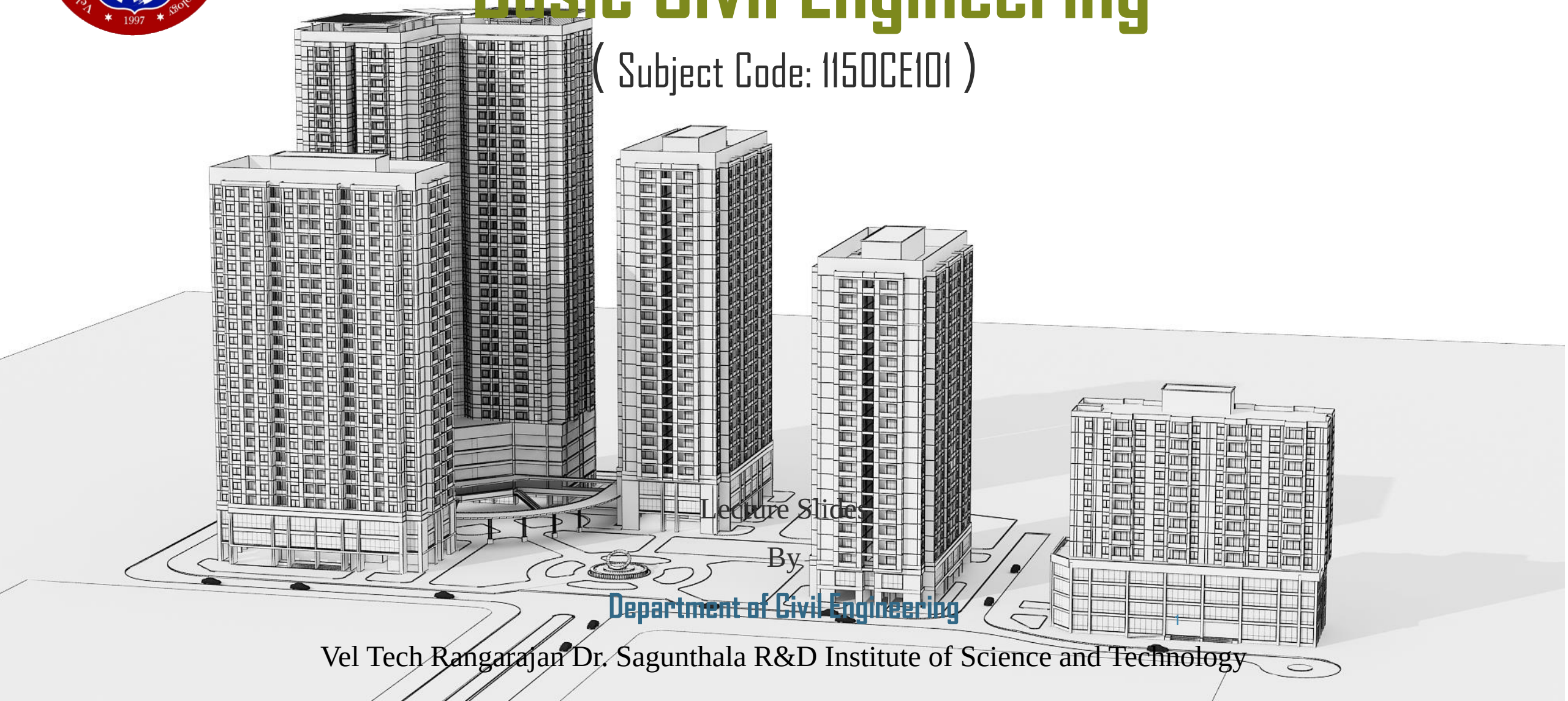
Basic Civil Engineering

(Subject Code: 1150CE101)



Lecture Slides

By

Department of Civil Engineering

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Syllabus

UNIT I: Building Materials

Introduction – Civil Engineering – Materials – Bricks – Composition – Classifications – Properties – Uses – Stone – Classification of Rocks – Quarrying – Dressing – Properties – Uses – Timber – Properties – Uses – Plywood –Cement – Grades – Types – Properties – Uses – Steel – Types – Mild Steel – Medium Steel – Hard Steel –Properties – Uses – Market Forms – Concrete – Grade designation – Properties – Uses – Advancements in Concrete – Pre-stressed Concrete – Pre fabricated concrete.

UNIT II: Building Components

Building – Selection of site – Classification – Components – Foundations – Functions – Classifications – Bearing Capacity – Flooring – Requirements – Selection – Types – Cement concrete marble – Terrazzo floorings – Roof – Types and requirements.

UNIT III: Planning Aspects and Regulations

Building types and design criteria – Space standards for residential, commercial and institutional categories – Building by-laws applicable for approval by the local governing body – Development control rules for Chennai Metropolitan Area. Basic guidelines for earthquake resistant structures.

UNIT IV: Water Supply and Sanitary Systems

Water supply – Objectives – Quantity/Quality of water –Sources – Standards of drinking water – Distribution system –Sewage – Classification – Technical terms – Septic tank – Components and functions – layout of external services –water supply – Sewage disposal – water supply and plumbing layout for a residential building.

UNIT V: Surveying and Transportation

Surveying – Objectives – Classification – Principles of Survey – Transportation – Classification – Cross section and components of road – Classification of roads – Railway – Cross section and components of permanent way – Functions – Water way – Docks and Harbors – Classification - Components – Bridges – Components of bridges.

Unit II: Building Components

Building – Selection of site – Classification – Components – Foundations – Functions – Classifications – Bearing Capacity – Flooring – Requirements – Selection – Types – Cement concrete marble – Terrazzo floorings – Roof – Types and requirements.

Building

“A building is any structure enclosing a space and provided with roof. Such a structure may be meant for people to live (or) to provide working space for offices (or) to accommodate machinery (or) to store materials or any purpose”

Building

A building has to be planned in such a manner that it is comfortable and pleasant for living. Building meant for offices, factories, etc. should be planned to provide a healthy environment offering good light, ventilation, drainage and good water supply connections.

Some of the requirements of a building are as follows:

(i) A building should not be affected by atmospheric conditions

(ii) A building should be strong enough carry safely all the possible loads that are liable to act on it.

(iii) A building should be planned to prevent entry to moisture

(iv) A building should have good ventilation

(v) Doors and windows must be properly located to afford good lighting without causing glaring.

(vi) A building should be constructed so as to be safe against fire hazards.

Site Selection

I. Site Selection for Residential Buildings: The selection of site has an important bearing on the planning as well as designing of building. A building has to be planned based on the location and geometry of the site.

The following points may be given due consideration while selecting a site for a residence:

(i) The site should be preferably in a well developed or a rapidly developing locality

(ii) The neighborhood should be civilized and sociable

(iii) General facilities like water line, sewer line, power line, street lighting should be available.

(iv) The site should be easily accessible by roads.

(v) The soil condition should be satisfactory. Hard rock or good compact soil should be available at a depth of ***1metre.***

(vi) Quarries, Kilns, factories etc. should not be close to the site.

Site Selection

II. Site Selection for Industrial Buildings: Industrial buildings are meant for production assembly, fabrications, etc. A site for an industrial building may be selected on the following considerations:

(i) The site should be at a good distance from congested localities. Then only there will be scope for future expansions.

(ii) The site should be near the source of raw materials needed for the industry.

(iii) Due to utilization of large quantity of water, it is very necessary that the site should be at a raised level facilitating easy drainage of wastewater.

(iv) The site should be easily approachable by road and rail.

(v) Enough power should be available. An industry can run only if there is continuous and adequate power supply.

Classification of Building

According to *National Building Code (1970)*, the buildings are classified based on:

I. **Type of Occupancy**

II. **Type of Construction**

III. **Fire Resistance**

I. Based on Occupancy

(i) *Residential Building:* These include any building in which accommodation is provided for normal residential purposes, with or without cooking and dining facilities. For eg. Houses, lodges, apartment houses.

(ii) *Educational Building:* These include any building used for schools, colleges, Universities, etc.

(iii) *Institutional Building:* These include any building which is used for treatment purposes. Hospitals, Clinics, houses for aged and infants, Jails, etc. comes under this category.

(iv) *Assembly Building:* These include any building where a group of people gather for recreation, social, religious, patriotic and similar purposes. Cinema theatres, gymnasiums, railway stations, stadiums etc. comes under this category.

Classification of Building

(v) Business Buildings: These include any building which is used for the transaction of businesses. Offices, bank city halls, courthouses and libraries comes under this category.

(vi) Mercantile Buildings: These include any building which is used as a shop, stores or markets for display and sale of merchandise either wholesale or retail.

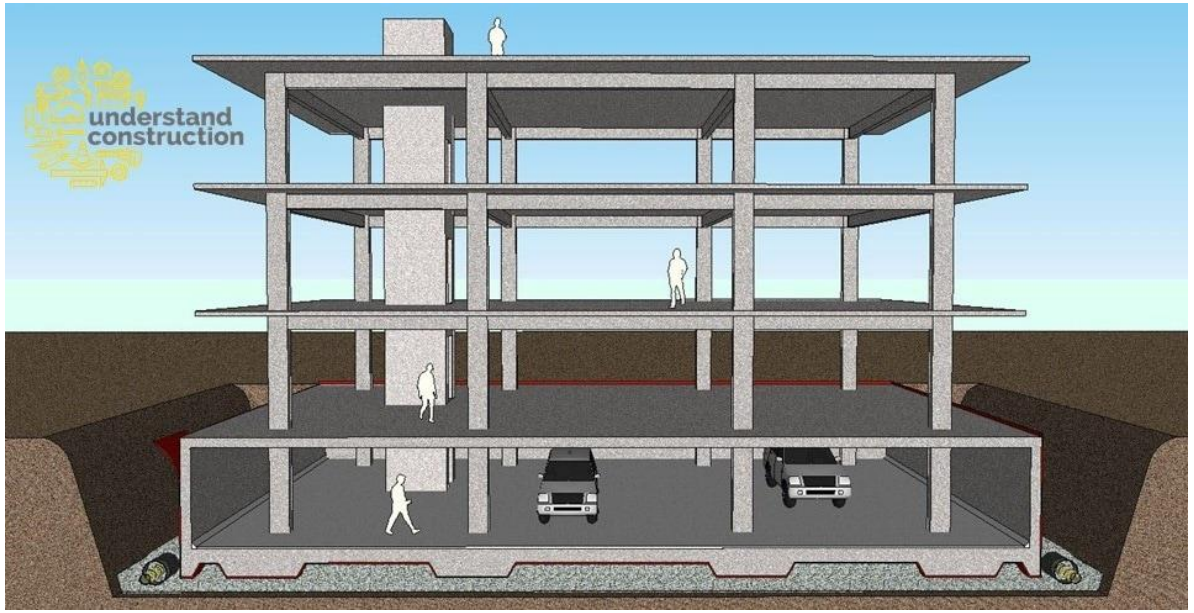
(vii) Industrial Buildings: These include any building in which products or materials of all kinds and properties are fabricated, assembled or processed. Laboratories, dry cleaning plants, power plants, sawmills, etc. comes under this category.

II. Based on Construction:

(i) *Load Bearing Wall System:* Raising the house, wall over wall and floor over floor, has been the most common method all over the world. In this system, the load is supported and transferred to the foundation through the masonry walls and there are no concrete structural elements, like columns or beams to support the load. Therefore, the walls must be strong enough for the purpose and are usually ***9 inches or more in thickness***.

(ii) *Framed System:* Also known as column-beam structure has a combination of beams and columns to support and transfer the load. The roof load rests on the beams, the beams transfer the load to the columns, which in turn transfer the load to the foundation. In this system, the masonry walls are not subjected to any load. Frame structures are preferable to load bearing wall structure in the construction of large and multi-storey buildings.

Load Bearing System



Framed System

Classification of Building

III. Based on Fire Resistance:

(i) *Type I:* Buildings those provides 4-hour fire resistance

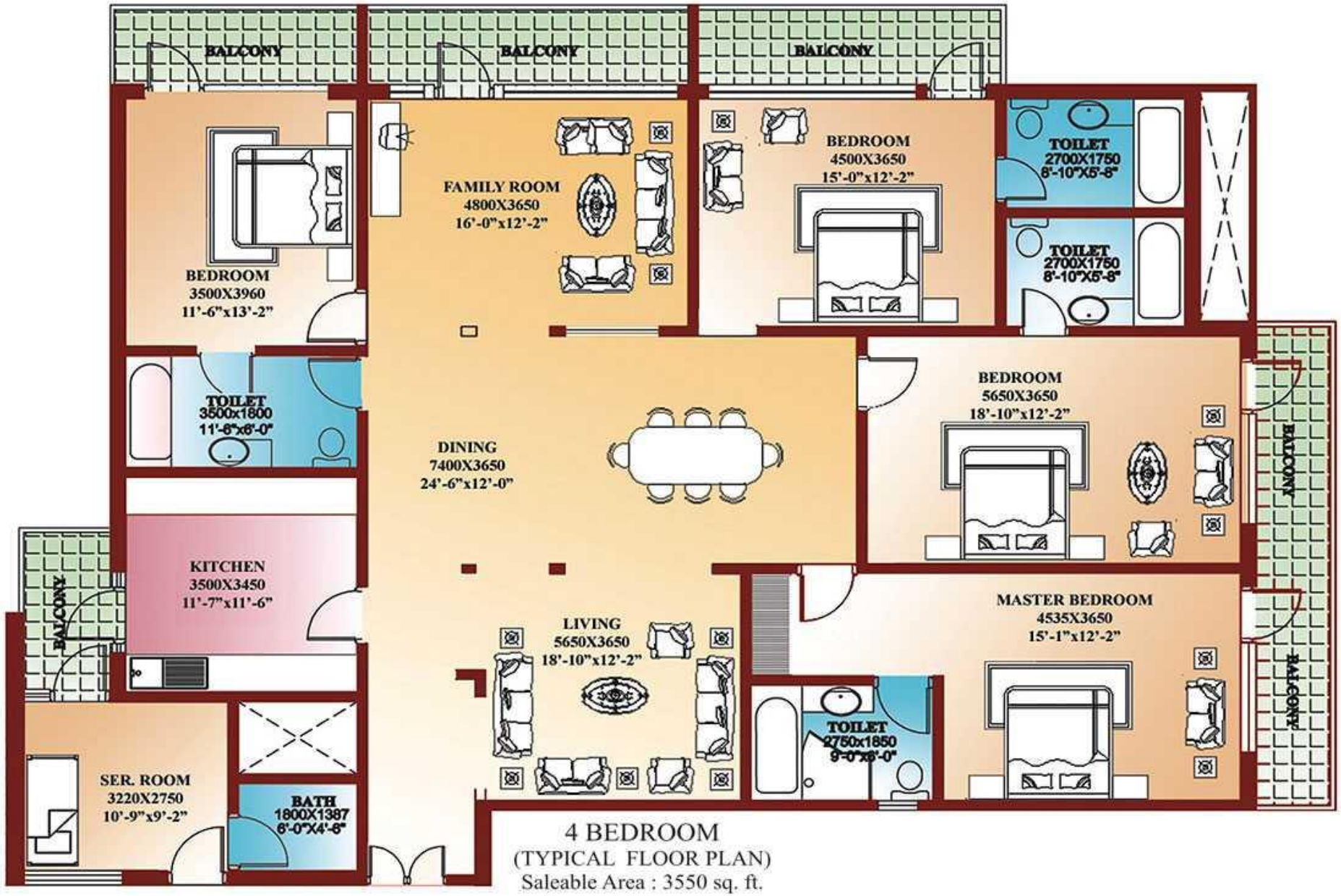
(ii) *Type II:* Building those provides 3-hour fire resistance

(iii) *Type III:* Buildings those provides 2-hour fire resistance

(iv) *Type IV:* Buildings those provides 1-hour fire resistance

Building Drawing

(Demonstration)



4 BEDROOM
(TYPICAL FLOOR PLAN)
Saleable Area : 3550 sq. ft.

TOWER : 5, 21, 23


16200
12400
6600
2300
1630
2100
5300
6080
2800
1540
4220

Components of Building

A building consists of following basic components:

(i) Foundation

(ii) Plinth

(iii) Damp Proof Course (DPC)

(iv) Plinth beam

(v) Floors

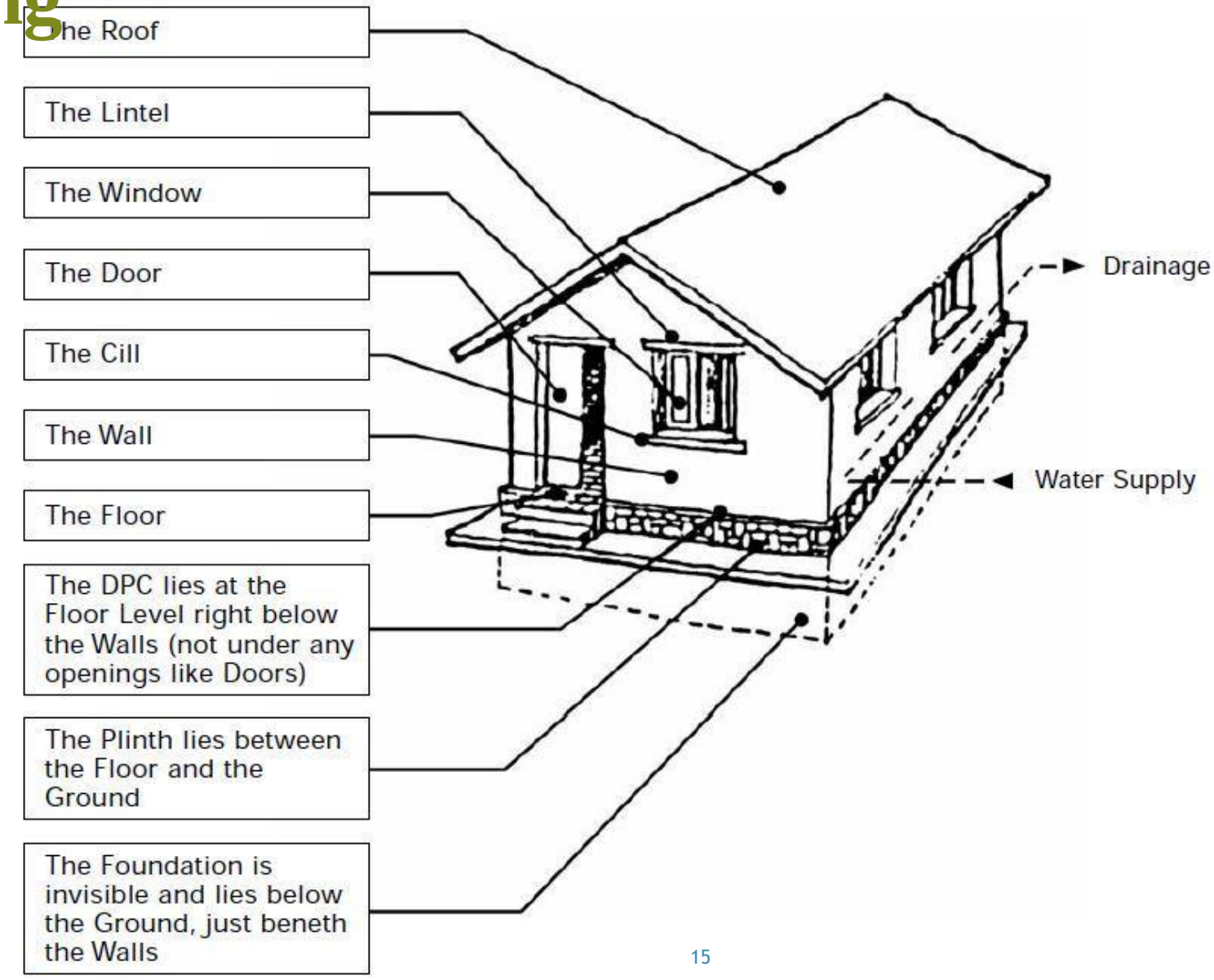
(vi) Walls

(vii) Openings

(viii) Stairs

(ix) Roofs

(x) Surface Finishes



Components of Building

1. Foundation

A foundation is necessary to evenly distribute the entire building load on the soil in such a manner that no damaging settlements take place. Hence, the foundations need to be constructed on good/solid ground.

2. Plinth

A plinth is normally constructed just above the ground level and immediately after the foundation. It raises the floor above the ground level and herewith prevents surface water from entering the building.

3. Damp proof course (DPC)

Damp proof course is a layer of water proofing material such as asphalt or waterproof cement. Walls are constructed above the damp proof course.

Damp proof course prevents surface water from rising into the walls.

Dampness reduces the strength of the walls and creates unhealthy living conditions. Also it affects the paint and plaster and increasing the cost of maintenance.

Damp proofing layer is not required where a plinth beam is constructed, because the plinth beam already performs like a DPC.

Components of Building

4. Plinth beam

A plinth beam is constructed depending upon the type of the structure of the building and nature of the soil. It provides additional stability in regard to settlements of the building and earthquake damages.

5. Floor

This is the surface on which we do most of our activities. Floorings is laid over the filling of the plinth and on subsequent floors.

Flooring can be done with different materials, but care must be given that the ground below the floor is well compacted. Flooring is done to prevent dampness from rising to the top and to have a firm platform that can be kept hygienic and clean.

6. Walls

Walls are the vertical elements on which the roof finally rests. They can be made of different materials like bricks, stones, mud, concrete blocks, lateritic blocks etc. If the walls are very long, columns can be provided to carry the roof.

Walls provide privacy and enclosure. Walls also provide security and protection against natural elements such as wind, rain and sunshine.

Openings are to be provided in wall for access and ventilation.

Components of Building

7. Openings

Openings are normally provided in the walls as door, windows and ventilators.

Doors provide access; windows and ventilators provide light and ventilation.

Lintels are constructed just above the openings. It is normally a stone slab or a concrete slab.

Sill is the part of the wall that is just below the window.

Lintels are constructed to hold up the walls above the openings. In earthquake prone areas a continuous lintel beam is provided all over the walls.

8. Stairs

A stair is a sequence of steps and it is provided to afford the means of ascent and descent between the floors and landings.

The apartment or room of a building in which stair is located is called staircase. The space or opening occupied by the stair is called a stairway.

There are different kind of stairs are used in buildings, like RCC stair, wooden stair, metal stair, brick stair etc.

