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LECTURE NOTE

ON

BASIC OF CIVIL ENGINEERING

COURSE CODE: BCE02001: 3.0.0 (CR 03)

Second Semester, B Tech, Civil Engineering

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VSSUT BURLA

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Syllabus for Second Semester, B Tech, Civil Engineering
BASIC OF CIVIL ENGINEERING (BCE02001)

Module-I

Introduction to Civil Engineering – Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country.
Introduction to types of buildings as per NBC, Selection of site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types.
Building Planning – Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.

Module-II

Surveying – Principle and objectives, Instruments used, Horizontal measurements, Ranging (direct ranging only), Instruments used for ranging, Leveling – Definition, Principles, Instruments, Preparation of level book, problems on leveling, Modern surveying instruments – EDM, Total station, GPS (Brief discussion)
Building Materials – Bricks, properties and specifications, Cement – Types, properties, grades, other types of cement and uses, Cement mortar – Constituents, Preparation, Concrete – PCC and RCC, Grades, Steel – Use of steel in buildings, types.

Module-III

Building Construction – Foundations, Classification, Bearing Capacity of Soil and related terms (definition only), Masonry Works – classifications, definition of different technical terms, Brick masonry – types, bonds, general principle, Roofs – functional requirements, basic technical terms, roof covering material, Floors – function, types, flooring materials (brief discussion), Plastering and Painting – objectives, types, preparation and procedure of application.

Module-IV

Basic Infrastructure services – air conditioning & purpose, fire protection & materials, Ventilation, necessity & functional requirements, Lifts, Escalators.
Introduction to planning and design aspects of transportation engineering, Transportation modes, Highway engineering – historical development, highway planning, classification of highway, Railway Engineering – cross section of rail track, basic terminology, geometric design parameter (brief discussion only).

Module-V

Airport engineering – development, types, definition, characteristics of aircraft, basic terminology, Traffic engineering – traffic characteristics, traffic studies, traffic operations (signals, signs, markings), Urban engineering – classification of urban road.
Irrigation & Water Supply Engineering – Introduction, Types of Irrigation, different types of hydraulic structures, dam and weirs, types of dam, purpose and functions.

Text Books:

- Basic Civil engineering, Gopi, S., Pearson Publication
- Basic Civil Engineering, Bhavikatti, S. S., New Age.

Reference Books:

- Construction Technology, Chudley, R., Longman Group, England
- Basic Civil and Environmental Engineering, C.P. Kausik, New Age.
- American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application

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BASIC OF CIVIL ENGINEERING (BCE02001)

Module-I

Module I Syllabus

Introduction to Civil Engineering *– Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country.*

Introduction to types of buildings as per NBC, Selection of the site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types.

Building Planning *– Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.*

Subject to Revision

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1.1 INTRODUCTION TO CIVIL ENGINEERING :-

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including public works such as roads, bridges, canals, dams, airports, sewage systems, pipelines, structural components of buildings, and railways.

Civil engineering is traditionally broken into a number of sub-disciplines. Civil engineering is the application of physical and scientific principles for solving the problems of society, and its history is intricately linked to advances in the understanding of physics and mathematics throughout history. Because civil engineering is a broad profession, including several specialized sub-disciplines, its history is linked to knowledge of **structures**, **materials science**, **geography**, **geology**, **soils**, **hydrology**, **environmental** science, **mechanics**, **project management**, and other fields.

1.2 DISCIPLINES OF CIVIL ENGINEERING-

The various disciplines of civil engineering are-

1. ARCHITECTURE AND TOWN PLANNING

An art of **shaping** and **guiding** the **physical growth** of the town creating buildings and environments to meet the various needs such as social, cultural, economic and recreational etc. and to provide healthy conditions for both rich and poor to live, to work, and to play or relax, thus bringing about the social and economic well-being for the majority of mankind is known as town planning.

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OBJECTIVES OF TOWN PLANNING-

- To create and promote **healthy conditions and environments** for all the people.
    - To make **right use of the land** for the right purpose by zoning
    - To ensure **orderly development**
    - To **avoid encroachment** of one zone over the other.

2. BUILDING MATERIALS TECHNOLOGY

All the building structures are composed of various types of materials. These materials are either referred to as building materials or materials of construction.

A builder, perhaps an architect or engineer, or a contractor needs to become familiar totally with these building materials.These are some of the most commonly used building materials -

1. Stones
2. Bricks
3. Cement
4. Sand
5. Mortar
6. Concrete
7. Timber
8. Metals
9. Glass
10. Ceramics
11. Miscellaneous Building Materials

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3. CONSTRUCTION TECHNOLOGY AND MANAGEMENT

It focuses on the knowledge and skills required for the **planning**, **coordination** and successful **implementation of large Projects** such as design and construction of structures and buildings, ship structures, aircraft, dams, roads, and bridges etc. It is a fusion of **engineering** and **management**.

4. ENVIRONMENTAL ENGINEERING:-

- This field is concerned with the study of the necessary methods and techniques of **environment protection** as well as the availability of the basic life elements such as water and air with a specific level of quality to protect the mankind health and environment.
- This includes design and construction of **water distribution networks, wastewater and storm water collection systems**, **water treatment plants and wastewater treatment** for reuse in industrial and agricultural fields.
- Environmental engineering involves also the study of the different techniques of **controlling air, water and soil pollution** as well as the **proper disposal or recycle of solid and hazardous wastes**.

5. GEOTECHNICAL ENGINEERING:-

- This field is concerned with the study of the **soil properties** of the construction site and its **bearing capacity**.
- Geotechnical engineering is concerned also with the **suitable solutions for any problem in the soil** as well as the choice of the best and secured methods of design and construction of the foundation of engineering structures.

6. HYDRAULICS AND WATER RESOURCES ENGINEERING-

- This field covers the basic concepts of **water science** and its related theorems and applications. This includes the methods of **transporting water from sources to distribution sites** through channels and pipelines, water sources and storage system, types of dams and their design methods.
- It involves also the study of **seawater movements and shore protection**.

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- Hydraulic engineering consists of the application of fluid mechanics to water flowing in an isolated environment (pipe, pump) or in an open channel (river, lake, ocean).

7. REMOTE SENSING ENGINEERING-

Remote sensing is the process of **detecting and monitoring the physical characteristics** of an area by measuring its **reflected and emitted radiation** at a distance (typically from satellite or aircraft).

Some specific uses of remotely sensed images of the Earth include:

- **Large forest fires** can be mapped from space, allowing rangers to see a much larger area than from the ground.
- **Tracking clouds** to help predict the weather or watching erupting volcanoes, and help watching for dust storms.
- **Tracking the growth of a city and changes in farmland or forests** over several years or decades.
- Discovery and mapping of the rugged topography of the ocean floor (e.g., huge mountain ranges, deep canyons, and the "magnetic striping" on the ocean floor).

8. STRUCTURAL ENGINEERING:-

- This discipline deals with the **analysis and design of concrete and steel structures**, such as multi-story buildings, bridges, towers....etc. It deals also with the study of the **durability** and **resistibility** of such structures for live loads, wind and earthquake.
- The study involves also the study of the properties of building materials according to the international specifications.

9. SURVEYING:-

Surveying typically involves measurements of **horizontal and vertical distances** between points. It also includes descriptions of the **exact characteristics of the land structure and surface**.

A **surveying engineer** also works to:

- provide the proper design and development of infrastructure
- protect the surrounding natural environment
- maximize the efficiency of the proposed structures

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10. <u>TRANSPORTATION ENGINEERING</u>:-

Transportation engineering is a branch of civil engineering that involves the **planning, design, operation, and maintenance of transportation systems** to help build smart, safe, and liveable communities.

