UNIVERSITI TEKNOLOGI MARA

BUILDING DEPARTMENT

FACULTY OF ARCHITECTURE, PLANNING & SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

OCTOBER 2013

It is recommended that this Report of Practical Training is prepared

By

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2011855364

Entitled

ROOF CONSTRUCTION

Accepted in partial fulfilment of the requirements for obtaining Diploma in Building.

Report Supervisor

Dr. Mohd Rofdzi Abdullah

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Coordinator of Faculty

Dr.Mohd Rofdzi Abdullah

BUILDING DEPARTMENT

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(PERAK)

SEPTEMBER 2013

STUDENT'S DECLARATION

I hereby declare that all the writing in producing this Practical Training Report was produced originally by me except for extract and summaries for which the original references stated herein during my practical training that I went through for 5 months starting from 13 May 2013 to 29 September 2013 in the Harraz Teguh Design and Construction Management. Additionally, it is also one of the conditions in passing DBN307 course and received partial fulfilment of the requirements for obtaining a Diploma in Building.

Name : Najwa Asyila Bt Kamal Shahrizan

IC Number : 930217055282

Date : 28 September 2013

ANCKNOWLEDGEMENT

Bismillahirrahmannirrahim, first of all, I would like to say Alhamdulillah and gratitude to Allah s.w.t for His Blessings and grace for giving me strength and health in order to complete my Practical Training Report and thus complete my 5 months Practical Training. Besides, I would like to take this opportunity to express my gratitude and appreciation to Encik Mohd Azli B. Mohd Noor as the General Manager of Harraz Teguh Design and Construction Management and Supervisor in-charge of Practical Trainees for his exemplary guidance, monitoring and constant encouragement throughout completing this Practical Training Report. The blessing, help and guidance given by him from time to time during my practical training at his company has given extensive experience and knowledge in the construction industry. Additionally, I also would like to take this opportunity to express a deep sense of gratitude to Encik Hasbullah B. Arifin and Encik Mazlan B. Yusof as Project Managers for their cordial support, valuable information and guidance, which helped me in completing this Practical Training Report task through various stages. Gratefulness to my family members for all the advice and support as well as providing expenses for the journey to and from the office or site project. Furthermore, I am obliged to staff members of Harraz Teguh Design and Construction Management, for the valuable information provided by them in their respective fields and I am grateful for their cooperation during the period of my Practical Training Report. Besides, I would like to express my gratitude towards Dr. Mohd Rofdzi B. Abdullah as my Report Supervisor which is also Building's Coordinator for his kind co-operation and encouragement which help me in completion of this Practical Training Report, En Noor Azam B. Yahya as my visit lecturer and Sr. Anas Zafirol B. Abdullah Halim as Practical Training Coordinator. Last but not least, my thanks and appreciations also go to my colleague and people who have willingly helped me out with their abilities.

ABSTRACT

This report briefly describes the process and methods involved in the construction of roof which it is produced based on the 5 months practical training experiences which I have been placed in the construction site and at the headquarters office. Additionally, this report is divided into several sections and it is started with the introduction of roof in different scope and then it is followed with company background for Chapter 2 and finally, the background of site project for Chapter 3. On my observation, the construction of roof is not as easy as expected which it needs proper planning and secure where it involves many parties and complicated process of roof construction. Before the construction, selection on type of roof needs to be made and then the cost of overall roof construction from beginning until placement of roof covering need to be calculated in order to avoid of excessive or least of materials. In this report, it have been briefly explained the type of major components used in the construction of roof and then, the method involved in the installation of roof trusses are also been explained in this report followed by the roof finishes. During the process of roof construction, there are some problems occur related to the installation of roof trusses which have been identified and with culminating of this report, some recommendations are mention in order to improve the work done during the construction of roof. Besides, the recommendations stated can be used as problem solvent. In conclusion, this report entitled roof construction can explain in depth the process and procedure practically to the reader which can be compared to the fact learned.

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LIST OF ABBREVIATIONS

UBBL	Uniform Building By-Law
UiTM	Universiti Teknologi MARA
PPE	Personal Protective Equipment

CHAPTER 1.0

INTRODUCTION

1.1 Introduction

According to Edward Allen and Joseph Iano (2009), a building's roof is its first line of protection against the weather in order to defend it from rain, snow and sun which roof help to insulate the building from extremes of heat and cold and to control the accompanying problems of air leakage and water vapour condensation. Besides, Edward Allen and Joseph Iano (2009) also states that like any frontline defender, roof must take the burden of the attack which a roof is subject to the most penetrating solar radiation of any part of a building.

At midday, the sun broils a roof with radiated heat and ultraviolet light but on clear nights, a roof radiates heat to the blackness of space and becomes colder than the surrounding air (Edward Allen and Joseph Iano, 2009). Edward Allen and Joseph Iano (2009) indicate from noon to midnight of the same day, it is possible for the surface temperature of a roof to vary from near boiling to below freezing where in cold climates, snow and ice cover a roof after winter storms, and cycles of freezing and melting distress the materials of the roof. A roof is important to the sheltering function of a building, yet it is singularly exposed to the destructive forces of nature (Edward Allen and Joseph Iano, 2009).

1.1.1 Factors in Selection of Roof

Before the construction of a roof, several factors need to be considered in designing and choosing types of roof that is suitable for specific building. According to Abd. Latiff et. all (2006) there are four factors on selecting a roof which are:-

1. Size of the building

   The size of a building is one of the considerations on selecting the type of roof where usually pitched roof is suitable for small size buildings such as residence and school while flat roof with pitch less than 10° is suitable for large size building such as shopping complexes and offices.

2. Shape of the Building

   Besides the size of a building, shape of a building is an important element for roof selection either pitched roof or flat roof. According to, pitched roof is suitable for rectangular or simple design of a building but the construction of roof is complicated.

3. Aesthetic Value

   Selection type of roof can affect the aesthetic value of a building where generally, pitched roof is considered to have high aesthetic value compared to flat roof. The characteristics of roof depend upon the purpose of building which covers the roofing materials and the local traditions of roof construction. Besides, the concepts of architectural design and practice of roof construction may also be governed by local or national legislation. Prestigious buildings in Malaysia such as the National Museum and National Art Gallery which utilise pitched roof.

Photo 1.1.1.1 Malaysia National Museum, Kuala Lumpur

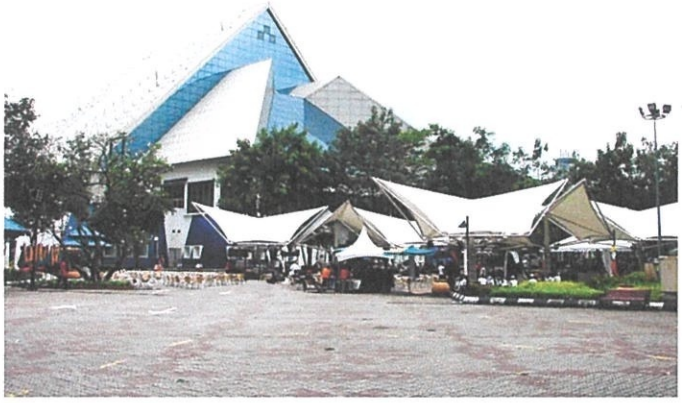


Photo 1.1.1.2 Malaysia National Art Gallery, Kuala Lumpur

4. Cost

   Cost is the fourth important factor in selecting the types of roof to be constructed for a specific building. The construction and maintenance costs should be should be considered before the roof selection. Pitched roof is normally more expensive to construct compared to flat roof where the construction of pitched roof is more complicated and need a proper planning.

1.1.2 Types of Roof

Around the world, there are two types of roof design which depend on the functions of the building and in different countries, different types of roof are used which are:-

1. Pitched Roof

Photo 1.1.2.1 House with pitched roof design

According to McMahon (2003), a pitched roof is a roof made up of two angled pieces which meet in the middle, with gables at either end. Besides, McMahon (2003) also stated that the pitch of both sides of the roof is generally the same, although sometimes they may be pitched at different angles for aesthetic reasons. It is also possible to make what is known as a single pitch roof, in which the entire roof is made of one flat segment installed at an angle which this method of construction is extremely common all over the world (McMahon, 2003).

McMahon (2003) states that the angle of the pitch varies considerably, depending on the size of the building and the size of the segments. In some regions, people traditionally build with a very deep pitch so that snow cannot accumulate on the roof while in other areas, the pitch may be shallower, with the roof angled just enough to allow water to drain from the roof (McMahon, 2003).

McMahon (2003) identified steep pitches can create more space under the roof, which may be useful in homes with lofts and attics where the height of the roof can limit head room while shallow pitches tend to create unusable space near the walls, unless the walls are high enough to elevate the roof well above the floor.

Pitched roof can be divided into three types which are:-

i. Hip Roof

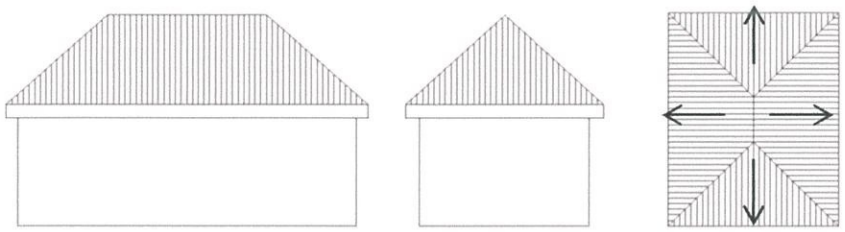


Figure 1.1.2.1 (i) Hip Roof

According to Carles Broto (2007), Hip Roof is a pitched roof having four surfaces with four sloped sides that meet along convex ridges.

ii. Gable Roof

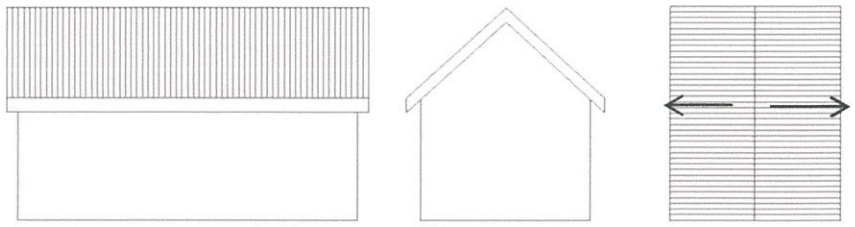


Figure 1.1.2.1 (ii) Gable Roof

A roof having two surfaces with two sloped sides that intersect along a ridge at the top, shedding the rainwater in two opposite directions is called a Gable Roof (Carles Broto, 2007).

iii. Lean-To-Roof

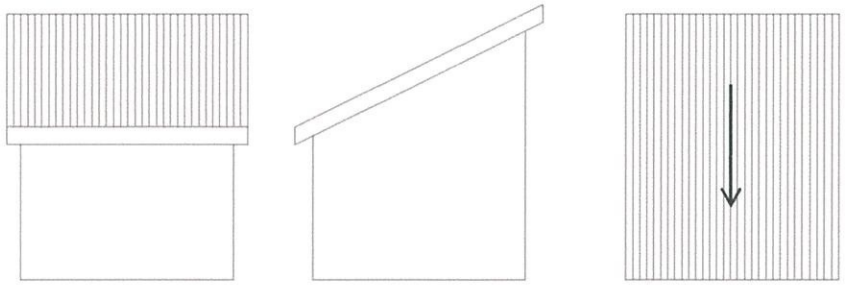


Figure 1.1.2.1 (iii) Lean-To-Roof

Carles Broto (2007) stated that Lean-To-Roof or Pent Roof is a pitched roof with only one side, one slope and one plane.

iv. Gamble Roof

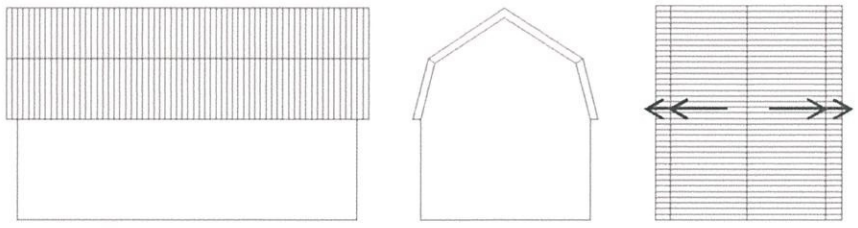


Figure 1.1.2.1 (iv) Gamble Roof

A pitched roof with two sides that slope away from the ridge in two successive angles, the lower of which is nearly vertical is called a Gamble Roof. Gamble Roof is also known as Curb Roof or French Roof (Carles Broto, 2007).

v. Mansard Roof

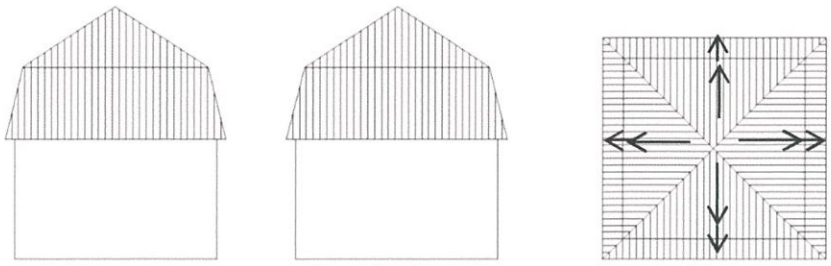


Figure 1.1.2.1 (v) Mansard Roof

Carles Broto (2007) identified that Mansard Roof is a roof consisting of more than one plane on each side where the total surfaces of a Mansard Roof is eight surfaces with four slope directions which the lower sections of which are the steepest.

vi. Butterfly Roof

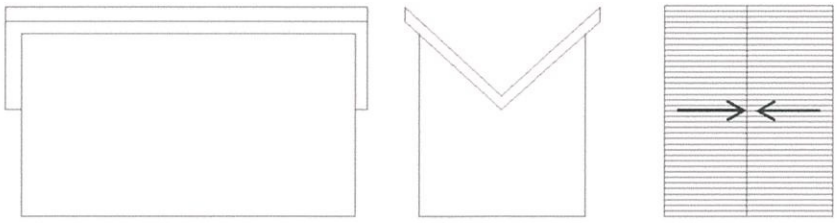


Figure 1.1.2.1 (vi) Butterfly Roof

Butterfly Roof is two sided pitched roof slopping in towards the central valley or gutter that leads the rain water to a downspout (Carles Broto, 2007)

2. Flat Roof

Photo 1.1.2.1 House with flat roof design

Flat roofs are traditionally found wherever the climate is hot and dry and rainfall is not significant where the term flat roof is a bit misleading, as even this type of roofing system must have some gradient so water will not accumulate on it but from an aesthetic standpoint, the look is radically different from that of a traditional pitched roof found on the vast majority of homes worldwide (County Flat Roofing, 2012). According to County Flat Roofing (2012), a flat roof is associated with south-western and pueblo style homes and more modern architecture, such as art-deco and the modernist movement.

County Flat Roofing (2012) states that the use of flat roofs in areas where rain and snow are significant has grown in the past decades as new materials have been developed that make the use of a flat roof more practical in any climate. Even with a slight gradient to shed water, a flat roof is particularly susceptible to ice accumulation which the ice formation blocks water flow during thawing leading to pooling and moisture seepage beneath the roof surface (County Flat Roofing, 2012). According to County Flat Roofing (2012), now a days, new flat roof technology and materials offer better seals making the roof far more waterproof than previous systems.

