SHREE

Elements of Civil Engineering

Importance of Civil Engineering in Society

Civil Engineering is the most basic branch in the field of engineering. The main contribution of Civil engineering to society is in the form of Construction. The overall development of society is depend upon the construction of different types of buildings that we see in our day to day lives.

These buildings are further categorize as Public Building and Residential Buildings.

Residential Buildings

These are buildings which are used for normal residential purposes and should facilitate activities such as sleeping, living and cooking. The building must include one or more family residencies, apartments, flats and private garages.

Educational Buildings

These are buildings housing educational institutions such as schools or colleges which are affiliated and recognized by an appropriate board, university or any similar affiliation authority. The building should promote the aggregation of instructional, educational and recreational activities pertaining to educational purposes. Further, it is mandatory for the building to have proper residential facilities for essential staff who need to reside within the campus. Apart from this, the institution should also have a hostel exclusive to the institute either within its premises or outside.

Institutional Buildings
These types of buildings consist of buildings that are constructed by the government, semi-government organizations or registered trusts for specific purposes. Those specific purposes include medical treatment purposes such as treatment of physical or mental illness, children's hospitals, old age homes, centers for the care of orphans or abandoned women, auditoriums or complexes meant to be used for cultural activities.

Industrial Buildings
Buildings used to manufacture, assemble or process products or materials are termed as industrial buildings. They include manufacturing units, assembly plants, factories, mills, power plants, oil refineries, gas plants, dairy plants, laboratories, etc.

Multi-Level Car Parking
These are buildings which are either partially below ground level and have two or more basements or above ground level with two or more floors that are principally used for parking cars, bikes, scooters and other light motorised vehicles.

Storage Buildings
If a building or a part of it is used for the storage of commodities, goods, merchandise, etc. then it is categorised as a storage building. They comprise buildings such as warehouses, cold storages, grain storage units, barns, stables, freight depot, transit shed, hangars, truck terminals, public garages, etc.

Agricultural buildings
Farm building, structures used in farming operations, which may include buildings to house families and workers, as well as livestock, machinery, and crops.

Commercial Building
A commercial building definition is one in which at least 50 percent of its floor space is used for commercial activities, such as retail, the providing of services, or food service (restaurants and the like).
A space that allows companies to carry out day-to-day operations and serve customers or clients. As such, a commercial property does not strictly need to be a store or restaurant; it can also be a space in which income is being generated by providing services to people, such as a law office or a doctor's office. Schools do not qualify as being commercial real estate; however, places of worship and lodging entities such as hotels, may be qualified as commercial properties.

Branches of Civil Engineering

Basically Civil Engineer is a most basic and core branch in the field of engineering.
Further Civil Engineering is divided into several number of branches where each branch has its own identity and of equal importance.

1. **Structural Engineering**
2. **Geo-Technical Engineering**
3. **Transportation Engineering**
4. **Environmental Engineering**
5. **Construction Management.**
6. **Earthquake Engineering**
7. **Water resource Engineering**
8. **Surveying.**

1. Structural Engineering

It is one of the main branch of Civil engineering. Structural engineering consist of the structural design of a building which is going to be construct on field.

When the Home plan or building drawing plan is ready then it is processed further by Structural design. The person who holds the responsibility is termed as Structural Design Engineer.

He decides the proper Size and Loading of structure and provides suitable design to Site Engineer who is working on site.

In structural drawing there are following details were included.

1. **Design of Footing.**
2. **Design of Column**
3. **Design of beam**
4. **Design of Slab**
5. **Typical details.**

6. **Section Plan.**
7. **Important General Notes.**

The use of steel is depend on structural design engineer. He decides the size of structural element and what steel should be provided according to use and loading considered.

The application of solid mechanics enables the structural engineer to assemble elements, such as beams and columns, into a structure that will resist both static and dynamic loads, such as gravity, wind, snow and earthquakes.

2. **Geo-Technical Engineering**

Geotechnical engineering is the study of the behaviour of soils under the influence of loading forces and soil-water interactions. This knowledge is applied to the design of foundations, retaining walls, earth dams, clay liners, and geosynthetics for waste containment. The goals of geotechnical engineers could range from the design of foundations and temporary excavation support, through route selection for railways and highways, to the increasingly important areas of landfill disposal of wastes and groundwater contamination.

