DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

SUBSTRUCTURE IN RAUB BIOMASS POWER PLANT

Prepared by:

AHMAD FIKRI BIN SAIPUZZAMAN

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DECEMBER 2018

It is recommended that the report of this practical training provided

By

AHMAD FIKRI BIN SAIPUZZAMAN

2016618016

Entitled

SUBSTRUCTURE IN RAUB BIOMASS POWER PLANT

Accepted in partial fulfillment of requirement has for obtaining Diploma in Building.

Report Supervisor	:	En Mohammad Hamdan bin Othman.
Practical Training Coordinator	:	En. Muhammad Naim bin Mahyuddin.
Program Coordinator	:	Dr Dzulkarnaen bin Ismail.

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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 herein, prepared during a practical training session that I underwent at Transgrid Ventures. for duration of 14 weeks starting from 3rd September 2018 and ended on 7th December 2018. It is submitted as one of the prerequisite requirements of DBG307 and accepted as a partial fulfilment of the requirements for obtaining the Diploma in Building.

Name : Ahmad Fikri Bin Saipuzzaman

Matric No. : 2016618016

Date : 11th December 2018

ACKNOWLEDGEMENT

Alhamdulillah, praise to Allah, the Most Merciful, the Most Graceful.

I want to take this opportunity to express a deep sense of gratitude to a group of amazing individuals. I would like to extend my thankful for the guidance, advice and help throughout the period of training by the following group of amazing individuals. First, I would like to thank to Mr Peter Karu for the opportunity given and to conduct my training in his company. His team of professionals comprising of Shashi Devan, Mr David Ah Meng, Surendran And Mr Hisham that have enabled me to learn and develop my understanding, knowledge and feel of real time projects, and the theory involved in analysis of structures, building and civil work.

I would also like to thank all the UiTM lecturers that have taught me and nurtured me with all the knowledge and shaping me becoming a better person. I would also like to extend my appreciation to the lecturers who have directly involved during my industrial training period. To En Mohammad Hamdan Bin Othman, my Supervising Lecturer, En Muhammad Naim bin Mahyuddin, Practical Training Coordinator for their time, effort, encouragement and ideas that have assisted me towards the succesful completion of my industrial training, this report and also the most importantly, the valuable knowledge that have been shared for the past semester.

Finally, special thanks to my beloved parents for their sacrifices over the years and also my classmate who help me to assemble the parts and gave suggestion about this report. Finally, I appreciate all their guidance

Thank you so much.

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CHAPTER 1.0

INTRODUCTION

1.1 Background and Scope of Study

The substructure is defined as the structural work below ground level used to support the structure above. Foundations, basement, subfloor are some components of this area. (www.qcon.ie). There are two types of foundation which are shallow foundation and deep foundation.

Shallow foundations are typically used where the loads imposed by a structure are low relative to the bearing capacity of the surface soils. Deep foundations are necessary where the bearing capacity of the surface soils is not adequate to support the loads imposed by a structure and so those loads need to be transferred to deeper layers with higher bearing capacity.

The structure itself consist of two part which is substructure and superstructure. It is very important to the structure because the function of the substructure is to bear any of load that comes from superstructure such as dead load and life load.

This report is carried out at Raub biomass power plant construction site. This construction site is held at Raub, Pahang. This is one of the first biomass power plant in Malaysia and but still in the construction progress. For construction of tanks, excavator is machinery that often used to excavate and lift the materials and tools. Mostly at this construction site are working on construct the slab for the tanks.

The aim of this report is to discover the construction of substructure at the Raub biomass power plant.

1.2 Objective

1. To construct the slab of the tank for the project

2. To describe the function of each tank.

3. To describe the problems have been facing by the contractor during construction

1.3 Method of study

Observation-

Along the practical training, monitoring work should be done often to ensure that construction work goes smoothly, and the learning process can be taken. Every work done by each worker will be recorded for the process of learning and for the data collection. For example, taking pictures and record the video. Every work should be carefully monitored to prevent any problem occur.

Interview-

Made some interview session with the person who are in charge in this project. Asking some questions to project manager Mr Peter, site supervisor and engineer Sashi Devan and Hisham, sub-contractor Mr Suren and Mr David and some workers at site. All related to safety and health will be guarded and explained by Mr. Idris as a safety and health officer.

Document review and internet-

All the information about the biomass power plant are not explained. I need to search the internet to get any information about the anaerobic reactor and on how it will process the waste. All worksite will be referring to the drawings and other report such as piling report.

Chapter2.0

Company background

2.1 introduction of company

Figure 2.1: company logo

Transgrid Ventures Sdn Bhd is a wholly owned by Malaysian registered firm in the field of engineering, procurement, construction and commissioning (EPCC) and project management and project management and consultancy (PMEC) organization in the power sector.

The company was established in 1999 and has a well-established track record in delivering projects which exceed client's expectations. The firm supported by local professionals, semi-professionals and administrative staff to serve the needs of expanding clients in Malaysia and globally.

As one-stop solution system provider, Transgrid offer as board range of expertise committed as part in meeting industrial and utility power needs. Our multi-disciplinary professional team does the needful to understand client's requirement and provide an optimum solution, from conceptual design, project management, construction and commissioning.

The company is focus in the business of power generation, transmission and distribution. We are true partner in providing the best possible economy in a competitive world without compromising reliability of supply through optimum technical performance and unmatched safety standards.

Transgrid provides specialized services as EPCC contractor and PMEC in several major field of practice including: -

- Power generation, transmission and distribution
- Renewable energy
- Reactive power compensation system

Our Specialization

Our experienced staff of professional engineers offer clients a complete range of services in the field of power transmission and distribution involving: -

- EHV MV substations
- Power Transformers
- Rehabilitation Works
- System Retrofitting

Project Management.

The Project Team delivers projects on-time to the satisfaction of clients and within budget with list of experience completing the following projects: -

- Reactive Power Compensation System Projects
- Turnkey substation 500/275/132/33/11kV Power Transformer Projects
- Rehabilitation and Refurbishment Projects Retrofitting and System Upgrading Projects

Engineering Design.

