Jaya Sdn. Bhd., Our Company been registered as Contractor Class G7 that carry out Civil, Mechanical and Electrical Works. Throughout this millennium era, We are very committed and productive to serve in the construction area with full commitments from all staffs and qualified technical officer.

Ever since been established, we have completed lots of projects from government and private sector such as DBKL, PNB, FELDA, FGV, IWK and many more.

With perseverance and persistence, we are determined to achieve the goals of becoming a successful company and in line with other Bumiputera companies to create a GLOBAL, ETHICS and a SUCCESSFUL company. Global Etika Jaya Sdn Bhd always take proactive measures to provide the best quality of service to all.

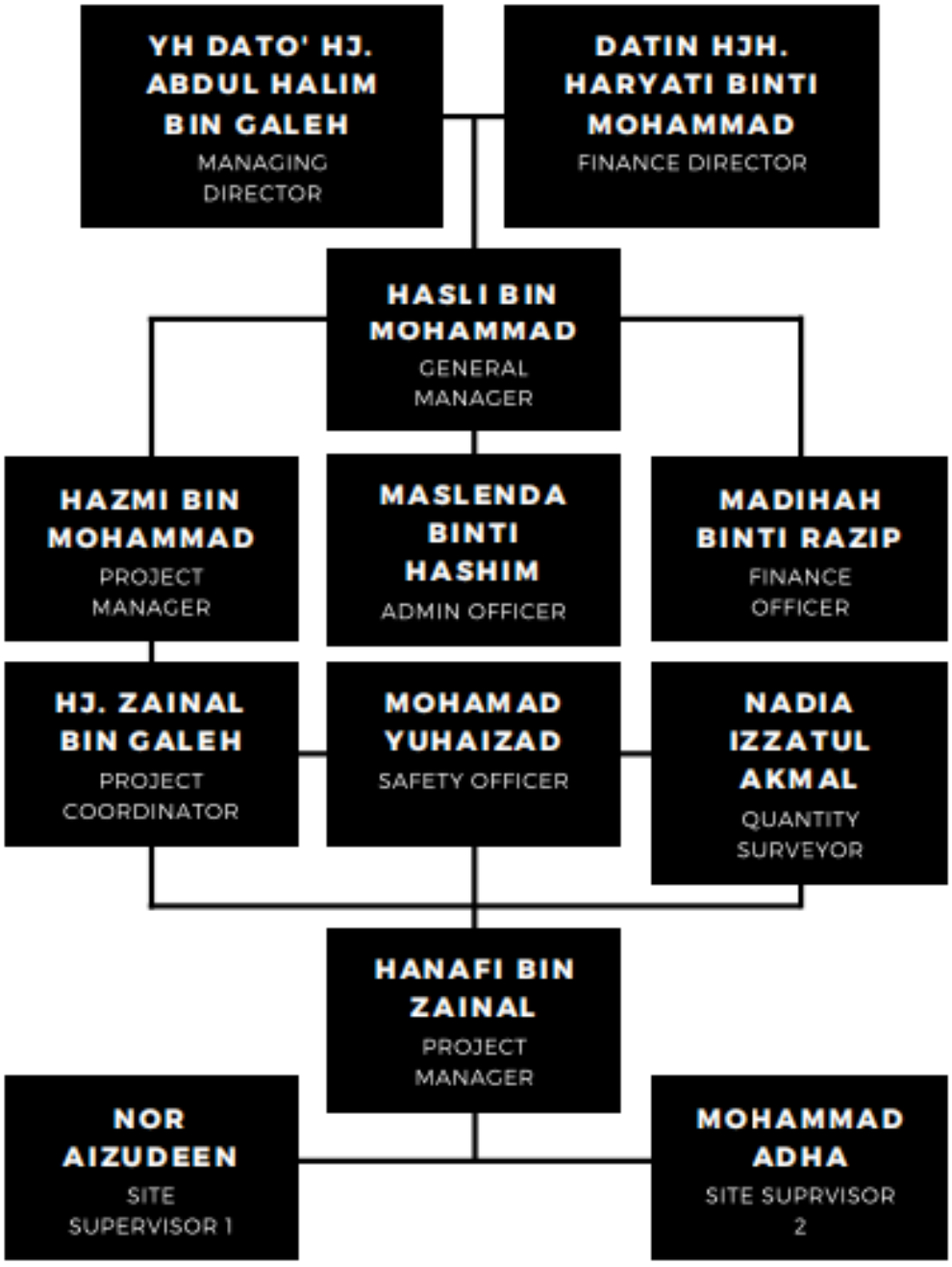
Figure 2 Location of Global Etika Jaya

2.2 Company Profile

COMPANY	: GLOBAL ETIKA JAYA SDN. BHD.
REGISTRATION NUMBER	: 714617-T
COMPANY ADDRESS	: PT 12999, Jalan BBN 1/7D, Putra Indah, Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan D.K.
BRANCH ADDRESS	: 13A – 23, Level 14, Plaza Azalea, Persiaran Bandar, Seksyen 14, 40000 Shah Alam, Selangor Darul Ehsan.
EMAIL	: g_ejaya@yahoo.com : globaletikajaya@gmail.com
PHONE NUMBER	: 06-850 7575/ 06-850 7574/ 019-757 5950
FAX NUMBER	: 06-850 7576
ESTABLISHED DATE	: 10TH NOVEMBER 2005
CIDB REGISTRATION NUMBER	: 0120090626-NS124350
TARAF	: BUMIPUTERA

COMPANY ORGANIZATION CHART

Table 1 Organization Chart



Source 1 : Global Etika Jaya Company Profile

LIST OF PROJECTS

Table 2 Completed Project