Aside from aesthetics, a well installed flat roof has other advantages over a sloping roof system which one of it is to ease the construction and results in much lower costs (County Flat Roofing, 2012). County Flat Roofing (2012) also states that a flat roof features has no complicated angles or compound cuts to be made, so construction will conducted in a very short time and less material is needed. Besides, inspection and maintenance are also much easier and low cost is needed which no scaffolding or special harnesses are required as in a sloped roof (County Flat Roofing, 2012).

According to County Flat Roofing (2012), space utilization is also better with a flat roof system as compared to pitched roof where pitched roof has a large open space under the roof which can be less energy efficient. The level area of a flat roof can also be put to use for other needs, such as HVAC equipment, or living space (County Flat Roofing, 2012).

1.1.3 Parts of Roof Structures

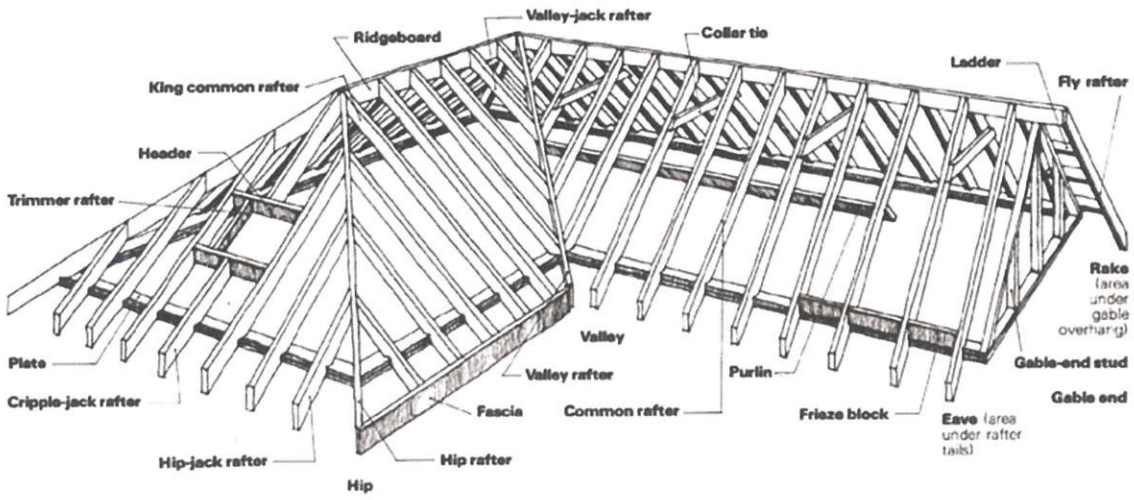


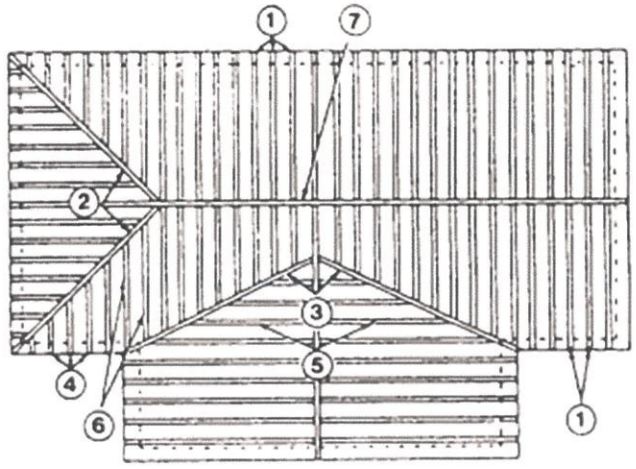
Figure 1.1.3.1 Roof Structures of Pitched Roof

Source: Sdelaysam (2011)

1. Ridge Board

   Malcolm Tatum (2003) states that ridge boards are boards that serve as part of the support system for roofs on many types of buildings specifically, the ridge board is a section of solid timber or metal that is positioned horizontally along the line of the ridge of the roof.

2. Rafter



1. Common rafters
2. Hip rafters
3. Valley rafters
4. Hip jack
5. Valley jacks
6. Cripple jacks
7. Ridgeboard

Figure 1.1.3.1 Type of Rafters for Pitched Roof

Source: Benjamin Barnow (1986)

The members making up the main body of the framework of all roofs are called rafter which are inclined members spaced from 400 to 1200 millimetres apart which vary in sizes depending on their length and spacing (Benjamin Barnow, 1986). Besides, Benjamin Barnow (1986) also indicates that the tops of the inclined rafters are fastened in one of several ways determined by the type of roof while the bottoms of the rafters rest on the plate member, providing a connecting link between the wall and the roof.

Common rafters extend from the plate to the ridge board at right angles to both while hip rafters extend diagonally from the outside corner formed by perpendicular plates to the ridge board (Benjamin Barnow, 1986). According to Benjamin Barnow (1986), Valley rafters extend from the plates to the ridge board along the lines where two roofs intersect whereas Jack rafters never extend the full distance from plate to ridge board which Jack rafters are subdivided into the hip, valley, and cripple jacks. In a hip jack, the lower ends rest on the plate and the upper ends against the hip rafter while in a valley

jack the lower ends rest against the valley rafters and the upper ends against the ridge board and finally, cripple jack is nailed between hip and valley rafters (Benjamin Barnow, 1986).

3. Gable end

   Martin Tate (2010) states that gable end wall is the triangular section of wall supporting two sides of a sloping roof which the phrase may also be used to describe the whole of the end wall of a building which includes a gable. On most modern houses, the roof tiles or slates extend over the top of a gable end wall, with some form of weather proofing added between tile and brickwork to stop the ingress of rainwater (Martin Tate, 2010).

4. Fascia

   According to S.E. Smith (2005), fascia board is a type of roof trim that is commonly used on houses which is mounted on the exposed ends of rafters or the top of exterior walls to create a layer between the edge of the roof and the outside. Additionally, to serves an aesthetic function by creating a smooth appearance on the edge of the roof, it also protects the roof and the interior of the house from weather damage (S.E. Smith, 2005).

1.1.4 Roof Trusses

Roof trusses which are structural components of houses or commercial buildings support the weight of roof timbers and coverings. Usually, they are constructed from pieces of timber or steel which are nailed, bolted, or pegged together to form mutually supporting and strong base for a roof. There are different types of roof trusses arrangements which are:-

1. Flat Truss

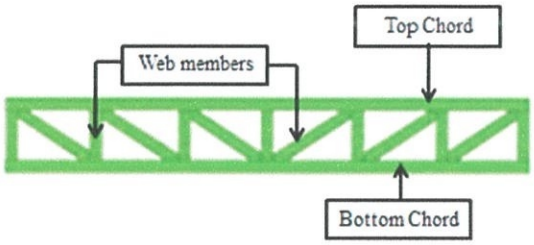


Figure 1.1.4.1 Flat Truss

Source: Rafter Tales (2008)

Francis D.K Ching (2008) states that flat truss have parallel top and bottom chords which are generally not as efficient as pitched or bowstring truss.

2. Double Howe Trusses

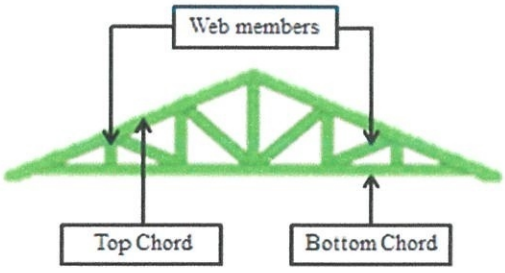


Figure 1.1.4.2 Double Howe Truss

Source: Rafter Tales (2008)

According to Francis D.K Ching (2008), Double Howe truss have vertical web members in compression and diagonal web members in tension and it is

generally more efficient to use a truss type in which the longer web members are loaded in tension.

3. Fink Trusses

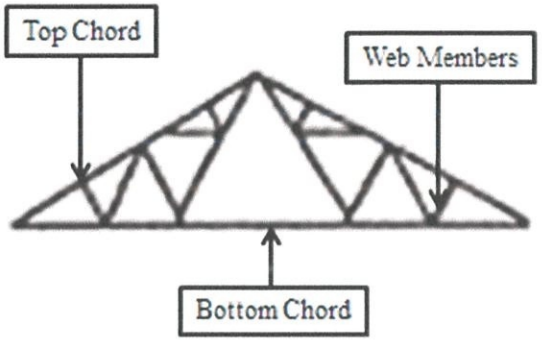


Figure 1.1.4.2 Fink Truss

Source: David L. Heiserman (2013)

Fink truss are Belgian truss having subdiagonals to reducee the length of compression web members toward the centerline of the span which diagonals connect a top to a bottom chord while subdiagonals join a chord with a main diagonal (Francis D.K Ching, 2008).

4. Warren Trusses

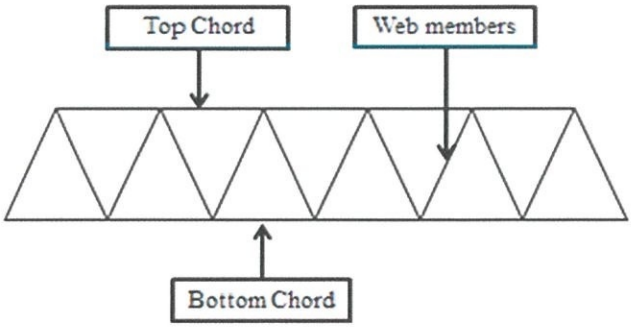


Figure 1.1.4.2 Double Howe Truss

Source: Balsa Wood Warren Truss. (n.d.)

Francis D.K Ching (2008) indicates that Warren truss have inclined web members forming a series of equilateral triangles. Vertical web members are

sometimes introduced to reduce the panel lengths of top chord which is in compression.

5. Scissors

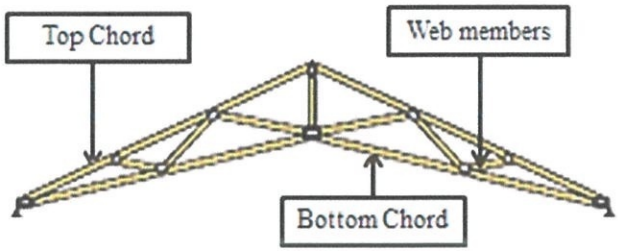


Figure 1.1.4.2 Double Howe Truss

Source: Roof Truss Design and Structural Engineers (n.d.)

According to Francis D.K Ching (2008), scissors truss have tension members extending from the foot of each top chord to an intermediate point on the opposite top chord.

1.1.5 Roof Covering

Roofs can be covered with many different types of materials which can be organized conveniently into two groups which those that work on pitched roof and those that work on flat roof, where the differences is important which a pitched roof drains itself quickly of water, giving wind and gravity little opportunity to push or pull water through the roofing materials (Edward Allen and Joseph Iano, 2009).

Therefore, Edward Allen and Joseph Iano (2009) identified pitched roof can be covered with roofing materials that are fabricated and applied in small, overlapping units by using shingles of wood, slate, or artificial composition such as tiles of fired clay or concrete or even tightly wrapped bundles of reeds, leaves or grasses. There are several advantages to these materials which many of them are inexpensive, individual units are easy to be handled and install as well as low maintenance cost (Edward Allen and Joseph Iano, 2009).

According to Edward Allen and Joseph Iano (2009), the effects of thermal expansion and contraction plus movements in the structure that supports the roof are minimised by the ability of the small roofing units to move with respects to one another. Water vapour vents itself easily from the interior of the building through the loose joints in the roofing material and a steep roof of well-chosen materials skilfully installed can be a pleasure to the eye but low-slope roofs have none of these advantages which water drains relatively slowly from the surfaces and small errors in design or construction can cause them to trap puddles of standing water (Edward Allen and Joseph Iano, 2009).

The membranes that cover low-slope roofs must absolutely watertight even small punctures, tears, or gaps in joints, caused by defects in construction, physical wear and tear, or movements within the building structure can allow large quantities of water to enter into the building structure and its interior, with potentially disastrous results (Edward Allen and Joseph Iano, 2009). Besides, Edward Allen and Joseph Iano (2009) said that water vapour pressure from within the building can blister and split an membrane but there are advantages of low-slope roofs such as it can covers a

building of any horizontal dimension, whereas a steep roof becomes economically tall when used on very broad building. A building with a low-slope roof has a much simpler geometry that is often less expensive to construct and low-slope roofs, when appropriately detailed, can serve a balconies, decks, patios, and even landscaped gardens or parks (Edward Allen and Joseph Iano, 2009).

1.2 Objectives

During the practical training, the construction of roof was drive to another to set objectives. The objectives of this study are as follows:

1. To study on the arrangement of roof trusses used which is suitable with the shape of the building and the amount of load it carries.
2. To investigate the types of material used for the roof structure in order to accommodate the load above it.
3. To identify the types of connections used in order to connect from one part of roof structure to another roof structure.

1.3 Scope of Study

The scopes of study in the roof construction are focused on the connection used between two roof structures in order to support the load above it. Besides, this study highlight on the types of material used for the structures of roof and the types of roof covering. This study also gained knowledge on the arrangement of roof trusses which is suitable for a specific building at Lot 11781, Lorong Dahlia 2/3, Taman Dato' Wan, 70100 Seremban, Negeri Sembilan Darul Khusus.

1.4 Method of Study

In order to produce a comprehensive report and gain a lot of information according to the selected topic, it had taken a few methods of study which are the first method is browsing some of the information by using the website. Browse on the internet and look through some information which is related to construction of a roof. Then, cited the selected information and insert it in this report. Besides using the internet as references, books are also have been used in order to create an extra-ordinary report. Different types of books have been used either my personal books or borrowed from the libraries which are in UiTM Perak and Negeri Sembilan public library.

Usually, after went for a site visit, then will return back to the office with full of questions to be asked to supervisor in charge which is Mr Azli. If Mr Azli is not in, Mr Hasbullah and Mr Mazlan are there to be asked. Whenever there were problems occur, they will explain until understand all the situations clearly. Besides, Mr Azli has provided a book of roof construction method from beginning until the end for my references. Additionally, he teaches on the calculation of roof structure which needs to be used during the construction.

Last but not least, the person whom has contributed a lot of knowledge in this report is Dr. Mohd Rofdzi Abdullah as my report supervisor or lecturer in charge. If there is any unclear procedure, he is there willing to help. Additionally, he advises and teaches me on producing a good report with all the information that has been assembled.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction

The business of Harraz Teguh Design and Construction Management was astablished two years after Natural Arch Concept was set up on 19th December 2010. Since the inception stage two year ago, the business are as an interior design, project management, architect consultant, landscape design, graphic design and construction company with sole proprietor status led by Mr Mohd Azli Mohd Noor @ Ramlee.

On 20th December 2012, with the divers faction of the business growth to the next level. Harraz Teguh Design and Construction Management was found with the partnership company of Mr Mohd Azli Mohd Noor @ Ramlee, Mr Hasbullah Ariffin and Mr Mazlan Yusof. The new scopes of business are expand to clearance site, civil engineering, interior design, mechanical and electrical, insurance agent and landscape. Harraz Teguh Design and Construction Management was managed by a team of people who had wide experience and expertise in their respective fields.

The management of Harraz Teguh Design and Construction Management had looking forward to participate and contribute on larger scale in civil construction projects. With the expanding market, strong management team and support from the financial institutions, Harraz Teguh Design and Construction Management will be able to expand the business further, to provide better services whilst incorporating and continuously keeping abreast with the latest technology. Their commitment is to

meet their clients' higher satisfaction through our practical technical solutions, competitive costs and fast tract schedule. All have been implemented in record time with high quality and to their clients' complete satisfaction.

