MODULE III

- Foundations
- Brick masonry
- Roofs
- Floors
- Basic infrastructure services
- Green buildings

BUILDING CONSTRUCTION

OVERVIEW

- **Building Construction**: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).
- **Brick masonry**: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.
- **Roofs and floors**: - Functions, types; flooring materials (brief discussion only).
- **Basic infrastructure services**: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.
- **Green buildings**:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Foundations

- Substructure
- Structural components of a building which are in direct contact with soil and which transmit loads of the super structure to the soil

Functions of foundations

- **Even load distribution:** It transmits weight of the
- **Reducing load intensity:** Transfers the load ground of the uniformly structure to the soil
- **Protection against soil movements:** It prevents a large differential area settlement
- **Lateral stability:** It ensure the stability of the structur
- **Provision of level surface:** It provides a level
- **Safety against undermining:** It ensure the stability

Bearing capacity

Ability of the foundation soil to hold the forces from the superstructure without undergoing failure or excessive settlement

- *The supporting power of soil without any failure*
- Depends on various factors
  - Soil type
  - Position of water table
  - Physical features of foundation like type, size of foundations

Bearing Capacity

2 Criteria

Shear Criteria:

- Must have enough load bearing power to carry the estimated loads safely

Settlement Criteria

- The settlement under the loads must be within permissiblelimits

Types of foundations

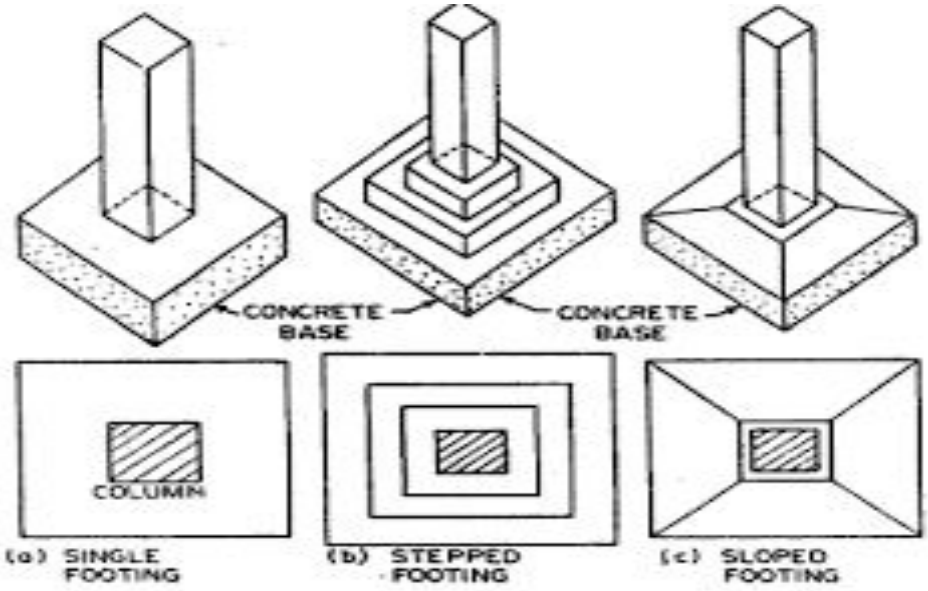
- Shallow foundation
  - When the depth of foundation is less than or equal to width.
  - Placed immediately below the lower part of the super structure supported by it.
  - Light loads
- Deep foundation
  - When the depth is very large compared to width
  - Adopted when top layer of soil is very weak
  - Adopted when heavy loads are to be supported

Shallow foundation

- Spread or Isolated or Column Footing
- Wall or strip Footing
- Combined Footing
- Continuous Footing
- Cantilever Footing
- Raft or Mat Foundation

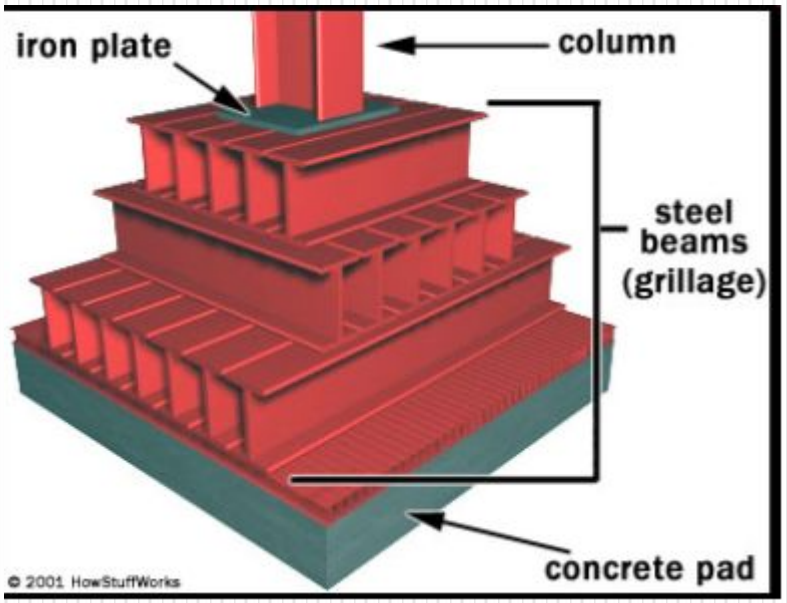
Isolated or Column Footing

- Provided for column to transfer the load safely to the soil beneath
- Adopted for light load



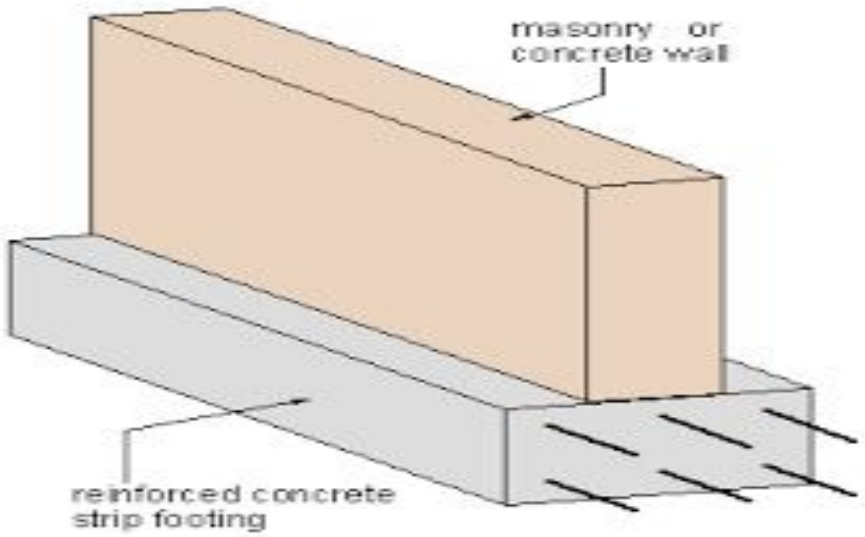
Foundation…

- Isolated footing (single footing, column footing)…

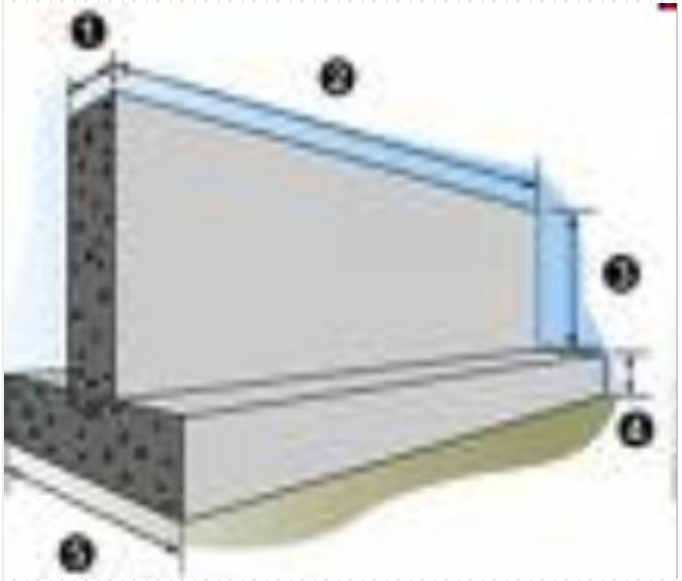


Wall or Strip Footing

- Is provided for throughout the length of a continuous structure is called Strip footing

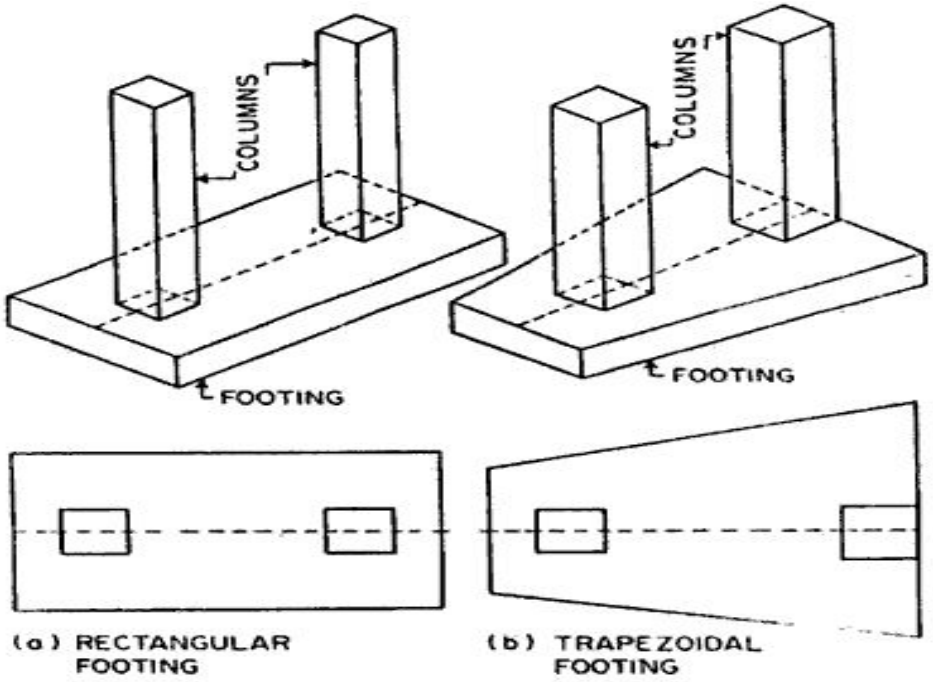


Strip Footings



Combined Footing

- When Footing is constructed for two or more columns then it is called combined footing



- Adopted when

  a)Two individual footing Overlap

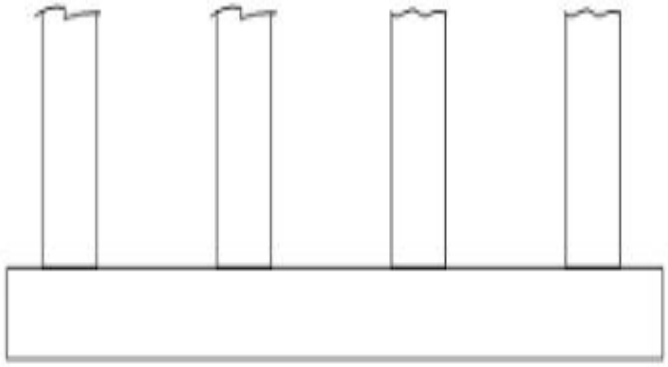
  b)When bearing capacity of soil is less requiring more area for individual footings

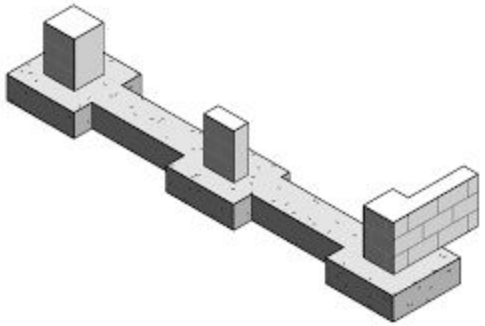
  c)When footing are constructed near boundaries of the plot

- Used in Water tank supporting columns, Bus shelter supporting columns etc

Continuous footing

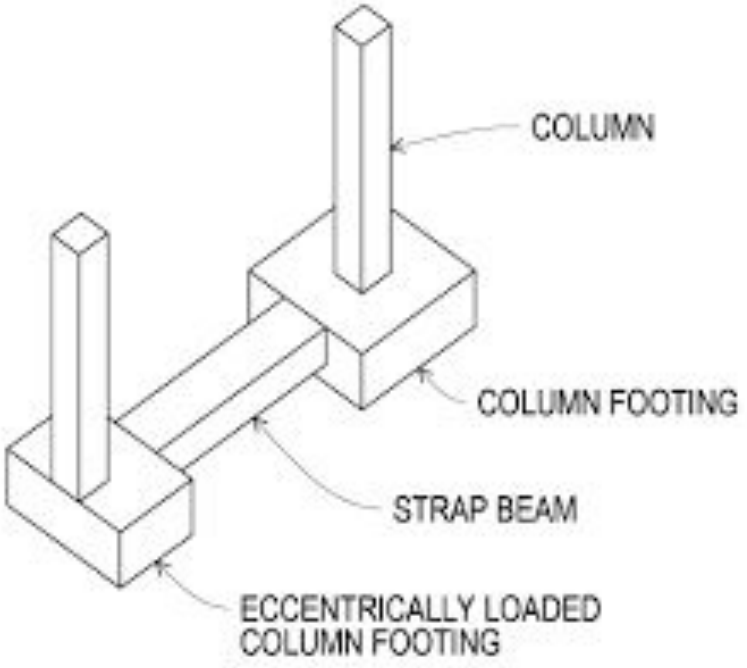
- A single continuous R.C.C slab is provided as foundation for 3 or more columns in a row





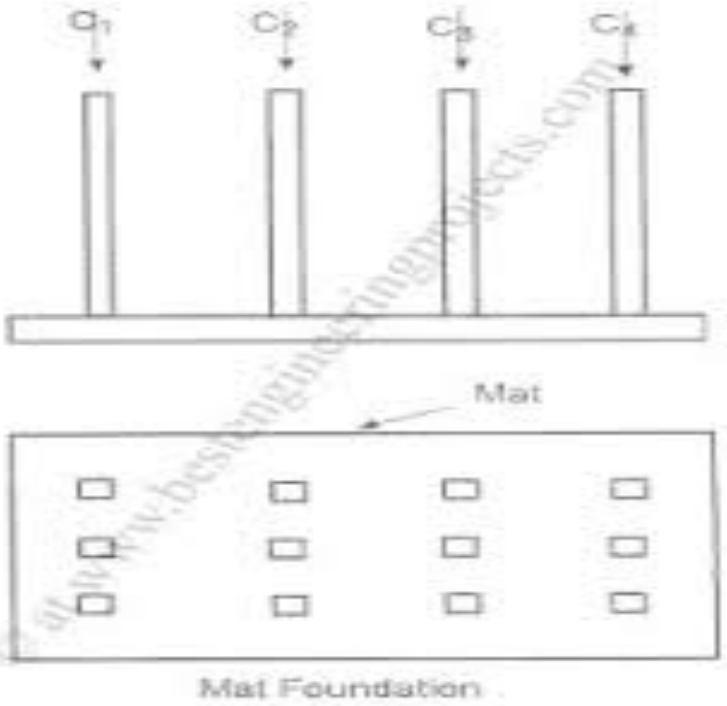
Cantilever Footing(Strap)

- A strap (or cantilever) footing consists of **two isolated footings** connected with a structural **strap or a lever**.
- **Used When distance between two columns is very long**



Raft or Mat Foundation

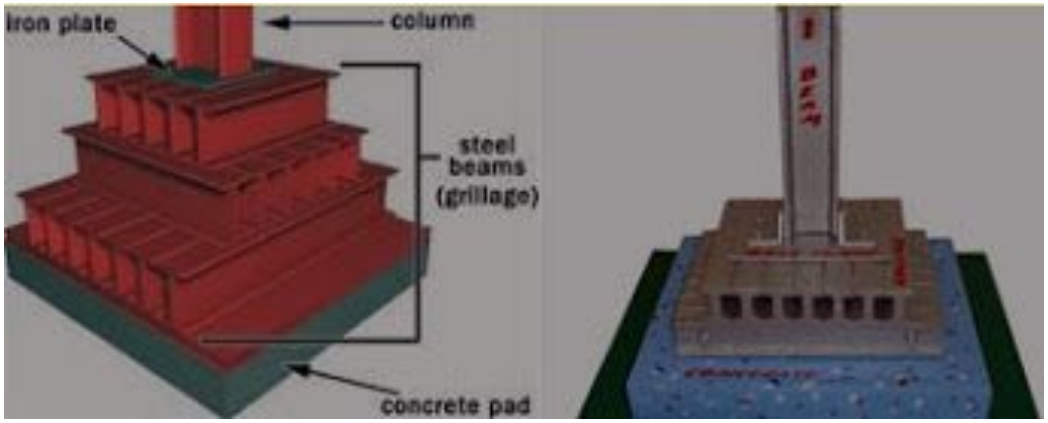
- Raft Foundation is combined footing which covers the entire area beneath the structure
- Supports a large number of columns and walls
- Required when allowable soil pressure is low and where columns and walls are so close that individual footings when provided may overlap or nearly touch each other

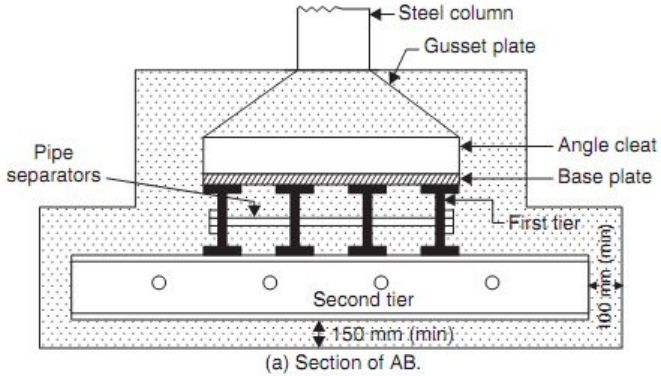


Raft or mat foundation

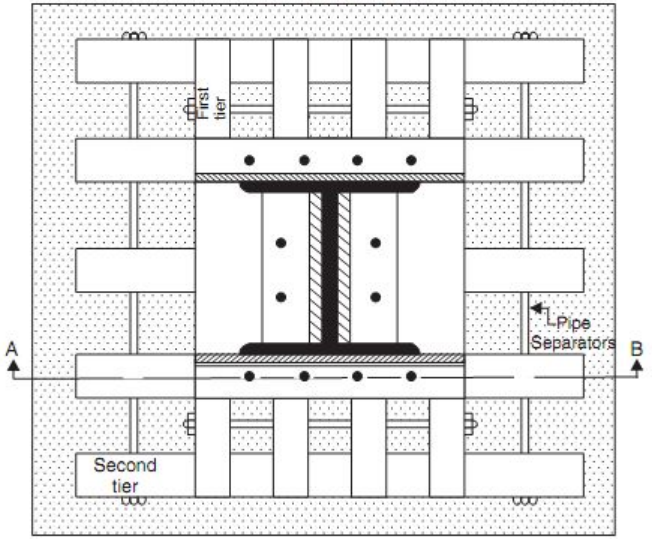
Grillage foundation

- **Grillage Foundation** consists of one, two or more tiers of steel beams superimposed on a layer of concrete, adjacent tiers being placed at right angles to each other, while all tiers are encased in concrete.
- **Grillage foundation** is used when heavy structural loads from columns, piers or stanchions are required to be transferred to a soil of low bearing capacity.





