KEJI YINGYU

高等学校教材

# 科技英语

## （土木工程专业适用）

武守信 陈伟庆 主编

中国铁道出版社

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## 内 容 简 介

作为土木工程专业英语的教材，本书共选编 20 篇课文，每课附有 1 至 3 篇阅读材料，内容包括土木工程材料、建筑结构、道路（含公路、铁路）、桥梁以及铁路隧道工程等。在附录中概括介绍了专业英语的翻译方法和技巧。

本书是土木工程专业本科和高职的教材，也可供有关专业工程技术人员参考。

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# 前　言

在学完大学英语课程后，土木工程专业的学生在阅读专业英语文献时，往往还会遇到不少困难。其主要原因是缺乏足够的专业英语词汇、词组和对专业英语的特点了解较少。为此，根据教学大纲的要求，选取了一些较典型的专业英语文献汇编成本教材，使学生通过较短时间的学习掌握一定的专业词汇、词组，了解专业英语的语法特点，提高阅读和翻译专业英语文献资料的能力。

作为土木工程专业英语的教材，本书共选编 20 篇课文，每课附有 1 至 3 篇阅读材料，内容包括土木工程材料、建筑结构、道路(含公路、铁路)、桥梁以及铁路隧道工程等。在附录中概括介绍了专业英语的翻译方法和技巧。每篇文章均来自相关专业领域的原版书刊，个别文章由编者作了少量的修改。

使用本书时，教师可根据学时的要求选取若干篇文章，或每篇选取部分作为精读，其余部分在教师指导下由学生自学，以进一步提高阅读能力。编写本教材时，参考了其他兄弟院校编写的专业英语教材，在此特向作者和出版社表示衷心感谢！

本书由西南交通大学桥梁与结构工程系的武守信副教授和西南交通大学峨眉校区土木工程系的陈伟庆副教授主编，西南交通大学峨眉校区土木工程系的唐秀军老师也参加本书的编写工作，此外，西南交通大学峨眉校区土木工程系的许多老师在本书编辑校对过程中做了大量的工作，在此一并表示衷心的感谢！

按土木工程大类编写专业英语教材，是一次新的尝试，由于编者业务和外语水平有限，缺点和错误在所难免，恳请广大读者和专家给予批评指正。

编　者

2001 年 10 月

# Contents

# Unit 1 Loads

Loads can be classified into two distinct categories: static and dynamic. Static loads are always a permanent part of the structure. Dynamic loads are all temporary: they change as time and season change, or as a function of spaces within or on a structure.①

The houses are subjected to great many different and often quite severe stresses during their lifetimes. Some of these stresses are inherent in the structure, others are imposed from outside. The accurate determination of the loads to which a structure or structural element will be subjected is not always predictable. Even if the load are well known of one location in a structure, the distribution of load from element to element throughout the structures requires assumptions and approximations. The loads imposed from outside include live loads, wind loads, snow loads and earthquake loads. Some of the most common kinds of loads are discussed in the following sections.

**Dead loads**

Dead load is a fixed position gravity service load, so called because it acts continuously toward the earth when the structure is in service. The dead loads include the weights of all the structural parts of the building — the studs, joists, rafters, roofing, flooring, insulation, plastering, and so on. The dead loads also include the weights of all the mechanical equipment permanently installed in the house — the plumbing and heating equipment, ductwork, central air-conditioning equipment, and the like.② In sum, the dead loads include everything in,on,or attached to the house③ that cannot possibly be omitted or eliminated if the house is to be considered complete and habitable. Since the weights and locations of all these materials are known, the dead loads can easily be calculated and the structure designed to support them.④

**Live Loads**

Gravity loads acting when the structure is in service, but varying in magnitude and location, are termed live loads. Live loads include everything that the inhabitants carry into a completed building to make it habitable, including themselves. Live loads, therefore, are additions to the floor dead loads. Anything that is movable is usually considered as part of the live load, though sometimes live loads shade off into dead loads. The permanent installation of large bookcases with their weight of books, a grand piano,or machineshop equipment,can be considered either as live load or as dead loads. In the former case, it is assumed that the joists will be able to support this weight without any additional reinforcement. In the latter case, the builder may find it necessary to reinforce the joists to help them support the additional loads.

**Wind Loads**

When calculating the wind pressures acting on a house, an engineer assumes that the wind will act in a horizontal direction. It doesn't always, of course⑤. Most people are also likely to

assume that the wind pushes down against a pitched roof. This assumption is not quite accurate. Imagine a strong wind blowing against a house that has a gable roof. When the wind strikes the house, it will be deflected to the sides and upward. As the wind passes over the roof, its velocity must increase. As its velocity increases, its pressure must decrease. Depending on the shape of the roof, there may even be negative pressure acting against the downwind side of the roof.

