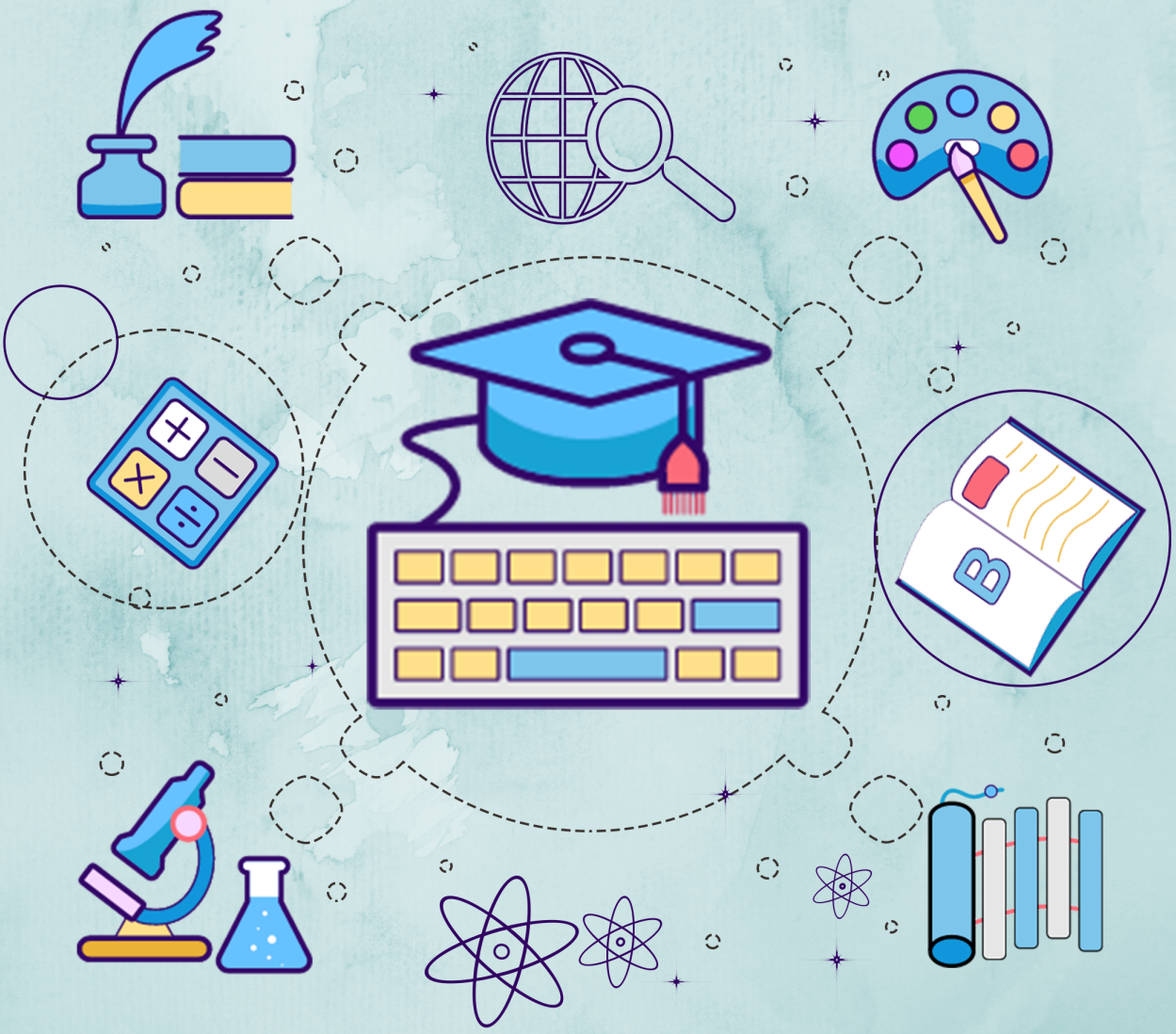
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

KeralaNotes



SYLLABUS | STUDY MATERIALS | TEXTBOOK

PDF | SOLVED QUESTION PAPERS

www.keralanotes.com

KeralaNotes

KTU STUDY MATERIALS

BASICS OF CIVIL ENGINEERING

EST120

Module 3

Related Link :

- KTU S1/S2 STUDY MATERIALS
- KTU S1/S2 NOTES
- KTU S1/S2 SYLLABUS
- KTU S1/S2 TEXTBOOK PDF
- KTU S1/S2 PREVIOUS YEAR SOLVED QUESTION PAPER

MODULE 3

Foundations

The sub-structure or foundation is the lower portion of the building usually located below ground level, which transmit the load of the super-structure to the sub soil. The super-structure is that part of the building which is above ground, and which serves the purpose of its intended use. The soil which is located immediately below the base of the foundation is called the sub-soil or foundation soil. A foundation is therefore that part of the structure which is in direct contact with the ground to which the loads are transmitted. The lowermost portion of the foundation which is in direct contact with the sub-soil is called footing.

