



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

**INSTALLATION OF SKILLION ROOF**

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**(PERAK)**

**DECEMBER 2019**

It is recommended that the report of this practical training provided by

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**entitled**

**Installation of Skillion Roof**

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

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**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 JKR Maran 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 fulfillment of the requirements for obtaining the Diploma in Building.

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Date : 20/12/2019

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Last but not least, my special appreciation to my lovely parents for their supports over the years and the last one I would like to all my friends for helping me during my practical training.

Thank you so much.



## **ABSTRACT**

A roof is the top covering of a building, including all materials and constructions necessary to support it on the walls of the building or on uprights. It provides protection against rain, snow, sunlight, extremes of temperature, and wind. A roof is part of the building envelope. This report was conducted for the building envelope at Kampung Kuala Wau, Maran, Pahang Darul Makmur. The building was 2-storey clinic which is located near to residential area. The objective of this report is to identify the type of roof used in the construction of clinic. Roof has many type and the type is depending on the what the building is and the weather also affected on the design of roof to make the building can function well. The next is how the roof of the clinic was built. It will focus on the method of roof construction. To build the roof, there is many step to follow. This report also highlights about advantages and disadvantages of type of roof used on site. A proper roof installation is very important to any building because it's can protect building and keeps the building dry.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of Study

The roofing system is a much more complex set of materials and engineering than most people give it credit for. Different components all work together to keep your home safe from the weather, elements and even some man made harm. One of the most important aspects of the roof is the roof covering. Roof covering is what most people think of when someone says the roof. While the roofing system is composed of several components, the roof covering is the most visual part of the whole system and makes up the majority of waterproofing and protection. Selection of a proper roof covering is one of the most important aspects of getting your roof redone (Philip, 2018). According to (M Hyde, 1972) roofing has been employed for many years, wherein a roof deck supports a weatherproof membrane where often the weatherproof membrane comprises a plurality of felt and bitumen layers which prevent the penetration of moisture of the roof deck.

There are three vital aspects of your roof: the covering that keeps your house dry, all the structure (sheathing and framing) that supports the covering and maintains the shape of the roof, and the connections between the roof structure and the walls below (the helmet strap, to take the analogy one step further). When you evaluate the ability of your roof to defend your home against a hurricane, you need to consider all of the elements of a roof because they all play vital, essential roles in protecting your house (Est. 1987).

Roofs do a lot more than just serving the most basic practical purpose of protecting a house and its occupants from the outside elements. For instance, a roof's shape plays a major role in defining the overall look and style of a house. Roofs can also provide additional living space, as well as make your home more resilient, energy efficient, and weather-proof. There are many types of roof such as gable roof, hip roof, mansard roof, gambrel roof and flat roof. However, the aim of this report is to discover the construction of skillion or lean-to roof. This roof is a single slope roof with its upper edge adjoining a wall or a building. This type of roof is the simplest type of pitched roof.



## **1.2 Objectives**

1. To identify the materials used in skillion roof.
2. To explain method of skillion roof installation.
3. To identify problems, occur during installation process and recommend the solutions of the problems.

## **1.3 Scope of Study**

The case study was located at Kampung Kuala Wau, Maran, Pahang Darul Makmur. This case study was focusing on what type of roof used. Method of roof installation also mentioned on this report from the beginning until the end of the process without stated the performance of the workers and the quality of the materials in details. Other than that, this study was included the advantages and disadvantages of the type of roof used for the building.

## **1.4 Method of Study**

This research of site that carried out by three methods which were by observation, interviews and document reviews. The resource and research method were helped by the person in charge, who take a responsibility to make a tour and share the information about the roof installation applied in the site area. The flow of this research method had start with observation, interview and continue to the document reviews.

### **1. Observation**

The observation of case study was observed during my practical training period. The observation was about the construction of Klinik Kesihatan Jenis 7 but for this report was focused on installation of roof. All the information and data will be recorded.

### **2. Interview**

The interview session was done with the person in charge of JKR to take care of the project, En Mohd Ikhwan. He provides all the information needed by touring around the site while explaining about the project. Other than that, the main contractor, En Jama'a Ismail, also gives more knowledge about the site.

## Document Review

Document that referred was the plans which is truss layout and truss detail, the file of the project, Bill of Quantities and also Critical Path Method (CPM).

## CHAPTER 2

### COMPANY BACKGROUND

#### 2.1 Introduction of Company

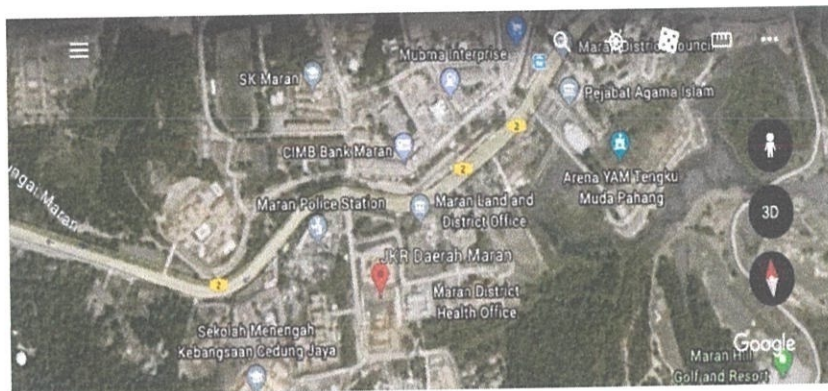
The Malaysian Public Works Department (JKR) is the federal government department in Malaysia under Ministry of Works Malaysia (MOW) which is responsible for construction and maintenance of public infrastructure in West Malaysia and Labuan. In Sabah and Sarawak, a separate entity of Public Works Department exists under respective state government's jurisdiction but both departments are also subordinate to the parent department at the same time. The Public Works Department (PWD) was established in 1872 with Major J.F.A McNair as the first head of the organization.

