21世纪全国本科院校土木建筑类创新型应用人才培养规划教材

# 土木工程专业英语

主　编　霍俊芳　姜丽云

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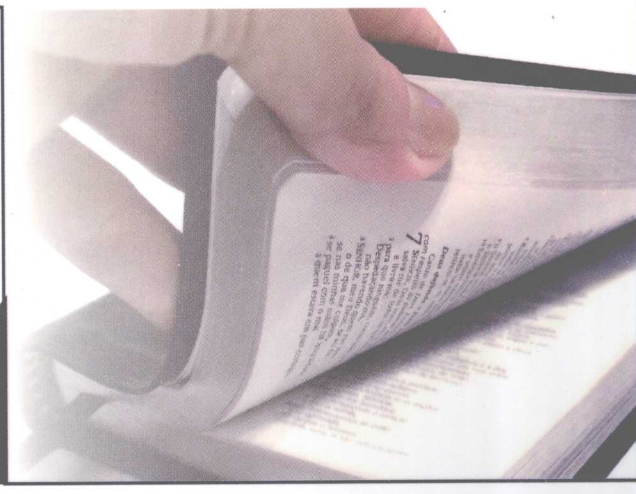

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# 内 容 简 介

本书共18章54篇文章，每篇文章都附有疑难词汇、相关练习题及参考译文和练习答案。内容涉及土木工程、交通工程、建筑材料、现代建筑、荷载及设计方法、桥梁结构、建筑施工、土力学、公路工程、环境工程、供热与通风工程、施工管理、项目管理、房地产、国际工程管理等。

本书既可作为土木工程专业本科生教材，也可供土木工程专业的教师及工程技术人员参考、阅读。

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# 前　　言

本书是为了满足应用型人才培养的需要，根据大学英语教学大纲的要求，面向土木工程专业编写的。本书从整体上考虑了“大土木”的专业课程设置和培养计划，将各专业方向的学时和内容统一安排协调，有利于拓宽学生的专业知识、增加专业词汇量、熟悉专业英语的表达习惯。针对学生在专业英语学习过程中词汇易误解、课文难理解、汉语表达不流畅的问题，编者在每章后编写了一些习题，专业英语语法及翻译与写作技巧，这有助于学生对每篇文章内容的理解和掌握，提高阅读理解能力和写作技能，增强学生学习专业英语的信心。本书可作为土木工程专业本科生教材，也可供土木工程专业的教师及工程技术人员参考、阅读。本书建议授课学时为50学时，也可根据授课对象调整学时。

本书突出体现了以下三个方面的特点。

(1) 内容丰富，选材广泛。其中包括一些近年来发展的新技术、新成果，有利于读者了解相关领域的研究动态，为读者阅读相关文献提供帮助。

(2) 在编写过程中注重知识的基础性和适用性以及文章的可读性，避免烦琐的公式和推导，尽量采用描述性的语言，做到言简意赅。

(3) 练习题针对性强，着重考查学生理解和综合应用知识的能力，避免学生采用“死记硬背”的学习方法。

本书由内蒙古工业大学的教师编写。全书共18章，其中第1、2、5章由姜丽云编写，第3、4、7章由霍俊芳编写，第6、9、10章由侯永利编写，第8、11、12章由冯蕾编写，第13、14、15章由贺玲丽编写，第16、17、18章由仲作伟编写。

由于编者水平有限，书中难免存在错误和不妥之处，敬请广大读者和同行批评指正。

编　者

2009年12月

# 目　录

# Chapter 1

# Civil Engineering

## Section A Introduction of Civil Engineering

One of the oldest **major** is **civil engineering**. Civil engineering is that branch of engineering which aims to provide a comfortable and safe living for the people shelter. The engineering marvels of the world, starting from the pyramids to today's shell structure, are the results of the development in civil engineering. One of the primary needs of mankind is provided by civil engineers. Civil engineers design and construct buildings, railways, roads, bridges, tunnels, harbors, water and sewage systems, and other public facilities. The efficient planning of water supply and irrigation systems increases the food production in a country. Shelters, apart from just being shelters, have been constructed by civil engineers to provide a peaceful and comfortable life.