2.2 Company Profile

Figure 2.2.1 Company Logo

Source: Harraz Teguh Design & Construction Management

Company Name	: Harraz Teguh Design & Construction Management
Registration Number	: NS0108167-X
Registered Address	: 178, Jalan Idaman Bayu 1/5, Taman Idaman Bayu 1, 71900 Bandar Sri Sendayan, Negeri Sembilan.
Office Address	: 2-01, Aras 2, Bangunan Seremban Plaza, Jalan Dato' Muda Linggi, 70100 Seremban, Negeri Sembilan.
Telephone Number	:
Email	: harraz_teguh@yahoo.com
Status of Company	: Bumiputera
Owners	: Mohd Azli b. Mohd Noor @ Ramlee Hasbullah b. Arifin Mazlan b. Yusof
Type of Business	: Partnership
Nature of Business	: Clearance Site, Civil Engineering, Interior Design, Mechanical and Electrical, Insurance Agent and Landscape
Activities	: Design, Renovation, Construction
Bank	: CIMB Bank

2.3 Organisation Chart

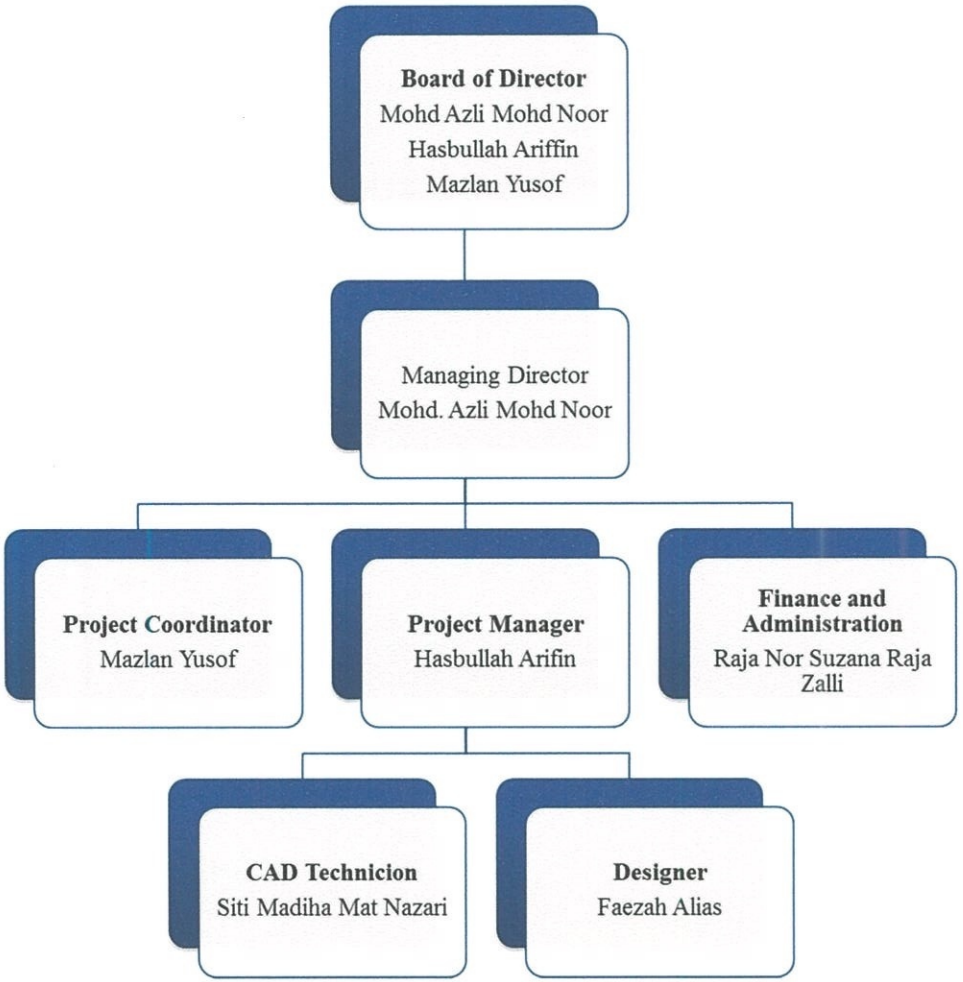


Figure 2.3.1 Company Organisation Chart

Source: Harraz Teguh Design & Construction Management

2.4 List of Projects

The following tables show the list of completed project and secured project of Harraz Teguh Design and Construction Management.

2.4.1 List of Completed Project

NO.	PROJECT TITLE	LOCATION
1.	Proposed to be build a warehouse with double storey office and dormitories as well as guardhouse.	Lot 16673, Kawasan Perindustrian Nilai Utama Entreprise Park, Mukim Sentul, Daerah Seremban, Negeri Sembilan Darul Khusus.
2.	Proposed to be build a single storey 'surau' completes with toilet, ablution area and prayer area in Taman Kobena.	Lot 12829, Mukim Ampangan, Bandar Senawang, Daerah Seremban, Negeri Sembilan Darul Khusus.
3.	Proposed to be build 2 units of Semi-D House	Lot 31675, Mukim Ampangan, Ampangan, Daerah Seremban, Negeri Sembilan Darul Khusus.
4.	Proposed to be renovated and extend 1 unit of apartment house including additional interior design work.	D4-09. Sri Hijauan Apartnment, Jalan Sri Ukay Perdana ½, Ukay Perdana, 68000 Ampang, Selangor Darul Ehsan.

NO.	PROJECT TITLE	LOCATION
5.	Proposed to be renovated a single storey terrace house including additional landscape work.	Lorong Cenderawasih, Taman Paroi Jaya, Paroi, 70400 Seremban, Negeri Sembilan, Darul Khusus.
6.	Proposed to be renovated a single storey house.	No. 116, Jalan Kemuning 3, Jalan Kemuning, Senawang, 70450 Seremban, Negeri Sembilan, Darul Khusus.
7.	Proposed to be renovated 1 unit of apartment house including additional interior design work.	B-00-09, Sri Camellia Apartment, Jalan Sepakat Indah 3, Taman Sepakat Indah, Sg. Chua, 43000 Kajang, Selangor Darul Ehsan.
8.	Proposed to be renovated a boutique premise including additional interior design work.	No. 542-G, Bandar Senawang, Senawang, 70450 Seremban, Negeri Sembilan, Darul Khusus.
9.	Proposed to be renovated a 2 ½ storey terrace house including interior design work.	Taman Ampangan Jaya 2, Ampangan, 70400 Seremban, Negeri Sembilan, Darul Khusus.

NO.	PROJECT TITLE	LOCATION
10.	Proposed to be renovated a single storey detached house.	No. 355, Lorong Cenderawasih 2, Taman Paroi Jaya, Paroi, 70400 Seremban, Negeri Sembilan, Darul Khusus.
11.	Proposed to be renovated a single storey terrace house including interior design work.	No. 74, Taman Kerisi Mambau, 70300 Seremban, Negeri Sembilan, Darul Khusus.
12.	Proposed to be renovated 1 unit of apartment house including additional interior design work.	C-5-02, Apartment Desajaya, Bandar Tasik Jaya, Senawang, 70450 Seremban, Negeri Sembilan, Darul Khusus.

2.4.2 List of Secured Projects

NO.	PROJECT TITLE	LOCATION
1.	Proposed to be built a single storey private bungalow	Lot 11781, Lorong Dahlia 2/3, Taman Dato' Wan, Ampangan, 70400 Seremban, Negeri Sembilan.
2.	Proposed to be renovated and extend Daerah Rembau Majlis Amanah Rakyat (MARA) office's including interior design work.	Bangunan Aked MARA, Jalan Terentang, 71300 Rembau, Negeri Sembilan, Darul Khusus.
3.	Proposed to be built partition walls as divider of premises lots, plastering and painting over 75' including the construction of 6 toilets completed with toilet accessories.	No. 1, 3, 5, 7, 9, 11 & 15, Jalan Padi Emas 1/3, 81300 Skudai, Johor Bahru. Darul Takzim.

CHAPTER 3.0

ROOF CONSTRUCTION

3.1 Introduction

Roof Construction is the most common construction which we usually observed but most people take is as unserious matters. In the construction of roof, calculations need to be done in order to ease the work during roof construction is conducted. Besides, Personal Protective Equipment (PPE) needs to be used in order to secure our safety during roof construction. In Malaysia, falls from roofs accounted for 1/3 of fall related construction fatalities from 1992-2013. Workers employed by small establishments, residential construction workers may face disproportionately high risks of roof fatalities.

Before proceed the roof construction, it is must be sure that all machineries and tools are well inspected in order to avoid any injuries. In addition, roof construction had involved materials that are high quality that is functioning to bare the load above it. During the construction of roof, skilled workers are known as roofer need to make sure that all the connections made are tight and strong to avoid any failure of roof occur.

The parties involved in the roof construction need to make sure that all the works conducted follow the requirement stated in the roof plan and they must perform their duties at the construction well, so that all the works conducted during the construction of roof runs smoothly.

3.1.1 Parties Involved

The role of individuals appointed should express a sense of responsibility and full commitment to ensure that the construction of roof runs smoothly without any extension of time or increases in cost. During roof construction, building owners and contractors both benefit with an unbiased third party roof professional to monitor the roof installation process and verify that the correct materials are being installed properly. All the parties involved need to cooperate with each other in order to achieve time management in the construction of roof. The individuals who are responsible in the construction of roof and their duties are:

1. General Contractor

   A general contractor is responsible for the day-to-day oversight of a construction site, management of vendors and trades, and communication of information to involved parties throughout the course of a building project which a contractor is also in-charge on the construction of roof. A contractor will calculate a price, also called an estimate which considers the cost of materials and equipment as well as the cost of labour to provide the owner with an approximate price for the project.

2. Architect

   An architect is a person who trained and licensed to plan, design, and oversee the construction of buildings including the construction of roof. To practice architecture works means to provide services in connection with the design and construction of buildings and the space within the site surrounding the buildings that have as their principal purpose human occupancy or use.

3. Engineer

   An engineer is a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics, and ingenuity to develop solutions for technical problems occur during the construction of roof.

Engineers design materials, structures, and systems while considering the limitations imposed by practicality, regulation, safety, and cost.

4. Materials Suppliers

   Material suppliers are responsible on supplying all the materials needed in the construction of roof which in order to ease the work of construction. Beside that, materials suppliers provide a right amount of materials that had ordered and deliver safely on at the construction site without any damages.

5. Roofers

   A roofer is a construction worker who specializes in roof construction which usually concentrates on the application of roof covering as a substrate for roofing materials to be installed on the rafters, beams, and trusses are the frame or skeleton for the roof to be built upon. Roofers must be skillfull and possess basic carpentry skills.

3.1.3 Types of Machineries and Tools Used

In order to connect between two members of roof structures, machineries need to be used in order to insert and tighten the connections without failed. Besides, the machineries need to be used in order to cut long stainless steel brackets which come in same length into specific length. All machineries used must been inspected before it was used. Types of machineries and tools used are:-

1. Measuring Tape

Photo 3.1.3.1 Measuring Tape

Measuring tape was used in order to measure the length of stainless steel which needs to be cut into specific length before the construction of roof is conducted.

2. Impact Gun

Photo 3.1.3.4: Impact Gun

Impact gun can be in electric or pneumatic or known as impact air gun which is functioning to loose and lighten bolts and nuts in a very fast way which the period on the construction of roof can be shortens.

3. Circular Saw

Photo 3.1.3.2: Circular Saw

The circular saw is a machine using a toothed metal cutting disc or blade which is able to cut the steel without damaging it or being cut crookedly. Besides, by using circular saw, all the cutting process can be fast.

4. Electric Drill

Photo 3.1.3.3: Electric Drill

A drill is a tool fitted with a cutting tool attachment or diving tool attachment which used for drilling holes in various materials or fastening various materials together with the use of fasteners. In the construction of roof, electric drill is used in order to connect the structure which required the installation of screw.

3.2 Project Background

Reference No.	: Bil (2) dlm MPS. KB 3 – 50/11
Project Name	: Cadangan Membina Sebuah Banglo Satu Tingkat
Location of Project	: Lot 11781, Taman Dato' Wan, Lorong Dahlia 2/3, Bandar Seremban.
Owner	: En. Abd. Latif Bin Abdul Rahman No. 502-M, Jalan Kenanga ½, Taman Kenanga ½, Kg. 8, 75200 Melaka.
Architect	: Arkitek Kaio Sdn. Bhd No. 48, Jalan Cempaka 1, Taman Seri Cempaka, Peringgit, 75400 Melaka.
Engineer	: AES Civil & Structural Engineers No 34-1A, Jalan TKL 6, Taman Kota Laksamana, Seksyen 1, 75200 Melaka
Contractor	: Harraz Teguh Design & Management 2-01, Aras 2, Bangunan Seremban Plaza, Jalan Dato' Muda Linggi, 70100 Seremban, Negeri Sembilan.
Project Price	: RM 563, 785.00
Project Starts	: 16 March 2013
Project Ends	: 15 August 2013

3.3 Case Study on Roof Construction

3.3.1 Roof Selection for Case Study

The first step before a construction of roof is conducted is to identify the size and shape of a building. In order to know the length and width of the building, drawing plans need to be referred. In the construction of roof for the bungalow house in Taman Dato' Wan, Ampangan, Figure 3.3.1.1 shows the dimensions of the house.

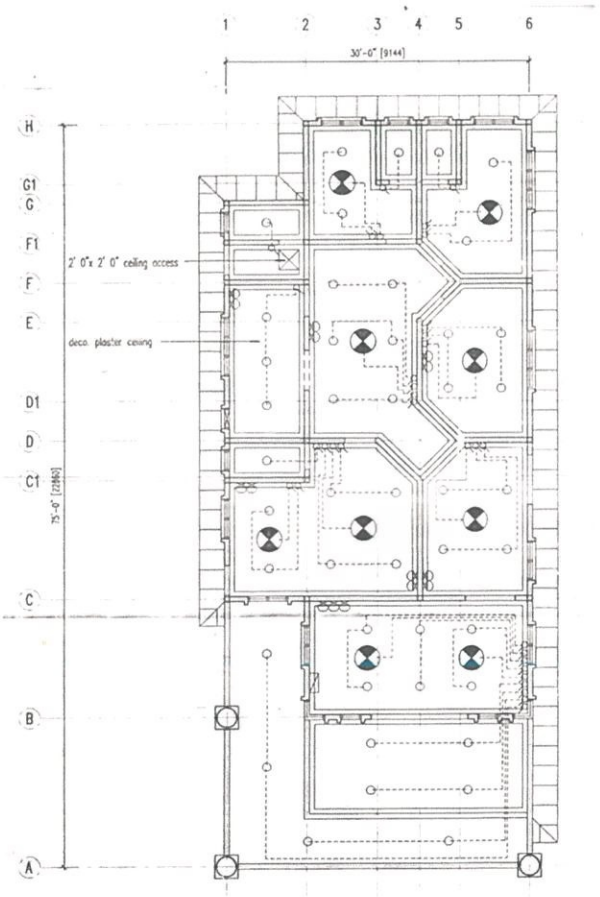


Figure 3.3.1.1 House Dimension of Bungalow House in Taman Dato' Wan, Ampangan

Source: Harraz Teguh Design & Construction Management

From the above Figure 3.3.1.1, we can see that the length of the house is 22860 cm long while the width of the house is 9144 cm which it shows that the size of building

is small and it requires a pitched roof design. Selection of pitched roof is supported by the simple design and shape of building which it is in rectangle compared to others mega buildings.

