UNIVERSITI TEKNOLOGI MARA

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

SEPTEMBER 2015

It is recommended that the report of this practical training provided

By

KHALIFAH HAFIZI BIN MOHD JAMIL

2013493966

entitled

Lightweight Steel Roof Trusses

accepted in partial fulfilment of requirement has for obtaining Diploma In Building.

Report Supervisor	:	En Anas Zafirol Bin Abdullah Halim.
Practical Training Coordinator	:	Pn. Noor Rizalinda Binti Ishak.
Programme Chairman	:	Dr. Mohd Rofdzi Bin Abdullah.

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STUDENT'S DECLARATION

I hereby declare that this report is my work except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Sri Sekamat Enterprise Sdn Bhd for duration of 5 months starting from 25 May and ended 9 October 2015. It is submitted as one of the prerequisite requirements of DBN307 and accepted as a partial fulfilment of the requirements for obtaining the Diploma in Building.

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UiTM ID No	:	2013493966
Date	:	20 July 2015

ABSTRACT

Roof is a very important structure to all building that will provide protection from weather and animal. This report will briefly describes about all the processes and method involved in the construction of the roof trusses. It is produced based on the experience in five months was placed at construction site. This report is divided into several parts and started with a company overview and background to the construction project. Observation found that the roof trusses construction is not as easy as it sounds. It involves a lot of parties and has complicated construction process. This report describes briefly the types and key components of a roof with in more detail about the methods involved and used in the construction of trusses. In conclusion, this report will describe in detail the process and method of roof trusses construction in practice.

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CHAPTER 1.0

PREFACE

1.1 Introduction

Industrial training is compulsory subject to Diploma in Building student's that has been provided by Universiti Teknologi MARA in semester 5 with course code DBN307. All student must attend this course within 20 weeks from 25 May 2015 until 9 October 2015.

While undergoing the industrial training at Sri Sekamat Enterprise Sdn. Bhd. for 20 weeks, there are lot of knowledge related to the construction industry was exposed to students. During this period the student gains knowledge and experience as also skills from various forms of work. Students are also able to apply all the theories that have been learned. Besides, it provide opportunities for students to relate the theories learned with real working situation in the construction industry. It is also able to increase the communication skills to inculcating the spirit of work as well as good relations among employees.

LIST OF APPENDIX

1.2 Objective

1.2.1 The objectives of this report enable the students:

i. To expose on the installation of the roof structure.
ii. To study about architectural and engineer drawing of roof.
iii. To understand the basic structure of roof.
iv. To know the common material use in the roof construction.

1.3 Scope of Study

This report is focused on the construction of lightweight steel roof trusses including type of roof, type of common truss and all detail connection to installation of the truss. Every step of installation has been taken by camera to provide method statement and observe every single step that started from the prefabrication work that must be done near to location of installation so that it is easy to be handle and install to the building structure until all the roof trusses have been braced after checking on all plan and drawing. Based on the engineer drawings and detail drawing provided more understanding to the connection of the roof truss.

1.4 Method of Study

1.4.1 Referencing material.

Study the basic structure of the roof by referring to the books and web sites that related to the roof construction as well as types of roof.

1.4.2 Record

All the process involved in the installation of roof trusses has been done by the labours has been recorded on note book and pictures have been taken by a camera time by time.

1.4.3 Observation

Base on engineer drawings and detail drawings that were studied all installation work of the trusses was examined closely to find any differences between on the work with the drawings.

1.4.4 Referencing person

To get more information about the roof structure and trusses, an interview has been done between the site engineer, Pn. Hawa Aznizar binti Abu Samah and En. Mohd. Shahril bin Dato' Mohd. Said as the project manager.

CHAPTER 2.0

COMPANY BANKGROUND

2.1 Introduction of Company

Sri Sekamat Enterprise was established in 1984 and was incorporated under the companies Act 1965 on 14th October 1988 as a civil engineering and construction company. The company Owned 100% equity (pure) native in the name of Sri Sekamat Enterprise Sdn. Bhd. and registered with Pusat Khidmat Kontraktor, received recognition from the Ministry of Finance as a competent contractor company. Sri Sekamat Enterprise Sdn. Bhd. has also been certified by Construction Industry Development Board (CIDB) under Grade 7 after registered in accordance with part IV of the Act the Malaysian construction industry Development Board, 1994. The company has already obtained recognition as a building contractor and civil engineering through ISO 9001:2008 certification in 2007.

Sri Sekamat Enterprise Sdn Bhd has also been selected by the leading Bumiputera Agenda (LEADING) to participate in the company's core programmes are know as high-performing Bumiputera companies to thrive within the 5 and 10 years future through participation in sectors and also enhance the contribution of NKEA contractor Bumiputra of GDP by the year 2020 in the Economic Transformation Plan (E.T.P).

During the period of the company's involvement in the construction and civil engineering sector, the company has completed all projects that have been offered successfully. In 1996, Dewan Perniagaan Melayu Malaysia Selangor Branch has chosen Sri Sekamat Enterprise Sdn. Bhd. as the winner of the 'Entrepreneurial Excellence

Award 1996 based on the implementation of the projects. As a result of the award, the company is able to implement projects that will be offered by the Government and the private sector, both inside and outside the country which is backed by The Country's Financial Institutions.

Line management of Sri Sekamat Enterprise Sdn. Bhd. composed of professionals with vast experience in consultancy as contractors who are able to implement projects tender, design and built, and join venture. With 30 years experience of Sri Sekamat Enterprise Sdn. Bhd. also successfully expanding their business networks to areas other than construction, namely, real estate, sports centres, retail building materials and automobile in addition to maintaining the construction field as the key business.

With all the experience, professional management team, business diversification and assets of the existing company, Sri Sekamat Enterprise Sdn. Bhd. is confident to face the challenges of future business with great success.

Photo 2.1: Company registered office.

2.2 Company Profile

COMPANY NAME	:	Sri Sekamat Enterprise Sdn. Bhd.
REGISTERED OFFICE	:	Bangunan Dato' Mohd Said Hj. Mat Saman, Lot 4711, Batu 12 ¾, Jalan Cheras, 43000 Kajang, Selangor Darul Ehsan. Tel. No.: Fax: 03 – 8736 2869 Email: dms_sse@yahoo.com.my
DATE OF ESTABLISHMENT	:	7hb. November 1984 - Sri Sekamat Enterprise 14hb. October 1988 - Sri Sekamat Enterprise Sdn. Bhd.
REGISTRATION UNDER	:	1. PKK Sijil Taraf Bumiputera 2. CIDB Gred G7 3. MS ISO 9001 : 2008
THE MAIN ACTIVITIES	:	The Construction and Civil Engineering
DIRECTOR	:	1. Dato' Hj. Mohd Said Hj. Mat Saman 2. Mohd Safry Dato' Hj. Mohd Said 3. Mohd Safuan Dato' Hj. Mohd Said
CAPITAL	:	1. Authorised capital RM5,000,000.00 2. Paid-up Capital RM5,000,000.00

AUDITORS	:	Tetuan Sundar & Associates, Suites B-02-05, Dataran 3 Two, No 2, Jalan 19/1, 46300, Petaling Jaya, Selangor.
COMPANY SECRETARY	:	Sopan Secretarial Services (Kl) s/b, 24-5-2, Jalan 2/101C, Cheras Business Centre, 5th Mile, Jalan Cheras, 56100 Kuala Lumpur.
BANK	:	**i. Malayan Banking Berhad** Cawangan Bukit Bintang, No.42-2, GF & 1st Floor, Jalan Sultan Ismail, 50250 Kuala Lumpur. **ii. Cimb Bank** No. 9 & 10, Jalan Tun Abdul Aziz, 43000 Kajang, Selangor Darul Ehsan. **iii. Public Bank Berhad** No. 10 & 11, Jalan Raja Harun, 43000 Kajang, Selangor Darul Ehsan.
LAWYER	:	The Law Office Of Anita Ferns No. 23-1, Jalan Semenyih Sentral 8, Semenyih Sentral, 43500 Semenyih, Selangor.

2.3 Organization Chart

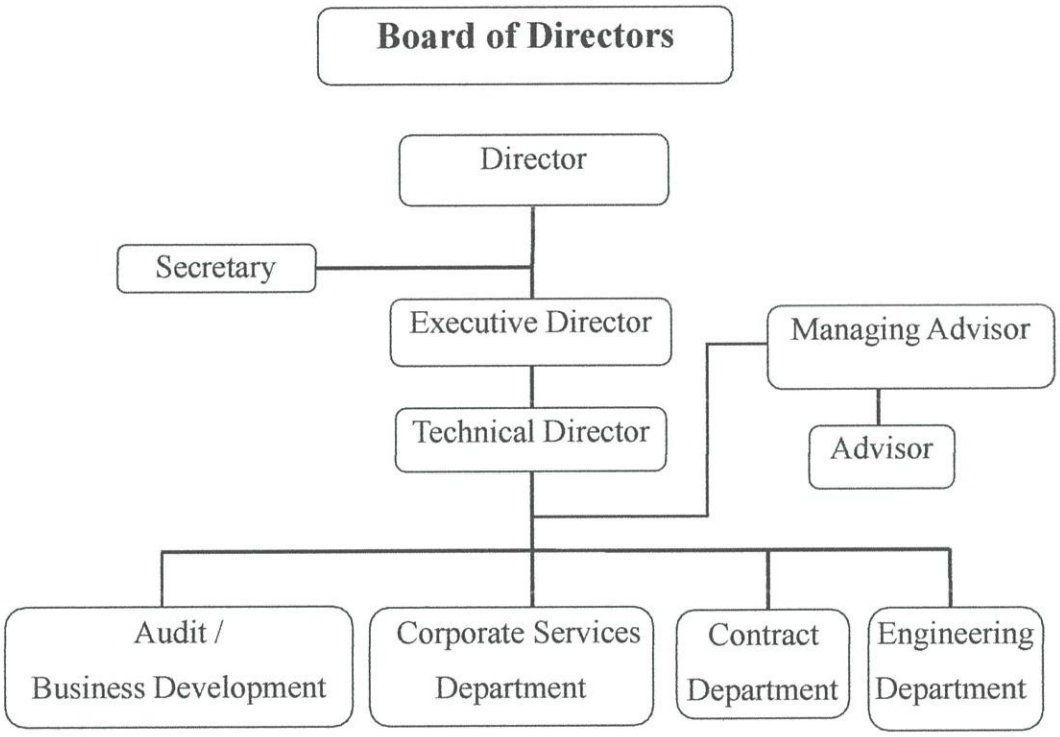


Figure 2.1: Sri Sekamat Enterprise Sdn. Bhd. organization chart.

Table 2.1: Board of Directors

	NAME	POSITION
1.	Dato' Mohd Said Hj.Mat Saman	Director
2.	Mohd Safry Dato' Mohd Said	Executive Director
3.	Mohd Safuan Dato' Mohd Said	Technical Director

Table 2.2: Technical Division.

	NAME	POSITION
1.	Mohd Shahril Dato' Hj. Mohd Said	Engineer
2.	Mohamad Azam B. Endut	Quantity Surveyor
3.	Mohammad Afiq Dato' Abdul Rahim	Project Coordinator
4.	Hawa Aznizar Bt. Abu Samah	Site Engineer

Table 2.3: Finance Department.

	NAME	POSITION
1.	Nor Hamnah Bt Yahya	Finance Manager
2.	Siti Fairuz Bt. Dorraman	Account Executive

Table 2.4: Department Of Administrative.