9. Roof

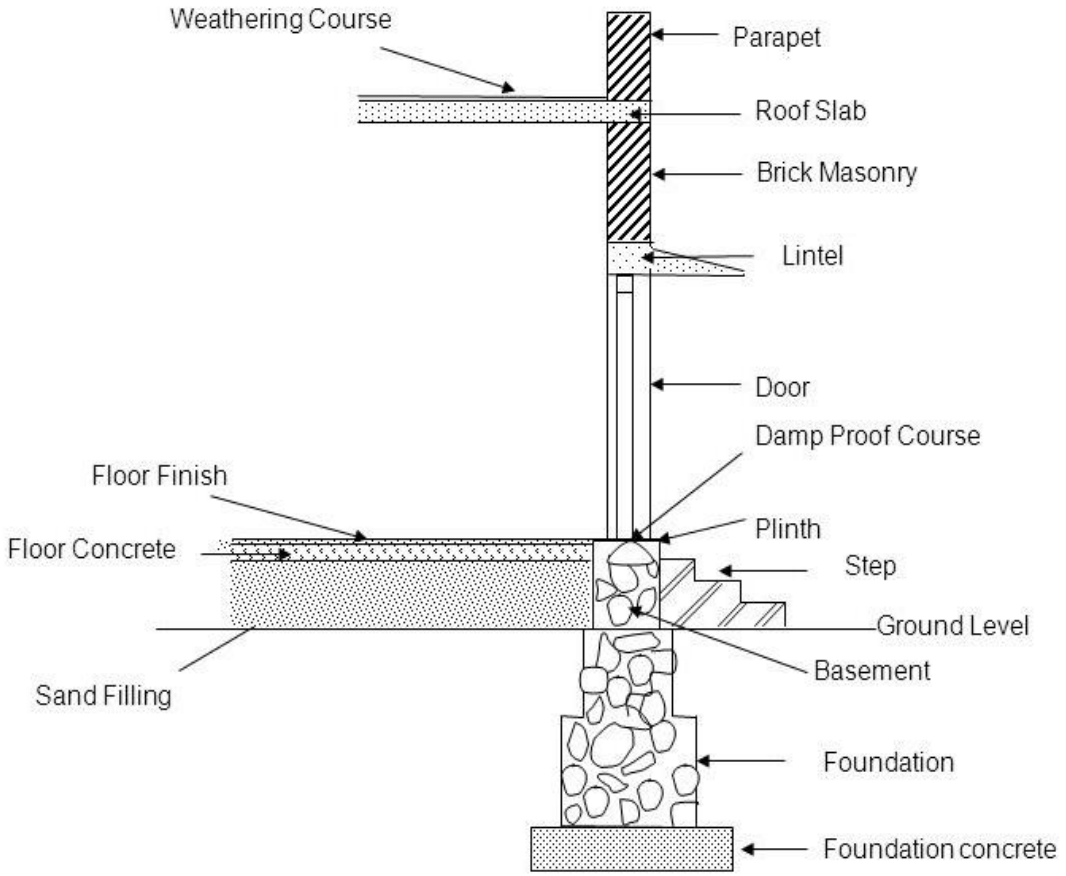
The roof provides protection for the building and the people living in it. The roof rests on the walls and requires proper anchoring so that wind and other mechanical impact cannot destroy it. A roof can have different shapes but it is always either flat or sloping.

Roof is typically made of RCC, stone slab, tiles etc.

Components of Building

10. Surfaces / Finishes

External finishes are the outer most layer of protection, which protect the structure from weathering. Internal finishes are the layers given on internal faces. They give durability and pleasing appearance to the inside.



COMPONENTS OF A BUILDING

Cross Sectional Components of Building

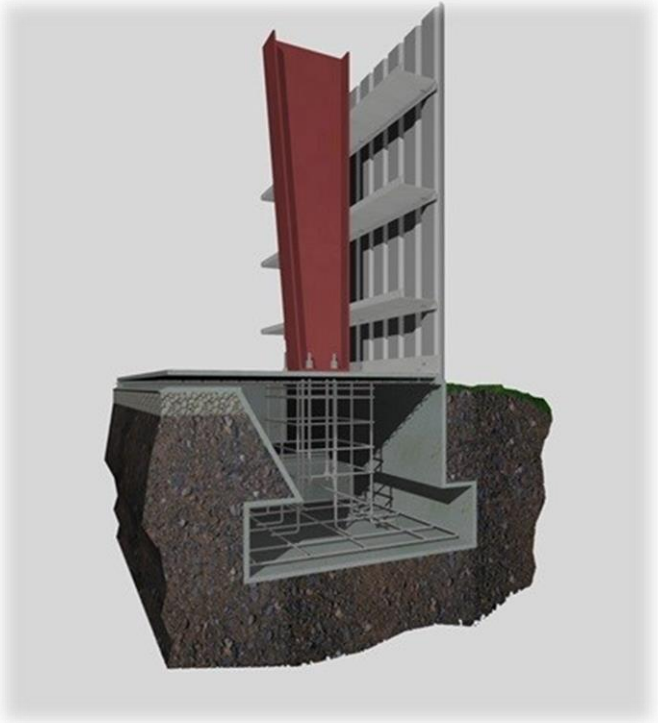
Foundation

“The foundation is a structural component of the building which is in direct contact with the ground and transmits the entire load of the building to the ground”

Functions of Foundation

(i) 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.



(ii) Even Distribution of load:

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 sub soil evenly with uniform soil pressure. Due to this, unequal or differential settlements are minimized.

(iii) Provision of Level Surface:

Foundation provide leveled and hard surface over which the super structure can be built.

(iv) Lateral Stability:

The stability of the building, against sliding and overturning, due to horizontal forces (such as wind, earthquake etc.) is increased due to foundations.

Classification of Foundation

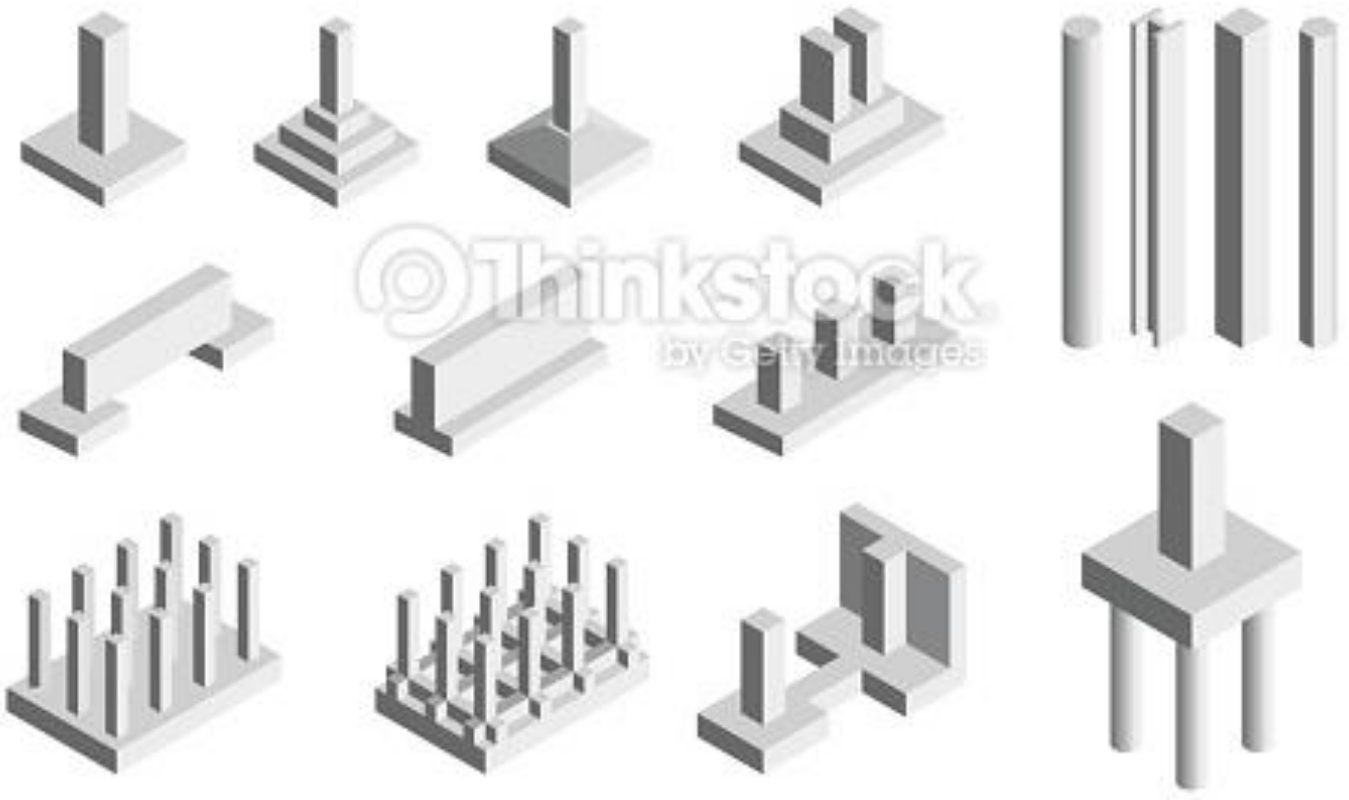
Foundations may be broadly classified into the following two categories:

(i) Shallow Foundation

(ii) Deep Foundation

A *Shallow Foundation* is the one in which the depth is equal to or less than its width.

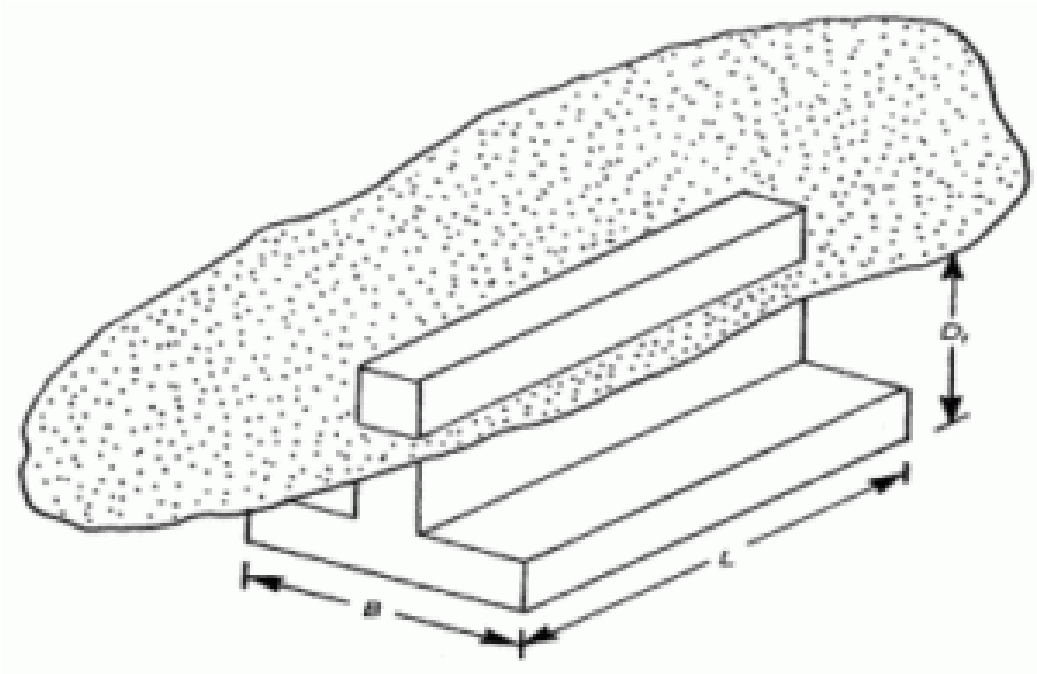
When the depth is more than the width of the foundation, it is termed as *Deep Foundation.*



Shallow Foundation

Shallow foundations are constructed where soil layer at shallow depth (up to 1.5m) is able to support the structural loads. The depth of shallow foundations are generally less than its width.

In this foundation, the total loads of the structure are distributed over a horizontal area at shallow depth below the ground level.



Types of Shallow Foundation

The different types of shallow foundations are:

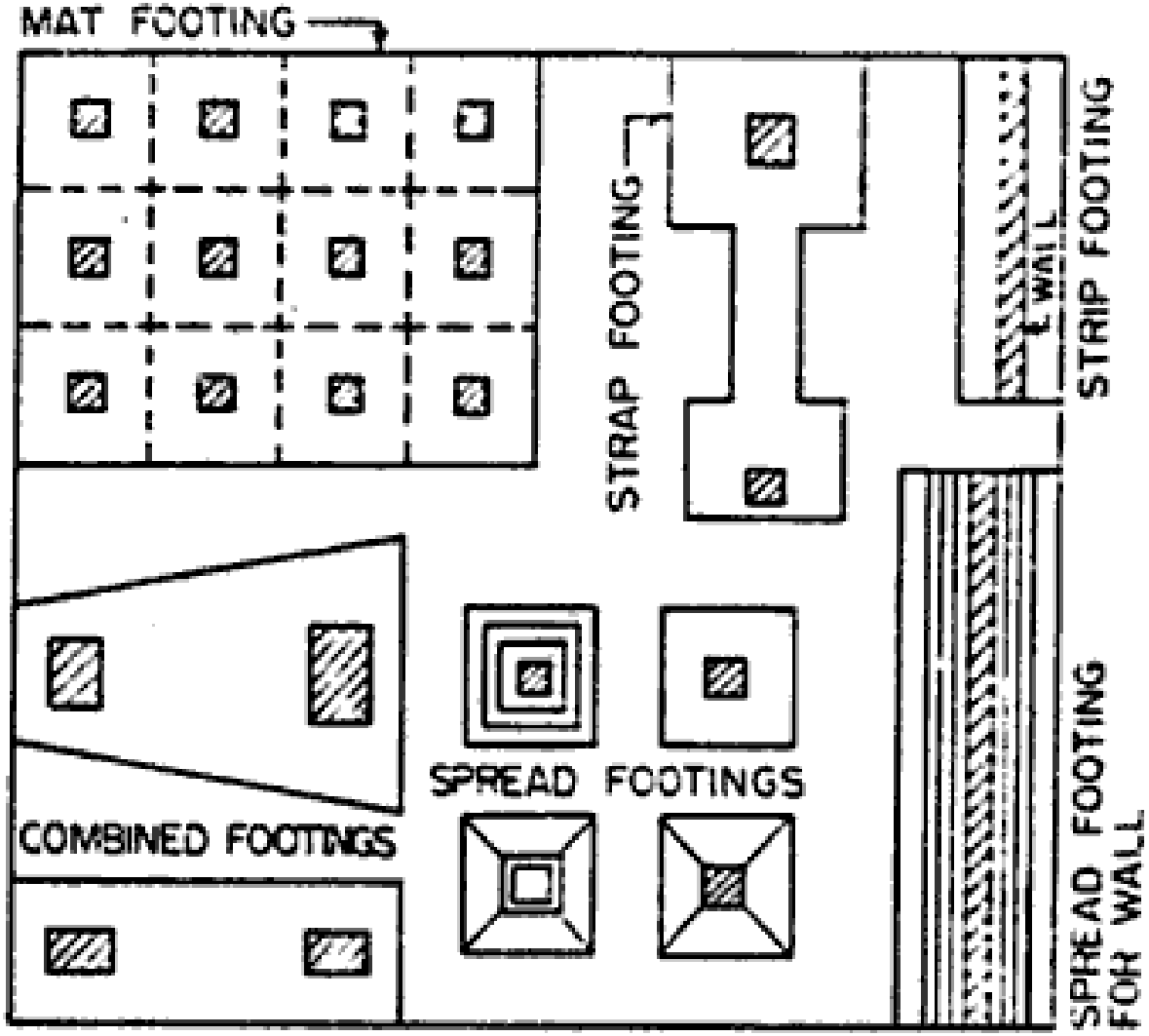
(i) Strip Footing

(ii) Isolated footing

(iii) Combined footing

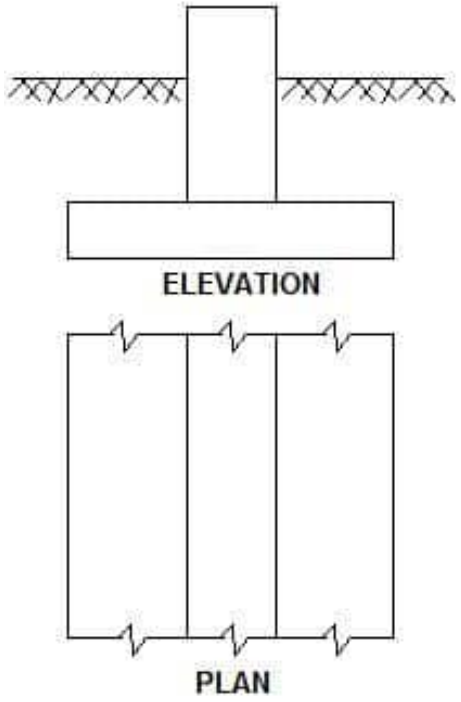
(iv) Strap or Cantilever Footing

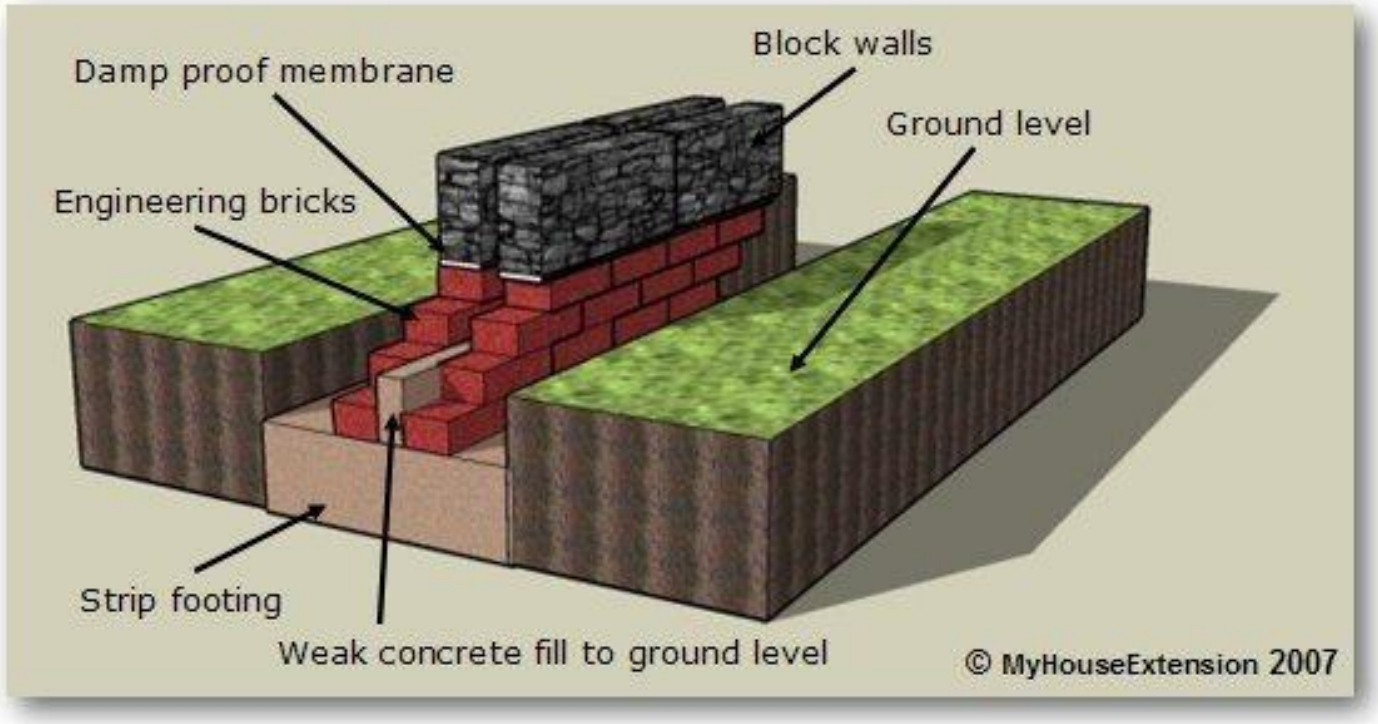
(v) Mat or raft foundation



Strip Footing

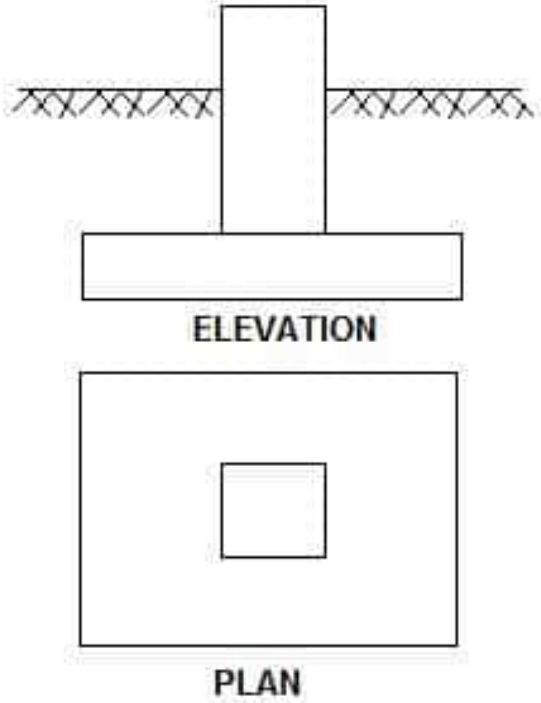
- A strip footing is provided for a load-bearing wall.
- A strip footing is also provided for a row of columns which are so closely spaced that their spread footings overlap or nearly touch each other.
- In such a case, it is more economical to provide a strip footing than to provide a number of spread footings in one line.
- A strip footing is also known as continuous footing.