Bearing capacity of soil

All civil engineering structures whether they are buildings, dams, bridges etc. are built on soils. A foundation is required to transmit the load of the structure on a large area of soil. The foundation of the structure should be so designed that the soil below does not fail in shear nor there is excessive settlement of the structure. The conventional method of foundation design is based on the concept of bearing capacity. *"The bearing capacity of a soil is the maximum load per unit area which the soil can support without failure."* It depends upon the shear strength of soil as well as shape, size, depth and type of foundation.

The term bearing capacity is defined after attaching certain qualifying prefixes, as defined below.

1. Gross pressure intensity(q):

The gross pressure is the total pressure at the base of the footing due to the weight of the superstructure, self-weight of the footing and weight of the earth fill, if any.

2. Net pressure intensity (q_n):

It is the difference in intensities of the gross pressure after the construction of the structure and the original over-burden pressure. If D is depth of foundation,
then $q_n = q - \gamma D$

3. Ultimate bearing capacity (q_f):

It is the minimum gross pressure at the base of the foundation at which soil fails in shear.

4. Net ultimate bearing capacity (q_{nf}):

It is the minimum net pressure intensity which causes shear failure of soil.

$q_{nf} = q_f - \gamma D$

5. Net safe bearing capacity (q_{ns}):

It is the net ultimate bearing capacity divided by a factor of safety.

$q_{ns} = q_{nf}/F$

6. Safe bearing capacity (q_s):

It is the maximum pressure intensity which the soil can carry safely without the risk of shear failure.

$q_s = q_{ns} + \gamma D = \frac{q_{nf}}{F} + \gamma D$

where F is the factor of safety

7. Allowable bearing capacity (q_a):

It is the net loading intensity at which neither the soil fails in shear nor there is excessive settlement detrimental to the structure.

Functions of foundation:

Foundation serves the following purposes.

1. Reduction of load intensity: foundation distributes the loads of the super-structure, to a larger area so that the intensity of the load at its base (i.e. total load divided by the total area) does not exceed the safe bearing capacity of the sub-soil. In the case of deep foundations, it transmit the super-imposed load to the sub-soil both through side friction as well as

through end bearing.

2. Even distribution of loads: foundations distribute the non uniform load of the super-structure evenly to the sub-soil.for example two columns carrying unequal loads can have a combined footing which may transmit the load to the sub-soil evenly with uniform soil-pressure. Due to this unequal or differential settlement can be minimized.

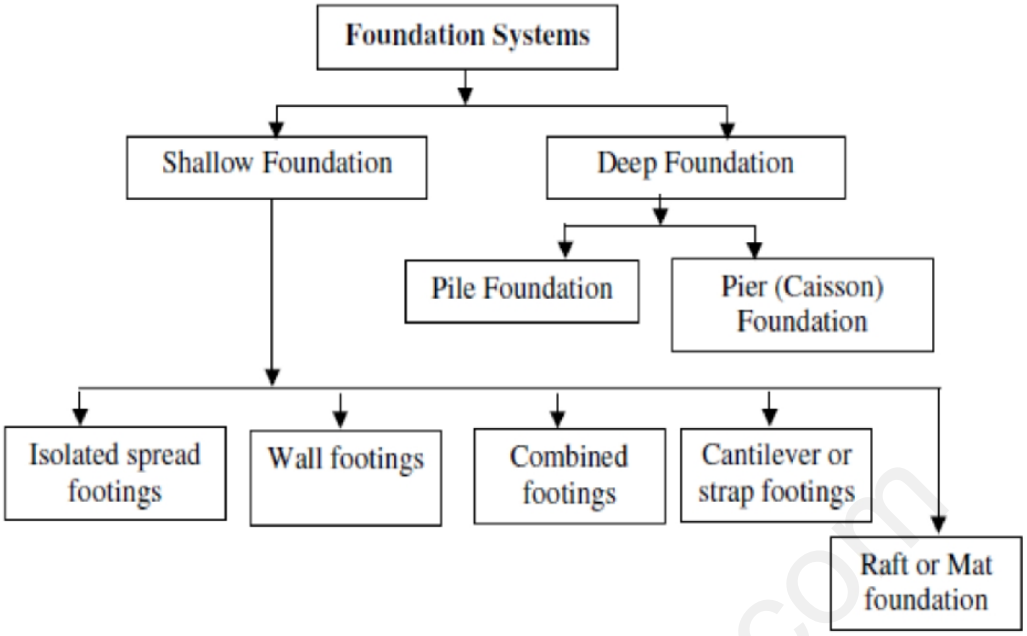
3. Provision of level surface: foundation provide level and hard surfaceover which the super-structure can be built.

4. Lateral stability: it anchors the super-structure to the ground, thus imparting lateral stability to the super-structure. The stability of the structure against sliding and overturningdue to horizontal forces (such as wind earthquake etc.) is increased due to foundation.

