DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

TOWER FOOTING STABILIZER WORKS

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

JULY 2020

It is recommended that the report of this practical training provided

By

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entitled

TOWER FOOTING STABILIZER WORKS

Be accepted in partial fulfilment of requirement has for obtaining 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 stated here in, prepared during a practical training session that I underwent at Semarak Geo Enterprise for duration of 14 weeks starting from 27 September and ended on 7th January 2021. 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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Thank you so much.

ABSTRACT

Soil nailing is a construction technique that allows for the safe over-steepening of new or existing soil slopes as a restorative solution to address unstable natural soil slopes. This report was conducted for the soil treatment at Tower 150 & 155 TNB cable 275Kv TPAH-UJLI. The objective of this report is to tell about soil nailing and how far soil nailing can safe every TNB`s tower from falling down.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

Soil nailing is a construction technique that allows for the safe over-steepening of new or existing soil slopes as a restorative solution to address unstable natural soil slopes. The main considerations for deciding whether soil nailing will be appropriate include the ground conditions, the suitability of other systems, such as ground anchors, geosynthetic materials, and so on and cost. The stability of the slope is increased with the installation of steel or glass fiber threaded soil nails placed into pre-bored holes or simultaneous drilling and installation techniques.

There are many types of soil nailing techniques such as drilled and grouted soil nailing method. In this type of soil nailing methods, the holes are drilled in walls or slope face. Second, driven soil nailing method.in this method, it is used for temporary stabilization of soil slopes and driven soil nailing method is considerably fast. Third, self-drilling soil nailing method. Hollow bars are used in self driven soil nailing method. Bars are drilled into the slope surface. Grout injected simultaneously during the drilling process. Fourth is jet grouted soil nailing method. In jet grouted soil nailing method, jets are used for eroding the soil for creating holes in the slope surface. Lastly, launched soil nail method. In this method of soil nailing, the steel bars are forced into the soil with a single shot using compressed air mechanism.

Advantages associated with soil nailing fall into three main categories, construction, performance, and cost. When compared to other building techniques such as drilled shafts or soldier pile walls, which need relatively heavy equipment, soil nail walls are less disruptive to traffic and have a lower environmental impact. When obstacles like as stones, piles, or subsurface utilities are encountered, simple modifications to nail inclination and position can be made. Corrections to the horizontal position and orientation of ground anchors, on the other hand, frequently necessitate changes to the soldier pile layout or the insertion of waler beams, making field adjustments costly. The installation of a soil nail wall is not constrained by overhead restrictions as much as the installation of soldier piles is. This benefit is especially valuable when work is being done beneath a bridge.

Because smaller equipment is more easily deployed, soil nailing may be more cost-effective at remote sites. In conclusion, there are many types of soil nailing, however, the aim of this is to discover the drilled and grouted soil nailing method for this project.

1.2 Objectives

The objectives of this study are:

i) To investigate the scope of works for soil nailing works such as preliminaries items, slope remedial works and drainage system.

ii) To investigate job safety analysis that used for this project.

iii) To determine the problems occurred during the operation of this project.

1.3 Scope of study

This study was carried out at Tower 150 & 155 TNB cable 275Kv TPAH-UJLI. This study focus on the scope of works for soil nailing. This is because several towers had experience soil erosion at the toe of tower`s area, which might impose negative impact to the rigidity ad stability of the tower`s foundation where one of the affected towers named as Tower 150 & Tower 155. Hence, immediate slope treatment is significantly crucial to prevent any mishap from happening. After that, there are job safety analysis that can be able to avoid all hazard at the project site. As example, during site clearing works, the hazard is workers will exposure to sharp part of tool and equipment. This project also used many equipment and machineries such as excavator, bulldozer, stagging, gunite machine and many more. In accordance with the failure severity, it is determined that the upper and lower slopes are largely critical that requires slope repair method designated to be soil nailing of 9m and 12m long of T25 steel bar, coupled with a gunite spray technique to cover the finishing slope surface.

1.4 Method of study

1.4.1 Observation

For this study, I had analyzed the data collected from observation when I was at site project almost 3 months. I had experienced all the real situation of working lifestyle at site project. In addition, from my observation soil nailing is the best choice for soil treatment. I also record the data by picture and video during my working time at site project.

