土木工程专业英语

English for Civil Engineering Majors

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武秀丽　主编

中国铁道出版社

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内 容 提 要

本书主要是为满足扩大对外经济与学术交流，把我国土木工程推向国际市场的迫切需要，参照教育部和建设部土木工程专业教育评估对专业英语的要求而编写的土木工程专业英语教材。本教材集听、说、读、写于一体。内容涉及国际工程投标，建筑材料，结构工程（桥梁、桩基、屋盖、网架结构、悬索、地下空间与结构），计算机辅助设计，施工，地基基础，现代钢结构，抗震结构设计等。

本书是高等学校土木工程专业本专科及函授学生的教材，也可供从事结构设计和施工的工程技术人员参考。

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前　言

随着我国改革开放的进一步发展，培养适应新世纪经济发展需要的复合型人才就显得越来越重要。本书正是为适应这种需要以及满足扩大对外经济与学术交流、尽快使我国土木工程专业与国际接轨而编写的土木工程专业英语教材。其内容涉及国际工程投标，建筑材料，结构工程（桥梁、桩基、屋盖、网架结构、悬索、地下空间与结构），计算机辅助设计，施工，地基基础，现代钢结构，抗震结构设计，等等。

本书具有如下特点：

(1) 是一本集听、说、读、写于一体的专业英语教材；

(2) 提供了大量土木工程专业的英语读物，在选择内容方面，坚持基本知识与专业最新发展并举的原则，难易结合以适应各层次需要；

(3) 为了提高英语科技写作水平，本书在讲解如何写作的同时，也提供了一些 1999 年以来部分国外土木工程专业博士学位论文的英文摘要，使大家在提高科技英语写作能力的同时了解国际上土木工程专业的最新发展方向；

(4) 为适应我国的招标承包制和建设监理制与国际接轨的需要，本书还集中讲解了国际工程招投标（FIDIC“土木工程施工合同条件”）及需要注意的问题，为开拓国际市场提供了必备的工具。

本书由武秀丽教授主编，吴康保、喻岩、郭忠贤、王景全、张永远参加了本书第四部分 Unit9～Unit17 的编写工作。王立军、付希清负责全书的校核。全部录音由外籍教师 Derbyshire Martin 和 Farzaneh Ghofarani 完成，需要磁带的读者请与编者联系。另外，在编写过程中，参考了有关兄弟单位的资料，在此一并致谢。

由于编者水平有限，虽经多次修改，但仍难免会有缺点和错误，敬请读者批评指正。

编　者

2000 年 6 月

目　　录

PART I

Listening and Speaking 听与说

本部分共分为四个单元：常用数字的英语读法、常用数学符号的英语读法、土木工程专业常用词汇的英语读法、土木工程专业小短文的英语读法。全部录音由外籍教师 Derbyshire Martin 和 Farzaneh Ghofarani 完成。

Unit 1 English Reading for Frequently-used Numerals

常用数字的英语读法

1/2	a half, one half, one over two
1/3	a third, one third, one over three
2/3	two thirds, two over three
1/10	a tenth, one tenth
1/4	a quarter, one quarter, one fourth, one over four
3/4	three quarters, three fourths, three over four
$2\frac{1}{2}$	two and a half
$3\frac{3}{5}$	three and three fifths
$137\frac{3}{4}$	one hundred thirty seven and three quarters, one hundred thirty seven and three over four
234/679	two hundred and thirty four over six hundred and seventy nine
0.3	zero point three, O point three, nought point three, point three
0.03	zero point zero three, O point O three, nought point nought three, point nought three
0.67	zero point six seven, O point six seven, nought point six seven, point six seven
$0.\dot{3}$	zero point three recurring, point three recurring
$5.8\dot{6}\dot{7}$	five point eight six seven, six seven recurring
46.73	four six point seven three, forty six point seven three
%	per cent
2%	two per cent