Any system that moves people and goods from one place to another falls under the scope of transportation engineering, which includes:

- Highways and roadways
- Railways
- Oil pipelines
- Public transport systems
- Traffic control systems
- Automated transport systems
- Space transport systems

1.3 <u>Importance of Civil Engineering in Infrastructure Development of the Country</u>:-

Civil Engineers play a major role in the **infrastructure development** of a country. All structures constructed in the past exhibit the path of civilization and current infrastructures development express the practices followed by civil engineers.

Infrastructure can be defined as activities that provide society with services necessary to conduct daily life and to engage in productive activity and development in a country's economy.

In a country like India, the major infrastructural. Factors that are most significant in accelerating the pace of economic development are energy, transport, irrigation, finance, communications, education, and health.

The knowledge of basic areas of civil engineering can be of great use in providing the infrastructural facilities where constructional aspects are involved for development of regions.

- Good surface communication links such as tar or concrete rods.
- Provision of water supply distribution system i.e., construction of water storage reservation or sumps, laying of underground pipes etc.
- Provision of a drainage system which may include construction of surface drains as subsurface drains for the disposal of wastewater.
- Supply of electrical power for which construction of transmission line towers, construction of electrical substations.

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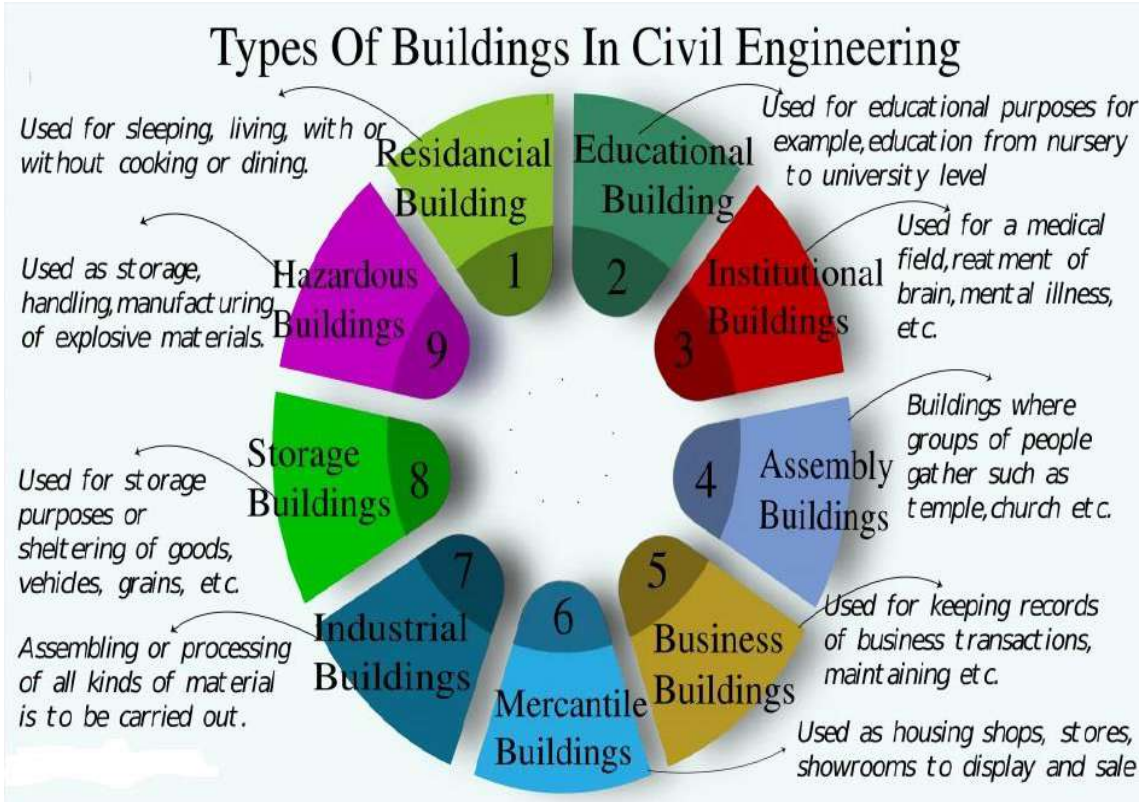
- Providing inland communications lines, i.e., telephone lines etc.
- Construction of recreational places e.g., gardens, parks etc.

1.4 <u>TYPES OF BUILDING AS PER NBC (NATIONAL BUILDING CODE)</u>:-

Any structure made for whatsoever purpose with any material, used for human habitation or not which included foundation, plinth, walls, floor, roofs, chimney, plumbing, and building services, Verandah, Balcony, and cornice, etc. is called a building. Buildings are classified based on **occupance** and **type of construction**:

A. RESIDENTIAL
B. EDUCATIONAL
C. INSTITUTIONAL
D. ASSEMBLY
E. BUSINESS
F. MERCANTILE (included **retail** and **wholeshale** store)
G. INDUSTRIAL (low, moderate and high fire hazards)
H. STORAGE
I. HAZARDOUS



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1. **Residential Buildings**-

Any building in which **sleeping accommodation** is provided for **normal residential purposes with or without cooking/dining**. These are further classified as:

Group A-Residential

A1: Lodging or rooming houses.
A2: One or two-family private dwellings
A3: Dormitories
A4: Apartment houses
A5: Hotels (upto 4 star category)
A6: Hotels (**Starred**- five star and above)

(i) **Lodging and rooming houses**- These are buildings in which separate **sleeping accommodation with or without a dining facility** but **without a cooking facility** is provided. For instance, Inns, Clubs, Motels, and Guesthouses.

(ii) **One or two-family private dwelling**- A private dwelling which is occupied by members of one or two-family. Maximum sleeping accommodation is provided for **20 persons**.

(iii) Dormitories- Any building in which group sleeping accommodation is provided with or without dining facilities. e.g., School and College Dormitories, Hostels, and Military Barracks.

(iv) Apartment Houses- Buildings in which living quarters are provided for **three or more families** having independent cooking facilities and living independently of each other. e.g., apartments, Mansions, and Chowls.

(v) Hotels -Buildings in which sleeping accommodation is provided with or without dining facilities for up to four-star categories (hotels).

(vi) Hotels (**Starred)** Normally five star and above by local authority.

2. **Educational Buildings**

Any building used for school, college, and other training institutions having a minimum of 20 students.

(i) Schools up to Senior Secondary level Minimum students should be 20.

(ii) All others/training institute Minimum students should be 100.

3. **Institutional Buildings-**

Buildings that are used for medical or other treatment, care of persons suffering from physical and mental illness, care of infants, for inmates etc are called institutional buildings

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(i) Hospital and Sanatoria -Any building which is used for the treatment of patients e.g., hospitals, sanatoria, infirmaries, and nursing homes.

(ii) Custodial Institutions Any building used for custody and care of a person for instance children, old age homes, orphanages, etc

(iii) Penal and mental institutions Any building which is used for housing persons whose liberty is restricted e.g., jails, prisons, mental hospitals, etc.

4. Assembly Buildings

Any building in which a minimum of **50 persons** gathers for recreational, amusement, social, religious, patriotic purposes e.g., theatres, assembly halls, exhibition halls, museums, estaurants, places of worship, etc.

These are classified into 7 types:

(i) The building having **theatrical or motion pictures** or any other stage having fixed seats for **over 1000** persons.

(ii) The building having **theatrical or motion pictures** or any other stage having fixed seats for **up to 1000** persons.

(iii) Buildings without a **permanent stage** having an accommodation for **300** or more persons but no permanent seating arrangements.