1.4.2 Interview

I was interviewed my supervisor at site project when I don’t know anything about the work. Sometimes, I also ask my manager when he comes to the site. By conducting an interview, I will be able to obtain important information about a previous project that used the same strategy. The entire conversation was recorded on the phone and written down in the notepad.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Figure 2.1: Company Logo

Semarak Geo Enterprise (SGeo) is a bumiputera construction company registered with Construction Industries Development Board (CIDB), under grade G4. Semarak Geo is directly involved in geotechnical works and rectification of slope failure using various methods such as Soil Nailing, Guniting, Horizontal Drain, Reinforced Soil Slope, Retaining Wall, Rockfill, Micropile, Tieack RC Wall, Gabion, Rubber Wall, Stone Pitching and Erosion Protection Mat with Closed Turfing or Hydroseeding.

Semarak Geo client consist of Government Agencies (JKR, JPS, KDN), Local Authorities (MBSA, MPS, MPSJ, MPAJ), and GLC (TNB). On top of that, Semarak Geo also committed themselves with private sector like Pintas Utama Sdn Bhd, Belati Wangsa (M) Sdn Bhd and KL Engineerung Sdn Bhd as sub-contractor.

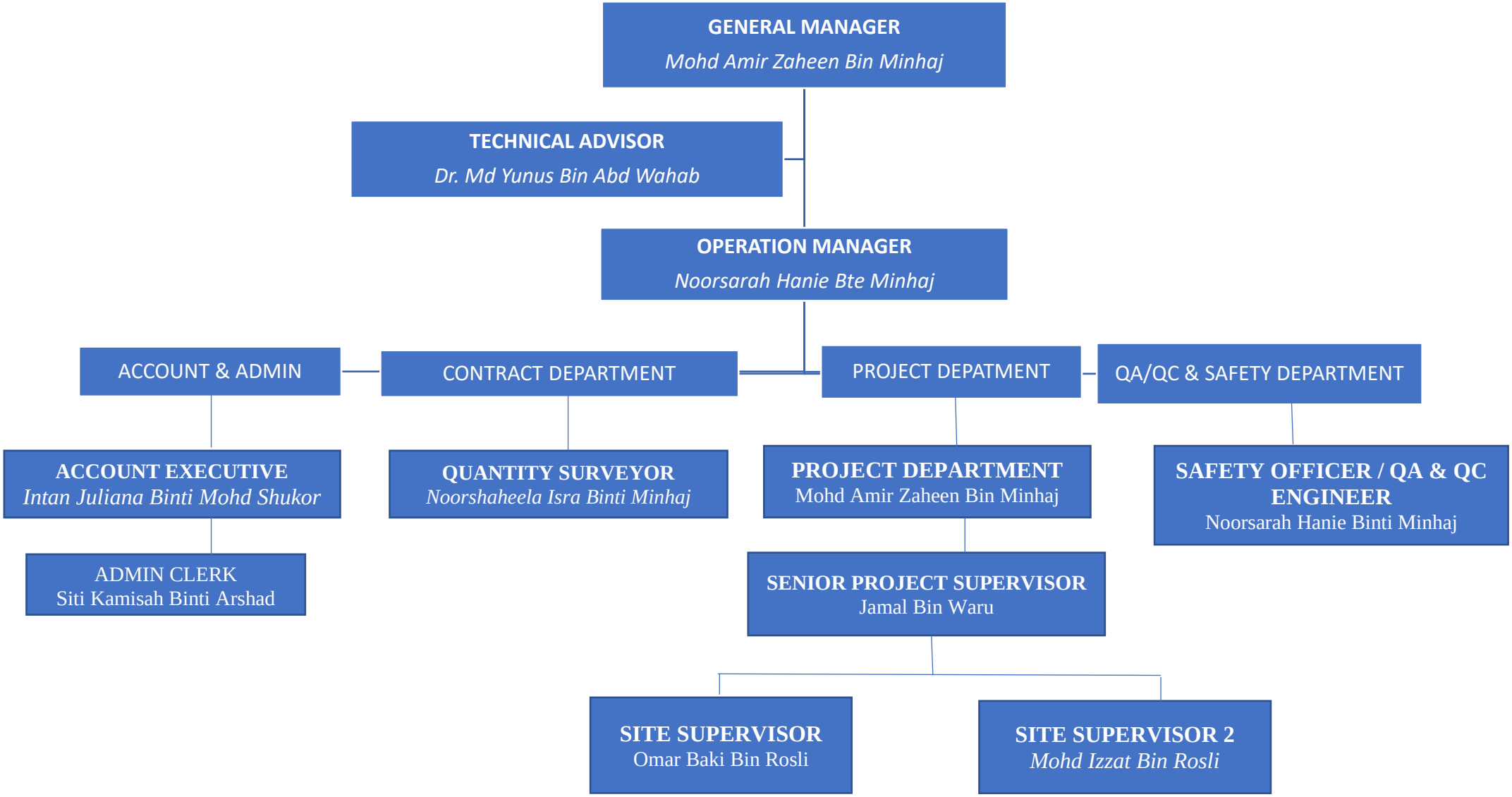
Semarak Geo capabilities are not only limited to open tender, they pride themselves in many of successful design and build project. Semarak Geo are made up of a group of capable professional civil engineers and very experienced site personnel that work together to propose the best solution to your slope problem. Semarak Geo is dedicated to provide the best solution for our clients in the competitive environment.

