

Chapter I : Introduction

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Introduction to Civil Engineering

- ✓ Civil engineering is considered to be **oldest** engineering discipline; deals with **planning, designing, constructing, maintaining and operating infrastructure like building, roads, bridges, canals, dams, water supply and treatment systems etc.**
- ✓ Civil Engineers protecting the **public and environmental health** as well as **improving existing infrastructure**.
- ✓ The civil engineer profession recognises the reality of limited natural resources, the desire for **sustainable practices** (including life cycle analysis and sustainable design technique) and the need for social equity in the **consumption of resources**.
- ✓ The basic responsibilities of civil engineers are **planning and designing** a structure and analysing its various aspects, making a **regular inspection** in the site to ensure that the construction is going according to plan and making the necessary **amendments** in the project, if required during the course of construction.
- ✓ Civil engineer has to make sure that the project is **cost effective** and structure is of required **strength and safety**.
- ✓ The civil engineer holds the **safety, health and welfare** of the public Paramount.
- ✓ Civil Engineering projects and Systems should be in **compliance** with **governmental guidelines and regulations**.
- ✓ Civil Engineering projects should be built **economically** to function properly with a **minimum of maintenance and repair** while withstanding anticipated usage and whether; and should **conserve energy** and allow **hazard free construction** while providing **healthful, safe and environmentally sound utilisation by society**.

Functions Of Civil Engineering

Civil engineering functions performed can broadly be classified in three categories.

- A. **Before construction**
- B. **During construction**
- C. **After Construction**

Before construction

- ✓ **Feasibility study:** In the beginning **technical feasibility, environmental impact assessment and economical viability** of the project are studied.
- ✓ **Surveying:** Surveying includes preparing **site plan, contour map and measurement of field dimensions and levels**.
- ✓ **Site investigation:** Soil investigation includes **collecting data regarding soil and bearing capacity of soil**. Soil investigations are done for the purpose of foundation design.
- ✓ **Planning ,Design and drawing:** On the basis of the data collected; **planning, designing, are carried out and drawings** are prepared.

- ✓ **Estimating:** Estimates are prepared to know the **probable cost** of completion of work.
- ✓ **Planning & Scheduling:** Detailed planning and scheduling are prepared to carry out different activities in time without any **delay**.

During construction

- ✓ **Dealing with clients, Consulting engineer and contractors:** Owner, engineer and contractor are the three constituents of a **construction team in engineering** profession; hence continuous communication among them is a very essential for the speedy progress of the work.
- ✓ **Execution and supervision:** Execution of work is actual construction carried out on the site with materials and equipment's, by the skilled and unskilled work force, under the technical guidance and supervision of engineer in charge.
- ✓ **Quality control:** During the construction engineer has to supervise the work carried out as per the specifications for quality control.
- ✓ **Costing:** Costing is the accounts procedure of arriving at the actual cost of construction.

After Construction

- ✓ **Maintenance and repairs:** After the construction regular maintenance of structures is to be carried out.
- ✓ **Valuation:** Valuation is carried out for the purpose of sale, purchase and many others purposes.

Specialization OR Branches of Civil Engineering

Civil Engineering is a wide field and includes many types of structures such as **residential buildings, public buildings, industrial buildings, roads, bridges, tunnels, railways, dams, canal and canal structures, airports, harbours, and ports, water treatment plants, waste water treatment plant, water supply networks, and drainage networks**.

According to the type of structures and activities carried out, main branches of civil engineering are classified as follows:

- I. **Structural Engineering**
- II. **Geotechnical And Foundation Engineering**
- III. **Environmental Engineering**
- IV. **Transportation Engineering**
- V. **Water Resource Engineering**
- VI. **Surveying**
- VII. **Town Planning**
- VIII. **Building Planning & Construction**
- IX. **Advance Construction**

Structural Engineering

- ✓ Load acting any structure is ultimately transferred to ground. In doing so, various components of the structure are subjected to **internal stresses**.
- ✓ For example, in a building, load acting on a slab is transferred by slab to ground through structural components like **beams, columns and footings**.
- ✓ Assessing various types of internal stresses in the components of a structure is known as **structural analysis** and finding suitable size of the structural component is known as **structural design**.

