# MODULE I

## GENERAL INTRODUCTION TO CIVIL ENGINEERING

*Civil Engineering* is the art of directing great resources of nature for the use and convenience of the man. Civil Engineers have one of the world's most important jobs. With creativity and technical skills, they 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. They are problem solvers, meeting the challenges of population, traffic congestion, drinking water and energy needs, urban redevelopment and community planning.

As the technological revolution expands, as the word's population increases and as environmental concerns mount, civil engineering skills will be needed throughout the world. So there cannot be modern civilization without Civil Engineers. Civil Engineering provided enduring monuments and lasting legacies. Pyramids of Egypt, Roman Aqueducts, Great wall of China, Taj Mahal etc shows the exceptional skills and remarkable abilities of Civil Engineers.

## RELEVANCE OF CIVIL ENGINEERING IN THE INFRASTRUCTURAL DEVELOPMENT

Infrastructure is the framework of supporting system consisting of transportation, communication, energy, lifeline facilities, irrigation facilities etc that help a community or government to function, grow and develop. It contributes to the economic development of a nation or country. Higher the infrastructure facilities higher will be the growth prospects. Economic infrastructure contributes directly to the economic development, while social infrastructure *viz*. education & training, social welfare, housing, water supply etc will have indirect influence on the economic development of the country.

**Various roles of civil engineers in infrastructural developments is given below**

- Construction of residential, commercial and industrial buildings for urban & rural areas.
- Town & city planning.
- Construction of roads, railway, ports, harbours & airports.
- Construction of dams for proper utilization of water resources and flood control.

- Providing safe domestic, agricultural, industrial water supply.
- Providing secure and scientific waste disposal.
- Monitoring land, water and air pollution and take measures to control them.
- Maintenance of facilities.
- Rebuilding, rehabilitation, retrofitting and repair.

## Disciplines of Civil Engineering

- **Structural Engineering** - Analysis and design of structures such that they should bear own weight and the loads they carry and resist extreme forces from wind, earthquakes, bombings, temperature & others.
- **Construction Engineering** - Turns designs into **reality.** Includes **Management** of construction resources: labor, materials, equipment, money and time.
- **Geotechnical Engineering** - Develop projects **below the ground**. Eg: tunnels, foundation, offshore platforms. Analyze the properties of soil and rock that support and affect the behavior of these structures.
- **Environmental Engineering** - Providing safe drinking water, cleaning up contaminated sites with hazardous materials, disposing of waste water and managing solid wastes.
- **Transportation Engineering** - Plan, design, construct, maintain and operate various transportation facilities. Eg - Highway, railway, airports, ports, etc.
- **Water resources Engineering** - Prevent floods, supply of water, protect beaches or to manage redirect, rivers. Design, construct and maintain hydroelectric power facilities, dams, pipelines, pumping stations, etc.
- **Surveying & Remote sensing** - Surveying - Determine the positions of points on, above below surface of the earth by means of direct or indirect measurements of distances, elevations and directions. Methods advanced from chain surveying to remote sensing.

## CLASSIFICATION OF BUILDINGS

### National Building Organisation Classification:

National Building Code(NBC) (SP :7 – 1983) Of India classifies the building structure based on occupancy, into 9 Different Groups represented from Group A to Group I .

As per NBC, buildings are classified based on occupancy as follows:

- Group A - Residential Buildings
- Group B - Educational Buildings
- Group C - Institutional Buildings
- Group D - Assembly Buildings
- Group E - Business Buildings
- Group F - Mercantile Buildings
- Group G - Industrial Buildings
- Group H - Storage Buildings
- Group J - Hazardous Buildings

### *Group A : Residential Buildings*

- These shall include any building in which sleeping accommodation is provided for normal residential purposes, with or without cooking or dining or both facilities, except any building classified under Group C.
- Residential types of building are further sub divided as per following
    - ❖ A-1 Lodging or rooming houses

- ❖ A-2 One-or two-family private dwellings
- ❖ A-3 Dormitories
- ❖ A-4 Apartment houses (flats)
- ❖ A-5 Hotels

***Group B : Educational Buildings***

These shall include any building used for school, college or day-care purposes involving assembly for instruction, education or recreation and which is not covered by Group D.

***Group C : Institutional Buildings***

These shall include any building or part thereof, which is used for purposes, such as medical or other treatment or care of persons suffering from physical or mental illness, disease or infirmity; care of infants, convalescents or aged persons and for penal or correctional detention in which the liberty of the inmates is restricted. Institutional buildings ordinarily provide sleeping accommodation for the occupants.