Figure 2.2: Location Map

2.2 Company Profiles

Company Name	: Semarak Geo Enterprise (SA0125765-T)
Company Address	: 16-1F, Jalan Boling Padang G 13/G, Seksyen 13 40100 Shah Alam Selangor Darul Ehsan.
Contact info	: Telephone: 03-55199593 : Fax: 0355119593 : Email: semarak.geo@gmail.com
Awards and Recognition	: Best Contractor Award 2021 by Malaysian Public Works Department (JKR) (INFRASTRUCTURE).
Company CIDB Grade	: G4 (Not exceeding 3 Million)
Company Expertise	: 1) Soil Nail : 2) Stone Pitching : 3) Tieback Wall : 4) Rockfill : 5) Gunite : 6) Gridbeam

2.3 COMPANY ORGANISATION CHART



2.4.1 Completed Projects

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Tender No: MPS/T/28/20- Cadangan Reka Dan Bina Bagi Membaikpulih Cerun Di Jalan SG 8/11, Taman Sri Gombak, Mukim Batu, Daerah Gombak, Selangor D.Ehsan	RM1,525,959.30	17/9/2020	5/3/2021	7 Month	Majlis Perbandaran Selayang (MPS)
2.	TNB 331/2020 Slope Rehabilitation at The Vicinity of JKR Road Diversion at Cameron Highland	RM1,199,593.00	8 Jun 20	9-Feb-21	9 Month	Tenaga Nasional Berhad (TNB)
3.	Projek Pembaikan Cerun Dan Kerja - Kerja Berkaitan Di SKN 340, TUDM Bukit Kubong, Wilayah Persekutuan Labuan	RM1,595,939.00	18-Apr-19	1-Jul-20	1 Year 3 Month	Jabatan Kerja Raya (JKR)
4.	TNB GRID/GMKL(PLANNER)/2019 Kerja - Kerja Kecemasan Pembaikan Cerun Di Sekitar Menara No. 22-23, Talian Atas 132kV TNHQ - SHMS, Kuala Lumpur.	RM877,617.00	4 Mei 2020	5-Sep-20	5 Month	Tenaga Nasional Berhad (TNB)

Table 2.2 Completed Projects

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
5.	Kerja Kecemasan Pembaikan Cerun TN34 Dan TN90 275kV TPAH - UJLI	RM1,620,000.00	11-Oct-19	19-Dec-19	3 Month	Tenaga Nasional Berhad (TNB)
6.	MARA/BBS:16/2018 Cadangan Kerja - Kerja Baikpulih Cerun Runtuh Di Padang Hoki Maktab Rendah Sains Mara (MRSM) Tun Ghazali Shafie, Kuala Lipis, Pahang Darul Makmur	RM1,315,185.00	10-Jan-19	7-Nov-19	11 Month	Majlis Amanah Rakyat (MARA)
7.	TNB 1541 / 2018 Cadangan Kerja Pembaikan Hakisan Cerun Di : Pakej A - Menara No. 110 Talian Atas 275kV PRMS - VALE Bagi Pejabat Pengurus Besar (UTARA), Jabatan Senggaraan Grid, Bahagian Grid, TNB	RM1,400,000.00	30-Jul-18	2-Jul-19	1 Year	Tenaga Nasional Berhad (TNB)
8.	Kerja - Kerja Pembaikan Hakisan Cerun di Menara No. 109 Talian Atas 500kV Tg. Bin - Bukit Batu, Sedenak, Johor	RM1,001,021.00	29-May-18	25-Sep-18	4 Month	Tenaga Nasional Berhad (TNB)

