BUILDINGS

→ Man requires diff. types of buildings for activities related to houses, flats for living, health centres, school, colleges, banks, shops, offices, factories, bus stations, air terminals, theates, temples, mosques, churches etc.

→ Each bldg has its own requirement.

→ Building activities are important indicator of countries' social progress.

→ Building design and building construction are executed by architecture and civil engg resp.

→ Main consideration for designing buildings are:

(a) climate & its effects, people & their requirements.

(b) Material for construction & its method

(c) Regulations & Bye laws of sanctioning authority

COMPONENTS OF BUILDING

Building has 2 basic parts:

(ii) Sub-structure (foundation) – (i)

(iii) Superstructure

(i) ~~Substruct~~

(i) Foundation

Foundation is that part of str^r which is in direct contact with structure & ground. It transfer load from str^r to ground.

(ii) Sub-structure - It is the intermediate part of str^r which is located just below the ground Level but avove the found^n.

(iii) Super-structure - super-str^r is that part of the str^r which is above ground level.

Detailed components of building are:

(a) Foundation

(b) Masonary units (walls, columns)

(c) Floor str^r

(d) Roof str^r

(e) Door, window, open to sky, other openings

(f) Vertical transportation str^r
(stairs, lifts, ramps etc)

TYPES OF BUILDING

Buildings can be classified on the basis of type of construction or by occupancy.

ON THE BASIS OF - TYPE OF CONSTRUCTION

(a) Load Bearing str^r

(b) Framed str^r

(c) Composite str^r

(a) Load Bearing str^r

In this str^r, the load bearing walls of stone or brick are constructed on a continous foundation and designed to support the entire load including their own load. The beams are always made to rest on load bearing walls.

(b) Framed str.

In this, no. of piers or columns are erected on their own independent found^n & are braced together by beams and slabs.. In this way, the whole str^r is erected & gaps b/w piers or col^n are filled with their partition walls. Fun^n of partition wall is simply to support their own weight & to serve as a screen for privacy. The entire load of str^r is carried out by the frome, piers column partition wall.

(c) Composite str^r

This str^r is the combination of load bearing str^r and framed str^r. In this type, outer wall consists of bearing walls whereas the frame of columns & beam rest with one end on bearing walls & other end on inner column with thin partition b/w bearing wa

ON THE BASIS OF - BY OCCUPANCY

Acc. to National Bldg Code (NBC) of India, 1970 buildings are :

(a) Group A - Residential bldg

- A-1 Lodging houses
- A-2 Family private dwellings
- A-3 Dormitories
- A-4 Apartment houses
- A-5 Hotels

(b) Group B - Educational bldgs

(c) Group C - Institutional bldgs

- C1 Hospitals
- C2 Custodial Institutions
- C3 penal Institutions

(d) Group D - Assembly bldgs

- D-1 In dec. order of accommodation & facilities
- D-2 —11—
- D-3 —11—
- D-4 —11—
- D-5 —11—

(e) Group-E

(f) Group-F

(g) Group-G

(h) Group-H

(i) Group - I

SITE PLAN

Site plan is included to locate the area belonging to any bldg, showing all details of interior together with surroundings. This plan should be prepared before construction of house and should represent boundary of plot, shape of site & house dimensions.

FACTORS AFFECTING IN SELECTION OF SITE

→ Site selection is very imp. in planning & designing of bldg.

→ An architect has either to make a choice of suitable site to plan his bldg str. or suit the available site.

→ General principles or factors should be kept in mind while selection of site:

(1) The site should be selected keeping in view the general scope or purpose of bldg & on the basis of extent of privacy desired.

(2) The site should be situated in locality which is fully developed or fast developing stage.

(3) To secure happy living cond^{n} where neighbours belong to an equal status in society who should be social & friend

(4) site should be such that unobstructed natural light & air.

(5) site should be available in locality where natural beauty, man-made envir. create healthy living and working cond".

(6) Good landscape.

(7) site which comes within the limit of an area where bye laws of local authority.

(8) The site should be situated on an elevated place and also leveled with uniform slopes must also have quick drainage of rain water.

(9) site should not have noisy, unhealthy envir.

(10) site should not have water logged areas, Industrial vicinity etc.

LAYOUT OF BUILDING PLAN

Layout of building or a str shows the plan of its foundation on the ground surface acc. to its drawings, so that excavation can be carried out exactly where required position & orientation of bldg is excatly specified. It is set as per drawing provided by engineer/ architect.

BUILDING BYE LAWS

Building bye laws are defined as the standards & specifications designed to permit min. safeguads to the workers during construction, health & comfort of the users & to provide safety to public in general.

CONCEPT OF SUNLIGHT VENTILATION

Sun path refers to the apparent, significont seasonal and hourly positional changes of the sun (and the length of daylight) as the earth rotates around the sun. The relative position of the sun is a major factor for the performance of solar energy system. Accurate location specific knowledge of sun path and climatic cond" is necessary for economic decision about solar collector area, orientation, landscaping, summer shading, cost effective uses of solar trackers.

climatic chart, metrological data & sun path diagram help in deciding main consid" in planning.

VENTILATION

Ventilation may be defined as the removal of all ventilated air from a bldg & its replacement with fresh air.

BASIC CONCEPT OF RCC

RCC : Reinforced Cement Concrete.

→ Concrete is strong in compressive strength & weak in tensile strength
→ Concrete is brittle material.
→ To increase the tensile strength steel bars are used in cement concrete thesby reinforcing it.
→ Sted bars (Diameter ranging 6 - 50 mm). These provide strength to concrete.
→ steel bars are rough at outer side
→ RCC prevent cracks and can carry designed loads

Uses of RCC

(1) Used in footing columns, Beams, Roofs, slabs, stairs.
(2) Structures - Bridges, Bldg, Dams, Retainingwalls
(3) Road airports.

Components of RCC structures designed

(1) Design of RCC beams
(2) ——— " ——— column
(3) ——— " ——— stairs.
(4) ——— " ——— Foundation
(5) ——— " ——— Slab.

TYPES OF FOUNDATION

Basic function of found^{n} is to transmit dead load, from bldg to soil.

Found^{n} is most imp. part of bldg. A found^{n} should be sufficiently strong to prevent excessive settlemen as well as unequal settlement.

Functions of found^{n}:

(1) Red^{n} of Load intensity.
(2) Even distribution of load
(3) Provision of level surface
(4) Lateral stability
(5) Protection against soil movements.

Types

(a) Shallow Found^{n} – spread footing
Combined footing
strap footing
Mat found^{n}

(b) Deep found^{n} – Deep strip
– pile found^{n}
– well found^{n}

PLINTH AREA

Plinth is defined as the portion of the str' b/w surface of surrounding ground & surface of the floor, immediately above the ground. The level of the floor is known as plinth level.

The build up covered area measured at the floor level is known as plinth area.

CARPET AREA

Carpet Area is the area that can actually be covered by a carpel, or the area of the apartment excluding the thickness of inner walls. It does not include space covered by common areas such as lobby, lift, stairs, play area etc.

FLOOR SPACE INDEX

Floor area ratio is the ratio of a bldg's total floor area, of the size of piece of land upon which it is buit.

$$FSI = \frac{(\text{Total covered area on all floors of all bldgs on a certair plot, gross floor area})}{(\text{Area of plot})}$$

Floor space area you can build on your land with rspect to the plot area that you have.

BUILT UP AREA

Built up area is the area that comes after adding carpet area and wall area.

The wall areas does not mean the surface area, but the thickness of inner walls of a unit.

1.2.1 Foundations

The basic functions a foundation is to transmit the dead loads, live loads and other loads to the sub soil on which it rests in such a way that :

(a) settlements are within permissible limits, without causing cracks in the superstructures and ;

(b) soil does not fail in shear.

Since, it remains below the ground level, the signs of failure of foundations are not noticeable till it has already affected the building. Therefore, it should be designed very carefully.

1.2.2 Masonry Units

Masonry may be defined as *the construction of building units bonded together with mortar*. Masonry units may be stones, bricks or precast blocks. Masonry is used for the construction of foundation of walls, columns and other similar structural components. The construction with stone units, bonded with mortar is known as *stone masonry*, while the construction with brick units, bonded with mortar is known as *brick masonry*. A *composite masonry* may uses different types of building units for the construction. Masonry units are walls, columns, etc.

☆ **Walls :** Walls are the most essential components of a building. The primary function of the wall is to enclose or divide space of the building to make it more functional and useful. Walls provide privacy, afford security and give protection against heat, cold, sun and rain. Walls may be either *load bearing walls* or *non load bearing walls*. Load bearing walls are those which are designed to carry the super imposed loads (transferred through roofs), in addition to their own (self) weight. Non load bearing walls carry their own loads only. They generally serve a *divide walls* or *partition walls*. Wall may be of several types, such as cavity walls, party walls, partition walls, dwarf walls, retaining walls.

☆ **Column :** *A column* is an isolated vertical load bearing member, the width of which is neither less than its thickness nor more than four times its thickness. A pier is a member similar to a column except that it is bonded into load bearing wall at the sides to form integral part and extents to the full height of the wall. A pier is used to increase the stiffness of the wall to carry additional load or to carry vertical concentrated load.

1.2.3 Floor Structures

Floors are the horizontal elements which divide the building into different levels for the purpose of the creating more accommodation within a restricted space one above the other and provide support for the occupants, furniture and equipment of a building.

The floor of a building immediately above the ground level is known as *ground floor*. All other floors which are above the ground floor are known as the *upper floors*. The floor of the first storey is known as *the first floor* and that of the second storey is known as the *second floor* and soon. In case, part of the building is constructed below the ground level, or the building has the basement, the floor is known as *basement floor*.

Every floor has two components :

(i) The *sub-floor*, which is a structural component to impart strength and stability to support the super- imposed loads and ;

(ii) *Floor covering* or *flooring consisting* of suitable floor finish.

Floor area is the usable covered area of a building at any floor level.

Floor Area Ratio (F.A.R.) : Floor area ratio is defined as the quotient obtained by dividing the total covered area (plinth area) on all floors and 100 by the area of the plot.

$$\text{F.A.R.} = \frac{\text{Total area covered of all floors} \times 100}{\text{Plot area}}$$

1.2.4 Roof Structures

A roof is the upper most part of a building. It is a covering provided on the top of the building with a view to keep out rain, snow, sun and wind and to protect the building from their adverse effects. Just as a floor, a roof consists of two components :

(i) **The roof decking :** It is a structural component which supports the roof covering. Roof decking may be either flat or sloping, and may be in the form of flat slab, dome, truss, portal or shell.

(ii) **The roof covering or roofing :** It is provided on the roof deck to safeguard the building against weather effects. These may be in the form of tiles, thatch covering, slates, flagstone covering, and corrugated sheets of galvanized iron or asbestos cement.

