交通版
高等学校土木工程专业规划教材
JIAOTONGBAN GAODENG XUEXIAO TUMU GONGCHENG ZHUANYE GUIHUA JIAOCAI

土木工程专业英语

郭仁东 孙雨明 荆 辉 主 编
黄 新 主 审

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Civil Engineering Specialized English

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内 容 提 要

本书是交通版高等学校土木工程专业规划教材会议确定编写的统编教材之一。全书共分15个单元,包括土木工程、流体运动、工程热力学等各专业共同需求的基本概念、原理和应用。各单元都选配了典型习题和阅读材料供教师和学生拓展知识面选读、选作。

本书可作为工科院校土木工程、建筑环境与能源应用工程、给排水科学与工程等专业用书,也可供有关工程设计人员参考,对于继续深造的相关工程技术人员也很有参考价值。

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序

随着科学技术的迅猛发展、全球经济一体化趋势的进一步加强以及国力竞争的日趋激烈，作为实施“科教兴国”战略重要战线的高等学校，面临着新的机遇与挑战。高等教育战线按照“巩固、深化、提高、发展”的方针，着力提高高等教育的水平和质量，取得了举世瞩目的成就，实现了改革和发展的历史性跨越。

在这个前所未有的发展时期，高等学校的土木类教材建设也取得了很大成绩，出版了许多优秀教材，但在满足不同层次的院校和不同层次的学生需求方面，还存在较大的差距，部分教材尚未能反映最新颁布的规范内容。为了配合高等学校的教学改革和教材建设，体现高等学校在教材建设上的特色和优势，满足高校及社会对土木类专业教材的多层次要求，适应我国国民经济建设的最新形势，人民交通出版社组织了全国二十余所高等学校编写“交通版高等学校土木工程专业规划教材”，并于2004年9月在重庆召开了第一次编写工作会议，确定了教材编写的总体思路。于2004年11月在北京召开了第二次编写工作会议，全面审定了各门教材的编写大纲。在编者和出版社的共同努力下，这套规划教材已陆续出版。

在教材的使用过程中，我们也发现有些教材存在诸如知识体系不够完善，适用性、准确性存在问题，相关教材在内容衔接上不够合理以及随着规范的修订及本学科领域技术的发展而出现的教材内容陈旧、亟待修订的问题。为此，新改组的编委会决定于2010年底启动了该套教材的修订工作。

这套教材包括“土木工程概论”、“建筑工程施工”等31门课程，涵盖了土木工程专业的专业基础课和专业课的主要系列课程。这套教材的编写原则是“厚基础、重能力、求创新，以培养应用型人才为主”，强调结合新规范、增大例题、图解等内容的比例并适当反映本学科领域的新发展，力求通俗易懂、图文并茂；其中对专业基础课要求理论体系完整、严密、适度，兼顾各专业方向，应达到教育部和专业教学指导委员会的规定要求；对专业课要体现出“重应用”及“加强创新能力和工程素质培养”的特色，保证知识体系的完整性、准确性、正确性和适应性，专业课教材原则上按课群组划分不同专业方向分别考虑，不在一本教材中体现多专业内容。

反映土木工程领域的最新技术发展、符合我国国情、与现有教材相比具有明显特色是这套教材所力求达到的，在各相关院校及所有编审人员的共同努力下，交通版高等学校土木工程专业规划教材必将对我国高等学校土木工程专业建设起到重要的促进作用。

交通版高等学校土木工程专业规划教材编审委员会
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前　　言

本书是在全国高等学校专业调整后，为适应土木工程、建筑环境与能源应用工程、建筑学、道路桥梁与渡河工程、城乡规划、给排水科学与工程和环境工程等专业不同学时需要，由全国专业教学指导委员会规划教材会议指定而编写的土木工程专业英语教材。

