新世纪土木工程系列规划教材

土木工程专业英语

王清标　李庆学　主编

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机械工业出版社
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序

一次学术会议上，王清标老师把他要编一本实用土木专业英语教材的想法说给了我，我表示了支持与鼓励，因为随着国际交流与合作的日益广泛和频繁，社会亟须能够掌握国际通用语言（英语）、具有国际视野、通晓国际规则，既有理论基础，又能面向实际，能在国际经济一体化环境下从事工程技术和管理工作的外向型、应用型人才。科学技术发展迅速，科技信息日新月异，能够直接及时地获取专业信息、掌握专业发展动态是工程技术人员和科研人员必须具备的基本能力，进行各种涉外合作和学术交流都要求专业技术人员能够熟练掌握专业英语。大学生无论是在校学习期间还是参加工作后，无论是学习英文版国外教材、专著和资料，撰写英文论文，出席国际会议，还是从事工程项目的设计、施工、管理以及其他技术工作（设计规范、设计图样、设计程序和招投标文件），都不可避免地接触大量以英语为主要载体的专业文献资料，这就要求技术人员不但要懂专业知识，更要懂英语。在此背景下，土木工程专业英语作为土木工程专业知识传播与信息传递的媒介，已成为专业技术人员必备的交流工具和手段。

随着我国的土木工程技术与劳务的输入输出，对土木工程技术人员的专业英语能力提出了更高要求，但既懂外语又懂专业技术的人才极度匮乏。土木工程专业英语的教学在培养复合型人才方面起着重要的作用，专业英语是提高学生综合能力，提升学生在专业方面的英语应用能力的重要工具。

专业英语在大学生的素质教育中占有重要地位。新的《大学英语课程教学要求》给专业英语的教学提出了更高的要求。《大学英语教学大纲》不仅强调学习专业英语的重要性，同时对专业英语的词汇和听、说、读、写、译的能力作出了明确的说明。过去土木工程专业英语教学把重点放在学生阅读理解和翻译能力的训练上，忽视了土木建筑专业口头交际和涉外业务应用文写作能力的培养。然而现在随着国际交流和全球化市场经济的发展，更加注重培养学生的专业英语口头交际能力和写作能力。本书内容科学合理、体现国际观点并注重社会科学知识的广度和专业知识的深度，能够反映出学科最新发展动态和科研成果，教学内容新颖，具有时代感。经验表明，英语听力的熟练对于提高阅读能力也是大有帮助的。由于语言的技能性重于其知识性，经常使用英语以加强练习是非常重要的。除了阅读本书之外，如能结合学习和工作经常阅读专业英语文献，对提高专业英语水平是大有好处的。

顺应土木工程国际化趋势，为满足国际化土木工程复合型人才培养的需要，该书本着覆盖面广、知识面宽、信息量大的原则，根据大学英语教学大纲的要求编写。该书可作为土木工程专业本科生学习专业英语的教材，也可供土木工程及相关专业的研究生学习参考，亦可供土木工程专业技术人员了解专业知识、查用专业词汇、提高英语水平时使用。

该书内容丰富，体现了“大土木、大工程”的专业特点，共有15个单元，每单元

分为 Part Ⅰ课文和 Part Ⅱ阅读材料两部分。该书课文和阅读材料语言规范，题材广泛，覆盖土木工程各专业的重要内容：建筑材料、地基工程、建筑工程、桥隧工程、市政工程、铁路和公路工程、海洋工程、防灾减灾、建筑工程事故和商业合同、科技论文写作等内容。内容丰富，材料充实新颖，有效地拓展了专业知识的广度与深度。教材配套资源丰富，包含教学课件、电子教案、教学大纲、教学计划、章节学习指导、章节练习题、自测题、模拟试题、教学视频及参考译文等内容，并且该配套资源获得了教育部第十二届全国多媒体课件大赛优秀奖。

王清标老师积极的工作热情与活力给我留下了深刻的印象，同时也体现在了该教材之中，我认为，好好研读一下该书，会有助于土木专业英语的学习，同时也达到了该书的教学效果。王清标老师还为该书精心制作了学习网站，投入了巨大精力，付出了许多心血。在这里，我衷心祝贺王清标老师编写取得的成功，望再接再厉，不断创新、完善、丰富该教材。