The word civil derives from the Latin for citizen. In 1782, Englishman John Smeaton used the term to differentiate his nonmilitary engineering work from that of the military engineers who predominated at the time. Since then, the term civil engineer has often been to refer to engineers who build public facilities, although the field is much broader.

The works of civil engineer include investigation (collect data before planning a project), surveying (prepare maps to locate the structure on the surface of earth), and design, construction, management, research and development, etc. The scope of civil engineering is broad, depending on the type of the project and the skills needed. Some specializations of civil engineering are listed below:

(1) Structural engineering;

(2) Geotechnical engineering;

(3) Transportation engineering;

(4) Fluid mechanics, hydraulics and **hydraulic** machines;

(5) Environmental engineering;

(6) Pipeline engineering.

Structural engineering is the most important specialization, it includes: positioning and arranging the various parts of the structure into a definite form to achieve best utilization; determining the forces that a structure must resist, its own weight, wind and **hurricane** forces, and temperature change that expand or contract construction materials, and earthquake. They also determine the combination appropriate materials: steel, **concrete**, plastic, stone, **asphalt**, brick, aluminum, or other construction materials; analyzing the behavior of parts of the structure subjected to the above forces; designing the structure such that its stability under the action of various loads is ensured; executing the work with selected construction materials and skilled workers. Most structural engineer work for apartment or public construction and factory constructions. They design the size, style and number of reinforcing steel bars， etc.

Civil engineers who specialize in geotechnical engineering deal with the following aspects: the properties of soils and rocks as materials that support the structure; the various types of foundation for a structure; **settlements** of buildings; **stabilities** of **slopes and fills**; effects of groundwater. Because foundation is the most important part of a building, it is very complicated underground and it is difficult to **remedy** if something is wrong. These engineers analyze the properties of soils and rocks that support structures and affect structural **behaviors**. They evaluate and work to minimize the potential settlement of buildings and other structures, which stems from the pressure of their weight on the earth. These engineers also evaluate and determine how to strengthen the stability of slopes and fills and how to protect structures against earthquakes and effects of groundwater. They often perform experiment to achieve pleased result.

Transportation engineering is the science of safe and efficient movement of people and goods. It is a sub-discipline of civil engineering. The planning aspects of transportation engineering relate to urban planning, and involve technical forecasting decisions and political factors. Passenger trips are the focus of transportation engineering because they often represent the peak of demand on any transportation system. The design aspects of transportation engineering include the sizing of transportation facilities, determining the materials and thickness used in pavement, designing the geometry of the **roadway**. Operation and management involve traffic engineering, older techniques include signs, signals and markings, newer technologies involve intelligent transportation systems, including advanced traveler information systems and advanced traffic control systems.

Fluid mechanics, hydraulics and hydraulic machines, in this branch of engineering, civil engineers deal with the properties and behavior of fluids at rest or in motion. Engineers design and maintain harbors, hydroelectric dams, **waterfront** facilities, control water **runoff**, control and harness of various resources of water, they construct dams, reservoirs, and distribute channels to the **cultivable** land.

Those engaged in environmental engineering design systems to **sanitize** water and air, they provide safety drinking water for people and control pollution of water supplies, they help to build water and wastewater treatment plants, **dump** sites to eliminate **hazardous** or toxic **wastes** and prevent pollution of surrounding land.

Civil engineers in pipeline engineering build pipelines and related facilities which transport liquids, gases, or solids ranging from coal **slurries** (mixed coal and water) and semi-liquid wastes to water, oil, and various types of highly **combustible** and noncombustible gases. The engineers determine pipeline design, the economic and environmental impact of a project on regions it must traverse, the type of materials to be used-steel, concrete, plastic, or combination of various materials installation techniques, methods for testing pipeline strength, and controls for maintaining proper pressure and rate of flow of materials being transported. When hazardous materials are being carried, safety is a major consideration as well.

Though the difference of special knowledge and skills needed, structural engineers determine the member's size, geotechnical engineers perform experiment to determine the earth capacity, transportation engineers aim at easing the transportation pressure, hydraulic engineers consider the behavior of fluids, environmental engineers study the project's potential pollution and protecting, pipeline engineers deal with aspects of design and installation of pipelines. These specialists always work together, computers are their necessary tool, they make extensive use of computers to handle large quantities of data and determine the best way to execute a project.