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
9.	Kerja Pembaikan Hakisan Cerun T08 Talian Atas 132KV BDNG - PWGR Bagi Pejabat Pengurus Besar (Utara), Jabatan Senggaraan Grid, Bahagian Grid, TNB	RM1,211,500.00	7-Jan-19	6-May-19	5 Month	Tenaga Nasional Berhad (TNB)
10.	Cadangan Kerja-Kerja Membaikpulih dan Menstabilkan Cerun Sediada di Jalan Indah 1, Taman Universiti Indah, Seri Kembangan, Untuk Majlis Perbandaran Subang Jaya	RM1,379,593.00	5 September 2017	4-Feb-18	7 Month	Majlis Perbandaran Subang Jaya (MPSJ)
11.	Cadangan Merekabentuk dan Membina Pembaikan Cerun di Jalan Desa Jaya 48, Taman Desa Jaya (Bersempadan Kubur Cina), Mukim Batu, Daerah Gombak, Selangor Darul Ehsan (MPS/T/75/17)	RM1,350,360.00	18 Ogos 2017	17 Februari 2018	7 Month	Majlis Perbandaran Selayang (MPS)
12.	Cadangan Kerja-Kerja Pembaikan Cerun Runtuh di Jalan Bukit Hijau 26/24, Seksyen 26, Shah Alam Untuk Majlis Bandaraya Shah Alam	RM634,045.18	12 Julai 2017	07 November 2017	5 Month	Lurun Enterprise

2.4.1 Project in Progress

No.	Project Title	Start Date	Client
1.	Kerja Pembaikan Cerun (Tower Foundation Stabiliser) di T31 275KV BTRK - CBDK, untuk Grid Maintenance (Selangor), Bahagian Grid, Tenaga Nasional Berhad  Figure 2.3	22/9/2021	TENAGA NASIONAL BERHAD (TNB)

Table 2.3 Project in Progress

CHAPTER 3.0

CASE STUDY

3.1 Introduction to Case Study

Along the line of TNB's cable 275KV TPAH- UJLI, several towers had experience soil erosion at the toe of the towers' area, which might impose negative impact to the rigidity and stability of the tower's foundation, where one of the affected towers named as Tower T155. Hence, immediate slope treatment is significantly crucial to prevent any mishap from happening.

It is observed that the failure region is separated into three divisions, which can be categories as upper, middle, and lower slope, where the tower's base is located above the middle slope. In accordance with the failure severity, it is determined that the upper and lower slopes are largely critical that requires slope repair method designated to be soil nailing of 9m and 12m long of T25 steel bar, coupled with a gunite spray technique to cover the finishing slope surface. Whilst the middle slope shall be rectified with a layer of shotcrete, as per engineer's design. The photographical of the current site condition is displayed in Figure 1 and 2. In addition, the construction method of statement for the mentioned work process is described with detail in this write up.

3.2 Method of Statement

3.2.1 Survey Work

i) Identify and distinguish limit of work area as per construction drawing.

ii) Label and mark the location of the slope failure that require contractor`s attention for repair as displayed in the provided construction drawing.

iii) Provide a survey drawing that demonstrate the existing layout plan and cross-section of the slope failure area that would require immediate action.

3.2.2 Preliminaries work

i) Recognize possible access road available on site as to be utilized for machines and materials mobilization process, as well as manpower transportation.

ii) Determine a suitable location or area on site for material storage and stockpile purposes during contract period.

iii) Identify a convenient location either on site or near to the site for labours`s accommodation throughout the project period.

iv) Determine a proper area to be made as a working station for the operation.

3.2.3 Access-road and maintenance work

i) Amend and restore identified access road for the operation purposes.

ii) Flatten an uneven path and cover or close water flow that existed n the road ensuring it is being directed into a proper discharge point.

iii) Preventive measure to protect the access road from being damaged by intractable water flow.

iv) Utilized machines for this process would be a single excavator.

3.2.4 Site clearing work

i) Site clearance prior to the slope remedial work.

ii) Clean ad clear existing bushes by cutting down any unwanted tress that hindrance the construction works.

iii) Dispose of unwanted structure and debris that existed on site.

