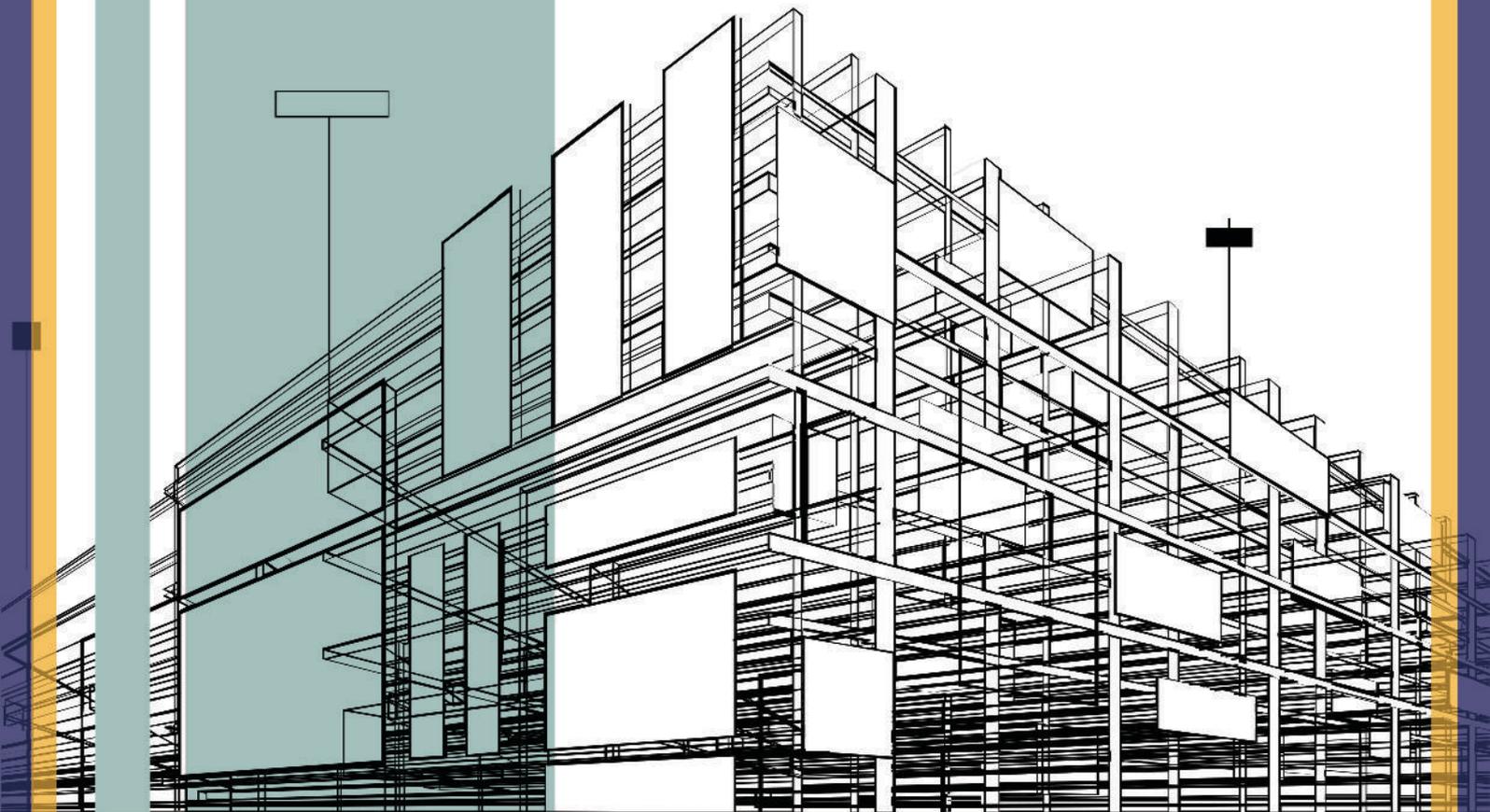


CIVIL ENGINEERING

THE APPLICATION OF STEEL FRAMING SYSTEMS

IN STUDENT PRACTICAL ACTIVITY

ERITA MAZWIN MAZLAN



CIVIL ENGINEERING

THE APPLICATION OF STEEL FRAMING SYSTEMS

IN STUDENT PRACTICAL ACTIVITY

ERITA MAZWIN MAZLAN

Second Edition 2024

©Politeknik Merlimau, 2024

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanic methods, without the prior written permission of the writer, except in the case of brief quotations embodied in reviews and certain other non-commercial uses.

ERITA MAZWIN MAZLAN

Published by:

Politeknik Merlimau, Melaka

Kementerian Pendidikan Tinggi

77300 Merlimau Melaka

Tel : 06 - 2636687

Fax : 06 - 2636678

Website : www.pmm.mypolycc.edu.my

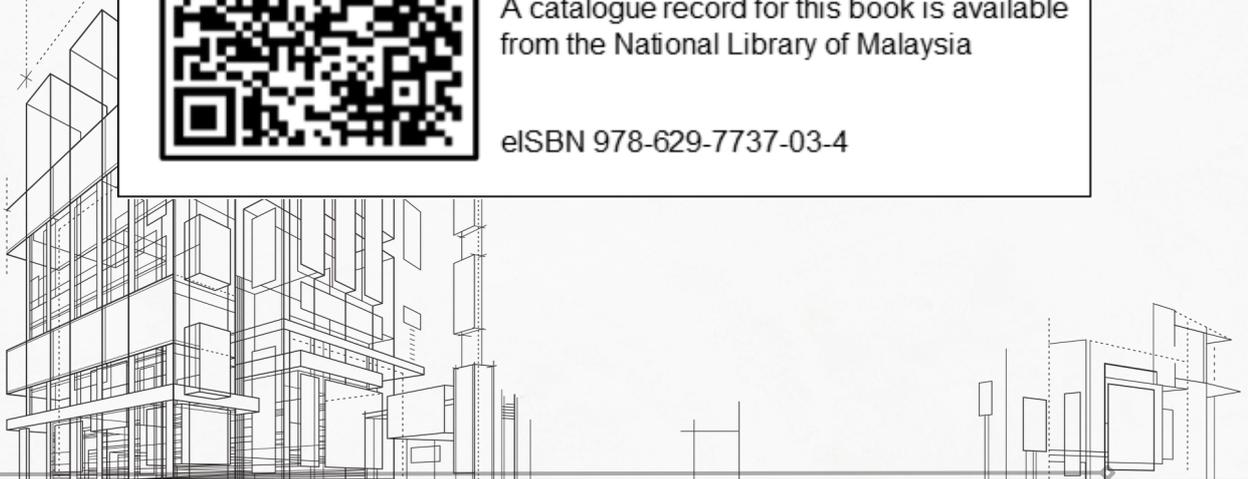


Cataloguing-in-Publication Data

Perpustakaan Negara Malaysia

A catalogue record for this book is available
from the National Library of Malaysia

eISBN 978-629-7737-03-4



EDITORIAL BOARD

MANAGING EDITOR :