《土木工程专业英语》是土木工程专业本科生的专业基础课程。随着我国的对外开放，土木工程行业与国际交流日益增强，技术人员所掌握的知识应与国际接轨，对本科毕业生专业英语的实际要求也在提高。过去，由于知识体系过窄过细的限制，很多专业英语教材所涉猎的专业内容狭窄，要想掌握较宽范围的交叉领域的专业术语需要大量的课外学时，这与当今的宽口径、大土木、少学时的课程体系相矛盾。基于此，我们编写了此本《土木工程专业英语》本科教材，本书的编写尽可能做到内容宽泛性、系统性和知识性，满足少学时、宽口径的本科教学要求。

本书内容主要包括土木工程概论、建筑力学、建筑材料、建筑结构设计与规范、土力学与基础工程以及流体力学及其应用等内容，总共 15 个单元。

本书的编写体系，与以前大多使用的教材体系有所不同。编写过程中，采用每一单元选定一门正课，附带课文所涉及的词汇。另设两篇阅读材料与正文紧紧相扣，但不附词汇索引，因为阅读材料的词汇大多可在正文中找到，或通过上下文理解其含义。另外，每单元还给出了简短的练习题及参考答案供广大师生选作。

本书编者认为该教材的使用比较灵活，可根据不同学校的具体情况进行设置，据编者了解除极少数学校外，大多数本科院校本着提高学生英语专业术语及提高考研能力、提高四六级英语过级能力等诸方面因素的考虑还是设置了该门课程。随着现代高等教育发展，国际化办学使得大量的本科学生有机会进行国际课程交流的学习，无疑学习本门课程对走出去学习的学生是有很大帮助的。建议教师在讲授本门课程时，应尽量的采用课堂讨论式教学方法，采用小班授课分组讨论，在老师讲解正文后由各小组把阅读材料翻译成中文作为课堂或课后作业，这样收到的教学效果更好。

全书共 15 个单元，由沈阳城市学院郭仁东、上海应用技术学院孙雨明、沈阳大学荆辉三位老师主编。沈阳大学王淞、何丽霞、李欣、胡铁明、梁振宇、沈阳城市学院孙利云、新疆石河子大学王丽参加了编写。孙利云编写第一单元，荆辉编写第二、第三、第四单元，胡铁明编写第五、第六单元，李欣编写第七、第八单元，郭仁东编写第九单元，梁振宇编写第十单元，孙雨明编写导论和第十一单元，王丽编写第十二单元，王淞编写第十三、第十四单元，何丽霞编写第十五单元。全书由郭仁东和荆辉统稿，黄新主审，孙利云对全书的插图进行了修改。

本书承蒙主编和参编单位提出了大量宝贵的修改意见，在此表示衷心的感谢。

本书的出版还要感谢人民交通出版社股份有限公司的大力支持，感谢上海应用技术学院、南京林业大学、沈阳大学、沈阳城市学院、新疆石河子大学诸多老师对本书编写工作的大力支持。

由于编著者水平有限，在书中难免会出现这样或那样的错误，希望读者批评指正。

编者

2015 年 3 月于沈阳

Contents

Introduction to Civil Engineering

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges tunnels, canals, dams, and buildings. Civil engineering is the second-oldest engineering discipline after military engineering. 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 engineering has often been used to refer to engineers who build public facilities, although the field is much broader.

It is traditionally broken into several sub-disciplines including architectural engineering, environmental engineering, geotechnical engineering, geophysics, geodesy, control engineering, structural engineering, earthquake engineering, transportation engineering, municipal or urban engineering, water resources engineering, materials engineering, offshore engineering, quantity surveying, coastal engineering, surveying, and construction engineering. Civil engineering takes place in the public sector from municipal through to national governments, and in the private sector from individual homeowners through to international companies.

