普通高校土木工程专业系列精品规划教材

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土木工程专业英语

TUMU GONGCHENG ZHUANYE YINGYU

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(Civil Engineering Specialty English)

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内 容 简 介

《土木工程专业英语(Civil Engineering Specialty English)》包括16章，各章内容既相互联系、又相对独立。每章包括阅读课文、生词和短语、难句分析和练习题。本书选材遵循下列基本原则：相关性、权威性、新颖性和广泛性。相关性原则要求教材内容与土木工程、工程管理、项目管理密切相关，权威性原则要求教材内容选自国外权威学者、机构的英文原著，新颖性原则要求教材内容尽可能选自国外学者、机构最近5年发表的著作，广泛性原则要求教材内容涉及基础工程、道路工程、铁道工程、隧道工程、桥梁工程、房建工程及其项目管理。

本书可作为高等院校土木工程、工程管理、项目管理专业本科生、研究生的专业英语教材。对于有志提高自身科技英语阅读、翻译和写作水平的理工科其他专业师生、工程技术人员和工程管理人员，本书亦有重要参考价值。

总 序

土木工程是促进我国国民经济发展的重要支柱产业。近30年来，我国公路、铁路、城市轨道交通等基础设施以及城市建筑进入了高速发展阶段，以高速、重载和超高层为特征的建设工程的安全性、经济性和耐久性等高标准要求向传统的土木工程设计、施工技术提出了严峻挑战。面对新挑战，国内、外土木工程行业的设计、施工、养护技术人员和科研工作者在工程实践和科学研究工作中，不断提出创新理念，积极开展基础理论和技术创新，研发了大量的新技术、新材料和新设备，形成了成套设计、施工和养护的新规范和技术手册，并在工程实践中大范围应用。

土木工程行业日新月异的发展，对现代土木工程专业技术人才培养提出了迫切需求。教材建设和教学内容是人才培养的重要环节。为面向普通高校本科生全面、系统和深入阐述公路、铁路、城市轨道交通以及建筑结构等土木工程领域的基础理论和工程技术成果，由中南大学出版社、中南大学土木工程学院组织国内土木工程领域一批专家、学者组成“普通高校土木工程专业系列精品规划教材”编审委员会，共同编写这套系列教材。通过多次研讨，确定了这套土木工程专业系列教材的编写原则：

1. 系统性

本系列教材以《土木工程指导性专业规范》为指导，教材内容满足城乡建筑、公路、铁路以及城市轨道交通等领域的建筑工程、桥梁工程、道路工程、铁道工程、隧道与地下工程和土木工程管理等方向的需求。

2. 先进性

本系列教材与21世纪土木工程专业人才培养模式的研究成果密切结合，既突出土木工程专业理论知识的传承，又尽可能全面反映土木工程领域的新理论、新技术和新方法，注重各门内容的充实与更新。

3. 实用性

本系列教材针对90后学生的知识与素质特点，以应用性人才培养为目标，注重理论知识与案例分析相结合，传统教学方式与基于现代信息技术的教学手段相结合，重点培养学生的工程实践能力，提高学生的创新素质。这套教材不仅是面向普通高校土木工程专业本科生的课程教材，还可作为其他层次学历教育和短期培训的教材和广大土木工程技术人员的专业参考书。

4. 严谨性

本系列教材的编写出版要求严格按国家相关规范和标准执行，认真把好编写人员遴选关、教材大纲评审关、教材内容主审关和教材编辑出版关，尽最大努力提高教材编写质量，力求出精品教材。

根据本套系列教材的编写原则，我们邀请了一批长期从事土木工程专业教学的一线教师负责本系列教材的编写工作。但是，由于我们的水平和经验所限，这套教材的编写肯定有不尽人意的地方，敬请读者朋友们不吝赐教。编委会将根据读者意见、土木工程发展趋势和教学手段的提升，对教材进行认真修订，以期保持这套教材的时代性和实用性。

最后，衷心感谢全套教材的参编同仁，由于他们的辛勤劳动，编撰工作才能顺利完成。真诚感谢中南大学校领导、中南大学出版社领导和编辑们，由于他们的大力支持和辛勤工作，本套教材才能够如期与读者见面。