	NAME	POSITION
1.	Noor Mahima Binti Mahmud	Administrative Assistant
2.	Nur Affida Bt Aripin	Administrative Assistant
3.	Siti Khatijah Binti Hasan	Receptionist

2.4 List of Project

2.4.1 Completed Projects

Table 2.5: List of Completed Projects.

Project Title	Start Date	Completion Date	Contract Value (Rm)
Proposed Slope Rehabilitation Works to Protect Two (2) Nos of 600mm Diameter Pipes Near Mutiara Court Apartment, Jalan Bukit Permai, Wilayah Persekutuan Kuala Lumpur Proposal C : Soil Nailing and Guniting.	05/11/2012	04/04/2013	1,870,210.00
Projek Bekalan Air Luar Bandar (BALB) Negeri Sarawak untuk Tahun 2010-2012 For KKLW - Wilayah Serian, Samarahan Sarawak : Temporary Works For Site Protection And Diversion Works From Protection of Mechanical & Electrical Facilities.	28/02/2012	27/11/2012	8,550,000.00
Proposed Slope rehabilitation works to failed slope at Taman Desa Serdang Reservoir, Hulu Langat, Selangor Darul Ehsan.	10/05/2010	09/09/2010	637,147.00

Proposed Emergency Works to Rehabilitate Failed Slope at Castlefield Reservior, Jalan Nikmat, Taman Bukit Aman, Petaling, Selangor	14/12/2009	13/05/2010	1,984,154.80
Universiti Kebangsaan Malaysia (UKM) – Pusat Perniagaan Siswazah.	26/03/2009	31/08/2011	19,953,716.30

2.4.2 Projects in Progress

Table 2.6: List of Projects in Progress.

Project Title	Start Date	Completion Date	Contract Value (Rm)
Membina dan Menyiapkan Bangunan Pusat Islam serta Lain-lain Kerja Berkaitan di Universiti Sains Islam Malaysia, Bandar Baru Nilai, Negeri Sembilan Darul Khusus.	2/6/2014	1/2/2016	20,186,456.15
Cadangan Membina Sebuah Masjid Dua Tingkat dan Satu Tingkat Kuarters Berkembar beserta Tiga Unit Wakaf Di Atas Lot 110019, Kg	24/5/2014	23/5/2016	9,800,000.00

Seri Aman, Puchong, Mukim Petaling, Daerah Petaling, Selangor Darul Ehsan. Untuk Jawatankuasa Pembinaan Masjid Kg. Seri Aman.			
Cadangan Membina Sebuah Kompleks Masjid Jamek di atas sebahagian Lot 5377, Jalan Institut, Serdang, Bandar Putra Permai, Mukim Petaling, Daerah Petaling, Selangor Darul Ehsan Yang Mengandungi Satu Blok Kuarters (4 unit) Kediaman 2 Tingkat, Satu Blok Rumah Sampah dan Pam Air 1 tingkat, Satu Loji Rawatan Kumbahan Dan Satu Blok Pencawang elektrik 1 Tingkat.	8/11/2012	15/9/2014	6,598,230.44

CHAPTER 3.0

CASE STUDY

3.1 Introduction of Project

The project of Masjid Kg. Seri Aman is located at Lot 19401 (99A), Jalan Aman, Kg. Seri Aman Hilir, 47100 Puchong, Selangor. Kampung Seri Aman is an area refers to a settlement by the river Kg Melayu Kelang. There are a total of 6 villages as a whole at Batu 13 near the edge of the Klang River, Kampung Baru Seri Puchong, Kampung Seri Langkas, Kampung Seri Langkas, Kampung Seri Aman, Kampung Tengah and Kampung Kenangan.

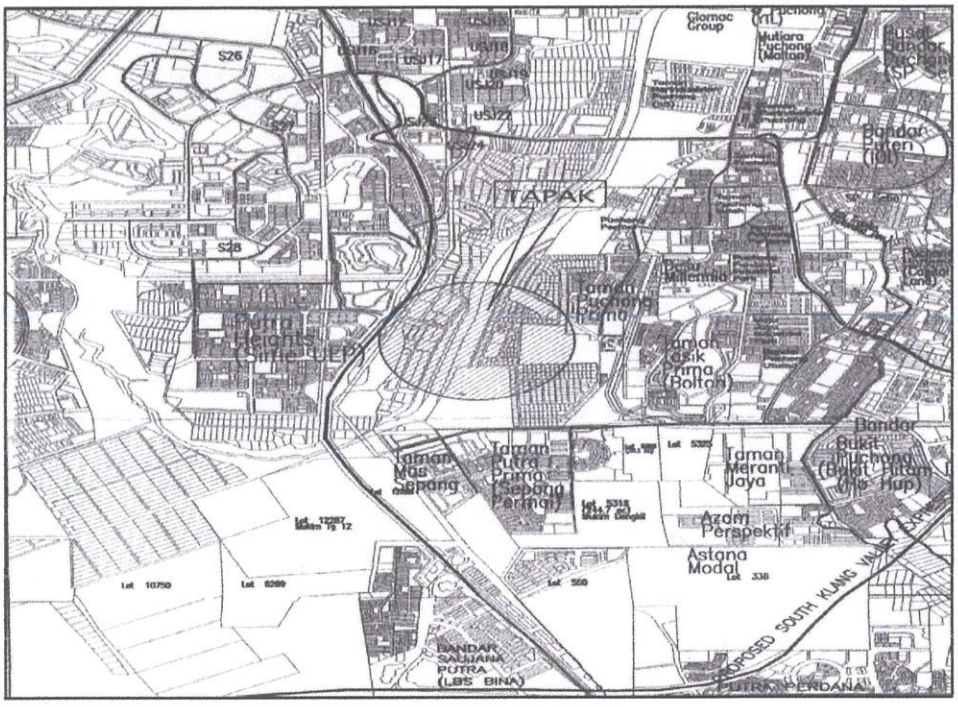


Figure 3.1: Location plan of Project Masjid Kg. Seri Aman, Puchong.

The Construction of the Mosque Committee Kg. Seri Aman in collaboration with accredited consultants appointed HIA Architect Sdn Bhd located at no. 5-G,7th Floor Block 1, Worldwide Business Centre, Shah Alam, Selangor had agreed to make the construction of the mosque in traditional architecture, taking of the basic requirements necessary for a mosque complex combined that with modern features without basic marginalize Islamic architecture.

Figure 3.2: Architect impression of the Masjid Kg. Seri Aman, Puchong.
Source: http://masjidkgseriaman.blogspot.com

Encompassing 2.7 acres mosque is located in the village area with a majority Muslim population. The mosque surrounded by trees and next to the lake with the spacious foyer, the mosque ideal for a variety of activities. In addition, it involves the development of 2-storey mosque built-up area of more than 16,000 square feet including the main prayer hall, classes, library, office, homes for imam and bilal, and several other basic facilities as a mosque.

Sri Sekamat Enterprise Sdn. Bhd. as the main contractor is responsible for the construction and completion of the mosque within 2 years starting from 24 May 2014 until 23 May 2016. Based on the design options and features contemporary and modern construction site, the total development cost is estimated at RM 9.5 million.

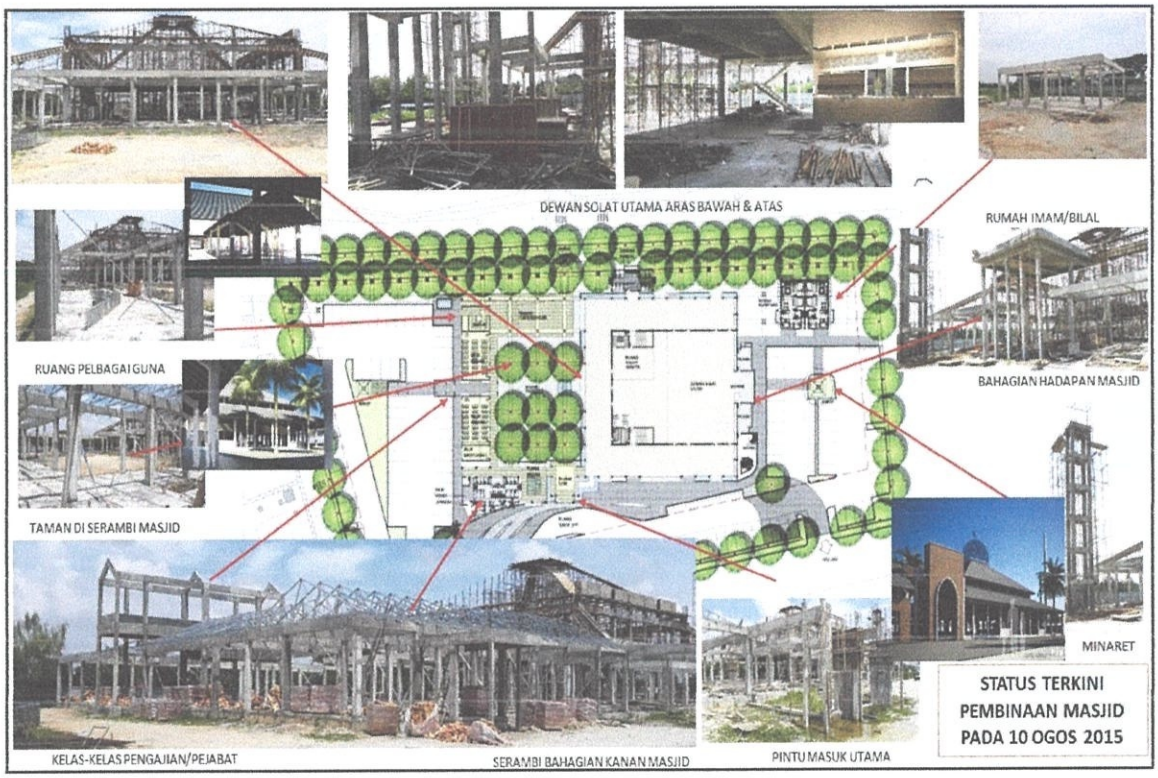


Figure 3.3: Status of Project Kg. Seri Aman until 10 august 2015.

Source: http://masjidkgseriaman.blogspot.com

3.2 Case Study

"A roof is the weatherproofed upper covering of a building or structure, which is designed to protect the interior from atmospheric elements such as sun, rain, hail, snow, frost and wind" (TAFE New South Wales Staff, 2013). The roof will affect the architectural view of a building. The roof with a slope or pitch, greater than 5 degrees is a pitched roof. A roof may have a single pitch such as monopitch roof and a double pitch like gable roof and hip roof. As a result, there are many variations on the basic design and numerous combinations of design elements with construction methods.

3.2.1 Types of Roofs

i. Monopitch roof

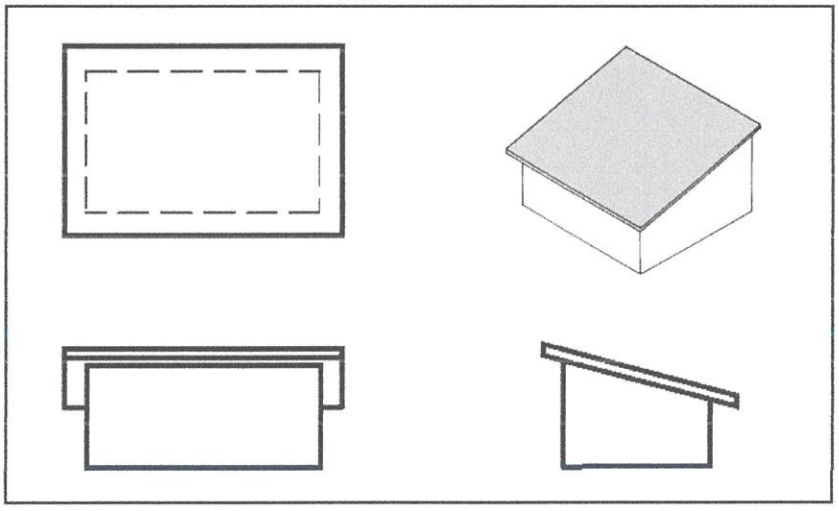


Figure 3.4: Elevation of monopitch roof.