- Institutional types of building are further sub divided as per following

- ❖ C-1 Hospitals and sanatoria
- ❖ C-2 Custodial institutions
- ❖ C-3 Penal and mental institutions

***Group D : Assembly Buildings***

These shall include any building or part of a building, where groups of people congregate or gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purposes, for example, theaters, motion picture houses, assembly halls, auditoria, exhibition halls, museums, skating rinks, gymnasiums, restaurants, places of worship, dance halls, club rooms, passenger stations and terminals of air, surface and marine public transportation services, recreation piers and stadia, etc.

Assembly types of building are further sub divided as per following

- ❖ D-1 Buildings having a theatrical stage and fixed seats for over 1000 persons
- ❖ D-2 Buildings having a theatrical stage and fixed seats for less than 1000 persons
- ❖ D-3 Buildings without a stage having accommodation for 300 or more persons but no permanent seating arrangement
- ❖ D-4 Buildings without a stage having accommodation for less than 300 persons
- ❖ D-5 All other structures designed for assembly of people not covered by subdivisions D-1 -to D-4

***Group E : Business Buildings***

These shall include any building or part of a building which is used for transaction of business (other than that covered by Group F), for keeping of accounts and records and similar purposes, professional establishments, service facilities, etc. City halls, town halls, court houses and libraries shall be classified in this group so far as the principal function of these is transaction of public business and keeping of books and records

Business types of building are further sub divided as per following

- ❖ E-1 Offices, banks, professional establishments, like offices of architects, engineers, doctors, lawyers, etc.
- ❖ E-2 Laboratories, research establishments and test houses.
- ❖ E-3 Computer installations.

***Group F : Mercantile Buildings***

- These shall include any building or part of a building, which is used as shops, stores, market, for display and sale of merchandise, either wholesale or retail.
- Mercantile types of building are further sub divided as per following
  - ❖ F-1 Shops, stores, markets with area up to 500 m2.

- ❖ F-2 Underground shopping centres, departmental stores with area more than 500 m2 Storage and service facilities incidental to the sale of merchandise and located in the same building shall be included under this group.

***Group G : Industrial Buildings***

- These shall include any building or part of a building or structure, in which products or materials of all kinds and properties are fabricated, assembled, manufactured or processed, for example, assembly plants, laboratories, dry cleaning plants, power plants, pumping stations, smoke houses, laundries, gas plants, refineries: dairies and saw-mills.
- Industrial types of building are further sub divided as per following
  - ❖ G-1 Buildings used for low hazard industries
  - ❖ G-2 Buildings used for moderate hazard industries
  - ❖ G-3 Buildings used for high hazard industries.

***Group H : Storage Building***

- These shall include any building or part of a building, used primarily for the storage or sheltering (including servicing, processing or repairs incidental to storage) of goods, wares or merchandise (except those that involve highly combustible or explosive products or materials), vehicles or animals, for example, warehouses, cold storage, freight depots, transit sheds, storehouses, truck and marine terminals, garages, hangars (other than aircraft repair hangars), grain elevators, barns and stables.
- Storage properties are characterized by the presence of relatively small number of persons in proportion to the area. Any new use which increases the number of occupants to a figure comparable with other classes of occupancy shall change the classification of the building to that of the new use, for example, hangars used for assembly purposes, warehouses used for office purposes, garage buildings used for manufacturing.

***Group J : Hazardous Buildings***

- These shall include any building or part of a building which is used for the storage, handling, manufacture or processing of highly combustible or explosive materials or

products which are liable to burn with extreme rapidity and/or which may produce poisonous fumes or explosions; for storage, handling, manufacturing or processing which involve highly corrosive, toxic or noxious alkalis, acids or other liquids or chemicals producing flame, fumes and explosive, poisonous, irritant or corrosive gases; and for the storage, handling or processing of any material producing explosive mixtures of dust which result in the division of matter into tine particles subject to spontaneous ignition.

## SITE SELECTION FOR BUILDINGS

The site of a building greatly affects its planning, design and construction. It may be selected as required or accepted as available. The selection of site depends upon the purpose for which the proposed building is to be constructed.

### FACTORS TO BE CONSIDERED WHILE SITE SELECTION

#### (1) LEVEL OF THE SITE

The level of the site must be higher than that of its surroundings, so as to provide good drainage.

