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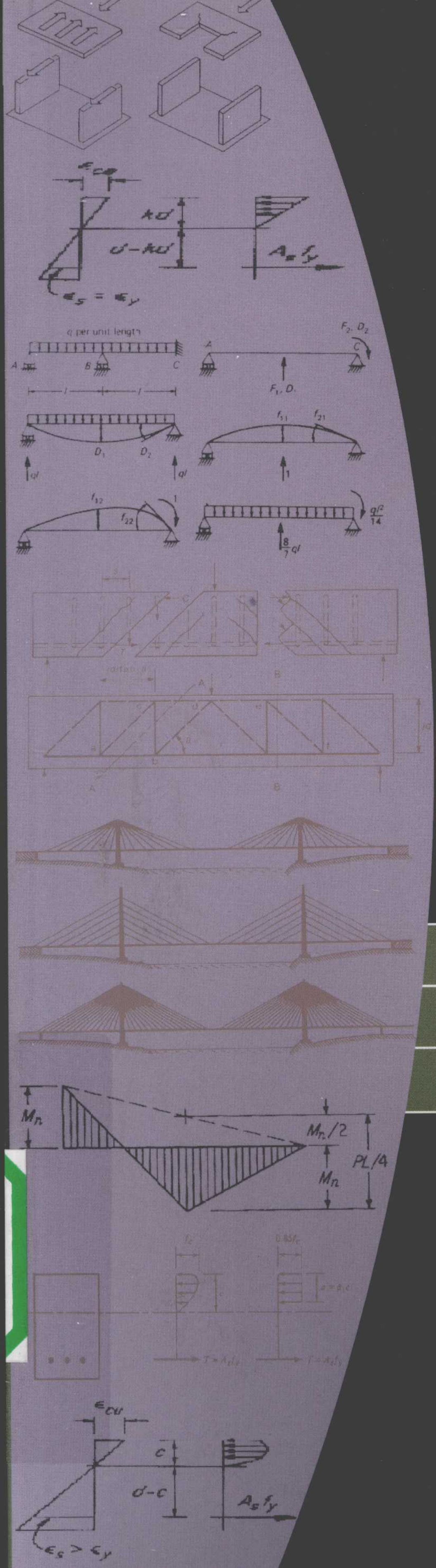

土木工程专业英语

ENGLISH FOR CIVIL ENGINEERING

主编　秦卫红

普通高等院校土木专业“十一五”规划精品教材

Civil Professional Textbooks for the 11th Five-Year Plan

主审　单建

华中科技大学出版社

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English for Civil Engineering

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内容提要

全书内容分为建筑与结构力学、建筑与管理工程、桥梁和道路工程、地基基础、港口工程等几个部分。每部分选材涵盖该专业所涉及的主要内容，绝大多数原文作者母语为英语，每篇力求做到语言表达地道、不出现生涩词汇。

教学模块及特点：课文正文后面附有专业词汇（带有音标）和常用词组，以及部分句子或内容的注释和说明，以便于读者快速、及时、准确掌握文章内容；课后所附相关练习有词汇或词组的中英文互译、句子的中英文互译和问答题等题型，以供课堂教学或者自学时及时考查对课文的掌握程度。每篇正文后面均有一篇与正文内容相关的阅读材料。正文和阅读材料不设全篇译文，避免产生中文依赖。全书以较小的篇幅介绍了土木工程专业英语中常用的阅读和写作技巧，并将内容由浅到深地分配到每一课课后，希望能借此提高读者的阅读和写作水平。

本书适合普通高等院校土木工程专业本科生使用，也可供土木工程师及相关从业人员阅读参考，对高校教师和研究生也有参考价值。

普通高等院校土木专业“十一五”规划精品教材

总　　序

教育可理解为教书与育人。所谓教书，不外乎是教给学生科学知识、技术方法和运作技能等，教学生以安身之本。所谓育人，则要教给学生做人道理，提升学生的人文素质和科学精神，教学生以立命之本。我们教育工作者应该从中华民族振兴的历史使命出发，来从事教书与育人工作。作为教育本源之一的教材，必然要承载教书和育人的双重责任，体现两者的高度结合。

中国经济建设高速持续发展，国家对各类建筑人才需求日增，对高校土建类高素质人才培养提出了新的要求，从而对土建类教材建设也提出了新的要求。这套教材正是为了适应当今时代对高层次建设人才培养的需求而编写的。