BIL	CONTRACT NAME	CONTRACT VALUE	CLIENT
1.	Cadangan Menyiapkan Kerja Tanah dan Infrastruktur yang berkaitan di Sebahagian Seksyen 9, Kota Puteri (Fasa 1) (Road&Drainage)	4,472,990.00	PI Brilliant Berhad
2.	Cadangan Meroboh 2 Blok Bangunan Sedia Ada dan Membina Semula Bangunan Pejabat Baru 2 Tingkat di Jabatan Pengangkutan Jalan (JPJ) Cawangan Muar, Johor.	5,830,000.00	JKR
3.	Cadangan Membina dan Menyiapkan Kerja-Kerja Tanah, Infrastruktur serta lain-lain Kerja yang berkaitan di Sebahagian Kawasan Perindustrian Elkay Fasa II dan Fasa III, Mukim Lipat Kajang, Daerah Jasin, Melaka.	22,000,000.00	SATRIA MARA SDN BHD
4.	Cadangan Kerja-Kerja Merobohkan 4 Blok Bangunan serta lain-lain Kerja berkaitan di Kolej Keris Mas, UKM, Bangi, Selangor.	4,452,000.00	UKM-KEP Contracting Sdn Bhd (Main-Con)
5.	Cadangan Membina, Menyiapkan dan Mentauliah Muka Sauk, Loji Rawatan Air Paip Mentah dan Terawat serta Kerja-Kerja berkaitan di Buluh Kasap, Segamat, Johor.	16,000,000.00	SATRIA MARA SDN BHD

6.	Membekal, Membina, Menguji dan Mentauliah Sebuah Loji Rawatan Air Konvensional DA Compact Berkapasiti 4JLH serta Muka Sauk dan Kerja-Kerja berkaitan di dalam Kawan Loji Air Lubuk Merbau, Daerah Padang Terap, Kedah Darul Aman.	10,899,586.90	FELDA TEKNIK PADU BINA SDN BHD
7.	Enhancement Works for Buffer Zone (JKR & KTM), Center Median, Pylon Signage, Road Widening at Phase 3A & Road Upgrading at Indah Point, Taman Perindustrian Pulau Indah, Mukim Klang, Daerah Klang, Selangor Darul Ehsan.	12,433,385.00	Central Spectrum (M) Sdn Bhd