1.2.5 Doors, Windows and Other Openings

A door is a movable barrier provided in the opening of a wall, to provide access to various spaces of a building. A door is a **frame work** of wood, steel etc. secured in the wall opening for the purpose of providing access to the users of the building. Similarly, a *window* may be defined as an opening made in the wall for the purpose of providing day light, vision and ventilation. Windows are also made of **frame work** of wood, steel, aluminum etc., provided with shutters.

Since, doors and windows are provided in the openings in the walls, a discontinuity is formed in the wall, in the vertical direction. Therefore, lintels are essentials. A *lintel* is a horizontal structural member provided over the doors, windows or other openings, to span the gap, so as to support the super- imposed load carried by the wall above the opening. Lintels may be made of timber, stone, steel or reinforced cement concrete (R.C.C.).

Sometimes, arch may be provided to span the opening, in the place of a lintel. An *arch* is a structure consisting of a number of small wedge- shaped units and jointed together with mortar, which is constructed to bridge across any opening in the wall. The arch may also be constructed of R.C.C.

1.2.6 Vertical Transportation Structures

These consist of stairs, ramps, ladders, lifts and escalators etc. to afford access between various floors. Out of these, stairs are common. A *stair* may be defined as series of steps suitably arranged for the purpose of connecting different floors of a building. Alternatively, a stair may be defined as an arrangement of treads, risers, stringers, newel posts, hand rails and balustrades so designed and constructed as to provide as easy, safe and quick access to the users of different floors. Stairs may be constructed of different materials such as timber, stone, reinforced concrete or steel.

1.2.7 Building Finishes

Building finishes are used to give protective covering to various building components, and at the same time, they provide decorative effects. Building finishes consist of the following items :

(i) **Plastering :** Plastering consists of providing a thin covering of plastic materials such as cement mortar, lime mortar etc. on walls, columns and other surfaces.

(ii) **Pointing :** It is the process of finishing of mortar joints in brick or stone masonry.

(iii) **Painting :** It is normally done on doors, windows and other timber and steel components.

(iv) **Varnishing and polishing :** It is also done on doors, windows and other timber and steel components.

(v) **White washing, Distempering, color washing** or **coloring** are done on plastered surfaces, to safeguard them against weathering effects and to improve the appearance.

(i) **Group A : Residential Buildings :** These are those buildings in which sleeping accommodation is provided for normal residential purpose, with or without cooking or dining or both facilities. It is further divided into 5 subgroups viz. A-l to A-5.

(ii) **Group B : Educational Buildings :** All those buildings which are meant for education from a nursery school to university for use of more than 8 hours per week. These buildings provided facilities like classrooms, staff cabins, laboratories, administrative blocks, library, play fields etc.

(iii) **Group C : Institutional Buildings :** This group includes any building or part which is used for the purpose of medical health, recovering health after illness; care of infants or aged person etc. These buildings normally provide sleeping accommodation for the occupants.

(iv) **Group D : Assembly Buildings :** These include any building or part of a building where group of people gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purpose e.g. theaters, assembly halls, auditorium, museums, restaurants, place of worship clubs, aerodromes etc. Buildings under this group are further subdivided into 5 sub groups i.e. D-l to D-5 in descending order of accommodation and facilities.

(vii) **Group G : Industrial Buildings (Gl, G2, G3) :** This group includes any building or part of a building in which products or materials of all kinds and properties are fabricated, assembled or processed, for examples, assembly plants, laboratories, dry cleaning plants, pumping stations, smoke houses, gas plants, refineries, dairies and saw mills.

(viii) **Group H : Storage Buildings :** This group includes those buildings which are primarily used for storage of goods (not highly combustible) for example: ware houses, cold storage garrage etc.

(ix) **Group I : Hazardous Buildings :** This group includes those building structures which are used for the storage handling manufacture or processing of materials which are liable to burn with extreme rapidly and prove hazardous of health, building component or building content, e.g.. building used for storage of gases under high pressure or for storage of highly flammable liquids or explosive etc.

2.10 BUILDING BYE LAWS

2.10.1 Introduction

The growth of civilization has also resulted in more and more laws, regulations, and restrictions and of course their violations as well. There are laws and laws, all around such as constitutional, civic laws, traffic laws, marriage laws, financial laws, personal laws etc. while some of the laws are essential for the humanity, there are other which held ion the proper and planned growth of civilization in general, in the olden days human beings had been wandering from place to place in search of livelihood but the modernization have put an end to all such adventures.

Human beings no longer have to roam around for proper shelter but live in better planned and construction of such houses, same basic rules and regulations which may be termed as 'building Byelaws are absolutely necessary.

So, Building Bye-Laws are tools used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. In India, there are still many small and medium sized towns which do not have building bye-laws and in the absence of any regulatory mechanism, such towns are confronted with excessive coverage, encroachment and haphazard development resulting in chaotic conditions, inconvenience for the users, and disregard for building aesthetics, etc.

2.10.2 Definition

The building byelaws are defined as the standards and specifications designed to grant minimum safeguards to the workers during construction, to the health and comfort of the users and to provide enough safety to the public in general. The regulation set out the basic requirements to be observed in the design and construction of buildings. They are applied to new building and also to extensions, material alterations, and certain changes of use of existing buildings.

These buildings Bye Laws are drawn up by a panel experts in various branches of the building industry such as :

- Town Planner

- Architecture
- Civil Engineer
- Electrical Engineer
- Air-conditioning
- Fire-fighting and administration etc.

Theses building bye-laws when formulated are enforced on all buildings whether constructed by government, local bodies, private persons or agencies.

2.10.3 Building Code

- A building code is a document containing standardized requirement for the design and construction of most types of building.
- Codes regulate building construction and building use in order to protect the health, safety and welfare of the occupant.
- Codes express all aspects of construction including structural integrity, fire resistance, safe exists, lighting, electrical, energy conservation, plumbing, sanitary facilities, ventilation, seismic design and correct use of construction materials.
- Building codes classify standard by use and apply different standards to each classification. For example, schools and office buildings are in separate occupancy category with different performance requirement.
- The National Building Code (NBC) is a single document in which, like a network, the information contained in various Indian Standards is woven into a pattern of continuity and cogency with the interdependent requirement of sections carefully analyzed and fitted in to make the whole document a cogent continuous volume.
- A continuous thread of pre-planning is woven which, in itself, contributes considerably to the economies in construction particularly in building and plumbing services.

2.10.4 National Building Code (NBC)

- It is a single document in which like a network the information contained in various INDIAN STANDARDS is woven into a pattern of continuity with interdependent requirements of sections carefully analyzed and fitted into to make the whole document, a continuous one.
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contributed in the economies in construction particularly in building and economic services.

- The purpose of all these building codes is to ensure public safety, health and welfare as affected by building construction. This purpose includes:
  - Structural Strength
  - Sanitary Equipment
  - Light and Ventilation
  - Fire Safety

2.10.5 Objectives of Bye-Laws

- To make it easier to pre-plan the building activities.
- Gives guidelines to the designing Architect or engineer.
- Prevents haphazard development without any resemblance to the development of the area as a whole.
- Gives safety (to humans who work and most importantly live in the buildings) against fire, noise, health hazard, structural failure (may be due to natural calamity).

2.10.6 Importance and Needs of Building Bye-Laws

Building bye laws are made to ensure orderly development of localities in urban areas so that every house is assured of good ventilation and no building affects the lighting and ventilation of neighbours. There has to be laws or regulations binding on the prospective builders, if not, the building constructed will be :

1. Unscientific
2. Unhealthy
3. Inconvenient for the people to occupy.

Therefore keeping this in mind :

(i) The buildings should not be constructed merely with profit motive without paying any attention to the health and comfort of the inhabitants.

(ii) The buildings must get sufficient sunshine, air and ventilation.

(iii) Open spaces should be well planned.

(iv) The buildings should create better environment.

(v) The buildings should be located in healthy surroundings and should have an aesthetic appearance.

(vi) But to achieve all this, there has to be a suitable regulations or what are know as model building bye-laws, enforced strictly by the authorities, and followed by the builders honestly and truthfully.

2.10.7 Principles of Building Bye Laws

The building bye-laws are generally based on the following principles :

1. The building bye-laws should be reasonably rigid and adequately flexible as they have to be sometimes revised according the improvements affected in science and engineering and as per peculiar circumstances existing at the time. These laws should be advantageously used for the common good of the people.
2. Minimum standards should be properly laid down and they should be strictly made to be adhered to by all concerned.
3. Minimum floor space and cubic space per member should be insisted upon.
4. The size of any room should not be less than a specified minimum.
5. Taking into consideration the number of inmates in the building the minimum window space and sanitary conveniences should be insisted upon.

   At least one window of the specified size/area should be provided in each room to open either on a street or open yard.
6. The room should receive direct light and air from exterior open space on at least two sides to satisfy ideal conditions of air circulation.
7. There should be some healthy relations between the cubic contents of the room building and open spaces around.

   The width and extent of the open space depends upon the height of the structure.
8. The height of the building is fixed as per the zone in which it is built. The width of the street should never be exceeded by the height of the building there.
9. The openings admitting light and air should bear a prescribed ratio to the floor space.

10. The set backs should be correctly followed. Setbacks are called as Building Lines.

Note : Width of set back varies from 1m to 1.50m for congested areas and 4.50m to 6m for new underdeveloped areas

- The width of front set back shall be regulated as per provisions indicated in respect of residential, commercial and industrial buildings and also in accordance with the provisions of ground coverage and F.A.R. (Floor Area Ratio) restrictions in respect of group housing, institutional and other public buildings.
- The side set backs shall be optional. Where left it shall not be less than 2 meters or 1/6th of the height of the building whichever is more.
- The width of the rear set back, if left at any point of building, it shall not be less than 3 meters or 1/5th of the height of the building whichever is more.

Sr.No.	Plot Area (sq. yds.)	Site coverage	Minimum front set back	Height permissible	F.R.R.
1	Upto 100 sq. yds.	80%	5'-0"	38'-6"	1:2.00
2	Above 100 to 150"	75%	6'-0"	38'-6"	1:1'.90
3	Above 150 to 200"	70%	7'-0"	38'-6"	1:1.75
4	Above 200 to 300"	65%	10'-0"	38'-6"	1:1.65
5	Above 300 to 500"	60%	15'-0"	38'-6"	1:1.50
6	Above 500"	50%	20'-0"	38'-6"	1:1.25

☆ **Line of Building Frontage :** The line up to which the plinth of the building adjoining a street or extension of street is known as the building line. The line refers to the line of building frontage. Generally

buildings are allowed to be constructed beyond the building line. But certain building, Such as cinemas, factories, commercial concerns which attract large number of vehicles should he set back a further distance apart from the building line. The minimum distance from the centre line of the road is prescribed for the line of building frontage.

☆ **Covered Area :** The area covered by building immediately above the plinth level ground floor is known as covered area. The covered area does not include the spaces covered by

(i) Compound walls, gate, un-storeyed porch and portico uncovered staircases and area covered by chajja and the like.

