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MODULE 1

SYLLABUS

General Introduction to Civil Engineering - Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of civil engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

GENERAL INTRODUCTION TO CIVIL ENGINEERING

Civil Engineering is the art of directing the great resources of nature for the use and convenience of man. Civil engineers have one of the world's most important jobs. They build our quality of life. With creativity and technical skills, civil engineers plan, design, construct and operate the facilities essential to modern life, ranging from bridges and highway systems to water treatment plants and energy efficient buildings. Civil engineers are problem solvers, meeting the challenges of pollution, traffic congestion, drinking water and energy needs, urban redevelopment and community planning.

American Society of Civil Engineering(ASCE) defines civil engineering as the profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied for the progressive well being of humanity by creating, improving and protecting the environment, in providing facilities for community living, industry and transportation etc.

As the technological revolution expands, as the world's population increases and environmental concerns mount, civil engineering skills will be increasingly needed throughout the world. It can be said that we cannot have modern civilization without civil engineers.

RELEVANCE OF CIVIL ENGINEERING IN THE OVERALL INFRASTRUCTURAL DEVELOPMENT OF THE COUNTRY

Infrastructure is the framework of supporting system consisting of roads, airports, bridges, buildings, parks and other amenities for the comfort of people. Infrastructure deals with the following:

- Transportation
- Telephone Network
- Television Network
- Educational Facility
- Good healthcare facility
- Agricultural Activity
- Construction Activity

Role of Civil Engineers in Infrastructural Development

- Construction of residential, commercial and industrial buildings for urban and rural areas.
- Construction of roads, railways, ports, harbours and airports.
- Town and City Planning
- Construction of dams for proper utilization of water resources and flood control
- Providing safe, domestic, agricultural and industrial water supply
- Providing secure and scientific disposal of waste
- Monitoring land, water and air pollution and take measures to control them
- Maintenance of facilities
- Rebuilding, Rehabilitation, Retrofitting and Repair

VARIOUS DISCIPLINES OF CIVIL ENGINEERING

As a wide branch of engineering, Civil Engineering has various disciplines which are as follows:

(1) Construction Management

Using technical and management skills, construction engineers turn the design into reality on time and within the budget. They apply their knowledge of construction methods and equipment, along with the principles of financing, planning and managing to turn designs into successful facilities.

(2) Structural Engineering

They design the structures that support their own weight and the loads they carry and that resist extreme forces from wind, earthquakes etc. They also plan, design and visit project sites to make sure the work is done properly.

(3) Geotechnical Engineering

They develop projects below the ground such as tunnels, foundations and offshore platforms. The analyse the properties of soil and rock that support and affect the behavior of structures. They also take part in the design and construction of dams, embankments and retaining walls.

(4) Environmental Engineering

They translate the physical, chemical and biological processes into systems to destroy toxic substances, remove pollutants from water, reduce non hazardous solid waste volumes, eliminate contaminants from air and develop groundwater supplies.

(5) Transportation Engineering

They design, construct and maintain all types of transportation facilities including airports, highways, railroads, mass transit system and ports. An important part of transportation engineering is upgrading our transportation facility by improving traffic control and by introducing high speed trains, people movers and other inter modal transportation methods.

(6) Water Resource Engineering

The deal with the physical control of water. They work with others to prevent floods, supply water for cities, industry and agriculture, to manage beaches or to manage and redirect rivers. They design, construct and maintain hydroelectric power facilities, canals, dams and pipelines, pumping stations, seaport facilities etc.

(7) Surveying and Remote Sensing

Surveying is used to determine the positions of points on, above and below the surface of the earth by means of direct or indirect measurements of distances, elevations and directions. Surveying using electronic sophisticated instruments are called remote sensing.

RESPONSIBILITY OF AN ENGINEER IN ENSURING THE SAFETY OF BUILT ENVIRONMENT

Engineers have a responsibility to maximize the value of their activity to build a sustainable planet. In order perceive attainable goal and recognition of the changes over time and demand of the society. Empathies about the environmental limits and finite resources.

Sustainable development has become as an accepted orthodoxy for the global economic development and environmental protection since the ending of the twentieth century where engineers play an important role for this sustainable development and fortification.

Some of the responsibilities are:

- Valuable and competent, scheduling and administration.

