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新核心 高职行业英语

ENGLISH FOR INTERNATIONAL CONSTRUCTION ENGINEERING

总主编 丁国声

国际工程英语

主 编 刘世法 张 伟

上海交通大學出版社
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前　言

随着我国综合国力的提升以及国际交流和全球化市场经济的快速发展，我国海外的建筑工程承包事业如火如荼。经过三年多的社会调查，我们发现中国在海外的建筑工程公司急需能熟练运用英语解决国际承包工程中出现的实际问题的人才。

专门用途英语（ESP）是根据学习者的特定目的和特定需要而开设的英语课程，目的是培养学生在一定工作环境中运用英语开展工作的交际能力。专门用途英语是我国英语教学改革的必然趋势，是新形势下我国高等教育人才培养的一个重要组成部分。

本书有三大特点。其一，把土木工程和国际工程管理的知识融为一体。本书共分十二章，内容包括基础工程、结构材料、道路工程、建筑结构、桥梁工程、施工工程以及招投标、合同、风险、保险与担保、付款和索赔。第二，讲练结合。本书配有形式多样的练习，如回答问题、术语解释、翻译及选择等，真正做到了讲练结合。第三，理论与实际的结合。本书的每一章由 Section A 和 Section B 构成，Section A 主要介绍本章所涉及内容的理论知识，Section B 提供的是与 Section A 部分相对应的实践练习，如拓展阅读、范例和图展等。综上所述，不难看出本书的实用性极强。

本书的编写，从准备材料、教学实践（国际工程英语已在外语系开设两年）前后历时三年有余，在编写过程中，我们参阅了国内外出版物和互联网的相关信息，听取了学生、专业教师和专家的意见，汲取同类、同层次教材的长处，在此谨向原作者表示衷心感谢。由于编者水平有限，书中难免有不足之处，恳请广大读者、同行雅正。

编　者

2014 年 6 月

Introduction

Engineers have probably contributed more to the shaping of civilization than any other professional group. In every society, the role of engineers is to develop the technological application to meet practical needs. For example, the application of an electrical system is to provide power to a city, an **artificial** heart is to **prolong** life, etc. The systems that supply our food, water, fuel, power, transportation network, communication and other conveniences are the products of engineering skill.

Engineering is the art of **converting** knowledge into useful practical applications. An engineer is a person who plays the key role in this process of conversion. Often, there are difficulties in distinguishing engineers from scientists. It is difficult to determine where the work of the scientist ends and that of the engineer begins. The basic **distinction** between the linked professions of science and engineering lies in their goals. Scientists aim to invent while engineers strive to use the inventions effectively to **cater** to the needs of mankind.

Civil engineering[1] is that branch of engineering which aims to provide a comfortable and safe living for the people. **Shelter**, one of the primary needs of mankind, is provided by civil engineers. 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 engineering marvels of the world, starting from the **pyramids** to today's Khalifa Tower[2], are the results of the development in civil engineering. Communication lines like roads, railways, bridges, etc. without which development is impossible, are fruits of civil engineers' work.

Scope of Civil Engineering

Any discipline of engineering is a vast field with various specializations. The major specializations of civil engineering are listed below.

Structural Engineering[3]

Structural engineering is the most important specialization in civil engineering. The construction of a structure needs efficient planning, design and method of construction to serve the purpose fully. Generally there are five major steps in any construction project.

1. Positioning and arranging the various parts of the structure into a definite form to

achieve best utilization.

2. Finding out the **magnitude**, direction and nature of various forces acting on the structure.
3. Analyzing the structure to know the behavior of the various parts of the structure subjected to the above forces.
4. Designing the structure so that its **stability** under the action of various loads is ensured.
5. **Executing** the work with selected construction materials and skilled workers.

Geotechnical Engineering[4]

For the efficient functioning of any structure built on earth, the behavior of soil must be known. Geotechnical engineering gives the basic idea about the soil. This branch also deals with the following aspects:

1. The properties and behavior of soil as a material under "soil mechanics[5]".
2. The various types of foundations for a structure, for a machine, etc. and their suitability.