(a) Section of AB.



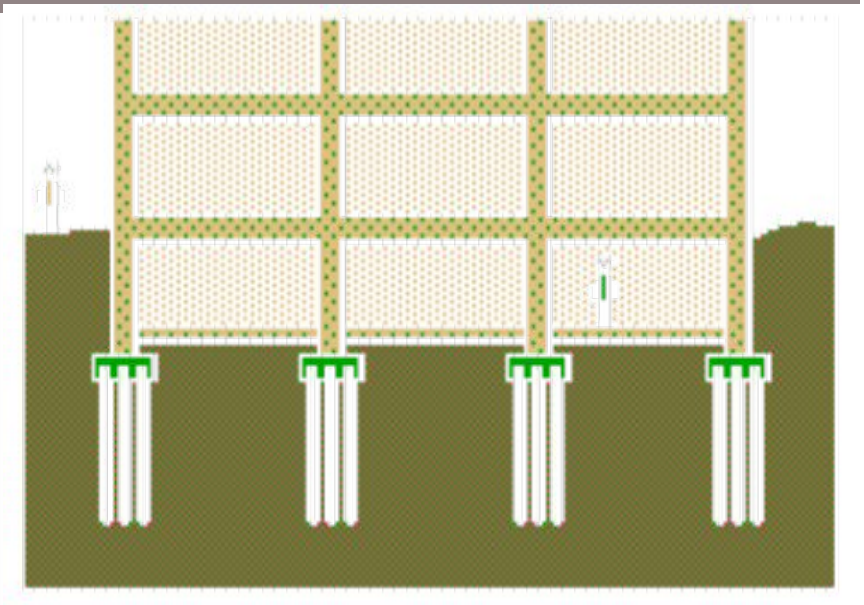
Deep foundations

- Pile Foundation
- Pier Foundation
- Well foundation

Pile Foundation

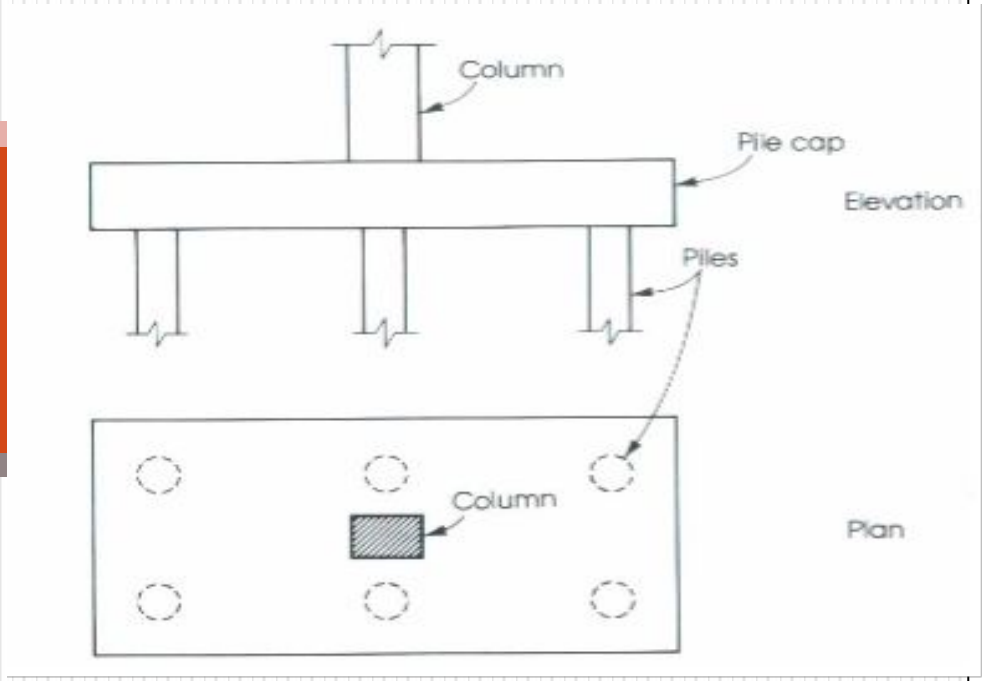
- A slender, structural member consisting steel or concrete or timber.

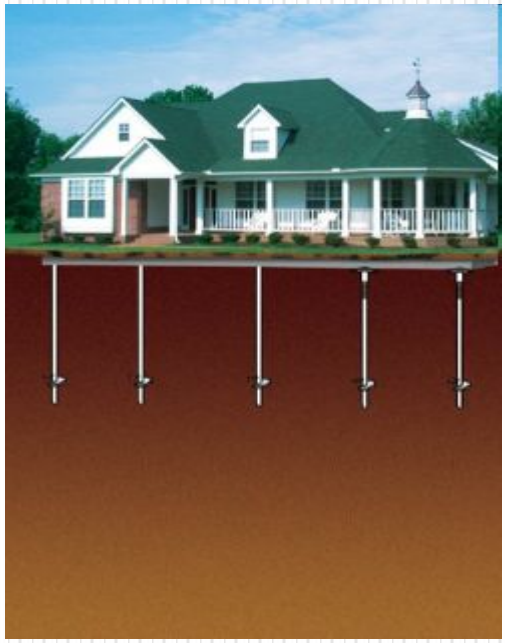
- To transfer the structural loads to soils at some significant depth below the base of the structure.

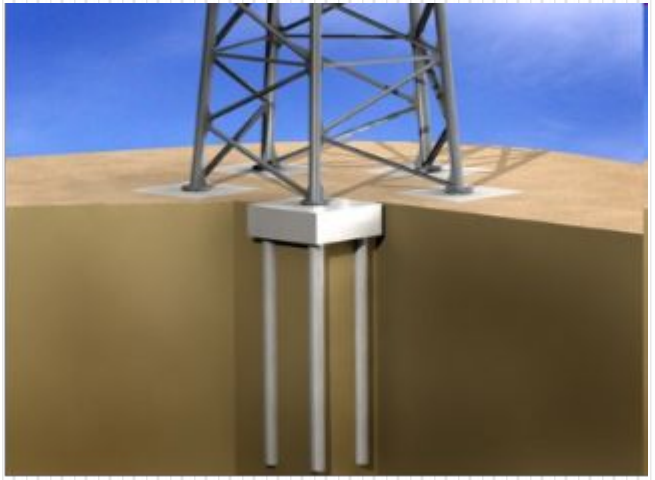


Pile caps

Thick slabs used to tie a group of piles together to support and transmit column loads to the piles.



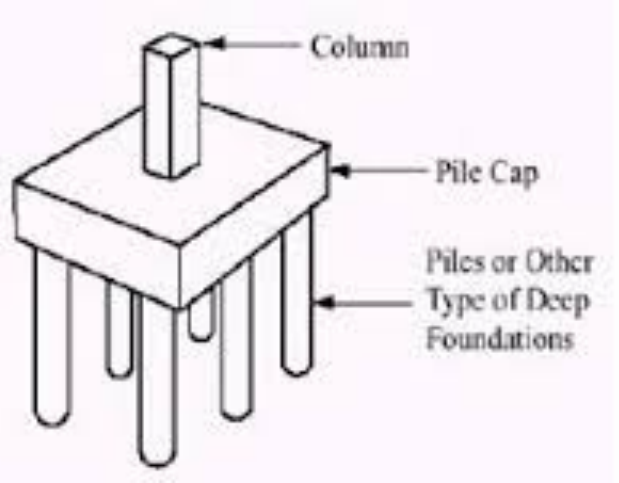




Pile Foundation

- Loads are taken to a very lower level by means of vertical members called piles

- Load is transferred to the underground strata due to the poor bearing capacity of the surface soil
- Pile is made up of concrete, steel, timber

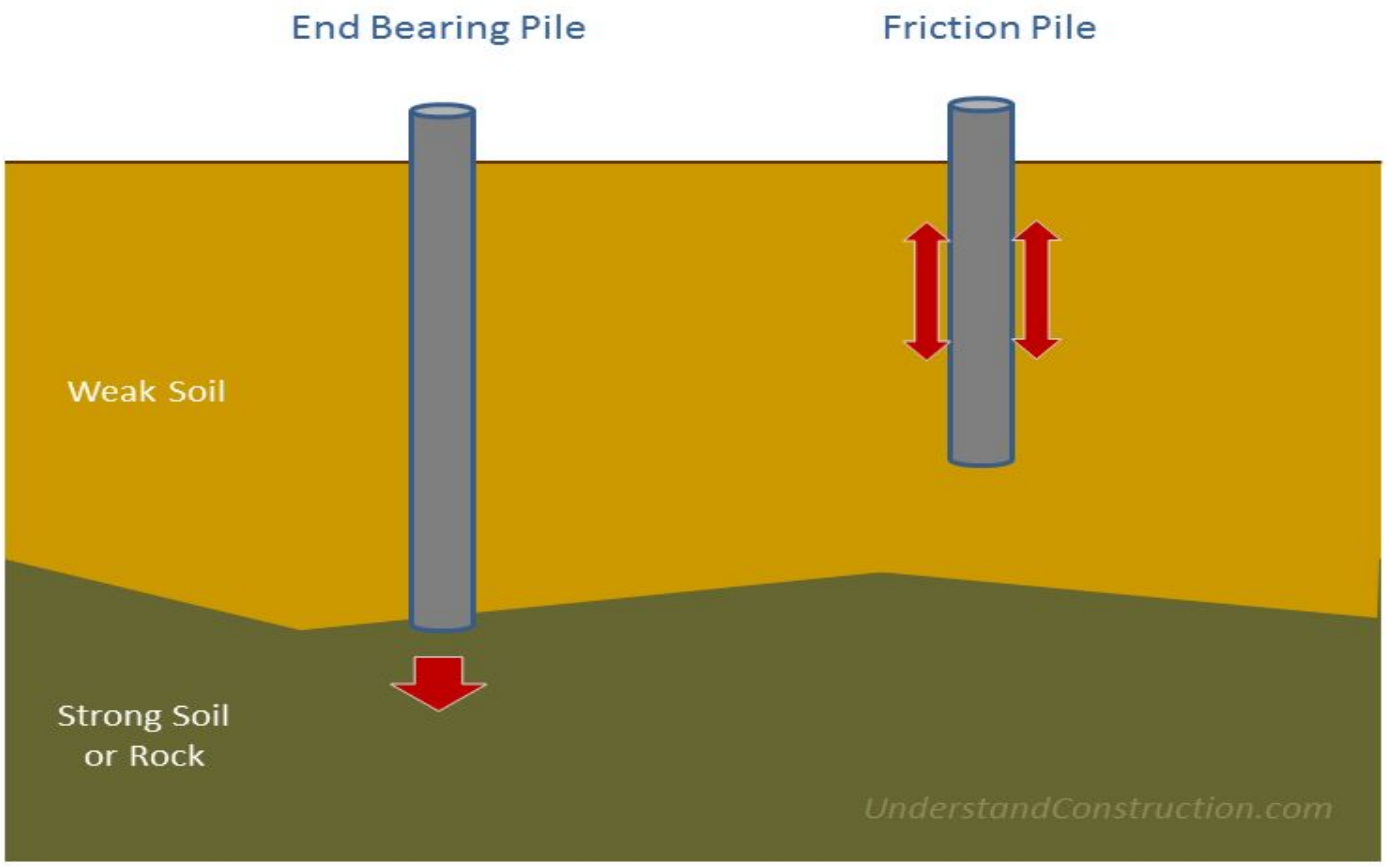


Types of Pile Foundation

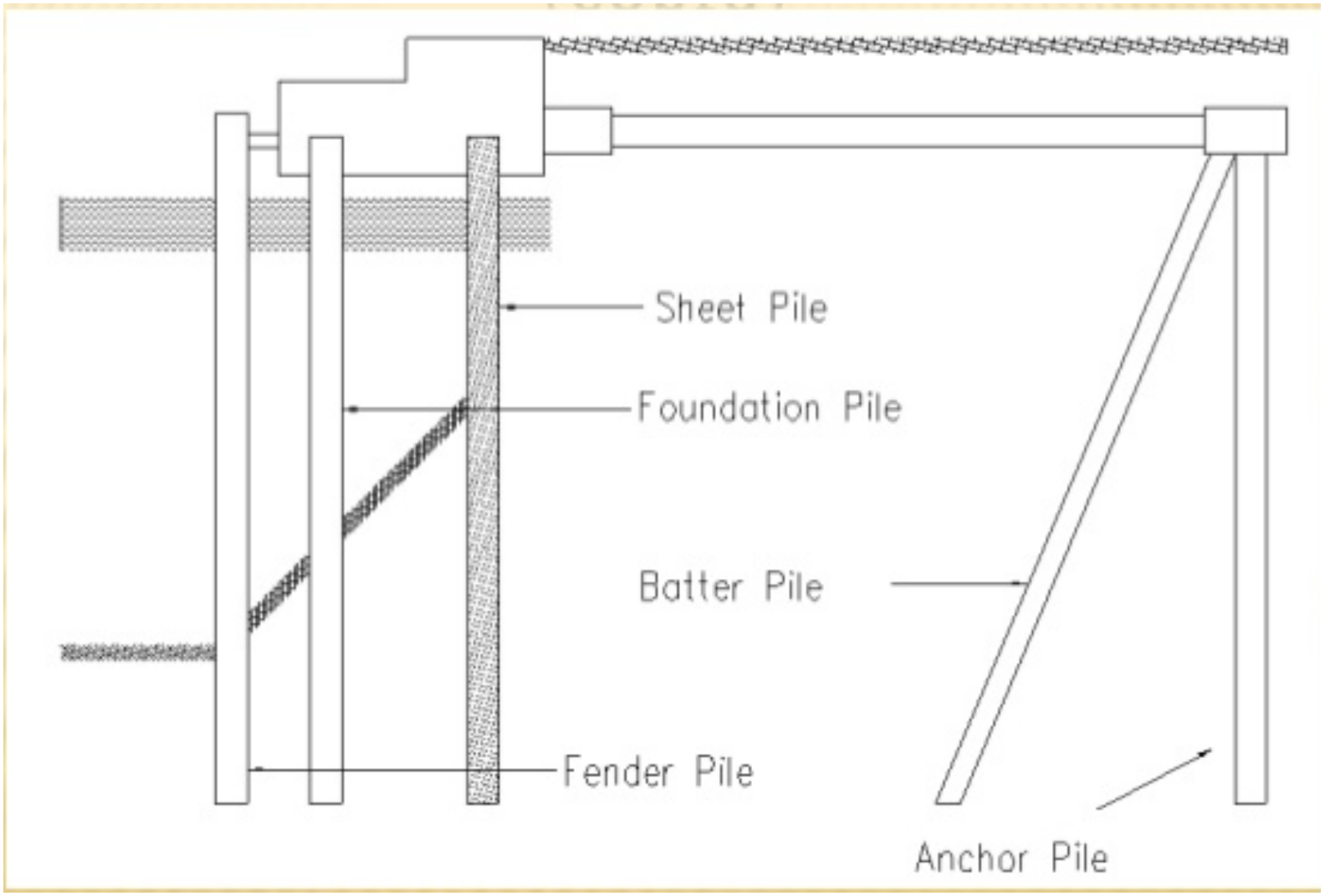
Based on Function or use of piles

- **Load bearing Piles** –Transfer the load from superstructure to soil
  - End bearing type
  - Friction Type
- **Non-Load Bearing Piles**-Doest not take vertical load but for other functions
  - Compaction pile densify soil
  - Batter pile inclined piles to resist horizontal load
  - Sheet pile retain soil
  - Fender pile protect waterfront structures from impact and abrasion

