



DEPARTMENT OF BUILDING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

ROADWORK CONSTRUCTION

Prepared by:

MUHAMMAD AZWAN ARASH BIN WAN SALMAN

2017206776

DEPARTMENT OF BUILDING
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

DECEMBER 2019

It is recommended that the report of this practical training provided

by

MUHAMMAD AZWAN ARASH BIN WAN SALMAN

2017206776

entitled

**ROADWORK CONSTRUCTION FOR PROPOSED DEVELOPMENT OF
ELMINA WEST**

be accepted in partial fulfilment of the requirement for obtaining the Diploma in Building.

Report Supervisor : Cik. Jannatun Naemah Binti Ismam

Practical Training Coordinator : En. Muhammad Naim Bin Mahyuddin.

Programme Coordinator : Dr. Dzulkarnaen Bin Ismail.

**DEPARTMENT OF BUILDING
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
(PERAK)**

DECEMBER 2019

STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at Pembinaan Tetap Teguh Sdn Bhd for a duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. 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.

.....

Name : MUHAMMAD AZWAN ARASH BIN WAN SALMAN

UiTM ID No : 2017206776

Date : 20 DECEMBER 2019

ACKNOWLEDGEMENT

I would like to extend my heartfelt gratitude for the guidance, advice and help rendered throughout the period of training by the following group of amazing individuals. First and foremost, I would like to thank Ir Pua Aik Hong and his team for the opportunity given, to conduct my training in his esteem company. His team of professionals 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, roadwork and civil works.

I wish to bid many thanks to my supervisor, En. Muhammad Azri Bin Zaharullil the site supervisor along with En. Khamizi Abdillah Bin Abu Kasim the project manager helped me on gaining my knowledge, wisdom and working etiquettes that will aid me on applying all this information in my future working experience. I would like to acknowledge with much obligation to the crucial roles of the staff from the group Cost and Contract, Procurement and Purchasing, Land Surveying Unit and Planning Department, who had given helpful advice in my practical training

I would also like to thank all the UiTM lecturers that have taught and nurtured me in becoming a better student and person. I would also like to extend my deepest appreciation to the lecturers who are directly involved during my training. To Cik. Jannatun Naemah Binti Ismam, Supervising Lecturer, En Muhammad Naim bin Mahyuddin, Practical Training Coordinator and Dr. Dzulkarnaen bin Ismail, Programme Coordinator, I value the time, effort, encouragement and ideas 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.

Finally, my special thanks to my beloved parents for their sacrifices over the years.

Thank you so much.

ABSTRACT

As part of future improvement, road is very important for vehicle to connect each one and another from place to place. Therefore, this report will discuss about roadwork construction for the future development of commercial building and residential building at the surrounding of the construction. The aim for this study is to observe the sequence of road construction in the project. The objective of this report is to determine the factors should be considered in roadwork construction consist of material and machineries to be used during the layer of pavement and from the ground level. To describe the method what was done is the surface of soil had created a well smooth, wide-ranging, and level surface by motor grader and back pusher. It spread the soil and then flattens that soil. The most important consequences of the work when the pavement layer of finishing had been laid, the road must have enough force to support or counter back the ton of load from the vehicle. In chapter three, in the process of observation would like to know about other technique and another new thing as well as the test that need to do for road layer.

CONTENTS	PAGE NO
Acknowledgements	i
Abstract	ii
Contents	iii
List of Tables	iv
List of Figures	v
CHAPTER 1.0 INTRODUCTION	
1.1 Background and Scope of Study	1
1.2 Objectives	1
1.3 Methods of Study	2
CHAPTER 2.0 COMPANY BACKGROUND	
2.1 Introduction of Company	3
2.2 Company Profile	4
2.3 Organization Chart	5
2.4 List of Project	
2.4.1 Completed Projects	6
2.4.2 Project in Progress	7
CHAPTER 3.0 ROADWORK CONSTRUCTION FOR PROPOSED DEVELOPMENT OF ELMINA WEST	
3.1 Introduction to Case Study	8
3.2 Factors should be considered in road construction	9
3.3 Methods of roadwork construction.	11
CHAPTER 4.0 CONCLUSION	
4.1 Conclusion	19
REFERENCES	

LIST OF TABLES

Table 2.1	Staff Percentage by Race (Pembinaan Tetap Teguh Sdn Bhd Website)	4
Table 2.2	Completed Project (Pembinaan Tetap Teguh Sdn Bhd Website)	6
Table 2.3	In Progress Project (Pembinaan Tetap Teguh Sdn Bhd Website)	7

