



**DEPARTMENT OF BUILDING  
UNIVERSITI TEKNOLOGI MARA  
(PERAK)**

**METHOD OF ROOF CONSTRUCTION**

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**(PERAK)**

**FEBRUARY 2022**

It is recommended that the report of this practical training provided

**By**

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**entitled**

**METHOD OF ROOF CONSTRUCTION**

be accepted in partial fulfillment 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 herein, prepared during a practical training session that I underwent at Huwariz Unggul Sdn Bhd for duration of 20 weeks starting from 23 August 2021 and ended on 7 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

.....

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Thank you.

## ABSTRACT

Roof is one of the most important parts of the building envelope. Therefore, this report will discuss about roof construction for a bungalow house. This report was conducted for a bungalow house located at Kampung Bukit Kapar, Klang. The aim of this report is to identify the method used for the roof construction using steel structure as well as to focus on the cost and time required to construct a roof. It will concentrate more on the procedure of constructing the roof beam and the roof coverings installation. In this project, the roof constructed is a pitched gable roof with steel structures. Every work process is done by the subcontractors from start until finish. In the end, roof construction is trickier than it appears in theory; thus, the construction of roof requires a significant attention as it is the coverings of the uppermost part of the building.

*Keywords: Roof construction, steel structure, method, installation.*

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## CHAPTER 1.0

### INTRODUCTION

#### 1.1 Background of Study

One of the most important aspects of building construction is roof construction. The roof is the component of the building envelope which is the coverings of the uppermost part of the building. It is an assemblage of materials used to provide protection for homes, buildings, commercial, and industrial. There are varieties of roof types and methods of construction using various of materials and technologies. A properly design and built roof provides a protection to the structure beneath it from the elements, provides structural support for superimposed loads, provides diaphragm strength to keep the structure below in shape, represses fire spread, and meets favored aesthetic criteria. A roof construction is an accumulation of layers and various materials that are placed on and attached to the roof deck. Every type of roof construction differs from each other, there are numerous design requirements, and construction methods. It is related to water entry from rain, snow, ice, as well as insulation for temperature change, fire propagation, wind uplift, and moisture migration.

There are several classifications of roof, which are pitched roof, flat roof and curved roof. Pitched roof is when top surface roof is slopping. Usually in two parts at an angle from a central ridge, but sometimes in just one part, from one edge to another. A roof's 'pitch' is its vertical rise divided by its horizontal span and is a measure of its steepness. A pitched roof is defined as a roof with a pitch greater than 20 degrees and less than or equal to 70 degrees. The types of pitched roof are mono pitch roof, couple roof, closed couple roof, collar roof, purlin roof, large section truss, and trussed rafter. Meanwhile the flat roof is when the top surface of a roof is flat. Flat roof can be constructed to the buildings of any shape and size, having longer span and larger areas. The main distinction in roof types is between pitched and flat roofs; a roof is considered pitch if it slopes more than 5 degrees(Safran, 2019). Lastly, curved roof is when the top surface of the roof is curved in shape. Cylindrical, parabolic, and dome like shape are usually used in curved roof.

There are many types of roof construction, however, the aim of this study is to discover the method of constructing pitched gable roof with trussed rafter using steel struts for a Banglo house. The roof construction was carried out for 2 weeks including the roof coverings and flashing.

## **1.2 Objectives**

The objectives of this study are as follows:

- i. To investigate the procedure of constructing roof beam.
- ii. To study the procedure of roof trusses installations.
- iii. To investigate the cost and time required of installing roof.

## **1.3 Scope of Study**

The title of the project is “Cadangan Membina dan Menyiapkan Kediaman Sesebuah di Atas Lot 4035, Jalan Rebung, Setia Jaya, Kg. Bukit Kapar, 42200 Kapar, Klang, Selangor Darul Ehsan.” by Huwariz Unggul Sdn. Bhd. This project consists of constructing a Banglo House for a client with a contract value of RM155,000.00 in a period of time of 6 month, the scope of study for this project is the method of constructing pitched gable roof with trussed rafter using steel struts. From the measurements to the materials calculation until the construction of the roof is studied and investigated in every detail. The number of labors, time and cost is documented along the process of construction.

## **1.4 Method of Study**

### **1. Observation**

Site visit with the Project Manager and Site Officer to observe the commencement of construction works. Every works is carefully observed and any data gathered on site is recorded down in a notebook in order to gather any new information.

