Civil Engineering Technical Areas Summary

Civil Engineering

Civil engineers help to create the building blocks of modern society. From dams and highways to bridges and buildings, the products of civil engineering are all around us. Civil engineers belong to one of the oldest and largest branches of engineering.

A background in civil engineering opens the door to a variety of career options. Areas of focus include construction engineering, environmental engineering, geotechnical engineering, structural engineering, as well as transportation, urban planning, and water resources. These and other civil engineering technical areas are listed and explained below.

Architectural Engineering

Architectural engineers are concerned with the task of combining the various building systems provided by today's advanced technology into an integrated whole. Architectural engineers apply the skills of many engineering disciplines to the design, construction and maintenance and recycling of buildings. What differentiates Architectural Engineering from its component disciplines is the effort to understand and design for the integration of all the building systems. Civil Engineers, for instance, can and do design the structure of a building. The Architectural Engineer with a specialization in structures will understand and accommodate not only the structural requirements for a building, but also the Architectural, HVAC, Plumbing, Electrical, Transportation, Acoustic requirements.

A common confusion is the distinction between Architecture and Architectural Engineering. Architects are responsible for the form and appearance of a building with a focus on the way that people use and experience the spaces of the building. The Architectural Engineer is responsible for ensuring that "the building works" - that it stands up, that the HVAC system operates, that light and power are delivered as needed. Architectural Engineers use primarily the tools of engineering to achieve optimum system selection and sizing within the overall constraints usually set by the architect.

Construction Engineering

Construction engineers build the facilities that serve society and the business world. All the buildings, highways, bridges, schools, airports, manufacturing plants, and water treatment plants were created by construction people. Construction engineers and managers are the people who figure out how, lead the teams, and take the responsibility, to make them happen. They apply their knowledge of construction methods and equipment along with principles of financing, planning, scheduling, and managing, to turn the designs of other engineers into successful facilities.

Earthquake Engineering

Earthquake Engineering can be defined as the branch of engineering devoted to mitigating earthquake hazards. In this broad sense, earthquake engineering covers the investigation and solution of the problems created by damaging earthquakes, and consequently the work involved in the practical application of these solutions, i.e., in planning, designing, constructing and managing earthquake-resistant structures and facilities.

Earthquake engineers are working to make roads, roadways, buildings, pipelines and other infrastructure safer in the event of a major earthquakes. This includes both improving the design of new buildings and bridges as well as strengthening older units to incorporate the latest advances in seismic and structural engineering. The Federal Emergency Management Agency plays a central role in funding research and development for the purpose of mitigating the effects of earthquakes.

Environmental Engineering

Environmental engineers develop methods to solve problems related to the environment. They assist with the development of water distribution systems, recycling methods, sewage treatment plants, and other pollution prevention and control systems. Environmental engineers often conduct hazardous-waste management evaluations to offer solutions for treatment and containment of hazardous waste. Environmental engineers work locally and globally. They study and attempt to minimize the effects of acid rain, global warming, automobile emissions, and ozone depletion.

Environmental engineers are concerned with protecting the environment by assessing the impact a project has on the air, water, soil and noise levels in its vicinity. This is done by studying the project's design, construction and operation and minimizing any adverse effects that it may have on the environment. Environmental engineers are also involved in removing problems caused by past activity, such as cleaning contaminated industrial land so it can be used for housing. Environmental engineers predict what problems may be caused by accidents, such as oil spills for example, and assess what may cause problems for the environment in the long term. They also plan and design equipment and processes for the treatment and safe disposal of waste material and direct the conservation and wise use of natural resources. They are involved in research and development of alternative energy sources, water reclamation, waste treatment and recycling.

Environmental engineers may work with government departments or in the private sector with resource processing companies as consulting engineers.

Water Resource Engineering

Water resource engineering deals with the physical control of water while working with others to prevent floods; supply water for cities, industry and irrigation; protect beaches; or manage and redirect rivers.

Water resources engineers help to protect water supplies and ensure that development of new sources does not disrupt natural processes. Typically, they would be involved with, but not limited to, the following tasks.