## Words and Phrases

civil engineering 土木工程
slopes and fills 边坡和路堤
waterfront ['wɔːtəfrʌnt] *n.* (都市中的)河，湖
settlement ['setlmənt] *n.* 沉降
stability [stə'biliti] *n.* 稳定性，坚固，耐久性
hydraulic [hai'drɔːlik] *adj.* 水利的，液压的
runoff ['rʌnɔːf] *n.* 流量，流泻，流放
behavior [bi'heivjə] *n.* 性能，性质
sanitize ['sænitaiz] *v.* 使清洁，除去……中的有害成分
dump [dʌmp] *n.* 垃圾堆
waste [weist] *n.* 废弃物
hazardous ['hæzədəs] *adj.* 危险的
major ['meidʒə] *n.* 专业科目
cultivable ['kʌltivəbl] *adj.* 可耕的，可培养的
remedy ['remidi] *v.* 补救，修理
roadway ['rəudwei] *n.* 路面，道路
hurricane ['hʌrikən] *n.* 飓风
asphalt ['æsfælt] *n.* 沥青
concrete ['kɔnkriːt] *n.* 混凝土
combustible [kəm'bʌstəbl] *adj.* 易燃的
slurry ['sləːri] *n.* 浆，泥浆

## Exercises

Ⅰ. Fill in the blanks with the information given in the text.

Loads to foundations are generally broken into two broad categories, gravity loads (dead and live) and ______ loads (wind and earthquake). All loads to foundations are treated as ______ loads. Live loads, wind loads, and ______ loads may actually be highly dynamic, but in practice such loads are applied as ______ static loads rather than as ______ loads.

Ⅱ. Translate the following passages from English into Chinese.

One of the primary needs of mankind is provided by civil engineers. Civil engineers design and construct buildings, railways, roads, bridges, tunnels, harbors, water and sewage systems, and other public facilities. The efficient planning of water supply and irrigation systems increases the food production in a country. Shelters, apart from just being shelters, have been constructed by civil engineers to provide a peaceful and comfortable life.

## Section B Structural Engineering

Structural engineering is a branch of civil engineering concerned with the designing and **execution** of all types of structures, such as buildings, bridges, highways, power plants, dams, transmission towers, and many other kinds of **specific** structures.

The designing phrase starts with the understand of the project, the designer must take through study of the technological and service performance requirements that must be expected from the structure, including load **intensities** and their **duration**, any **dynamic** action that might take place.

Load condition is the first factors that designers consider. The same structure in different location exhibits different design because of ground water level, soil **characteristic**. Foundation is particularly important in whole structure design. If the soil is soft, it should be strengthened. If the substructure is below the grounder water level, methods such as well points, or pumping from **sumps** should be taken to remove water.

A designer must first calculate the dead loads, live loads, earthquake and wind loads, and their combination, then selects structural system and construction materials. Finally, the designer analyzes structure and designs members. The live loads are usually provided by building codes. Steel and concrete are traditional materials, **carbon fiber** is **novel** material which has excellent strength and stiffness, but they are used only in limited application because of the high cost.

Analysis of structures aimed at determining the forces and deformations existed in members. These forces such as tension, compression, bending, shear and torsion could make structures **destroyed**. Excessive lateral sway may causes recurring damage to partions, ceilings, and other architectural details and may cause discomfort to the occupants of the building. This deformation must be kept within acceptable limits.

Structural design and structural analysis are components of structural engineering and a key component in the structural design process, they are **interlocked** subjects. The structural engineering has the objective of proportioning a structure such that it can safely carry the loads to which it may be subjected. Structural analysis provides the internal forces and structural design utilizes those forces to proportion the members or systems of members. Without structural analysis, design is impossible.

Member sizes designed are often from experience and comparison to some similar design and use of available empirical rules combined with some rough calculations. Most design are **initially** based on the strength and stability criteria, while other criteria are used to carry out checks at a later stage. To arrive at an optimum and economical design, it is usually to repeat the analysis with the revised sizes and shapes. In this stage, computer is a useful tool.