Civil engineers typically possess an academic degree in civil engineering. The length of study is three to five years, and the completed degree is designated as a bachelor of engineering, or a bachelor of science. The curriculum generally includes classes in physics, mathematics, project management, design and specific topics in civil engineering. After taking basic courses in most sub-disciplines of civil engineering, they move onto specialize in one or more sub-disciplines at advanced levels. While an undergraduate degree (BEng/BSc) normally provides successful students with industry-accredited qualification, some academic institutions offer post-graduate degrees (MEng/MSc), which allow students to further specialize in their particular area of interest.

In most countries, a bachelor's degree in engineering represents the first step towards professional certification, and a professional body certifies the degree program. After completing a certified degree program, the engineer must satisfy a range of requirements (including work experience and exam requirements) before being certified. Once certified, the engineer is designated as a professional engineer (in the United States, Canada and South Africa), a chartered engineer (in most Commonwealth countries), a chartered professional engineer (in Australia and New Zealand), or a European engineer (in most countries of the European Union). There are international agreements between relevant professional bodies to allow engineers to practice across national borders.

The benefits of certification vary depending upon location. For example, in the United States and Canada, "only a licensed professional engineer may prepare, sign and seal, and submit engineering plans and drawings to a public authority for approval, or seal engineering work for public and private clients." This requirement is enforced under provincial law such as the Engineers Act in Quebec.

No such legislation has been enacted in other countries including the United Kingdom. In Australia, state licensing of engineers is limited to the state of Queensland. Almost all certifying bodies maintain a code of ethics which all members must abide by.

Engineers must obey contract law in their contractual relationships with other parties. In cases where an engineer's work fails, he may be subject to the law of tort of negligence, and in extreme cases, criminal charges. An engineer's work must also comply with numerous other rules and regulations such as building codes and environmental law.

In general, civil engineering is concerned with the overall interface of human created fixed projects with the greater world. General civil engineers work closely with surveyors and specialized civil engineers to design grading, drainage, pavement, water supply, sewer service, electric and communications supply, and land divisions. General engineers spend much time visiting project sites, developing community consensus, and preparing construction plans. General civil engineering is also referred to as site engineering, a branch of civil engineering that primarily focuses on converting a tract of land from one usage to another. Civil engineers apply the principles of geotechnical engineering, structural engineering, environmental engineering, transportation engineering and construction engineering to residential, commercial, industrial and public works projects of all sizes and levels of construction.

Materials science is closely related to civil engineering. Material engineering studies fundamental characteristics of materials, and deals with ceramics such as concrete and mix asphalt concrete, strong metals such as aluminum and steel, and polymers including polymethyl methacrylate (PMMA) and carbon fibers.

Materials engineering also involves protection and prevention (paints and finishes). Alloying combines two types of metals to produce another metal with desired properties. It incorporates elements of applied physics and chemistry. With recent media attention on nanoscience and nanotechnology, materials science has been at the forefront of academic research. It is also an important part of forensic engineering and failure analysis.

Construction engineering involves planning and execution, transportation of materials, site development based on hydraulic, environmental, structural and geotechnical engineering. As construction firms tend to have higher business risk than other types of civil engineering firms do, construction engineers often engage in more business-like transactions, for example, drafting and reviewing contracts, evaluating logistical operations, and monitoring prices of supplies.

Earthquake engineering involves designing structures to withstand hazardous earthquake exposures. Earthquake engineering is a sub-discipline of structural engineering. The main objectives of earthquake engineering are to understand interaction of structures on the shaky ground; foresee the consequences of possible earthquakes; and design, construct and maintain structures to perform at earthquake in compliance with building codes.

Environmental engineering deals with treatment of chemical, biological, or thermal wastes, purification of water and air, and remediation of contaminated sites after waste disposal or accidental contamination. Among the topics covered by environmental engineering are pollutant transport, water purification, waste water treatment, air pollution, solid waste treatment, and hazardous waste management. Environmental engineers administer pollution reduction, green engineering, and industrial ecology. Environmental engineers also compile information on environmental consequences of proposed actions.