一部好的教材应该把人文素质和科学精神的培养放在重要位置。教材中不仅要从内容上体现人文素质教育和科学精神教育，而且还要从科学严谨性、法规权威性、工程技术创新性来启发和促进学生科学世界观的形成。简而言之，这套教材有以下特点。

一方面，从指导思想来讲，这套教材注意到“六个面向”，即面向社会需求、面向建筑实践、面向人才市场、面向教学改革、面向学生现状、面向新兴技术。

二方面，教材编写体系有所创新。结合具有土建类学科特色的教学理论、教学方法和教学模式，这套教材进行了许多新的教学方式的探索，如引入案例式教学、研讨式教学等。

三方面，这套教材适应现在教学改革发展的要求，提倡所谓“宽口径、少学时”的人才培养模式。在教学体系、教材编写内容和数量等方面也做了相应改变，而且教学起点也可随着学生水平做相应调整。同时，在这套教材编写中，特别重视人才的能力培养和基本技能培养，适应土建专业特别强调实践性的要求。

我们希望这套教材能有助于培养适应社会发展需要的、素质全面的新型工程建设人才。我们也相信这套教材能达到这个目标，从形式到内容都成为精品，为教师和学生，以及专业人士所喜爱。

中国工程院院士　王思敬

2006 年 6 月于北京

前　言

随着社会、经济的飞速发展，国际联系日趋紧密，国际化已成为当今社会的流行语。与其他行业一样，土木工程行业也在逐步与国际接轨，因此，对从业人员的专业素养和综合素质提出了更高的要求。高校在制定土木工程专业培养计划时，不仅要着眼于使学生拥有坚实的专业知识，而且还要使其具备较强的计算机应用能力和较高的外语水平。所以，在大学阶段，学好外语，尤其是专业外语，是获取专业知识、参与国际招投标、进行国内外学术交流和技术合作等的基本前提。

编者正是以此为目标，精心选择地道的土木专业英语文献，图文并茂，较为系统地编写了本书。本书可作为各类土木工程专业本科生的教材，授课时数可根据需要采用 32～64 课时，也可供土木工程科技工作者和研究生自学时选用。

为了满足各层次人员的需要，本书力求做到深入浅出。首先，安排了力学基础等方面的知识内容，以便于不熟悉土木工程英语的读者迅速掌握专业词汇和提高阅读能力；同时，为了适应当今高校大土木的培养方案，在选材方面兼顾建筑工程、桥梁工程、道路和港口工程等专业方面的内容，可供师生选用；最后，每个单元都编入了土木工程英语阅读技巧、科技论文撰写技巧及论文摘要的撰写等方面的内容，可以使读者较快地提高科技英语的表达能力。全书共有 30 课，每课由正文、词汇与词组、注释、课后习题和课后阅读材料等组成，有助于读者掌握和巩固各方向专业英语词汇和表达技巧。

本书第 1～6、10、12、18、19 课由东南大学秦卫红编写；第 7、27 课由青岛理工大学陈静茹编写；第 9 课由华中科技大学董平编写；第 8、14 课由秦卫红、董平共同编写；第 11 课由秦卫红、陈静茹共同编写；第 13 课由陈静茹、董平共同编写；第 24、25、26 课由青岛理工大学许婷华编写；第 15、16、17 课由东南大学张晋编写；第 20、21、22、23 课由东南大学戴国亮编写；第 28、29、30 课由大连水产学院陈昌平、张明慧共同编写。课后科技英语阅读和写作技巧部分由秦卫红统一编写。全书由秦卫红主编，东南大学单建教授主审，陈昌平、许婷华、董平为副主编。

本书在编写过程中曾得到东南大学孟少平教授、舒赣平教授和叶继红教授，天津大学陈志华教授，大连水产学院孙继红教授等专家的指点，在此向这些老师的无私帮助表示由衷的感谢！在书稿的撰写过程中，钱叶瑶、任舒婷、林俊军等参与了部分编辑和校对工作，对他们的辛勤付出这里也一并表示感谢！

由于编者水平有限，缺点和错误在所难免，希望广大读者多提宝贵意见，不胜感激！

秦卫红

2009 年 2 月 19 日

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CONTENTS

Lesson 1

STRESS AND STRAIN

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 through its length and a straight axis. In this illustration, the bar is assumed to be loaded at its ends by axial forces P that produce a uniform stretching, or tension, of the bar. By making an artificial cut (section m-m) through the bar at right angles to its axis, we can isolate parts of the bar as a free body (see Fig.1-1b).① At the right-hand end the tensile force P is applied, and at the other end, these forces will be continuously distributed over the cross section, analogous to the continuous distribution of hydrostatic pressure over a submerged surface.② 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, from 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

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

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 forces P as shown in the figure, the resulting stress is a tensile stress; if the forces are reversed in direction, causing the bar to be compressed, they are called compressive stresses.