Load Bearing Piles



Non- load bearing piles

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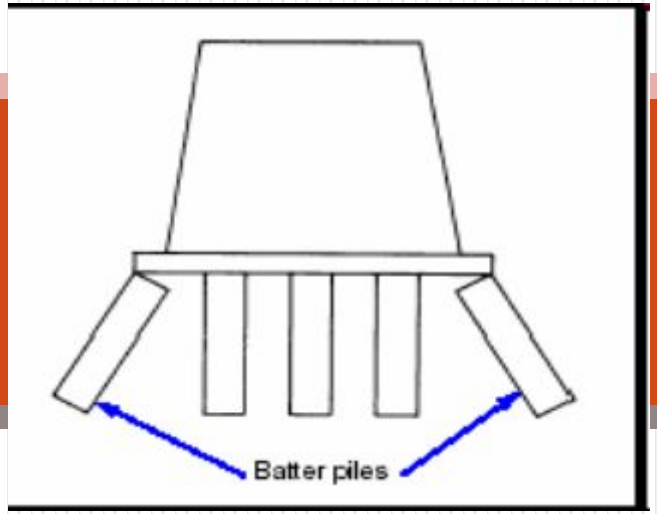
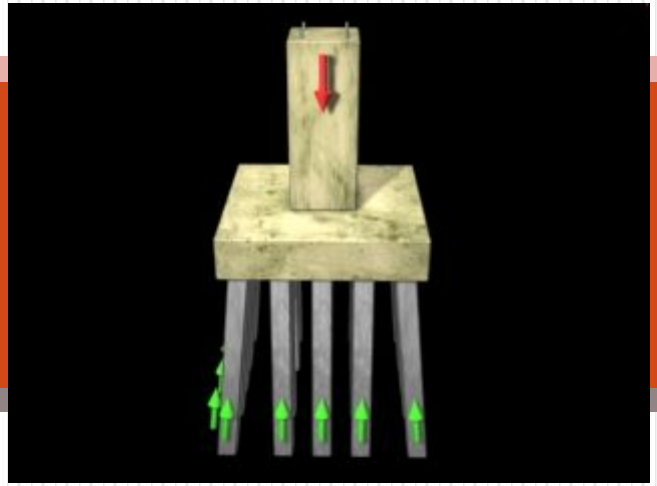
Batter Piles

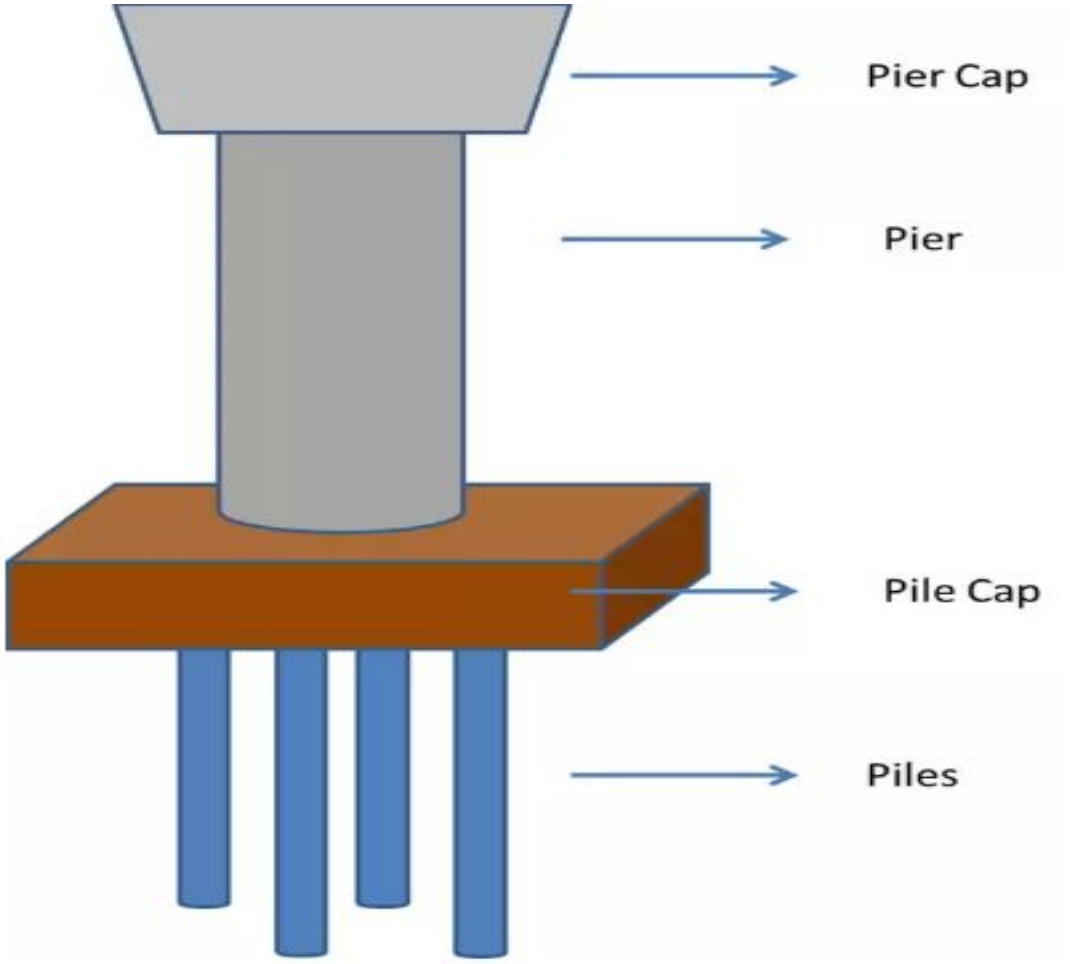




Pier foundation

- A *pier* is a raised structure typically supported by well-spaced foundation system
- Foundation system below pier can be either Pile or Caisson
- Used as foundations of bridges, towers etc

Pier foundation



Well foundation

- Prefabricated Hollow box or cylinders sunk into ground at required depth and filled with concrete or sand
- Type of deep foundation generally provided below the water level for bridges
- Wells can resist large horizontal forces & vertical loads

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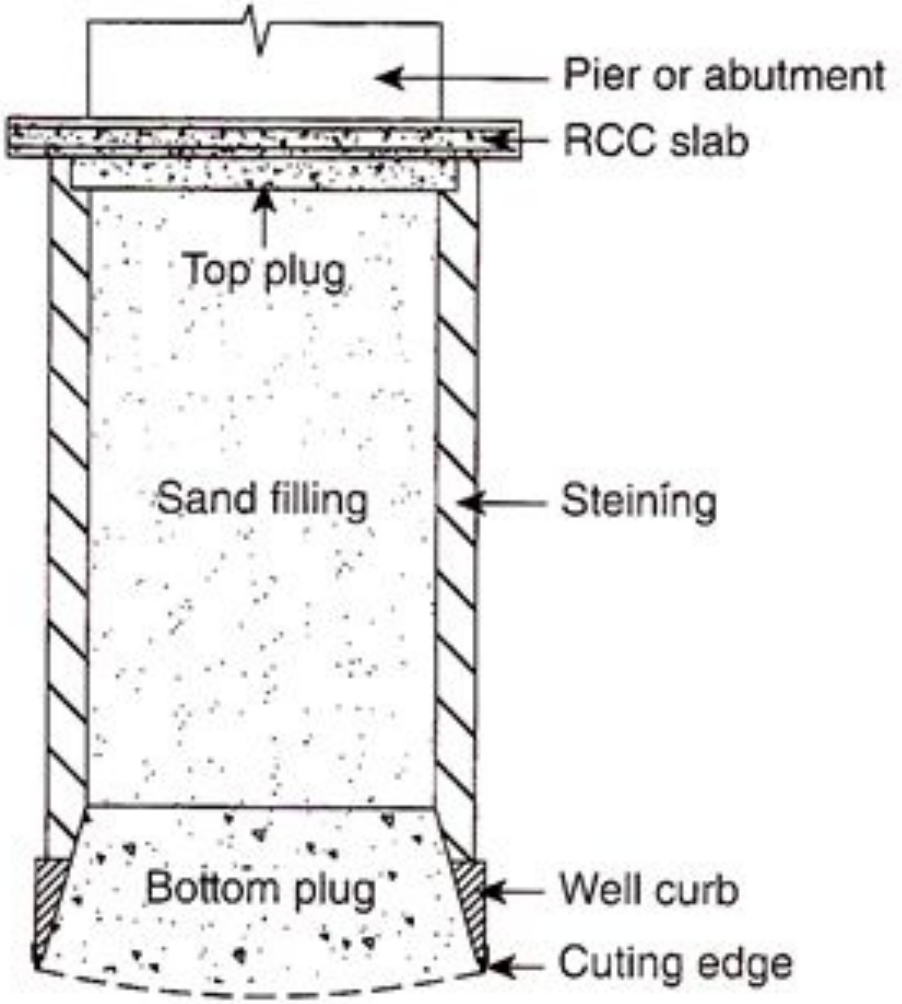
Cross section of a Well foundation



Brick Masonry

What is Brick Masonry ?

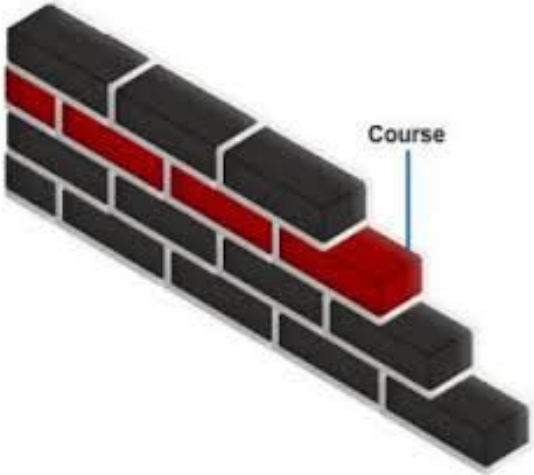
Masonry : Construction of building units bonded together with Mortar

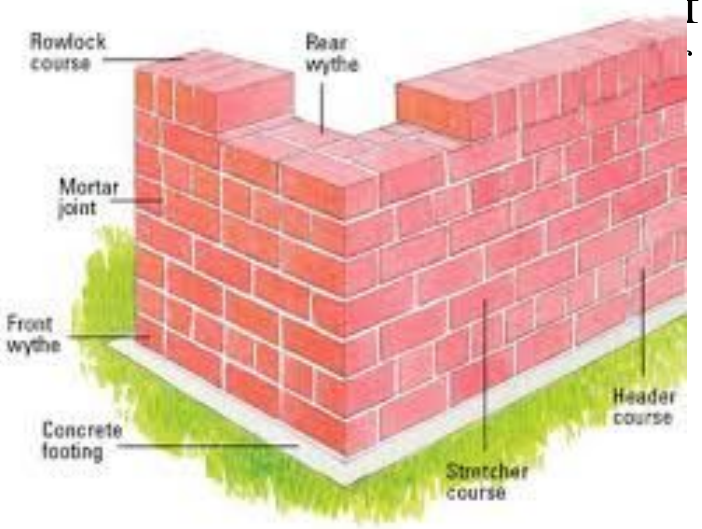
Brick Masonry (IS 2212-1991)

- Common type of Masonry
- Strength depends on type, uniformity as well as style of masonry
- Cheaper compared to stone masonry
- Have more bonding strength and more durable
- Required less skilled labour.
- Have more fire resistance

Basic Terms

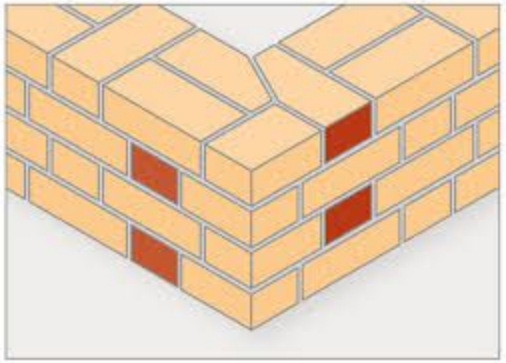
- Course: A horizontal layer of masonry unit
  - Thickness of one masonry unit is the thickness of one unit+ thickness of mortar joint
- Header : brick with length perpendicular to face of wall (9 x 9cm face exposed)
- Header course: A course showing only headers on the exposed face of the wall (*Or when the longer side of the brick is perpendicular to the face of the construction*)
- Stretcher : brick with length parallel to face of wall(19 x 9cm face exposed)
- Stretcher course: A course showing only st f the wall *le of the br the consti*



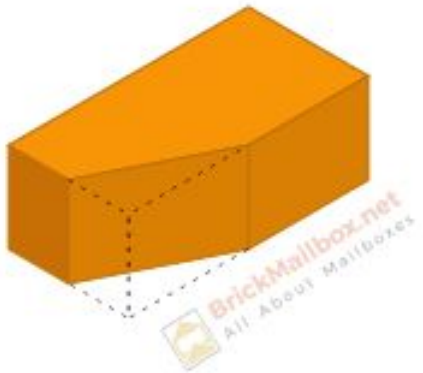


Basic Terms contd..

- Closer: it is a portion of a brick with the cut made longitudinally and is used to close up bond at the end of the course. Closers may be of different type

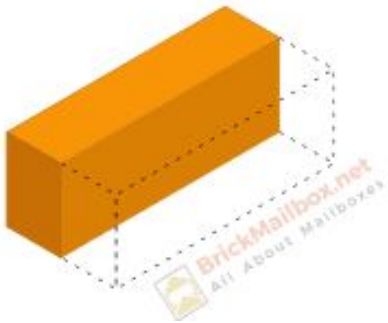


- King closer : It is the portion of a brick which is so cut that the width of one its end is half that of a full brick, while the width at other end is equal to the full width
  - It is obtained by cutting out a triangular portion of the brick between the centre of one end (width side) and the centre of the other end (lay side).
  - Thus it has half header and half stretcher face.

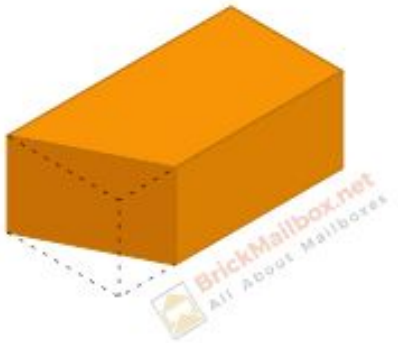


Basic Terms contd..

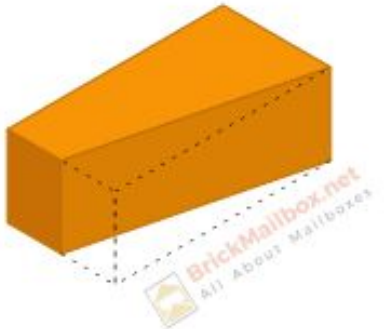
- Queen closer : it is a portion of a brick obtained by cutting a brick lengthwise into two portions.



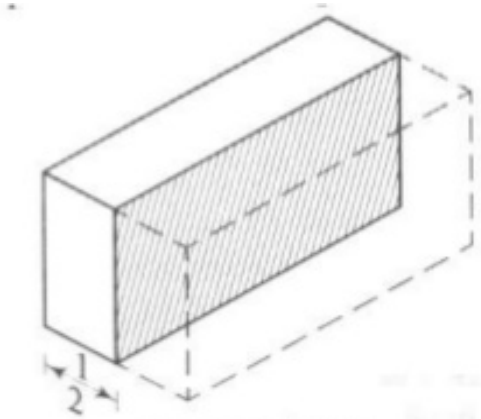
- Mitred closer : it is a portion of a brick whose one end is cut splayed or mitred for full width. The angle of splay may vary from 45 to 60^0



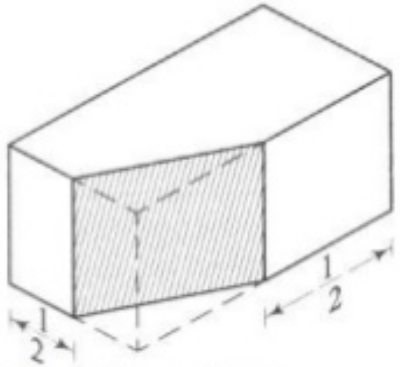
- Bevelled closer : it is a special form of a king closer in which the whole length of the brick is bevelled in such a way that half width is maintained at one end and full width is maintained at the other end



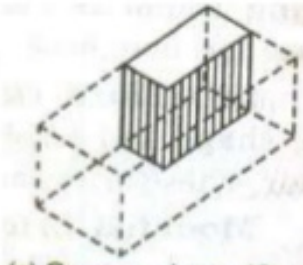
Basic Terms contd..



