

*Understanding*  
**CONSTRUCTION  
& MATERIALS**  
WITH CONFIDENCE





UNDERSTANDING  
**CONSTRUCTION &  
MATERIALS**  
WITH CONFIDENCE

*NORUL FAZLINA / NORZALINA / NORNAWAR LAILI*

Politeknik Port Dickson



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Phone No. : 06-662 2000 / 2111  
Fax No. : 06-662 2026 / 2027  
<https://polipd.mypolycc.edu.my>

First Publication 2023  
©National Library of Malaysia, 2023

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Published by:  
Perpustakaan Negara Malaysia  
232, Jalan Tun Razak  
50572 Kuala Lumpur  
Phone: 03-2687 1700 / Fax: 03-2694 2490  
[www.pnm.gov.my](http://www.pnm.gov.my)  
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[blogpnm.gov.my](http://blogpnm.gov.my)  
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Cataloguing-in-Publication Data  
Perpustakaan Negara Malaysia

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

eISBN 978-629-7643-12-0



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## ACKNOWLEDGMENTS

Bismillahirrahmanirrahim  
Assalamualaikum w.b.t

We want to thank The Almighty Allah for His blessings throughout our journey to complete this e-book successfully.

This e-book would not have been possible without the support of many people. So, we are incredibly grateful and also like to thank our colleagues for their empathy, friendship, love, and great sense of humor.

Also, we sincerely thank our top management and students' Diploma in Architecture for their love and support in permitting us to use their cooperation.

To all readers, your support and valuable feedback will be greatly appreciated in improving our next e-book edition.

Finally, special acknowledgments are accorded to the; Politeknik Port Dickson and Jabatan Pengajian Politeknik dan Kolej Komuniti have given us a lot of helpful cooperation and support.

**Dr. Ishak bin Mohamad**  
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acknowledgments

# PREFACE

e-BOOK 2023

## *Understanding* **Construction & Materials** *with confidence*

The purpose of this e-book is to provide a clear explanation of the building materials used in the construction industry, such as timber, concrete, and masonry. In addition, this e-book shows several examples of building component drawings that use timber and concrete as building materials. Clear explanations with examples and quizzes or tutorials related to building construction and materials are included in this e-book.

Having the illustration of the drawing is hoped that students will understand better and be more explicit about the construction methods they need to learn.

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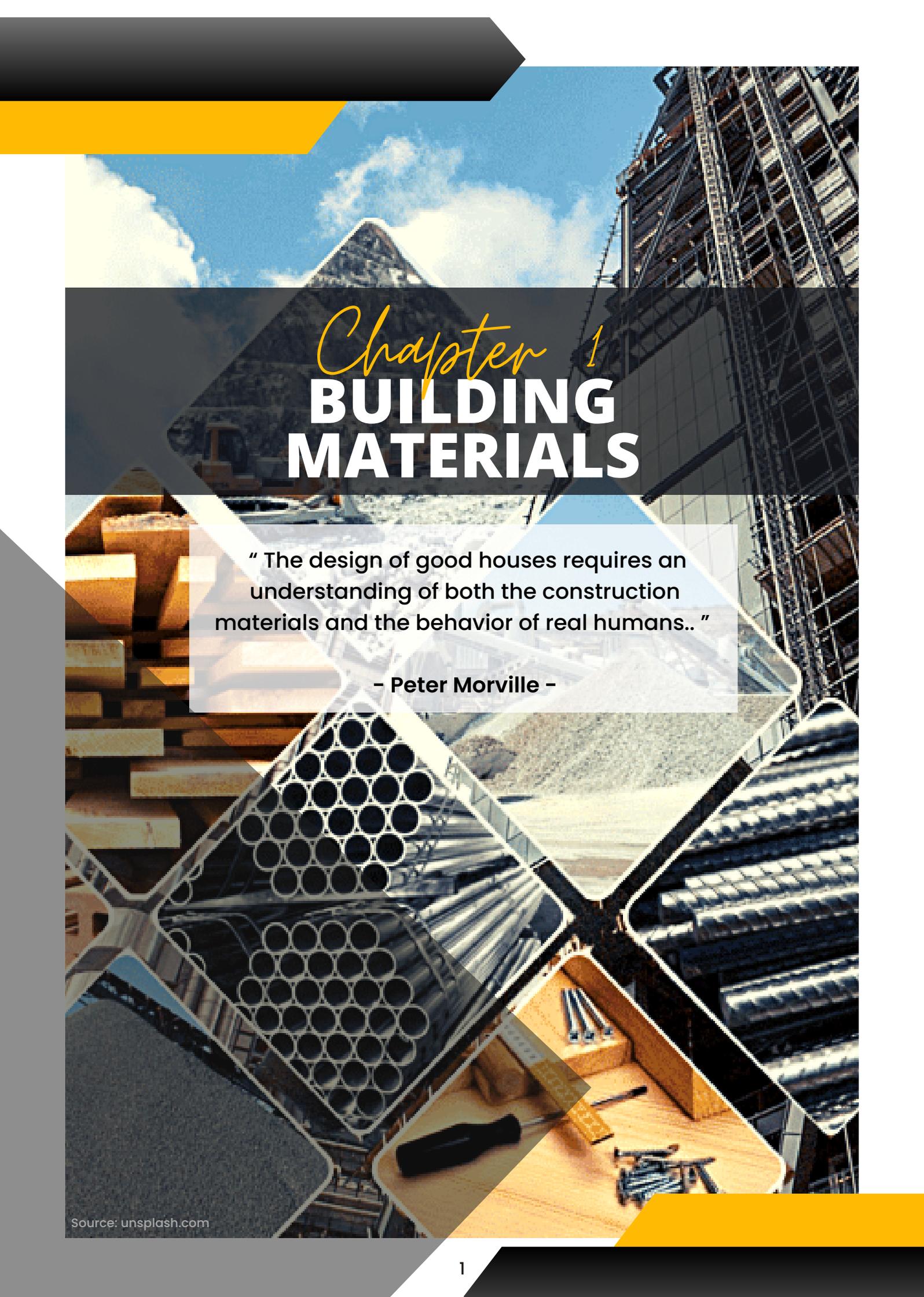


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# Chapter 1 **BUILDING MATERIALS**

“ The design of good houses requires an understanding of both the construction materials and the behavior of real humans.. ”

- Peter Morville -



# 1.1 TIMBER

## as Building Materials

### Topics

- 1.1.1 Introduction
- 1.1.2 Types of Timber for Building Construction
- 1.1.3 Advantages and Disadvantages of Timber in Building Construction

### Objectives

*Apply knowledge related to timber as building materials that comply with Malaysian Standard (MS) for a specific project.*

# TIMBER as Building Materials

## 1.1.1 Introduction

Timber is one of the longest natural resources that has been utilized in the construction industry in Malaysia. Timber has many advantages where it is suitable for building. Timber is a renewable construction material that is available worldwide and has a lower carbon footprint than materials that require a lot of fossil fuel energy to produce.

The use of timber in construction is also cost-effective and requires less time for assembly than traditional methods. Timber has a value that must be accepted and appreciated. Timber can be shaped into any intended design that is preferred by the architect, especially a façade that requires endless possibilities. About a few hundred years ago, humans already started to build 10 storeys using timber, many architectural building uses timber as a key building material in the world.



### BUILDING FACADE

The use of timber on the facade of the building will give a more exclusive appearance

*Did you know?* 

According to ITTO (2020), the Malaysian industry produced in 2018 about 18.6 million m<sup>3</sup> of logs, of which around 9% was exported in round logs, for a value of around 230 million US dollars, while the total exports of the main primary timber products accounted for a value of around 2'175 million US dollars.

The use of timber on Facade Galeri Glulam Tampoi Johor Bahru

## 1.1.2 Types of Timber for Building Construction

### Why to use timber in construction?

As professionals become more conscious about climate change, architects have adapted their designs to include wood in construction to make way for an eco-friendly future. However, wood in construction isn't a novel concept. Before the rise of steel, carpenters, and woodworkers were already using wood to bolster the structural integrity of building projects. Engineers classify wood into two distinct categories: softwood, hardwood and engineered wood.

Classification	Density Range, kgm <sup>-3</sup> (at 15% MC)
Heavy Hardwood	800-1120
Medium Hardwood	720-880
Light Hardwood	400-720

Source: MTIB (2008)

## LET WOOD BE WOOD

Malaysian Architect Azman Md Nor is a huge fan of wood. He is quietly championing this material in Malaysia.



## Types of Timber

### Hardwood

Hardwood is typically heavier than softwood, which makes it a suitable material for constructing the foundations of a building project. Contractors will use hardwood to create ceilings, walls and floors. Its strength and durability are ideal for builds that require longevity. This makes it a high-quality but costly option for sophisticated home furnishings, solid wood moldings and interior joinery.



No.	Common Names	Botanical Names
1	Balau / Selangan Batu	<i>Shorea spp</i>
2	Balau, Red/ Selangan Batu Merah	<i>Shorea spp</i>
3	Belian	<i>Eusideroxylon zwageri</i>
4	Bitis	<i>Madhuca spp. and Palaquii spp.</i>
5	Chengal	<i>Neobalanocarpus heimii</i>
6	Giam	<i>Hopea spp.</i>
7	Kekotong	<i>Cynometra spp.</i>
8	KerANJI	<i>Dialium spp.</i>
9	Malangangai	<i>Eusideroxylon malangangai</i>

## Hardwood

Hardwood can withstand heavy use and is less prone to damage, making it suitable for long-lasting applications in construction. Hardwood is typically harder and denser than softwood, which gives it greater strength and load-bearing capacity, and it is ideal for structural components in buildings. Hardwood species are naturally resistant to decay, fungi, and insect infestations, making them suitable for outdoor applications such as decking, siding, and exterior trim.

Hardwoods	
 <b>Oak</b>	Very rough, porous wood. Heavy, hard, and strong.
 <b>Maple</b>	Small pores making it smooth to the touch, wavy grain patterns, with a reddish cast.
 <b>Mahogany</b>	Look for a pinkish background color with dark lines throughout. Smooth texture with uniform pores and interlocking grain.
 <b>Cherry</b>	You will never find a uniform piece of cherry. Simple, close, but noticeable grain. Black specks, commonly found throughout.
 <b>Walnut</b>	Chocolate brown coloring with distinct contrast between rings, sapwood, and heartwood similar to pine.
 <b>Poplar</b>	Very soft hardwood, with a wooly grain. Colors range from purple, to green, to gray.

## Softwood

Carpenters use softwood to construct inner structures, such as doors, window frames and frames of hardwood. It's also a common building material to create furniture. Since softwood is much denser than hardwood, it closely adheres to the form-meets-function design principle. For example, a softwood door is durable enough to last years, yet agile enough to push and pull.



*Did you know?*

Timber is five times better than concrete as insulation. Wood works well as an insulator because of all the empty space it contains in its cells. This means that wood can retain heat

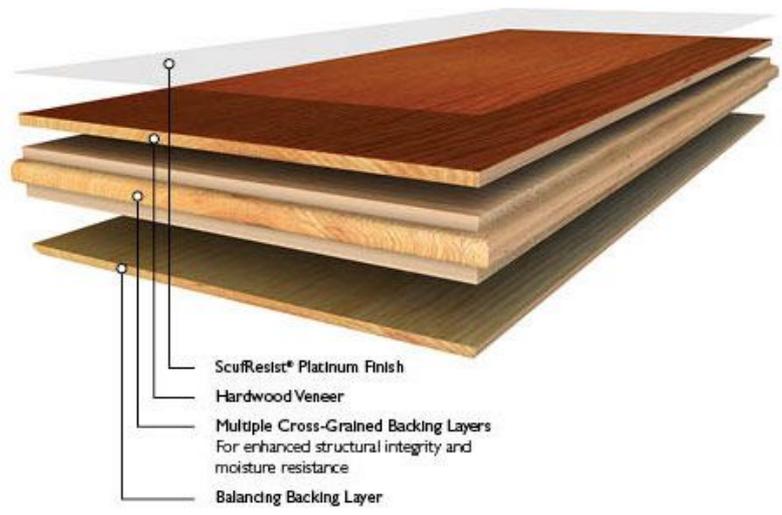
## Softwoods

 <b>Pine</b>	One of the only light colored woods with a very distinct color contrast between its' growth rings, heartwood, and sapwood.
 <b>Spruce</b>	Whiter and paler than pine, with very little contrasting parts. Heavy and stiff softwood.
 <b>Redwood</b>	Fine, even grain, with deep red color tone. Incredibly smooth compared to other woods with similar coloring. Sand before identifying.
 <b>Hemlock</b>	Uniform in coloring. Very coarse texture compared to other light colored woods. Much harder than pine.
 <b>Cedar</b>	Light, brittle, with a distinct smell. Smooth surface and reddish to yellow coloring. Will gray if left outside untreated.

# ::: Types of Timber

## Engineered Wood

Engineered wood is ideal for construction projects for its versatility, strength and relative costs. This type of wood is common in large construction projects as a part of load-bearing beams, wall coverings, sub-flooring and a variety of other types of construction projects. This type of wood is also beneficial because many types of engineered wood use the wood waste of other wood types, which can help reduce the environmental impact of harvesting wood products for residential, commercial and industrial construction projects.



	Hardwood	Softwood	Engineered wood
<b>Origin</b>	Deciduous trees that have leaves and seeds	Conifer trees that have needles and cones	Real timber, waste wood or a combination
<b>Examples</b>	Ash, Beech, Birch, Cherry, Oak, Maple, Walnut, Mahogany, Rosewood, Acacia, Teak, Bamboo, Mango, and Mindi	Cedar, fir, pine, spruce and redwood	CLT, OSB, LML, LSL, Plywood, MDF, Chipboard and Veneered Boards
<b>General Characteristics</b>	Slower growth rate and often higher density	Faster growth rate and often lower density	Large standard sized panels of varying density
<b>Uses</b>	High quality furniture, decorative woodwork, decks, flooring...	Building components, furniture, exterior cladding...	Furniture (shelves and cupboards), walls, counters...
<b>Cost</b>	Typically, higher cost	Typically, lower cost	Lower cost

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## 1.1.3

# Advantages *and* Disadvantages of Timber in Building Construction

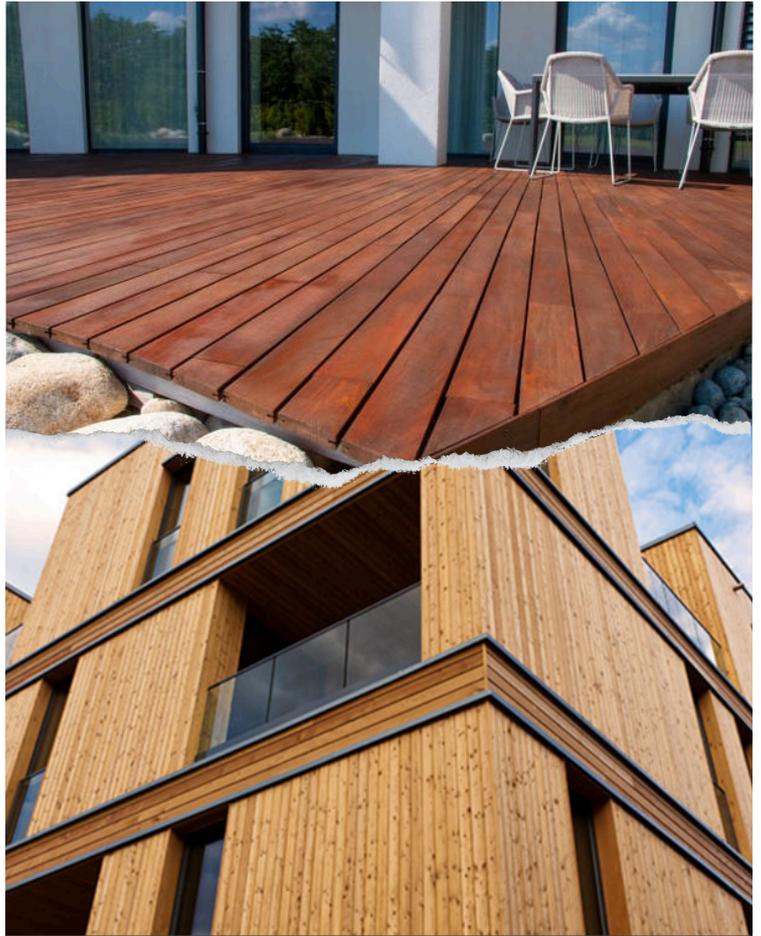
### Advantages of Timber in Building Construction

#### Versatility and Durability

As briefly mentioned above, timber is one of the most versatile materials used within the construction industry. This material can be bent into its required shape, connected to another material and much more. Many types of timber are capable of withstanding harsh weather conditions and are resistant.

#### Cost

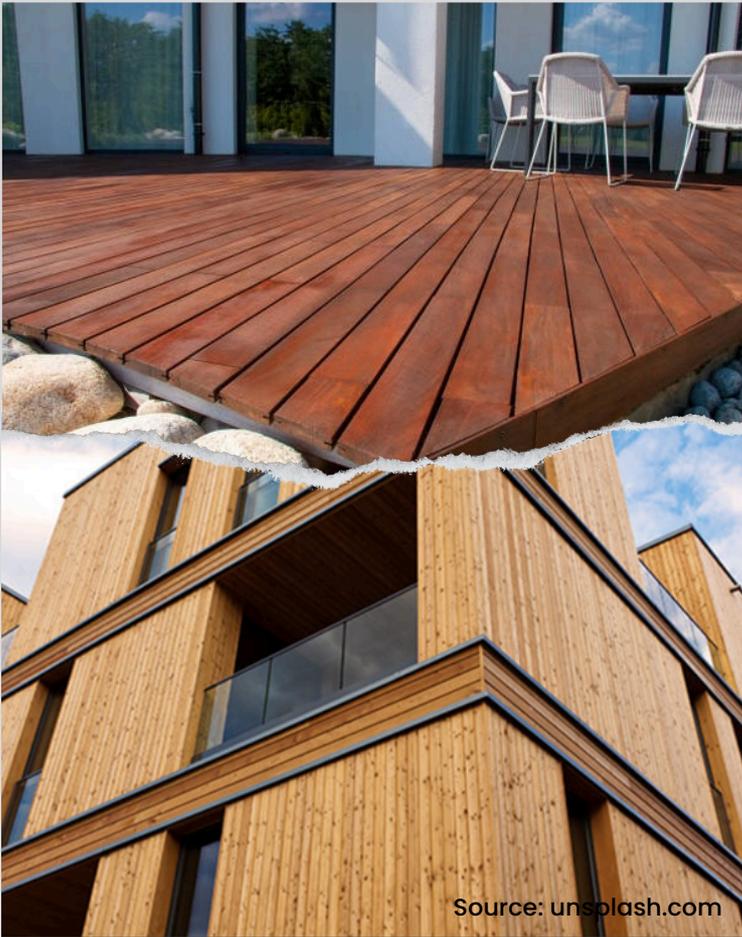
The cost will, of course, depend on the scale of the project, but timber can be cheaper than a steel-framed building or masonry building, partially due to its speed of construction. If large open plan spaces are required, however, steel framing will likely be required to ensure structural stability.



#### Insulation

Timber can be great for insulation on buildings, whether that is sound or heat. Timber tends to perform a lot better than steel or brick when used in external cladding to help keep the heat in, and this can be extremely beneficial for those looking to create a structure which is more efficient and environmentally friendly. It is also important to know that timber is a renewable resource making it incredibly eco-friendly.

# Disadvantages of Timber in Building Construction



## Shrinkage and Swelling

Timber is a natural material and may shrink or swell as it has the ability to absorb water. Timber should always be suitably treated depending on its use and exposure, and if left exposed to water rot can lead to loss of quality.

## Condensation

Condensation is a problem which can occur in any type of structure but having to deal with it can be extremely difficult. Condensation occurs when warm air from the inside touches a cold wall which has not been insulated well. If this happens to a structure which has a timber frame, it can rot the skeleton of the building.

## Fire

If by any chance a fire breaks out, a timber-framed house will not be able to withstand the heat and flames in the same way a brick or steel structure would. Although a timber-framed house can be treated with fire retardants, this tends to slow down the surface spread of flames as well as reducing the production of smoke.

Choosing the right material completely depends on your given project, but each building material has its own advantages and disadvantages, there are many different materials to choose from.

However, timber will always be widely used throughout the construction industry, as one of its biggest advantages is that it is a natural resource, making it readily available and very economically.

It is important to remember that no construction material is perfect, and that is why a number of different ones are often used for each project. Aluminium is expensive, steel is one of the most popular materials but has a relatively poor strength to weight ratio, rusts in an untreated state and can sometimes be prone to brittle fractures.

*Video Time!*

**Timber - WHAT and TYPES**  
[https://youtu.be/e4GUdSc\\_eYw?si=jiimcHKschPnLpCy](https://youtu.be/e4GUdSc_eYw?si=jiimcHKschPnLpCy)



# 1.2 CONCRETE

## as Building Materials

Concrete can be used to create stunning shapes and structures that would be unthinkable in any other material



Source: unsplash.com

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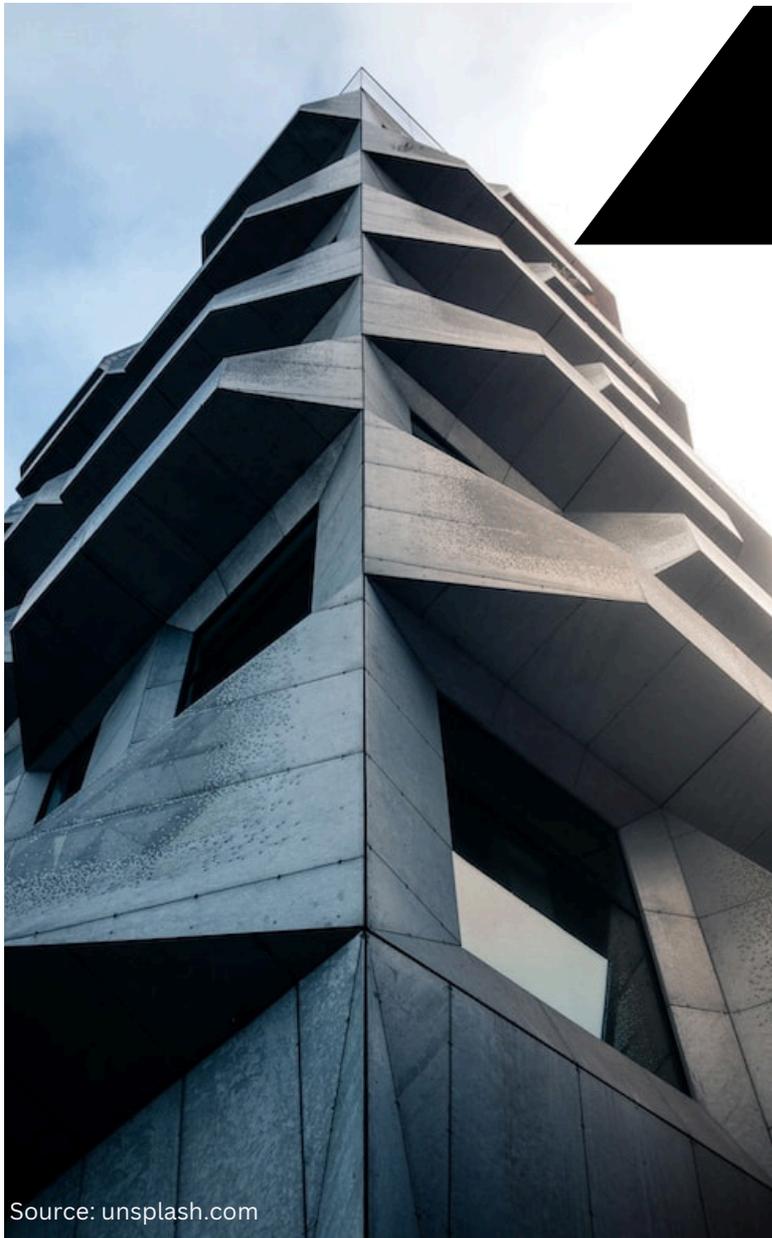
- 1.2.1 Introduction
- 1.2.2 Concrete Mixture
- 1.2.3 Types of Concrete
- 1.2.4 Advantages and Disadvantages of Concrete in Building Construction
- 1.2.5 Types of Concrete Finishes

## Objective

*Apply knowledge related to concrete as building materials that comply with Malaysian Standard (MS) for a specific project.*

# CONCRETE as Building Materials

## 1.2.1 Introduction



Source: unsplash.com

Concrete is the most widely used in construction material in the entire world such as buildings, dams, bridges, roads and others. It is a versatile material that can easily mixed to meet a variety needs and formed to any shape.

Concrete is the composite material composed of the binding medium such as the mixture of cement, water, and different fine and coarse aggregates.



Source: unsplash.com



*Did you know?*

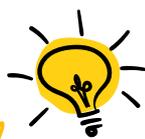
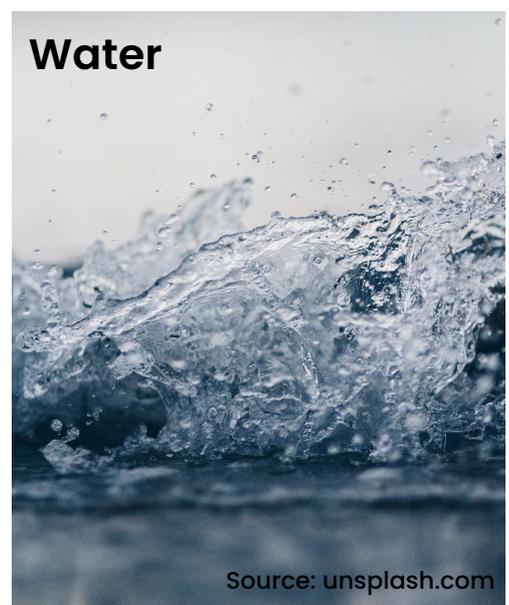
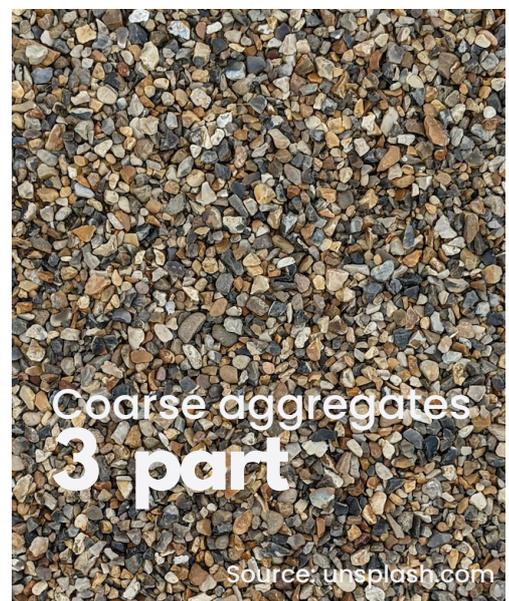
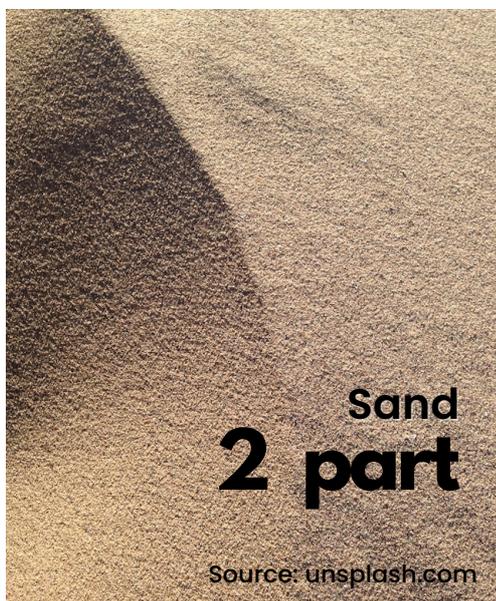
Properly cured concrete can last for decades and is essential in building durable and stable structures

Source: unsplash.com

## 1.2.2 CONCRETE MIXTURE

The concrete mix ratio is a vital factor in determining the strength, durability, and workability of the concrete mixture

The general composition of the concrete ingredients is as follows.



*Did you know?*

Aggregate assists the cement paste in holding the coarse aggregate particles in suspension. The best concrete mixing contains a mixture of variable aggregate sizes, so the particles of different size fractions will be incorporated in appropriate proportions.

# 1.2.3 TYPES of Concrete

## 4 TYPES OF CONCRETE:

- **REINFORCED  
CONCRETE**

Reinforced concrete is a **composite material** composed of **concrete and reinforcement elements**, usually steel bars or mesh, that work together to provide **enhanced strength, durability, and resistance** to various structural forces. The combination of concrete's **compressive strength** and steel's **tensile strength** creates a material capable of handling a wide range of loads and conditions. This makes reinforced concrete one of the most widely used construction materials for buildings, bridges, dams, and various other structures.



Source: housing.com



Source: designingbuildings.co.uk

- **PRE STRESSED  
CONCRETE**

Prestressed concrete is a specialized form of concrete that is designed to **withstand greater loads and stresses** by introducing internal forces through the use of **pre-tensioning** or **post-tensioning** techniques. The goal of prestressing is to counteract the tensile stresses that naturally occur in concrete structures when subjected to various loads. This technique **enhances** the overall **strength, durability** and performance of concrete structures, allowing for **longer spans, reduced material usage**, and improved **resistance to cracking and deformation**

## • PRECAST CONCRETE

Precast concrete is a construction technique where concrete is cast into a **reusable mold or form off-site**, in a controlled environment, and then transported to the construction site for installation. This method offers several advantages over traditional cast-in-place concrete, where the concrete is poured and cured on-site.

Common examples of precast concrete elements include **wall panels, beams, columns, stairs, bridge components**, and various **architectural elements**.

It's important to note that while precast concrete offers numerous benefits, it may not be suitable for all types of construction projects. The decision to use precast concrete should consider factors such as project size, complexity, transportation logistics, and the availability of skilled labor for installation.



Source: [designingbuildings.co.uk](http://designingbuildings.co.uk)



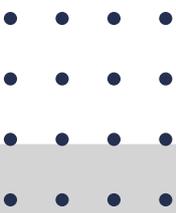
Source: [newspire.net](http://newspire.net)

## • IN-SITU CONCRETE

In-situ concrete, also known as **cast-in-place concrete** or **site-cast concrete**, refers to the process of mixing, pouring, and curing concrete directly at the construction site, where it will remain as a permanent part of the structure. This method involves **creating the concrete mixture on-site, placing it into formwork** that defines the desired shape, and allowing it to **cure and harden in place**.

In situ concrete is commonly used for various construction elements, such as foundations, **slabs, walls, columns, and beams** in buildings, as well as in infrastructure projects like bridges and roadways.

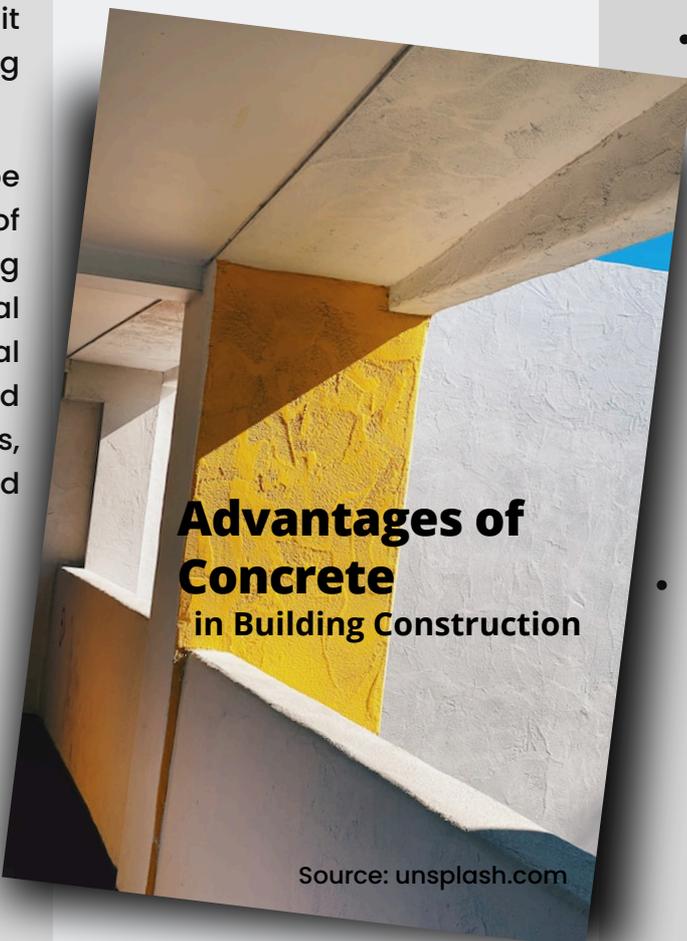
# 1.2.4 Advantages & Disadvantages of Concrete in *building construction*



- **Durability and Longevity:** Concrete is known for its high compressive strength, which makes it capable of supporting heavy loads and resisting structural stresses. It's also durable and can withstand harsh weather conditions, making it suitable for long-lasting structures.
- **Versatility:** Concrete can be cast into a wide range of shapes and sizes, allowing for diverse architectural designs and functional applications. It can be used for foundations, walls, floors, bridges, pavements, and more.
- **Fire Resistance:** Concrete has excellent fire-resistant properties due to its low thermal conductivity. It doesn't burn or release harmful gases when exposed to fire, making it a safe choice for building structures.
- **Sound Insulation:** The density of concrete contributes to effective sound insulation, reducing the transmission of noise between different spaces and providing acoustic comfort within buildings.

- **Cost-Effectiveness:** Over its lifecycle, concrete can prove cost-effective due to its durability and low maintenance requirements, offsetting higher initial construction costs.

- **Design Flexibility:** With the use of formwork and casting techniques, concrete can be shaped and textured to achieve a wide range of architectural designs and surface finish.



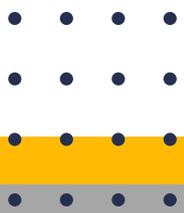
## Advantages of Concrete in Building Construction

Source: unsplash.com

- **Sustainability:** The primary ingredients of concrete (cement, aggregates and water) are often locally available. Additionally, innovations in concrete production, such as using supplementary cementitious materials, can reduce its environmental impact.

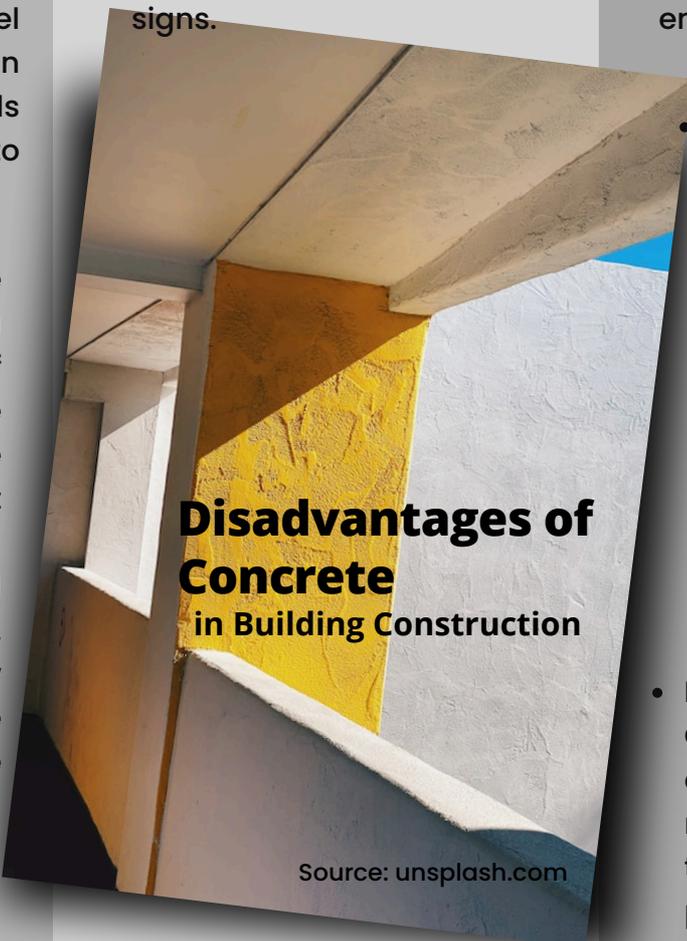
- **Thermal Mass:** Concrete's ability to absorb, store, and release heat slowly provides thermal mass. This property helps regulate indoor temperatures, reducing the need for excessive heating or cooling and contributing to energy efficiency.
- **Low Maintenance:** Well-designed and constructed concrete structures require minimal maintenance over their lifespan, reducing ongoing maintenance costs and the need for frequent repairs.

- **Ease of Construction:** Once formwork is set up, pouring and placing concrete can be relatively straightforward. Many construction professionals are familiar with concrete construction techniques, leading to efficient and consistent work.



- **Low Tensile Strength:** Concrete is strong in compression but has relatively low tensile strength. This means it can crack and fail under tensile loads, leading to structural issues. Reinforcement with materials like steel (reinforced concrete) can mitigate this, but it adds complexity and cost to construction.
- **Environmental Impact:** The production of cement, a key component of concrete, is a major source of carbon dioxide emissions. Cement production requires high-energy consumption and contributes to air pollution. Additionally, mining for raw materials used in concrete production can have negative environmental impacts.
- **Weight:** Concrete is heavy, which can lead to challenges in transportation, handling, and overall structural design. It might not be suitable for all types of buildings, especially those with specific weight limitations or requirements.

- **Brittleness:** Concrete is brittle, which means it doesn't deform much before failure. This lack of flexibility can result in sudden and catastrophic failure rather than gradual deformation or warning signs.



## Disadvantages of Concrete in Building Construction

Source: unsplash.com

- **Thermal Conductivity:** Concrete has relatively high thermal conductivity, meaning it can transfer heat readily. This can lead to temperature variations within a building if not properly insulated, affecting energy efficiency.
- **Susceptibility to Corrosion:** Reinforced concrete structures can be susceptible to corrosion if water and air infiltrate the concrete, leading to the rusting of the steel reinforcement. This can weaken the structure over time and necessitate expensive repairs.
- **Long Curing Time:** Concrete typically requires a curing period to reach its maximum strength. During this time, it needs to be protected from moisture loss and temperature fluctuations. This can delay construction schedules.
- **Formwork Costs:** Creating the molds or formwork required for pouring concrete can be expensive and time-consuming, particularly for complex shapes or designs.

# 1.2.5 TYPES OF CONCRETE FINISHES

Concrete finishes refer to the surface treatment applied to concrete structures to achieve specific aesthetic or functional qualities. There are various types of concrete finishes, each with its own appearance and characteristics. Here are some common types of concrete finishes

## Floating or Troweling



This is achieved by using a steel trowel to create a **smooth and flat surface**. It's commonly used for indoor floors and areas where a **clean and polished appearance** is desired.

## Broom Finish



After the concrete has set but is still slightly wet, a stiff-bristled broom is dragged across the surface to create a **textured pattern**. This finish provides better traction and is often used for **outdoor walkways, driveways, and pool decks**.

## Exposed Aggregate Finish



This finish **exposes the aggregates** (stones, pebbles, or decorative materials) within the concrete by washing away the top layer of cement paste. It creates a **visually interesting textured surface** and is often used for **decorative purposes**.



# TYPES OF CONCRETE FINISHES

## Stamped Concrete Finish



Stamped concrete involves pressing or stamping a pattern onto the surface of freshly poured concrete. This can mimic the appearance of various materials like brick, stone, or wood, providing a decorative look without the higher cost of those materials.