3.2.5 Temporary slope protection work

i) A temporary canvas or tarpaulin sheet shall be used to cover the failure area as to avoid from worsening the slope condition.

ii) Even so, the main scope of work remedial works must be expedited as soon as possible.

iii) Water diversion shall be properly rerouted to helps prevent further landslides.

3.2.6 Earthwork

i) Trimming and excavation work on the slope surface as per construction drawing as to prepare a platform for slope remedial works.

ii) The left part of the slope failure shall be reprofiled using an excavator prior to the installation of soil nailing, spraying of gunite and steel grid netting.

iii) The excavator shall also be utilized to remove the fallen accumulated earth or dirt on the current access road for the operation purposes.

3.2.7 Slope remedial work

Slope repair method established specifically for this project are as listed below

i) Soil nailing with nail head

ii) Guniting slope surface protection

iii) Drainage system`s construction

iv) Closed turfing

3.3 Job Safety Analysis

Work Activity	Hazard Identification		
	Hazard	**Consequence**	**Existing Control Measures**
Site Clearing	i) Exposure to sharp part of tools and equipment.	i) Deep cuts through the skin. ii) Suffering of minor injuries.	i) Practices warning communication system on site, such as hand or mechanical signal when operating. ii) Toolbox meeting prior to start work. iii) Prepare a first aid kit on site. iv) Wear a suitable and complete PPE.
	i) Exposure to falling of loose material from the top of slope.	i) Hit by falling material and suffering from injuries.	i) Manually remove any loose materials beforehand to ensure safety on site during operation. ii) Installation of safety net as a catch platform o any falling materials. iii) Supervision by site safety supervisor during operation.

Work Activity	Hazard Identification		
	Hazard	**Consequence**	**Existing Control Measures**
Excavation works	i) Exposure to sharp part of tools and equipment.	i) Deep cuts through the skin. ii) Suffering of minor injuries.	i) Toolbox meeting prior to start work. ii) Prepare a first aid kit on site. iii) Wear a suitable and complete PPE. iv) Practices housekeeping system on site to prevent from accidently hitting sharp objects
	i) Poor handling of wasted materials	i) Suffering from minor injuries. ii) Fall & slip step during operation	i) Isolate an area for the stockpile of the wasted material. ii) Provision of adequate containment to retain the waste material for disposal. iii) Install barricade surrounding the working area

Work Activity	Hazard Identification		
	Hazard	**Consequence**	**Existing Control Measures**
Spraying of grout mix	i) Exposure to moving mechanism of machineries concrete mixer	i) Hit by moving equipment ii) Suffering of minor injuries	i) Practices warning communication system on site ii) Installation of signages to warn the public about the operation iii) Inspection of machineries as per safety checklist.
	i) Working at the height of slope surface	i) Falling steps & slip when operating.	i) SSS to supervise the process during operation. ii) Provision of sufficient access and egress from the working area as well a stable working platform iii) Wear a suitable and complete PPE during operation

Work Activity	Hazard Identification		
	Hazard	**Consequence**	**Existing Control Measures**
Concrete placement	i) Exposure to moving mechanism of machineries such as concrete mixer	ii) Hit by moving equipment iii) Suffering of minor injuries	i) Practices warning communication system on site ii) Installation of signages to warn the public about the operation iii) Wear a suitable and complete PPE during operation
	i) Exposure to unhealthy materials or contaminant in the environment	i) Suffering from breathing difficulties ii) Suffering from sore eyes or irritation	i) Provide medical surveillance for all workers ii) Operating with a shift working interval to avoid working a a long hour under an extreme weather

Table 3.1 Job Safety Analysis

3.4 The Problems Occurred

3.4.1 Bad weather condition

Construction workers spend a lot of time outside, in all kinds of weather, which exposes them to a lot of dangers. Construction workers' lives are put in a thunderstorm when they operate heavy machinery during a rainstorm. Working in excessive heat puts construction workers' health at risk, as they are exposed to heat-related disease and weariness for long periods of time. Because of the chemical nature of construction materials like cement, they require a specific temperature and moisture level to achieve optimal strength.

3.4.2 Construction Noise

Construction sites may be extremely noisy, and they are frequently temporary settings where different trades come to the site for brief periods of time to complete their work. Because of the continual changes in location, the size of the construction site, and the transience of the work force, noise during construction may be more difficult to control and ensure that hearing protection are utilized effectively.