#### (2) CLIMATIC CONDITIONS

The intensity of rainfall and sub-soil water level should be low, so as to avoid dampness in the building.

#### (3) SUB-SOIL CONDITIONS

A hard stratum should be available at a reasonable depth (3ft to 4 ft from the ground level), so as, to construct the foundations of the building safely and economically.

#### (4) AVAILABILITY OF MODERN AMENITIES

The site must be within municipal limits, so that, modern amenities like, water supply, electricity, sewerage, roads, etc. can be made available with more ease, if there is no provisions at present.

#### (5) AVAILABILITY OF OTHER FACILITIES

The site should provide an easy access from the nearest road and offer sufficient light and air. There should be good and cheap transport facilities available near the site. It is always better, if public services like, fire brigade, police station, etc, are also not very far off from the site.

**(6) SURROUNDINGS**

The situation and surroundings of the site must be such as to suit the purpose for which the building is to be constructed. Each type of building requires different surroundings, than for others.

## GENERAL PRECAUTIONS IN SELECTION OF SITE

(1) The site consisting of reclaimed soil (made useful for cultivation) should be avoided, as far as possible.

(2) The site must not be located in water logged areas or near the bank of a river.

(3) Old quarry sites must be avoided, as far as possible.

(4) The site for a residential building should be away from the area causing foul odor or smoke nuisance due to industrial buildings.

(5) The site for a residential building, school or hospital should be away from noisy areas.

(6) There should be no disabling easement.

(Easement is a right, which a person may have over another man's land by law, such as, the right to walk over it or to run a pipe through it).

## COMPONENTS OF A RESIDENTIAL BUILDING

A Building can be broadly divided into two parts;

- Sub-structure (portion below ground, transmit load to ground)
- Super-structure (portion above Plinth level)

Building components can be summarized as;

- Foundations
- Plinth
- Walls
- Columns & Beams
- Floors
- Doors & Windows (Openings)
- Stairs & Lifts
- Roof
- Lintels and Arches
- Building Finishes (Plastering, Pointing)
- Building Services (Plumbing, Electrical, Water Supply, Sewerage, Utility..)

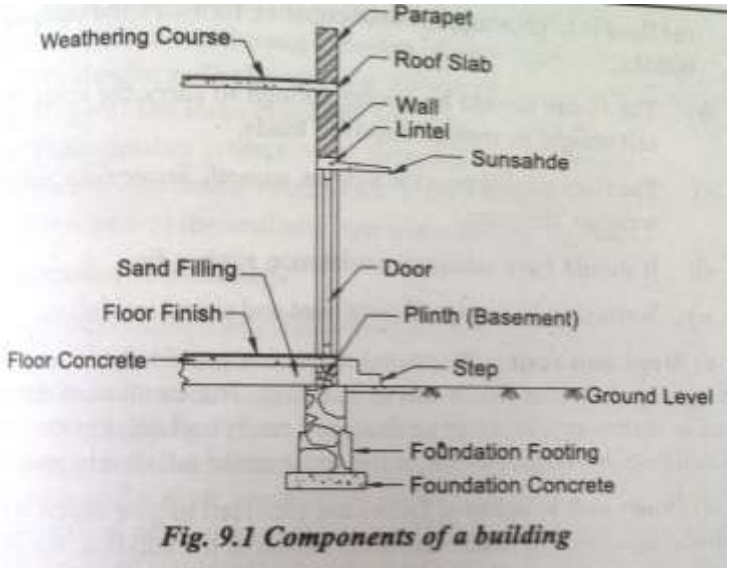
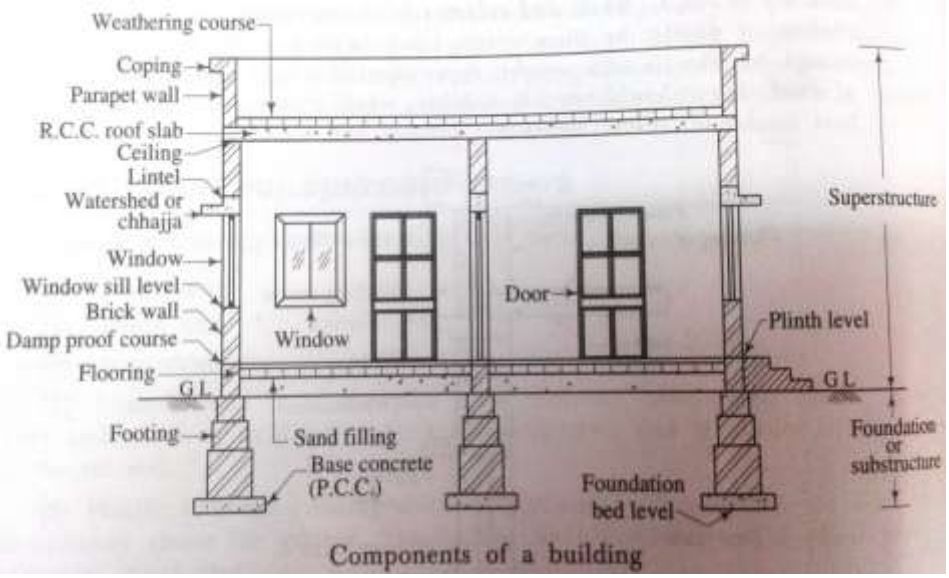