Transgrid provides an experience and a perspective that sets it apart from other transmission and distribution engineering service providers. Bringing in an in-depth understanding of the electric supply network, electrical codes & regulations, client's technical requirements, Transgrid offers optimized design and construction features. Our team of design engineers offers a full range of services in the following disciplines: -

- EHV Substations — AIS and GIS
- Oil Filled / XLPE Power Cable Systems
- Transmission System
- Rehabilitation and Refurbishment System

2.2 Company profile

Corporate Information

Table 2.1: Corporate information of Transgrid Ventures Sdn Bhd

Date of incorporation	12 august 1999
Business address	E-07-3 East Wing, Jalan SS 15/4g, Subang Square Business Centre, 47500 Subang Jaya, Selangor
Telephone no	
Fax no:	
Nature of business	-EPCC in utility transmission and distribution -project management and engineering consultancy -trading of utility product
Authorised capital:	RM10,000,000
Paid-up number	RM8,800,000
Tax payer number	E900449309
Banker	-HSBC Bank Malaysia, Petaling Jaya -Arab Malaysian Bank Berhad, Jalan Ampang -Affin Islamic Bank, Jalan Raja Chulan -United Overseas Bank (M) Bhd, Medan Pasar -Citibank Berhad, Jalan Ampang
Auditor	Morison Anuarul Azizan Chew 18, Jalan/64, Off Jalan Kolam Air Jalan Ipoh 51200 Kuala Lumpur
Company Secretary	Focas Management Service 49a, Jalan Usj 1/20 75600 Subang Jaya Selangor Darul Ehsan