LIST OF FIGURES

Figure 3.1	Key Plan and Location Plan	8
Figure 3.2	Construction site 1 and construction site 2	9
Figure 3.3	Motor Grader	10
Figure 3.4	Back Pusher	10
Figure 3.5	Road Roller	11
Figure 3.6	Truck	11
Figure 3.7	Wheel Loader	11
Figure 3.8	Hydraulic Excavator	12
Figure 3.9	Tandem Roller	12
Figure 3.10	Paver Machine	13
Figure 3.11	Pneumatic-Tyred Roller	13
Figure 3.12	Thermometer	14
Figure 3.13	Steel Rod	14
Figure 3.14	Crusher Run	15
Figure 3.15	Sand	15
Figure 3.16	Tack Coat	16
Figure 3.17	Premix	16
Figure 3.18	Hydraulic Excavator	17
Figure 3.19	Back Pusher	18
Figure 3.20	Motor Grader	18
Figure 3.21	Roller Drum	19
Figure 3.22	Eyewitness by Consultant	19
Figure 3.23	Back Pusher Spreading	20
Figure 3.24	Granular Result of Soil Moisture Data from TRU Testing	20
Figure 3.25	Spreader Crusher Run	21
Figure 3.26	California bearing ratio (CBR)	22
Figure 3.27	Field Density Test	22

LIST OF FIGURES

Figure 3.28	Thickness Data Report	23
Figure 3.29	Excavate and Measure The Thickness of Crusher Run	23
Figure 3.30	Premix Temperature Test	24
Figure 3.31	Premix Thickness Test	24
Figure 3.32	Fresh premix transfer to Paver Machine	25
Figure 3.33	Spread Premix	25
Figure 3.34	Tandem Roller Compacting	16
Figure 3.35	Pneumatic Tyre Roller Compact for Final Finishing	16

CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

A road is a thoroughfare, route, or way on land between two places that has been paved. Road design is part of highway design. Road design is designing a road for its environment in order to extend its longevity and reduce maintenance. The shell pavement method is used in many countries for the design of new asphalt roadsides. Roads are designed and built for primary use by vehicular and pedestrian traffic. (Wikipedia, 2018)

National highways are main roads of a country. They connect all major cities to the capital of the country. They run throughout the length and breadth of the country. State highways are second main roads which connect major parts of state with in it. State highway ultimately connects to the national highways. Village roads connects the nearby villages with each other. They lead to nearby town or district roads. Usually low-quality roads are provided as village roads because of low traffic. (Anupoju,2016)

In Malaysia, road constructions have begun since before independence. Before 1957, there has been a road system linking Johor Bahru in the south with Kangar in the north and Kota Bharu in the East Coast, connecting main cities between the other cities. After the country gained independence in 1957, efforts to improve the road system has been done properly and through the rapid development planning, especially Malaysia Plan every five years which was launched by the Federal Government.

The road construction for proposed development of Elmina West. This study was focusing on top-down method layer by layer from earthwork. The methods for this study include the common machineries used in the construction work and the type of pavement layer that they use. This study may include Field Density Test (FDT), California Bearing Ratio (CBR Test), Crusher Run Thickness Test (CRTT) for the road specifically for residential area.

1.2 Background and Scope of Study

This study was carried out in Elmina West, Shah Alam, Selangor. It is a road project for future residential project. The project has been developed by Sime Darby Cooperation. However, in this study will be more focused on the quality of material and quality of workmanship include the practice on site to ensure the quality of materials and the workmanship and supervision for road construction project at Elmina West, Shah Alam, Selangor. The methods that has been studied starting from construction of soil based, compaction, crusher run and layer of premix. There are some machineries that has been used for instances, motor grader, back pusher, hydraulic excavator, pneumatic roller and drum roller.

1.3 Objectives

- i. To determine the factors that should be considered in road construction.
- ii. To study the methods of roadwork construction.

1.4 Method of Study

Data collection methods:

i. Literature review

The review from a few journals about road construction can gain some new interesting fact about roadwork. The journals also give a point about using recycled aggregate in road construction base on the standards and technical regulation. Based on these journals can also apply on site.

ii. Observation

Method of constructing the roadwork are from subgrade, subbase and base course. It is layer by layer by different material such as sand, crusher run, binder course and pavement. In this observation it took about a month for me to involve in this construction until the final layer. The observe was record on picture and written note during the construct.

iii. Interviews

The interview was taking place at the construction site during the construct of roadwork. Interviewed site supervisor about how the road from subgrade to road base. Site supervisor explains based on drawing first then explain on site. The thickness of sand and crusher run needed are also explain in the sequence of laying the material.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Pembinaan Tetap Teguh (PTT) is one of the Malaysia's leading construction company, specialized in Earthworks and Infrastructure works. This company focus on green and environmental - friendly construction, work ethics, occupational health and safety, PTT offers competitive creative solutions not least for the most challenging and impactful assignments. PTT is an ISO certified company in ISO 14001 :2004, ISO 9001:2008 and OHSAS 18001:2007. PTT also registered with CIDB as a G7 Contractor. PTT being the 1st fleet owner of Caterpillar 745C Articulated Truck & one of the largest fleet owners of Caterpillar heavy equipment in Malaysia.