A monopitch roof is similar to a flat roof but has more pitch and has one direction of slope. Because the roof comes with a continuous slope, this type of roof has no ridge.

ii. Gable roof

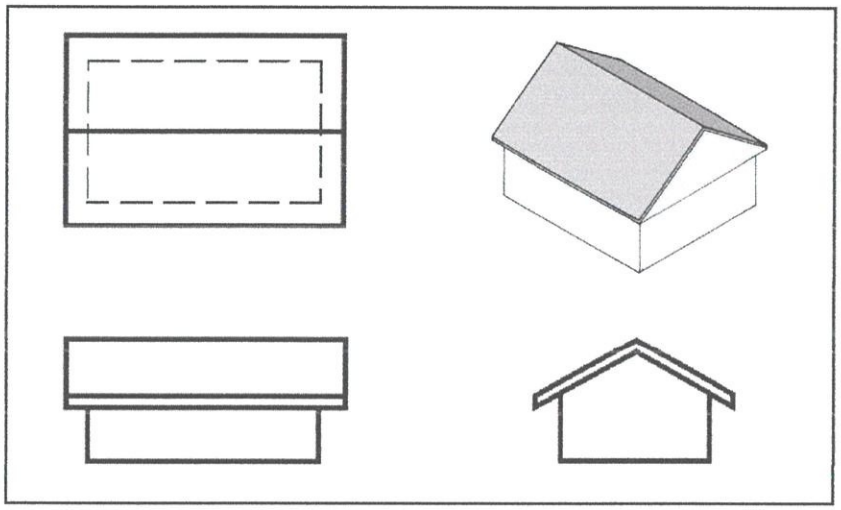


Figure 3.5: Elevation of gable roof.

The gable roof is a very popular type of roof. This is a roof with a double pitch and vertical ends. Rafters or truss meet at top peak to a ridge.

iii. Hip Roof

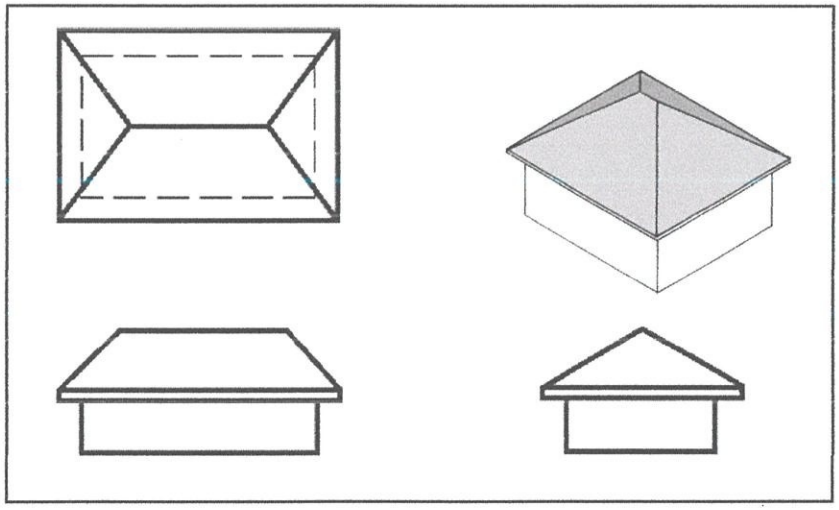


Figure 3.6: Elevation of hip roof.

This is a roof with four sloping sides on a rectangular base. The ends are triangular in shape and the sides form a trapezoidal shape.

iv. Dutch gable

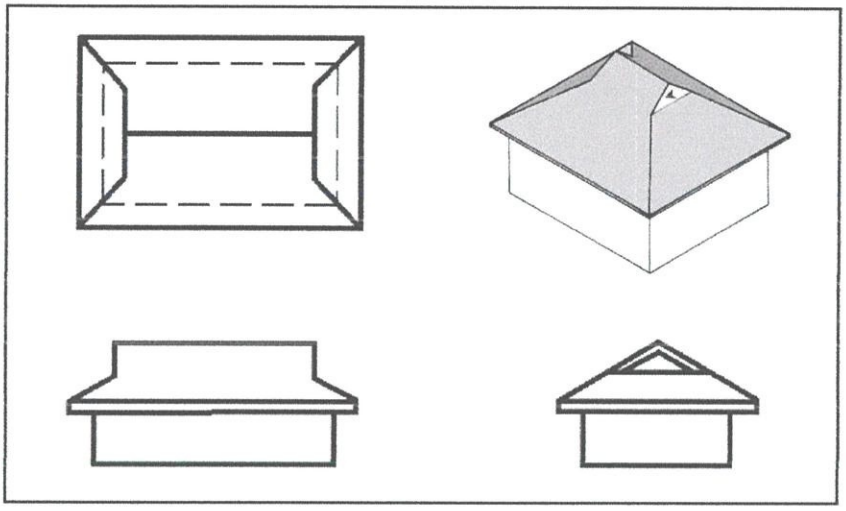


Figure 3.7: Elevation view of dutch gable roof.

The dutch gable roof is basically a hip roof with a small gable at either end. This type of roof providing a more unique style of roof surface.

v. Monitor roof.

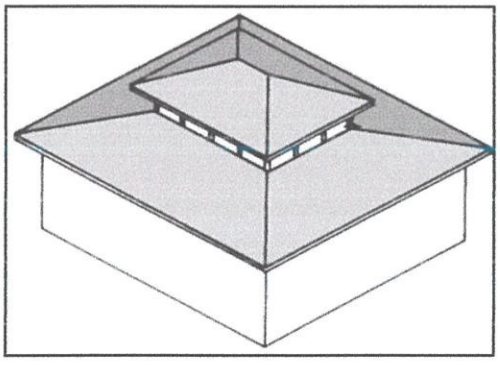


Figure 3.8: Isometric view of monitor roof.
Source: Basic Roof and Ceiling Framing (2013).

This is a portion of a roof, which has been raised up above the main roof, usually flat, with continuous vertical glazing around the perimeter for natural lighting. Mainly used for mosque and industrial buildings.

3.2.2 The Roof Truss

The roof truss is an important structure to the roof of a building to support the roofing covering can be made of clay, concrete and corrugated steel. Beside that, roof truss must be able to support other possible load above the roof covering such as dead leaves, and weather. Because of the reason, the roof truss must have a good strength to be able to transfer the load continuously to the foundation. Thus, material used of the truss must have good physical strength properties for example, timber and steel.

Photo 3.1 : The usages of lightweight steel and timbers as the roof truss.

In the booming construction industry today, the steel truss was mostly used for the roof structure. Furthermore, the production of wood has been controlled in order to prevent the extinction of the forests in the treasures of the world for a long time. Steel is a material that is lightweight and able to bear the burden of many times its own weight. This steel have properties of ductile, malleability, durability and rust resistance that make it suitable to be use as the roof truss. Because of the truss is lightweight, it is easy to operate it can be form in various designs.

3.2.3 Advantages of Lightweight Steel Roof Trusses

i. Lightweight

Make the roof construction less complicated and easy to handle.

ii. Eco-friendly

The steel roof trusses are recyclable into new steel form.

iii. Durability

It is resistant to fire, corrosion, pest infection such as termites and less defects.

iv. Easy to get.

The availability source of steel material is higher and easy to get the supply.

v. Non-combustible.

The steel does not burn and will not contribute fuel to the spread of a fire which is compliance with Uniform Building By-Laws 1984.

3.2.4 Roof Truss Terminology

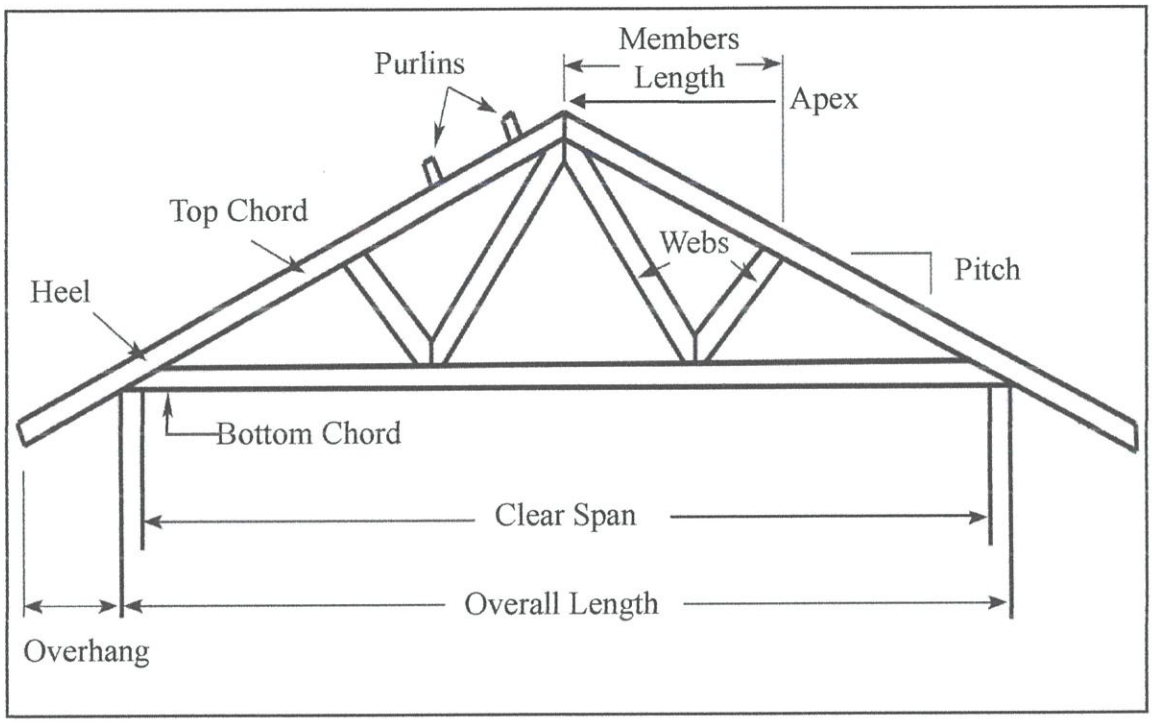


Figure 3.9: Roof truss terminology.

Source: Roof truss (2014).

i. Top Chord is an inclined or horizontal chord member that establishes the upper edge of a truss. This member is subjected to compressive and bending stresses.

ii. Bottom Chord is the horizontal member defining the lower member of a truss, carrying ceiling loads where applicable.

iii. Overhang is the extension of the top chord beyond the heel joint.

iv. Overall Length is horizontal distance between outside faces or supports such as wall.

v. Clear Span is the horizontal distance between inside faces or supports.

vi. Apex is the highest point on a truss where the sloped top chords meet.

vii. Heel is the joint in a pitched truss where top and bottom chords meet.

viii. Webs are members that join the top and bottom chords to form the triangular patterns that give truss action.

ix. Purlin is a structural member fixed perpendicular to the top chord of a truss that provides lateral restraint to truss support roof sheeting and also support roof covering.

x. Pitch is the units of horizontal run, in one unit of vertical rise for inclined member which is top chord.

3.2.5 Types of Trusses

The pitched is characterized by its triangular shape. It is most often used for roof construction. Some common trusses are named according to their web configuration, such as the King Post and Howe truss by the chord size and web configuration.