## Stained Concrete Finish



Acid or water-based stains are applied to the surface of the cured concrete to create a colored, variegated look. Stained concrete can give a unique appearance and is often used for interior floors and decorative features.

## Polished Concrete Finish



Through a process of grinding and polishing with progressively finer grits of abrasive pads, the surface of the concrete is polished to a high gloss. This finish is used to achieve a sophisticated and reflective appearance.



# TYPES OF CONCRETE FINISHES

## Salt Finish



Large rock salt crystals are embedded into the surface of the concrete, and after the concrete has cured, the salt is washed away, leaving behind small, random indentations. This finish adds texture and is often used for outdoor surfaces.

## Swirl Finish



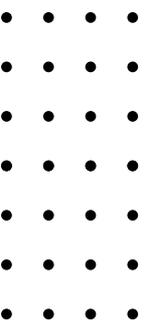
Swirl patterns are created by using a specialized trowel or float to create circular or spiral designs on the concrete surface. It's a decorative finish also used for walls, columns, and other vertical surfaces.

## Pigmented Concrete Finish



This type of decorative concrete finish involves adding color to the concrete mix before it's poured to achieve a specific desired hue. Colour options is usually limited to "earthy" browns and tans, but greens, blues, and greys are also available.





# 1.3 MASONRY

## As Building Materials

Explore the world of masonry - an ancient and timeless building technique that artfully blends beauty and durability.



Source: unsplash.com

## Topics

- 1.3.1 Definition
- 1.3.2 Brick Size
- 1.3.3 Types of Masonry
- 1.3.4 Advantages and Disadvantages of Masonry in Building Construction
- 1.3.5 Brick Closure
- 1.3.6 Types of Masonry Bond
- 1.3.7 Types of Masonry Pointing & Jointing

## Objectives

*Apply knowledge related to masonry as building materials that comply with Malaysian Standard (MS) for a specific project.*

"Architecture starts when you carefully put two bricks together. There it begins."

Ludwig Mies Van Der Rohe



Bricks

Source: unsplash.com

## 1.3.1 DEFINITION

### MASONRY AS A BUILDING MATERIAL

#### Bricks

Bricks are made of fired clay and come in various sizes with different finishes, strengths, and textures.

#### Concrete Blocks

Blocks are the most common type of masonry and are made of cement, water, and aggregates. They come in standard sizes with different finishes, colors, and strengths.

#### Stone

Historically, stone has been used in many places around the world. They come in different sizes, colors, textures, and finishes.

#### Adobe

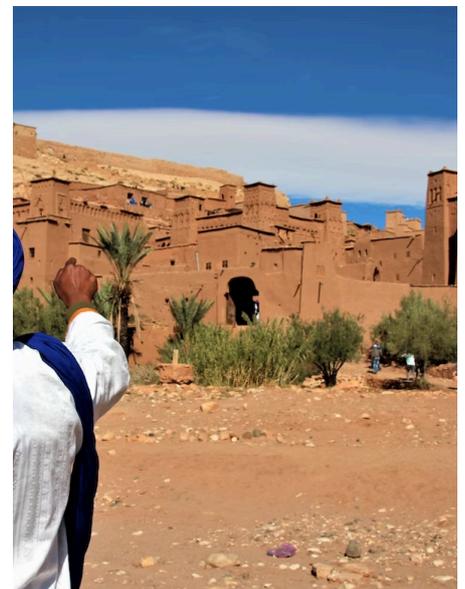
Adobe consists of sun-dried mud bricks made of clay, sand, and straw. They come in various shapes and sizes and are commonly used in hot and dry climates around the world.



Concrete Blocks



Stone

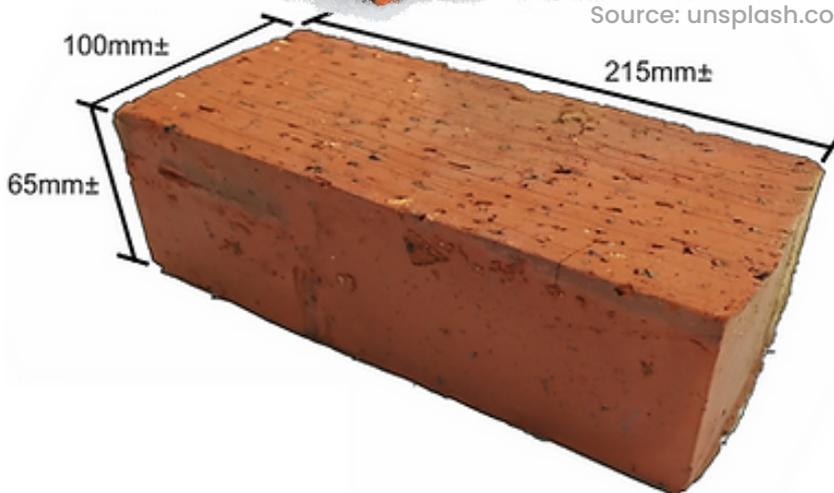


Adobe

Source: unsplash.com



Source: unsplash.com



Source: brickdotcom.com

## 1.3.2 BRICK SIZE

The most widely utilized construction materials are bricks. Bricks are made by moulding clay into rectangular blocks of uniform size, drying them, and then burning them.

In building construction, bricks come in various sizes depending on the region and specific requirements of the project. The standard dimensions of bricks can vary:

- 1. Standard Brick Size:** The standard size of a brick is often referred to as "full brick" or "common brick." It typically measures about 215 mm in length, 102.5 mm in width, and 65 mm in height.
- 2. Modular Brick Size:** Modular bricks are widely used in many countries. They are designed to facilitate construction by using consistent module sizes. A modular brick typically measures about 194 mm in length, 92 mm in width, and 57 mm in height.

**3. Engineer Brick Size:** Engineering bricks are denser and stronger than standard bricks. They are often used in applications where high load-bearing capacity or resistance to chemical attack is required. The size of an engineering brick is usually similar to a standard brick.

Additionally, there are also specialized bricks available in different sizes for specific purposes, such as capping bricks, bullnose bricks, and corner bricks, which are used for finishing and decorative purposes.



*Did you know?*

The word "masonry" comes from the Latin word "murus," which means "wall."

# 1.3.3 TYPES of Masonry

## 3 TYPES OF MASONRY:

### COMMON BRICK

Common bricks are basic and widely used building materials. They are known for their **affordability, versatility, and ease of production**. These bricks are typically **made from clay or shale** and are used for **non-decorative purposes** in construction. Common bricks have a **rectangular shape** with standard dimensions



### FACING BRICK

Facing bricks, also known as **façade bricks** or face bricks, are specifically designed for **decorative or exposed applications**. They are used **to create visually appealing** facades and walls that are meant to be seen. Facing bricks are available in a **variety of colors, textures, and finishes**, allowing architects and builders to achieve the desired aesthetic for the building. These bricks are **durable** and provide both a **decorative and protective function** to the structure.



Source: unsplash.com

### ENGINEERING BRICK

Engineering bricks are **dense, strong, and highly durable** bricks that are designed for use in situations requiring **high loads, strength, and/or resistance to chemical attack**. They are commonly used in applications where structural integrity and durability are critical, such as in the construction of **foundations, retaining walls, and areas subject to high stress or exposure** to harsh environments. Engineering bricks are **made from high-quality clay** or other materials and have superior strength and water absorption properties compared to common bricks.



Source: aathaworld.com

## 1.3.4 ADVANTAGES OF MASONRY CONSTRUCTION

- **Durability and Longevity:** Masonry structures are known for their durability and longevity. Bricks and other masonry materials have a high resistance to weathering, fire, and other external forces, making them suitable for long-lasting construction.
- **Fire and Weather Resistance:** Masonry materials, such as bricks, have excellent fire resistance properties. They do not burn or contribute to the spread of fire, providing enhanced safety in case of a fire outbreak. Additionally, masonry structures are resistant to weather conditions, including wind, rain, and extreme temperatures.
- **Energy Efficiency:** Masonry has good thermal insulation properties, which can help regulate indoor temperatures and reduce the need for excessive heating or cooling. This energy efficiency can lead to lower energy consumption and reduced utility costs over time.
- **Low Maintenance:** Masonry structures generally require minimal maintenance. Properly constructed masonry walls can withstand the test of time, reducing the need for frequent repairs or replacements.



Source: unsplash.com

# ADVANTAGES & DISADVANTAGES OF MASONRY

## DISADVANTAGES OF MASONRY CONSTRUCTION

- **Weight and Installation Complexity:** Masonry materials, especially bricks, can be heavy, which can increase the load on the foundation and structural elements of a building. The weight of masonry construction requires careful consideration during the design and construction process. Additionally, the installation of masonry materials can be complex and time-consuming, requiring skilled labor and specialized techniques.
- **Cracking and Settling:** Improper design or construction practices can lead to cracking in masonry walls over time. Factors such as settlement, thermal expansion and contraction, and moisture-related issues can contribute to the development of cracks. Proper design, material selection, and construction techniques are essential to minimize the risk of cracking.
- **Limited Design Flexibility:** Compared to some other construction materials, masonry may offer limited design flexibility. The size, shape, and weight of masonry units can limit the architectural possibilities, requiring careful planning and coordination in the design phase.
- **Cost Considerations:** Masonry construction can be relatively expensive compared to other construction methods. The cost of materials, skilled labor, and specialized equipment can contribute to higher overall project costs.



*Did you know?*

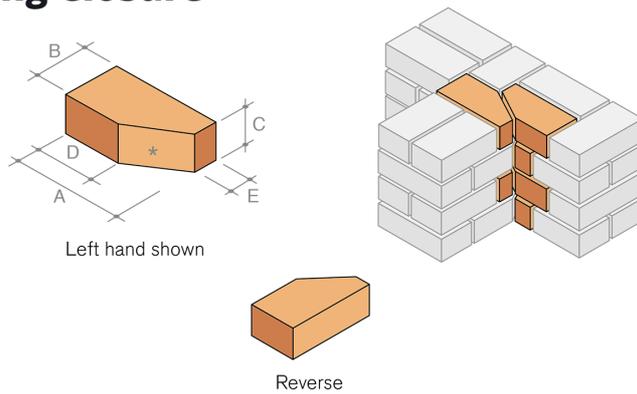
The oldest known masonry structure is the Göbekli Tepe temple complex in Turkey, which was built around 11,500 years ago.

# 1.3.5 BRICK CLOSURE

The closure is the brick is cut in such a way that one portion is kept remains with the break and used another part for closing the gap.

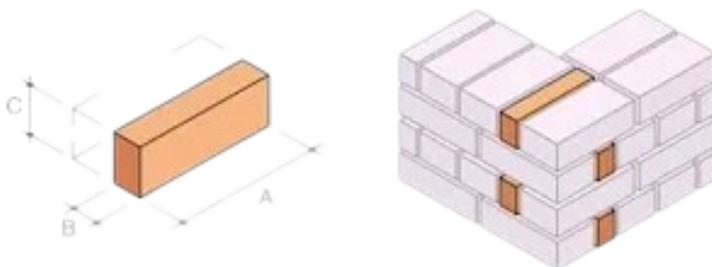
## Types of Closure;

### King Closure



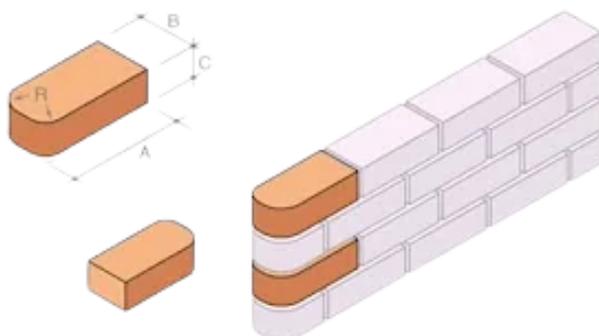
King closer is a closer bigger than a half brick, more specifically a brick with one corner cut away making the header at that end half the width of a brick.

### Queen Closure



The bricks are cut along the length for making two equal parts longitudinally called Queen closer width of Queen closer brick is half of the original brick called as half Queen closer.

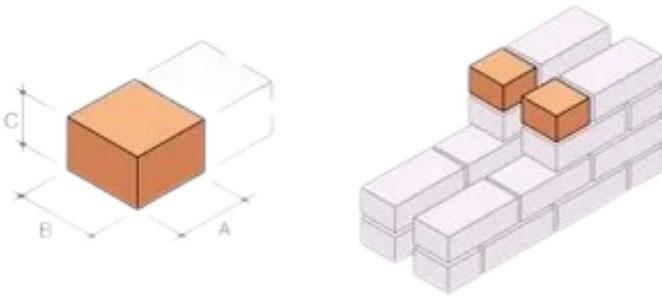
### Cow Nose Closure



Molded with a double bullnose on the end.

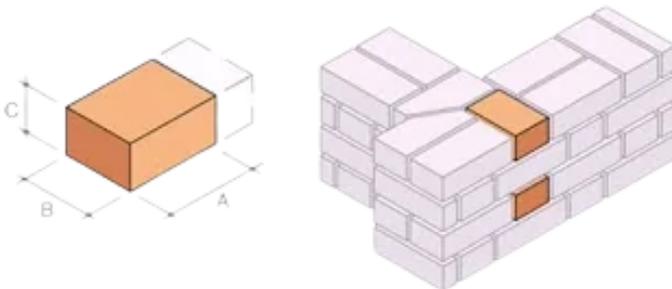
# Brick Closure

## Half Brick Bat



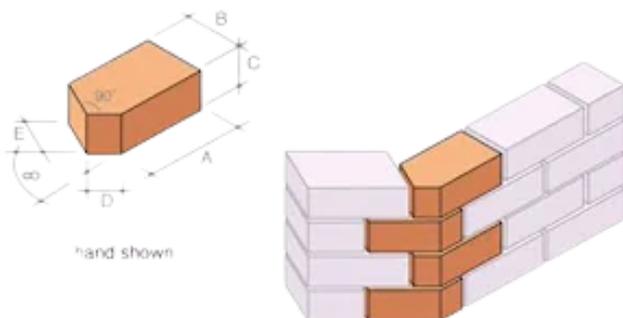
A square cut brick across the short length leaving half.

## Three Quarter Bat



A square cut brick across the short length leaving three quarters

## Squint Brick



It is also cut brick. The portion of the cut forms angles other than the right angle. Uses exterior or interior corners are to be built at some angle and also for ornamental purposes.



*Did you know?*  
The first fired bricks were made in Mesopotamia around 7,000 years ago.

# 1.3.6 TYPES OF MASONRY BOND

Masonry bond is the way that bricks are arranged in a wall to create a strong and durable structure. There are many different types of masonry bonds, each with its own strengths and weaknesses.

Some of the most common types of masonry bonds include:

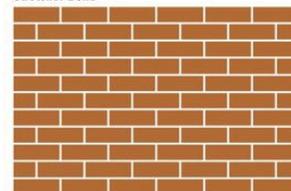
- 1) Stretcher bond
- 2) Header bond
- 3) English bond
- 4) Flemish bond
- 5) Stack bond

Other types of masonry bonds include:

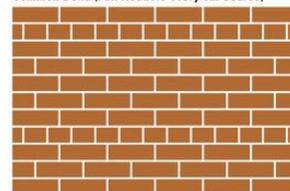
- 6) Garden wall bond
- 7) Dutch bond

The type of masonry bond that is used will depend on the strength and durability requirements of the structure. For example, a high wall or a structure that needs to be very strong will require a stronger bond, such as Flemish bond or Dutch bond. A low wall or a structure that does not need to be as strong can use a weaker bond, such as stretcher bond or header bond.

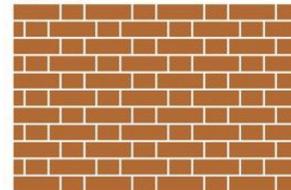
Stretcher Bond



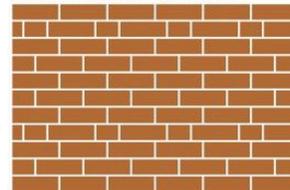
Common Bond (Full Headers every 6th Course)



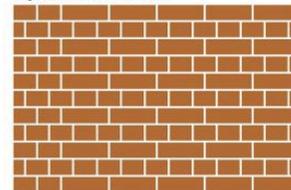
Flemish Bond



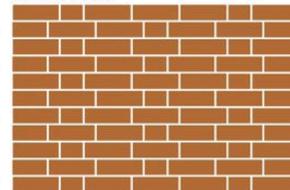
Common Bond (Flemish every 6th Course)



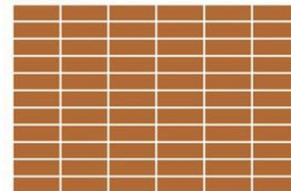
English Cross or Dutch Bond



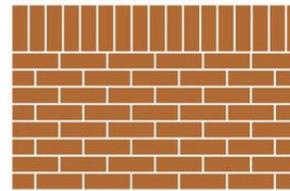
Garden Wall Bond



Stack Bond



Soldier Course (With Stretcher Bond)



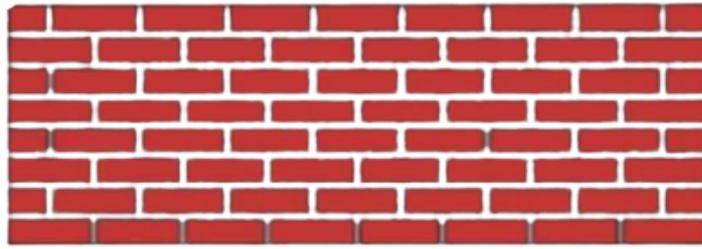
Source : Construction Visual Dictionary

*Brickwall Bond\_A bond is the pattern in which bricks are laid.*

# TYPES OF MASONRY BOND

## STRETCHER BOND

This is the simplest type of bond, and is made up of only stretchers (long sides of the brick facing outward). It is not very strong, but it is easy to build and is often used for low walls or garden walls.



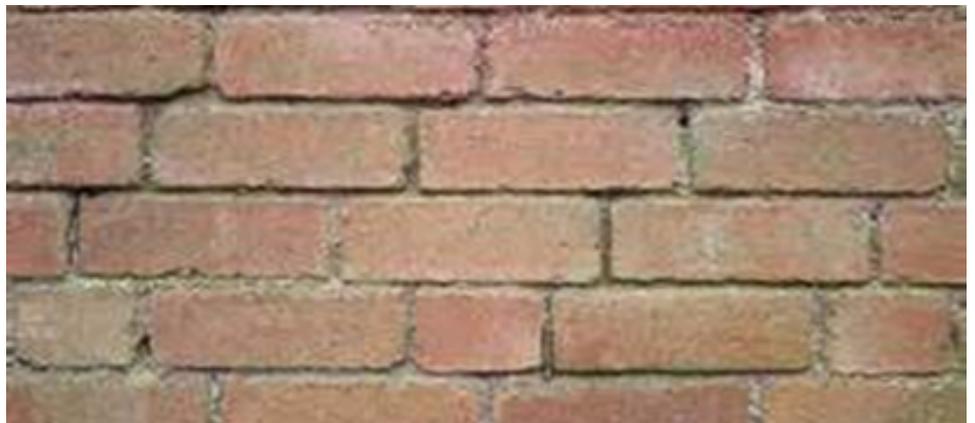
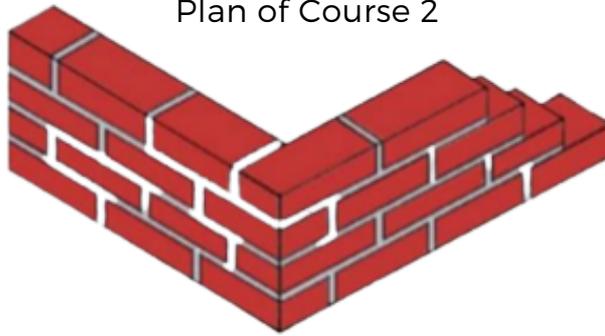
Front Elevation



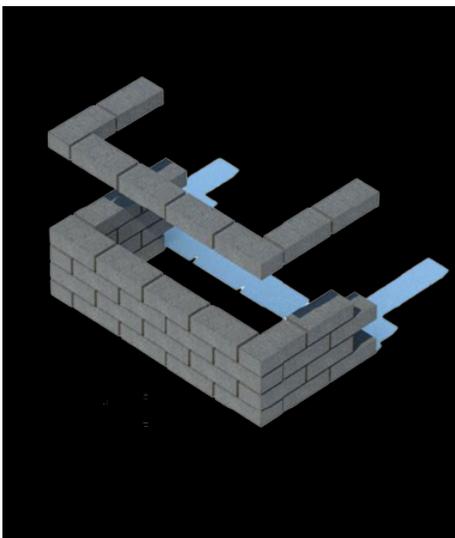
Plan of Course 1



Plan of Course 2

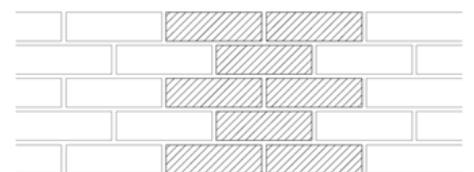


Source : unsplash.com



All stretchers are used in this approach, which is the simplest way to lay bricks. It's frequently utilised in cavity and facing tile wall constructions. Originally used for single brick walls since it needed the least amount of cutting. As a result, it is the most cost-effective bond pattern, and it is widely utilised in modern structures.

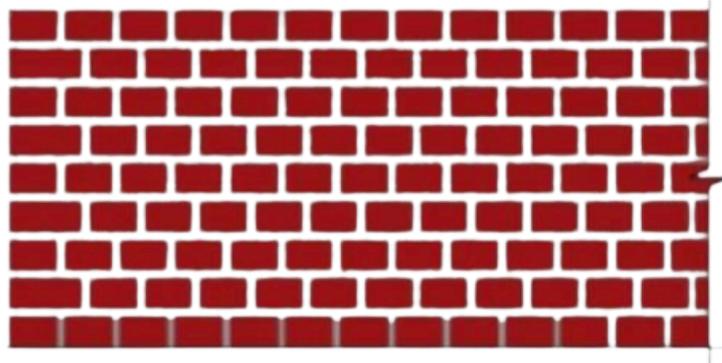
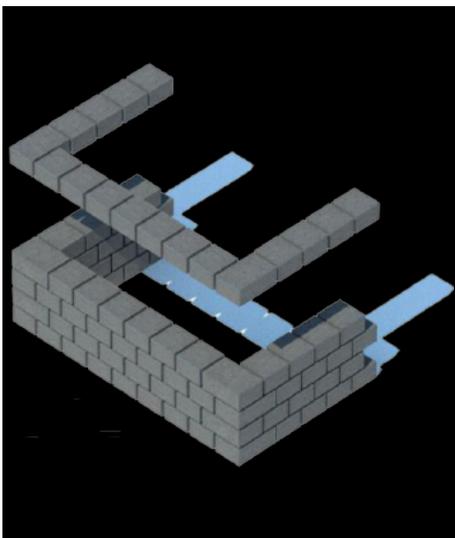
It was originally designed for single brick walls, but it quickly became the natural choice for cavity walls because it required the least amount of cutting. As a result, it is the most cost-effective bond pattern, and it is widely utilised in modern construction.



# TYPES OF MASONRY BOND

## HEADER BOND

This is made up of only headers (short sides of the brick facing outward). It is also not very strong, but it is more watertight than stretcher bond and is often used for retaining walls or other structures that need to be watertight.



Front Elevation



Plan of 1,3,5.....courses



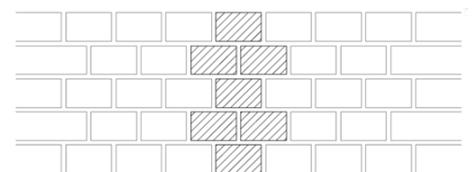
Plan of 2,4,6.....courses



Source : unsplash.com

A brick or masonry bond in which all members are vertically aligned and the head faces the outside. There is an overlapping effect. Because the width of the wall is the entire length of a brick, this method is exceptionally sturdy. It was traditionally utilized for high-end structures, and it was frequently employed for curved brickwork.

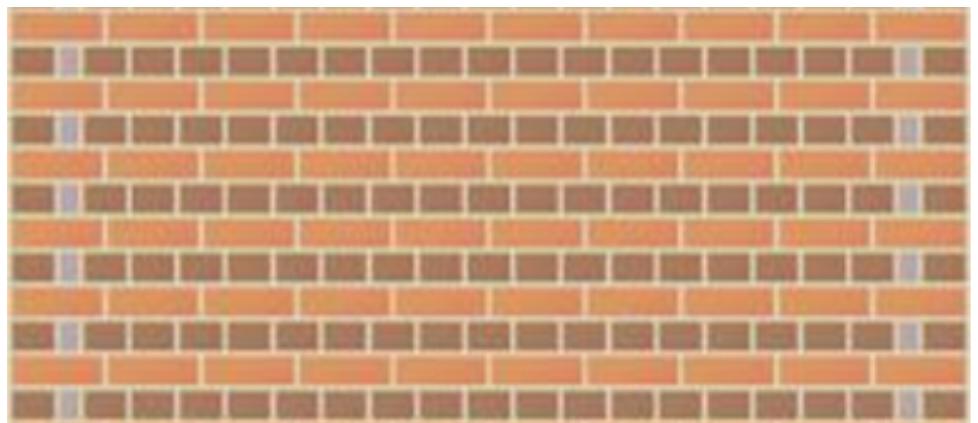
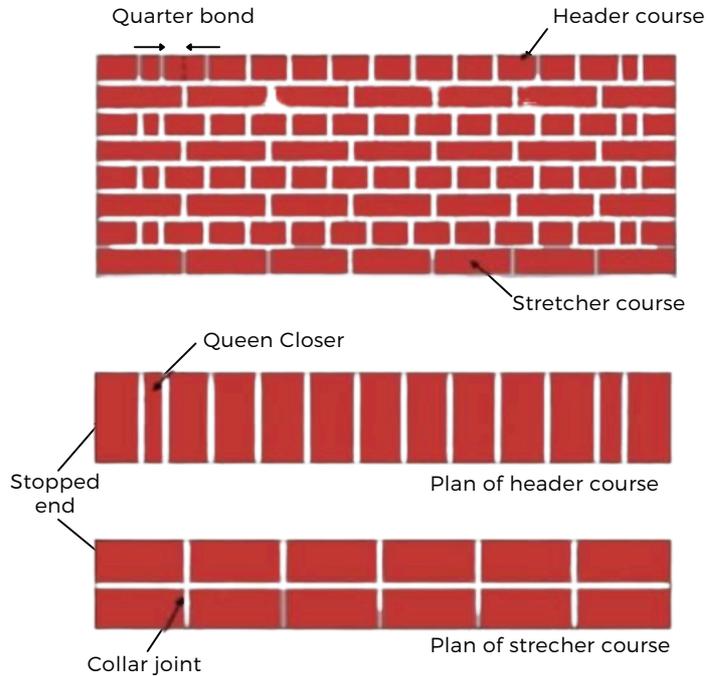
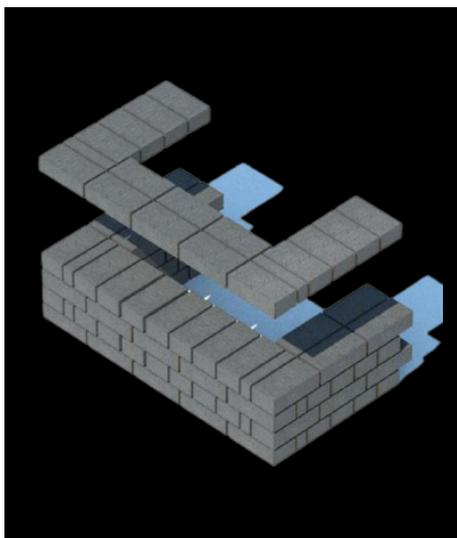
A brick course with the short end of the brick exposed, set flat. Because the width of the wall is the entire length of a brick, this method is exceptionally sturdy. It was traditionally utilized for high-end structures, and it was frequently employed for curved brickwork.



# TYPES OF MASONRY BOND

## ENGLISH BOND

This is a combination of stretchers and headers, with every other course alternating between the two. It is stronger than stretcher bond or header bond, and is a common choice for walls that need to be strong and durable.

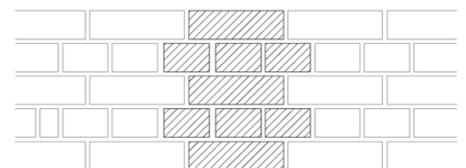


Source : unsplash.com

A brick or masonry bond in which all members are vertically aligned with the head and side facing the outside in one layer. There is an overlapping effect. The layouts are arranged in a clockwise direction.

It is made up of different courses of headers and stretchers. When the wall is one brick thick, it forms a solid link. Bridges, viaducts, embankment walls, and other civil engineering structures use this bonding pattern.

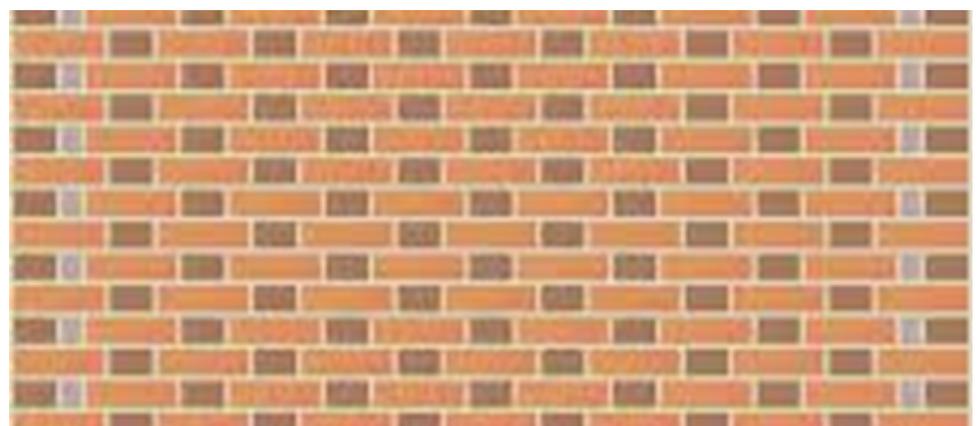
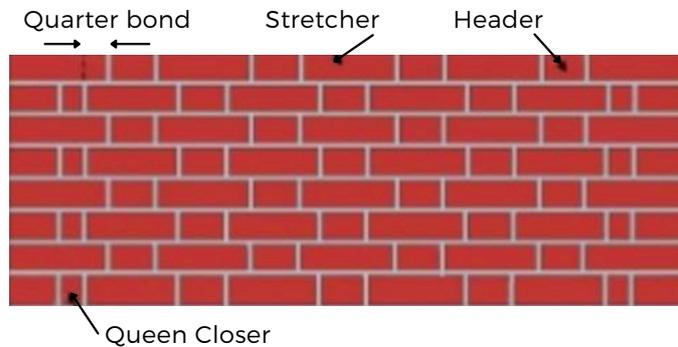
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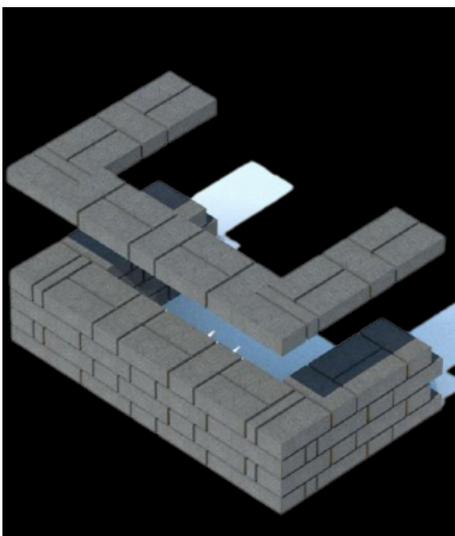
# TYPES OF MASONRY BOND

## FLEMISH BOND

This is similar to English bond, but with headers and stretchers alternating in every course. This makes it even stronger than English bond, and is a good choice for high walls or structures that need to be very strong.

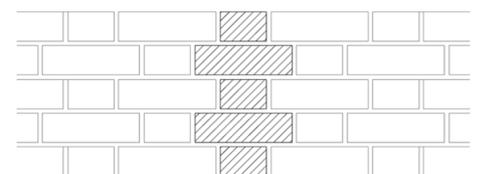


Source : unsplash.com



A brick or masonry bond in which all members are vertically aligned with the head and side facing the outside. There is an overlapping effect. The layouts are arranged in a clockwise direction. Flemish bonds can be duplicated in a cavity wall's half-brick outer leaf by utilising entire bricks as stretchers and half bricks called bats or snap-headers as headers. At one brick thick, it is not as sturdy as English bond.

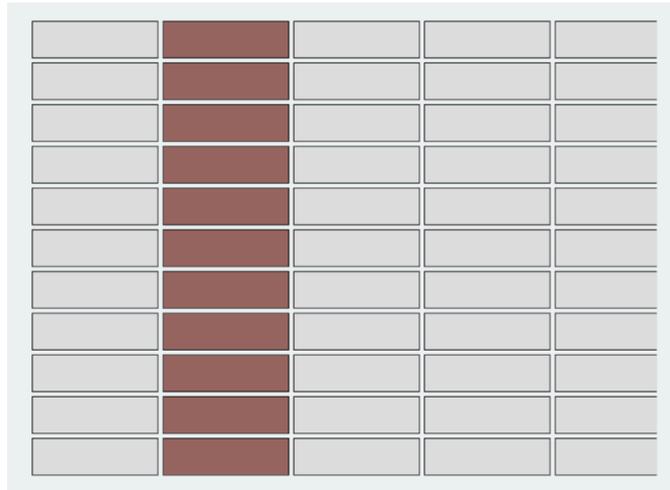
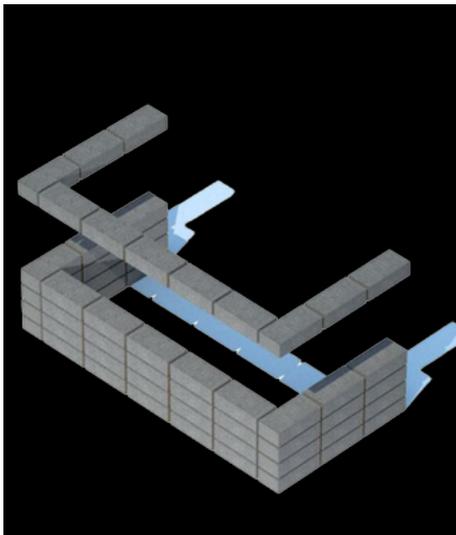
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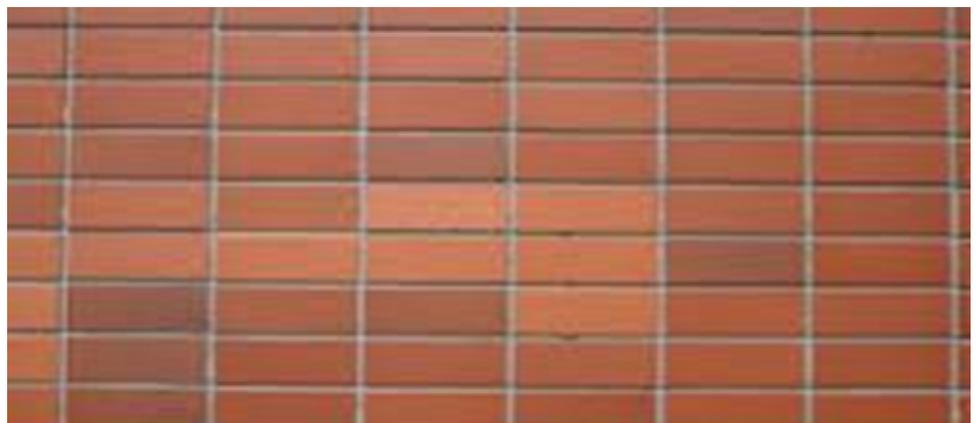
# TYPES OF MASONRY BOND

## STACK BOND

This is a type of bond where all of the bricks are laid in the same direction, with the long sides facing outward. This is the weakest type of bond, but it is also the easiest to build.



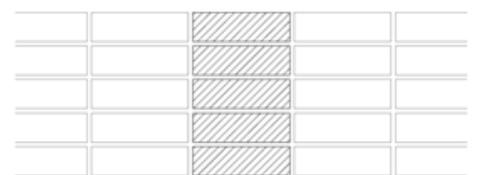
Source : archtoolbox.com



Source : unsplash.com

All members of a brick or masonry bond are vertically aligned. The arrangement is fundamentally weak because there is no staggered effect or overlapping. Stacked Bond is another name for this type of bond. This bond is only used for aesthetic purposes and for infill panels where structural strength is provided by other means. Even so, it's usually a good idea to utilize extra bed reinforcement while stack bonding.

Because the bricks in the stack bond do not overlap, the arrangement is essentially weak. Stainless steel ladder reinforcement is often placed into every third bed joint to compensate for the lack of bonding.



# 1.3.7 BRICKS

## pointing & jointing

The joint on the face of the brickwork is unevenly filled in, while the wall is being constructed. These unfinished joints need to be filled and finished correctly. This method improves the appearance of the masonry brick. Others are to protect it from weathering actions.

### Brick pointing

Generally, pointing is done with the following two types of mixes:

- Lime mortar- (1:2) 1 part of lime and 2 parts of sand
- Cement Mortar – (1:3) / (1:4) 1 Part of cement and 3 or 4 parts of sand

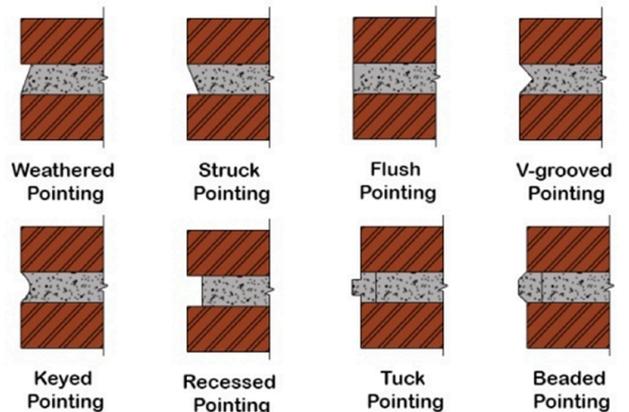


### •BRICK JOINTING / POINTING

- The finish given to the joints
- Purpose: produce a neat and good brickwork
- Advantages: practical, strong, faster, and economical
- Disadvantages: hard to get the uniformity of the color and cannot be done during a rainy day



### Types of Pointing

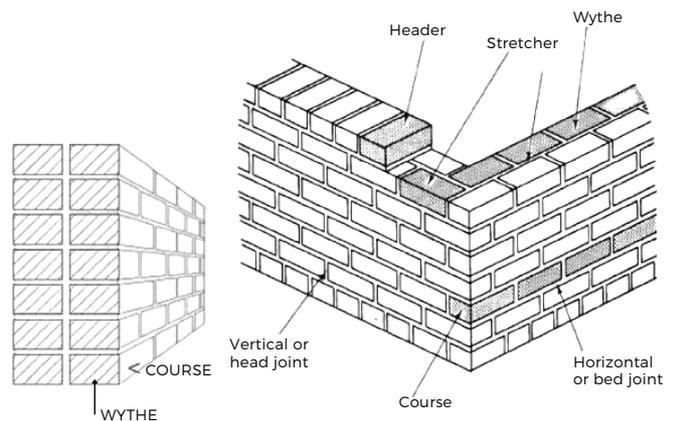


# TYPES OF *jointing*

- Lapped Joint
- Vertical Joint
- Lateral or Horizontal Joint
- End Joint
- Toothing
- Racking Back

## Brick jointing

Jointing is the bricklayer's term for the action of finishing the joint faces of the bedding mortar as work proceeds. It is the oldest method for finishing brickwork and was mainly executed using trowels until the early 17th century when jointing tools increasingly became standard.