The labors and the Project Manager explained all of the work along the construction process to help better understanding. For future references, an important picture of the construction progress is taken.

### **2. Interviews**

An unstructured interview is held during the site visits alongside with observations. The works conducted on site is distinguished and referred to the Project Manager to learn any new information upon handling construction projects.

Weekly meeting is conducted to discussed about project progress and any question regarding the roof construction is presented.

### **3. Document Reviews**

The drawing plan is reviewed with the Project managers and laborers in order to commence the construction. Details about the construction contract is acknowledged to gather as much information about the construction. Alongside with progress report of the construction.

## CHAPTER 2.0

### COMPANY BACKGROUND

#### 2.1 Introduction to Company

Formerly known as Huwariz Unggul Venture, was founded in 2015. However, in the year 2018, the company was transformed into cooperate named Huwariz Unggul Sdn. Bhd. that it is now. “HUWARIZ” is a combination of founder’s children. The nature of the company is construction services, which focuses on building and infrastructure work that specializes in housing and development. The company is registered under Construction Industry Development Board (CIDB) and Small Medium Entrepreneur (SME) Corporation.

#### 2.2 Company Profile



Figure 2. 1: Logo of Huwariz Unggul

Mr. Raja Mohd Zulhilmi Bin Raja Azhar as the executive director, the company is located in Kota Warisan, Sepang, Selangor. The services offered in this company is building works, civil engineering, mechanical and electrical, and landscaping in the aspect of construction. While from designer aspect, the company’s partner Aras Strategic Consultancy PLT, provide professional design, project management consultation, and land survey. With a paid-up capital of RM1,000,000.00 the company is a thriving incorporation of private company with a strategy to innovation in every design and specification and affordable price, and the goal to educate the community to accept the current changes towards a green-friendly country.

## Vision

- To live the better world with the balance between of technological and environmental development.

## Mission

- To develop the best Green-Tech house concept with sophisticated innovation.