Figure 2.2: CIDB registration certificate

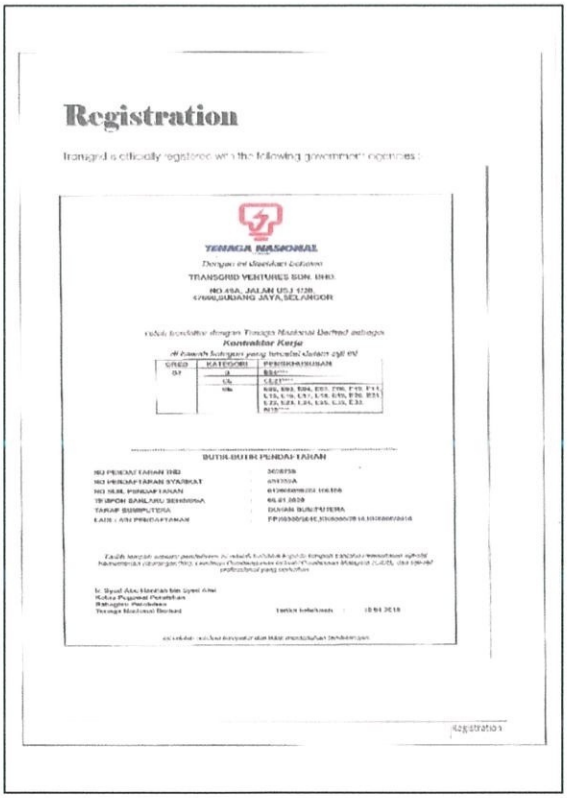


Figure 2.3: TNB registration certificate

2.3 Organization chart

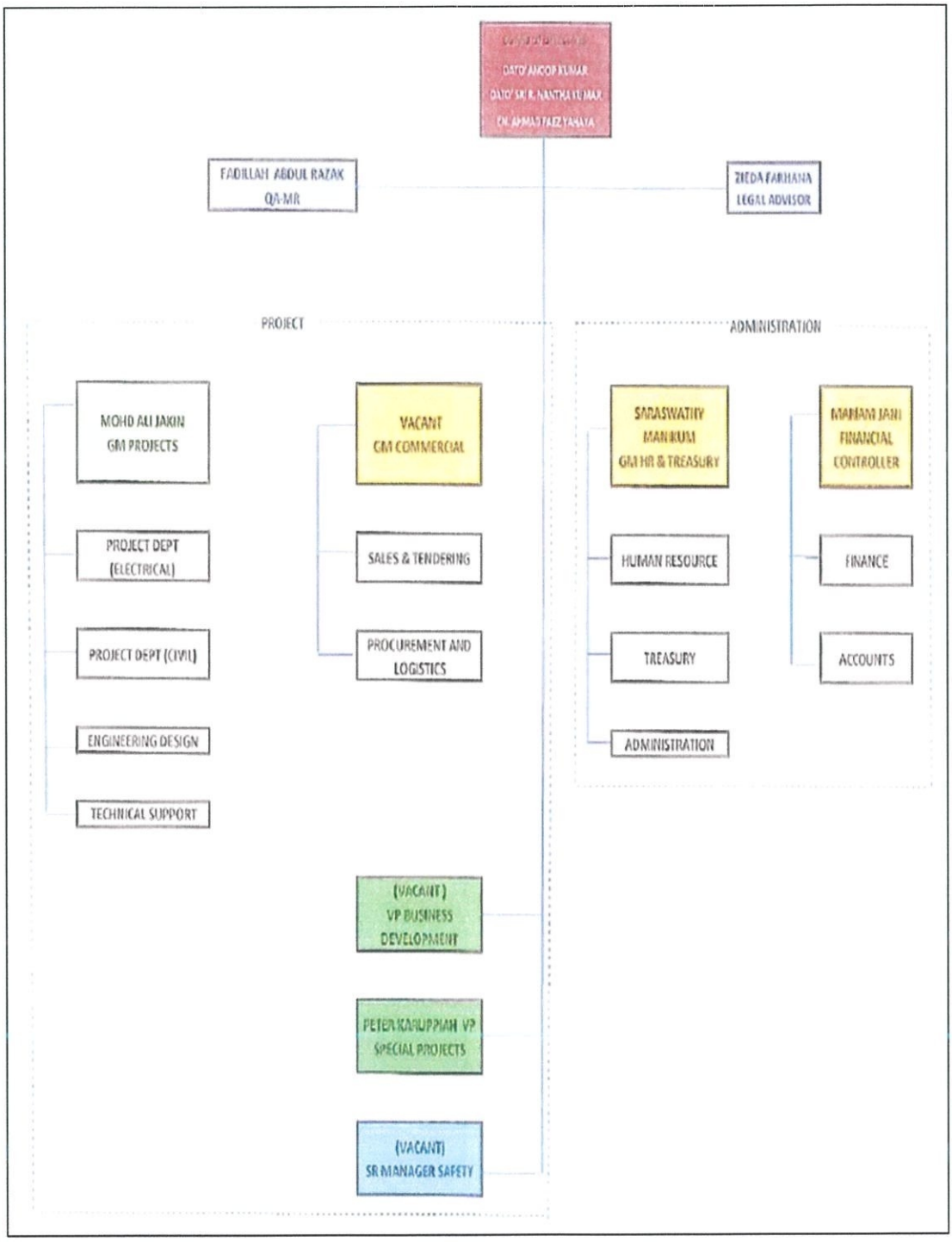


Figure 2.4: Organization chart of Transgrid Ventures Sdn Bhd

2.4 List of projects

Table 2.2: list of past and ongoing projects of Transgrid Ventures Sdn Bhd.

Project title	Contract value (RM)	Commencement date	Duration	Status
SUPPLY AND ERECT 132KV ANCILLARY EQUIPMENT AND ASSOCIATED CIVIL WORKS FOR EXTENSION WORKS AT NKST SUBSTATION	12,602,329.00	9/7/2006	15 MONTHS	COMPLETED
ESTABLISHMENT OF PMU 132/33KV SRI HARTAMAS GIS AND DOULBE CIRCUIT LILO132KV SEGAMBUT, DAMANSARA HEIGHTS TNBHQ INTO PMU SRI HARTAMAS GIS	43,169,880.25	14/5/2014	16 MONTHS	COMPLETED
PROPOSED PROCUREMENT CONSTRUCTION, INSTALLATION, TESTING AND COMMISSIONING, COMPLETION AND ANY OTHER ASSOCIATED WORKS OF PROPOSED PENCAWANG MASUK UTAMA (PMU) NO 2 AT LOT 5, KUALA LUMPUR CITY	99,000,075.00	10/4/2017	30 MONTHS	ONGOING

KERJA KERJA PMU 275/33 KV SEDENAK (2X210MVA)	33,466,838.00	8//8/2017	30 MONTHS	ONGOING
PMU 132/33KV PELANGI INDAH, JOHOR (2X210MVA)	56,893,245.00	25/3/2017	730 DAYS	ONGOING
ESTABLISHMENT OF PMU 132/33KV DUNGUN INDUSTRY (2X DCMYA)	29,951,336.00	19/2/2013	16 MONTHS	COMPLETED
ESTABLISHMENT OF NEW PMU 275/33 KV JELI, KELANTAN	21,775,448.77	10/7/2013	16 MONTHS	COMPLETED
KERJA KERJA ESTABLISHMENT OF PMU 275/33 KV HULU TERENGGANU, TERENGGANU	20,377638.85	18/3/2013	17 MONTHS	COMPLETED
SRI HARTAMAS TEMPORARY	5,007,210.00	30/9/2009	14 MONTHS	COMPLETED
ESTABLISHMENT OF NEW PMU 275/33KV (2X240MVA) EBOR GIS SELANGOR	18,261,961.00	9/10/2013	18 MONTHS	COMPLETED
ESTABLISHMENTOF 132/33KV PMU TANJUNG GEMOK (2X45MVVA) AND CONFIGURATION OF EXISTING 132/33 KV OHL FROM MERSING TO PPU TANJUNG GEMOK TO PMU TANJUNG GEMOK	20,815,661.15	14/10/2013	18 MONTHS	COMPLETED

EXTENTION OF 275KV BAY FOR 750MVA 500/275KV XGT AP PMU TG BIN COMPLETE WITH ASSIOCIATED CIVIL WORKS AND EXTENTION OF ONE OVERHEAD LINE BAY AT EXSISTING 500KV DIAMETER AT PMU BUKIT BATU COMPLETE WITH ASSOCIATED REMOTE END WORKS	31,175,995.57	17/7/2013	24 MONTHS	COMPLETED
275KV SERDAND EAST SWITCHING STATION, SELANGOR	26,178,069.00	15/6/2017	18 MONTHS	ONGOING
PMU 275/132KV MAHKOTA CHERAS EXTENTION (2X210MVA) SELANGOR	29,056,075.00	8/8/2017	880 DAYS	ONGOING
ESTABLISHMENT OF PMU 500/275KV BAHAU SOUTH (2X210MVA) NEGERI SEMBILAN	164,824,275.00	4/1/2018	858 DAYS	ONGOING
PMU 132/33KV PMU TAMAN MELAWATI GIS (2X210MVA), KUALA LUMPUR	29,175,526.00	4/9/2018	730 DAYS	ONGOING

2.1.1 Introduction of Company

Figure 2.5: company logo

Malaysia has an abundance of Renewable Energy resources which has not been fully exploited. Biomass is one of it that provides alternatives to reduce our dependence on fossil fuel while improving our environmental footprint. Being a versatile fuel, biomass can be burned directly, or converted into a gas or oil to generate electricity (biomass power) and heat or converted into liquid fuels (biofuels) for our transportation needs. The use of biomass in replacing fossil fuel for electricity generation provides substantial environmental benefits as it reduce the emission of GHGs.

In line with the YAB Prime Minister's vision to make Malaysia green savvy and 40% reduction of carbon emission by year 2020, Raub Energy Ventures (RE) Sdn Bhd (REVSB), a registered Malaysian company has engaged itself in renewable energy activities principally in biomass power. The establishment of REVSB serves as a Special Purpose Vehicle (SPV) in setting up of a 10MW Biomass Gasification Power Plant in the district of Raub, Pahang. The company structure is designed to provide the best possible environment for the implementation of high-value innovative energy project. REVSB is subsidiary of the Transgrid Ventures Sdn Bhd, who is the established player in the power sector.