CHAPTER 4.0

4.0 DETAILS METHOD OF STATEMENT

4.1 Method of statement for soil nailing

4.1.1 Equipment used

Item	Type of equipment	Quantity
1.	Soil nailing machines: i) Rotary machines spider rock drill with drag bit (rotary system) on soil formation or downhole hammer for rock formation	1
2.	Air compressor: i) Atlas Copco with 150 psi ii) 600-700 CFM	1
3.	Grout Mixer	1
4.	Grout Pump	1

Table 4.1 List of equipment used in soil nailing.

4.1.2 General

i) This method statement intended to be a step-by-step sequential order of all the operations entailed in the fabrication, installation, and grouting of soil nail.

4.1.3 Reinforcement

i) The effective reinforcement for soil nails comprises of 12m length of galvanized high yield steel bar is designated as per engineers' specifications.

ii) Difficulties are likely encountered in the mobilisation of such materials however, contractor shall put an utmost care and effort for safe delivery.

4.1.4 Slope Preparation

i) Localized slope surfaces shall be trimmed when necessary.

ii) The slope surface is to be trimmed and removed any loose and unwanted materials until it is made safe for the operations.

4.1.5 Temporary staging

i) The type of drilling machine used is dependent on the existing slope profile, height, spacing and the availability of the working platform.

ii) Temporary staging shall be erected along the slope side as to enable drilling of soil nails using small portable drilling machine and as a working platform for all the workers.

iii) The staging will be constructed using Gl bracing pipes fastened together via pipe clamps.

iv) Rigidity of the whole frame is enhanced by having installations of extra bracings and firmness of the ground on which the supports stand is to be ensured.

Figure 4.1: Temporary staging

4.1.6 Drilling

i) Minimum of 100 mm nominal diameter borehole is drilled at the required location using a rotary drilling machine to the required depth and inclinations.

ii) A layer of wet geotextile/ netting will be placed at the surface of drill hole necessarily to prevent the release of dust to the air and the surrounding area, as well as to prevent disturbance to the resident environment.

Figure 4.2: Drilling

4.1.7 Installation of Reinforcement

i) Prior to insertion of any reinforcement, the boreholes are to be flushed clean with air pressure.

ii) Reinforcement of 12 m steel is chosen specifically for the soil nailing at this respective tower.

iii) The insertion of nailing is executed manually using the provided soil nailing machine.

iv) Zero excessive force shall be allowed during the process.

v) In case of any reinforcement insertion refusal, it shall be removed from the borehole and re-flushed with air once again, before repeating the insertion process afterwards.

4.1.8 Grouting

i) Grouting is carried out after the insertion of the reinforcement process, which is described previously.

ii) It shall be mixed in a high-speed grout mixer and pumped into the borehole by tremie method through a PVC grout hose.

iii) Consequently, grouting shall continue until neat cement grout flows out from the boreholes.

iv) If temporary casings are being utilised, they shall be withdrawn immediately after grouting is completed. Any grout waste from the casing withdrawal process shall be topped up necessarily.

v) Installation of reinforcement and grouting work will be carried out on the same day of drilling works being completed.

4.1.8.1 Grout mix design for soil nailing work

Material

These are three materials used for soil nailing grout mix:

i) Ordinary Portland cement
ii) Clean water free from harmful substances.

Mix ratio

i) The water to cement ratio of grout shall not exceed 0.45. For every 1.0 kg of cement the quantity of water required is 0.45 kg (0.45 litres).

ii) For every 1 bag of 50 kg cement, the quantity of water required is: 0.45 kg x 50 kg = 22.5 kg = 22.50 litres

Method

i) Tremie method is applied for this specific process with zero pressure implemented in grouting of soil nailing.

Summary

i) The proportion of grout and the minimum strength of work cubes shall comply with the following requirement:

Water quantity, litre	Cement quantity, kg
22.5	50 (1 bag)
45.0	100 (2 bag)
67.5	150 (3 bag)
90.0	200 (4 bag)

Table 4.2: Ratio of water to cement in grouting.

Cubes age	Cube strength
7 days	21 N/mm²
28 days	30 N/mm²

Table 4.3 Cube test requirement.