## 2.3 Company Organization Chart

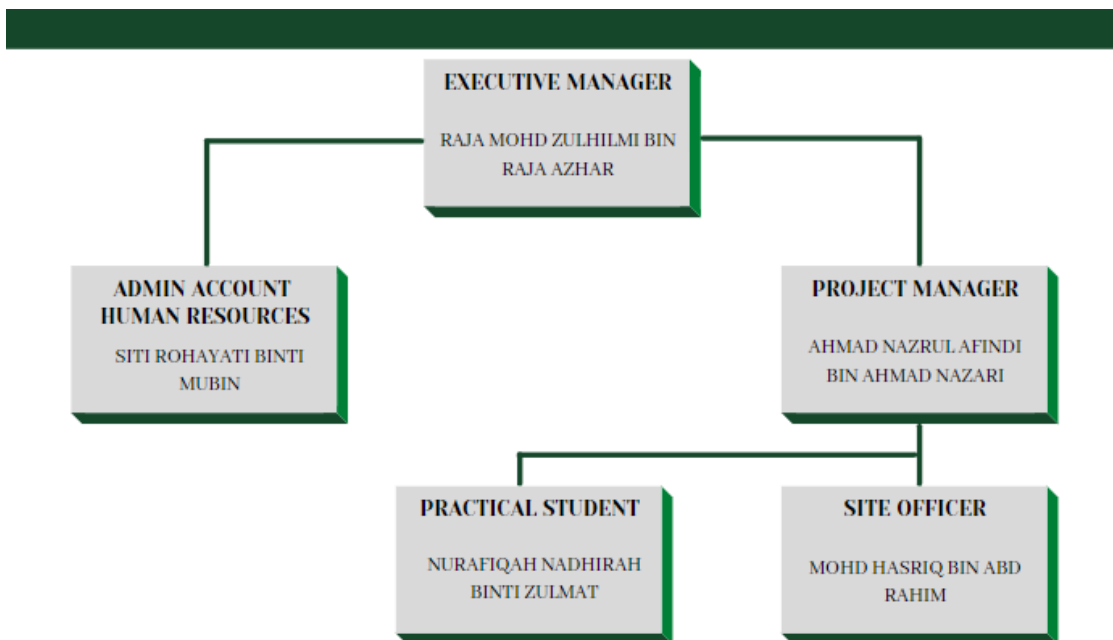


Figure 2. 2: Company's Organizational Chart

## 2.4 List of Projects

### 2.4.1 Completed Projects

Table 2.4. 1: Company's List of Completed Projects

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Cadangan Kerja Tanah, Infrastruktur dan Landskap di Atas Tanah Lot 888 Bagi Tetuan Wanhaj Development Kampung Bharu Lanjut, Mukim Labu, Daerah Sepang, Selangor Darul Ehsan (Fasa 1 dan Fasa 2).	RM266,265.00	5.3.2021	4.6.2021	4 Months	Wanhaj Development
2.	Cadangan Membina Sebuah Rumah Sesebuah 1 Tingkat di	RM255,000.00	15.3.2019	20.8.2019	6 Months	Mohammad Hairy Azuan Bin Anuar.

	Atas Lot PT 3687, Mukim Labu, 43900 Daerah Sepang, Selangor Darul Ehsan.					
3.	Cadangan Membina Sebuah Kediaman Sesebuah 1 Tingkat di Atas PT 15996, Mukim Bandar Ampang, Daerah Hulu Langat, 68000 Selangor Darul Ehsan.	RM201,500.00	18.3.2018	26.8.2018	6 Months	Azmie Bin Zakaria
4.	Cadangan Membina Sebuah Rumah Sesebuah 1 Tingkat di Atas Lot 1781, Mukim	RM90,000.00	1.8.2019	15.12.2019	4 Months	Zamri Bin Nordin

	Masjid Tanah, 78000, Daerah Alor Gajah, Melaka.					
5.	Cadangan Membina Kerja-kerja Ubahsuai Bagi Tetuan Nurfareizea Zulkafli dan Nurfarahein Zulkafli, No.10, Taman Desa Salak Pekerti 3, 43900, Sepang, Selangor Darul Ehsan.	RM37,620.00	18.6.2019	20.9.2019	3 Months	Nurfareizea Zulkafli dan Nurfarahein Zulkafli,
6.	Cadangan Membina Kerja-kerja Ubahsuai Bagi Tetuan Nurfareizea Zulkafli dan Nurfarahein Zulkafli, No.11, Taman Desa	RM12,115.00	6.5.2018	3.6.2018	1 Month	Siti Khadijah Binti Arip.



	Salak Pekerti 3, 43900, Sepang, Selangor Darul Ehsan.					
7.	Cadangan Membina Sebuah Rumah Sesebuah 1 Tingkat di Atas Lot 2816, 5 ½ Jalan Kebun, Mukim Klang, Klang, Selangor.	RM102,000.00	15.8.2019	28.12.2019	4 Months	Zamri Bin Nordin

## 2.4.2 Project in Progress

Table 2.4. 2: Company's List of On-going Project

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Cadangan Membina dan Menyiapkan Kediaman Sesebuah di Atas Lot 4035, Jalan	RM155,000.00	22.5.2021	-	6 Months	Mohd Tamami Bin Maslon

	Rebung, Setia Jaya, KG. Bukit Kapar, 42200 Kapar, Klang, Selangor Darul Ehsan.					
2.	Cadangan Membina dan Menyiapkan Kediaman Sesebuah di Atas Lot 7142, Mukim Labu, Salak Tinggi, 43900 Sepang, Selangor Darul Ehsan.	RM172,000.00	15.3.2021	24.12.2021	9 Months	Mohd Ezzudin Bin Mat Saimi

## **CHAPTER 3.0**

### **CASE STUDY**

#### **3.1 Introduction to Case Study**

Cadangan Membina dan Menyiapkan Kediaman Sesebuah di Atas Lot 4035, Jalan Rebung, Setia Jaya, KG. Bukit Kapar, 42200 Kapar, Klang, Selangor Darul Ehsan started from 22<sup>nd</sup> May 2021 and is still in progress. This project consists of building a Banglo house of 110-meter square with 3 Bedroom and 2 Bathroom. The value of this project is RM155 000.00 for a client named Mohd Tamami bin Maslon. The project will be completed approximately in December 2021 considering the progress of the construction is 50% completed. The work below lowest floor, Structure work, and building framework is completed. The Roof work is in construction; thus, the focus of this case study is regarding the method of roof construction for this Banglo house. The method of the roof construction is pitched gable roof with trussed rafter using steel struts.