Besides, pitched roof has high aesthetic value because of uniqueness of the shape and design but pitched roof construction need high concentration due to its complicated arrangements and connections. Additionally, the cost of pitched roof construction of the bungalow house in Taman Dato' Wan, Ampangan is from the range of RM 11 000 to RM 15 000 which the cost included manpower cost, machineries, materials and roof covering.

Malaysia is one of warm humid climate country which the air temperature during the day is between 27°C and 32°C while during the night, it is between 21°C and 27°C which the range of air temperature is suitable of pitched roof design. Basically, pitched roof design has a space between the ceiling and the roof structure which it is functioning as air reaction circulation space where 70% of air humidity will be filtered before it was transfer through the ceiling straight to the interior area of the house. Besides, the space can be used as an attic which one of its advantages.

There are several advantages on the selection of pitched roof as Taman Dato' Wan, Ampangan bungalow house's roof design which is pitched roof has high aesthetic value. It acted as main attractive of a house. Besides that, pitched roof has low maintenance cost because it is easy to be maintained which at least roof covering need to be change if there are any leakage. Additionally, it is fast in conveying the rain water which the roof will be free from water stagnation and it leads to absence of fungi which may cause damage to the roof.

3.3.2 Roof Trusses

A truss is essentially a triangulated system of straight interconnected structural elements. The most common use of trusses is in buildings, where support to roofs, the floors and internal loading such as services and suspended ceilings, are readily provided. The main reasons for using truss are long span, lightweight, controlled deflection and opportunity to support considerable loads.

Selecting the best type of roof truss for a house is quite challenging. Functionality and aesthetic conditions will lead the considerations of the type of roof truss that will be selected in the construction of houses and buildings. Most often, variations of the common truss are named for their web configuration, such as the King Post, Bowstring, Fink and Howe truss, with the chord size and web configuration typically being determined by the load, span and spacing.

In roof construction of a bungalow house in Taman Dato' Wan, Ampangan there are three types of trusses chosen for specific area with different span which are suitable for that types of roof truss arrangement. From the roof plan in the drawing submission which is shown in Figure 3.3.2.1, we can see that the highlighted roof which is used in the front section of this house is Queen Post Truss type of arrangement.

Figure 3.3.2.1 Roof Plan of Bungalow House in Taman Dato' Wan, Ampangan

Source: Harraz Teguh Design & Construction Management

Queen Post Truss arrangement is where a vertical web member which is known as king post is built between two diagonal queen posts in tension and it is generally more efficient to use this type of truss in which the longer web members are loaded in use a truss type in which the longer web members are loaded in tension. Besides, as usual, top chord and bottom chord are built at the top and bottom of the web members which is shown in Figure 3.3.2.2.

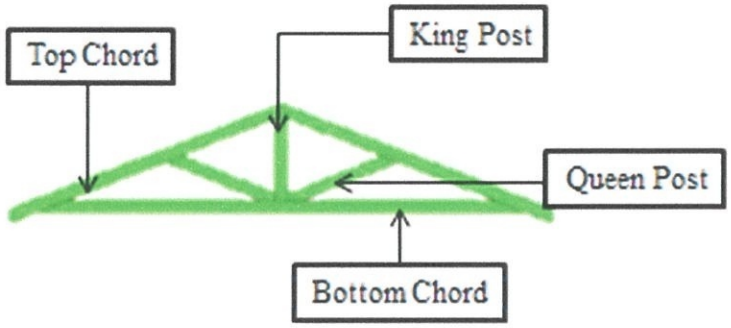


Figure 3.3.2.2 Queen Post Truss

Source: Rafter Tales (2008)

Additionally, in Queen Post Truss design, the loads above the truss which is the roof covering is distributed equally to two of the top chords and the king post. Then, when it comes to the queen posts, for once more time, the loads will be distributed to the queen posts. After that, the load at the queen posts will combine with the loads at the king post and then it will distribute to the bottom chord. At the junction between the top chord and bottom chord, all the loads collected will be transferred to the wall of house and straight to the foundations which can be seen in Figure 3.3.2.3 where the arrows represent the load and this figure shows how the loads are distributed.

Figure 3.3.2.3 Load distribution

Source: Rafter Tales (2008)

The same theory is applied on the Queen Post Truss arrangement used in the roof construction at the bungalow house in Taman Dato' Wan, Ampangan for the front section of the house or known as living area. Photo 3.3.2.4 shows on the application of Queen Post Truss arrangement at the construction site.

Photo 3.3.2.4 Queen Post Truss in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Besides Queen Post type of arrangement, Belgian Truss arrangement also been used in the roof construction of a bungalow house in Taman Dato' Wan, Ampangan where this type of truss design is applied at the middle section of the house which including the master bedroom, wet kitchen, dining area, bedroom 1 and dry kitchen. From the roof plan shown in Figure 3.3.2.5, the application of Belgian Truss arrangement can be seen clearly which have been highlighted for understanding.

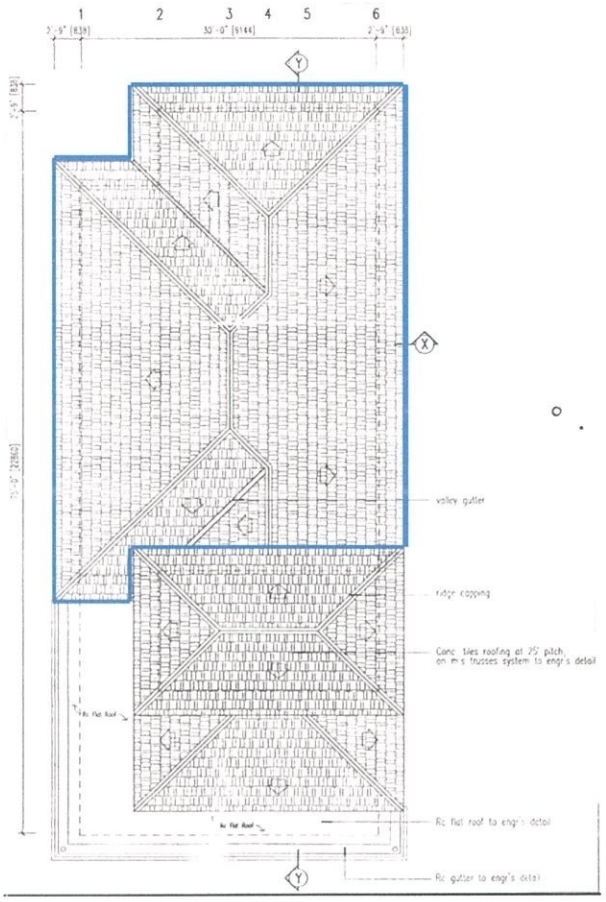


Figure 3.3.2.5 Roof Plan of Bungalow House in Taman Dato' Wan, Ampangan

Source: Harraz Teguh Design & Construction Management

Belgian Truss arrangement is where only consist of inclined web members which known as queen posts are built. Besides queen posts, top chords and bottom chords are constructed in order to complete as a Belgian Truss which have been shown in Figure 3.3.2.6.

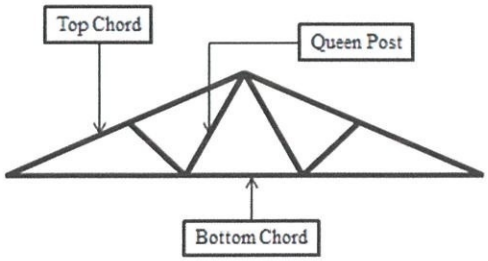


Figure 3.3.2.6 Belgian Truss

Source: David L. Heiserman (2013)

In Belgian Truss arrangement, the load distribution method starts from roof covering above the truss which will be distributed to the roof structure starts from top chords. Besides top chords, loads are also have been divided to queen posts built. The loads carried by the top chords are then been transferred to two of the inclined queen posts. After that, all the loads carried by four of the queen posts are then been transferred the bottom chord. Lastly, all the loads distributed are assembled at the end of the top chords and bottom chord before the load is shifted to the walls of the building. The load distribution concept of Belgium Truss can be understand by referring Figure 3.3.2.7 which the arrows in the figure represent the load distribution.

Figure 3.3.2.7 Load Distribution
Source: David L. Heiserman (2013)

Belgian Truss arrangement has been applied in the construction of roof for the bungalow house in Taman Dato' Wan, Ampangan as the second types of roof truss. Additionally, the construction of Belgian Truss is made on site where the details connection on the trusses are made traditionally without involving any mega machineries or factory made which can be seen in Photo 3.3.2.8.

Photo 3.3.2.8 Belgian Truss of Bungalow House in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

For different angle of pitched roof, two types of trusses arrangement are applied which without one on this trusses, the roof structure cannot bare the load above which will lead to failure. Two of these trusses are used in order to produce angle of 30° to 40° pitched roof which called Step down Hip Truss and Hip Truss arrangement. Besides of these arrangements, various type of roof trusses arrangement can also use but under one condition, Hip Truss need to be remaining in order to create a perfect angle for the roof. According to figure 3.3.2.9 and figure 3.3.2.10, these are two type of roof trusses have been used in the roof construction for the bungalow house in Taman Dato' Wan, Ampangan. Step down Hip Truss and Hip Truss arrangements are applied for the car porch and rear elevation of this house which can refer to Figure 3.3.2.11 for roof plan.

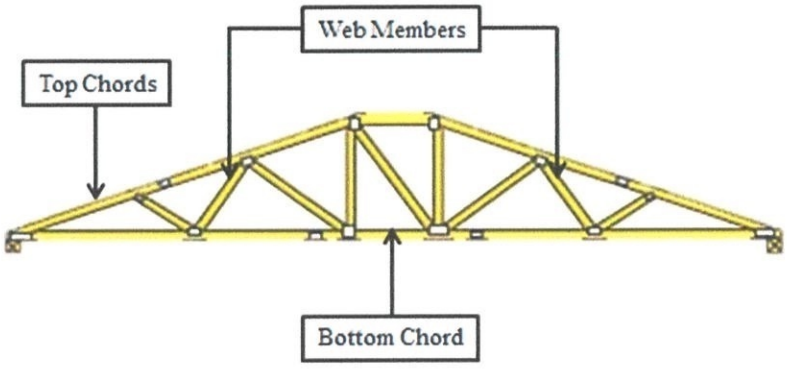


Figure 3.3.2.9 Step down Hip Truss

Source: Roof Trusses & Engineered Joists

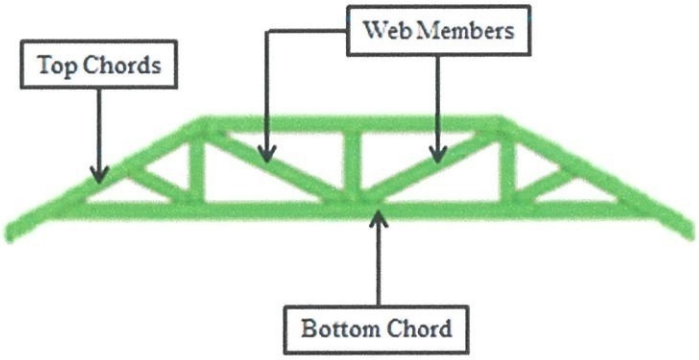


Figure 3.3.2.10 Hip Truss

Source: Rafter Tales (2008)

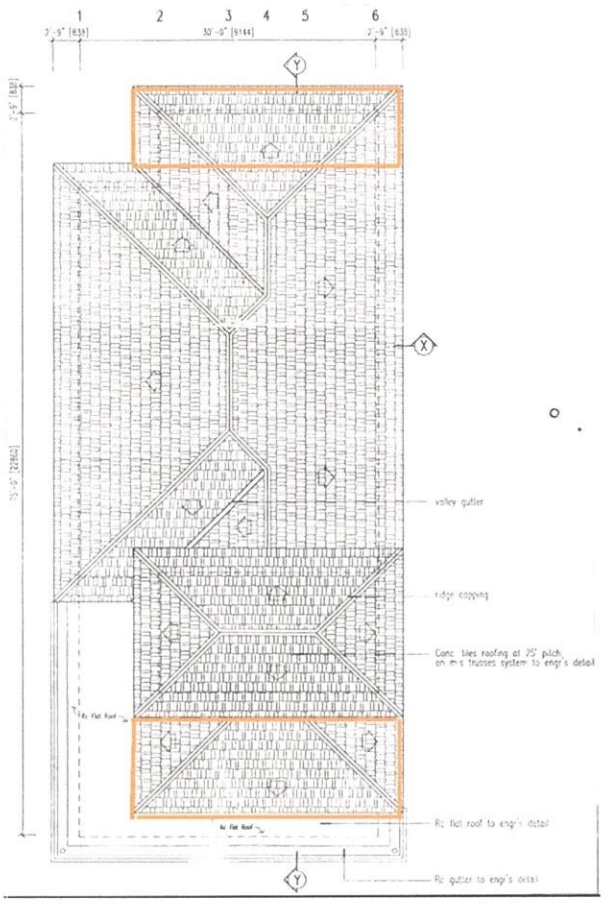


Figure 3.3.2.11 Roof Plan of Bungalow House in Taman Dato' Wan, Ampangan

Source: Harraz Teguh Design & Construction Management

At the construction site, Step down Hip Truss and Hip Truss are constructed on site where detail connected is shown during the construction as compared to the truss made in factory, all the details and procedures have been made in the factory and then it is transferred to site for the installation. Figure 3.3.2.12 shows the two types of trusses made in order to produce pitched for pitched roof.

Photo 3.3.2.12 Combination of Step down Hip and Hip Truss in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

3.3.3 Roof Materials

The proliferation of various today's construction industry has been created and developed technology. There are also a number of technologies developed overseas and then brought into the country varied according to local needs. For example, many construction based on steel technology have undergo research and have been developed in countries like America, Canada, Britain and Australia which are also a precursor to the research and development of this technology.

Stainless steel is a material that is lightweight which able to bear the burden away several times from its own weight. This material has been used as a building material around the world. Furthermore timber production has been controlled to prevent the extinction of the world's forests into treasure over a long time. In the wake from that, various alternative materials were created and manufactured for the choice of building materials. Hence, the use of stainless steel as roof trusses become one of the main alternatives proposed in Malaysia.

Prefabricated technology roof trusses are first brought into Malaysia about 5 years ago. This technology was brought in from Britain and Australia where Australian technology is most popular in Malaysia and most other Southeast Asian countries. Malaysia's technology and construction method system is first used extensively in the early 1990s.

Technology on truss system gain support from software designs are constantly being developed and amended from time to time. The amendment made according to type of load applied, environmental conditions, weather and terrain conditions, the availability and suitability of materials in buildings.

In the roof construction for the bungalow house in Taman Dato' Wan, Ampang, stainless steel trusses is used in order to replace the usage of timber as shown in Photo 3.3.3.1 as an example of stainless steel material.

Photo 3.3.3.1 Stainless Steel

There are several advantages of stainless steel as roof trusses compared to timber which are:

1. Lightweight

   Stainless steel is a material that is lightweight which is able to bear the burden away several times from its own weight. Besides, it is easy to be carried by only using manpower without any help of mega machineries such as crane as compared to timber which needs a big number of manpower and sometimes, machineries need to be used in order to transport the timber to the top of the building.

2. Durable

   Stainless steel has the best resistance from moisture and termites. Although preserved, the timber is not entirely protected because of their low resistance which will lead to termites attack and decay problems due to frequent exposed to water.

3. Fire Resistance

   Stainless steel has high resistance of fire which the material made have been examined before it is used as an important part of a building. Besides, as

compared to timber which has low fire resistance, stainless steel can prevent the spread of fire.