- Explicit care and concern about technology's impact on nature and the environment.
- Principles of sustainable development followed, while thinking about any technical and engineering designs.
- Reduce the demand of resources.
- Reduction of waste production by using effectively the resources that are used.
- Make use of systems and products which reduce embedded carbon, energy and water use, waste and pollution, etc.
- Adopt strategies such as salvaging, reprocessing, decommissioning and discarding of components and materials.
- Carrying out a comprehensive risk assessment prior to starting of the project.
- Risk assessment should ensure and includes the potential environmental, economical and societal impacts, way ahead of the natural life of the engineering venture.
- Monitoring systems to measure any environmental, social and economical impacts of engineering projects so it can be identified at an early stage.
- Promote effective utilization, storage, handling, and discarding of harmful substances.
- Make joint efforts with other authorities to perk up treatment of contaminated sites and promote sustainable redevelopment.
- Promote early detection and response to land quality issues through legislated requirements for mandatory reporting of site contamination.
- Develop, modify and upgrade the ambient water monitoring system with proper maintenance.
- Team-up with the Department of Health to tackle issues related to contaminants in drinking water.

INTRODUCTION TO BUILDINGS

National Building Code of India defines the building as : 'Any structure for whatsoever purpose and of whatsoever materials constructed and every part there of whatever used for human habitation or not, includes all the structural elements like foundation, plinth, walls, floors, roofs, etc.

Building is a kind of structure which is built with materials and including with foundation, plinth, walls, floors, roofs, chimneys, plumbing and building services, fixed platforms, veranda, balcony, cornice or projection, part of a building or anything affixed thereto or any wall enclosing or intended to enclose any land or space and signs and outdoor display structures. For example, houses, factories, shopping malls, hospitals, etc.

The aim of a building is giving shelter along with security. Other purposes such as buildings serve several needs of society primarily as shelter from the weather, security, living space, privacy, to store belongings, supplied electricity and to comfortably live and work.

TYPES OF BUILDINGS

CLASSIFICATION OF BUILDINGS ACCORDING TO NBC:

According to National Building Code of India, buildings are classified based on occupancy criteria:

1. **Group A: Residential buildings**: Any building in which sleeping accommodation is provided for normal residential purposes with or without cooking or dining or both facilities.
2. **Group B: Educational Buildings**: Any building or part used for schools, colleges or day care purposes involving assembly for instruction, education or recreation.

   Eg: schools, colleges, day care centres etc.

3. **Group C: Institutional Buildings**: Any building or part of building used for medical treatment, care of persons suffering from physical or mental illness, diseases or care of infants or aged persons in which liberty of inmates is restricted.

   Eg: Hospitals, Custodial institutions etc.

4. **Group D: Assembly Buildings**: Any building or part where groups of people gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purposes.

   Eg: Theatres, assembly halls, auditoriums, museums, places of worship, exhibition halls etc.

5. **Group E: Business buildings**: Buildings used for transaction of business, for keeping accounts and records, professional establishments, service facilities etc.

   Eg: offices, banks, offices of engineers, laboratories, computer installations etc.

6. **Group F: Mercantile Buildings**: Building which is used for shops, stores, markets for display and sale of mercantile either wholesale or retail.

   Eg: shops, stores, markets, departmental stores.

7. **Group G: Industrial Buildings**: Building in which products or materials of all kinds and properties are fabricated, assembled, manufactured or processed.

   Eg: Laboratories, dry cleaning plants, power plants, refineries etc.

8. **Group H: Storage buildings**: Buildings used for storage or sheltering of goods, wares, vehicles or animals.

   Eg: Ware houses, cold storage, garage, store houses.

9. **Group J: Hazardous buildings**: Buildings used for storage, handling, manufacture or processing of highly combustible and explosive materials.

