

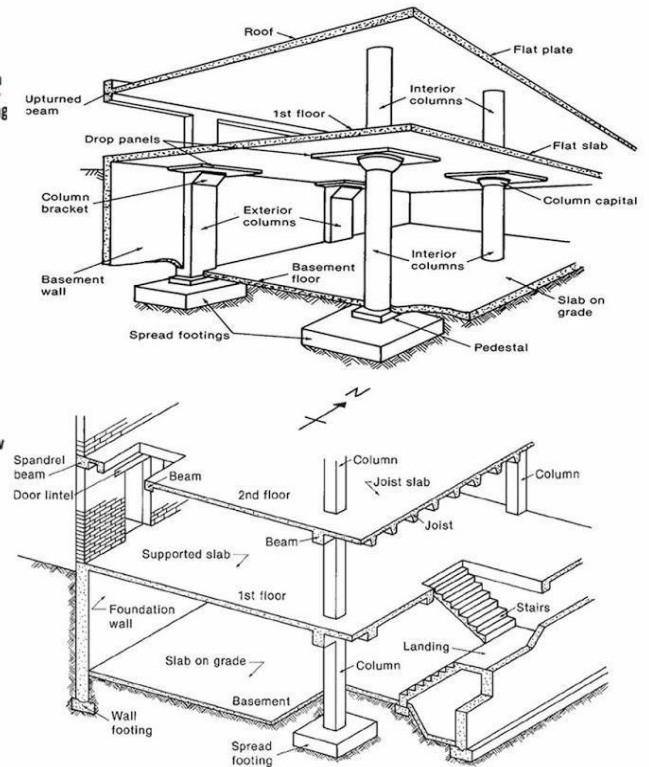
ELEMENTS OF ENGINEERING I (ENGG 111)

BUILDING MATERIALS, COMPONENTS AND STRUCTURE

Substructure & Superstructure



TODAY A READER
TOMORROW A LEADER



SUPERSTRUCTRE

The portion above the ground level and below the ground floor level is known as **plinth**.

The portion above the ground floor level is known as **super structure**. It includes walls, columns, beams, floors, roofs, doors, windows, lintels, staircases etc.

Types of Superstructure based on the method of Load Transfer

Load Bearing Structures

1. Load on the structure is transferred vertically downward through walls.
2. Cost is less.
3. Suitable up to three stories.
4. Walls are thicker and hence more floor area is reduced.
5. Resistance to earthquake is poor.

Framed Structures

1. Load transferred through frame work of columns, beams and floors
2. Cost is more.
3. Suitable for any number of stories.
4. Walls are thinner and hence more floor area available for use.
5. Resistance to earthquake forces is good

A. WALLS

Walls are built as structural members and as partition to divide living area into different parts

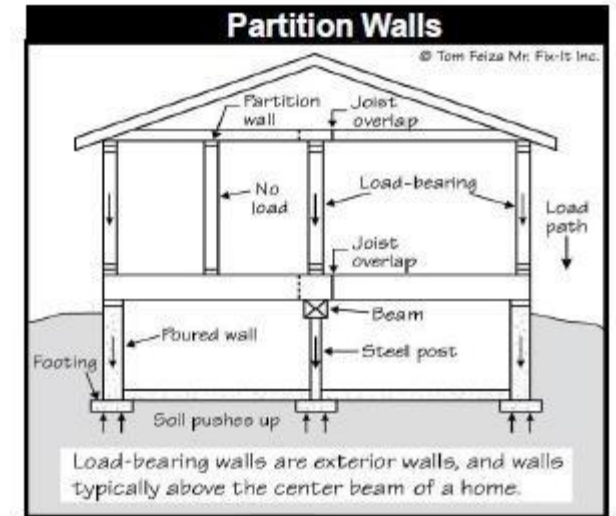
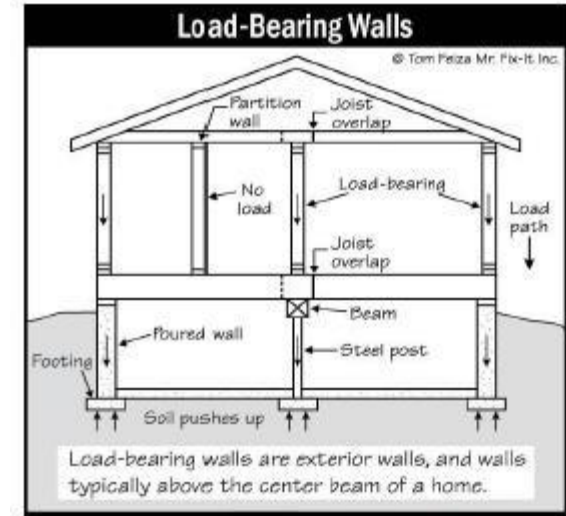
Load Bearing Walls:

1. When beams and columns are not used, load from roof and floors are transferred to foundation by walls,
2. Minimum wall thickness used is 200 mm.