The roof may, in fact, be pulled up and away from the walls supporting it. Tiles and shingles that are "blown off" a roof are not pushed off by the wind. They are sucked off by negative air pressures. Everyone has seen photographs of wind-damaged houses that have had their roofs "blown off". What has actually happened is that a suction pressure has lifted the roof from the walls.[6] I don't think anyone has seen a photograph of a house that has had its roof blown in during a windstorm.

## New Words and Expressions

1. gravitational [ˌgrævi'teiʃənəl] *a*. 引力的,地球引力的,重力的
2. distinct [dis'tiŋkt] *a*. 不同的,清楚的
3. category ['kætigəri] *n*. 种类,类型
4. static ['stætik] *a*. 静态的,固定的
5. temporary ['tempərəri] *a*. 暂时的,一时的
6. function ['fʌŋkʃən] *n*. 功能,函数
7. earthquake ['ə:θkweik] *n*. 地震
8. stud [stʌd] *n*. 板墙筋,立筋
9. joist [dʒɔist] *n*. 梁,搁栅,托梁
10. rafter ['ra:ftə] *n*. 椽子
11. flooring ['flɔ:riŋ] *n*. 铺地面板,地板材料
12. insulation [ˌinsju'leiʃən] *n*. 绝缘材料,隔热层
13. air-conditioning ['ɛə kən'diʃəniŋ] *n*. 空气调节,通风
14. plastering ['pla:stəriŋ] *n*. 抹灰,抹灰层,灰浆,墙粉
    *vt*. 粉刷,抹灰
15. ductwork ['dʌktwə:k] *n*. 管道设施,管道系统
16. attach [ə'tætʃ] *vt*. 附上,连上
17. omit [ou'mit] *vt*. 省去,忽略
18. eliminate [i'limineit] *vt*. 除去,消除
19. habitable ['hæbitəbl] *a*. 可居住的,适于居住的
20. inhabitant [in'hæbitənt] *n*. 居民,住户
21. movable ['mu:vəbl] *a*. 可移动的,可拆卸的
22. installation [instɔ:leiʃən] *n*. 装置,设备
23. bookcase ['bukeis] *n*. 书柜(架)
24. grand [grænd] *a*. 大的
25. machineshop [mə'ʃi: nʃɔp] *n*. 机工车间,机械厂
26. former ['fɔmə] *a*. 在前的,前面的

27. assumption [ə'sʌmpʃən] *n*. 假设,假象
28. gable ['geibl] *a*. 双坡的,人字的
29. deflect [di'flekt] *v*. 偏转,倾斜
30. downwind ['daunwind] *ad*. 顺风
31. tile [tail] *n*. 瓦,砖 *vt*. 铺瓦
32. suck [sʌk] *v*. 吸收,吸取
33. win-damaged ['wind'dæmidʒd] *a*. 受风影响而损坏的
34. suction ['sʌkʃən] *n*. 吸,吸力
35. windstorm ['wind stɔ:m] *n*. 风暴
36. plumbing ['plʌmiŋ] *n*. 管道
37. duct [dʌkt] *n*. 导管,喷管,管道
38. pitch [pitʃ] *n*. 坡度,高跨比 *v*. 投掷,倾斜,铺砌
39. shingle ['ʃiŋgl] *n*. 木瓦,盖板,屋面板
40. be classified into…… (被)分成……
41. in sum 总之
42. shade off into…… 逐渐变成……
43. push down 向下压(推),推下
44. be pulled up (被)向上拉,拉起
45. be pulled away 使……脱出,离开
46. be pushed off ……被推开(下)
47. stick to……附着,附于,坚持

## Notes

①…… or as a function of spaces within or on a structure

a function of 的意思是"随……而变化(的东西)"。此部分应译为:随结构内部或上部的空间而变化。

②and the like 译为"等等",the like 表示的是同类的人或物。

③……the dead loads include everything in, on, or attached to the house ……恒载包括房屋内部,上部及附设其上的一切东西。

④the dead loads can easily be calculated and the structure designed to support them. the structure 和 designed 之间省略了 can easily be。

⑤It doesn't always, of course……此句中 always 后省略 act in a horizontal direction。

⑥What has actually happened is that a suction pressure has lifted the roof from the walls. 实际发生的是吸力将墙顶抬高。

## Reading Material Ⅰ Snow Loads and Earthquake Loads

### Snow Loads

A roof is usually designed to support a dead load of 20 lb per sq ft. This includes the weight of the rafters and the roofing material, whether it be asbestos shingles, wood shingles, asphalt

roll roofing, clay tiles, or whatever, although the roof is usually built a lot stronger than normal if the rafters are required to support the weight of slate or clay-tile roofing. If a flat roof is to be increased accordingly, the total dead and live load on a roof garden are assumed to be 100 lb per sq ft; on a sun deck, 60 lb per sq ft.