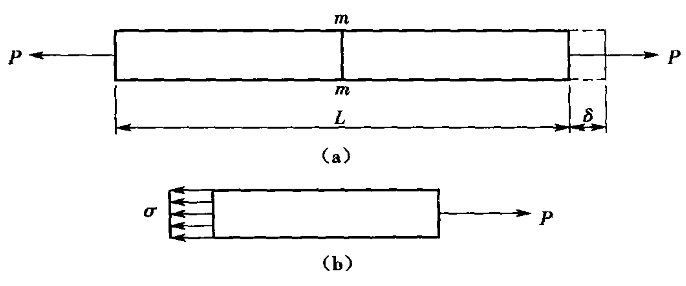

Fig.1-1 Prismatic bar in tension

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.③ This condition will be realized if the axial force P acts through the centroid of the cross section, as can be demonstrated by statics.④ When the load P does not act at the centroid, bending of the bar will result, and a more complicated analysis is necessary. However, here, 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,⑤ it is generally assumed that the weight of the object itself is neglected, as was done when discussing the bar in Fig.1-1.

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

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

where L is the total length of the bar. 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 across sections of the bar move closer to one another.

*One kip, or kilopound, equals 1000 pounds.

Words and Expressions

stress	[stres]	*n.* 应力
strain	[strein]	*n.* 应变
load	[ləud]	*n.* 负荷，荷载，负载 *v.* 加载
prismatic	[priz'mætik]	*adj.* 棱柱形的，棱镜的
uniform	['ju:nifɔ:m]	*adj.* 均匀的
tension	['tenʃən]	*n.* 张力，拉力
tensile	['tensail]	*adj.* 张力的，拉伸的
distribute	[dis'tribju(:)t]	*v.* 分布,区分
distribution	[ˌdistri'bju:ʃən]	*n.* 分布
analogous	[ə'næləgəs]	*adj.* 类似的，相似的
analogue	['ænəlɔg]	*n.* 类似物
static (hydrostatic)	['stætik] ([ˌhaidrəu'stætik])	*adj.* 静力学的（流体静力学的）
statics (hydrostatics)	['stætiks] ([ˌhaidrəu'stætiks])	*n.* 静力学(流体静力学)
submerge	[səb'mə:dʒ]	*v.* 浸没，淹没

intensity	[in'tensiti]	*n.* 强度
denote	[di'nəut]	*v.* 表示，记
resultant	[ri'zʌltənt]	*n.* 结果，合力
		adj. 合成的，组合的
equilibrium	[ˌi:kwi'libriəm]	*n.* 平衡，均衡
compression	[kəm'preʃ(ə)n]	*n.* 压缩
compressive	[kəm'presiv]	*adj.* 有压力的，压缩的
centroid	['sentrɔid]	*n.* 重心，质心，形心(曲线)
elongation	[ˌi:lɔŋ'geiʃən]	*n.* 伸长，延长(部分)
nondimensional	['nɔndi'menʃənəl]	*adj.* 无量纲的
adjacent	[ə'dʒeisənt]	*adj.* 附近的
in an elementary way		以基本方法
at right angles		成直角
be analogous to		类似于
constant cross section		等截面
axial force		轴向力
tensile strain		拉应变
tensile stress		拉应力
be in tension		受拉
be in compression		受压
to the contrary		意思相反的(地)
compressive stress		压应力

Notes

① 本课和书中以后各课出现-ing 形式(包括传统语法的现在分词和动名词)，在句中它们常担任宾语和状语。

第一段中出现了 by considering，By making。-ing 形式担任介词宾语，它与介词在一起构成介词短语，在句中作状语。第二段最后一句出现了 when discussing the bar in Fig.1-1，由连词 when 引起的-ing 分词短语在句中作时间状语。

② these forces will be continuously distributed over the cross section, analogous to the continuous distribution of hydrostatic pressure over a submerged surface.