As such, the geotechnical engineer is involved in field and laboratory investigations to determine the engineering properties of site soils

3. **Transportation Engineering**

Transportation has always played an essential role in the development of society, originally with regard to trade routes and harbours, but more recently with regard to land- and air-based systems as well. To plan, design, build, operate and maintain these systems of transport is of prime importance. The complete planning and drawings are to be submitted by Transportation Engineer.

It is the transportation engineer's responsibility to plan, design, build, operate and maintain these systems of transport, in such a way as to provide for the safe, efficient and convenient movement of people and goods.

Increasing environmental concerns have revived an interest in the development and management of public transportation systems. Professional activities can range from road and transit design and operation at the urban scale, to railroad, seaway and airport location, construction and operation at the regional and national scale. Automobile infrastructures can be split into the traditional area of highway design and planning, and the rapidly growing area of traffic control systems. The transportation engineer faces the challenge of developing both network links and major terminals to satisfy transportation

demands, with due regard for the resultant land-use, environmental and other impacts of these facilities.

4. **Environmental Engineering**

Environmental engineers study water, soil and air pollution problems, and develop technical solutions needed to solve, attenuate or control these problems in a manner that is compatible with legislative, economic, social cause.

This goal is achieved by managing these resources so that environmental pollution and degradation is minimized.

Civil engineers are particularly involved in such activities as water supply and sewerage, management of surface water and groundwater quality, remediation of contaminated sites and solid waste management. The main purpose is to ensure that societal development and the use of water, land and air resources are sustainable.

Environmental engineers are called upon to play an important role in environmental protection, because engineering solutions are required to meet the environmental standards.

Following are the activities and responsibilities of engineers are included

1. **Planning, design, construction and operation of water and wastewater treatment plant, in municipalities and industries.**
2. **Planning for the disposal and reuse of wastewaters and sludge's.**
3. **Modelling and analysis of surface water and groundwater quality.**
4. **Collection, transport, processing, recovery and disposal of solid wastes according to accepted engineering practices.**

5. **Construction Management**

Construction management is a professional service that provides a project's owner(s) with effective management of the project's schedule, cost, quality, safety, scope, and function.

Any project has the basic way of layout including the following

1. **The owner, who commissions the project and either funds the project directly or finances it through a variety of methods.**
2. **The architect/engineer, who designs the project.**
3. **The general contractor, who oversees day-to-day operations and manages subcontractors.**

The main parameter in completion of any kind of project are Time and Economy.

Owner is always active member in looking forward to complete project as per prescribed time and under proper estimated budget. Due to this we can save economy and workmanship.

CMs are uniquely qualified through combined education and experience to work with the owner, architect, general contractor, and other stakeholders to determine the best possible sequence of construction operations and develop a detailed schedule and budget, while also establishing plans for project safety and security and helping the owner manage risk.

6. Earthquake Engineering

Earthquake engineers study the seismic forces and earthquake resistant structures. In regions that are known for seismic activities, engineers must design and construct structures based on how well they will react within an earthquake situation. Earthquake might have a very less probability of occurring in some region, but the probability shouldn't be neglected when a structure is being constructed, because even if there is one tremor due to Earthquake in the buildings life span it can be a risk to the occupants of the building.

As the construction of high rises has increased in the recent years and the number of occupants in a building is increasing, Structural designers have been giving more importance to Earthquake induced loads for designing a building along with taking into consideration the Dead, Live and Wind loads. Designers and researchers have been coming with innovative ways to decrease the effect of Earthquake on a structures in the recent years.

7. Water resource Engineering

Water resources engineering is the quantitative study of the hydrologic cycle -- the distribution and circulation of water linking the earth's atmosphere, land and oceans. Surface runoff is measured as the difference between precipitation and abstractions, such as infiltration (which replenishes groundwater flow), surface storage and evaporation. Applications include the management of the urban water supply, the design of urban storm-sewer systems, and flood forecasting.