Geotechnical engineering studies rock and soil supporting civil engineering systems. Knowledge from the field of geology, materials science, mechanics, and hydraulics is applied to safely and economically design foundations, retaining walls, and other structures. Environmental efforts to protect groundwater and safely maintain landfills have spawned a new area of research called geoenvironmental engineering.

Structural engineering is concerned with the structural design and structural analysis of buildings, bridges, towers, flyovers (overpasses), tunnels, off shore structures like oil and gas fields in the sea, aerostructure and other structures. This involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, and then designing the structure to successfully support and resist those loads. The loads can be self-weight of the structures, other dead load, live loads, moving (wheel) load, wind load, earthquake load, load from temperature change etc. The structural engineer must design structures to be safe for their users and to successfully fulfill the function they are designed for (to be serviceable). Due to the nature of some loading conditions, sub-disciplines within structural engineering have emerged, including wind engineering and earthquake engineering.

Surveying is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, vertical and slope distances. With computerisation, electronic distance measurement (EDM), total stations, GPS surveying and laser scanning have supplemented (and to a large extent supplanted) the traditional optical instruments. This information is crucial to convert the data into a graphical representation of the Earth's surface, in the form of a map. This information is then used by civil engineers, contractors and even realtors to design from, build on, and trade, respectively. Elements of a building or structure must be correctly sized and positioned in relation to each other and to site boundaries and adjacent structures. Although surveying is a distinct profession with separate qualifications and licensing arrangements, civil engineers are trained in the basics of surveying and mapping, as well as geographic information systems. Surveyors may also lay out the routes of railways, tramway tracks, highways, roads, pipelines and streets as well as position other infrastructures, such as harbors, before construction.

Transportation engineering is concerned with moving people and goods efficiently, safely, and in a manner conducive to a vibrant community. This involves specifying, designing, constructing, and maintaining transportation infrastructure which includes streets, canals, highways, rail systems, airports, ports, and mass transit. It includes areas such as transportation design, transportation planning, traffic engineering, some aspects of urban engineering, queueing theory, pavement engineering, Intelligent Transportation System (ITS), and infrastructure management.

Municipal engineering is concerned with municipal infrastructure. This involves specifying, designing, constructing, and maintaining streets, sidewalks, water supply networks, sewers, street lighting, municipal solid waste management and disposal, storage depots for various bulk materials used for maintenance and public works (salt, sand, etc.), public parks and bicycle paths. In the case of underground utility networks, it may also include the civil portion (conduits and access chambers) of the local distribution networks of electrical and telecommunications services. It can also include the optimizing of waste collection and bus service networks. Some of these disciplines overlap with other civil engineering specialties, however municipal engineering focuses on the coordination of these infrastructure networks and services, as they are often built simultaneously, and managed by the same municipal authority. Municipal engineers may also design the site civil works for large buildings, industrial plants or campuses (i. e. access roads, parking lots, potable water supply, treatment or pretreatment of waste water, site drainage, etc.).

UNIT ONE

Text

Introduction to Mechanics of Materials

[1] Mechanics of materials is a branch of applied mechanics that deals with the behavior of solid bodies subjected to various types of loading. It is a field of study that is known by a variety of names, including "strength of materials" and "mechanics of deformable bodies." The solid bodies considered in this book include axially-loaded bars, shafts, beams and columns, as well as structures that are assemblies of these components. Usually the objective of our analysis will be the determination of the stresses, strains, and deformations produced by the loads: if these quantities can be found for all values of load up to the failure load, then we will have obtained a complete picture mechanical behavior of the body.