4. Quick installation

   The installation of stainless steel trusses can be completed in two to three weeks while the assemble of timber roof trusses is longer which four to six weeks which mortise is used as the connection between two timber trusses while the connection of stainless steel trusses are by using bolt and nut.

5. Neat installation

   Installation of roof tiles becomes more streamlined with steel trusses. Timber trusses often cause problems to the roof construction because of inconsistent of wood craftsman such as crooked, sagging, unequal sizes which cause untidy installation of roof tiles.

6. Minimum wastage

   The uses of wood trusses often result in high wastage due to the size of timber wood inconsistent and limited length to 20 to 24 feet. Instead the size stainless steel trusses are consistent because it was determined by engineers which the long of stainless steel trusses can reach up to 40 feet.

3.3.4 Roof Construction and Connection

In the construction industry, stainless steel structures have been widely used in all over the countries which most of the roof structures are made in the factory with specifications required. Then it is transported to the site by using lorry and when it is required to be assembled for installation, crane is used in order to lift the structures from the lorry to the top of the building. Usually, structures which are made in factory come with big quantities and required short time of roof installation.

Differences can be seen in the roof construction conducted at the site project where a construction of a bungalow house on-going located at Taman Dato' Wan, Ampangan. The construction of roof is made on site starts from the roof assemble until the completion of roofing as the outermost surface for the roof.

During the roof construction, detail connections have been shown where the knowledge on the connections between two roof structures or trusses has been gained. There are three types of trusses arrangement but I would like to highlight on the structure connection of Belgian Truss where there are three typical joints which are shown in Figure 3.3.4.1.

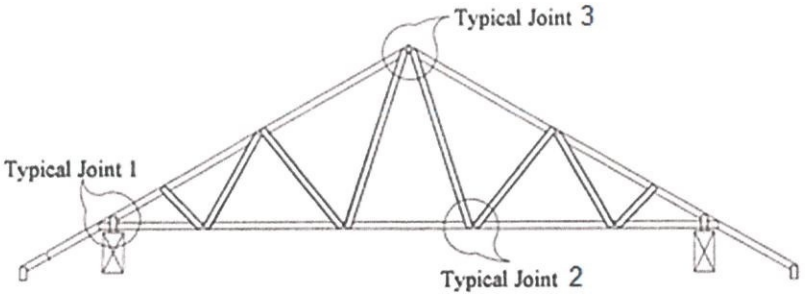


Figure 3.3.4.1 Roof Trusses

Source: Harraz Teguh Design & Construction Management Roof Plan

After the roof structures have been assembled at the highest level of the house, the stainless steel which come in same sizes and length will be measured by using measuring tape and then it will be cut by using circular saw into specific length

required in order to construct Belgian Truss but the roof framing is manufactured from the factory. After all the structure have been completely cut, first of all, the roof framing will be plced across the beams where the roof construction will be conducted at the specific area requested for the application of Belgian Truss. The construction is continued by applying typical joint 1 which is used as connection between the Bottom Chord and Top Chords as shown in Photo 3.3.4.2 which between these two type of chords, bracket stamp or level adjuster is act as connector. The bracket stamp is bolt by using penaumatic impact gun where three bolts on both of the Chords and as a permenet connection, the bolt is welded in order to increase the strength of connection to avoid failure of structure.

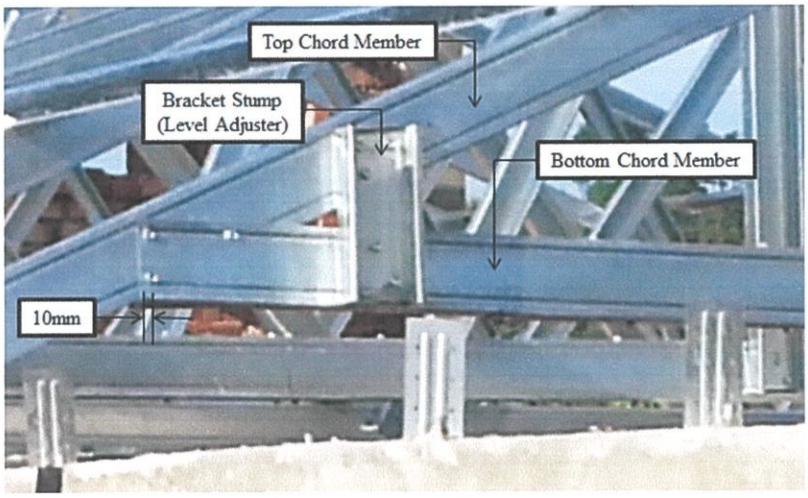


Photo 3.3.4.2 Typical Joint 1 of Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

The reason on choosing manufactured roof framing in the roof construction for this house is to standardized all the sizes and length of framing in order to avoid unstabalised of rafter installation. Roof construction is then continued with the installation on the web members where it symbolized the name and types of truss arrangement. The truss installation connection according to Figure 3.3.4.3 shows that application of typical joint 3 between web members and Top Chord where web members will be attached temporarily in order to decide on the truss arrangement.

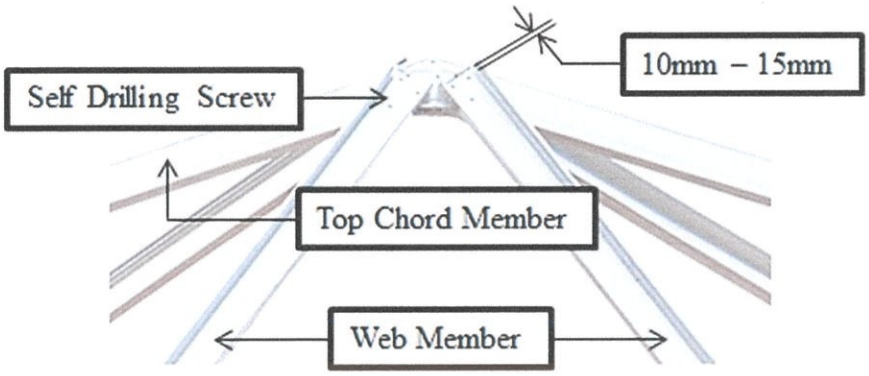


Photo 3.3.4.3 Typical Joint 3 of Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Belgian Truss is where 'W' shape arrangement of web members is constructed where two of the web members are connected to the pitch of Top Chords where the screw is drilled into the Top Chord by using electric drill and there are three screws been immersed in the web members. The drilling of screws need to be conducted in the distance of 10mm to 15mm from the edge of web members in order to avoid decreases in strength which may lead to over drilled and out of the web member track. The connection made must be convinced that it is firm and stand the load above it.

After the connection between the web members and Top Chords is completed, typical joint 2 is conducted which the connection is shown in Figure 3.3.4.4. In this type of connection, web members are connected to the Bottom Chord of roof framing. As this connection need to be installed on site, a proper planning on the connection need to be made. When the web members are connected to the Top Chord, there are no movement of truss occur but in order to strengthen the roof truss, connection need to be made which if the load applied above the roof structure is more than the requirement, the truss will not be sagging.

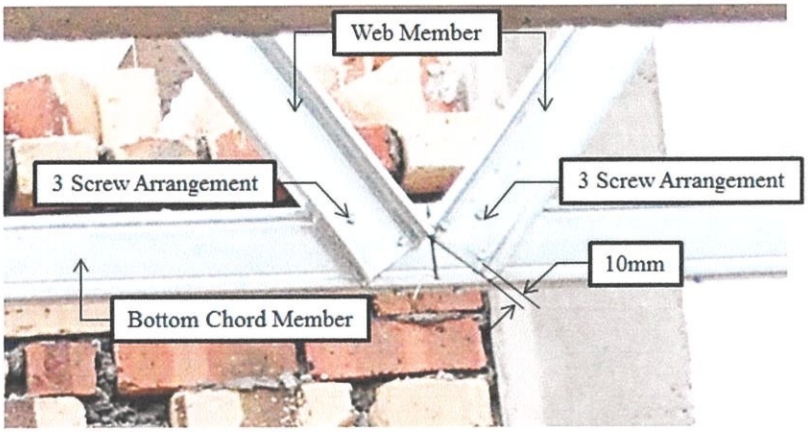


Photo 3.3.4.4 Typical Joint 2 of Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

In typical joint 3, screws are drilled into the web members where the web members and Bottom Chord will be attached together. The number of screw needed for the connection is at least three and the distance between the screw and web members edge must be in a distance of 10mm which the connection for typical joint 3 is similar to typical joint 2.

After all web members have been connected to the Top Chords and Bottom Chord with the type of arrangement required in order to produce Belgian Truss, the roof truss is then been lift on by cooperation of the workers. Before the truss is connected to the wallplate, L-Bracket is firstly been installed where bolt is used in order to connect the L-Bracket to the wallplate. L- Bracket is installed in a specific distance required which have been measured and marked on the wall plates of the house. Then, the complete construction of roof truss is lift and attached to the L-Bracket where it will be bolt between the L-Bracket and the Bottom Chord of the truss on both of the truss ends. For additional strength, the connection between the L-Bracket and the Bottom Chord is strengthen by adding screws as fastener to avoid failure on the roof constructed. Based on photo 3.3.4.5, it is the close up image on the connection of L-Bracket and Bottom Chord for more understanding.

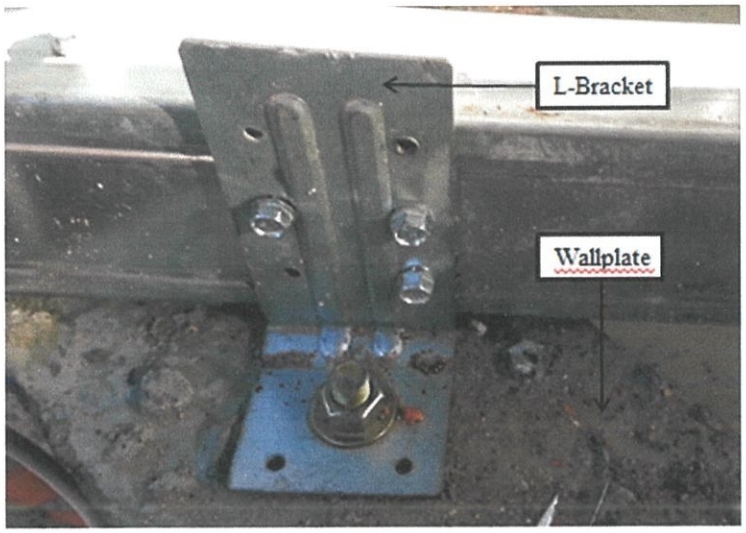


Photo 3.3.4.5 Connection between L-Bracket and Bottom Chord

After all the construction of trusses are completed, construction of roof is continued with the installation of ceiling joist which is located on top of the bottom chord which it is installed across end to end of roof truss. The length of ceiling joist is measured from end to end of roof truss where usually by using measuring tape. Then, by using circular saw, stainless steel is cut according to the measurement of ceiling joist required. Based on Photo 3.3.4.6 shows that installation of ceiling joist is conducted.

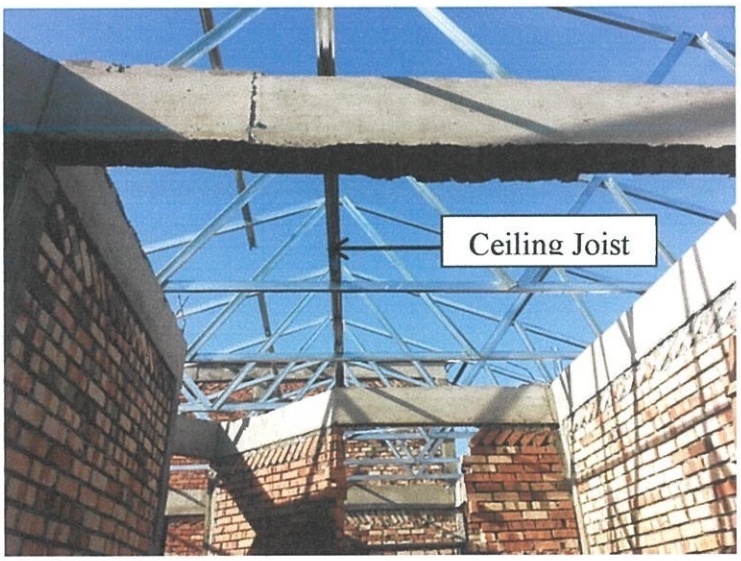


Photo 3.3.4.6 Installation of Ceiling Joist for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Rafter is then installed after the completion of ceiling joist installation where it is installed at the pitched point of roof truss to the corner of wall plate which will produce an inclined view of roof. Usually, Hip Rafter is used in this type of roof construction in order to produce a perfect angle of pitched roof. Then, one by one rafter is cut and installed by using screws as connection according to the roof plan given which is shown in Photo 3.3.4.7.

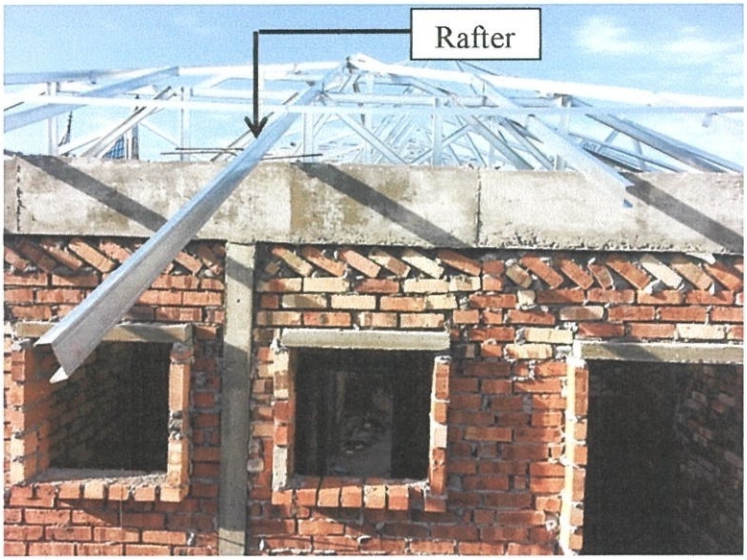


Photo 3.3.4.7 Installation of Rafter for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Roof construction is then been inserted of heat insulation which is functioning as absorber of heat. Usually, heat insulation will be installed after the construction of roof truss and before the installation of roof batten. Heat insulation absorbs most of the heat produced by the sun which is not reflected by the roof tiles before it is distributed into the house. Heat insulation is a type of aluminium paper which is placed and attachment to the roof truss by using stapler gun that is durable in order to avoid the heat insulation from flying off. Photo 3.3.4.8 shows the application of heat insulation in the roof construction.

Photo 3.3.4.8 Application of Heat Insulation for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

After that, another two steps left before construction of roof is completed which are installation of roof battens and lastly the roof tiles. Installation of roof battens is conducted where the stainless steel is cut into specific length which is measured from the first roof truss to the end of roof truss which they are arranged in one straight line. Before that, the inclined Top Chord of roof truss is marked according to the roof plan in order to ease the installation of roof batten where the gap between one batten to another batten must be similar. Then, roof batten is placed from end to end with help of three workers which two of them hold the batten and the other worker help to fasten the connection of roof batten to the roof truss which bolt is used. The same method is used for all the installation of roof batten and Photo 3.3.4.9 the view of roof after the installation of roof batten.