2014 年 7 月

前　言

建筑业是我国和世界上很多国家的支柱产业。随着我国建筑业实力增强和对外开放扩大，过去30多年，我国对外工程承包和设计咨询业务总量规模持续快速扩大，新签合同额和完成营业额分别从1979年的3 352万美元和3 000万美元，增长到2011年的1 423亿美元和1 034亿美元。为了适应未来激烈的全球市场竞争形势，提高我国企业对外工程承包和设计咨询业务的质量和效益，我国高等院校培养的土木工程、工程管理、项目管理专业的本科生和研究生，必须具备阅读、理解和使用专业英语的能力。为此，我国高等院校土木工程、工程管理、项目管理专业应该在大四或研一开设专业英语课程，使学生比较系统地接受专业英语训练。

10多年来，作者先后承担了中南大学土木工程学院的"科技英语阅读"、"科技英语写作"和"项目管理专业英语"等本科生和研究生课程的教学任务，并于2002年编写出版了《科技英语阅读与写作》教材。为了保持知识的新颖性，使学生了解本专业国外的新进展，在中南大学出版社的大力支持下，我们主编了这本《土木工程专业英语》。

《土木工程专业英语》包括16章，各章内容既相互联系又相对独立。每章包括阅读课文、生词和短语、难句分析和练习题。各章阅读课文分别为：第1章扩大基础与打入桩基础；第2章柔性路面；第3章铁路横断面；第4章新奥法；第5章新意法及其优势；第6章现有室内结构竣工建筑信息模型高效构建方法；第7章施工技术进展：从遥远过去到未来的连续体；第8章建筑全寿命期设计和预制：综述和香港案例研究；第9章基于监测数据的预应力混凝土桥梁施工评估与长期预测；第10章基于多元回归分析和改进案例推理的铁路桥梁施工成本模型；第11章招标文件的编写；第12章评标与授予合同；第13章总承包项目采购时间与项目绩效之间关系研究：水、废水项目与运输项目的比较；第14章工程总承包巨项目设计管理：SR99暗挖隧道案例研究；第15章民间主动融资项目成本管理；第16章使用质量绩效指数评估高速公路施工质量。书后提供了3套模拟试卷。授课老师可以向中南大学出版社免费索取每个单元练习题和3套模拟试卷的参考答案，目的是减轻授课老师的备课负担。建议本教材的总教学时数为64学时。如果教学时数不够，授课老师可根据实际教学时数和教学大纲的要求，灵活选择教学内容。

本书形成和出版过程中，作者得到过许多单位和个人帮助。本书问世也凝聚着中南大学出版社刘颖维编辑的辛勤劳动。同时，本书写作出版得到了中南大学出版社和中南大学土木工程学院大力支持。对这些个人和单位，作者表示衷心感谢。本书参考了大量的文献资料，作者对这些文献的作者表示感谢。

作者水平有限，书中如有错误和不妥之处，欢迎读者指正。

宇德明

2014年10月

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Chapter 1

Spread footings and driven pile foundations

There are many different kinds of foundations, among which spread footings and driven pile foundations are generally adopted in practical constructions. In this unit, they will be introduced in order.

1.1 Spread footings

Spread footings (also referred to as shallow foundation) carry the loads from columns, walls, or other substructure elements and spread these loads laterally to the underlying soil so that the bearing pressure is reduced to a safe value. Alternatively, footings are proportioned to control settlement. In this case the two essential design requirements are that the total settlement of the structure must be limited to a tolerable amount and that differential settlement of various piers and abutments must be controlled or eliminated.

Individual footings, usually rectangular in plan view, are the most common foundation type for columns, whereas strip footings are used to support walls. More complicated foundation members are those required to support several columns, and are usually referred to as combined footings. A combined footing may have a rectangular or trapezoidal shape or be a series of pads connected by narrow rigid beams referred to as strap footings. Footings for bridge piers and abutments are individual, strip, or combined.

Spread footings with tension reinforcement may be designed as two-way or one-way members depending on whether the steel bars used for flexure are placed in both or one direction. Individual (square) footings are usually two-way slabs, and strip footings one-way slabs. Concrete is almost universally used for footing construction because of its durability and relative economy.