Geotechnical engineering also deals with the analysis, design and construction of foundation.

Bridge Engineering[6]

A bridge is a structure providing passage over an **obstacle** such as a valley, road, railway, canal, river, without closing the way beneath. Bridges link the whole country with road and railway communication maintaining a **uniform** flow of people, goods and other essential commodities. The branch of civil engineering which deals with the design, planning construction and **maintenance** of bridge is known as bridge engineering.

Transportation Engineering[7]

The development of a nation mainly depends on the communication **facilities** available. A nation's wealth is measured in terms of the road and railway facilities available. There are three modes of transportation, viz., land, water and air. This specialization deals with the design, construction and execution of the communication routes.

The different branches of transportation engineering include the following: highway engineering, railway engineering, **harbor** engineering and airport engineering.

Water Supply and Drainage Engineering[8]

Civil engineers also take the responsibility of providing **potable** water to the public and disposing the waste water safely. Water supply engineering deals with the location, collection of water, its treatment method, tests for standard limits and efficient supply of water. Used water, solid wastes, toxic wastes, etc. cannot be disposed directly since these affect the environment. Hence these have to be treated and tested for the standard limits and then disposed. Sanitary engineering deals with the collection of used water, their treatment methods and effective disposal which safeguards the whole world.

Irrigation Engineering[9]

Irrigation may be defined as the process of supplying water by man-made methods for the purpose of land cultivation. Irrigation engineering includes the study and design of works related to the control of river water and the drainage of **waterlogged** areas. Thus, irrigation engineering deals with the controlling and harnessing of various resources of water, by constructing dams, **reservoirs**, canals, and distribution channels to the **cultivable** land.

Functions of the Civil Engineer

Civil engineering incorporates activities such as construction of structures like buildings, dams, bridges, roads, railways, hydraulic structures[10], water supply and sanitary engineering.

Various functions of a civil engineer are listed below.

Investigation

The first function of a civil engineer is to collect the necessary data that is required before planning a project.

Surveying

The objective of surveying is to prepare maps and plans to locate the various structures of a project on the surface of earth.

Planning

Depending on the results obtained from investigation and surveying, a civil engineer should prepare the necessary **drawing** for the project with respect to capacity, size and location of its various **components**. On the basis of this drawing, a preliminary estimate should be worked out.

Design

After planning, the safe **dimensions** of the components required are worked out. With these dimensions a detailed drawing is prepared for various components and also for the whole structure and a detailed estimate is also calculated.

Execution

This function deals with the preparation of schedules for construction activities, floating of tenders, finalization of contracts, supervision of construction work, preparation of bills and maintenance.

Research and Development

In addition to the above works, a civil engineer has to engage himself in research, accelerate the development of economy, and improve the efficiency to meet the present and future needs.

Nowadays, more and more countries cooperate to **implement** one construction project, and the construction projects are becoming more and more internationalized. In the dictionary, "construction" is defined as "to form by **assembling** parts", but this phrase sometimes refers to the construction process itself. Construction involves not only the building of homes, shops and office buildings, but also the building of highways, tunnels, airports and dams. It also involves more

people than the construction workers on construction sites. Many others are working behind the scenes. Just as **divergent** materials come together to form a structure, a **diverse** group of people come together to make the project possible. It is the peculiar challenge of the construction industry to bring together numerous independent businesses and corporate personalities into one goal oriented process. The whole organization of architects, engineers, owners, builders, manufacturers and suppliers work together and cooperate to forge a partnership and ensure the success of a project. Construction tody is a large and growing industry. It is more basic to our economy and to our daily lives; besides, it also affects and is affected by developments in technology, computers, government policies, labor relations, and economic and political practices.

An international construction project is a kind of project that more than one country's companies participate in and is managed internationally. In China, the projects include two kinds. In the first situation, our construction companies participate in the overseas projects in foreign countries; and in the second, our construction companies participate in the foreign projects **domestically**.

Types of ICP[11]

There are two types of International Construction Project: international construction consulting[12] and international construction contracting[13].