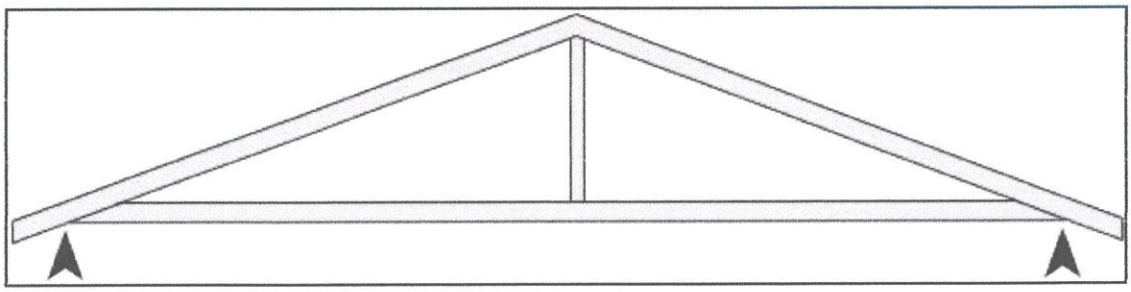


Figure 3.10: King Post truss.

A truss for spans that not more that 4 metre. Usually used in house and garage construction.

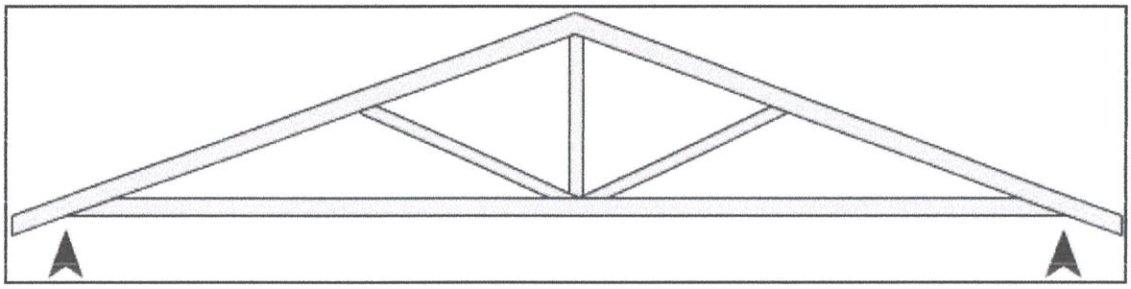


Figure 3.11: Queen Post Truss.

The truss spans approximately 6 metres. Used mainly for house construction.

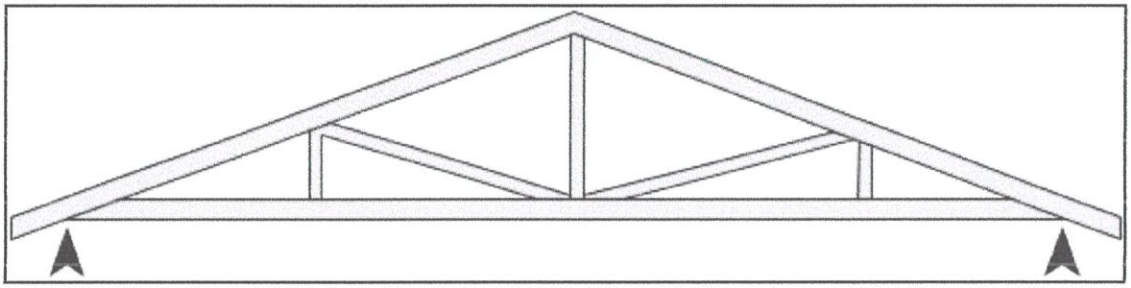


Figure 3.12: Howe Truss.

A truss spans that up to 12 metres. Used mainly for applications which involve high loading of the bottom chord.

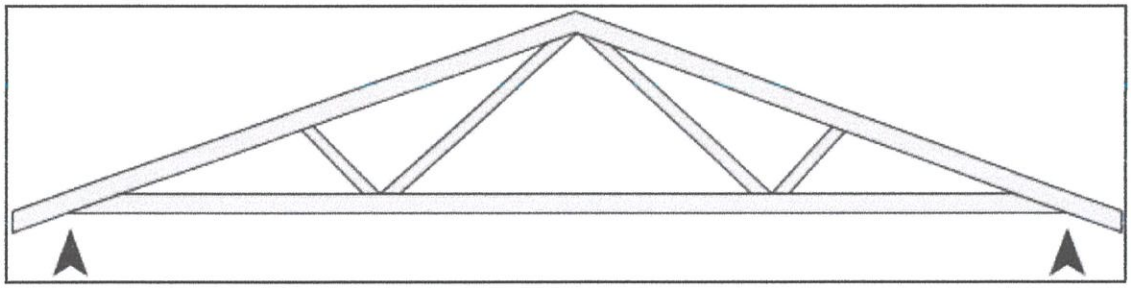


Figure 3.14: A-Truss.

A spans truss approximately 9 metres. This is the most commonly used truss for both domestic and commercial application.

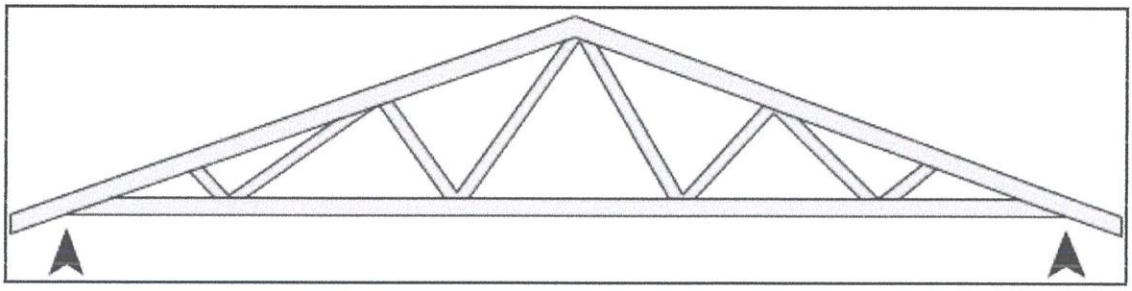


Figure 3.15: B-Truss.

For roof spans approximately 13 metres. Used mostly in residential and smaller commercial buildings, this truss is generally preferred to the A-truss for larger spans that offers greater strength with additional web members.

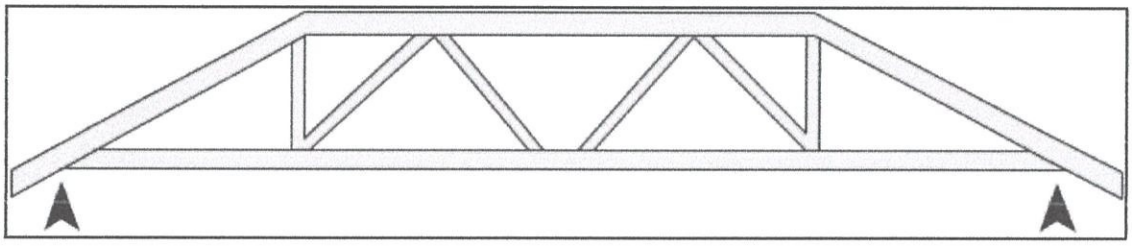


Figure 3.16: Truncated truss.

The truss has varying depth with a horizontal top chord. There are two types of truncated truss which is the truncated girder truss and the standard truncated truss. Together they facilitate hip roof construction.

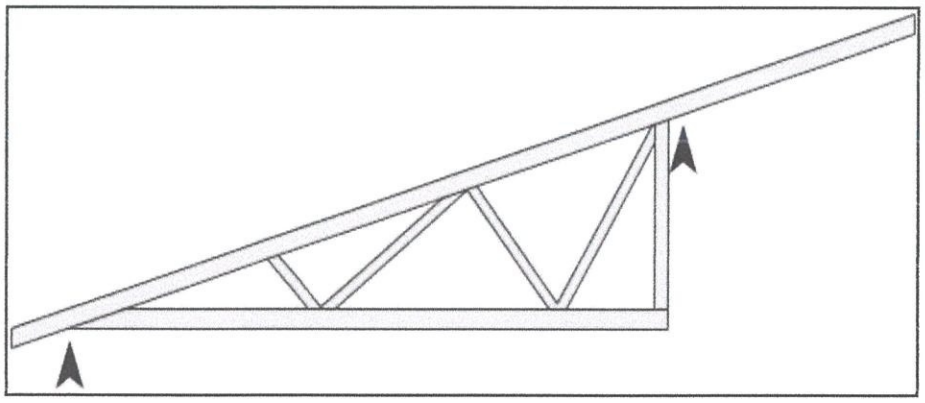


Figure 3.17: Hip truss.

A half truss with an extended top chord which is used to form the hip ridge of a hip roof.

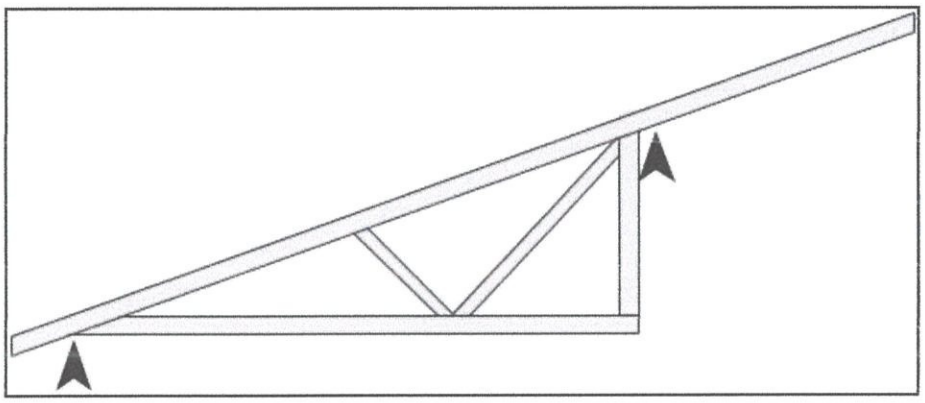


Figure 3.18: Jack Truss.

The truss similar to the half A-truss but with an extended top chord which overlies a truncated truss to meet the extended top chord of a Hip Truss.

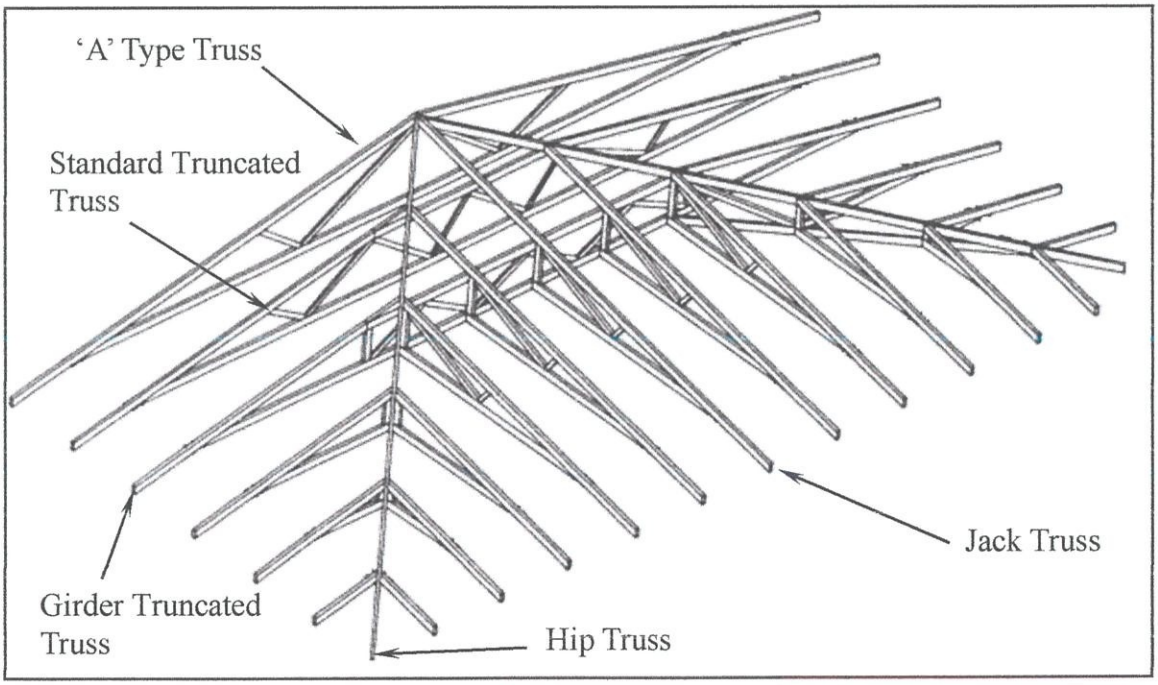


Figure 3.19: Hip roof construction with various types of trusses.