This project is using conventional and IBS system. An AAC Block is used in the construction instead of the traditional red clay bricks. This is because Huwariz Unggul is moving towards a green and eco-friendly construction, therefore the use of IBS system is implemented for this project. Autoclave Aerated Concrete (AAC) Blocks are environmentally friendly, lightweight, all-weather construction materials with outstanding performance and durability. They are eight to nine times larger than a traditional red clay brick and provides excellent strength properties in all construction projects. This light weight brick is also a huge cost saving as it that save approximately 20 – 25 percent of the total cost. This is because it can speed up the construction process and it uses less mortar that affect the end cost.

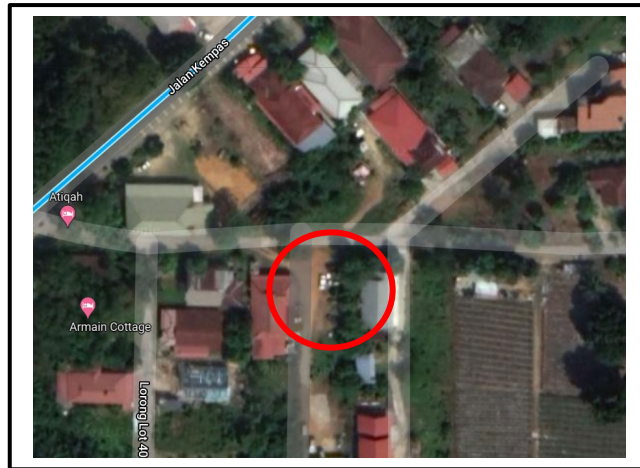


Figure 3. 1: The Location of Site Project

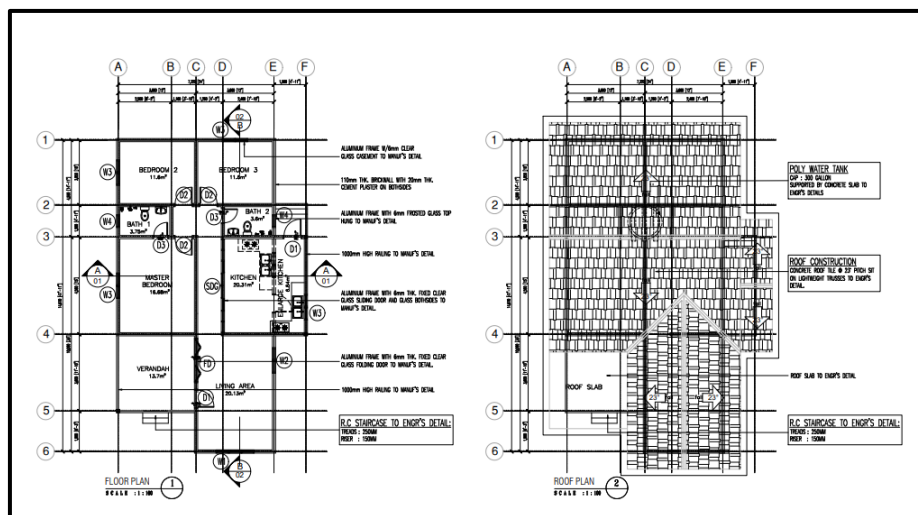


Figure 3. 2: The Drawing Plan of The Banglo House

The contract of this project consists of Quotation and Agreement with the client. The timeframe of this construction contract is 6 months with a Denda Lewat Kerja (LAD) as 6% per year and Defects Liability Period of 3 months. This contract uses staged payment method as the construction commenced. It is including the Kerja-kerja Asas Kediaman, Kerja-kerja Kerangka Kediaman, Kerja-kerja Mendirikan Dinding Bata Kediaman, Kerja-kerja Kerangka Bumbung dan Bumbung Kediaman, Kerja-kerja Kemas Kediaman, Kerja-kerja Perpaipan dan Sistem Kumbahan Serta Kerja-kerja Luar Kediaman, Serah Kunci Kediaman and after 3 months of Defects Liability Period. Every construction progress is fixed with the price percentage and will be claimed according to the progress.

### 3.2 The Procedure of Constructing Roof Beam

Roof beams are one of the most important parts in roof construction. The roof beam is a structural element that can withstand load primarily by resisting bending. It supports the roof and fortifies the walls, keeping them securely in place and preventing them from spreading out or leaning in, roof beams also support the rest of the roof's components, such as joists, trusses, battens, and roofing materials.