Source 2 Global Etika Jaya Company Profile

Table 3 Projects in Progress

BIL	CONTRACT NAME	CONTRACT VALUE	CLIENT
1.	Proposed Pipe Replacement Program in Selangorm W.P. Kuala Lumpur and Putrajaya for year 2017/18 (Continuation for Completion of the Project) (Package 10 : Gombak and Hulu Selangor)	17,471,957.00	PENGURUSAN AIR SELANGOR
2.	Pakej 77 – Membina, Memasang dan Mentauliah Laluan Paip Air Jenis Keluli Lembut (MSCL) bergaris Pusat Nominal 400mm, 200mm, 150mm dan Tangki Sedutan, Peralatan Mekanikal dan Elektrikal, Rumah Pam Penggalak Felda Bukit Tembaga serta Kerja-Kerja berkaitan di Felda Sungai Tiang, Felda Lubuk Merbau dan Felda bukit Tembaga, Daerah Kuala Nerang, Kedah Darul Aman.	6,424,563.83	FELDA – KEP Contracting Sdn Bhd (Main-Con)
3.	Membekal dan Menghantar 140 ekor Lembu Jantan Baka Kacukan ke Projek Gedung Makanan Negara (GMN) di Ladang Satelit Kg. Londah Negeri Sembilan D.K.	180,500.00	FELDA
4.	Membekal dan Menghantar Perabot Pejabat di Rancangan Felda Wilayah Raja Alias, 72120, Bandar Seri Jempol, Negeri Sembilan D.K.	517,916.00	FELDA

Source 3 Global Etika Jaya Company Profile

CHAPTER 3.0

CASE STUDY

3.1 Introduction to Case Study

The case study is about Water Supply System Repair Works. The project where has started the construction in 3rd October 2016 and the project ended or completed on 13th August 2017. The cost of construction approximately One Million Six Hundred Ninety-Nine Thousand Eight Hundred Ringgit Malaysia (RM1,699,800.00). This project has ended years ago but my supervisor recommended me to choose this case study for the report. Thus, this report will be explained not only regarding installation but including the machinery and tools, the time that have been carry out and the problem and solution of the construction. Nevertheless, the study do not concentrate on cost matters and manpower. The site location took place at the Sekolah Menengah Kebangsaan Za'aba Kuala Pilah, Negeri Sembilan D.K.