5. Safety against undermining: it provides the structural safety against undermining or scouring due to burrowing animals and flood water.

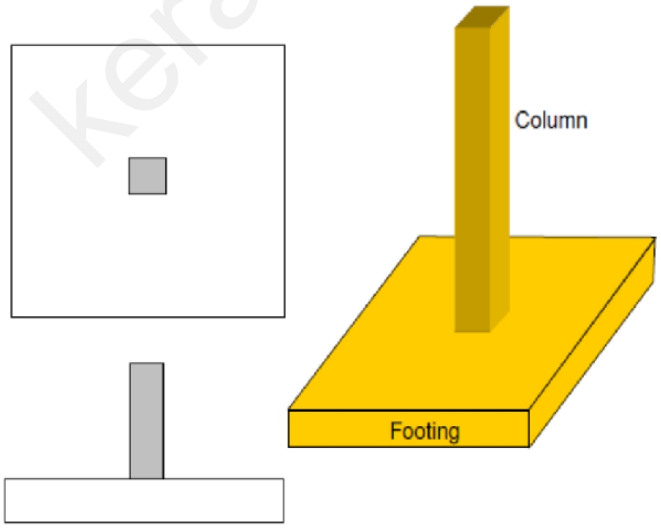
6. Protection against soil movements: special foundation measures prevent or minimize the distress (or cracks) in the super-structure, due to expansion or contraction of the Sub-Soil Because Of Moisture Movements In Some Problematic Soils.

Types of Foundation.



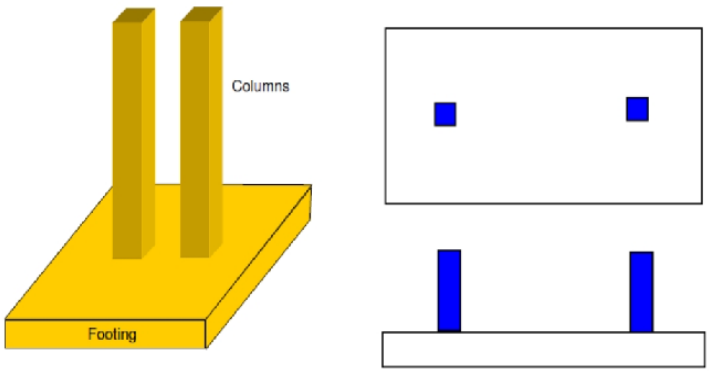
Shallow foundation: if the depth of the foundation is less than or equal to the width, then it is called a shallow foundation.

i. Spread footing: under individual columns. These can be square, rectangular, or circular.

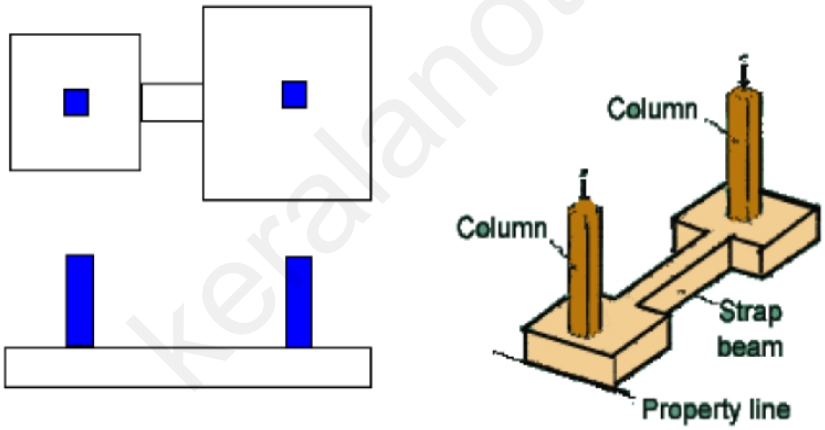


ii. Combined footings: support two or more columns. These can be

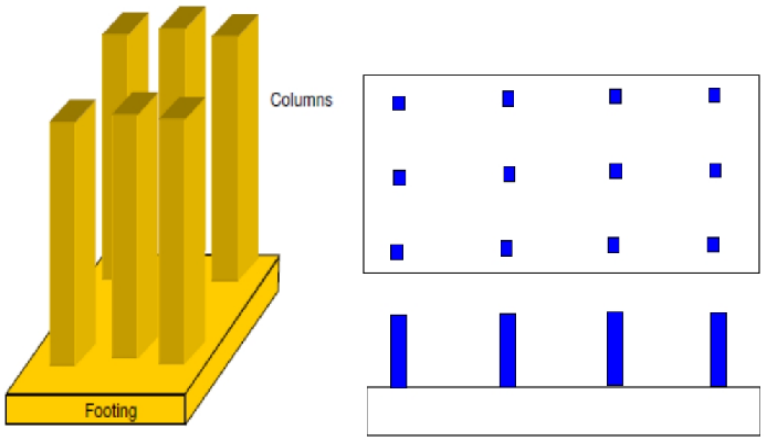
rectangular or trapezoidal plan.



iii. Strap footing: These are similar to combined footings, except that the footings under columns are built independently, and are joined by strap beam



iv. Mat or raft foundation: This is a large continuous footing supporting all the columns of the structure. This is used when soil conditions are poor but piles are not used.