The laying of roof beam in this project was done in 4 stages which are formwork, bending and binding steel bars, laying cement concrete, and curing. The first step was the installation of the formwork of the roof beam. The formworks were placed according to the dimensions of the beams provided in the design drawings. The centering and shuttering were placed.

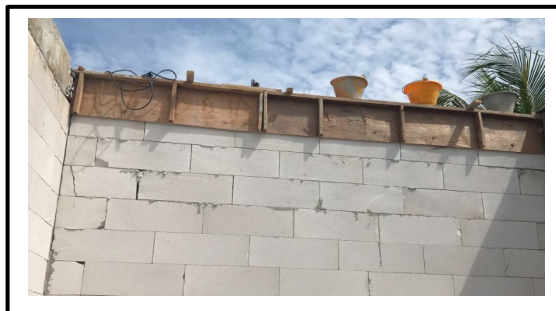


Figure 3. 3: Formwork of The Roof Beam

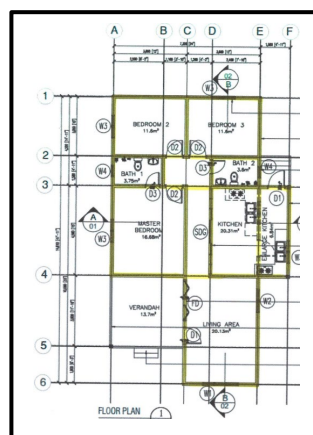


Figure 3. 4: The Placement of The Roof Beam

After the installation of the formwork is done, the bending and binding steel bars began. Y12 steel bar is used for the reinforcement and R6 steel bar is used for stirrups. Every roof beam consists of four Y12 steel bars and R6 steel bar linking it with 200mm distance from centre to centre. Stirrups is used to tight the steel properly and fixed to made sure it is straight and aligned. The spacers is tied to the rebar steel horizontally and vertically on the bottom and sides of the rebar. Lastly, the reinforcement bar and forms were checked by the site officer before concreting.

Next, the concrete is mixed on site using a mixer machine. The ratio of the concrete is 3:1 and is mixed by the sub-labour on site. The mixed concrete is poured into the formwork and being compacted using a vibration equipment to extinguish any air bubbles in the concrete. Finally, after 24 hours or until the concrete is cured, the framework is removed.



Figure 3. 5: Roof Beam

### 3.3 The Procedure of Roof Trusses installation

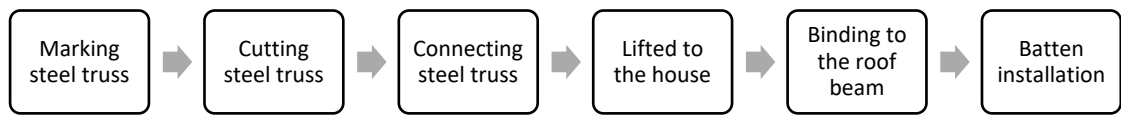


Figure 3. 6: Diagram of Roof Trusses Work Flow

The roof trusses installation progress is done in steps, which are marking the steel truss, cutting the steel truss, connecting the steel truss, lifted to the house, binding to the roof beam, and batten installation. Firstly, marking the layout to the steel trusses using measuring tape based on the approved drawings, the distance between truss and level is ensured as per drawing. By marking the layout on the steel trusses can prevent any wastage as it can make the cutting work easier and to avoid error of the size of the steel trusses while cutting them.



Figure 3. 7: Connected Steel Trusses Laid Out

Next, cutting work of the steel trusses commenced. Grinder machine is used to cut the steel trusses according to the marking that has been done. After all of the C channel steel was cut to size, it is sorted by the sizes to ease the installation process. Then, the steel parts are arranged according to the frame shape in the drawing, which in this case is double howe shape. After that, all of the steel parts that has been put to shapes are connected to each other by an inch screw using bore machine. And then, it is done repeatedly until all the steel structure for the roof frame is done.



Figure 3. 8: Steel Frame is Lifted Up to the House



Figure 3. 9: Steel Frame is Erected

Then, all of the steel frame is lifted up by the sub labours one by one to the house. The trusses are erected by first hanging them upside down across the span of the house. Then, they are turned over and fixed to the roof beam. Finally, after all of the frames is fastened to the roof beam, the installation of battens is started. The sub labours bring the battens up to the roof to attach them to the frames by using an inch screw. The distance between the battens is 300mm from center to center.