(iv) All other structures including **temporary structures** designed for assembly of peoples.

(v) Buildings having **mixed occupancies** of assembly and mercantile

(vi) **Underground and elevated mass rapid transit** system.

5. Business Buildings

Any buildings used for the **transaction of business, professional establishments, service facilities**, etc. are termed as business buildings.

These are further divided into 5 types –

(i) Offices, banks, professional establishments etc.

(ii) Laboratories, clinics, research establishments and libraries etc.

(iii) IT parks, call centers etc.

(iv) Telephone exchange

(v) Broadcasting stations, TV stations and air traffic control towers.

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6. Mercantile Buildings

Any building which is used as **a shop, store, market**, etc. is known as mercantile buildings. These are further classified as:

(i) Shops, stores, departmental stores, markets (covered area **up to 500 sq. m**).

(ii) Shops, stores, departmental stores, markets (covered area **more than 500 sq. m**).

(iii) Underground shopping centres, storage and service facilities

7. Industrial Buildings

Any building in which products or materials are **fabricated, assembled, manufactured, or processed**. For instance, assembly plants, industrial laboratories, power plants, pumping stations, etc.

- Buildings for **low hazard industry** –
    - Buildings in which those things are manufactured that have low combustibility.
- Buildings for **moderate hazard industry**-
    - Buildings in which those things are manufactured which will burn with moderate rapidity.
- Buildings for **high hazard industry**-
    - Buildings in which those things are manufactured which will burn with extreme rapidity and results in hazardous situations.

8. STORAGE BUILDINGS

- Any building which is used for **storage of goods**, ware or merchandise, vehicles or animals. e.g., warehouse, cold storage, garages, stables, etc.

9. HAZARDOUS BUILDINGS

- Buildings which are used for storage, handling, manufacture, or processing of highly combustible or explosive material. For instance, manufacture of explosives and fireworks, storage of highly flammable liquids, storage of LPG, rocket propellants, etc.

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1.5 SELECTION OF SITE FOR BUILDINGS :-

1. The soil of site should have good bearing capacity. Hard strata should be available at reasonable depth, around 1.2m to1.5m depth from ground level.
2. The site should be on elevated ground. It should have slope towards front street to afford good facility of drainage.
3. Sites nearer to ponds ,pools of water, water logged areas must be avoided as they remain in damp condition .
4. Sites near to high voltage power transmission lines are avoided.
5. Sites very nearer to big shopping complexes , markets, railway station ,airport are avoided
6. The surrounding of site should be pleasing and calm.
7. The orientation of site should be such that it receives natural light and air in plenty.
8. The location of site is such that the common facilities like school, transportation, medical facilities etc are within reasonable range.
9. Sites in developed colonies should be preferred.
10. The layout of the colony should be approved by local authorities. This will help in getting essential facilities like water , drainage ,electricity, telephone connection etc easily.

1.6 COMPONENTS OF RESIDENTIAL BUILDING

Building component means any subsystem, subassembly, or other system designed for use in, or as part of, a structure, which may include structural, electrical, mechanical, plumbing, and fire protection systems and other systems affecting health and safety.

The basic function of a building is to provide **structurally sound and environmentally controlled spaces** to **house and protect** occupants and contents.A building is combination of various components. A Civil Engineer should have good knowledge of execution of each and every component with respect to design layouts given by Architect.

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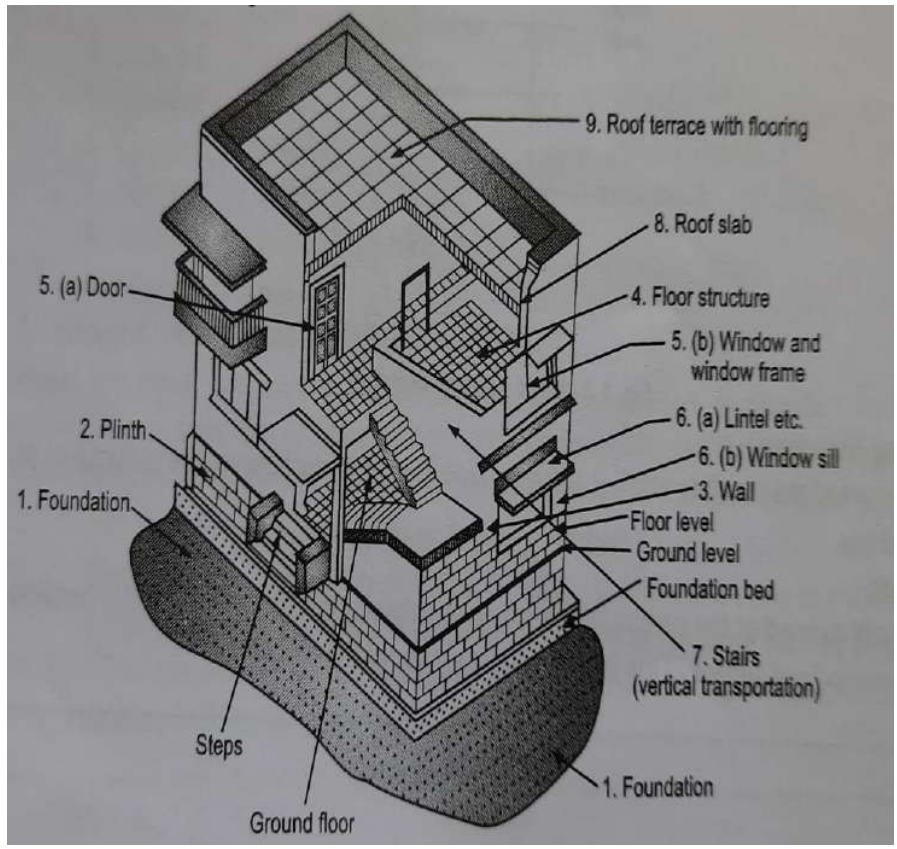

The following are the basic component parts of a **residential building**:-

1. Foundation
2. Plinth
3. Walls and columns
4. Sills, lintels and chejjas
5. Doors and windows
6. Floors
7. Roofs
8. Steps, stairs and lifts
9. Finishing work
10. Building services.
11. Parapet

The functions of these elements and the main requirement of them are discussed below-

1. <u>Foundation</u>:

Foundation is the most important part of the building. Building activity starts

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with digging the ground for foundation and then building it. It is the lower most part of the building. It transfers the load of the building to the ground. Its main functions and requirements are:

(a) Distribute the load from the structure to soil evenly and safely.

(b) To anchor the building to the ground so that under lateral loads building will not move.

(c) It prevents the building from overturning due to lateral forces.

(d) It gives level surface for the construction of super structure.

2. Plinth:

- The portion of the wall between the **ground level** and the **ground floor level** is called **plinth**. It is usually of stone masonry. If the foundation is on piles, a plinth beam is cast to support wall above floor level. At the top of plinth, a damp proof course is provided. It is usually 75 mm thick plain concrete course.
- The function of the plinth is to keep the **ground floor above ground level**, **free of dampness**. Its height is **not less than 450 mm**. It is required that plinth level is at least **150 mm above the road level**, so that connections to underground drainage system can be made.

3.Walls and Columns:-

The function of walls and columns is to transfer the load of the structure vertically downwards to transfer it to foundation. Apart from this wall performs the following functions also:

(a) It encloses building area into different compartments and provides privacy.

(b) It provides safety from burglary and insects.

(c) It keeps the building warm in winter and cool in summer.