3. Stones or bricks are used for the construction.
4. Load bearing walls are exterior walls, typically above c/line of beam

Partition Walls

1. In framed structures partition walls are built to divide floor area for different utilities.
2. They do not carry loads from floor and roof.
3. Normally partition walls are thin.
4. Stones are not used for the construction of partition walls.





Load Bearing Brick Walls

Aluminium Frame Partition Walls



Masonry means construction of buildings using building blocks like stone, bricks, concrete blocks

1. Stone Masonry

Types of Stone Masonry

Rubble Masonry

Uncoursed rubble masonry



- In rubble masonry, the blocks of stones that are used are either undressed or comparatively roughly dressed. The masonry has wide joints since stones of irregular size are used.
- It is the roughest and the cheapest form of stonewalling. Since stones are not of uniform shape and size, they are arranged with great care so as to distribute pressure over the maximum area and at the same time avoid long vertical joints
- Are used for the construction of foundations, compound walls, garages, quarters etc.

Coursed rubble masonry

- Are used for the construction of public and residential buildings.
- In this type of stone masonry the **uniform height stones** are used in horizontal layers



Coursed Rubble Masonry

Ashlar Masonry

- masonry stones **are dressed to get suitable shapes and sizes.**
- Height of the stones **varies from 250 mm to 300 mm.**
- **Length should not exceed three times the height.**



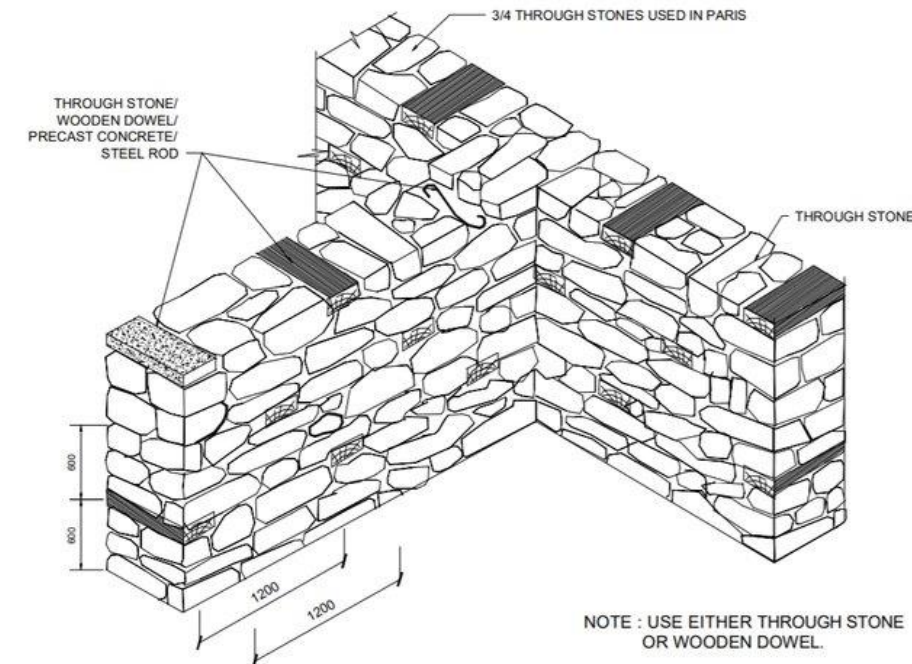
Ashlar Masonry

Supervision of Stone Masonry Construction

- Use of hard and Durable stone
- No flaws and cavities
- Properly wet before used to avoid sucking of water from mortar.
- Laid on natural bed
- Avoid thick mortar joints
- Check perpendicularity of wall plumb bob
- Through stone be used within 1500 mm.
- Correct C:S:A should be used