(ii) Garden, rockery, well, and well structures plant nursery, water pool, uncovered swimming pool, platform round a tree, tank, beach, chabuttra with open top and unenclosed on side by wall and the like,

(iii) Gutter, chamber, gulley pit etc.

In short, covered area of the building is equal to the plot area minus the area due for open space.

☆ **Floor Area Ratio (FAR) :** It is the quotient obtained by dividing the total covered area on the-entire floor multiplied by 100 by the area of the plat.

☆ **Principles Underlying Building Bye Laws :**

(i) Classifying the building with unit as a family and mentioning the requirements.

(ii) Classifying the rooms according to use and then specifying minimum standards of each room with respect to size, height, floor area, ventilation and light.

(iii) Specifying height of compound wall and location of compound wall gates.

(iv) Controlling height of structures and lying maximum limit of height in certain zones.

(v) Controlling projections in marginal spaces.

(vi) Insisting on suitable FS1 or FAR.

(vii) Specifying the suitable arrangement with respect to drainage and water supply.

(viii) Specifying materials and workmanship as per standard specifying for the construction of building.

(ix) Specifying minimum size of plots, their dimension and frontages.

☆ **Open Spaces :** The open space inside and around the building particularly have to provide for the lighting and ventilation requirements. Each site shall have a minimum frontage of 6m on any street. For row housing schemes, the minimum frontage may be 5.5m.

(1) Exterior open space : It can be classified in three types :

(i) Front open space : Minimum width of font yard has to be 3m. If building has fronts 2 sides or more sides to streets, the average width of front yard should be 3m but in no case less than 1.8m.

(ii) Rear open space : Every building shall have yard forming an integral part of the site. The average width of the rear yard should be 3 but at no place measuring less than 1.8. If building about on 2 streets or more, it shall be provided throughout the entire face of the rear wall.

(iii) Side open space : Every building should have a permanent open air space forming integral part of the site of not less than 3m in width at the sides.

(2) Interior open space : The whole of one side of one or more rooms intended for human habitation and not abutting on either the front, minimum width shall be 3m. In this provision height of the building up to 10m.

(3) Joint open air space : All the exterior and interior open spaces shall be entirely within the owner's own premises. If such common air open space is treated as permanent open air space and no boundary wall between such joint open air space shall be raised to a height of more than 2m.

☆ **Means of Access :** Every building shall have a means of access at least 3.6m in width up to 3 storeys and 5m in width beyond 3 storeys height.

No building should be erected so as to deprive any other building of means of access. It should be satisfactorily drained and lighted.

In case of multi-storeyed row housing schemes, means of access should be independent for plot and there should not be common running balcony.

☆ **Plinth Area Regulation :** Plinth area is also referred by name covered area. The maximum plinth area of buildings of different classes shall be governed by the following regulations.

(i) In a bazzar or marked area, the plinth area shall not exceed 75% of the area of the site.

Provided that sufficient off street parking facilities for loading and unloading of vehicles are provided on the same plot of building.

(ii) In an industrial plot, the plinth area shall not exceed 60% of the site area,

(iii) In residential plot, the covered area shall be as follows:

(a) Less than $200m^2 \rightarrow 66\frac{2}{3}\%$ of the plot area on the ground and first floor and nothing on the second floor except a barasti not exceeding 25% of the ground floor.

(b) 201 to 500 $m^2 \rightarrow 50\%$ of the plot area or 133 m^2 whichever is more.

(c) 501 to 1000 $m^2 \rightarrow 40\%$ of the plot area or 250 m^2 whichever is more.

(d) More than 1000 $m^2 \rightarrow 33\frac{1}{2}\%$ of the plot area or 400 m^2 whichever is more.

5.3 VENTILATION

Ventilation may be defined as the removal of all vitiated air from a buildin and its replacement with fresh air. In other words, ventilation is supply of fres outside air into an enclosed space for the removal of inside air from the enclose space. It may be achieved either by natural or by artificial (or mechanical) means

Ventilation is necessary for the following reasons : All homes nee ventilation the exchange of indoor air with outdoor air to reduce indoor moisture odors, and other pollutants.

(i) Prevention of undue accumulation of carbon-dioxide.

(ii) Prevention of condensation or deposition of moisture on wall surface.

(iii) Prevention of suffocation conditions in conference rooms, committee halls, cinema hall, big rooms, etc.

(iv) Prevention of flammable concentration of gas vapour.

(v) Removal of body heat generated/liberated by the occupants.

5.3.1 Functional Requirements of Ventilation System

According to human comfort, ventilation system should meet the following functional requirements :

(1) Air changes or air movement.

(2) Humidity.

(3) Quality of air.

(4) Temperature of air.

(1) **Air changes or air movement :** In an enclosed space, where people are working or living, air has to be moved or changed to proper ventilation. Air change per hour is the volume of outside air allowed in the room or enclosed space per hour compared to the volume of the room. The minimum rate of air change is one per hour, while the maximum rate of air change is sixty per hour, cross ventilation is provided to increase the rate of air movement in a naturally ventilated building while fan etc. are used in care of mechanically ventilated buildings.

Most approaches are supply ventilation designs that introduce ventilation air into the return side of the forced-air, duct system, although some introduce air into the supply side. To the most effective, heating and cooling duct work must the as airtight or located within the condition space of the hour.

Table 1 : Recommendations for ventilation in public buildings

S.No.	Type of building	Minimum rate of fresh air in the building
1.	Assembly halls, canteens, shops, restaurants etc.	30 m^3 person per hour.
2.	Factories and workshops (i) Workrooms (ii) Lavatories	25 m^3 per person per hour. 2 air changes per hour.
3.	Hospitals (i) Operation theatres etc. (ii) Wards	10 air changes per hour. 3 air changes per hour.
4.	Schools (i) Rooms ; space provided between 8 m^3 per person. (ii) Carridors, lavatories and w.c.s,	20 to 30 m^3 per persons per hour respectively 2 air changes per hour.
5.	Offices (i) Office rooms with, space from 5 m^3 per persons to 11 m^3 per person. (ii) Lavatories and w.c.s.	30 m^3 per person per hour to 17 m^3 per person per hour 2 air changes per hour.

A rough guidance can be taken from following table.

Air space per person (m^3)	Fresh air supply per person (m^3/h)
5.5	28.5
8.5	20.5
11.0 and upwards	17.0

Indian Standard, IS : 3362-1965 recommends the following values for residential buildings :

(i) **Living rooms and bed rooms :** In the case of living rooms and bedrooms, minimum of three air changes per hour should be provided.

(ii) **Kitchens :** Large quantity of air is needed to remove the steam, heat, smell and fames generated in cooking and to prevent excessive rise of temperature and humidity, minimum rate of ventilation of about three air changes per hour should be provided.

(iii) **Bathrooms :** Considerable ventilation of bathrooms and water closets is desirable after use, and the equivalent of three air changes perhour should be provided.

(iv) **Passages :** The period of occupation of passages lobbies and the like is very short, and as such no special consideration is designing their ventilation system.

2. **Humidity :** *Relative humidity is defined as the ratio of amount of water vapour present in the air to the amount of water vapour, if the air were saturated at the same temperature*. Thus, the relative humidity of saturated air is 100%. Relative humidity within the range of 33 to 70% at the working of 21° C, is considered to be desirable for higher temperatures, low humidity and greater air movements are necessary for removing greater portion of heat from the body.

3. **Quality of air :** The quality of air plays a significant role in the comfort of people affected by a ventilation system. It is essential that ventilation air should be free from impurities, odors, organic matter inorganic unhealthy flumes of gasses like carbon-mono-oxide, Carbon-di-oxide, Sulphur-dioxide etc. All these impurities depend on the habits of occupants, volume of the room, surrounding conditions, source of ventilating air etc. The ventilation air should no come from the chimneys, kitchens, latrine urinals, stables or such other sources.

Air containing less than 0.5 mg. of suspended impurities per cubic meter and less than 0.5 part per million of sulphur-dioxide is consider to be clean and does not required any other treatment.

Pure air in buildings is compulsory for the sustenance and improvement of health for the perfect combustion of fuel and for the preservation of materials of which the building is constructed.

4. **Temperature of air :** It is required that the incoming air for ventilation should be cool in summer and warm in winter before it enters in the room. Whenever the velocity of the incoming air is high, its temperature should not be lower than the room temperature. The general temperature difference between inside and outside is kept not more than 8°C with regard to human comfort. The term effective temperature is more useful, the effective temperature indicates a most suitable temperature of the majority of people considering the comfort of human body under the probable condition of humidity and air motion. Its value for human comfort point of view, depends upon the type of activity, geographical conditions, age of occupants, amount of heat loss from the body etc. The common values of effective temperature in winter and summer are 20°C and 22°C respectively.

5.3.2 System of Ventilation

It may be divided into two categories :

1. Natural ventilation.
2. Mechanical ventilation or artificial ventilation.

1. **Natural Ventilation :** It is affected by the elaborated use of doors, windows, ventilators and skylights. This is only suitable for residential buildings and small houses. It is not useful for big buildings, offices, conference halls, auditoriums, large factories, etc. The rate of ventilation depends upon two effects :

   (a) Ventilation due to wind effect.

   (b) Ventilation due to stack effect,

   (a) Ventilation due to wind effect : Ventilation due to wind action means the rate of ventilation depends upon the direction and velocity of wind outside and positions of openings.