## LAPPED JOINTING

A lap joint, also known as an overlap joint, is one where the members overlap. Masonry, wood, plastic, and metal can all be joined with lap joints. A full lap, half lap, or quarter lap joint can be used.

## VERTICAL JOINTING

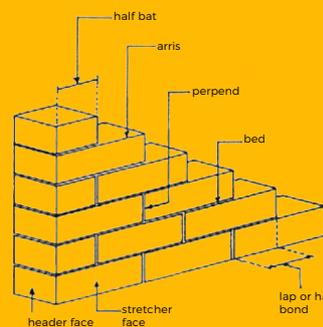
The vertical seams between blocks or bricks that have been set in a horizontal course to build a wall are referred to as 'perpend.' The bed joint is the term used to describe the horizontal mortar joint in wall construction.

## LATERAL OR VERTICAL JOINTING

Lateral or horizontal jointing is the process of finishing the joints between bricks in a wall that are parallel to the ground. This type of jointing is important for creating a watertight wall and for providing a smooth, finished surface.

## END JOINTING

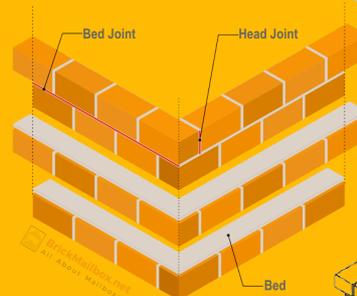
End jointing is the process of finishing the joints between bricks at the ends of a wall. This is important for both aesthetic and structural reasons. Aesthetically, end jointing helps to create a clean, finished look for the wall. Structurally, end jointing helps to prevent water from penetrating the wall and causing damage.



## LAPPED JOINTING



## VERTICAL JOINTING



## LATERAL OR VERTICAL JOINTING



## END JOINTING

# 1.4 Quizzes



## QUESTION

### Timber as Building Materials

- 1) What are the advantages of using hardwood in building construction?

*Answer: page 38 - 39*

- 2) List some differences between softwood, hardwood, and engineering wood.

*Answer: page 6*

## QUESTION

### Concrete as Building Materials

- 1) Explain the role of aggregates in the concrete mixtures ?

*Answer: page 11*

- 2) What are the advantages of using precast concrete components in building construction, and when is it a preferred option?

*Answer: page 13*



## QUESTION

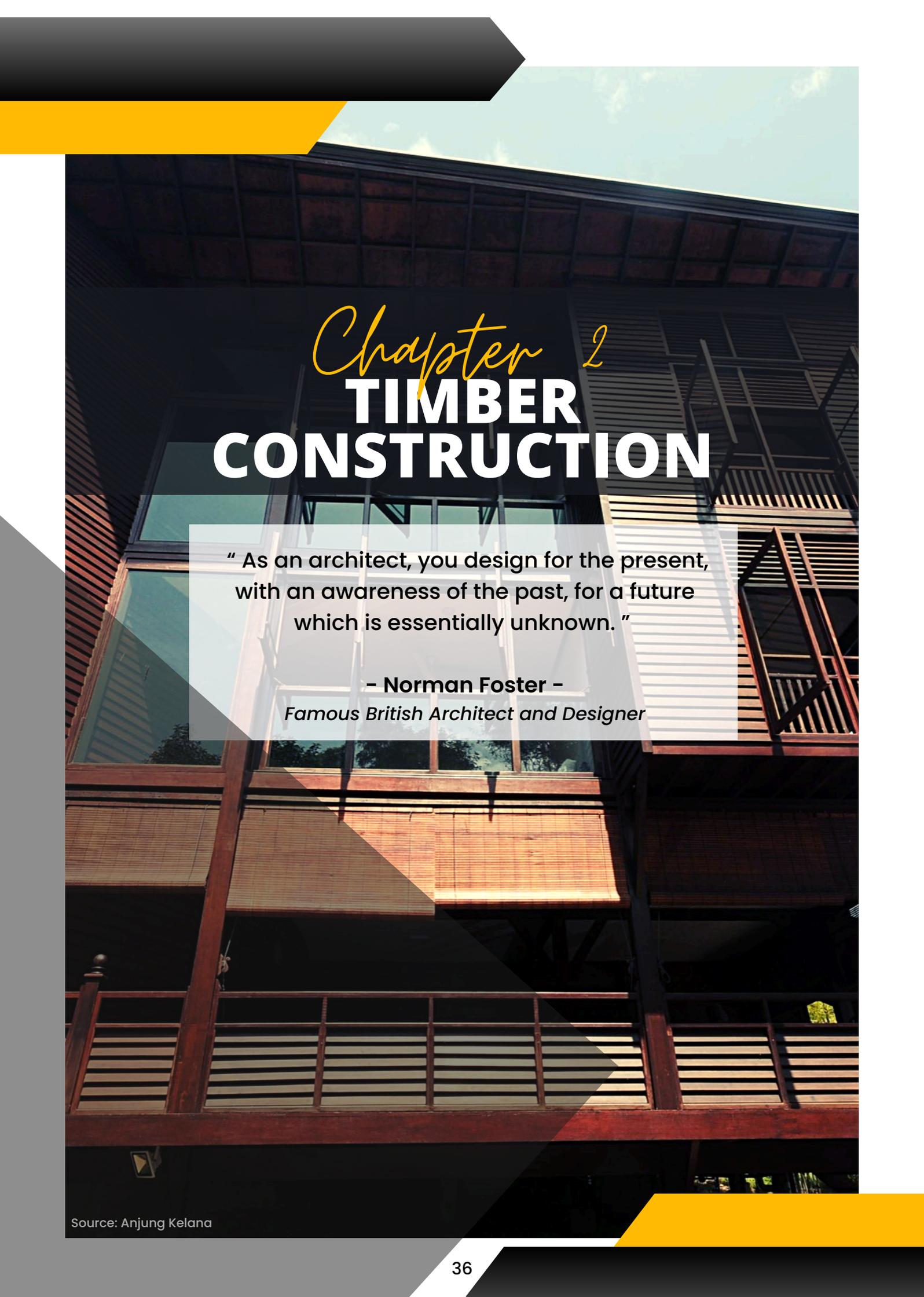
### Masonry as Building Materials

- 1) List and illustrate the types of brick closures in construction.

*Answer: page 25 & 26*

- 2) Define a masonry bond and explain its purpose in masonry construction.

*Answer: page 29-32*



# Chapter 2 TIMBER CONSTRUCTION

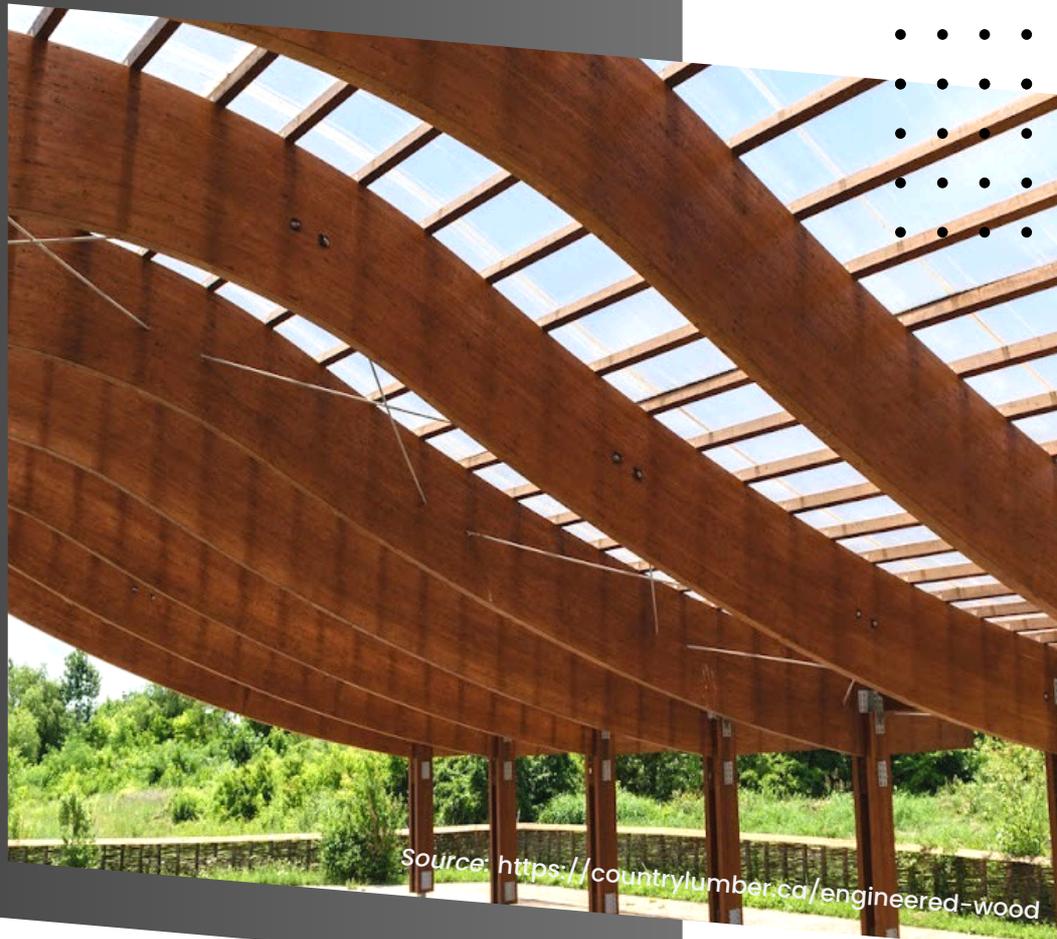
“ As an architect, you design for the present,  
with an awareness of the past, for a future  
which is essentially unknown. ”

– Norman Foster –  
*Famous British Architect and Designer*

# TIMBER

## CONSTRUCTION

Timber building is a “lightweight” building where timber is used to build its main structural components and is built by various types of mortices and tenons. This method relies on timber frame beams as a means of structural support for the proposed building. It is an engineered, quality-assured building method that is the norm in most parts of the developed world. Over 70% of people in the developed world live in timber frame housing.



## Topics

- 2.1 Introduction (Timber Roof Functions)
- 2.2 Structural Components of Timber Roof
- 2.3 Roof Construction for Timber
  - 2.3.1 Basic Components of Timber Roof Construction
  - 2.3.2 Timber Roof Frame Construction Details
- 2.4 Wall Construction for Timber
  - 2.4.1 Steps of Timber Wall Construction
  - 2.4.2 Basic Components of Timber Wall Construction
  - 2.4.3 Types of Timber Wall Cladding
- 2.5 Floor Construction for Timber
- 2.6 Quizzes

## Objectives

*Apply knowledge related to timber construction that complies with Malaysian Standard (MS) for a specific project. This topic is to emphasize skills, professionalism, and communication to understand the methods of construction in compliance with Uniform Building By-Laws (UBBL 1984).*

# 2.1 INTRODUCTION



## Timber ROOF FUNCTIONS

The timber roof of a building serves several important functions, all of which are vital for the comfort, safety, and longevity of the structure and its occupants. Here are some of the key functions of a timber roof:

### Shelter and Protection

The primary function of a roof is to provide shelter and protection from the elements. It shields the interior of a building from rain, snow, hail, sunlight, wind, and other weather conditions, preventing water infiltration and maintaining a comfortable indoor environment.

### Thermal Regulation

Roofs play a critical role in regulating the temperature inside a building. They provide insulation, which helps to retain heat during cold weather and reflect or dissipate heat during hot weather, contributing to energy efficiency.



Source: [www.quadrantai.co.uk](http://www.quadrantai.co.uk)



Source: [wernerroofing.com/blog](http://wernerroofing.com/blog)

### Structural Support

Roofs provide structural support to the building, distributing the weight of the roof materials and any accumulated snow or water evenly to the load-bearing walls and foundation. The roof structure, such as trusses or rafters, ensures the building's stability.

### Safety and Security

Roofs contribute to the overall safety and security of the building. They deter unauthorized access, prevent the intrusion of pests and animals, and protect against falling debris or objects.



# Timber

## • ROOF FUNCTIONS

### Energy Efficiency

Properly designed and insulated roofs can significantly reduce energy consumption by maintaining comfortable indoor temperatures. This, in turn, can lead to lower heating and cooling costs.

### Sound Insulation

Roofs can offer sound insulation, reducing the transmission of external noise into the interior spaces and vice versa, creating a more peaceful living or working environment.

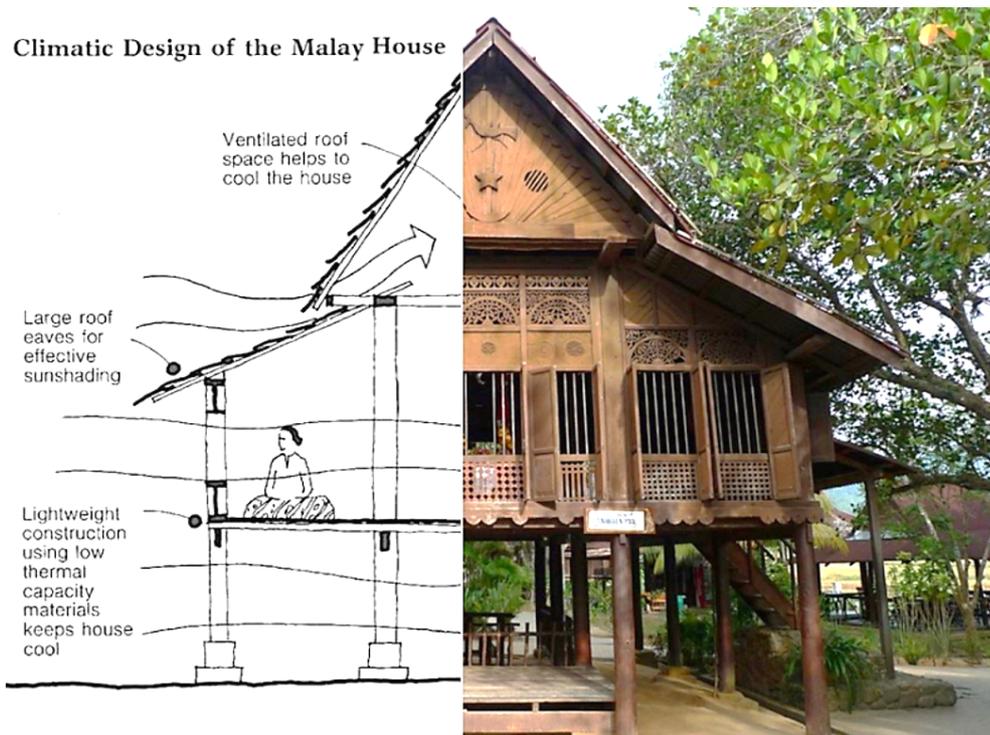
### Ventilation

Roofs often incorporate ventilation systems to allow the exchange of air between the interior and exterior. Proper roof ventilation helps prevent moisture buildup, reduces the risk of mold and mildew, and improves indoor air quality.



Source: [www.urbanfront.com](http://www.urbanfront.com)

### Climatic Design of the Malay House



### Aesthetic Appeal

Roofs contribute to the overall aesthetic of a building. Architectural design and roof materials can enhance the visual appeal and style of a structure, adding to its curb appeal and market value.

Source: [www.libur.com.my/rumah-tradisional-melayu](http://www.libur.com.my/rumah-tradisional-melayu)



## 2.2 STRUCTURAL COMPONENTS

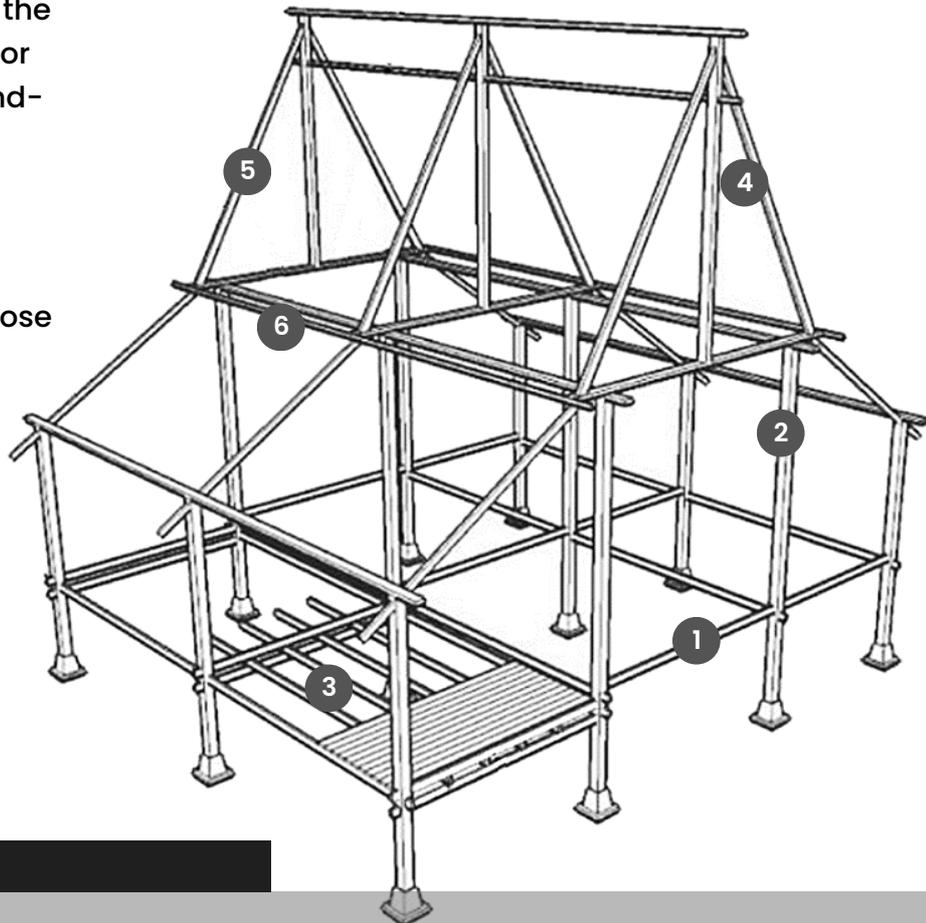
### *of Timber Roof*

Timber involves various methods and techniques for using wood as a primary building material. Timber is commonly used in construction for various structural and non-structural purposes. These are basic components commonly used in timber construction for structural components:

#### STRUCTURAL COMPONENTS

- 1 Beams:** Timber beams are horizontal members that support the load from above, such as the weight of floors or roofs. They are often used in frameworks and truss systems.
- 2 Columns:** Timber columns are vertical load-bearing elements that support the structure. They are commonly used for supporting roof loads and in post-and-beam construction.
- 3 Joists:** Joists are horizontal framing members used to support floors or ceilings. They are typically spaced close together and provide a surface for flooring or ceiling materials.
- 4 Trusses:** Timber trusses are triangular structures used to support roofs. They are made up of beams and can provide clear spans without the need for interior columns.

- 5 Rafters:** Rafters are sloped timber members that support the roof and transfer its load to the walls. They are typically used in traditional pitched roof systems.
- 6 Purlins:** Purlins are horizontal members that support rafters in roof construction. They distribute the load and provide additional structural support.
- 7 Bracing:** Diagonal members like braces stabilize and reinforce structural components, preventing lateral movement and improving structural integrity.
- 8 Plates:** Timber plates are horizontal members that connect wall studs and rafters. They distribute loads and provide a surface for fastening.



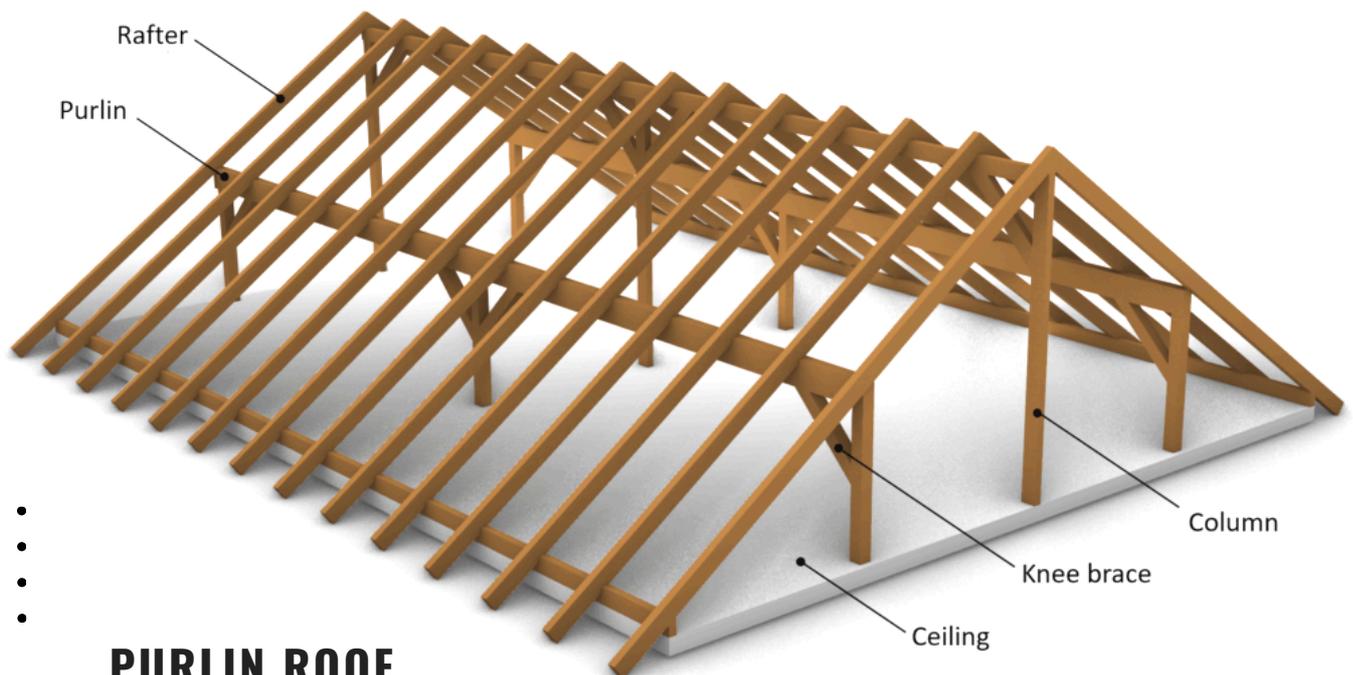
## 2.3 ROOF CONSTRUCTION FOR TIMBER



Source: milieusolar.com

### ROOF CONSTRUCTION

Roof construction using timber is a traditional and commonly used method in residential and commercial building projects. Timber offers several advantages, such as being cost-effective, readily available, and relatively easy to work with. Roof construction is a critical aspect of building construction and involves several steps to create a secure and weather-resistant. The specific details of roof construction can vary depending on the type of roof, materials used, and local building codes. Roof timber is a fundamental part of the overall roofing system and plays a key role in maintaining the structural integrity of a building.

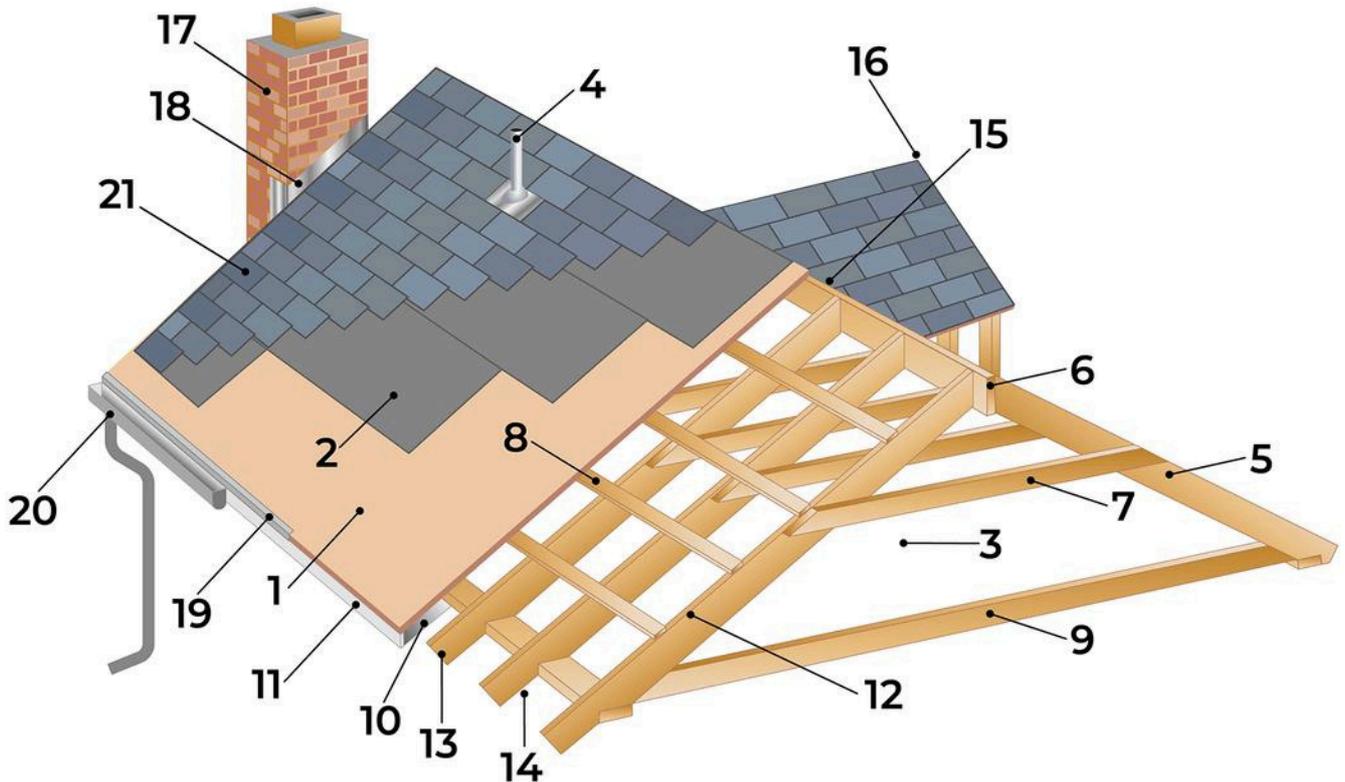


### PURLIN ROOF

Source: www.structuralbasics.com

## 2.3.1

# BASIC COMPONENTS OF *Timber Roof Construction*



- |                 |                |              |                            |
|-----------------|----------------|--------------|----------------------------|
| 1. Decking      | 7. Collar Beam | 13. Hip      | 19. Drip Edge              |
| 2. Underlayment | 8. Battens     | 14. Eaves    | 20. Gutters and Downspouts |
| 3. Attic        | 9. Joists      | 15. Valley   | 21. Covering               |
| 4. Vents        | 10. Soffits    | 16. Dormer   |                            |
| 5. Rafter       | 11. Fascia     | 17. Chimney  |                            |
| 6. Ridge        | 12. Rake       | 18. Flashing |                            |

LawnStarter®  
Source: [www.lawnstarter.com](http://www.lawnstarter.com)

These are the basic components of timber construction. The specific components and techniques used can vary widely depending on the type of structure, architectural design, regional building codes, and local construction practices. Proper design and construction techniques are crucial to ensure safety and structural integrity in timber construction projects.

### **UNDERLAYMENT**

as a protective blanket providing cushioning and waterproofing for your roof. Installed directly onto your roof's deck, the waterproofing material creates a moisture barrier between your home and the outside world.

### **ATTIC**

space under your roof, your attic protects your roof from the excessive summer heat and winter moisture through ventilation and allows your roof to breathe.

### **RAFTER**

Providing the overall shape or frame of your roof. Connected to exterior walls, rafters are support beams running from one end of your roof to the other and landing on top of your roof's ridge board. Your rafters provide a base to support your home's roof deck and roof covering.

### **RIDGE**

The roof's ridge forms the horizontal line at the top of your roof's peaks, creating a triangle shape. It is the highest point of your roof and connects to the rafters to form your roof's frame.

### **BATTENS**

Also known as roofing laths, they provide a surface for your roofing materials to be fixed to. The spacing of your roof's battens depends on the type of roofing material you select.

### **JOISTS**

Ceiling joists are an internal component of your roofing system. Joists provide extra support for your soffits, eaves, and balconies.

### **FASCIA**

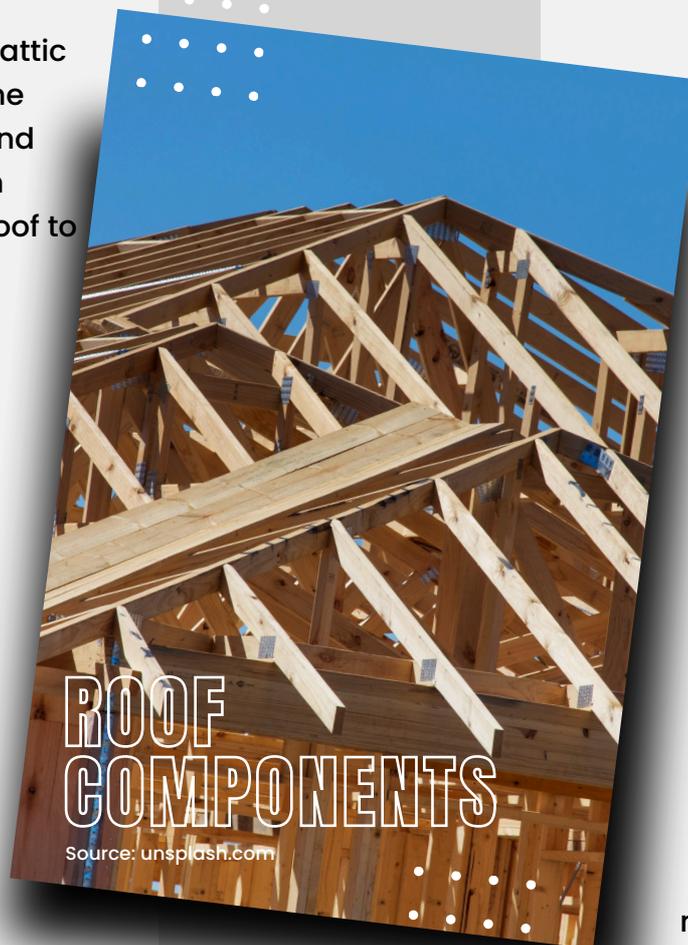
Fascia boards run along the edges of your roof, covering rafters and exposed trusses. These strong boards connect your walls with your rooftop and provide support for your gutters.

### **GUTTERS AND DOWNSPOUTS**

Gutters and downspouts make up their own system and are external roof fixtures. Comprising ducts to direct water away from your home,

### **COVERING**

Roof's covering provides protection, durability, and curb appeal. It comprises any outer material secured to your roof to keep out the elements. Roof covering includes shingle, tile, slate, metal roofing, and more.



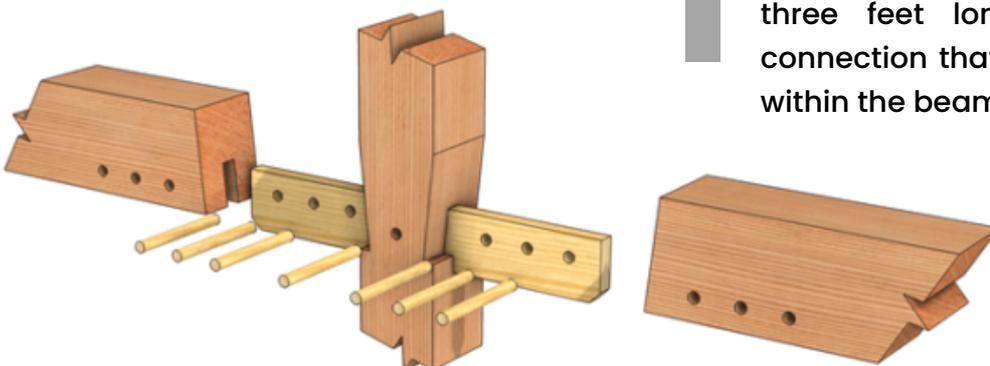
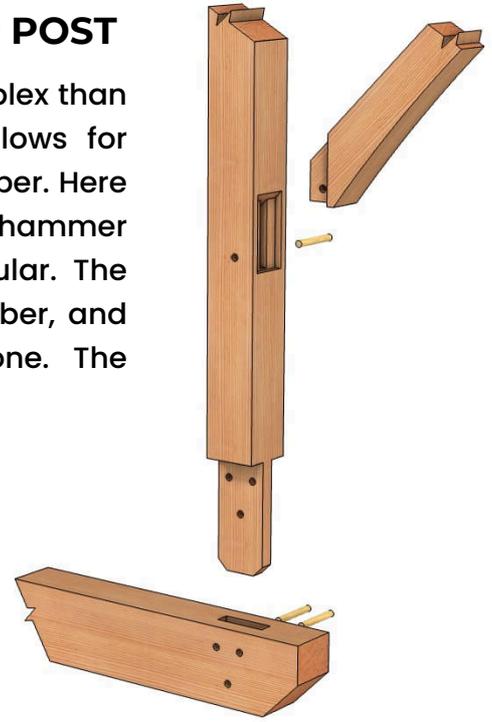
## 2.3.2

# TIMBER ROOF FRAME

## *Construction Details*

### HAMMER BEAM TO HAMMER POST

The hammer beam truss is more complex than the other types of trusses, but it allows for larger spans with shorter pieces of timber. Here we will take a look at the joinery of the hammer beam to the hammer post in particular. The hammer beam is the horizontal member, and the hammer post is the vertical one. The diagonal timber is the hammer brace.

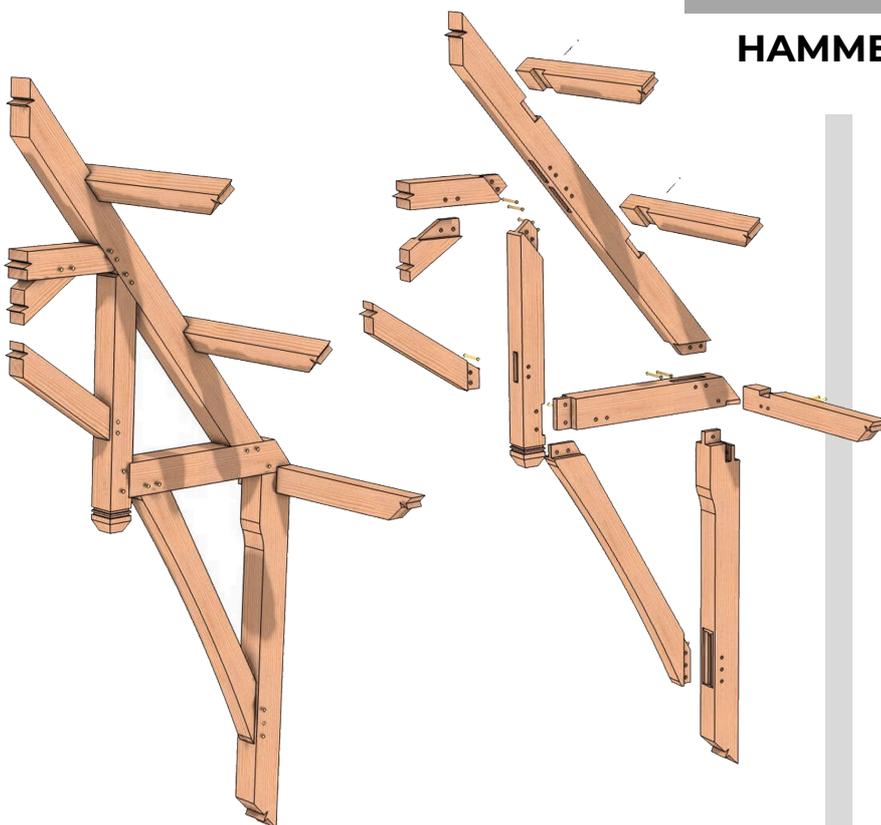
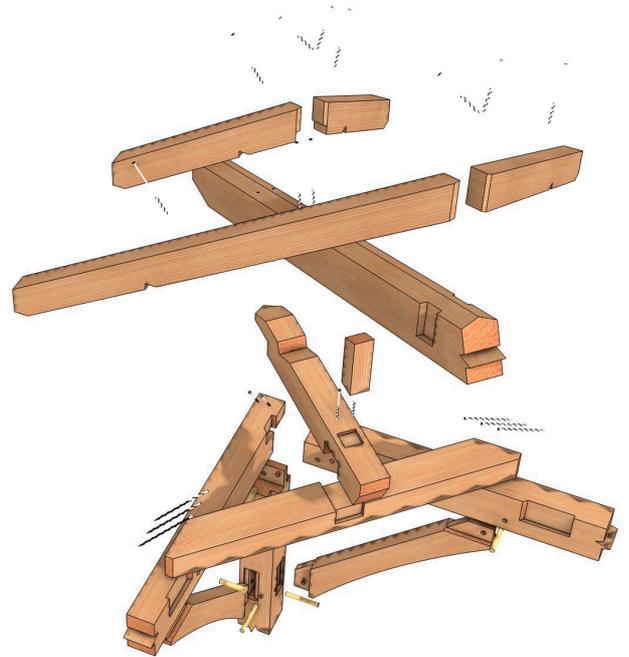
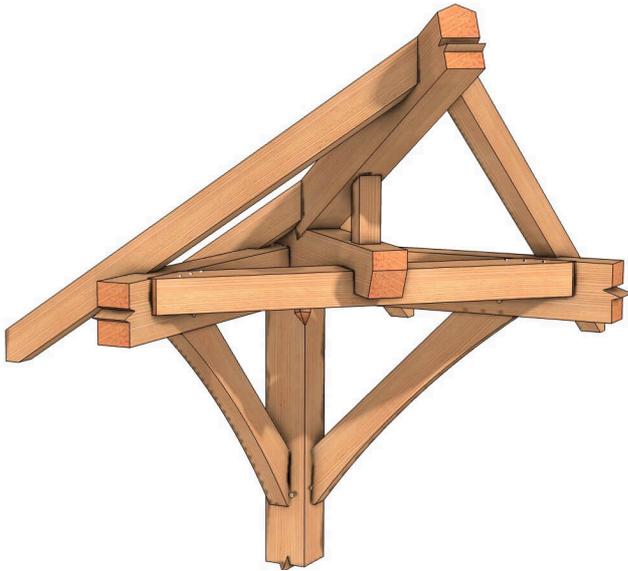


### SPLINE JOINERY

The spline is a thin piece of suitable hardwood that is passed through the beam's through-mortise, and the open mortise on each supporting beam. The spline then gets pegged through the beams to secure everything together. The size of the spline can vary, but for a typical 8x8 post, it is usually made from a 2x6 and can be in the neighborhood of three feet long. It makes a strong connection that resists the tensile forces within the beams. The bonus is that the spline and its pegs make for a beautiful detail in the frame.

## DRAGON BRACE ASSEMBLY

The dragon brace assembly is used on hipped roof timber frames. It is made up of the dragon beam, dragon brace and dragon post. The dragon brace is a timber that runs diagonally between the top plates at the corner of a building. The dragon beam runs from the middle of this brace and at right angles to it and extends to the corner. And the dragon post connects these two timbers.



## HAMMER BEAM TRUSS ASSEMBLY

A hammer truss is an often-requested type of truss because of its mesmerizing beauty. Beyond the beauty of a hammer truss, they do have the advantage of being able to span larger distances with shorter timbers. This hammer truss assembly is composed of the hammer beams (horizontal members), the hammer posts (vertical members) and the hammer braces (diagonal members). In addition, the frame structure includes rafters (upper diagonal members), purlins (parallel timbers atop the rafters) and jowled posts.