Source: Truss Facts Book (2010).

3.2.6 Roof Truss Detail Connection

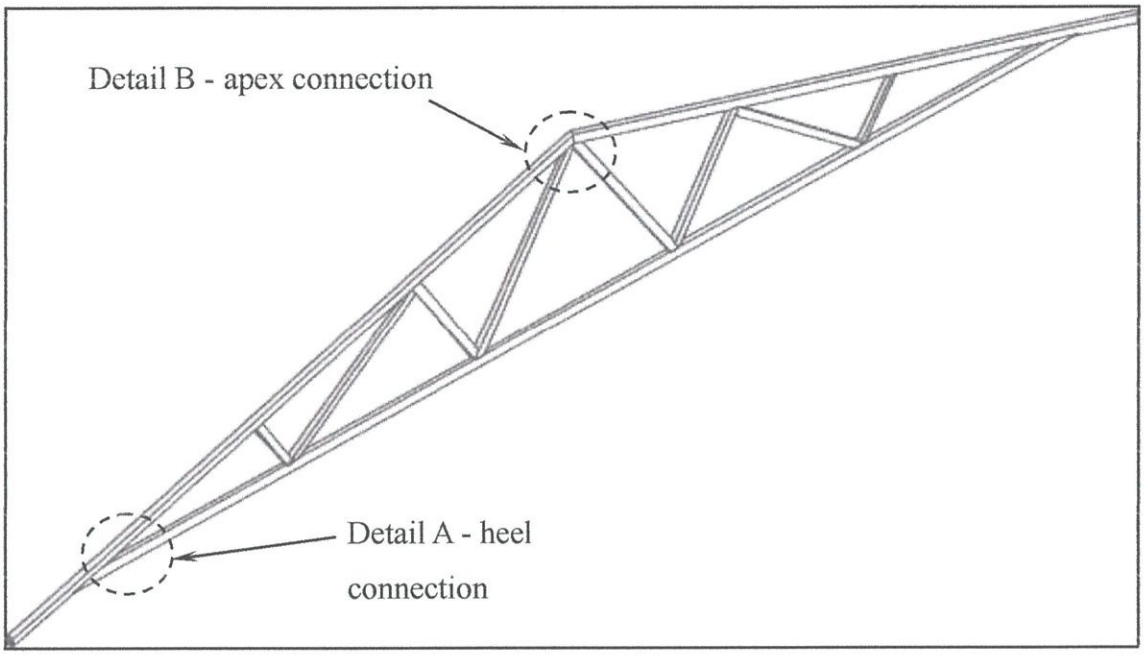


Figure 3.20: Standard truss connection.

Source: PW/MKSA/13029

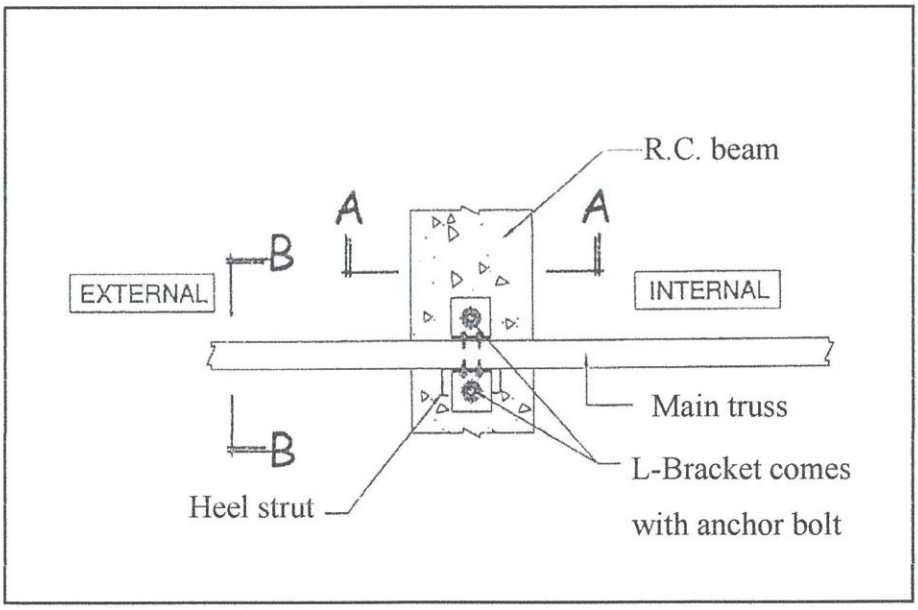


Figure 3.20: Plan view to heel connection (detail A).

Source: PW/MKSA/13025

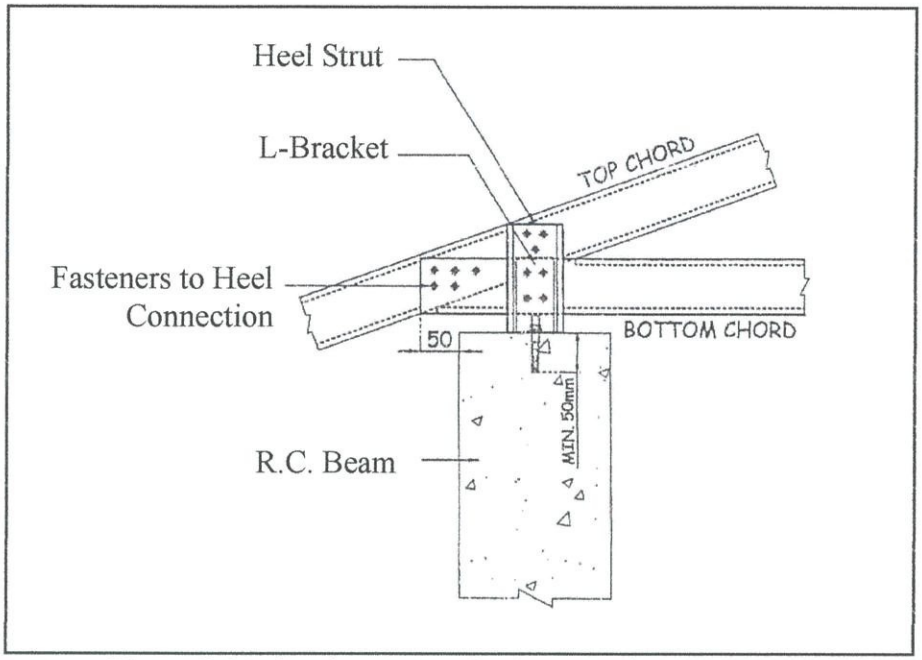


Figure 3.21: Section A-A to heel connection (detail A).
Source: PW/MKSA/13025

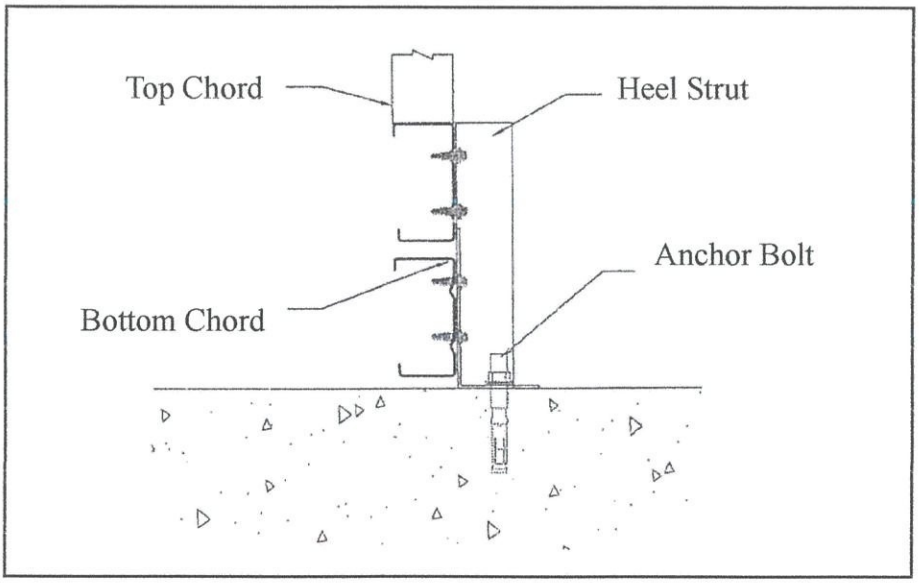


Figure 3.22: Section B-B to heel connection (detail A).
Source: PW/MKSA/13025

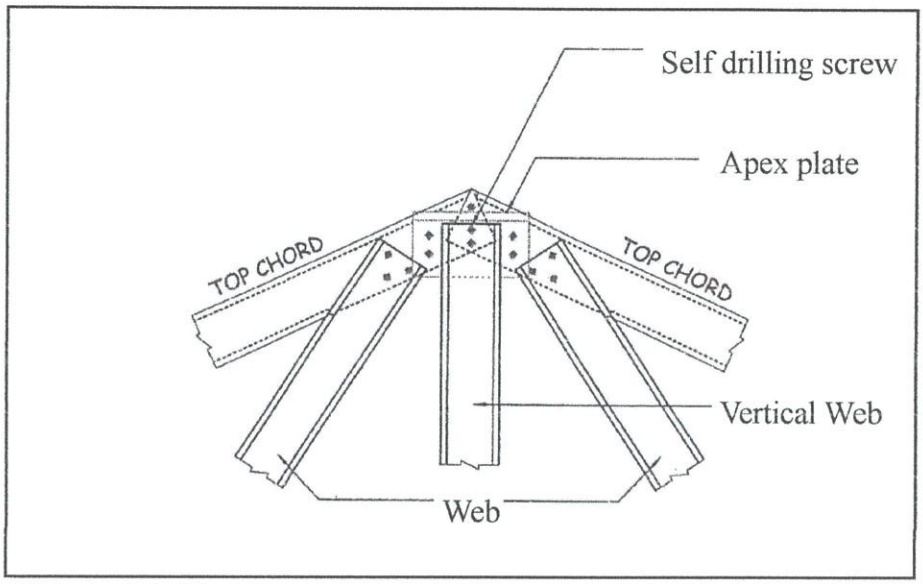


Figure 3.23: Apex connection (detail B).