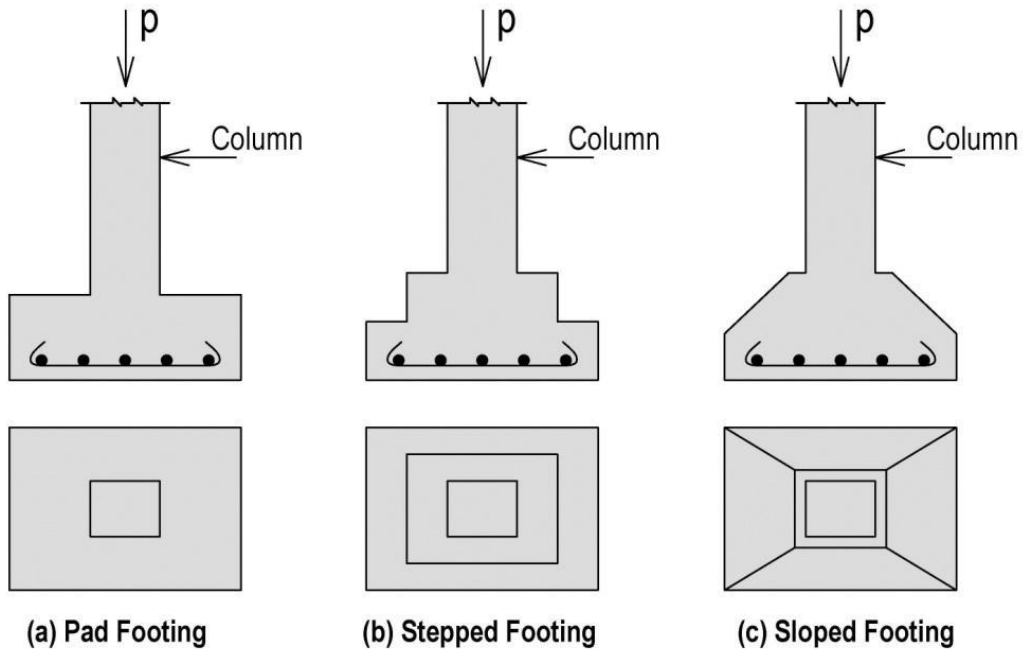




Isolated Footing

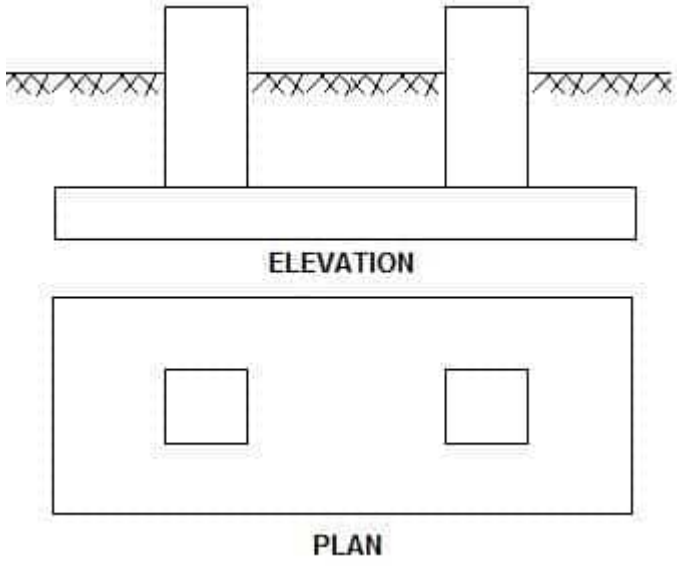
- Isolated footing (or Stepped or pad) footing is provided to support an individual column.
- Isolated footing is circular, square or rectangular slab of uniform thickness.
- Sometimes, it is stepped or haunched to spread the load over a large area.

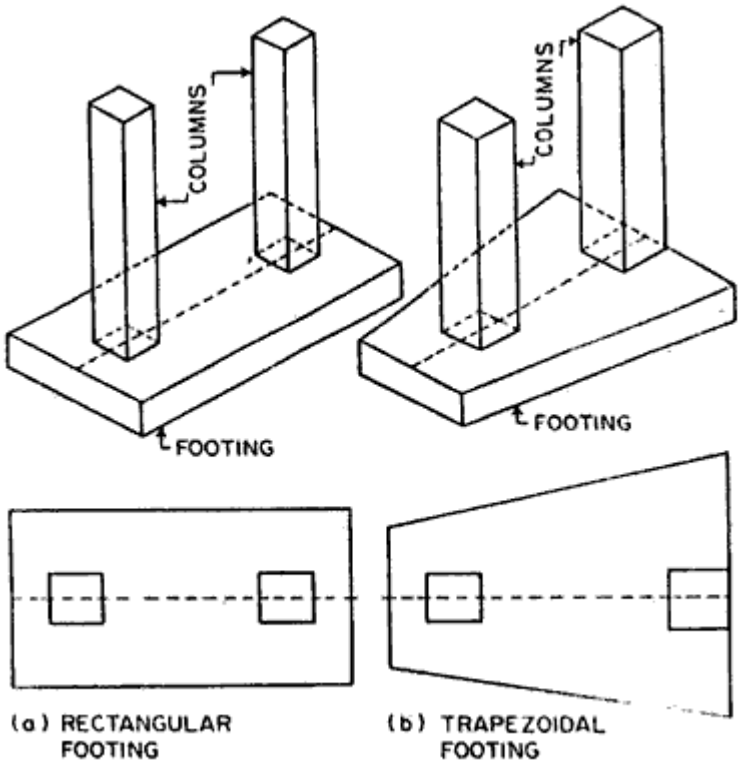


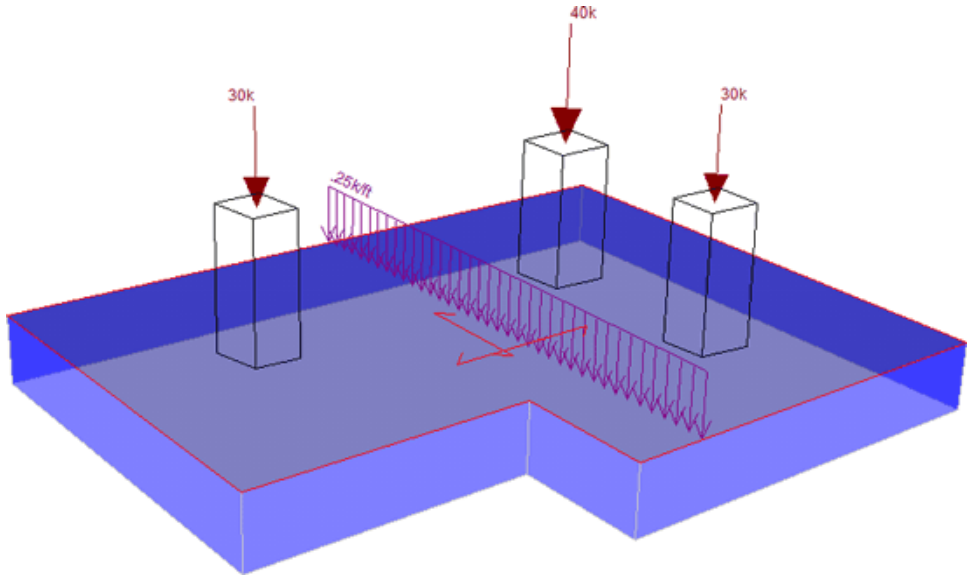


Combined Footing

- A combined footing supports two columns.
- It is used when the two columns are so close to each other that their individual footings would overlap.
- A combined footing may be rectangular or trapezoidal in plan.

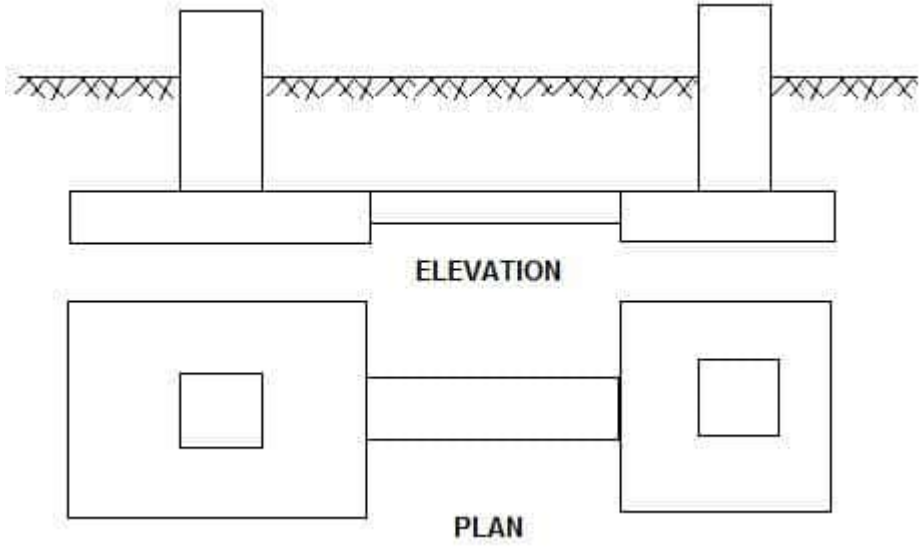


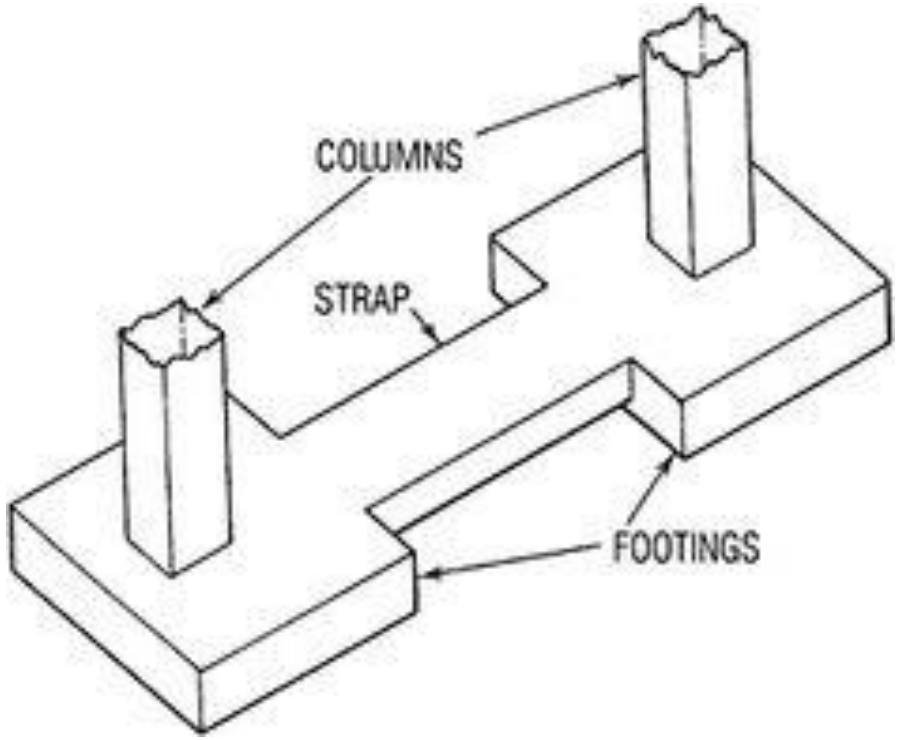




Strap or Cantilever Footing

- A strap (or cantilever) footing consists of two isolated footings connected with a structural strap or a lever.
- The strap connects the two footings such that they behave as one unit.
- A strap footing is more economical than a combined footing when the allowable soil pressure is relatively high and the distance between the columns is large.





Mat (or) Raft Foundation

- A mat or raft foundation is a large slab supporting a number of columns and walls under the entire structure or a large part of the structure.
- A mat is required when the allowable soil pressure is low or where the columns and walls are so close that individual footings would overlap or nearly touch each other.
- Mat foundations are useful in reducing the differential settlements on non-homogeneous soils or where there is a large variation in the loads on individual columns.

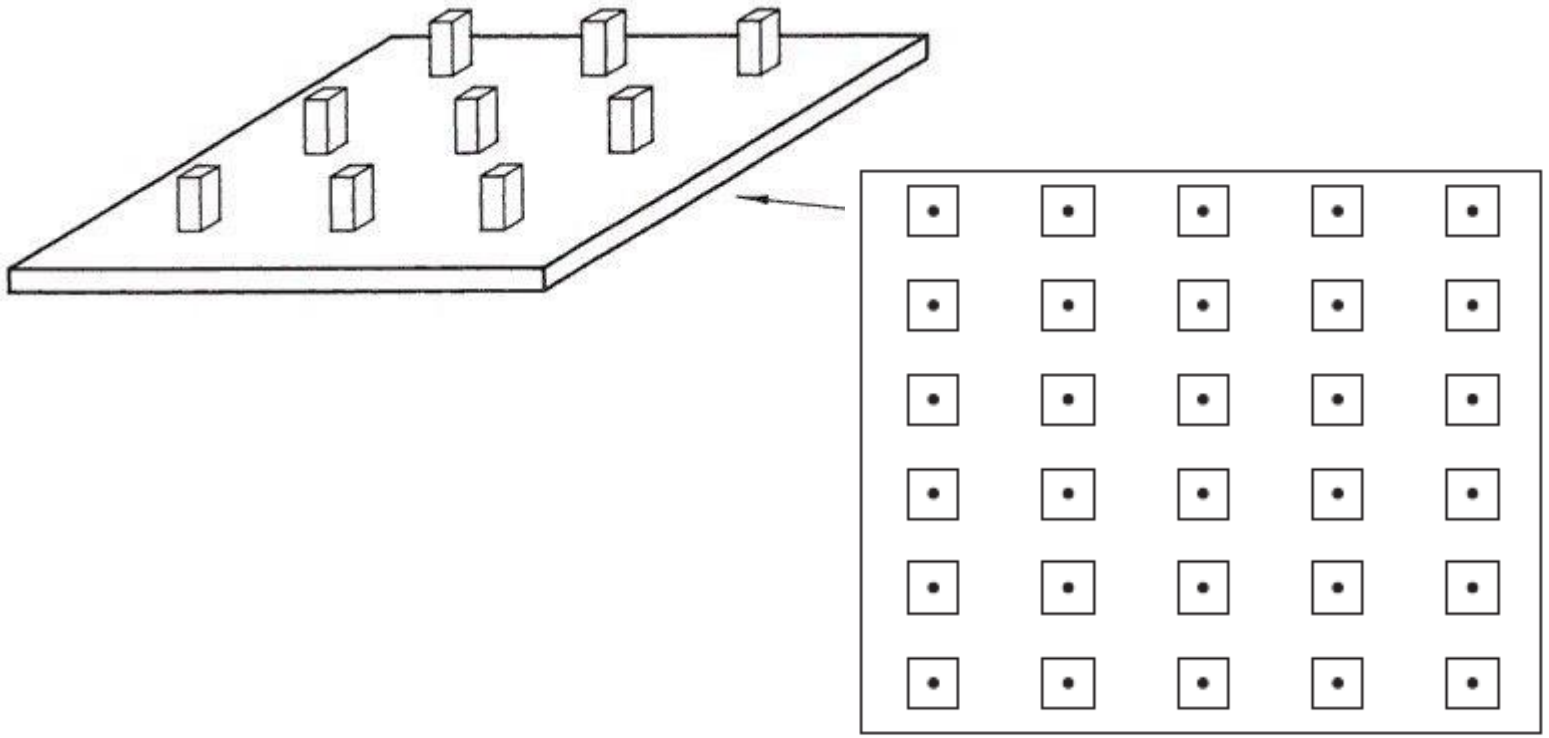
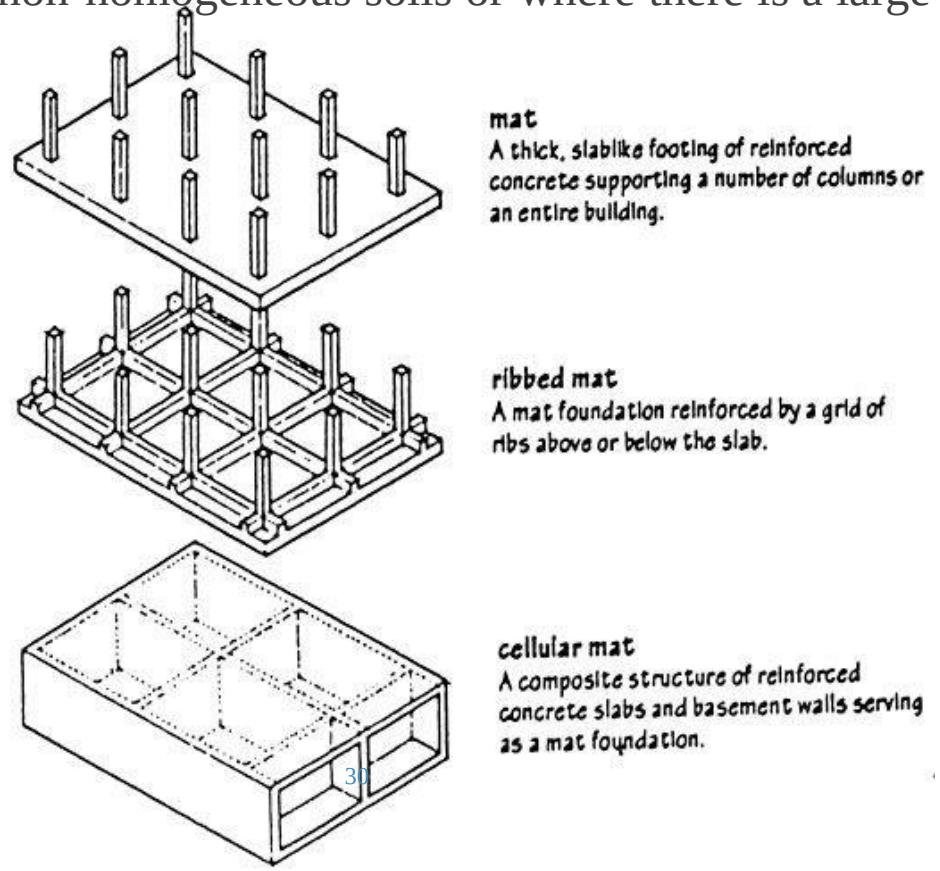


Fig. 7.6. Raft foundation

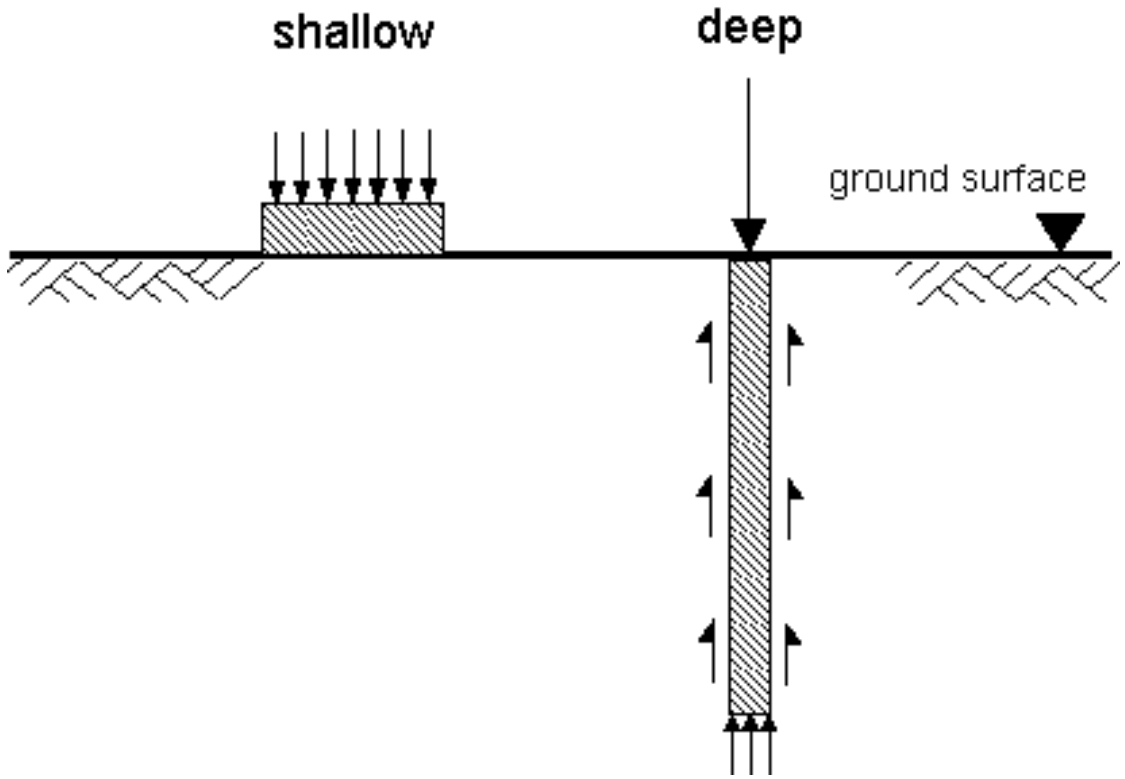


Deep Foundation

A deep foundation is a type of foundation which transfers building loads to the earth farther down from the surface than a shallow foundation does, to a subsurface layer or a range of depths.

There are many reasons a geotechnical engineer would recommend a deep foundation over a shallow foundation, such as for a skyscraper.

Some of the common reasons are very large design loads, a poor soil at shallow depth, or site constraints (like property lines).