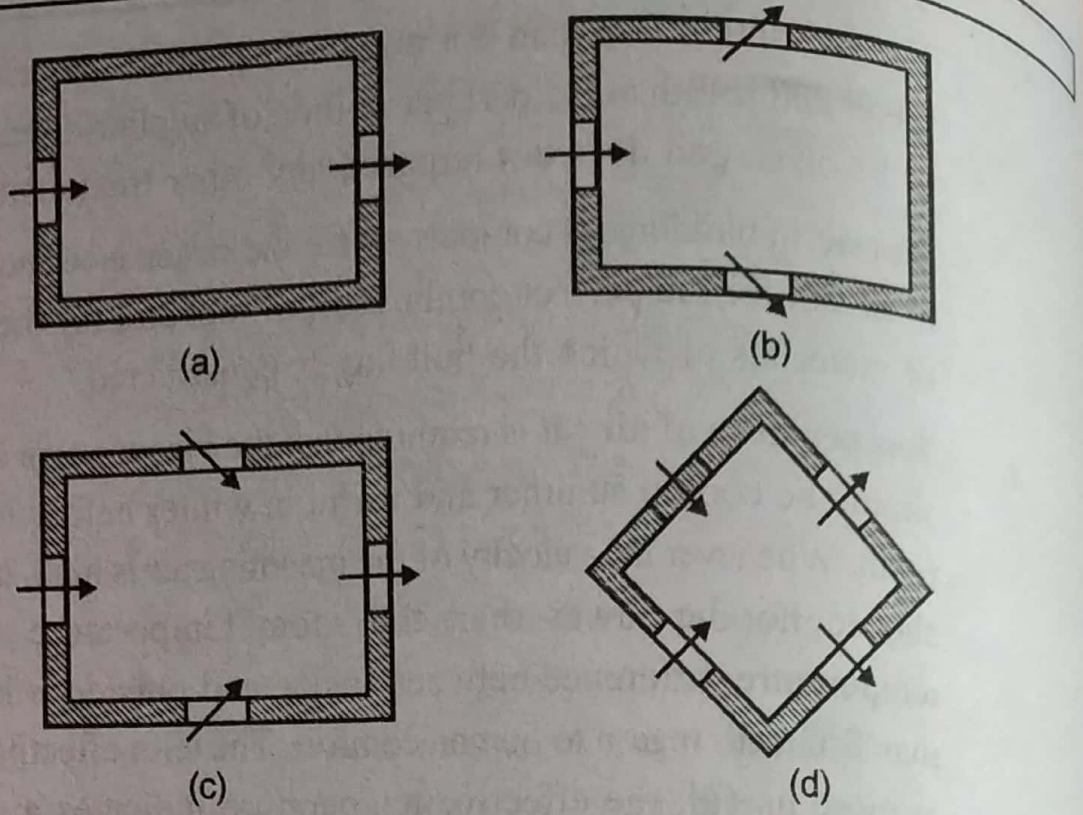


Fig. 5.7 : Movement of wind through buildings

When wind blows at right angles to one face of a building pressure differences are generated positive pressure is produced on wind ward face and negative pressure is produced on the leeward faces. If the wind direction is at 45° to one of the faces, positive pressure will be produced on two wind ward faces and negative pressure on the two leeward faces.

In the case of pitched roof, the pressure will depend upon the pitch of the roof. It is seen that the roof pressure in general are negative, except wind ward side of the roof with shape greater than 30°.

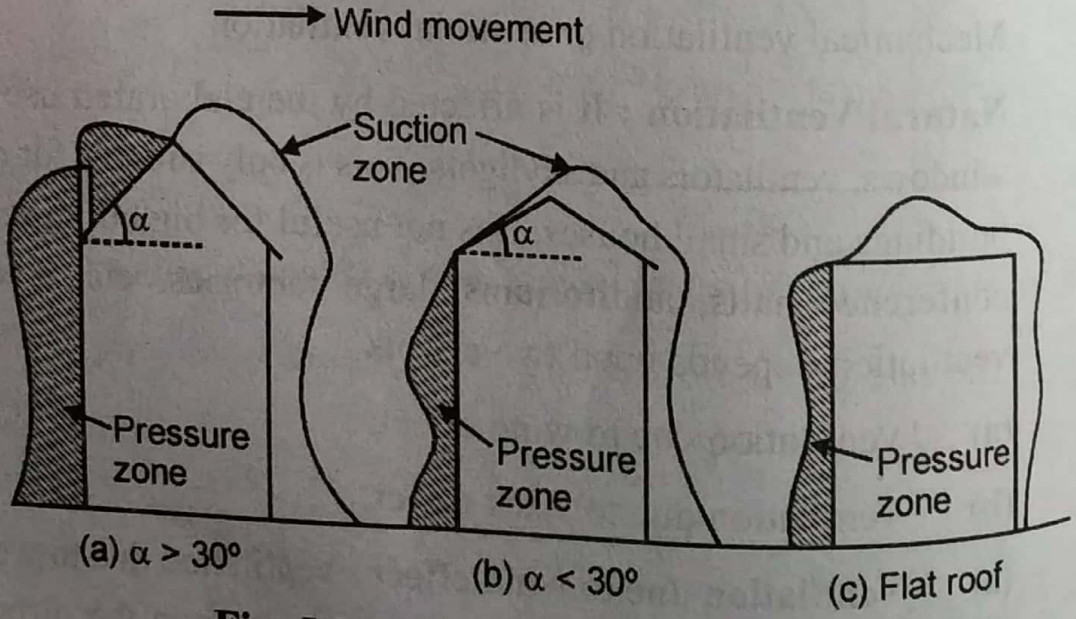


Fig. 5.8 : Wind pressure and suction zone

Due to wind blowing on the wall containing the opening is given by the expression :

$$Q = KAV$$

Where,

Q = The rate of air flow in m^3/h

K = Coefficient of effectiveness.

A = Area of smaller opening in m^2.

and V = Wind speed in m/h.

The coefficient of effectiveness depends upon the direction of the wind relative to the opening and on the ratio between the area of the two opening. It is a maximum when the wind blows directly on the opening and it increase with the relative size of the large opening,

(b) Ventilation due to stack effect : It is affected by the convection effects arising from temperature or vapour pressure differences between inside and outside of the room and another by difference in the height between the outlet and inlet openings.

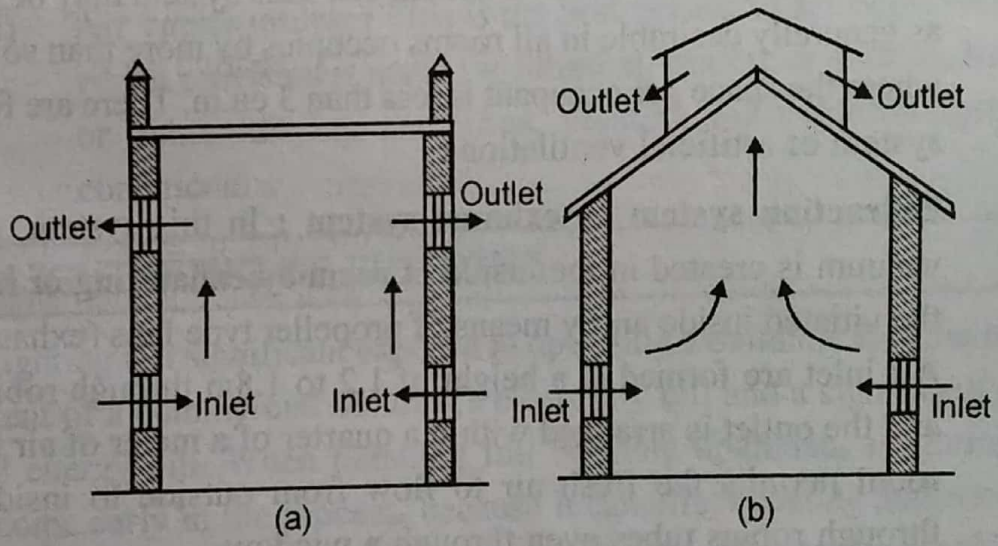


Fig. 5.9 : Ventilation due to stack effect

The rate of air flow arising from temperature difference between outside and inside is given by

$$Q = 640C.A.\sqrt{h(t_1 - t_0)}$$

where,

R = Rate of air flow in m^3/h.

C = Coefficient of effectiveness (0.65 for general condition) ; (0.50 for unfavourable condition).

A = Free area of inlet opening.

h = Vertical height difference between inlet and outlet.

t_1 = Average temperature of inside air in °C.

t_0 = Average temperature of outside air in °C.

(2) **Mechanical (or Artificial) Ventilation :** Mechanical ventilation or artificial ventilation involves the outside air is supplied into a building either by positive ventilation or by infiltration by reduction of pressure inside due to exhaust of air or by a combination of positive ventilation and exhaust of air. It is provided in those circumstances where satisfactory of ventilation of air quantity, quality or controllability cannot be obtained by natural means. This system is costly, but it results in considerable increase in the efficiency of persons under the command of the system. This system is adopted for big offices, banks, assembly halls, auditoriums, theaters, large factories, workshops, places of entertainment etc. This system may be regarded as generally desirable in all rooms occupies by more than so persons, where the space per occupant is less than 3 cu.m. There are following system of artificial ventilation :

(a) **Extraction system or exhaust system :** In this system, a partial vacuum is created in the inside of room by exhausting or removing the vitiated inside air by means of propeller type fans (exhaust fans). Air inlet are formed at a height of 1.2 to 1.8m through robin tubes, and the outlet is arranged within a quarter of a meter of air from the room permits the fresh air to flow from outside to inside either through robins tubes even through a window.

These fans for exhaust are installed at suitable place in the outside walls of roofs and they are further connected to different rooms through a systems of duck work. This system is more useful in removing smoke, dust, odors, etc. from kitchens, latrines, industrial plants, etc.

(b) **Plenum system or supply system :** In this system, the space is filled with air by means of a fan but no special provision is made to remove it. The air inlet is selected on that side of the building where

2.4. TYPES OF FOUNDATIONS

Foundations may be broadly classified under two heads :

(*a*) Shallow Foundations (*b*) Deep Foundations.

According to Terzaghi, a foundation is *shallow* if its depth is equal to or less than its width. In case of *deep foundations*, the depth is equal to or greater than its width.

(A) SHALLOW FOUNDATIONS

From the point of view of design, shallow foundations may be of the following types :

1. Spread footings. 2. Combined footings
3. Strap footings. 4. Mat foundation.

Various types of *shallow foundations* are shown in Fig. 2.1.

A brief description of these is given below. Details about the design requirements etc. are discussed in Chapter 3.

1. Spread Footings : Spread footings are those which spread the super-imposed load

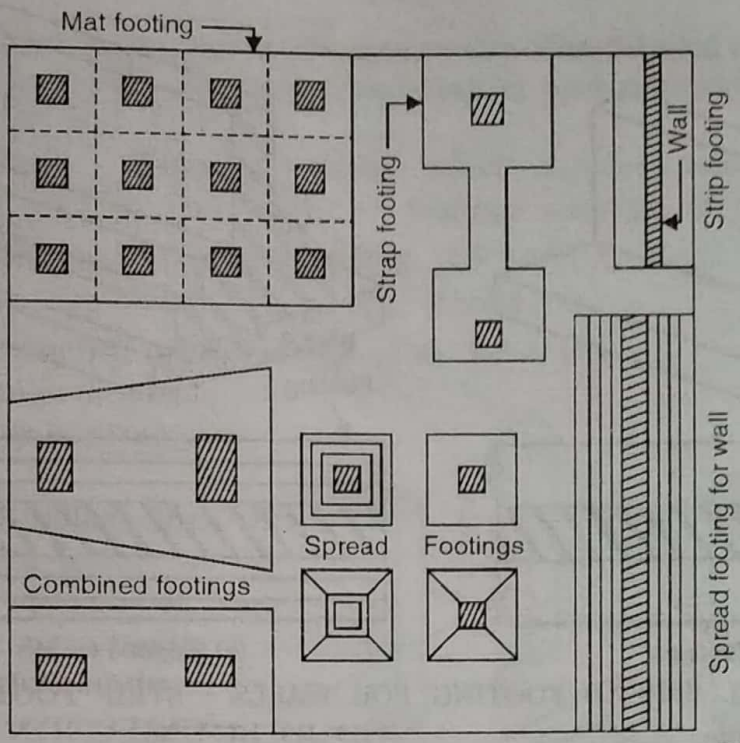


FIG. 2.1. VARIOUS TYPES OF SHALLOW FOUNDATIONS.

of wall or column over a larger area. Spread footings support either a column or wall. Spread footings may be of the following kinds :

(*i*) Single footing [Fig. 2.2(*a*)] for a column
(*ii*) Stepped footing [Fig. 2.2(*b*)] for a column
(*iii*) Sloped footing [Fig. 2.2(*c*)] for a column
(*iv*) Wall footing without step [Fig. 2.3(*a*)]
(*v*) Stepped footing for wall [Fig. 2.3(*b*)]
(*vi*) Grillage foundation [Fig. 2.4].