Photo 3.3.4.9 The View of Pitched Roof after the Installation of Roof Batten in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Last but not least, the final and important item in roof construction is the application of roof tiles or known as roofing. In the roof construction of this case study, single lap roof tiles arrangement is applied where side lapping is required and minimal end lap of roof tiles. Before the installation of roof tiles is conducted, proper planning needs to be planned in order to avoid wastage and short of materials during the installation of roof tiles. Photo 3.3.4.10, Photo 3.3.4.11 and Photo 3.3.4.12 show the steps of roof tiles installation. In the installation of roof tiles, usually, upper tiles and lower tiles are arranged parallel to each other.

Photo 3.3.4.10 Before the Installation of Roof Tiles for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Photo 3.3.4.11 During the Installation of Roof Tiles for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

Photo 3.3.4.12 After the Installation of Roof Tiles for Pitched Roof in Roof Construction of Bungalow House in Taman Dato' Wan, Ampangan

CHAPTER 4.0

CONCLUSION AND SUGGESTION

In conclusion, roofs are important in every construction of a building does not matter whether it is a skyscrapers, houses, shop houses, hunt or factories. Generally building would not be completed without the construction of a roof. There are several types and designs of roof which are divided into traditional and modern. In order to accommodate the load of the roof tiles above, the structure of the roof members must be constructed correctly with proper planning in order to avoid any failures. Besides, from beginning of the roof construction, calculation is made in order to know the amount of roof trusses needed for specific area and the types of truss should be used. After that, the most important stage is conducted where the installation of roof members which it will be connected to one another by using several types of connection. As the world is growing up especially in the construction industry, big changes have been made where steel is used in most of the roof construction. There are several advantages on the usage of steel as compared to timber which most it gives benefits in the construction industry.

As a new generation, we must take good care on the nature in order to maintain the forests all over the world from distinction and as a solution, steel is used for the replacement of timber which is a part of roof construction. Besides, timber cannot be manufactured in factory where all the installation of main members of roof structure is conducted. Additionally, not all the timbers can be used as roof member but only matured and selected timber can be used. In the roof construction, it was learnt that roof connection and installation from beginning until the placement of roofing. Last but not least, it should be highlighted that roof construction is an important element which need to be learned and should not take it as a simple construction without learning it in the first place.

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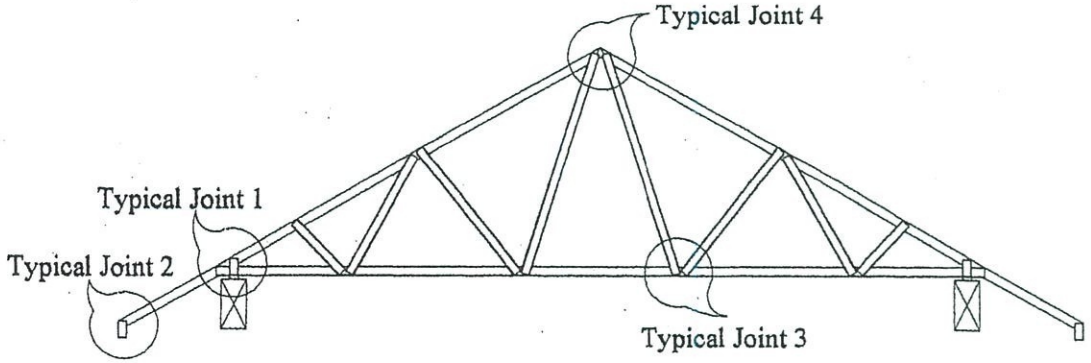
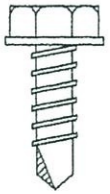
APPENDIX A: DRAWING PLAN

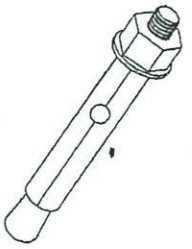
APPENDIX B: DRAWING INSTALLATION



TRUSS FABRICATION CONCEPT



Self Drilling Screw



Sleeve Anchor

NOTE :

1. Truss member to be Zincalume or G.I. High Tensile Steel SGCH (Min. 550Mpa)
2. Self Drilling Screw to be DS520HOR (Ruspert) Fastmark with Ø4.87mm.
3. Sleeve Anchor to be SYW Anchor (M10-M12).
4. Minimum Fasteners per Connection = 2 Unless Otherwise Marked.

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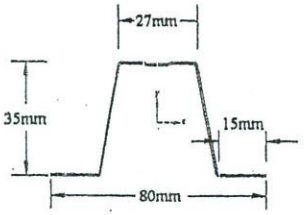
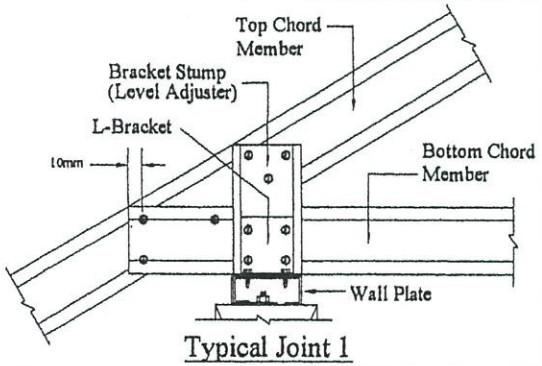


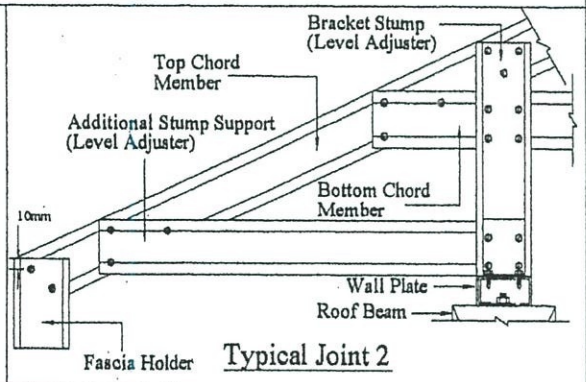
BEB0535 - Batten/Bracing Member

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

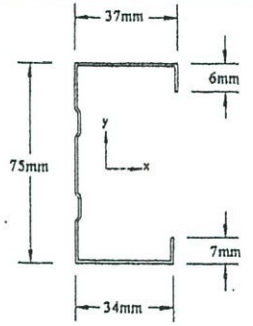
UNTUK TETUAN :
SURAU



Typical Joint 1



Typical Joint 2



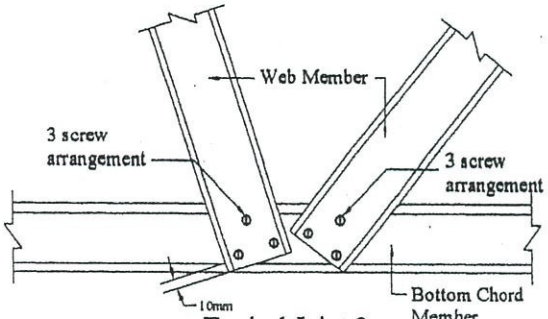
BEC1075 - Chord/Web Member

DRAWING TITLE :
TRUSS GENERAL DETAIL 2

Truss Fabrications & Accessorie

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. ([illegible])
Plot 7, Jalan PBR 33, Kawasan Perindustrian Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3516877



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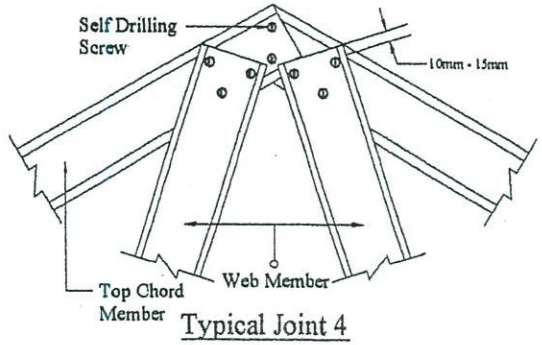
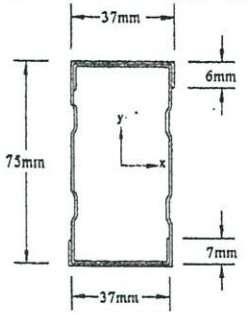


Typical Joint 4



BEC1075BOX - Box-up Member

MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	31 JANUARI 2013
Checked By	NASA	Revision	REV001
Approved By	NASA	Scale	Not for Scale

Drawing No. :
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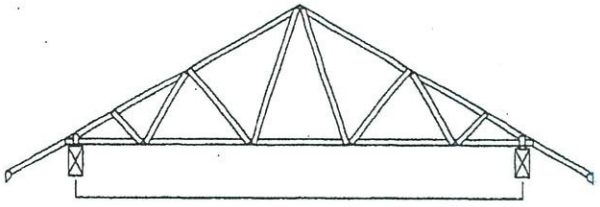
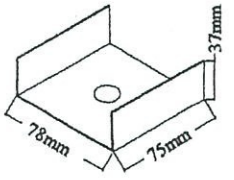
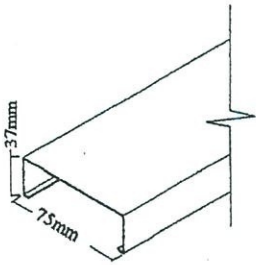


1) For Truss Span < 10 m

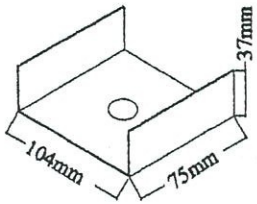


U-Bracket (1.55mm TCT)

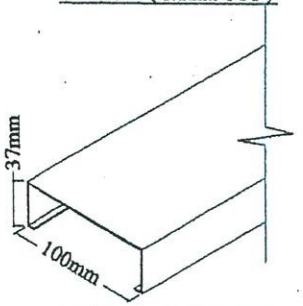


Wall Plate (1.2mm TCT)

2) For Truss Span > 10 m

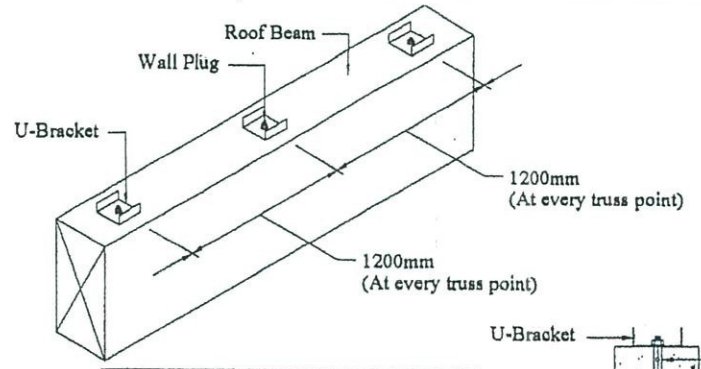


U-Bracket (1.55mm TCT)

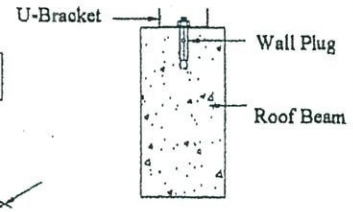


Wall Plate (1.2mm TCT)

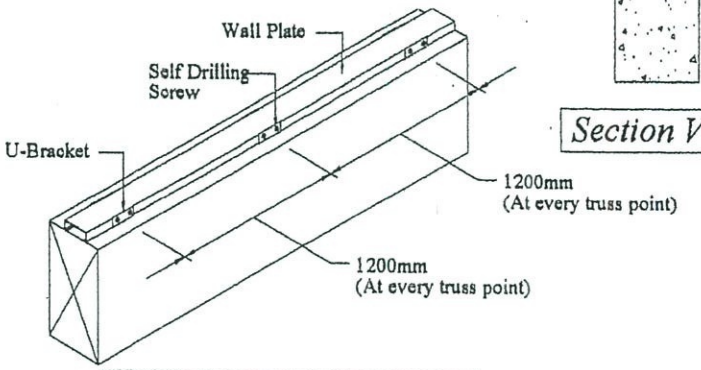
Wall Plate Specification



Step 1 : U-Bracket Fixing

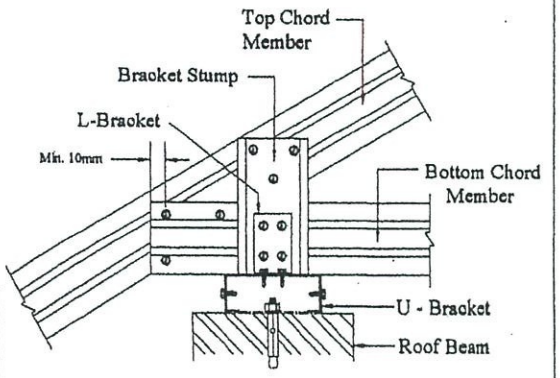


Section View

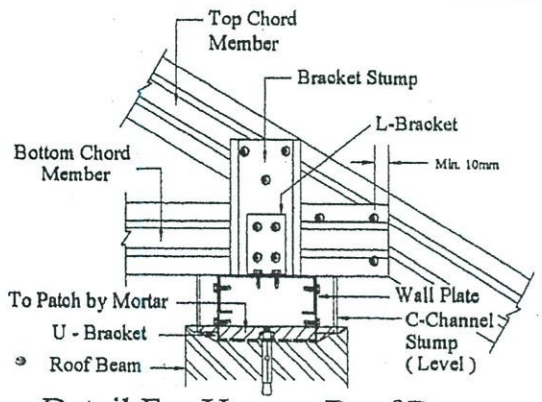


Step 2 : Wall Plate Fixing

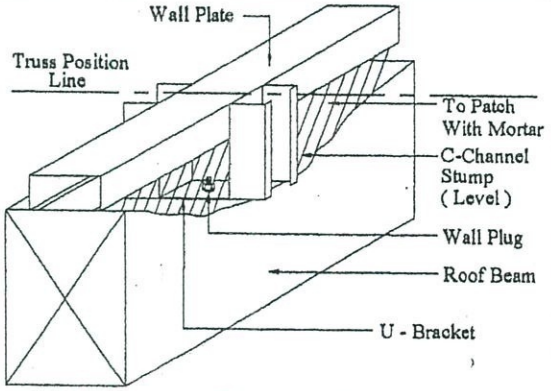
Wall Plate Installation Method



Detail For Even Roof Beam



Detail For Uneven Roof Beam



3D View : Uneven Roof Beam

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 3

Wall Plate System

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (0000-X)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3216877

MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	31 JANUARI 2013
Checked By	NASA	Revision	REV001
Approved By	NASA	Scale	Not for Scale

