# Civil Engineering

*A People Serving Profession*

Civil engineers plan, design, construct, operate and maintain, and rehabilitate the infrastructure of the world. Civil engineers are involved in our entire constructed environment: sewers to water works, dams to power plants to transmission towers and lines, railroads to highways to bridges, irrigation canals to river navigation to shipping canals, traffic control to airport runways and terminals, tunnels to industrial plant buildings to skyscrapers.

## Brief Historical Background

- One of the oldest of the engineering professions; said to have begun in 18th century France
- First "Civil Engineer" was an Englishman, John Smeaton in 1761.
- Civil engineers have saved more lives than all the doctors in history --- development of clean water and sanitation systems.
- Henry H. White, first KY Civil Engineering Graduate from Bacon College in 1840.
- Fall of 1886, "State College" established civil engineering degree.
- John Wesley Gunn of Lexington received first Civil Engineering degree from A & M College in 1890.

## Civil Engineering Specialties

It is not necessary for students in civil engineering to specialize at the undergraduate level. In fact, specialization may be counterproductive for the following:

- Students who desire a broad civil engineering background.
- Students who have not developed specific civil engineering interests.
- Students planning advanced education in other areas such as law, medicine, business, etc.
- Students who having highly developed interests not encompassed by the several areas of specialization.

Such individuals are encouraged to select their elective courses from those that best meet their individual educational objectives.

### Construction Engineering and Management

The civil engineer engaged in construction may be involved with the design of construction support systems such as form work, scaffolding, lifting apparatus, etc. and/or the management of construction resources such as labor, materials, equipment, money and time. Desired attributes for engineers in construction are a broad civil engineering background, an understanding of project management, computer literacy, and an ability to communicate both orally and in writing with technical and non-technical people alike. Typically, engineers in construction are involved with taking plans and specifications developed by specialists and translating these into completed projects consisting of buildings, highways, bridges, tunnels, etc. - on time, within budget and to a specified quality. This process requires the ability to understand the technical aspects of the project and communicate them to owners, bankers,

public organizations, and other interested parties. Opportunities abound for engineers in construction, for instance, starting in a field position and progressing to project manager and on to upper management in a construction company. Alternate career paths lie in organizations that buy construction services or organizations that support construction such as banks, insurance companies, material and equipment suppliers, and a variety of public agencies.

**Environmental/Water Quality Engineering**

Water quality control engineers apply their technical skills to the solution of problems associated with water treatment and water pollution control. They design facilities for the treatment of water supplies to produce safe and aesthetically acceptable drinking water. They design facilities for the treatment of municipal and industrial wastewater to produce effluent acceptable for discharge back into the environment. The design of facilities for both water and wastewater treatment requires a knowledge and understanding of many unit processes and operations which are synthesized into an overall treatment system. These processes and operations may generally be classified as physical, chemical, or biological in nature. Therefore, training in chemistry and biology in addition to the traditional engineering sciences is invaluable to a water quality control engineer.

The environmental aspects of water quality control engineering are concerned primarily with the movement and behavior of water pollutants in natural waters. A typical problem is the determination of the permissible quality of treated wastewater effluent that may be discharged at a specific point so that the water quality standards for the receiving water are not violated. The analysis and solution of this problem typically requires a knowledge of the physical, chemical, and biological phenomena associated with the receiving water and the application of computer modeling. The solution then leads to the design of the appropriate wastewater treatment facilities to produce an effluent with the required quality.

Water quality planning is an integral part of the field. Practicing engineers develop long-range plans for the protection and enhancement of water quality for areas of various geographical sizes - a river basin, for example. In performing this planning function, they utilize basic planning concepts, mapping, hydrology, economics, statistics, and computer modeling, in addition to their basic water quality control engineering skills.

**Geotechnical Engineering**

Geotechnical engineers are involved in the design and construction of numerous civil engineering systems. For example, structural foundations, highway and airfield pavements, bridge piers and abutments, retaining walls, earth and rock fill embankments, containment structures for solid and liquid wastes, dams and levees, canal and roadway cuts, shafts and tunnels. They must have an unusually broad background of training and experience that includes physics, geology, mechanics, hydrology, structures, and construction practice. Modern geotechnical practice makes extensive use of the computer for analysis and design, data acquisition and reduction, planning and scheduling, and cost analysis. A Geotechnical engineer has opportunities to work in the field and laboratory as well as in the design office.