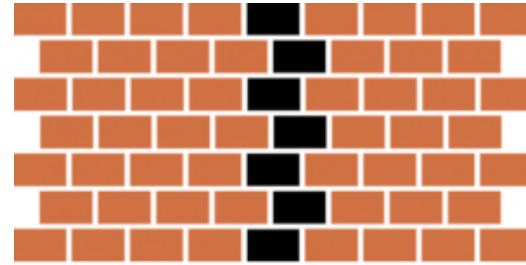
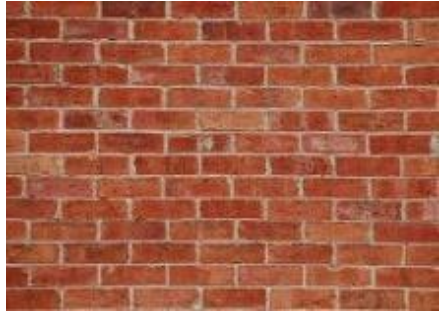
Through/Bond stone

- Single stone to cover entire wall thickness up to 600 mm.
- One bond stone should appear in every 0.5 sq.m area of wall face

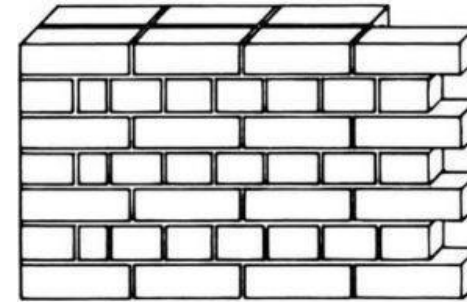


Type Of Brick Masonry Bonds

Stretcher Bond Header Bond English Bond

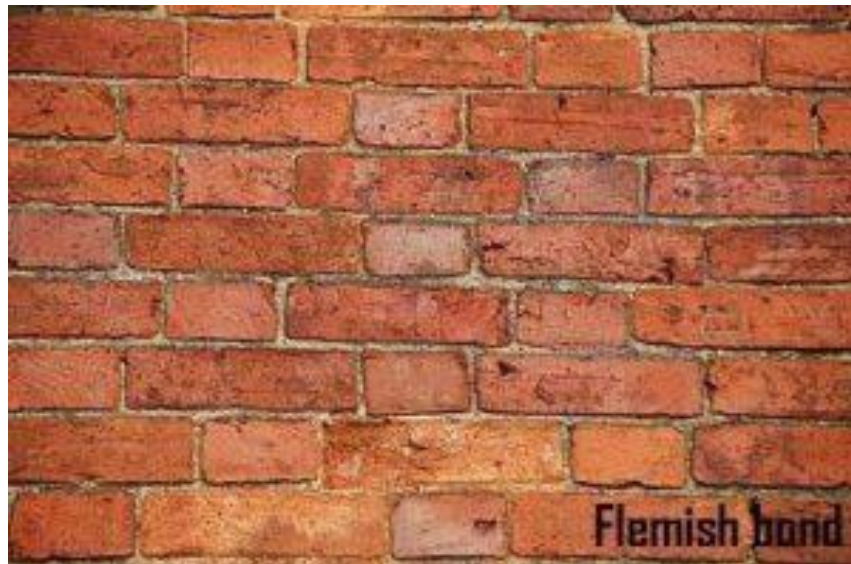


Header Bond

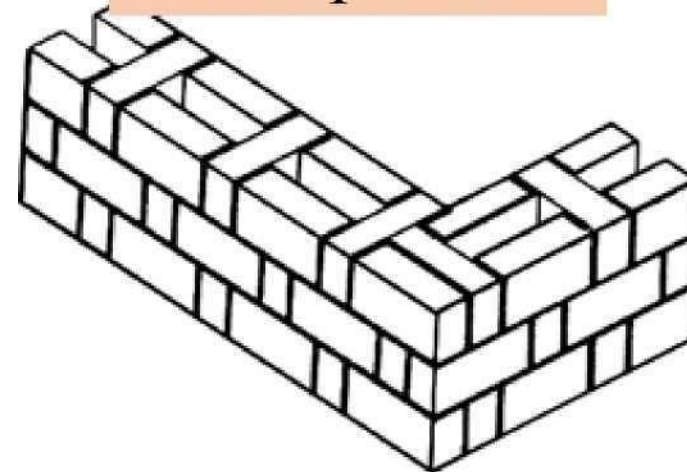


English bond

Flemish Bond



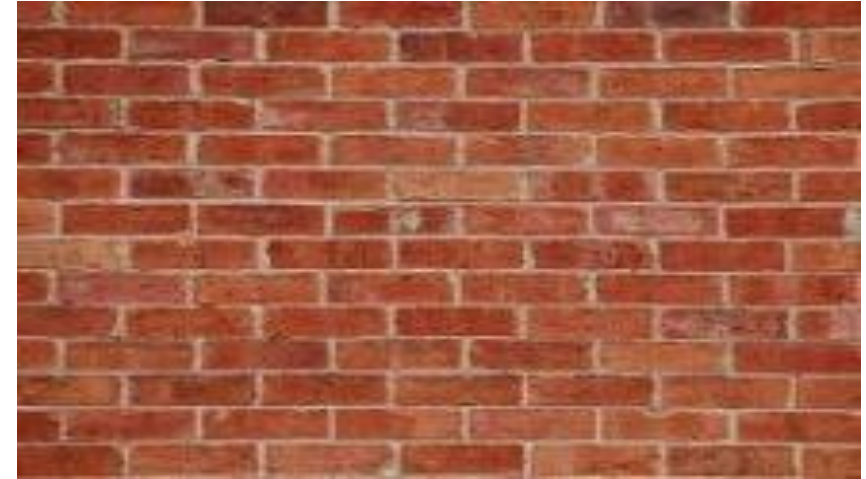
Rat trap Bond



Stretcher Bond

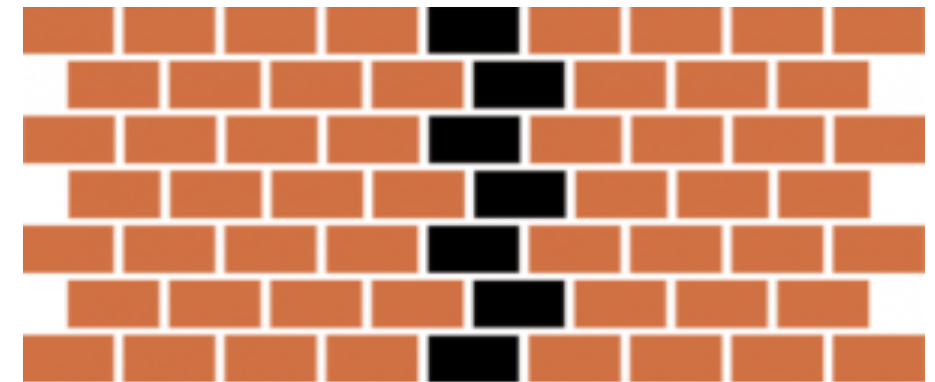
Stretcher bond:

- The most commonly used bond in the UK, a pattern is made only using stretchers, **with the joins on each course centred above and below by half a brick.**