Key Business Activities

- Active promotion of 'green & renewable" energy sources.
- Identify and develop Renewable Energy Projects in response to Government's goal to achieve 5% of the total power generation from renewable energy.
- Working with both local and foreign technology partners to implement the state-of-the-art biomass based renewable energy project.
- Engaging in the development of biomass processing technology and its industrial applications.
- Key Player in Carbon Credit Trading in Malaysia.

Business Concept and Objective of REVSB shall leverage its business networks in statutory boards, financial institutions and expertise in project development and implementation to close business deals.

- More importantly, REVSB has the backing and capability to ensure financial close as well as smooth implementation and management of the selected project.
- REVSB is committed to be a long-term player cum leader in this biomass and/or biogas technologies and applications.
- REVSB shall build on its credibility as the most reliable Renewable Energy project developer cum operator in Malaysia and Asia countries.

2.2.1 Company profile

- The Group Structure

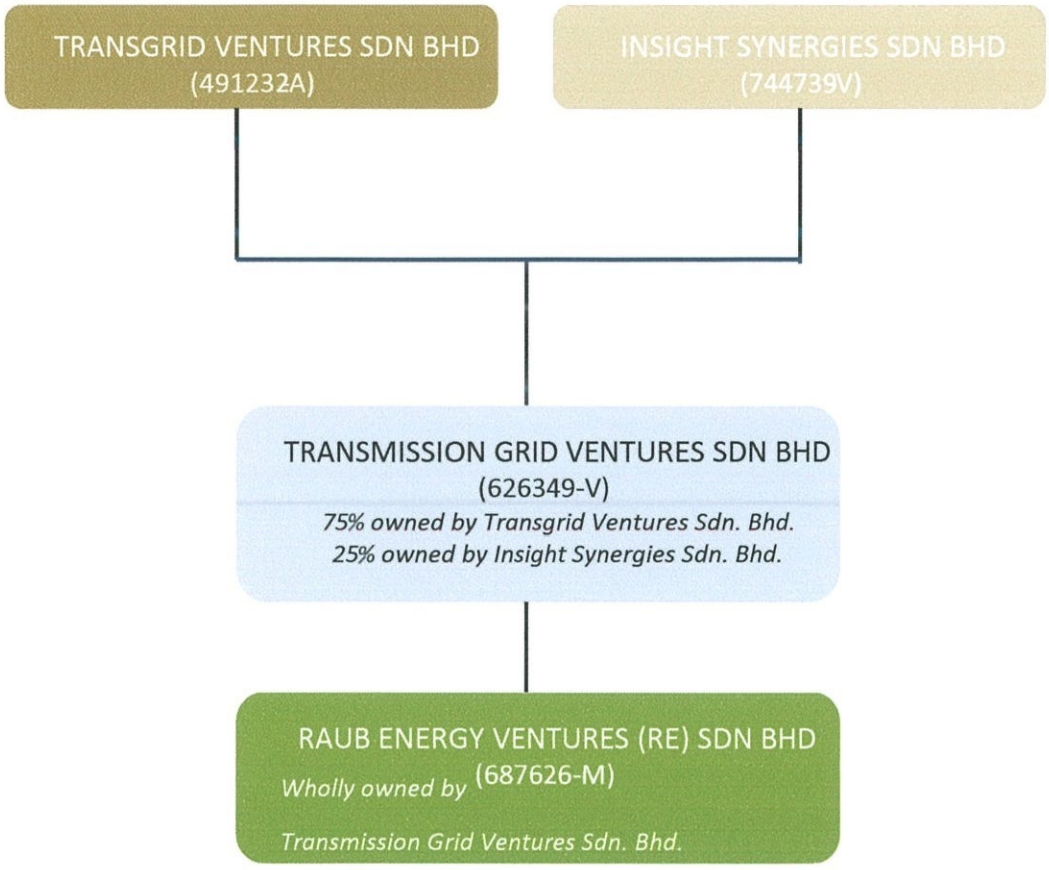


Figure 2.6: the group structure of Raub Energy Ventures Sdn Bhd

- The Directors

The shareholders and directors have been very passionate in ensuring all staff from all level shares the same aspiration in achieving the Company's Vision and Mission.

- Dato' Ir. Anoop Kumar Dhawan
- R. Nantha Kumar a/l J.C. Ramalu
- Ahmad Faez bin Tan Sri Yahaya
- Tengku Shariman Tengku Ibrahim

Table 2.3: Corporate Information of Raub Energy Ventures Sdn Bhd

Date of incorporation	7th April 2005
Shareholders	Transmission Grid Ventures Sdn Bhd
Business address	E-07-3 East Wing, Jalan SS 15/4g, Subang Square Business Centre, 47500 Subang Jaya, Selangor
Telephone no	
Fax no:	
Nature of business	Biomass-based Renewable Energy
Authorised capital:	RM5,000,000
Paid-up number	RM4,325,000
Tax payer number	E900449309
Banker	-HSBC Bank Malaysia, Petaling Jaya -Arab Malaysian Bank Berhad, Jalan Ampang -Affin Islamic Bank, Jalan Raja Chulan -United Overseas Bank (M) Bhd, Medan Pasar -Citibank Berhad, Jalan Ampang
Auditor	Morison Anuarul Azizan Chew 18, Jalan/64, Off Jalan Kolam Air Jalan Ipoh 51200 Kuala Lumpur
Company Secretary	Focas Management Service 49a, Jalan Usj 1/20 75600 Subang Jaya Selangor Darul Ehsan

2.3.1 Organization chart

The shareholders and directors are professionals in their line of expertise and have tremendous years of experience. Whilst we have dedicated focus areas and operations team working with their specialized areas, these specialized areas are collocated, so that our people are rooted only to their expertise. Our flexible structure means that we ensure that our projects are developed by a hand-picked team who most understands the goals of the projects.