Source: PW/MKSA/13026

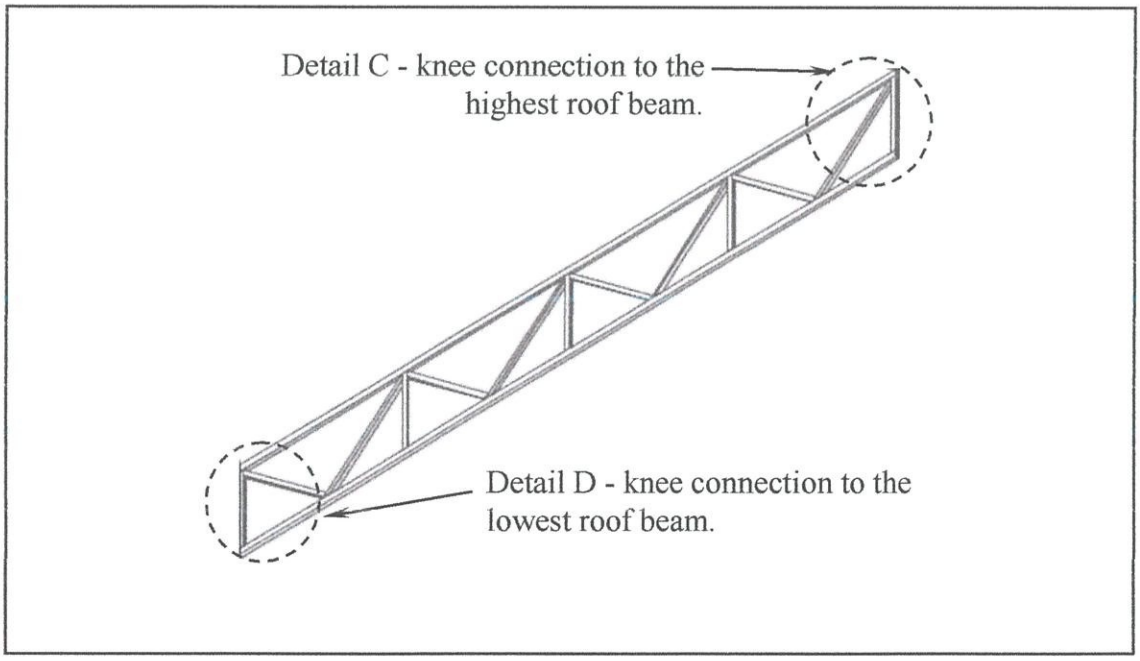


Figure 3.24: Parallel chord truss connection.

Source: PW/MKSA/13027

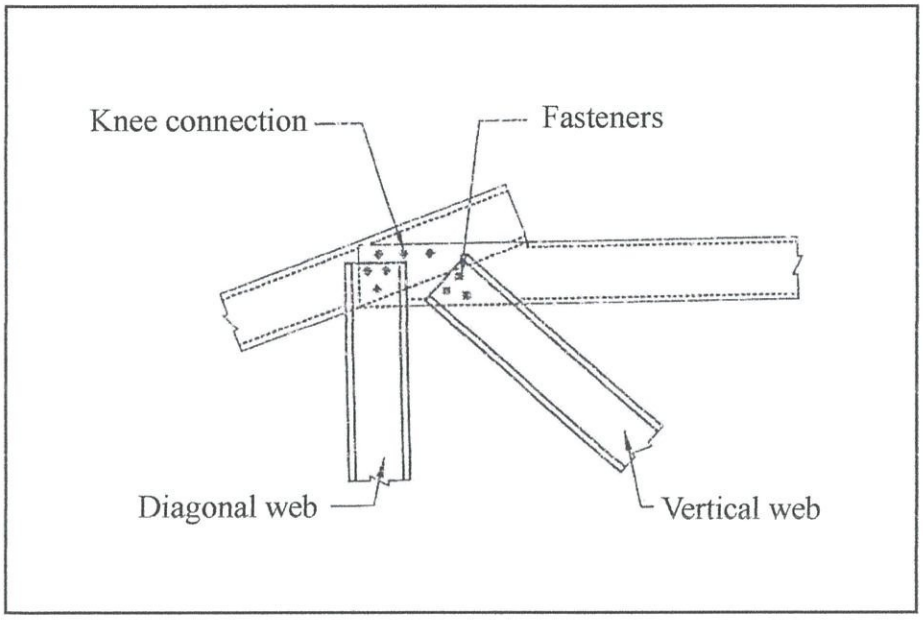


Figure 3.25: Typical knee connection.
Source: PW/MKSA/13029

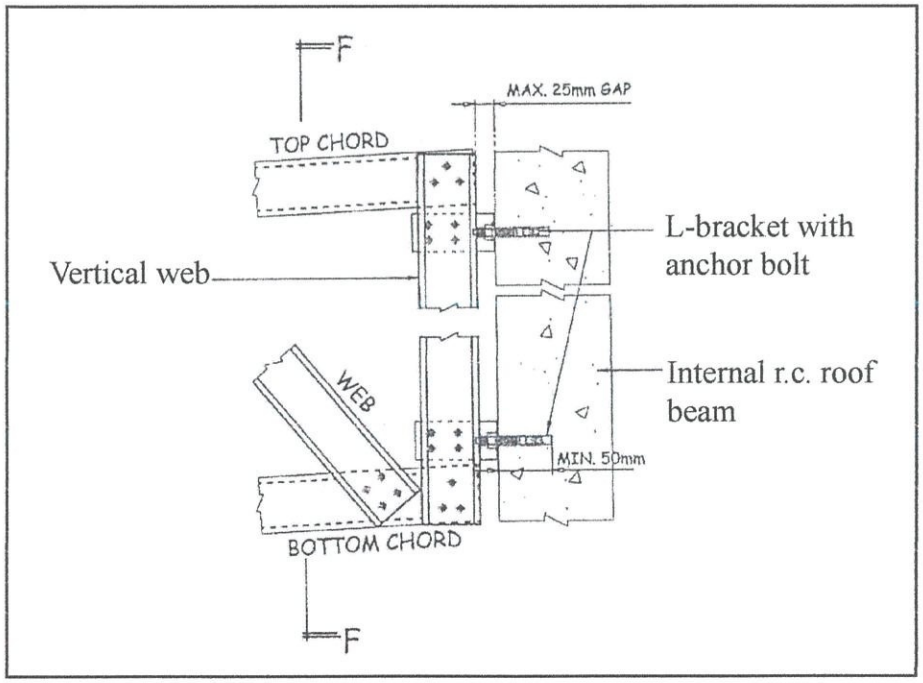


Figure 3.26: Connection to the highest beam.

Source: PW/MKSA/13029

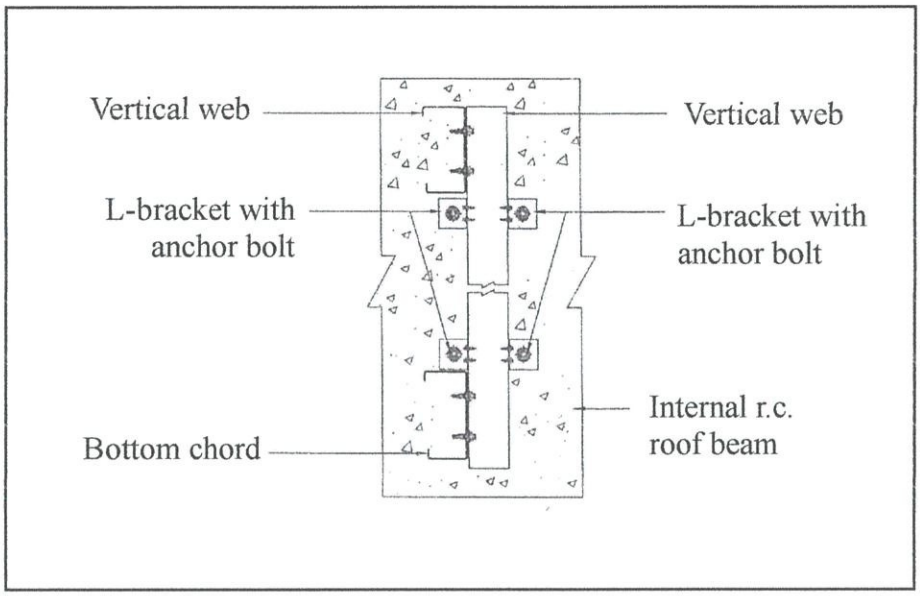


Figure 3.27: Section F-F to the highest roof beam.

Source: PW/MKSA/13029

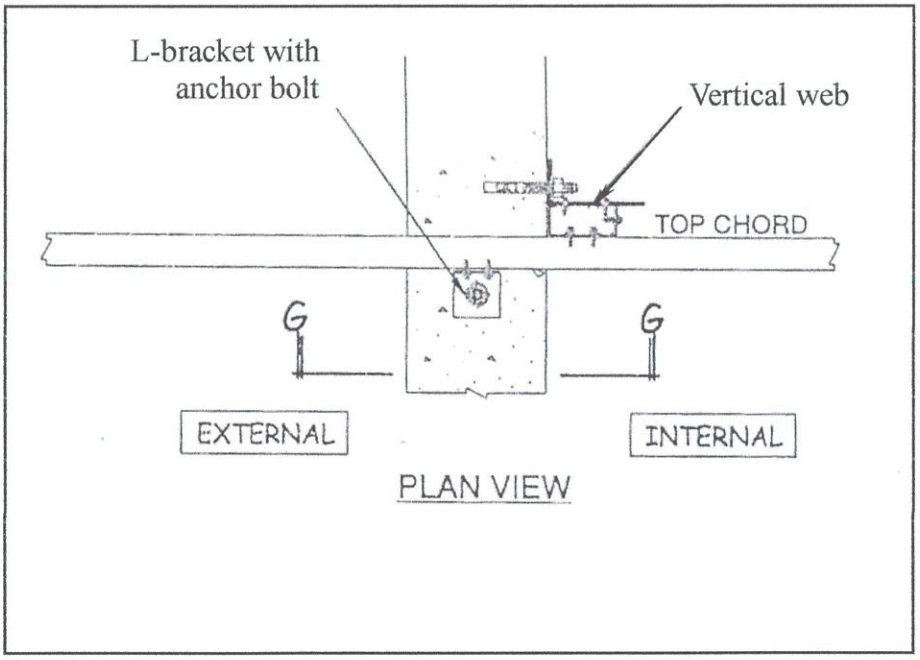


Figure 3.28: Plan view knee connection to the lowest roof beam.

Source: PW/MKSA/13029

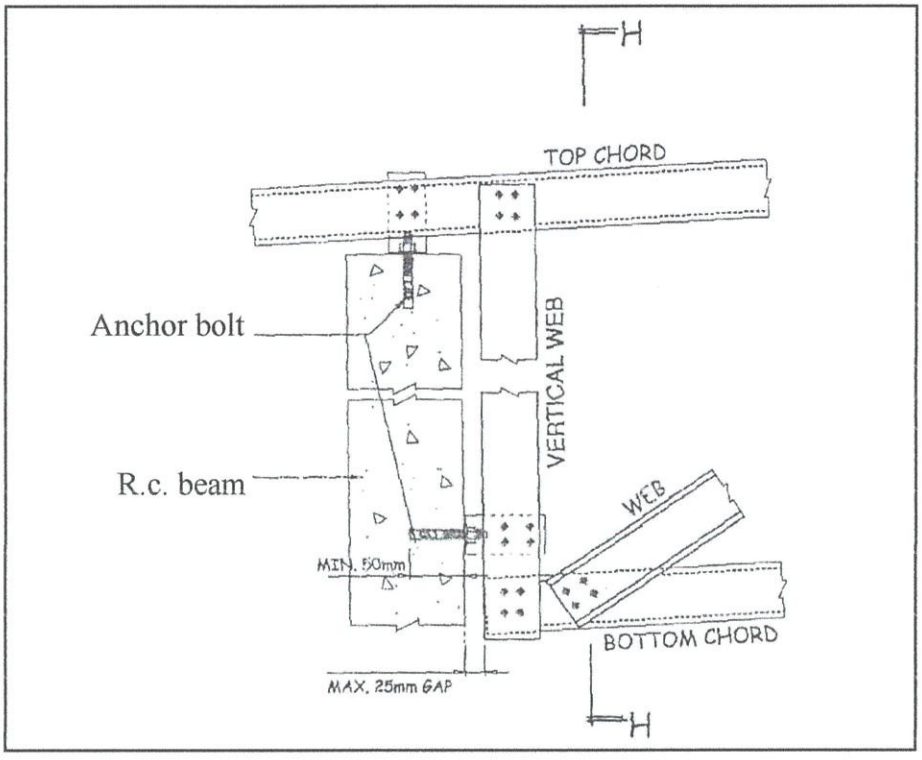


Figure 3.29: Section G-G to the lowest roof beam connection.