## 2.4 WALL CONSTRUCTION FOR *Timber*

Walls function as building boundaries and support the structure, separating the interior of the building into rooms and protecting or delineating the space in the open area. The use of timber as a building material on the walls will make the façade of the building look more attractive and exclusive. However, most timber products have a limited lifespan and eventually require replacement. With new technologies of building materials and improved standard practices, the design and installation of timber walls has been used as a structure because of its strength and more durable alternatives. A traditional timber wall is typically constructed with pressure preservative treated lumber that is held together with steel rebar pins.



Source : [architectazmanzainal.com](http://architectazmanzainal.com)



## 2.4.1 Step of **TIMBER WALL CONSTRUCTION**

Constructing a wall with timber typically involves framing and sheathing, and the specific construction method can vary depending on the type of wall you're building (e.g., interior or exterior wall). Here's a basic overview of timber wall construction.

### 1 **CUT THE TIMBER**

Measure and cut the top and bottom plates to the desired length. Cut the wall studs to the appropriate length for your wall height. Ensure they are plumb (vertical) and uniform in length.

### 2 **ASSEMBLE THE FRAME**

Lay the bottom plate on the floor and secure it in place. Position the wall studs vertically on top of the bottom plate, aligning them with the layout marks. Attach the top plate to the upper ends of the wall studs to create a rectangular frame.

### 3 **INSTALL HEADERS AND BLOCKING**

Add headers and blocking between studs where needed to provide support for doors and windows. Make sure they are level and properly positioned.



# Step of **TIMBER WALL CONSTRUCTION**

## 4 **SHEATHING**

Cover the outside face of the wall frame with sheathing material (typically plywood or OSB). Fasten the sheathing to the studs using nails or screws. Make sure to follow local building codes for fastener spacing.

## 5 **DRYWALL OR FINISH MATERIAL**

Cover the interior face of the wall with drywall or other finish materials.

## 6 **EXTERIOR FINISH**

Depending on your project, you might add exterior finishes such as siding, brick, or stucco.

## 7 **INTERIOR FINISHING**

Finish the interior of the wall with paint, trim, or other desired materials.

## 8 **DOORS AND WINDOWS**

Install doors and windows in their respective openings.

## 9 **FINAL INSPECTION**

Ensure that the wall is level, plumb, and meets all local building codes and requirements.

The specific steps and materials may vary depending on the type of wall you are constructing and local building codes. It's essential to follow best practices and obtain any necessary permits or inspections when building a wall with timber.



## 2.4.2

# BASIC COMPONENTS OF Timber Wall Construction

Timber walls, also known as wood-framed walls, consist of several essential components that work together to create a structurally sound and functional wall. These components can vary in size and specification depending on the specific design and purpose of the wall. Here are the key components of a timber wall:

### 1. STUDS

Vertical members that form the main framework of the wall. Typically spaced at regular intervals (usually 16 or 24 inches in center) to provide structural support. Studs are usually made of 2x4, 2x6, or other dimensional lumber, and they support the wall's load.



Source: [anicehome.com](http://anicehome.com)

### 2. TOP PLATE

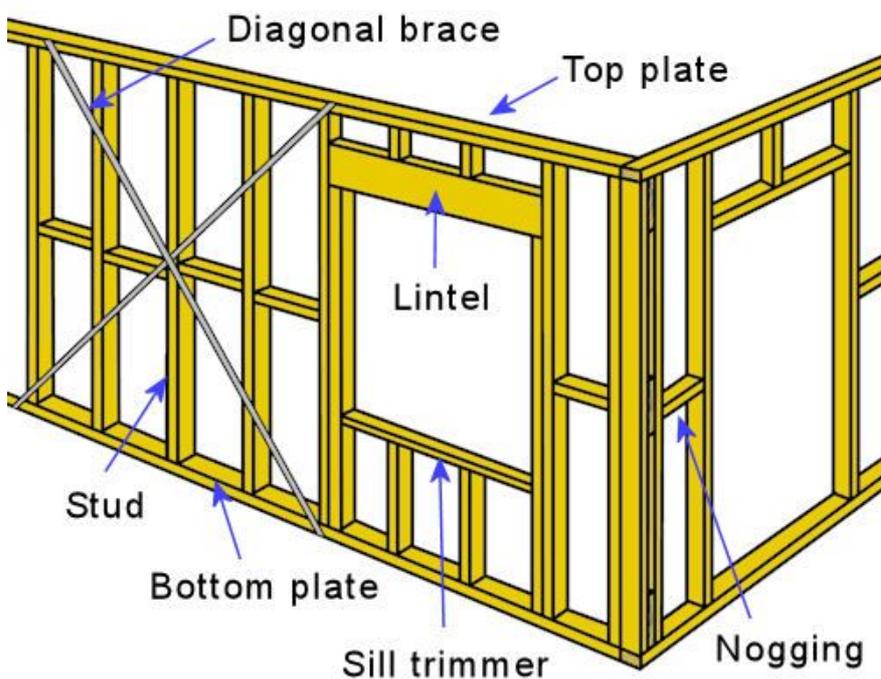
A horizontal member that runs along the top of the wall. Provides stability and connects the upper ends of the studs. Often made of the same size lumber as the studs.

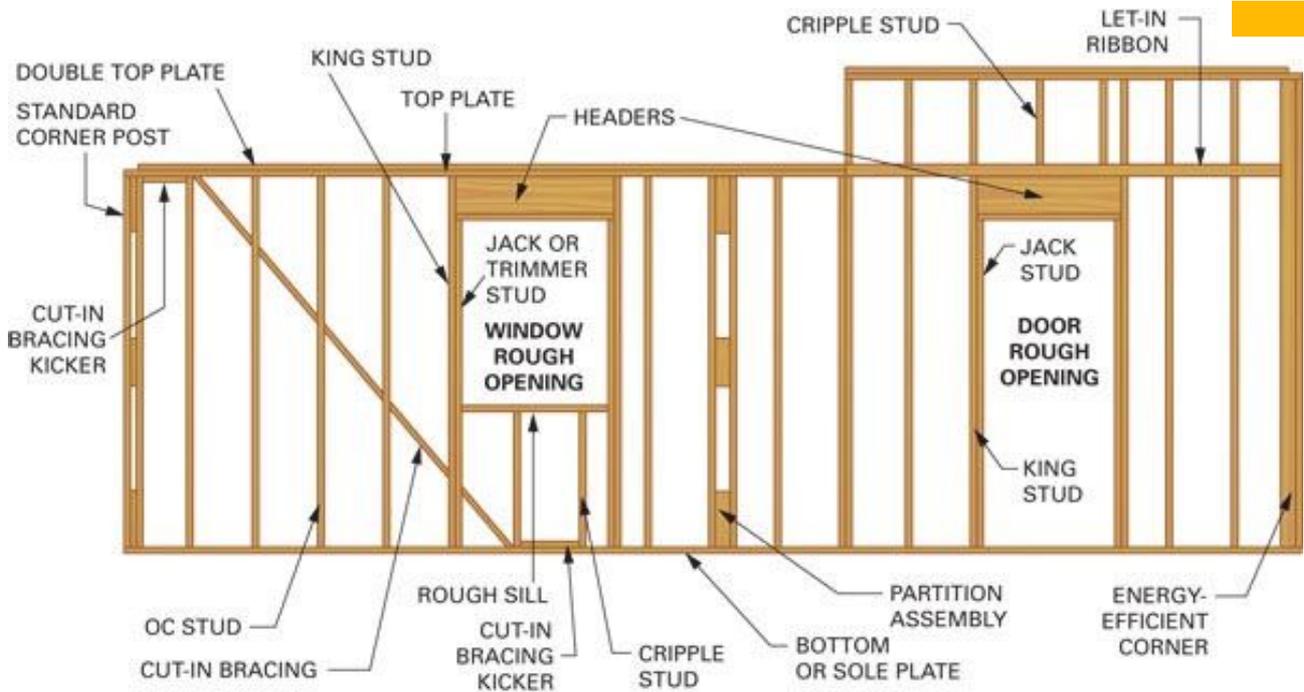
### 3. BOTTOM PLATE

A horizontal member that runs along the bottom of the wall. Anchored to the floor or foundation to provide a secure base for the wall. Made of the same size lumber as the studs and top plate.

### 4. NOGGING

A horizontal or diagonal bracing or blocking that is installed between the vertical studs in a timber-framed wall.





These components work together to create a sturdy and functional timber wall. The exact specifications and materials used can vary depending on the specific building design, local building codes, and the intended use of the wall (interior, exterior, load-bearing, non-load-bearing, etc.).

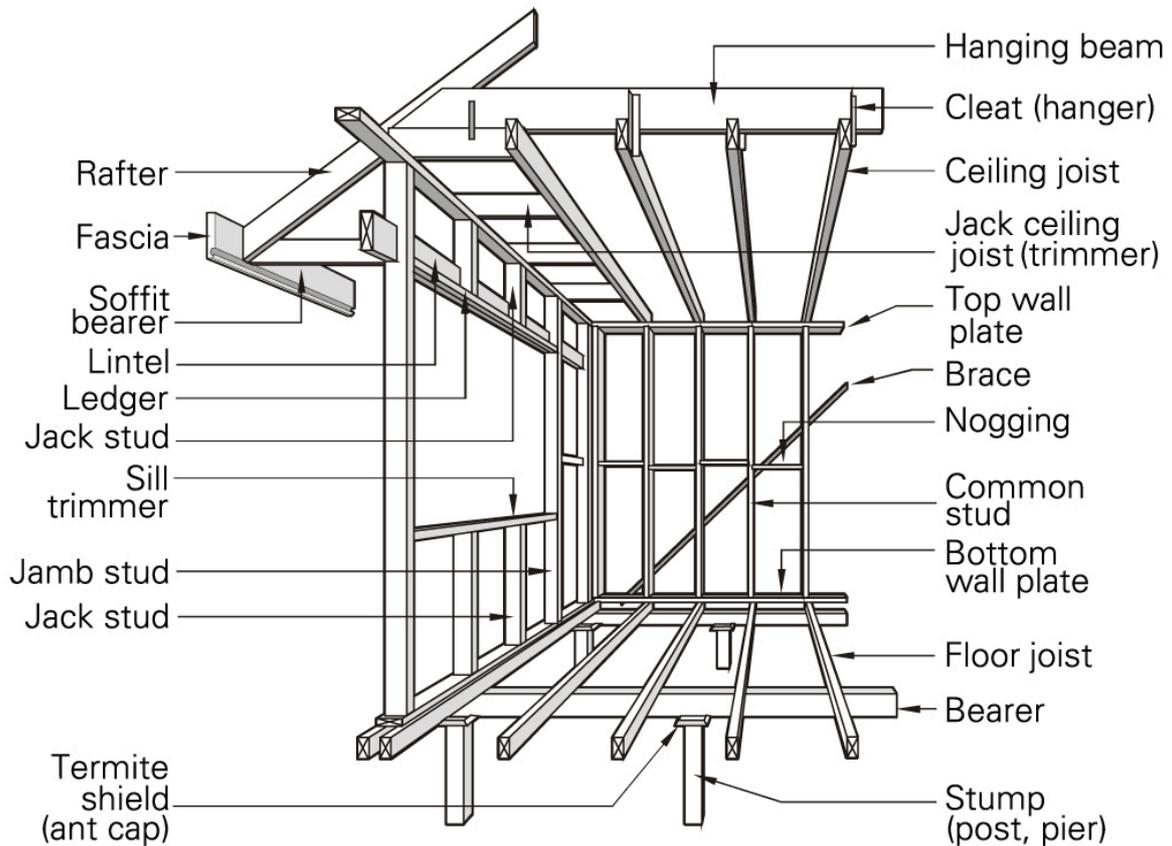
## 5. HEADERS

Horizontal framing members were installed above door and window openings. Distribute the load from above and around the openings to the adjacent studs. Headers are typically made by doubling up or using larger pieces of lumber.



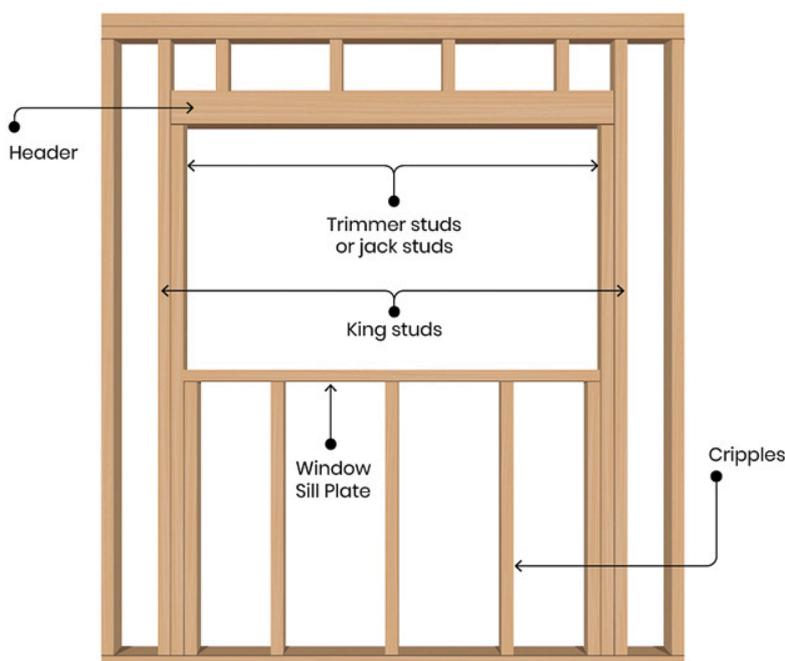
## 7. KING STUD AND JACK STUD

King studs are full-height vertical members placed on either side of a door or window opening. Jack studs are shorter vertical members installed between the king studs and the header. These components support the header and transfer loads to the bottom plate.



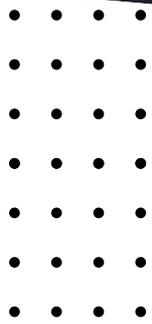
## 6. ROUGH SILL

A rough sill, also known as a rough window sill, is a critical component in the construction of windows and doors. It is the horizontal framing member located at the bottom of a window or door opening, and it serves several important functions.



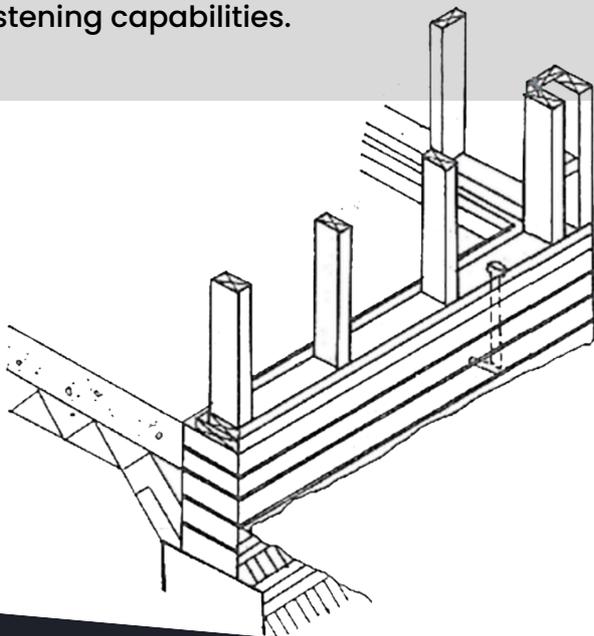
## 8. CRIPPLE STUDS

A short vertical framing member is used in construction, particularly in wall framing. Cripple studs are typically installed above or below structural openings, such as windows, doors, and other openings in walls.

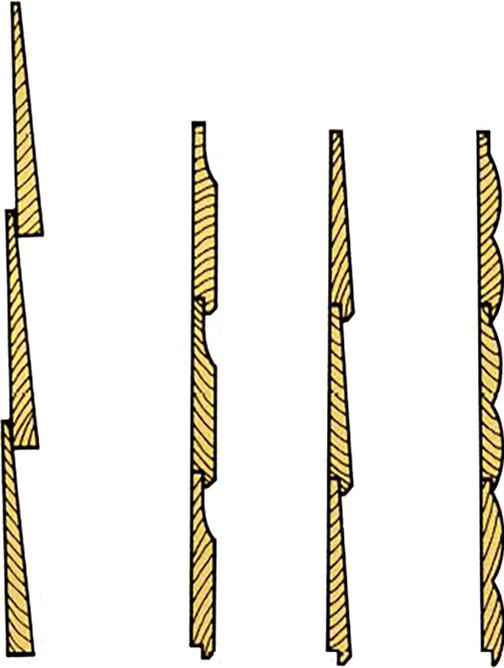


# 2.43 Types of **TIMBER WALL CLADDING** FOR INTERIOR & EXTERIOR

Timber cladding is the perfect natural material to affix to the interior or exterior of both homes and businesses. It is both decorative yet functional, providing structures with insulation and a natural look. As either a feature wall or on the entire exterior of your building. As Newcastle and Lake Macquarie's timber cladding specialists, we can customise the width, species (colour), grade, finish and fastening capabilities.



# TYPES OF Timber Wall Cladding



Sawn Weatherboard

Rusticated

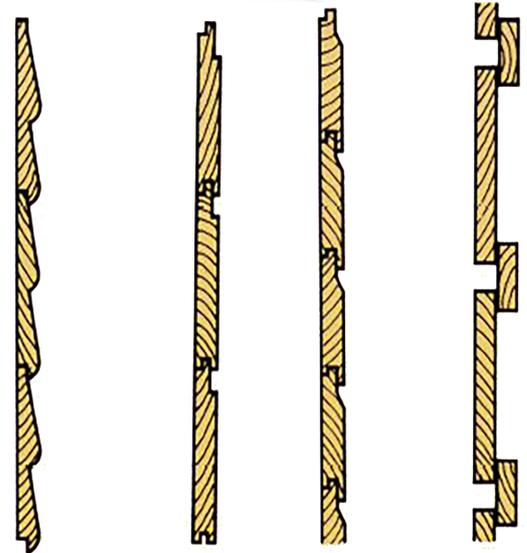
Splayed  
Checked  
and  
Chamfered

Double Log Cabin

Timber wall cladding comes in various types, each with its own style and installation method. The choice of timber wall cladding type depends on your design preferences, budget, and specific project requirements.



Source: housing.com



Double Teardrop

Ship-lap  
or  
Channel

T&G  
Chamfer

Board  
and  
Batten

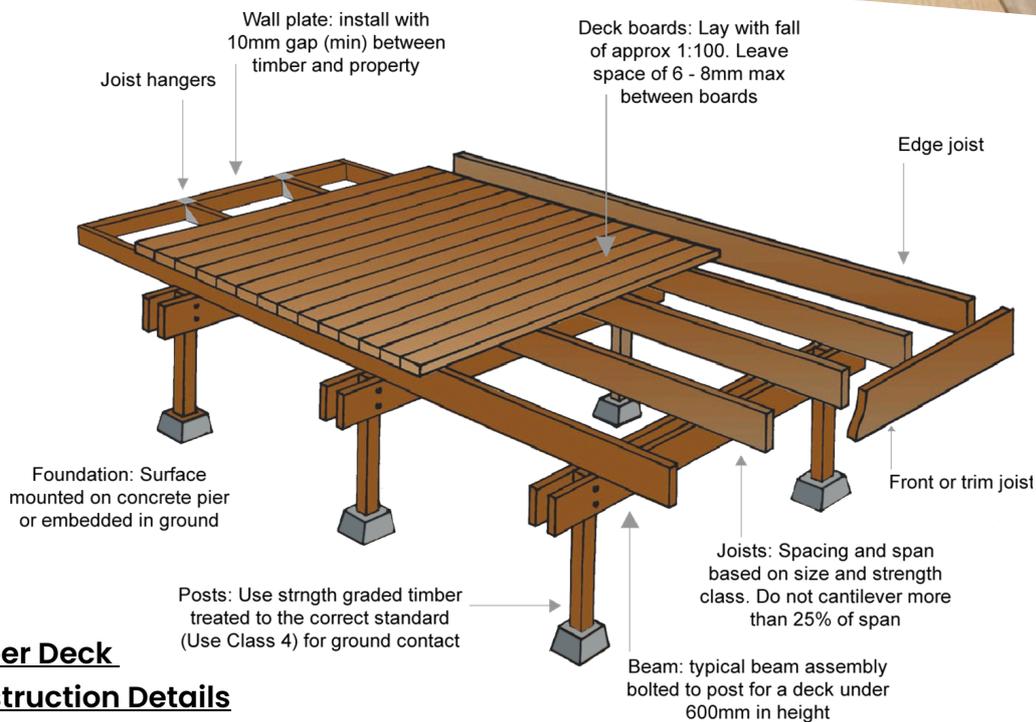
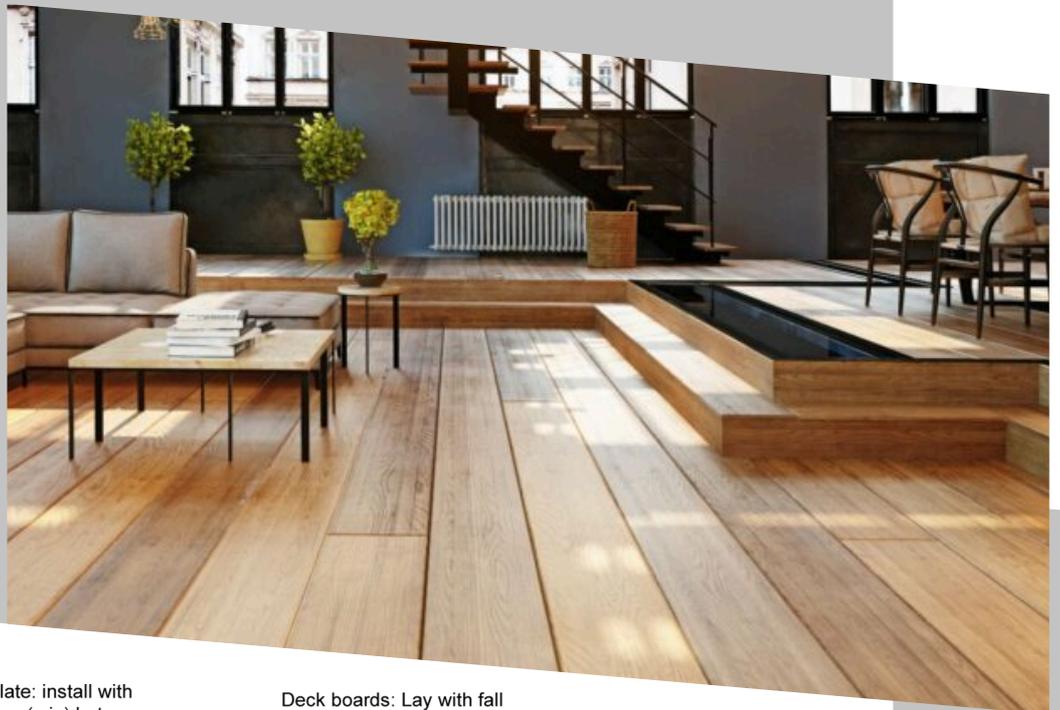
It's essential to consider the climate, local building codes, maintenance requirements, and the desired aesthetic when choosing the type of timber cladding for your project. Additionally, you'll need to select the appropriate wood species and finishing options to ensure the durability and longevity of your cladding.

# 2.5 TIMBER FLOOR

## Construction

### INTRODUCTION

The flooring is made of timber, i.e., wood is called timber flooring. Timber floors, also known as hardwood floors, are popular for their natural beauty, environmental profile, durability, re-storability, and timeless appeal. Timber floors can be installed in various settings, including residential homes, commercial spaces, and even industrial buildings. Timber floor construction involves the assembly of a floor structure using wooden components.



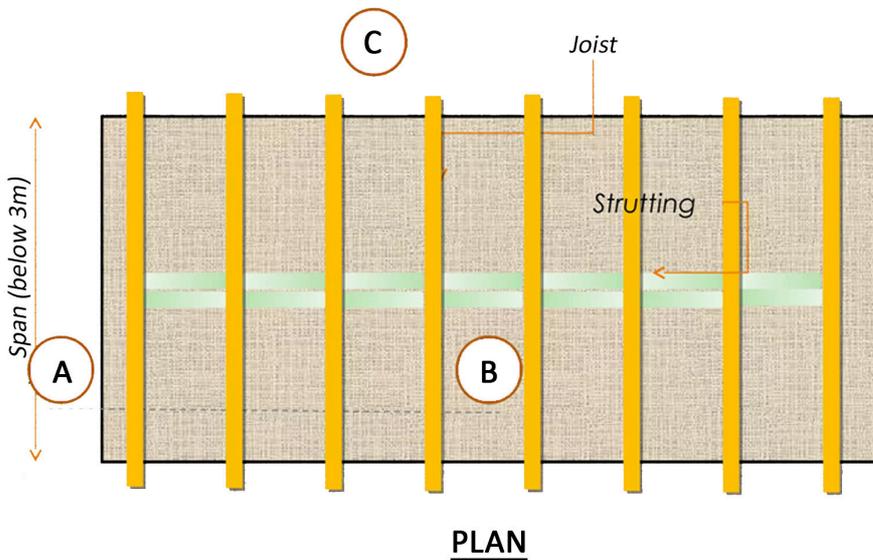
### Timber Deck Construction Details

# 2.5.1 Types of **TIMBER FLOORING**

## **SINGLE JOIST TIMBER FLOOR**

A single joist timber floor refers to a type of flooring system in which the floor structure is supported by individual timber joists rather than a more complex system involving multiple joists, beams, and other components.

It's important to note that the suitability of a single joist timber floor depends on factors such as the size of the space, intended use, and local building regulations.



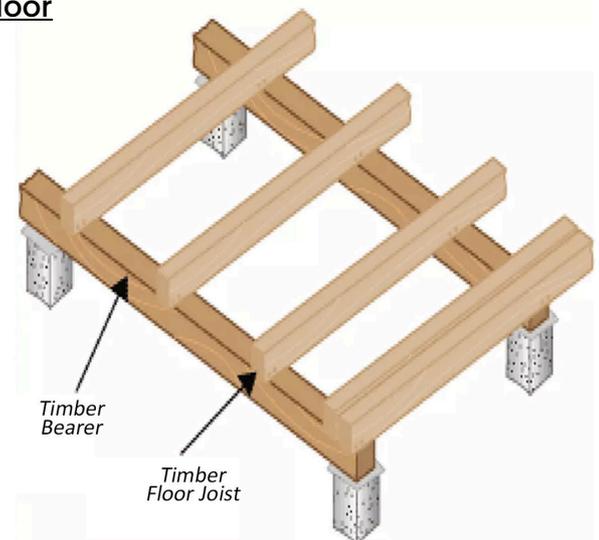
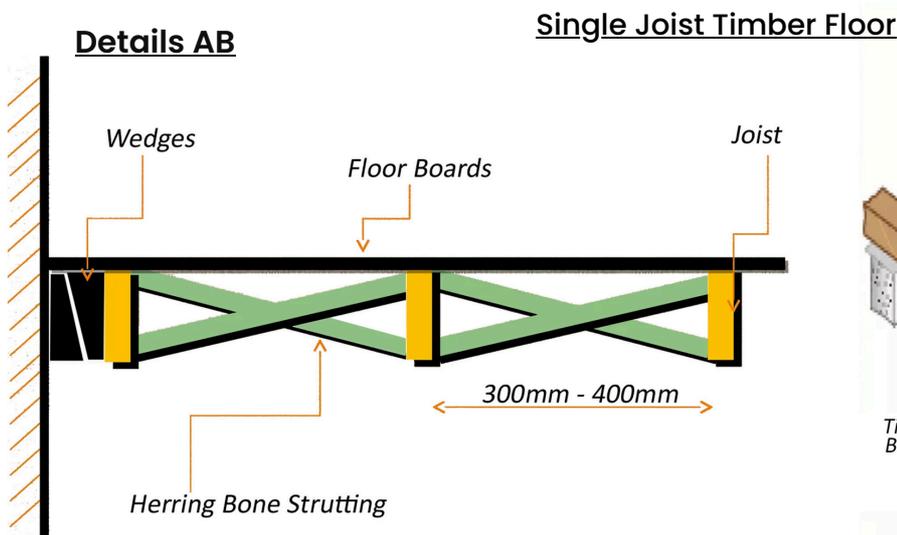
This single joist timber floor is the cheapest form of wooden floor. It is easy to construct and is frequently used in small domestic buildings. Those floors are constructed by fixing wooden planks about 20mm to 30mm thick to wooden joints known as 'bridging joists' spaced 30cm to 40cm apart.

## **ADVANTAGES**

- **Simplicity:** Single joist timber floors are relatively simple in design and construction.
- **Cost:** They can be cost-effective compared to more complex floor structures.
- **Adaptability:** Suitable for various types of flooring materials.

## **CONSIDERATIONS**

- **Span:** The span of the joists is a critical factor in determining the floor's load-bearing capacity. Longer spans may require larger or stronger joists.
- **Load Distribution:** Proper load distribution and support at the ends of the joists are essential to prevent sagging or other structural issues.
- **Building Codes:** Compliance with local building codes and regulations is crucial to ensure the floor meets safety standards.

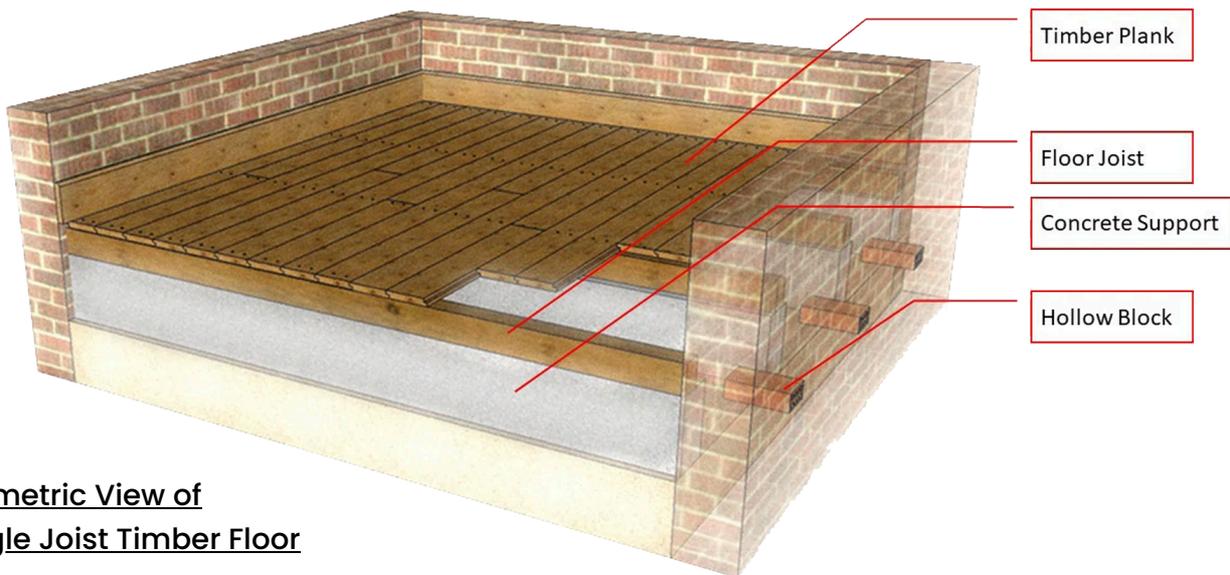
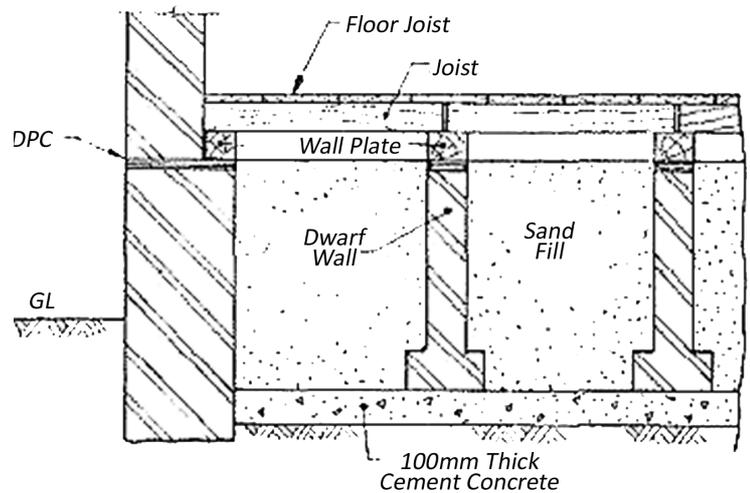


# Types of **TIMBER** FLOORING

## **DOUBLE JOIST** *Timber Floor*

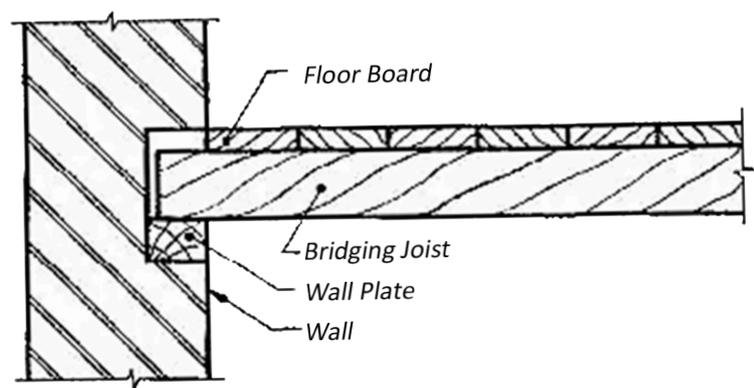
This is the simplest type of timber floor used for residential buildings, where spans are short or moderate ( usually up to 4 m) and loads are comparatively lighter. The floor consists of wooden joists spaced 300 mm to 400 mm apart and supported on end walls. The timber planking or boarding is fixed over the joists. The width of the joist is kept 50 mm to 80 mm wide. The depth of the joist is determined by the thumb rule:

$$[\text{Depth (mm)} = ( 4 \times \text{span in meters} ) / 50 \text{ mm}]$$



Isometric View of  
Single Joist Timber Floor

The joist is supported in wall plates 100 mm X 70 mm to 120 mm X 70 mm in size, at the end walls. A spacing of about 50 mm is kept at the ends for air circulation. When the span exceeds 2.5 m, it becomes essential to strengthen the timber joist by providing herringbone strutting at the mid-span, using inclined pieces of timber of size 50 mm X 30 mm to 50 mm X 50 mm. End wedges are provided between the wall and the joist.

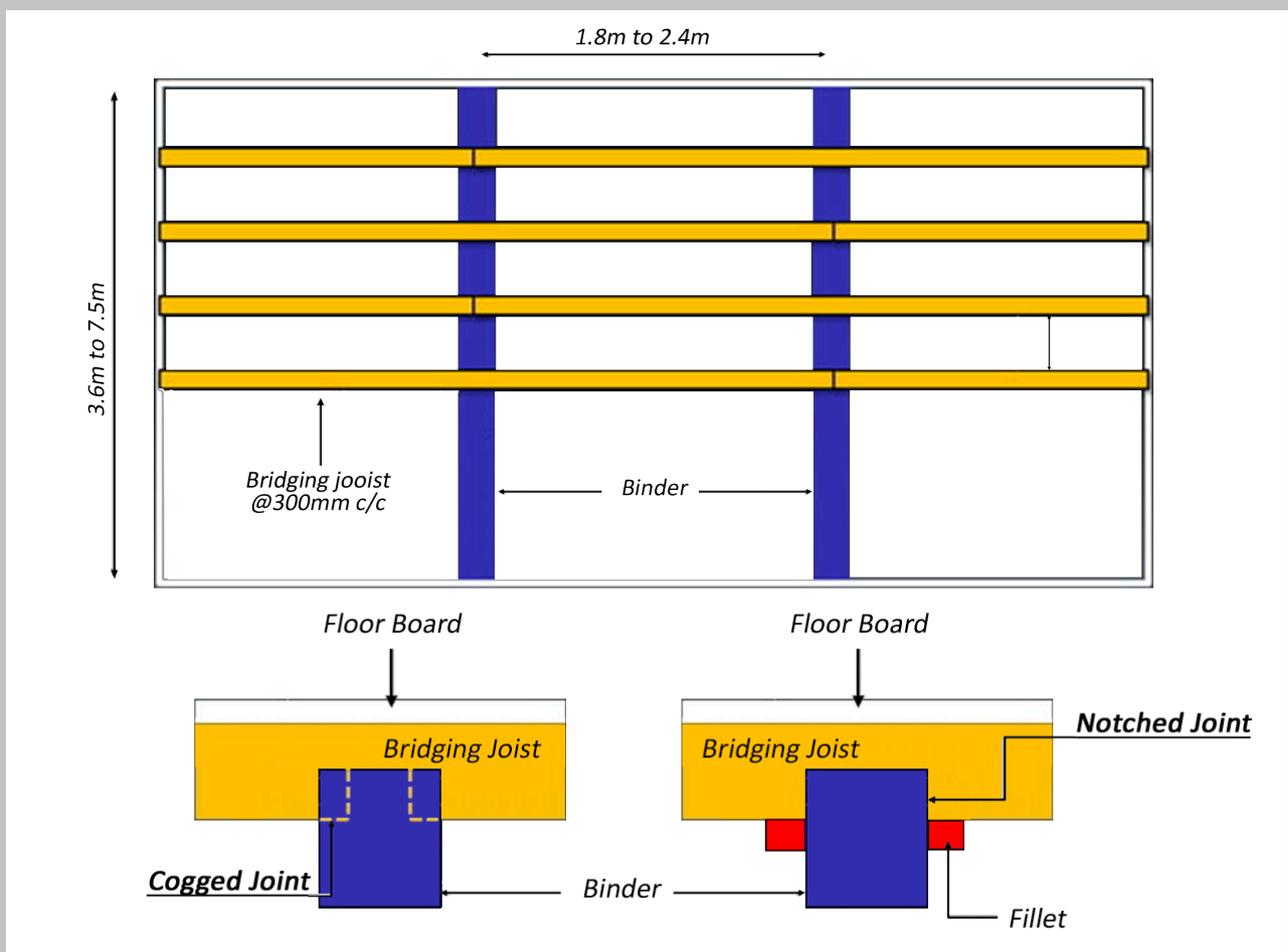


The end joists are nailed, coggled or notched to the wall plates. If the joists of the adjacent room run in the same direction, they may overlap and be nailed to each other. Planking consists of a wooden board 40 mm thick and 100 to 150 mm wide, fixed to the bridging joists.

# Types of **TIMBER** FLOORING

## DOUBLE JOIST *Timber Floor*

A double joist timber floor is a type of flooring system that involves using two parallel timber joists instead of a single joist to provide additional strength and support. This design is often employed in situations where a single joist may not provide sufficient load-bearing capacity, especially for larger spans or heavier loads. A double joist timber floor is often employed in situations where a higher load-bearing capacity is required, such as in commercial buildings, areas with heavy furniture, or spaces with specific load requirements.



### CONSIDERATIONS

- **Spacing:** Proper spacing between the double joists is crucial for structural integrity. The spacing depends on factors like the span length and the load the floor must support.
- **Connection:** The double joists must be securely connected to the supports at both ends to ensure proper load transfer.
- **Building Codes:** Compliance with local building codes and regulations is essential to ensure that the floor meets safety standards.