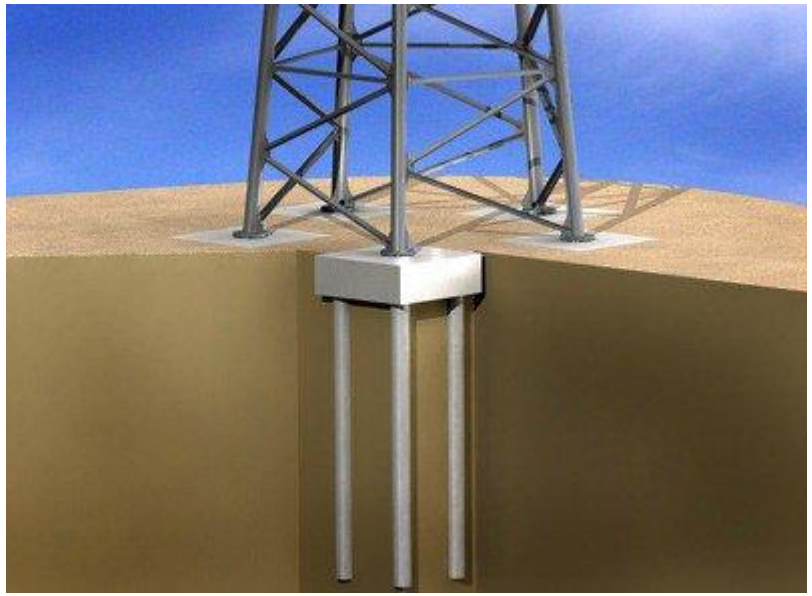


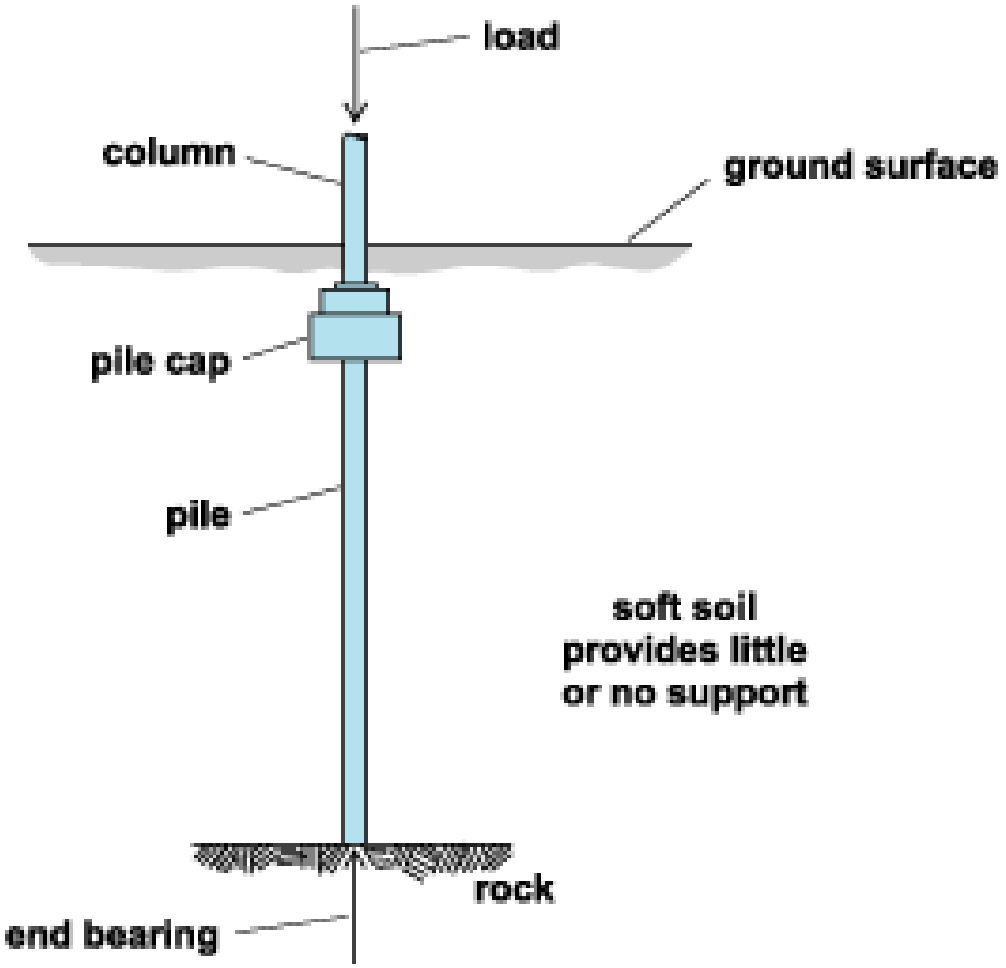
Types of Deep Foundation

The different types of deep foundations are:

(i) Pile Foundation

(ii) Well (or) Caisson Foundation



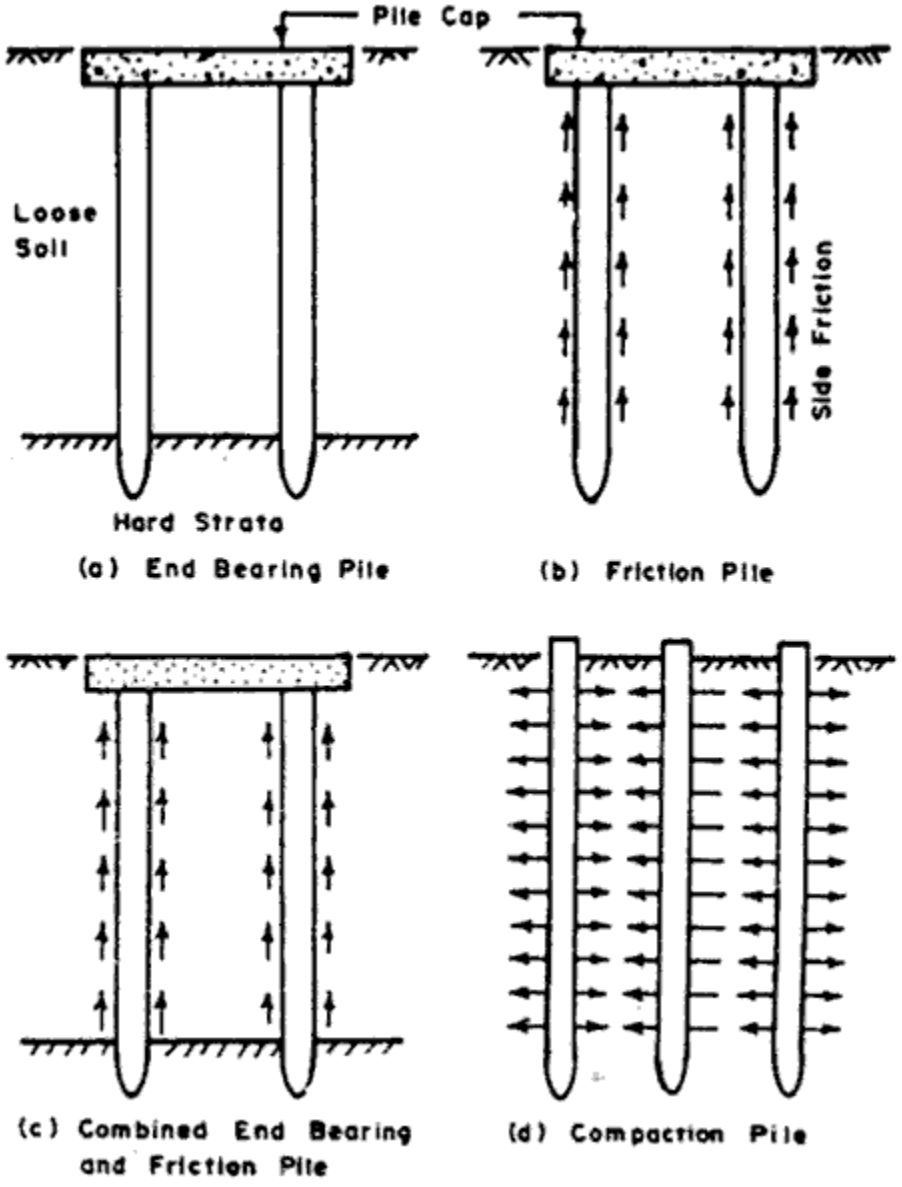


Pile Foundation

A pile is basically a long cylinder of a strong material such as concrete that is pushed into the ground to act as a steady support for structures built on top of it.

Pile foundations are used in the following situations:

- When there is a layer of weak soil at the surface. This layer cannot support the weight of the building, so the loads of the building have to bypass this layer and be transferred to the layer of stronger soil or rock that is below the weak layer.
- When a building has very heavy, concentrated loads, such as in a high rise structure, bridge, or water tank.



Types of Pile Foundation

There are two fundamental types of pile foundations (*based on structural behaviour*), each of which works in its own way.

End Bearing Piles: In end bearing piles, the *bottom end of the pile rests on a layer of especially strong soil or rock.*

The load of the building is transferred through the pile onto the strong layer. In a sense, this pile acts like a column.

Friction Piles: Friction piles work on a different principle. The pile transfers the load of the building to the soil across the full height of the pile, by friction.

In other words, the entire surface of the pile, which is cylindrical in shape, works to transfer the forces to the soil.

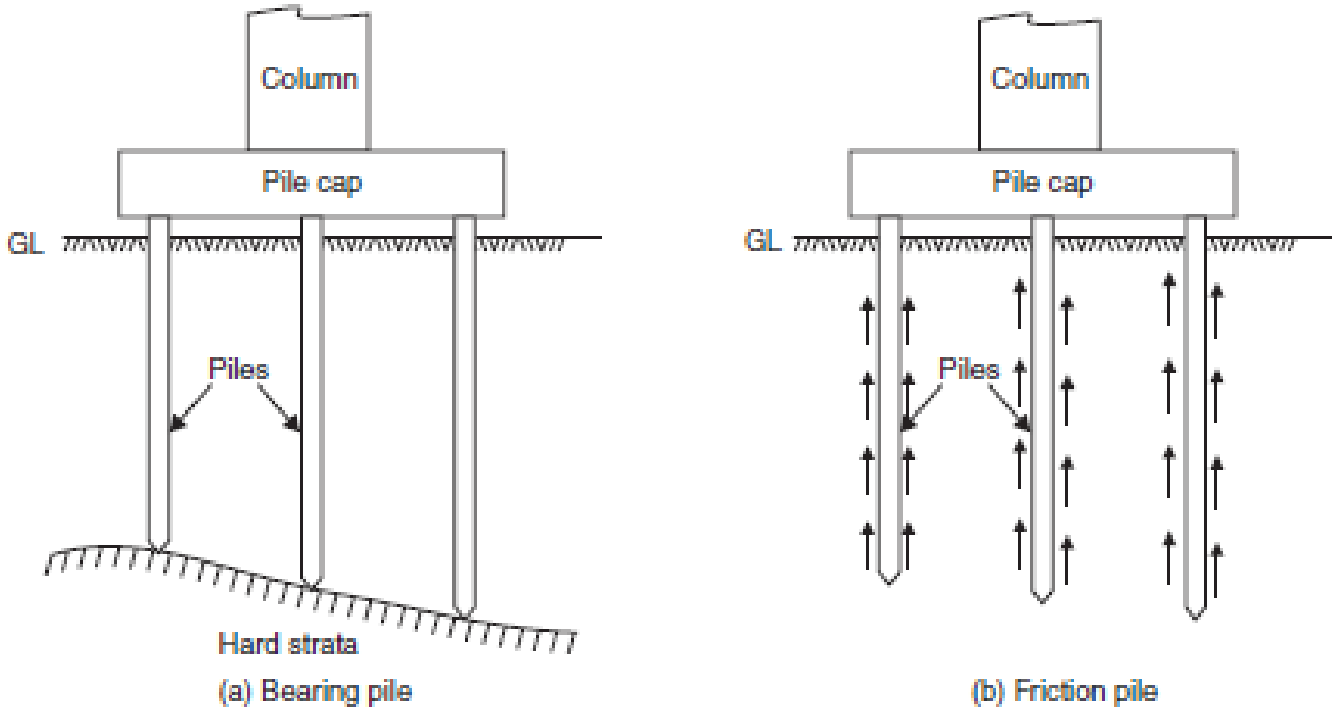
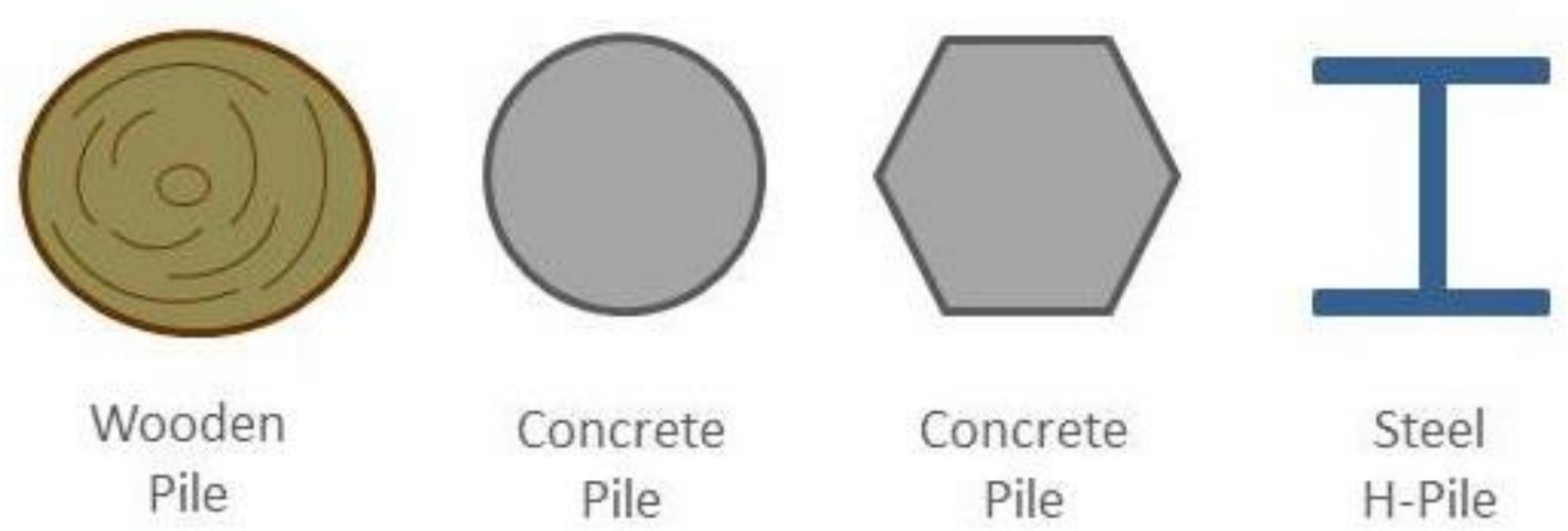


Fig. 7.9. Pile foundations

Materials for Pile Foundation

Piles can be made of wood, concrete, or steel.

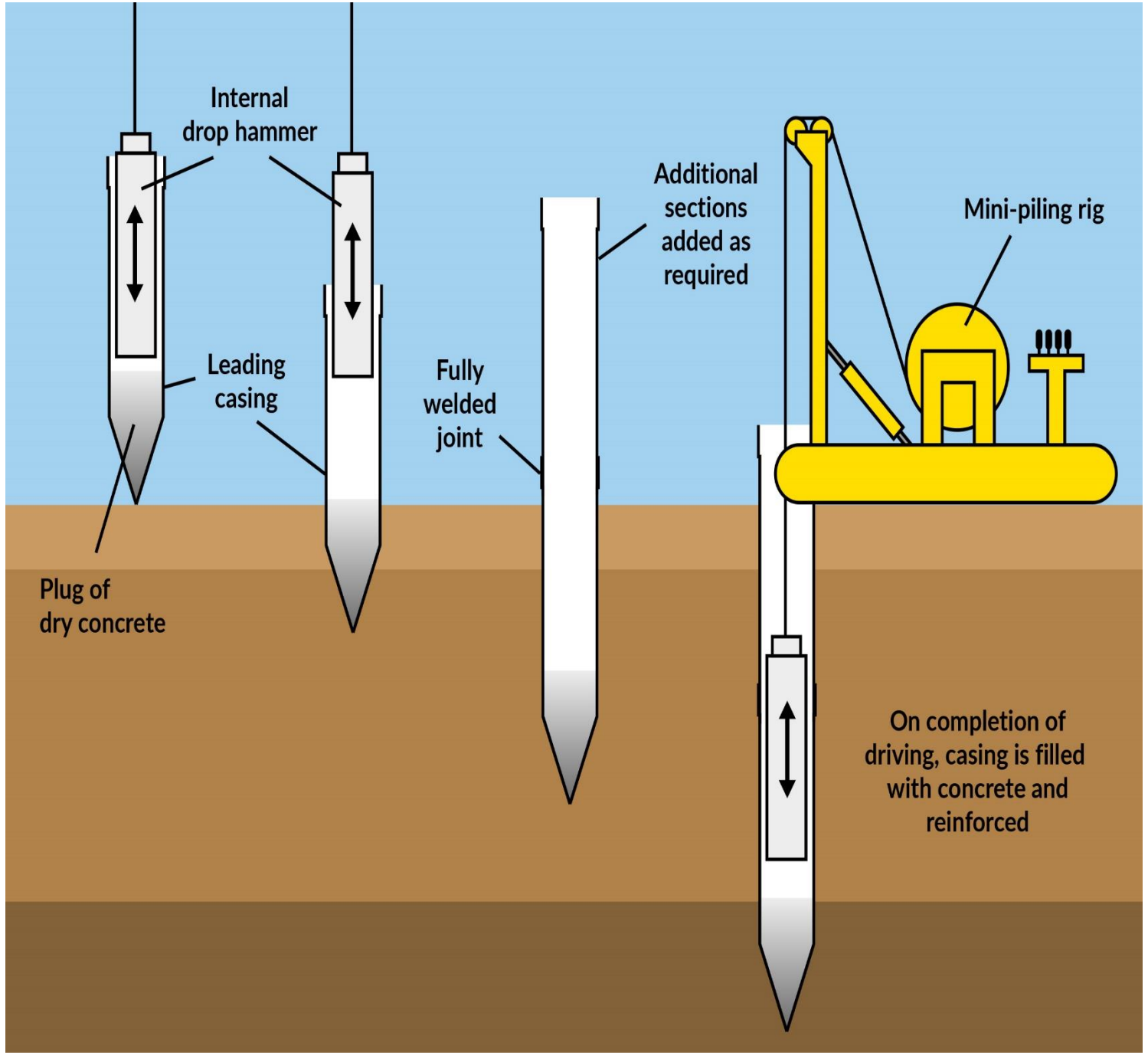


Construction of Pile Foundation

Piles can be either cast-in-place or precast driven piles.

Cast-in-place piles are made in the following steps:

- Hammer a thin-walled steel tube into the ground
- Remove all earth left inside the tube
- Lower a steel reinforcement cage into the tube
- Cast the pile by pouring wet concrete into the tube
- The thin walled steel tube is called the *casing*, and only serves to form a secure mould for casting concrete that is free from earth and debris. It has no structural role to play after the casting is complete.



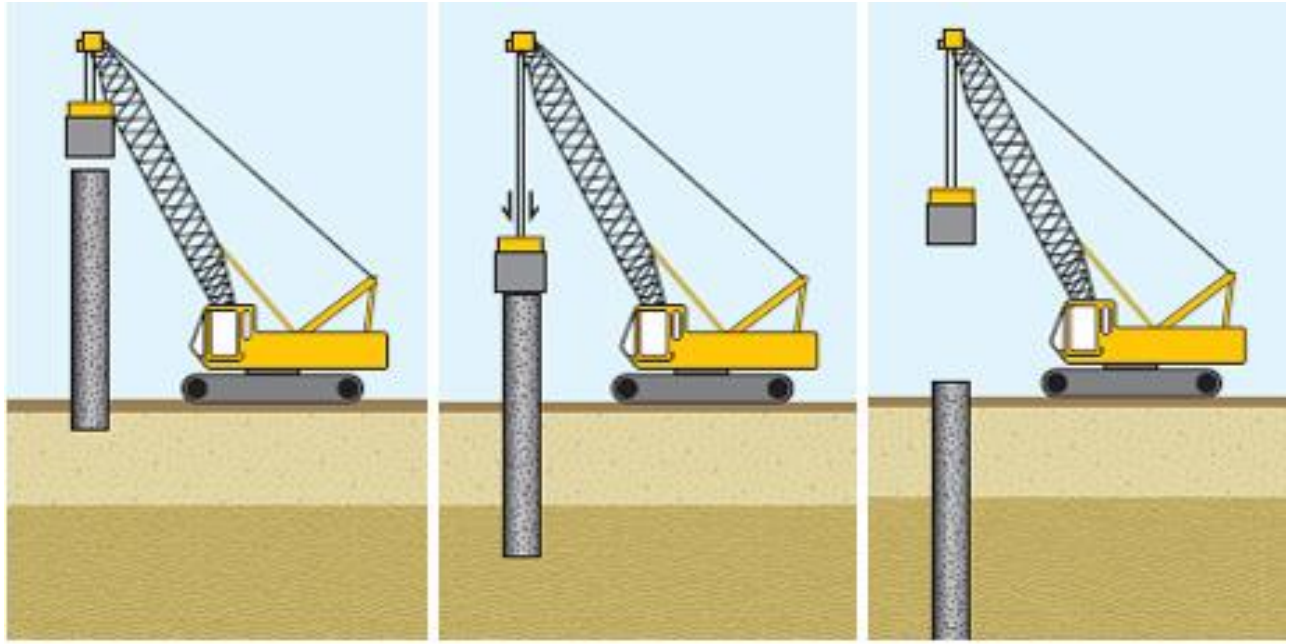
Construction of Pile Foundation

Precast Driven Piles are first cast at ground level and then hammered or *driven* into the ground using a *pile driver*.

This is a machine that holds the pile perfectly vertical, and then hammers it into the ground blow by blow.

Each blow is is struck by lifting a heavy weight and dropping it on the top of the pile.

The pile is temporarily covered with a steel cap to prevent it from disintegrating



Well (or) Caisson Foundation

- Well foundations are also called as Caisson foundation.
- It is box like structure – circular or rectangular that sunk from the surface of land or water to the desired depth.
- Well foundation forms the most common type of deep foundation for bridges in India.