JKR has many branches which is Building Branches, Road Branch, Slope Engineering Branch, Electrical Branch, Mechanical Branch and Military Works Branch. For Building Branches, JKR is responsible for building and maintaining government buildings in Malaysia such as public government offices, schools, hospitals, police and army facilities, port and airports. It consists of General Building Works Branch, Health Works Branch, Security Works Branch, Education Works Branch, Airport and Maritime Works Branch. The JKR's Road Branch is responsible for building and maintaining roads in Malaysia, such as federal roads, state roads, bridges and interchanges. For Slope Engineering Branch, they responsible for monitoring and maintaining all slopes in Malaysia. The JKR's Electrical Branch is responsible for installing, maintaining and wiring electrical components such as the installation of street lights and traffic lights on roads, electrical wiring for government building. Mechanical Branch is to maintain machinery and mechanical construction for the department. Lastly, for Military Works Branch, they responsible for the construction and maintains all military bases and facilities in either Army, Navy, Air Force, Police and Maritime Enforcement Agency.

On 1<sup>st</sup> July 1986, JKR Daerah Maran established at fourth floor of Pejabat Daerah Maran. At that time, there are three staff only, where district engineer is En. Che Ali bin Che Hitam, Kadir and Mohd Taib bin Harun as his assistant. On 1<sup>st</sup> March 1987, the presence of staff from JKR Temerloh for about 200 staffs made the company have a lot of staff working



there. Because of that fraction, there are four departments formed which is Administration Department, Building, Road, Water Supply and Store. Then, the Water Supply Department was established on 1<sup>st</sup> March 1992 and the JKR Daerah Maran was reduced to four departments. As a result of the split of department, JKR Daerah Maran staff was reduced to just hundred staff only. Throughout the establishment of JKR Daerah Maran, about ten staff of District Engineer have served to sow devotion to succeed the project given to them. In Rancangan Malaysia ke-9, Kementerian Kerja Raya approved the Bangunan Persekutuan JKR Daerah Maran project. This building built at Jalan Seri Keramat on the early of the year 2019 and ready to occupied on mid-2009.



*Figure 2.1: Location of JKR Maran*



*Figure 1.2: JKR Maran Building*

## 2.2 Company Profile



Figure 2.2: Company Logo

<b>Name of Company</b>	:	<b>Jabatan Kerja Raya Daerah Maran</b>
<b>Address</b>	:	JKR Maran, lot 12, Jalan Seri Keramat, 26500 Maran, Pahang Darul Makmur.
<b>Telephone</b>	:	
<b>Fax</b>	:	
<b>Email</b>	:	<b>maran@jkr.gov.my</b>

Table 2.1: Company Details

## 2.3 Organization Activities

### 2.3.1 Specialist Services

#### Quantity Surveying

The Quantity Surveys and Contract Management Division is a division that performs supporting tasks for other divisions of JKR Maran in carrying out government-mandated projects.

Responsibilities:

- i. Ensuring that the allocation of projects is done in accordance with the rules outlined in the Treasury Directives.
- ii. To ensure that the contractual administration of the projects is working smoothly and in accordance with proper regulations.

- iii. The Quantity Surveys and Contract Management Division is non-personally responsible in providing the necessary advisory services to those concerned.

### Electric

#### Responsibilities:

- i. Ensuring the implementation of infrastructure development projects for government agencies in the area of electrical engineering to meet the quality, time and cost specified.
- ii. Ensures that the management of the electrical engineering assets in the government premises meets the best expectations so that they are always functioning well, safe and cost effective
- iii. To ensure consultancy services in electrical engineering to government agencies based on professionalism and integrity.

#### Function:

- i. Technical Consulting Services (Design & Procurement).
- ii. Planning, designing and managing procurement for government projects.
- iii. Providing technical advisory services to other government agencies.
- iv. Project Management (Electrical Installation Site Management).
- v. Plans, manages, coordinates, supervises and controls the implementation stages of project construction according to the quality, duration and cost.
- vi. Asset Facility Management (Electrical Facility Maintenance Management).
- vii. Performs maintenance works for electrical installations in accordance with customer charters and maintenance programs as determined by the customer department.
- viii. Provide technical consultancy services related to electrical maintenance management to other government agencies.

### **2.3.2 Administration & Finance Department**

The main purpose of the establishment of this division is to assist the management of JKR Maran to carry out its responsibilities as part of helping to enhance the corporate image of the State JKR of Pahang in general and to coordinate all kinds of information in planning all forms of implementation in line with the mission and vision of the Department of Public Works.