4. Sills, Lintels and Chejjas:-

- A **window frame should not be directly placed** over masonry. It is placed over **50 mm to 75 mm thick plain concrete course** provided over the masonry. This course is called as **sill**.
- **Lintels** are the **R.C.C. or stone beams** provided **over the door and window openings** to **transfer the load transversely** so as to see that door or window frame is **not stressed unduly**. The width of lintels is equal to the width of wall while thickness to be provided depends upon the opening size.

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- **Chejja** is the projection given **outside the wall to protect doors and windows** from the rain. They are usually made with R.C.C. In low cost houses stone slabs are provided as chejjas. The projection of chejja varies from 600 mm to 800 mm. Sometimes drops are also provided to chejjas to improve **aesthetic** look and also to get additional protection from sun and rain.

5. <u>Doors and Windows</u>:-

- The function of a **door** is to give access to different rooms in the building and to deny the access whenever necessary. Number of doors should be minimum possible. The size of the door should be of such dimension as will facilitate the movement of the largest object likely to use the door.
- **Windows** are provided to get light and ventilation in the building. They are located at a height of 0.75 m to 0.9 m from the floor level. In hot and humid regions, the window area should be 15 to 20 per cent of the floor area. Another thumb rule used to determine the size and the number of windows is for every 30 sq. m of inside volume there should be 1 sq. m window opening.

6. <u>Floors</u>:-

- Floors are the important component of a building. They give working/useful area for the occupants. The ground floor is prepared by filling brick bats, waste stones, gravel and well compacted with not less than 100 mm sand layer on its top. A lean concrete of 1 : 4 : 8, 100 mm thick is laid. On this a damp proof course may be provided. Then floor finishing is done as per the requirement of the owner.
- Cheapest floor finish for a moderate house is with 20 to 25 mm rich mortar course finished with red oxide. The costliest floor finish is mosaic or marble finishing. Other floors are usually of R.C.C. finished as per the requirements of the owner.

7. <u>Roof</u>:-

- Roof is the top most portion of the building which provide top cover to the building. It should be leak proof. Sloping roof like tiled and A.C. sheet give leak proof cover easily. But they do not give provision for the construction of additional floor. Tiled roof gives good thermal protection. Flat roofs give provision for additional floors. Terrace adds to the comfort of occupants. Water tanks can be easily placed over the flat roofs.

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8. <u>Step, Stairs and Lifts</u>:-

- **Steps** give convenient access from ground level to ground floor level. They are required at doors in the outer wall. 250 to 300 mm wide and 150 mm rise is ideal size for steps. In no case the size of two consecutive steps be different. Number of steps required depends upon the difference in the levels of the ground and the floor.
- **Stairs** give access from floor to floor. They should consist of **steps of uniform sizes**. In all public buildings lifts are to be provided for the conveniences of old and disabled persons.
- In hostels **G + 3 floors can be without lifts**. Lift is to be located near the entrance. Size of the lift is decided by the number of users in peak hours. Lifts are available with capacity 4 to 20 persons.

10. <u>Finishing</u>:-

- Bottom portion of slab (ceiling), walls and top of floor need smooth finishing with plaster. Then they are provided with white wash, distemper or paints or tiles. The function of finishing work is:
    - Give protective cover
    - Improve aesthetic view
    - Rectify defective workmanship
    - Finishing work for plinth consists in pointing while for floor it consists in polishing.
- **<u>Building Services</u>:-**
- **Water supply, sanitation and drainage works, electric supply work and construction of cupboards and show cases** constitute major building services.
- For storing water from municipal supply or from tanker a **sump** is built in the house property near street. From the sump water is pumped to overhead tanks placed on or above roof level so as to get water all the 24 hours. Plumbing work is made so as to get water in kitchen, bathrooms, water closets, sinks and garden taps. For draining rain water from roofs, down take pipes of at least 100 mm diameters should be used. Proper slopes should be given to roof towards down take pipe. These pipes should be fixed at 10 to 15 mm below the roof surface so that rain water is directed to the down take pipe easily.

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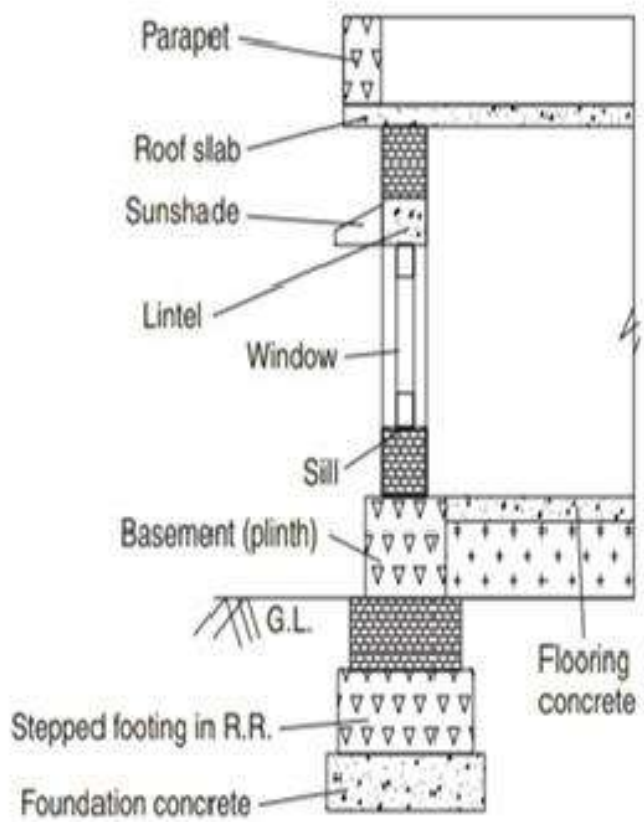
- The **sanitary fittings** are to be connected to stone ware pipes with suitable traps and chambers. Stone ware pipes are then connected to underground drainage of municipal lines or to the septic tank.
- Many **carpentry works** are required for building service. They are in the form of showcases, cupboards, racks etc.
- **Electric supply** is essential part of building services. The building should be provided with sufficient points for supply of lights, fans and other electric gadgets.

11.<u>Parapet</u>:-

- The parapet is a minor wall around the edge of a roof, balcony, terrace, or stairway, usually covering the roof's perimeter. It protects the top and pre-built structures from corrosion and degradation.



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1.7 INTRODUCTION TO INDUSTRIAL BUILDING AND TYPES-

- Any building structure used by the industry to s**tore raw materials or for manufacturing products** of the industry is known as an industrial building.

- Industrial buildings are generally used for steel plants, automobile industries, utility and process industries, thermal power stations, warehouse, assembly plants, storage, garages, etc.

Factors Considered while Selecting Site For Industrial Building:-

- Site should be located on an arterial road.
- Local availability of raw material.
- Facilities like water supply, electricity
- Topography of an area
- Soil conditions with respect to foundation design
- Waste disposal facilities
- Transportation facilities
- Sufficient space for storage of raw materials

Types of Industrial Building

1. Warehouses
2. Cold Storage Buildings

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3. Telecom Centres or Data Hosting Centres
4. Flex Buildings
5. Light Manufacturing Buildings
6. Research And Development Set up

1. Warehouse

- There are buildings that are used for **storing goods on behalf of other companies**. These are called warehouses. Although warehouses can be of different sizes, they are usually large and are located outside city limits. They can have more than one storey and can have loading docks, huge parking lots of big trucks. They can also have a small office set up inside the premises.
- These typical single-story warehouses range in size from 5,000 to hundreds of thousands of square feet and are used for the storage and transport of goods. Ceilings are generally at least 60 feet high because of the necessary racking and storage systems concealed beneath its roof. Loading docks, big truck doors, and parking areas for semi-trailers used for distribution are among the other important elements of an industrial building.