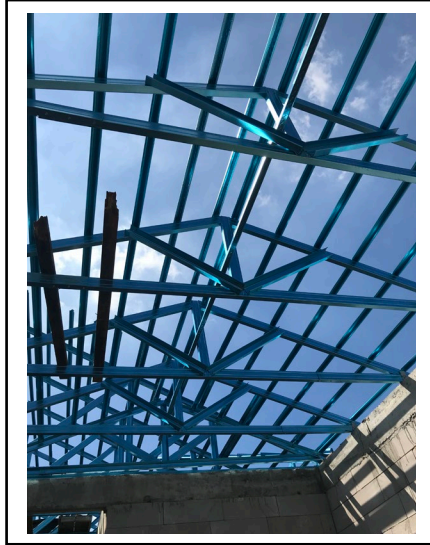


Figure 3. 10: Roof Frame Trusses is installed

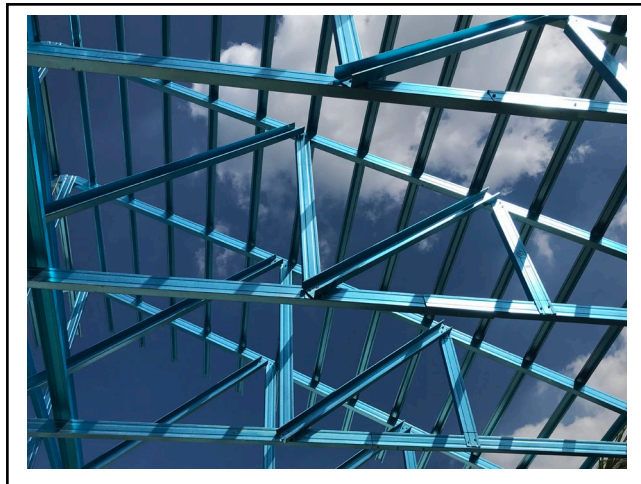


Figure 3. 11: Batten is Installed

### 3.3.1 Roof coverings

The installation of roof tiles is installed by the sub labours. The roof tiles used is the interlocking roof tiles, the underside of the tile has protruding nibs for locating the tiles on the battens. The interlocking tiles is laid with 0.7mm to 1.2mm shunt to prevent from the tile from lifting and causing stress that led to cracking the tiles.



Figure 3. 12: Sample of Interlocking Roof Tile

These tiles have the underside of the overlap on the left; therefore, these tiles were laid from right to left. All of the tiles were put on the roof structure first to ease the laying work so that the sub labour workers don't have to climb up and down from the roof to transfer the roof tiles. The tiles were laid starting from the eaves and hooking the tile nibs to the batten, and the next tile is laid alongside that it is overlap with the nibs hooked to the batten. Then the ridge cap is laid, before that, a bitumen layer is put to prevent from any leaking. The ridge tiles are laid overlap from each other to cover the top of the roof. Then, the workers made sure that the ridge cap is laid straight and checked for any mistakes.

### **3.4 The Cost and Time of Installing Roof**

The roof construction's cost and time records in this project is retrieved by analyzing the productivity and data accuracy from monitoring the construction process and data recorded when site surveying. In this Banglo Kampung Bukit Kapar project, the construction of the roof beam only was carried out for 2 weeks. This is because of the inefficient workflow process, seeing that there were only 2 workers constructing the roof beam. There were also problems regarding the insufficient materials on-site, therefore, the site manager has to order more materials, which the process can take up to 3 days. Thus, this shows how the simplest problems can results in the obstruction of the construction timeframe.

In continuing with the roof construction, the company has moved into a new contract with a new subcontractor to complete the remainder of the construction project. This contract is a lump-sum contract; however, the material cost is not included in the contract since the materials on-site is provided by the company. This contract only covers the cost of labour. According to the contract and work program, the roof should be completed in 2 weeks. The number of workers on the site was recorded daily. As per the contract, the price that must be paid to the subcontractor for roof construction is 10% of the agreement, which is RM3700.