The speedy execution of the project requires the ready supply of all materials, equipment and labor when needed. The construction engineer must control whole operations. These operations include: excavation, foundation and **superstructure** construction, electrical and mechanical installation.

**Excavation** follows preparation of the site, it may be done by special **excavator**, and the soil excavated can be used for **landscaping** and **fill**. If the excavation areas are wet, **dewatering** and stabilizing of the soil become major operation; if the materials encountered are hard, blasting will be needed. There are several types of **foundation** in different structures. If defects exist, the foundation must be strengthened. In superstructure construction, it generally consists of several operations: forming, concrete production, **placement and curing**. Electrical and mechanical systems need **ancillary** space to provide a comfortable environment. All these **construction** must be **proceeded** according to drawings.

Engineers apply both technical and managerial skills, including knowledge of construction methods, planning, organizing, financing, and operating construction projects. They coordinate the activities of virtually everyone engaged in the work: the **surveyors**, workers who lay out and construct the temporary roads and ramps, excavate for the foundation, build the forms and pour the concrete; and workers who build the steel framework. These engineers also make regular process reports to the owner of the structure.

## Words and Phrases

execution [ˌeksiˈkjuːʃən] *n.* 施工，实施，执行
specific [spiˈsifik] *adj.* 特殊的，专门的，具体的
dynamic [daiˈnæmik] *adj.* 动力的，冲击的
characteristic [ˌkæriktəˈristik] *adj.* 特有的；*n.* 特性，性能
intensity [inˈtensiti] *n.* 强度，密度
sump [sʌmp] *n.* 排水坑，集水坑
carbon fiber 碳纤维
novel [ˈnɔvəl] *adj.* 新的，异常的
excavation [ˌekskəˈveiʃən] *n.* 挖掘，开挖
landscape [ˈlændskeip] *n.* 风景，(环境)美化
fill [fil] *n.* 填土
ancillary [ænˈsiləri] *adj.* 辅助的，附属的
foundation [faunˈdeiʃən] *n.* 基础
excavator [ˈekskəveitə] *n.* 挖掘机，开凿者
proceed [prəˈsiːd] *v.* 继续进行，开始
interlock [ˌintəˈlɔk] *v.* 使联结，使组合
construction [kənˈstrʌkʃən] *n.* 建造，施工
surveyor [səːˈveiə] *n.* 测量员
dewater [diːˈwɔːtə] *n.* 排水
placement and curing 浇筑和养护
superstructure [ˈsjuːpəˌstrʌktʃə] *n.* 上部结构
duration [djuəˈreiʃən] *n.* 持续时间
destroy [disˈtrɔi] *v.* 破坏，毁坏
initially [iˈniʃəli] *adv.* 最初，开始

## Exercises

Ⅰ. Put the following into Chinese (English).

1. 流体力学
2. 给排水系统
3. 边坡和路堤稳定
4. 强度和耐久性
5. 控制水流量
6. safety factor
7. strength and stiffness
8. active recruiting
9. translate the theory into practice
10. placement and curing

Ⅱ. Fill in the blanks with the information given in the text.

In the discussion of practical mechanics the principles are outlined whereby the ______ may take a structure or mechanical component with known ______acting on it and proceed to find out the various ______those forces will have on the system. In other words, the study of mechanics might start with a beam acted upon by given forces and use established methods to predict the ______ of the beam and the force ______ within the beam due to those applied forces.

# Section C Careers in Civil Engineering

Engineering is a profession, which means that an engineer must have a specialized university education. Many government **jurisdictions** also have licensing procedures which require engineering graduates to pass an examination, similar to the **bar** examination for a lawyer, before they can actively start on their careers.

In the university, mathematics, physics, and chemistry are heavily emphasized throughout the engineering **curriculum**, particularly in the first two or three years. Mathematics is very important in all branches of engineering, so it is greatly stressed. Today, mathematics is included in **statistics**, which deals with gathering, classifying, and using numerical data, or pieces of information. An important aspect of statistical mathematics is probability, which deals with what may happen when there are different factors, or variable, that can change the results of a problem. Before the construction of a bridge is undertaken, for example, a statistical study is made of the amount of traffic the bridge will be expected to handle. In the design of the bridge, variable such as water pressure on the foundations, impact, the effects of different wind forces, and many other factors must be considered.