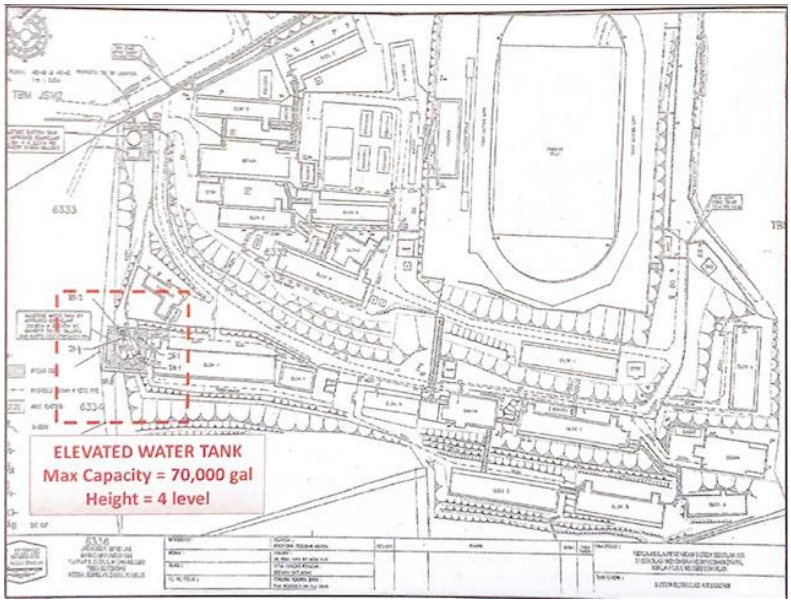


Figure 3 Location of site based on Drawing Plan

Source 4 : Final Report SMK Za'aba Project Document Files

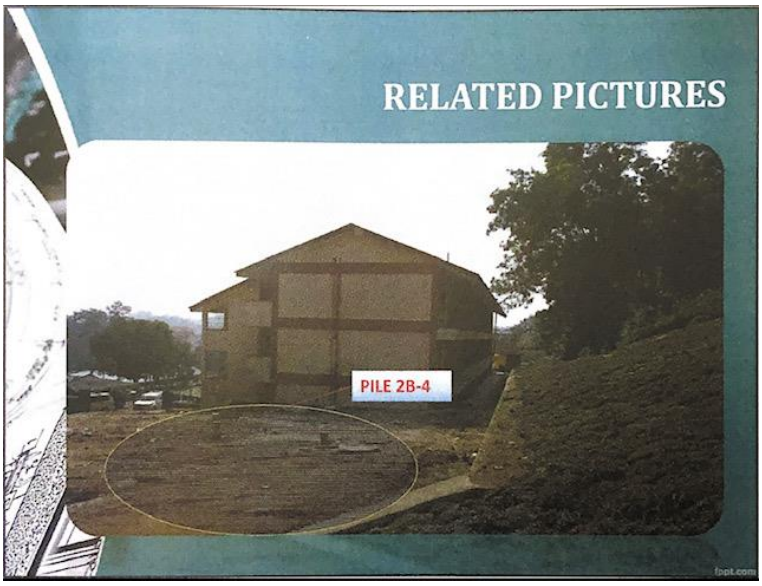


Figure 4 Exact Location of the Project

The Project Construction Located at Sekolah Menengah Za'aba Kuala Pilah, Negeri Sembilan D.K. . This construction area is located at South West of the school and it is fair from actual student's activities. The Boy's Room is the nearest building from the site. There are several existing building around the site but it is safe from student's activities.

The activities that have been carry out on the site is Water Supply System repair Works which this project executed perfectly far from student, the site is closed by temporary gate where only people that involved in this project is allowed and the machineries and tools are safe placed far from students. The machineries and tools that been used is Drilling Rig, Grout Mixing Machine, Grout Pump, Air Compressor and Water Pump.

Last but not least, the problems of Water Supply System Repair Works process will be determined throughout the construction process. The solution of the problems also will be state after determine the problem of the process. This chapter will be focused on to identify the soil condition for safe piling, method installation of Micro Pile and Method of construction of water tank.

3.2 To identify the soil condition for a safe piling construction that provide a foundation for the water tank.

Studies of Soils Which Are Pertinent to Engineering Usage Are Being Carried Out in Various Disciplines. The Methods of Study Have Similarities, And There Is Interdisciplinary Interest in This Work, With The Contributions from One Field Being Used in Another. The Relationship of Soil Mechanics to Other Disciplines Is Found Especially on The Recent Widespread Interest in The Behavior if Clay Soils. It Is in Its Treatment of Clays That This Book Differs Most from Others in Its Field. The Behavior of Clays Is Quite Different from That of Granular Soils. Recent Advances in Quantitative Colloid Chemistry and Mineralogy Are Now Being Applied to The Study of Clays and A Body of Information Is Being Built Up. This Material Is Presented in on Easily Available Form. The Book Has Been Written Primarily as an Introductory Text On Soil Behavior for Students Taking Soil Mechanics Courses, For Research Workers in Soils, and for Practicing Engineers Who Require a More Detailed Knowledge of Soil Properties. Some Aspects of Soil Properties and Methods of Investigation Which Would Be Covered in an Elementary Course in Soil Mechanics or Soil Engineering Have Been Included to Provide for Completeness In The Treatment Of Soil Behavior, And Also To Provide For Continuity. While Applications Are Not Omitted, The Explanation of Soil Behavior Is Emphasized Rather Than Study of Soil as A Material for A Particular Application.