- This type of bonding is not particularly strong.



Header Bond

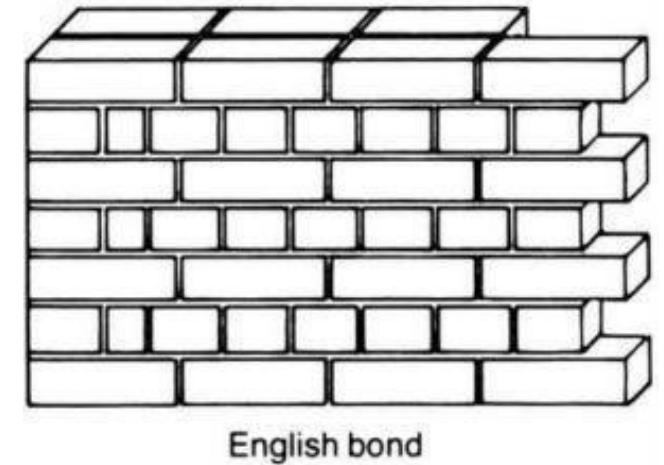
- A header is **the shorter face of the brick**. In header bond brick masonry, all bricks are constructed in the header course.
- In this bond, **the overlap is performed corresponding to a half width of the bricks.**



Header Bond

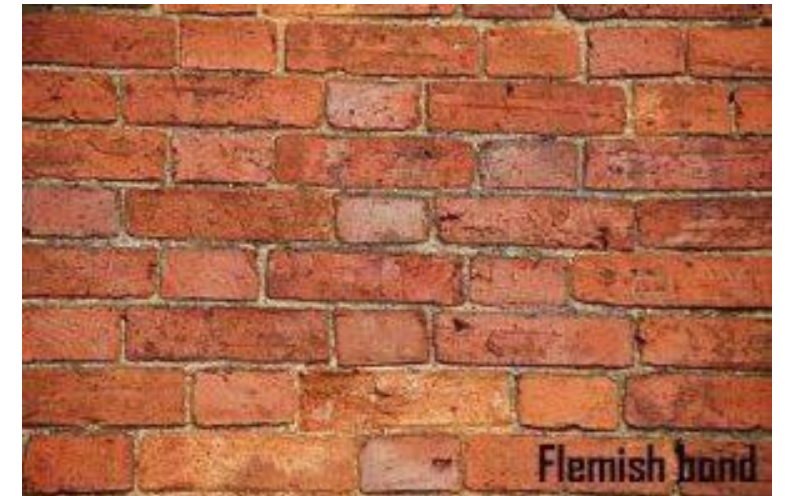
English Bond

- One of the most commonly utilized variations of brick bonds in masonry works.
- This bond essentially comprises of alternating courses of headers and stretchers.
- Headers are laid centred over the stretchers and below and each alternate row is vertically aligned.