Because a great deal of calculations are involved in solving these problems, computer programming is now included in almost all engineering curricula. Computers, of course, can solve many problems involving calculations with greater speed and accuracy than a human being can. But computers are useless unless they are given clear and accurate instructions and information—in other words, a good program.

In spite of the heavy emphasis on technical subjects in the engineering curriculum, a current trend is to require students to take courses in the social sciences and the language arts. The relationship between engineering and society is getting closer; it is sufficient, therefore, to say again that the work performed by an engineer affects society in many different and important ways that he or she should be aware of. An engineer also needs a sufficient command of language to be able to prepare reports that are clear and, in many cases, **persuasive**. An engineer engaged in research need to be able to write up his or her finding for scientific publications.

In the last two years, an engineering program includes subjects within the student's field of specialization. For the student who is preparing to become a civil engineer, these specialized courses may deal with such subjects as **geodetic** surveying, soil mechanics, or hydraulics.

Active **recruiting** for engineers often begins before the student's last year in the university. Many different corporations and government agencies have competed for the services of engineers in recent years. In the **science-oriented** society of today, people who have technical training are, of course, in demand. Young engineers may choose to go into environmental or sanitary engineering, for example, where environmental concerns have created many openings; or they may choose construction firms that **specialize** in highway work; or they may prefer to work with one of the government agencies that deal with water resources. Indeed, the choice is large and varied.

When the young engineer has finally started actual practice, the theoretical knowledge acquired in the university must be applied. He or she will probably be assigned at the beginning to work with a team of engineers. Thus, on-the-job training can be **acquitted** that will demonstrate his or her ability to translate theory into practice to the supervisors.

The civil engineer may work in research, design, construction supervision, maintenance, or even in sales or management. Each of these areas involves different duties, different emphases, and different uses of the engineer's knowledge and experience.

Research is one of the most important aspects of scientific and engineering practice. A researcher usually works as a member of a team with other scientists and engineers. He or she is often employed in a laboratory that is financed by government or industry. Areas of research concerned with civil engineering included soil mechanics and soil stabilization techniques, and also the development and testing of new structural materials.

Civil engineering projects are almost unique; that is, each has its own problems and design features. Therefore, careful study is given to each project even before design work begins. The study includes a survey both of **topographical** and subsoil feature of the proposed site. It also includes a consideration of possible alternatives, such as a **concrete** gravity dam or an earth- fill embankment dam. The economic factors involved in each of the possible alternatives must also be weighed. Today, a study usually includes a consideration of the environmental impact of the project. Many engineers, usually working as a team that includes surveyors, specialists in soil mechanics, and experts in design and construction, are involved in making these feasibility studies.

Many civil engineers, among them the top people in the field, work in design. As we have seen, civil engineers work on many different kinds of structures, so it is normal practice for an engineer to specialize in just one kind. In designing buildings, engineers often work as consultants to architectural or construction firms. Dams, bridges, water supply systems, and other large projects ordinarily employ several engineers whose work is coordinated by a systems engineer who is in charge of the entire project. In many cases, engineers from other disciplines are involved. In a dam project, for example, electrical and mechanical engineers work on the design of **powerhouse** and its equipment. In other cases, civil engineers are assigned to work on a project in another field; in the space program, for instance, civil engineers were necessary in the design and construction of such structures as launching pads and rocket storage facilities.

Construction is a complicated process on almost all engineering projects. It involves scheduling the work and utilizing the equipment and materials so that cost is kept as low as possible. Safety factors must also be taken into account, since construction can be very dangerous. Many civil engineers therefore specialize in the construction phrase.

Much of the work of civil engineers is carried on outdoors, often in **rugged** and difficult **terrain** or under dangerous conditions. Surveying is an outdoor occupation, for example, and dams are often built in wild river valleys or **gorges**. Bridges, tunnels, and **skyscrapers** under construction can also be dangerous places to work. In addition, the work must also process under all kinds of weather conditions. The **prospective** civil engineer should be aware of the physical demands that will be made on him or her.