$\frac{3}{8}\%$	three eighths per cent, three eighths of one per cent
0.2%	point two per cent
‰	per mille
2‰	two per mille
1/2 m	half a meter
2/3 m	two thirds of a meter
3/4 km	three quarters of a kilometer
2.83 km	two point eight three kilometers
7.8 m/s	seven point eight meters per second
15℃	fifteen degrees Centigrade
34℉	thirty four degrees Fahrenheit

Unit 2 English Reading for Frequently-used Mathematical Symbols

常用数学符号的英语读法

$+$	plus
$-$	minus
$\times$	multiplied by, times
$/$	divided by
$\pm$	plus or minus
$=$	is equal to, equals, is
$\equiv$	is identically equal to, identically equals
$\approx$	is approximately equal to, approximately equals
$\lvert x \rvert$	the absolute value of x
$\overline{x}$	x bar, the mean value of x
b'	b prime
b''	b double prime, b second prime, b two prime
b_1	b subscript one, b sub one
b^2	b superscript two, b super two
$\dot{x}$	x dot
$\ddot{x}$	x two dots
$f(x)$	function f of x
$\mathrm{d}x$	dee x, differential x
$\frac{\mathrm{d}y}{\mathrm{d}x}$	the first derivative of y with respect to x, the differential coefficient of y with respect to x
$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$	the second derivative of y with respect to x

$\frac{d^n y}{dx^n}$	the *n* th derivative of *y* with respect to *x*
$\frac{\partial y}{\partial x}$	the partial derivative of *y* with respect to *x*
∇	del, nabla
∇^n	*n* th del (nabla)
$\int$	integral
$\int_a^b$	integral between limits *a* and *b*
∞	infinity
$(a+b)$	bracket *a* plus *b* bracket closed
$a:b$	the ratio of *a* to *b*
x^2	*x* square, *x* squared, the square of *x*, the second power of *x*, *x* to the second power
x^3	*x* cube, *x* cubed, the cube of *x*, the third power of *x*, *x* to the third power
x^{4}	the minus fourth power of *x*, *x* to the minus fourth power
$\sqrt{x}$	the square root of *x*
$\sqrt[3]{x}$	the cube root of *x*, the cubic root of *x*
$\sqrt[5]{x^2}$	the fifth root of *x* square
$\log_n x$	log *x* to the base *n*
$x!$	factorial *x*

Unit 3 English Reading for Frequently-used Civil Engineering Vocabulary

土木工程专业常用词汇的英语读法

ACI Building Code	ACI 建筑规范
allowable or permissible stresses	许用应力
allowable-stress design	许用应力设计方法
architectural design	建筑设计
axial force	轴向力
bending moment	弯矩
building codes	建筑规范
cable net structure	悬索网架结构
cable tension	悬索张力
chandelier	枝形吊灯
civil engineering	土木工程

cladding wall	承重墙
composite material	复合材料
computer-aided design	计算机辅助设计
computer simulation	计算机仿真
concrete and masonry structure	砖混结构
concrete beam	混凝土梁
conditions of operation	工作条件
crack width	裂纹宽度
critical design load	临界设计载荷
cross-bracing	交叉支撑
decision-making process	决策过程
deflection	挠度
degree of accuracy	精确度
design process	设计过程
diagonal bracing	斜撑
earthquake load	地震载荷
earthquake-resistant design	抗震设计
epicenter of the earthquake	震中
equilibrium equation	平衡方程
factor of safety	安全系数
fixed end	固定端
fluid mechanics	流体力学
geologic fault	断层
girder	桁架
height-to-span ratio	高跨比
high-rise building	高层建筑
high-strength concrete	高强混凝土
high-strength steel	高强钢
Incremental length	长度增量
in the horizontal direction	在水平方向
in the vertical direction	在垂直方向
lifeline	生命线
live load	活载
limit state	极限状态
load-combination factor	荷载组合系数
load-factor design	荷载系数设计方法
load propagation	荷载的传递
long-span structure	大跨结构
log-normal distribution	对数正态分布
low-rise building	底层建筑
materials of construction	建筑材料
maximum sag	最大下垂
modulus of elasticity	弹性模量
natural frequency of vibration	振动固有频率