**Hydraulic Engineering**

Hydraulic engineering deals with the engineering analysis and design of systems to transport liquids. This includes small and large systems of pipes, prismatic channels, and natural

channels. All aspects of the liquid transportation process are of interest including hydraulic machinery such as pumps and turbines, hydraulic controls such as valves and weirs, hydraulic structures such as dams and spillways, and models. Transportation of solid-liquid slurries and sedimentation problems are also covered.

**Structural Engineering**

Structural engineering is concerned with the design and analysis of all man-made objects whose primary function is load resistance. Included in this are the load carrying portions of buildings, bridges, aircraft, towers, radar domes and antennas, retaining walls, drilling platforms, etc. In addition to the basic design, structural engineers must also concern themselves with the economics, esthetics and the social implications of their creations. They rely heavily in this work on the laws of mechanics, material science, and mathematics, as well as on experience, judgment and engineering intuition.

Upon completion of this specialized undergraduate program, the student is qualified to work either as a junior engineer in a structural design group, to work as a resident engineer or field engineer on construction projects, or to continue formal education as a graduate student in structural engineering. A number of states, including Kentucky, encourage or require specialized professional registration for practitioners in this field.

**Surveying**

According to one of the many definitions of surveying, it includes: "those activities involved in measuring the physical features of any surface or space and representing them for such purposes as engineering projects of resource evaluation and development plans". This implies that Surveying, often aided by the relatively new sciences of Photogrammetry and Geographic Information Systems, is a necessary part of the planning, design and layout of all civil engineering projects. Surveying is recognized by the American Society of Civil Engineers as an important branch of the profession. The recent increase in interest in land use planning, resource development and the environmental impacts of man's activities has brought about a need for more civil engineers with professional training in surveying and related fields. A number of other universities in the U.S. and Canada now offer advanced degrees in this field and job opportunities are numerous. Surveyors must obtain specialized registration as Land Surveyors.

**Transportation Engineering**

Transportation engineering involves all phases of the movement of persons and goods. Transportation engineering includes the planning, design, construction, maintenance and operation of fixed facilities of the various transportation modes, for example, highway, railway, guide way, air, water, conveyor and pipeline systems. Additionally, transportation engineers are involved in the regulation and accommodation of driver/operators, passengers, goods, and vehicles. Adequate training in transportation engineering therefore requires a basic knowledge of one or more of its phases or modes.

Transportation engineering graduates are typically employed by private engineering consulting firms or in city, state, or federal transportation agencies where the specialized knowledge from several individuals or groups can be utilized effectively. Advancement in practice normally requires a period of continuing improvement of personal specialized knowledge of one or more phases (planning, design, construction, maintenance, operation) of

a transportation mode, accompanied by developing capability for management of the input of specialized knowledge from other Civil, Mechanical, and Electrical engineers.

**Water Resources Engineering**

Water resources engineering is concerned with the development, use, and management of the worlds' water resources. Consequently, water resources engineers must have a broad background of training and experience in the areas of hydrology, fluid mechanics, chemistry, economics, statistics and computer modeling. They are responsible for the planning, design, construction, operation, and management of water resource projects. Such projects may include the following objectives: water supply, flood control, navigation, hydroelectric power, recreation, fish and wildlife enhancement, and urban drainage. Water resources engineers are also responsible for analyzing the impact of other engineering projects on the natural hydrologic system. Most are employed by private engineering consulting firms or in city, state, or Federal agencies that deal with water resources.

# Civil Engineering High School Preparation

Students planning to pursue civil engineering should complete the following courses while in high school:

- Four years of mathematics through pre-calculus, but preferably calculus.
- One year of chemistry.
- One year of physics.
- One year of biology.
- One year of earth science.
- Computer skills course.
- Writing and public speaking.
- Two years of the same foreign language.

If any of the above areas are not completed in high school, then it may take longer than the scheduled four years to complete an undergraduate degree in civil engineering or any other field of engineering.

Any student that is interested in engineering is encouraged to visit the University of Kentucky engineering web site at:

www.engr.uky.edu

From this location, you can click onto the civil engineering program or any other engineering program. General information on the University of Kentucky is located at

www.uky.edu

***If you have any questions*** do not hesitate to contact the Director of Undergraduate Studies at gebland@engr.uky.edu or (859) 257-1855.