*Fig. 9.1 Components of a building*



Components of a building

**Sub-structure or Foundation**

- Portion of the building below ground level which transmits the load of the super structure to the soil. Most critical part which safeguards the building against the forces of wind, uplift, soil pressure etc. Any fault in foundation leads to the collapse of the building.

Important functions are:-

a) It distributes the total load coming on the building uniformly to a large bearing area.

b) It provided a level and firm surface for the construction of superstructure.

c) It prevents unequal or differential settlement of the structure.

d) It ensures stability of the building against sliding, overturning etc.

e) It ensures the stability of the building against undermining due to flood water or burrowing animals.

**Plinth**

- It is the middle part of the building above the surface of the surrounding ground up to the surface of the floor (ie floor level). Also called basement. Minimum height of plinth is usually kept as 45 cm. Usually a coping (projection) of finely dressed stones or of concrete is provided at the top of plinth.

Important functions are:-

a) It transmits the load from superstructure to sub structure.

b) It act as retaining wall for filling inside the plinth or raised floor.

c) It protects the building from dampness and moisture penetration.

d) It improves the architectural appearance of the building.

**Super structure**

- Component of building which is constructed above the plinth level. Includes walls and piers, floors, doors and windows, lintels, sunshades, roofs, steps and stairs and finishes for walls.

***Walls and piers***

- Main function is to divide the space into different rooms. Walls support the loads from the roof/upper floors to the foundations. Piers or pillars are thickened sections of the walls placed at intervals to carry the concentrated loads. Walls are built with bricks, stones, or with concrete.

Important features of walls:-

a) It should be strong enough to carry the its self weight as well as imposed loads from upper floors.

b) External walls should provide sufficient resistance against weathering agencies like sun, wind, rain and snow.

c) It should be stable against overturning by lateral forces.

d) It should have adequate resistance against fire.

e) It should have sufficient heat and sound insulation.

It should provide sufficient privacy and security against theft

***Floors***

- Floors are provided to divide a building into different storeys for creating more accommodation one above the other. Its main function is to give support to occupants, furniture and equipment of a building.

Features of floor are:-

a) It should be strong enough to carry the loads safely its self weight as well as imposed loads.

b) Should be clean, smooth, impervious, durable and weather resistant.

c) It should have adequate resistance against fire.

d) Should have sufficient heat and sound insulation.

***Steps & stairs***

- They are provided for access to the building or to the other floors of the building. Location of stair is fixed in such a way that it can be accessed quickly from all parts of the building.

***Doors & Windows***

- Doors are provided to give access to outside of the building as well as to connect inner rooms of the building. Window is an opening provided for ventilation and natural light.

Important features of doors & windows:-

a) They should be weather resistant.

b) They should have adequate resistance against fire.

c) they should have sufficient heat and sound insulation.

d) They should provide sufficient privacy and security against theft.

***Beams & Lintels***

- Beam is a horizontal structural member, which carries floor slab or roof.

- Lintel is a beam that supports masonry work over openings in the walls.

***Sunshade***

It is projection provided outside a building above the doors and windows to prevent direct sunlight and rain to the rooms.

***Roof***

- It is a cover for the building to protect it from rain , wind, snow, sunlight etc. May be flat, sloped or curved type.

Important features of Roofs:-

a) It should be strong, durable & weather resistant.

b) It should have adequate resistance against fire.

c) It should have sufficient heat and sound insulation.