(*i*) Fig. 2.2 (*a*) shows a single footing for a column, in which the loaded area ($b \times b$) of the column has been spread to the size $B \times B$ through a single spread. The base is generally made of concrete. Fig. (*ii*) 2.2(*b*) shows the stepped footing for a heavily loaded column, which requires greater spread. The base of the column is made of concrete. Fig. (*iii*) 2.2(*c*) shows the case in which the concrete base does not have uniform thickness, but is made sloped, with greater thickness at its junction with the column and smaller thickness at the ends.

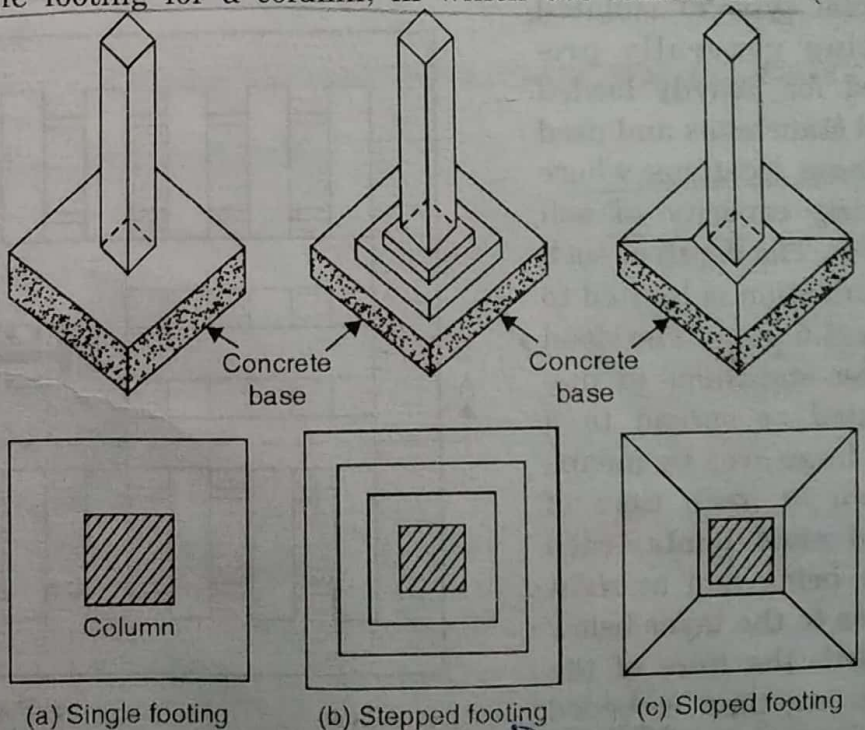
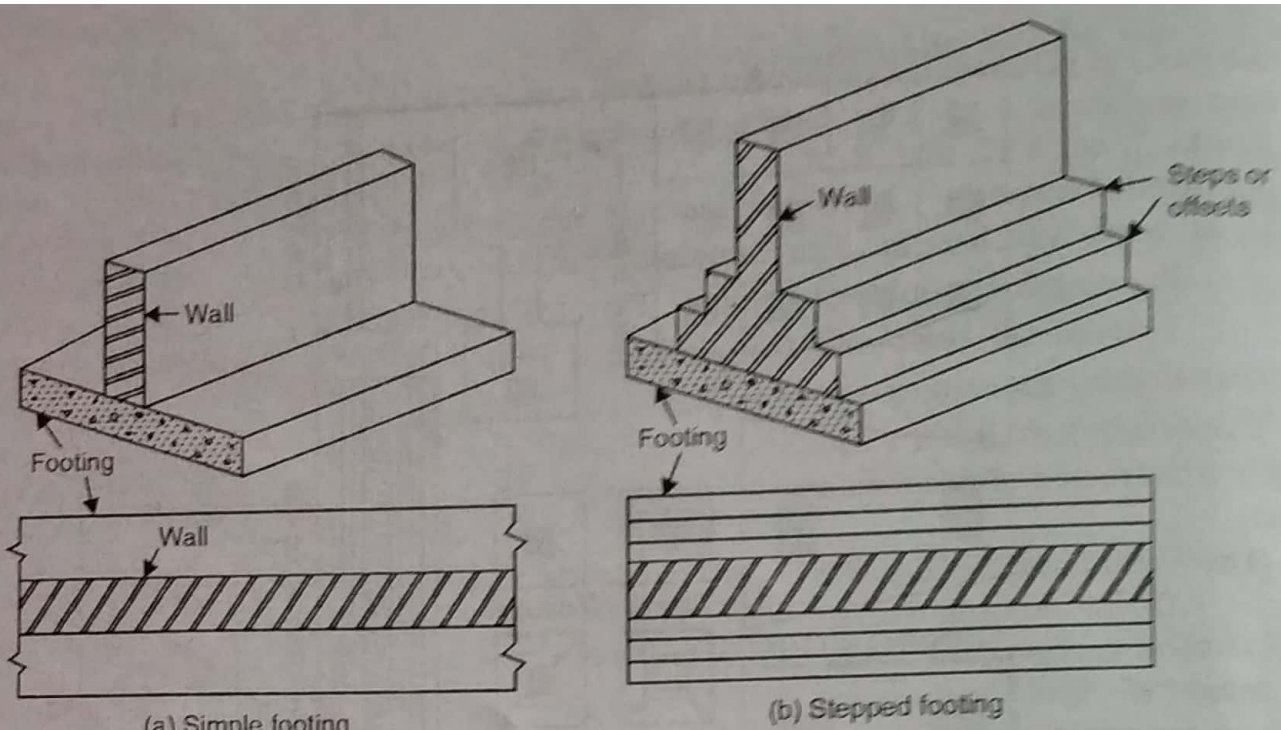


FIG. 2.2. SPREAD FOOTINGS FOR COLUMNS

Fig. 2.3 (*a*) shows the spread footing for a wall, con-

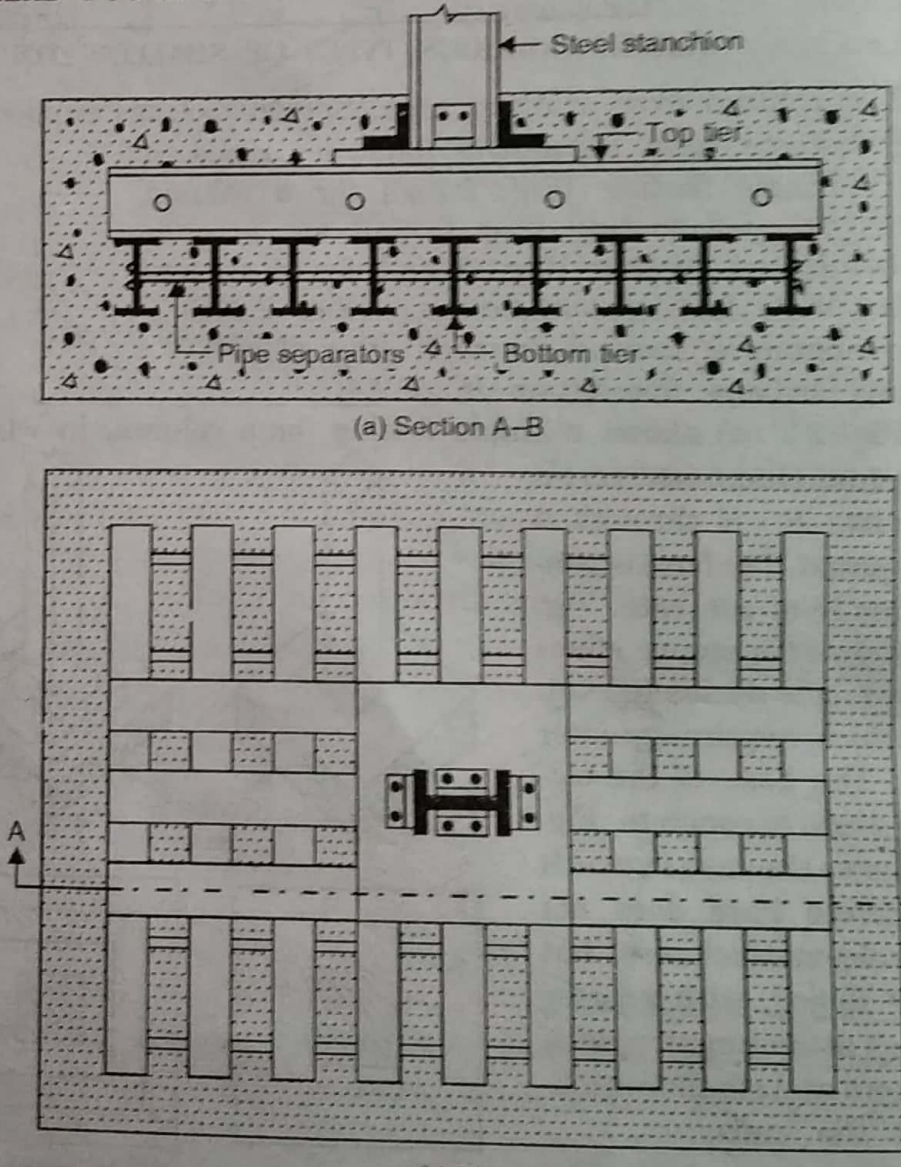


(a) Simple footing (b) Stepped footing

FIG. 2.3. SPREAD FOOTING FOR WALLS : STRIP FOOTING.

sisting of concrete base without any steps. Usually, masonry walls have stepped footings as shown in Fig. 2.3 (*b*), with a concrete base.

Fig. 2.4 shows a steel grillage foundation for a steel stanchion carrying heavy load. It is a special type of isolated footing generally provided for heavily loaded steel stanchions and used in those locations where bearing capacity of soil is poor. The depth of such a foundation is limited to 1 to 1.5 m. The load of the stanchion is distributed or spread to a very large area by means of two or more tiers of rolled steel joints, each layer being laid at right angles to the layer below it. Both the tiers of the joists are then embeded in cement concrete to



(a) Section A–B

(b) Plan

FIG. 2.4. GRILLAGE FOUNDATION.

keep the joists in position and to prevent their corrosion. The detailed method of construction has been explained in § 3.6. Grillage foundation is also constructed of timber beams and planks (Fig. 3.12 and 3.13).