PTT are one solid company, a strong team with five Major Achievements Visionary Leadership, Solid Teamwork with mutual trust, Strong Commitment, Dynamic Excellence, Creative Partnerships.

This company have just celebrated his 15th Anniversary recently, they are committed in putting more collaborative efforts in making this company the top choice in this competitive industry, and also look forward to fulfilling the market's renewed demands and positive expectancy. PTT's philosophy is to offer real value to its clients and work with them in close and lasting co-operation that provides outstanding performance in relation to the maintenance, innovation and expansion of built-up environments. PTT is recognized and acknowledged for the quality and reliability of its products and services as well as for the commitment, knowledge and experience of its dynamic employees.

The company vision is to be one of the most preferred Civil Works Contractor in South East Asia specializing in earth works, roads constructions and infrastructure works. The mission is understanding the needs of our clients and deliver the works on time, of good quality and cost efficient

2.2 Company Profile

As Henry Ford said, “Coming together is a beginning, Keeping together is progress, Working together is success”. Let’s build a bright future together. We warmly welcome you to the exciting new world of success in PTT “TOGETHER WE MAKE IT HAPPEN”

PTT department is an interdependent collection of individuals who work together towards a common goal and who share responsibility for specific outcomes of our organization. There are many components to becoming a top performing team, but we believe in working on highly cooperative relationship. We are committed to create a relaxed and comfortable atmosphere where members can be themselves and are engaged and invested in the project work. All team members are encouraged for relationship building. Each member is responsible to give constructive feedback, reorganizations, values and utilization of unique strengths of each other. Our team is tuned on and built upon Trust, Harmonious Cooperation and Solid Teamwork.

“With dynamic Leadership and unwavering Teamwork, we are committed in striving for more meaningful and measurable success in our near future. See you guys at the Top of Excellence and progressive Achievement!” a quotation from Ir. Pua Aik Hong, Chief Operating Officer.

