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**Introduction to Civil Engineering**

1.1 Introduction to Civil Engineering:

Civil engineering is a branch of engineering that deals with the design, construction, and maintenance of the built environment, including roads, bridges, buildings, dams, and other infrastructure. It is one of the oldest and most diverse engineering disciplines, with a focus on creating functional, safe, and sustainable structures and systems. Civil engineers use a variety of tools and techniques, including computer-aided design (CAD) software, project management tools, and engineering analysis software, to plan, design, and oversee construction projects.

One of the key responsibilities of civil engineers is to ensure that structures and systems are built to withstand natural forces such as earthquakes, floods, and windstorms. They also work to ensure that structures and systems are safe and efficient, and that they meet the needs of the communities they serve. This can include designing and building new infrastructure, such as roads, bridges, and buildings, as well as maintaining and upgrading existing infrastructure.

Civil engineers also work to address environmental and sustainability concerns. This can include designing structures and systems to minimize their environmental impact, such as reducing energy consumption, and incorporating renewable energy sources into the design. Additionally, civil engineers work to protect and preserve natural resources such as water and land, and to ensure that the built environment is accessible to all members of the community.

Civil engineering is a challenging and rewarding field that offers many opportunities for career advancement. Civil engineers can work in a variety of settings, including government agencies, consulting firms, construction companies, and private industry. They may specialize in a particular area, such as transportation engineering, structural engineering, or water resources engineering, or they may work on a variety of projects throughout their career. Civil engineering is a field that will continue to be in high demand, as the world's population continues to grow and the need for infrastructure and sustainable development increases.Top of Form

1.2 Infrastructural Projects and its Types:

Infrastructure projects refer to the construction and maintenance of physical and organizational structures that support the basic operations and economic development of a society. These projects include the building and maintenance of roads, bridges, tunnels, airports, public transportation systems, water and sewage systems, power plants, and communication networks. They also include social infrastructure projects such as hospitals, schools, and public housing. The goal of infrastructure projects is to provide essential services and support economic activity while also being sustainable, resilient and safe.

There are several types of infrastructure projects, which can be broadly categorized into the following categories:

1. Transportation infrastructure: Projects that involve the construction and maintenance of roads, bridges, tunnels, airports, and public transportation systems. These projects are designed to improve mobility and accessibility within a region.
2. Energy infrastructure: Projects that involve the construction and maintenance of power plants, transmission lines, and other energy-related infrastructure. These projects are designed to ensure the reliable supply of energy to a region.
3. Water and sewage infrastructure: Projects that involve the construction and maintenance of water supply and treatment systems, as well as sewage treatment and disposal systems. These projects are designed to ensure the safe and reliable supply of water and the proper treatment and disposal of waste water.
4. Communication infrastructure: Projects that involve the construction and maintenance of communication networks, such as telephone and internet networks. These projects are designed to improve connectivity and access to information.
5. Social infrastructure: Projects that involve the construction and maintenance of hospitals, schools, public housing, and other public buildings and facilities. These projects are designed to improve the quality of life for citizens.
6. Environmental infrastructure: Projects that involve the construction of infrastructure to protect the environment and natural resources, such as dams, levees, and waste management facilities.
7. Disaster risk reduction and management infrastructure: Projects that involve the construction of infrastructures that protect communities from natural hazards such as floods, earthquakes and storm surges.

Each of these types of infrastructure projects plays a critical role in supporting the growth and development of a society, and must be carefully planned, designed, and constructed to meet the needs of the community and be sustainable in the long term.Top of Form

1.3 Fundamentals in Construction:

The fundamentals in construction involve understanding the basics of building, including the materials and techniques used, the design process, and the management of resources. This includes understanding the properties and behavior of materials such as concrete, steel, and wood, as well as the use of tools and equipment. It also involves understanding the principles of engineering and architectural design, as well as the principles of project management, including budgeting, scheduling, and safety management. Additionally, construction professionals should have knowledge of construction law, zoning regulations and building codes. The fundamentals in construction are essential for ensuring the safety, quality and efficiency of the construction process.