nominal load	名义载荷
nominal strength	名义强度
one-way slab	单向板
permissible stress	许用应力
pinned end	铰接端
pitched-roof	斜屋顶
planar truss	平面桁架
plastic hinge	塑性铰
polygon of force	力多边形
precast	预浇
prestressing	预应力
primary structural component	主要结构组成
probability	概率
random process	随机过程
reinforced concrete structure	钢筋混凝土结构
resultant of forces	力的合成
return period	返还周期
Richter scale	里氏级数
rigid frame	刚架
rigid joint	刚结点
roof truss	屋盖桁架
secondary bracing	次要支撑
service-load design	使用载荷设计方法
shear force	剪力
shear force diagram	剪力图
snow load	雪载
structural engineering	结构工程
structural system	结构体系
structure of construction	建筑结构
seismic excitation	地震反应
seismic hazard	地震灾害
seismic load	地震载荷
sense of the force	力的方向
shape of a parabola	抛物线形状
shear wall	剪力墙
soil behavior	土壤性质
statically determinate structural system	静定结构体系
stress cycle	应力循环
stress/strain diagram	应力/应变图
structural member	构件
structure element	构件
structural engineer	结构工程师
tectonic earthquake	构造地震

three-dimensional	三维
three-pin arch	三铰拱
traffic flow	交通流
transfer mechanism	传递机理
two-dimensional	二维
ultimate load	极限载荷
ultimate tensile strength	极限拉伸强度
upper and lower chord	上下弦
wind load	风载
working load	使用载荷
yield stress	屈服应力

Unit 4 Civil Engineering Essays

土木工程专业小短文

1. A building or a bridge is composed of a number of individual structure elements that must function together to resist the applied loads. Throughout the design process the structural engineer must be able to visualize the various individual load-carrying elements and to understand the functional interrelationships necessary for transmitting the applied loads through the structure. Usually the structure will be subjected to several distinct types of loading (e.g., lateral as well as vertical), and the effective load -transfer mechanisms typically vary with the applied loads.

2. The two chords are composed of the upper chords of the two primary trusses, and the lateral struts (bb', dd', etc.) are compression members that transmit the loads between the two primary trusses. Note that the diagonals in each bay have been arranged in pairs; the main diagonal has been augmented with a second diagonal member called a counter. A cursory examination of this truss reveals that the truss has six redundant members; however, if properly designed, the truss can be regarded as statically determinate.

3. The structure engineer is a member of a team whose members work together to design a building, bridge, or other structures that will fulfil the specific needs of a client. In the case of a building, an architect generally provides the overall layout, and mechanical, electrical, and structural engineers design individual systems within the building. A geotechnical or foundation engineer provides information necessary for the design of foundations, basement walls, and so on.

4. To allow for the possibility that the resistances may be less than computed, and the load effects may be larger than computed, strength reduction factors, φ , less than 1, and load factors, α , greater than 1, are introduced:

$$\varphi R_n \geq \alpha_1 S_1 + \alpha_2 S_2 + \cdots$$

where R_n stands for nominal resistance and S stands for load effects based on the specified loads.

5. If Y follows a standard statistical distribution, and if Y and σ_Y are known, the probability of failure can be calculated or obtained from statistical tables as a function of the type of distribution and the value of β. Thus if Y follows a normal distribution and β is 3.5, then Y=3.5 σ_Y and from tables of the normal distribution, P_f is 1/9091 *or* 1.1×10^{-4}.

6. The slope of the stress/strain line up to the yield point is called the modulus of elasticity E of the material and is a constant for the material.

$$E = \frac{\text{stress}}{\text{strain}} = \frac{\sigma}{\theta}$$

This value of E for steel is 29×10^6 psi ($199.9\times10^3 N/mm^2$), with a value of 30×10^6 psi ($206.8\times10^3 N/mm^2$) being sometimes used for design.