Objective of this department is to:

- i. Implementing Strategic and Corporate Planning to enhance JKR Maran's performance in line with the Vision and Mission of the Department.
- ii. Improving the quality of department delivery with effective control and monitoring of quality procedures, quality of implementation and product quality while promoting innovation and creativity through ICT and quality incentives.
- iii. Increase JKR Maran's competency level with well-planned training and enhanced use of Information Technology.

### **2.3.3 Building Department**

The Building Division is a coordinating body that acts as the planning, implementation and supervisor of building projects in the state of Pahang for various customer departments. All activities related to the construction of construction projects and maintenance of State and Federal buildings.

Function:

- i. Managing and coordinating the implementation of Federal building projects.
- ii. Coordinating State government building maintenance works.
- iii. Performing small-scale projects requested by other departments.
- iv. Providing technical advisory services to other government departments.

### **2.3.4 Road Department**

The Road Division is responsible for developing a comprehensive, complete and safe and economical road network and road network to meet the needs



of implementing national development policies. The provision of a good and efficient road network will provide transportation to areas where there is no road network as well as open and develop new areas.

*Function:*

- i. Implement road and bridge development projects for the Federal and State Governments.
- ii. Maintain roads and bridges to keep users safe and secure at all times.
- iii. Upgrading existing roads especially in terms of safety and convenience of road users.
- iv. Review and comment on development applications from the private sector involving JKR roads.
- v. As technical advisor to Government and Government Departments.
- vi. Performs census and national traffic work and road safety studies.

#### **2.4 Objective of department**

To provide public infrastructure and facilities especially roads, buildings, airports, ports and bases to meet the needs of the country's development by always emphasizing:

- i. As fast as possible of timeframe
- ii. Economical cost
- iii. The best design and quality

#### **2.5 Mission of JKR**

- i. JKR's mission is to contribute to the nation's development by helping our clients *realize their policy goals and delivering services through strategic partnerships.*
- ii. Leverages our processes and systems to deliver consistent service results.
- iii. Provide effective and innovative asset management and project management services.
- iv. Strengthen existing engineering competencies.
- v. Develop "*modal insan*" and new competencies.
- vi. Prioritize integrity and service delivery.
- vii. Establish a harmonious relationship with the community.

## 2.6 Vision of JKR

Become a world-class service provider and center of excellence in the areas of asset management, project management and engineering for the country's infrastructure development based on creative and innovative “*modal insan*” and the latest technology.

## 2.7 List of Projects

No	Title of project	Client	Status
1	Projek Pembaikan Cerun dan Kerja-Kerja Berkaitan di Sekolah Menengah Kebangsaan Sri Jaya, Maran, Pahang	Kementerian Pendidikan (Sektor Pelajaran)	In a construction
2	Projek Menggantikan Jambatan Sg. Maran FT002/284/80 Maran, Pahang	Kementerian Kerja Raya (KKR)	In a construction
3	Klinik Kesihatan (Jenis 7) Kg. Kuala Wau, Maran, Pahang	Kementerian Kesihatan	In a construction
4	Menaik Taraf Jalan Kampung Bunian, Chenor, Maran, Pahang	Unit Penyelarasan Perlaksanaan	Handover
5	Pembinaan Masjid Baharu Kg. Chenor Seberang, Maran, Pahang Darul Makmur	Pejabat Pembangunan Negeri	Handover
6	Pembinaan Bangunan Baru Perpustakaan Desa Di Kuala Sentul, Daerah Maran, Pahang	Kementerian Pelancongan, Seni Dan Budaya	Handover
7	Projek Menaiktaraf Jalan Kuala Wau - Kertau (C130), Daerah Maran. Pahang	Kementerian Pembangunan Luar Bandar (KKLW)	Hand over
8	Membina Baru Masjid Bandar Tun Abdul Razak, Jengka, Pahang Darul Makmur.	Pejabat Pembangunan Negeri	Hand over

No	Title of project	Client	Status
9	Jalan Perhubungan Desa Negeri Pahang – Baik Pulih Jalan Perhubungan Desa Di Kg Bukit Kerut Dan Kg. Pasak Di Jengka Batu 13, Maran Pahang.	Kementerian Pembangunan Luar Bandar (KKLW)	Hand over
10	Jalan Perhubungan Desa Negeri Pahang – Bina Baru Jalan Perhubungan Desa Di Jalan Masuk Kg Serdang Ke Bukit Berapi Kg Senggora, Maran, Pahang.	Kementerian Pembangunan Luar Bandar (KKLW)	Hand over
11	Klinik Kesihatan (Jenis 5) Sri Jaya, Maran, Pahang.	Kementerian Kesihatan (KKM)	Hand over
12	Jalan Perhubungan Desa Negeri Pahang – Naik Taraf Jalan Perhubungan Desa Di Kg Baru Sg Ling, Maran, Pahang.	Kementerian Pembangunan Luar Bandar (KKLW)	Hand over
13	Naik Taraf dan Pembinaan Padang Permainan Sekolah Menengah Kebangsaan Jengka 2, Bandar Jengka, Pahang	Kementerian Pendidikan (Sektor Pelajaran)	Hand over