The following components are to be considered while designing the well foundations. They are:

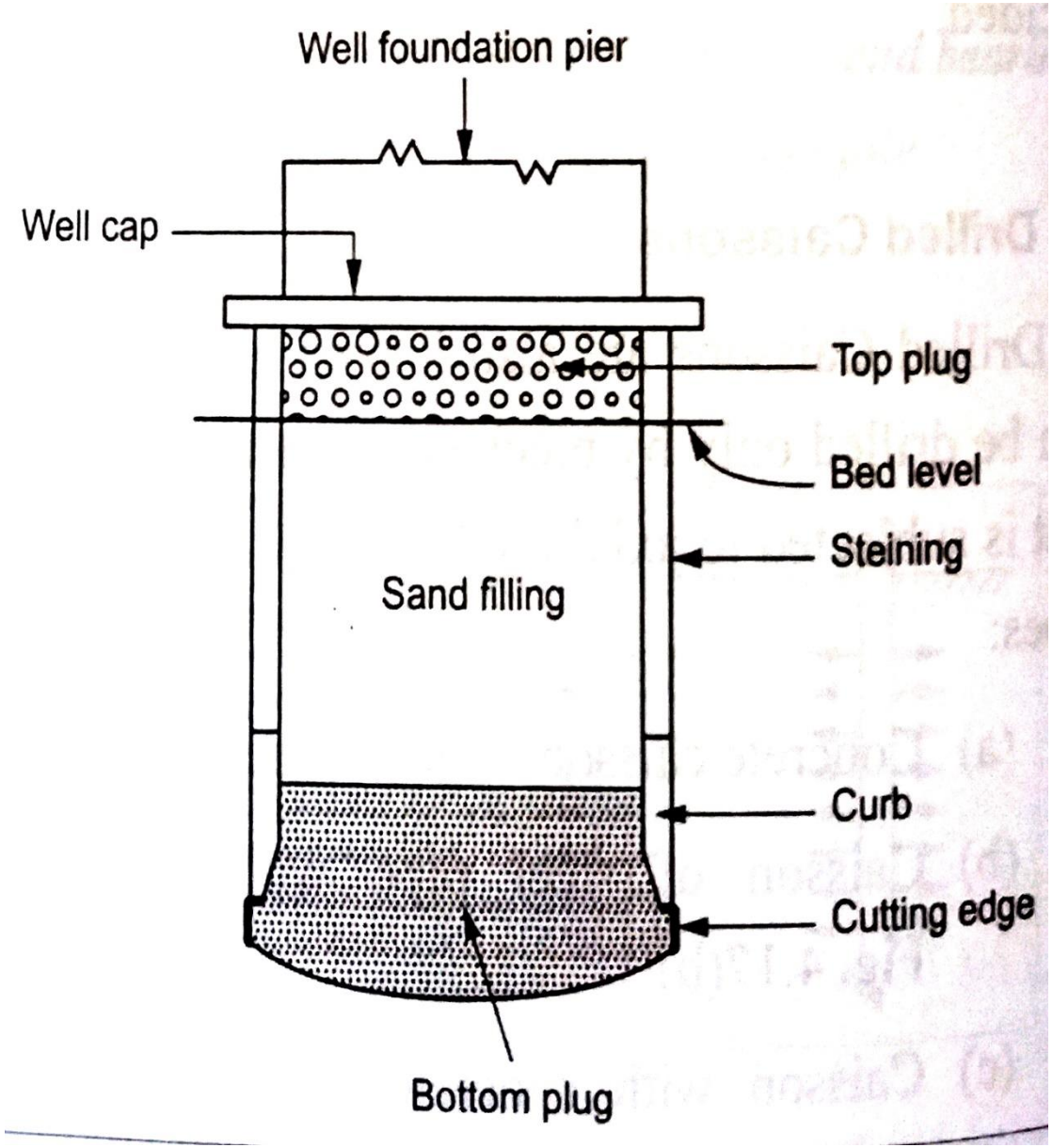
(i) Well Curb

(ii) Cutting edge

(iii) Bottom plug

(iv) Steining

(v) Well cap



Well (or) Caisson Foundation

Advantages of Well Foundations:

(i) It can go to large depth

(ii) The cost of construction is low

Uses of Well Foundations:

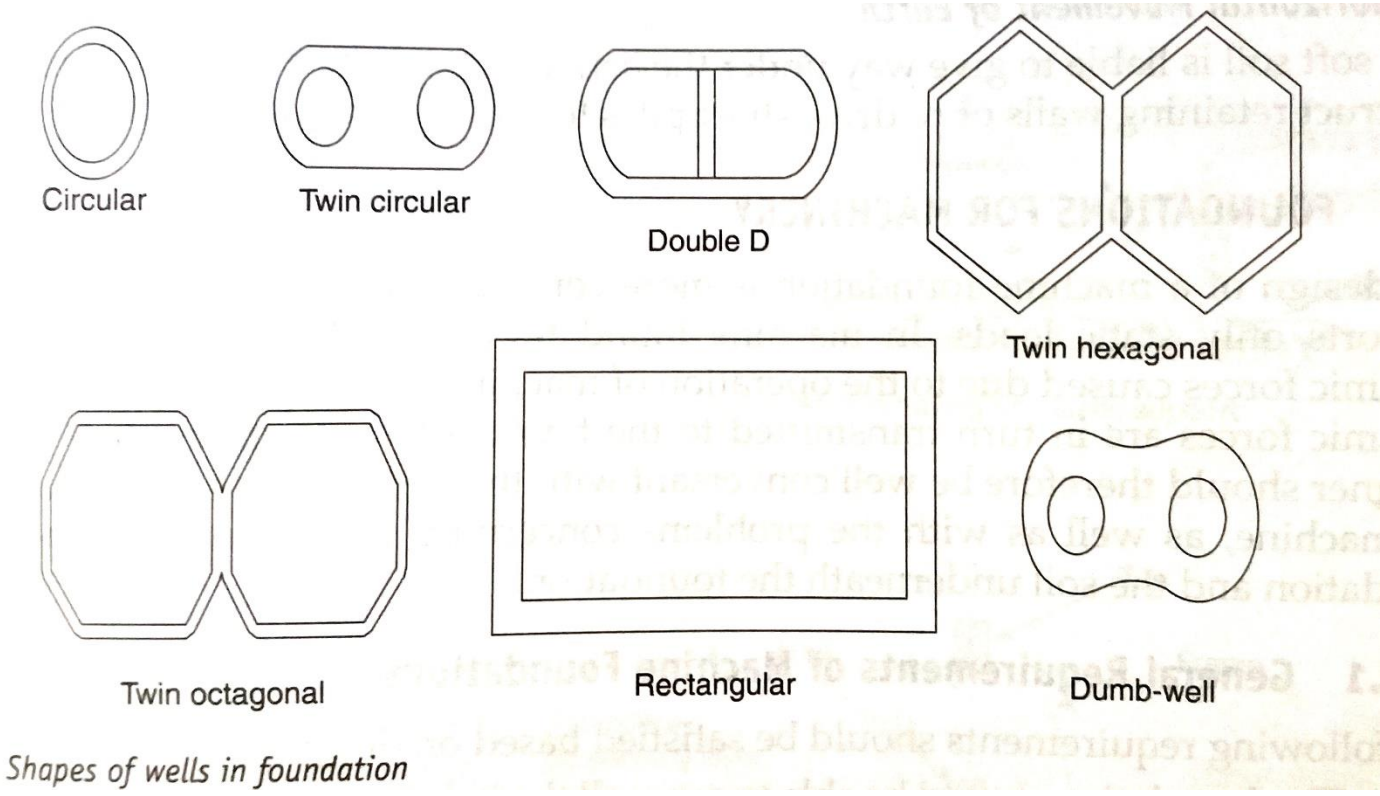
Caisson or well foundations are used for major foundation works like:

(i) Break water and other structures for shore protection

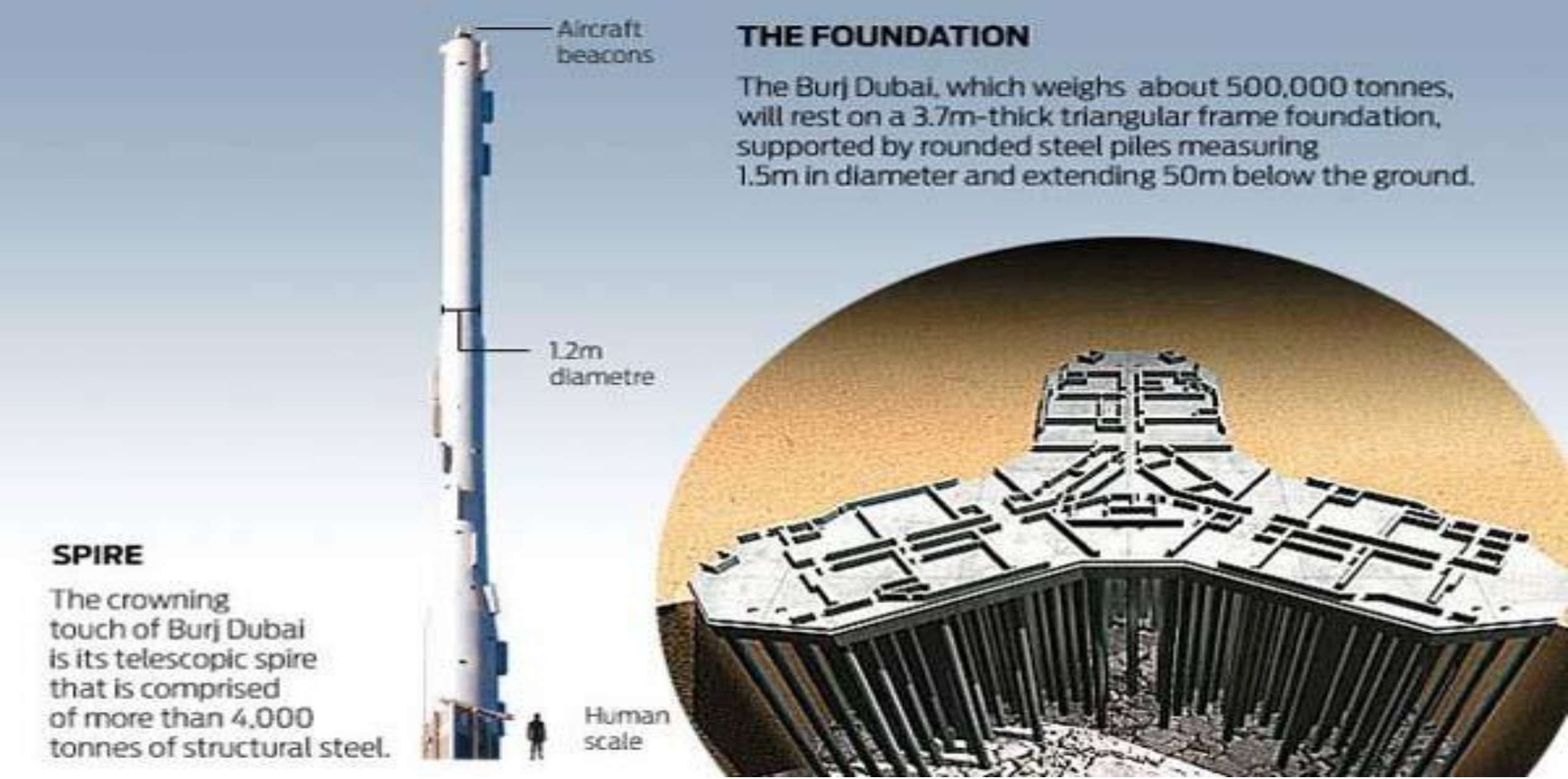
(ii) Wharves, quay walls and docks

(iii) Bridge piers, abutments in lakes, rivers, etc.

(iv) Pump houses that is subjected to heavy vertical and horizontal loads



Shapes of wells in foundation



Foundation of World's Tallest Building

Bearing Capacity of Soil

The maximum load which the soil can bear per unit area without any yielding (or) failure is called as bearing capacity. Safe bearing capacity is obtained by,

Safe bearing capacity = (Ultimate bearing capacity / Factor of safety)

It is denoted by kN/m^2.

Methods for Improving Bearing Capacity of soil:

If the bearing capacity of the soil is very low, the dimensions of the footing should be very large and will be uneconomical. In such cases, it is better to improve the bearing capacity of the soil. The following methods are used to improve the bearing capacity of the soil:

(i) Increasing the depth

(ii) Draining the soil

(iii) Compacting the soil

(iv) Confining the soil

(v) Cement grouting

(vi) Chemical treatment.

Improving Bearing Capacity

(i) Increasing the depth:

- For sandy soils, the bearing capacity can be increased by increasing the depth of foundation.
- But, this method is not economical because the cost of construction and load on the foundation increase with the increase in the depth.

(ii) Draining the soil:

- The presence of water in the soil decreases the bearing capacity especially when it is saturated. Hence the water should be drained from the soil.
- Water can be drained by using gravity pipe drainage system (or) by installing shallow tube wells.
- Drainage results in decrease in the void ratio and improvement of bearing capacity.

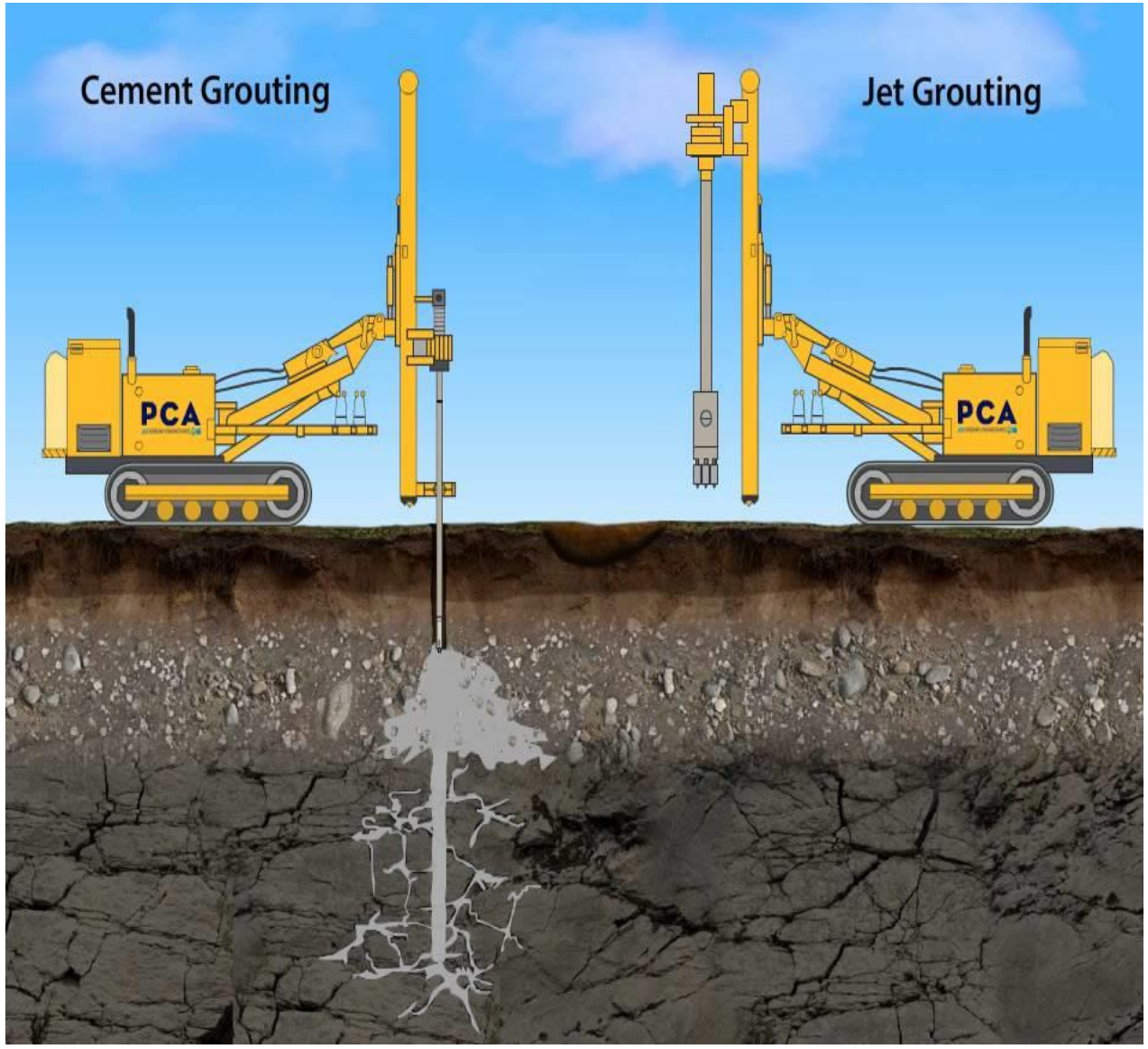
(iii) Confining the soil:

- Due to the lateral movement of loose granular soil, the safe bearing capacity of the soil may be low.
- This movement of soil under the action of load can be prevented by confining the ground by the use of *sheet piles*. The sheet piles are driven outside the perimeter of foundation area, thus forming an enclosure and confining the soil.

Improving Bearing Capacity

Improving Bearing Capacity

Geo-grids for soil confining



Improving Bearing Capacity

(iv) Cement Grouting:

- Number of bore holes are driven in the ground.
- Then the cement grout is forced through these holes under a high pressure.
- The voids, cracks and fissures of rocks are filled with the cement grout, thus resulting in the increase of bearing capacity.

(v) Chemical Grouting:

- This method is as same as cement grout method except which certain chemicals are grouted in the place of cement grout.
- The chemicals used should be in such a way that it can solidify and gain early strength.

Improving Bearing Capacity

(vi) Compacting the soil:

Compaction of the soil reduces the open space between the individual particles and hence it is less liable to displacement. So the bearing capacity is increased. Compaction of the soil can be achieved by the following :

(a) Ramming the moist soil

(b) Rubble compaction

(c) Flooding the soil

(d) Vibrating the soil

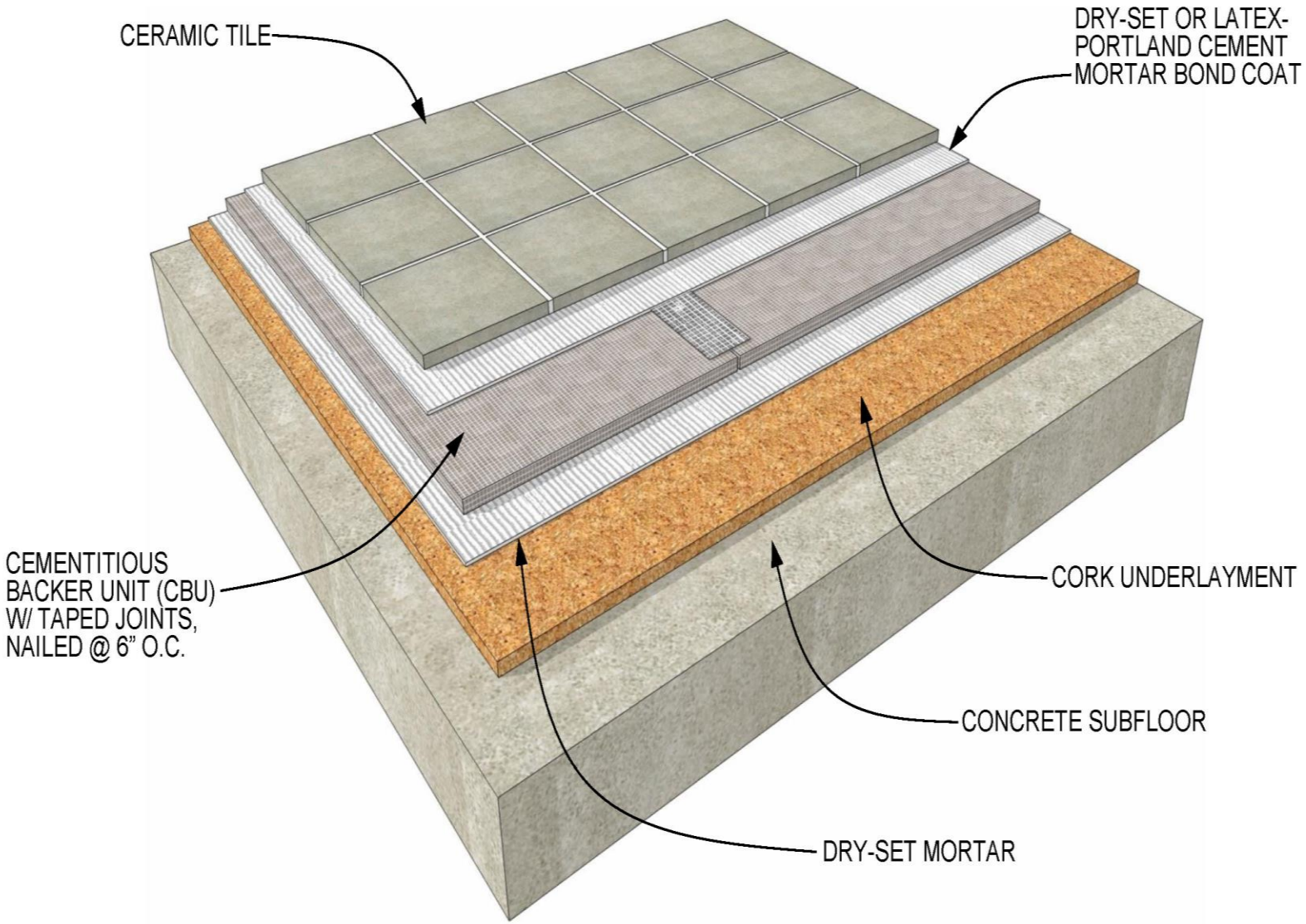
(e) Vibrofloatation method

(f) Pre-loading

(g) Sand piles

Flooring

"The solid construction that subdivides the portion between basement level and roof level is known as *floors* and exposed top surface of floor is known as *floorings.*"



Components of Floor

A floor consists of two essential components namely,

(a) Subfloor – Base course or floor base

(b) Floor covering – flooring or paving

(a) ***Sub floor:*** A sub floor is a structural component that supports the floor covering. The main purpose of sub floor is to impart strength for load bearing capacity and stability to support other super imposed loads.

(a) ***Floor Covering:*** The covering over the sub floor is called as floor covering. The main purpose of floor covering is to provide a hard, clean, smooth and attractive surface to the floor. Floor covering can also be called as paving or flooring.

Requirements of Floor

Following are the functional requirements of floors in a building:

(i) Strength and Stability of floors in building:

- Floor strength depends on the properties of material such as timber, reinforce concrete, and steel that are employed to construct the structure of the floor.
- The strength of floor structure should be adequate to carry dead load of the floor, finishes, fixtures, partitions, services and expected imposed loads of occupants.

(ii) Resistance of floors to weather and ground moisture:

- There are various factors which affect the moisture penetration level from the ground to the floor includes the nature of subsoil, water table, and whether the site is horizontal or sloping.
- There is small amount of moisture penetration into the ground if the base is gravel or coarse grain sand (because water table level is below the surface during the whole year); in this case, concrete slab is suitable solution to resist moisture penetration.

Requirements of Floor

(iii) Durability and free from maintenance:

The durability and free from maintenance of floors are rely on the nature of materials applied and the wear they are exposed to.

(iv) Fire Resistance of floors:

- Floors should withstand fire for enough period during which the occupant can get out of the building.
- Reinforced concrete floors combat fire for longer period compare with timber floors.

(v) Resistance to passage of heat:

Ground floor can be constructed in a way that prevents heat transfer from the floor to the ground or from ground to the floor by applying hardcore and a damp-proof membrane.

(vi) Resistance to passage of sound:

- It is considerably significant that upper floors, which separate dwellings, shall work as barrier and prevent transmission of sound.
- Reinforced concrete floor work better in preventing transmission of airborne sound compare to low mass timber floor.
- That is why reinforced concrete floor can be effectively used to separate residents.

Selection of Flooring Material

The selection of flooring material i.e. floor covering should be made by considering the following factors:

(i) Initial cost

(ii) Cleanliness

(iii) Appearance

(iv) Durability

(v) Sound insulation

(vi) Fire resistance

(vii) Damp resistance

(viii) Thermal insulation

(ix) Hardness

(x) Smoothness

(xi) Comfort criteria

(xii) Maintenance

Selection of Flooring Material

(i) Initial Cost:

- During the selection of a type of floor and floor covering, the cost of construction is one of the important factor.
- The floor coverings like marbles, rubber tiles and special clay tiles are very expensive whereas concrete and brick type floor coverings are the cheapest type.

(ii) Cleanliness:

- Flooring should be a non-absorbent and should be capable of being cleaned easily. It should be water tight and oil substance should not affect on flooring material.
- Floorings made up of marble, tiles and slates can be cleaned easily.

(iii) Appearance:

- Floor covering should give pleasing appearance and it should give desired color effect and architectural beauty.
- Flooring of tiles, marbles, cement mortar give pleasing appearances.

Selection of Flooring Material

(iv) Durability:

- The flooring material should give long life to floor.
- It should be resistant to temperature, chemical actions, wear and tear, etc.
- Floorings made up of marble, terrazzo, tiles are the best types that gives durability to floor.

(v) Sound Insulation:

- A floor should neither create noise nor transmit noise.
- It is an important factor in case of upper floors, where they act as horizontal barriers for the passage of sound.
- Cork tile flooring and rubber flooring give excellent sound insulation properties.

(vi) Fire Resistance:

- In order to safeguard the life, the flooring material should be resistant to fire.
- This is an important factor in case of upper floor which are required to act as a highly resistant fire barrier.
- Flooring made up of concrete, brick, clay tiles and marble are resistant to fire.

Selection of Flooring Material

(vii) Damp Resistance:

- The flooring material should provide sufficient resistance against dampness.
- Flooring made up of clay, tiles, concrete, bricks, terrazzo, etc. are preferred for use where the floors are subjected to dampness.