Zuraida binti Yaacob
Nurul Aqilah binti Johar
Mazlinda binti Ithnin

EDITOR :

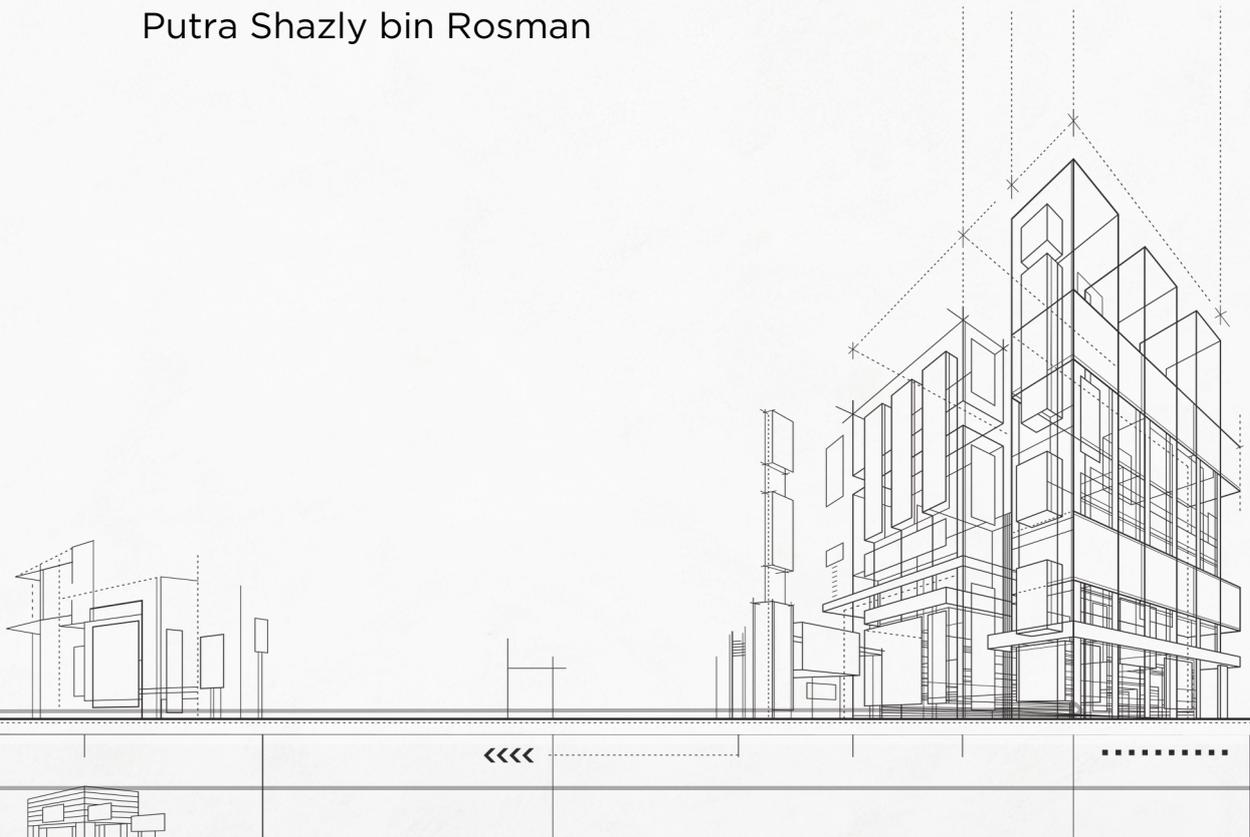
Azah binti Abas

DESIGNER :

Siti Zulaikha binti Nur Anbiah

PROOFREADING & LANGUAGE :

Putra Shazly bin Rosman



ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the
Most
Merciful.

Much appreciation to Politeknik Merlimau,
Jabatan Pengajian Politeknik dan Kolej Komuniti
(JPPKK)

who is offering an electronic book platform so that
authors can get creative with academic writing.

Thanks are also addressed to colleagues and
family members who gave their thoughts,
feedback, and recommendations for preparing this
e-book. The creation of this e-book is intended to
serve as the foundation for future IBS practical
themes. The created ebook is expected to benefit
instructors' instruction and students' education.

Thank you.



PREFACE

The book is specially written for students taking IBS subjects. It contains comprehensive notes with practical guidance for students to deepen their knowledge and understanding of the subject. IBS concepts and types of IBS are presented clearly in simple English for easy understanding. One of the IBS components is used in a chapter's practical work to give students quick experience and reinforcement for the abilities they have learned. Students can follow the practical instructions with the assistance of diagrams. Besides, the last chapter also provided a quiz with answers. It is hoped that IBS will be a fascinating subject that will always develop good mankind.