中国科学院院士

前　　言

在“大土木、大工程”背景下，土木工程类专业合并成一个土木工程专业后，许多课程的设置和内容都进行了调整，原来分门别类的专业英语课程也与时俱进合并成一门“土木工程专业英语”课。专业英语是大学英语教学的一个重要组成部分，是促进学生将普通英语知识与专业知识有机结合的有效途径。土木工程各专业的学生在大学本科一、二年级的基础英语学习和三年级的科技英语学习的基础上，通过专业课程的学习，需要对专业英语知识有所了解，专业英语的学习不仅有助于巩固《大学英语》和《科技英语》所学知识，而且在很大程度上也是英语学习水平和能力的培养、补充、延伸和提高。

本教材具有如下特色：

1）知识的系统性。根据土木工程各专业的特点，本着覆盖面广、知识面宽以及适当介绍前沿专业知识的原则，本教材课文和阅读材料语言规范，题材广泛，覆盖土木工程各专业的重要内容，内容丰富，材料充实新颖，有效地拓展了专业知识的广度与深度。

2）内容的实践性。结合多年来本课程的教学经验，编者们查阅了大量资料，在选材上作了认真的筛选，让教材内容更贴合教学实际，更加注重对专业基础内容和前沿专业知识的关注与认识。每课所列生词表、专业术语、短语以及注释都是教学实践中学生经常提出的问题，因此针对性较强，可以满足课堂和课下英文练习实践的要求，夯实专业英语学习的基础。

3）模式的创新性。各章紧扣主题，内容丰富，每章分为系统的三个部分，分别为基础阅读学习材料、阅读提升部分和科技翻译学习。各章节均带有说明性和解释性的材料，扩充知识，加深理解。课后丰富的练习题，可巩固专业英语的基础知识，扩大词汇量，提升学习深度，尤其是科技翻译练习，更显其实用之处。教材采用各种配套说明图片，清晰明确，图文并茂。同时，为了适应现今工程项目发展和论文的写作要求，特别增加了商务合同和科技论文的写作指导部分，满足读者更多的要求。

4）适用的广泛性。本书选材广泛新颖，覆盖面广。目前我国土木工程行业与国外有许多交流，并参与国际市场的竞争，专业技术人员希望有系统的土木工程专业英语参考书。本书除可用作土木工程本科生、研究生教材外，也可供土木工程专业的教师、研究人员和工程技术人员参考。

5）目的的针对性。本教材重视语言技能训练，突出对阅读和翻译能力的培养，讲究学以致用，在每篇课文的后面还选取了与本专业课题有关的阅读材料，供学生使用，以期提高学生的自学能力，并进一步拓宽学生的专业知识视野。力求达到《大学英语专业阅读阶段教学基本要求》所提出的目标：“通过指导学生阅读有关专业的英语书刊和文献，使他们进一步提高阅读和翻译科技资料的能力，并能以英语为工具获取专业所需

的信息”。

本书是在参考国内外诸多教材版本的基础上，取长补短，借鉴经验编写而成的，并参阅了诸多文献资料，在此对这些文献的作者表示衷心感谢。

受编者知识水平所限，疏漏之处在所难免，敬请读者不吝赐教。

编　者

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Unit 1 Structural Materials

Part Ⅰ Reinforced Concrete

Introduction

Structural materials, the material base of civil engineering, are the general term of all the materials of construction. Costs of structural materials account for about 50% of the cost of the building. So it is very important to make a reasonable choice for the structural materials. This chapter simply introduces the categories, applications and properties of structural materials at home.

Concrete and reinforced concrete are used as building materials in every country. Reinforced concrete is a dominant structural material in engineering construction.

Concrete

Concrete is a mixture of water, sand, gravel and cement (see Fig. 1. 1). That the mixing together of such disparate and discrete materials can result in a solid mass (of any designed shape) with well-defined properties, is a wonder in itself.

Concrete has been in use as a building material for more than 150 years. Its success and popularity may be largely attributed to:

1) durability under hostile environments (including resistance to water);

2) ease with which it can be cast into a variety of shapes and sizes;

3) its relative economy and easy availability;

4) strong in compression.

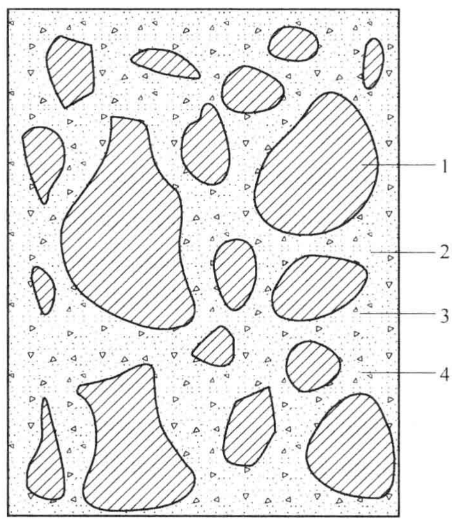

Fig. 1. 1 Concrete
1—Stone 2—Sand
3—Cement 4—Air hole

But as we all know, concrete has comparatively low tensile and bending strength compared to its high compressive strength. As a result, cracks develop whenever loads, or restrained shrinkage or temperature changes, give rise to tensile stresses in excess of the tensile strength of the concrete. For structural applications it is normal practice to incorporate steel bars to resist any tensile forces or to apply compressive forces to the concrete to counteract these tensile forces.