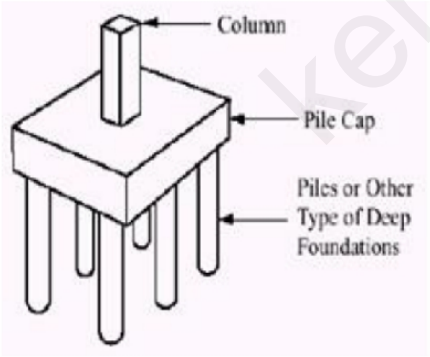


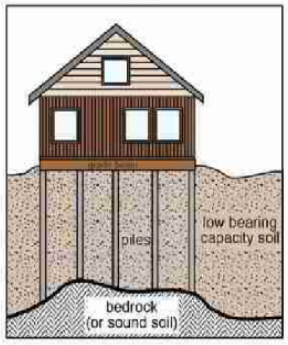
Deep foundation: if the depth of the foundation is greater than that of the width, then it is called a deep foundation. It is of the following type.

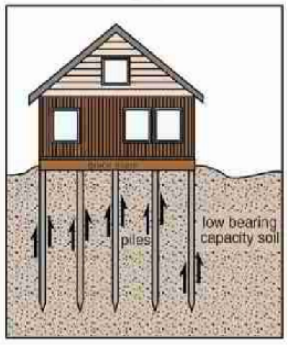
i. Deep strip, rectangular or square foundation
ii. Pile foundation
iii. Pierfoundation or drilled caisson foundation
iv. Well foundation or caisons

Pile foundation is the most important deep foundation.

Pile foundation: loads are taken to the deeper layers by vertical members called piles made of timber concrete or steel. Loads are carried by end bearing, friction or by the combined action of both.







Brick Masonry

Brick is a building material used to make walls, pavements and other elements in

masonry construction. It can be composed of clay-bearing soil, sand and lime, or concrete materials.

Standard size of a brick = 19cm X 9cm X 9cm

Nominal size of a brick = 20cm X 10cm X 10cm

Definition of terms in brick masonry

1. **Course:** A course is a horizontal layer of bricks or stones.

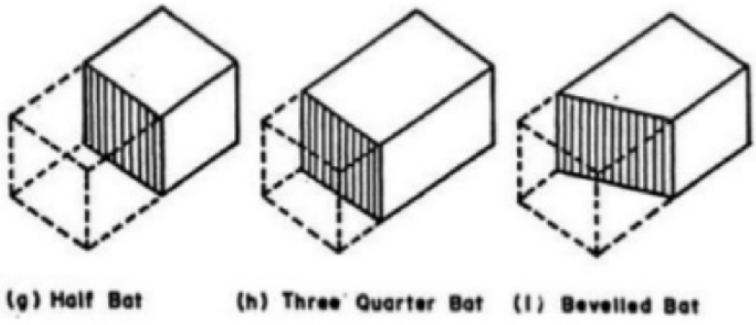
2. **Joint**: It is the junction of two or more bricks or stones. If the joint is parallel to the bed of bricks or stones in a course then it is termed as bed joint. The joint which are perpendicular to the bed joints are termed as vertical joints or side joints or simply joints.

3. **Header**: It is a brick or stone which lies with its greatest length at right angles to the face of the work.The course of brick work in which all the bricks are laid as headers is known as header course.

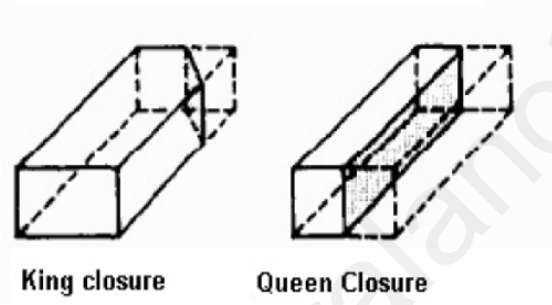
4. **Stretcher**: It is a brick or a stone which lies with its longest side parallel to the face of the work. The course of brick work in which all the bricks are laid as stretchers is known as stretcher course.

5. **Bond**: This is the method of arranging bricks so that the individual units are tied together. Bonding is essential to eliminate continuous vertical joints both in body as well as on the face of wall.

6. **Bat**: it is the portion of brick cut across the width.
   - **Half bat:** If the length of the bat is equal to half the length of the original brick, it is known as ***half bat***.
   - **Three quarter bat:** It is a form of brick bat having its length equal to three quarter of the length of a full brick.
   - **Beveled bat:** A brick bat is called ***beveled bat***, when its width has beveled.