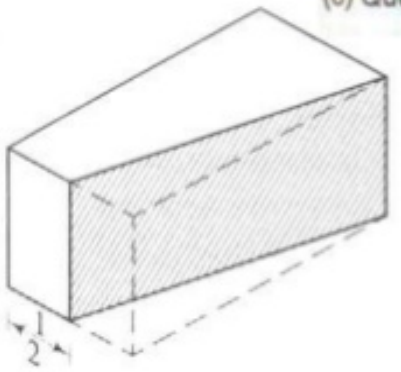
Queen closer



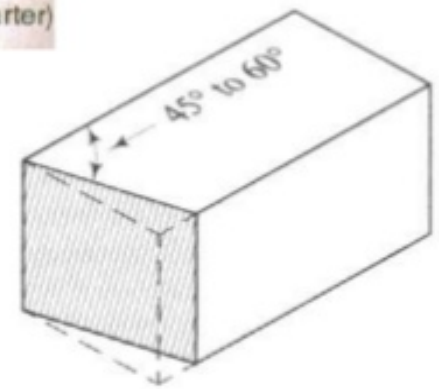
King closer



(c) Queen - closer (Quarter)



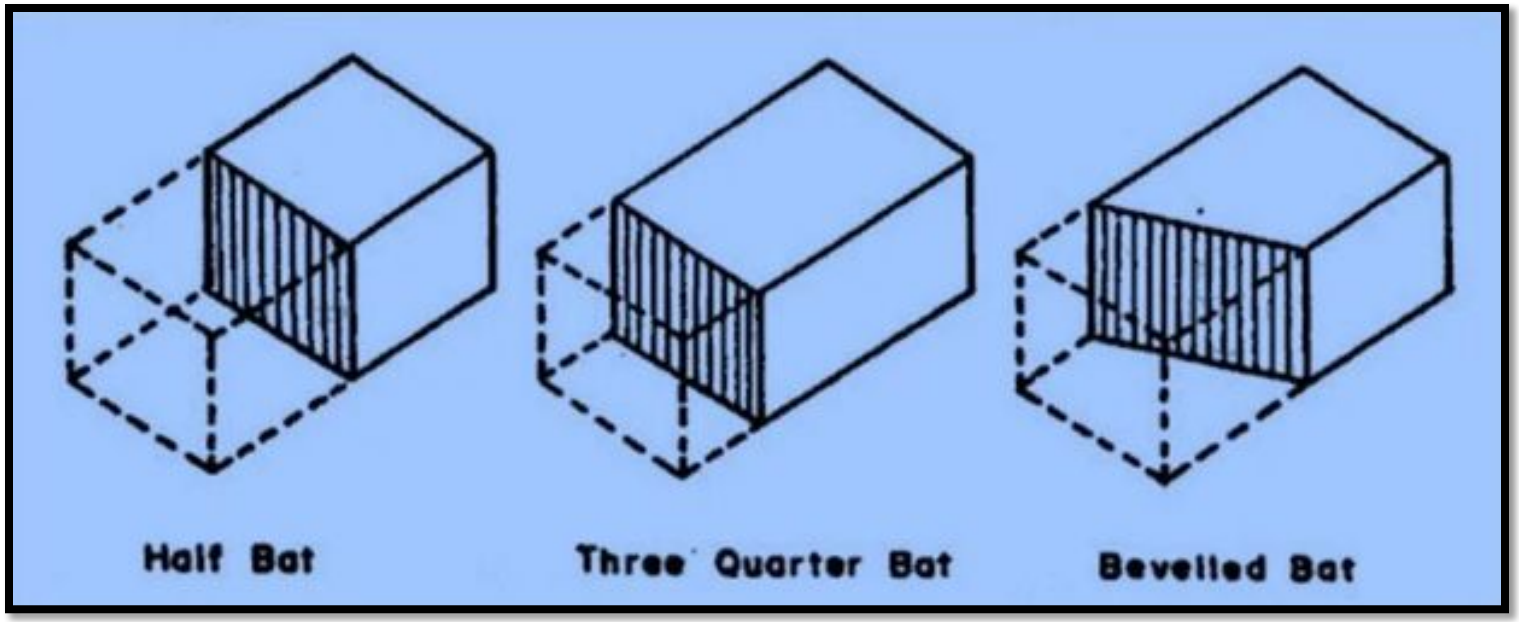
Bevelled closer



Mitred closer

Basic Terms contd..

- Bat: it is the portion of a brick cut across the width. If the length of the bat is equal to half the length of the original brick it is known as half bat.
  - Half bat: length = half the brick length
  - Three quarter bat: length= $3/4^{th}$ the brick length
  - Bevelled bat: splayed sideways



Masonry Wall Requirements

The usual functional requirements of a masonry wall include:

i) Adequate strength to support imposed loads

ii) Sufficient water tightness

iii) Sufficient visual privacy and sound transmission

iv) Appropriate fire resistance

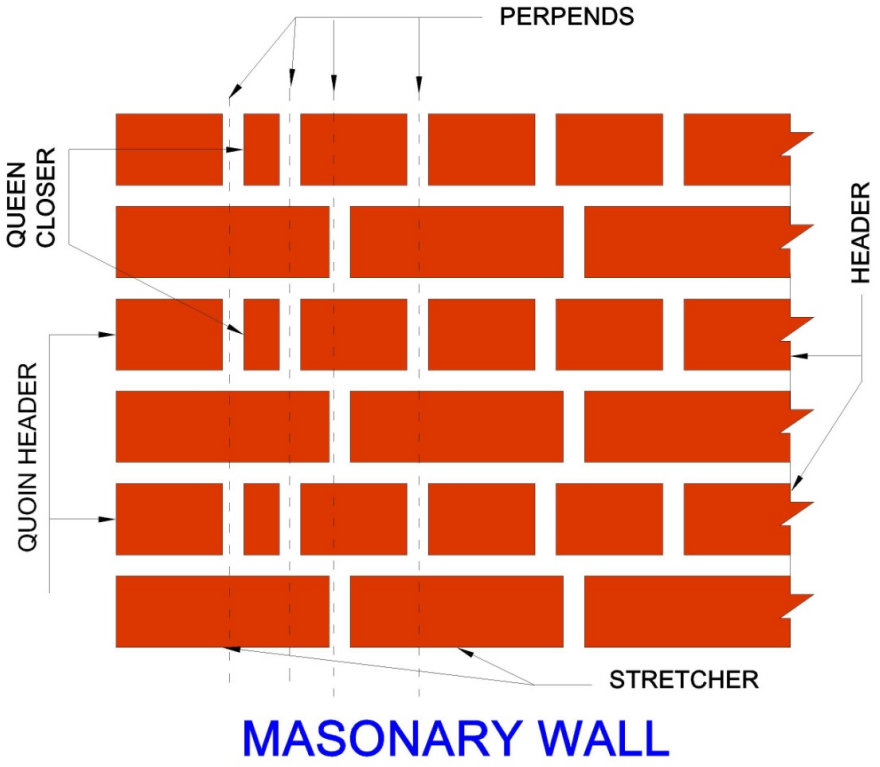
v) Ability to accommodate heating, air conditioning, electrical, and plumbing equipment

vi) Ability to receive various finish materials cost

vii) Ability to provide openings such as doors and window

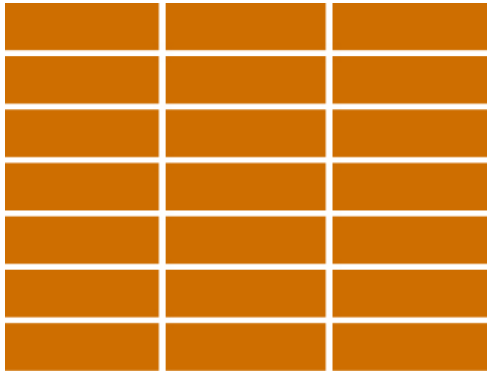
Bonds In Bricks

- The arrangement of bricks in courses so that individual brick units are tied together so that the vertical joints do not come over each other.



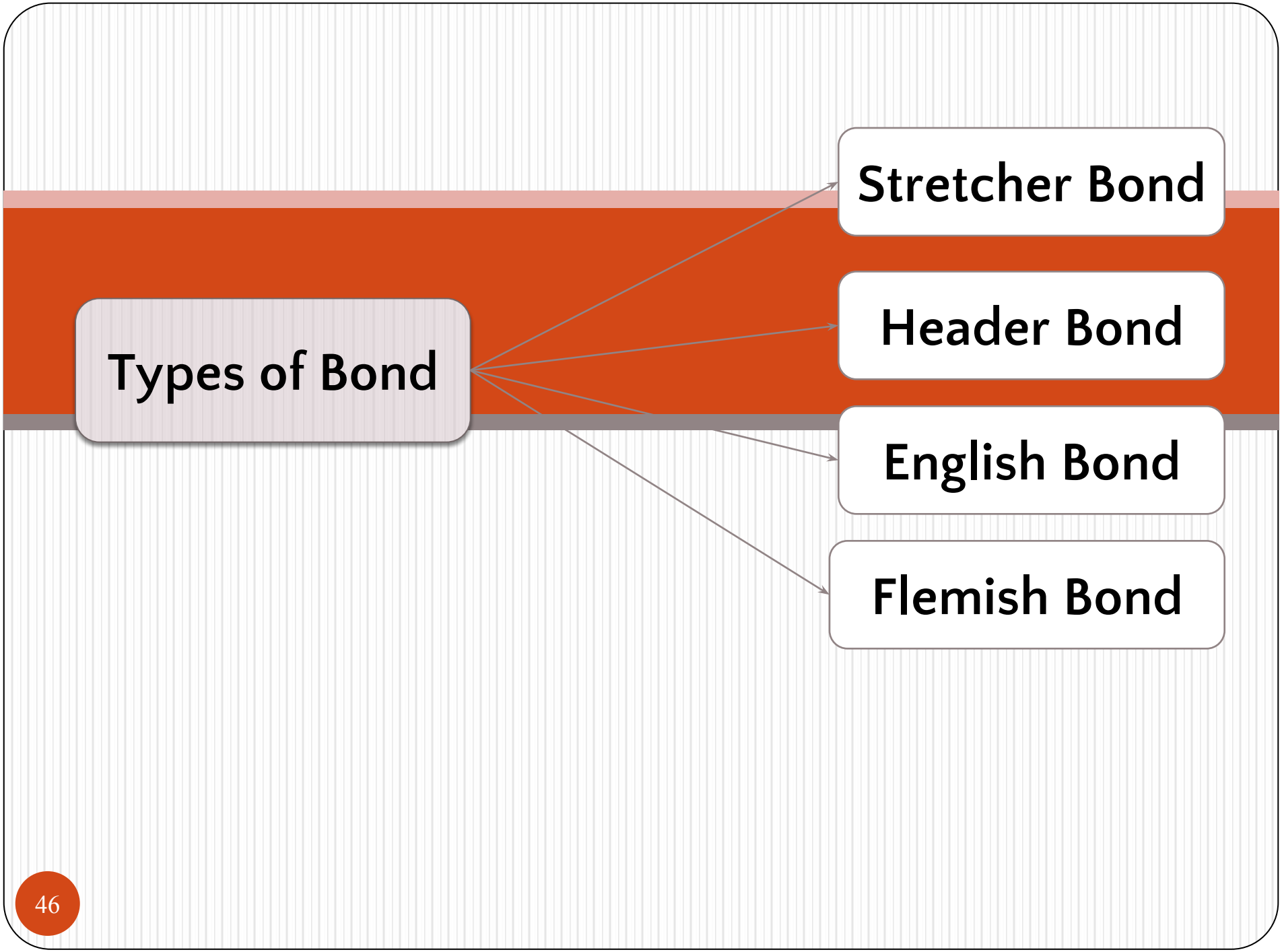
Purpose of Bonds In Bricks

- If bonds in brick are not arranged properly , then a continuous vertical joint will result. This is called an unbonded wall having little strength and stability
- To obtain maximum strength
- To ensure maximum stability and resistance to thrust
- To create an acceptable appearance



Rules in bonding

- Uniform size bricks
- Minimum number of bats
- Vertical joints
- Stretchers- facing; headers – hearting
- In alternate courses, the centreline of header should coincide with the centreline of the stretcher in the course above or below it.

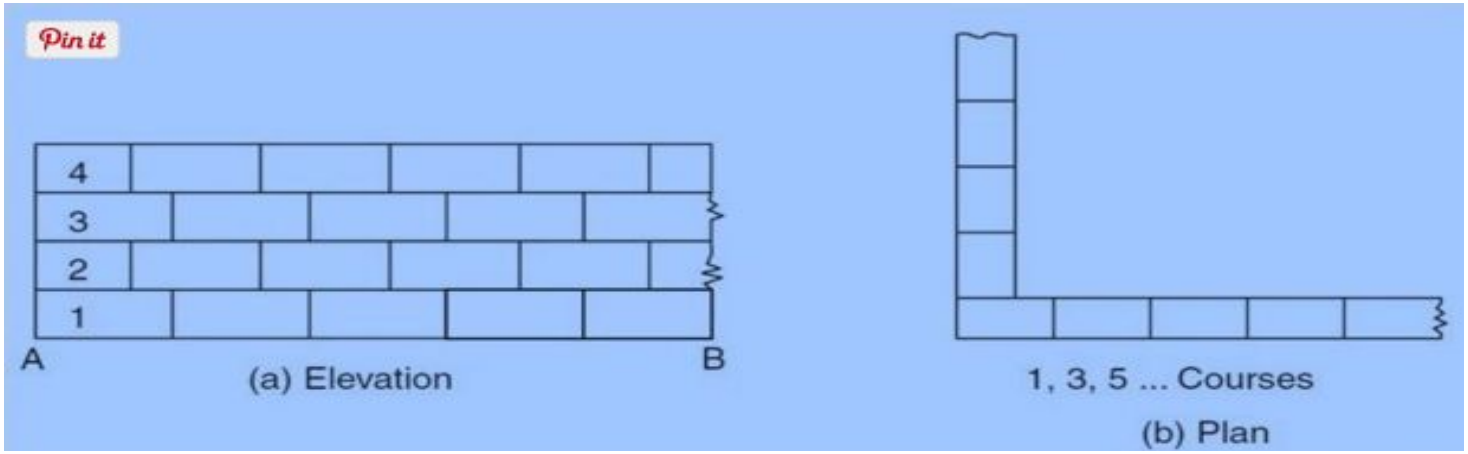

Types of Bond
Stretcher Bond
Header Bond
English Bond
Flemish Bond

Stretcher bond

Stretcher/Common Bond

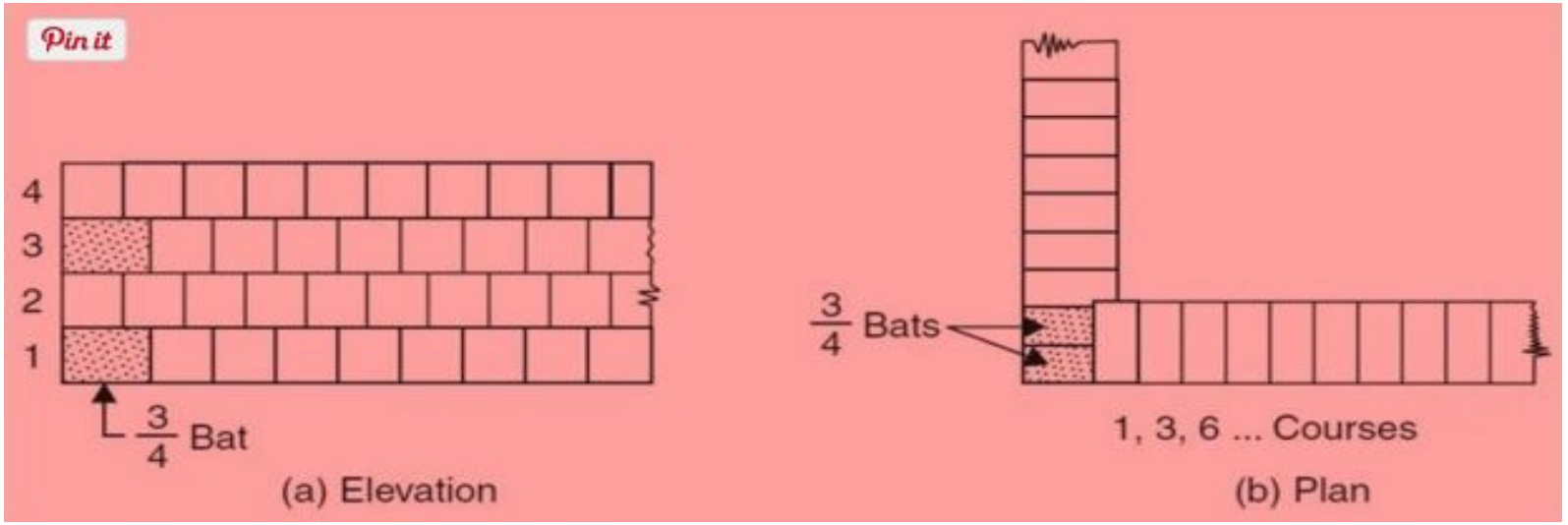
Only used for walls of half brick thickness (partition wall), this is the only practical bond which can be used on a wall of this thickness.

- To break the vertical continuity **½ brick bat** is provided in alternating courses



Header bond

- **Header Bond** also known as **Spanish bond** is a very common bond for load bearing walls.
- It is composed of header bricks, set in rows that are offset ¾ of a brick as a quoin brick in alternating courses, which produces a solid easy to lay bond.



Stretcher bond & Header bond

- **Stretcher bond** is formed by laying bricks horizontally as stretchers on the faces of walls. The length of the bricks is along the horizontal direction of the wall.