Prestressed Concrete

Methods of inducing compression in concrete member before it is loaded are known as prestressing. The construction that uses steels and concrete of very high strength in combination is known as prestressed concrete. The development of early cracks in reinforced concrete due to non-compatibility in the strains of steel and concrete was perhaps the starting point for the development of a new material "prestressed concrete".

Prestressed concrete is an improved form of reinforcement. Steel bars are bent into the shapes to give them the necessary degree of tensile strength. They are then used to prestress concrete, usually by one of two different methods. The first is to leave channels in a concrete beam that correspond to the shapes of the steel bars. When the bars are run through the channels, they are then bonded to the concrete by filling the channels with grout, a thin mortar of binding agent. In the other method, the prestressed steel bars are placed in the lower part of a form that corresponds to the shape of the finished structure, and the concrete is poured around them. Two methods are referred to as "pre-tensioned method" and "post-tensioned method". Because prestressed concrete is so economical, it is a highly desirable material.

The advantages of prestressed concrete are as follows:

1) The concrete and the steel are severely tested during the prestressing operation, and a lower factor of safety is justified.

2) The permissible working stress in the concrete is generally one-third of the compressive strength, thus allowing a margin to cover the risk of poor concrete occurring at a critical section.

3) The risk is reduced by prestressing, because the stress induced in the concrete during the prestressing operation may be 50% to 75% of its compressive strength.

Today, prestressed concrete is used in buildings, underground structures, TV towers, floating storage and offshore structures, power stations, nuclear reactor vessels, and numerous types of bridge systems including segmental and cable-stayed bridges. They demonstrate the versatility of the prestressing concept and its all applications. The success in the development and construction of all these structures has been due to the advances in the technology of materials, particularly prestressing steel, and the accumulated knowledge in estimating the short-term and long-term losses in the prestressing forces.

1. Steel

Steel is an outstanding structural material (See. Fig. 1. 2). It has a high strength on a pound-for-pound basis when compared to other materials, even though its volume-for-volume weight is more than ten times that of wood. It has a high elastic modulus[1], which results in small deformations under load. The properties of steel that have been described so far are applicable only if the ambient temperature stays within reasonable proximity of 70F, say from 30 to 110F. This range encompasses the service conditions for most structures, but it is still important to understand what will take place if the temperature were to depart, significantly from the normal level. The characteristic of steel vary a great deal between low-temperature and high-temperature conditions.