2. Combined Footings : A spread footing which supports two or more columns is termed as combined footing. The combined footings may be of the following kinds :

(*i*) Rectangular combined footing [Fig. 2.5 (*a*)]

(*ii*) Trapezoidal combined footing [Fig 2.5(*b*)]

(*iii*) Combined column-wall footings [Fig. 2.6(*a*),(*b*)]

Combined footings are invariably constructed of reinforced concrete.

The combined footing for columns will be rectangular in shape if they carry equal loads. The design of rigid rectangular combined footing should be done in such a way that centre of gravity of column loads coincide with the centroid of the footing area. If the columns carry unequal loads, the footing is of trapezoidal shape, as shown in Fig. 2.5 (*b*).

Sometimes, it may be required to provide a combined footing for columns and a wall. Such combined footings are shown in Fig. 2.6 (*a*) [when the columns carry equal loads] and in Fig. 2.6 (*b*) [when the columns carry unequal loads] . The design principles of these footings have been discussed in Chapter 3.

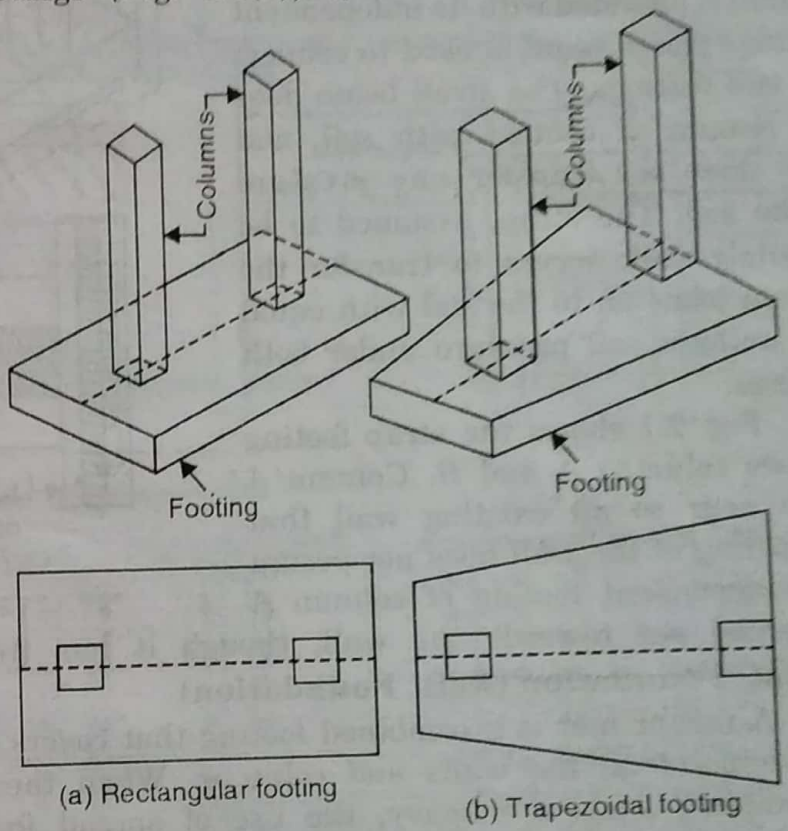


FIG. 2.5. COMBINED FOOTINGS FOR COLUMNS.

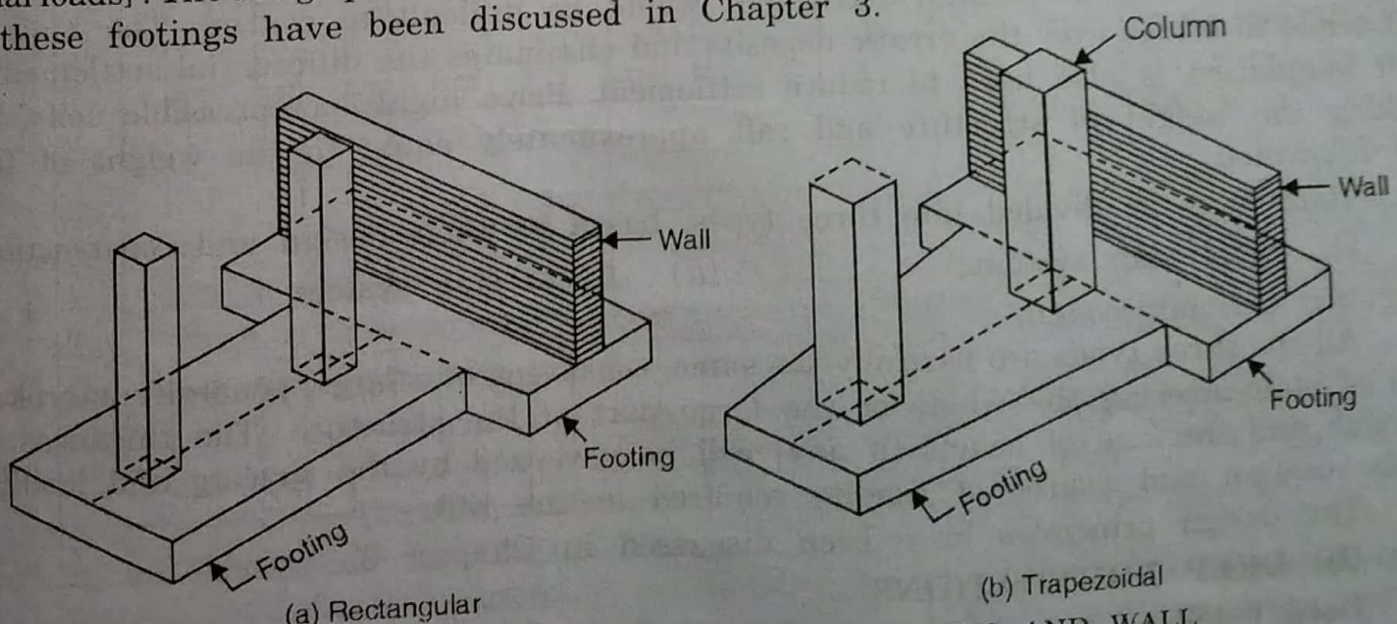


FIG. 2.6. COMBINED FOOTINGS FOR COLUMNS AND WALL.

3. Strap Footings : If the independent footings of two columns are connected by a beam, it is called a *strap footing*. A strap footing may be used where the distance between the columns is so great that a combined trapezoidal footing becomes quite narrow, with high bending moments. In that case, each column is provided with its independent footings and a beam is used to connect the two footings. The strap beam does not remain in contact with soil, and thus does not transfer any pressure to the soil. The strap, assumed to be infinitely stiff, serves to transfer the column loads on to the soil with equal and uniform soil pressure under both footings.

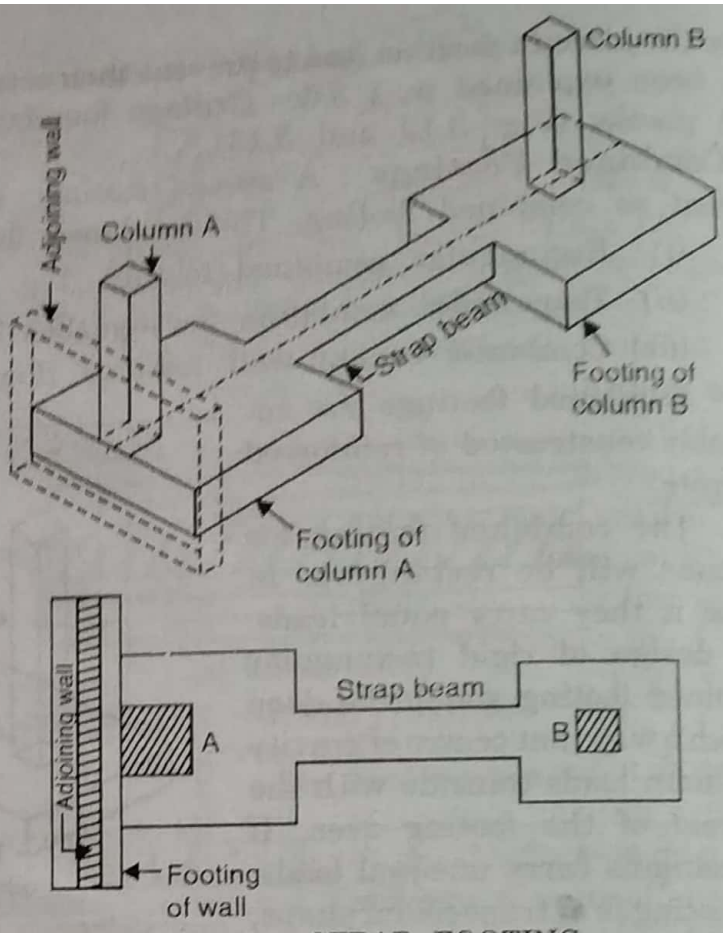


FIG. 2.7. STRAP FOOTING.

Fig. 2.7 shows the strap footing for two columns *A* and *B*. Column *A* is so near to an existing wall that the footing of the wall does not permit the independent footing of column *A* to spread out towards the wall, though it has freedom in other directions.

4. Mat Foundation (Raft Foundation)

A raft or mat is a combined footing that covers the entire area beneath a structure and supports all the walls and columns. When the allowable soil pressure is low, or the building loads are heavy, the use of spread footings would cover more than one half the area and it may prove more economical to use *mat or raft* foundation. They are also used where the soil mass contains compressible lenses or the soil is sufficiently erratic so that the differential settlement would be difficult to control. The mat or raft tends to bridge over the erratic deposits and eliminates the differential settlements. Raft foundation is also used to reduce settlement above highly compressible soils, by making the weight of structure and raft approximately equal to the weight of the soil excavated.

Rafts may be divided into three types, based on their design and construction:

(*i*) Solid slab system (*ii*) Beam slab system

(*iii*) Cellular system

All the three types are basically the same, consisting of a large, generally unbroken area of slab covering the whole or the large part of the structure. The thickness of the slab and the size of beams (if any) will be governed by the spacing and loading of the column and degree of rigidity required in the raft.

The design principles have been discussed in Chapter 3.

(B) DEEP FOUNDATIONS

Deep foundations may be of the following types :

1. Deep strip, rectangular or square footings.
2. Pile foundation.
3. Pier foundation or drilled caisson foundation.
4. Well foundation or caissons.

(1) As stated earlier, the usual strip, rectangular or square footings come under the category of deep foundations, when the depth of the foundation is more than the width of the footing. Well foundations are generally adopted for bridge piers etc. and not for building foundations.

(2) **Pile foundation**

Pile foundation is that type of deep foundation in which the loads are taken to a low level by means of vertical members which may be of timber, concrete or steel. Pile foundation may be adopted (*i*) instead of a raft foundation where no firm bearing strata exists at any reasonable depth and the loading is uneven, (*ii*) when a firm bearing strata does exist but at a depth such as to make strip or spread footing uneconomical, and (*iii*) when pumping of sub-soil water would be too costly or timbering to excavations too difficult to permit the construction of normal foundations.