***Parapet***

- Short masonry wall built on top of the roof of a building. Serves as an enclosure above the roof and as an element for good appearance.

***Weathering course***

- Layer provided over the roof slab to protect the roof from weathering agencies like sunlight, rain and wind.

***Finishes for walls***

- They are pointing, plastering, painting etc.
- Main functions:
    - ✓ Protects walls from effects of weather.
    - ✓ Covers the defective materials or poor workmanship to some extent.

Improves aesthetic appearance of the building

## Significance of FAR

$$FAR = \frac{\text{Total floor area}}{\text{area of the plot}}$$

→ It is used as one of the regulations in city planning along with the building to land ratio.

→ FAR can be used in zoning to limit urban density.

→ While it directly limits building density, indirectly it also limits the number of people that a building can hold, without controlling a building's external shape.

→ Determination of FAR is essential to ensure the best posible living conditions for the residents of the area.

→ FAR include a clear demarcation between the open spaces & the constructed spaces.

→ It helps the authorities to incorporate stable & planned construction.

Chapter 3

# BUILDING RULES

## 3.0 National Building Code

### 3.0.1 Introduction

The planning commission of India has emerged out with efforts to unify and standardize the construction practices in our country soon after the Third Five Year Plan. Various studies conducted in this resulted in a recommendation that a National Building Code (NBC) be prepared to unify the building regulations throughout the country. The task of preparation of National Building Code was entrusted to Bureau of Indian Standards (BIS). The first version of NBC was published in 1970. This was revised in 1983 by including large number of comments and suggestions received from various sections of the people concerned. Later this edition was again revised to current one in 2005 and in 2016. Now this code has 11 parts namely

Part 0 Integral Approach

Part 1 Definitions

Part 2 Administration

Part 3 Development Control Rules & General Building Requirements.

Part 4 Fire and Safety

Part 5 Building materials

Part 6 Structural Design

Part 7 Constructional Practices and Safety

Part 8 Building Services

Part 9 Plumbing Services

Part 10 Landscaping, Signs and Outdoor Display Structures

## 3.1 Relevance of NBC

National Building Code (NBC) controls ultimately all construction activities in our country. It provides guidelines for all regulations related to building construction. States and Union territories of our country have framed building rules and rules of fire fighting, solid waste management etc. based NBC. Still in the absence of a state rule, provisions of NBC prevail. This Code, besides prescribing various provisions, also allows freedom of action to adopt appropriate practices absorbing traditional practices as well as latest developments in knowledge in the various disciplines as relevant to a building including computer aided and/or other modern sensors aided activities in the various stages of conceptualization, planning, designing, constructing, maintaining and repairing the buildings. Information and mandatory practices are available in NBC related to the following aspects.

1. *Development and building planning:* - General Building regulations, fire and life safety, building materials, landscape development, sustainability approach.
2. *Structural Design aspects:*- Loads and forces, Soils and foundations, Building materials, Masonry, Concrete, steel, Glazing and Prefabrication.
3. *Construction and Asset/Facility Management*: Construction management practices and safety, Asset and facility management.
4. *Building services*: Lighting and Natural Ventilation, Electrical and Allied Installations, Air Conditioning, Heating and Mechanical Ventilation, Acoustics, Sound Insulation and Noise Control. Installation of Lifts, Escalators and Moving Walks, Information and Communication Enabled Installations
5. *Plumbing services and solid waste management*: Water supply. Drainage and sanitation, Solid waste management, Gas supply.

## 3.2 Kerala Building Rules

In our country, the building construction activities are regulated by a set of rules and guidelines called Building Regulations. Building regulations are framed based on NBC guidelines to suit town and country planning schemes and proposed land use patterns of the particular area. These rules are framed based various aspects like, development and land use patterns, utilization of



natural resources like sunlight and breeze, scope for future development of roads and public utilities, current and projected population growth, settlement patterns of people engaged in agricultural, commercial and industrial sectors.

The building regulations also ensure the quality and safety in construction by the way of warranting the services of qualified professionals like Architects, Engineers, Supervisors and Town Planners. Building regulations also play an important role in providing legal base to the authorized constructions and also for tax collection authorities like local body institutions and revenue authorities.

In Kerala State, building rules were first introduced in 1964, later revised in 1984 and 1999. The prevailing rules are "Kerala Municipal Building Rules 1999" for urban areas and "Kerala Panchayath Building Rules 2011" for rural areas.