International Construction Consulting

International construction consulting is a kind of intellectual service, which runs through the whole procedure of a project by the consultant, who employs the technology, experience, and information, etc. It includes the investment opportunity study, pre-feasibility, **feasibility**, project evaluation, survey and design, preparation of tendering documents[14], project management, **supervision**, and post-evaluation etc.

International Construction Contracting

International construction contracting means a series of activities to build and maintain served by construction companies, who are authorized by the owner and carry out the whole or section of construction. It includes the bidding[15], executing, equipment, and materials purchasing, installing and testing the equipment, sub-contracting, supplying the labor; occasionally, it needs doing some detailed construction drawing and design of **permanent** works according to the request of the owner.

Characteristics of ICP

Compared with the domestic construction projects, international construction projects have their particular features. Firstly, the owner and contractor are multiple from more than one country, so the projects are restricted by different regulations and law internationally. Secondly, complicated influential factors make the risks increase. The political and economical factors

are the most influential ones among others. For example, restriction or the **embargo** might be raised by the tense relationship internationally and there may be decreasing or **suspension** of the payment from the overseas project. Sometimes the political condition in the country where the project is located is not stable. For example, the two countries fight along shared borders or there might be a civil war, **riot** or economic crisis. Thus the contractors should pay more attention to the political and economic environment of the countries where the projects are located and the **adjoining** situation than the projects themselves. Thirdly, conditions of contract and the internal practice are very restrict. The conditions of contract are not copied from one country, and the solution of disputes can not abide by[16] one country's law or regulations if there's any. Finally, the technical standard and regulations are quietly complicated. In the international market, there is the detailed technological request on the materials and workmanships.

From planning to completing, a construction project takes quite a long time, while the international construction project is more complicated. From tendering[17] to taking over[18], ICP needs more efforts and the requirements are much higher and stricter. Since ICP involves not only one country, the staff should not only possess the accurate academic knowledge, but also good abilities of communication, in which language, especially English, plays an important role.

Notes

[1] civil engineering: 土木工程
[2] Khalifa Tower: 哈利法塔
[3] Structural Engineering: 结构工程
[4] Geotechnical Engineering: 岩土工程
[5] soil mechanics: 土力学
[6] Bridge Engineering: 桥梁工程
[7] Transportation Engineering: 交通工程
[8] Water Supply and Drainage Engineering: 给排水工程
[9] Irrigation Engineering: 水利工程
[10] hydraulic structures: 水工结构
[11] ICP: 国际工程
[12] international construction consulting: 国际工程咨询
[13] international construction contracting: 国际工程承包
[14] tendering documents: 招标文件
[15] bidding: 投标
[16] abide by: 遵守；依照
[17] tendering: 招标
[18] taking over: 工程接收

New Words

artificial /ˌɑːtɪˈfɪʃl/ *adj.* 人造的；仿造的；虚伪的
prolong /prəˈlɒŋ/ *v.* 延长；拖延
convert /kənˈvɜːt/ *v.* 转变；变换
distinction /dɪsˈtɪŋkʃn/ *n.* 区别；差别
cater /ˈkeɪtə/ *v.* 迎合；满足需要
shelter /ˈʃeltə/ *n.* 庇护；避难所；遮盖物
pyramid /ˈpɪrəmɪd/ *n.*（古埃及的）金字塔
magnitude /ˈmægnɪtjuːd/ *n.* 大小；量级
stability /stəˈbɪlətɪ/ *n.* 稳定性
execute /ˈeksɪkjuːt/ *v.* 实行；执行
obstacle /ˈɒbstəkl/ *n.* 障碍；干扰；妨害物
uniform /ˈjuːnɪfɔːm/ *adj.* 一致的；相同的
maintenance /ˈmeɪntənəns/ *n.* 维修；保养
facility /fəˈsɪlətɪ/ *n.* 设施；设备
harbor /ˈhɑːbə/ *n.* 海港
potable /ˈpəʊtəbl/ *adj.* 适于饮用的
waterlogged /ˈwɔːtəlɒgd/ *adj.* 涝的；浸满水的
reservoir /ˈrezəvwɑː/ *n.* 水库；蓄水池
cultivable /ˈkʌltɪvəbl/ *adj.* 可耕种的
drawing /ˈdrɔːɪŋ/ *n.* 图纸；图样
component /kəmˈpəʊnənt/ *n.* 构件；成分
dimension /daɪˈmenʃn/ *n.* 尺寸；维度；量纲
implement /ˈɪmplɪmənt/ *v.* 施工；实施；执行
assemble /əˈsembl/ *v.* 聚集；集合
divergent /daɪˈvɜːdʒənt/ *adj.* 不同的；有分歧的
diverse /daɪˈvɜːs/ *adj.* 不同的；多种多样的
domestic /dəˈmestɪk/ *adj.* 本国的；国内的
feasibility /ˌfiːzəˈbɪlətɪ/ *n.* 可行性
supervision /ˌsuːpəˈvɪʒn/ *n.* 监督；管理
permanent /ˈpɜːmənənt/ *adj.* 永久性的
embargo /ɪmˈbɑːgəʊ/ *n.* 禁止；禁令
suspension /səˈspenʃn/ *n.* 延期；推迟
riot /ˈraɪət/ *n.* 暴乱；骚乱
adjoin /əˈdʒɔɪn/ *v.* 紧挨；毗邻