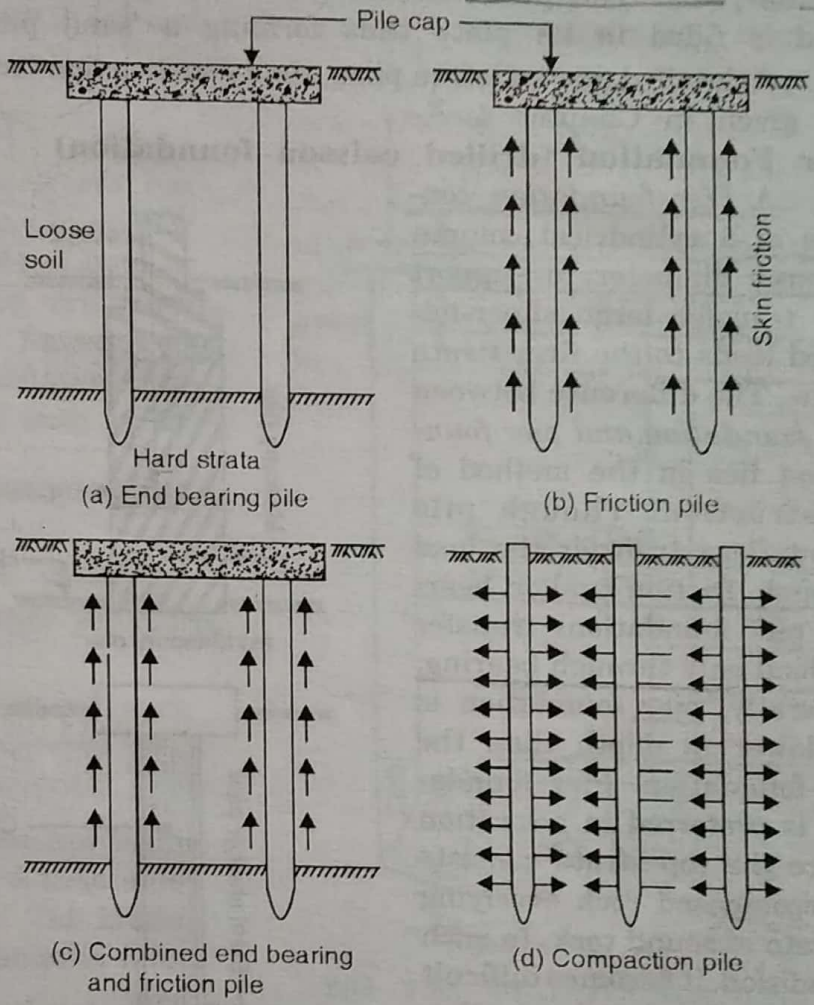


FIG. 2.8. PILE FOUNDATIONS

Piles used for building foundation may be of four types :

(*i*) End bearing pile [Fig. 2.8 (*a*)]

(*ii*) Friction pile [Fig. 2.8 (*b*)]

(*iii*) Combined end bearing and friction pile [Fig. 2.8 (*c*)] and

(*iv*) Compaction piles [Fig. 2.8 (*d*)]

End bearing piles [Fig. 2.8 (*a*)] are used to transfer load through water or soft soil to a suitable bearing stratum. Such piles are used to carry heavy loads safely to hard strata. Multi-storeyed buildings are invariably founded on end bearing piles, so that the settlements are minimised.

Friction piles [Fig. 2.8 (*b*)] are used to transfer loads to a depth of a friction-load-carrying material by means of skin friction along the length of the pile. Such piles are generally

used in granular soil where the depth of hard stratum is very great.

Fig. 2.8 (*c*) shows a pile which transfers the super-imposed load both through side friction as well as end bearing. Such piles are more common, specially when the end bearing piles pass through granular soils.

Compaction piles [Fig. 2.8 (*d*)] are used to compact loose granular soils, thus increasing their bearing capacity. The compaction piles themselves do not carry a load. Hence they may be of weaker material (such as timber, bamboo sticks etc.) — sometimes of sand only. The pile tube, driven to compact the soil, is gradually taken out and sand is filled in its place thus forming a 'sand pile'.

A detailed discussion on piles, their construction techniques and the design procedures are given in Chapter 4.

(3) Pier Foundation (drilled caisson foundation)

A *Pier foundation* consists of a cylindrical column of large diameter to support and transfer large super-imposed loads to the firm strata below. The difference between *pile foundation and pier foundation* lies in the method of construction. Though pile foundations transfer the load through friction and/or bearing, pier foundations transfer the load only through bearing. Generally, pier foundation is shallower in depth than the pile foundation. Pier foundation is preferred in a location where the top strata consists of decomposed rock overlying a strata of sound rock. In such a condition, it becomes difficult to drive the bearing piles through decomposed rock. In the case of stiff clays, which offer large resistance to the driving of a bearing pile, pier foundation can be conveniently constructed.

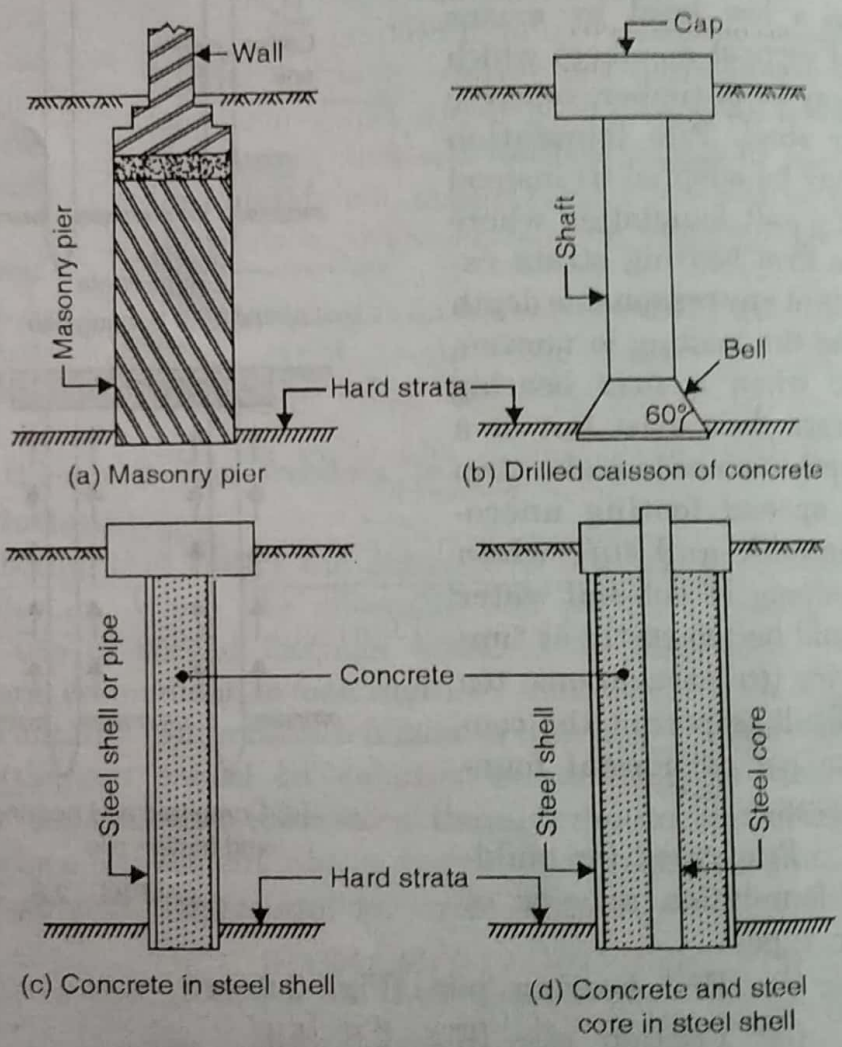


FIG. 2.9. PIER FOUNDATIONS

Pier foundations may be of the following types :

(*i*) Masonry or concrete pier

(*ii*) Drilled caissons.

These are shown in Fig. 2.9.

When a good bearing stratum exists upto 5 m below ground level, brick, masonry

or concrete foundation piers in *excavated pits* may be used [Fig. 2.9 (*a*)]. The size and spacing of the piers depends upon the depth of hard bed, nature of overlying soil and super-imposed loads.

The terms *drilled caissons, foundation pier* or *sub-pier* are interchangeably used by engineers to denote a cylindrical foundation. A *drilled caisson* is largly a compressed member subjected to an axial load at the top and reaction at the bottom. Drilled caissons are generally drilled with the mechanical means. Drilled caissons may be of three types: (*i*) concrete caisson with enlarged bottom [Fig. 2.9 (*b*)], (*ii*) caisson of steel pipe with concrete filled in the pipe [Fig. 2.9 (*c*) and (*iii*) caisson with concrete and steel core in steel pipe [Fig. 2.9 (*d*)].

Well Foundations (or caissons)

Well foundations or caissons are box like structure – circular or rectangular – which are *sunk* from the surface of either land or water to the desired depth. They are much large in diameter than the *peir foundations* or *drilled caissons*. Caisson foundations are used for major foundation works, such as for:

(*i*) Bridge piers and abutments in rivers, lakes etc.
(*ii*) Wharves, quay walls, docks.
(*iii*) Break waters and other structures for shore protections.
(*iv*) Large water front structures such as pump houses, subjected to heavy vertical and horizontal loads.

Well foundations or caissons are hollow from inside, which may be filled with sand, and are plugged at the bottom. The load is transferred through the perimeter wall, called steining (Fig. 2.10).

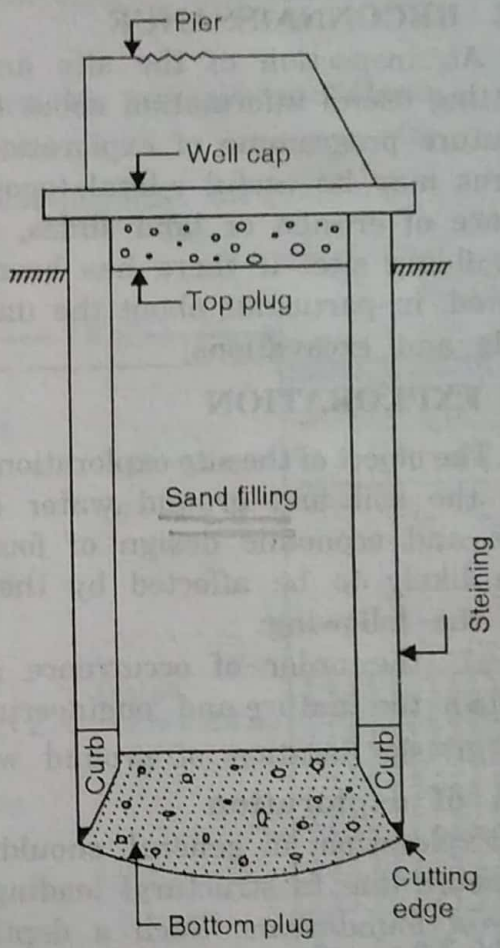


FIG. 2.10. WELL FOUNDATION.