### 3.2.1 Terminology

1) **Permit:** A permission or authorization in writing by the authority to carry out work.
2) **Site:** A parcel (piece) of land enclosed by definite boundaries. It is also called as plot.
3) **Set back Line:** A line usually parallel to the plot boundaries and laid down in each case by the Authority, beyond which nothing can be constructed towards the site boundaries.
4) **Open Space:** An area forming an integral part of the plot left open to the sky. Open space provided across the front is called *front open space*, for rear side it is *rear open space* and for sides, it is *side open space*.
5) **Plinth:** The portion of a structure between the surface of the surrounding ground and the surface of the floor, immediately above the ground.
6) **Floor:** The lower surface in a storey on which one walks in a building.
7) **Plot Area:** The area enclosed between plot boundaries.
8) **Covered Area:** Ground area covered by the building immediately above the plinth level. Gardens, well, drainage, culvert, compound

wall, gate, uncovered stair case, ramps, watch man's booth, garbage shaft etc. are excluded from covered area.

9) **Plinth Area:** The built covered area measured at the floor level of the basement or of any storey.

10) **Floor Area:** The built up covered area in all floors including basement floor. It is sometimes called as built up area.

11) **Carpet Area:** The covered area of the usable rooms at any floor level (excluding area of walls). Area of staircases, lift wells, escalators, ducts etc. are also excluded in carpet area.

In the absence of sufficient data, for calculating carpet area, *twenty* percent of floor area shall be deducted from total floor area.

12) **Floor Area Ratio (FAR):** The quotient obtained by dividing the total floor area on all floors by the plot area.

$$\text{FAR} = \frac{\text{Total floor area of the floors}}{\text{Plot area}}$$

13) **Coverage:** It is the covered area of the building. Normally expressed as the percentage of plot area.

### 3.2.2 Open Space Requirements

As per the latest Kerala Municipal Building Rules 1999, exterior open spaces are necessary for proper lighting and ventilation requirements.

*1) Exterior open spaces (set backs)*

a) Every building up to 10m in height shall have a minimum front yard of 3m depth. (Clearance from boundary)

b) Every building up to 10m in height shall have a minimum rear yard of 2m depth.

c) Every building up to 10m in height shall have an open air space of not less than 1.2 m width on one side and not less than 1.0 m on other sides other than front and rear yards.



d) For buildings above 10m in height, 0.5 m per increase of every 3m height is to be provided apart from minimum front, rear and side open spaces.

| | |
|---|---|
| Front open space | 3.0m + 0.5 m per every additional height of 3m above 10 m. |
| Rear open space | 2.0m + 0.5 m per every additional height of 3m above 10 m. |
| Side open space | 1.2m/1.0m + 0.5 m per every additional height of 3m above 10 m. |

e) For building above 4 storeys from ground level, a minimum open space of 5m is to be provided on any one side contiguous to front side.

f) For the buildings constructed on small plots, i.e. plot area less than 125 sq.m, the exterior open spaces (set backs) as follows.

| | |
|---|---|
| Front yard depth | 1.8m |
| Rear yard depth | 1.0m |
| Side yard depth | 0.9 m on one side and 0.6m on other sides |

*11) Interior open spaces*

### 3.2.3 Permissible Coverage and FAR for different types

To regulate the intensity of the construction and to ensure the scientific distribution of developmental activities, coverage and FAR are limited to various types of buildings as given below.

**Table 3.1 Permissible Coverage and FAR as per building rule**

| Sl. No. | Type of Building | Coverage | Max. FAR | Max. FAR with additional fees |
|---|---|---|---|---|
| 1 | Residential | 65 | 3.00 | 4 |
| 2 | Special Residential A2 | 65 | 2.50 | 4 |
| 3 | Educational B | 35 | 2.50 | 3 |
| 4 | Medical/Hospital C | 60 | 2.50 | 3.5 |
| 5 | Assembly D | 40 | 1.50 | 2.50 |
| 6 | Office/Business E | 70 | 3.00 | 4 |
| 7 | Mercantile/Commercial F | 70 | 3.00 | 4 |
| 8 | Industrial G1 | 65 | 2.50 | ... |
| 9 | Small Industrial G2 | 75 | 3.5 | 4 |
| 10 | Storage H | 80 | 3.0 | 4 |
| 11 | Hazardous I(1) | 45 | 2.00 | ... |

## 3.3 Coastal Regulation Zone (CRZ)

Central Government has declared the coastal stenches up to its territorial limit of our country excluding the islands of Andaman and Nicobar and Lakshadweep as Coastal Regulation Zones (CRZs) as per section 3 of the Environment (Protection) Act, 1986 and imposed restrictions on construction activities, setting up of industries, as per the notification in 2011. Many activities are prohibited like expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances and some of them are regulated.