*Table 2.2: List of Project*



## 2.8 Organization Chart

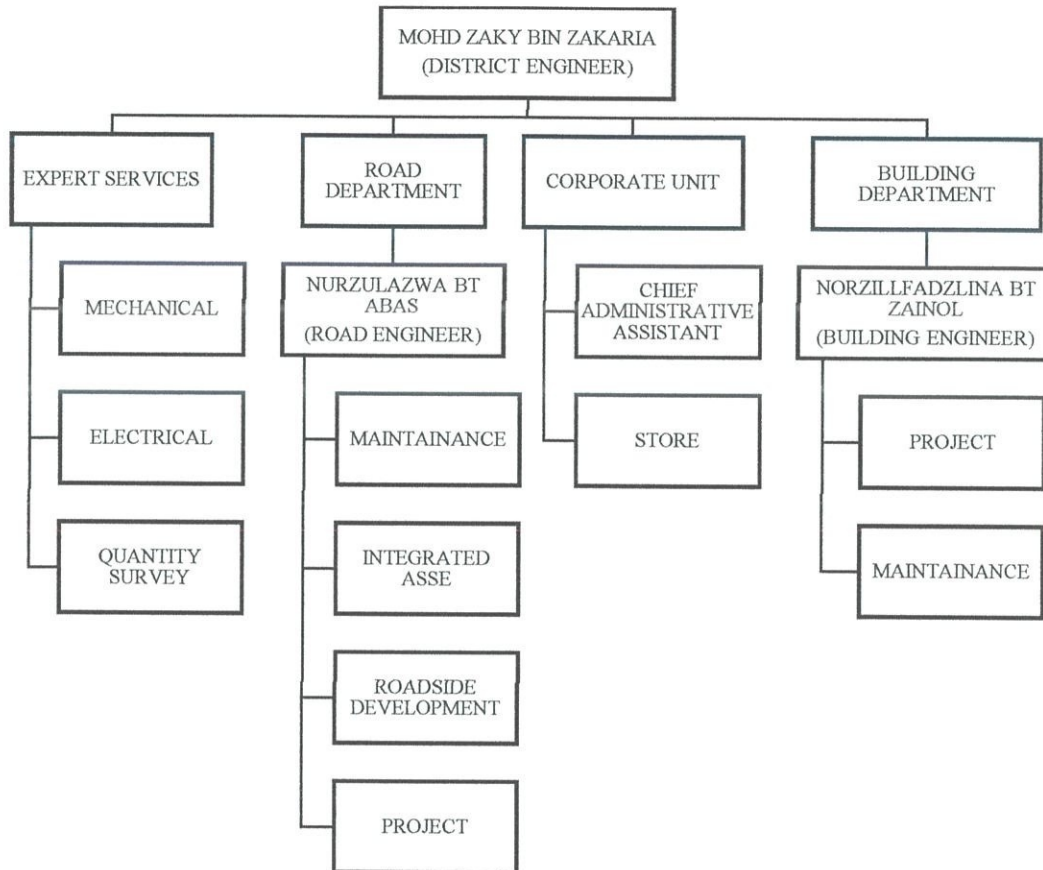


Figure 2.3: Organisation Chart

## CHAPTER 3

### CASE STUDY

#### 3.1 Introduction to Case Study

The case study was located at Kampung Kuala Wau, Maran, Pahang Darul Makmur. The cost of this project was RM 4 217 104.00 and the area of this site about 31.89m × 31.89m. This location was at Chenor (Mukim Luit), Maran, Pahang. The location of the project was near to Sekolah Kebangsaan Kuala Wau. The location from Bandar Maran to the site is about 89.4km. While from Bandar Baru Chenor to the site is about 34.1km. Coordinate of the site location is 3.482678, 102.785360.



*Figure 3.1: Site Location*

The building contain of 1 block (Jenis 7) which divided into many different areas. The areas consist of Registration Area, Administration, Emergency Area, Parents & Children, Patient Area, Pharmacy, Training Unit and other area. Quarters (class G) placed at second floor and third floor where each floor consists of 2 units. Total of all quarters units are 4 units. At the level of fourth floor is where storage tank placed. Others block involved are included Pump House, Tube Well House, Flagpole and parking area will be built on the same site.

For my case study, i will focusing on roof of the clinic. The building use skiliion roof type. To be more clear, here are plans of the building roof.