- ✓ This **branch of civil engineering** deals with **structural analysis and design of structures**. Structural analysis is done to calculate stresses in structural components, on the basis of loads, acting on structures.
- ✓ Structural analysis requires much calculation; hence advanced computing **software's** are used to carry out structural analysis and design.
- ✓ The structures to be designed may be of masonry, R.C.C., Prestressed concrete or of steel. Structural engineering involves analysis of various structures like **buildings, water tanks, chimneys, bridges etc.** And designing them using suitable materials like **masonry, R.C.C., Prestressed concrete or steel.**

Geotechnical And Foundation Engineering

- ✓ **Soil property** changes from place to place. Even in the same place it may not be uniform at various depth. The soil property may vary from season to season due to varying moisture content. The loads from all structures are to be **safely transferred to soil**. Hence, safe bearing capacity of the soil is to be properly assessed.
- ✓ Geotechnical engineering is that field of civil engineering which deals with **soil investigation and design of proper foundations of structures**. Soil investigation includes **collection and testing** of soil samples.
- ✓ Geotechnical engineering includes measurement of **soil parameters and safe bearing capacity**. It also includes construction and design of simple foundations, pile foundations, well foundations, caissons, coffer dams, construction of foundation of dams, construction of tunnels, sub base of road, earthen dams, and earth related constructions.
- ✓ It involves study of **ground improvement techniques** also. Since **stability** of every structure depends on how **safely load is transferred to ground**, this branch of civil engineering is very important.

Environmental Engineering

- ✓ Environmental Engineering deals with **pollution control and public health engineering**. Different types of pollutions are water, air, noise and other pollution.
- ✓ Public health engineering includes **water treatment, water distribution network, & solid waste management**.
- ✓ Due to large scale **industrialization, population growth, rapid urbanization** and several other human activities like **construction, mining, transportation, environment gets polluted**. Environmental engineering deals with technologies & facilities which are engaged in reducing pollution.
- ✓ Environmental engineering includes **design, construction and maintenance** of water treatment plant, waste water treatment plant, water distribution network and sewerage system.
- ✓ **Supplying potable water** to rural areas, towns and cities and **disposal of waste water and solid waste** is another field of civil engineering.
- ✓ Solid waste management and **disposal** of electronic waste **systematically** is the need for maintaining good environment in towns and cities.
- ✓ Study of sources, causes effects and remedial measures associated with **air pollution, water pollution, land pollution and noise pollution forms environmental engineering branch of civil engineering.**

Transportation Engineering

- ✓ Transportation means **movement of passengers and goods** by means of vehicles on land, ship on water and aircrafts in air.
- ✓ Transportation engineering is that branch of civil engineering which deals with **planning, designing and construction of roads, bridges, railways, tunnels, harbours, ports, docks, runways, and airports.**
- ✓ As for development of any nation good transportation network is of prime importance. Study of various construction materials used in construction of roads, traffic engineering are also considered under transportation engineering.
- ✓ Another important amenity that public requires is **good roads.**
- ✓ Design of good road involves the **design of base courses, surface finishes, cross drainage works, road intersections, culverts, bridges and tunnels.**
- ✓ Roads need suitable **design of horizontal and vertical curves** also.
- ✓ Railway is another important long way transport facility. **Design construction and maintenance of railway lines and signal systems** are part of transportation engineering.
- ✓ **Design, construction and maintenance** of harbours and airports are also the need of globalization era. All these activities constitute the transportation engineering.

Water Resource Engineering

- ✓ Water resource engineering means **measurements, utilization and development of water resources for agriculture, municipal and power generation purpose.**
- ✓ Water resource engineering deals with planning **designing and developing water resources** by constructing several hydraulic structures like **dams, barrages, hydropower stations, canal and pipe networks etc.** It also includes irrigation engineering,
- ✓ Water is to be supplied to agricultural field. Hence **suitable water resources** are to be identified and water retaining structures are to be built.
- ✓ Identifying, planning and building water retaining structures like tanks, canals and dams to carrying stored water to fields is known as **irrigation engineering.**
- ✓ It also includes **watershed planning, water harvesting techniques, soil conservation and soil reclamation.**
- ✓ Hydrology is also a part of water resource engineering. Hydrology includes study of **sources of water, measurement of rainfall, study of rainfall, runoff, flood control.**

Surveying

- ✓ Surveying is the science of **map making.** To start any development activity, the **relative positions of various objects** in the area with respect to horizontal and vertical axes through a **reference point** is required.
- ✓ This is achieved by surveying the area. Earlier, the conventional instruments like **chain, tape and levelling instruments were used.**
- ✓ In this electronic era, modern electronic equipment like **electronic distance meters (EDM) and total stations** are used, to get more accurate results easily.
- ✓ It also includes measurements of **areas and volumes.** Basic aim of surveying is to prepare a map of the area to some scale

- ✓ Preparing **topo maps of talukas, districts, states and countries** and showing all important features like **rivers, hills, forests, lakes, towns and cities in plan and elevation** (by contour lines) also forms part of surveying.
- ✓ Surveying is carried out to **fix the alignment of road, railway canal**. It is also useful in selecting the site for the construction of structures.
- ✓ Modern surveying instruments like **Electronic total station and Geographical Positioning System (GPS)** are the modern electronic digital instruments for survey works.
- ✓ **Remote sensing and Geographical Information system (GIS)** are adopted for surveying and planning of many civil engineering projects.