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Chapter 1

Structural Material — Concrete

Section A

Concrete is a mixture of **cement**, **aggregates** and water, with any other admixtures which may be added to modify the **placing** and **curing** processes or the ultimate physical properties. Initially when mixed, concrete is a plastic material, which takes the shape of the **mould** or **formwork**. When hardened, it may be a dense load-bearing material or a lightweight thermally insulating material, depending largely on the aggregates used. It may be reinforced or prestressed by the incorporation of steel.

Most concrete is crushed and recycled at the end of its useful life, frequently as hard core for new construction work. However, a growth in the use of recycled aggregates for new concrete can be anticipated, as this will have a significant environmental gain in reducing the demand on new aggregate extraction.

Concrete Composition

Cement

Portland cement may be manufactured from any of a number of raw materials, providing they are combined to yield the necessary amounts of lime, iron, silica, and alumina.[1] Lime is commonly furnished by limestone, **marble**, marl, or seashells. Iron, silica, and alumina may be obtained in the form of clay or shale. The exact **ingredients** used depend on what is readily available, and the recipe varies widely from one **geographic** region to another, often including slag or flue dust from iron furnaces, chalk, sand, ore washings, bauxite, and other minerals. The selected constituents are crushed, ground, proportioned and **blended**, then conducted through a rotating kiln at temperatures of 2600 to 3000 degrees Fahrenheit (1400 to 1650℃) to produce clinker. After cooling, the clinker is pulverized (along with a small amount of gypsum

to retard the curing process) to a powder finer than flour. This powder, **Portland cement**, is either packaged in bags or shipped **in bulk**.

Aggregates and Water

Because aggregates make up roughly three-quarters of the **volume** of concrete, the structural strength of a concrete is heavily dependent on the quality of its aggregates. Aggregates for concrete must be strong, clean, resistant to freeze-thaw deterioration, chemically stable, and properly graded for size. An aggregate that is dusty or muddy will contaminate the cement paste with inert particles that weaken it, and an aggregate containing any of a number of chemicals from sea salt to organic compounds can cause problems ranging from **corrosion** of reinforcing steel to retardation of the curing process and ultimate weakening of the concrete. A number of standard **ASTM** laboratory tests are used to assess the various qualities of aggregates.

Mixing water for concrete must be free of harmful substances, especially organic material, clay, and salts such as chlorides and sulfates. Water suitable for drinking is generally suitable for concrete.

Admixtures

Ingredients other than cement, aggregates, and water are often added to concrete to alter its properties in various ways.

Air-Entraining Admixtures. Air-entraining admixtures may be put in the mix, if they are not already in the cement, to increase workability of the wet concrete, reduce freeze-thaw damage, or in larger amounts, to create very light weight nonstructural concretes with thermal insulating properties.

Water-Reducing Admixtures. Water-reducing admixtures allow a reduction in the amount of mixing water while retaining the same workability, while results in a higher strength concrete.