- Development and use computer software to analyze and design water management systems
- Identify and evaluate watershed management options
- Design systems to distribute and collect water used in cities, industries and agriculture
- Design systems for protection and control of rivers, reservoirs, irrigation and drainage, and water conservation
- Apply bioengineering and naturalization to rehabilitate polluted water, degraded channels and eroding soils
- Develop policies for preservation and enhancement of water resources

Geotechnical Engineering

Geotechnical Engineering is a discipline of Civil Engineering that deals with soil, rock and underground water, and their relation to design, construction and operation of engineering projects. It is also sometimes called soils engineering, ground engineering or geo-technics as it is closely related to Engineering Geology. Nearly all civil engineering structures are supported on or built into the ground, and thus require geotechnical engineering.

These engineers provide information and knowledge on how the soil and rocks beneath a proposed structure will behave under pressure. An understanding of the structures being built is needed in order to assist in the design of their foundations. Geotechnical engineers spend a lot of time outdoors, collecting samples and testing ground areas and advising on work in progress.

Geotechnical engineering has evolved and branched off into new areas such as geo-environmental engineering, which deals with underground environmental problems. Another area is Geo-mechanics. Modern geotechnical engineering use sophisticated tools such as the finite element method for computing the behavior of geological structures. These rely heavily on principles of mechanics featuring systems of forces, displacements, stresses and strains that are used to characterize the behavior of geo-materials (soils and rocks).

Hydraulic Engineering

Hydraulics (Water) Engineering is concerned with planning and organizing how water is provided and removed both for large and local schemes. Hydraulics engineers also deal with the treatment of waste from industry, the control of rivers and flood waters, the protection of the coastline and careful planning of harbors.

Hydraulic engineers have had an important role to contribute to our Society although the technical challenges are gigantic, often involving interactions between water, solids, air and biological life. The extreme complexity of hydraulic engineering is closely linked with the geometric scale of water systems, the variability of river flows and the complexity of basic fluid mechanics with governing equations characterized by non-linearity and natural fluid instabilities.

Structural Engineering

Natural forces such as wind, waves and earthquakes and their effects all need to be taken into account when a structure is designed and built. Certain stresses caused by the modern environment, such as the traffic of both cars and people, also need to be considered. A structural engineer ensures that structures are built in such a way that they stand up to these forces. Innovative solutions to these problems are researched, developed and tested by structural engineers.

Structural engineers often work with architects, builders and those in mechanical, electrical and chemical engineering to organize and supervise the construction of particular structures.

Land Surveying

Civil engineers are involved in the precise measurement of the earth's surface to obtain reliable information for locating and designing engineering projects. They measure land, air space, and water areas. They describe where a certain area of land is. They explain what it looks like, and how much is there. They put these facts in deeds, leases, and other legal documents. Land surveyors also define air space for airports. In addition, they measure construction and mineral sites. Land surveyors are the leaders of survey parties (or surveying projects).

Transportation Engineering

Transporting Engineering is concerned with the transport means for both people and freight.

Transport engineers design, test and improve systems and structures used to move people,

cars, trains, airplanes and ships. For example, it is vital that traffic intersections are designed in such a way that traffic flows freely and does not cause unnecessary congestion. The layout of train lines needs to be designed with similar objectives in mind. Transport engineers also plan future travel needs of city and country areas as populations increase and needs change.

Transportation engineers focus on the design, construction and maintenance of structures, supporting transport networks, such as bridges, tunnels and railway tracks. Their responsibilities include:

- Using specialist knowledge of the ground or soil conditions to design tunnels, bridges, etc
- Planning how to improve passenger comfort
- Providing a transport system which will be safe, efficient and good value for money
- Finding new solutions to transport problems
- Overseeing the laying and alignment of railway tracks
- Analyzing the effects on the environment
- Liaising with clients and other construction professionals.
  There is also a high demand for transport engineers.

Urban & Community Planning Engineer

Urban and community planning engineers analyze a variety of information to coordinate projects such as projecting street patterns, recreation areas, and determining areas for industrial and residential growth.

Urban and community planning engineers figure out the best way to use the land in cities and neighborhoods. They report on the best location for houses, stores, and parks. They try to solve a lot of problems. These include things such as too much traffic and increases in air pollution. Urban and community planning engineers want to make sure that people can get to a bus or subway. They need to plan where people should drive their cars and where they can park.

Urban and community planning engineers also are concerned about saving the wetlands, and trees. They try to find safe places for getting rid of trash.

Before making plans for a community, urban and community planning engineers need to know where everything is. They find out how many people use the streets, highways, water, sewers, schools, libraries, museums, and parks. Urban and community planning engineers listen to the advice of people who live in the communities. With these and many other facts, they explain their new plans. They tell how much the changes will cost.