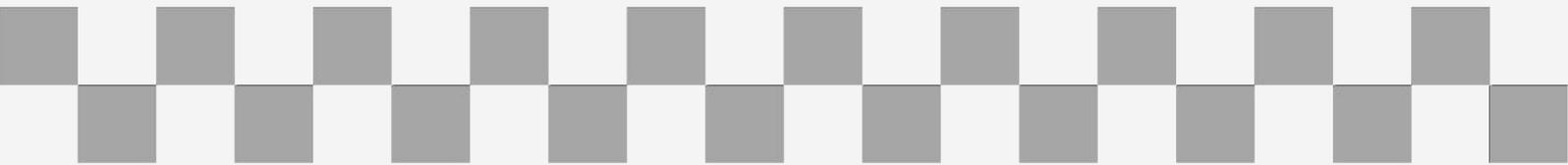


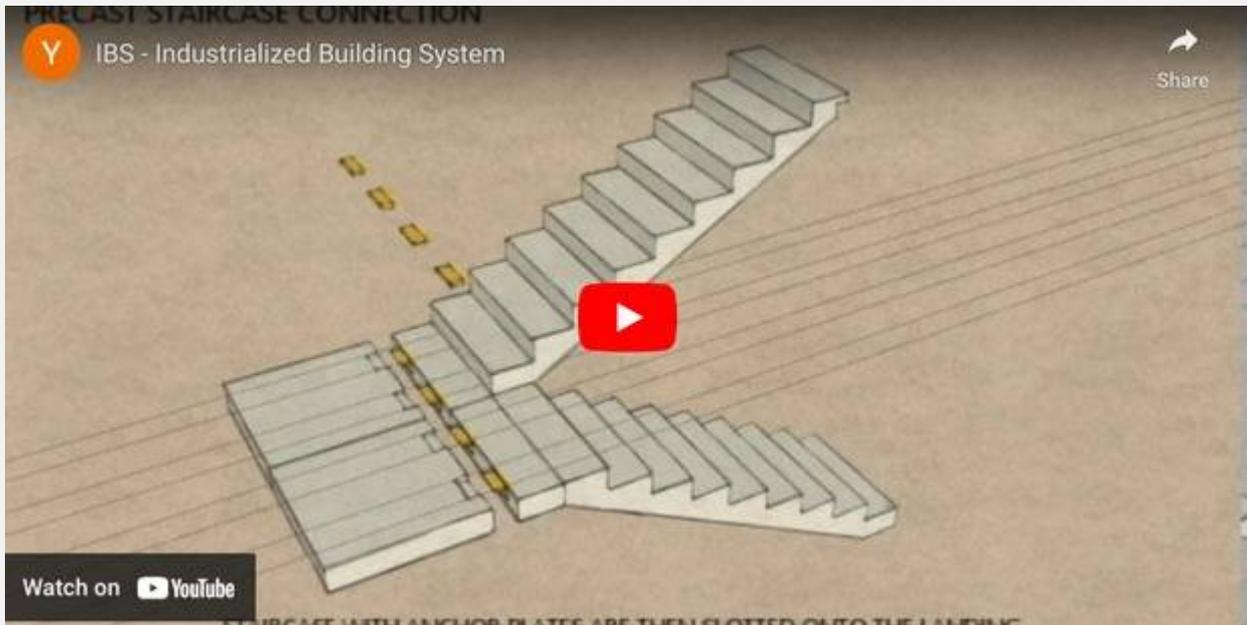
TABLE OF CONTENTS

Introduction to sustainable construction	01
Types of IBS	04
Advantages of each type of IBS	11
Component of roof truss	15
Apparatus / materials	19
Fabricated steel structures – practical work	22
Let's test your mind	27
References	32



1

INTRODUCTION TO SUSTAINABLE CONSTRUCTION



WHAT IS INDUSTRIALISED BUILDING SYSTEM (IBS)?

The term "Industrialized Building System" (IBS) refers to a process that uses industrialized manufacturing, transportation, assembly, and on-site erection to thoroughly integrate subsystems, parts, and components into a single overall system.

The Industrialized Building System (IBS), a more methodical and automated approach, is replacing traditional techniques in Malaysia's building sector. Every state in Malaysia is presently looking at the IBS's advancements and how they could be able to address the nation's housing problem.

The IBS was started in Malaysia in the 1960s after the Ministry of Housing and Local Government visited various European towns to evaluate their plans for housing construction. Following a triumphant tour conducted in 1964, the Malaysian government initiated a project to evaluate the effectiveness of the IBS.

This is done in order to assess its potential as a system that may be used in place of the traditional system, which was already well-established in Malaysia. The primary goals that need to be achieved are the major improvement in affordable housing quality as well as its acceleration in Malaysia. The IBS turned out to be successful as it was effective in quickening the building process as well.

This kind of construction is done using an industrial process whereby building components are created, delivered to the construction site, and then assembled in accordance with the blueprints. It occasionally incorporates relevant software, which is necessary to provide settings that are favorable to industrial progress.

The conventional way refers to integrating the adoption of IBS components with traditional in-situ methods, as per existing industrial practice. While some building components may not be entirely conventionally produced, it frequently entails the use of a formwork system and/or other IBS components at a reduced percentage in conjunction with conventional construction methods for other portions of the structure. To put it succinctly, it is a combination of traditional and IBS technology, but with a lower proportion of the latter.



2

TYPES OF IBS



Please scan me to know the types of IBS

TYPES OF IBS

● PRECAST CONCRETE SYSTEM ●



DEFINITION

Precast concrete component that is transported to the site, put together where it is needed, and left in its reusable mould to cure in a controlled environment.

This strategy involves the manufacture of building components along with their mechanical erection and integration into the intended building structure.

Precast concrete can be made in any size or shape as long as it complies with the statics laws, the materials' strength and stiffness, formwork limitations, handling, shipping, and erection requirements.

EXAMPLE

Beam, column, half slab, hollow core slab, prestressed planks, staircase, wall and 3D components such as balconies, staircases and toilets.

TYPES OF IBS



• FABRICATED STEEL STRUCTURE •



DEFINITION

An organization's floors, roof, and walls are supported by a steel framing system, which is made up of a rectangular grid of steel columns and beams that are fixed to the frame.

frequently employed for residential, commercial, industrial, and high-rise structures.

Its key feature is the ability to move enormous loads across wide spans. It can also carry the loads through their beams and girders to columns and the ground.

EXAMPLE

Steel beams, columns, portal frames, roof truss.

TYPES OF IBS



● PREFABRICATED TIMBER STRUCTURE ●



DEFINITION

The Prefabricated Timber Framing System is a structural method that uses strong, squared-off timbers that are expertly fitted and linked, with the joints held in place by huge wooden pegs.

It can be referred to as half-timbered if the load-bearing timber structural frame is left visible on the outside of the building. Often, the infill between the timbers is employed for ornamental effect.

Mechanical joints with internal connection plates and bolts or fasteners are more useful for bigger spans because they can offer better fire protection and increased load resistance.

EXAMPLE

Timber frames, prefabricated timber roof trusses post-and beam construction

TYPES OF IBS



BLOCKWORK SYSTEM



DEFINITION

The blockwork system is a progression from traditional brick usage. Concrete or concrete brick construction is known as a blockwork system.