Single footings may have a uniform thickness or be either stepped or sloped. Stepped or sloped footings are used where they can produce considerable savings in the volume of concrete and where the footing is not reinforced.

Special attention should be given to footings placed on fills. Problems with insufficient bearing or excessive settlement in fill can be significant particularly in poor soil such as soft, wet, frozen, or non-durable materials and improperly compacted backfill. Such settlement around piers can result in considerable increase in footing loads caused by down-drag of friction forces exerted on the pier by the settling fill. Even properly placed and compacted fill is likely to undergo some form of settlement depending on the soil type, moisture conditions, method of placement, and degree of compaction. In selecting spread footings the following factors must be considered: ① depth, ② groundwater effects, ③ uplift, and ④ adjacent structures. Below these factors will be discussed in order.

The bottom of footing elevation should be determined with regard to the character of the foundation materials, considering also the possibility of undermining. Footings in waterways and stream crossings should be founded at a depth below the anticipated depth of scour. Footings that are not exposed to the action of stream current should rest on a firm layer below frost level. Special attention is given to footings on rock in conjunction with the effects of blasting, especially if this involves highly resistant competent rock formations that can result in some rock fracturing below the depth of the final rock surface. Blasting in this case is likely to reduce resistance to scour within the rock zone immediately below the footing level, and this operation should be carried out with care.

Frost penetration often occurs to different depths and in some instances erratically and with uncertainty. Where frost protection appears marginal or deficient, consideration should be given to the use of insulation to enhance frost protection.

The design of footings should typically consider the highest anticipated groundwater table because of the obvious effect on the actual soil bearing strength. Evaluation of seepage forces and hydraulic gradients is essential in foundation excavations that extend below the groundwater table. Upward seepage forces in the bottom of excavations can result in piping in dense granular soil or heaving in loose granular soil. These problems can be controlled by adequate dewatering, often using wells or well points. However, dewatering of excavation in loose granular soils is likely to cause settlement of the surrounding ground, and if the associated damage is expected to be high, some form of protection should be considered.

If in the final service the foundation is likely to be subjected to uplift forces, this effect should be investigated in the context of resistance to pullout and for structural capacity.

Where substructure elements are placed near existing structures, the design should study the influence of the existing structure on the behavior of the foundation as well as the effect of the new foundation on the existing structure.

1.2 Driven piles

Driven piles are basically deep foundations usually described as columnar elements inserted in the soil for the purpose of transferring loads from a superstructure to the ground. There are several good references and they classify piles in different ways that can be grouped into one of the following main categories: ① pile material, ② method of pile fabrication, ③ extent of ground disturbance during pile installation, ④ method of pile installation into the ground, and ⑤ method of load transfer.

In this section we will consider only piles installed by driving. The classification further narrowed down to types identified in terms of ground disturbance. Driven piles used in bridge foundations can be divided into two basic categories: ① displacement piles that have solid sections or hollow sections with a closed end, and ② non-displacement piles, such as H-piles. Displacement piles displace the soil during installation involving driving, jacking, or vibration, but non-displacement piles do not. During the installation of non-displacement piles, the placement causes little or no change in lateral ground stress, and consequently, these piles develop less shaft friction than displacement piles of the same size and shape. Below we choose to describe driven piles in terms of pile material, and articulate other pile characteristics according to their importance.

1.2.1 Timber piles

These are the oldest type of pile foundation in brick work. They are obtained from straight and slender sections of tree trunks with no defects and a uniform taper. Material deterioration and protection are essential. Timber piles situated wholly below the permanent groundwater table are resistant to fungal decay. However, when the project is above the groundwater, piles must be treated with preservatives to retard deterioration. The life of timber piles above the water table can be considerably increased by treating with creosote, oil-borne preservatives, and salt. Creosote application by pressure treatment is the most effective method of protection and almost the generally accepted preservation.

The advantages of timber piles are: ① They are light and easy to handle; ② they have a high strength-weight ratio; and ③ they are durable when placed below the groundwater table.

Conversely, their disadvantages are: ① Their structural capacity is relatively low compared to other types; ② they are prone to damage during driving, especially in dense soil; ③ they need protection when placed above the groundwater table; and ④ they are difficult to splice when extra length is needed.