Snow weighs about 8 lb per cu ft when dry and from 10 to 15 lb per cu ft when wet or tightly packed. This snow load is calculated on the basis of the horizontal area covered by the roof, not the actual area of the roof itself, which, of course, will be greater when the surfaces of the roof are slanted. If the total anticipated snowfall for two months (the usual method of calculating the total snow load) exceeds 20 lb per sq ft, then it is the snow load that will determine how strong the roof must be constructed, not the weight of the rafters and roofing material①.

There is an alternative to strengthening the roof rafters when exceptionally heavy snow loads are anticipated. This is to make the roof steeper. The steeper a roof, the less the maximum anticipated snow load for the obvious reason that snow has difficulty sticking to a steep surface. A roof that slopes 60 degrees or more hasn't any snow-load requirement at all.

The question arises: How does one calculate combined snow and wind loads? The answer is that one never assumes that heavy accumulations of snow and strong winds will occur simultaneously, which seems sensible. If the anticipated snow loads are greater than the anticipated wind loads, the snow loads will determine the roof design; otherwise, the wind loads will be the determining factor.

**Earthquake Loads**

Since the loads imposed on a house by an earthquake are basically horizontal loads of the same sort that are imposed by wind loads, though the earthquake loads are much shorter and sharper, a wood-frame house that can resist the usual design wind loads of 15 lb per sq ft is considered to be capable of resisting the shock loads produced by most earthquakes②. Therefore, for a wood house, there is no need to take earthquake loads into account in the design of the house.

Masonry houses, on the other hand, are far more likely to require special construction techniques to resist earthquake loads, brick, concrete, concrete blocks, and stonework are much more brittle materials than wood, and they are held together by rigid mortar joints. Masonry hasn't the resilience of wood to sudden, sharp loadings. An unreinforced masonry wall will very likely suffer some damage in even a moderate earthquake. If the shock is severe, an entire masonry building must be especially reinforced to resist sudden horizontal loads.

## New Words and Expression

1. whether it be A or B 无论是 A 还是 B
2. sun deck 日光浴平台
3. slant [sla:nt] *v*. 倾斜
4. anticipate [æn'tisipeit] 预料
5. simultaneously [ˌsiməl'teiniəsli] *ad*. 同时,一齐
6. brittle ['britl] *a*. 脆性的
7. resilience [ri'ziliəns] 弹性能,回弹能

8. earthquake-prone 易于发生地震的

**Notes**

①If the total anticipated snowfall …… and roofing material.

如果所预料的两个月的总降雪量(计算总的雪荷载的通常方法)超过每平方英尺 20 磅，那么决定屋顶必须建造得如何坚固的是雪荷载，而不是椽子和屋顶材料的重量。

②Since the loads imposed …… by most earthquakes.

因为地震加在一座房子上的荷载和风荷载加在房子上的荷载，基本上都是水平方向的，所以，尽管地震荷载的时间短暂，并且强烈得多，一般认为能够承受每平方英尺 15 磅风荷载的木框架结构房屋也能够承受大多数地震产生的冲击荷载。

## Reading Material Ⅱ Highway Live Loads

Highway vehicle loading in the United States has been standardized by the American Association of State Highway and Transportation Officials (AASHTO) into standard loads that approximate a series of trucks. There are two systems, designated H and HS that are identified by the number of axles per truck. The H system has two axles per truck, whereas the HS system has three axles per truck. Altogether there are five classes of loading: H10, H15, H20, HS15, and HS20. The loading is shown in Fig. 1-1.