(viii) Thermal Insulation:

- The flooring should have good thermal insulation.
- It should maintain constant temperature inside the building.
- Floor covering of wood, rubber, cork, PVC tiles are better for this purpose.

(ix) Hardness:

- The flooring material should be sufficiently hard.
- It should have resistance to marks (or) signs that are caused during shifting (or) rubbing of furniture, equipment etc.
- Flooring made up of concrete, marble, stones, etc. does not show any impressions.

Selection of Flooring Material

(x) Smoothness:

- Flooring should be smooth and even surface but it should not be slippery.
- Floor coverings of tiles, concrete, terrazzo have better performance while considering smoothness.

(xi) Comfort Criteria:

- The flooring should have a shock absorbing and good conductivity property.
- The floorings made up of cork tiles, rubber, wooden blocks, plastic, etc. provide comfort criteria.

(xii) Maintenance:

- The flooring material should require less maintenance.
- It should be such that repairs can be done easily.
- The coverings of tiles, marble, terrazzo, concrete, etc. requires less maintenance.

Types of Flooring

Based on the materials used, for flooring, the different types of floorings are listed below:

(i) Mud Flooring

(ii) Stone Flooring

(iii) Brick Flooring

(iv) Timber Flooring

(v) Concrete Flooring

(vi) Mosaic Flooring

(vii) Terrazzo Flooring

(viii) Granolithic Flooring

(ix) Tiled Flooring

(x) Rubber Flooring

(xi) Linoleum Flooring

(xii) Cork Flooring

(xiii) Magnesite Flooring

(xiv) Glass Flooring

(xv) Marble Flooring

(xvi) Plastic (or) P.V.C Flooring

Concrete Flooring

Concrete flooring is commonly used for residential, commercial and industrial buildings. The floor has two components namely:

(i) Base Course

(ii) Wearing Course

These two components can be constructed either *monolithically* (or) *non-monolithically.*

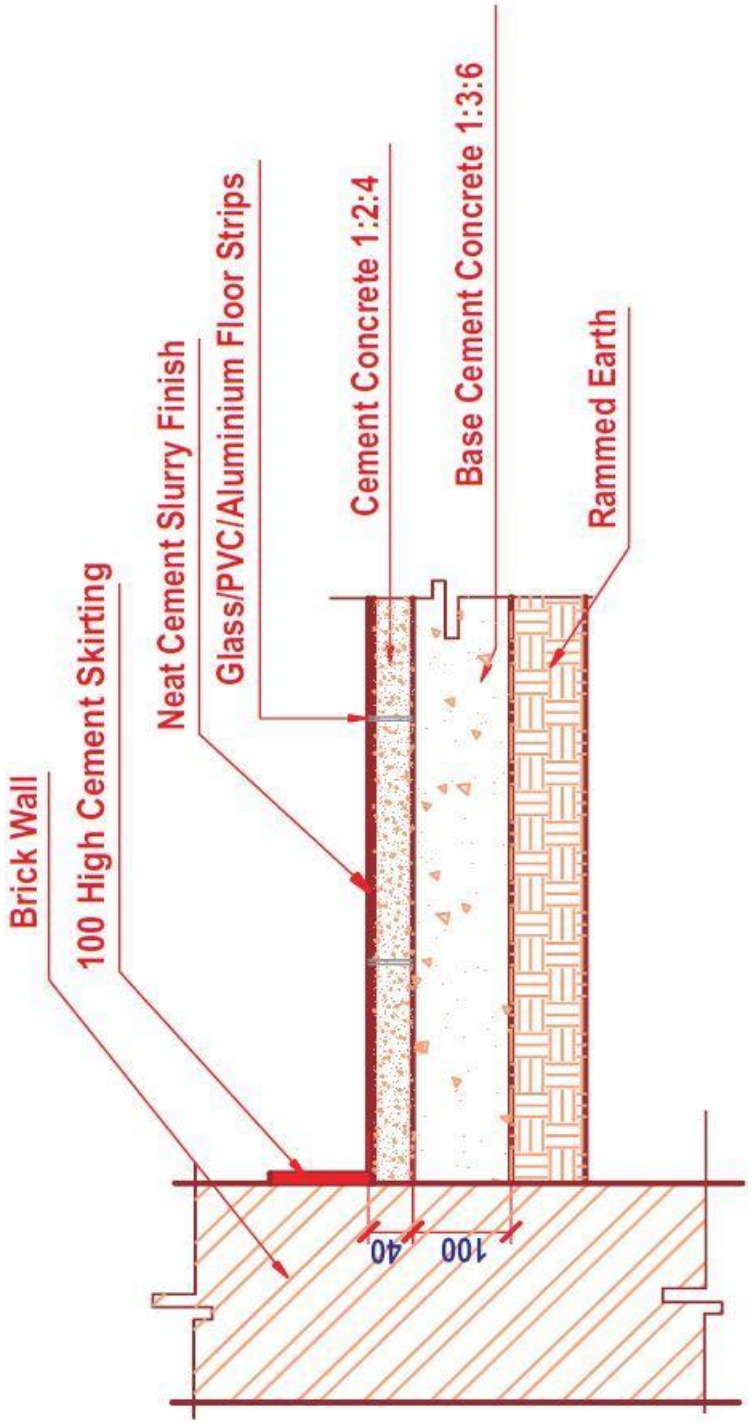
Monolithic Construction:

- The topping is laid immediately after the base course is laid.
- In this type, base remains in plastic state, so topping get damaged and hairy cracks may develop.

Concrete Flooring

Non-Monolithic Construction:

- As the 1st step, the ground should be well-watered, levelled and rammed.
- Above this, a 15cm hick layer of broken stones is spread and consolidated. This base is called as the hardcore.
- A layer of lime concrete (1:2:4) about 10cm thick is laid on the hardcore.
- This layer is watered and well rammed for two days.
- On the third day, the water is drained and a small quantity of dry cement is sprinkled and it is swept with a broom.
- Then a cement concrete of proportions 1:2:4 about 4cm thickness is laid. The concrete is rammed and smoothened with a power float.
- At last finishing surface about 2cm thick cement mortar is laid on concrete surface
- After flooring is completed, the whole surface is curved with wet gunny bags.



Concrete Flooring

Advantages of Concrete Flooring:

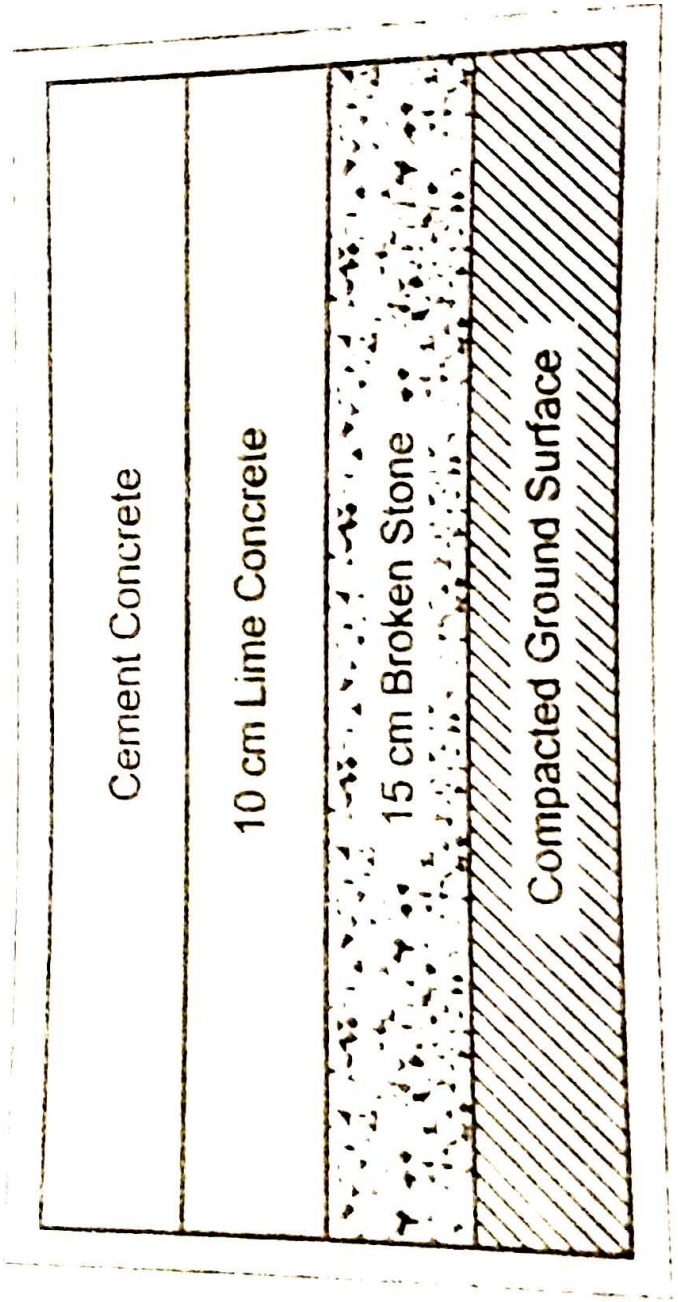
(i) It offers resistance to dampness and fire.

(ii) It is smooth, durable, hard, even and gives pleasing appearance.

Disadvantages of Concrete Flooring:

(i) The defects cannot be easily rectified.

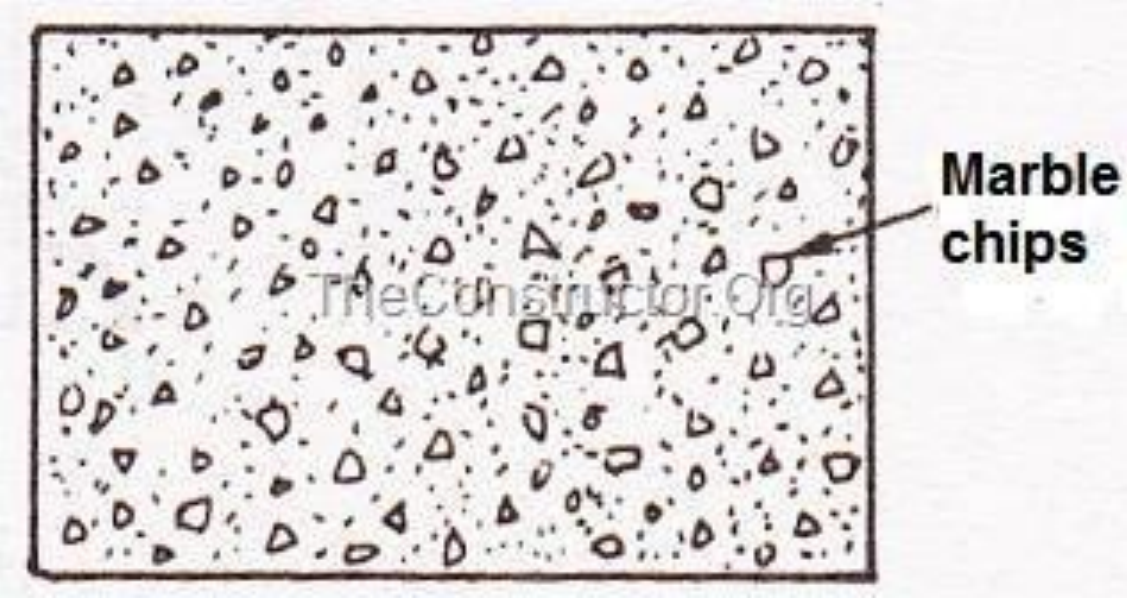
(ii) It does not possess satisfactory insulation against heat and sound.



Terrazzo Flooring

The floor whose topping consists of ***marble chips (terrazzo)*** is known as terrazzo flooring. The construction of terrazzo flooring is described below:

- The ground surface should be properly rammed and compacted.
- Over this, a 15cm thick sand cushion is laid.
- Over sand cushion a 10cm thick lime concrete is placed
- Above this 3cm thick cement concrete (1:2:4) is laid evenly and the surface is left without troweling.
- Depending upon the required pattern strips of aluminium, brass or glass is inserted. The strips should project 25mm above the level.
- The terrazzo mix containing cement, marble chips and water is laid over the surface up to the top of dividing surface.
- The surface is levelled by screeding and additional chips may be added during tamping and rolling operation.
- At last the surface is floated and left to dry for 12 to 20 hours.



Terrazzo Flooring

Advantages of Terrazzo Flooring:

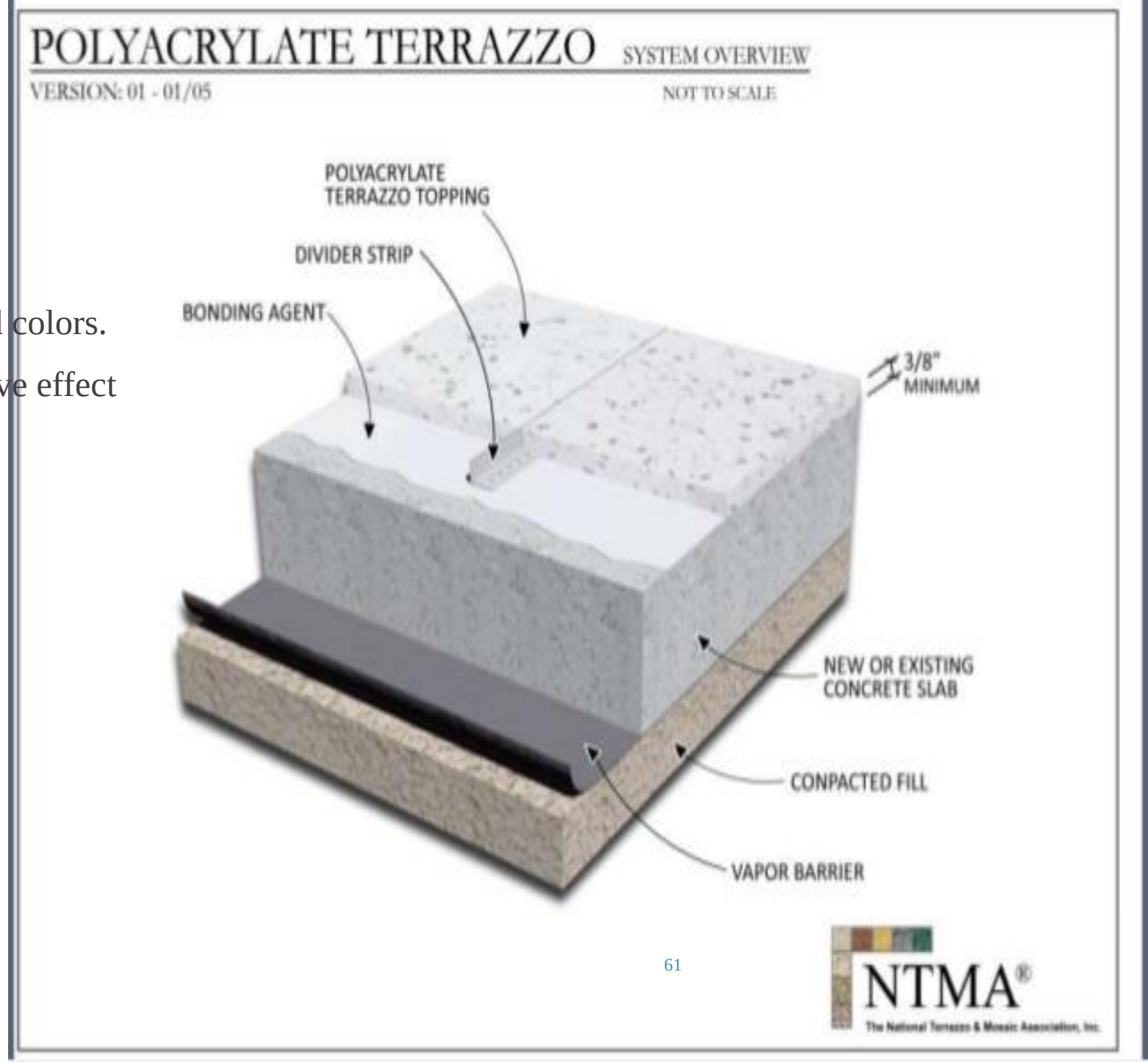
(i) It provides smooth and even surface.

(ii) It is available in different shades, sizes and colors.

(iii) It has wear-resisting property and decorative effect

Disadvantages of terrazzo Flooring:

(i) Terrazzo flooring coat is very high.



Marble Flooring

Marble flooring is used in superior type of floor constructions where sanitation and cleanliness are required. Marble flooring is used in hospitals, temples, theatres, bathrooms, etc.

Marble slabs are available in different sizes and are usually rectangular or square in shape. Its thickness varies from 20mm to 40mm.

The construction of marble flooring is described below:

- A base concrete is prepared in same way as that for concrete flooring.
- Over this, 1:4 cement mortar (bedding for marbles) is spread over it for a thickness of about 20mm under the area of each slab.
- Then the slab is laid over it, and it is pressed with wooden mallet.
- The laid marble is lifted up again and hollows of bedding mortar are filled by fresh mortar.
- Cement slurry is spread over it and then the edges of the slab are smeared with cement and slurry paste. Then the slab is again placed in the position.
- The placed marble is pushed with wooden mallet and as a result cement paste oozes out from the joint and it is cleaned with a cloth.
- The paved area is cured for a week.

Marble Flooring

Advantages of Marble Flooring:

(i) It gives aesthetic look.

(ii) Less maintenance is required

Disadvantages of Marble Flooring:

(i) Initial cost is high

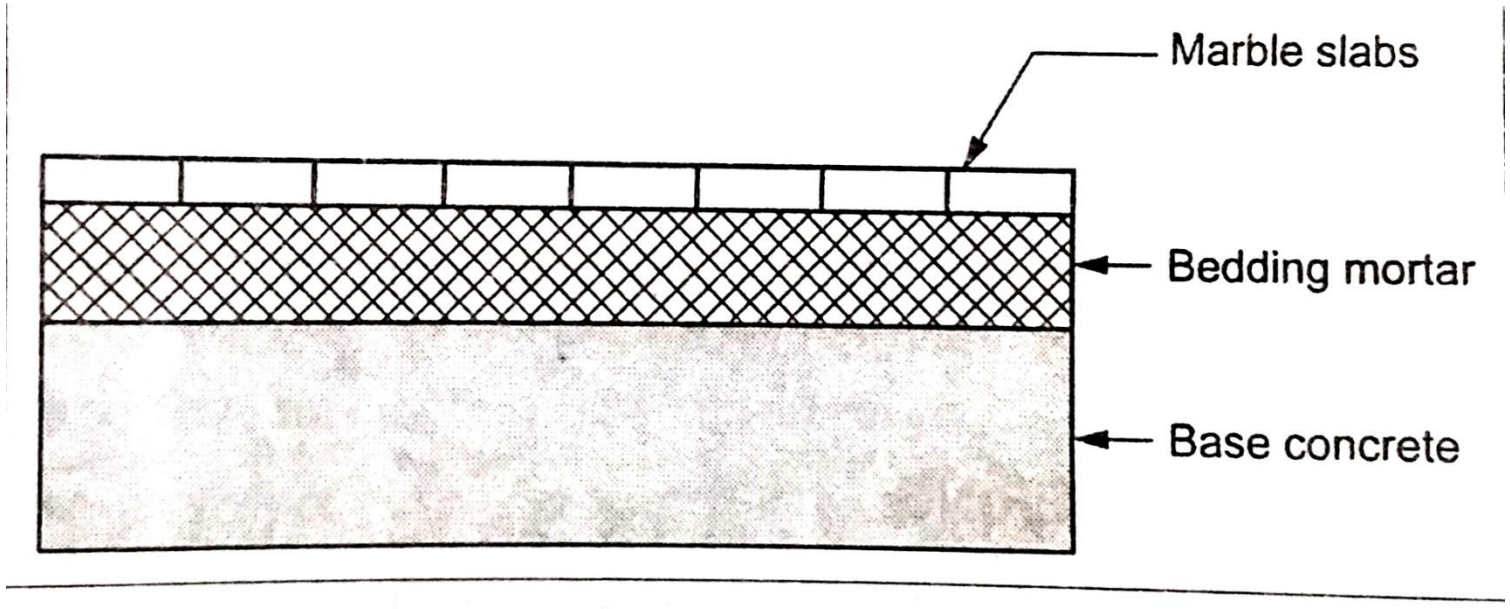
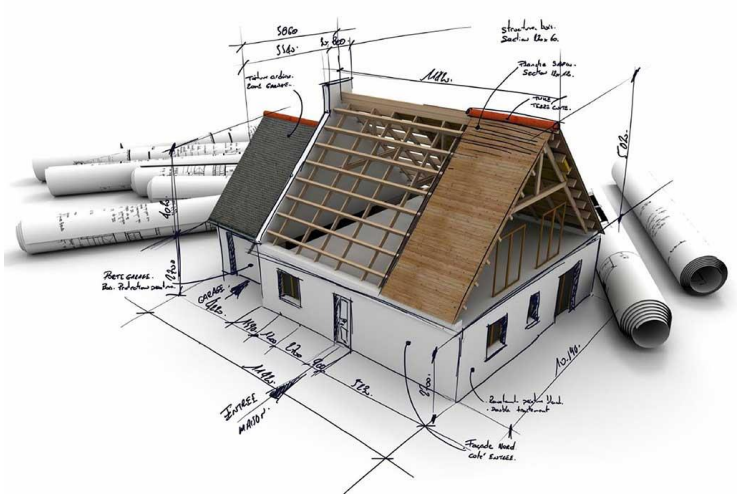


Fig. 5.70. Marble flooring



Roofing

“A Roof is the uppermost part of the building which is supported by structural members and covered with roofing materials.

Roof encloses the space or buildings and protect the building from various weather agencies”

Requirements of Roof

The selection of roof depends on:

- Availability of materials
- Climate of the place
- Size and shape of the building
- Architectural considerations
- Cost

The requirements of a roof are:

(i) It should be durable against the adverse effects of the natural forces like sun, wind, rain, etc.

(ii) It should be water proof and fire proof

(iii) It should have sufficient thermal insulation capacity

(iv) It should have desirable insulation against sound and heat

(v) It should have adequate strength and stability to withstand the superimposed dead and live load

(vi) It should be well drained.