### 3.3.1 Objectives of CRZ

1. To ensure livelihood security to the fisher communities and other local communities, living in the coastal areas.
2. To conserve and protect coastal stretches, its unique environment and its marine area.
3. To promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming



**Applicability**

CRZ shall be applicable in the following area

(i) The land area from High Tide Line (HTL) to 500 meters on the landward side along the sea front.

(ii) The land area between HTL to 100 meters or width of the creek whichever is less on the landward side along the tidal influenced water bodies* that are connected to the sea up to a distance based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year which shall be determined by the Coastal Zone Management Plans (CZMPs).

** tidal influenced water bodies means the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks.*

(iii) The land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body.

(iv) The land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

(v) The water and the bed area between the LTL to the territorial water limit (12 Nm – Nautical Mile) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

### 3.3.2 Classification of the CRZ

For the purpose of conserving and protecting the coastal areas and marine waters, the CRZ area shall be classified as follows, namely:-

**(i) CRZ-I**

**A.** The areas that are ecologically sensitive and the geo morphological features which play a role in the maintaining the integrity of the coast,-

(a) Mangroves areas;

(b) Corals and coral reefs and associated biodiversity;

(c) Sand Dunes, Mudflats which are biologically active;

(d) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas.

(e) Salt Marshes, Turtle and Horse shoe crabs habitats;

(f) Sea grass beds, Nesting grounds of birds;

(g) Areas or structures of archaeological importance and heritage sites.

**B.** The area between Low Tide Line and High Tide Line;

**(ii) CRZ-II**

The areas that have been developed upto or close to the shoreline.

**Explanation.-** For the purposes of the expression "developed area" is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

**(iii) CRZ-III**

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

**(iv) CRZ-IV**

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;

**B.** shall include the water area of the tidal influenced water body from the mouth of the water body at the sea up to the influence of tide which is measured as five parts per thousand during the driest season of the year.

**(v) Areas requiring special consideration.**

A. (i) CRZ area falling within municipal limits of Greater Mumbai;



(ii) The CRZ areas of Kerala including the backwaters and backwater islands;

(iii) CRZ areas of Goa.

**B.** Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisher folk.

### 3.3.3 Norms for regulation of permissible activities

The development or construction activities in different categories of CRZ shall be regulated by the concerned Coastal Zone Management Authority (CZMA) in accordance with the following norms. Existing structure means regular structure existing as on 19.2.1991 wherein CRZ notification, was notified.

**I. Permissible activities in CRZ-I**

(i) No new construction shall be permitted in CRZ-I except.-

(a) Projects relating to Department of Atomic Energy;

(b) Pipelines, conveying systems including transmission lines;

(c) Installation of weather radar for monitoring of cyclones.

(d) Construction of harbour sea link

(e) Development of green field airport.

(ii) The following activities permissible in areas between LTL and HTL.

(a) Exploration and extraction of natural gas;

(b) Construction of dispensaries, schools, public rain shelter, community toilets, bridges, roads, jetties, water supply, drainage, and sewerage with approval from concerned CZMA.

(c) Desalination plants;

(d) Storage of non-hazardous cargo.

(e) Construction of harbour sea links, roads on stilts or pillars without affecting the tidal flow of water.

**II. Permissible activities in CRZ-II**

(i) Buildings shall be permitted only on the landward side of the existing road, or on the landward side of existing authorized structures;

(ii) Buildings permitted on the landward side of the existing and proposed roads or existing authorized structures.

(iii) Reconstruction of authorized building.

(iv) Facilities for Fuel.

(v) Desalination plants and associated facilities;

(vi) Storage of non-hazardous cargo

(vii) Facilities for generating power by non-conventional power sources.

**III. Permissible activities in CRZ-III**

**A. Area up to 200mts from HTL on the landward side**

In case of seafront and 100mts along tidal influenced water bodies or width of the creek whichever is less is to be earmarked as "No Development Zone (NDZ)",

(i) The NDZ shall not be applicable in such area falling within any notified port limits;

(ii) No construction shall be permitted within NDZ except for repairs or reconstruction of existing authorized structure.