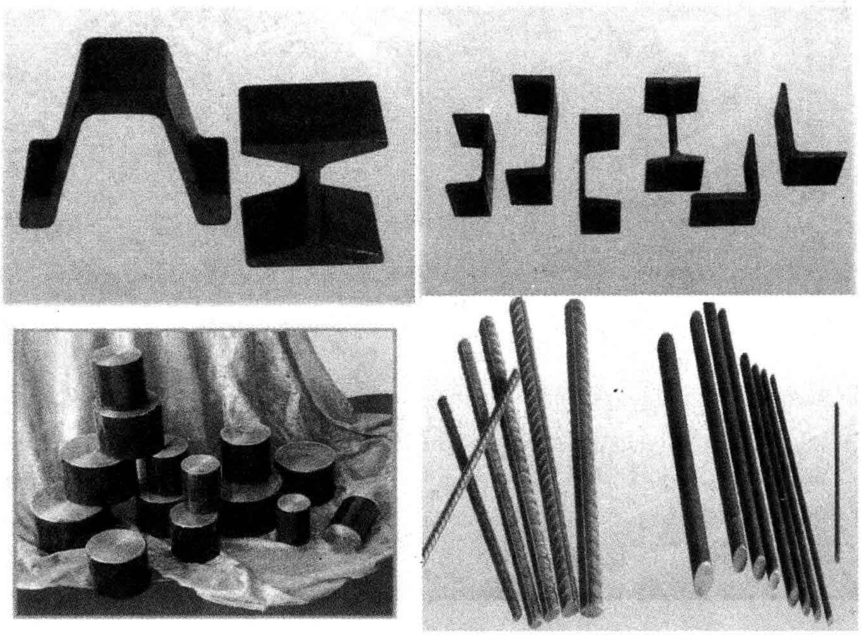

Fig. 1. 2 Steel

Compared with concrete, the enormous advantage of steel is its tensile strength, that is, it does not lose its strength when it is under a calculated degree of tension, a force which, as we have seen, tends to pull apart many materials. The useful strength of ordinary reinforcing steels in tension as well as compression, for example, the yield strength, is about 15 times the compressive strength of common structure concrete, as well as over 100 times its tensile strength. The steel is the important part of the structure, since concrete is deficient in tensile strength. It is impossible to build a structure frame from steel without concrete, but not from concrete without steel. On the other hand, steel is a high-cost material compared with concrete. Although steel occupies only a small part of the volume of reinforced concrete (on the average about 2 percent), it is a major part of the cost.

2. Reinforced Concrete

Reinforced concrete, also called ferroconcrete in some countries, is concrete in which reinforced bars or fibers have been incorporated to strength a material that would otherwise be brittle (See Fig. 1. 3).

Reinforced concrete invented in the latter half of the 19th century. Concrete and reinforced concrete are used as building materials in every country. Reinforced concrete is a dominant structural material in engineering construction in many countries including the United States and Canada. The universal nature of reinforced concrete construction stems from the wide availability of reinforcing bars and the constituents of concrete, gravel, sand and cement. The relatively simple skills required in concrete construction, and the economy of reinforced concrete compared to other forms of construction. Concrete and reinforced

Fig. 1.3 Reinforced concrete

concrete are used in bridge, buildings of all sorts, underground structures, water tanks, television towers, offshore oil exploration and production structures, dams, and even in ships.

Concrete would not have gained its present status as a principal building material, but for the invention of reinforced concrete, which is concrete with steel bars embedded in it. The idea of reinforcing concrete with steel has resulted in a new composite material, having the potential of resisting significant tensile stresses, which was hitherto impossible. Steel bars are embedded in concrete to make reinforced concrete in concrete beams and structures where tension will develop, the proper adhesion between the steel and the concrete is of the greatest importance, and bars should be of a sufficiently small diameter to offer an adequate area of contact with the concrete; note that the smaller the diameter of the bars, the greater their surface area for any given percentage of reinforcement[2]. The practical limit is reached when the bars become so numerous that they obstruct the proper placing of concrete. The resulting combination of the two materials, known as reinforced concrete, combines many of the advantages of each:

1) the relatively low cost;

2) good weather and fire resistance;

3) good compressive strength;

4) excellent formability of concrete;

5) the higher tensile strength;

6) much greater ductility and toughness of steel.

It is this combination which allows the almost unlimited range of uses and possibilities of reinforced concrete in the construction of buildings, bridges, dams, tanks, reservoirs, and a host of other structure.

They also complement each other in another way: they have almost the same rate of contraction and expansion. They therefore work together in situations where both compression and tension are factors.

Concrete and steel form such a strong bond, the force that unites them, that no relative movements of the steel bars and the surrounding concrete occur. This bond is provided by the relatively large chemical adhesion which develops at the steel-concrete interface, by the natural roughness of the mill scale of hot-rolled reinforcing bars, and by the closely spaced rib-shaped surface deformations with which reinforcing bars are furnished in order to provide a high degree of interlocking of the two materials. Still another advantage is that the steel is therefore completely surrounded by the concrete and the steel does not rust in concrete.

Reinforced concrete can be classified as precast concrete and cast in-situ concrete. Much of the focus on reinforcing concrete is placed on floor systems. Designing and implementing the most efficient floor system is a key to creating optimal building structures. Small changes in the design of a floor system can have a significant impact on material costs, construction schedule, ultimate strength, operating costs, occupancy levels, and end use of a building.

The adoption of structural steel and reinforced concrete caused major changes in traditional construction practices. In the earlier steel of concrete frame building, the curtain walls were generally made of masonry, they had the solid look of bearing walls. Today, however, curtain walls are often made of lightweight materials such as glass, aluminum, plastic, in various combinations. It was no longer necessary to use thick walls of stone or brick for multistory buildings, and it became much simpler to build fire-restraint floors. Both these changes served to reduce the cost of construction. It also became possible to erect buildings with greater heights and longer spans.

Reinforced concrete construction is not the outcome of structural design alone. It is a collaborative venture involving the client, the architect, the structural engineer, the construction engineer, and the contractor. Other specialists may also have to be consulted, with regard to soil investigation, water supply, sanitation, fire protection, transportation, heating, ventilation, air-conditioning, acoustics, electrical services, etc. Typically, a construction project involves three phases: planning, design, and construction.