Source: PW/MKSA/13029

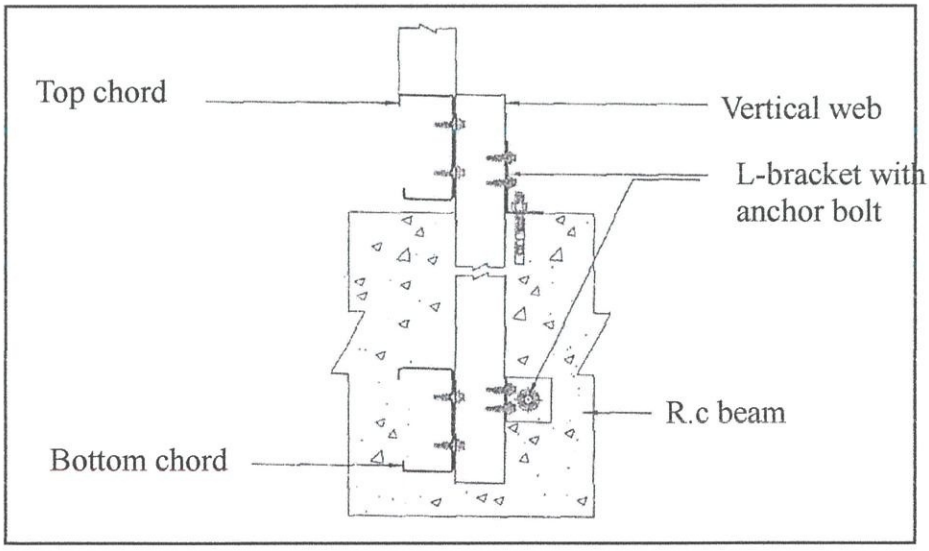
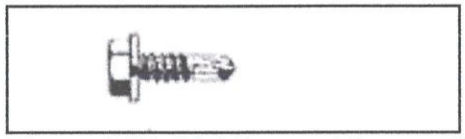
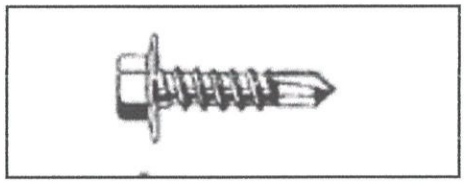
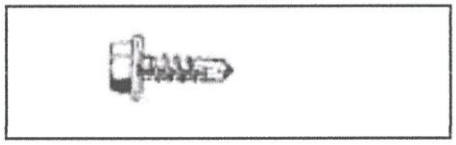
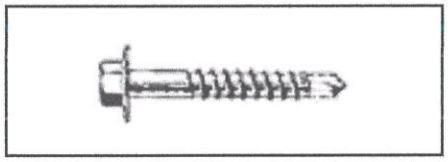
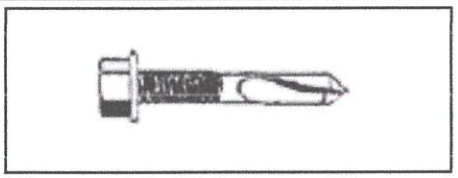


Figure 3.30: Section H-H to lowest roof beam connection.

Source: PW/MKSA/13029

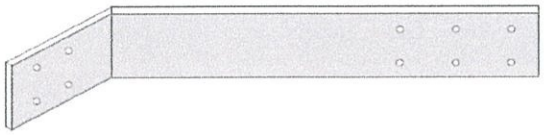
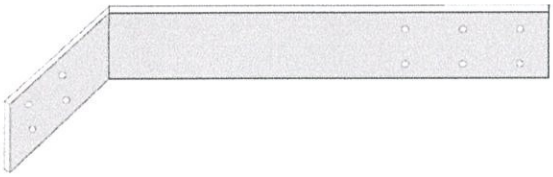
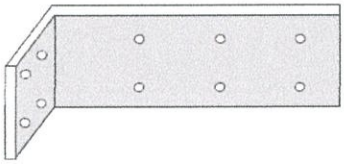
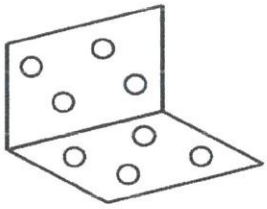
3.2.7 Types of Fasteners

Table 3.1: Types of screw use to connect the truss members.

NO.	SCREW TYPES	USES
1.	 Figure 3.31: 10-16mm x 16mm self drilling screw.	General non-structural fixing screw which is use at roof purlins and roof battens.
2.	 Figure 3.32: 12-14mm x 20mm self drilling screw.	Structural fixing screw, tiles roof truss fixing, girder truss, heel and bracket fixing,
3.	 Figure 3.33: 14-10mm x 20mm self drilling screw.	Structural fixing screw low wind area as also for sheet roof truss fixing, rafter beam fixing and high load sheet connections
4.	 Figure 3.34: 12-14mm x 45mm self drilling screw.	Fixing wall plate to steel joints.
5.	 Figure 3.35: 12-24mm x 32mm self drilling hex.	Used for fixing steel brackets or joists to heavy steel up to 12mm thickness.

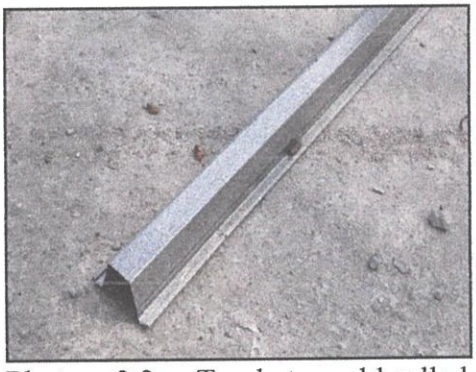
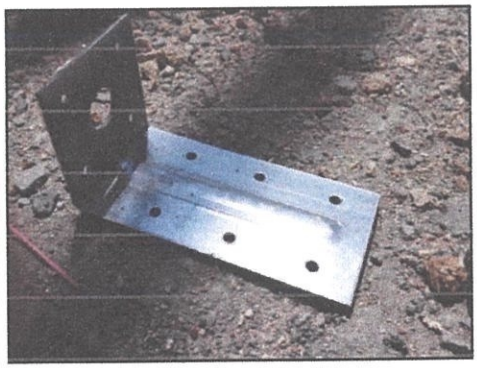
3.2.8 Types of Brackets

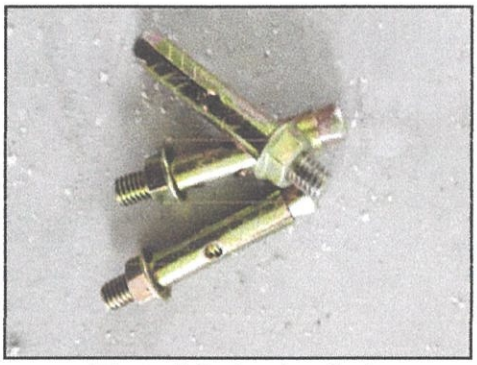
Table 3.2: Brackets that commonly use in roof truss construction.

NO.	BRACKETS TYPES	USES
1.	 Figure 3.36: 50mm x 100mm L-brackets.	Connects jack trusses to bottom of hip trusses
2.	 Figure 3.37: 75mm x 100mm L-brackets.	Connects jack trusses to the top of hip trusses.
3.	 Figure 3.38: 50mm x 75mm L-brackets.	Connects jack trusses to girder trusses
4.	 Figure 3.39: 38mm x 38mm x 38mm angle plate.	Connects hip trusses to girder chords and members

3.2.9 Material Used

Table 3.3: The material use for roof trusses.

NO.	MATERIAL	FUNCTION	MARKET PRICE
1.	 Photo 3.2: C-channel cold-rolled steel.	As a chord member to be combine to form any design of the roof trusses.	RM 19.00/ 6 metre.
2.	 Photo 3.3: Top-hat cold-rolled steel.	Act as purlin that tie all roof trusses together and battens to support the roof covering.	RM 12.00 / 6 metre
3.	 Photo 3.4: L-brackets.	To connect the roof truss to the roof beam.	RM 3.00 / pc

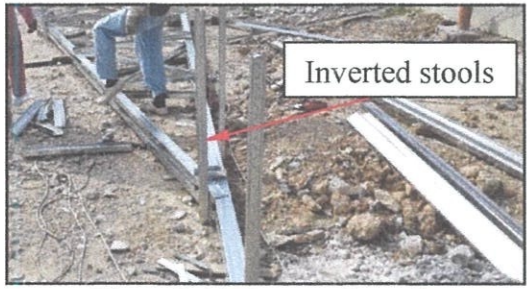
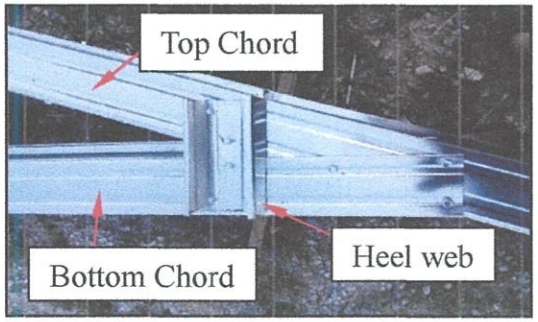
4.	 Photo 3.5: Anchor bolt.	As connector between the L-brackets and the roof beam.	RM 1.50 / pc
5.	 Photo 3.6: Screw-Class 2.	Function as site connection to joint the roof truss member together.	RM 5.00 / packet

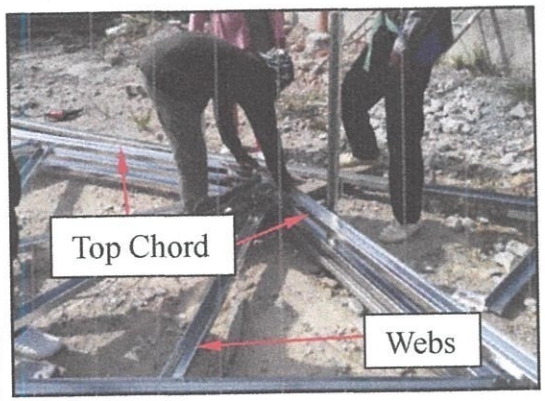
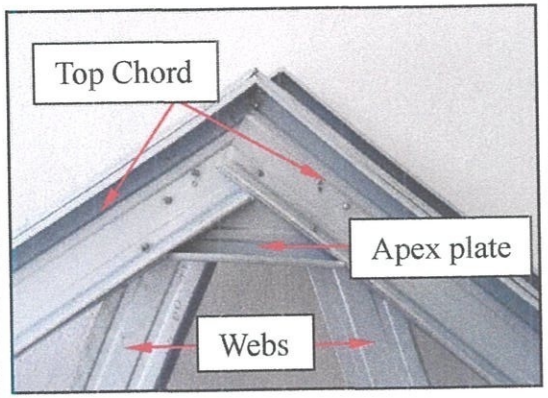
3.3 Method Statement