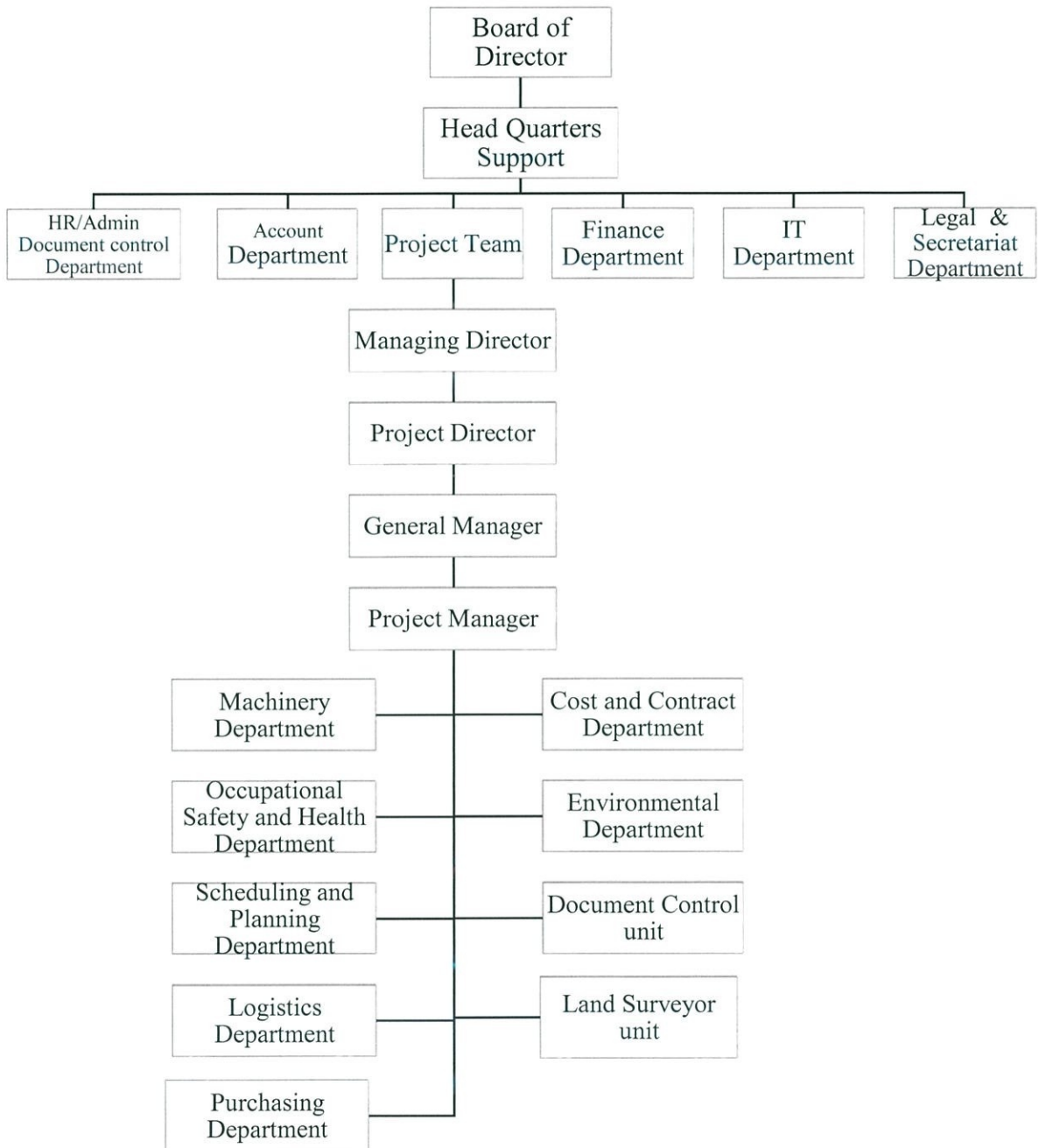
Table 2.1: Staff Percentage by Race

Race	Percentage
Bumiputra	63.90%
Chinese	29.00%
Others	7.10 %

(Source: Pembinaan Tetap Teguh Sdn Bhd Website)

2.3 Organisation Chart

The organization are based on the company chart



(Source: Pembinaan Tetap Teguh Sdn Bhd Website)

2.1 List of Project

Table 2.2: Completed Project

NO	PROJECT	AGENCY	YEAR	CONTRACT	
				VALUE (RM)	VALUE (RM)
1	The Construction and Completion of Bridge 1 and Associated Works at Persiaran Atmosfera in Elmina East Development, Shah Alam, Selangor Darul Ehsan.	SIME DARBY	2018	6,099,000	Million
2	The Construction and Completion of Main Infrastructure Works and Tnb Sub-stations at Phase 2 (Northern Area) of Elmina East Development, Shah Alam, Selangor Darul Ehsan.	SIME DARBY	2018	28,660,826	Million
3	Description: Proposed Construction and Completion of Main Infrastructure Works (Road, Drainage, Water Reticulation, Sewerage, Vehicular Bridge (Bridge No. 3), Bridge Crossing for Sewer Pipe, Street Lighting, Telephone and Ancillary Works) for Access to E&O (Part of Phase 1A-Parcel 3) for Proposed Development of Elmina West on Lot 368, PT50037 (Part of Old Lot 360), Lot 2132, Mukim Sungai Buloh and Lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor Darul Ehsan.	SIME DARBY	2018	38.5	Million
4	Proposed Construction and Completion of Roadworks, Detention Pond, Main Drain, Bridge, Utilities and Other Associated Works (Package 1b) for The Proposed Development of Ampar Tenang, Mukim Dengkil, Daerah Sepang, Selangor Darul Ehsan - for Stage 1		2017	73.0	Million
5	Proposed Flood Mitigation Works for The Proposed Development of Elmina West, Lot 368, Pt50037 (Part of Lot 360), Lot 2132, Mukim Sungai Buloh and Lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor Darul Ehsan.	SIME DARBY	2017	37,685,290	Million

(Source: Pembinaan Tetap Teguh Sdn Bhd Website)

Table 2.3: Project in Progress

NO	PROJECT	AGENCY	YEAR	CONTRACT	
				VALUE (RM)	VALUE (RM)
1	Proposed Construction and Completion of Phase 1 Water Supply System Consists of 2.5MG Reinforced Concrete Reservoir, 2.0MG Reinforced Concrete Suction tank, Pump House, Incoming Main, Pumping Main, Falling Main, Access Road to Reservoir and Suction Tank (Road, Drainage, Water Reticulation, Street Lighting, Telephone) and Ancillary Works for Proposed Development of Elmina West on Lot 368, PT50037 (Part of Old Lot 360), Lot 2132, Mukim Sungai Buloh and Lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor Darul Ehsan.	SIME DARBY	2018	35.2	Million
2	Description: Proposed Construction and Completion of Earthworks, Main Drain, Retention Pond A1 & A2 and Ancillary Works (Phase 1B/1 for Elmina Green) for Proposed Development of Elmina West on Lot 368, PT50037 (Part of Old Lot 360), Lot 2132, Mukim Sungai Buloh and Lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor Darul Ehsan.	SIME DARBY	2018	42.5	Million
3	Proposed Construction and Completion of Earthworks, Main Drain, Retention Pond J and Ancillary Works (Phase 1a/1 For Connection To Gce) for Proposed Development of Elmina West on Lot 368, Pt50037 (Part Of Old 360), Lot 2132, Mukim Sungai Buloh and Lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor Darul Ehsan.	SIME DARBY	2018	-	
4	Proposed Construction and Completion of Earthworks and other Related Works for Development of Phase 2 (R11A & R13), at Bandar Bukit Raja 2, Mukim Kapar, District of Klang, Selangor Darul Ehsan for Messrs. Sime Darby USJ Development Sdn Bhd.	-	2017	-	
5	Proposed Construction and Completion of Roadworks, Detention Pond, Main Drain, Bridge, Utilities and Other Associated Works (Package 1b) for The Proposed Development of Ampar Tenang, Mukim Dengkil, Daerah Sepang, Selangor Darul Ehsan	-	2017	-	