句中 analogous to 是形容词短语作说明语。全句意思是：这些力连续分布在整个横截面上，类似于浸没面上液体静压力的连续分布。

③ 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.

for Eq.1-1 是动词不定式 to be valid 的逻辑主语，意思为：公式 1-1 能够成立的必要条件是。后面的 that 引出一个表语从句。

④ This condition will be realized if the axial force *P* acts through the centroid of the cross section, as can be demonstrated by statics.
as can be demonstrated 及本段最后一句中的 as was done， 其中的 as 是关系代词，引出非限制性定语从句，as 代表整个主句所讲的内容，并在从句中作主语。

⑤ However, here, 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...
前一句中由 unless 引导的从句意为：除非特殊说明不同情况。后一句：同样，除非另有说明……

Exercises

Ⅰ. Translate the following words into Chinese.

1. a total elongation of a bar carrying an axial force________________
2. a bar that has constant cross section throughout its length and a strait axis
____
3. a uniform stretching____________________________
4. Units of force divided by area________________________
5. a compressive stress____________________________
6. at right angles to its axis__________________________

Ⅱ. Translate the following words into English.

1. 等截面
2. 单位面积上的力
3. 无量纲的量
4. 杆件的横截面面积
5. 横截面的形心
6. 单位长度伸长量
7. 相邻横截面
8. 除非另有说明

Ⅲ. Translate the following sentences into Chinese.

1. This condition will be realized if the axial force *P* acts through the centroid of the cross section, as can be demonstrated by statics.
2. Also, unless stated otherwise, it is generally assumed that the weight of the object itself is neglected, as was done when discussing the bar in Fig.1-1.
3. By making an artificial cut through the bar at right angles to its axis, we can isolate parts of the bar as a free body.
4. The concepts of stress and strain can be illustrated in an elementary way by considering the extension of prismatic bar.

5. Assuming that the stress has a uniform distribution over the cross section, we can readily see that its resultant is equal to the intensity σ times the cross-section area A of the bar.
6. 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 direction, causing the bar to be compressed, they are called compressive stresses.

Ⅳ. Translate the following sentences into English.

1. 力的集度，即单位面积上的力，称为应力。
2. 应力常用希腊字母 σ 来表示。
3. 单位长度的伸长量称为应变，常用以下公式确定。
4. 材料力学是应用力学的一个分支。
5. 材料力学讨论固体在承受各种荷载时的性能。

Ⅴ. Answer the following questions briefly.

1. What is the concept of stress?
2. What is the concept of compression strain?
3. How do we obtain the tension strain?
4. What is the condition for Eq.1-1 to be valid?
5. Please give us the units of the stress and strain, and show some examples.

Reading materials

Statically Indeterminate Beams

In this paper we will consider the analysis of beams that have a larger number of *reactions*(反力) than the number of equations of static equilibrium. Such beams are said to be *statically indeterminate*(静不定的，超静定的), and their analysis requires that the deflections be taken into account. Only *statically determinate beams*(静定梁) were considered in the previous lesson, and in each instance we could immediately obtain the reactions of the beam by solving equations of static equilibrium. Knowing the reactions, we could then obtain the *bending moments*(弯矩) and *shear forces*(剪力), which in turn made it possible to find the stresses and deflections. However, when the beam is statically indeterminate, we cannot solve for the forces on the basis of statics alone. Instead we must take into account the deflection of the beam and obtain equations of compatibility to supplement the equations of statics. This same procedure was discussed for the case of statically indeterminate problems involving members in tension and compression.

Several types of statically indeterminate beam are illustrated in Fig.1-2. The beam part(a) of the figure is fixed(or clamped) at support A and simply supported at B; such a beam is called either a *propped cantilever beam*(有支承悬臂梁) or a "fixed simple" beam. The reactions of the beam consist of horizontal and vertical forces at *A*, *a couple*(力偶) at *A*, and a vertical force at *B*. Because there are only three independent equations of static equilibrium for the beam, it is not possible to calculate all four of these reactions by statics. The number of reactions in excess of the number of equilibrium equations is called the *degree of statical indeterminacy*(超静定次数). Thus, the beam pictured in Fig.1-2a is statical indeterminacy to the first degree. Any reactions in excess of the number needed to support the structure in a statically determinate manner are called *statical redundants*(赘余力), and the number of such redundants necessarily is the same as the degree of indeterminacy. For example, the reaction R_b shown in Fig.1-2a may be considered as a redundant reaction. Note that when it is removed from the structure, there remains a cantilever beam. The statically determinate structure which remains when the redundant is released is called the *released structure*(放松结构) or the *primary structure*(基本结构). Another approach to the beam in Fig.1-2a is to consider the reactive *moment*(弯矩、力矩) M_a as the redundant; if it is removed, the released structure is a simple beam with a *pin support*(铰支座) at *A* and a *roller support*(滚轴支座) at *B*.