Town Planning

- ✓ New towns and cities and extension areas of existing cities are to be planned properly so that suitable **communication system, educational facilities medical facilities, shopping centres** are provided along with residential areas. **Growing industrialisation** of country has brought importance to 'Town Planning' aspect of civil engineering.
- ✓ Town planning means planned & controlled growth of town by **dividing town in to different land use zones** and regulating building construction to provide better environment for the people of the town.
- ✓ In the town planning areas of town are divided **into residential, commercial, recreational and industrial zones, which are called zoning**.
- ✓ **Floor space index and other byelaws** are fixed to guide and regulate the building construction.
- ✓ For towns and cities **master plan** for town planning schemes are prepared to accommodate future growth of town in better way.
- ✓ Planning of very large area covering several towns and villages is known as **regional planning**.

Building Planning & Construction

- ✓ Civil engineers are concerned with many types of structures of which buildings are of prime importance.
- ✓ Buildings are planned according to the **fundamental principles of planning & bylaws of local municipal bodies**.
- ✓ Building planning requires basic knowledge **of principles of architecture**.
- ✓ Buildings may be residential or public building like school, colleges, government office, hospitals, etc. they are designed according to need of specific occupants and purposes.
- ✓ Construction of **dams, bridges, tunnels, ports**, requires several advanced techniques of construction.
- ✓ **Under water construction** requires specific type of equipment. Pile foundations or well foundations are generally provided for foundation of bridges across rivers in alluvial soil.
- ✓ A large scale earthwork requires equipment's like **power shovel, dragline, bulldozers, etc.** For massive concrete work in dam concrete mixing plant is required to be erected at the dam site.

- ✓ Construction of power station, off shore oil rigs, ports, tunnels etc., come under category of advanced construction

Advance Construction

✓ Planning

Planning is the decision-making process about **What, Where, Who and How (WWWH)** to start a project work.

What:

- ✓ An individual or a group of enterprising people or a government/public sector agency **plan to start a project**.
- ✓ They **form a group of high level managers**. They identify **goals, form the objective** and identify the opportunities of the project. This type of planning is called as **strategic planning**.

Where: The next step the strategic planners takes is **where to start the project work**.

Who:

- ✓ The strategic planners identifying the **middle level and operational level managers** to carry out the task.
- ✓ The **middle level management** deals with **financial management** and coordinates with the **operational planners and strategic planners**.
- ✓ **How:**
- ✓ The operational planners have to work at **minute details** of the work assigned.
- ✓ find the requirement of **machinery and work force** and plan day to day activities.
- ✓ They should be ready with **alternative plans**, if uncertainties creep in at any stage
 - **Scheduling**

Scheduling is the process of dividing the project into various stages, various events and identifying time, machinery and human resources required for each event. For example, the construction of a building may be divided into the following stages:

1. **Mobilizing**
2. **Laying foundation**
3. **Building superstructure**
4. **Finishing**

Laying the foundation may be divided into the following events:

1. **Digging**
2. **Laying bed concrete**
3. **Constructing stone masonry for foundation**
4. **Providing coping concrete**
5. **Pointing the joints and**
6. **Filling the trenches**

Like this all other stages involve a number of events. For each event, scheduled date of commencement and completion are to be fixed. Material, equipment and human resources requirement should be identified. Critical activities are identified, the delay of which will delay the entire project. All efforts are concentrated to execute these events as per schedule.

Construction Management

- ✓ Management is a social and scientific process of defining the **objectives, planning, organizing, staffing, coordinating, motivating, scheduling controlling, executing and harnessing the resources** of an organization at the optimum level to achieve predetermined goal.
- ✓ Five M of management **Man, Money, Material, Machine, and Methods**.