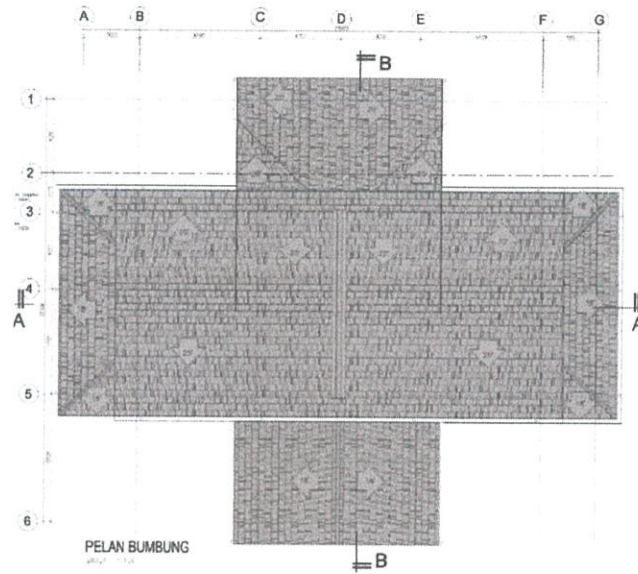


Figure 3.2: Roof Plan



Figure 3.3: Front Elevation



Figure 3.4: Rear Elevation

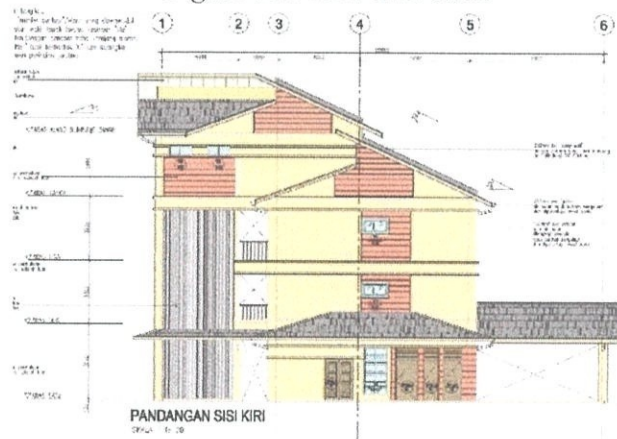


Figure 3.5: Left Elevation

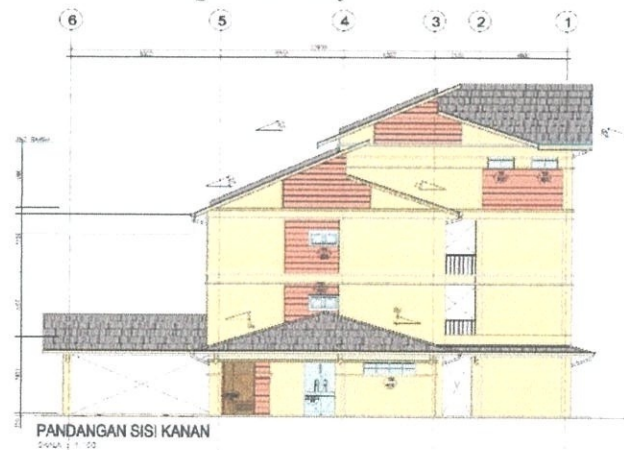


Figure 3.6: Right Elevation



Table below show the details of this project :

<b>PROJECT:</b>	
MEMBINA DAN MENYIAPKAN KLINIK KESIHATAN JENIS 7 DI KG. KUALA WAU, MARAN, PAHANG DARUL MAKMUR.	
<b>EXECUTIVE OFFICER:</b>	
DISTRICT ENGINEER, JKR DAERAH MARAN.	
	
<b>REPRESENTATIVES OF EXECUTIVE OFFICER:</b>	
BUILDING ENGINEER, JKR DAERAH MARAN.	
<b>CLIENT:</b>	
KEMENTERIAN KESIHATAN MALAYSIA	
	
<b>CONTRACTOR:</b>	
MESTARITEAM SDN. BHD.	
<b>START:</b>	<b>FINISH:</b>
24/04/2018	28/10/2019
<b>CONTRACT NO.:</b>	
F/PHG/M/DK/103/2018	

*Table 3.1: Project Details*

## 3.2 Materials used in roof construction

### 3.2.1 Roof Tiles

Concrete tiles are the most economical and durable roofing material on the market. Just like concrete bridges and the structural elements of buildings, concrete tiles get stronger with age. Concrete tiles truly embrace the harsh elements. Concrete tiles are made of mixture of sand, cement and water, which are molded under heat and high pressure. The exposed surface of a tile may be finished with a paint like material. Concrete tiles have additional water locks, or interlocking ribs on the edges that prevent water infiltration.

Concrete tiles come in three main appearances which are flat profile with no curves, low profile with small curves and has a rise to width ratio equal to 1:5 or less and the last one is high profile with large curves and has a rise to width ratio greater than 1:5. Concrete tiles can simulate the appearance of traditional clay tiles, wood shake, slate and stone. Like clay, concrete tile surfaces can be textured or smooth, and tile edges can be ragged or uniform. They are resistant to hail, wind and fire, making them a very safe roofing material when properly installed.



Figure 3.7: Roof Tiles



Figure 3.8: Type of Roof Tiles

### 3.2.2 Truss Batten

Roof battens are one of those frequently misunderstood and overlooked aspects of house construction. But roof battens perform some incredibly important structural functions to safeguard the roof. Roof battens provide a breathable space allowing any condensation to be eliminated. It increase the structural performance of roof truss systems. Also, it enable roofing materials to be secured firmly to the roof. Other than that, it assist with correct alignment of roofing sheets.

The choice of roof batten material is extremely important as is the design of any batten system. This is because battens serve to evenly spread load stresses such as wind (uplift and direct loading) and weight across the roof truss system.

Roofs can be subject to enormous forces especially during high wind events and many roofs have failed due to the use of inappropriate fasteners or the incorrect choice of batten material. A batten is most commonly a strip of solid material, historically wood but can also be of plastic, metal, or fiberglass. Battens are variously used in construction, sailing, and other fields. In the lighting industry, battens refer to linear light fittings. In the steel industry, battens used as furring may also be referred to as "top hats", in reference to the profile of the metal.