(iii) Construction/reconstruction of dwelling units of traditional coastal communities including fisher folk permitted between 100 and 200 metres from the HTL along the seafront with approval from competent authority.

(iii) However, the following activities may be permitted in NDZ –

(a) Agriculture, horticulture, gardens, pasture, parks, play field, and forestry;



(b) Projects relating to Department of Atomic Energy;

(c) Facilities for receipt and storage of petroleum and fuel products.

(d) Facilities for generating power by non conventional energy sources;

(e) Foreshore facilities for desalination plants and associated facilities;

(f) Construction of dispensaries, schools, public rain shelter, community toilets, bridges, roads, provision of facilities for water supply, drainage, sewerage, crematoria, cemeteries and electric sub-station with approval from CZMA.

(g) Construction of units or auxiliary thereto for domestic sewage, treatment and disposal with the prior approval of the concerned Pollution Control Board or Committee;

(h) Facilities required for local fishing communities such as fish drying yards, auction halls, net mending yards, traditional boat building yards, ice plant, ice crushing units, fish curing facilities and the like;

(i) Development of green field airport.

**B. Area between 200mts to 500mts**, - The following activities shall be permissible in the above areas;

(i) Development of vacant plot in designated areas for construction of hotels or beach resorts for tourists or visitors.

(ii) Facilities for receipt and storage of petroleum and gas products

(iii) Development of green field airport.

(iv) Storage of non-hazardous cargo.

(v) Foreshore facilities for desalination plants and associated facilities;

(vi) Facilities for generating power by non-conventional energy sources;

(vii) Construction or reconstruction of dwelling units for natives of existing fishing villages with height of construction not exceeding 9mts with two floors (ground + one floor);

(viii) Construction of public rain shelters, community toilets, water supply drainage, sewerage, roads and bridges with approval of CZMA.

(ix) Reconstruction or alteration of existing authorised building subject to sub-paragraph (vii), (viii);

**(IV) Permissible activities in CRZ-IV**

Traditional fishing and related activities undertaken by local communities are permissible with the condition that no waste shall be let off or dumped to seawater.

**V. Permissible activities in areas requiring special consideration**

1. CRZ areas falling within municipal limits of the Greater Mumbai.

(i) Construction of roads, approach roads and missing link roads approved in the Developmental Plan of Greater Mumbai on stilts ensuring that the free flow of tidal water is not affected.

(ii) In CRZ-II areas-

(a) The development or redevelopment shall continue to be undertaken in accordance with the norms laid down in the Town and Country Planning Regulations.

**Questions**

1. What is relevance of NBC ?
2. Explain Coverage and FAR.
3. What are the different CRZs ?
4. Differentiate between plinth area and carpet area

## 1.4 Responsibility of an engineer in ensuring the safety of built environment

A built environment means the human-made space in which people live, work, and recreate on a day-to-day basis. In civil engineering contest, it may be a single dwelling house, apartment complex, office building, industrial building, shopping mall or an educational building etc. During the construction phase, a construction safety document is to be prepared by the engineer and that is compiled and added to on an ongoing basis throughout the life of the project. It is handed over to the first occupier of the building or structure and should contain details about maintenance and use of the building. It should highlight any potentially dangerous features of the building, such as the problems of cleaning windows on the 12th floor, and explain how the designer envisaged that this could be done safely. It should also contain details of the plant and machinery in the building and the most effective method of use of these. The responsibility of engineer to ensure safety in built up environment include the following.

1. After the completion of the project, ensure that all the installations including machineries, electrical appliances have met the safety standards specified.
2. Identify any safety lapses in construction like un-guarded openings of ducts and ensure that those are corrected.
3. Hand over all the documentations of all installations in the building with specific safety remarks.
4. Ensure all warning instructions displayed in place and legible.
5. Hand over the periodical maintenance schedule especially fire fighting equipments etc. to ensure the proper functioning of facilities.

## 1.5 Major Disciplines of Civil Engineering

As a wide branch of engineering, Civil Engineering has various disciplines, few important are the following.

### 1.5.1 Construction Engineering

As the name indicates construction engineering means execution of all designs and plans on the ground. The construction phase of a project represents the first tangible result of a design. Using technical and management skills,