### ADVANTAGES

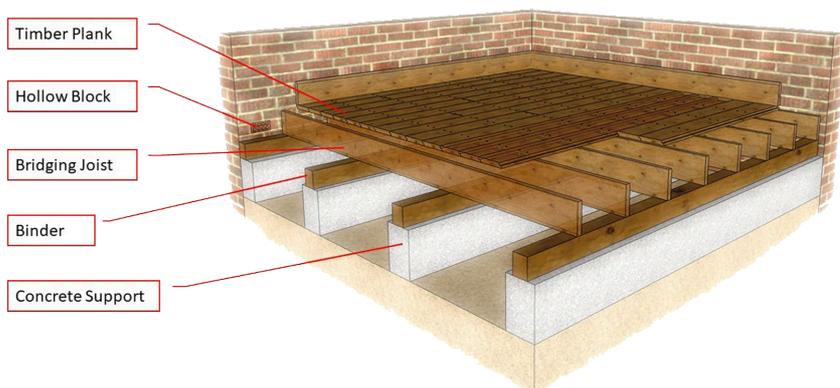
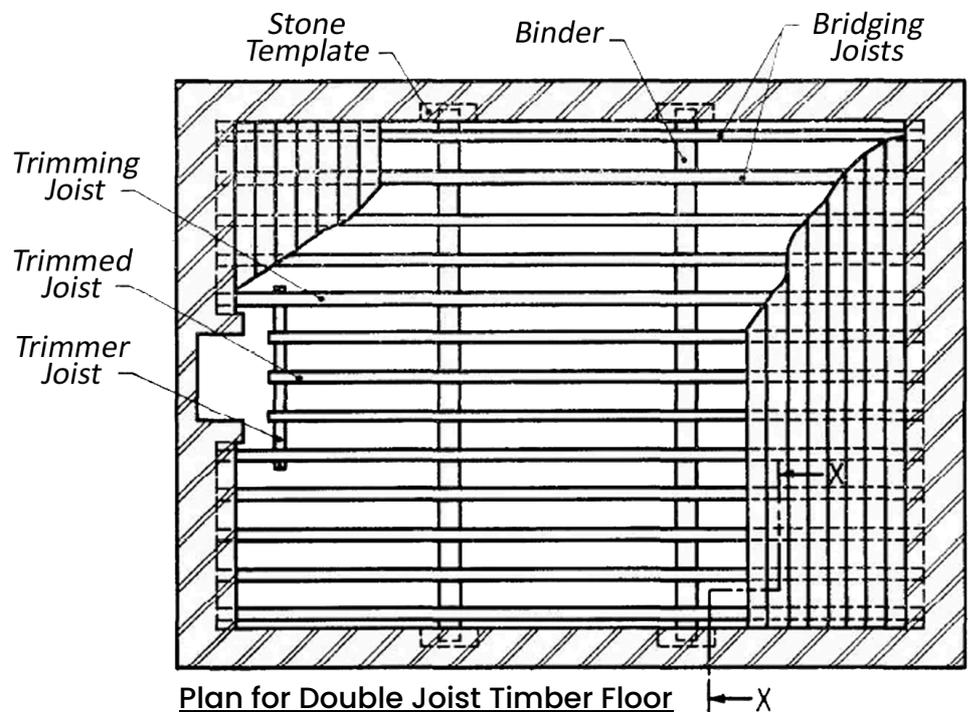
- **Increased Strength:** Using double joists enhances the load-bearing capacity and overall strength of the floor system.
- **Reduced Deflection:** The additional joist helps minimize floor deflection, providing a stiffer and more stable structure.

# Types of **TIMBER FLOORING**

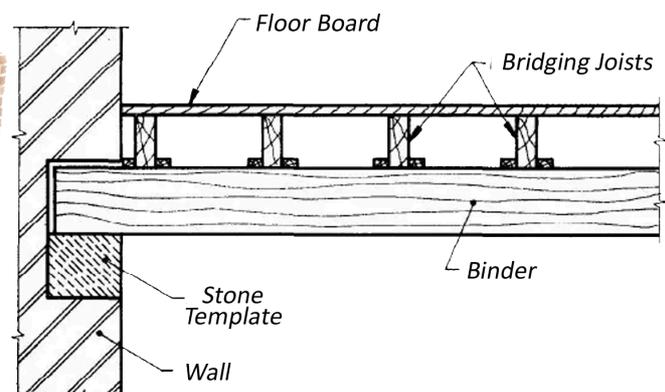
## **DOUBLE JOIST** *Timber Floor*

This type of flooring is more robust and is used for spans between 3.5 m to 7.5 m. The bridging joist is supported on intermediate wooden supports, called binders. Thus, loads of bridging joists are first transferred to the binders and through them to the end walls in the form of highly concentrated loads. This is a disadvantage of this type of flooring. Also, the overall depth of the flooring is increased. Because of intermediate support, the bridging joists are of smaller sections and are spaced at 300 mm centres.

The spacing of binders is kept at 2 to 3.5 m, and they rest on stone or wooden bearing templates that are not less than 0.75 to 2.5 m in length. To reduce the overall depth of the floor, bridging joists are cogged to the binders, with a depth of sinking equally to a one-third depth of bridging girders and bearing not less than 25 mm. Alternatively, the ends of the bridging girders are cut, and they are joined with the help of fillers provided along the two sides of the binder.



**Isometric View of Double Joist Timber Flooring**

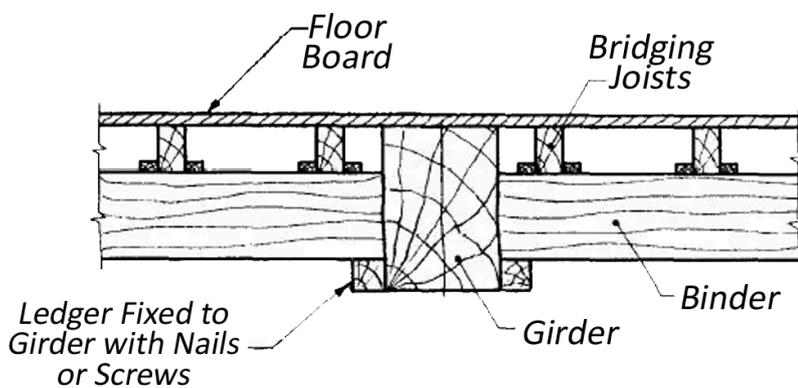
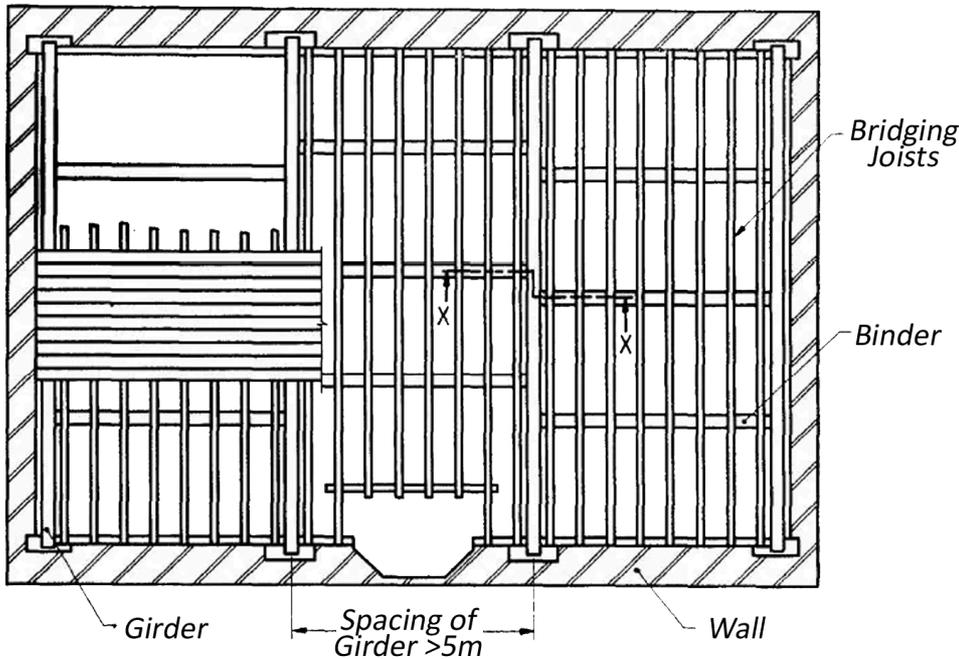


**Section X-X**

# Types of TIMBER FLOORING

## TRIPLE JOIST *Timber Floor*

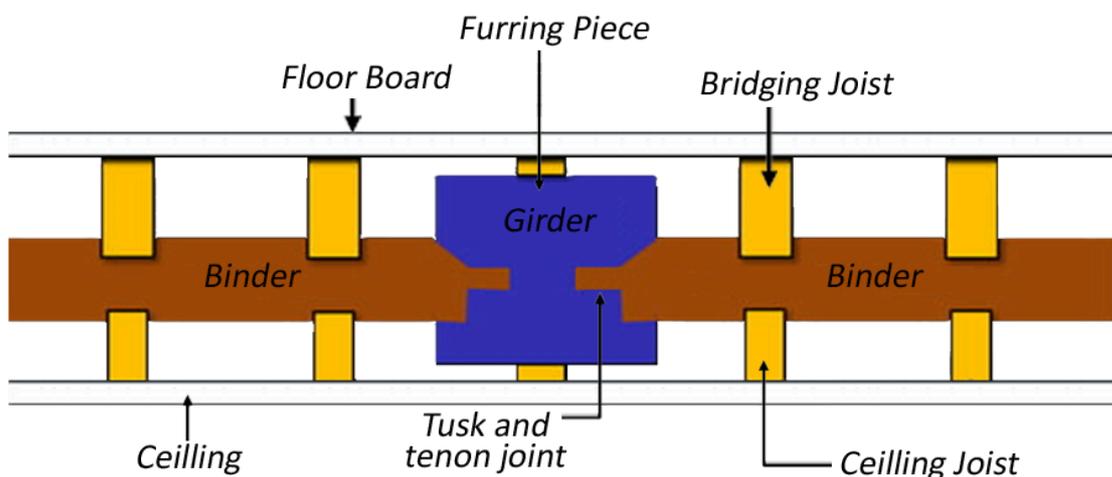
Triple Joist Timber Flooring Plan



This type of timber flooring is suitable for spans between 5 to 7.50 m and the superimposed load is very heavy. The intermediate supports known as girders are provided for the binders. There are four elements of flooring:

- Floorboards
- Bridging joist
- Binder
- Girder

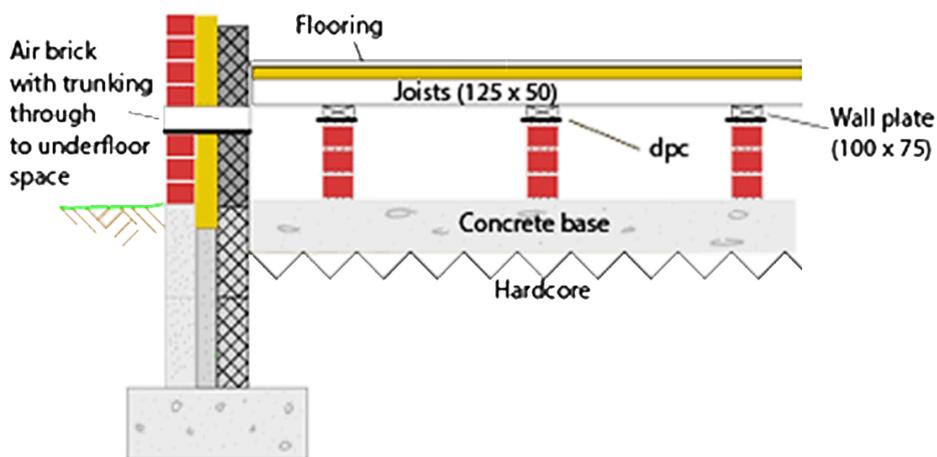
The bridging joists support the floorboards. The binders are staggered and connected to girders by tusk and tenon joints, to increase the rigidity of the floor and decrease the overall depth of the floor. Figure 6 shows the plan of the triple joist floor, while Figure 7 shows the enlarged section view of joint detail. Sometimes, the wooden girders may be replaced by rolled steel joists.



# Types of **TIMBER** FLOORING

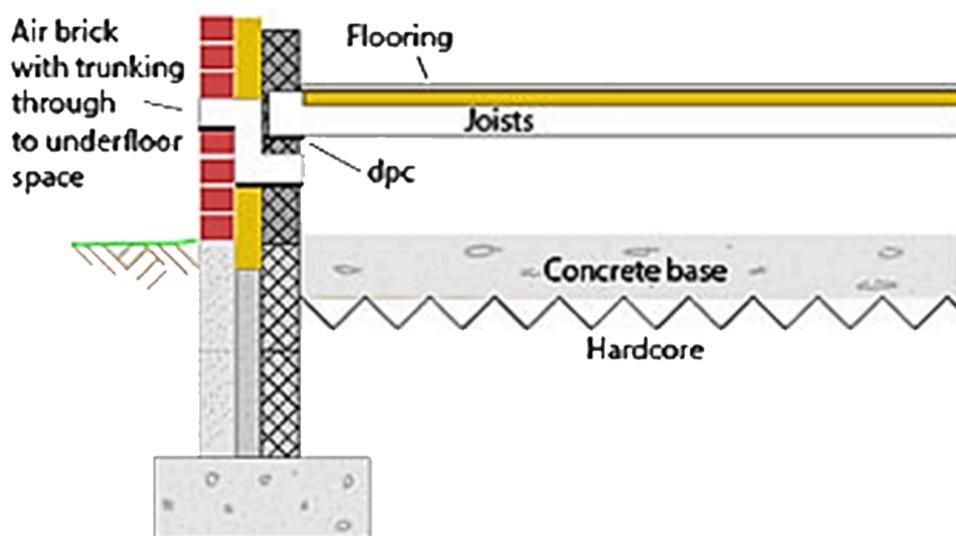
## GROUND FLOOR SUSPENDED TIMBER FLOORING

Suspended timber floors need to have spaces underneath ventilated via air 'bricks' through the outer walls and gaps in any internal walls so that the air can move across the building underneath the floors to prevent the build up of moisture in the timber which could lead to fungal attack. A typical suspended floor is shown below in Fig. 1 with the joists resting on sleeper walls at right angles. Air bricks through the outer walls, facilitate air movement.



In 1910 to 1980, air bricks were often fitted just in the outer brick skin with a brick left out in the inner skin, thus the air brick vented both under the floor and the wall cavity, but modern regulations require the air brick to bridge the cavity and just ventilate under the floor. In 1910, air bricks were not always fitted - in such properties, they should be retro fitted where possible.

A stepped air brick is shown just to illustrate an alternative to the straight style illustrated in Fig 1 - there's no advantage in either type although the stepped style may be required if there is a high external ground level.



# Types of Timber <sup>2.5.2</sup> FLOOR FINISHING

## STRIP TIMBER FLOORING

Strip timber flooring typically refers to a type of hardwood flooring that consists of long, narrow wooden strips that are usually about 2.25 to 3.25 inches wide. This type of flooring is popular for its classic and timeless look. If you are interested in installing or maintaining strip timber flooring.



Source: [www.royalhardwoodfloors.com](http://www.royalhardwoodfloors.com)

## PARQUET FLOORING

Parquet flooring is a type of wood flooring known for its distinct geometric patterns and decorative designs. It consists of small wood pieces, called parquet tiles or blocks, arranged in a mosaic-like fashion to create intricate patterns and associated with elegance and has been used in various architectural styles.



Source: [www.tedtodd.co.uk](http://www.tedtodd.co.uk)

## WOOD BLOCK FLOORING

Wood block flooring refers to a type of flooring that is made up of small, individual blocks or tiles of wood. These blocks are typically square or rectangular and are installed in a parquet pattern, creating a visually appealing and often intricate design.



Source: [www.tedtodd.co.uk](http://www.tedtodd.co.uk)

## PLANK FLOORING

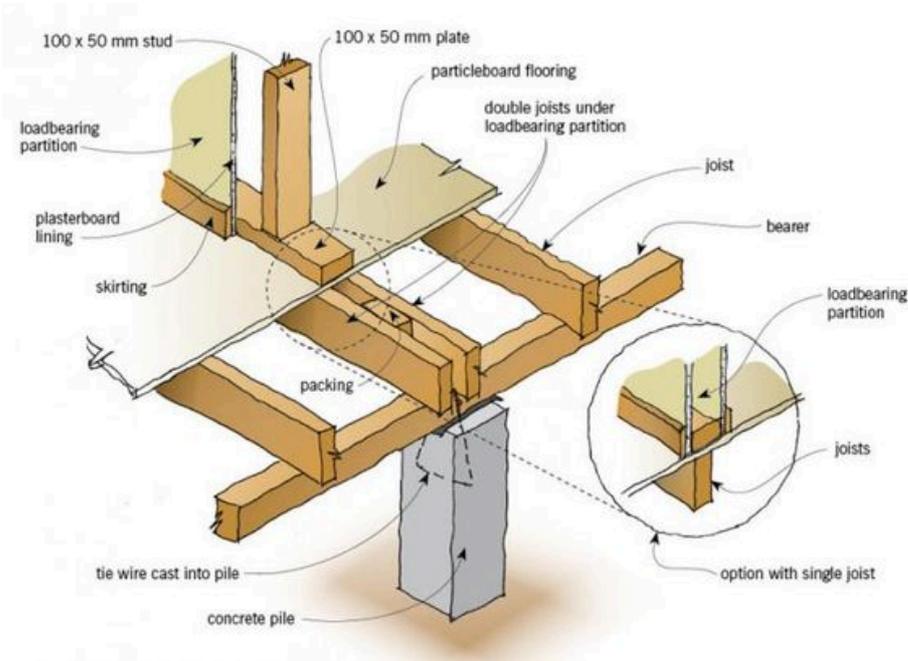
Plank flooring refers to a type of flooring that uses long, wide planks of wood to cover the floor. This style of flooring is popular for its natural, rustic appearance and can be made from various types of wood.



Source: [www.homedepot.com/](http://www.homedepot.com/)

# Timber Floor

## Construction Details



Source: [www.tedtodd.co.uk](http://www.tedtodd.co.uk)

Subfloor framing Details

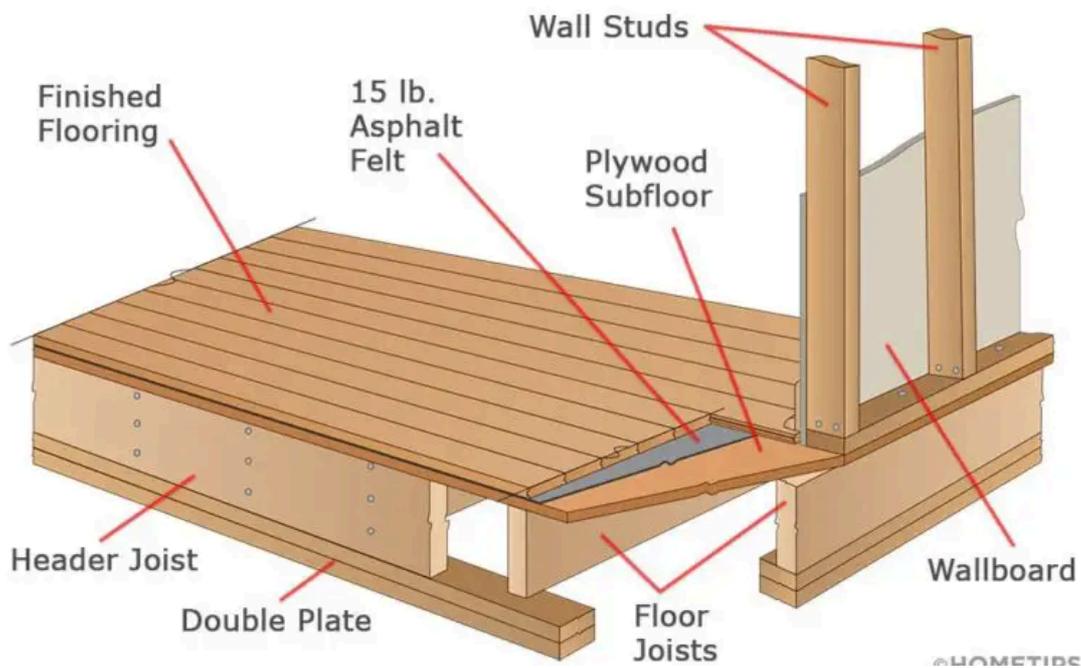
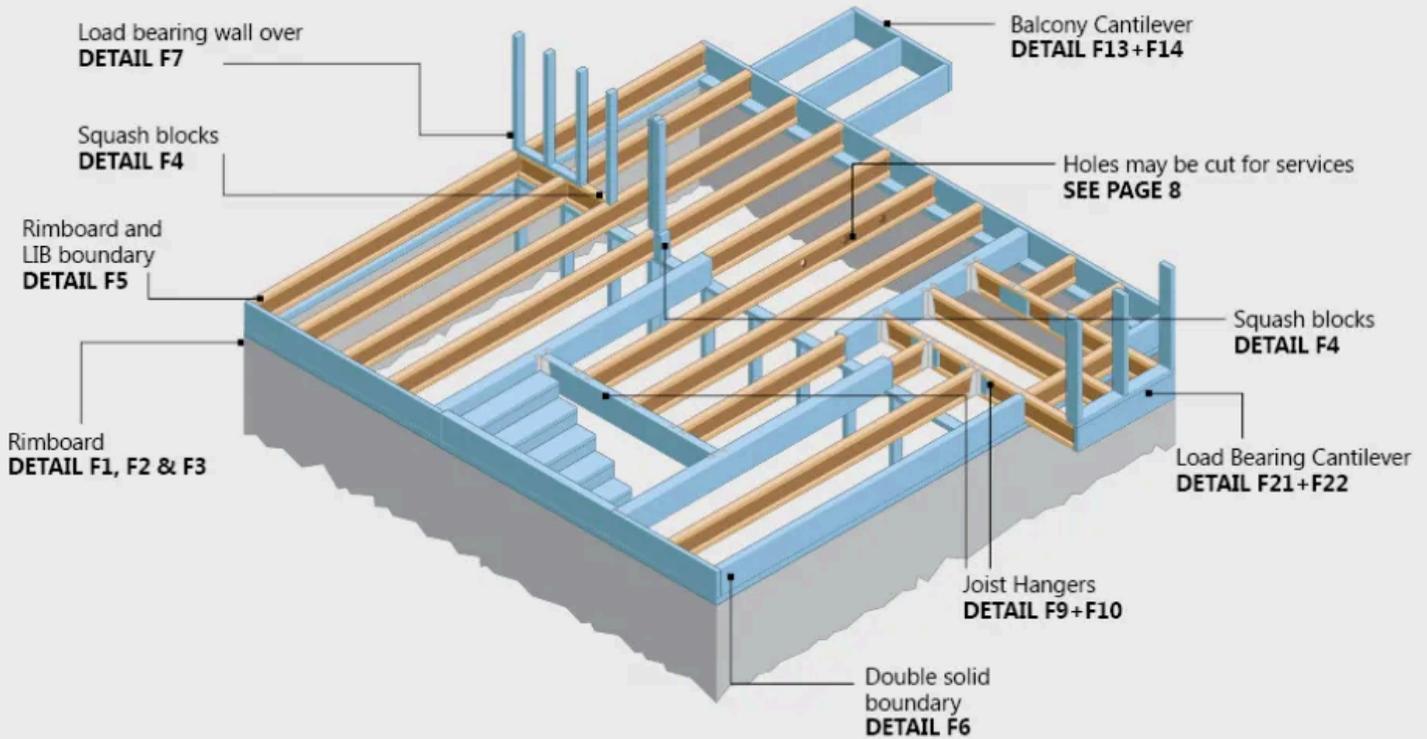


Diagram of Typical Floor Construction

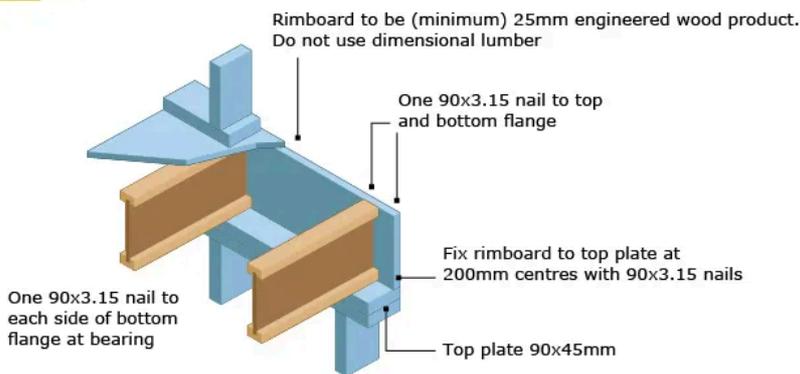
# Timber Floor

## Construction Details

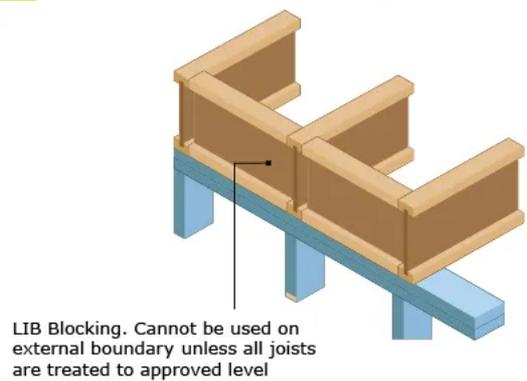
### METHODS FOR FLOOR CONSTRUCTION



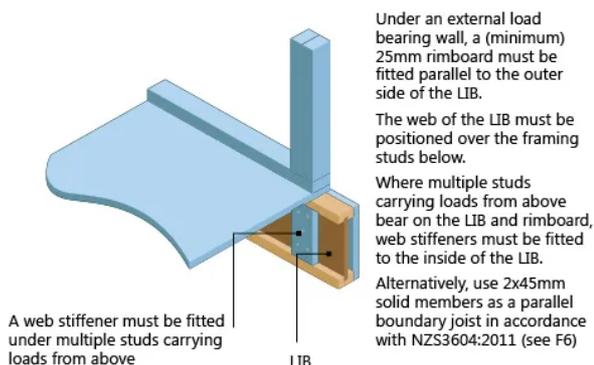
#### F1 Fixing rimboard to ends of I-Beams



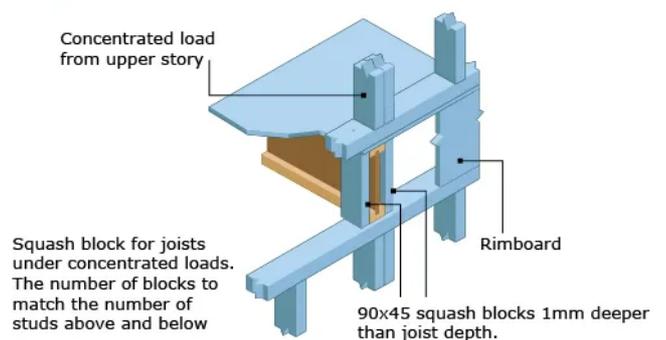
#### F3 Blocking option for lateral support



#### F5 Use of web stiffeners under concentrated loads within external load bearing walls

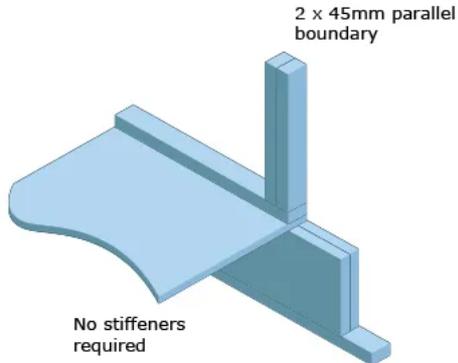


#### F4 Use squash blocks under concentrated loads from above

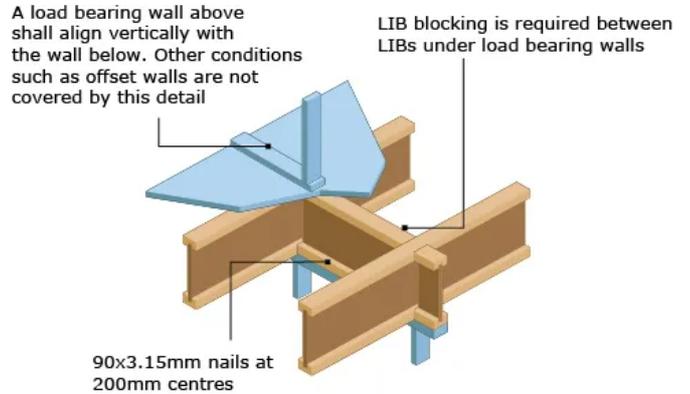


## METHODS FOR FLOOR CONSTRUCTION

**F6** No web stiffeners required under concentrated loads within load bearing walls when NZS3604:2011 applied

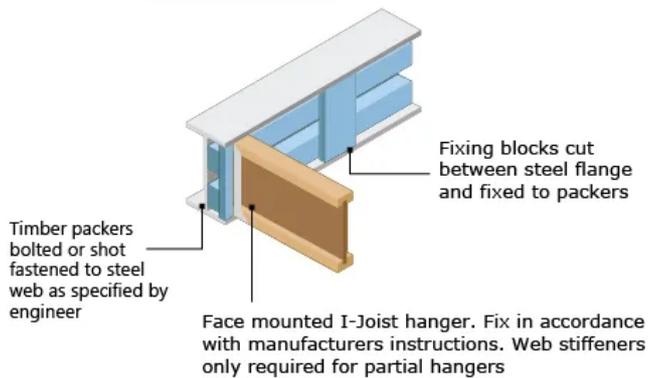


**F7** Blocking between LIBs where load bearing wall above bears on load bearing wall below

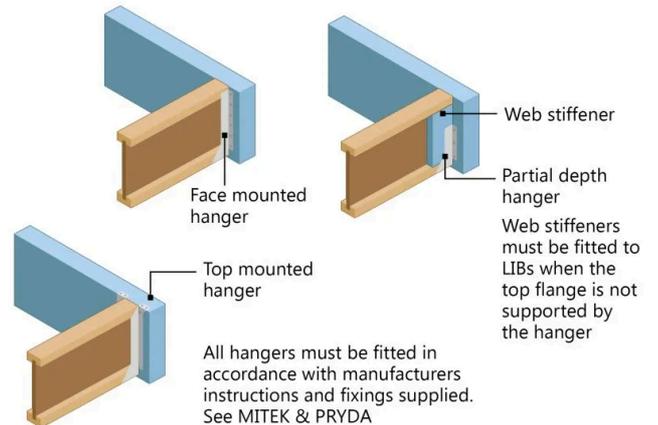


**F9** LIB connection to steel beam

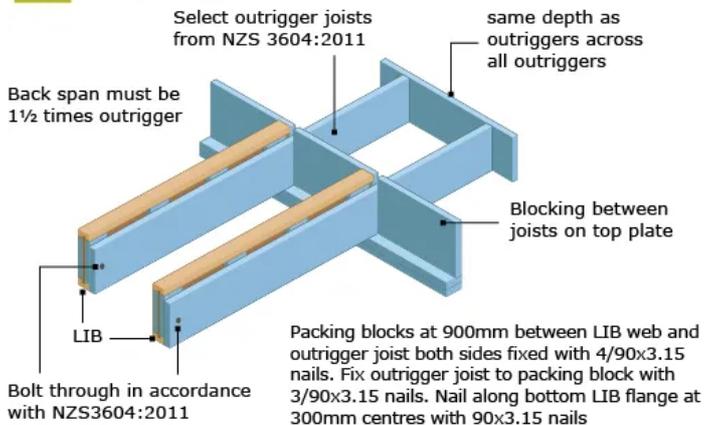
Wide Flange Steel UB connection



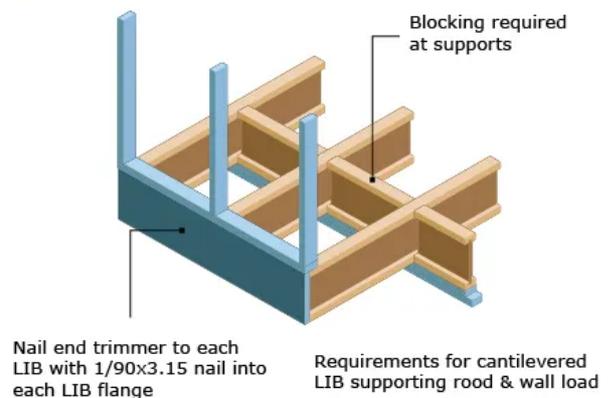
**F13** Typical joist hanger connections



**F20** Fixing outrigger joists to LIB



**F22** Fixing load bearing cantilevers



# Timber Floor

## Construction Details

### JOIST SUPPORT

#### Details

Joists were nominally 5 x 2" (125 x 50 mm) or 6 x 2" (150 x 50 mm) at 18" (450 mm) centres. It was not common for any solid blocking or herringbone strutting to be used to provide lateral support to floor joists.

Ground floor joists could be;

- Directly supported by the bearers (Figure 1) – they were sometimes notched over the bearer to form a level platform, as the framing was typically rough sawn and not gauged and this allowed the variation between individual members to be accommodated.
- Supported by a stringer or ledger fixed to the side of the jack framing to the subfloor, with a vermin plate inserted between each vertical stud (Figure 2)
- Parallel to the bearer (Figure 3).

Wall bottom plates were supported directly on joists (double joists where the wall plate was parallel to the joists) except for external walls parallel to the bearer where the wall plate was supported off the bearer with blocking (Figure 4).

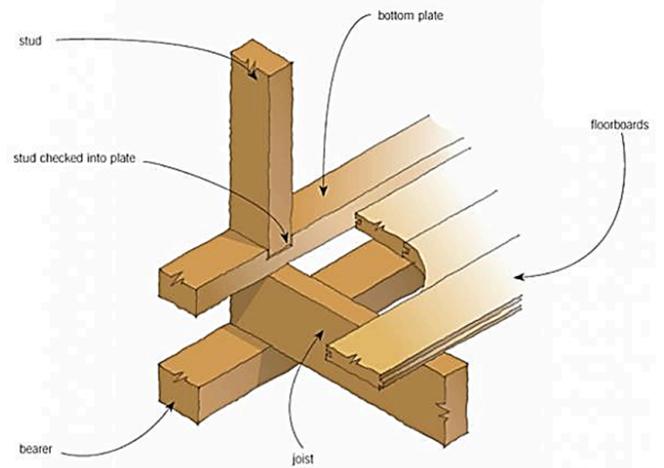


Fig 1: Joists directly supported by bearers.

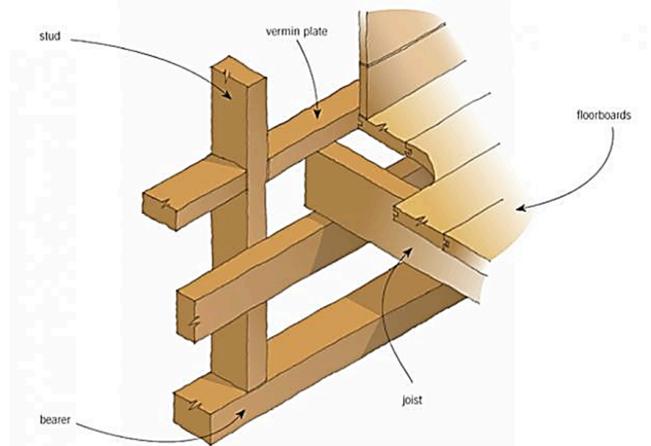


Fig 1: Joists directly supported by bearers.

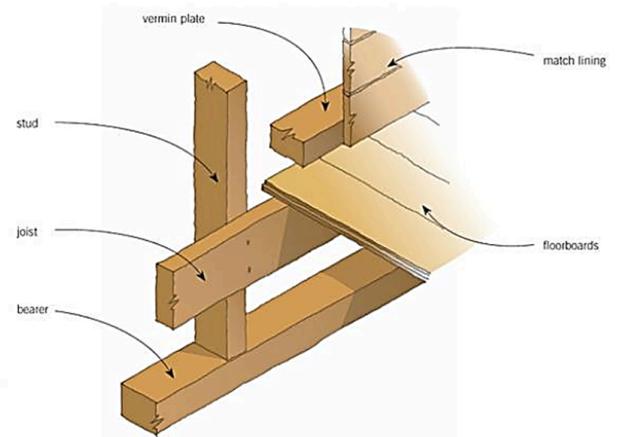


Fig 1: Joists directly supported by bearers.

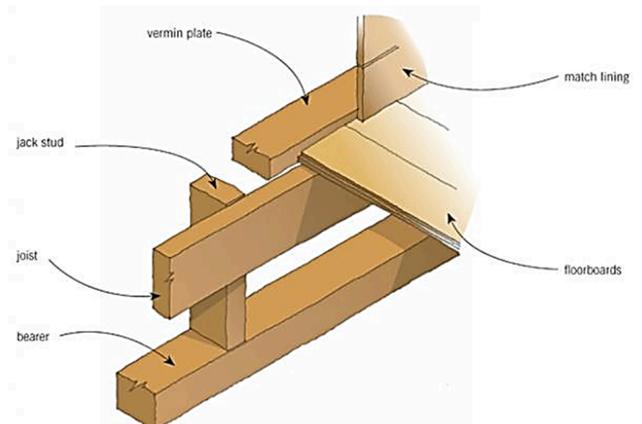


Fig 1: Joists directly supported by bearers.

## 2.6 Quizzes



### QUESTION

1) What is the function of using a timber roof in construction?

*Answer: page 38 - 39*

2) State the functions of structural components below.

i. Columns

ii. Joists

iii. Trusses

iv. Purlins

*Answer: page 40*

### QUESTION

1) What is the function of using timber walls in building construction

*Answer: page 46*

2) List the basic components of timber wall and their functions

*Answer: page 49 - 51*

3) List and illustrate types of timber wall cladding.