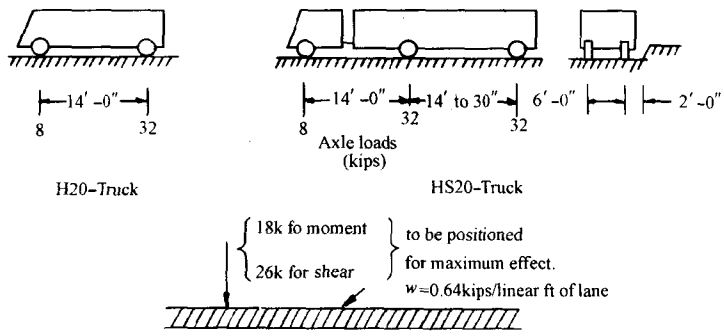


Fig. 1-1 AASHAO— 1997 highway H20 and HS20 loadings(for H15 and HS15 use 75 percent of H20 and HS20, and for H10 use 50 percent of H20)(1 kip = 4.45 kN)

In designing a given bridge, either one equivalent truck loading is applied to the entire structure, or the equivalent lane loading is applied. When the lane loading is used, the uniform portion is distributed over as much of the span or spans as will cause the maximum effect. In addition, the one concentrated load is positioned for the greatest effect. On continuous structures, in determining maximum negative moment at the support only, an additional concentrated load must be used in a span other than the position of the fist one. The load aistribution across the width of a bridge to its various supporting members is taken in accordance with semi-empirical rules that depend on the type of bridge deck and supporting structure.

The single truck loading provides the effect of a heavy concentrated load and usually governs on relatively short spans. The uniform lane load is to simulate a line of traffic, and the added con-

centrated load is to account for the possibility of one extra heavy vehicle in the line of traffic. These loads have been used with no apparent difficulty since 1944, before which time a line of trucks was actually used for the loading. On the interstate system of highways a military loading is also used that consists of two 24-kip (107-kN) axle loads spaced 4 ft (1.2m) apart.

Railroad bridges are designed to carry a similar semiempirical loading known as the Cooper E72 train, consisting of a series of concentrated loads a fixed distance apart followed by uniform loading. This loading is prescribed by the American Railway Engineering Association (AREA).

## New Words and Expressions

1. semiempirical *a*. 半经验的
2. interstate *a*. 州与州之间的,州际的
3. truck loads 汽车荷载
4. lane loads 车道荷载
5. bridge deck 桥面板
6. military loading 军用荷载
7. AASHTO 美国各州公路与运输工作者协会

# Unit 2 Concrete and Reinforced Concrete

Concrete is a man-made conglomerate stone composed of essentially four ingredients: portland cement, water sand and coarse aggregate. The cement and water combine to make a paste that binds the sand and stones together. Ideally, the aggregate are graded so that the volume of paste is at a minimum, merely surrounding every piece with a thin layer①. Most structural concrete is stone concrete, but structural lightweight concrete (roughly two-thirds the density of stone concrete) is becoming increasing popular.

Concrete is essentially a compressive material having almost no tensile strength, so concrete's weakness in tension also causes it to be weak in shear. These deficiencies are overcome by using steel bars for reinforcement at the places where tensile and shearing stresses are generated②, under load, reinforced concrete beams actually have numerous minute cracks which run at right angles to the direction of major tensile stresses. The tensile forces at such locations are being taken completely by the steel "re-bars".

The compressive strength of a given concrete is a function of the quality and proportions of its constituents and the manner in which the fresh concrete is cured. (Curing is the process of hardening during which time the concrete must be prevented from "drying out", as the presence of water is necessary for the chemical action to progress.) Coarse aggregate that is hard and well graded is particularly essential for quality of concrete. The most important factor governing the strength, however, is the percentage of water used in the mix. A minimum amount of water is needed for proper hydration of the cement. Additional water is needed for handling and placing the concrete, but excess amounts cause the strength to drop markedly.

These and other topics are fully covered in the booklet, "Design and Control of Concrete Mixtures," published by the Portland Cement Association. This is an excellent reference, treating both concrete mix design and proper construction practices. The American Concrete Institute publishes a widely adopted code specifying the structural requirements for reinforced concrete.

Concrete is known as the "formable" or "moldable" structural material. Compared to other materials, it is easy to make curvilinear members and surfaces with concrete. It has no inherent texture but adopts the texture of the forming material, so it can range widely in surface appearance. It is relatively inexpensive to make, both in terms of raw materials and labor, and the basic ingredients of portland cement are available the world over. (It should be noted, however, that the necessary reinforcing bars for concrete may not be readily available in less-developed countries.)

The best structural use of reinforced concrete, in terms of the characteristics of the material, is in those structures requiring continuity and/or rigidity. It has a monolithic quality which automatically makes fixed or continuous connections. These moment-resistant joints are such that

many low-rise concrete buildings do not require a secondary bracing system for lateral loads. In essence, a concrete beam joints concrete column very differently from the way steel and wood pieces join, and the sensitive designer will not ignore this difference. (These remarks do not apply to precast structural elements, which are usually not usually not joined in a continuous manner.)