Words and Phrases

reinforce [riːin'fɔːs] *vt.* 增强，加强，增援

cement [si'ment] *n.* 水泥

gravel ['grævəl] *n.* 沙砾，砾石

compression [kəm'preʃən] *n.* 压缩，浓缩

tensile ['tensail] *a.* 可拉长的，可伸展的，张力的

incorporate [in'kɔːpəreit] *vt.* 包含，吸收；把…合并，使并入

brittle ['britl] *adj.* 易碎的，脆弱的

hitherto [ˌhiðə'tuː] *adv.* 迄今；至今

embed [im'bed] *vt.* 使嵌入，内嵌
adhesion [əd'hiːʒən] *n.* 支持；黏附；固守
bond [bɔnd] *n.* 粘合力
interface ['intəfeis] *n.* 界面；接口；接触面
mill [mil] *n./v.* 碾磨
deformation [ˌdiːfɔː'meiʃən] *n.* 变形
interlock [ˌintə'lɔk，'intəlɔk] *v.* 互锁；连锁
crack [kræk] *n.* 裂缝
reinforced concrete 钢筋混凝土
hot-rolled reinforcing bar 热轧钢筋
rid-shaped surface 肋形表面
rate of contraction 收缩率
rate of expansion 膨胀率
tensile strength 抗拉强度
compressive strength 抗压强度
reinforcing bar 钢筋
elastic modulus 弹性模量
yield strength 屈服应力

Notes

1. elastic modulus：弹性模量是指当有力施加于物体时，其弹性变形（非永久变形）的数学描述。物体的弹性模量定义为弹性变形区的应力—应变曲线（stress-strain curve）的斜率。

2. percentage of reinforcement：配筋率是钢筋混凝土构件中纵向受力（拉或压）钢筋的面积与构件的有效面积之比（轴心受压构件为全截面的面积）。受拉钢筋配筋率、受压钢筋配筋率分别计算。钢筋混凝土构件最小配筋率如下：受压构件，全部纵向钢筋 0.6%，一侧纵向钢筋 0.2%；受弯构件、偏心受拉、轴心受拉构件一侧的受拉钢筋 0.2%。

计算公式：$\rho=A_s/A$。

式中 A_s——受拉或受压区纵向钢筋的截面面积；

A——根据受力性质不同而含义不同，分别为：受压构件的全部纵筋和一侧纵向钢筋以及轴心受拉构件、小偏心受拉构件一侧受拉钢筋的配筋率计算中，A 取构件的全截面面积；受弯构件、大偏心受拉构件一侧受拉钢筋的配筋率计算中，A 取构件的全截面面积扣除受压翼缘面积后的截面面积。

Exercises

Ⅰ. Read the whole text and answer the following questions.

1. Describe the composition of concrete?
2. Why dose concrete become so popular?
3. What's the weakness of concrete?
4. What's the advantage of steel?
5. What is reinforced concrete?
6. When was the reinforced concrete invented?
7. Reinforced concrete is usually used in which area?
8. What are the two methods to prestress concrete?
9. What's the advantage of reinforced concrete?

10. How many kinds can the reinforced concrete be classified?

Ⅱ. Translate the following terms into Chinese or English.

1. hot-rolled reinforcing bar
2. rid-shaped surface
3. reinforcing bar
4. elastic modulus
5. yield strength
6. characteristic compressive strength
7. cube compressive strength
8. prismatic compressive strength
9. splitting tensile strength
10. stress-strain curve
11. 收缩率
12. 膨胀率
13. 抗拉强度
14. 抗压强度
15. 工作载荷
16. 水泥细度
17. 正态分布
18. 标准差
19. 极限强度
20. 水灰比

Ⅲ. Translate the following sentences into Chinese or English.

1. The advantage of reinforced concrete structures over steel ones are their heavy weight that makes them more stable under wind load, they hardly experience corrosion and can last longer in a fire without rapid loss of strength due to their concrete cover to steelbars.

2. Concrete and reinforced concrete are used in bridge, buildings of all sorts, underground structures, water tanks, television towers, offshore oil exploration and production structures, dams, and even in ships.

3. For structural applications it is normal practice to incorporate steel bars to resist any tensile forces or to apply compressive forces to the concrete to counteract these tensile forces.

4. 混凝土是一种广泛使用的人造材料，可定义为由胶结介质胶结而成的固体物质，它的主要成分包括水泥、石子、砂和水。

5. 如果世贸大厦由钢筋混凝土建造，当时就不可能在受到打击时倒塌得那样快。

Ⅳ. Fill in the blanks with the given words.

useless	removal	deform	removed	elasticity
properties	deformation	load	bend	stretch