   Eg: Power plants

SELECTION OF SITE FOR BUILDING

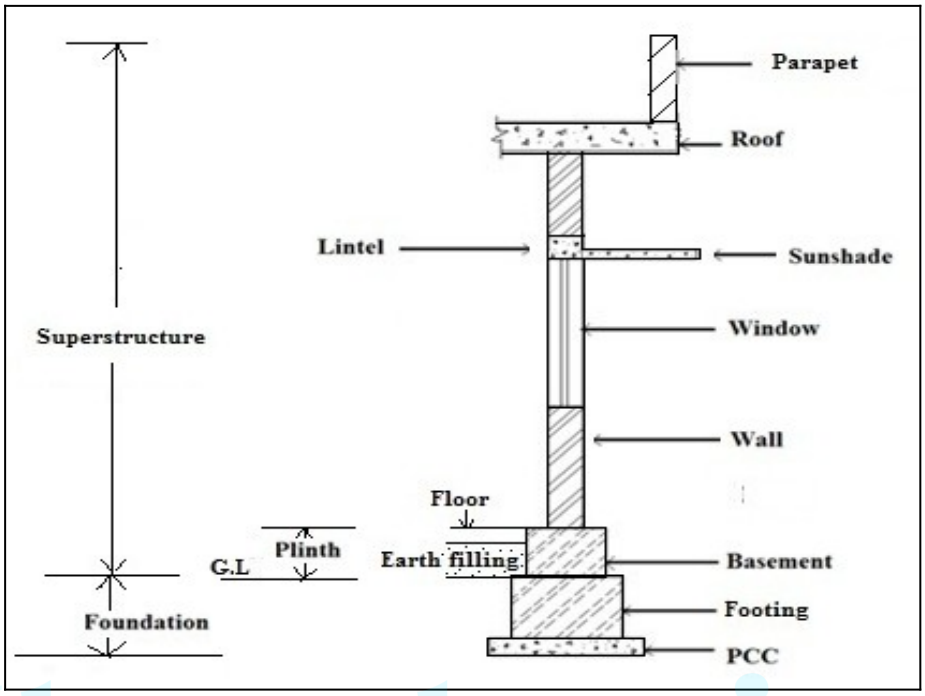
The following are the various factors to be considered during the selection of site for a building:

1. The site should suit the purpose of building and the extent of privacy needed.
2. Availability of natural light, pollution free air and should be away from noise pollution.
3. Type of building also affects the site selection.

   (For example, industrial buildings should be situated outside the city, residential buildings must be near schools and hospitals, and public buildings should be located in open area so that all the requirements may be fulfilled)

4. Legal and financial aspects – proper ownership right and reasonable cost.
5. The locality should be well developed or a fast developing one.
6. Easy access to Transportation facilities like roads and railways.
7. Availability of utility services like water supply, electric lines, gas, and drainage etc near to site.
8. Availability of community services like police and fire protection, clearance of waste, street cleaning etc.
9. Amenities like schools, hospitals, libraries; recreation centres etc should be available near the site.
10. Soil existing at that site, should be of natural type. Not a made up land.
11. Site should be a levelled ground. Should not be in a depression. Or it will increase the cost of levelling.
12. The site should have its general slope, for the easy drainage of water.
13. The ground water table in the site should not be high.
14. The site should possess a good soil at reasonable depth so that the foundation cost is reduced.
15. The selected site should be adequate to accommodate all the essential accessories required in the building.
16. Climatic conditions and Topographical features of the region.
17. Natural beauty – for healthy living and working condition.
    Site along seashore is good from the entertainment point of view but sea breeze affects health.
18. The area of the plot must be sufficient to meet the present needs and the future needs for expansion.
19. Proper ownership and other legal matters have to be checked before buying a site.

COMPONENTS OF A RESIDENTIAL BUILDING AND THEIR FUNCTIONS



A building can be divided in to 2 parts.

1. ***Superstructure***: - It is the part of the structure above the ground floor.
   - **Parapet** – Thin walls constructed at the edge of roof slab for safe usage.
   - **Roofs** – It is the top most part of a building. It covers the space enclosed by walls. It can be sloping or flat. Tiled roof gives good thermal protection. Flat roofs provide provision for additional floors.
   - **Wall** – It divides enclosed space in to rooms and provides privacy. It transfers load of structure to the foundation. It provides safety from theft, illegal entry etc. It keeps the building from adverse effects of weather changes.
   - **Lintel-** It is the structural element above the window and door opening, which supports the wall above. It protects doors and windows from loads above. Width of lintel = thickness of wall.
   - **Sunshade** – It is a slab provided just above doors and windows on the external wall. It protects the doors and windows from direct sunlight and rain.
   - **Doors and windows** – Connects different internal and external parts of a building. It gives access to different rooms in the building and also to deny access whenever

necessary. Also allows the entry of light and air in to the rooms. Windows are located at a height of 0.75-0.9 m from floor level. In hot and humid regions, window area should be 15-20% of floor area.

- **Ventilators**- Openings provided on top of the outer walls for the escape of foul gases from rooms.
- **Window sill**- Protects the top of the wall from wear and tear. It consist of a 50-75 mm thick plain cement concrete provided over the masonry.
- **Steps, Stairs** or lifts – These are structures to climb from one floor to another. Stair consists of a number of steps of uniform size. Steps are usually provided with 15cm rise and 25-30cm wide.

  Lifts provides easy access to different floors.
- **Floors**- Provides supports for occupants, furniture and equipments in a building. It divides the building in to different levels. It provides useful area for the occupants.
- **Finishes**: Ceiling, walls and top of floor need smooth finishing with plaster. It gives protective cover and improves appearance.
- **Plinth** - It is the portion between ground floor level and the ground level. It is usually made up of stone masonry. Height of plinth should be less than 45cm and atleast 15cm above the road level for providing proper drainage systems.