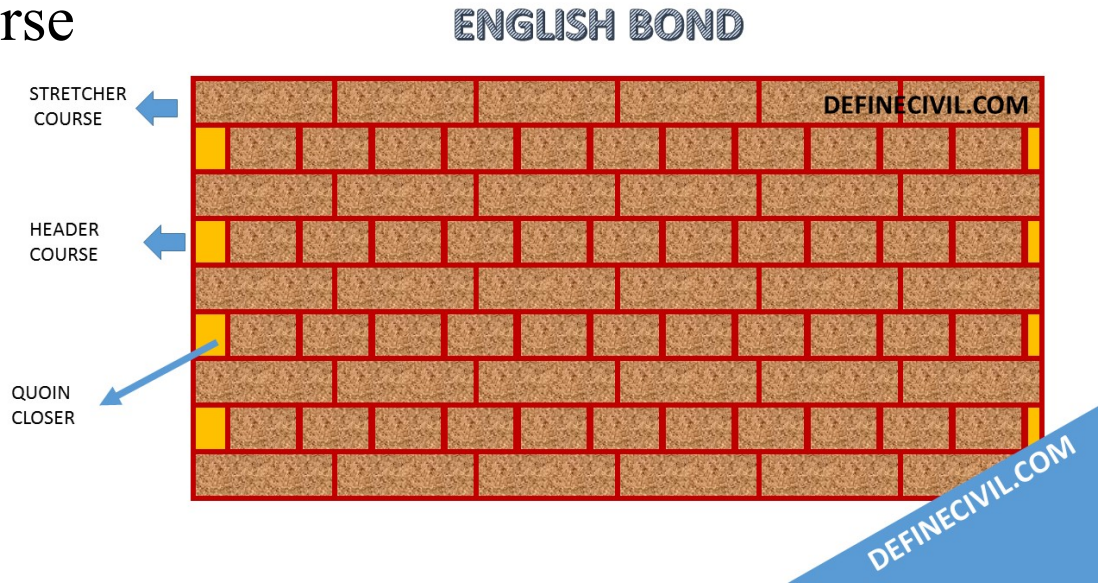
- When all the bricks are placed as headers on the faces of the walls, the bond formed is called "**Header Bon**

English bond

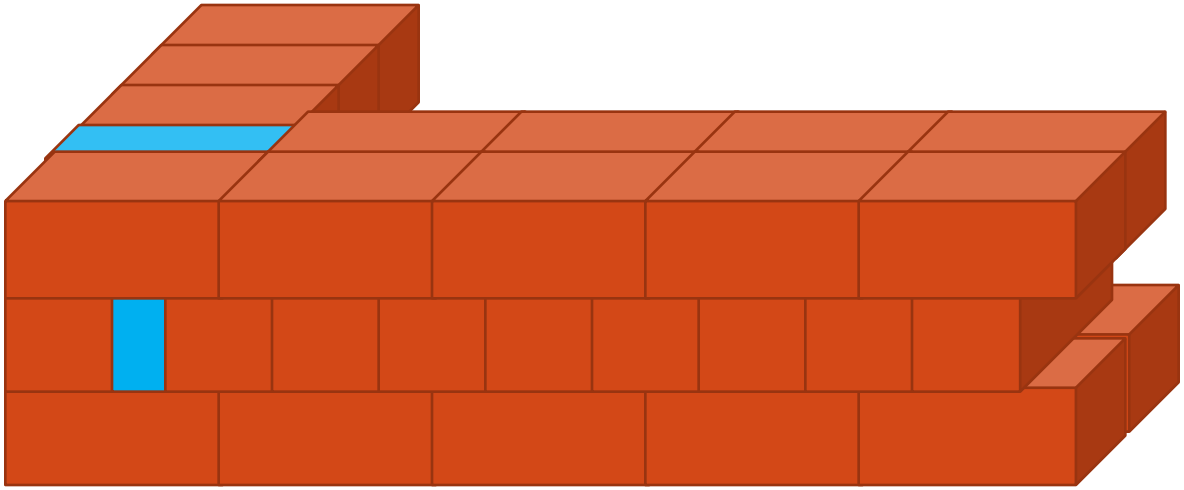
- The strongest bond
- This bond maximizes the strength of wall
- **Alternate courses of headers and stretchers**
- To avoid the vertical joints ,

Queen closer is placed after the first

Header in each heading course

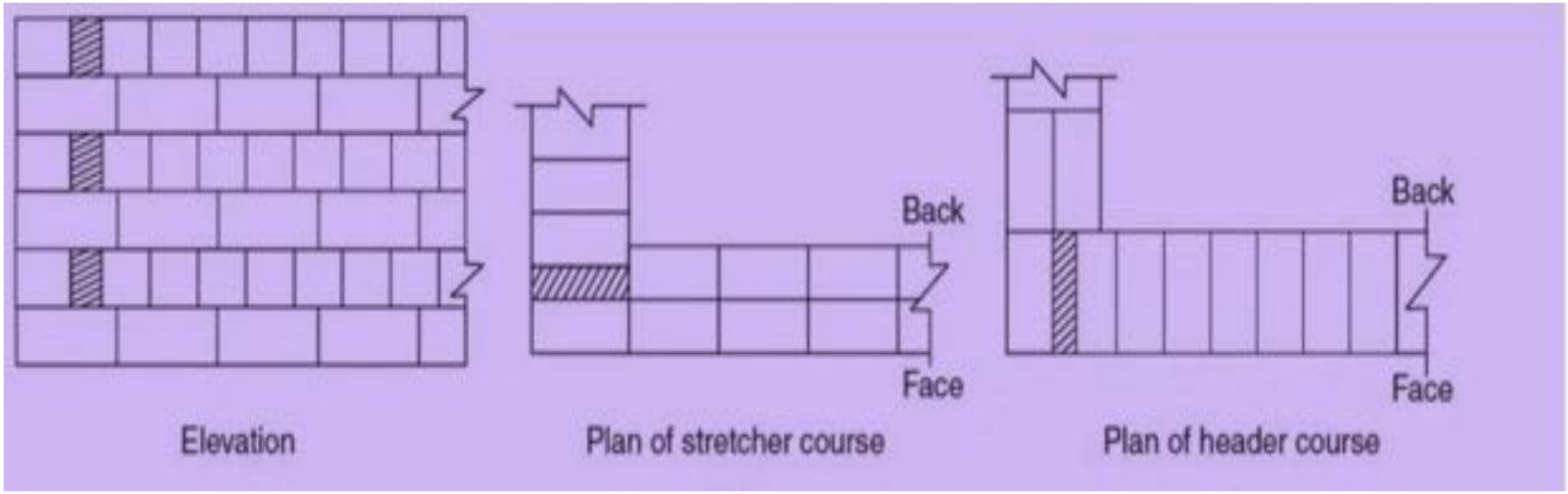


English Bond



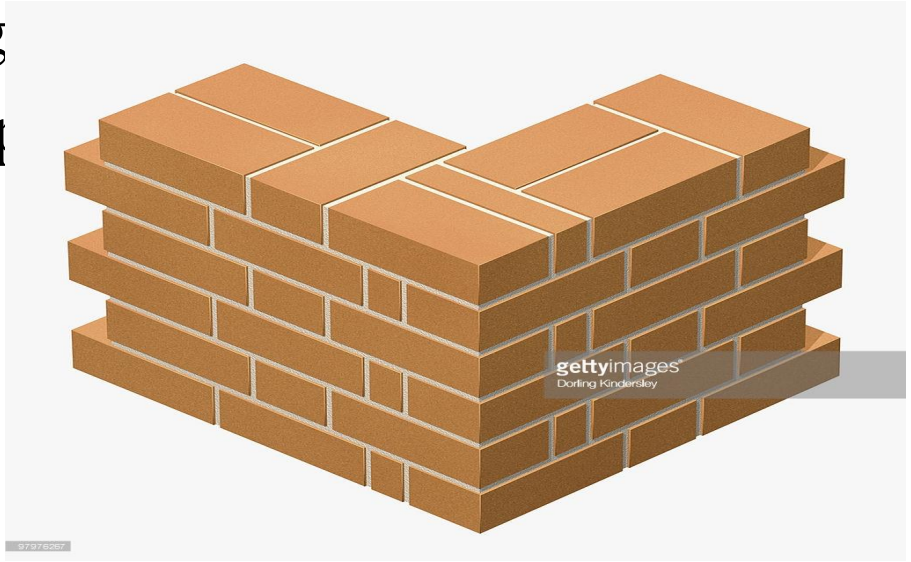
Essential features of English bond

1. Alternative courses will show either headers or stretchers in elevation
2. Every alternate header comes centrally over the joint between two stretchers in course below
3. There is no continues vertical joint



Flemish Bond

- Introduced in 17th century
- More aesthetic look
- **Alternate Stretchers and Headers in each course**
- Each header is placed centrally over a stretcher
- More used in private building
- Requires skilled workmanshi



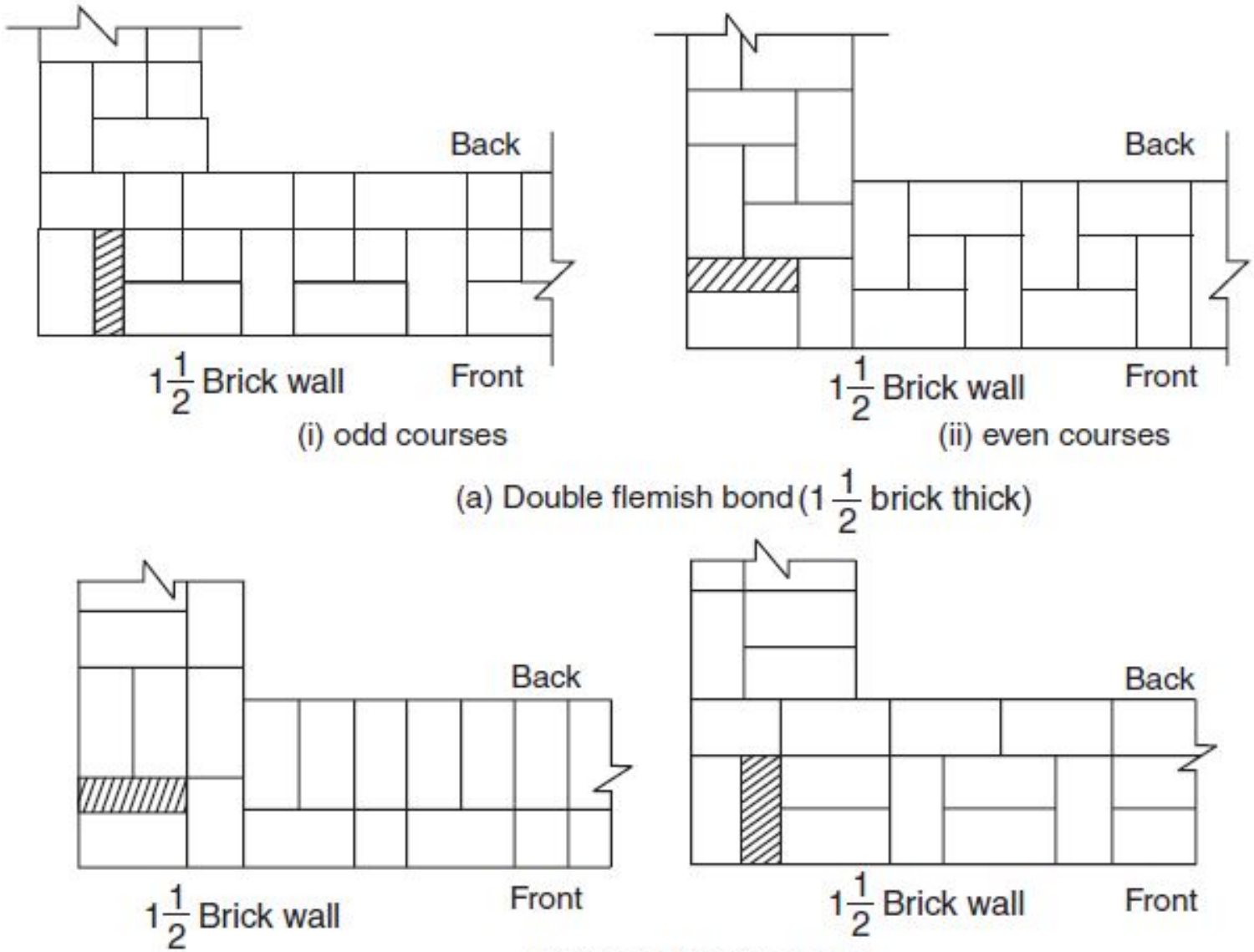


Fig. 8.7. Flemish bond

- 2 types
  - Single flemish
  - Double flemish
- Features of double flemish:
  - Alternate headers & stretchers
  - Same appearance on facing and backing
  - Queen closer placed next to quion headers

Flemish vs English

- Arrangement
- Strength
- Appearance
- Skill

- Plan & elevation of
  - English – 1 brick thick wall
  - Flemish- 1 brick thick wall
  - English- 1 & half thick wall
  - Flemish- 1& half thick wall

STONE MASONRY

Stone masonry

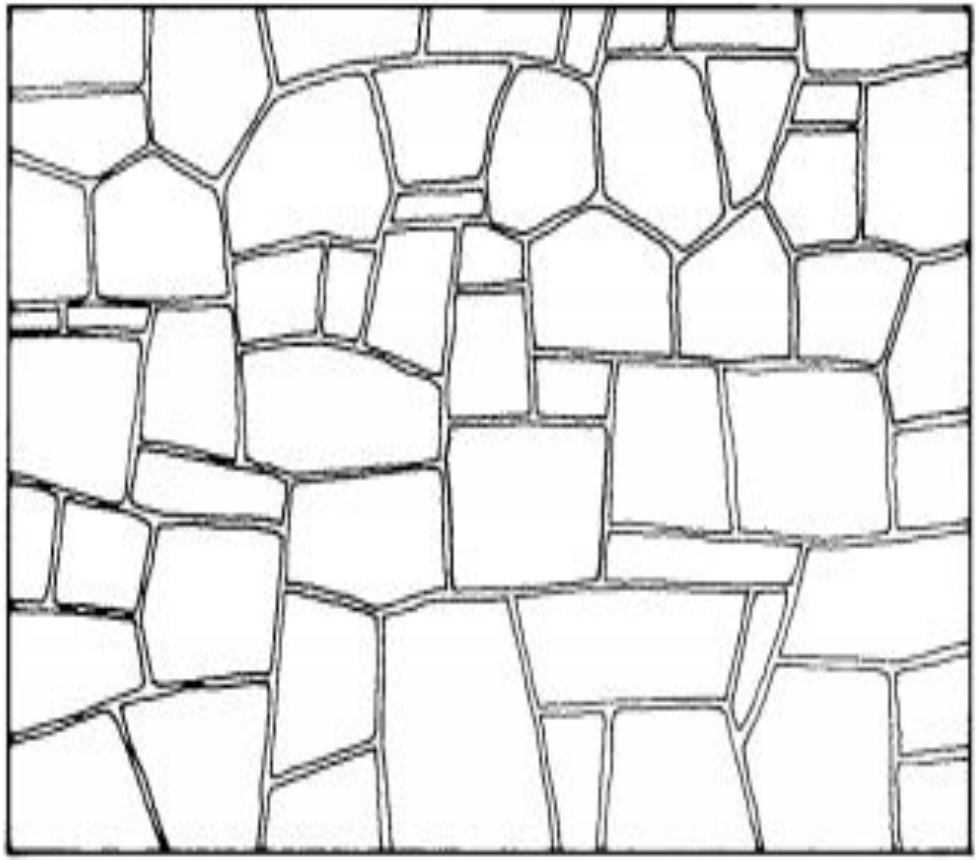
- 2 types
  - Rubble
  - Ashlar
- Random Rubble masonry (RR masonry)
  - Uncoursed
  - Built into courses

RR Masonry -Uncoursed

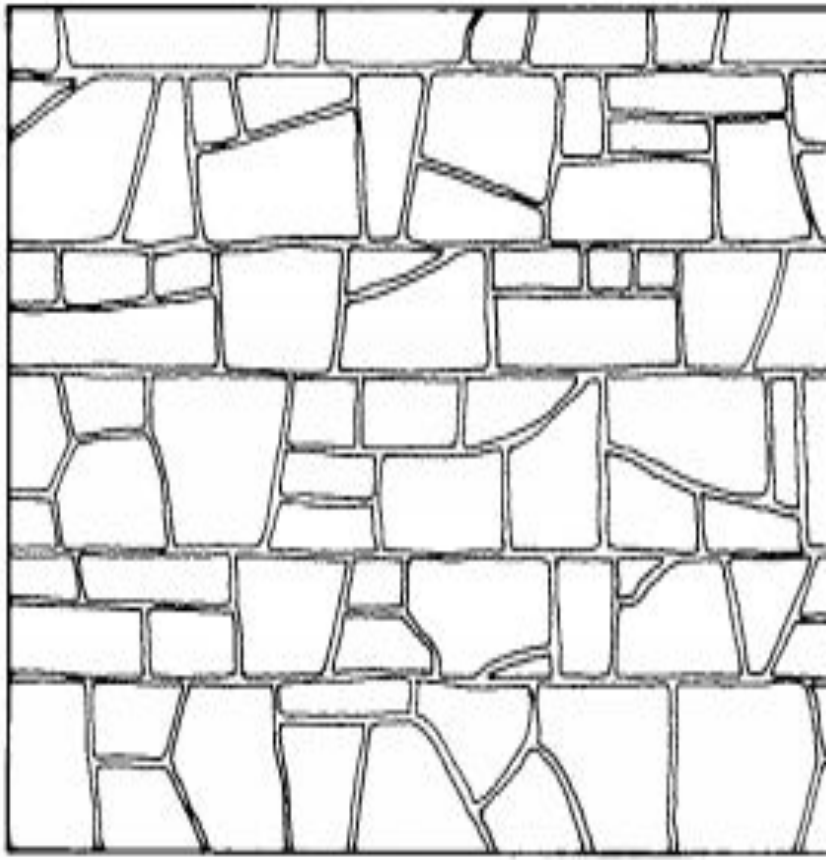
- Rough and cheap
- Irregular size and shape
- Staggering of vertical joints
- Better load distribution

RR Masonry –BUILT INTO COURSES

- Stones are arranged into courses
- 30-45 cm height
- All courses need not be of same height



Random Rubble



Coursed Rubble

ROOFS

The uppermost part of a building which is constructed in the form of a framework to give protection to the building against rain, heat, snow, wind.

- Consist of Roof coverings (GI sheets, AC sheets etc.) supported by structural elements (trusses, slabs etc.) at the top of the building.
- Type of roof depends upon: functional requirement, availability and local practices

Functional requirements

- Durable
- Waterproof
- Strong and stable against action of wind, water and other forces
- Fire resistant
- Thermal insulation
- Sound insulation
- Should provide comfortable environment for the users
- Sufficient insulation against heat gain
- Pleasing appearance

- Types of roof
  - Flat or terraced roof
  - Pitched or sloping roof
  - Curved roof

1. FLAT or TERRACED ROOFS

- Nearly flat(slope less than 10 ^{o})
- Used at places with moderate rainfall.