Types of Roof

The roofs are classified according to shape, span and structural design principles as follows:

(i) ***Flat Roofs***

(i) RCC Roof

(ii) Madras Terrace Roof

(ii) ***Sloping (or) Pitched Roof***

(i) Single Roof

(ii) Double Roof

(iii) Trussed Roof

(iii) ***Curved Roof***

(i) Shell Roof

(ii) Dome Roof

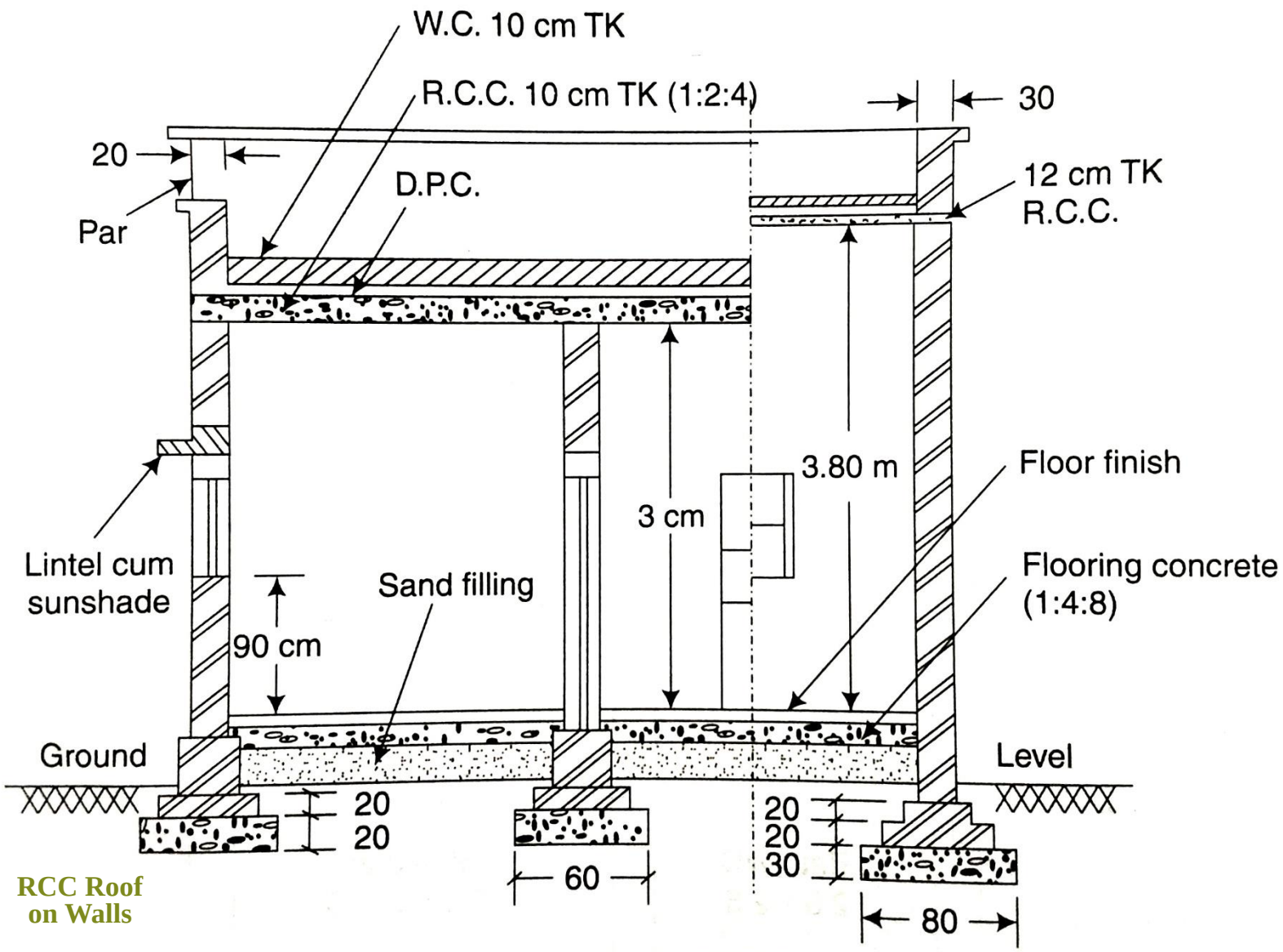
Flat Roof

- Flat roofs are used in buildings of any shape.
- They are economical too.
- They are suitable for buildings in plains or in hot regions, where rainfall is moderate and where there is no snowfall.
- Flat roofs are two types: RCC Roof & Madras Terrace Roof

RCC Roof:

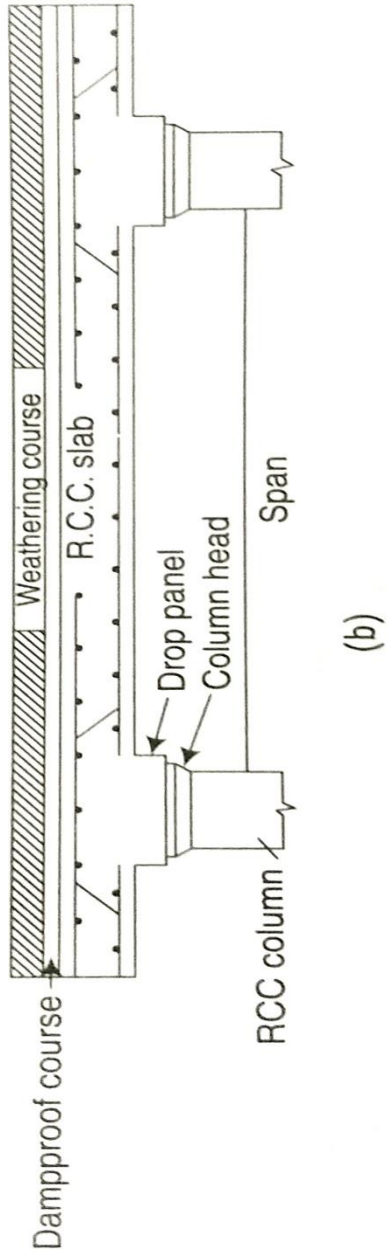
- An RCC roof is commonly and most widely used. In this roof, concrete with steel reinforcement bars are used to form a flat roof.
- An RCC roof consists of an RCC slab, built monolithically with the supporting columns.
- The slab is reinforced in both the principal directions. The load is carried by the slab, which is directly supported by the columns.
- The thickness of the roof slab depends on the span and loading conditions.

Flat Roof



RCC Roof
on Walls

RCC Roof
on Columns



Flat Roof

Madras Terrace Roof:

- This roof is also called as ‘Brick Jelly or Composite Roofs’.
- The construction details of Madras Terrace roof is shown below:

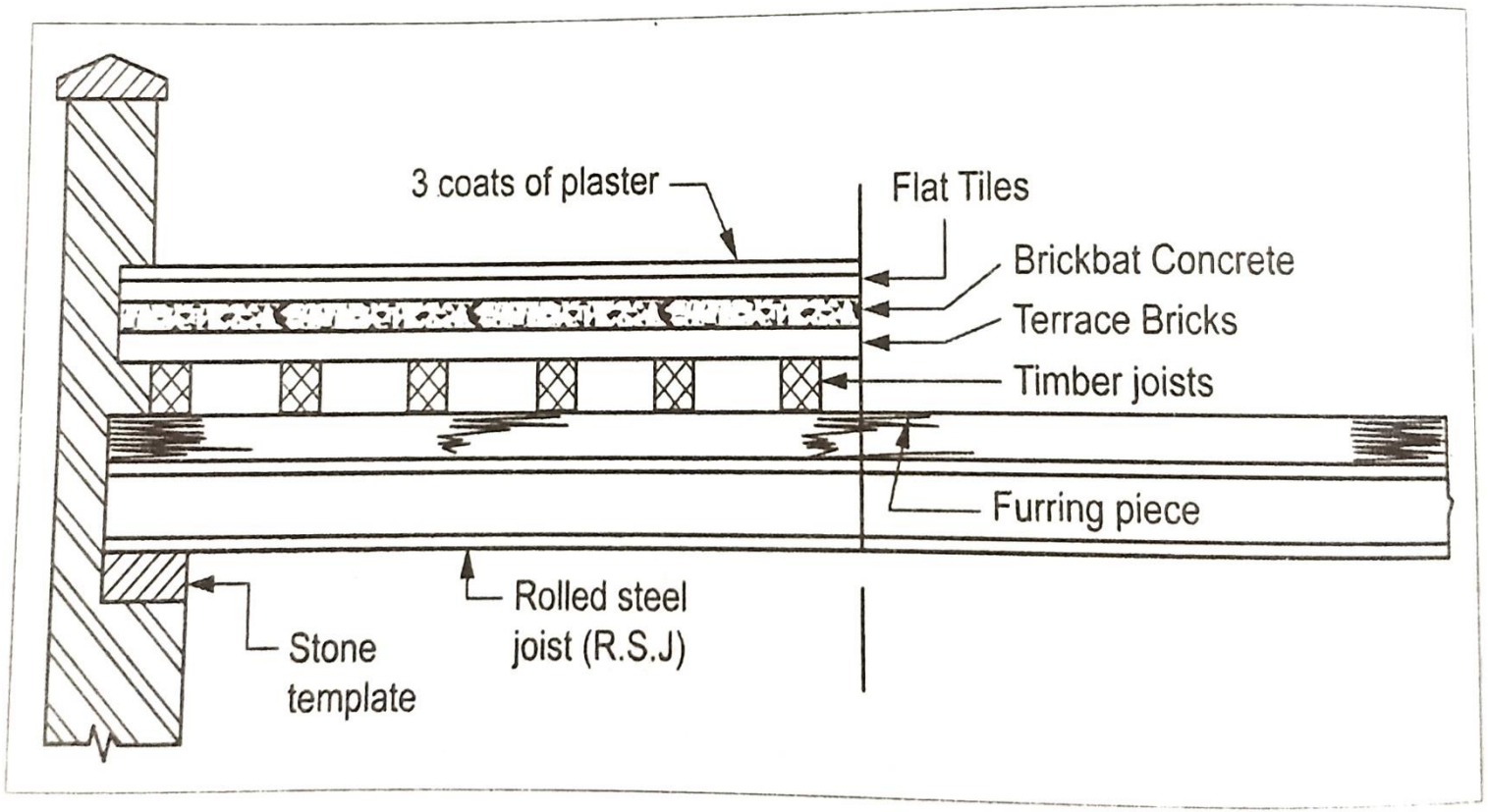


Fig. 5.62. Madras Terrace Roof

Advantages & Disadvantages of Flat Roof

Advantages:

(i) The flat roof can be used for several purposes like a place of celebrating functions, roof garden, drying yards, play ground, etc.

(ii) Flat roof is stable against high wind

(iii) Flat roof can be made fire proof than a pitched roof.

(iv) Flat roof requires lesser area of roofing material than pitched roof.

(v) Upper floor can be easily constructed.

Disadvantages:

(i) Flat roof cannot be used for long span, without the columns and beams

(ii) Construction speed is slower than the pitched roof

(iii) Flat roof is not suitable for places of heavy snowfall and rainfall

(iv) Initial cost is higher than the pitched roof

Pitched Roof (or) Sloping Roof

- Pitched roof consists of decks or surfaces with considerable slope for covering the building structure.
- It has pitch exceeding 10 degrees and it is constructed to drain the rain water easily.
- It is lighter than the flat roof and is constructed with wood or steel.
- Pitched roof is normally constructed in small buildings.
- Pitched roof is broadly classified into three:

(i) Single Roof

(ii) Double Roof (or) Purlin Roof

(iii) Trussed roof

Pitched Roof (or) Sloping Roof

Single Roof:

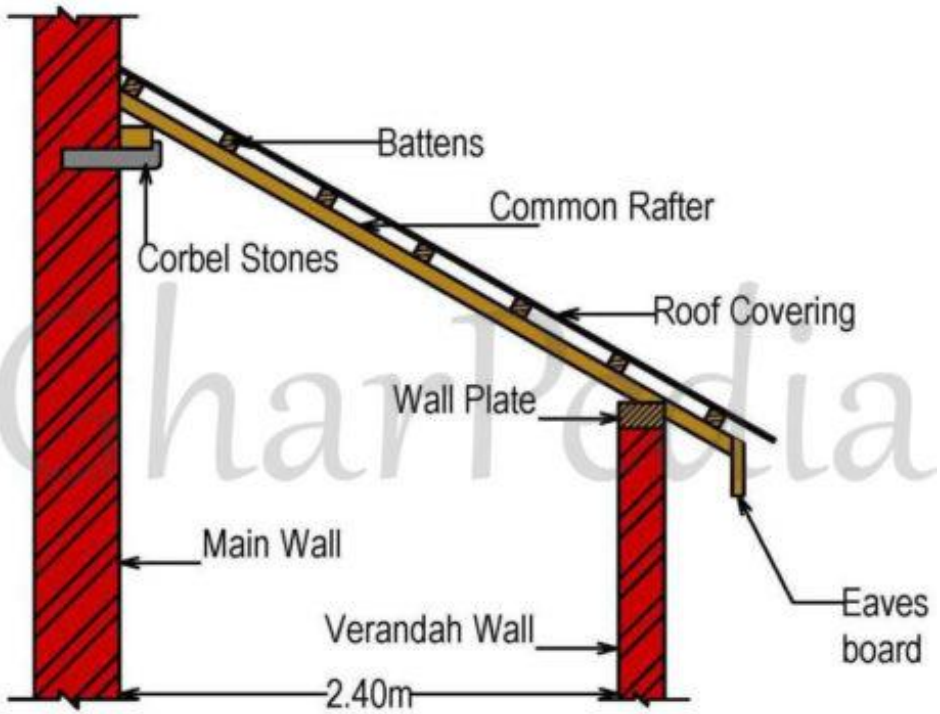
In this type of roof, common rafters are provided to each slope without any intermediate support. Following are the types of single roofs:

(i) Lean to Roof

(ii) Couple Roof

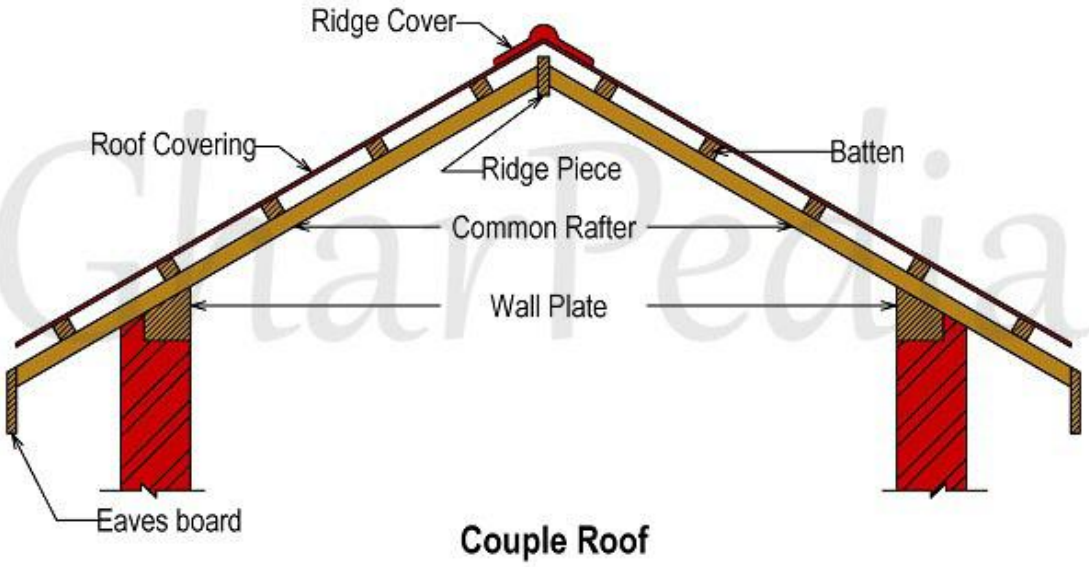
(iii) Couple Close Roof

(iv) Collar beam Roof

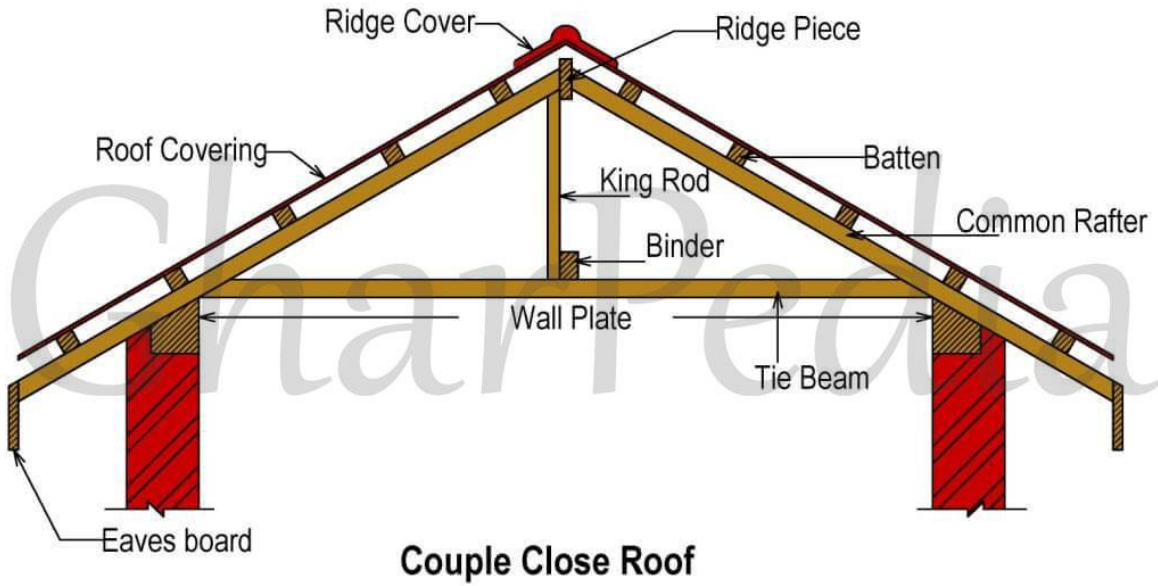


Lean to Roof

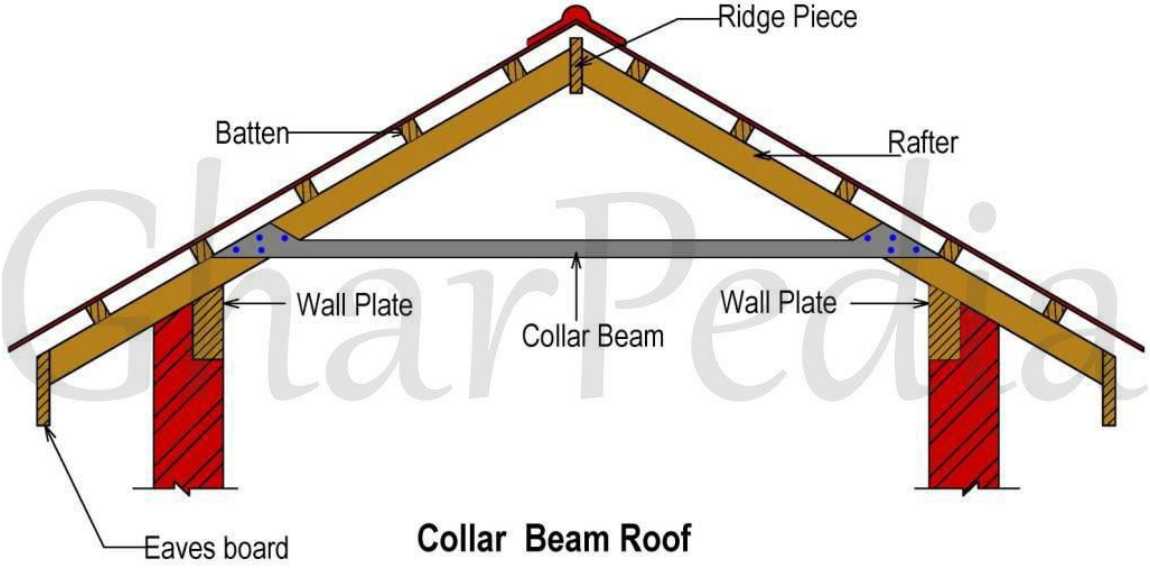
Pitched Roof (or) Sloping Roof



Couple Roof



Couple Close Roof

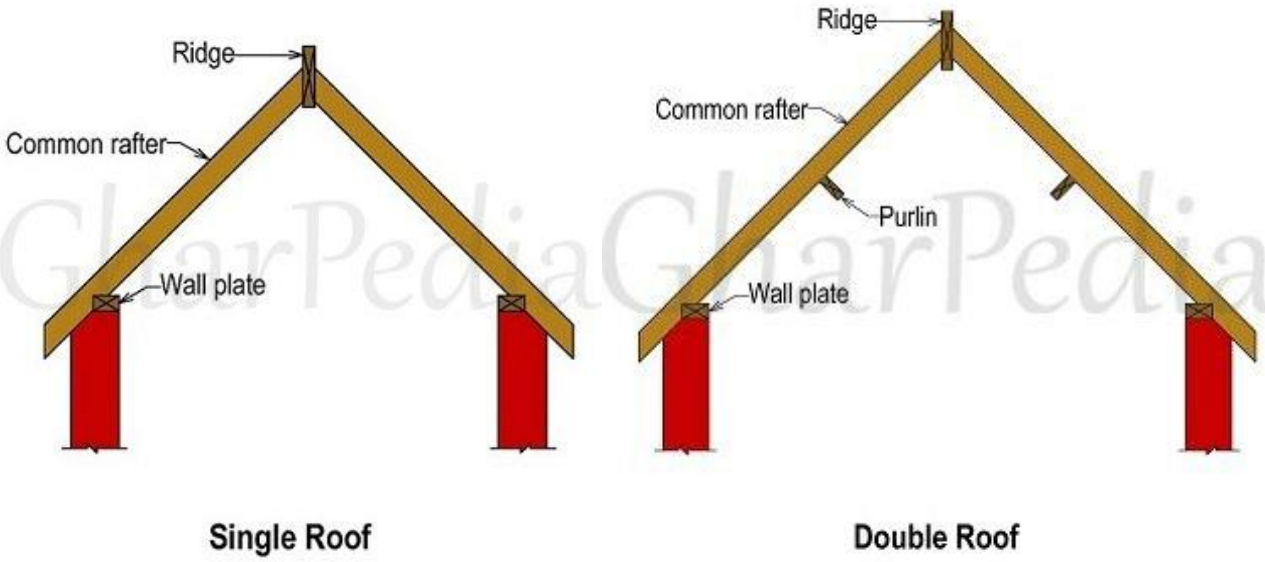


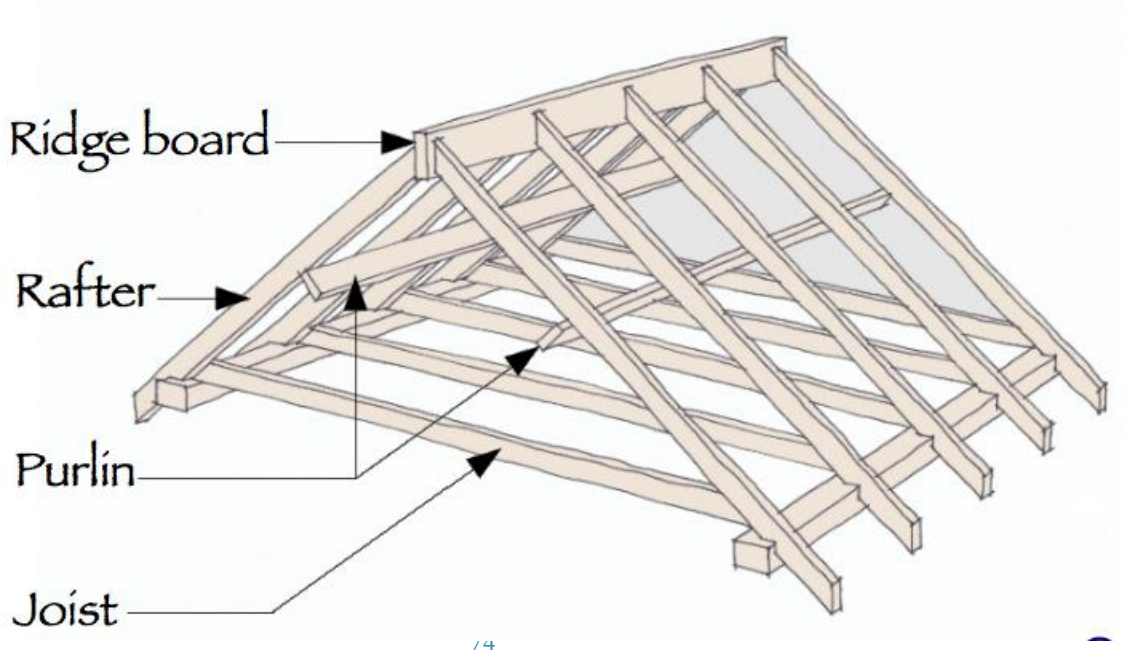
Collar Beam Roof

Pitched Roof (or) Sloping Roof

Double or Purlin Roof:

- When the span exceeds about 2.40m, the necessary size for the rafters becomes uneconomical.
- Hence, in order to reduce the size of rafters, intermediate supports, called *Purlins* are introduced under the rafters.
- Such a roof is called as Double (or) Purlin Roofs.