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2. **Cold Storage Buildings-**
   - Refrigeration and cold storage facilities are distribution centres dedicated to food items like meat, produce, and dairy. These buildings provide rooms for cooling and freezing in order to maintain goods at the right temperatures before they are sent out. Other key features include docks with special seals to keep products cool, as well as insulated overhead doors that keep them frozen.
   - These are especially built to store large amounts of food products and keep them under refrigerated conditions for long periods. These buildings are located mostly along state and national highways and in places where there is good supply of electricity.

3. **Telecom/Data Hosting Centers (Switching Centers, Cyber Centers, Web Hosting Facilities, Telecom Centers)**

   - These highly specialized industrial buildings are located close to major communications trunk lines to allow for access to an extremely large and redundant power supply capable of powering extensive computer servers and telecom switching equipment.

4. **FLEX BUILDING:-**
   - This is the newest addition to the category of industrial segment of industrial real estate and is a result of the evolving needs of modern times. These flex building have **more than one usage and can accommodate a Rand D facility**, an office set up, light manufacturing and even showroom spaces. They are flexible in nature and some of the uses can be changed by making simple modifications.

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- **FLEX Building** Systems is committed to providing flexible, superior building systems for a variety of applications. Flex buildings often incorporate different areas or spaces in a design, optimised for different purposes and needs. This can be either an uninsulated or insulated **warehouse, workshop, garage or even a showroom**, often in combination with one or more offices. The buildings often have to balance complex solutions for production, cold storage and heating. Flex space buildings are mainly of three types - **Research and Development buildings, Data centre buildings, and Show rooms.**

5. LIGHT MANUFACTURING BUILDING:-

These buildings can be used in processing **food items or assembly of light machinery like fans, water pumps, gadgets,** etc. These are generally small in size as compared to heavy industrial buildings and do not have blast furnace, high capacity exhaust systems etc. These

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buildings can sometimes find alternative uses like a unit making water pumps can be converted in to assembly unit for gadget by making changes in the some of the installed machinery.

6. RESEARCH AND DEVELOPMENT BUILDING:-

Research and Development (R&D) forms an integral part of many businesses and they like to set up their own R&D centres which cater to their specific requirements. A lot of life sciences companies have their R&D centres which are usually owned by them. These centres are generally not in the centre of the city. Companies can house their scientists and other staff in these centres and hence there are residential elements in this kind of a set up. There can also be elements of office buildings in a R&D centre. Sometimes these centres run on rented buildings also but the lease period is usually long.

7. SHOWROOM BUILDINGS:-

A showroom, also referred to as a gallery, is a large space used to display products or show entertainment. A showroom is a large space used to display products for sale, such as automobiles, furniture, appliances, carpet or apparel. It is a retail store of a company in which products are on sale in a space created by their brand or company. There are many types of showroom buildings like jewellery shops, malls, large vehicle showroom, furniture showrooms etc.

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1.8 BUILDING PLANNING AND BASIC REQUIREMENTS:-

Every family needs a building to reside in. Apart from residential purposes, buildings are required for educational, institutional, business, assembly, and industrial purposes. Buildings are necessary for the storage of materials also. This article will discuss the basic requirements of a building concerning **orientation**, the **utility** of space, **energy efficiency**, and other **requirements**,etc.

"The concept of positioning all the elements and units of a building in a systematic and practical manner to have the **maximum and best utilization of the available space, area and facilities** is termed as **Principles of Building Planning**."

1.8.1 PRINCIPLES OF BUILDING PLANNING:-

"The concept of positioning all the elements and units of a building in a systematic and practical manner to have the **maximum and best utilization of the available space**, **area** and **facilities** is termed as **Principles of Building Planning**."

There are several principles that affect the planning of a building. This article will give you a brief knowledge of all those principles.

Factors Affecting Building Planning

1.8.2 FACTORS AFFECTING THE PLANNING OF THE BUILDING:

1. The **function** of the building e.g. residential, industrial, public, commercial, etc.
2. **Shape and size of the plot**

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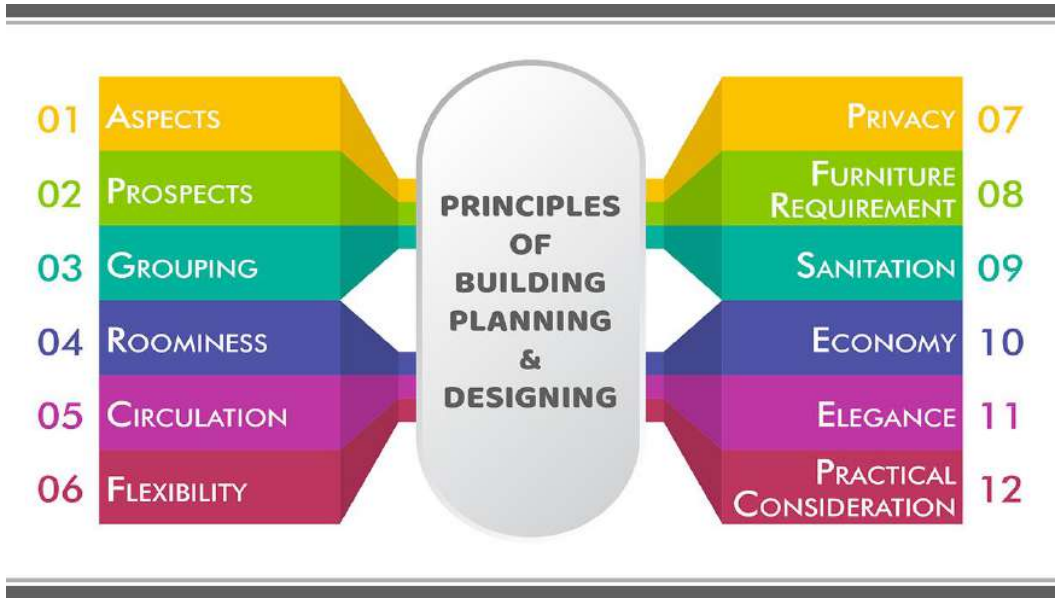
3. **Topography**
4. **Climatic** condition
5. Building by-Laws etc.

1.8.3 REQUIREMENTS OF BUILDING PLANNING AND THE CONSTRUCTION:



01. What is an ASPECT in building planning?

A building is a complete constitute of different rooms and blocks in it. All the rooms are located according to the standard **use** of components considering the **proper access of natural resources,** i.e., **sunlight** and **wind**. ASPECT is defined as a significant **arrangement of doors and windows** in abuilding, which are enough and efficient to provide **sunlight**, **hygiene**, **wind**, and **eco-friendly environment**. There must be sufficient **light** and **ventilation** in each room and across the house.