Testing

i) Six (6) numbers of grout samples in cube (100mm x 100mm x 100mm) form shall be prepared and cured in water for seven (7) days and 28 days. Where three (3) cubes will be taken for compressive strength testing for seven (7) and 28 days age respectively.

This specific working process shall be executed in the safest manner ensuring the safety of the public including the tower itself. All the machineries used in performing soil nailing work will not affect the condition of the tower, as it is an immobile equipment which does not impose any impact towards the tower.

4.2 Method of Statement for Guniting

4.2.1 Equipment & material used

Item	Type of equipment	Quantity
1.	Air compressor 650 CFM	1
2.	Aliva 246 gunite machine	1
3.	High pressure water pump	1
4.	Concrete mixer	1

Table 4.4 List of equipment for guniting works.

Item	Type of materials	Quantity
1.	BRC wire mesh	As per BQ
2.	PVC pipe of 50mm diameter	As per BQ
3.	Geotextile separator	As per BQ

Table 4.5 List of materials for guniting works.

4.2.2 Strength of gunite sprayed concrete

i) Grade 30 gunite sprayed concrete is equivalent with cement to sand ratio of 1:3 (cement/ sand mixed proportion base on volume).

ii) Please refer to design mix section for Grade 30 unite sprayed concrete.

4.2.3 Design mix for G30 Gunite sprayed concrete

Material

i) These are the materials used for design dry mix of G30 Gunite sprayed concrete:

   i) Ordinary Portland Cement

   ii) Clean water free from harmful substances

Water supply shall be discharged through the nozzle from a water pump to form a wet mix at the nozzle.

Mix ratio

i) Gunite sprayed concrete of G30 is governed by the ratio between cement and sand of 1:3 with respect to its volume.

   i) For volume of cement and sand measured using 18 litrecontainer the ratio would be demonstrated as below:

      For a bag of 50 kg cement, 1.5 nos of 18 litre containers are filled. Therefore, for one bag of cement, the volume of sand required would be 6 nos of 18 litre containers.

Summary

The proportion of mix ratio for each one bag of 50 kg cement are summarised as below:

No. of bag cement	No. of container sand
1	4.5
2	9
3	13.5

Table 4.6 Mix ratio of cement to sand for G30 Gunite sprayed concrete.

4.2.4 Work procedure for guniting

i) All surface roots, vegetations and loose materials shall be removed.

ii) Install BRC-A6 mesh reinforcement on the designated surface area.

iii) Mesh reinforcement shall be secured on the slope surface using T12 dowel bar.

iv) Prior to guniting, 50 mm diameter PV weep holes shall be installed at predetermined location and secured to the wire mesh using tie wires. The exposed end which will eventually be protruding out of the finished gunite face shall be wrapped with plastic to prevent ingression of gunite mix during guniting works.

v) The plastic wrapping shall later be removed upon completion of guniting.

vi) Cement and sand are to be mixed using a concrete mixer based on 1:3 mixed proportion (volume). The mixed is then transferred to a gunite machine and conveyed to the slope surface by compressed air (50 psi) through a delivery hose. Connectors are used, when necessary, to create a longer extension of the delivery hose and shall be assuredly secured with a hose connecting tie.

vii) Water supply shall be discharged through the nozzle from a water pump to form a wet mix at the nozzle.

viii) The nozzleman shall control the water flow during the mx supply at the nozzle.

ix) Gunite mix is sprayed onto the cleaned surface in circular motion until minimum thickness of required thickness is achieved.

x) The sequence of guniting shall be from the top to the bottom of the slope.

4.2.5 Technique of spraying gunite

i) The gunite mix shall be sprayed at a right angle (90°) to the slope surface.

ii) A nozzleman shall be accounted to hold and control the nozzle host during the spraying of gunite concrete on top of the slope surface.

iii) In parallel to the operation, a second nozzleman is appointed to aid in controlling the movement of the host from the bottom, as to ease the completion of the process.

iv) Prior to the spraying of the gunite concrete, the installation of BRC mesh wire fastened with dowel bars on the surface will be used as a strong working platform for the nozzleman to secure his foot and coupled with the protective equipment of a body harness while accomplishing the task.

v) The two nozzlemen shall have a shift rotation to avoid ergonomics hazards from the process.

vi) Considering the condition of the slope, the nozzleman is required to wear at lifeline attached to an anchor firmly fixed and planted with mass concrete at the top of the slope, coupled with a complete personal protective equipment, PPE, such as hand gloves, safety harness, and safety helmet throughout the process.