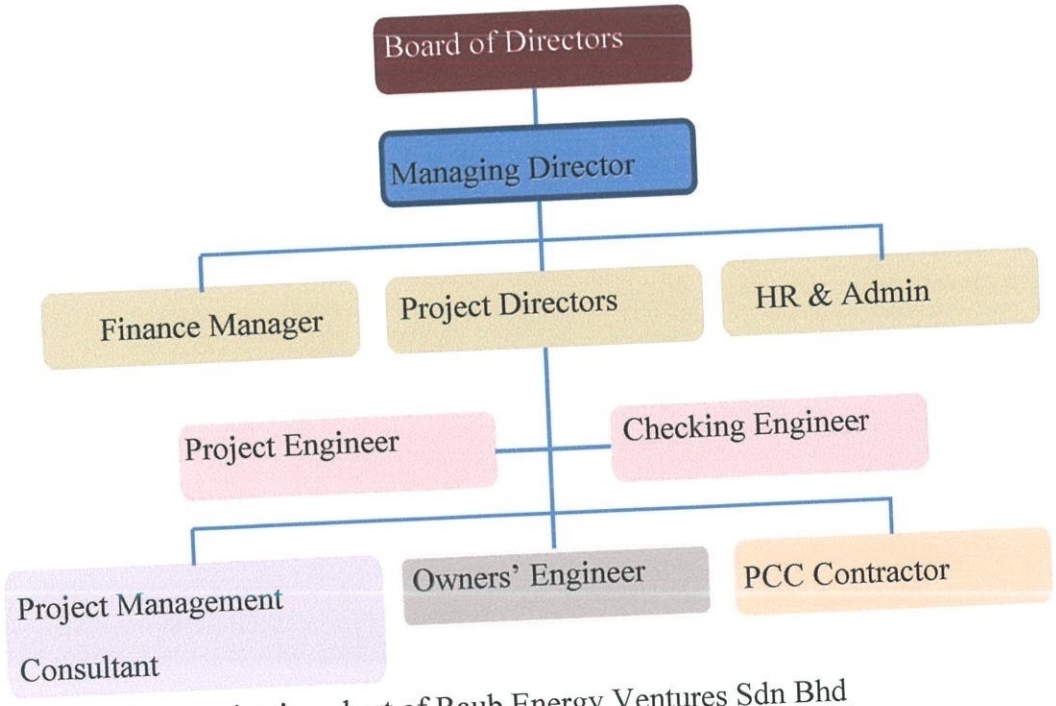
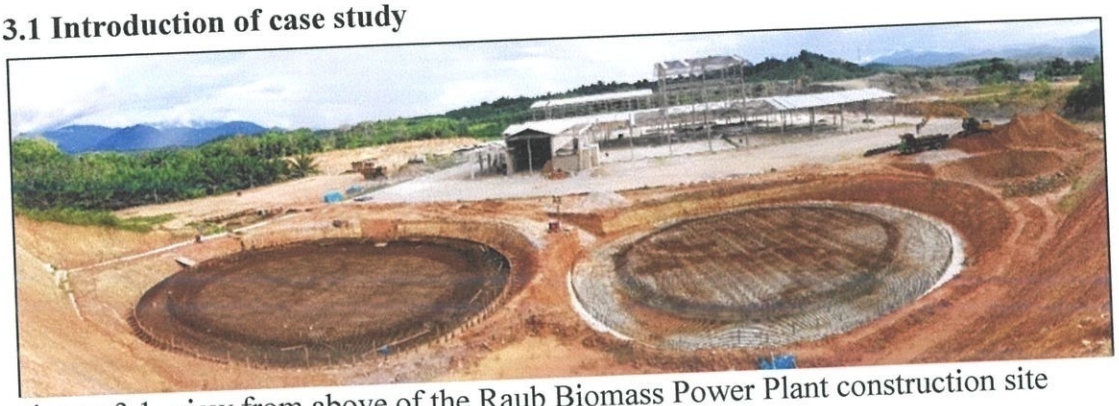


Figure 2.7: organization chart of Raub Energy Ventures Sdn Bhd

Chapter 3.0

Case study

3.1 Introduction of case study



picture 3.1: view from above of the Raub Biomass Power Plant construction site

This project is about to construct Sebuah Stesen Janakuasa Kecil,Biomass, Diatas Lot 1424 Gm2714(No.Lot Baru 42444) Dan Lot 2096 Gm 432 (No Lot Baru 42445) Jalan Lipis, Mukim Gali, Daerah Raub, Pahang Darul Makmur. A small biomass power station that held at the raub district. This power station is produced electricity by processing the oil palm loam. Raub Energy Ventures Sdn Bhd as a client and main contractor in this project.

This project started at May 2016 and estimated finished at May 2019. This project divided into two main works which is tank and factory. The factory including the control room, engine room, loading unloading area and office are managed by the sub-contractor Malingga Krishnan Sdn Bhd. The tank area is managed under sub-contractor by Ska Senibina Sdn Bhd. The tanks area is including: -

1. Anaerobic Reactors, Degasser, Settler & Sludge Recycle Pumps
2. Final Collection Tank & Final Collection Transfer Pumps
3. MCC Room & Chemical Storage Area, Sludge Sump & Thickener Feed Pumps
4. Sludge Thickener, Thickened Sludge Sump & Belt Filter Press Feed Pumps
5. Centrate Sump, Centrate Transfer Pumps, Belt Filter Press and Gas Holders

3.1.1 Site location

This project are located at Diatas Lot 1424 Gm2714(No.Lot Baru 42444) Dan Lot 2096 Gm 432 (No Lot Baru 42445) Jalan Lipis, Mukim Gali, Daerah Raub, Pahang Darul Makmur. This project can be seen from the main road Jalan Lipis and located at the high ground.