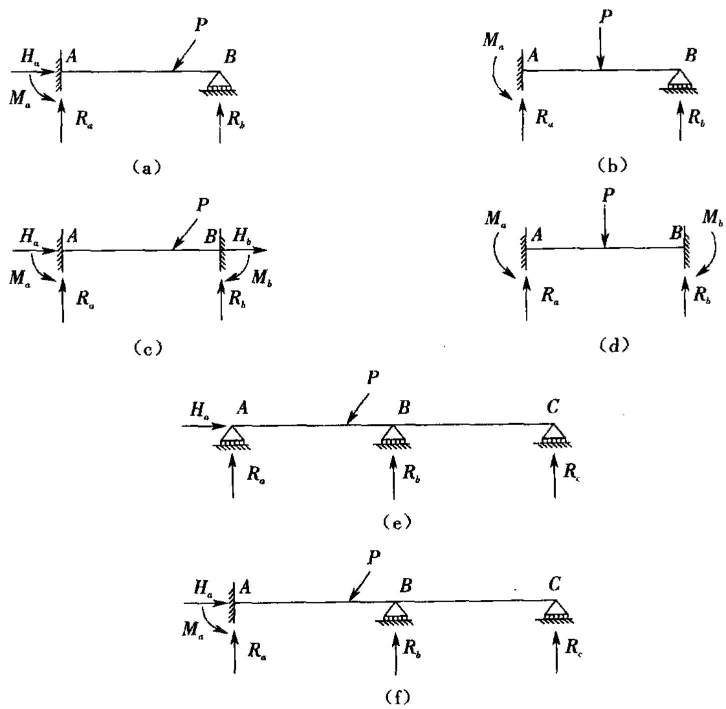

Fig.1-2 Statically indeterminate beams

A special case arises if all loads on the beam are vertical (see Fig.1-2b) because then the horizontal reaction vanishes. However, the beam is still statically indeterminate to the first degree inasmuch as there are now two independent equations of static equilibrium but three reactions.

A fixed-end(固定端) beam sometimes called a "fixed-fixed" beam, is shown in Fig.1-2c. At each support there are three reactive quantities, and hence the beam has a total of six unknown reactions. Because there are three *equations of equilibrium*(平衡公式), the beam is statically indeterminate to the third degree. If we take the reactions at one end as the three redundants, and if we remove them from the structure, a cantilever beam will remain as the released structure. If we remove the two fixed-end moments and one horizontal reaction, the released structure is a simple beam.

Again considering the special case of vertical loads only (see Fig.1-2d), we find that now there are only four reactions to be determined. The number of static equilibrium equations is two and, therefore, the beam is statically indeterminate to the second degree.

The remaining two beams shown on Fig.1-2 are examples of continuous beams, so called because they have more than one span and are continuous over a support. The beam shown in Fig.1-2e is statically indeterminate to the first degree because there are four reactive forces and only three equations of static equilibrium. If R_b is selected as the redundant, and if we imagine it to be removed from the beam, then there will remain a statically determinate simple beam *AC*. If R_c is selected, the released structure will be a simple beam *AB* with an overhang *BC*. The last beam shown in the figure 1-2f is statically indeterminate to the second degree. We might select R_b and R_c as the redundant reactions, and then the released structure is a cantilever beam.

科技英语阅读技巧(1)—— 读而不译
Reading Skills(1)—Reading without translating

Some students complain that they can't read well in English. The primary reason, that they do not read well is that they simply do not read, they translate. They don't believe they understand anything, unless they translate it into Chinese. Reading and translating are not the same thing. Translating is an important skill. It can be helpful in the early stages of reading, but it should be left behind as soon as possible if you want to read more and faster.

Now read the following paragraphs without translating. Try to understand the meaning directly from English.

Both *uniaxial*(单轴的) and *biaxial*(双轴的) stresses are special cases of a more general stress condition known as *plane stress*(平面应力). An element *inplane*(平面内) stress may have both *normal*(法向) and *shear*(剪切) stresses on the *x* and *y* faces, as shown in Fig.1-3, but no stresses on the *z* face of the element. The shear stress on the *x*