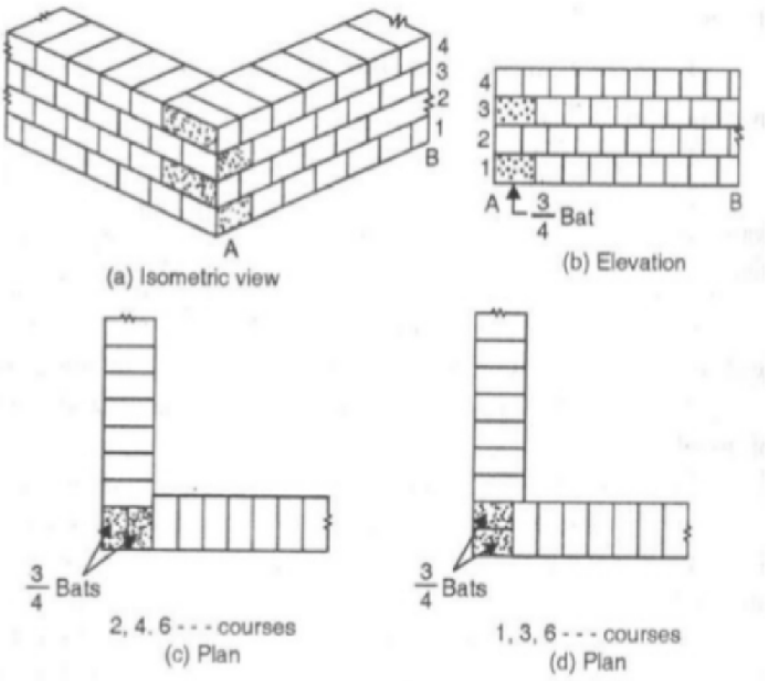
7. **Closer**: it is the portion of the brick cut length wise in such a manner that its one long face remains uncut.
   - **Queen closer**: It is the portion of brick obtained by cutting a brick length wise into two portions.
   - **King Closer**: these are the portions of a brick obtained by cutting off the triangular piece between the center of one end and the center of one side.



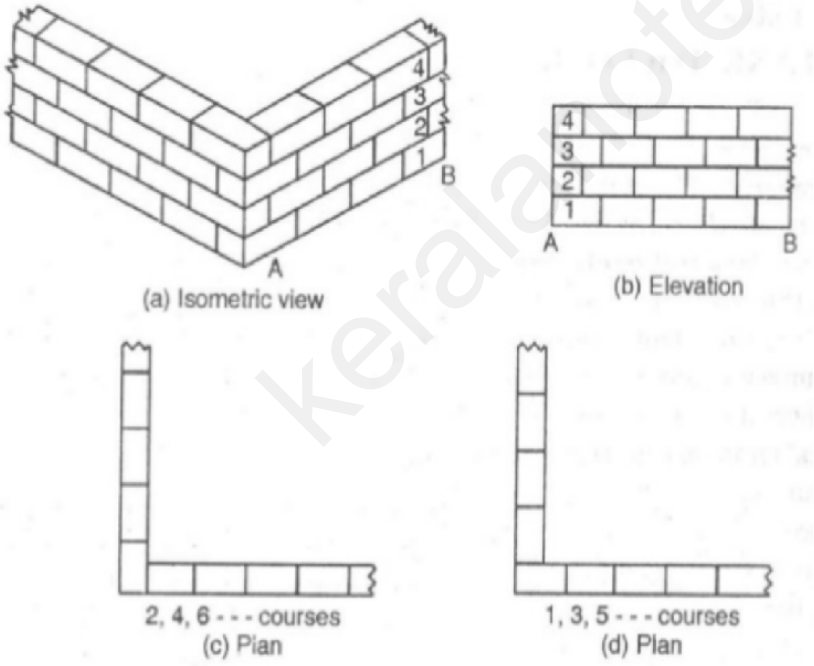
Types of bonds in brick masonry: The main types of bonds generally used in brick masonry are;

1. Header bond
2. Streatcher bond
3. English bond
4. Flemish bond

Header bond: bond in which all the bricks are laid in headers.