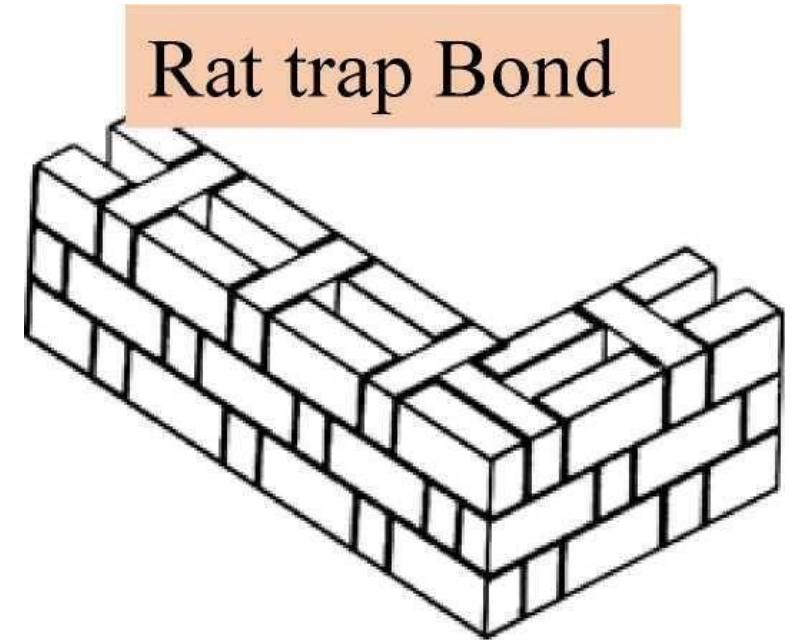
Flemish Bond

- For this type of bond, each course is made up of alternate headers and stretchers.
- Each header is centered on a stretcher above and below and every alternate course begins with a header in the corner



Rat Trap Bond

- In this bond, bricks are laid on edge or placed in a vertical position instead of the conventional horizontal position.
- This creates **a cavity (hollow space) within the wall.**
- This feature **helps in keeping enhanced thermal comfort and keep the interiors cooler than the outside and vice versa.**
- This type of walls **consumes a smaller number of materials due to the internal cavity.**
- The Rat Trap Bond looks very similar to the Flemish Bond in appearance.
- Skilled labor and extra care are needed to design this bond.



Supervision of Brick Masonry Construction

- **Use bricks of uniform color**
- **Well burnt, shape and size**
- **Frog laid upward**
- **Brick soaked in water before use**
- **Brick courses perfectly horizontal**
- **Follow mortar Specification**
- **In no case can wall be raised more than 1.5 m**
- **Check perpendicularity of wall by plumb bob**



B. PLASTERING

- Application of **Mortar coats on wall surface, column ,ceiling to get smooth surface finish.**
- Can be **lime mortar, Cement Mortar or Lime-Cement Mortar**
- Lime Mortar:1:3 or 1:4
- Cement Mortar: 1:4 or 1:6

Requirement of Good Plaster

1. Should stick to background easily
2. Hard and Durable
3. Less permeabilty
4. Cost effective

Why plastering??

1. To conceal defective workmanship
2. Give smooth surfaces
3. Good look
4. Protect wall from rain



C. FLOORING

1. To get good, hard, levelled and beautiful surface : Flooring
2. Floor directly resting on ground are ground Floor
3. Floor of each story are Upper floors.
4. Damp resistive

Types of Flooring

a) Mud and Moorum Flooring

- These floorings are used in low cost housing
- Floor needs a thin wash of cow dung at least once a week



b) Brick Flooring

- This is also a cheap floor construction.
- Brick layer is provided on sand bed or on lean concrete (1 : 8 : 16)



Brick Flooring

c) Cement Concrete Floors

- It consists of two courses-base course and wearing coat.
- Base course is laid over well compacted soil. Its thickness is usually 75 mm to 100 mm(lean cement concrete mix (1 : 4 : 8))
- Panels of 1 m x 1 m, 2 m x 2 m or 1 m x 2 m wearing coat of 40 mm is laid



Cement Concrete Floors

d) Timber Flooring

- Timber flooring are used in dancing halls and in auditoriums
- Timber plates may be directly placed on concrete bed or may be provided over timber frame work



D. ROOFING

1. To give proper cover to building: Roofing
2. Can be **Flat roof, Pitched Roof, Folded roof**

1. Flat Roofs

- These roofs are nearly flat.
- However **slight slope (not more than 10°)** is given to drain out the rain water.