*Figure 3.9: Steel Truss*



### 3.2.3 Aluminium Foil

A large amount of the heat, up to 93%, is transmitted by radiation. A house without insulation loses this radiant heat. Insulation materials made solely from glass fibers or cellulose cannot stop radiation losses.

Unlike aluminum foils and aluminum composite films. Aluminum foil reflects up to 96% of the radiant heat. Aluminum is ideal as an extremely cost-effective and easy-to-shape, adaptable material for the insulation of walls and roofs.

Aluminum foil is the ideal partner for composite insulations and is durable thanks to a protective coating. This makes aluminum foil one of the most versatile materials in the insulation of houses.



*Figure 3.10: Aluminium Foil*

### 3.2.4 Gutter

Having an efficient guttering system in the home is crucial. The two most common types of guttering systems are metal and plastic (PVC). On site, they use PVC gutter instead of metal because it is strong. PVC gutters come in one continuous unit as they are made from moulded plastic. They have no seams and need no paint, hence a lesser chance of corrosion with time. There is also a smaller chance of dents as well as blemishes and scratches on their surface as compared with the metallic ones. Then, as we all know that plastic is flexible. Compared to some metal gutters, plastic does not easily lose its shape when it bows. In fact, they are made with this fact in mind. Metal gutters, although flexible, tend to distort after a considerable bit of pressure is applied. They bend, twist and dent much easier than the plastic

variants. PVC gutters are less costly and more convenient to install than metal guttering systems. Plastic systems are less expensive on face value, and because they are lighter, you can install or replace them without needing to hire a professional. Plastic is easy to modify. This is because PVC is essentially moulded plastic, making its shape and colour highly adaptable to the design of any building.



Figure 3.11: Gutter (Source: Google)

### 3.2.5 Rafter

Rafters are sloped framing members running downward from the peak of the roof all the way to the plates of the outside walls. They are the support for the roof load. Ceiling joists tie the outside walls together, support the ceiling materials for the room below, and secure the bottom ends of the rafters. Carpenters build conventional rafter roof frames on-site. The rafters are installed one piece at a time.

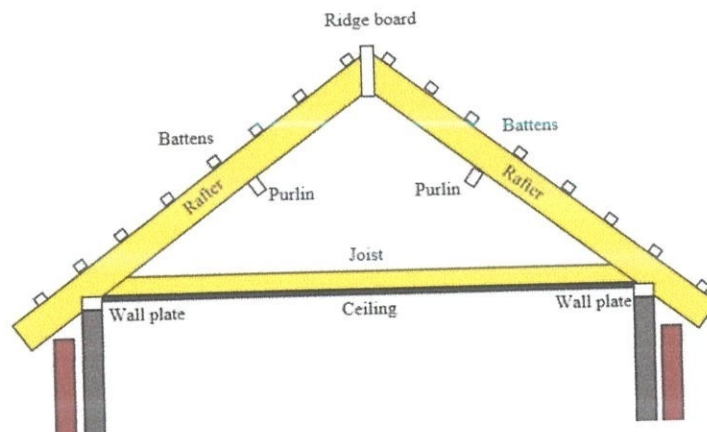


Figure 3.12: Rafter (Source: Google)

### 3.3 Installation of Roof

#### 3.3.1 Material delivery, Handling and Storage

All steel structure sections, roof covering and accessories will be delivered from factory to the fabrication area by the use of truck or truck trailer. Manpower and mobile crane will be deployed for the sling, loading and unloading of Steel Structure sections, roof coverings and accessories. Great care will be taken during the transit and handling as to avoid damaging the materials. Materials arriving to site should be arranged in orderly manner as such would permit easy discerning of identification marks and to ease fabrication works. The materials should be stacked nearest to fabrication site where ample level grounds are available for assembly works. Location of materials to be identified by C.O.W to ensure right location which should be away from traffic or any pending construction works.



*Figure 3.13: Material on Site*



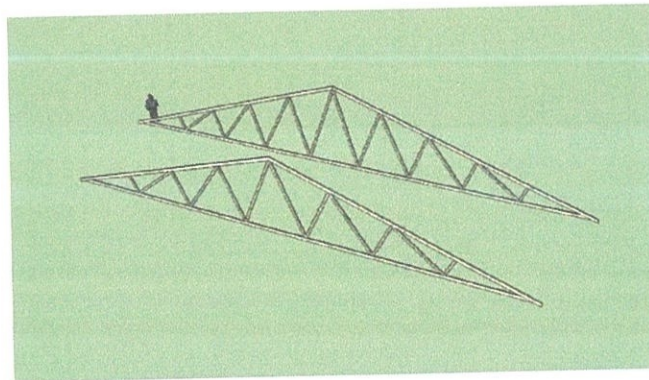
Clerk of Works is an essential part of the site team. Clerk of Works, also known as Site Inspectors, Quality Assessors or NEC Supervisors, to inspect the construction works throughout the duration of construction. A Clerk of Works provides an independent assessment of the works undertaken, checking the quality of the build, M&E, structural and architectural works.

They produce regular reports and a dialogue with the design team. Reports include a *site diary*; *photographic evidence*; *progression of the works against the programme*; site meeting information and highlight any potential risks. Clerk of Works can be appointed directly by the end-client or sub-let through a project team member and can attend the site on a full or part-time basis depending on the project requirements.