2. ***Foundation***: - I t is the lowest part of the building below Ground level. It transmits all the loads from superstructure to the soil below. It consists of footing and a thin layer of Plain Cement Concrete course. It provides a level surface for the construction of the super structure.

Building component	Nominal Dimension
Plinth (Height)	30,45,60,75,90 cm
Wall thickness Partition wall Load bearing wall	 10 cm 20, 30,40 cm
Lintel (thickness)	15 cm
Chajja Projections	30,45,60,75,90 cm
Slab thickness	0,1 to 0.15 m
Parapet wall thickness	10 cm
Parapet height	1 m
Door width	0.8, 0.9, 1.0, 1.2 m
Door height	1.8, 2.0, 2.1 m
Sill height	0.07 to 0.1 m
Lintel height	2.0 m from floor level

BUILDING RULES AND REGULATIONS

The following building rules and regulations have been established to provide a safe and well-maintained business environment for all tenants.

RELEVANCE OF NATIONAL BUILDING CODE (NBC)

National Building Code (NBC) is a national instrument providing guidelines for regulating the building construction activities across India. It serves as a Model Code for adoption by all agencies involved in building construction works. The Code mainly contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction, safety etc.

- It provide minimum standards for safety, health and general welfare including structural integrity, mechanical integrity (including sanitation, water supply, light and ventilation), means of egress, fire prevention and control, and energy conservation.
- Building codes provide safety.
- It ensures the economic well being of the community by reducing potential spread of fire and disease.
- Building codes conserve energy.
- It protects future home purchasers who deserve reasonable assurance that the home they buy will be safe.

RELEVANCE OF KERALA BUILDING RULES (KBR)

- Under the guidelines of NBC, every state has framed their own building rules.
- For framing the KBR norms, the climatic conditions, population density, geography, topography etc are considered.
- It enables uniform building construction practice throughout the state. For example, hot and humid climate of Kerala requires more ventilation for the buildings but for states having cold climate requires only less ventilations.
- A minimum setback rules are framed to assure wind flow, sunlight and passage space which are of at most importance.
- It helps for the future widening and development of streets and roads if necessary.

- Actions can be taken if these minimum criteria's are not met and violation to these norms is identified.
- For very special cases where the setback rules cannot be implemented fully, certain considerations are allowed by the local bodies.
- It helps to avoid unnecessary disputes between people.
- It can be used to categories different types of buildings and its uses.

RELEVANCE OF COASTAL REGULATION ZONE (CRZ) NORMS

The Rules, mandated under the Environment Protection Act, 1986, were first framed in 1991.The regulation zone has been defined as the area up to 500 m from the high-tide line. Several kinds of restrictions apply, depending on criteria such as population, ecological sensitivity, distance from shore, etc. CRZ Rules govern human and industrial activity close to the coastline, in order to protect the fragile ecosystems near the sea.

The restrict activities are:

- large constructions
- setting up of new industries
- storage or disposal of hazardous material
- Mining, or reclamation and bunding, within a certain distance from the coastline.

The basic idea is: because areas immediately next to the sea are extremely delicate, home to many marine and aquatic life forms, both animals and plants, and are also threatened by climate change, they need to be protected against unregulated development.

CRZ along the country has been placed in four categories.

- **CRZ-1**: these are ecologically sensitive areas these are essential in maintaining the ecosystem of the coast. They lie between low and high tide line. Exploration of natural gas and extraction of salt are permitted
- **CRZ-2**: these areas are urban areas located in the coastal areas. Now under new coastal zone regulations 2018, the floor space index norms has been de-freezed and permit FSI (floor

space index) for construction projects, which enable redevelopment of these areas to meet the emerging needs.

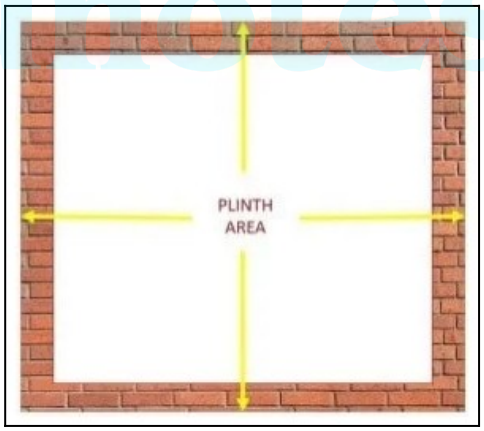
- **CRZ-3**: rural and urban localities which fall outside the 1 and 2. Only certain activities related to agriculture even some public facilities are allowed in this zone
- **CRZ-4**: this lies in the aquatic area up to territorial limits. Fishing and allied activities are permitted in this zone. Solid waste should be let off in this zone.