Well foundations are not used for buildings.

1.1 INTRODUCTION

Man requires different types of buildings for his activities: houses, bungalows and flats for his living; hospitals and health centers for his health; schools, colleges and universities for his education; banks, shops, offices, buildings and factories for doing work; railway buildings, bus stations and air terminals for transportations; clubs theatres and cinema houses for recreation, and temples, mosques, churches, dharmshalas etc. for worship. Each type of the above building has its own requirements. The above building activities are important indicator of the country's social progress.

Houses, bungalows, flats, huts etc. provide shelter to man. The first hut, with bamboos and leaves, can be taken as the first civil engineering construction, carried out to satisfy the needs for a shelter. The history of development of housing facilities reveals that man has been moulding his environment throughout the ages, for more comfortable living. India still has many old cave temples with halls and rooms having beautiful carvings. Egyptians constructed huge pyramids. The Greeks developed a style of proportions of building elements; these proportions are known as the *Orders of Architecture*. Romans developed arches for vaults and domes. They used pozzolona, sand, mortar, Plaster and concrete. During the Gothic period of Architecture (1100-1500A.D.) churches with pointed arches and the ribs supporting masonry vaults were constructed. The arched ribs were supported by stone pillars strengthened by buttresses. These structures led to the idea of framed structures.

The period from 1750A.D. onwards is known as the Period of *Modern Architecture*. Due to economic pressure after the war, and industrial development, many new methods and materials of construction were developed. The use of reinforced concrete construction triggered the rapid development of modern architecture. Functional and structural components such as columns, chajjas, canopies, R.C.C. slabs became increasingly popular because of the increased speed in construction. Use of plywood, glass, decorative etc., helped the designers to make the new structures looks more elegant.

The building design has been the responsibility of the architect Traditionally, the building construction has been the responsibility of the civil engineer. Also, the structural designs of the buildings are the responsibility of a civil engineer. On small projects, a civil engineer may sometimes be entrusted with the architectural design work, along with structural design. The main considerations in architectural design buildings for all purposes are as follows:

Regulations and Bye-Laws of sanctioning authority.

1.2 COMPONENTS OF A BUILDING

A building has two basic parts :

(i) Sub-structure or foundations, and

(ii) Super-structure

(i) **Sub-structure** or **foundation** is the lower portion of the building, usually located below the ground level, which transmits the loads of the super structure to the supporting soil. *A foundation is therefore,* that *part of the structure which is in direct contact with the ground to which the loads are transmitted.*

(ii) **Super structure** is that part of the structure which is above ground level, and which serves the purpose of its intended use. A part of the super structure, located between the ground level and the floor level is known as plinth. Therefore, plinth is defined as *the portion of the structure between the surface of the surrounding ground and surface of the floor, immediately above the ground.* The level of the floor is usually known as the **plinth level.** The build- up covered area measured at the floor level is known as **plinth area.**

A building has the following components :

(i) Foundations

(ii) Masonry units such as walls and columns

(iii) Floor structures

(iv) Roof structures

(v) Doors, windows and other openings

(vi) Vertical transportation structures, such as stairs, lifts, ramps, etc.

1.3 TYPES OF BUILDINGS

Buildings can be classified on the basis of *type of construction* or by *occupancy*.

1.3.1 Classification of Buildings on the Basis of Type of Construction

(i) Load Bearing Structure,

(ii) Framed Structure,

(iii) Composite Structure.

(i) Load Bearing Structure : In this structure, the load bearing walls of stone or brick are constructed on a continuous foundation and designed to support the entire load including their own load. Hence, in this type of structure, the beams etc. are always made to rest on load bearing walls.

(ii) Framed Structure : In this structure, a number of piers or columns are erected on their own independent foundations and are braced together by beams and slabs. In this way, the whole structure is erected and the gaps between the piers or columns are filled with partition walls. The function of partition wall is simply to support their own weight and to serve as a screen for privacy. The entire load of the structure is carried out by the frame, Piers Column-Partition wall.

(iii) Composite Structure : This structure is the combination of load bearing structure and framed structure. In this type of structure, the outer wall consists of bearing walls, whereas the frame of columns and beams rest with one end on bearing walls and other end on inner column with thin partition between the bearing walls.

1.3.2 Classification of Buildings by Occupancy

According to the National Building Code (NBC) of India (1970), buildings are classified as :

(i) **Group A : Residential Buildings**

A-1 : Lodging Houses

A-2 : Family Private Dwellings

A-3 : Dormitories

A-4 : Apartment Houses (i.e. flats)

A-5 : Hotels

(ii) **Group B : Educational Buildings**

(iii) **Group C : Institutional Buildings**

C-1 : Hospitals and Sanitaria

C-2 : Custodial Institutions

C-3 : Penal Institutions.

(iv) **Group D : Assembly Buildings**

D-1 : In descending order of accommodation and facilities

D-2 : In descending order of accommodation and facilities

D-3 : In descending order of accommodation and facilities

D-4 : In descending order of accommodation and facilities

D-5 : In descending order of accommodation and facilities

(v) **Group E : Business Buildings**

(vi) **Group F : Mercantile Buildings**

(vii) **Group G : Industrial Buildings (Gl, G2, G3)**

(viii) **Group H : Storage Buildings**

(ix) **Group I : Hazardous Buildings**

(i) **Group A : Residential Buildings :** These are those buildings in which sleeping accommodation is provided for normal residential purpose, with or without cooking or dining or both facilities. It is further divided into 5 subgroups viz. A-1 to A-5.

(ii) **Group B : Educational Buildings :** All those buildings which are meant for education from a nursery school to university for use of more than 8 hours per week. These buildings provided facilities like classrooms, staff cabins, laboratories, administrative blocks, library, play fields etc.

(iii) **Group C : Institutional Buildings :** This group includes any building or part which is used for the purpose of medical health, recovering health after illness; care of infants or aged person etc. These buildings normally provide sleeping accommodation for the occupants.

(iv) **Group D : Assembly Buildings :** These include any building or part of a building where group of people gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purpose e.g. theaters, assembly halls, auditorium, museums, restaurants, place of worship clubs, aerodromes etc. Buildings under this group are further subdivided into 5 sub groups i.e. D-l to D-5 in descending order of accommodation and facilities.

(vii) **Group G : Industrial Buildings (Gl, G2, G3) :** This group includes any building or part of a building in which products or materials of all kinds and properties are fabricated, assembled or processed, for examples, assembly plants, laboratories, dry cleaning plants, pumping stations, smoke houses, gas plants, refineries, dairies and saw mills.

(viii) **Group H : Storage Buildings :** This group includes those buildings which are primarily used for storage of goods (not highly combustible) for example: ware houses, cold storage garrage etc.

(ix) **Group I : Hazardous Buildings :** This group includes those building structures which are used for the storage handling manufacture or processing of materials which are liable to burn with extreme rapidly and prove hazardous of health, building component or building content, e.g.. building used for storage of gases under high pressure or for storage of highly flammable liquids or explosive etc.

1.4 SITE PLAN

The site plan or plot plan is included to locate the area belonging to any building, showing all the detail of interior together with surroundings. This plan should be prepared before construction the house and should represent boundary

of plot, shape of site and house dimensions. Setback line at the front back and sides, zoning and building restrictions which may affect the site and location of fire hydrant should be marked.

1.4.1 Factors Affecting in Selection of Site

Site selection is very important in planning and designing of a building. Generally, an architect has either to make a choice of suitable site to plan his building structure or suit the available site. Natural defects of a site will involve considerable expenditure on construction and maintenance of the building, while unsatisfactory condition in the neighbourhood of locality will cause unhappy living conditions on one hand and on the other hand, possible deterioration of the value of property. However, the following general principles or factors should be kept in mind while selection of site :

1. The site should be selected keeping in view the general scope or the purpose of building and on the basis of extent of privacy desired.
2. The site should be situated in locality which is already fully developed or fast developing in stage. To secure happy living conditions, a neighbourhood is preferred where neighbours belong to an equal status in society and who should be social and friendly.
3. The situation of the site should be such as to ensure unobstructed natural light and air.
4. The site should be available in a locality where natural beauty and man-made environment create healthy living and working conditions.
5. The site should has a good landscape but away from quarries, factories etc.
6. Besides these factors, the legal and financial aspects, which dictate upon ownership rights and the cost should be given due consideration before the purchase of a plot.
7. A site which comes within the limit of an area where the by- laws of the local authority enforce restrictions regarding proportions of plots to be built up vacant space to be left in front and sides, heights of buildings etc. should be preferred.
8. Area of the plot or land should be such that the house constructed keeping in view the restrictions of the local authority which meet the requirement of the owner, preferably with possibilities of future extensions. The site should not be irregular in shape or size or having any sharp corners.

9. The plot should be in a locality where the various facilities like-

   (a) Community services such as police and fire protection, clearing of waste and street cleaning.

   (b) Utility services such as water supply, gas, electricity and drainage,

   (c) Amenities such as schools, hospitals, libraries, recreation, telephone etc.,

   (d) Shopping facilities, and

   (e) Means of transportation are available.

10. The site should be situated on an elevated place and also leveled with uniform slopes from one end to the other so as to provide good and quick drainage of rain water.

11. The soil surface of the site should be good enough to provide economical foundations for the intended building without causing any problem, generally for most satisfactory constructions. The site should have rocks and firm soil below 60 cm to 120 cm layer of light soil or even black cotton soil.

12. A site should be abandoned under adverse circumstance such as :

   (a) Unhealthy, noisy or crowded localities.

   (b) Immediate neighbourhood of rivers carrying heavy floods, badly maintained drains and nallahs.

   (c) Reclaimed soil or water logged areas, subject to submergence or settlement, and

   (d) Industrial vicinity having smoke and obnoxious odors.

1.4.2 Information Given by Site Plan

The site plan or plot plan is included to locate the area belonging to any building showing all the details of interior together with surroundings. This plan should be prepared before construction of the house and should provides the following information :

(i) The boundary of the plot, shape of the site and exterior house dimensions.

(ii) Setback line at the front, back and sides.

(iii) Any existing permanent boundary or marks should be indicated on the plan.

(iv) Name and width of existing streets and roads whether of concrete, asphalt etc. should be indicated.

(v) Grade elevation of corners of the plot and at corners of the house should be indicated by means of counter lines.

(vi) Size and location of garage, if attached.

(vii) Plot number and block, if any, and name of adjoining properties.

(viii) Directions of prevailing winds and north line.

(ix) Footpaths, if any, width and kind of it.

(x) Zoning and building restrictions which may affect the site.

(xi) Size and location detail of gas line, underground drainage, water main hole, ventilating pipes etc. should be indicated.

(xii) Location of fire hydrant should be marked.