7. Timber, or wood, is a natural building material. It is available either as lumber, which is a natural wood, or as glued laminated timber. This latter form is much stronger and conglue or adhesive. The laminations usually do not exceed 2 in. in thickness. Glued laminated beams are available in a variety of shapes. Both lumber and glued laminated timber are widely used in building construction.

8. The use of materials in both tensile and compressive structures is extremely efficient since the entire cross section of each member is uniformly stressed. The strength of the members in a tensile structure is limited only by the basic material strength; thus, these are generally lightweight systems that are economical for spanning large distances. The cable-stayed bridge in Fig. 11.1a is a suspension structure in which the primary structural components are totally in tension. Since the members in compressive structures have a propensity for buckling, the material stress is limited to a level which is lower than that for tensile members. The arch is a common type of compressive structure, but under some conditions the internal state of stress can include shear and bending moment. Nevertheless, compression is usually the dominant internal force. An example of an arch bridge is illustrated in Fig. 11.1b.

9. A variety of cross-sectional geometries for the completed box structure are possible, with the

number of girders varying from two to six or more depending upon the plan geometry of the structure (Fig. 13.2). Typical cross-sectional geometries are given in Fig. 13.3 for three two-box girder systems. Both single and double bearing arrangements and shallow and deep end-support diaphragms are illustrated. Typical spacing of the centreline of the box girders varies from 4.3 to 6.7 m, and the depth of the cast-in-place concrete deck varies from 190mm to 250mm. Thus, the ratio of dead load moment to live load moment for box girder structures will depend upon the depth of deck, the cross-section and the span arrangement chosen by the design engineer.

10. For conventional bored piles it is common practice to adopt values of K of 0.7, while for piles bored with a continuous-flight auger, values of 0.9 (for sandy soils) down to 0.6 (for silts and silty sands) are taken. In general, the roughness of the hole will ensure that the full soil friction is mobilized at the pile edge. However, potential loosening of the soil during the installation process may be allowed for by taking the friction angle δ between ϕ' and ϕ'_{cv}.

11. The end-bearing pressure mobilized by a pile should, in principle, be comparable with that measured during a cone penetration test. However, effects of scale and of different rates of testing combine to yield variations in the ratio q_b/q_c ranging from under 0.5 to over 2. Unless there is particular evidence to the contrary, for a given soil, the end-bearing pressure should be taken equal to that measured in a cone penetration test.

12. Earthquake-resistant design is achieved with an accepted risk level. Thus, in practice, design of structures to withstand earthquakes of all potential magnitudes is neither practical nor economical. Within an accepted risk, however, design requires one or more of the following alternatives:
    A. Design and detailing of structural members and beam-column joints for the prescribed earthquake loads given in the code.
    B. Design of "shear wall" as earthquake load-carrying members.
    C. Design of cross-bracing in structural frames.
    D. Use of the isolation concept.

PART II

Technical English Writing 科技英语写作

科技论文 (Science Papers) 是论述自然科学研究和技术成果的说理性文章。按其写作目的，可分为学位论文 (Thesis) 和学术论文 (Research Papers)。这部分讲述并列举了如何撰写学术论文，最后还给出了 13 篇 1999 年以来的博士论文摘要。它们既是很好的英文摘要的范例，也代表了土木工程专业最新的发展方向。

Unit 5 Styles and Features of English Technical Writing

英文科技论文的写作格式与特点

学位论文的写作是非常严格的，分为前部、正文、后部三大部分。各部分所包含的内容如下：

FRONT 前部

Front Cover 封面
Title Page (Subtitle) 扉页
Author's Name, Author's Address 作者姓名，作者联系地址
Distribution List 分发范围
Preface or Foreword 序言/前言
Acknowledgements 致谢
Abstract 摘要
Keywords 关键词
Table of Contents 目录
List of Illustrations (Tables, Graphs) 图表目录