Hydraulic engineering consists of the application of fluid mechanics to water flowing in an isolated environment (pipe, pump) or in an open channel (river, lake, and ocean). Civil engineers are primarily concerned with open channel flow, which is governed by the interdependent interaction between the water and the channel.

Civil engineers play a vital role in the optimal planning, design and operation of water resource systems. Job opportunities in hydrology and water resources are quite varied.

8. **Surveying**

Surveying is the branch of civil engineering which deals with measurement of relative positions of an object on earth's surface by measuring the horizontal distances, elevations, directions, and angles. Surveying is typically used to locate and measure property lines; to lay out buildings, bridges, channels, highways, sewers, and pipelines for construction; to locate stations for launching and tracking satellites; and to obtain topographic information for mapping and charting.

It is generally classified into two categories: Plane surveying (for smaller areas) and Geodetic surveying (for very large areas).

Types of Building – Load building Structure and Framed Structure

Load Bearing Structure

A Structure in which loads are transferred through walls to the foundation refers to a load-bearing structure.

In this type of structure, loads from the slabs are transferred to the walls, then moved to the foundation.These structures don't have columns and beams. Load- bearing walls are built over a continuus foundation.They are planned to carry the entire load including their load.

Load-bearing structures were preferred for construction of small houses and low – rise buildings in earlier days.But nowadays, they are rarely adopted. These structures are suitable for construction of bioldings up to two floors only.

Load bearing structure consist of thick brick masonry or stone masonry supporting whole structure including slab, floor slab made of wood , steel and reinforced cement concrete.

These days, load bearing structures are less preferred among the builders as they leave less carpet area, have poor resistance to earthquakes, take a lot of labour and time to build. The load bearing structure cost is less on the forefront, however, this cost can go up if the soil conditions are unfavourable, and need more labour. Another limitation of the load bearing structure is that you have less or no room of making changes in the design. All these factors collectively have made this structure less popular. These days' people prefer frame structure as it provides more flexibility in design, construction type, and area preferences.

Framed –Structure

In framed structural system, loads from slabs gets transferred to beams, beams to columns and finally from columns to the foundation. The structural elements involved in a framed structural element are

1. **Slab**
2. **Beam**
3. **Column**
4. **Footing**

Here Slab is resting on the beam. The loading is considered on the Slab then Slab transfers the load to beam. Then Beam is a structural element that is resting on the column. The beam transfers the load to column.

The column is connected to the foundation which is casted below the ground surface.

The load from beam is taken by column and then column transfers that load to the respective foundation or footing.

Footing is casted on the firm ground i.e., hard strata or hard rock. The load coming from column is taken by footing and it distributes that to the soil beneath.

Framed structural system has framed structure of columns and beams which have high resistance to lateral forces. The framed structural system is more flexible compared with load-bearing structural system.

Advantages of RCC frame structure

- **RCC framed structure is good in compression in comparison to other construction materials**
- **They can resist fire for a long time**
- **There is a low maintenance cost and better service life**

Cement concrete is robust in compressive strength however weak in tensile strength, to increase the tensile strength we use the mild steel bar or Tor Steel bar in cement concrete.