If the regulations listed in the CRZ Notification are implemented properly, the coastal zones can be safeguarded against encroachments.

BUILDING AREA

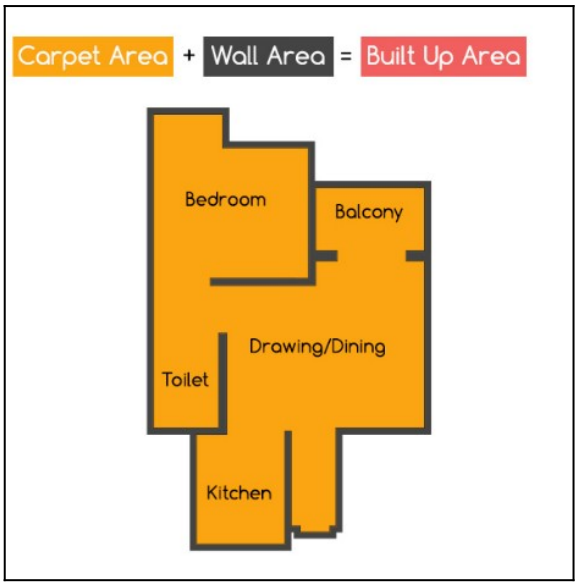
1. Plinth Area

The built covered area measured at the plinth level of the building is known as plinth area. Plinth area is the covered built-up area measured at the floor level of any storey or at the floor level of the basement. Plinth area is also called as built-up area and is the entire area occupied by the building including internal and external walls. Plinth area is generally 10-20% more than carpet area.



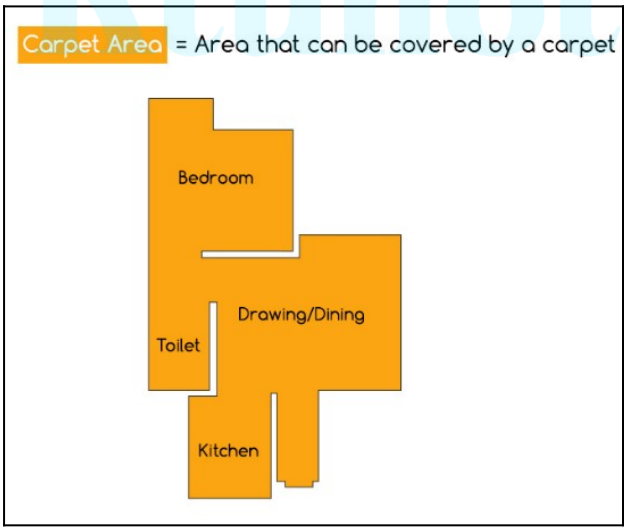
2. Built Up Area

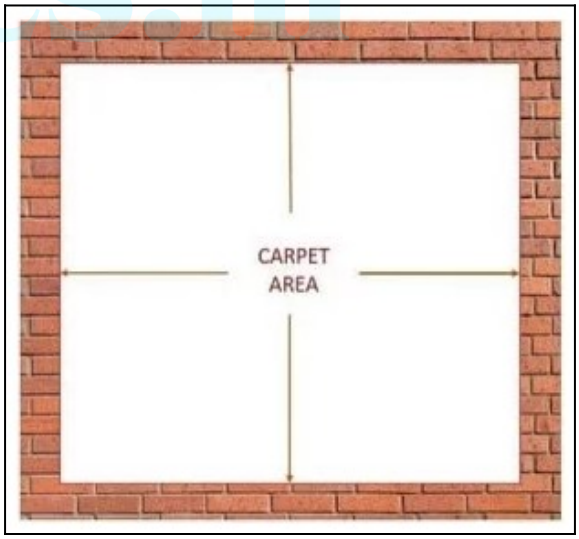
Built-up area is the carpet area plus the area covered by walls. The built-up area includes balconies, terraces (with or without roof), mezzanine floors and other detachable habitable areas such as servant room, etc. You should also know that walls which are shared with other units are factored in at 50 per cent while other walls are computed fully.



3. Carpet Area

Carpet area is the covered area of the usable spaces of rooms at any floor. It is measured between walls to walls within the building and is the sum of the actual areas of the rooms where you can carpet.





4. Floor Area Ratio (FAR)

Floor area ratio means the quotient obtained by dividing the total floor area on all floors by the area of the plot.

Floor area means the built up area of a building at any floor level