Drawing No. :
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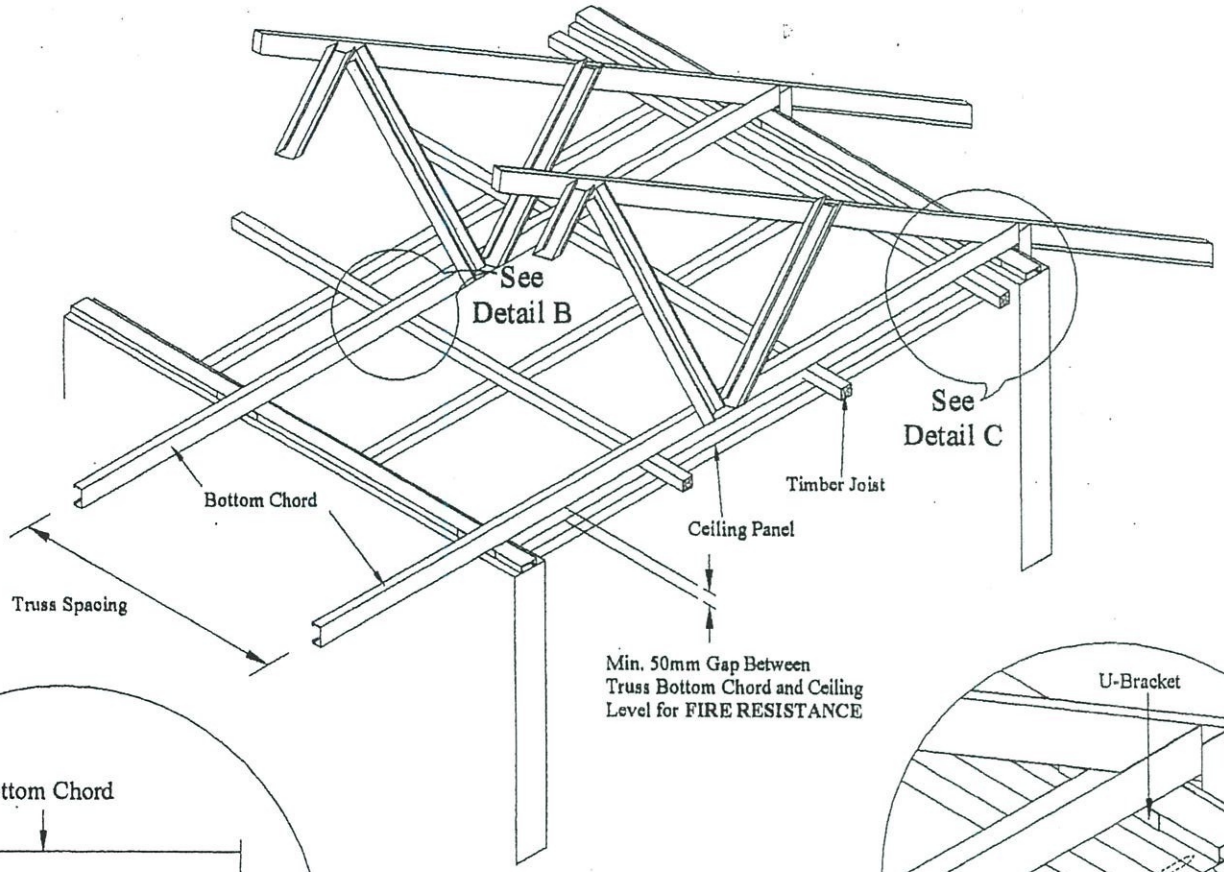
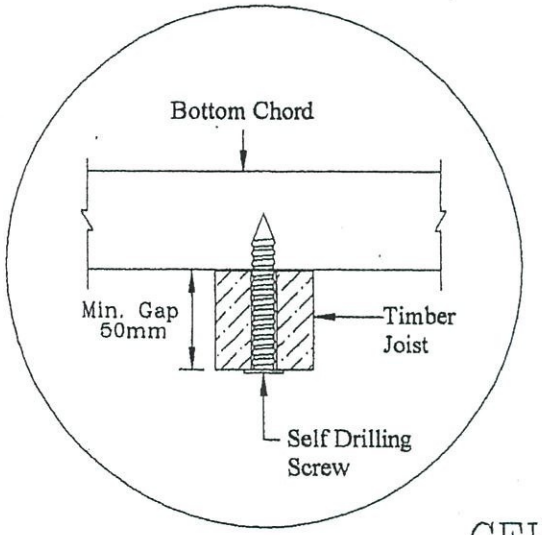
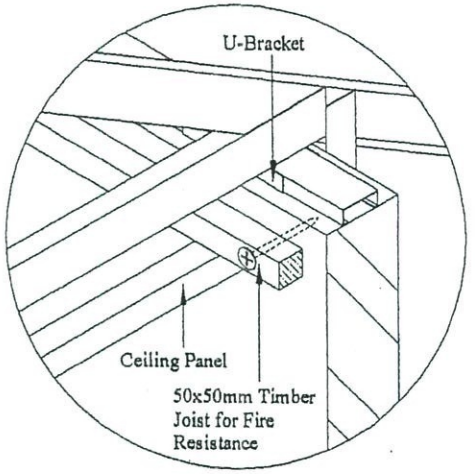




DETAIL B



DETAIL C

CEILING CONNECTION DETAIL FOR FIRE RESISTANCE

NOTE :

1. Min. 50mm gap to be provided between truss bottom chord & ceiling panel for fire fighting purpose.

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 4
Ceiling Panel Installation & Fire Fighting Requirement

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (0000-U)
Plot 7, Jalan PBR 33, Kawasan Perindustrian Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3516877

MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	31 JANUARI 2013
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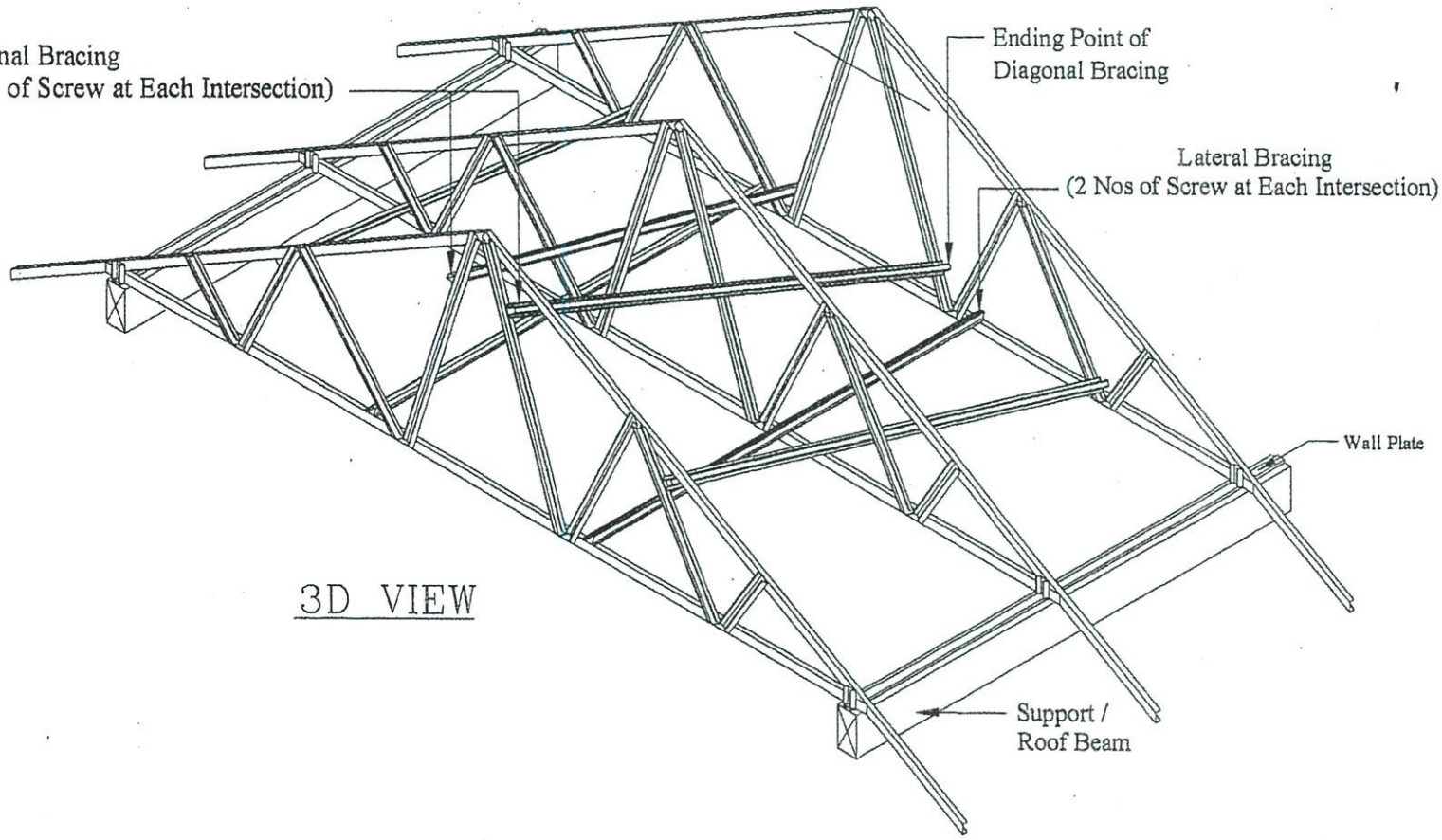
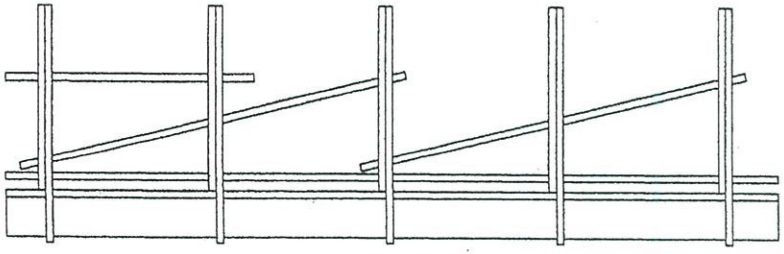
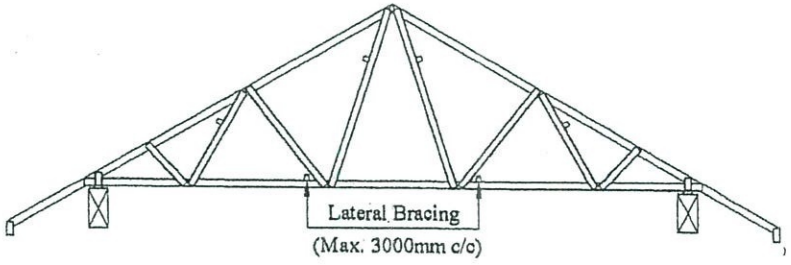


3D VIEW



SIDE VIEW



FRONT VIEW

NOTE :

1. Lateral or diagonal bracing member to be BEB0535 Hat Channel.

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 5

Bracings

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (0000-X)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3516877

MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

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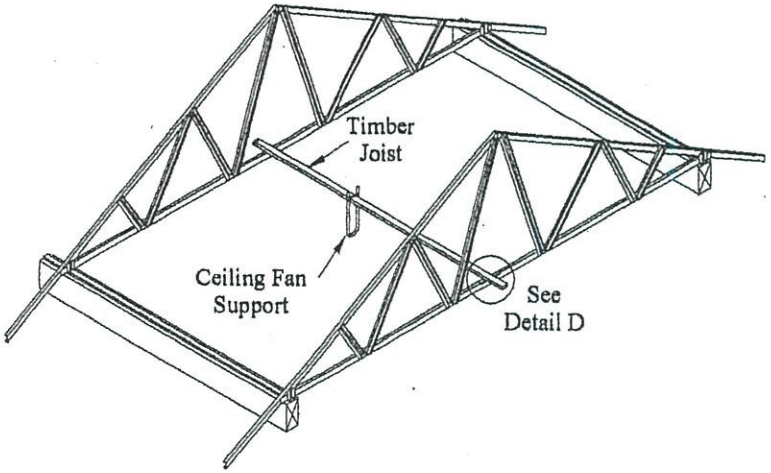
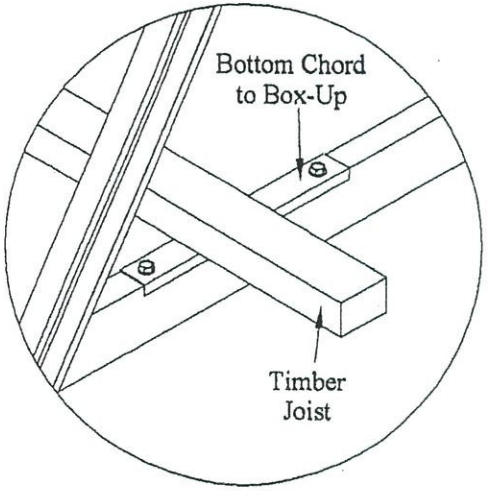
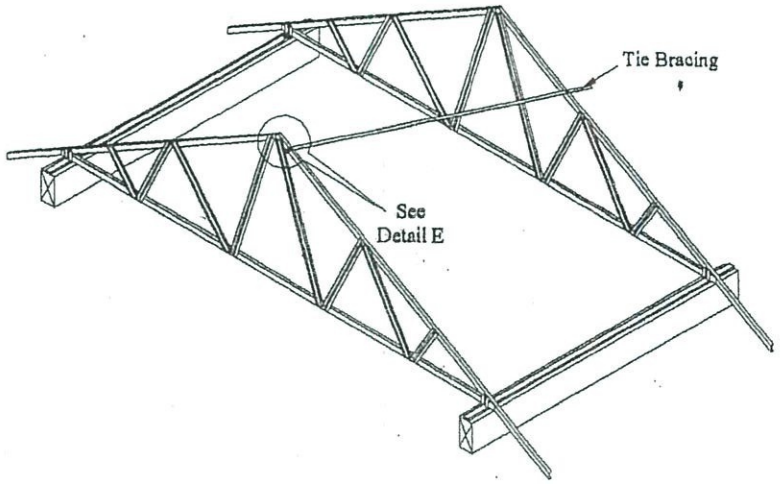
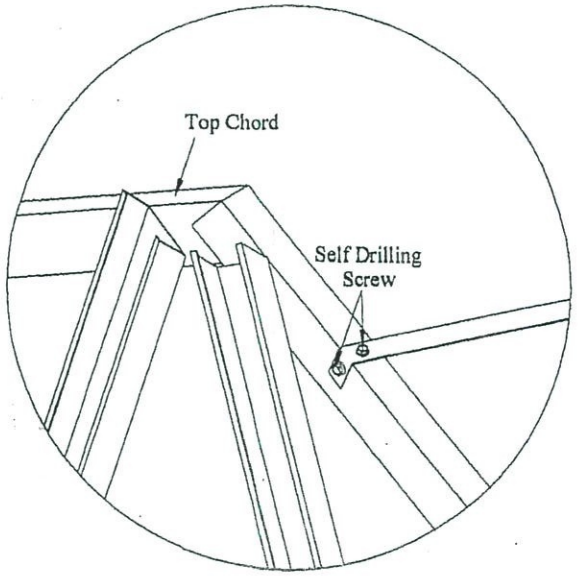




DETAIL D

CEILING FAN/DUCTING JOINT DETAIL





DETAIL E

TIE BRACING FIXING DETAIL

NOTE :

1) M&E services NOT to be installed directly to the Bottom Chord or any other members.
2) Tie bracing to be 19x0.8mm thick G.I. or Zincalume.