Pitched Roof (or) Sloping Roof

Trussed Roof:

- These are the roofs provided when the span is greater than 4.80m and there are no inside supporting walls or partitions for the purlins.
- In trussed roof, the rafters support the roof and purlins provide intermediate support to the rafters.
- Different forms of trusses are as follows:

(i) King Post Truss

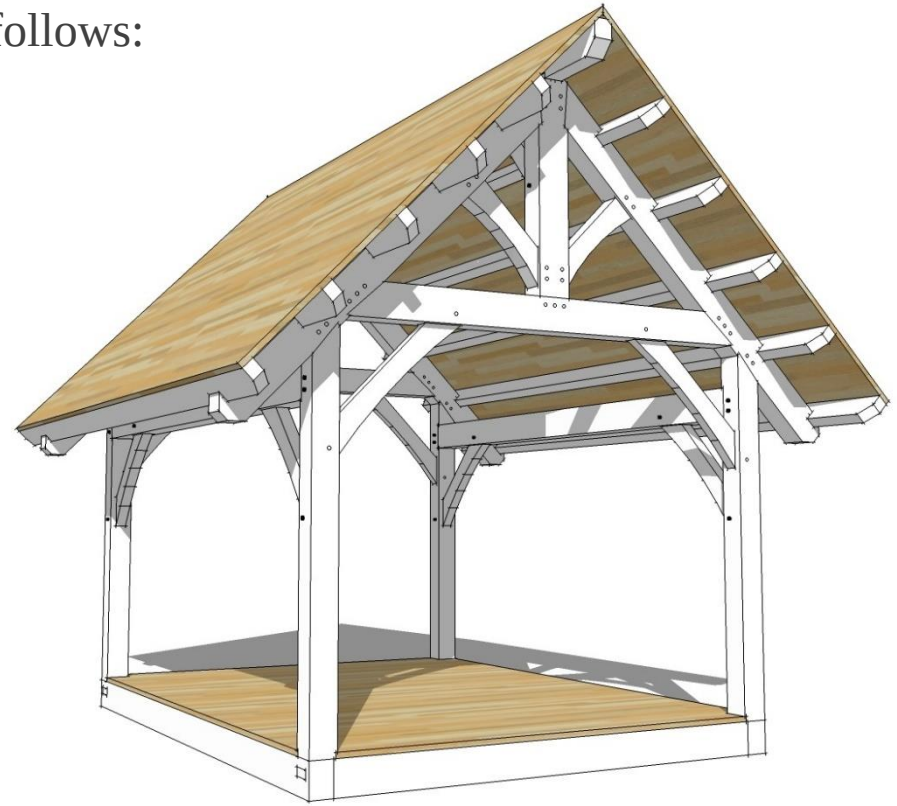
(ii) Queen Post Truss

(iii) Mansard Truss

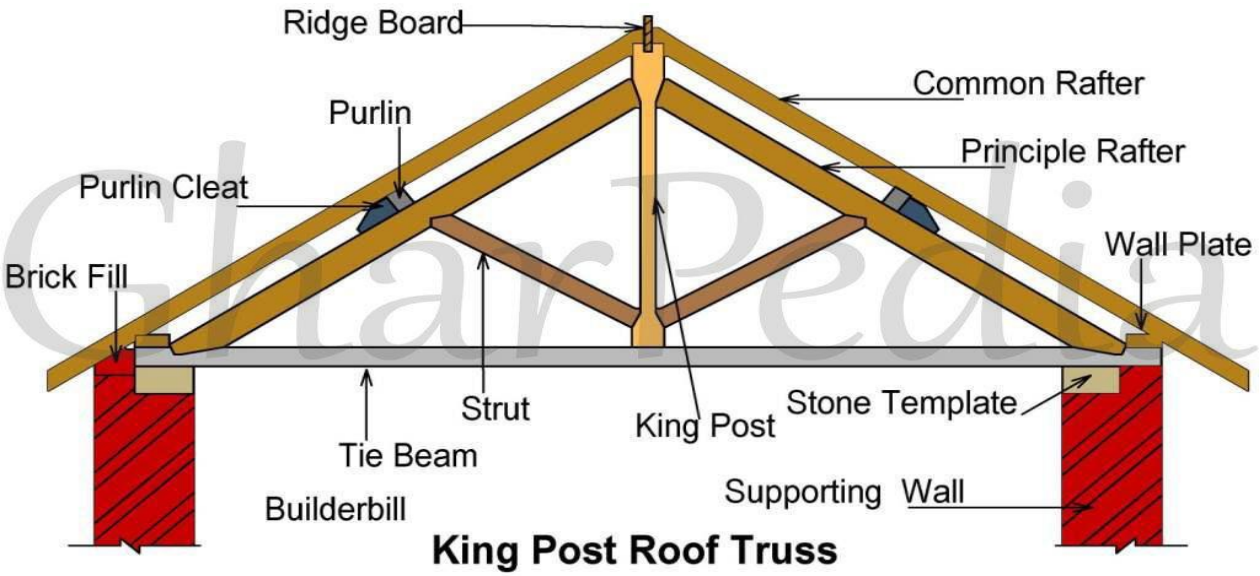
(iv) Truncated Truss

(v) Steel Trusses

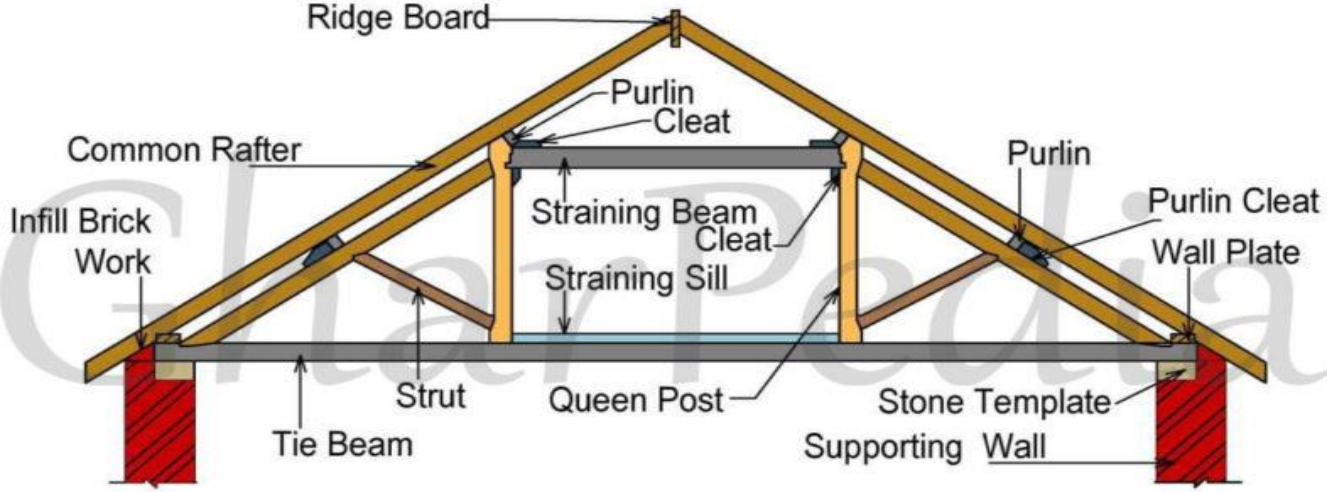
(vi) Composite Truss



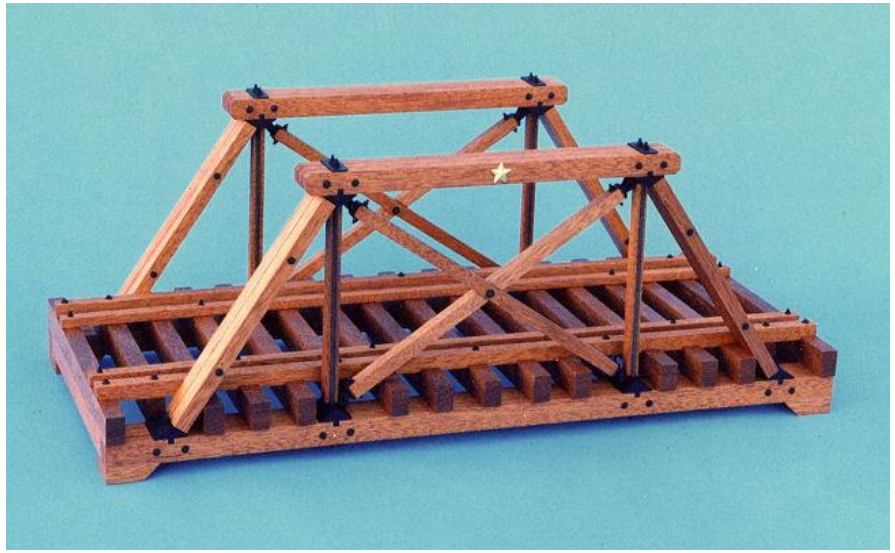
Pitched Roof (or) Sloping Roof



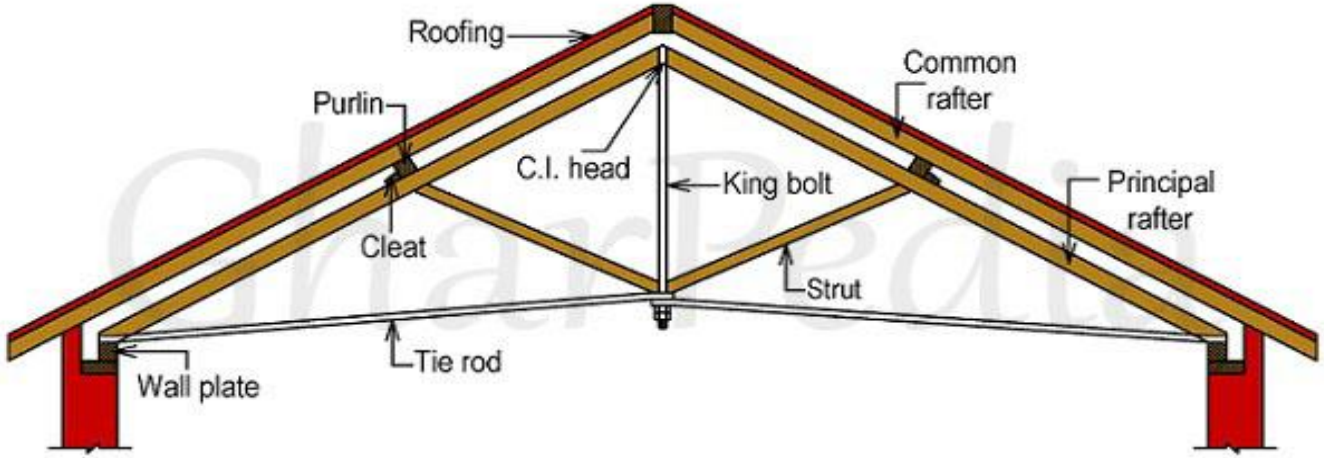
King Post Roof Truss



Queen Post Truss



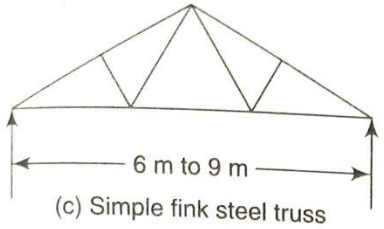
Pitched Roof (or) Sloping Roof



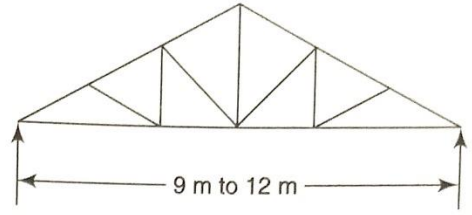
Composite Roof Truss

Mansard Truss Roof

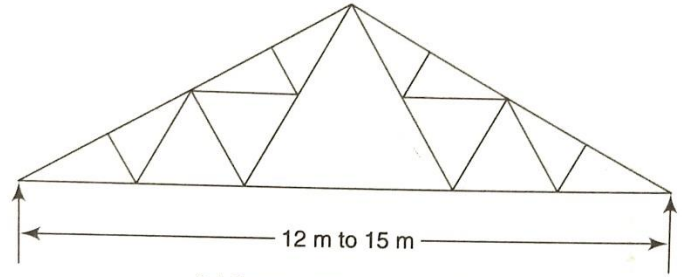
Mansard Truss Roof



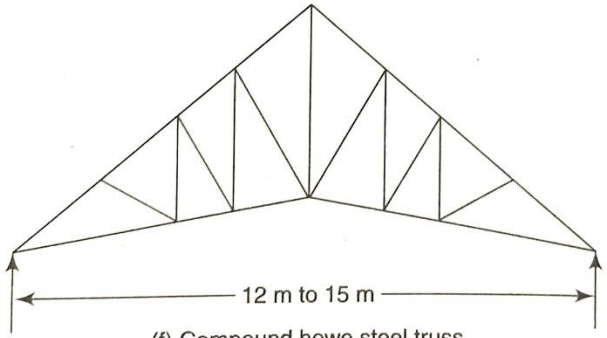
(c) Simple fink steel truss



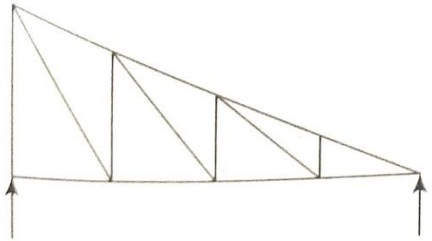
(d) Howe steel truss



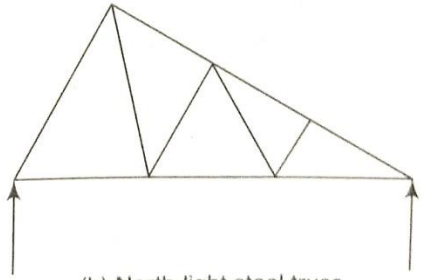
(e) Compound fink steel truss



(f) Compound howe steel truss



(g) North-light steel truss



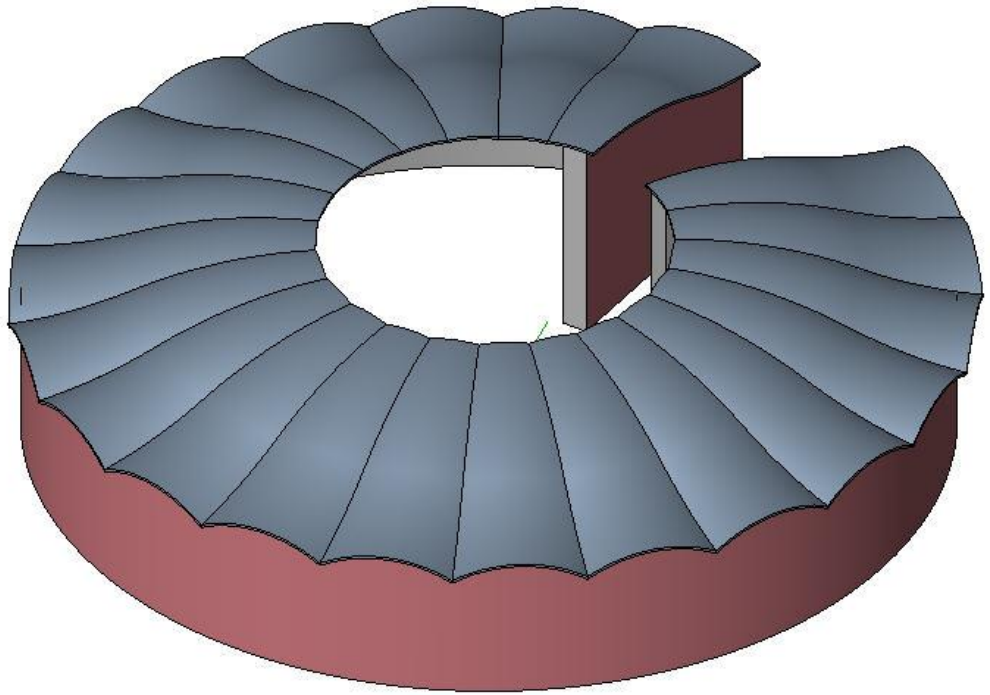
(h) North-light steel truss

Curved Roof

- Curved Roof is used to cover large area and to give architectural effect.
- It is the modification of pitched roof.
- These are of two types:

(i) Shell Roof

(ii) Dome



Curved Roof

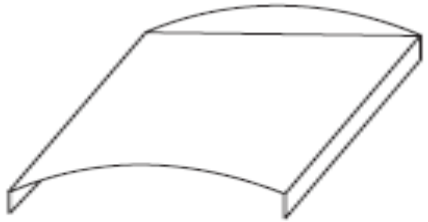
Shell Roof:

- Shell roof is a very thin section of roof structure, resembling the shell of egg.
- There is a lot of saving in material as the section is very thin.
- Shell roof can be constructed with several materials like timber, steel sheets, ceramics, glass, plastic, RCC, etc. in which RCC shell roof is more popular.

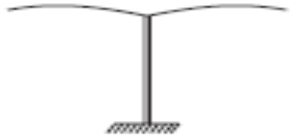
Domes:

- Domes is semi-spherical or semi-elliptical in shape which is used for covering large circular areas.
- These are used for architectural structure.
- Domes are made up of wood, steel or aluminium.

Curved Roof



(a) Cylindrical



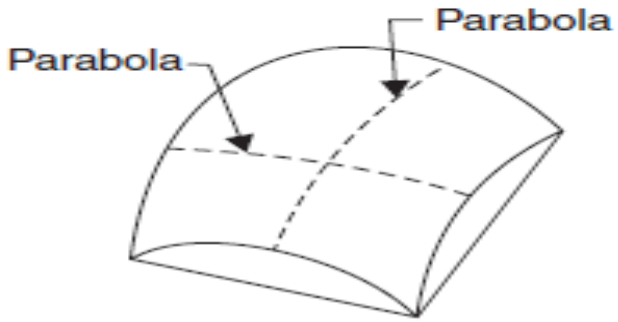
(b) Butterfly

(c) North light

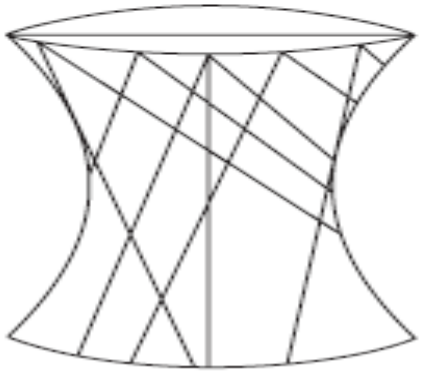
(d) Spherical dome

(e) Paraboloid

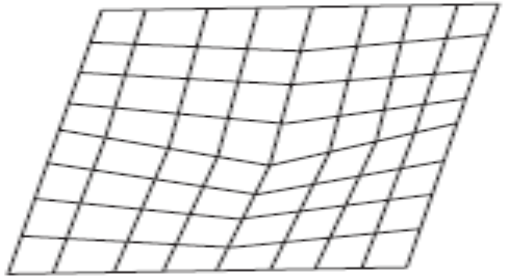
(f) Ellipsoidal



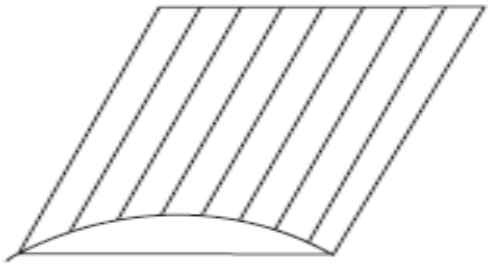
(g) Elliptic paraboloid
[vertical section parabola
horizontal sections ellipse]



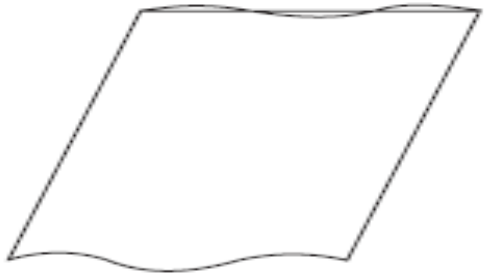
(h) Hyperbola of revolution



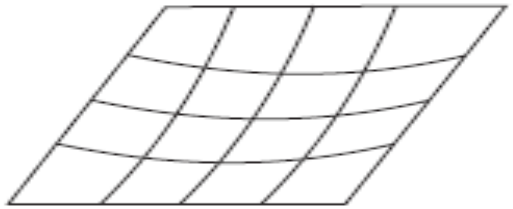
(i) Hyperbolic paraboloid
[inverted umbrella type]



(j) Conoid



(k) Corrugated shells



(l) Funicular shell

Fig. 8.18. Types of shell roof

Advantages of Curved Roof

(i) Coverage of huge areas

(ii) Used for industrial structures

(iii) Used in monuments

(iv) Used for big structures like theatres, recreation centers, stadium, libraries, etc.

(v) Thin section is provided and thus savings in material.