Figure 3.1: site location

Source: Google map (2016)

3.1.2 Project consultant

Table 3.4: list of consultants

PROJECT: Membina Sebuah Stesen Janakuasa Kecil,Biomass Diatas Lot 1424 Gm2714(No.Lot Baru 42444) Dan Lot 2096 Gm 432 (No Lot Baru 42445) Jalan Lipis, Mukim Gali, Daerah Raub, Pahang Darul Makmur.	
DEVELOPER	Raub Energy Ventures Sdn Bhd.
MAIN CONTRACTOR	Raub Energy Ventures Sdn Bhd.
STRUCTURAL ENGINEER	R&A Geotechnics Sdn Bhd Ska Senibina Sdn Bhd
ELECTRICAL ENGINEER	Mr Kumaren Kanthasamy Raub Energy Ventures Sdn Bhd.
ESH OFFICER	Mohd Idris Bin Mohd Raub Energy Ventures Sdn Bhd.
QUANTITY SURVEYOR	Raub Energy Ventures Sdn Bhd.
ARCHITECT	Augustina Tradelink Pvt Ltd

3.2 Case study

A Substructure can be defined as an underlying or supporting structure part to the superstructure part. It is below ground level. It mainly consists of foundations for the building and column, walls below ground level and basement. The function of this structure is to transfer load from the superstructure to the earth.

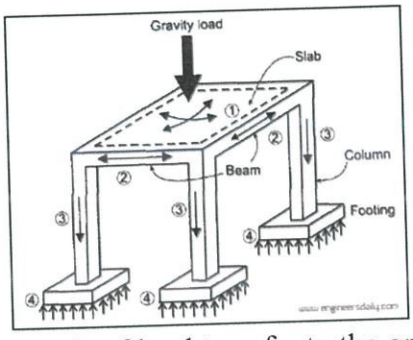


Figure 3.2: example of load transfer to the ground

Source: www.engineersdaily.com

All load from the superstructure are transfer to the substructure. Along with this process, substructure must strong enough to bear load. The main member which comprises the substructure is foundation. There are two types of foundation commonly used for transfer of loads which are shallow foundation and deep foundation.

Shallow foundation is applied when depth of foundation for a structural system is normally less than or equal to 3 meters. Some of the type of shallow foundations are isolated footing, combined footing, trench footing, raft or matt footing. Meanwhile Deep Foundation is applied when depth of foundation for a structural system exceeds 3 meters. Some of the deep foundations are pile foundation, pile and raft footings, and caissons.

Throughout on the main project of construction of a biomass power station, providing tanks for processing wasted materials such as oil palm loam is important. This tank is known as an anaerobic reactor will be performed to reduce wastewater strength in terms of chemical oxygen demand (COD) value and biogas is produced as by-product. By providing these tanks, it needs a strong substructure to support a huge load to producing biogas. In this case, these tanks are applied shallow foundation on construction site.

Along with this foundation, it will strong enough to bear load from the tank. This slab is in cylinder shape to follow the tanks shape. This biggest slab is anaerobic reactors slab. The diameter of this slab is 32900 mm. the height of the slab is 2300 mm. this site consists of seven tanks to be construct.

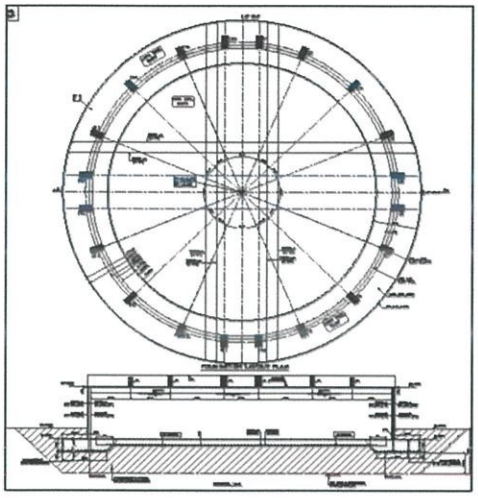
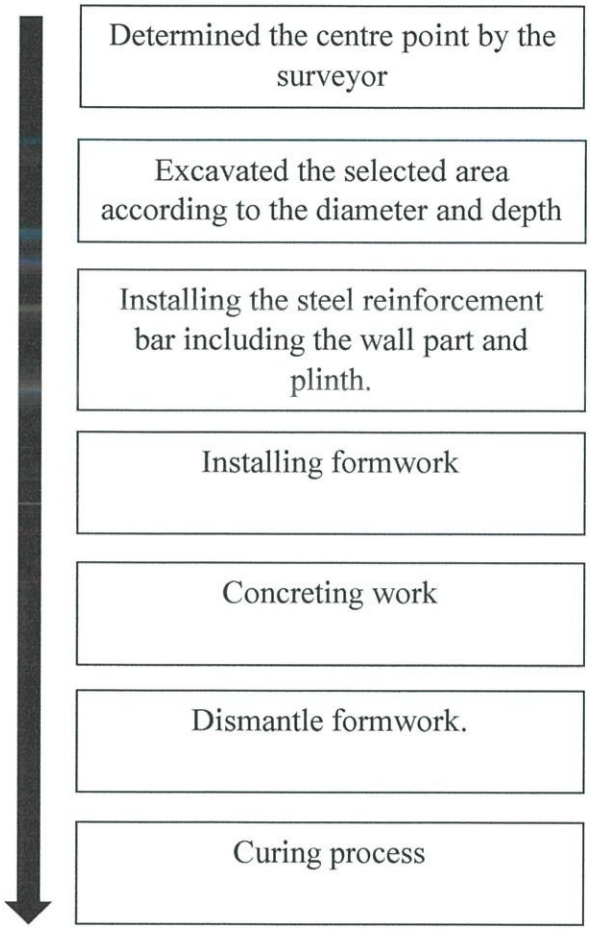


Figure 3.3: shape of the slab

Picture 3.2: view of the slab from above

3.2.1 step of construction of slab

Below is the major step to construct the slab of the tank.



Picture 3.3: installing the formwork

3.3 Function of each tank in Raub Biomass Power Plant

Biomass gasification may allow production of electricity in a renewable energy at high efficiencies. Along with this process, all tanks have their own function to convert waste into electricity. All the tanks in this construction site are placed in the wastewater treatment plant zone. Below are the position and its function of each tank.