Whereas many consultants' time can be limited on site, Clerk of Works is there reviewing the work under construction and acting as 'eyes and ears' on site.

### 3.3.2 Fabrication of Steel Roof Trusses

Steel Roof Trusses will be fabricated in accordance with relevant shop drawing and manufacturer's recommendations in the fabrication yard using power tools by skilled workers to ensure uniformity of Truss shape. Self-Drilling screws will be screwed by power tools to ensure good connectivity. Completed Steel Trusses will be inspected by skilled workers prior to be transported to the intended building. The truss shape will be like what shown in figure below.



*Figure 3.14: Roof Trusses (Source: Google)*

Trusses are designed with factors of safety in mind. Structures and structural members must always be designed to carry some reserve load beyond what is expected under normal use. Under allowable stress design, safety is provided by using an allowable stress that is low enough to protect against variation in material properties, errors in design theory and uncertainties as to the exact load. The ratio of the load that would cause failure to the load for which the structure is designed is called the factor of safety.

*Metal plate connected wood trusses are designed with factors of safety. In accordance with the Truss Plate Institute's ANSI/TPI 2, metal connector plates are designed with a factor of safety of 3.2 for withdrawal, 1.44 for steel shear yield strength and 1.67 for steel tension yield strength. These factors result in a steel factor of safety of 2.0 on overall steel strength. Often, in an overloading scenario, tooth withdrawal resistance failure occurs, but steel and lumber failures could occur as well.*

*Because wood is a heterogeneous product, the factor of safety varies depending on the direction of the applied load to the direction of lumber grain. According to ASTM D245 and ASTM D1990, the following factors of safety should be applied to the lower fifth percentile exclusion limit on clear softwood properties: 2.1 in bending and tensile strength parallel to grain, 1.9 in compressive strength parallel to grain, and 1.67 in compressive strength perpendicular to grain.*

Overall, the factor of safety of the composite truss should be in the conservative range of 2 to 2.5, depending on the failure mode, and can easily be as high as 3 to 3.5. When overloaded, plates may exhibit “peeling.” The gap between plate and lumber will be at a maximum at the outside of the plate and taper off towards the inside. Lumber may exhibit hairline fractures that are not visible with the naked eye when trusses are overloaded.

The Wood Engineering and Construction Handbook defines fatigue as progressive damage or failure due to a member or structure being subjected to cyclic, repeated loading at levels less than the static strength. It is directly related to the duration of the load. Fatigue properties are generally of little concern in many applications of

wood but can become important in applications where there are many repetitions of stress. Long term fatigue can cause damage to lumber if it is not considered in the truss design when repetitions of design stress or near-design stress are expected to be more than 100,000 cycles during the normal life of the structure.

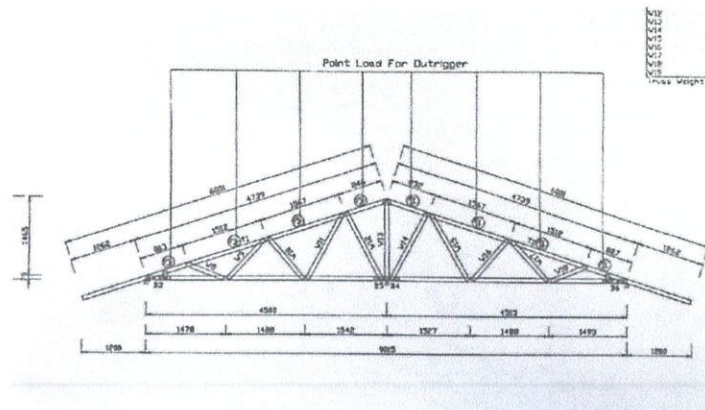


Figure 3.15: Load Span on Trusses

Figure above shows how the loads transfer through the trusses then it goes to the structure and the last is it will reach at the foundation and spread underground.

### 3.3.3 Erection of Steel Roof Trusses

Steel Roof Trusses will be hoisted up to the reinforced Concrete Roof Structures by the use of mobile crane. Manpower and power tools will be deployed to install Steel Battens/Purlins upon completion of Steel Roof Trusses and other Steel Supporting Structures.



Figure 3.16: Roof Trusses



When lifting, care must be taken to avoid damaging joints and timber. Spreader bars with attachment to the panel points are recommended where span exceeds 9000mm. Never lift by the apex joint only. The trusses may also be placed on the top plates by pulling them up skids, spread at 3000mm, taking the same precaution as described above. Ensure that the trusses are not distorted or allowed to sag between supports. The recommended method of lifting trusses will depend on a number of factors, including truss length and shape. In general, sling the truss from top chord panel points as shown in (Fig 1). Slings should be located at equal distance from truss centreline and be approximately 1/3 to 1/2 the truss length apart. Chains and hooks should not be used for lifting as these can damage the chords and plates. Polyester web slings are recommended. The angle between the sling legs should be 60° or less and where truss spans are greater than 9000mm it is recommended that a spreader bar or strongback be used. Some typical examples are shown in (Fig 1).