1.2.2 Concrete piles

This type includes precast concrete piles, prestressed concrete piles, and composite versions. Precast piles are long slender units of reinforced concrete with square, octagonal, or circular cross section that must be designed to withstand handling and driving stresses in addition to service loads. They are made to carry a wide range of loads, typically up to 300 tons, and are reinforced for bending and uplift.

Prestressed concrete piles have steel rods or wires enclosed in a conventional spiral. They are further grouped into pretensioned and posttensioned piles. Possible length range is as much as 130 feet[①]. Their advantages are: ① They have relatively large axial capacity and suitability to soil and water conditions that require long piles; ② they have ability to withstand aggressive ground or marine environment with proper design; ③ they offer resistance during hard driving; and ④ they

① feet (ft, 英尺): 长度单位, 1 ft = 0.3048 m.

also have all the advantages inherent in prestressing.

Conversely, concrete piles may suffer damage during handling and driving, and cutting off excess length or splicing after driving is difficult and costly.

Composite versions are obtained either by encasing steel or timber piles by concrete in the zone susceptible to deterioration, or by making steel sections at the lower part where hard driving is anticipated.

1.2.3 Steel piles

These include H-piles and steel pipe piles. Steel H-piles are suitable for penetrating rock and other hard and resistant materials. During driving they displace a minimum of soil mass, and therefore the operation does not cause heave. The usual load range is 40 to 120 tons, and the common length range is 40 to 100 feet①. Preferably, the flange width should be at least 85 percent of the depth of the pile section to ensure comparable strength in the weak axis.

Steel H-piles have the following advantages: ① They are robust and light; ② they come in various sizes and can easily be spliced; ③ they provide ample axial capacity and resistance to buckling; ④ they can penetrate hard layers; and ⑤ they accommodate situations with close pile spacing.

Their inherent disadvantages are susceptibility to corrosion if left unprotected, small bearing resistance because of the small bearing area if left unplugged, and susceptibility to deflection if they hit hard sloping layers and obstructions.

Steel pipe piles can be driven with either open or closed ends, and may be used filled with concrete or unfilled. Unfilled open-end pipe piles are suitable if greater penetration depths are desired, since the soil inside can be removed during driving. Their advantages are: ① They have small weight but sufficient stiffness to prevent damage during handling; ② they offer availability and variety of sizes that can easily be spliced; ③ they have relatively high axial capacity and resistance to buckling; ④ they conform to the loads and moments by varying pipe size and wall thickness; and ⑤ they allow easy inspection to detect deviations from intended alignment. However, like steel H-sections, steel pipe piles are prone to corrosion if left unprotected.

1.2.4 Composite piles

Composite piles are combinations of different pile types such as concrete and timber, concrete and steel, and concrete-filled steel pipes. Other combinations have also been used, the intent being to deal with difficulties arising due to the soil conditions. The structural capacity of these piles is determined by the weakest material. Certain types, such as timber-concrete, have been abandoned in North America because of the difficulty in forming good joints. High-capacity pipe and steel H-concrete composite piles do not present this problem and should be used when proven economical.

1.3 Factors to be considered in selecting piles

Driven piles should be considered when spread footings cannot be founded on rock or on solid earth material at reasonable cost. Piles may also be used as a protection against scour at sites where spread footings would be suitable but the potential of erosion exists. Other factors that will influence the selection of a pile foundation are the structural capacity of the pile, durability and resistance to handling, feasibility of splicing, ground displacement during driving, and penetrability.

New words and expressions

abutments	桥台
aggressive	腐蚀性的
alternatively	换句话说
articulate	清晰说明，明确表达
backfill	回填土
bearing pressure	承载压力
bearing resistance	抗压力，抗压强度
bearing strength	承载力，承载强度
buckling	弯折
column	柱
combined footing	多柱基础，联合柱基
competent rock	强岩
composition version	混合型
creosote	木榴油
differential	不均匀的
displacement pile	挤土桩
down-drag	下拉力
driven pile	打入桩
elevation	高程，标高
encase	饰面，护壁，砌面
erratically	无规律地
fill	淤泥，填土，路堤
flexure	弯曲
formation	地层，构造
fracturing	破裂，断裂
fungal decay	真菌引起的腐烂
groundwater	地下水
heaving	隆起