No	Date	Description	By

PROJECT TITLE :

CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :

SURAU

DRAWING TITLE :

TRUSS GENERAL DETAIL 6

Ceiling Fan &
Tie Bracing Fixing

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (######-X)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-351 6877

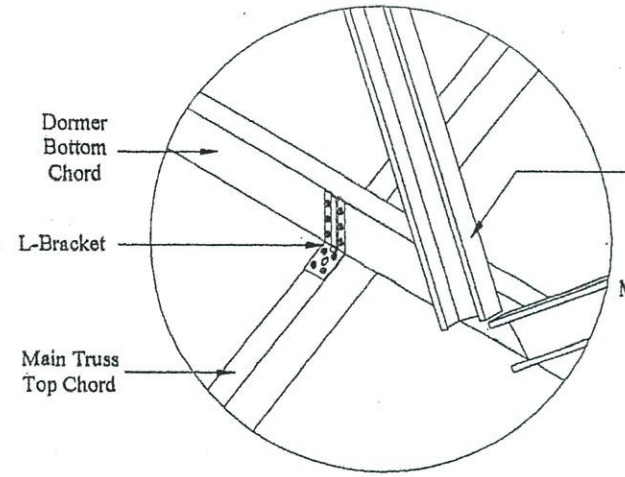
MAIN CONTRACTOR :

INSPIRASI TEGUH ENTERPRISE

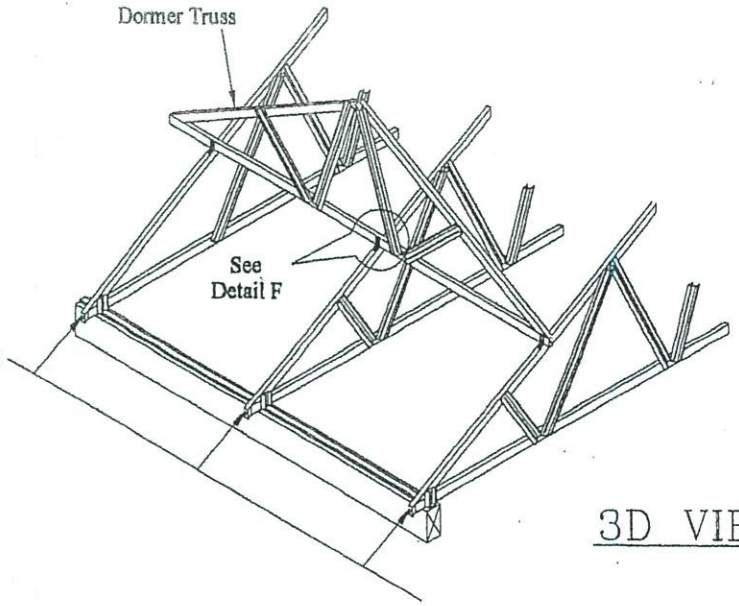
Drawn By	NAJIB	Date	31 JANUARI 2013
Checked By	NASA	Revision	REV001
Approved By	NASA	Scale	Not for Scale

Drawing No. :

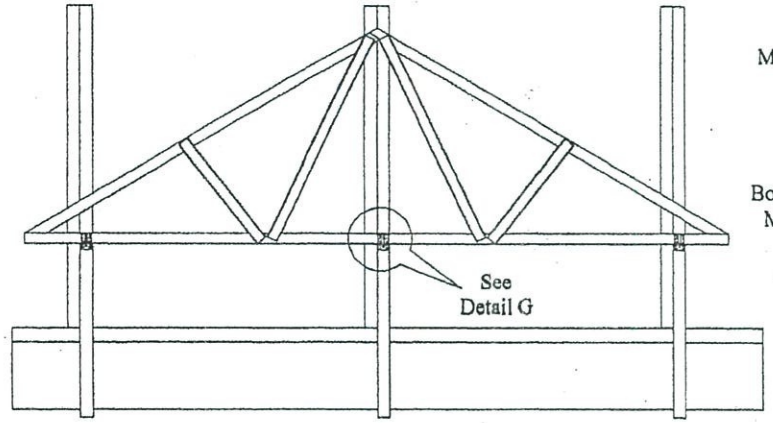
RNET\2013\P006\B01\TGD0(



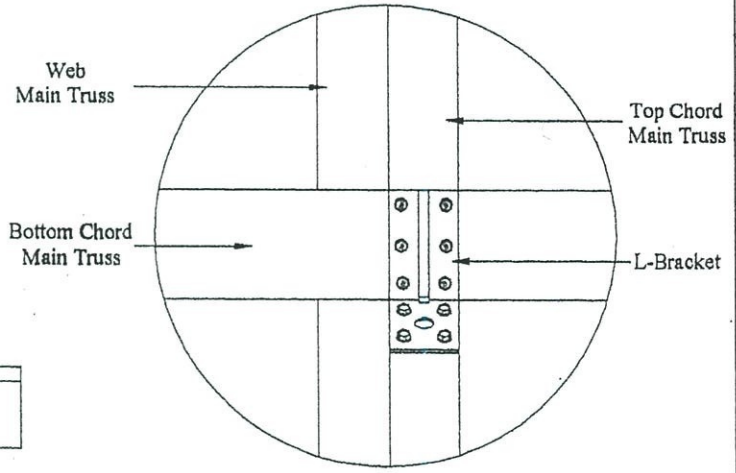
DETAIL F



3D VIEW



2D VIEW



DETAIL G

DORMER TRUSS FIXING DETAIL

NOTE :

1) Support Bracket to be 75x75x2mm thick or its equivalent approved by Brickwell Designer

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 7

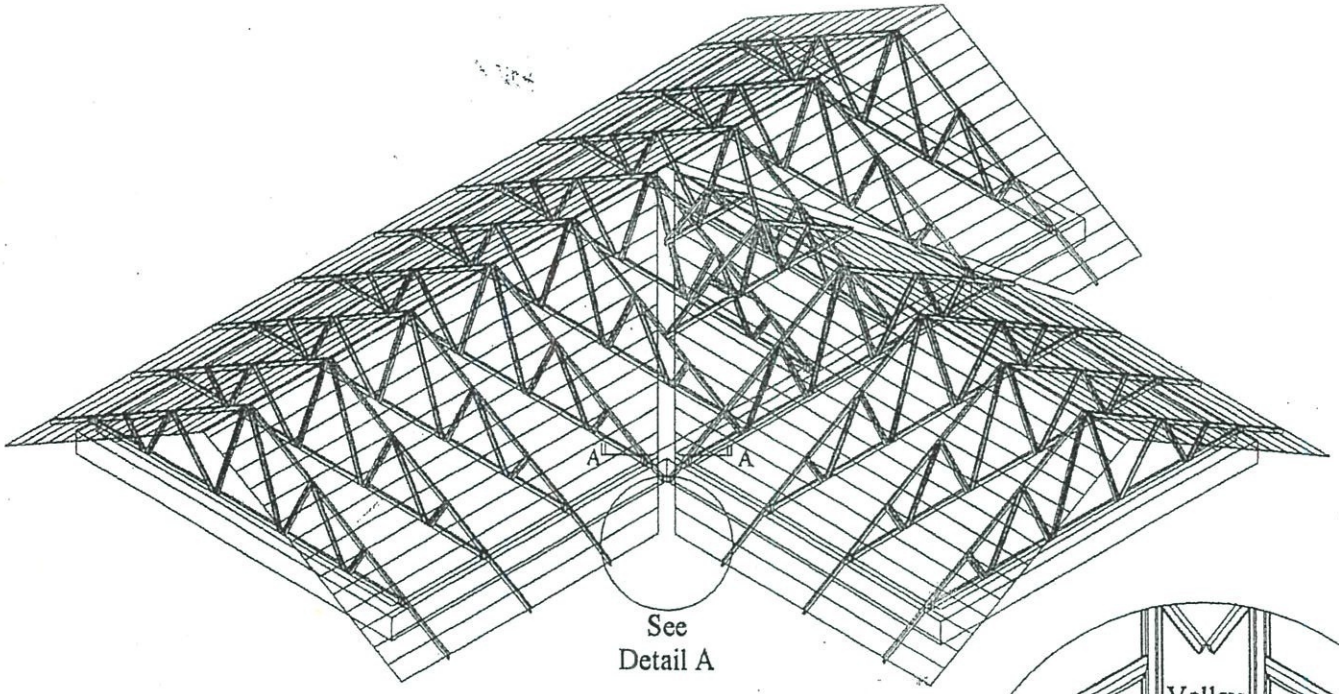
Dormer Truss Fixing Detail

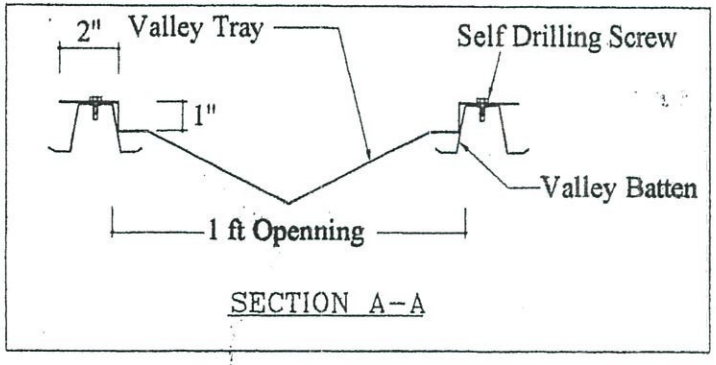
SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (xxxxx-x)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3516877

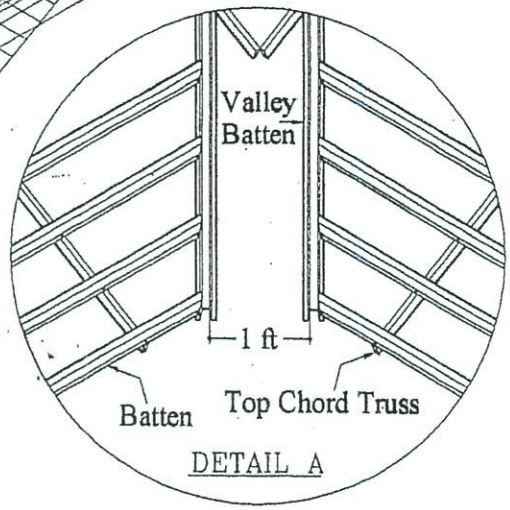
MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	31 JANUARI 2013
Checked By	NASA	Revision	REV001
Approved By	NASA	Scale	Not to Scale
Drawing No. :			





VALLEY TRAY DETAIL



VALLEY BATTEN DETAIL

NOTE :

1) Min. 1 ft Opening Valley Batten for match the Valley Tray \ Gutter.

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 9

Valley Details

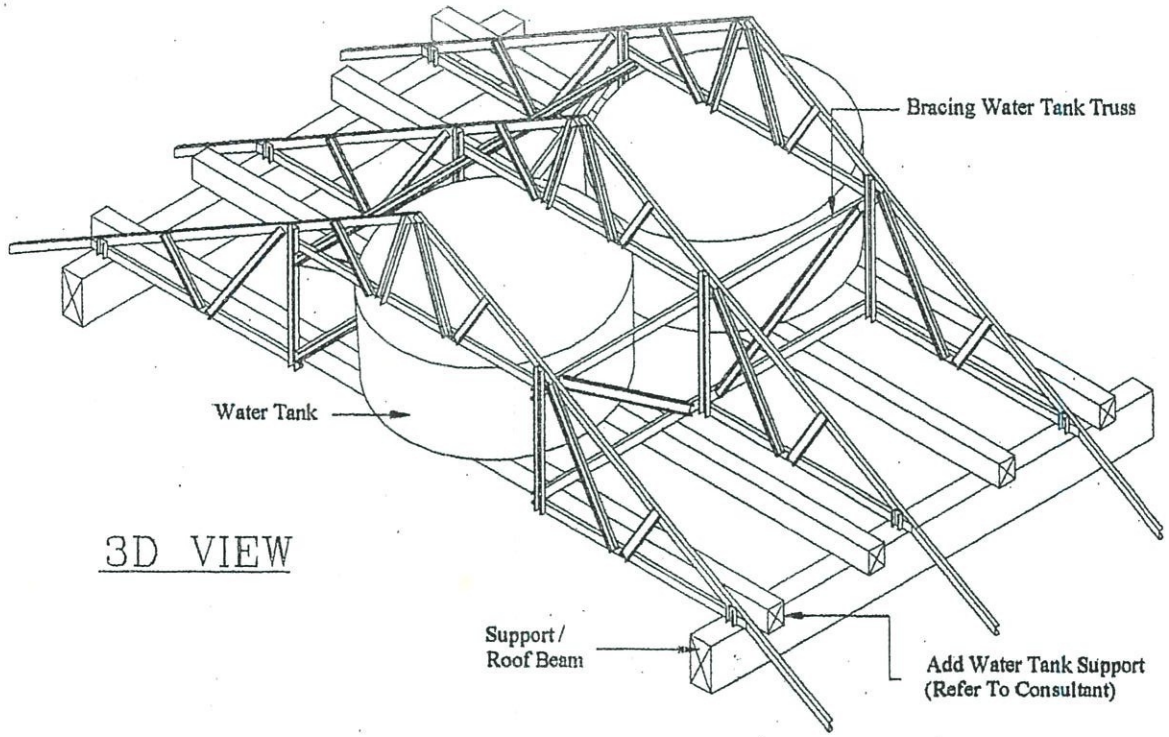
SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (653883-U)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3516877

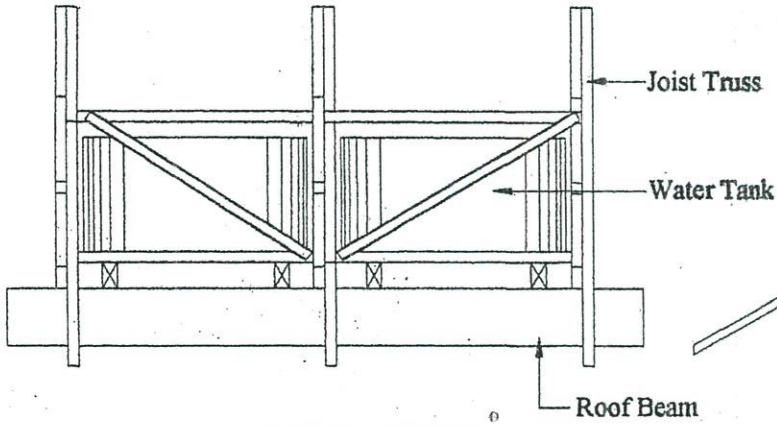
MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	31 JANUARI 2013
Checked By	NASA	Revision	REV001
Approved By	NASA	Scale	Not for Scale

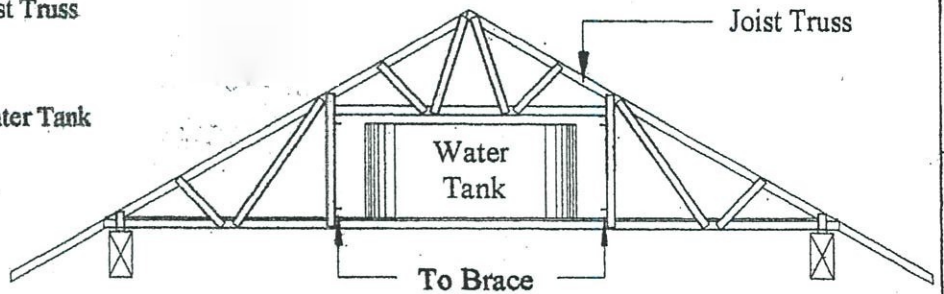
Drawing No. :



3D VIEW



SIDE VIEW



FRONT VIEW

NOTE :

1. Lateral or diagonal bracing member to be BEB0535 Hat Channel

No	Date	Description	By

PROJECT TITLE :
CADANGAN MEMBINA DAN MENYIAPKAN SURAU TAMAN KOBENA, SENAWANG.

UNTUK TETUAN :
SURAU

DRAWING TITLE :
TRUSS GENERAL DETAIL 10

Water Tank Truss Detail

SPECIALIST CONTRACTOR :

RONASNIAGA ENTERPRISE SDN BHD. (439445)
Plot 7, Jalan PBR 33, Kawasan Perindustrian
Bukit Rambai, 75400 Melaka.
Tel: Fax: 606-3515877

MAIN CONTRACTOR :
INSPIRASI TEGUH ENTERPRISE

Drawn By	NAJIB	Date	11 JANUARI 2013
Checked By	NASA	Revision	REV 001
Approved By	NASA	Scale	Not for Scale