Advantages

- Suitable for complex buildings. Construction of upper floor takes lesser time.
- Easiness to build and maintain.
- Multipurpose type:
Eg: Cloth drying zone, open space for leisure time, Garden
- Better light and Ventilation

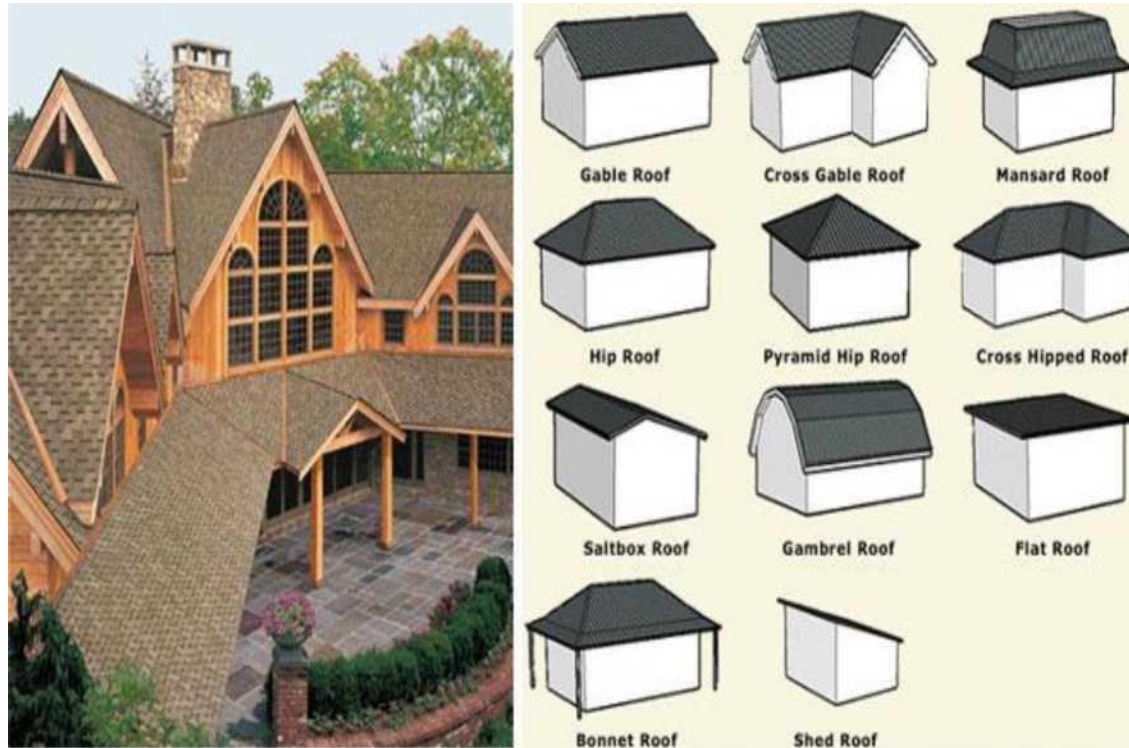
Disadvantages

- not suitable where rainfalls and snowfall is heavy.



2. Pitched Roofs

- In the areas of heavy rain falls and snow fall sloping roof are used.
- The slope of roof shall be more than 10° . They may have slopes as much as 45° to 60° .



Advantages

- **Traditional and Aesthetic use.**
- Easiness in water evacuation where rainfall and snowfall are heavy.
- Easily constructed, economical