Moreover, Studies in soil dynamics have made unique contributions to the understanding of soil behavior for small, nearly elastic, strains, while studies in soil statics have shed light on the plastic behavior and strength of soils. This paper attempts to synthesize information from soil dynamics and statics into a comprehensive three- dimensional effective stress-strain relation for soils, that will apply to static and dynamic, single or cyclic loadings of cohesionless or cohesive soils, accounting for inherent and stress induced anisotropy. A set of equations is presented that provide the general framework. Many of the details have been worked out, but others require further investigation. Some of the interrelationships between stress-dilatancy, critical state soil mechanics, work-hardening plasticilty,

empirical equations for modulus and the hyperbolic stress-strain relation are demonstrated. Although an effective stress-strain relation is formulated, it is believed that it will ultimately be applied to undrained and partially drained soils. It is believed that the ultimate solution to these problems lies in effective stress analysis. Of course, this does not diminish the importance of undrained strength analyses to current practice.

3.3 To explain the installation of the piling system chosen according to the soil condition.

The method statement is intended to describe the technical procedures that will be adopted during execution of the installation of micro pile. For the start, the material that been used are Ordinary Portland cement or equivalent and the reason they chose Ordinary Portland cement is because have been examined by analytical transmission electron microscopy (TEM) and electron microprobe analysis (EMPA). The stability of the various hydrate phases in the electron microscope is discussed. Although all are subject to damage in varying degrees, even the least stable phase, AFt, can be recognized in relict form in the TEM. The basic framework of the microstructure and the differentiation into inner and outer hydration product are well-established at 24 h hydration and the next one is Reinforcement Bar T16 and Helical Link R8. The plant and Machinery are Drilling Rig is to drill or bore hole for micro pile installation, Grout Mixing Machine is to prepare and mix cement grout, Grout Pump is to pump and grout Micro Pile from grouting plant, Air Compressor is to run high pressure operated hammer and air flush drilled materials and lastly, Water Pump is to supply water or for wash boring.

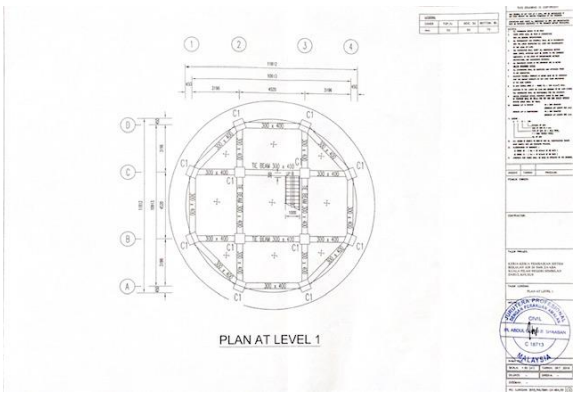


Figure 5 Plan at Level 1

Next, the method of drilling generally there are 3 method of drilling for micro-piling works and the selection of the drilling method is subjected to the actual sub-soil condition, which in nature is non-homogeneous in term of type, physical and mechanical properties from one location to another location. The drilling method may be combination of these 3 method, which is subjected to the complexity of the soil/rock condition. Firstly, Drag Bit

which is end of casing or drilled rod mounted with cutting bit, if drilled in rock will attach with tungsten carbide (Roller Bit). Next is DTH Hammer which is Down-The-Hole hammer is operated by high air pressure and the last one is ODEX Hammer is overburden drilling system with eccentric reamer for drilling follow with permanent casing as per design requirement and for Medium of Drilling is wash boring and air flush.