During the guniting process, the existing Tower AP37/1 will be covered using a sheet of canvas, as to protect the tower itself from gunite spraying. In parallel, it is also assured that no machineries are placed or parked on top of the tower's footing.

Figure 4.3 Technique of spraying gunite

4.3 Method statement of drainage work

4.3.1 General

i) This method statement is intended to be a step-by-step sequential order of all the operations entailed in the construction of drainage works.

4.3.2 Slope Preparation

i) Upon completion of soil nail installation, remove the lodged temporary staging and carry out the preparation work on the slope surface for the construction of cast in-situ concrete drainage. Any emphasize uneven slope surfaces shall be trimmed, backfill, or patched where necessary to provide a uniform surface.

4.3.3 Excavation Works

i) Excavate manually about 50 mm depth trench connecting each completed soil nails prior to the installation of steel reinforcement and formwork.

4.3.4 Reinforcement

i) The reinforcement for concrete drain comprised of BRC A8 fabric mesh with 50 mm thick lean concrete G15, as emphasized in detail drawing.

4.3.5 Formwork

i) Formwork for casting of drainage is prepared using 12 mm thick plywood and 2” x 1” timber. The 12 mm plywood will be cut to the drain’s height and strengthen by 2” x 1” timber at each end. These formworks are applicable and useable for at least 3 times for casting of the drain.

4.3.6 Concrete Mix

i) Concrete G25 used to cast the drainage system will be mixed on-site using portable concrete mixer provided. The proportion of cement to sand and 2 mm aggregate of concrete grade G25 is 1:1.5:3 with respect to its volume.

4.3.7 Work procedure for drainage system

The procedure for constructing concrete drainage are as follows:

i) Complete the excavation of trenches on the slope profile as shown in construction drawing.

Figure 4.4

ii) Place the prefabricated steel reinforcement of BRC A8 fabric mesh into the trenches.

Figure 4.5

iii) Install the formwork initially erected on the top and bottom sides of the drain.

Figure 4.6

iv) Mixed concrete grade G25 are pour and place into the installed formwork.

Figure 4.7

v) Use a vibrator to create vibration wave into the poured concrete, as to provide an even concrete flow inside the formwork.

vi) Remove the formwork after a period of at least one day.

vii) All the steps above are repeated until the drainage works are fully completed on site.

4.4 list of equipment

Item	Type of equipment	Model	Photo
1.	Concrete mixer	Generic model	 Figure 4.8 Concrete mixer
2.	Air compressor	Airman PDS655	 Figure 4.8 Air compressor
3.	Power pack	Eurocrete	 Figure 4.9 Power pack
4.	Rotary machines drill with drag bit	Eurocrete	 Figure 4.10 Rotary machines drill with drag bit

Item	Type of equipment	Model	Photo
4.	Grout mixer	Agigator	 Figure 4.11 Grout mixer
5.	Grout pump	Wilden pump	 Figure 4.12 Grout pump
6.	Gunite machine	EGP-5A	 Figure 4.13 Gunite machine

Table 4.7 List of Equipment.

CHAPTER 5.0

CONCLUSION

I have learned a lot of things when I do the industrial training at Semarak Geo Sdn Bhd (SGeo). It gives a big impact to me on how to manage all the task, solve the problem, divides my time, plan daily works at site. It is really hard for me at the beginning maybe I not feel comfortable with the environment, but now I can do my job without problem, if I don't know how to do the job, I will ask my supervisor for help. For me, we all have to adapt the situation that we face. These is the best working experience that I never forget. That is make me survive in industrial training for 14 weeks. Before this I never work at a big company as a drafter, now I got an opportunity to feel the environment of workplaces.

Being in this company or construction industry really gave me such an opportunity to explore more in the industry itself. In SGeo, I was gained a lot of knowledge that I have learned. A very thankful and grateful to all the staff of SGeo for all the guidance and advise me. I feel so grateful because this experience is hard to get out there. Last but not least, an industrial training is a very important for student who in their study, because it's the only for all of us applied the theories that we learned at college. We can know the different of the theories and working environment. Because of that, we must take the advantages from what we have learned from industrial training. I hope this training report can be a reference to fix or upgrade the quality of work in future.