- ✓ The functions of management are **planning, organizing, staffing, directing, coordinating, controlling and communicating**.
- ✓ A manager **not only directs his subordinates but motivates them** to do the work. Communication skill and leadership qualities are to be developed for good construction management.
- ✓ **Definition:-** “Civil Engineering is the art of directing the great sources of power in nature for the use and convenience of man”.- Royal Charter of Institute of Civil Engineers London.
- ✓ “Civil Engineering is that field of engineering concerned with **planning, design and construction for environmental Control, development of natural resources, buildings, transportation facilities and other structures required for health, welfare, safety, employment and pleasure of mankind**”. Fredrick .S. Merit Hand book for Civil Engineers.
- ✓ The main scope of civil engineering or the task of civil engineering is **planning, designing, estimating, supervising construction, managing construction, execution, and maintenance of structures like building, roads, bridges, dams, etc.**
- ✓ Scope can be understood in two ways, firstly **infrastructure development** in India and secondly the types of **job available** for civil engineer in India.

Scope of Civil Engineering

A civil engineer has to **conceive, plan, estimate, get approval, create and maintain** all civil engineering activities. Civil engineer has very important role in the development of the following infrastructure:

- (i) Measure and map the earth's surface.
- (ii) Plan new townships and extension of existing towns.
- (iii) Build the following suitable structures for the rural and urban areas for various utilities.
 - a) **Design and construction of buildings:**
 - b) **Construction of Roads:**
 - c) **Design and Construction of bridges:**
 - d) **Design and Construction of Dams**
 - e) **Water Supply**
 - f) **Waste Water Management**
 - g) **Irrigation Works**
 - h) **Surveying Work**
 - i) (iv) Build **tanks and dams** to exploit water resources.
 - j) (v) Build **river navigation and flood control** projects.
 - k) (vi) Build **canals and distributaries** to take water to agricultural fields.
 - l) (vii) **Purify and supply water** to the needy areas like houses, schools, offices etc.
 - m) (viii) **Provide and maintain communication systems** like roads, railways, harbours and airports.
 - n) (ix) Devise systems for control and efficient flow of traffic.
 - o) (x) Provide and maintain **solid and waste water disposal** system.
 - p) (xi) Monitor **land, water and air pollution** and take measures to **control** them.
 - q) Fast growing industrialization has put heavy responsibilities on civil engineers to preserve and protect environment

Role of civil Engineer in Society

- ✓ Design, in-order to **meet safety, reliability, environmental, cost operational and maintenance objectives.**
- ✓ Realize products and projects
- ✓ **Create ,operate and sustain complex systems**
- ✓ Understand the **physical constructs and economic, industrial, social, ethical political and international**, context within which engineering is practiced.
- ✓ Contribute to building a **sustainable society, present and future;**
- ✓ Apply **professional and responsible** judgement and take a leadership role;
- ✓ Do more than just comply with legislation and codes;
- ✓ Use resources **efficiently and effectively;**
- ✓ Seek multiple views to **solve sustainability challenges;**
- ✓ Manage risk to **minimize adverse impact** to people or the environment
- ✓ Infrastructure defines as a set of facilities through which **goods and services** are provided to public.
- ✓ Infrastructure is the **stock of basic facilities and capital equipment** needed for the functioning of a country or area.
- ✓ The term to refer collectively to the **road, bridges, rail line and similar public works** that are required for an **industrial economy**, or a portion of it, to function infrastructure includes in its broadest term the following.

Impact of infrastructural development on economy of Country

The infrastructural (Economic Infrastructure) facilities mainly are following:

- i. **Transportation:** Road, Railway, Airport and shipping port & harbours
 - ii. **Power & Energy :** Coal, Electricity, Wind & Solar Energy and Oil & Gas
 - iii. **Communication:** Ports, Telegraphs, Telephones, Radio, Television
 - iv. **Intermediate goods and output:** Minerals, Steel, Fertilizers, Chemicals
 - v. **Increasing productivity of natural resources:** Irrigation, Reclamation of land, Afforestation, Drainage
 - vi. **Water resources:** Dams, Canals, water bodies
 - vii. **Banking:** All banking related facilities
 - viii. **Science and Technology:** Research , National Labs
 - ix. **Information system:** Mass Media, Book and Journals, Fairs & Exhibitions
- ✓ These facilities create environment in which Industries and business can grow.
 - ✓ Due to the basic facilities which any industry needs are provided by infrastructural sector, country has progressed well. **Per capita income and Gross domestic product are the economic measures for assessment of development.**
 - ✓ **Per Capita Income:** Per Capita income is the **average income of normal resident of a country in a particular year**. It is obtained by dividing national income of a country by its population
 - ✓ **Gross domestic Product:** Gross domestic product at market price is the value of **all fixed goods and services** at prices prevailing in the market produced in the **domestic territory of a country** during a given year.
 - Due to the acceleration of progress of infrastructural projects overall development and upliftment of common man can be done. Thus the infrastructure development is key to economic development of any country.