Table 3.2: Method statement of roof trusses

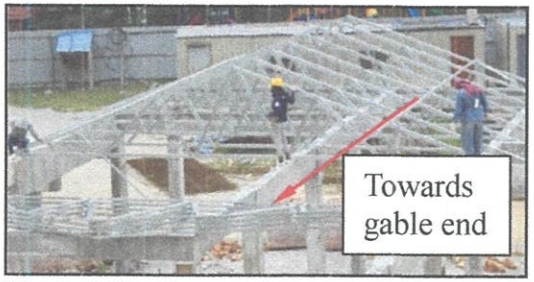
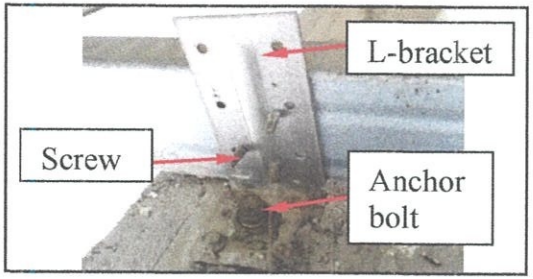
NO.	OPERATION	DIAGRAM	PLANT/ EQUIPMENT	LABOUR	OUTPUT
1.	Construct the roof beam with dimension of 150mm x 300mm start from the installation of the formwork, lay down the reinforcement bar, concreting and curing.	 Photo 3.7: All roof beam ready to be install.	Barbender Machine, Concrete Mixer.	Carpenter, Barbender, Concreter.	1 Week.
2.	Measure the 6 metres C-channel cold-rolled steel into top chord, bottom chord and web members based on engineers drawing then mark with marker pen.	 Photo 3.8: Roofer measuring the truss member.	Measuring tape, Marker pen.	Roofer.	1/4 hour.

3.	Cut the 6 metre cold-rolled steel based the dimension been marked earlier, using angle cutter.	 Photo 3.9: 6 metre C-channel cold-rolled steel being cut to form trusses member.	Angle Cutter.	Roofer.	1/4 hour.
4.	Creating a truss sample. This sample will form the basis of similar trusses in the project. This method will ensure that subsequent truss will have same configuration and slope.	 Photo 3.10: Roofer making the truss temple.	Cordless screwdriver, Measuring tape.	Roofer.	1/2 hour.

5.	Inverted stools are used to align truss member.	 Photo 3.11: Inverted stools.	Inverted stool.	Roofer.	1/10 hour.
6.	From the sample truss and the inverted stools, roofer use a drill gun to fasten the screws at the bottom cord and web members to form the other roof truss.	 Photo 3.12: Installation of truss member.  Photo 3.13: Heel web.	Cordless screwdriver, Drill gun, Measuring tape.	Roofer.	1/10 hour.

7.	Screws are being fastened at the apex joint. Continuously assemble the roof trusses by staking over previously assembled trusses to follow the template outline.	 Photo 3.14: Roofer joining the chord member at apex joint.  Photo 3.15: Apex joint.	Cordless screwdriver, Drill gun, Measuring tape.	Roofer.	0.1 hour.

8.	Subsequent truss are being installed over the truss template.	 Photo 3.16: Roofer installing truss by stacking it over the truss template.	Cordless screwdriver, Drill gun, Measuring tape.	Roofer.	2 hours.
9.	After completing the installation of trusses, the trusses the moves from the template stack to the storing area. These trusses are ready to be installed onto roof beam.	 Photo 3.17: Storing area that near to the work place.		Roofer.	0.1 hour.

10.	Trusses are being installed at the gable end first and worked towards to the other gable end.	 Photo 3.18: Trusses being install towards another gable end.	Cordless screwdriver, drill gun, measuring tape, L-brackets, anchor bolt.	Roofer.	3 hours.
11.	L-bracket are installed to the beam and trusses are fixed to the L-bracket using anchor bolt according to the shop drawing.	 Photo 3.19: L-bracket being install to joint the roof truss and the roof beam.  Photo 3.20: Roof beam to roof truss.	Cordless screwdriver, drill gun, L-brackets, anchor bolt.	Roofer.	1 hour.

12.	All the trusses are braced according to the specification.	 Photo 3.21: The trusses bracing by purlin.  Photo 3.22: The entire truss was finished been braced.	Cordless screwdriver, Drill gun, Top-hat purlin.	Roofer.	2 hours.

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

From the overall aspect, lightweight steel truss as roof structure is commonly used in construction. It is more practical and economical to be use because the steel has a physical and chemical property which is recyclable make the steel environmental friendly. In addition, the availability source of the steel material is higher then the timber material to be use as roof the trusses make the construction of the roof completely eliminates the need for timber. This is also make the steel especially the lightweight steel to be more cost effective because of the stability supply of steel.

As steel truss is lightweight it is easy to be fabric and erect base on any design that can be form as the roof structure by allow for ground assembly before raising the pre-fabrication structures by using a crane onto it final position. This make also the construction has greater flexibility in determining cost-effective solution by using less manpower for the installation and less wastage on site.

Moreover, the lightweight steel has higher durability compare to the timbers. This is due to the resistant of pest infestation such as terminates and corrosion resistant. Compare to timber that will be warp, split, rot or settle in range of time, the lightweight steel has more dimensional stability. It is also fire resistance because the roof truss member are 100% non-combustible by definition, improving fire safety in compliance with Uniform Building By-Laws 1984.

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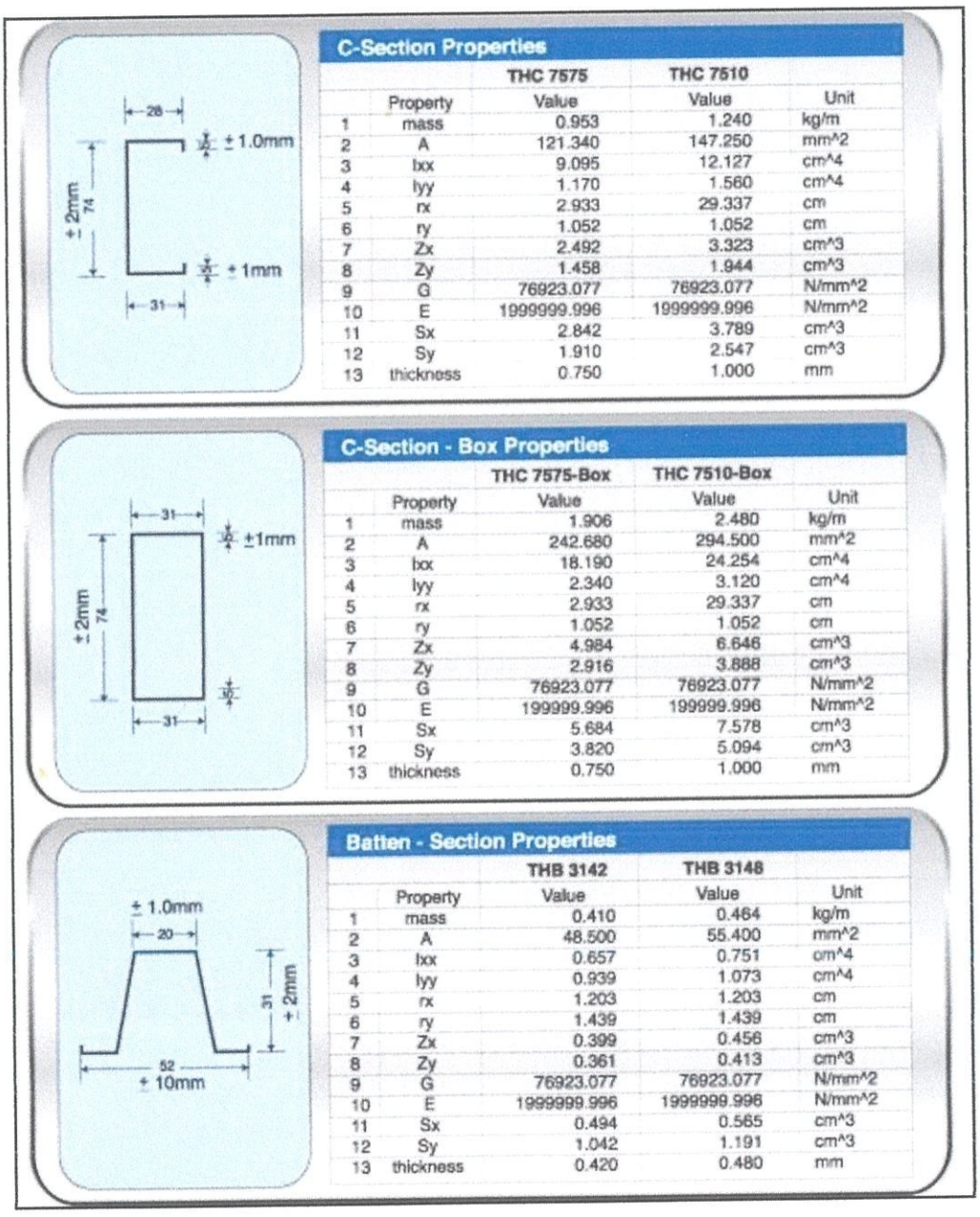
APPENDIX

Appendix A : Material Lightweight Steel Trusses.

Source: Thung Hing Group, TH® Truss System.

Appendix B: Section Properties of Lightweight Steel Truss.



C-Section Properties

		THC 7575	THC 7510	
	Property	Value	Value	Unit
1	mass	0.953	1.240	kg/m
2	A	121.340	147.250	mm^2
3	Ixx	9.095	12.127	cm^4
4	Iyy	1.170	1.560	cm^4
5	rx	2.933	29.337	cm
6	ry	1.052	1.052	cm
7	Zx	2.492	3.323	cm^3
8	Zy	1.458	1.944	cm^3
9	G	76923.077	76923.077	N/mm^2
10	E	1999999.996	1999999.996	N/mm^2
11	Sx	2.842	3.789	cm^3
12	Sy	1.910	2.547	cm^3
13	thickness	0.750	1.000	mm

C-Section - Box Properties

		THC 7575-Box	THC 7510-Box	
	Property	Value	Value	Unit
1	mass	1.906	2.480	kg/m
2	A	242.680	294.500	mm^2
3	Ixx	18.190	24.254	cm^4
4	Iyy	2.340	3.120	cm^4
5	rx	2.933	29.337	cm
6	ry	1.052	1.052	cm
7	Zx	4.984	6.646	cm^3
8	Zy	2.916	3.888	cm^3
9	G	76923.077	76923.077	N/mm^2
10	E	199999.996	199999.996	N/mm^2
11	Sx	5.684	7.578	cm^3
12	Sy	3.820	5.094	cm^3
13	thickness	0.750	1.000	mm

Batten - Section Properties

		THB 3142	THB 3148	
	Property	Value	Value	Unit
1	mass	0.410	0.464	kg/m
2	A	48.500	55.400	mm^2
3	Ixx	0.657	0.751	cm^4
4	Iyy	0.939	1.073	cm^4
5	rx	1.203	1.203	cm
6	ry	1.439	1.439	cm
7	Zx	0.399	0.456	cm^3
8	Zy	0.361	0.413	cm^3
9	G	76923.077	76923.077	N/mm^2
10	E	1999999.996	1999999.996	N/mm^2
11	Sx	0.494	0.565	cm^3
12	Sy	1.042	1.191	cm^3
13	thickness	0.420	0.480	mm

Source : Thung Hing Group, TH® Truss System.