[2] Theoretical analyses and experimental results have equally important roles in the study of mechanics of materials. On many occasions we will make logical derivations to obtain formulas and equations for predicting mechanical behavior, but at the same time we must recognize that these formulas cannot be used in a realistic way unless certain properties of the material are known. These properties are available to us only after suitable experiments have been made in the laboratory. Also, many problems of importance in engineering can not be handled efficiently by theoretical means, and experimental measurements become a practical necessity. The historical development of mechanics of materials is a fascinating blend of both theory and experiment, with experiments pointing the way to useful results in some instances and with theory doing so in others. ① Such famous men as Leonardo da Vinci (1452-1519) and Galileo Galilei (1564-1642) made experiments to determine the strength of wires, bars, and beams, although they did not develop any adequate theories (by today's standards) to explain their test results. By contrast, the famous mathematician Leonhard Euler (1707-1783) developed the mathematical theory of columns and calculated the critical load of a a column in 1744, long before any experimental evidence existed to show the significance of his results. Thus, Euler's theoretical results remained unused for many years, although today they form the basis of column theory.

[3] The importance of combining theoretical derivations with experimentally determined properties of materials will be evident as we proceed with our study of the subject. In this article we will begin by discussing some fundamental concepts, such as stress and strain, and then we will investigate the behavior of simple structural elements subjected to tension, compression and shear.

[4] The concepts of stress and strain can be illustrated in an elementary way by considering

the extension of a prismatic bar [see Fig. 1-1a)]. A prismatic bar is one that has constant cross section throughout its length and a straight axis. In this illustration the bar is assumed to be loaded at its ends by axial force P that produce a uniform stretching, or tension of the bar. By making an artificial cut (section m-m) through the bar at right angle to its axis, we can isolate part of the bar as a free body [see Fig. 1-1b)]. At the right-hand end the tensile force P is applied, and at the other there are forces representing the action of the removed portion of the bar upon the part that remains. These forces will be continuously distributed over the cross section, analogous to the continuous distribution of hydrostatic pressure over a submerged surface. The intensity of force, that is, the force per unit area, is called the stress and is commonly denoted by the Greek letter σ. Assuming that the stress has a uniform distribution over the cross section [see Fig. 1-1b)], we can readily see that its resultant is equal to the intensity σ times the cross-sectional area A of the bar. Furthermore, form the equilibrium of the body shown in Fig. 1-1b), we can also see that this resultant must be equal in magnitude and opposite in direction to the force P. Hence, we obtain as the equation for the uniform stress in a prismatic bar. This equation shows that stress has units of force divided by area—for example, pounds per square inch (psi) or kips per square inch (ksi). When the bar is being stretched by the force P, as shown in the figure, the resulting stress is a tensile stress; if the forces are reversed in directions, causing the bar to be compressed, they are called compressive stresses.

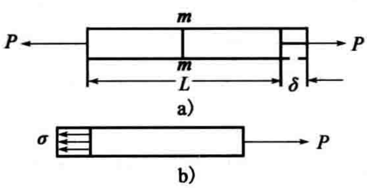

Fig. 1-1 Prismatic bar in tension

$$\sigma = \frac{P}{A} \tag{1-1}$$

[5] A necessary condition for Eq. (1-1) to be valid is that the stress σ must be uniform over the cross section of the bar[2]. This condition will be realized if the axial force P acts through the centroid of the cross section, as can be demonstrated by statics. [3]When the load P does not act at the centroid, bending of the bar will result, and a more complicated analysis is necessary. Throughout this book, however, it is assumed that all axial forces are applied at the centroid of the cross section unless specifically stated to the contrary. Also, unless stated otherwise,[4] it is generally assumed that the weight of the object itself is neglected, as was done when discussing the bar in Fig. 1-1.

[6] The total elongation of a bar carrying an axial force will be denoted by the Greek letter δ[see Fig. 1-1a)], and the elongation per unit length, or strain, is then determined by the equation

$$\varepsilon = \frac{\delta}{L} \tag{1-2}$$

where L is the total length of the bar. [5] Note that the strain ε is a nondimensional quantity. It can be obtained accurately from Eq. (1-2) as long as the strain is uniform throughout the length of the bar. If the bar is in tension, the strain is a tensile strain, representing an elongation or stretching of the material; if the bar is in compression, the strain is a compressive strain, which means that adjacent cross sections of the bar move closer to one another.