The calculation for the materials on site was done prior to the roof construction. The amount of material required in this roof construction was calculated based on the project's construction drawing plan. The material cost was calculated based on the market surveys. The prices for each material unit and the delivery fee are based on a specific roofing store surveyed. The cost of roof steel, C Channel is RM4300± and the cost for roof tiles is RM2440 for 1300 pieces. The sum of material and labor costs was regarded as the construction cost. Therefore, the total cost of roof construction for this Banglo is RM10,440±.

ROOF STRUCTURE					
SITE:	KAPAR, KLANG			QUANTITY: C CHANNEL=	99 NOS
BUILD-UP:	108.21 m <sup>2</sup>			BATTEN=	72 NOS
ROOF COVERING AREA:	159.66 m <sup>2</sup>				
<b>MATERIAL</b>	<b>MEASUREMENT</b>	<b>KALISTA MAJU</b>		<b>THIAM SIENG STEEL</b>	
C CHANNEL	152mm x 75mm 6m	RM	32.00	RM	30.60
BATTEN	110mm x 45mm 6m	RM	16.00	RM	15.00
DELIVERY		RM 100	(< RM 1,500.00)	RM 120	(< RM4000)
<b>KALISTA MAJU</b>	<b>QUANTITY</b>	<b>PRICE</b>		<b>TOTAL</b>	
C CHANNEL	99 nos	RM	32.00	RM	3,168.00
BATTEN	72 nos	RM	16.00	RM	1,152.00
			<b>TOTAL</b>	RM	4,320.00
			TRANSPORT CHARGE	RM	-
			<b>FINAL TOTAL</b>	RM	4,320.00
<b>THIAM SIENG STEEL</b>	<b>QUANTITY</b>	<b>PRICE</b>		<b>TOTAL</b>	
C CHANNEL	99 nos	RM	30.60	RM	3,029.40
BATTEN	72 nos	RM	15.00	RM	1,080.00
			<b>TOTAL</b>	RM	4,109.40
			TRANSPORT CHARGE	RM	145.00
			<b>FINAL TOTAL</b>	RM	4,254.40

Figure 3. 13: The Calculation of Roofing Materials

KAPAR: ROOF WORK			
	<b>Wall Plate</b>		<b>Rafter</b>
	<b>Length</b>		<b>Numbers of</b>
			<b>Rafter</b>
			<b>Length</b>
			7.320
			<b>Add</b>
	b/wall		0.150
	2/0.5/0.150		
	<b>Verge</b>		1.200
	2/0.600		8.670
	<b>Less</b>		
	<b>Verge</b>		1.200
	2/0.600		
	<b>b/wall</b>		0.300
	2/0.150		
	<b>Clearance</b>		0.100
	2/0.050		
	<b>Rafter</b>		0.050
	2/0.5/0.050		0.800 ) 7.020
			11.700
			<b>Add</b>
			1.000
			12.700
			<b>No's of rafter</b>
			= 12 @ 13
	<b>Roof A</b>		
	1 / A-E	7.320	
	4 / A-E	7.320	
		14.84	
	<b>Hall Span of Rafter</b>		
	<b>Length</b>		
		4.555	
	Add overhang	0.600	
		5.155	
	<b>Less</b>		
	0.5/fascia	0.5/0.025 0.0125	
	0.5/ridge	0.5/0.025 0.0125	
	board	5.130	
	<b>Length of Rafter</b>		
		5.130	
		Cos 23	
		= 5.573	
	Add tapped end	0.050	
		5.623	

Figure 3. 14: The Measurement Calculation of Roof

## **CHAPTER 4.0**

### **CONCLUSION**

#### **4.1 Conclusion**

In conclusion, roof construction is more complicated in real life than it is in theory. The process of measurement calculation requires a lot of attention and work as it can determine the quantity of materials needed for the construction. Similarly, to finding a reliable supplier near the construction site, it is crucial to ensure that the materials on site is in great condition and quality. Based on the observation made throughout the construction process, the method and procedure of constructing the roof is quite similar to the theory, however, the process of conducting the project regarding the subcontractors, suppliers and calculations is a more tedious process. The problems faced throughout the construction was challenging, nevertheless, it is solvable. In particular the problems with the previous subcontractor that are unreliable and the workflow was taking so much time. By that, in order to solve the problem, the company has made a new contract with a different subcontractor to continue the construction. To sum up the report, Project Banglo Bukit Kapar is completed and has been handover to the client after every works defined in the contract is complete.

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