1.4 Key Aspects of Different Civil Engineering Structures:

Civil engineering structures can be broadly classified into several categories, each with its own unique characteristics and key aspects. Some of the main types of civil engineering structures and their key aspects are:

Bridges: Bridges are structures that are built to span a physical obstacle, such as a river or valley, and provide a means of transportation over the obstacle. Key aspects of bridges include the design of the foundation, the type of materials used, and the load-bearing capacity.

Buildings: Buildings are structures that are built to provide shelter and protection for people and their activities. Key aspects of buildings include the design and layout, the materials used, and the energy efficiency of the structure.

Dams: Dams are structures that are built to hold back water and create a reservoir. Key aspects of dams include the design of the foundation, the strength of the materials used, and the ability to withstand the forces of water.

Tunnels: Tunnels are structures that are built to provide a subterranean passage through a mountain or other obstacle. Key aspects of tunnels include the design of the excavation, the materials used, and the ventilation and lighting systems.

Roads and Highways: Roads and highways are structures that are built to provide a means of transportation for vehicles and pedestrians. Key aspects of roads and highways include the design of the pavement, the materials used, and the drainage systems.

Airports: Airports are structures that are built to provide a platform for the takeoff and landing of aircrafts. Key aspects of airports include the design of the runways, the materials used, and the safety and security measures.

Canals and Docks: Canals and docks are structures that are built to provide a means of transportation for boats and ships. Key aspects of canals and docks include the design of the waterway, the materials used, and the safety and security measures.

All of these types of civil engineering structures require a detailed understanding of the design, materials, and construction processes, and must be built to meet safety and quality standards.

1.5 Stages of Project:

The stages of a construction project can be broadly categorized into four main phases:

Pre-Construction Phase: This phase includes the initial planning and design of the project, as well as the procurement of necessary permits and approvals. During this phase, the project scope, budget, and schedule are established, and the project team is assembled.

Construction Phase: This phase includes the actual physical construction of the project. This includes site preparation, excavation, installation of foundations, and the construction of the building or structure itself. This phase also includes the installation of systems such as electrical, plumbing, and HVAC.

Post-Construction Phase: This phase includes the completion of punch-list items, final inspections and approvals, and the handover of the project to the owner. During this phase, the project team completes final documentation, such as as-built drawings, and warranties are issued.

Maintenance Phase: This phase includes the ongoing maintenance and upkeep of the building or structure. This includes regular inspections, repairs, and upgrades as needed to ensure the longevity and performance of the structure.

The specific stages of a construction project will vary depending on the type and scope of the project, but these general phases are common to most construction projects.

1.6 Preparation of Project Reports

**Summary**

2 Principles of Practices

2.1 Construction Management

2.1.1 Civil Engineering Works

2.1.2 Contracts and Sub Contracts

Contracts and sub-contracts are legal agreements that outline the terms and conditions of a construction project. A contract is a binding agreement between the owner of the project (the client) and the main contractor (the company or individual responsible for the overall management and execution of the project). A sub-contract is a similar agreement between the main contractor and a sub-contractor (a company or individual responsible for a specific aspect of the project, such as electrical work or plumbing).

Contracts and sub-contracts typically include details such as the scope of work, the schedule, the budget, and the responsibilities of each party. They also include clauses for resolving disputes and addressing any issues that may arise during the project.

The main contractor is responsible for managing the project and ensuring that the work is completed on time and within budget. They also have the responsibility of ensuring that the subcontractors are following the regulations and standards as per the contract. The subcontractors, in turn, are responsible for completing their specific scope of work, and are typically responsible for providing their own materials, labor, and equipment.

In some cases, the main contractor may also enter into a sub-subcontract with a third-party contractor to complete a specific aspect of the project. The main contractor is still the responsible party for the project and is still responsible for the work of the sub-subcontractor.

Contracts and sub-contracts are critical to the success of a construction project as they help to ensure that all parties understand their roles, responsibilities, and expectations, and provide a framework for resolving any issues that may arise during the project.