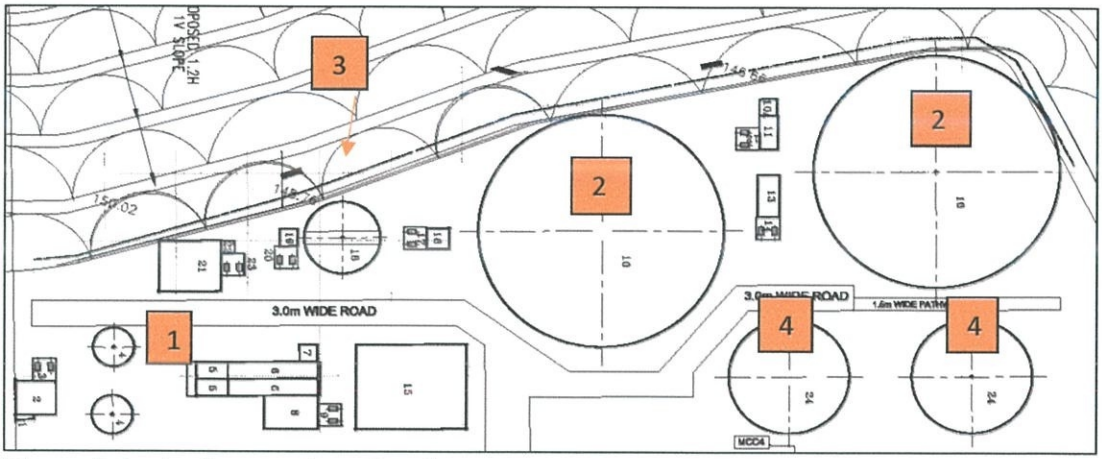


Figure 3.4: site layout plan of tanks area

1. Thickener Clarifier Tank

Function: collect all domestic waste from Raub Biomass Power Plant to be undergo the thickening and clarifying process before it can be sent to anaerobic reactor. Content: domestic waste.

2. Anaerobic Reactor

Function: this tank will be performed in order to reduce waste strength of COD value and produce biogas. Which is this biogas will be used as source to generate electricity for the whole power plant. Content: EFB juice.

3. Sludge Thickener

Function: collect sludge from the thickener clarifier tank to be further treated through thickening process Content: thickened sludge.

4. Gas Holder Tank

Function collect, and stored gas produced in the anaerobic reactor. Content: biogas

3.4 problem facing by the contractor

3.4.1: Bad weather

Bad weather can be a huge problem for the construction site. This may be more affected to the fully outdoor construction. This type of weather may leave the construction work behind the initial schedule. This construction site also facing with this problem. The average of the bad weather in Raub district are high.

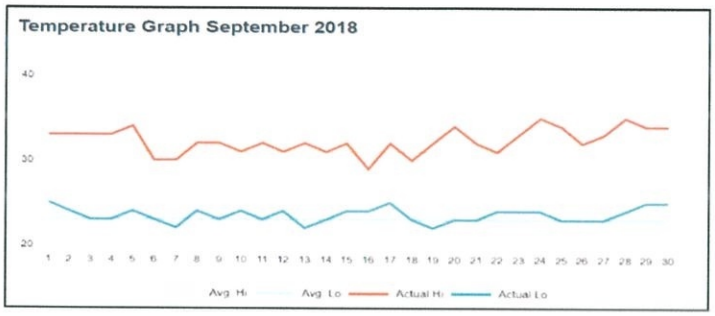


Figure 3.5: temperature graph on September 2018

Source: www.accuweather.com

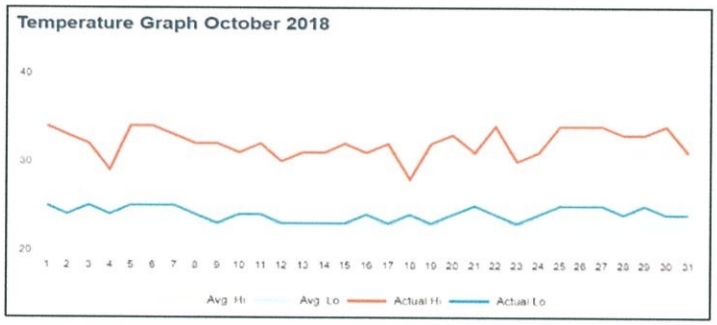


Figure 3.6: temperature graph on October 2018

Source: www.accuweather.com

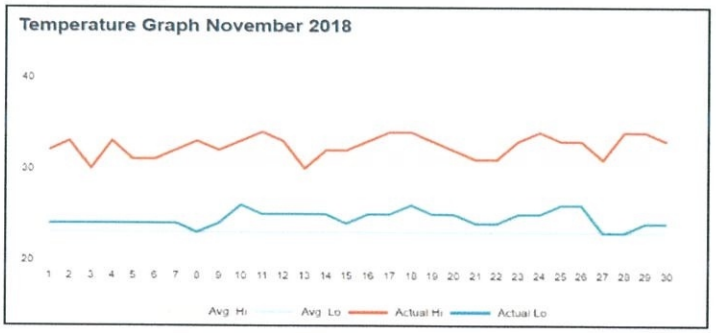


Figure 3.7: temperature graph on November 2018

Source: www.accuweather.com

Along with this average type of weather, it is causing this construction site are delayed from the initial period. The workers cannot take the risk to continue the work during the bad weather. This construction site is fully outdoor and rebar work are still in the process.

The rain also causes the bottom of the slab are full of water and covered with mud. The flowing rainwater brings along mud from the slope site. It causes the workers unable to continue the work properly even though the rain is over. Excavate work also must postponed the excavate work until get a proper weather. This is because the heavy rains can cause the ground to become sodden and may cause high risk to the excavator.

The solution for this problem is we need to dig a temporary drain to prevent rainwater flowing from the slope directly into the slab. All rainwater is in the slab need to pump out before starting the rebar work. All mud needs to clean before the concrete work done.

picture 3.4: water pump out

picture 3.5: built the temporary drain

picture 3.6: cleaning the mud

3.4.2: Wrong marking centre point

During the surveyor work, this type of problem must be avoided by any workers. This may lead to the wasting time. During this construction work, the surveyor marks the centre point of tank at the wrong place. This problem causes the position of the slab is offset 400mm further from the actual place.