(Source: Pembinaan Tetap Teguh Sdn Bhd Website)

CHAPTER 3.0

ROADWORK CONSTRUCTION FOR PROPOSED DEVELOPMENT OF ELMINA WEST

3.1 Introduction to Case Study

The project that are ongoing is roadwork construction monitored by the site supervisor and site engineer. The name of the project is to proposed construction and completion of main infrastructure works (road, drainage, street lighting, telephone and ancillary works) for main road to reservoir, suction tank and Elmina Vally -EV5 (part of phase 1A-Parcel 4) for proposed development of Emina West on lot 368, pt50037 (part of old lot 360), lot 2132, Mukim Sungai Buluh and lot 2685, Mukim Bukit Raja, Daerah Petaling, Selangor. The sequence of the project is from the earth work to the layer of pavement. Name of the new road is “Jalan Shorea U15/35A”and “Jalan Shorea U15/35” at Elmina West Shah Alam Selangor as in figure 3.1 key plan and location plan. The project starts from 2 Febuary 2017 until end of November 2019 but had apply extension of time (EOT) no 7 and the project was 90% completed with total of 10 million ringgit. This study was focused on the roads at Elmina West – EV5 (part of phase 1A-Parcel 4). The premix work will be complete as well as the time spent but will depends on the situation surrounding such as weather and capability of workers.



Figure 3.1: Key plan(left) and location plan (right)

3.2 Factors should be considered in road construction

The principle goal of this underlying period of road construction is to build up explicit objectives for road network development along with the more general location needs. There are three factors should be considered in road construction during my practical training which is location of site or type of soil, machinery and materials that was used during the construction.

i. Location of site and type of soil

This project was located at “Jalan Shorea U15/35A” and “Jalan Shorea U15/35” –Ev5 (Part of Phase 1A-Parcel 4) Elmina West as in figure 3.2. Long ago the site was located deep in the oil palm plantation by Sime Darby. The location had been turned into land of development for the future. Therefore, the subgrade had been compacted to make it stable to withstand the load from above. Throughout the study the soil had to take a field density test (FDT) and send it to the lab to calculate the moisture and dry density content.



Figure 3.2: construction site 1 construction site 2

ii. Machinery and Tools

The second factors that are considered in roadwork are the machinery. The machinery that are used in constructing the road are motor grader, back pusher, soil compactor, wheel loader and truck. The motor grader as shown in figure 3.3 was indicate the machine used to create a well smooth, wide-ranging, and level surface. The machine also named as road grader are used to spread fill and trim the soil. They consist of a blade which can rotate in a about a sub horizontal axis and can support below a longitude frame between to the front steering wheels and the back-drive wheels. The front wheels are usually attached against the back wheels are set in

tandem under the motor. The blade is used to trim the soil and motor graders usually operate in going forward direction.



Figure 3.3: Motor Grader

The next machinery is back pusher as shown in figure 3.4. The back pusher is a multi-purpose machine mainly for pushing and spreading uneven soil, sand and crusher run. The machine also can equip angle broom sweeper and it was very efficient to cleans, polishes, and smooth gravel.



Figure 3.4: Back Pusher

In figure 3.5 below is a road roller. Soil compaction is required for the improvement of the subsurface and the finish level of a road. Compaction and the surface smoothness are very important. Basically, the roller drum weight is used for the compaction of the surface that need to be compacted. The compaction is required using roller with tires. The wheels are flexible for some vertical movement and that enables the roller to operate on an unlevel ground surface. After that, the final road surface finish is obtained using rollers with metal drums.



Figure 3.5 Road Roller

Material on site such as crusher run, and sand are carried by truck as in figure 3.6 from material on site using wheel loader as in figure 3.7 to fill the truck with the material.



Figure 3.6: Truck



Figure 3.7: Wheel Loader

Excavator machine are used to dig out surface soil and to make the road level based on peg form surveyor (figure 3.8 excavator).



Figure 3.8: Hydraulic Excavator

In my observation the previous machinery uses more on subgrade and subbase layer. On the other hand, machinery and tool that are used for base course are tandem roller, paver machine, pneumatic-tyred rollers, thermometer and steel rod. As in figure 3.9 tandem vibratory rollers are usually used to compact paving materials, such as premix.