2.1.3 Basic Business Laws of Relations in Construction

Construction projects involve many different parties and can be complex, so it is important for all parties to understand the basic business laws that govern their relationships. Some of the key laws that apply to construction projects include:

Contract Law: Contracts are legal agreements between parties that outline the terms and conditions of the project, including the scope of work, the schedule, and the budget. Contract law governs the formation, performance, and enforcement of contracts.

Tort Law: Tort law deals with civil wrongs and applies to construction projects through concepts like negligence, which refers to the failure to exercise reasonable care, resulting in injury or damage to another party.

Labor Law: Labor law governs the rights and responsibilities of employers and employees and applies to construction projects through the regulation of issues such as wages, working hours, and health and safety.

Environmental Law: Environmental law regulates activities that have an impact on the environment and applies to construction projects through the regulation of issues such as air and water pollution, land use, and waste management.

Product Liability Law: Product liability law applies to the manufacture and sale of products and applies to construction projects through the regulation of issues such as defects in building materials and faulty construction.

Insurance Law: Insurance law governs the purchase and sale of insurance policies and applies to construction projects through the regulation of issues such as liability, property damage, and worker's compensation.

Intellectual Property Law: An intellectual property law protects the rights of creators of original works and applies to construction projects through the regulation of issues such as copyrights, patents, and trademarks.

All parties involved in a construction project should be aware of these basic business laws and how they apply to their specific roles and responsibilities. This will help ensure that all parties are aware of their rights and obligations and can help prevent disputes and legal issues from arising.

2.2 Geo Technical

2.2.1 Field Investigations

2.2.2 Preparation of Field Reports

2.2.3 Bearing Capacity Test from Field Data or Reports

2.3 Water Resources Engineering

2.3.1 Estimation of Runoff and Construction of Hydrograph

2.3.2 Flood Forecasting

2.3.3 Analysis & Design of Water Distribution Networks and Design of Sewers

2.4 Highway Engineering

2.4.1 Determination of Highway Capacity and Highway Geometric Design

2.4.2 Design of Flexible and Rigid Pavements

2.4.3 Design of Traffic Signal System

3 Codes of Practice

3.1 Important Codes of Civil Engineering

The Indian Standards (IS) codes are technical standards that are used in India to ensure consistency and quality in various aspects of civil engineering. Some of the important IS codes in civil engineering include:

1. IS 456:2000 - Plain and Reinforced Concrete - Code of Practice
2. IS 800:2007 - General Construction in Steel - Code of Practice
3. IS 13827:1993 - Determination of Workability of Concrete by Slump Test
4. IS 383:1970 - Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
5. IS 516:1959 - Method of Tests for Strength of Concrete
6. IS 1343:1980 - Prestressed Concrete - Code of Practice
7. IS 1433:1987 - Specification for Concrete Batching and Mixing Plant
8. IS 4031:1968 - Specification for Plain and Reinforced Concrete Pipe
9. IS 4926:2003 - Code of Practice for Concrete Batching and Mixing Plant
10. IS 650:1991 - Standard Sand for Testing of Cement

These codes provide guidelines and specifications for the design, construction, and testing of various aspects of civil engineering projects, including concrete, steel, and pre-stressed concrete structures. It is important for civil engineers to be familiar with the relevant IS codes for their specific projects, as compliance with these codes is often required by local building regulations and codes.

3.2 Environmental Impact Management

3.3 Safety Rules for Construction Practices

Construction sites can be hazardous environments, so it is important for all workers to follow safety rules to prevent accidents and injuries. Some of the key safety rules for construction practices include:

1. Personal Protective Equipment (PPE): Workers should wear appropriate PPE, such as hard hats, safety glasses, gloves, and high-visibility clothing, to protect themselves from potential hazards on the construction site.
2. Site Safety Plan: The construction site should have a comprehensive safety plan that outlines the measures to be taken to prevent accidents and injuries. The plan should be communicated to all workers and reviewed regularly.
3. Hazard Identification and Risk Assessment: Hazard identification and risk assessment should be conducted regularly to identify and assess potential hazards on the construction site.
4. Proper Training: Workers should receive proper training on the use of equipment, tools, and other materials, as well as the specific safety procedures for their tasks.
5. Proper Signage: Proper signage should be displayed throughout the construction site to warn workers of potential hazards and to provide guidance on safe work practices.
6. Regular Inspections: Regular inspections should be conducted to ensure that all workers are following the safety rules and procedures and to identify and address any potential hazards.
7. Emergency Preparedness: The construction site should have an emergency plan in place and all workers should be trained on how to respond in the event of an emergency.
8. Substance Abuse Policy: Substance abuse should not be tolerated on the construction site, and all workers should be aware of the consequences of drug or alcohol use while on the job.

By following these safety rules and practices, construction workers can help prevent accidents and injuries and ensure a safe working environment.

3.4 Energy Consumption System

3.5 Sustainable and Recycling Practices

Sustainable and recycling practices in civil engineering aim to reduce the environmental impact of construction and improve resource efficiency. Some of the key sustainable and recycling practices in civil engineering include:

1. Green Building Design: Green building design incorporates environmentally-friendly materials, energy-efficient systems, and sustainable practices into the design and construction of buildings.
2. Materials Recycling: Recycling of materials, such as concrete, steel, and asphalt, can reduce the amount of waste generated on construction sites and conserve natural resources.
3. Water Management: Effective water management practices, such as rainwater harvesting and greywater reuse, can reduce the demand for potable water in construction projects.
4. Energy Efficiency: Energy-efficient design and construction practices, such as the use of renewable energy sources and energy-efficient systems, can reduce energy consumption and improve energy sustainability.
5. Sustainable Landscaping: Sustainable landscaping practices, such as the use of drought-tolerant plants, can reduce the demand for water and energy and improve the environmental impact of construction projects.
6. Life Cycle Assessment: Life cycle assessment (LCA) is a tool that assesses the environmental impact of a construction project over its entire life cycle, from the extraction of raw materials to the disposal of waste materials.
7. Sustainable Procurement: Sustainable procurement involves sourcing materials and products that are environmentally friendly and sustainably produced.

By incorporating sustainable and recycling practices into civil engineering projects, engineers can help reduce the environmental impact of construction, conserve resources, and create a more sustainable built environment

3.6 Optimization and Costing of Sustainable Practices

4 Case Studies

4.1 Buildings (Antilia, Mannat, Rajkumari Ratnavati Girls School)

4.2 Bridges (Bandra Worli Sea Link, Pamban Bridge, Eshima Ohashi Bridge)

4.3 Ports (Port of Shanghai, Mumbai Port, Visakhapatnam Port)

4.4 Airports ( Delhi, Mumbai, Banglore, Hyderabad)

4.5 Dams (Three Gorges Dam, Hirakud Dam, Tehri Dam, Nagarjuna Sagar Dam)

4.6 Reservoirs (Dindi Reservoir, Tatipudi Reservoir, Lower Manair Reservoir)

A Case Study on **Building – *Antilia***

A Case Study on **Building - *Mannat***

A Case Study on **Building - *Rajkumari Ratnavati Girls School***

A Case Study on **Bridges - *Bandra Worli Sea Link***

A Case Study on **Bridges - *Pamban Bridge***

A Case Study on **Bridges - *Eshima Ohashi Bridge***

A Case Study on **Ports - *Port of Shanghai***

A Case Study on **Ports – *Mumbai* *Port***

A Case Study on **Ports – *Visakhapatnam Port***

A Case Study on **Airports - *Delhi***

A Case Study on **Airports – *Mumbai***

A Case Study on **Airports – *Bangalore***

A Case Study on **Airports – *Hyderabad***

A Case Study on **Dams – *Three Gorges Dam***

A Case Study on **Dams – *Hirakud Dam***

A Case Study on **Dams – *Tehri Dam***

A Case Study on **Dams – *Nagarjuna Sagar Dam***

A Case Study on **Reservoir – *Dindi Reservoir***

A Case Study on **Reservoir – *Tatipudi Reservoir***

A Case Study on **Reservoir – *Lower Manair Reservoir***