## Words and Phrases

jurisdiction [ˌdʒuəris'dikʃən] *n.*权限，管辖权
bar [bɑː] *n.*法庭，律师的职业
curriculum [kə'rikjuləm] *n.*课程，学习计划
statistic [stə'tistik] *adj.*统计学的；*n.*统计表
persuasive [pə'sweisiv] *adj.*有说服力的；*n.* 动因，诱因
recruit [ri'kruːt] *v.* 补充，招收
science-orient 注重科学的
specialize ['speʃəlaiz] *v.*专门研究，使专业化
geodetic [ˌdʒiːə'detik] *n.* 大地测量学
acquit [ə'kwit] *v.* 尽职，赦免
topographical [ˌtɔpə'græfikəl] *adj.*地形学的
powerhouse *n.* 动力室，发电厂
rugged ['rʌgid] *adj.* 崎岖的，艰难的
terrain ['terein] *n.* 地域，地带
gorge [gɔːdʒ] *n.* 峡谷
skyscraper ['skaiskreipə] *n.* 摩天楼
prospective [prəs'pektiv] *adj.* 将来的，未来的

## Exercises

Ⅰ. Decide whether the following statements are true (T) or false (F).

( ) 1. Doing experiment to achieve the properties of soils and rocks is environmental engineer's work.
( ) 2. A structural engineer must calculate loads, and then select structural system.
( ) 3. A civil engineer need not work in research and management, they should grasp knowledge learned from lessons.
( ) 4. Steel concrete and carbon fiber are traditional materials.
( ) 5. Most preliminary designs begin with the strength and stability criteria.

Ⅱ. Translate the following passages from English into Chinese.

The architect has now chosen his structural system and his materials of construction. He has accounted for load propagation through his structural system and the effects of that propagation on the material. Thus he can provide enough material. In other words, members of proper size—for all elements of his structure to ensure that the internal stresses developed are less than those permissible for the material in question.

# 参 考 译 文

## 第 1 章　土木工程概论

### Section A　土木工程

土木工程是最古老的专业之一。它是工程的一个分支，目的是为人类提供一个舒适而安全的住处。世界上的工程奇迹，从金字塔到当今的壳结构都是土木工程发展的结果。人类的主要需求之一是由土木工程师提供的。土木工程师设计并建造房屋、铁路、道路、桥梁、隧道、港口、给水和污水系统以及其他公共设备。供水及灌溉系统的合理设计会提高一个地区粮食的产量。除了仅仅作为住处之外，由土木工程师建造的住处提供了一个和平而舒适的生活。

土木一词来源于拉丁语，意为民用。在 1782 年，英国人 John Smeaton 用这个词将非军事工程与占主导地位的军事工程的工程师区别开来。从那时起，土木工程师这个词用来指建设公共设施的工程师，尽管这一领域非常广阔。

土木工程师的工作包括调查(设计项目之前搜集资料)，测量(准备图纸以确定结构在地表的位置)和设计、施工、管理、研究和开发等。土木工程的范围很广，这取决于项目的类型及所需的技术，主要的土木工程专业如下：

(1) 结构工程；
(2) 岩土工程；
(3) 运输工程；
(4) 流体力学、水利及水利机械；
(5) 环境工程；
(6) 管道工程。

结构工程是最重要的一个专业，它包括：将结构的不同部分进行定位和布置，从而形成一个确定的形式以获得最好的利用；确定结构必须抵抗的力，结构的自重，风和飓风，使施工材料产生的膨胀和收缩的温度变化，以及地震力；确定合适的材料组合，包括钢材、混凝土、塑料、石头、沥青、砖、铝及其他建筑材料；分析在承受上面这些力时结构各部分的性能；设计结构以使它在不同荷载作用下的稳定性能够得到保证；在选定建筑材料和技术工人的情况下建造工程。大多数结构工程师从事公寓建筑、公共建筑和厂房建筑工作。他们设计构件尺寸，结构形式和钢筋数量等。