Figure 3.9: Tandem Roller

These machines have two steel drums that vibrate. The machine also can be adjusted to the frequency and amplitude of the vibratory action. Next, is paver machine in figure 3.10. This machine used to lay pavement on roads as it lays the premix flat and provide small compaction before it is compact by a roller. In front of the machine are called paver's hopper that are receiving stockpile of fresh pavement then it transfers to auger by rubber belt that are called conveyer. The auger put a stockpile

of fresh premix in front of the bucket. The bucket takes the stockpile of material and spreads it over the width of the road and provides good compaction.



Figure 3.10: Paver Machine

The third machine is the pneumatic-tyred roller as in figure 3.11. The machine gives squeeze action such as compression to the earth soil. It consists of a base or a platform. The back of the machine has more wheel than the front. Using water or sand blasting to increase the self-weight.



Figure 3.11: Pneumatic-Tyred Roller

Tools that are used in laying premix are thermometer to check the suitable amount of heat of premix and steel rod to check the thickness after the premix had been laid as in figure 3.13 and figure 3.14.



Figure 3.12: Thermometer



Figure 3.13: Steel Rod

iii. Materials

The common materials that are used in roadwork are crusher run, sand, tack coat, and premix. In figure 3.14 the crusher run stone is a quarried material that is crushed to sizes. It has the fines, or dirt, left in it which causes the stones to bind together which makes it the perfect for road. It is the most strong and good material that you can use to construct a road. The crushed stone and the dust particle will naturally stick to one another, forming a strong bond that will prevent pieces from changing and spreading. In addition, sand are used for levelling the surface in figure 3.15.



Figure 3.14:Crusher Run



Figure 3.15: Sand

A layer of tack coat also known as bond coat. It is a light surface of asphalt emulsion between hot premix layers designed to make a strong sticky bond as in figure 3.16.



Figure 3.16: Tack Coat

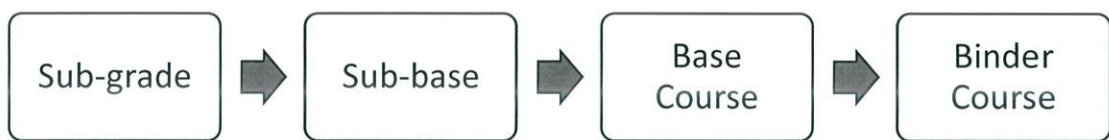
As in figure 3.17 premix usually refers to a substance or object which is mixed in an early stage in the manufacturing. It is something that is mixed or blended from two or more ingredients or elements before being used. There are two type of premix that are used in this project which is asphalt concrete binder course (ACBC) and asphalt concrete wearing course (ACWC).



Figure 3.17 Premix

3.3 Methods of roadwork construction.

Every structure starts from ground base to the top or final process. The basic construction process for building a road is similar for any road. The process begins with road design, including surveying the alignment, allowing for drainage and considering the expected volume of traffic and planned development in the area. Next, the important base layers are completed using graders, back pusher and compactors, and then the surface layer is applied. The diagram below shows sequence and layer by layer of road construction.



3.3.1 Sub-grade

Before starting the construction process, site clearance has been done along the way base on drawing and alignment of peg that had been done by the site surveyor. Hydraulic excavator in figure 3.18 can dig out current soil to sub-base level. From the road level to sub-base are about 0.540-meter follow with another layer on top of the sub- base. The thickness of the road depends on the width. In my case study the width of the road are 7.3 meters.



Figure 3.18: Hydraulic Excavator

With the help of back pusher machine can push away the soil after hydraulic excavator dig out unwanted level of soil as in figure 3.19.



Figure 3.19: Back Pusher

The process of removing the soil are also used motor grander. The motor grander machine (in figure 3.20) was used to create a smooth, wide-ranging, and level surface. The machine consists of a blade which can rotate in a circular arc to make it easier to level the ground. It spread the soil and then flattens the uneven soil.



Figure 3.20: Motor Grander

After achieving the required level of sub-grade, the roller drum weight in figure 3.21 is used for compression of the surface to be compacted. The compaction of soil needs to strengthen the bond of the soil. The machine also pushes away some moisture content in the soil. Only machine operator is being used to construct the road. To construct the sub-base also depends on the weather. If its rain the sub-base need to be dry by natural sunlight due to high moisture content in soil. Then roller drum had to compact back after drying the surface.



Figure 3.21: Roller Drum

There will be field density test (FDT) for sub-grade after the compaction of soil. The purpose of the test is to calculate the moisture content and density of sub-grade after compaction. In calculation to pass the test is 95% above then the next layer of sub-base can be lay. If the test failed, then the sub-grade needs to be compact again. During the test an eyewitness from consultant sir Azamie and site supervisor is needed has shown (in figure 3.22) while the test is taking by the workers.



Figure 3.22: Eyewitness from Consultant

The test will be taking the sub-grade sample consist of soil and sand by Truth Testing company and send it to the lab. The sample of the test should be more then tree or four due to the area of the sub-grade that had been compact. There will be tree to four data shown the result of the soil moisture where the soil had been taken in figure 3.23 below. The consultant should sing the document after the test had ended for approval.