*Answer: page 53*



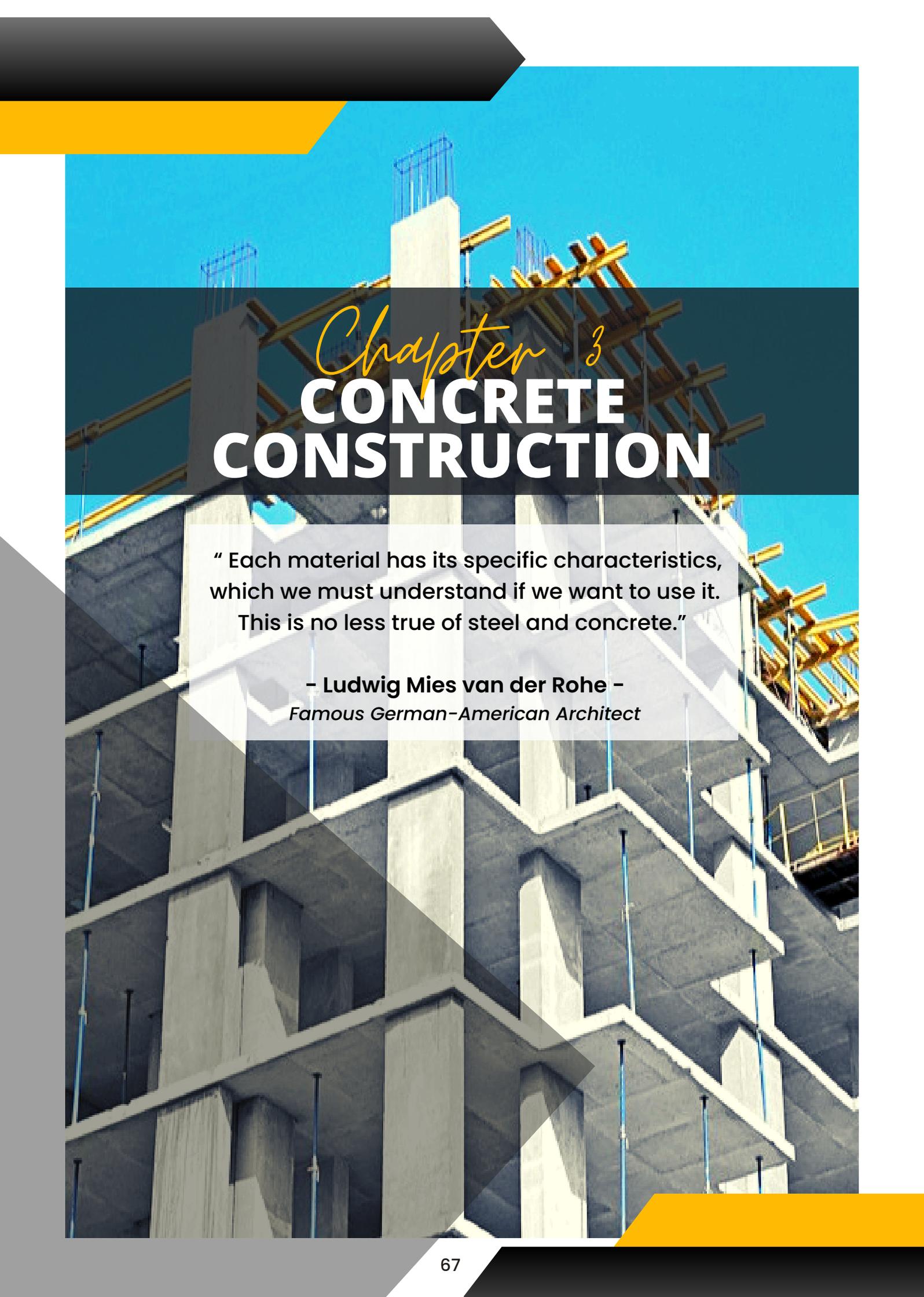
### QUESTION

1) List types of timber flooring can use in building construction.

*Answer: page 55 - 59*

2) List types of timber floor finishing can use in building construction.

*Answer: page 61*



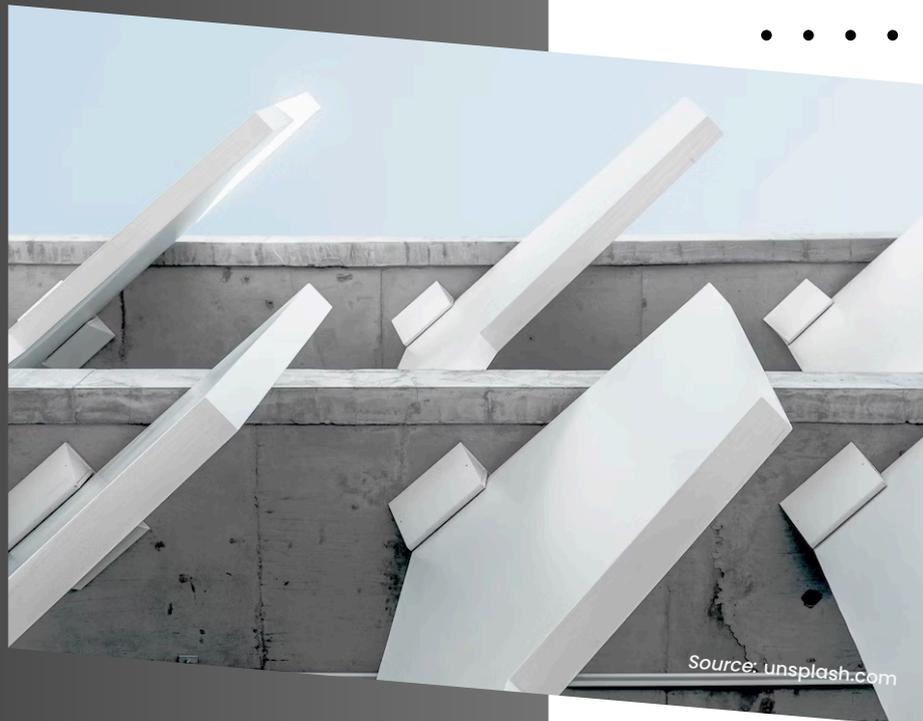
# Chapter 3 CONCRETE CONSTRUCTION

“ Each material has its specific characteristics,  
which we must understand if we want to use it.  
This is no less true of steel and concrete.”

– Ludwig Mies van der Rohe –  
*Famous German-American Architect*

# CONCRETE CONSTRUCTION

Concrete is a composite material made of cement, water, and aggregates (sand and gravel). It is one of the most widely used construction materials in the world and is used in a wide variety of applications, including buildings, bridges, roads, and dams. Concrete construction is a complex process that involves a number of steps, including formwork, placing the reinforcement, mixing the concrete, pouring, and curing. Once the concrete has cured, it is ready to be used. Concrete is a versatile material that can be used in a wide variety of applications. It is strong, durable, and fire-resistant, and is relatively inexpensive to produce.



## Topics

- 3.1 Introduction (Basic Construction for Concrete)
- 3.2 Concrete Roof Construction
- 3.3 Concrete Wall Construction
- 3.4 Concrete Slab/Flooring Construction
- 3.5 Concrete Footing/ Foundation Construction
- 3.6 Quizzes

## Objectives

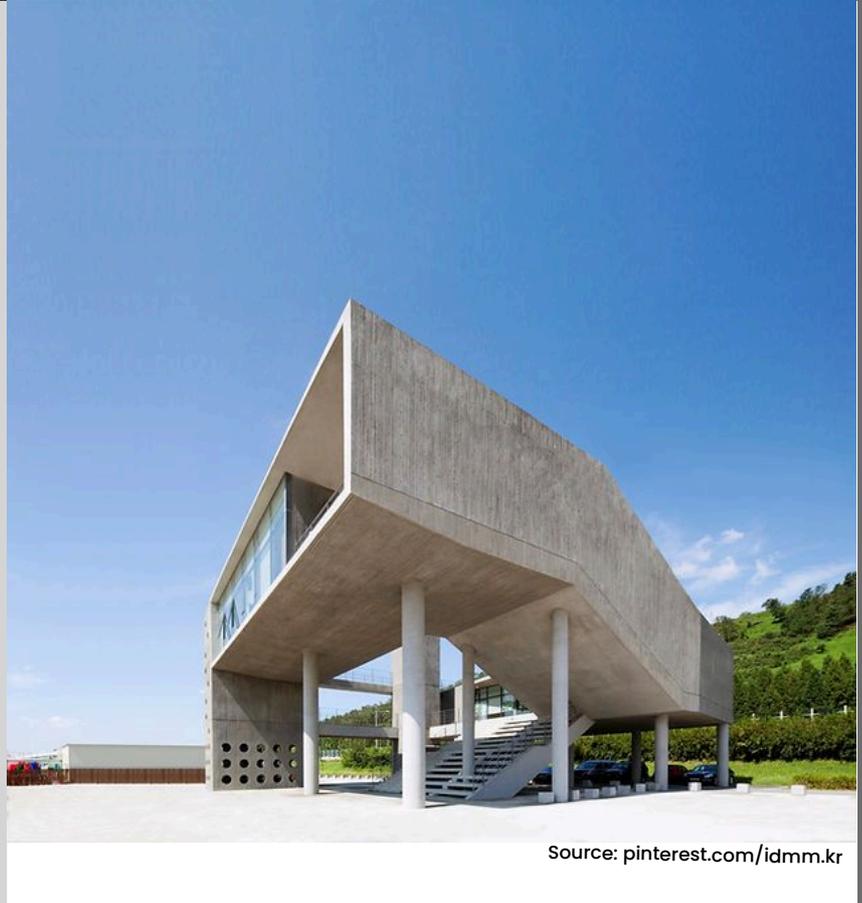
*Apply knowledge related to concrete construction that complies with Malaysian Standard (MS) for a specific project. This topic is to emphasize skills, professionalism, and communication to understand the methods of construction in compliance with Uniform Building By-Laws (UBBL 1984).*

# BASIC CONSTRUCTION FOR *Concrete*

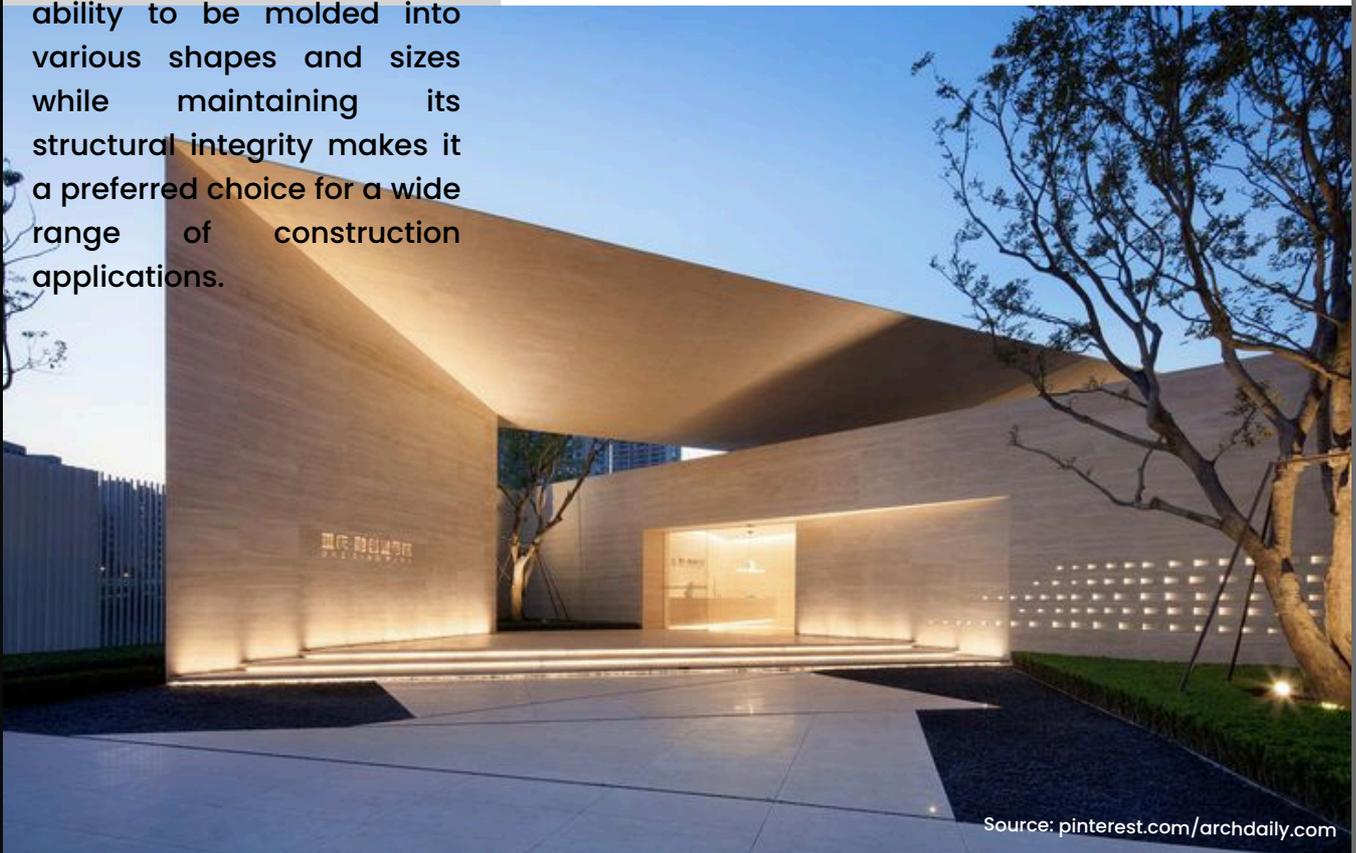
## 3.1 Introduction Basic Construction For Concrete

Concrete is one of the most essential materials in modern building construction. Its versatility, durability, and structural capabilities have made it a fundamental element in architectural design.

- Concrete is composed of cement, aggregates (such as sand and gravel), water, and often other additives.
- When mixed and cured properly, it gains strength and becomes a solid, long-lasting building material. Its ability to be molded into various shapes and sizes while maintaining its structural integrity makes it a preferred choice for a wide range of construction applications.



Source: [pinterest.com/idmm.kr](https://pinterest.com/idmm.kr)



Source: [pinterest.com/archdaily.com](https://pinterest.com/archdaily.com)

## 3.2 CONCRETE

# ROOF

## CONSTRUCTION



Concrete roofs offer a robust and reliable solution for various building types, ranging from residential to commercial and industrial structures. Concrete roof construction can be achieved through two primary methods: cast-in-place concrete and precast concrete panels.

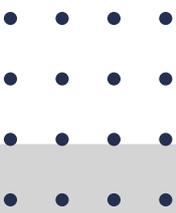
### Cast-in-Place Concrete Roofs:

- Involves pouring concrete directly onto the roof structure's formwork.
- Reinforcement, such as steel bars or mesh, is embedded within the concrete to enhance its tensile strength.
- The concrete is poured, leveled, and finished to achieve the desired surface texture.
- Proper curing is crucial to achieve optimal strength and durability.
- Cast-in-place roofs are versatile and can accommodate complex shapes and designs.

### Precast Concrete Roof Panels:

- Panels are manufactured off-site in controlled environments.
- These panels are then transported and lifted into place using cranes.
- Connections between panels are carefully designed to ensure structural integrity.
- Precast panels can have various finishes, textures, and even embedded architectural details.

# Cast-in-Place Concrete Roof



Casting structural components in situ (cast-in-place) is the classic method of concrete construction. Components are produced where they will be used in their final structural position. Although the structural components that were the subjects of Joseph Monier's first reinforced concrete patent in 1879 were essentially precast concrete elements, cast-in-place concrete construction was always regarded as the main construction method in the application and development of modern concrete construction.

The first stage of in-situ concrete construction is to erect formwork (a mould) to shape the subsequent structural component's geometrical form.

If reinforced concrete is used, the next step is to make and lay reinforcement. These operations are often carried out step by step, because formwork can only be completed after reinforcement is completely laid

Concrete cast in situ forms the basis for a monolithic concrete structure from start of construction to the completion of the building's shell.



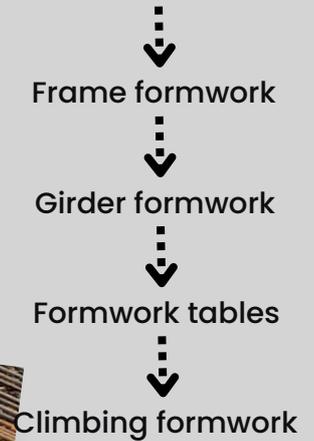
## Cast-in-Place Concrete Roof

Laying and tying reinforcement in a slab

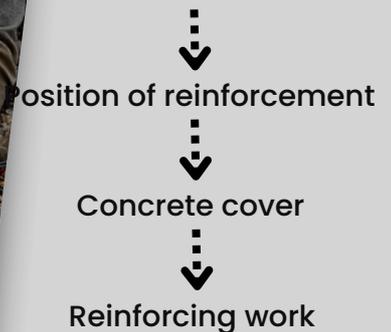
Source: unsplash.com

The friction-locked connection to the next structural component forms an adequate connecting reinforcement. Apart from a few exceptional cases, formwork is removed after the concrete sets. There is some stages from formwork until concreting to form cast-in-place concrete structure.

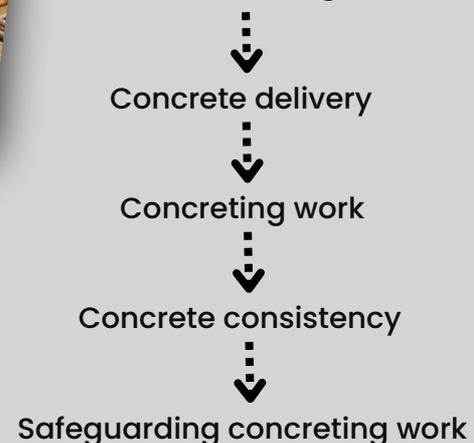
### 1) Formwork and formwork skin.



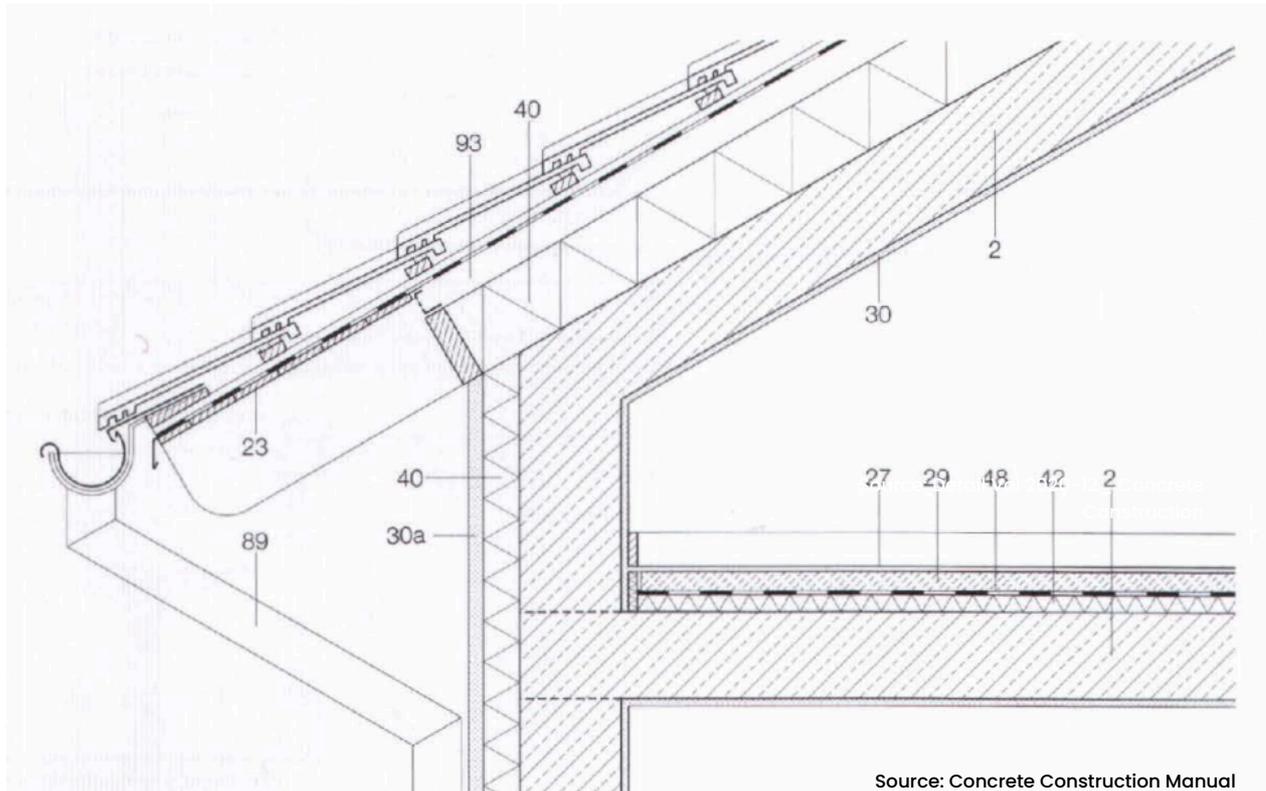
### 2) Reinforcement



### 3) Concreting



## SOLID ROOF CAST-IN-PLACE CONCRETE



Source: Concrete Construction Manual

- 1. Concrete
- 2. In-situ reinforced concrete
- 3. Precast concrete element
- 4. Grout
- 14. Timber
- 20. Sheet metal capping
- 20a. Metal roof covering
- 23. Timber boarding
- 27. Synthetic floor covering/ carpet
- 29. Screed
- 30. Plaster
- 30a. Rendering
- 40. Thermal insulation
- 42. Impact sound insulation
- 43. Waterproofing
- 48. Interlayer

Section detail of solid roof  
Cast-in-place/ In-situ concrete

# Precast Concrete Roof Panel

Industrial construction with precast components began in the mid-20th century and its share of the total volume of concrete construction is still constantly growing. Today's precast component plants can produce a one-off structural component as efficiently as they can produce many identical units because mould construction, production, the installation of reinforcement and other built-in elements, concreting and even finishing, stripping and storage logistics, are all electronically controlled and largely automated.

**This methods starts from some stages to produce pre-cast concrete components:**

- 1) Joints techniques
- ↓
- 2) Design of precast components
- ↓
- 3) Compressive strengths of the concrete in precast components
- ↓
- 4) Structural elements
- ↓
- 5) Semi-finished parts
- ↓
- 6) Thermo-active structural components
- ↓
- 7) Tolerances
- ↓
- 8) Surface qualities
- ↓
- 9) Acceptance



Precast concrete component production



concrete hollow slab made of 50 mm concrete, hollow concrete blocks and semi-finished concrete beams between them

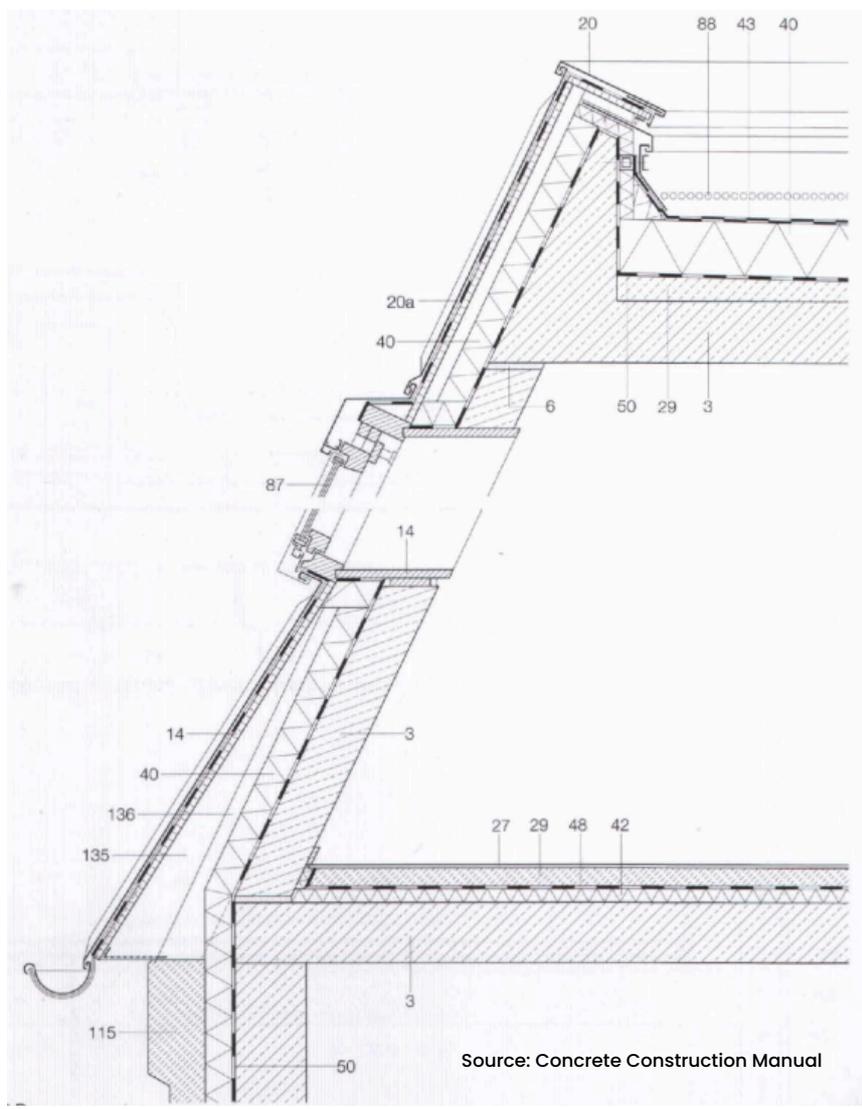


Thermo-active semi-finished elements for production



Laid slab elements with integrated thermal and sound insulation, connecting reinforcement

## SOLID ROOF PRECAST CONCRETE



- 1. Concrete
- 2. In-situ reinforced concrete
- 3. Precast concrete element
- 4. Grout
- 14. Timber
- 20. Sheet metal capping
- 20a. Metal roof covering
- 23. Timber boarding
- 27. Synthetic floor covering/ carpet
- 29. Screed
- 30. Plaster
- 30a. Rendering
- 40. Thermal insulation
- 42. Impact sound insulation
- 43. Waterproofing
- 48. Interlayer

Section detail of solid roof  
Precast concrete

# Flat Roofs

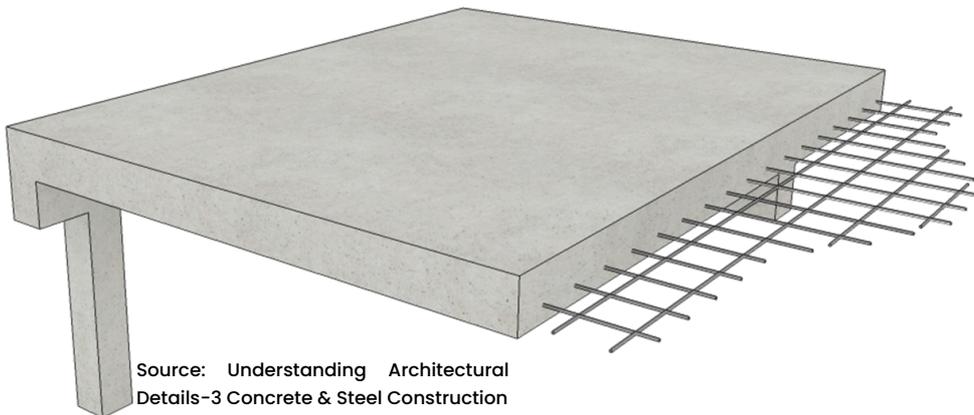
*construction*

A flat roof is a roof with a pitch less than 10°. The main elements of the flat roof are the roof structure, usually provided by the building frame. The roof deck, which is the element to which the covering will be applied, and the roof covering that provides the weather protection.

In some cases we see that the roof deck and structure are combined, for example when constructed in concrete cast in situ or precast units.

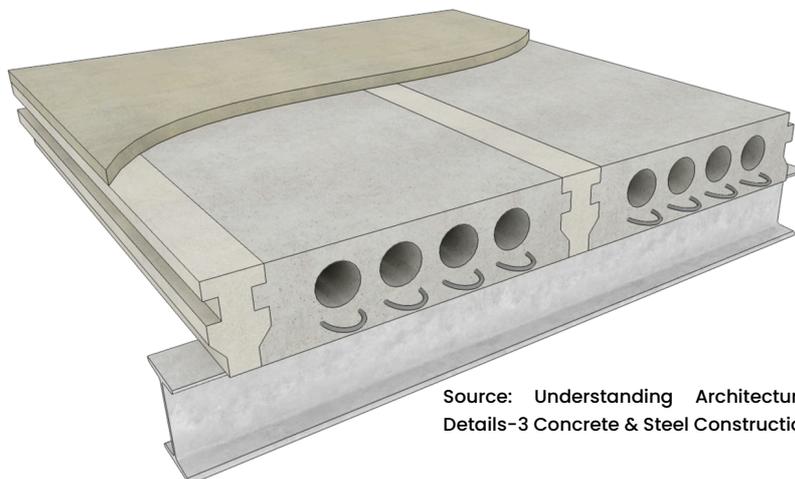
Flat roof deck:

The flat roof deck can be constructed of concrete or profiled steel sheets which are supported by the structure of the building. Concrete options include cast in situ, plank, beam and block, hollow precast, or plank and beam. Profiled metal decking is usually as base for the addition of a concrete upper section that provides the final deck for the insulation and waterproof membrane.



Source: Understanding Architectural Details-3 Concrete & Steel Construction

Example of a reinforced concrete deck cast in-situ



Source: Understanding Architectural Details-3 Concrete & Steel Construction

Example of a hollow pre-cast deck

# Flat Roofs

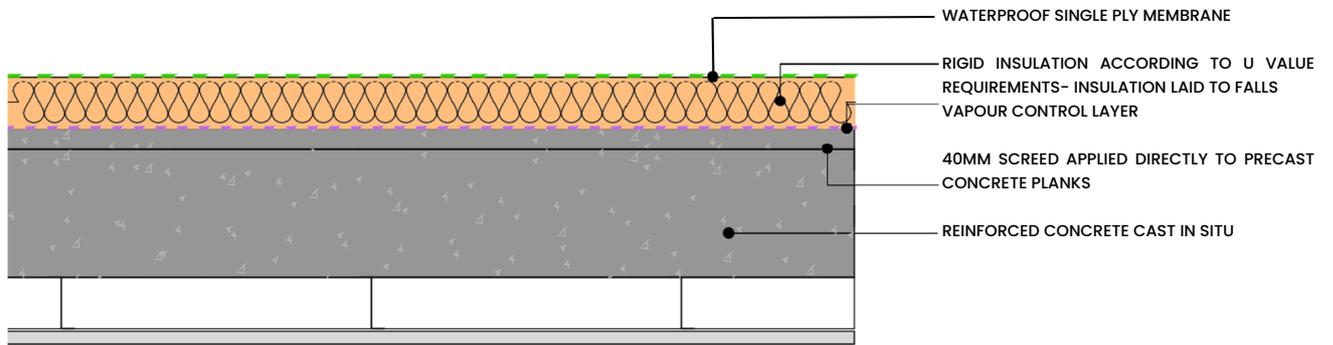
*construction*



Source: Understanding Architectural  
Details-3 Concrete & Steel Construction

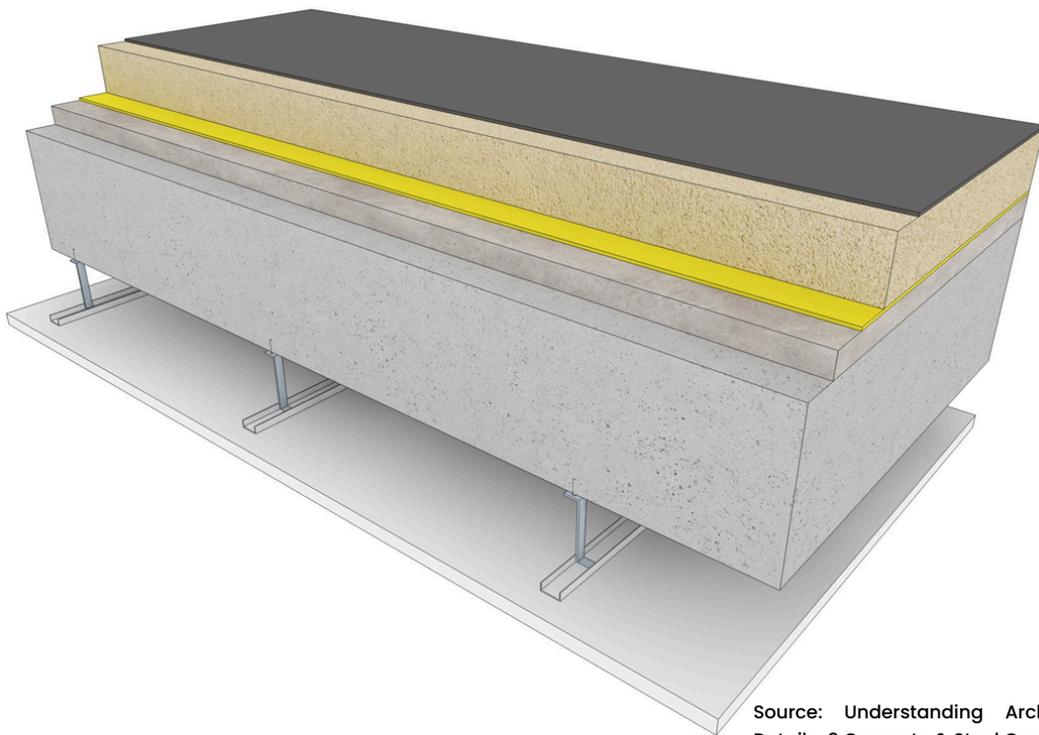
Example of a beam and block deck

# Roof construction Details



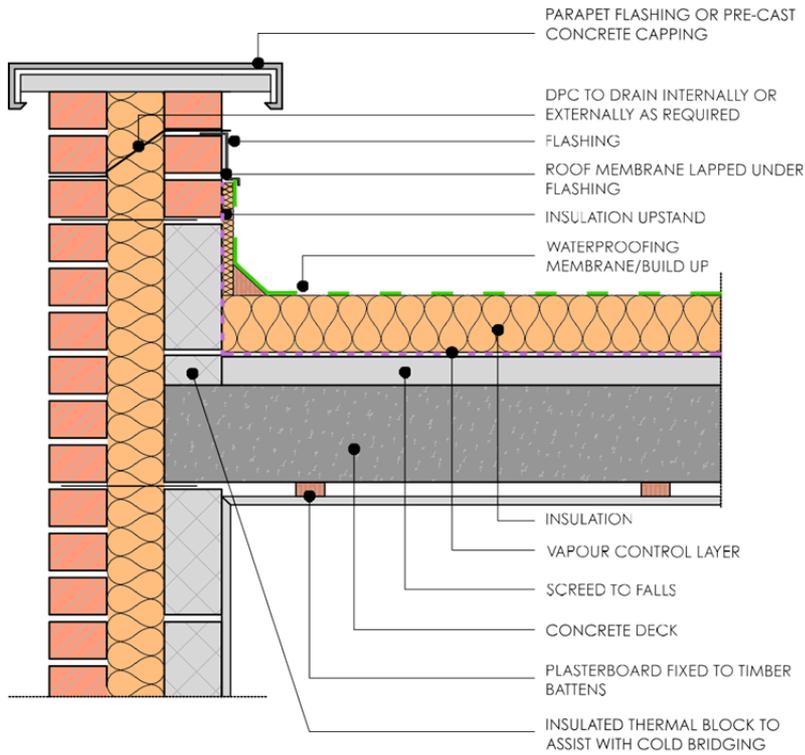
Source: Understanding Architectural Details-3 Concrete & Steel Construction

Example of a beam and block deck



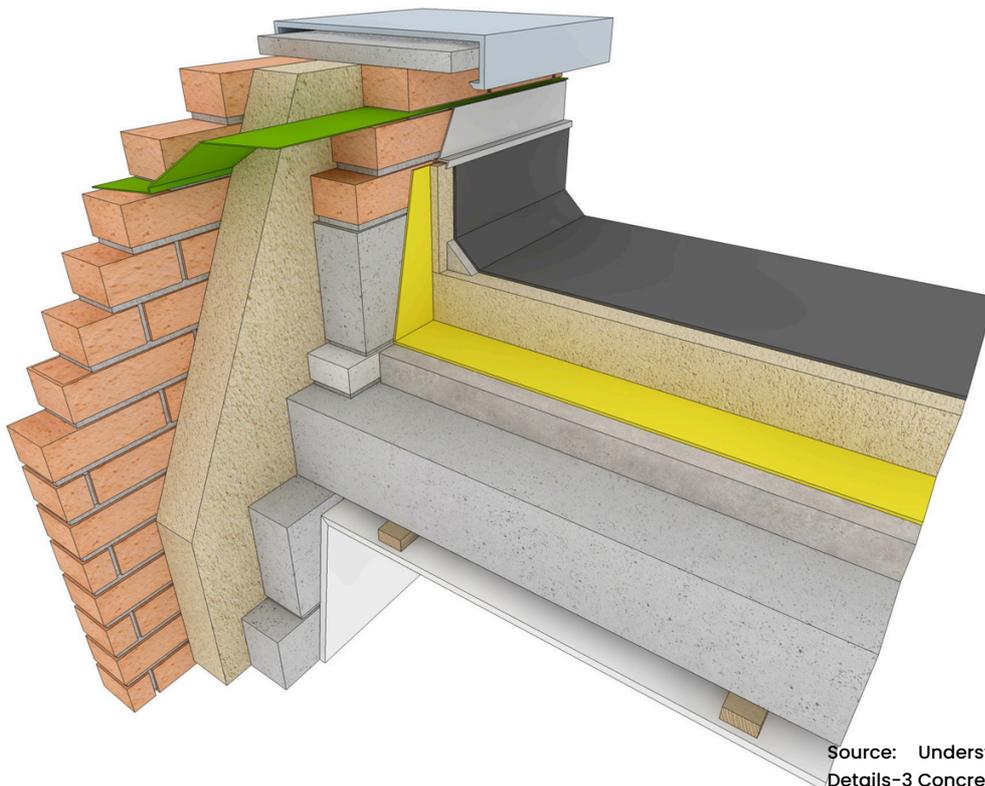
Reinforced concrete warm deck

# Roof construction Details



Source: Understanding Architectural Details-3 Concrete & Steel Construction

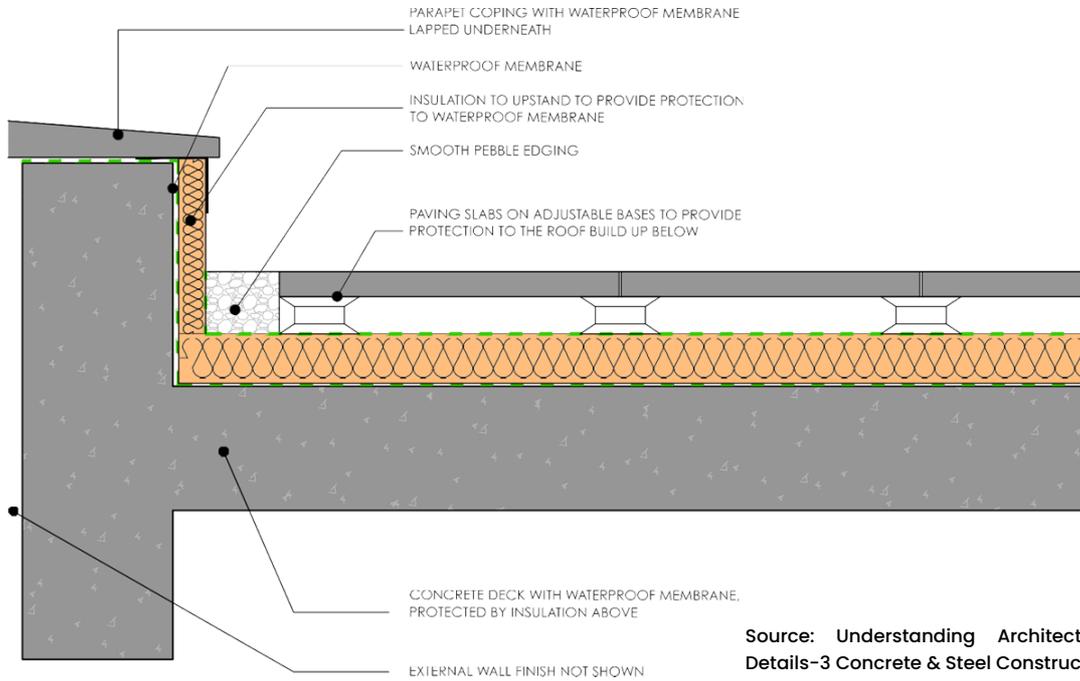
Section drawing of concrete deck parapet junction