从事岩土工程专业的土木工程师研究的是以下几个方面：作为支撑结构材料的土壤和岩石的性能；结构不同的基础类型；建筑物的沉降；边坡和路堤的稳定；地下水的影响。由于基础是建筑物最重要的部分，地下情况非常复杂，出现任何错误都很难补救。这些工程师要分析支撑结构和影响结构性能的土壤及岩石的性能。他们评估并采取措施使建筑物和其他结构的重量对地面的压力引起的潜在的沉降最小化。这些工程师还评估并确定如何加强边坡和

路堤的稳定性以及如何保护结构抵抗地震和地下水的影响。工程师们经常做试验以获得满意的结果。

运输工程是人和物安全而有效运动的学科，它是土木工程的一个子学科。运输工程规划方面与城市规划相关，并涉及技术上的预先决策和政治因素。在任何运输系统中，旅客的运输需求最大，因此在运输工程中旅客的运输成为焦点。运输工程的设计包括确定运输设备的大小，确定道路所使用的材料和厚度，设计路面的几何形状。运输工程的运行和管理方面包括交通工程，旧的技术手段包含交通标志、交通信号和交通标线。新的技术手段包含智能运输系统，智能运输系统包括先进的运输信息系统和先进的交通控制系统。

流体力学、水力学和水利机械，在这个工程分支中，土木工程师研究的是处于静止或运动的流体的性能。工程师们设计并维护港口、水电坝、河流设施，控制水流量，控制并治理不同的水资源，他们建造坝、水库并把水渠分布到耕地。

从事环境工程的人们设计系统来净化水和空气，他们为人们提供安全的饮用水并控制供水污染，他们帮助建造水和废水处理厂、垃圾站来消除有危险的和有毒的废物并避免周围环境的污染。

从事管道工程的土木工程师建造管道和相关设施来运输液体、气体和固体，运输的物质范围从煤浆(煤与水混合)和半液态废弃物到水、油和各种高度易燃和不易燃的气体。工程师要确定管道的设计和工程项目对管道必经地区的经济和环境的冲击，所用材料的类型(钢材、混凝土、塑料或各种材料的组合)和安装技术，管道强度的测试方法，以及控制运输材料适当的压力和流速。当运输危险材料时，安全也是一个考虑的主要因素。

尽管所需的专业知识和技能不同，结构工程师要确定构件的尺寸，岩土工程师做试验来确定土壤的承载力，水利工程师考虑流体的性能，运输工程师的目的是减轻运输压力，环境工程师研究项目潜在的环境污染及保护，管道工程师处理的是管道的设计与安装方面的问题。然而这些专家总是一起工作，计算机是他们必备的工具，他们充分利用计算机来处理大量的数据并确定最好的方法来实施项目。

## Section B　结构工程

结构工程是与各种类型结构如房屋、桥梁、公路、电厂、坝、传输塔及许多其他特种结构的设计和施工有关的土木工程的一个分支。

设计阶段开始于对项目的理解，结构师必须充分研究结构所期望的技术和使用性能需求，包括荷载强度及其作用的持续时间，任何可能发生的动力作用。

荷载情况是设计师考虑的首要因素。处于相同位置的不同结构由于水位、土壤性能的不同而显示出不同的设计。在整个设计中，基础尤其重要。如果土壤较软，基础就需要加强；如果下部结构位于地下水位线以下，那么就需要采取一些方法来排水，如井点降水和集水坑抽水。

设计师必须首先计算出恒载、活载、地震荷载，风荷载及它们的组合，然后选择结构体系和建筑材料，最后设计师分析结构并设计构件。活荷载通常由建筑规范给出。钢材和混凝土是传统的材料，碳纤维是新材料，它有良好的强度和刚度，但是由于造价较高，因而应用受到限制。

结构分析的目的是确定构件中的力和变形，如拉力、压力、弯矩、剪力和扭矩。过大的侧向摆动会引起隔墙、顶棚及其他一些建筑部分的循环破坏，也会使房屋的居住者感到不舒服。这样的变形必须限制在允许的范围内。

结构设计和结构分析是结构工程的组成部分，并且是结构设计过程中的主要部分。它们