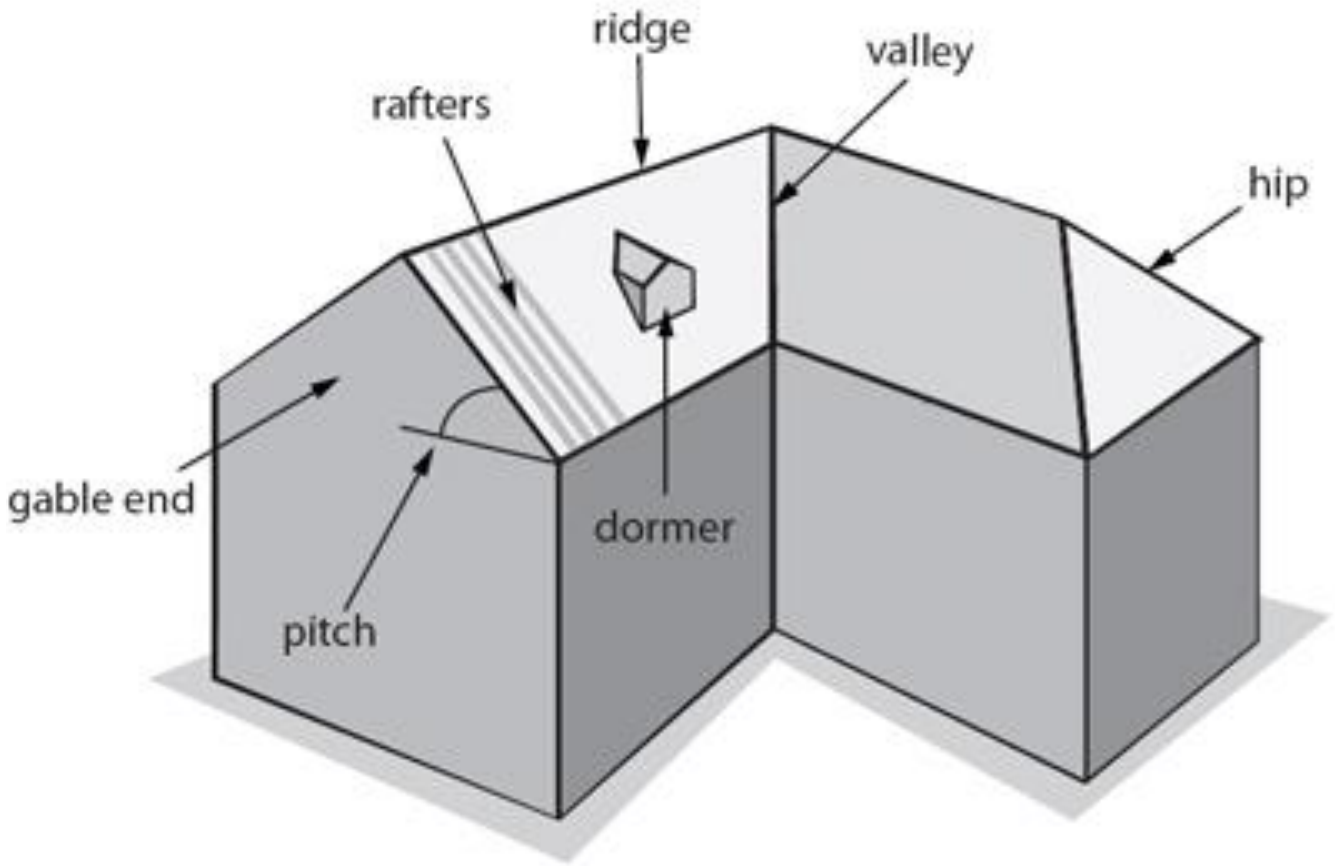
- Advantages
  - ✔ simple construction
  - ✔ roof area can be utilized for roof-gardens, drying yards, playing, overhead water storage tanks, etc
  - ✔ more stable against high wind
- Two types: RCC roof and Madras Terrace roofing

2. PITCHED or SLOPING ROOFS

- A roof having one or more surfaces with a slope **greater than 10 ^{0}from the horizontal**
- Useful at places where rainfall or snowfall is heavy.
- 3 types: **Single roofs, Double or Purlin roofs & Trussed roofs**

Main Terms

- Span – clear distance between the supports of roof
- Ridge – apex line of sloping roof
- Eaves – lower edge of the inclined roof surface
- Rafter – inclined member running from the ridge to eaves
- Purlins – horizontal wooden or steel members, used to support roofing material of a roof


ridge
valley
rafters
hip
gable end
dormer
pitch

(i) *Lean-to-roof:*

- Simplest type of sloping roof
- Rafters that slope in one direction
- Max. span – 2.50m.
- One wall is carried up sufficiently higher than the other one to give necessary slope to the roof.
- Used for covering verandah ,sheds and outhouses connected to main buildings

(ii) *Couple roof:*

-A pair of (couple of) common rafters slope upwards from the opposite walls & they meet on a ridge piece in the middle.

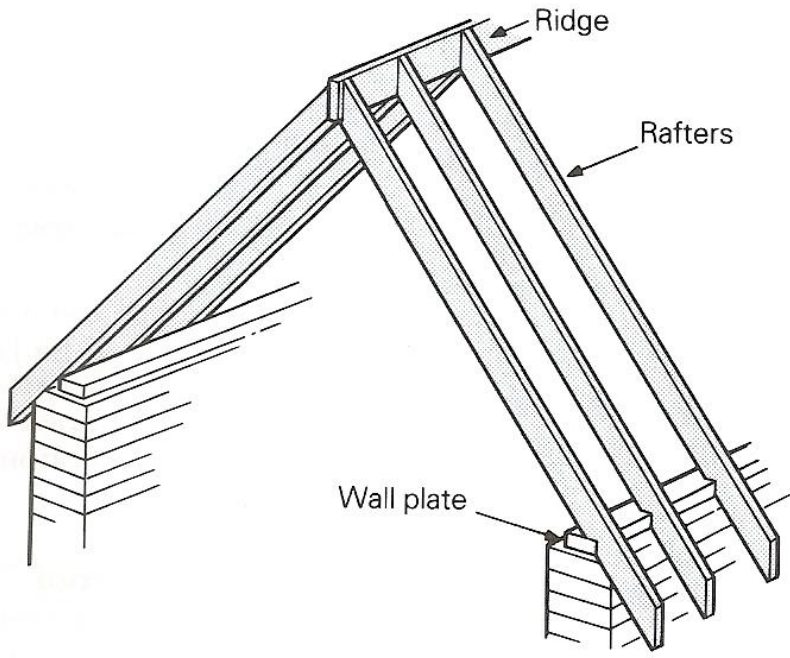
-Used for spans upto 3.50m

- **Double pitched roof**
- Opposite rafters

are not tied together

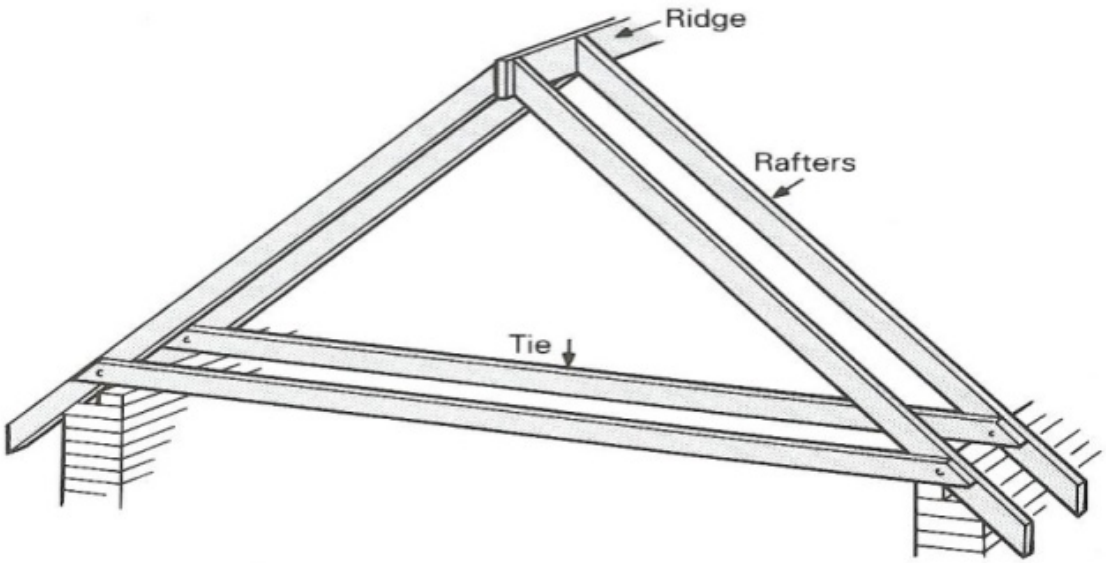
- Outward forces is

resisted by the walls



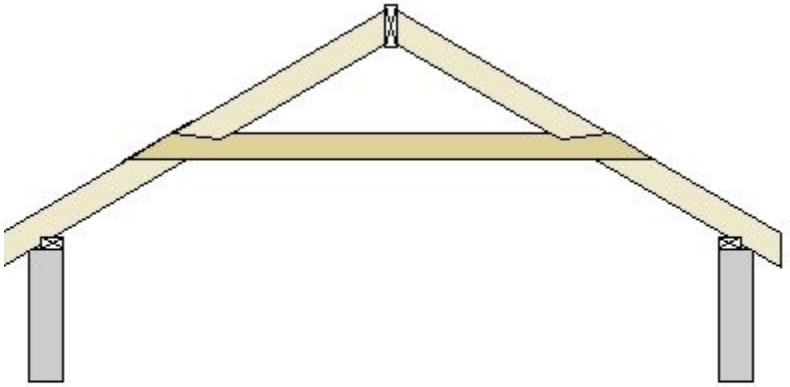
(iii) *Couple-close roof*: similar to couple roof except that **the legs of the common rafters are connected by a tie beam**.

- Tie beam prevents the tendency **of rafters to spread out and thus danger of overturning of wall is avoided**
- Max Span:4.2 m



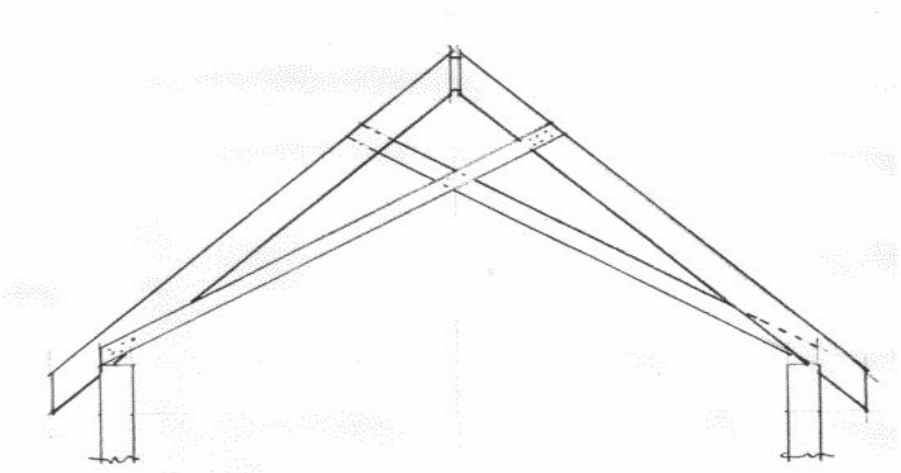
(iv) *Collar beam roof*:

- Similar to couple roof & a tie beam is raised & placed at a higher level. This tie beam is known as collar beam.
- Adopted to economise the space & to increase the ht. of a room.
- Max. span – 4.80m.

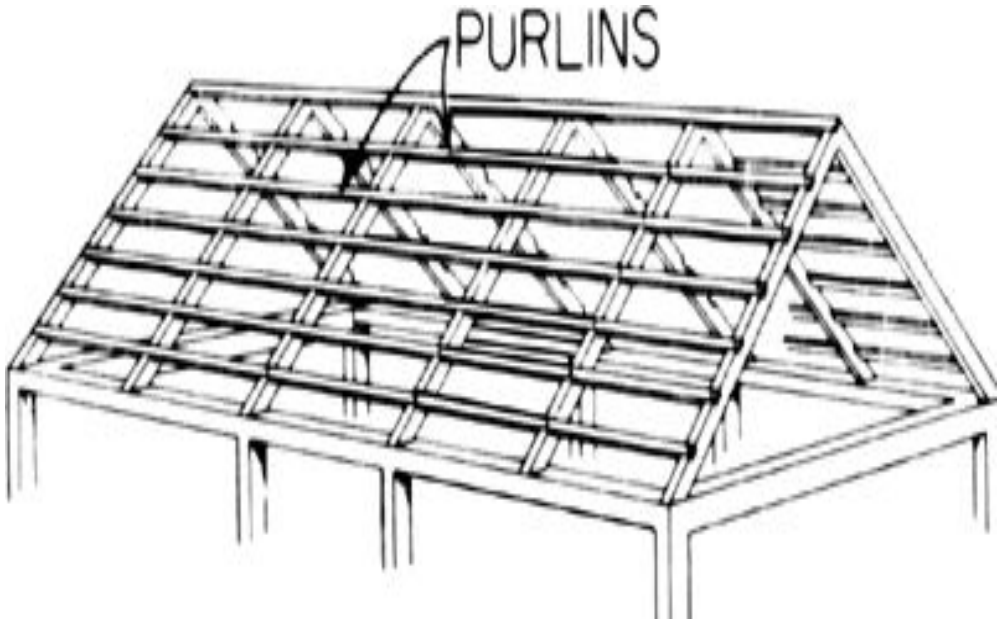


(v) *Collar & scissors roof*:

Similar to collar beam ,except the two collar beams which are crossing each other to present an appearance of scissors.

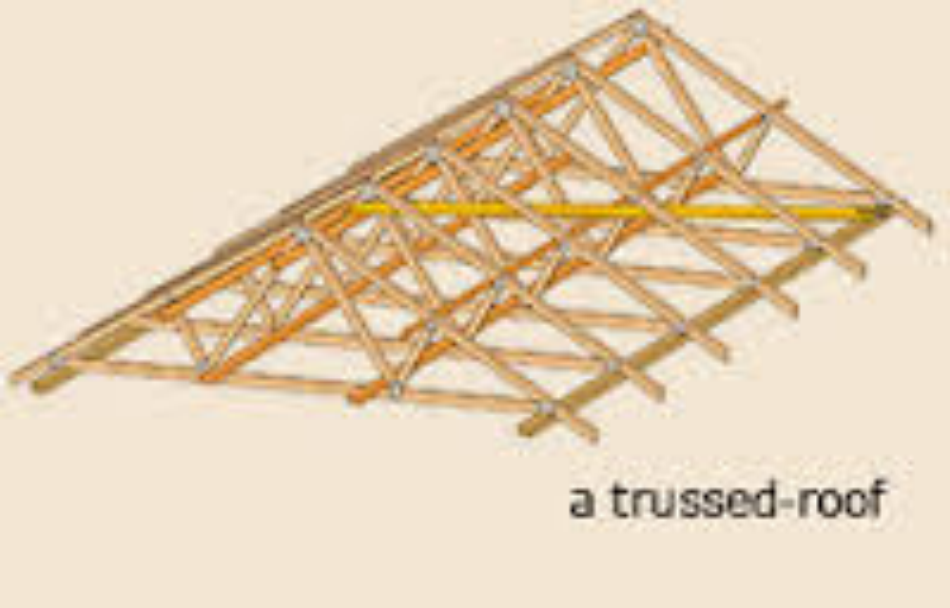


- ***Double or Purlin roofs:*** when the span exceeds 2.40m, the necessary size for the rafters becomes uneconomical. Hence to reduce the size of rafters, the intermediate supports called purlins are introduced under the rafters. Also known as *rafter & purlin roof*. Used for spans upto 4.80m.



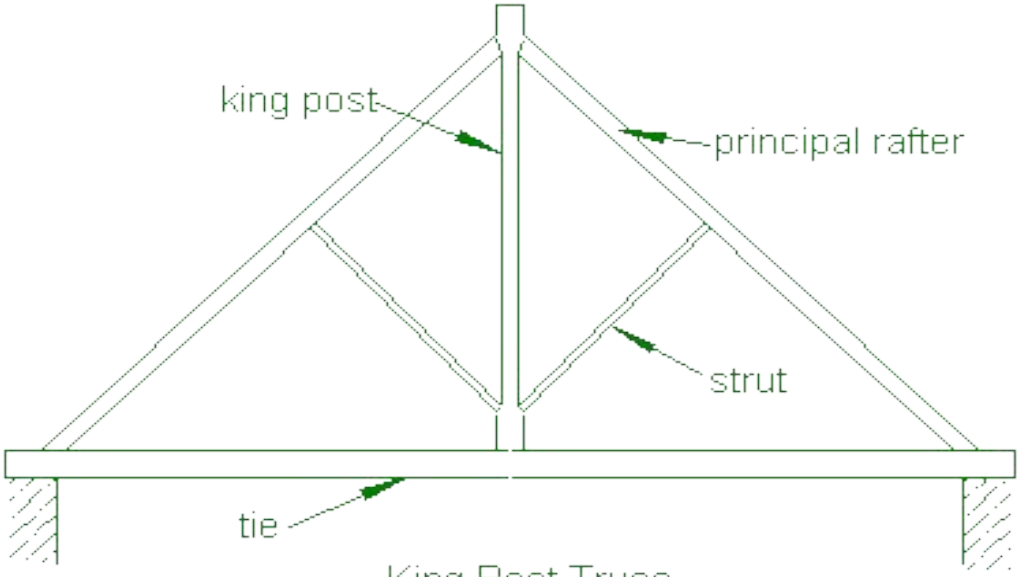
Trussed roof

- when the span exceeds 4.80m & when there are no inside supporting walls or partitions for the purlins, the framed structures known as trusses are used.