Accelerating Admixtures. Accelerating admixtures cause the concrete to cure more rapidly, and retarding admixtures slow its curing to allow more time for working with the wet concrete.

Fly Ash. Fly ash, affine powder that is a waste product from coal-fired power plants, increases concrete strength, decreases **permeability**, increases sulfate resistance, reduces temperature rise, reduces mixing water, and improves pump ability and workability of concrete.

Silica Fume. Silica fume, also known as micro-silica, is a kind of powder that is approximately 100 times finer than Portland cement, consisting mostly of silicon dioxide. When added to a mix, it can be used to produce extremely high-strength concrete that also has a very low permeability.

Blast Furnace Slag. Blast furnace slag is a by-product of iron manufacture that can

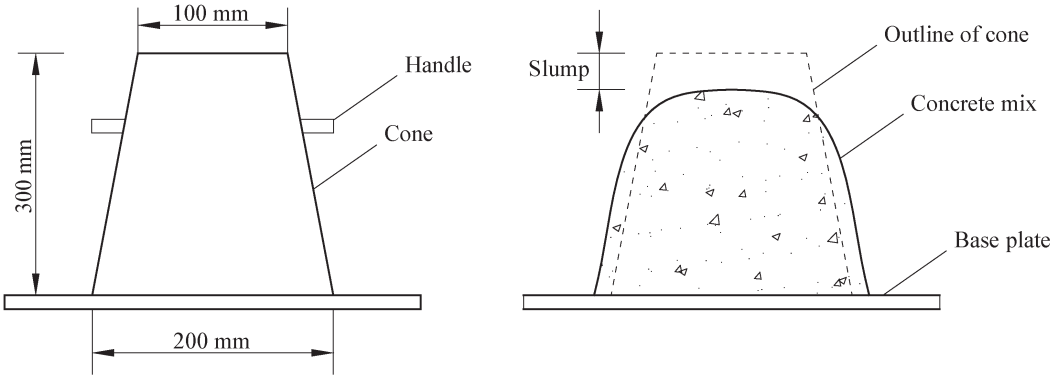
improve concrete workability, increase strength, reduce permeability, reduce temperature rise, and improve sulfate resistance.

Properties of Concrete

Workability

The term workability is used to describe the ease or difficulty with which the concrete is handled, transported and placed between the forms with minimum loss of homogeneity. However, this gives a very loose description of this vital property of concrete which also depends on the means of compaction available. For instance, the workability suitable for mass concrete is not necessarily sufficient for thin, inaccessible or heavily reinforced sections. The compaction is achieved either by ramming or vibrating. The workability, as a physical property of concrete alone irrespective of a particular type of construction, can be defined as the amount of useful internal work necessary to produce full compaction.[2]

In the workability of concrete mixture, various tests are developed. Tests such as flow test and **compaction** test are used mostly in laboratory. The **slump test**, which is commonly used in the field, is briefly described below. It should, however, be remembered that numerous attempts have been made to correlate workability with some easily determinable physical measurement. Although they may provide useful information within a range of variation in workability but none of these tests is fully satisfactory. At the same time, the slump test does not measure the workability of concrete. It is simply useful in detecting variations in the uniformity of a mix of given nominal **proportions**.



(a) The cone filled with concrete paste (b) The settled paste after the cone is removed

Fig. 1–1 Slump Test

Compressive Strength

It may be defined as the maximum compressive load that can be taken by concrete per unit area. It has been shown that with special care and control, concrete can be made to bear

loads as high as 80 N/mm^2 or even more. In practice, however, concrete with compressive strength between 10—50 N/mm^2 can be easily made on the site for common type of construction.

The compressive strength also called the crushing strength of concrete is determined by loading axially cube shaped (or cylindrical shaped) specimens made out of the concrete. The tests are carried out 3 days, 7 days and 28 days after the casting of the samples. It is the 28 days compressive strength which is taken as a standard value for concrete of a particular batch.