TRU TESTING SDN BHD		FIELD DENSITY TEST (SAND REPLACEMENT METHOD)		JALAN SAMANEA	
Date Sample: 21.11.2019					
PROPOSED CONSTRUCTION AND COMPLETION OF EARTHWORKS, MAIN DRAIN/RETENTION POND AT RAJ AND ANGLIARY ROAD (PHASE 1B) FOR ELMINA GREEN FOR PROPOSED DEVELOPMENT OF ELMINA WEST ON LOT 369, PT 50057 (PART OF OLD LOT 369), LOT 2132, MUKIM SINGAI BULOH AND LOT 2685, MUKIM BUKIT RAJA, RAJA, DAERAH PETALING, SELANGOR DARUL EHSAN					
Engineer: HANIFILL CONSULTING SDN BHD		Date Test: 22.11.2019		Ref Sample No: S2A	
Contractor: PEMBINAAAN TETAP TEGUH SDN BHD		Tested By: Thiva & David		Maximum dry density: 1.977 Mg/m ³	
Description of soil: Light Brownish Sandy Silty CLAY with Little Gravel		Bulk Density of calibrating sand (ρ _s): 1.30		Optimum moisture content: 18.8 %	
Depth of hole excavated: 150mm					
Sample No:	1	2			
Reduce Level:	T	T			
Container No:					
Weight of soil from hole (W _s):	g	2415	2536		
Weight of sand before pouring (W ₁):	g	3000	3000		
Weight of sand after pouring (W ₂):	g	1139	1063		
Weight of sand in cone (W ₃):	g	390	390		
Weight of sand in hole (W ₄ = W ₁ - W ₂ - W ₃):	g	1471	1547		
Bulk density P = $\frac{W_4}{V_4}$:	Mg/m ³	2.13	2.13		
MOISTURE CONTENT					
Container No:		T12	U10		
Weight of wet soil + Container (M ₁):	g	97.6	94.2		
Weight of dry soil + Container (M ₂):	g	89.6	87.2		
Weight of Container (M ₃):	g	28.6	29.3		
Weight of Moisture (M ₄ - M ₃):	g	7.9	7.0		
Weight of dry soil (M ₂ - M ₃):	g	61.0	57.9		
Moisture content (w = $\frac{M_4 - M_3}{M_2 - M_3} \times 100$):	%	13.0	12.1		
DRY DENSITY					
Dry Density P _d = $\frac{100 P}{100 + w}$:	Mg/m ³	1.80	1.90		
Relative compaction:	%	95.6	96.2		
Specification requirements:	%				
Remarks:					
Checked By:		Main Contractor:			
Name:		Name:			
Position:		Position:			
Date:		Date:			

Figure 3.23: Result of Soil Moisture Data from TRU Testing

3.3.2 Sub-base

After sub-grade had been well compacted, the next layer is sub-base. The process of this layer is almost the same as the sub-grade. The material for this sub-base is the sand or granular. From the stockpile to the construction site are carry with truck that are fill using wheel loader. Sand in meter square are cost 6 ringgits. The truck also dumps the granular evenly on the sub-grade. Next, back pusher shown in figure 3.24 play the role of spreading the granular with 100 mm thickness.



Figure 3.24 Back Pusher Spreading Granular

The thickness can check from the existing layer of soil and the surface of the sub-base. In my observation, roller drum does not need to be compact this sub-base as it will compact with base course.

3.3.1 Base Course

If there is a sub-base course, the base course is constructed directly above this layer. Typical base course thickness also depends on the width of the road. In my case study the thickness of the base course is 375 mm thick of crusher run. Crusher run in meter square are cost 20.70 ringgit. The method for laying the crusher run is the same method as sub-base. After the crusher run had been spread in figure 3.25, the base course was compacted by the roller drum to ensure the strength of the base that can support a heavy load for vehicle.



Figure 3.25: Spreader Crusher Run

After the compaction there will be three type of test on base course which is Field density test (FDT), California bearing ratio (CBR), Thickness inspection of crusher run. California bearing ratio test is a penetration test used to evaluate the subgrade strength of roads and pavements. This is the most common technique for the structure of adjustable premix. Based on my understanding the CBR test is needed to see the pressure that can be taken by the surface of crusher run. There are two pressure meters consist of the pressure that impact on surface and a meter reading of the surface that bounce back pressure to the surface layer. The ratio at 2.5 mm penetration is used as the CBR. In some cases, the ratio at 5 mm may be better than that at 2.5 mm. If this occurs, the ratio at 5 mm should be used. The CBR is a

measure of resistance of a material to penetration of a standard plunger under controlled density and moisture conditions as shown in figure 3.26



Figure 3.26: California bearing ratio (CBR)

Next, As the field density test is also same test method in sub-grade earlier, but the sample will be different which is crusher run will be test the density and moisture content as shown in figure 3.27.