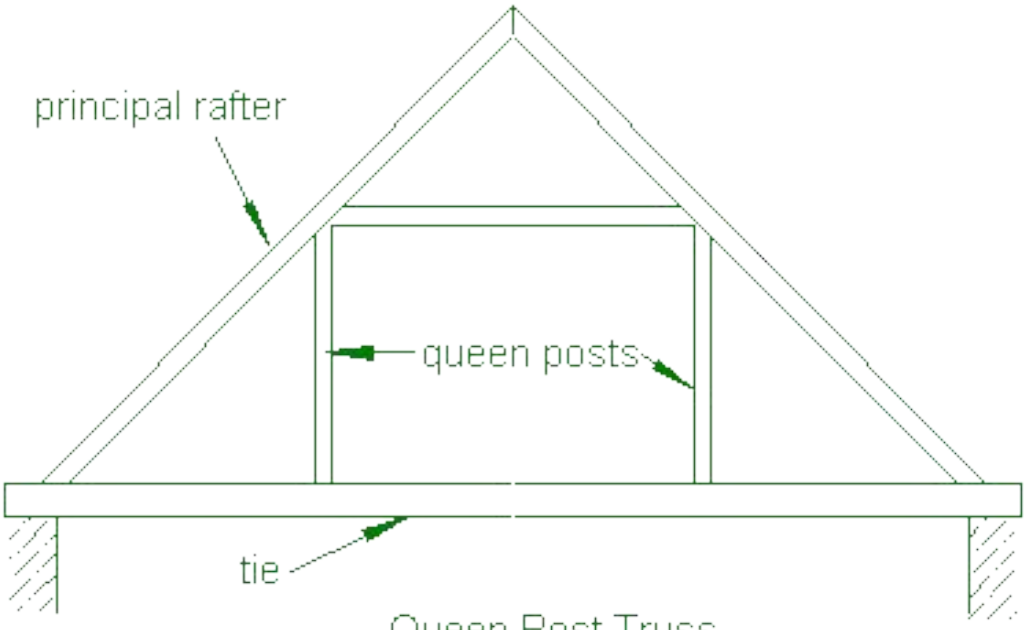


(i) *King-post truss*: the central post, known as king-post, forms a support for the tie beam. The inclined member known as *struts*, prevent the principal rafters from bending in the middle.

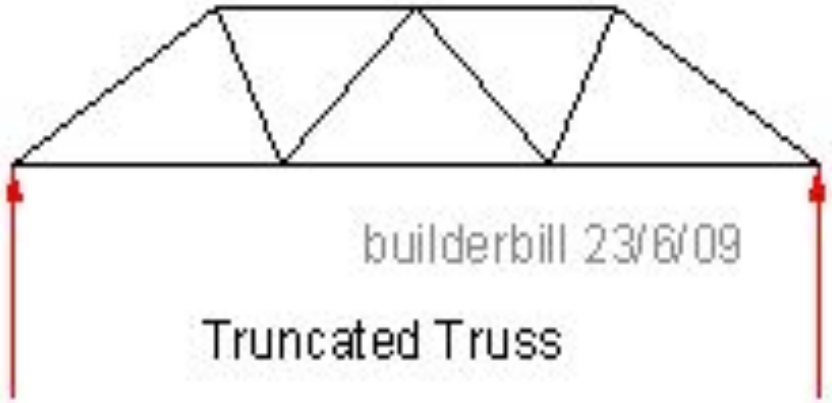
(i) *Queen-post truss:* this truss have two vertical members known as the queen-posts. The upper ends of the queen-posts are kept in position by means of a horizontal member known as *straining beam*.

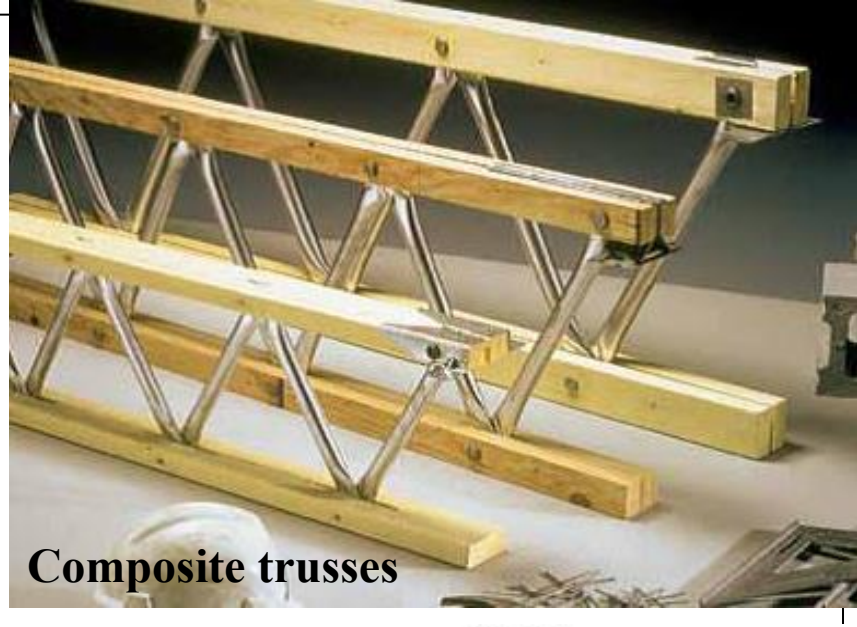


King Post Truss

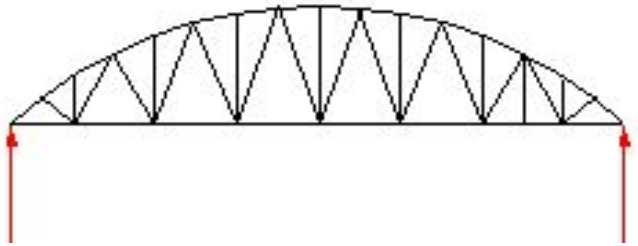


Queen Post Truss




Composite trusses

Steel trusses




Bel-fast truss

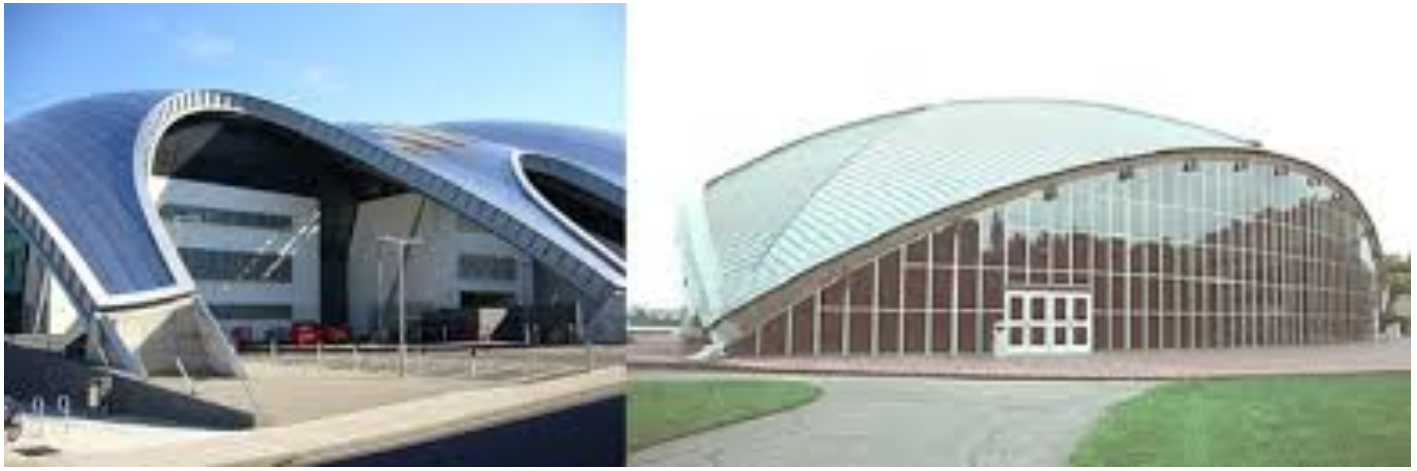
3. CURVED ROOFS

- Modification of pitched roofs & their top surface are curved.
- Suitable for public buildings to develop the architectural effects.
- Shell roofs & domes are the varieties of the curved roof.
- *Uses:* factories, monumental works, libraries, theatres, recreation centres.
- Constructed of timber or RCC.

- *Adv*: When prefabricated, construction is easy, do not require skilled supervision, cheap in construction, requires less formwork.

Shell roof

Dome



Shell roof

ROOFING MATERIAL

Factors to be considered before selecting the type of roof covering for a pitched roof:

- ✔ Climate of the locality
- ✔ Nature of the building
- ✔ Initial cost & maintenance cost
- ✔ Durability
- ✔ Availability of material
- ✔ Fabrication facilities
- ✔ Type of roof framework
- ✔ Resistance to fire & heat

Types of Roofing material

- Thatch covering
- Shingles
- Tiles
- Asbestos cement sheets
- Corrugated GI sheet
- RCC slab

1. Thatch

Light roof covering

A roof covering of straw, reeds, palm leaves, or a similar material

Combustible

Absorbs moisture rapidly & is easily liable to decay

Unstable against high winds

Used in rural areas because it is the cheapest & simple in construction

shingles

- **Roof shingles** are a roof covering consisting of **individual overlapping elements**
- Shingles are made of various materials such as **wood, cement, metal, plastic, or composite materials**
- They **are easy to install, relatively affordable, last 20 to 50 years** and are recyclable in some areas.
- Asphalt shingles come in a large number of styles and colors

Wooden Shingles:

- wood shingles are obtained from well-seasoned timber.
- Used in hilly areas where the wood is easily & cheaply available

3. Tiles

- Thin members made out of clay or concrete
- They are of different shapes and sizes.
- According to shape and pattern they are manufactured in a similar manner as bricks

- Supported over battens and rafters
- Life expectancy of 40 to 50 years

Clay Tile
Concrete Tile

4. Asbestos cement sheets

- Manufactured using asbestos (silky fibrous material) and Portland cement
- Widely used sheets for industrial buildings, factories, cinema halls, auditoriums, etc

Asbestos cement sheet

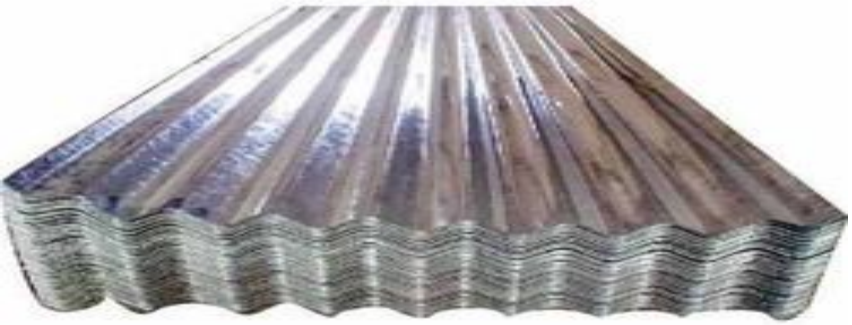
- **Weatherproof , durable, corrosion resistant and heat insulating**
- Available in corrugated and semi –corrugated forms
- Laid on purlins

Asbestos cement sheets – Advantages

- **They are cheap, fire resistant, strong, tough**
- **Water proof**
- They do not require any protective paints
- Light in weight
- Durable
- Available in larger size , which makes the laying fast
- Maintenance is also less

Galvanized iron sheets

- **Galvanization** is the process of applying a protective zinc coating to steel or iron in order to prevent it from rusting
- **Zinc weathers at a slow rate** so coating generally has long life
- They are fixed on steel purlins
- Durable, fireproof ,light in weight
- Less maintenance

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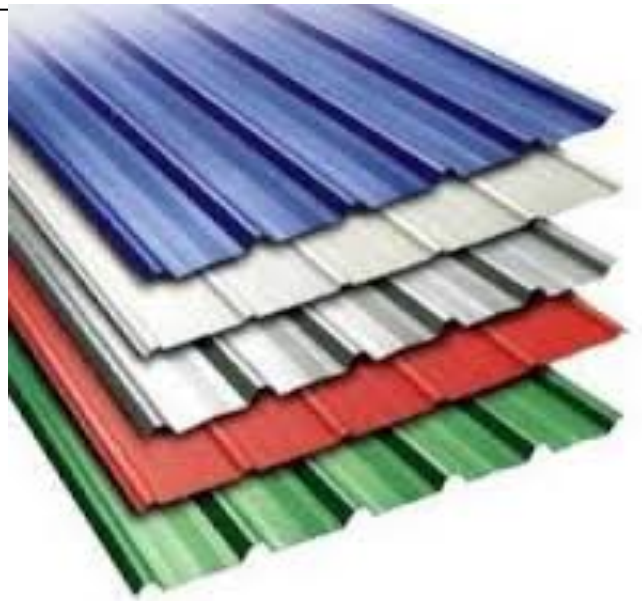
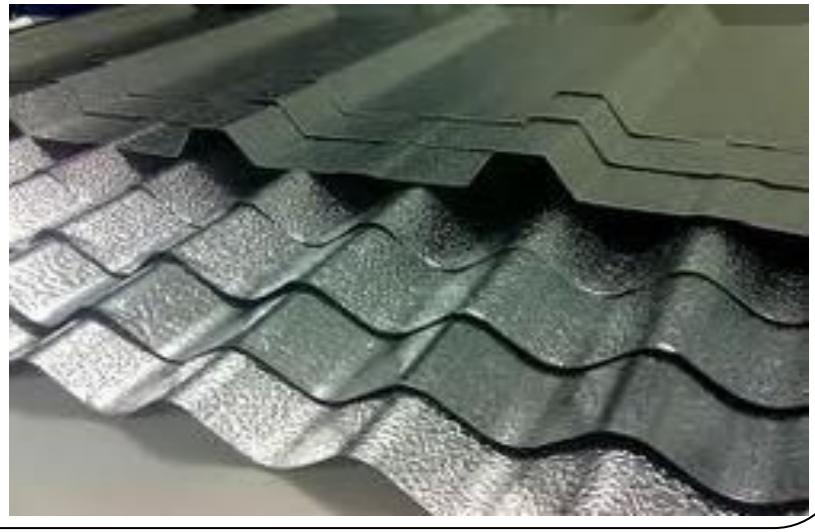
5. Corrugated GI sheets



- Galvanized iron sheets are prepared by pressing flat wrought iron plates & galvanized with a coat of zinc.
- Commonly known as G.I. sheets.
- Corrugations increases strength & rigidity & permit easy flow of rain water.

6. Aluminium sheets

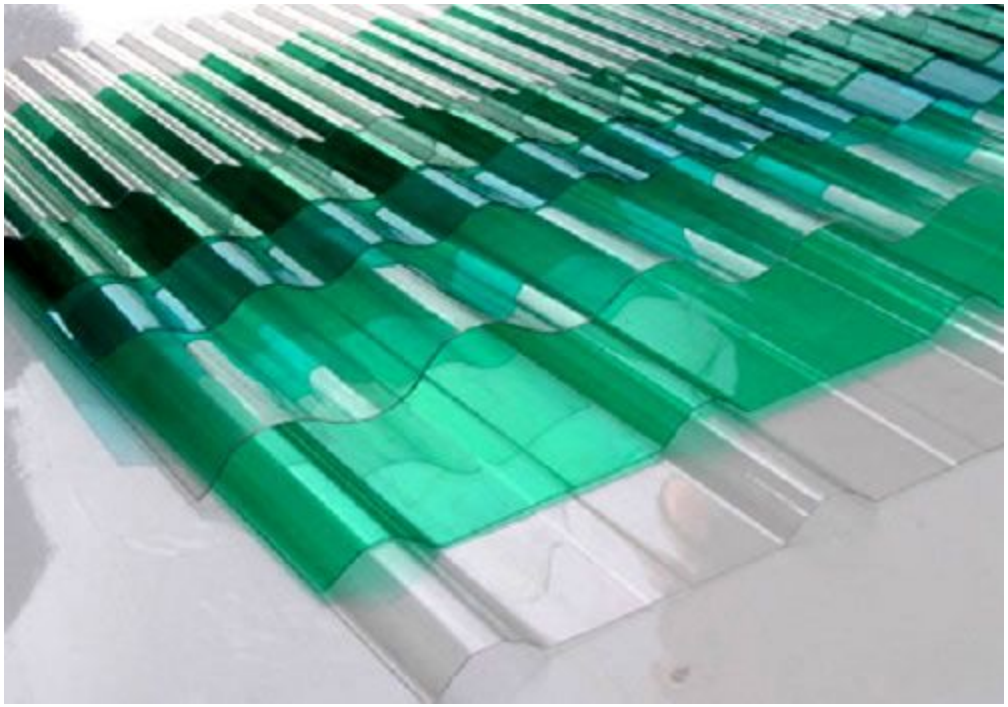
- Long lasting
- Economical than PVC, steel and cement sheets
- **Corrosion free**
- Zero maintenance
- **Light in weight and with better appearance**
- **Only disadvantage – more expensive**



7. Fiber reinforced plastic sheets

- Fiber reinforced polymer (FRP) are made with glass or any suitable fiber with a suitable resin.
- **Fibre-reinforced plastic** (**FRP**) (also *fibre-reinforced polymer*) **is a composite material made of a polymer matrix reinforced with fibres**.
- The fibres are usually glass, carbon, or basalt
- It is available in different colors and shapes.