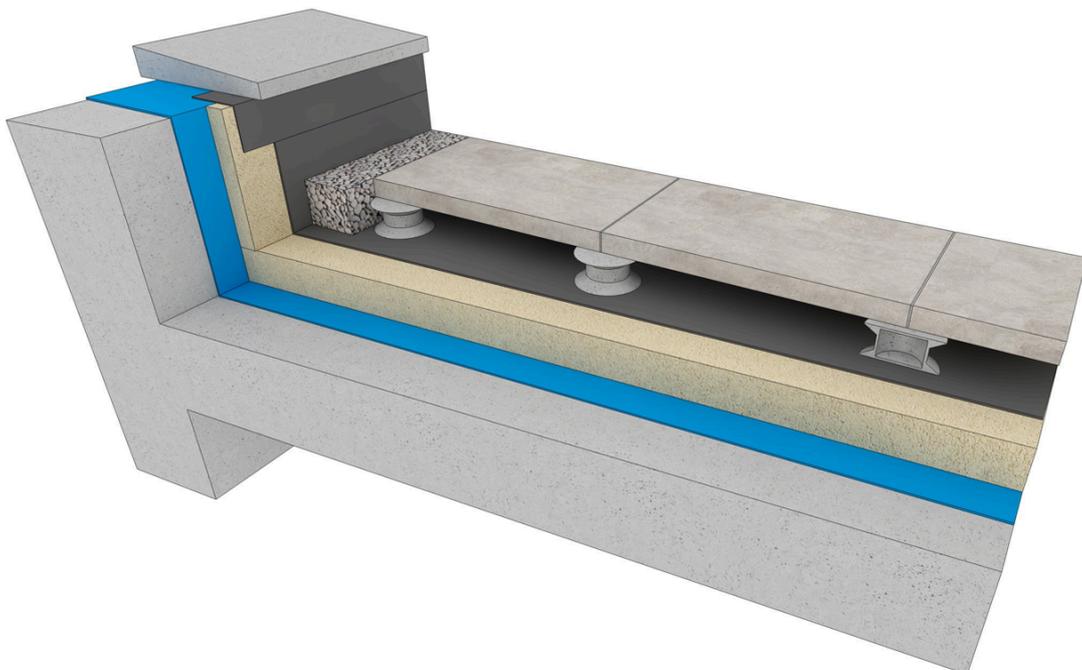
Source: Understanding Architectural Details-3 Concrete & Steel Construction

3D drawing of concrete deck parapet junction

# Roof construction Details

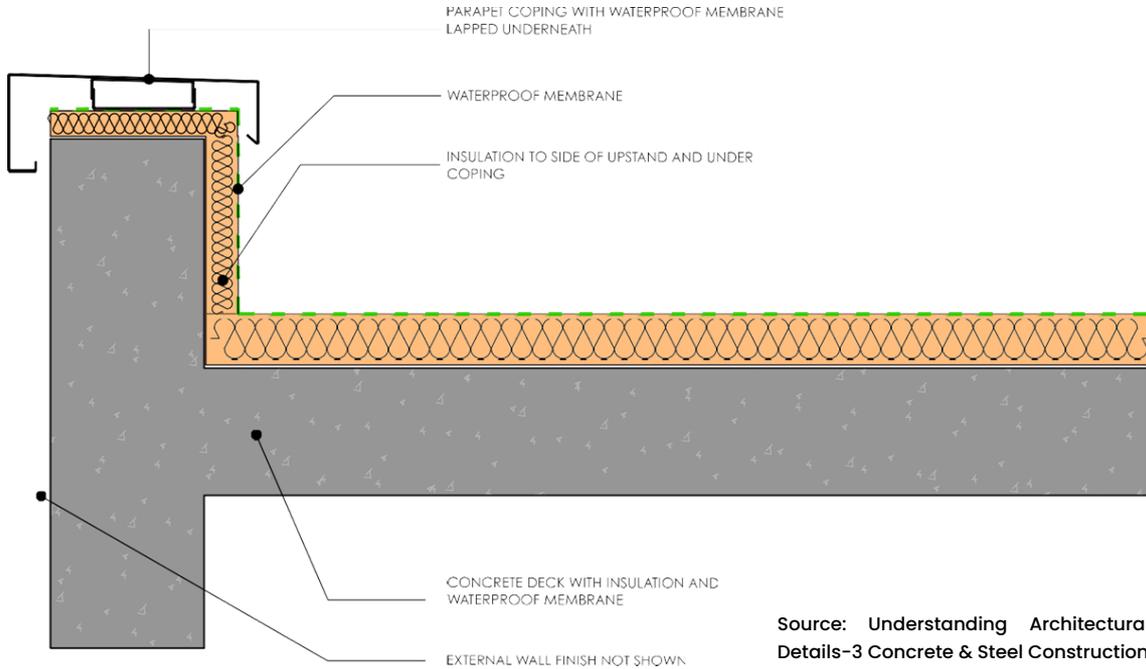


Section drawing of concealed and protected membrane

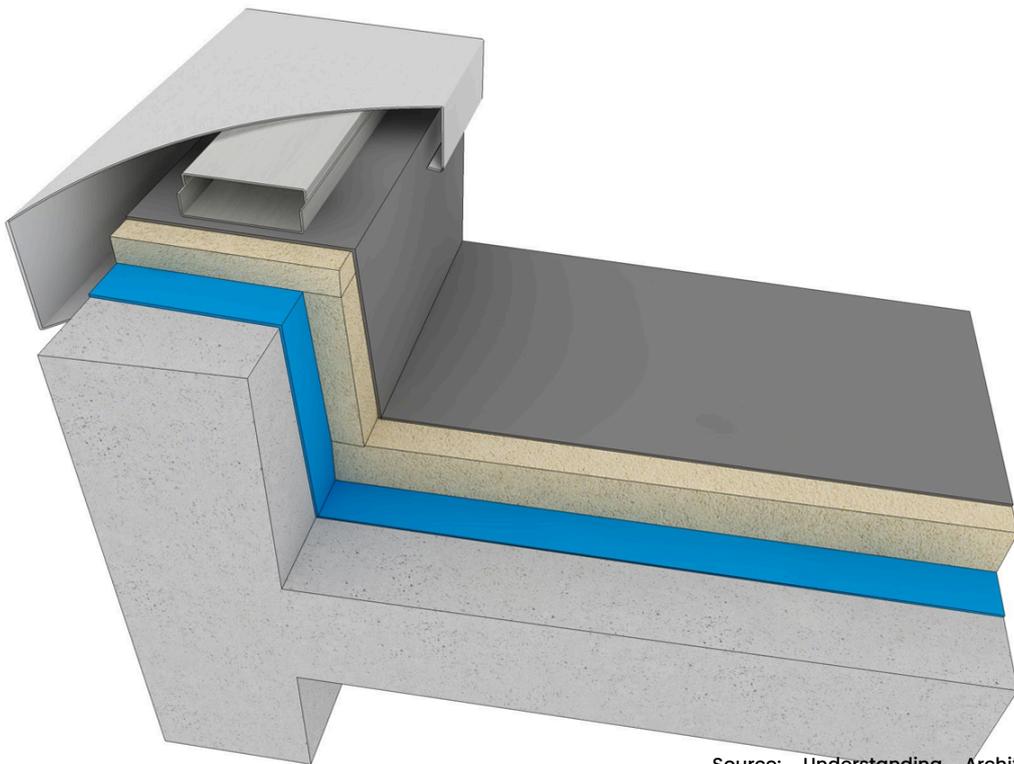


3D drawing of concealed and protected membrane

# Roof construction Details

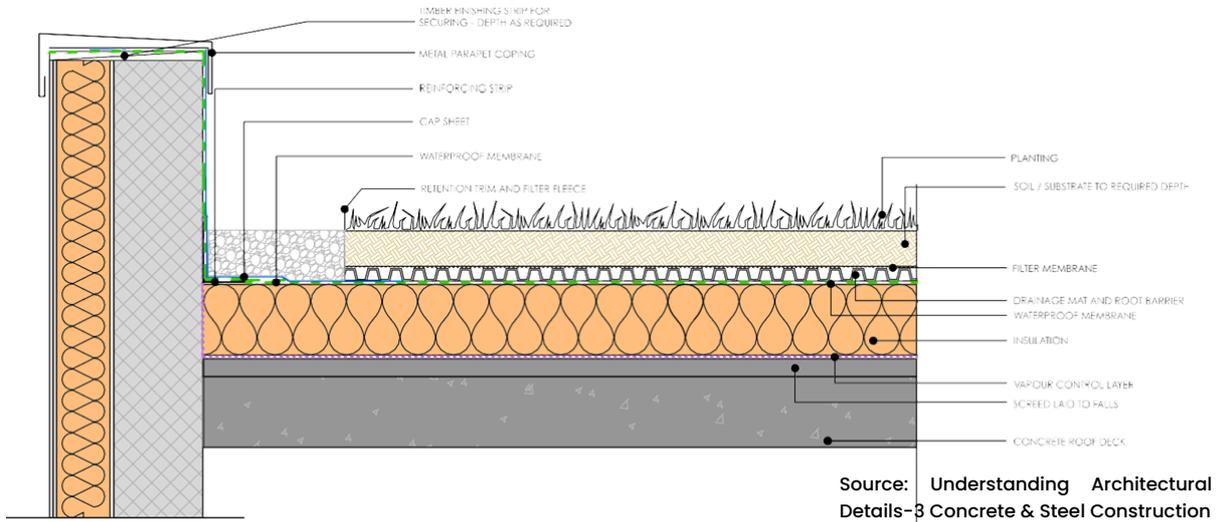


Section drawing of exposed single ply membrane

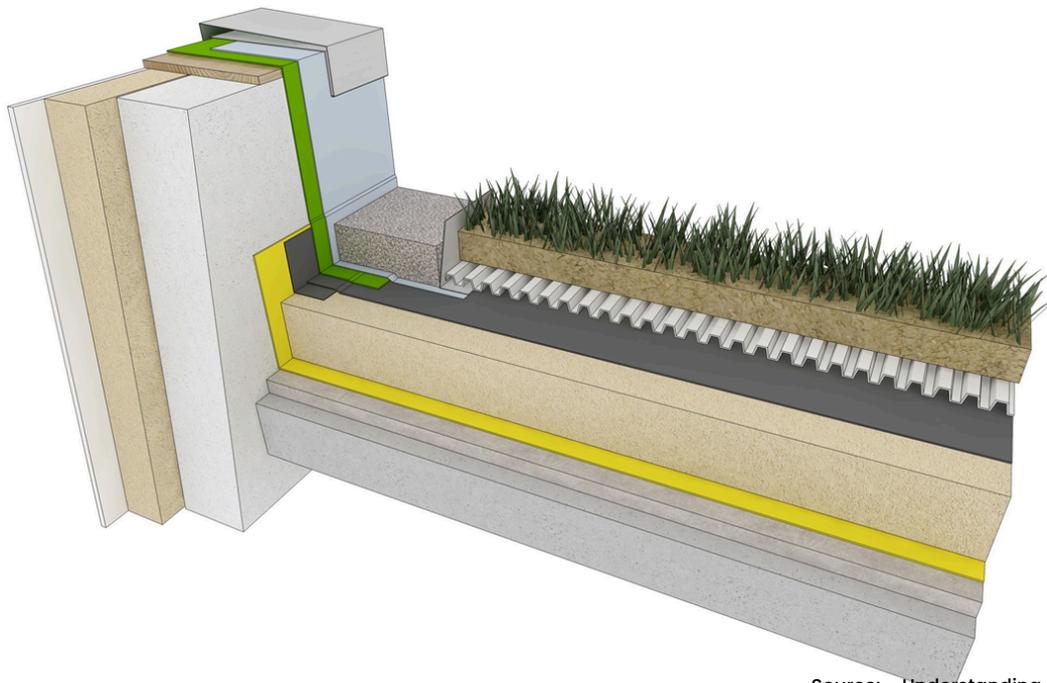


3D drawing of exposed single ply membrane

# Roof construction Details



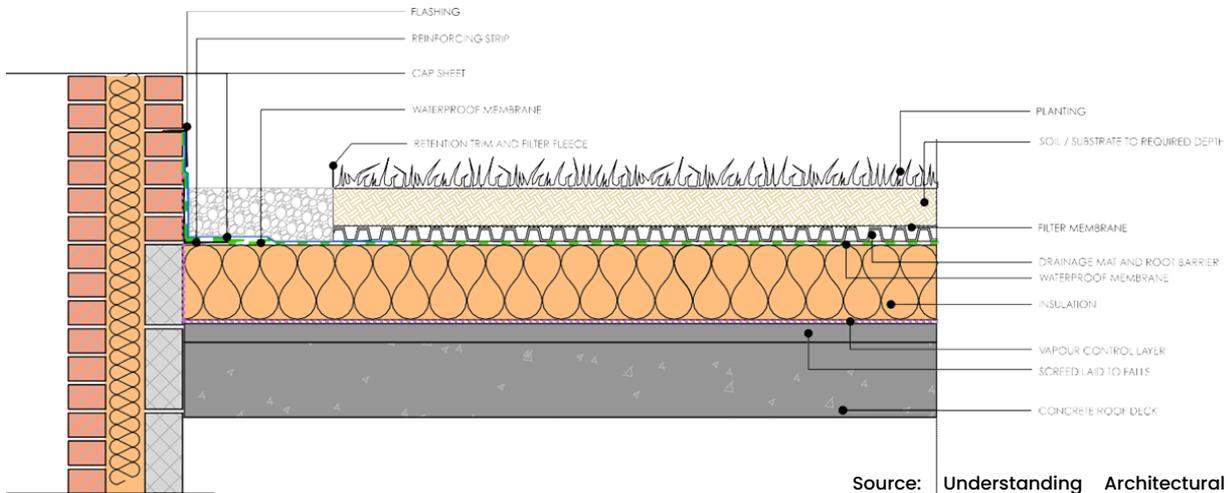
Section drawing of extensive green roof – parapet detail option



Source: Understanding Architectural Details-3 Concrete & Steel Construction

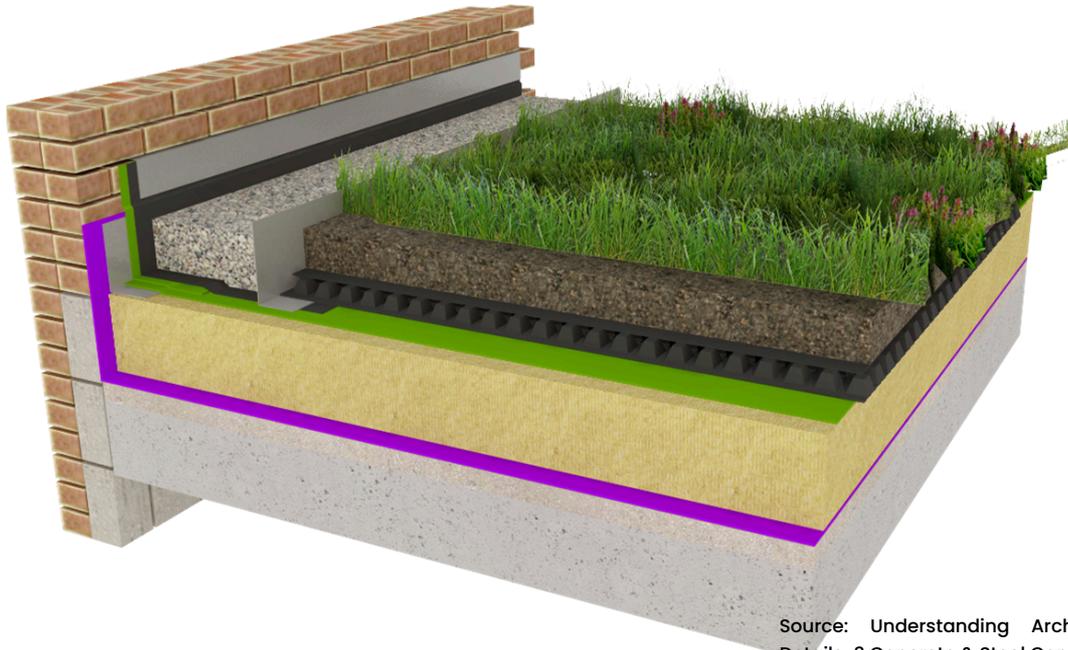
3D drawing of extensive green roof – parapet detail option

# Roof construction Details



Source: Understanding Architectural Details-3 Concrete & Steel Construction

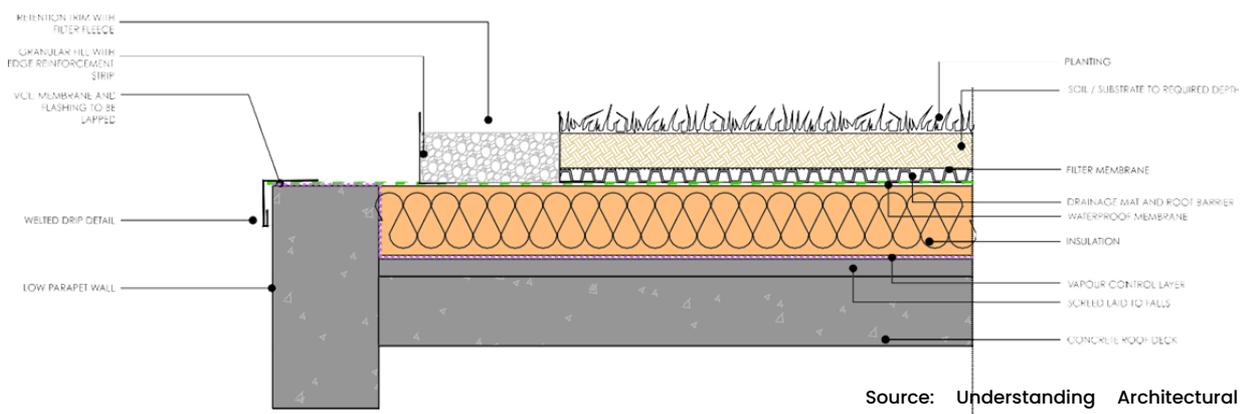
Section drawing of extensive green roof - wall connection



Source: Understanding Architectural Details-3 Concrete & Steel Construction

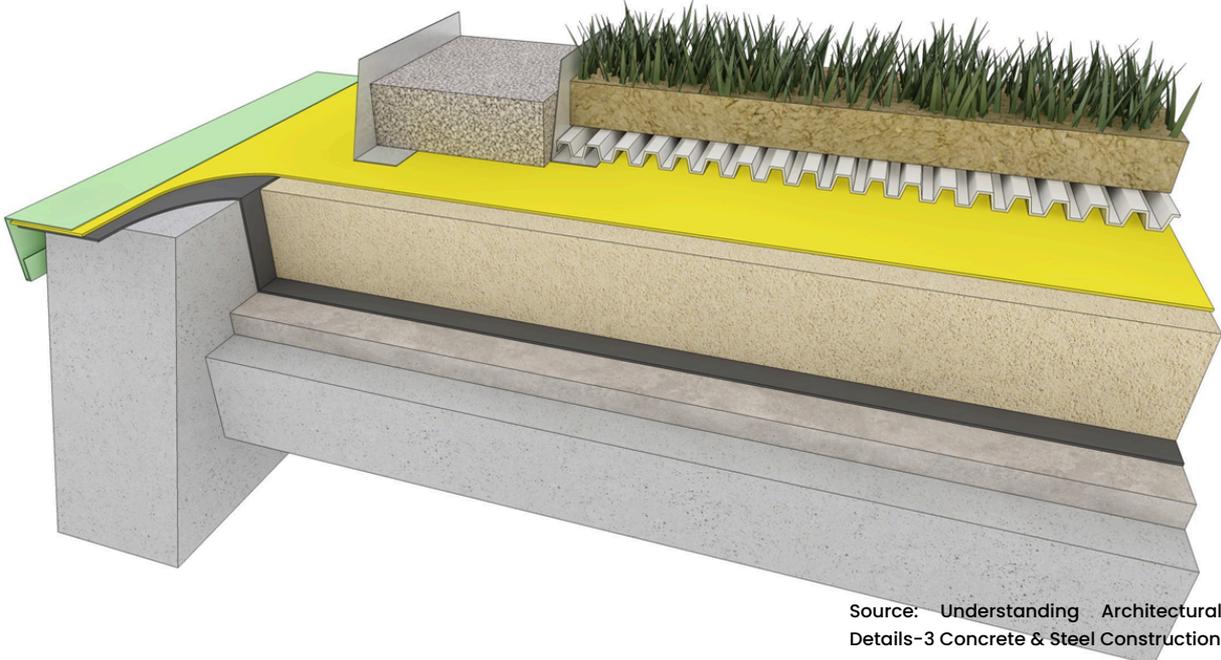
3D drawing of extensive green roof - wall connection

# Roof construction Details



Source: Understanding Architectural Details-3 Concrete & Steel Construction

Section drawing of extensive green roof - low parapet



Source: Understanding Architectural Details-3 Concrete & Steel Construction

3D drawing of extensive green roof - low parapet

## 3.3 CONCRETE

# Wall

## CONSTRUCTION

Concrete walls serve as load-bearing and non-load-bearing components of a building's structure. They can be used for exterior and interior walls, providing strength, fire resistance, and insulation. Concrete wall construction methods include:



”

### Cast-in-Place Concrete Walls:

- Similar to cast-in-place roofs, concrete is poured into formwork to create the wall structure.
- Reinforcement is crucial to handle lateral forces and prevent cracking.
- Formwork can be removed after the concrete gains sufficient strength.
- These walls can support vertical loads and resist external pressures.

”

### Concrete Block Walls:

- Concrete blocks are pre-manufactured units made from concrete or concrete-like materials.
- Blocks are stacked and mortared together to form walls.
- Different block types (solid, hollow, etc.) offer various insulation and load-bearing capabilities.
- Concrete block walls are commonly used for both structural and partition walls.

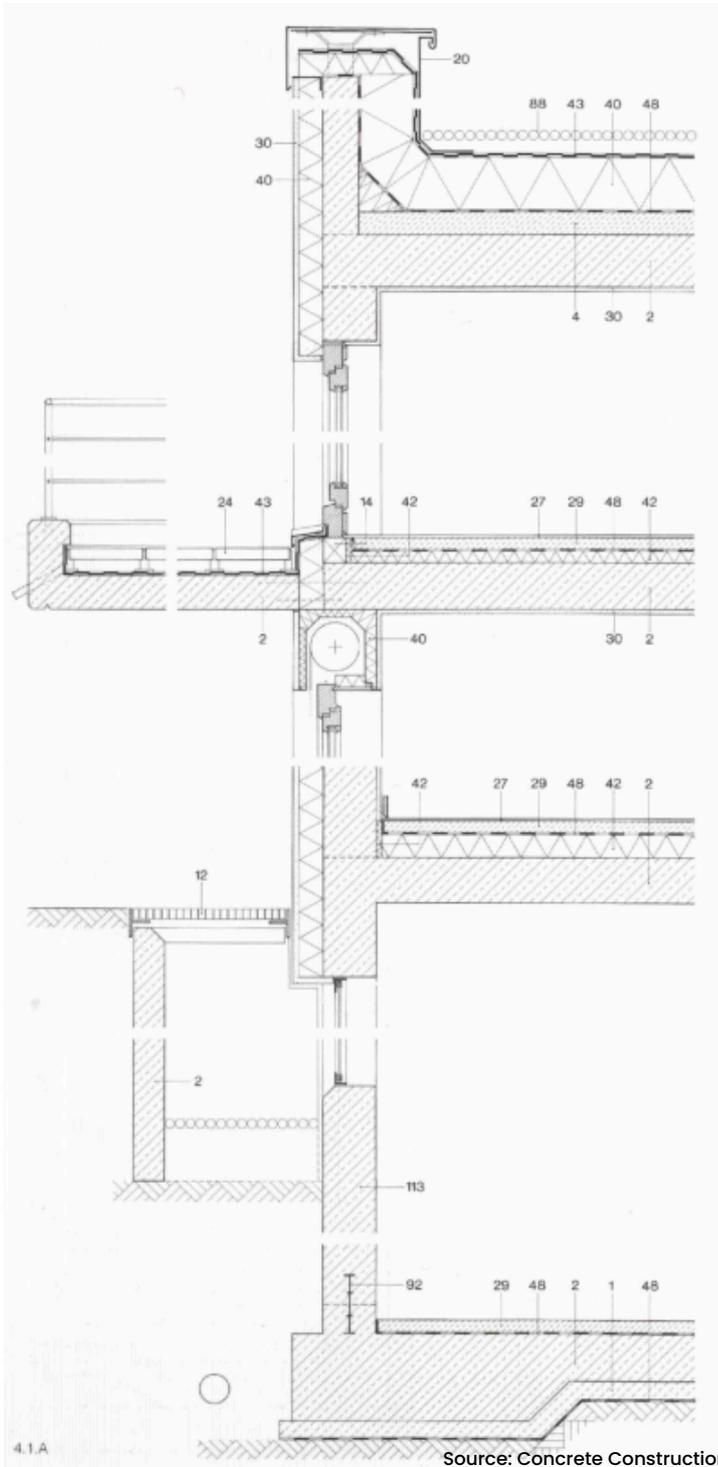
”

### Precast Concrete Wall Panels:

- Similar to precast roof panels, precast wall panels are manufactured off-site.
- Panels can have integrated insulation, finishes, and openings.
- Installation is quicker than cast-in-place methods, reducing construction time.

# Wall construction Details

## CAST-IN-PLACE/ IN-SITU CONCRETE WALL



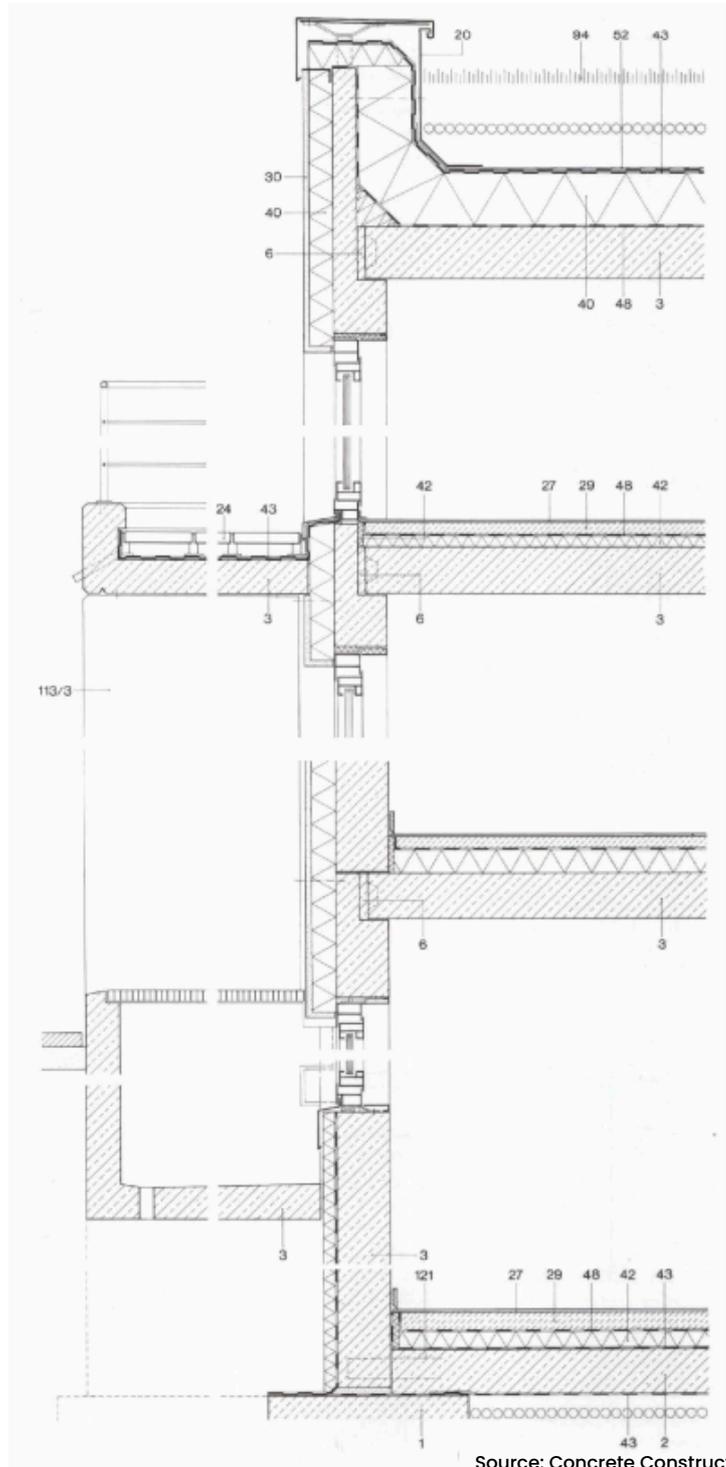
Source: Concrete Construction Manual

- 1. Concrete
- 2. In-situ reinforced concrete
- 3. Precast concrete element
- 4. Lightweight concrete
- 6. Grout
- 12. Steel grating
- 14. Timber
- 20. Sheet metal capping/ flashing
- 24. Paving slabs
- 27. Synthetic floor covering/ carpet

Section detail of Loadbearing external wall, single leaf  
In-situ concrete

# Wall construction Details

## PRECAST CONCRETE WALL



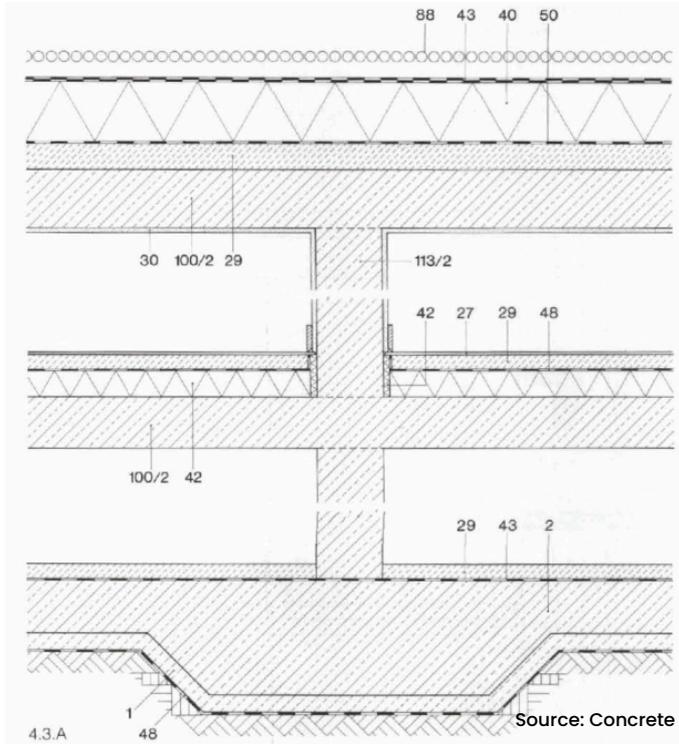
- 29. Screed
- 30. Rendering
- 40. Thermal Insulation
- 41. Impact Sound Insulation
- 42. Bitumenised felt (waterproofing)
- 48. Interlayer
- 52. Roof penetration protection mat
- 88. Gravel
- 92. Roof planting
- 113. Wall
- 121. Reinforced

Source: Concrete Construction Manual

Section detail of Loadbearing external wall, single leaf  
Pre-cast concrete

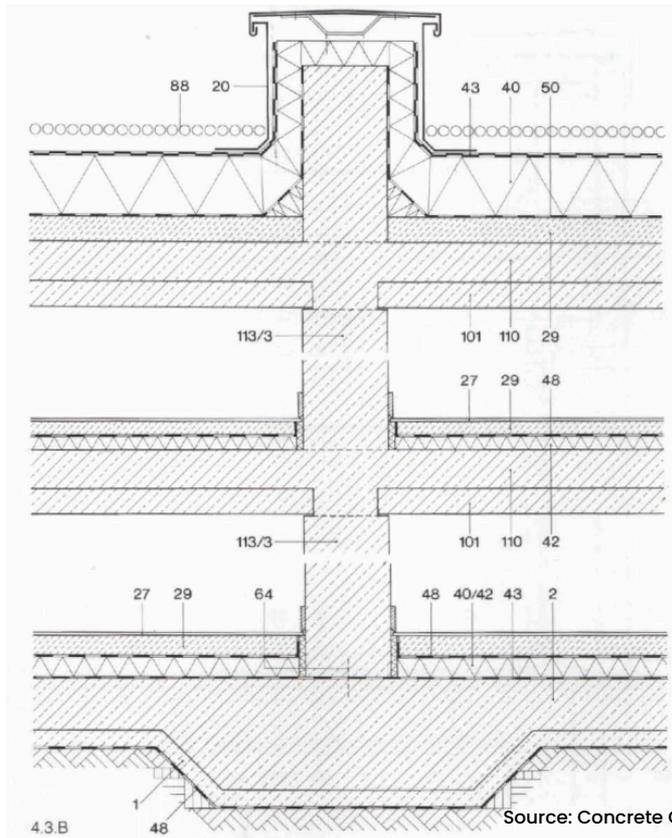
# Wall construction Details

## LOADBEARING INTERNAL WALL



- 48 Interlayer
- 50. Vapour Layer
- 52. Root Penetration protection mat
- 64. Dowel Bar
- 88. Gravel
- 94. Roof Planting
- 100. Slab supported on beam or wall
- 101. Precast roofing unit
- 110. Concrete topping
- 113. Wall
- 114. Sandwich panel
- 132. Spandrel beam

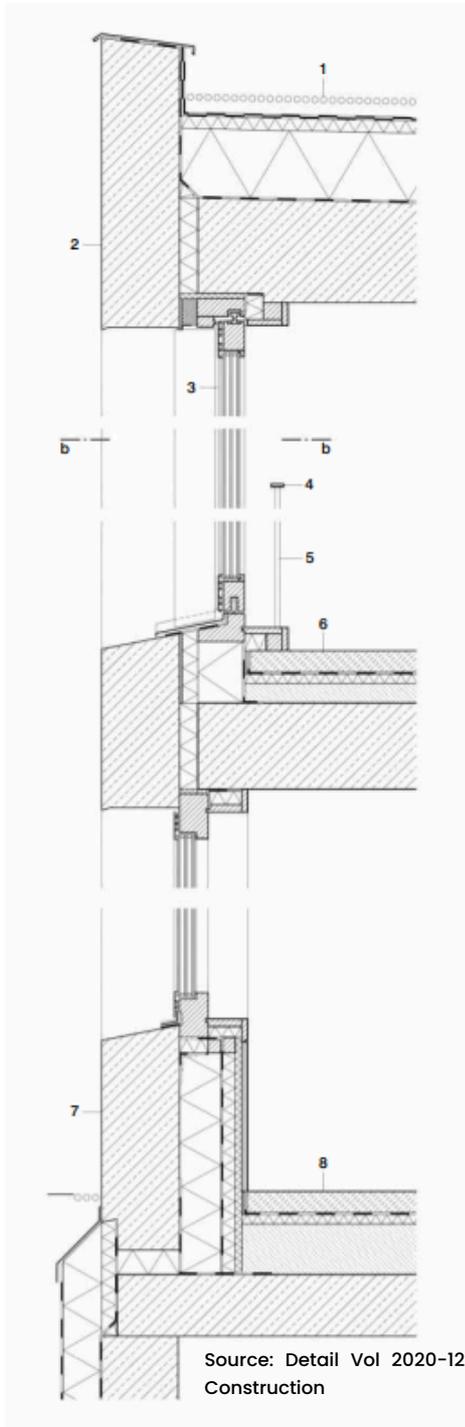
Section detail of loadbearing internal wall  
In-situ concrete



- 48 Interlayer
- 50. Vapour Layer
- 52. Root Penetration protection mat
- 64. Dowel Bar
- 88. Gravel
- 94. Roof Planting
- 100. Slab supported on beam or wall
- 101. Precast roofing unit
- 110. Concrete topping
- 113. Wall
- 114. Sandwich panel
- 132. Spandrel beam

Section detail of loadbearing internal wall  
Precast concrete

# Wall construction Details



Source: Detail Vol 2020-12\_ Concrete Construction



Source: Detail Vol 2020-12\_ Concrete Construction

Housing and Studio Block in Bregenz

- 1 roof construction: 60 mm bed of round gravel ( $\varnothing$  16–32 mm) with thermal insulation 250–340 mm reinforced concrete roof finished to falls
- 2 250 mm black pigmented reinforced conc. parapet wall
- 3 sliding door in wood frame with burnished brass lining
- 4 brass handrail
- 5 brass balusters
- 6 upper floor: 70 mm cement and-sand screed separating layer 30 mm glass-wool impact-sound insulation 70 mm EPS filling 280 mm reinforced concrete floor
- 7 wall construction: reinforced concrete with extruded polystyrene thermal insulation adhesive fixed to concrete vapour barrier
- 8 ground floor construction: 70 mm cement and-sand screed with sound insulation reinforced concrete floor

Section detail of reinforced concrete parapet wall with sliding door.



Source: unsplash.com

## 3.4 CONCRETE

# SLAB/FLOORING

## CONSTRUCTION

Concrete slab and floor construction are fundamental components of building structures, providing the foundation and walking surfaces in various types of buildings. These elements are critical for ensuring stability, durability, and functionality in construction projects.

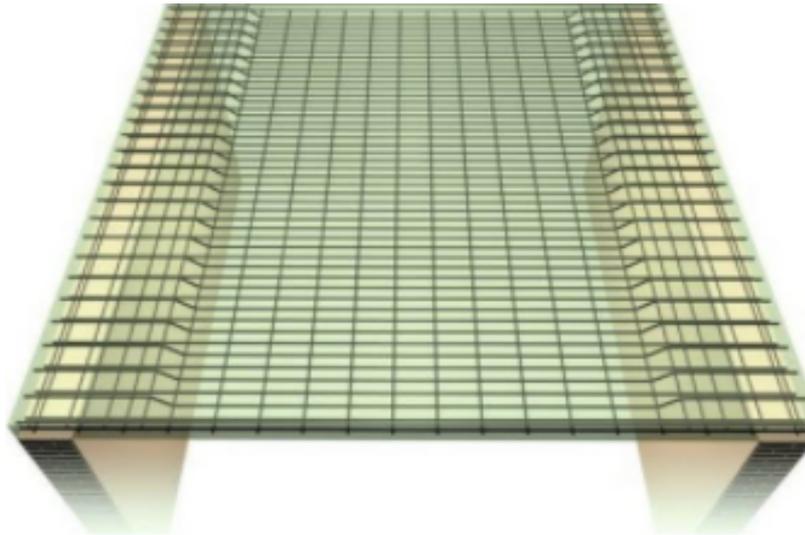
### Types of concrete slab systems

- One-Way Slab
- Two-Way Slab
- Ribbed/ Waffle Slab
- Hollow Core Slab

# One-Way Slab

*construction*

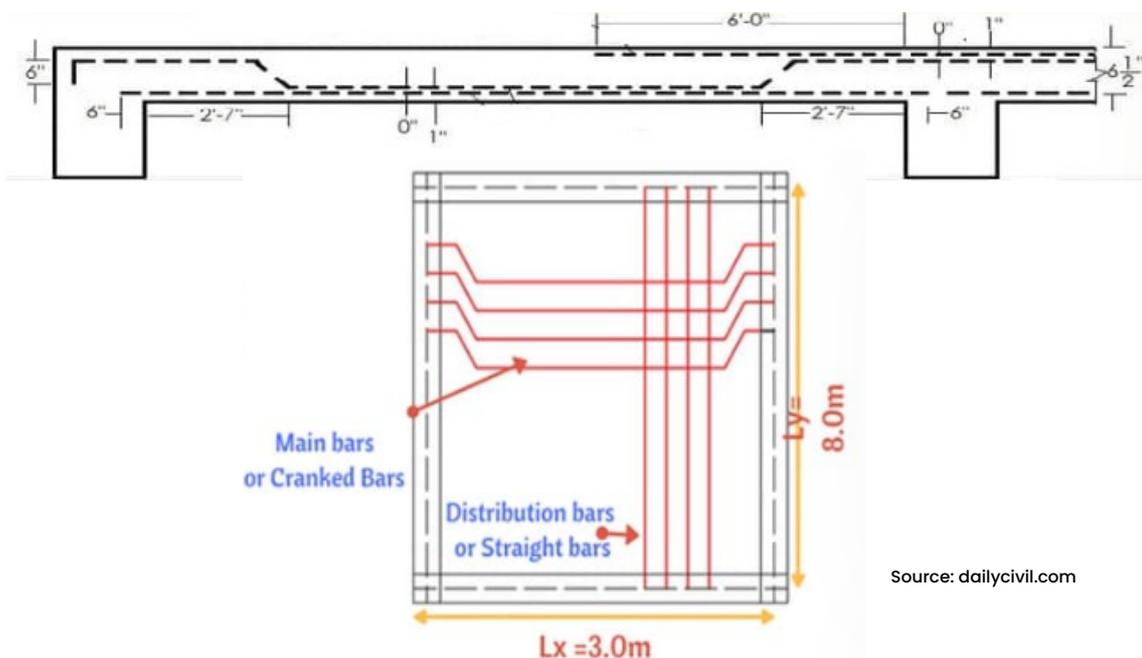
A one-way slab is a type of reinforced concrete slab that is designed to primarily support and distribute loads in one direction. It is one of the simplest and most common forms of concrete slab systems used in construction. They are often used in structures with long spans, such as beams and girders, to support the slab.