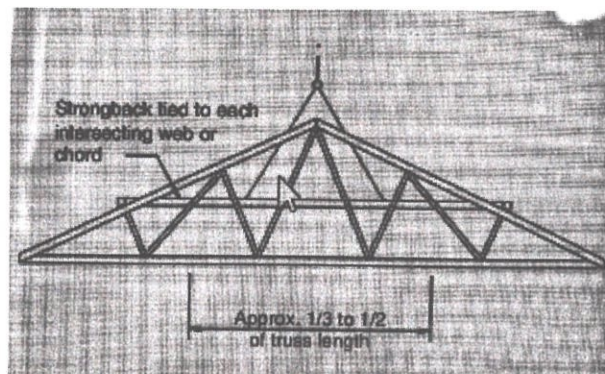


Figure 3.17: How to lift up trusses

### 3.3.4 Roof Covering and Accessories

Roof covering and accessories will be hoisted up to roof structure by the use of mobile crane and manpower. Manpower and power tools will be deployed to install roof covering and accessories. Roof tiles pallet should never be allowed to fully seat onto the roof trusses. Pallet is only allowed to partially seat onto truss but crane slings should remain taut (tension) throughout the process, while workers unload tiles. Although not preferred, a pallet can be allowed to seat onto trusses provided no more than 50 tiles are on the pallet at on the pallet at any time during the works.



Each stack of concrete tiles must be not more than 6 nos. of tiles which at 5 kg each is at total of 30 kg concentrated load. On the other hand, if stacks are between trusses, no more than 4 nos. of tiles per stacks is recommended (equivalent to 20 kg load).

Installation of tiles start on one side then move alongside roof's length. Install first nail into battens then tiles then using clips anchor onto the battens the tiles. For interlocking tiles, nail tiles to battens or sheathing. For tight spots cut the tiles, obstacles such as chimneys will find their way and with tiles they will be cut such that they fit around those areas tightly. And also each row's end tiles will also be cut. After tiles installation on roof's broad surface the tops need special capping with ridge tiles. Ridge tiles are round in shape and as per their design they can either be laid in overlapping or end-to-end style.

Concrete tiles work well for severe weather and also the material is durable generally. This roofing type as well is wind resistant as well as resistant to hail damage allowing snow to easily slide off especially if a smooth textured tile is gone for.

There are some mistakes which should avoid when install roofing of concrete tiles. They include placing of the tiles. It is the main cause of error during tile's installation whereby tiles are placed in such a way that they overlap improperly. Such error may lead to rain or windblown snow damaging the roof. Choice of concrete tiles in terms of weight. Choosing tiles which are very light in weight is risky as although they are more expensive compared to standard tiles but then they are very fragile. For the lightweight in cases where the roof needs repair or else maintenance may get damaged or even cracked during heavy rains. Consult a professional to advice on the ideal option as per your structure.

The area to be roofed. Concrete tiles type of roofing is never the best choice to go if intending to roof either an area which is complex or small. This is because *concrete tile roofing is quite difficult among other roofing types and therefore, with such areas a lot of cutting is required which might be difficult and also increase cost of looking for the special equipment to perform such.* With such areas additionally,

it's hard to install batten underlayment. Also the tiles should not be worked on when the weather is wet although it supports vast temperatures as in wet weather it is quite slippery. Next, post maintenance. If the roof that are installing no much attention would be give after installation, do not go for concrete tiles roofing type. This is because concrete tiles tend to fade very fast and therefore need installation of replacement tiles after some time.



*Figure 3.18: Rafter install roof tiles*

### **3.4 Problems occur during installation process with recommend solution**

#### **3.4.1 Lack of workers**

Construction industry is one of the sectors that attracted a large number of foreign workers working at construction sites. Contractor wants to cut cost so that the contractor reduces the number of workers. This is will disturbing the process of work on site. The contractor should hire more workers to make sure the works can be done on time to avoid EOT.

#### **3.4.2 Lack of two-way communication**

Great managers know how to a great job and great leaders know how to get employees to do a great job. Regular two-way communication lies at the very foundation of what great leaders deliver. When employees know what a manager knows, it creates an attitude and behavior of company ownership that leads to excellent performance. Management should make a regular concerted effort in communicating with all employees through as many mediums as possible.

### **3.4.3 Lack of equipment and facilities**

Management must make sure to pay attention to the type and condition of equipment that is being utilized by the employees. Capital expenditures on equipment and facilities are a very high percentage of operation expenses. Know what is needed, furnish it and then maintain it. Make sure employees participate all the way.

## CHAPTER 4

### CONCLUSION

This report had discovered all the information and knowledge about a roof construction. As a result, a roof is very importance element to the construction industry because of its function and purpose to protect any building from sunlight, rain and many more. Because of the roof, many people can live comfortably. Any design create by architect and engineer can be real and practical.

For this report, the case study is taken on site at Kampung Kuala Wau, Maran, Pahang Darul Makmur. They build a new building which is clinic for locals. This project estimated to use a skillion roof. *This type of roof is rarely used by JKR. This report elaborate more* on the installation of skillion roof type to achieve our purpose.

The purpose of this report to find and determine the objective. First, it is to identify the materials used in roof construction. Secondly, is to explain the method of roof construction. The last one is to identify advantages and disadvantages of lean-to roof type. All this objective were discovered well and it cover all the topic on roof construction.



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