The aspect of building can be achieved by **arranging** the rooms, kitchen, veranda, and many other components in **proper directions**. The ways to cover the direction with advisable aspect is given below:

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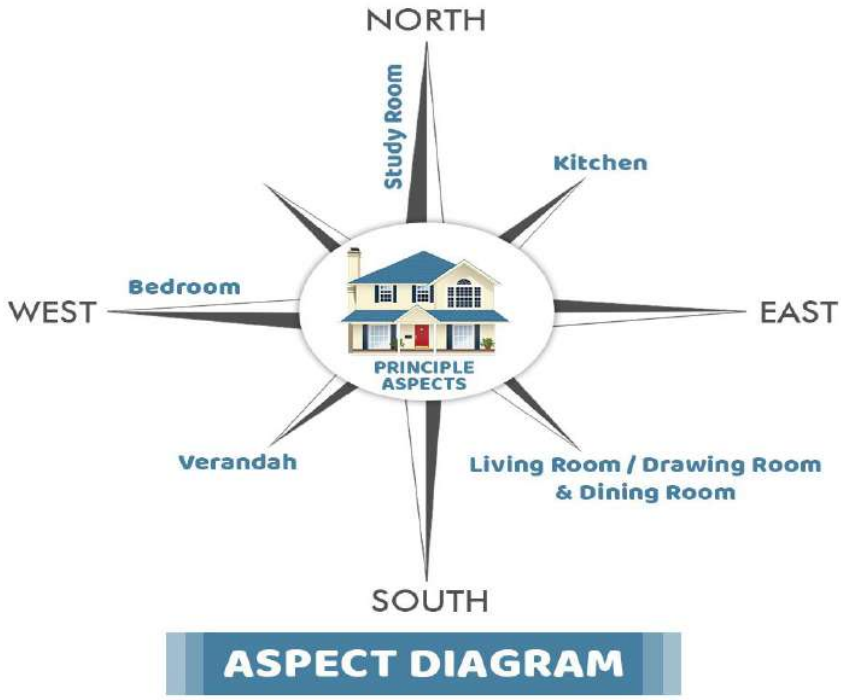

The above diagram indicates the appropriate directions which should be preferred for the **positioning** of various rooms in a house.

02. What are the PROSPECT principles in building planning?

In these modern times, all the buildings and constructions are aimed to achieve an **aesthetically appealing look** from both **exteriors** and **interior** considerations. The appearance of a house or a building is defined as **PROSPECT.**

The standards are raised to accomplish the building's **pleasant look** by locating doors and windows at an **accurate location** to view nature's beauty and avoid unwanted attributes from getting entry into the house.

One of the other factors of the prospect is to have a pleasant view outside a house from doors, windows, balconies as clearly as possible, as shown in the above image.

03. What does the GROUPING mean in building planning?

GROUPING: It is to organize the different rooms in such a way that they are adequately **interconnected with each other** to form a functional and practical layout of the house. The **accessibility** of all the rooms is **interlinked** with each other, and this provision can be satisfied by grouping.

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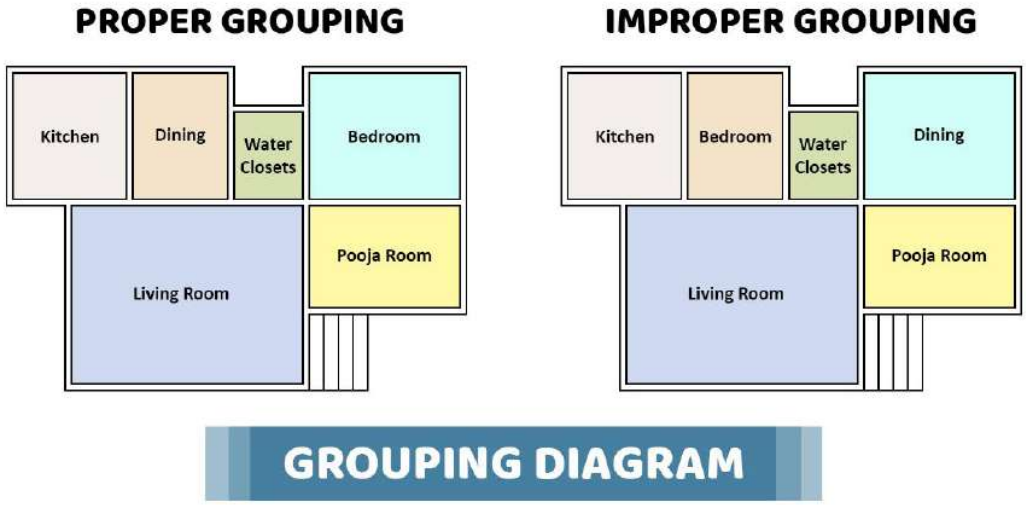
To understand the theory of grouping, let us consider an example. In a simple sense, the dining room should be near to the kitchen so that both the units can be easily used for the service. Similarly, water closets should be close to the bedrooms and living room but not close to the kitchen.

An idea of the grouping is applicable not only in a residential building but also applies to commercial and industrial buildings. In industries, the storage rooms must be near the road to ease the loading and unloading of the goods.



GROUPING DIAGRAM

The above figure indicates the common groups of rooms, which should be combined together while planning a residential building.

04. How ROOMINESS can be a principles of building planning?

- The meaning of ROOMINESS is to **<u>maximize the advantage of the available space</u>** from the **minimum dimension** of a room. Both the size and shape of the room play a vital role in providing roominess.

<u>POINTS TO UNDERSTAND THE ROOMINES</u>

- A square room seems small in size when compared to a rectangular room.
- It is always advisable to plan a rectangular room with a proportion of **1.2 to 1.5 times the ratio of the length to the breadth**. The increase in ratio due to length gives the tunnel experience as it looks longer.

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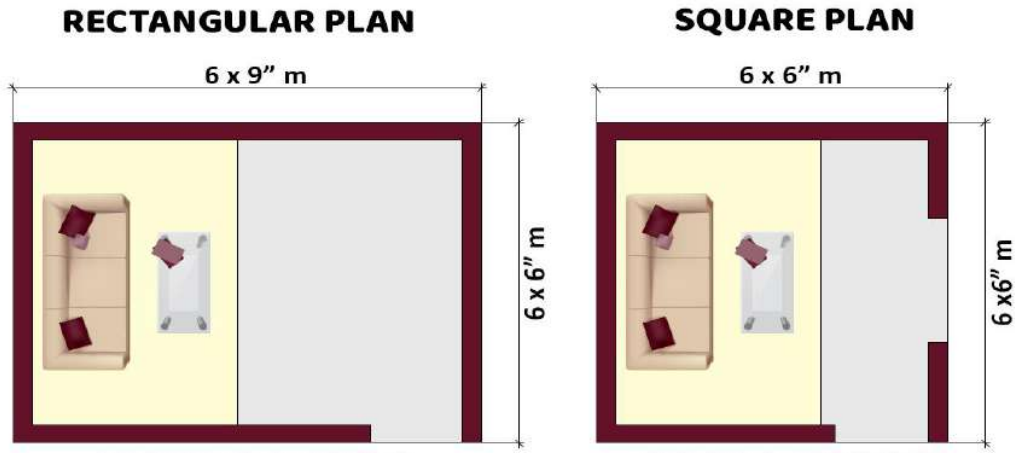
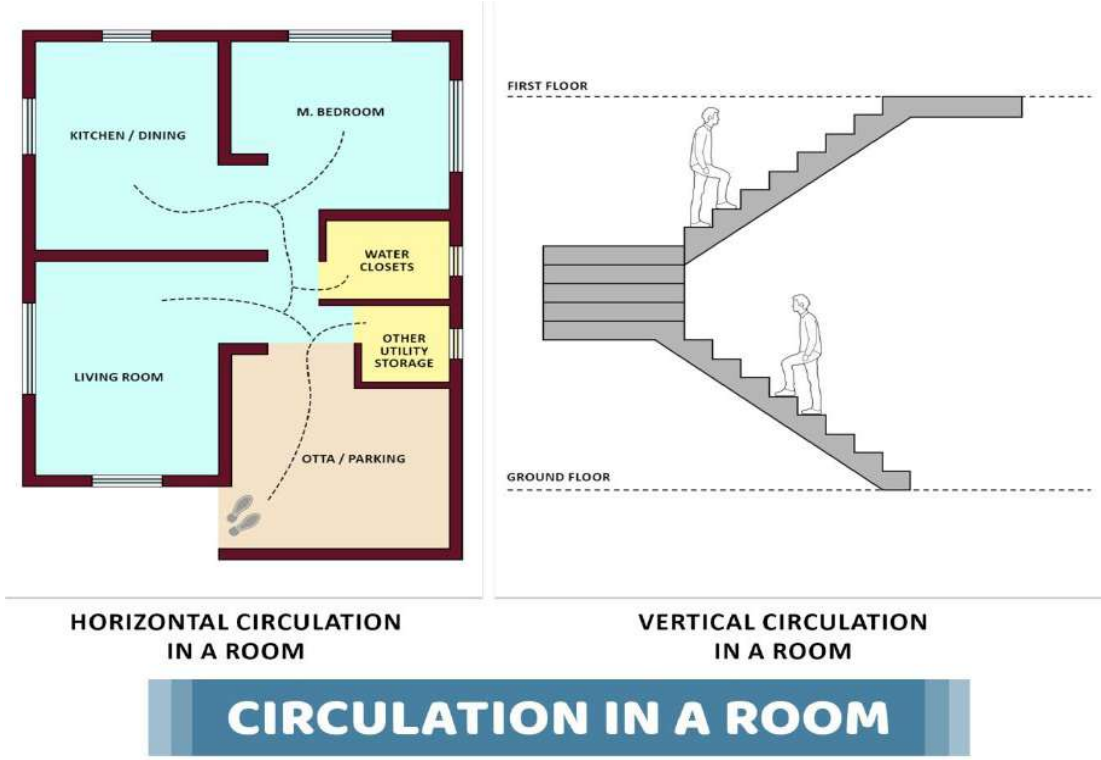
- Also, the **height** should neither be too high nor too less that the ceiling becomes a hindrance.
- Floors, ceilings, walls, ceiling, lifts, furniture, and all such elements should be appropriately placed to offer more space in the rooms.