MAIN TEXT 正文

Introduction 引言
Analysis and/or Experiment Methods and Procedure 分析/实验方法和过程

Results　结果

Discussion　讨论

Conclusions (Summary)　结论

Recommendations　建议

BACK 后部

List of References　参考文献

Appendixes　附录

Tables　表

Graphs　图

Index　索引

学术论文，是指期刊论文 (Journal Papers) 和会议论文 (Conference Papers)，其写作格式一般为：

Title　标题

Author's Name　作者姓名

Author's Address　作者联系地址

Abstract　摘要

Keywords　关键词

Introduction　引言

Analysis and/or Experiment Methods and Procedure　分析/实验方法和过程

Results　结果

Discussion　讨论

Conclusions (Summary)　结论

Acknowledgments　致谢

References　参考文献

Appendixes　附录

科技论文的**标题**要简明、朴实，统计资料显示：一般标题的平均词数为 10。有的期刊要求不超过 20 个词。**摘要**通常不超过 200 个词，要求简短扼要，引人入胜，而且要能独立使用，使读者不读正文也能对论文的工作一目了然。一般概括如下内容：为什么从事这项研究？完成了哪些工作？突出的成果；成果的意义。尽管摘要放在正文的前面，但它往往是在最后写作；为方便文献检索，一般从论文中选取 3～8 个能表达主题内容的**关键词**排在摘要的左下方。**引言**向读者解释论文的主题、目的和总纲，通过引言的初步介绍，可以引导读者明确地领会该研究成果的研究背景、研究意义、采用的方法、简单了解研究中的发现。科技论文的**正文**要求准确性、鲜明性、生动性。除了对材料、研究方法和研究过程的描述，还应包括讨论、结论、建议等内容。**结论**比研究结果和分析还要推进一步，要反映出该研究如何经过概念、判断、推理的过程而形成总的观点，结论必须严密，不能有第二种解释，更不能杜撰。在研究工作中得到的常规以外的帮助，应在文末予以致谢，用词要恰如其分。科技论文所列举的**参考文献**反映了作者严肃的科学态度和研究工作的广泛依据。**附录**放在论文的最后，起帮助读者阅读论文的作用。

下面以一篇科技论文举例说明（因为本节旨在讲解写作，故这里略去了论文中的插图）。

A Simplified Optimization for Vibration of Rectangular Plates with Cylindrical Voids

带空洞矩形板振动问题的简单优化解

Wu Xiuli[1] and Jean-Pierre Bardet[2]

ABSTRACT

This paper proposes a simple method for calculating the natural frequencies of rectangular plates with cylindrical voids that are arbitrarily positioned and illustrated its usefulness by optimizing the natural frequencies. The discontinuous variations in rigidity and mass density of plate that are induced by the voids are expressed by using the extended Dirac function. The free transverse vibration of the plate with cylindrical voids is obtained with the help of the Galerkin method. The natural frequency coefficients of the plate with voids are found to depend not only on the dimensions of the plate and the sizes as well as locations and dispositions of the voids, but also on Poisson's ratio of plate material. It is pointed in the paper that voids locations and radii can be optimally designed to get the desired natural frequencies, e.g., the maximum or the minimum. Furthermore, a very simple formula is extended to derive approximate values of the higher order natural frequencies for plates with cylindrical voids.

KEYWORDS

Natural Frequencies; Cylindrical Voids; Rectangular Plate; Extended Dirac Function; Optimization.

INTRODUCTION

Plates with voids are often used in civil engineering because they are light and structurally efficient. Many authors have discussed the analytical methods for static analysis of plates with voids. For example, Elliotto and Clark(1982) investigated cylindrically voided concrete slab stiffness using the finite element method. Very few studies have been performed on the dynamic analysis of voided plate. Takabatake (1991) solved the dynamic response of elastic rectangular plates with arbitrarily disposed rectangular voids by means of the extended Dirac function, in which the modified variables are thickness and rigidity. He proposed some free and forced vibration

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