Figure 3.27: Field Density Test

The Third test is thickness inspection of crusher run. In this test sub-base was excavate at four or five point to measure the thickness of crusher run that had been laid as shown in figure 3.28. Lastly laid some tack coat. The report of the thickness also needs to be collected. Data of the report also need to be four check point.



Figure 3.28: Excavate and Measure The Thickness of Crusher Run

JABATAN KEJURUTERAAN
BAHAGIAN KAWALAN INFRASTRUKTUR

**LAPORAN PEMERIKSAAN STRUKTUR LAPISAN JALAN
(PASIR/ BATU HANCUR/ LAPISAN PENGIKAT/ LAPISAN PENGHAUSAN)**
* Sila potong mana yang tidak berkenaan

No. Rujukan Fail : (10)MBSA/KE/TK/A/600-79/2019 (d/b)
Tajuk Projek : Proposed construction and completion of main infrastructure works (Road drainage, water reticulation, sewerage, street lighting, telephone and ancillary works) for main road to reservoir suction tank and Elmida Valley - EV5 (part of phase 1A-1B) for proposed development of Elmida West

Nama Pemilik/ Pemaju : Sime Darby Elmida Development S/B
Nama Perunding : Rashid Bersekutu
Nama Wakil Perunding : En. Velou
No. Telefon Bimbit : 016-336 0027
Tarikh Lawatan : 20/1/18

Bil	Lokasi Lubang	Ketebalan Di Pelan Lulus (mm)	Ketebalan Di Tapak (mm)	Ulasan
1	760 CH RHS	375mm + 100mm	540mm	diterima
2	750 CH LHS	375mm + 100mm	460mm	diterima
3	530 CH RHS	375mm + 100mm	560mm	diterima
4	570 CH LHS	375mm + 100mm	500mm	diterima
} Persebaran } } Elmida }				

Disahkan Oleh:

Figure 3.29 Thickness Data Report

3.3.2 Binder Course

Typical premix pavements consist of two premix layers which are installed successively. The fresh premix will be tested the temperature by using a thermometer in figure 3.30.



Figure 3.30: Premix Temperature Test

Steel rod are used to check the thickness of the premix before setting out the thickness level and after laying the premix at the paver machine (in figure 3.37).



Figure 3.31: Premix Thickness Test

Choosing a suitable binder for the layer is highly important for the whole road structures. Paving a very thick base and a very thin wearing course at standard speeds on the capability of the compact paver machine. A large amount of base course mixture was be placed to the required cross-section line and level. In figure 3.32 fresh premix transfer to in front of paver machine.



Figure 3.32: Fresh premix transfer to Paver Machine

Paver's hopper that are receiving stockpile of fresh pavement then will transfer to auger by conveyor. The auger places a stockpile of material in front of the bucket. The bucket takes the stockpile of material and spreads it over the width of the road and provides compaction as shown in figure 3.33 below.



Figure 3.33: Spread Premix

Next after laying the premix, tandem roller shown in figure 3.34 are used to compact the premix the thick layer was initially rolled with low static load, then compacted four times with vibration and high load and finally smoothed. Compaction forces into the soil. Initial compaction on a road project is done

using a drum roller, which can achieve higher compaction density to the pads having less surface area.



Figure 3.34: Tandem Roller Compacting Premix

Next as shown below figure 3.41 the machines are a pneumatic tyre roller are being used. These rollers consist of two rows front and back of pneumatic tyres that overlap, and the flexibility of the tyres provides squeeze actions that cover the surface and with some vertical movement of the wheels, enables the roller to operate effectively on unstable ground. Once the soil base is flat the pad drum compactor is no longer used on the road surface. The roller can be a simple drum with a handle that is operated by one person. Another worker is used to cover some hole after the premix is being laid. They are only use shovel to scoop some premix and cover the uneven area.



Figure 3.35: Pneumatic Tyre Roller Compact for Final Finishing

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

The research about roadwork had properly taken and were located at Shah Alam, Selangor. In process of investigation, there are step by step to make road structure begin with the sub-grade until the thin layer of wearing course in method of study. Every layer of material must compact make the surface strong to support in the upper load. There are several methods that are uniquely different from theory which is the different type of layer in road depends on the location of the construction. Method of making the roadwork are the same but some road has different type of layer such as highway and residential road. In theory dose not teach about test that was taken such as the field density test, California bearing ratio, crusher run inspection and quarrying test. All the layers must insert and install properly according the required standards. Therefore, the lifespan of the road will become much better or as much as predicted then it can bear all the load according the strength of the road. From this study, also can be concluded that roadwork is also have the method structure to construct with safety and detail of each installation had been made. The users also have realized the importance of the conditions of the road and safety.