Their hollow cores, which also boost their insulating capacity, are part of the block structure that makes them lighter and simpler to work with.

Block work techniques bind bricks without the use of mortar, their use differs from that of traditional bricks.

EXAMPLE

Interlocking concrete masonry, lightweight concrete blocks.

TYPES OF IBS



FORMWORK SYSTEM



DEFINITION

Formwork is a temporary structure used to hold and support freshly mixed concrete until it is strong enough to support itself



IBS formwork is separated into two categories: Table Form and Tunnel Form.

IBS formwork appears to be a solution to the issue of lowering the usage of traditional formwork, which is notorious for requiring more site work and severe waste in terms of time, money, and safety.



EXAMPLE



Lightweight prefabricated formwork composed of steel, fiberglass, or aluminum is used in cast in-situ building systems.

TYPES OF IBS



INNOVATIVE SYSTEM

DEFINITION

An innovative system is a system that blends different materials and components.

This combination makes it possible to build bigger, taller buildings by allowing specifiers and architects to take advantage of the unique qualities and strengths of various materials.

One of the mostly used IBS innovative for IBS components is the polystyrene and concrete combination

EXAMPLE

Lightweight sandwich panels, lightweight concrete panels, permanent formwork and composite plant-based products.

3

ADVANTAGES OF EACH TYPES OF IBS

ADVANTAGES OF EACH TYPES OF IBS

PRECAST CONCRETE SYSTEM

- 01 The precast components are made with steel or fibreglass moulds using premium concrete and strong, long-lasting steel, allowing for extensive, cost-effective reuse.
- 02 Easy pre-tensioning of structural concrete elements during precast production.
- 03 Prefabrication is inexpensive, lightweight, and has the ability to insulate against heat.

FABRICATED STEEL STRUCTURE

- 01 Components made of structural steel are stronger and lighter. A weight-bearing steel construction weighs 30% to 50% less than a wooden one.
- 02 Steel frame buildings are so resistant to fire, that they lower the danger of fire in a building and slow its spread if it does occur. This characteristic of structural steel is increased by certain flame-retardant coatings.
- 03 Fast erection times enables other trades to start working sooner in the construction schedule.

ADVANTAGES OF EACH TYPES OF IBS

PREFABRICATED TIMBER STRUCTURE

- 01 The wall's timber frame section can be equipped with insulation. When a pre-insulated factory frame is delivered to the site, it is already compliant with the specification.
- 02 It is very well-liked and widely used since it offers appealing designs and excellent aesthetic qualities for resort chalets, making a significant contribution to the travel and tourism sector.
- 03 Weather-independent; construction can begin at any time without being delayed by it.

BLOCKWORK SYSTEM

- 01 Block system has hollow cores that boost their insulating ability, it is lighter and simpler to work with.
- 02 Allows the installation to be simple and don't require a lot of equipment or labour. It has a high tolerance level and is readily manageable.
- 03 The primary method of installation is to employ interlocking or intersecting blocks, which is simpler to do when done correctly rather than using regular bricks.

ADVANTAGES OF EACH TYPES OF IBS

FORMWORK SYSTEM

- 01 This technique works well for huge quantities of housing units where formwork needs to be used repeatedly. There won't be much waste if the formwork is reused often.
- 02 Its benefits over conventional construction methods include less expensive construction, quick construction, low maintenance, long-lasting structures, and low skill requirements.

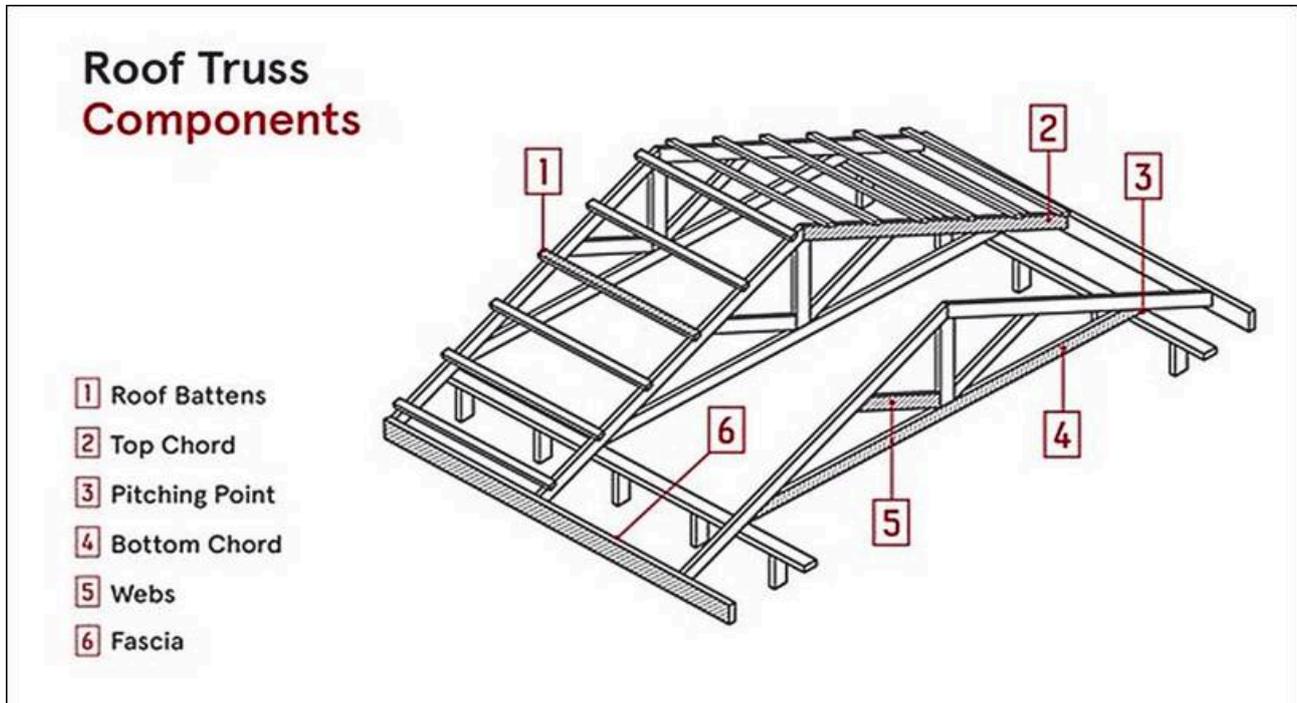
INNOVATIVE SYSTEM

- 01 One crucial aspect of creative system design for building development is its ability to be easily adapted to any configuration.
- 02 Durability and assistance of various architectural styles are employed in buildings, regardless of the structural's structure.
- 03 For landed and low-rise buildings, new technologies can be employed as flooring, external walls, and internal partitioning.