ROOMINESS DIAGRAM

05. How CIRCULATION act as a principle of building planning?



CIRCULATION IN A ROOM

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The **internal access in a room in both ways** i.e. in **horizontal and vertical** directions of a building is defined as **CIRCULATION**. The movement from one room to another on the same floor can be described as **horizontal circulation**. Likely, the movement from one floor to the other floor is termed as vertical circulation. To have the efficient circulation in a building, passages, corridors and foyer etc should be provided in such a way that these elements are neither too **narrow nor too large**. They must have **good lighting and ventilation**. Some better options are highlighted in the diagram which reflects the ways of good circulation in a house.

06. What is Flexibility in building planning?

Flexibility means "to **allow use of the particular element in another way possible to fulfil a specific purpose.** An element is initially designed for one **particular reason**, but later the same element is **used differently**."

Let us take an example to understand the concept of the flexibility. One storey residential house has a dining and drawing hall on the ground floor, separated with a fibre partition wall in it. For various events and gatherings, both **dining** and **drawing** hall can be **combined** and converted into a **banquet hall** by removing partition wall. Also, future expansions of converting one unit to another must be kept in mind as it is one of the basic principles of construction.

07. What does Privacy means in building planning?

Privacy is an important factor that needs prior attention. Usually, the privacy can be considered in two ways:

01. Internal Privacy: This deals with the privacy inside a house, amongst the rooms. It covers the privacy between rooms and water closets, corridors, passage lobbies etc.

02. External Privacy: Privacy of a building with respect to other buildings and the things outside the building- such as streets, roads, etc., is external privacy.

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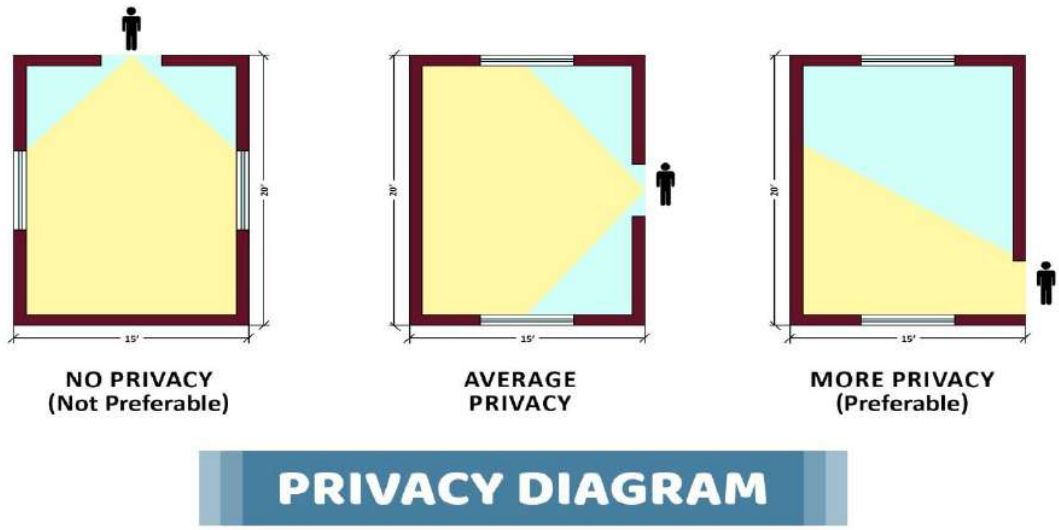

08. How FURNITURE influence principles of building planning?

According to rooms' functions, the type of furniture varies. The architects and planner must consider the **furniture's relative positions** to **avoid the congestion** of space. The furniture should match the purpose of the room and justify the **effective use of a room and furniture** as well.

There are many points to consider while choosing furniture for your house.

09. What is SANITATION in building planning?

The **hygiene maintenance** in a building is crucial. **Light, ventilation**, and **sanitary conveniences**, are essential factors that provide good sanitation in a building. Adequate sanitation can be achieved by placing **doors**, **windows**, and **ventilators** appropriately. Installing **exhaust fans, lighting lamps, suitable absorbent flooring, and improvised plumbing equipment** can lead to better sanitation.

It is studied that for **proper lighting**, the **least area of window** should **not be less** than **1/10th of floor area** in residential building. This ratio can be raised to **1/5th for buildings other than residential** ones.

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11. What is the importance of ECONOMY in building planning?

The economy is also one of the major factors to keep in mind while planning a structure. The building should not be **too expensive**. However, having said that, the cost cutting should not happen by **compromising on the safety and the building principles**. Often, the cost of the construction at the initial stage is higher as standard designs and materials are used, but it reduces the cost of maintenance and repair in the future.

11. What is ELEGANCE in building planning?

The elegance has a direct connection with the **appearance and layout** of a plan. It has become a trend nowadays to construct **attractive elevations**, which gives a pleasant sense of visibility. Straight, it depends on the **materials used** for construction in the exterior portion and relies on the positions of the door, windows, chhajja, balconies, and many such factors. All these components aim to enhance the look and thus it is necessary to give more footage to it while building planning.

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12. What are the PRACTICAL CONSIDERATIONS in building planning?

While **designing and planning** a building, there are several practical points to be considered for better results. These practical considerations are briefly mentioned as follows:

Life of a Building:

Having considered all the above important attributes a common question that arises is how long a building will survive and sustain and will remain serviceable? It is generally said that, a building has a **100 years life**, but this is not always true. The life of a building does not only deal with the **physical life** but also focuses on **economic** as well as **functional life**.

1.9 <u>BUILDING AREA TERMS</u>:-

<u>Plot area</u>:

The area which is **surrounded by a boundary line** (fencing) is called as Plot Area.

<u>Plinth area or Built-up area</u>

The **total building area** in plot area is referred as **Built up area**. In simple, Area **excluding empty space** around the building is called Built up area or Plinth area.