Importance of RCC Framed Structure

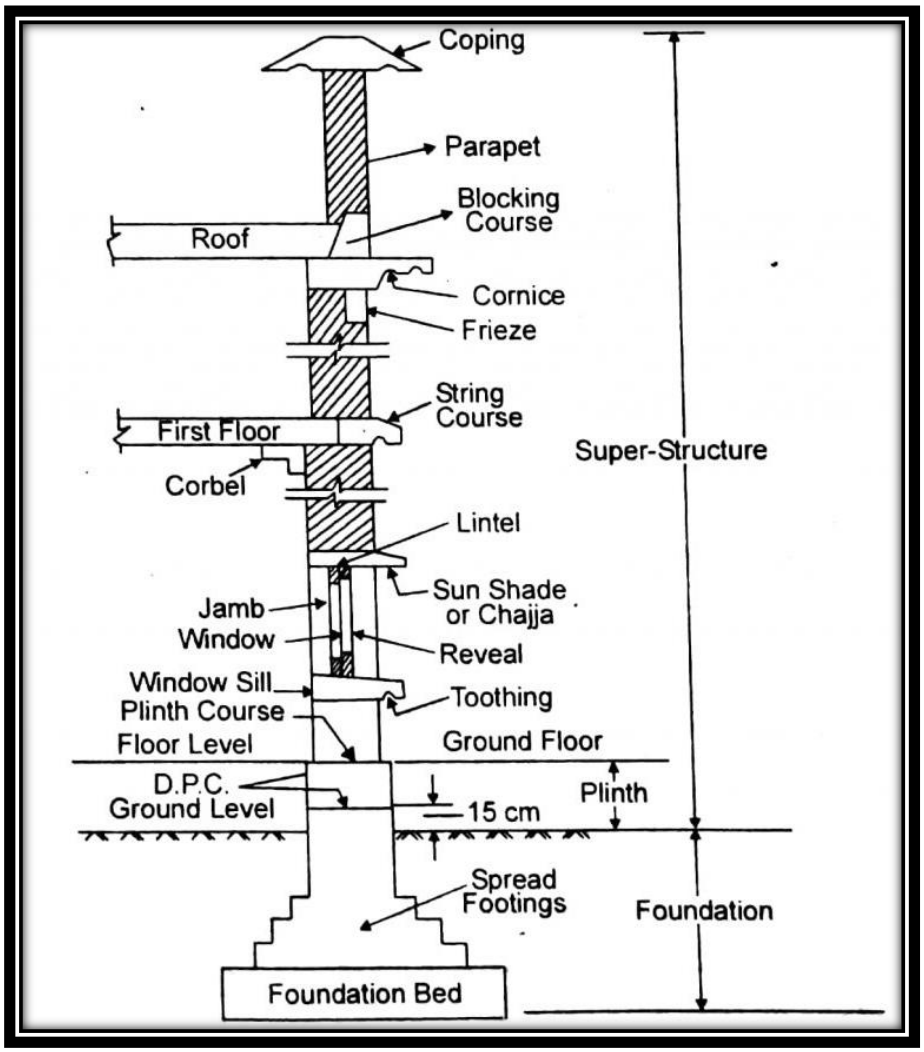
- **The steel bars utilized in cement concrete provide good strength to the structure.**
- **Usually, the steel bars are scratched or corrugated to enhance the bonding or cohesion between concrete and steel.**

- **Care should be taken that the steel bars used for RCC work should not have any joints, so steel must have a longer length.**
- **If full-length steel bars are not available, the steel bar must be given the appropriate overlap and the overlap must be vibrated.**
- **Care should be taken that steel should not be disturbed during concreting.**
- **The steel rods must be properly tied and have proper planks or plates for walking.**
- **The curing of concrete is treated for a minimum of 20 days.**

Difference between Load bearing structure and framed structure

Load Bearing Structure	Framed Structure
Load bearing structure is rarely used for construction purposes.	Framed structure is generally used for construction purposes.
It is a complicated process.	It is a simple process.
The thickness of the wall increases a height increases.	The thickness of the wall remains as it is with the increase in height.
There is no flexibility in designing and planning.	The position of the walls can be changed so designs and plans can be changed accordingly.
It has lower earthquake power resistance.	It has good resistance to handling earthquakes.
More materials are needed for construction.	Fewer materials are needed for construction.
It has more excavations.	It has less excavation.
Less cement and steel are required.	More cement and steel are required.
Many labours are required for load-bearing construction.	Less labours are required for framed structure construction as compared to load bearing structure.
Life is not affected much due to the technique of work.	Life span is reduced if not done properly.
It is effective for 2 storey building economically.	It is effective for multi-storey buildings economically.
The load is transferred to the soil from the wall-bearing structure.	Beams and columns transfer the loads through the footing to the soil.

Typical Section of Sub-Structure and Super Structure



Substructure

The purpose of the substructure of a building is to transfer loads of the superstructure to the soil that is underneath. This is why the substructure is right against the soil that supports it. Now, it is important that you spend time working with structural engineers to ensure that all support beams, columns, and foundations are incorporated properly to ensure that nothing will collapse within the substructure.