4

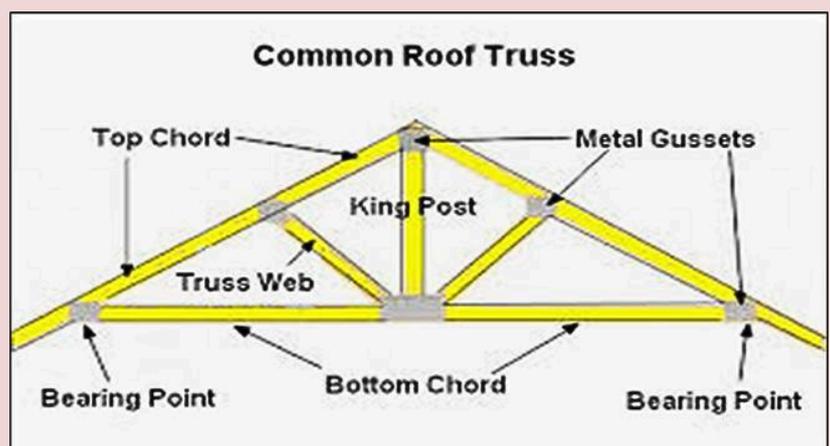
COMPONENT OF COMMON ROOF TRUSS

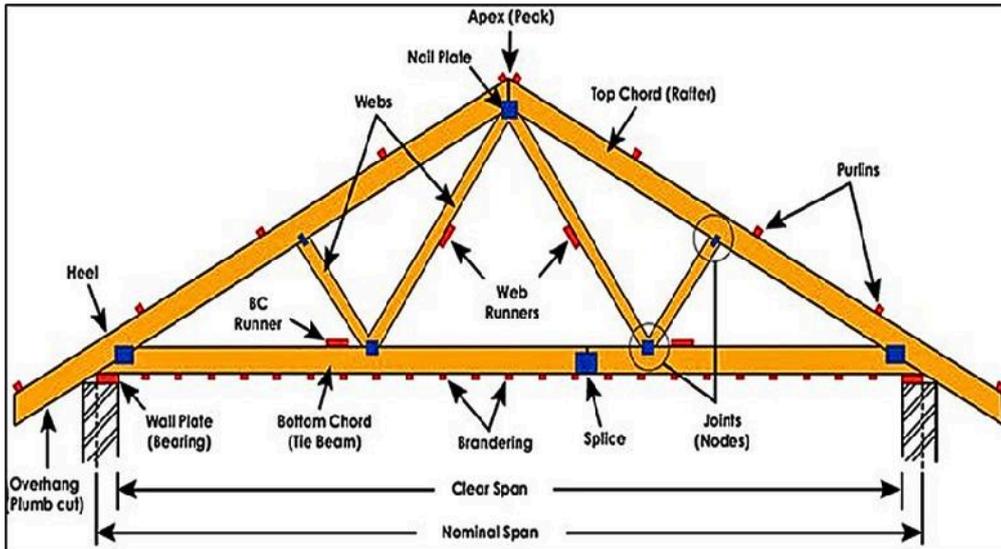
INTRODUCTION



A truss is a construction made up of only two force components that are arranged in such a way that the entire assembly acts as if it were a single item. A "two-force member" is a structural component that only applies force to two places

C-shaped galvanized steel is used to make trusses. Rather than weight, each member's strength derives from its geometry.

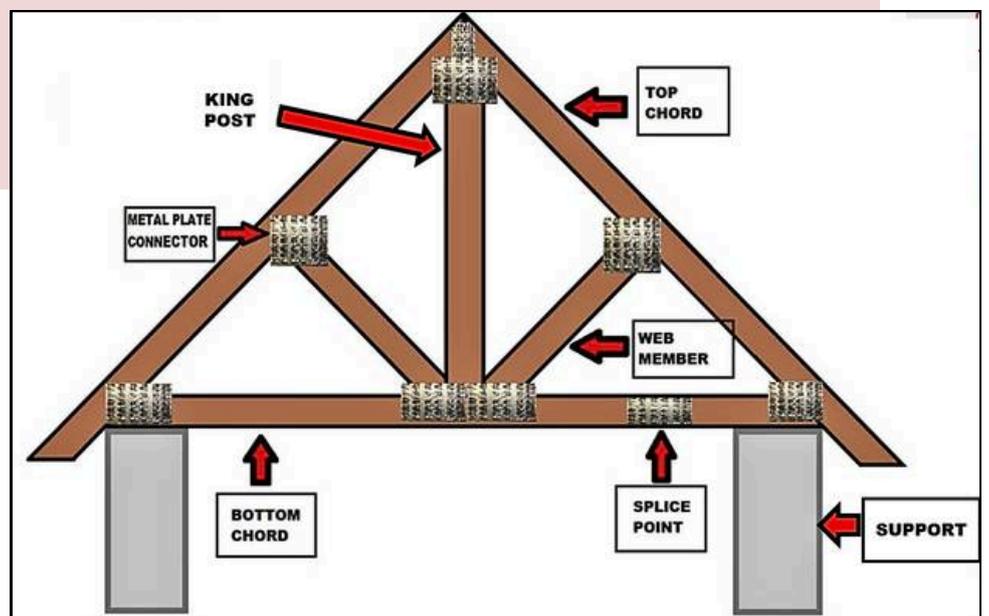




A typical truss is made up of several triangles that form a stable, difficult-to-distort geometric shape when under load.