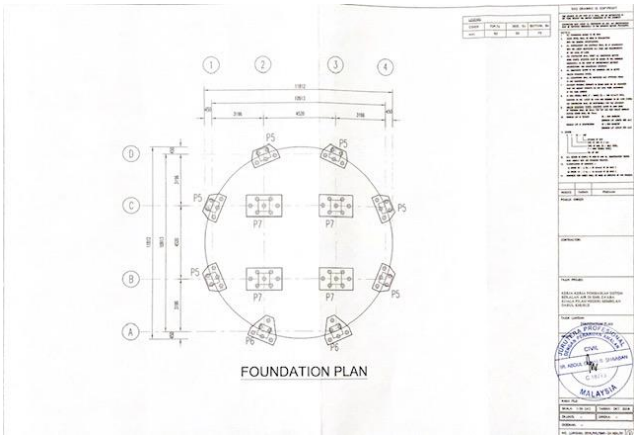


Figure 6 Foundation Plan

In addition, step of boring process is :

1) Mobilize the drilling machine to the Micro-Pile position.
2) Set up the drilling rig directly above the pile point.
3) Check the verticality of the leader or casing prior to drilling by using spirit level.

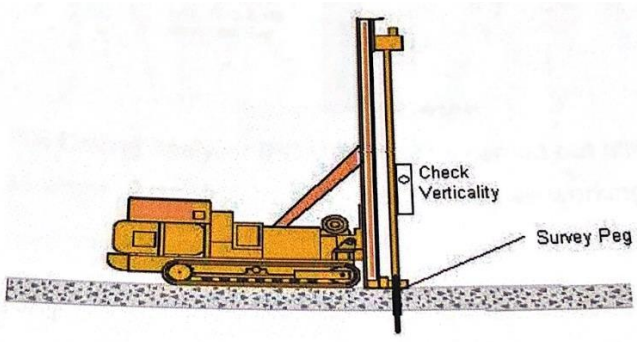


Figure 7 Checking the Verticality

4) Roller bit mounted to drilling rod to be used for drilling pile hole.
5) To drill until the desired depth.

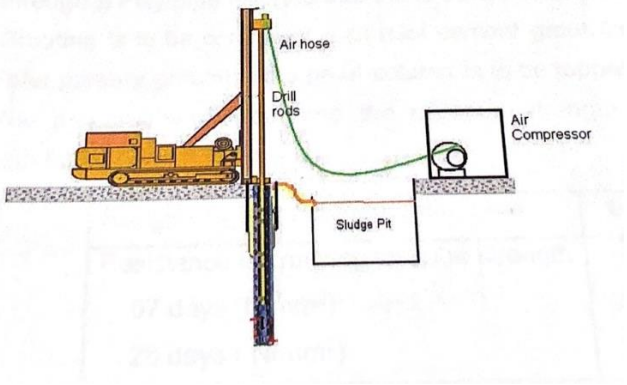


Figure 8 Drilling

6) Install 3T16 with R8 spiral link.
7) Pump cements grout into the borehole through grout pipe until fresh grout overflow. Grounting is done by tremie method.

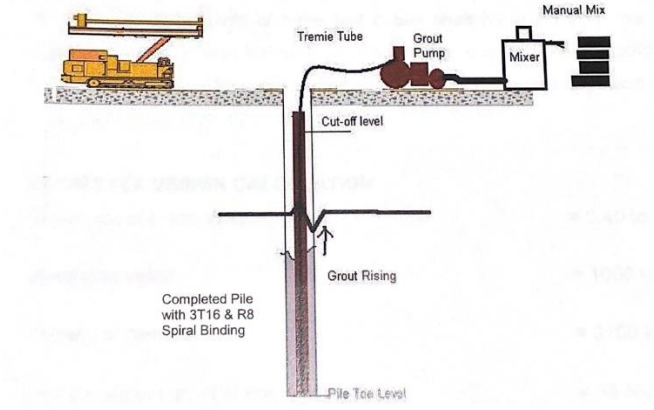


Figure 9 Cement Pumping

8) Pile Driving Ananlyzer (PDA) test will be carried out after cube test achieve strength of 35N/mm2. Test shall be carried out to 2 times working load of 200kN.