Tensile Strength

Plain concrete (without **steel reinforcement**) is quite weak in tensile strength which may vary from 1/8 to 1/20 of the ultimate compressive strength. It is primarily for this reason that steel bars (reinforcement) are introduced into the concrete at the laying stage so as to get a concrete which is very strong in compression as well as in tension.[3] In plain concrete, tensile strength depends to a great extent on the same factors as the compressive strength does.

Tensile strength of concrete becomes an important property when it is to be used in road making and runways. It is determined by using indirect methods.

Durability of Concrete

It refers to that concrete can resist the influence of exterior corrosive substance and maintain good usability and complete appearance so that it can maintain the safety and usability of the structure.[4] That is to say, concrete can maintain stable quality after being used for a long time.

Anti-Permeability. It refers to the ability to resist the permeability from compressive water. It is one of the most important symbols of durability. It influences the anti-freezing and anti-corrosion of the concrete directly.

It is necessary for any of the various **voids** in concrete to become filled with water before any of the deteriorating mechanisms of freezing and thawing operate. **Gel pores** are too small to significantly contribute to permeability, and the air voids are not connected. It is the capillary voids that become filled with water and permit the ingress of **moisture** into concrete. They tend to rise and collect under particles of aggregate, thus providing channels for water to **penetrate**. The **capillary porosity** can be reduced by reducing the amount of uncombined water in the Portland cement paste. Low water-cement ratios and low mixing-water content will reduce permeability. Although normal amounts of entrained-air voids increase the porosity of concrete, they do not tend to increase permeability. Being larger, spherical disconnected voids, they tend to stop capillary flow through concrete.

Freezing Resistance. It refers to that concrete can resist circles of freezing and thawing after saturation with water. Concrete in cold region should have strong anti-freezing ability after contacting with water or suffering from freezing. The density, pore's quantity and structure and water filling are all the important factors regarding to anti-freezing.

Carbonation / Neutralization. When calcium hydroxide, $Ca(OH)_2$, is exposed to the air, it will react with CO_2 and form $CaCO_3$. Calcium hydroxide is one of the hydration products of Portland cement and is available to react with CO_2 in the atmosphere. This process occurs slowly and is not usually important in hardened concrete with the possible exception of dimensional instability of lightweight masonry units.

Carbonation can be a serious problem when freshly placed concrete floors are exposed to excessive concentrations of CO_2. This problem occurs frequently when open-flame space heaters, used to prevent freezing, exhaust the oxygen in the air and leave excessive concentrations of CO_2. This produces a soft inferior layer on the surface of the concrete.

$$Ca(OH)_2+CO_2+H_2O=CaCO_3+2H_2O$$

Alkali-Aggregate Reaction. The volume of sodium silicate hydrate gel is over 3 times than that of the admixture, leading to expending crack. Reaction conditions: (1) cement with high alkali content; (2) active aggregate; (3) water.

$$Na_2O+SiO_2+nH_2O\rightarrow Na_2O\cdot SiO_2\cdot nH_2O$$

The Varieties of Concrete

High Density Concrete

The concrete whose unit weight ranges from about 3360 — 3840 kg/m^3 and which is about 50 percent higher than the unit weight of normal concrete is known as high density concrete.

The high density concrete is mainly used in the construction of radioactive shields. High density concrete is made by using such a heavy weight aggregate whose specific gravity is more than 3.5. The aggregates used in this type of concrete should be clean, strong, inert and relatively free from deleterious material. Normally barite, magnetite, limonite are used to make high density concrete. To produce high density and high strength concrete, it is necessary to control the water-cement ratio, correct admixture and **vibrators** for good compaction.

Light Weight Concrete

Natural stone aggregate concretes typically have densities within the range 2,200 to 2,500 kg/m^3, but where densities below 2,000 kg/m^3 are required, then an appropriate light weight concrete must be used. The three general categories of light weight concrete are: light weight aggregate concrete, aerated concrete, and no-fines concrete.

Light Weight Aggregate Concrete. By replacing the usual mineral aggregate by cellular porous or light weight aggregate, light weight aggregate concrete can be produced. Light weight aggregate can be classified into two categories namely natural and artificial light weight aggregate.

Aerated Concrete. By introducing gas or air bubbles in **mortar**, aerated concrete can be