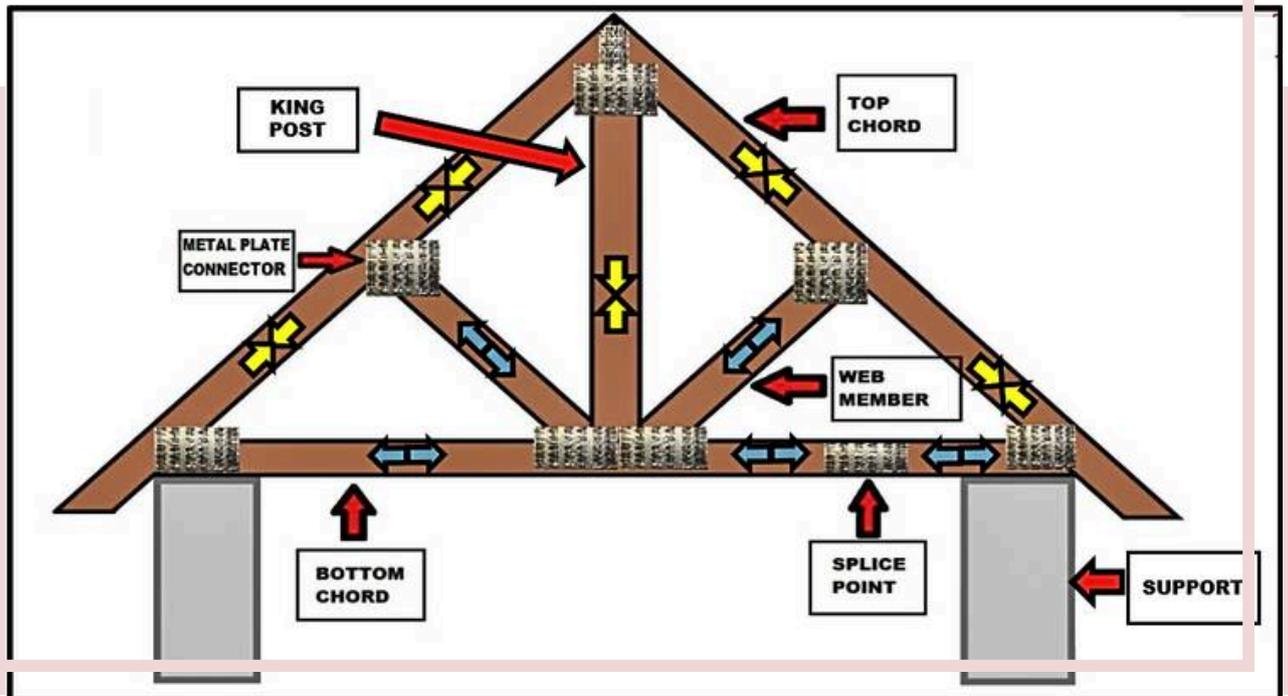
Every chord and web in a truss, regardless of the structure's total dimensions, forms a triangle.

By distributing the loads across all of the other members, these triangles create a light structure that is stronger than the sum of the strengths of its separate parts. Some of the steel roof trusses generally used are king post, bottom chord, top chord and web.





Normal roof system stresses exhibit certain parts under tension and others under compression.



The triangle shapes that make up the truss itself are what give roof trusses their strength. Triangles are hard, unyielding geometric shapes by nature.

The top chords push down at the peak and out at the heel when they are compressed. The bottom chord is normally in tension to resist outward thrust.

Smaller triangles formed by the webs provide the structure stiffness and strength. Depending on the kind of strain, there can be tension or compression loads on each individual web.



5

APPARATUS & MATERIALS

GRINDER



Used for cutting through different types of materials including metal and other solid materials such as bricks, aluminum, stone and concrete.

CIRCULAR SAW MACHINE



Designed to cut hard materials such as metal pipe and tube, concrete and masonry.

MEASURING TAPE



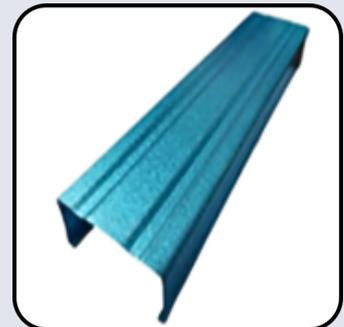
Type of hand tool typically used to measure distance or size.

CORDLESS DRILL



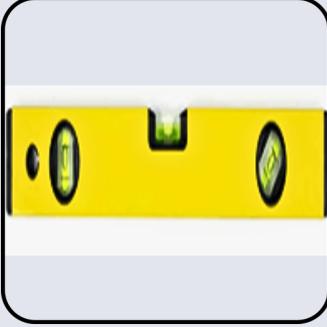
Mostly used for boring holes or fastening head framing screw to the c-channel.

C-CHANNEL



Widely used in construction as building, wall, roof, and ceiling supports.

SPIRIT LEVEL



Designed to indicate whether a surface is level, whether it is horizontal or vertical.

HEAD FRAMING SCREW



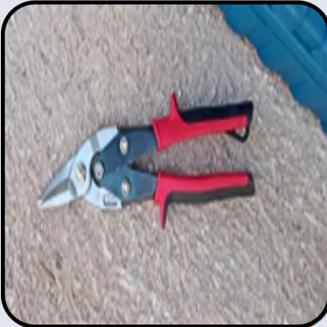
To hold things together or to lift objects.

MARKER PEN



Used for marking on c-channel.

AVIATION SNIP



Used to cut curves and irregular shapes from light gauge (16 and up) sheet metal and plastic material.

L-SHAPED RULER



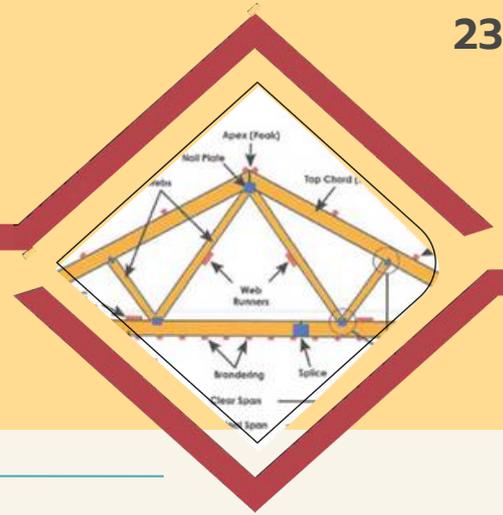
Is a two-piece ruler arranged in an L shape. The L-square is used to create scaled patterns from original sewing patterns.