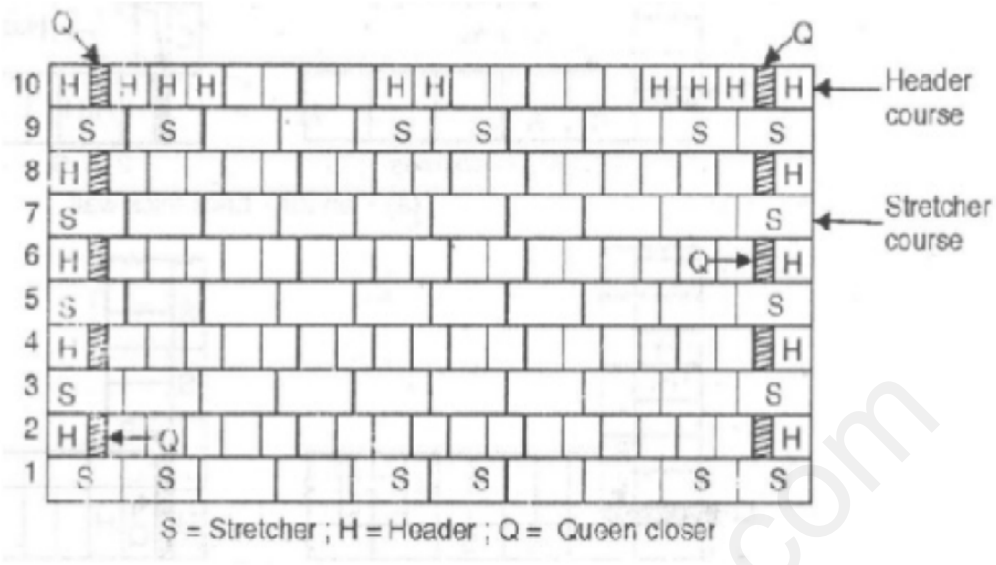


Streatcher bond: bond in which all the bricks are laid as streatchers.

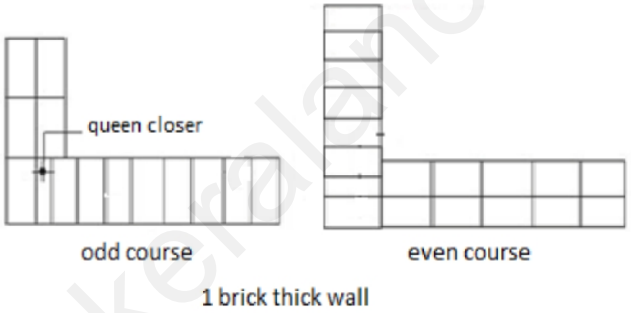


English bond: In this alternate courses consist of headers and stretchers. This is considered to be the strongest bond. Hence it is commonly used bond for the walls of all thicknesses. To break continuity of vertical joints a brick is cut

lengthwise into two halves (Queen closer) and used in the beginning and end of a wall after first header

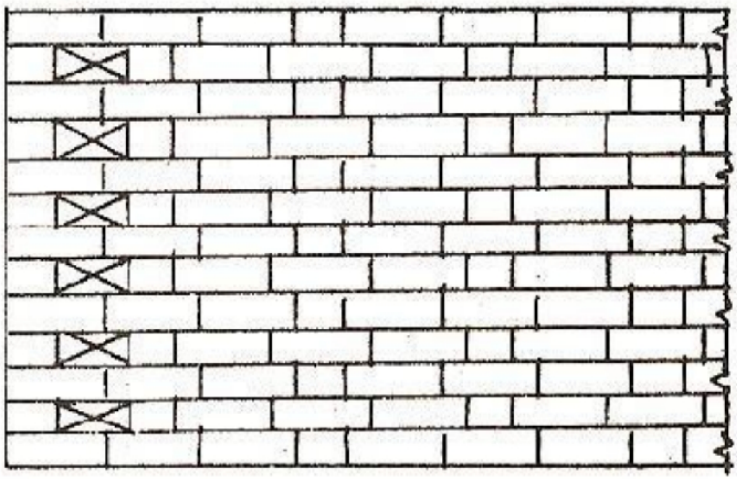


Elevation of English bond

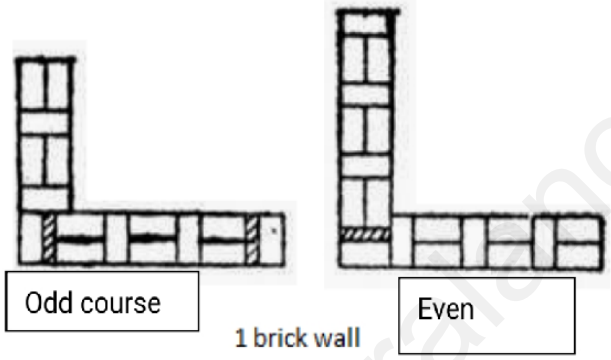


1 brick thick wall

Flemish bond: In this type of bond each course comprises of alternate header and stretcher. Alternate courses start with stretcher and header. To break the vertical joints queen closers are required, if a course starts with header. Every header is centrally supported on the stretcher below it.



Elevation of Flemish bond



ROOFS

A roof is the uppermost part of a building whose main *function* is to enclose the space and to protect the same from the effects of weather elements such as rain, wind, sun, heat and snow. A good roof is just as essential as a safe foundation. As a well-designed foundation secures the building against destruction starting at the bottom, similarly a good roof affords protection for the building itself and what the building contains and prevents deterioration starting from the top. To fulfill this main function efficiently, the roof should satisfy the following functional requirements in its design and construction.