Built up Area = Carpet area+ Thickness of All walls + balcony

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The **plinth area** is the area that lies within the **outer-to-outer dimensions** of the walls of the building and is obtained by multiplying the out-to-out dimensions of the building at any floor level. The **space** covered by **pillars**, **pilasters**, and other **intermediate support** are not calculated in the floor area.

The built-up area and plinth area may or may not same.

Carpet Area:

It is the area that can **actually be covered by a carpet**, or the area of the apartment **excluding the thickness of inner walls**. Carpet area does **not include** the space covered by common areas such as **lobby**, **lift**, **stairs**, **play area**, etc. **Carpet area** is usually around **70%** of the **built-up area**.

Setback area:

The **empty space** around the building is called **Setback area**. The setback area is decided by Municipal Authority. In India, we **leave 4 ft from all the sides of the building**. The reason behind leaving setback area is to make ease for moving **vehicles, ventilation and during emergency purposes**. However set back area increases for High rise building and may go up to several meters.

Setback area = Plot area – Built-up Area

Built-Up Area:

Built-up area is the area that comes after adding **carpet area (70%) and wall area (30%)**. Now, the **wall area** does not mean the surface area, but the **thickness of the inner walls** of a unit. The area constituting the **walls is around 20% of the built-up area** and totally changes the perspective.

The built-up area also consists of other areas mandated by the authorities, such as a **dry balcony, flower beds,** etc., that add up to **10%** of the built-up area. So, when you think about it, the usable area (carpet area) is only **70% of the built-up area**.

Super Built-Up Area:-

It is the area calculated by adding the **built-up area and common area** that includes the **corridor**, **lift lobby, lift**, etc. In some cases, builders even include amenities such as a **pool**, **garden** and **clubhouse** in the common area. A developer/builder charges you on the basis of the **super built-up area** which is why it is also known as '**saleable' area**.

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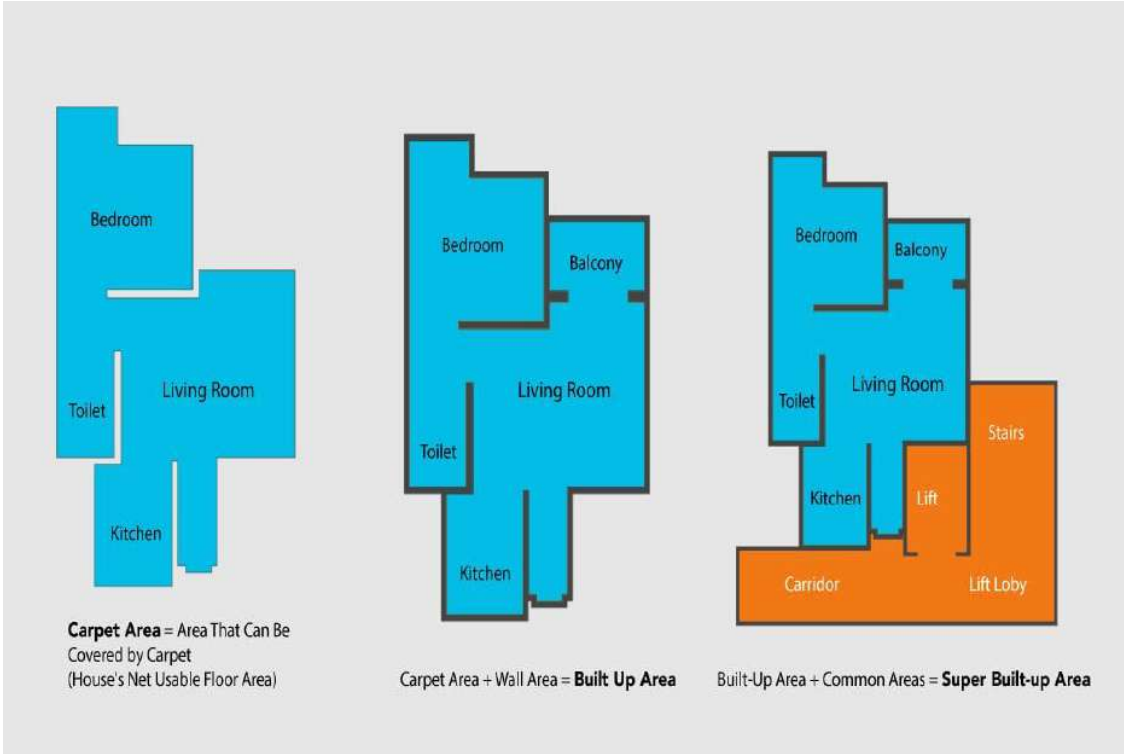

COMPUTATION OF PLINTH AREA/BUILT UP AREA -

- Plinth area = building carpet area + wall area (both internal and exterior walls) + parasitic area + elevator openings, etc.
- The plinth area is the space between the building's exterior and outer bounds or its walls.
- The **plinth area is 10 to 20% greater than the carpet area**.

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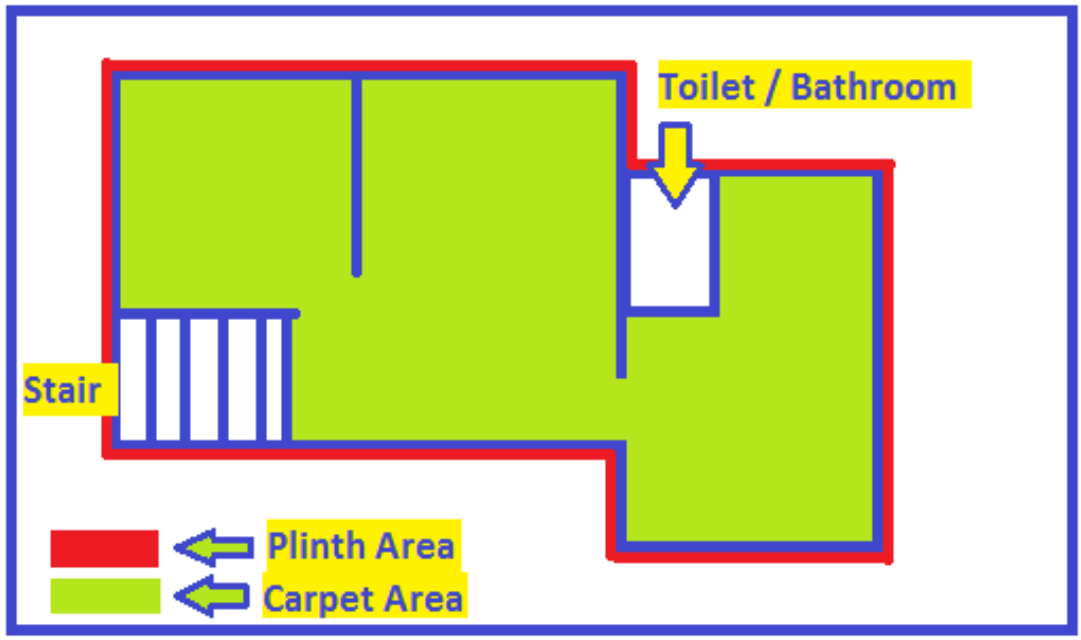

COMPUTATION OF CARPET AREA/LIVABLE AREA-

- Calculated by subtracting the area of the **outer and inner walls** of the building from the **total floor area of the building**. **Carpet Area = Built-up area – Area of walls**.
- For example, if the built area of a property is 2000 sq ft, then its carpet area would be 1400 sq ft.
- The carpet area is the sum of the **actual areas of the rooms that you can carpet**
- The carpet area is smaller than the plinth area by 10 to 20%.

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