6

FABRICATED STEEL STRUCTURES – PRACTICAL ACTIVITY



PROCEDURE



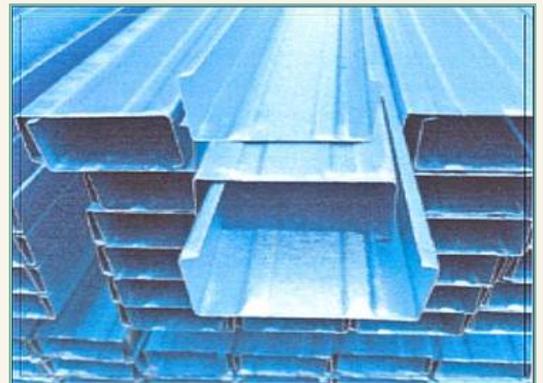
Ensure all members wear personal protective equipment (PPE) such as safety helmets, ear muffs, goggles, protection masks, safety gloves, and safety boots.

1



2

Prepare the c-channel roof frame and make sure other items are in good condition.



3



Measure and mark the c-channel according to the truss member such as Top Chord, Bottom Chord, Web and King Post following the measurement given in Table 1.

Table 1 Measurement for truss members

Truss members	Symbol	Quantity	Length (inch)
Top Chord	T1	2	74.00
Bottom Chord	B1	1	84.00
Web	W1	2	23.53
King Post	K1	1	30.00



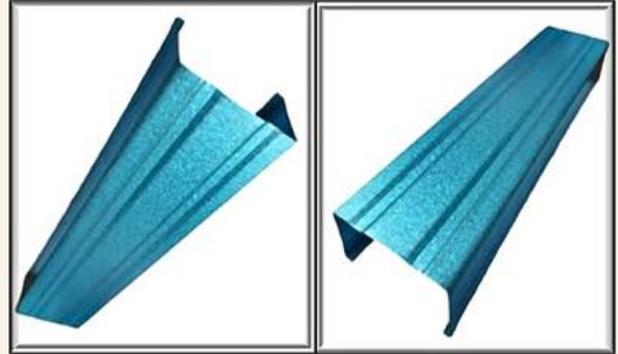
Measurements can be taken in units of mm or inches?



5

Then cut on truss members for Top Chord with a measurement of 74 inches using a circular saw machine. Then cut on truss members for Web measuring 23.53 inches. Repeat the same steps on truss members for Bottom Chord part with a measurement of 84 inches and 30 inches for King Post (refer Table 1).

4



When to start cutting, combine the c-channel with other c-channels to stop the cut channel from being thrown away.



Lock the circular saw machine first before setting the measurements for cutting.

WHY?

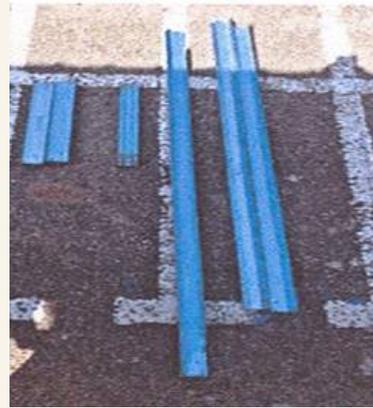


With today's circular saws, a spindle lock is standard. This will prevent your blade from spinning as you unfasten your bolt.

It's usually situated between the motor and the upper blade guard at the back of the saw. Hold the spindle lock in place after pressing it in.



After all of the truss members have been cut to size lay them down flat on the ground in the truss shape.



6

7



Start with joining the King Post with Top Chord. Height of span of the truss members must parallel in the middle of the Top Chord and Bottom Chord. In this case, the King Post's 90-degree location must be determined using the L-shape ruler.



Trim the edge of the front corner of the using aviation snip at both ends of the Top Chord and Bottom Chord to join them together.



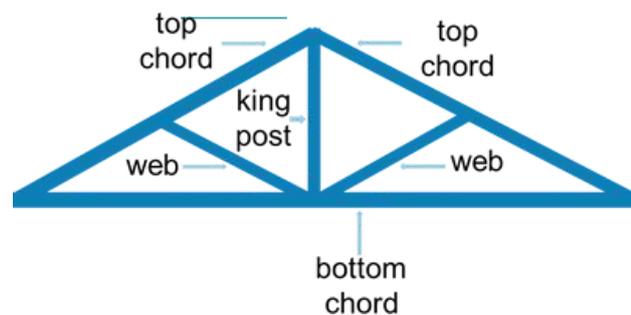
8

9

Screws on each corner of the roof using a cordless drill. Minimum 3 screw needed at each connections. Repeat the same procedure to all truss members.



The **RESULT** of the successful roof truss installation work.

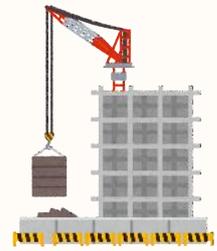


1

LET'S TEST YOUR MIND



IT IS QUIZZ TIME!



Question: Roof Framing (based on the practical roof truss installation)

QUESTION 1

To what extent does the roof truss slope?

- a 35 degrees
- b 40 degrees
- c 45 degrees

QUESTION 2

For every roof truss, how many c-channels are needed to complete it?

- a 6 rods
- b 7 rods
- c 5 rods

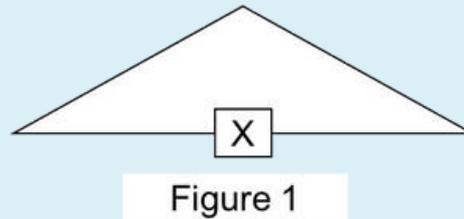
QUESTION 3

Head framing screws are used to join c-channels together. How many screws are needed at most for one connection?

- a 2 screws
- b 3 screws
- c 4 screws

QUESTION 4

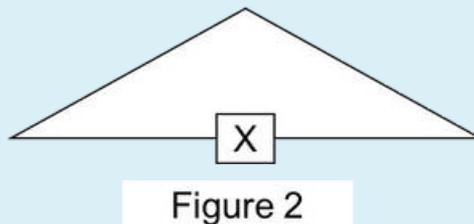
Each c-channel rod has a different surface height. Where should the height (H) position will be located on X?



- a bottom
- b top

QUESTION 5

What is the designation of the C Channel with the symbol X?



- a bottom chord
- b web
- c post

QUESTION 6

An apparatus for maintaining the king post at a 90-degree angle.