3.4 To determine the method of construction of water tank.

This research aims to investigate the feasibility of using ambient vibration testing for system identification of an elevated water tank. To identify the natural dynamic properties, the experimental study is carried out on an elevated steel water tank located in Tehran. The tank is instrumented with a sensitive velocimeter sensor (microtremor), and the ambient velocity of the tank is recorded for 30min in three orthogonal axes. Employing the peak-picking method in the frequency domain, the fundamental frequency of the tank is determined as about 1.9Hz. Then, the numerical model of the tank is generated and calibrated based on the obtained data. In the primary modeling, the values of natural frequencies of the tank are in good agreement with the results of the ambient vibration data. This finding is judged to be reasonable considering no clear sign of corrosion in the steel material.

Elevated concrete water tanks are mainly used for water supply and fire protection. One of the major problems that may lead to failure of these structures is earthquakes. Therefore, the analysis of elevated tank must be carefully performed, so that safety can be assured when earthquake occurs and the tanks remain functional even after earthquake. The irregular shape of the elevated water tanks for which most of the mass confluent in the upper part of the tank makes it more sensitive to any dynamic load, especially due to an earthquake.

Elevated water tank can be simulated based on SDOF, 2DOF or FEM, which governed by one mode, two modes, or more respectively. It is widely recognized that these analysis are not always the appropriate approach for simulating response of structures subjected to seismic excitation. The estimation of damages made using this approach is normally poor (Hamburger, 1996). The response of elevated water tank when dynamic effects are considered is deeply dependent upon the soil deformability and liquid characteristics (Somnath, et al., 2004; Livaoglua, and Dogangu, 2006; Livaoglua and Dogangu, 2007; Halil et al., 2008). Therefore, interaction between tank foundation and liquid should be accounted in the analysis of these structures. Previous studies on the seismic behavior of

elevated water tanks were only focusing on the linear seismic response, therefore in this paper investigation on the behaviors of elevated water tanks based on nonlinear dynamic analysis is presented.

Due to the lack of real seismic excitations recorded at the site that need to be considered in this study, an artificial seismic excitation has been generated which is compatible with local response spectrum at the bedrock. The local site effects are estimated based one nonlinear one dimensional approach.

CHAPTER 4.0

CONCLUSION

The Water Supply System are important to any building there are to create a suitable and hygiene for the residents of the building or places as well as providing clean water. The water supply system method was started from plan out drawing, projects and all. The process is quite complicated to understand for a new person who is not from construction path.

The process might take a while from the other because it need to be the right thing such as the type, last long, and the material which it need to be neat from the start to the end to avoid any accident happen. for a complex water supply system by considering major difficulties posed by a complicated tariff; especially demand charges, discrete pump discharges, and other physical constraints. The model decomposes in space and time the system into several subsystems, and planning periods into operational periods. Progressive optimality is applied to solve a dynamic programming model. The pump discharges are discretized and arranged by heuristic methods in order to reduce the number of times pumps are switched on. In real-time operation, billing monthly demand is estimated by a long-term model and then incorporated in a short-term model to obtain an optimal daily schedule in a relatively short computational time. Application is made to the city of Pittsburgh's water supply system. To implement the model in making operational decisions, a computer software package is also coded. A simulation run on part of the system in a test year shows that the optimal solution could have saved 20% of the actual cost.

Lastly, the water supply system is one of the important aspects of the building especially for sanitary and hygiene. It is our study shows that this approach is a useful tool in water supply system design that prevents system failure at a certain level of risk.

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