Source: tutorialstipscivil.com

# One-Way Slab Details

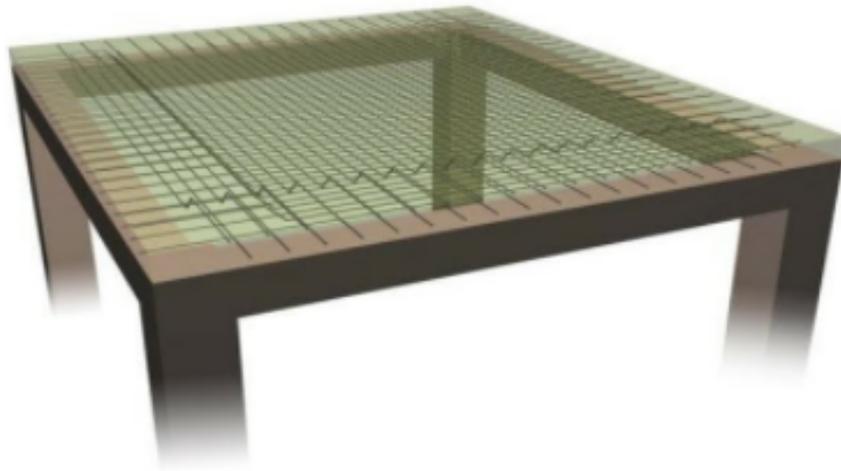
*construction*



Source: dailycivil.com

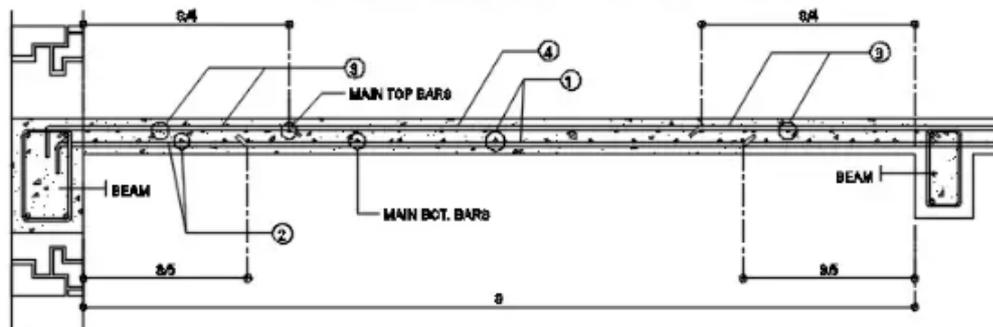
# Two-Way Slab *construction*

A two-way slab is a type of reinforced concrete slab that is designed to distribute and support loads in both the longitudinal and transverse directions. Unlike one-way slabs, which primarily carry loads in one direction, two-way slabs are better suited for situations where loads are distributed more evenly and may come from various directions.



Source: tutorialstipscivil.com

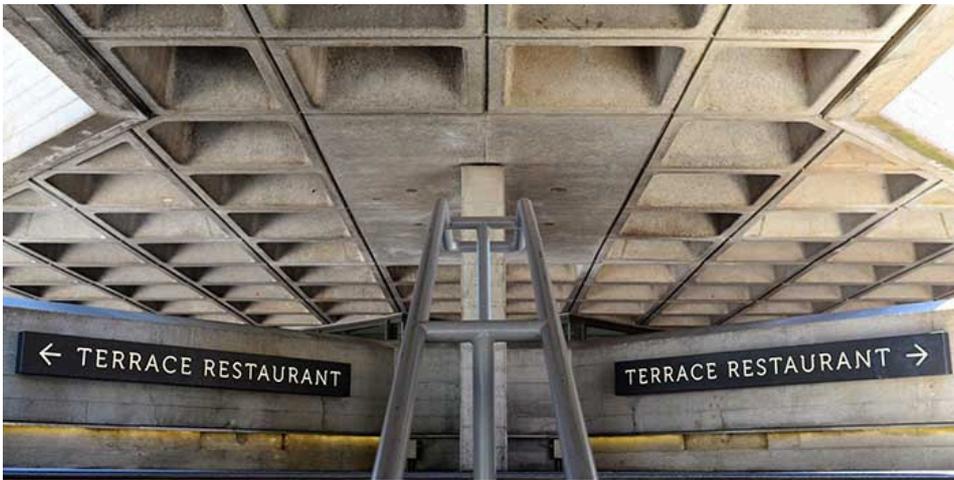
# Two-Way Slab Details *construction*



Source: cadbull.com/detail/169955

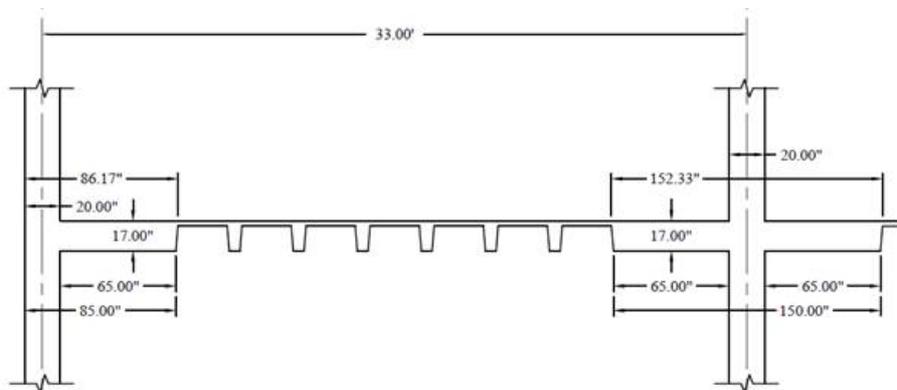
# Waffle Slab *construction*

A waffle slab, also known as a ribbed slab or grid slab, is a type of reinforced concrete slab characterized by a grid-like pattern of deep ribs or voids formed on the underside of the slab. These ribs create a waffle-like appearance and give the slab its name. Waffle slabs are used in various construction projects, especially in commercial and industrial buildings, and they offer several advantages in terms of strength, load-bearing capacity, and aesthetics.



Source: internationalemc.com

# Waffle Slab Details *construction*



Source: structurepoint.org

# Hollow Core Slab

*construction*

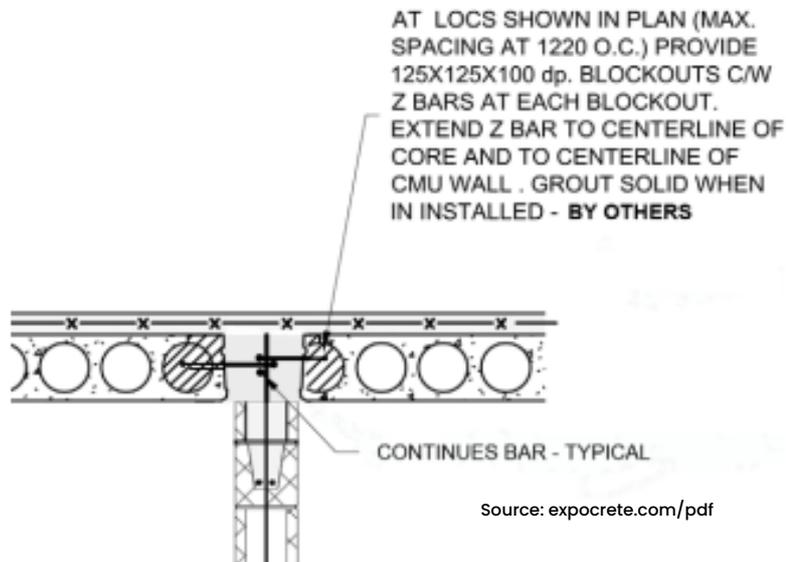
A hollow core slab is a type of precast concrete slab with hollow voids running longitudinally through the slab's cross-section. These voids or cores help reduce the overall weight of the slab while maintaining its structural integrity. Hollow core slabs are commonly used in various construction applications, such as residential, commercial, and industrial buildings, to create floors and ceilings.



Source: metric.com.my

# Hollow Core Slab Details

*construction*



Source: expocrete.com/pdf

## 3.5 CONCRETE

# FOUNDATION

## CONSTRUCTION



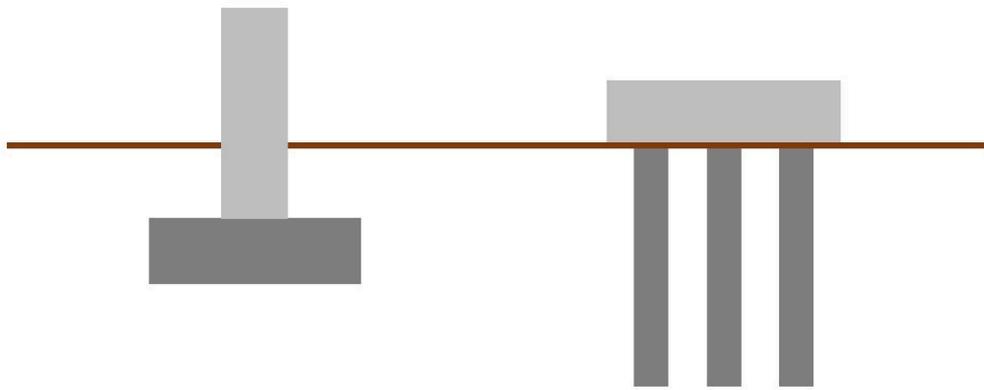
Source: mnaquality.com

A concrete foundation is a fundamental structural element used in construction to provide a solid and stable base for buildings or other structures. It serves as the platform upon which the entire structure is built, supporting the weight of the building and transferring it to the ground. Concrete is the most common material used for constructing foundations due to its strength, durability, and ability to withstand the compressive forces associated with supporting structures.

There are various types of concrete foundations, and the choice of type depends on factors like local building codes, soil conditions, climate, and the specific requirements of the building.

# Types of Foundation Systems

Basically there are two broad categories of foundation. There are shallow foundations and deep foundations.



**Shallow Foundations**

**Deep Foundations**

A shallow foundation, also known as a "spread footing" or "surface foundation," is a type of foundation used in construction where the load from the structure is distributed over a relatively shallow depth beneath the ground surface. Shallow foundations are typically used when the soil or rock directly beneath the building is strong enough to support the structure without the need for deep excavation.

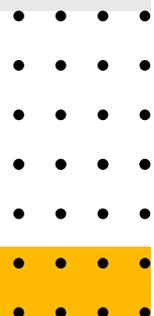
A deep foundation is a type of foundation used in construction when the soil or rock near the ground surface is unable to support the loads of a building or structure. Deep foundations are designed to transfer the load to deeper, more stable layers of soil or rock below the surface. These foundations are typically used in areas with poor or inconsistent soil conditions, heavy structural loads, or when the structure needs to be anchored to bedrock.

Common types of shallow foundation include:

1. Strip Footing
2. Spread Footing
3. Raft Foundation

Common types of deep foundation include:

1. Pile Foundations
2. Caisson Foundations



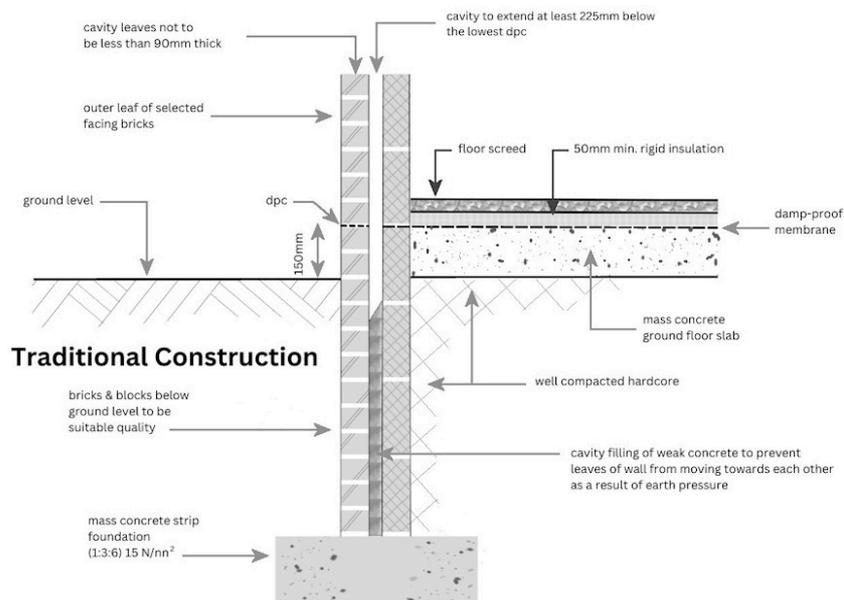
## Strip Footing *construction*

A strip footing, also known as continuous footing or strip foundation, is a type of shallow foundation used in construction to distribute the structural load of a building or wall along a continuous, horizontal strip of concrete. It is typically constructed beneath load-bearing walls, perimeter walls, or columns and serves to transfer the building's weight to the underlying soil.



Source: housing.com

## Strip Footing Details *construction*

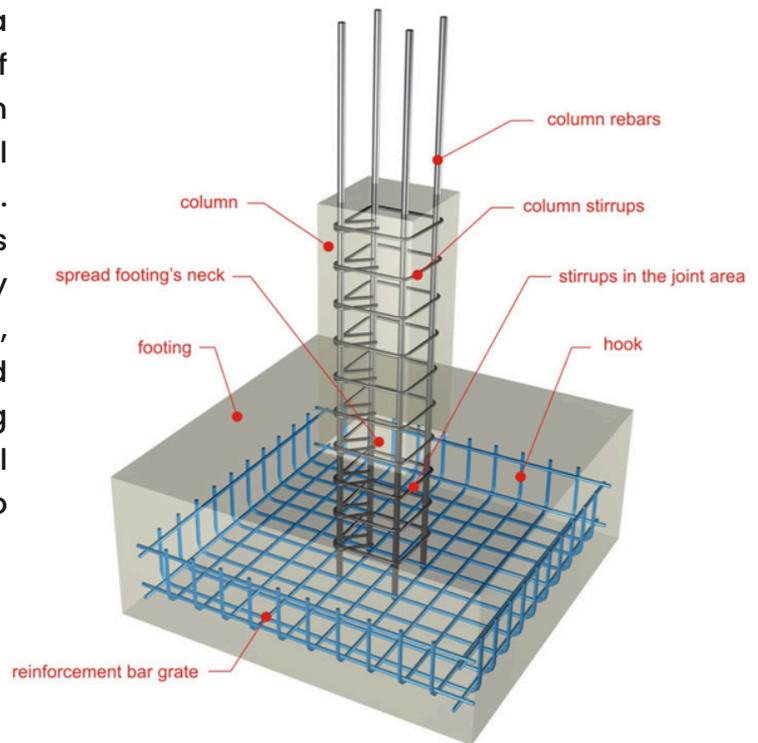


### Strip Foundations For Cavity Walls

Source: gravitasbuild.co.uk

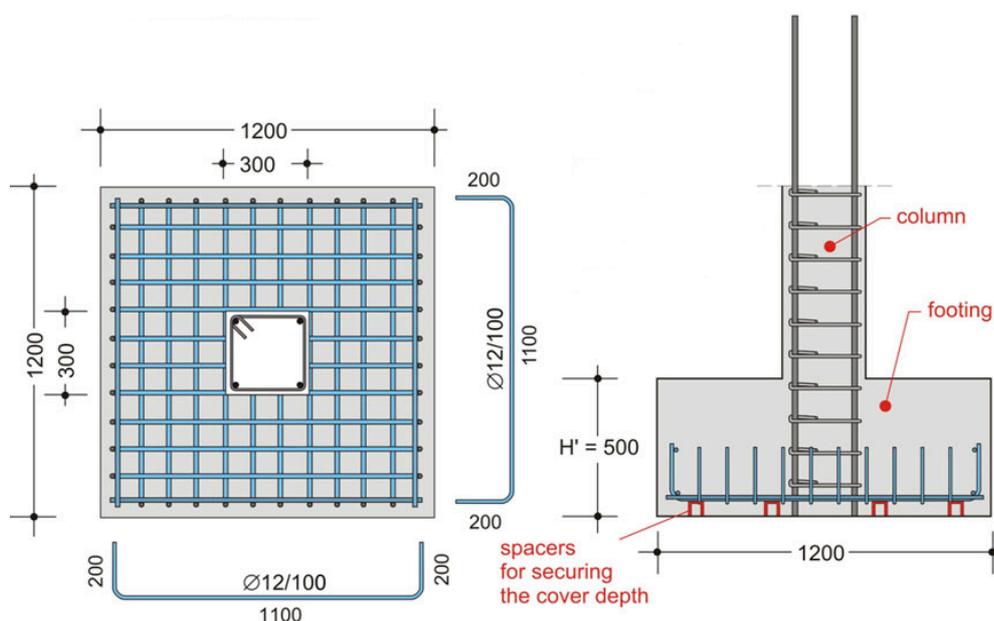
## Spread Footing *construction*

A spread footing, also known as a spread or isolated footing, is a type of shallow foundation used in construction to support individual columns, piers, or structural loads. Unlike continuous footings (such as strip footings), which run continuously along a wall or structure's length, spread footings are isolated and directly beneath each load-bearing element. They distribute the structural load over a larger area of the soil to prevent excessive bearing pressure.



Source: engineeringfeed.com

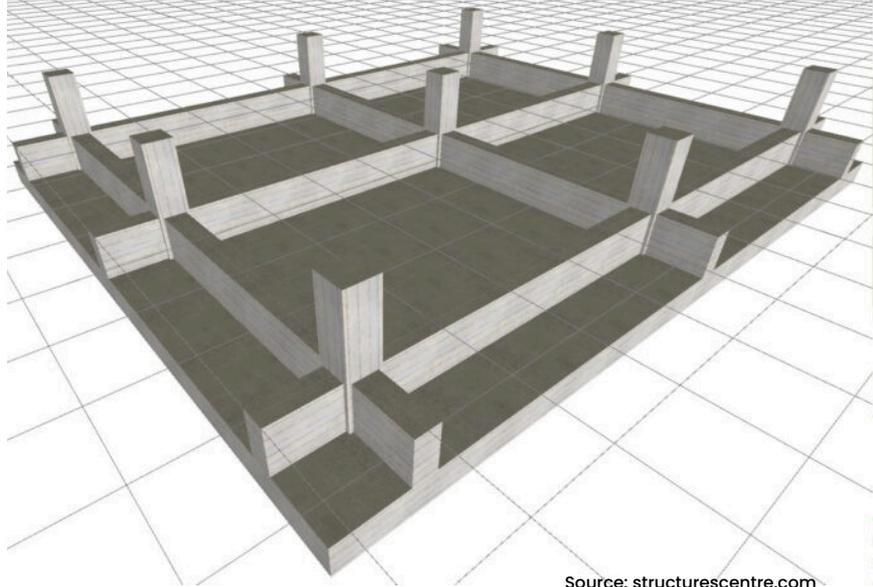
## Spread Footing *construction* Details



Source: engineeringfeed.com

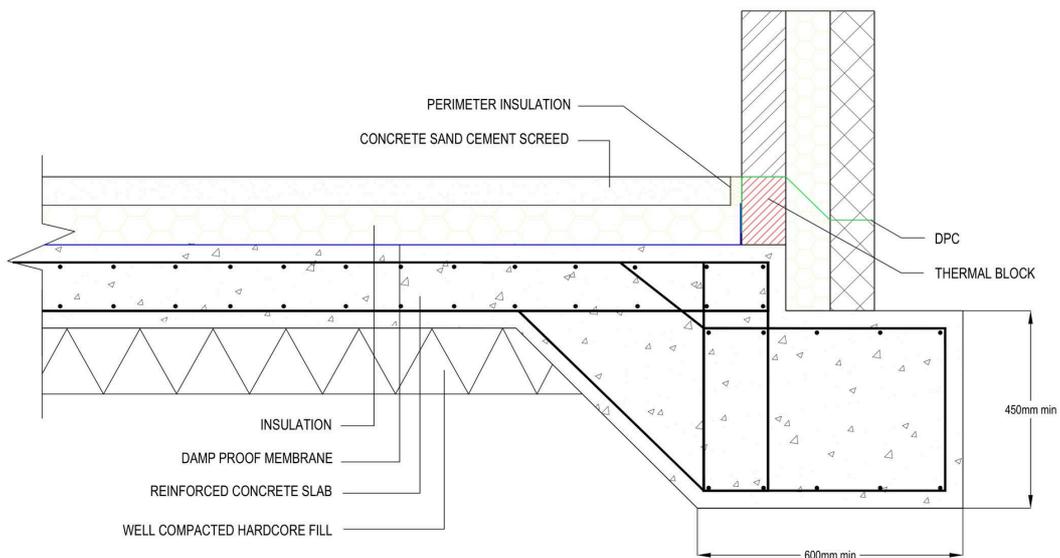
## Raft Foundation *construction*

A raft foundation, also known as a mat foundation, is a type of deep foundation used in construction to distribute heavy structural loads over a large area, providing stability and preventing excessive settlement. It is particularly useful in situations where the soil's bearing capacity is low, and it's not feasible to use conventional spread footings or strip footings. Raft foundations are commonly employed for large and heavy structures like high-rise buildings and industrial facilities.



Source: structurescentre.com

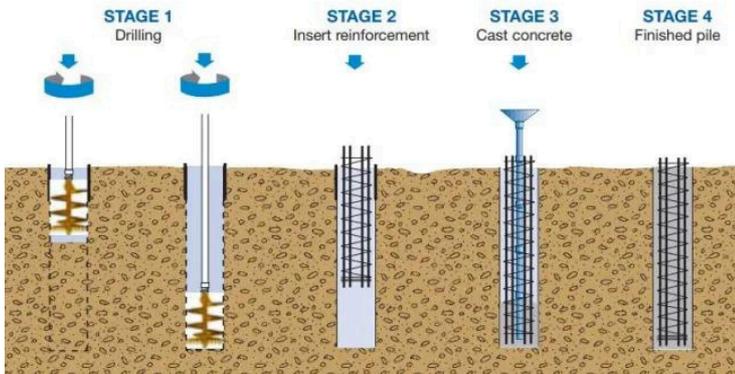
## Raft Foundation Details *construction*



Source: housebuild.com

## Pile Foundation *construction*

Pile foundations are a type of deep foundation used in construction to transfer structural loads from a building or structure to deeper, more stable layers of soil or rock. They are essential when the shallow soil near the surface is inadequate to support the loads of the structure, or when the construction site has challenging soil conditions. Pile foundations are commonly used in the construction of high-rise buildings, bridges, and other heavy structures.

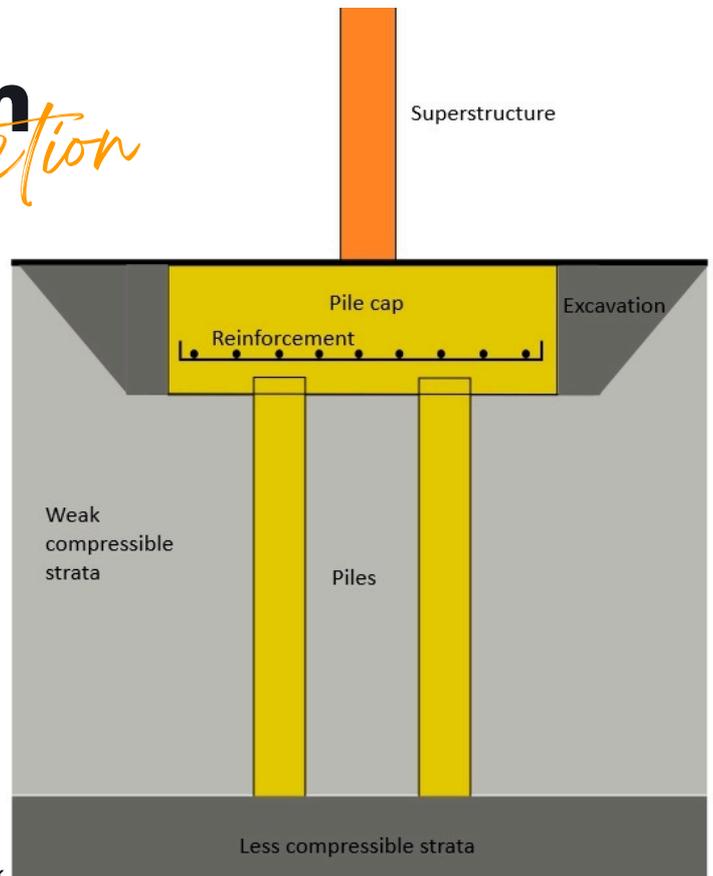


Source: theconstructor.org



Source: liveenhanced.com

## Pile Foundation Details *construction*



Source: designingbuildings.co.uk

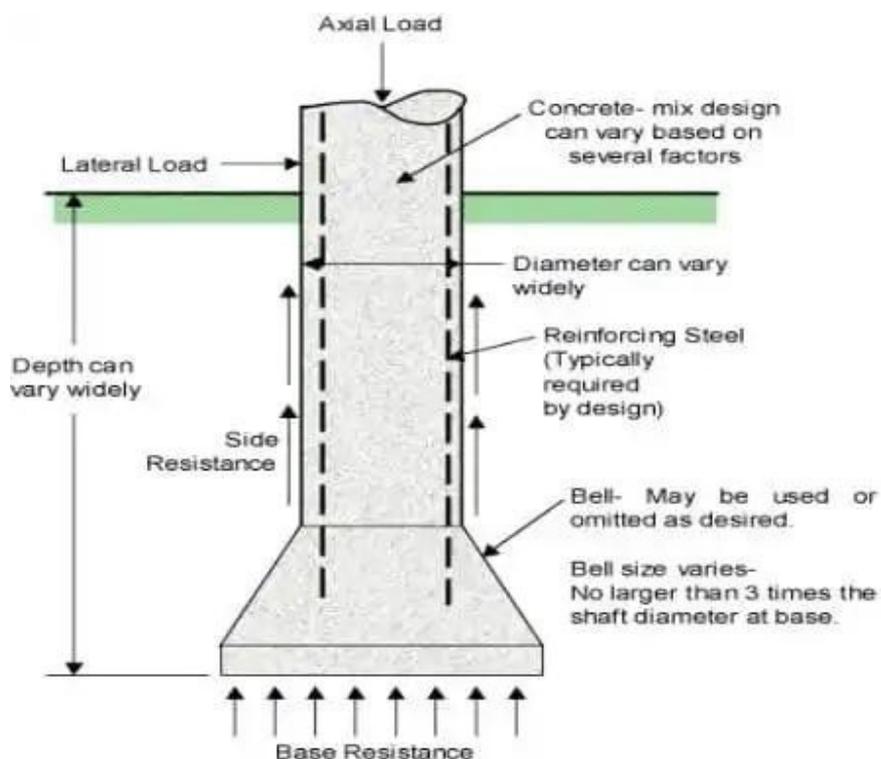
## Caisson Foundation *construction*



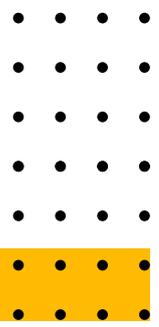
Source: newcivilengineer.com

A caisson foundation, also known as a drilled shaft foundation or simply caisson, is a type of deep foundation used in construction to transfer heavy structural loads to stable soil or bedrock layers deep beneath the ground's surface. Caisson foundations are particularly suitable for projects with challenging soil conditions or sites near bodies of water. They are commonly used in the construction of bridges, piers, tall buildings, and other structures.

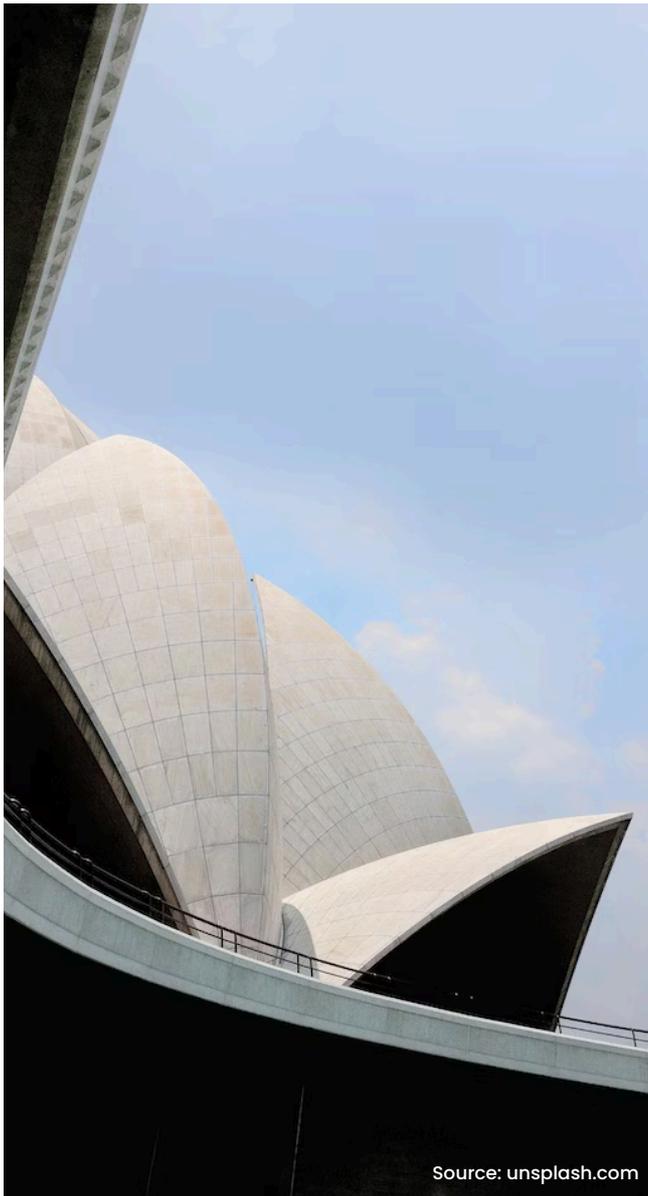
## Caisson Foundation Details *construction*



Source: theconstructor.org



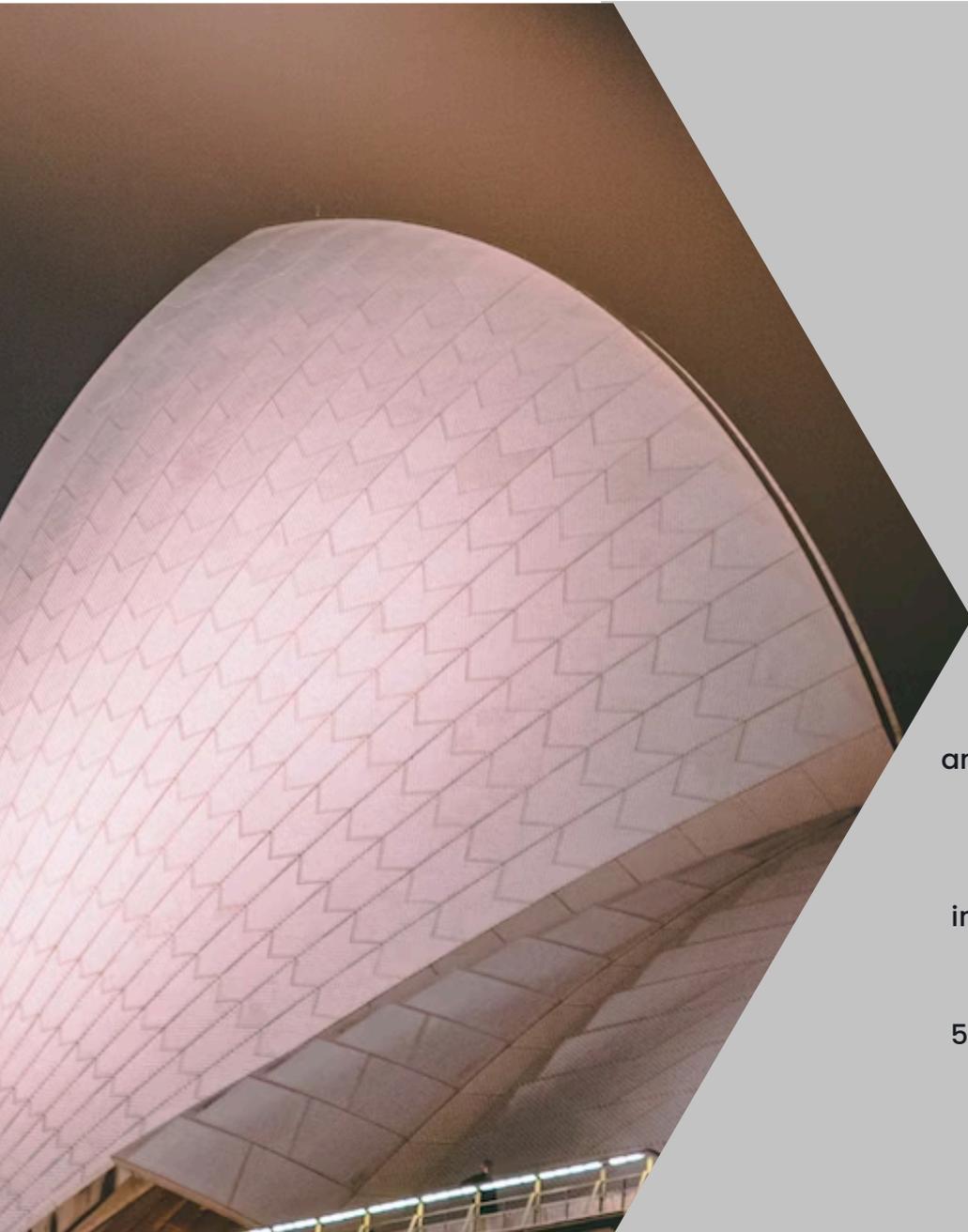
Concrete construction techniques have evolved over time, incorporating advanced technologies and innovative materials. Architects and engineers must consider factors such as structural integrity, aesthetics, energy efficiency, and environmental impact when designing and constructing concrete buildings



In conclusion, concrete is a fundamental building material that has shaped the architecture of our modern world. Its application in roof and wall construction showcases its adaptability, strength, and endurance, allowing architects and builders to create iconic and sustainable structures.

# 3.6 Quizzes

Concrete Construction



## QUESTION

Concrete Roof Construction:

- 1) Compare and contrast cast-in-place concrete roofs and precast concrete roof panels in terms of construction methods and benefits.
- 2) What are the key structural considerations when designing a concrete roof for a building? How do these differ from traditional pitched roofs?
- 3) Discuss the challenges and solutions related to water drainage and waterproofing in flat concrete roof construction.
- 4) How can thermal insulation be integrated into a concrete roof design to improve energy efficiency?
- 5) Provide an example of a real-world building with an innovative concrete roof design. What were the architectural and engineering considerations?

Source: unsplash.com

# 3.6 Quizzes

Concrete Construction



## QUESTION

Concrete Wall Construction:

- 1) Explain the roles of reinforcement and formwork in cast-in-place concrete wall construction.
- 2) Compare the advantages of using concrete blocks for walls with those of cast-in-place concrete walls.
- 3) How can precast concrete wall panels expedite construction while maintaining quality and aesthetics?

Source: unsplash.com



Source: unsplash.com

## QUESTION

Concrete Slab/ Flooring Construction:

- 1) Explain why reinforcement required on slab.
- 2) What are the factors that influence the decision to choose a concrete slab system.

## QUESTION

Concrete Footing/ Foundation Construction:

- 1) What is the purpose of a concrete footing in a building's foundation, and how does it contribute to the structure's stability?
- 2) Explain the key differences between shallow and deep footings in foundation construction, and in what situations would each be used?

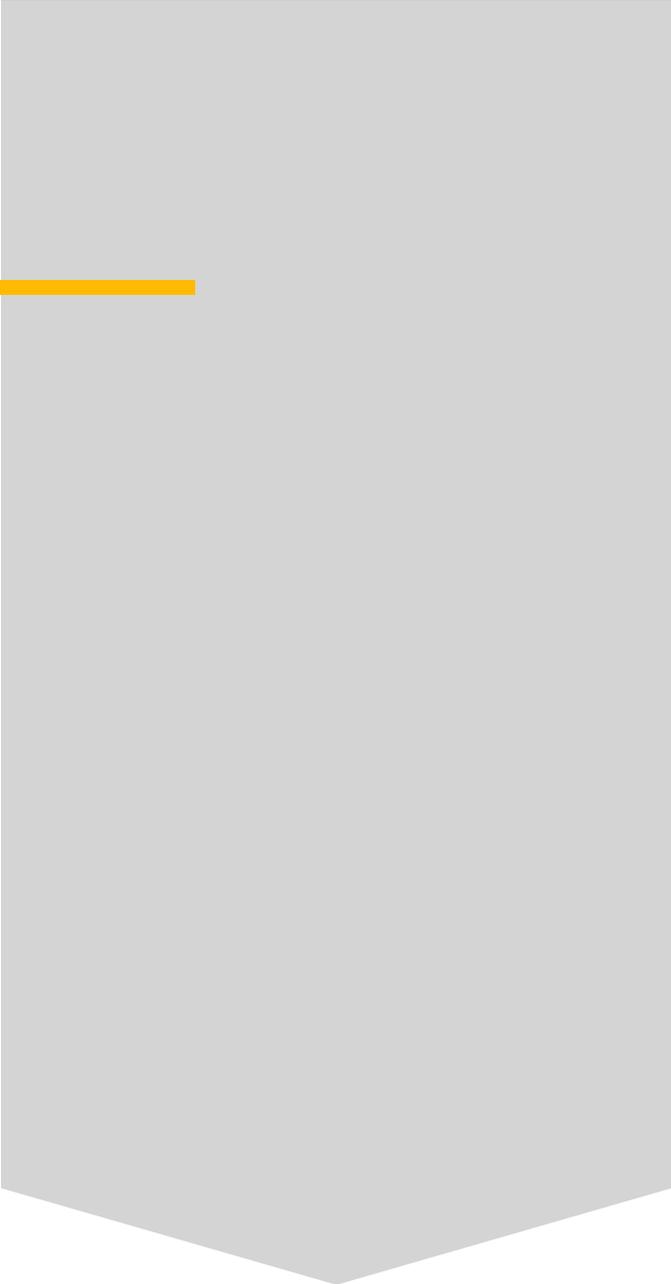


Source: unsplash.com

# WRITE YOUR NOTES HERE



A large grid of small black dots arranged in approximately 25 columns and 40 rows, intended for writing notes.



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