New Words and Expressions

(be) subjected to		承受,经受
deformable [diˈfɔːməbl]	*a.*	可变形的
axially [ˈæksiəli]	*ad.*	轴向地
shaft [ʃaːft]	*n.*	轴,杆状物
derivation [deriˈveiʃən]	*n.*	推导
realistic [riəˈlistik]	*a.*	现实的,实际的
fascinate [ˈfæsineit]	*v.*	迷住,强烈吸引
blend [blend]	*n.*	混合,融合
prismatic [prizˈmætik]	*a.*	等截面的,柱状的
tensile [ˈtensail]	*a.*	拉力的,拉伸的
sectional [ˈsekʃənəl]	*a.*	截面的,部分的
hydrostatic[ˈhaidrəuˈstætik]	*a.*	静水力学的
analogous [əˈnæləgəs]	*a.*	类似的
analogous to		类似于
submerged [səbˈməːdʒd]	*a.*	浸在水中的
uniform [ˈjuːnifɔːm]	*a.*	均匀的
denote [diˈnəut]	*v.*	指示,表示
equilibrium [iːkwiˈlibriəm]	*n.*	平衡
resultant [riˈzʌltənt]	*n.*	合力
magnitude [ˈmægnitjuːd]	*n.*	大小,尺寸
equation = Eq. [iˈkweiʃən]	*n.*	方程
kip [kip]	*n.*	千磅
tensile [ˈtensail]	*a.*	拉力的
compressive [kəmˈpresiv]	a.	压力的,压缩的
centroid [ˈsentrɔid]	*n.*	矩心,形心
specifically [spiˈsifikəli]	*ad.*	具体地,特定地
elongation [ˌiːlɔːŋˈgeiʃən]	*n.*	伸长,拉长
nondimensional [nʌndiˈmenʃənəl]	*a.*	无量纲的
adjacent [əˈdʒeisənt]	*a.*	相邻的

Notes

①两个 with 引出各自的独立结构,用 and 联结。doing 是代动词,指 pointing。第二个独立结构的完整形式是 with theory pointing the way to useful results in other instances。

②从 for 开始是动词不定式的复合结构,作 condition 的后置定语,for 引出动词不定式的逻辑主语 Eq. (1-1)。

③as 是关系代词,引出非限定性定语从句;as 代表整个主句所讲的内容,并在从句中作主语。

④unless 引出省略的条件句,等于 unless it is stated…。

⑤where 是关系副词,引导非限定性定语从句。

Exercises

Reading Comprehension

Ⅰ. Choose the most suitable alternative to complete the following sentences.

1. The objective of our analysis will be the determination of the stresses , strains and deformations produced __________.

A. with the stretching

B. in the tension

C. by the loads

D. on the equation

2. Galilei made experiments to determine the strength of wires, bars, and beams ,although he __________.

A. advanced a new theory

B. did not develop any adequate theories

C. developed any theory of experiments

D. calculated the critical load

3. A prismatic bar is one that __________.

A. has constant cross section only

B. we can isolate part of the bar as a free body

C. has constant cross section throughout its length and a straight axis

D. has a straight axis

4. A necessary condition for equation to be valid is that __________.

A. he experiment must be uniform over the bar

B. the strain must be uniform throughout the bar

C. the stress must be uniform over the cross section of the bar

D. the equilibrium must be over the cross section of the bar

5. It can be obtained from Eq. (1-2) as long as __________.

A. the load is uniform across the whole bar

B. the distribution has been done throughout the length of the bar

C. the strain is uniform throughout the length of the bar

D. the axial force has been done across the whole bar

Ⅱ. From the list below choose the most appropriate headings for each of the paragraphs in the text, then put the paragraph numbers in the brackets.

A. The importance of the derivation and experiment (　　)

B. The illustration of the concepts of stress and strain (　　)

C. The importance of theoretical analyses and experimental results (　　)