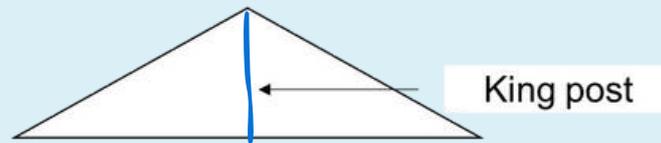


Figure 3

- a spirit level
- b ruler
- c l-shape ruler

QUESTION 7

Which of the following methods for cutting on c-channel is NOT CORRECT?

- a installing brickwork beneath c-channel
- b straightening c-channel with the use of a water level
- c combining c-channel with c-channel to make cutting easier

QUESTION 8

What are safety glasses used for?

- a to shield the eyes from sparks
- b to prevent hair from covering the eyes
- c to shield eyes from dust ingress

QUESTION 9

The c-channel we require for cutting must be on the...



Figure 4

- a left side
- b right side

QUESTION 10

The MAIN POINT to do when using a circular saw machine?

- a the switch is not activated initially
- b place c-channel at the designated location
- c adjust the c-channel to be cut

🔍 Scan this QR code to check your answer ✕



8

REFERENCES

Al-Aidrous, A. H. M., Shafiq, N., Mohammed, B. S., Al-Ashmori, Y. Y., Baarimah, A. O., & Al-Masoodi, A. H. (2021). Investigation Of The Current Innovative Industrialized Building Systems (IBS) in Malaysia. In 2021 Third International Sustainability and Resilience Conference: Climate Change (pp. 382-387)

Azharuddin Ahmed, Anup Kumar Mandal. (2020). Benefits and Challenges of Precast Construction in India – A review. SSRG International Journal of Civil Engineering. Volume 7 Issue 7, 7-10 July 2020, ISSN:2348-8352/doi:10.14445/23488352/IJCE-V7I7P102

Azman, M. N. A., Bahari, F. A., Kusumawardani, R., & Kiong, T. T. (2019). Implementation of Blockwork System in Malaysia. KnE Social Sciences, 775-786.

Baharuddin, M. N., Bahardin, N. F., Zaidi, M. A., Yusof, M. R., & Lokman, I. (2017). An Analysis Of Key Importance Factors for IBS Formwork System Among Malaysian Construction Stakeholders. Malaysian Construction Research Journal (MCRJ), 80.

CIDB. (2018). IBS Manufacturer & Product Assessment & Certification (IMPACT). Kuala Lumpur, Malaysia

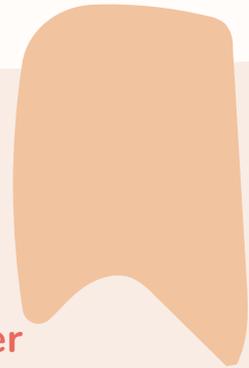
M.A.Othman Mydin, N.Md Sani, M.Taib. (2014). Industrialised Building System in Malaysia : A Review. MATEC Web of Conference. DOI:10.1051/matecconf/20141001002.

Mayouf, M., Jones, R., Ashayeri, I., & Nikologianni, A. (2022). Methods of construction to the meet housing crisis in the UK residential sector: a comparative study between timber frame and masonry construction. Buildings, 12(8), 1177.

Olupolola, A. O., Olajide, F. J., Zakariyyah, J. I. B., Ibilola, K., Sunday, S. A., & Dele, R. S. (2019). Industrialised Building System As Smart Construction Method: Its Awareness And Practice In Lagos City.



ANSWERS



1 45 degrees

6 L-shape ruler

2 6 rods

7 straightening c-channel with the use of a water level

3 3 screws

8 to shield the eyes from sparks

4 top

9 right side

5 bottom chord

10 the switch is not activated initially

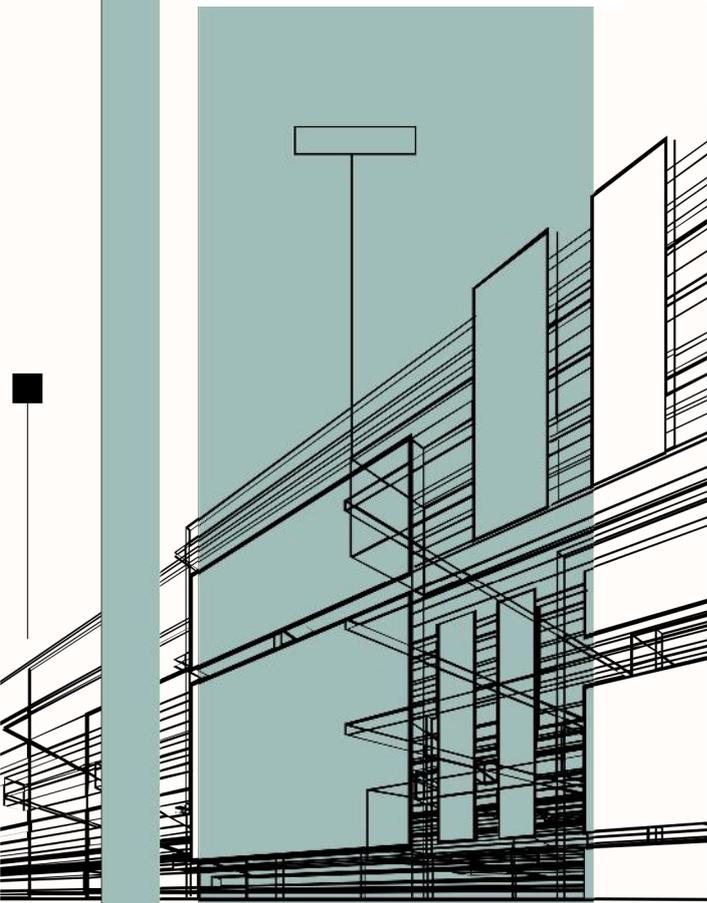
THE APPLICATION OF STEEL FRAMING SYSTEMS

IN STUDENT PRACTICAL ACTIVITY

e ISBN 978-629-7737-03-4



9 786297 737034



The book is specially written for students taking IBS subjects. IBS concepts and types of IBS are presented clearly in simple English for easy understanding. Students can follow the practical instructions with the assistance of diagrams. It is hoped that IBS will be a fascinating subject that will always develop good mankind.

ERITA MAZWIN MAZLAN