Concrete is naturally fireproof and needs no separate protection system. Because of its mass, it can also serve as an effective barrier to sound transmission.

In viewing the negative aspects, concrete is unfortunately quite heavy and it is often noted that a concrete structure expends a large portion of its capacity merely carrying itself③. Attempts to make concrete less dense, while maintaining high quality levels, have generally resulted in increased costs④. Nevertheless, use of lightweight concrete can sometimes result in overall economies.

Concrete requires more quality control than most other building materials. Modern transit-mixed concrete suppliers are available to all U.S. urban areas and the mix is usually of a uniformly high quality. Field-or-job-mixed concrete requires knowledgeable supervision, however. In any type of concrete work, missing or misallocated reinforcing bars can result in elements with reduced load capacities. Poor handling and/or curing conditions can seriously weaken any concrete. For these and other reasons, most building codes require independent field inspections at various stages of construction.

Proper concrete placement is also somewhat dependent upon the ambient weather conditions. Extremely high temperatures and, more important, those below (or near) freezing can make concrete work very difficult.

## New Words and Expressions

1. conglomerate [kən'glɔmərit] *n*. 砾岩,石材
2. ingredient [in'gri:diənt] *n*. 成分
3. epoxide [e'pɔksaid] *n*. 环氧化物
4. polyester *n*. 聚酯
5. resin *n*. 树脂
6. constituent [kən'stitjuənt] *n*. 成分,要素
7. polymer *n*. (化学)聚合物
8. hydration [hai'dreiʃən] *n*. 水化(作用)
9. precast *v*. 预制 *a*. 预制的,预浇铸的
10. excess [ik'ses] *a*. 超量的
11. booklet ['buklit] *n*. 小册子
12. moldable = mouldable *a*. 可塑的
13. curvilinear ['kə:viliniə] *a*. 曲线的
14. markedly ['ma:kidli] *ad*. 显著地
15. texture ['tekstʃə] *n*. 纹理,质地
16. rigidity [ri'dʒiditi] *n*. 刚性,刚度
17. brace [breis] *n*.*v*. 支柱;撑牢

18. in essence 大体上,本质上
19. monolithic [ˌmɔnəu'liθik] *a*. 整体的
20. precast ['pri:'ka:st] *vt*. *a*. 预制(的)
21. supervision [sju:pə'viʒən] *n*. 监督
22. ambient ['æmbiənt] *a*. 周围的
23. transit-mixed *a*. 拌合运输的
24. field-or-job-mixed *a*. 现场或临时拌合的
25. moment-resistant *n*. 抗扭矩
26. placemen ['pleismənt] *n* . 灌(浇)筑
27. misallocated [mis'æləkeitid] *a*. 放错位置的
28. inspection [in'spekʃən] *n*. 检查

**Notes**

①surrounding 为现在分词短语，做主句的方式状语。

②by using steel bar……中的介词 by 引导的短语相当于 by means of，在句中做方式状语；where 引导的定语从句修饰 the places。

③In viewing……意为：考虑到；carrying itself 是分词短语做伴随状语，修饰全句。

④由连词 while(而)连接的不定式短语 to make concrete……和现在分词短语 maintaining high……共同做主语 attempts 的后置定语。

## Reading Material Ⅰ Structural Steel

Steel is the strongest and stiffest building material in common use today. Relative to wood and concrete, it is a high-technology material made by highly refined and controlled processes. Structural steel has a uniformly high strength in tension and compression and is also very good in shear. It comes in a range of yield strengths made by adjusting the chemistry of the material in its molten state. It is the most consistent of all structural materials and is, for all practical purposes, homogeneous and isotropic, meaning it has like characteristics in all directions (By contrast, wood is an isotropic.)[①].

The greatest asset to steel is its strength and plastic reserve. It is highly ductile and deforms greatly before failing if overloaded. Because of steel's strength, the individual members of a frame are usually small in cross section and have very little visual mass.

Steel is a linear material and can be economically made into a visual curve only by using a segmented geometry. It is most appropriately used in rectilinear structures where bolted or welded connections are easy to make. The structural shapes (i.e., pipes, tubes, channels, angles, and wide-flange sections) are manufactured to uniform dimensions having low tolerances. They are fully prepared (cut, trimmed or milled, drilled or punched, etc.) in a fabrication shop, remote from the site, and then delivered ready for erection. Such structures go up rapidly with a minimum of on-site labor. The most popular form of construction used today is referred to as shop-welded, field-bolted. In this method the various clip angles, beam seats, and so on, are welded to