FRP Sheets



8. PVC roofing sheets

- Consists of thermoplastic membrane
- Use of chlorine increases life span
- Transparent with light transmission
- Resistant to chemicals, acids and oils
- Life span is 25 years
- Not fire proof
- Used in temporary constructions, car parking etc where light roofing of pleasing appearance is required


16/01/2008

Floor

The portion of the building which divides different levels of accommodation,and supports the occupants , furniture and other utilities

Depending upon position of floor

- Basement Floor: Floor constructed below GL
- Ground Floor: Floor constructed just above GL
- Upper Floors: Floors above Ground Floor

Requirements of a good floor

- Strong enough to support the floor covering and other superimposed loads
- Provide impervious and wear resisting surface
- Durable
- Adequate fire resistance
- Sufficient heat and sound insulation
- Resilient to receive impact load

Components of Floor

- **Sub-Floor or base course** :Provides support to Floor Covering

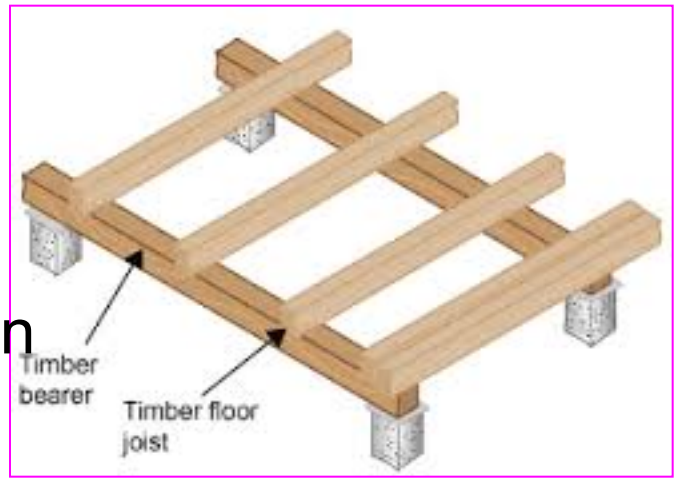
- **Floor covering or Finish** :Provides a smooth, clean, impervious and durable surface

Types of floors

- Timber Floor
- Filler Joist Floor
- Jack Arch Floor
- RCC Floor

1. Timber Floor

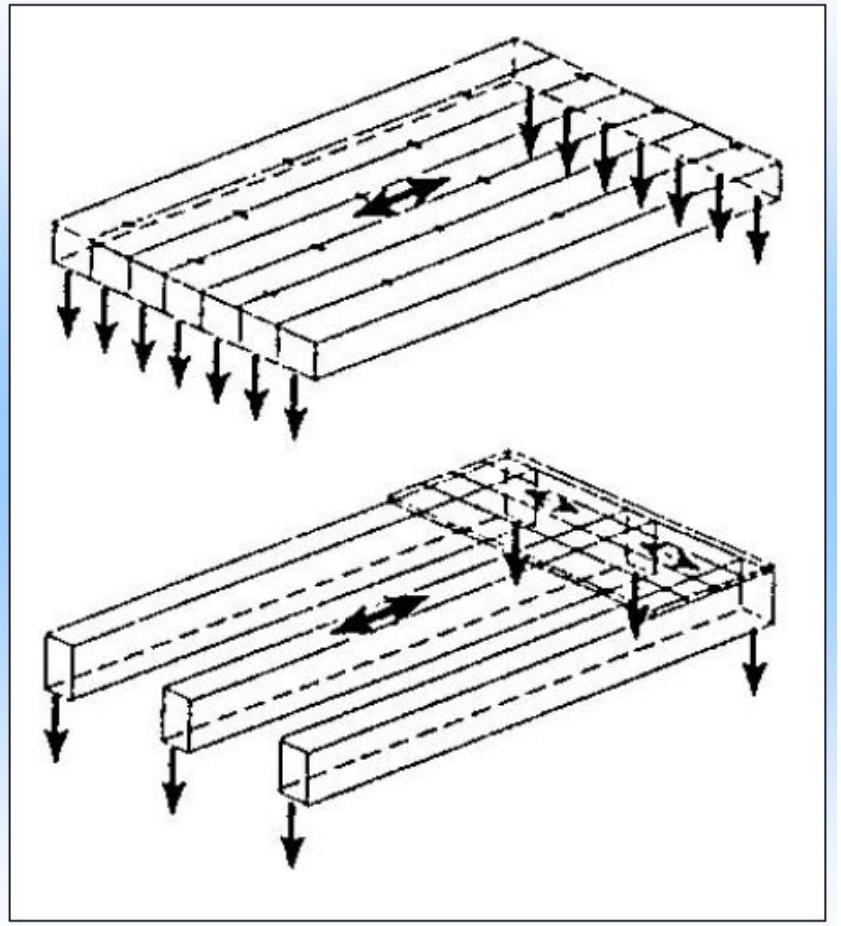
- Timber beams or slabs
- Max span is up to 6 m
- More aesthetic appearance
- More uniform load distribution



Disadvantages:

- Joists may sag, cracks devel
- Costly
- Takes time for the floor to se
- Not sound proof

- timber slab structure
- beam (joist) structure

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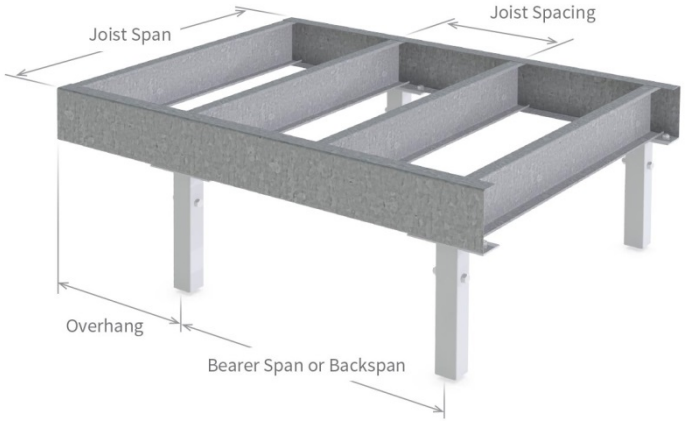
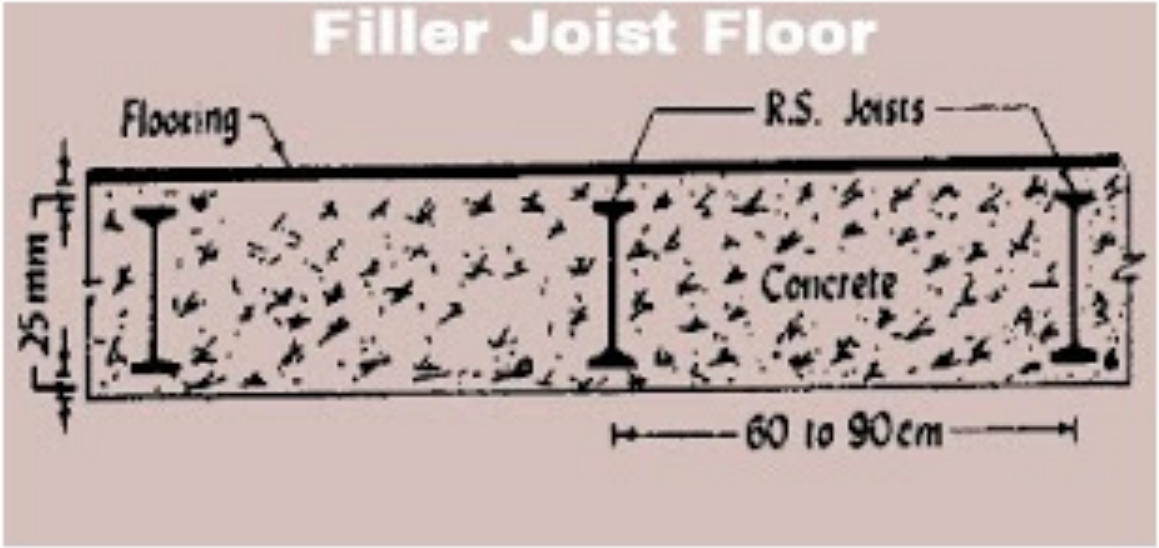
2. Filler Joist Floor

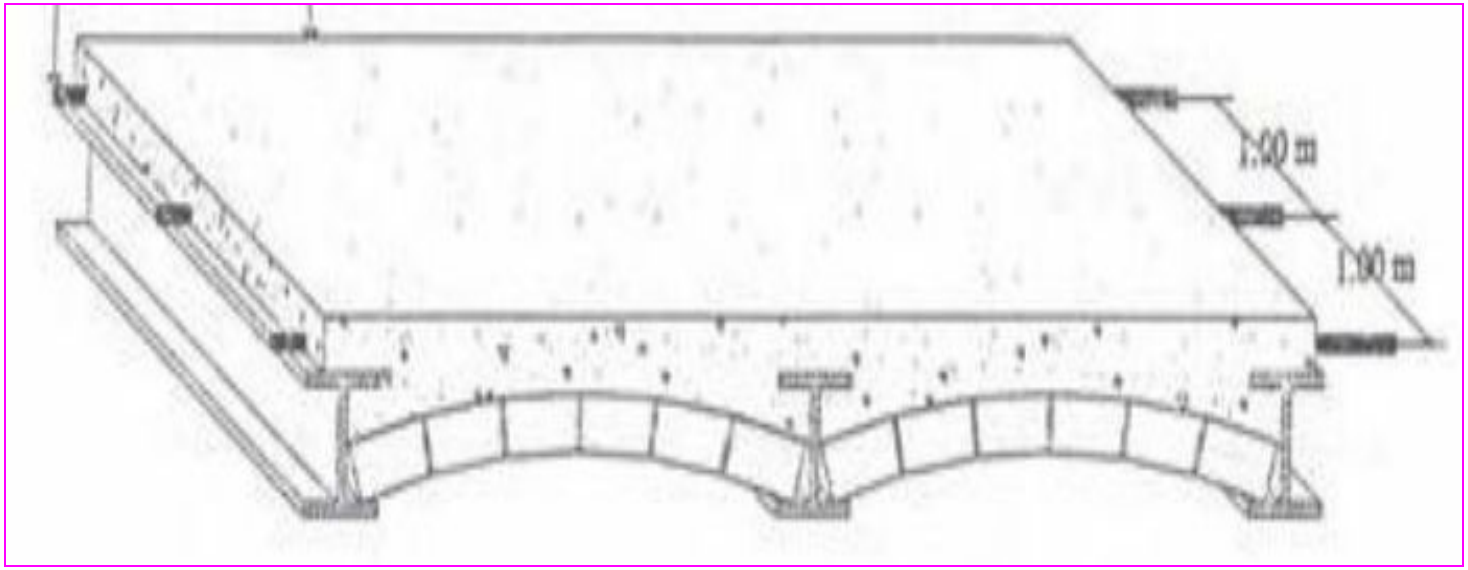
- A type of floor in which the *principal supporting members are steel joists, the gaps between the joists being filled with concrete*
- Joists rest on a wall or a steel beam
- Joists are spaced at a center to center distance *60 to 90cm*
- Concrete completely surrounds the joists


Joist Span
Joist Spacing
Overhang
Bearer Span or Backspan


Filler Joist Floor
Flooring
R.S. Joists
Concrete
25 mm
60 to 90 cm

3. Jack Arch Floor

- *Brick arches or concrete arches are constructed* and these arches rest on the lower flanges of mild steel joists
- The joists rest on wall
- Joists are placed at a distance of about *80 to 120 cm* center to center
- Rise of arch is *10 to 15cm*


1.50 m
1.00 m

4. RCC Floor

- Widely *used in modern construction*
- As per the loads coming on the floor, *slabs and beams are designed with proper reinforcement*
- Thickness varies from *120 mm and above*
- Diameter of reinforcement used (steel bars) is *8mm to 12mm*
- Can be cast in situ or pre cast
- Advantages – *Only initial cost, Durable, Easy to construct & Fire proof*

Double Flagstone floor

- Flagstone flooring is flooring made from flagstone, a form of sedimentary rock which is well-suited to splitting into flat slabs for flooring, roofing

- Flagstone can be polished to a high sheen, or left with a slightly matte finish, and it comes in a range of colors including gray, bluish, green, brown, red, yellow, and cream.

6.Raised Floor or Elevated Floor

- Floor not supported on ground
- Can be of timber, Precast concrete etc.
- Applications/ Advantages:
  - Low bearing capacity soils
  - Sloping sites
  - Utility space
  - Rise of ground water

Floor covering materials

- For comfort, durability, safety and decoration

- Selection of materials depends on:

Cost

Strength

Noise insulation

Comfort

Cleaning effort

- Mud Floor Covering
- Stone Floor covering
- Brick Floor covering
- Concrete Floor covering
- Tiled Floor covering
- Granite Floor covering
- Mosaic Floor covering
- Marble Floor covering
- Terrazzo Floor covering
- Ceramic Floor covering
- Rubber Floor covering

1. Mud flooring

- Usually used in villages for huts & other unimportant buildings
- Cheap, easy to construct and maintain
- Hard, impervious & has good thermal insulation capacity
- When mud is readily available
- Flooring is easy

2. Brick floor covering

- Used when bricks are available locally
- **Easy to construct and economical**
- Cheap construction & used for places where heavy articles are to be stacked as in case of **godowns, sheds, stores.**
- The bricks are laid on the floor & the brickwork is carried out in cement or lime mortar.
- Adv: non-slippery, durable, sufficiently hard & easily repairable.
- Disadv: absorbs water

3. Stone floor covering

- Square or rectangular slabs of stones are used
- The stones used should **be hard, durable, tough & of good quality and should resist abrasion**
- **Stones used:** Granite,marble etc
- **Thickness:20 to 40 mm**
- Size:30x30 cm 45x45cm,60x60cm

3.a. Marble floor covering

- **Marble slabs** are directly laid **over a sub grade** set in lime or cement mortar
- Then it is polished with carborandum stones
- Have hardness, durability & aesthetic appearance
- Used in superior type of constructions & places where sanitation & cleanliness are important

3.b. Granite floor covering

- Available in different colors & textures
- Laid in the similar way of marble & possess better qualities than marble
- It is hard and possess high water and stain resistance.

4. Concrete floor covering

- Durable, easy to construct
- One of the **most common** type of flooring
- Economical compared to tile flooring
- It consists of two layers:
  a) Base course (10-15cm thick cement concrete)
  b) Wearing course (2.5- 4 cm lime or cement)
- But defects once developed in concrete floors, whether due to poor workmanship or materials, cannot be easily rectified
- Poor insulation against heat & sound

5. Mosaic floor covering

- Over concrete base, lime or cement mortar is placed.
- Over that a layer of cementing material is spread. It consists of slaked lime, powdered marble, pozzolona
- After this, a mixture of coloured cement & small pieces of broken glazed tiles are laid
- This is compacted with a light roller

6. Terrazzo floor covering

- Terrazzo is a special type of concrete with *cement and marble chips as aggregates*
- Desired color is obtained by adding marble chips of different color or using colored cements
- This type flooring is costly and is used to obtain a clean, attractive & durable surface in public buildings, hospitals etc.
- It requires more time to finish terrazzo flooring

7. Tiled floor covering

- Most widely used in all types of buildings
- Advantages :
  - shorter time of installation,
  - pleasing appearance
  - durability
  - non-absorbent, decorative surface
- Terracotta (earthen ware) tiles, ceramic tiles, vitrified tiles, glazed tiles, cement concrete tiles are important varieties of tiles used

8. Rubber floor covering

- It is made of **pure rubber mixed with cotton fibre, granulated cork or asbestos fibre & the desired coloring pigments**
- It has **good elasticity & noise insulation properties**
- They are expensive but provide a durable wearing surface
- Hospitals, X-ray rooms
- **It is available in sheets or tiles of rubber , fixed to concrete floor with the help of adhesives** .

9. Glass floor covering

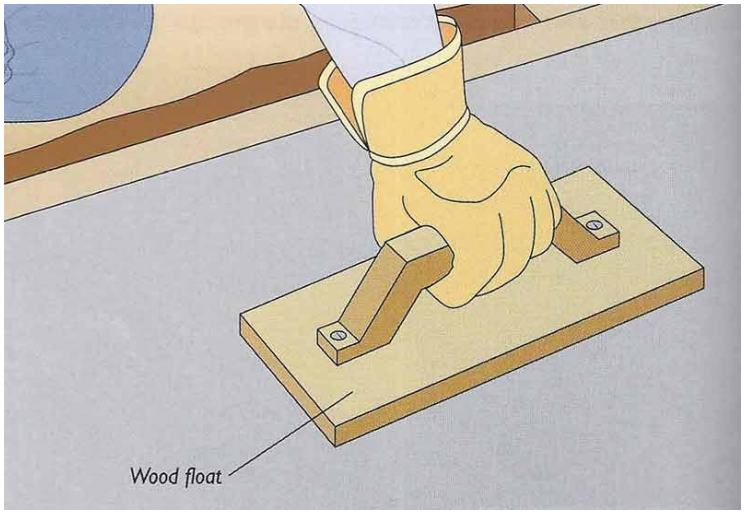
- It is used when it is desired to allow light to the floor below
- Structural glass available in the form of tiles or slabs
- Not a common flooring as it is costly.

10. Plastic or PVC floor covering

- Plastic tiles are made of PVC
- Adv: resilient, smooth, good looking, easily cleaned.
- Disadv: costly, easily damaged when it comes into contact with burning objects
- Plastic floor coverings are used in all types of buildings like offices, hospitals, shops etc

Plastering

- Method of *covering rough and uneven surfaces of various components of a building* with plastic material i.e., mortar which is called plaster.
- Means, *process of covering rough surfaces of wall, columns, ceilings and other building components with thin coat of plastic mortar* to form a smooth durable surface.
- Tools used – Wood float, Trowel, Plumb bob & Straight edge
- Types of plaster – *Lime plaster* & *Cement plaster*


Wood float

Purpose of Plastering

- To provide an *even and durable finished surfaces*
- To enable the *external surfaces to resist the atmospheric influences particularly the penetration of water*
- To provide the surfaces a *smooth finish such that dust and dirt cannot lodge*
- To protect the *surface against vermin*
- To form a good surface for *taking colour wash, distemper or a paint*
- To *hide a poor workmanship* or *use of inferior quality materials*

Procedure of Plastering

1. Surface Preparation

- ✔ Background surface first prepared by *cleaning & roughening the surface*
- ✔ Any projection *more than 12mm on the background surface should be removed* and the *cavities and holes are filled properly* so as to obtain an even surface
- ✔ *Surface washed well with water* and *kept for sufficient time before plastering*

Procedure of Plastering

2. Making of Plaster

- ✔ The chosen type of plaster should be made by means of homogeneous mixing (*Dry mortar is mixed initially and thereafter water is added to get required workability*)
- ✔ The mortar made should be consumed *within 30 minutes*
- ✔ If excess mortar is prepared, it dries up either due to *evaporation of water* or due to *water absorption by sand* or due to *water consumed by cement hydration*

Procedure of Plastering

3. Application of Plaster

- ✔ Screeds are developed with the help of plumb bob to act as gauges to obtain uniform thickness of mortar
- ✔ The mortar is dashed against the surface between screeds and *levelled using floats and straight edges*
- ✔ The *final finish is obtained with trowels* and the surface is watered for about 7 days
- ✔ For surfaces which needs two coats, the *second coat only should make after 1 or 2 days of first coat*