Requirements of a good roof

- It should be leak proof
- It give protection from sun and rain
- It should be durable
- It should be fire resistant
- It should be structurally stable

Types of Roofs

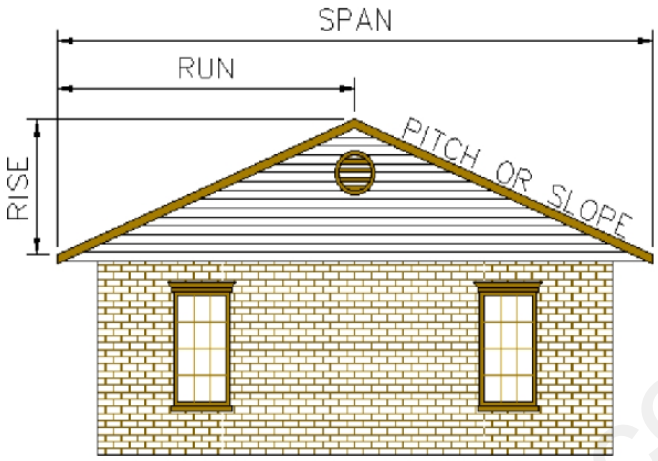
- Flat or terraced roofs
- Sloping or pitched roofs
- Folded plates or shell roofs

Flat roofs are used where rainfall is low to moderate; sloping roofs are used in places of heavy rainfall. Folded plates and shell roofs are used to cover large column free areas such as auditoriums.

Flat or terraced roofs: Flat roofs are horizontal but with a slight slope to drain out rain water.

Sloping or pitched roofs: Sloping roofs are adopted in places of heavy rain fall. It

consists of a structure over which roofing materials like tiles, GI sheets, AC sheets are fixed. The slope of the roof varies from 10 degrees to 60 degrees. This type of roofs are generally adopted for large span buildings like factories, workshops, auditoriums etc.



Folded plates or shell roofs: Folded plate roof is a slab with a number of folds. Shell roofs are curved roofs. These can be built to cover large areas without columns.

Folded plate roof

shell roof

Roofing materials:

i. Thatch covering: cheapest roof covering, commonly used in villages. Very light but highly combustible, unstable against high winds.
ii. Wood shingles: The thin slabs of wood used to cover roofs are called wood.

They are readily combustible and conductive to fire spread. Prone to termite attack.

iii. Tile roofing: here tiles are used for the roof covering purpose, and this is the most popular ands common type of roofing material for residential buildings and country houses.

iv. Asbestos cement sheet: these are manufactured from asbestos fibre and Portland cement. Asbestos is a silky fibrous mineral existing in veins of metamorphizeds volcanic rocks.

v. Galvanized Iron sheets (G.I. sheets): G.I sheets are manufactured with corrugations running from one end to the other. The corrugations impart additional strength to the sheets. They are made of iron sheets which are galvanized with zinc to protect them from rusting action of water and wet weather.

FLOORS

A floor is the bottom surface of a room. Floors may be of stone, wood, concrete or any other material that can support the expected load. The levels of a building are often referred to as floors although a more proper term is storey. Floors typically consist of a subfloor for support and a floor covering used to give a good walking surface. Requirements of a floor are as follows;

i. It should be durable
ii. It should have an attractive finish
iii. It should be impervious
iv. The floors should be strong enough to withstand the loads
v. It should not be too costly
vi. The maintenance cost should not be high
vii. It should have a level surface

Factors to be taken into the selection of flooring materials are;

- Durability
- Appearance
- Damp resistance
- Fire resistance
- Resistance to abrasion
- Initial cost
- Maintenance

Types of Flooring material are;

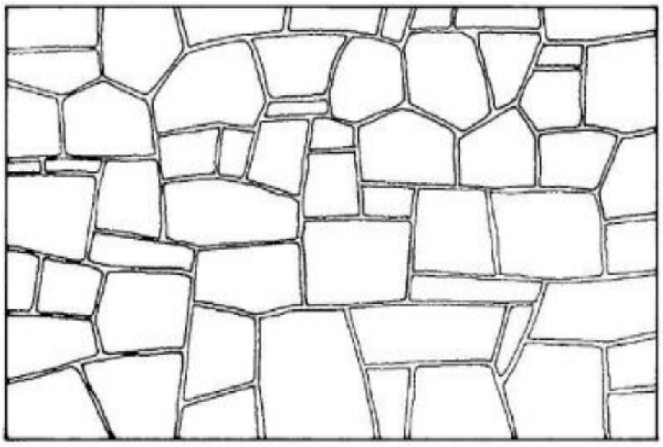
- Mud
- Brick
- Cement Concrete
- Terrazzo
- Mosaic
- Marble
- Tile
- Timber
- Rubber
- Linoleum

Random Rubble Masonry

- Stone masonry has two types Rubble masonry and Ashlar masonry
- Under Random Rubble masonry
  - Uncoursed
  - Built into courses