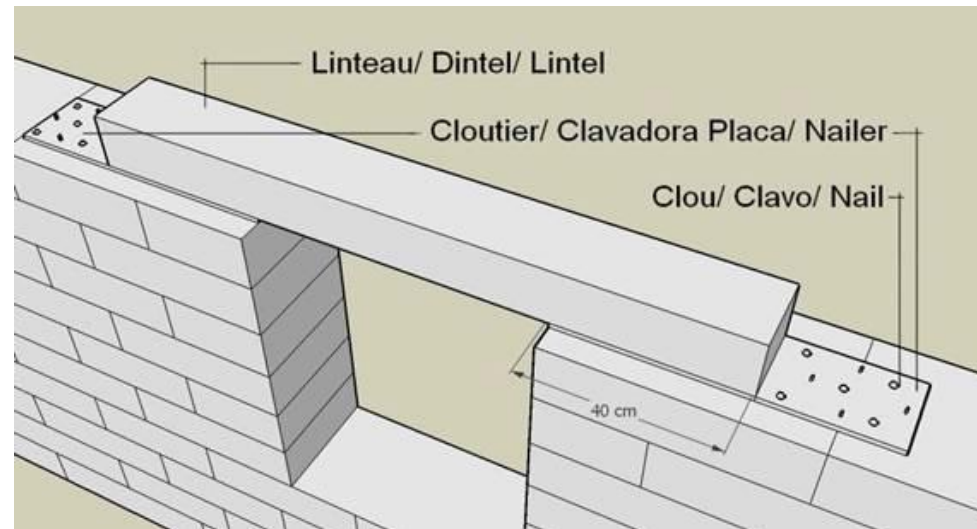
Disadvantages

- Not Durable
- Leakage problem
- Mostly iron sheets used which has rusting problem.



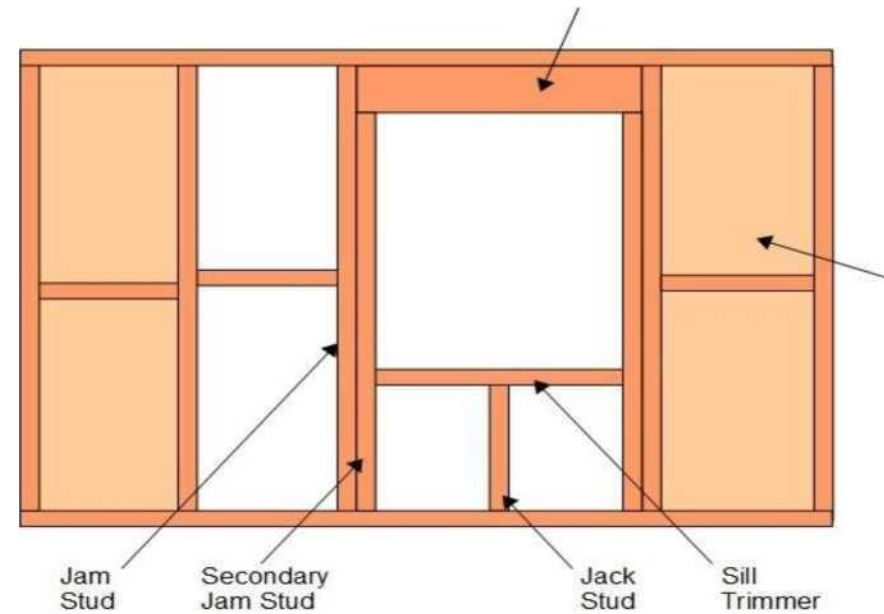
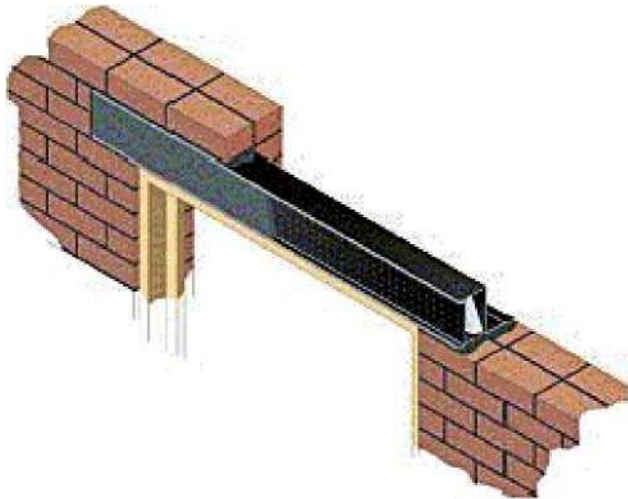
D. LINTELS

- Horizontal Flexural member that runs over opening in wall for door, Window, Ventilators
- Load of Masonry over opening transferred to Lintel but not the frames of door and window.
- End Bearing: 200 mm



Types of Lintels

- Wood Lintel
- Stone Lintel
- Brick Lintel
- RCC Lintel
- Steel Lintel



Wooden Lintels



- These are the oldest type of lintels but are used even today.
- Wooden lintels are commonly used in hilly areas where timber is cheaply available in abundance.
- In plains, the wooden lintels are rarely used on account of their high cost, susceptibility to catching fire, and susceptible to decay because of rot or termites.