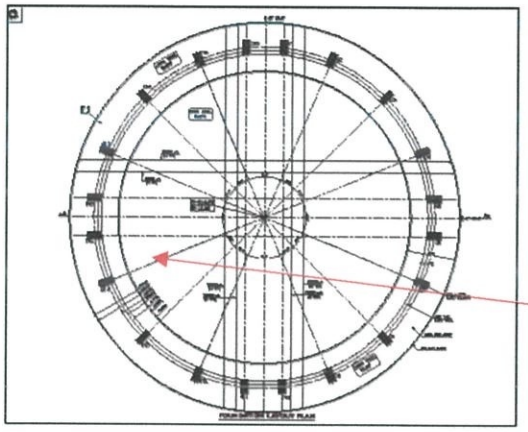


Figure 3.8: plan view of anaerobic reactor

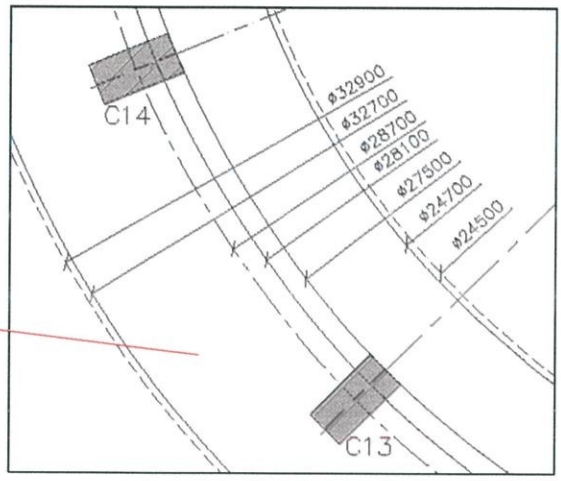


Figure 3.9: plan view of anaerobic reactor zoom version

The actual design of the wall steel bar to the outer slab are 2300 mm length by not adding the lean concrete length. But in work site, we managed to get only 2000mm length. This may cause risk to the slab because it might not able to bear the load from the tank.

picture 3.7: actual distance of slab

picture 3.8: actual distance of slab

The solution of this problem is we excavated the ground with excavator another 1500 mm length. Adding the crusher run until it same level with the lean concrete. Adding additional reinforcement steel bar to get the length of diameter of tank back.

picture 3.9: excavate work

picture 3.10: pouring the crusher run

picture 3.11: adding steel reinforcement bar

picture 3.12: adding steel reinforcement bar

3.5 method statement for the construction of slab of tank.

3.5.1 construction of slab of tanks until installing of formwork.

NO	OPERATION	SEQUENTIAL DIAGRAM	MACHINERY & PLANT	LABOUR	EQUIPMENT	DURATION
1.	Surveyor survey the selected centre point of the tank		-	- surveyor	- theodolite	1 Day

2.	Excavate the ground according to the size of the tank. The diameter of the tank is 35 meters by adding the walkway and the depth of the slab is 3 meters.		- excavator	-excavator operator	-	2 weeks

3.	Pouring the crusher run while compacted it.	 	-Compactor -exvatator	-excavator operator -3 unskilled workers	- scope	2 Days

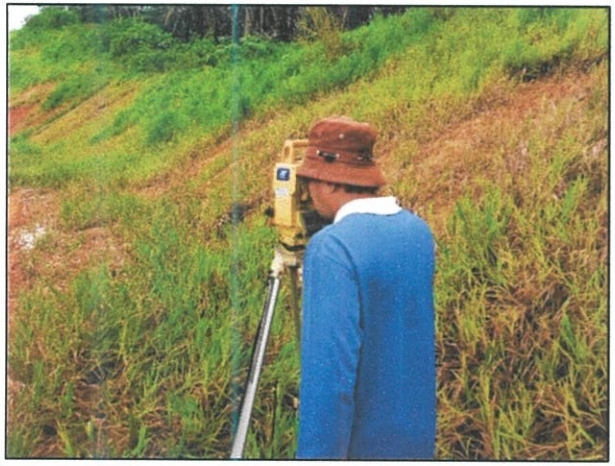
4.	Checking the level BL=137.7.		-	-1unskilled worker -1 skill worker	- levelling -staff	1 Day
5.	Marking point for the lean concrete. The point is at 100mm up the ground level.		-	-2 unskilled workers	-Measuring tape -Masking tape	1 day

6.	Pouring the lean concrete at the tank. The thickness of the lean concrete is 100mm.	 	-Lorry cement -excavator	-Excavator operator -1 skilled worker -3 semi-skilled workers	-Shovel -trowel	1 day

7.	Placing the reinforcement bar at the bottom of the foundation. Using the T12@100 c/c. put the spacer block below the reinforcement bar to isolate the reinforcement bar from the lean concrete. All reinforcement bars are tied with iron wire every intersection.	 	-	-5 semi-skilled workers	-Measuring tape -Tying tool for rebar	3 Days

8.	Bar cutting and bar bending according to the length and shape.	 	-Bar bender -Bar cutter	- 6 unskilled worker	-Measuring tape	3 days

9.	Placing the 'n' shaped reinforcement bar for isolate the bottom reinforcement bar from the top reinforcement bar		-	-5 semi-skilled workers	-Tying tool for rebar	2 days
10.	Installing the reinforcement at the top and bottom of the slab also for the wall part.		-	-5 semi-skilled workers	-Tying tool for rebar	3 weeks

11.	Surveyor marking the position of the column.		-	-surveyor	-theodolite	1 day
13.	Installing formwork. Adding some support to keep the formwork strong.		-	-5 skilled workers	-Hammer -Saw -Nail	2 weeks

Chapter 4.0

CONCLUSION

4.1 conclusion

Throughout this project, the construction progress at Raub Biomass Power Plant going well and follow the right procedure. all works during the tank's construction are follow step by step to prevent any work overlap.

All tank functions are well understood to facilitate during the construction of the tank. Workers need to know what they are built because this is not an ordinary tank. All work must follow exactly to the drawing to prevent any leakage to the tank later.

Even though there was problem that occurs during the construction, all the problem was handled as fast as possible to prevent any delay of time on worksite. For example, managed to build the temporary drain to handle problem of rainwater.

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Appendix