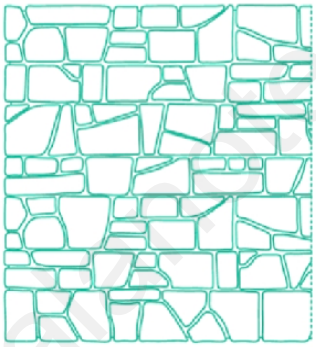
Uncoursed

- Roughest and cheapest form of masonry
- Stones of different shapes and sizes are used as obtained from Quarry
- They are arranged in such a way that the vertical joints wont coincide



Built into course

- In this masonry the stones are brought to course varying from 30 to 45cm
- All courses are of approx.same height



BASIC INFRASTRUCTURE & BUILDING SERVICES

Vertical transportation is an important service to be designed with due care especially in multi storied buildings for the circulation of traffic both in normal use & in emergencies. The various measures of vertical transport are staircases, ramps, elevators or lifts and escalators.

Elevators or lifts

Elevator or lift is an appliance designed to transport persons or materials between two or more levels in a vertical or substantially vertical direction by means of a guided car or platform. Elevators are used in buildings having more than three storeys. They are either electric traction elevators or hydraulic elevators. Electrical traction elevators are used exclusively in tall buildings. Hydraulic elevators are generally used for low-rise freight service which rises upto about six storeys.

Various types of lifts are passenger lift, hospital lift, goods lift, service lift, fireman's lift. The important considerations of design of lift system are number of floors to be served, Floor to floor distance, Population of each floor, maximum peak demand. Various design parameters are population (The total building population & its future projections are required), quantity of service (Handling capacity- It is the measure passenger handling capacity), & Quality of service (or interval – time interval a passenger has to wait). The location of elevators should be such that it can be easily accessed by people.

Escalators

Escalators are power driven, inclined and continuous stairway used for raising or lowering passengers. These are used to move large number of people from floor to floor of buildings. Escalators are installed at commercial centres, shopping malls, airports, railway stations and in other public buildings where heavy people movement is expected. These stairs have continuous operation without the need of operators. Escalators with electronic sensors are also available which operate automatically only when people approach to use it so as to save energy. Escalators have large capacity with low power consumption. Escalators are in the form of an inclined bridge spanning between the floors.

They are generally operated at a speed of 0.5 to 0.75 m/s. Slope of stairs is standardized at 30^0. For a given speed, the width of steps decides the capacity of the powered stairs. Normally a design capacity of 3200 to 6400 person per hour is adopted depending upon the width of the escalator. Escalators are installed at where traffic is heaviest & convenient for passengers in a building. Escalators are generally installed as pair. Up going traffic & down moving traffic are carried by this pair of escalators. The arrangement of escalators in each storey can be

either parallel or criss-cross. Criss-cross is more compact & reduces walking distance.

Ramps

Ramps are sloping surfaces used to provide an easy connection between the floors or access from ground to the floors. They are especially useful when large number of people or vehicles have to be moved from floor to floor. They are usually provided at places such as garages, railway stations, stadiums, town halls, offices etc. As per the prevailing building bye laws, ramps are to be provided in all public buildings and residential apartments for the use of physically challenged persons in lieu of steps/stairs. It is also provided in hospitals to facilitate movement of stretchers & wheel chairs from one floor to other floor.

Ramps should be constructed with a non-slippery surface. Ramps are generally given a slope of 15 percent. But a slope of 8 to 10 percent is usually preferred. A level landing of minimum length 1.1m is provided at places where direction of ramp changes or at door steps. Minimum width of pedestrian ramp is 1.2m.

Air Conditioning

Air conditioning is the process of treating air so as to control simultaneously its temperature, humidity, purity, distribution, air movement and pressure to meet the requirements of the conditioned space.

Purposes:

- It is required to preserve & maintain the health, comfort & convenience of occupants
- It preserves quality of products & working of industrial process such as artificial silk, cotton etc.

Air conditioning is classified into:

- Comfort air conditioning: conditions of air inside the room are created to give max. human comfort.
- Industrial air conditioning: conditions are created, controlled and maintained which is suitable for the material processing, manufacturing

and storage etc. rather than comfort.

Systems of air conditioning:

- Central system: In this system, all the equipments pertaining to air conditioning are installed at one central point & then the conditioned air is distributed to all rooms or enclosures by ducts. This type system is adopted usually in commercial, office, public & industrial buildings.
- Self-contained or unit system: In this system, special portable attractive cabinets which fit in with the decoration of modern rooms are placed inside the room near the ceiling or window.
- Semi-contained or unitary central system: In this system, every room is provided with an air- conditioning unit and the room unit obtains its supply from the central system.
- Combined system: A combined system may consist of one of the following combinations.
  a) Central and self-contained system
  b) Central and semi-contained system
  c) Self-contained and semi-contained system