Most of the time, the substructure is made from plain cement concrete or reinforced cement concrete. Once that is in place, stones, bricks, or additional concrete is added until it all reaches the plinth level. It is necessary for a damp-proof course to be laid on top, so that moisture doesn't penetrate any part of the substructure.

Superstructure

The superstructure of a building is where people will spend most of their time. This area includes the first and second floors inside a home and any number of floors in larger buildings. The superstructure includes beams, columns, finishes, windows, doors, the roof, floors, and anything else.

The parts of the superstructure are much lengthier than the parts of the substructure. This shouldn't be surprising since the superstructure is much larger than the substructure.

Parts of the Superstructure

Floor

The floors of the superstructure are what separates the different levels of a building. Of course, it is also the area where you walk around, place furniture on, and store numerous items.

1. **Roof**

A roof is necessary on every building because it keeps the floors, and the rest of the superstructure, out of the elements. There is not a one roof fits all solution when it comes to roofing options, so depending on where you are constructing a building, you can choose from different types of roofs. Flat roofs are often used within the plains, while sloped roofs are best near the mountains or where there is a lot of snow.

2. **Lintel**

The lintel is the area over any doors and windows, and it is there to support the wall over the larger openings. A lintel beam is normally made from reinforced cement concrete, but it can also be made from concrete and bricks. The width of the lintel is usually the same as the width of the wall. When it comes to the thickness though, the lintel should never be thinner than four and a half inches. However, it should also never be thicker than its width.

3. **Parapet**

The external walls that extend past the roof slab are called parapets. The purpose of this part of the superstructure is to keep water from pouring over to the entrance of the building, while also offering a safe spot for those who are up on the roof.

4. **Chajja**

The Chajja is put in place with the lintel and it protects both doors and windows from the sun and the rain.

5. **Beams**

Beams are horizontal elements that withstand all vertical loads. All the weight from those vertical loads are supported at the endpoints of the beams and that weight is then transferred to the columns or the beam supports.

6. **Columns**

Columns are vertical structures that can hold a lot of weight. Any columns that are not put in place properly will collapse once additional weight is put on top of them. Of course, all that weight goes from the columns down to the foundation.

7. **Walls**

Without walls inside a building or a home, we would all have large wide-open spaces. However, since none of us wants our bedroom right next to the kitchen, walls are always installed to enclose specific areas of buildings. Most walls are made from concrete or masonry and they hold the weight from the roof, slabs, and even the beams.

8. **Doors, Windows, and Other Openings**

All the doors, windows, and other openings in a house or building are also considered part of the superstructure. The number of doors, windows, and other openings will be dependent on how large the building or house is.

9. **Stairs, Ramps, Lifts, and Other Vertical Transportation Structures**

All those vertical transportation structures that you see in buildings and homes are part of the superstructure. While stairs and ramps are often the only things seen in homes, buildings will also usually have escalators and elevators.

10. **All the Finishing Touches**

Most people forget that all the finishing touches inside a building or a home are part of the superstructure. This includes trim, flooring materials, curtains, blinds, and even heating and cooling units.

Basic Conversion Units for Civil Engineering

1. **1 Cm = 10 mm**
2. **10 cm = 100 mm**
3. **1' = 304.8 mm**
4. **1'' = 25.4 mm**
5. **1 m = 1000 mm**
6. **1 mm = 0.001m**
7. **1 m = 3.28 ft**
8. **1' = 0.3048 m**
9. **1 m sq = 10.764 sq .ft**
10. **1 sq.ft = 0.0929 sq m**
11. **1 cubic m = 35.314 cubic feet**
12. **1 cubic feet = 0.0283 cubic meter**
13. **1 Acre = 43560 Sq. Ft**
14. **1 Hectare = 107639 sq.t**
15. **1 Guntha = 1086 Sq.Ft**
16. **1 Acre = 40 Guntha**
17. **1 Guntha = 0.025 Acre**
18. **1 Hectare = 2.47 Acre**