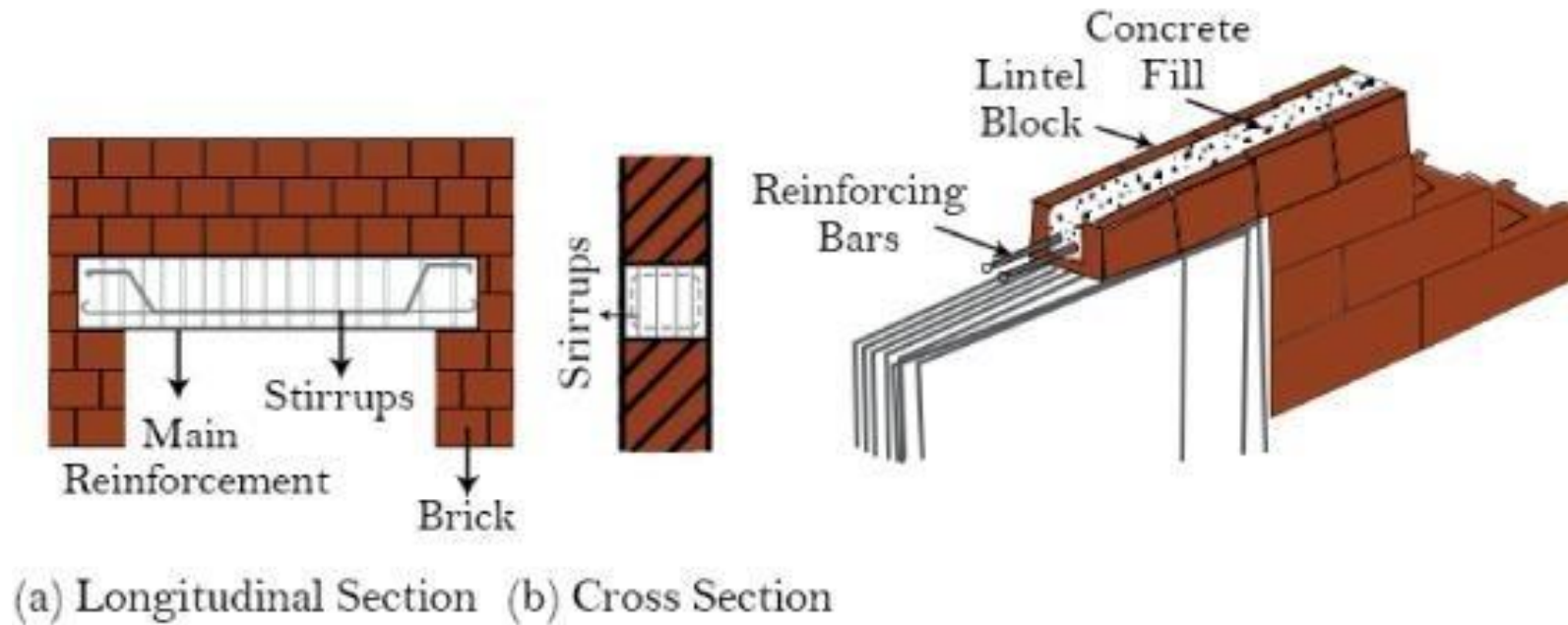


- These are recommended only in places where **the stone is available in abundance** and the structure is made of stone masonry.
- The stone lintels may also be used in buildings which consist of stone facing.
- Stone lintels are made **of slabs of stones of sufficient length without flaws either in single piece or combination of more pieces.**



- These are **used to span small openings** (less than one meter) with light loading.
- They generally **consist of bricks which** are normally laid on end and occasionally on the edge.
- The **brick lintel is constructed over temporary wood support** (i.e. acting as centring) known as turning piece.
- **Bricks with frogs are more suitable for construction of lintels**

Reinforced Brick Lintels



- When **brick lintels** are required to be used over large spans, they are reinforced with steel bars.
- These **lintels** are constructed on the same principles as RCC lintels, the only difference being good quality bricks are used instead of concrete.



- These are prepared with plain concrete beams. **They are devoid of steel bars; hence, they are not useful for heavy loads**
- They are made for **only a span of up to one meter.**
- **Concrete is strong in compression but weak in tension. Hence, these lintels are not used for a longer span**



- RCC lintels are fire-proof, durable, strong, economical, and easy to construct
- These lintels can be used for varying spans as well as loading conditions.
- The speed of construction is increased if precast RCC lintels are used