SPECIAL ENGLISH
ON CIVIL ENGINEERING
EXCESS OF TECHNICAL WRITING

建筑工程
专业英语
附科技英语写作

张汶贤 编

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内 容 提 要

本书主要是为适应现行《大学英语教学大纲》关于在本科基础英语结束后第五至第七学期必修"专业英语阅读"课100——120学时，总阅读量为25万词左右的要求而编写的教材。目的在于提供比较丰富而标准的专业英语阅读与翻译材料，同时也是为了满足扩大对外经济与学术交流，把我国建筑业推向国际市场的迫切需要。课文全部采用近年国外出版的专业书刊原文，内容涉及建筑学，结构，建材，施工，地基基础，供暖，通风与空调，高层建筑原理，计算机辅助管理、制图与设计，人工智能与专家系统、室内设计等方面，略偏重于结构工程。全书共30课，每学期(30—35学时)10课。每课后面有：1. 单词和词组；2. 培养阅读理解与英文写作能力的练习题（教师可另外布置翻译题）；3. 翻译和注释；4. 语法和科技英语写作等四个部分。科技英语写作部分可单开一门课，讲授20学时左右。

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编　　者　张汶贤

Associate Professor of Jianghan Petroleum Institute (JPI)

顾　　问　金燕凯

Chief of Construction Bureau, China Oil and Gas Co. General

专业主审　李桂青（Professor of Wuhan Industry University)
李著璟（Professor of Qinghua University)
彭少民（Professor of Wuhan Industry University)
张维全（Senior Engineer of China Oil and Gas Co. General)

英语主审　Robert E.Finn Jr.（Master in Education)
刘怀朴（Associate Professor of JPI)

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张 汶 贤

1993.12

A. READING SKILLS

Reading English for academic study or research can be divided into three types: (1) for exploring information sources; (2) for general information; (3) for special information. The following provides the types of reading skills as reference.

(1) Reading for information sources

This occurs when you widely explore the information sources you need. In this case, the reading procedure may be:

Start by skimming the title and subtitles, and guess what the article or chapter tells.

Read the abstract if the article has one, and see whether or not there is any information which interests you.

If you would still like to know further general ideas of various sections or paragraphs, read their topic sentences.

A topic sentence tells main idea of a paragraph, It normally is the first sentence, but sometimes the second or the last sentence of the paragraph.

(2) Reading for general information

This takes place after reading for the information sources as above, when need to obtain general information—more details than subtitles and topic sentences, so as to gather information or procedure a new idea in your field of interest. What follows is the strategies reading for general information.

• Incessantly read paragraph by paragraph to comprehend the main idea and supporting details, but never analyze sentence by sentence. When you meet an unknown word or word group, underline it, and to continue reading over the whole paragraph or article.

Always try to understand the general idea of the paragraph. Train yourself to seize the meaning of word group rather than a single word.

To understand a complicated sentence, you may look for its subject and verb — grab the key words.

• Guess vocabulary from the context, the constitution of the words and structure of the sentence.

Guessing the sense of a word has many ways. They are briefed later.

If necessary, look up the still unfamiliar word group in your dictionary. Use an English–English dictionary as much as possible.

• Look and think to the back contents of the article. If the idea not yet clear in your mind, then,

• Read it second time. Quickly reading twice or thrice is more efficient to understand the context than slowly reading one time. The fast, repeated reading is very efficient method to raise your reading comprehension.

(3) Skimming for specific information

Supposing you are studying or researching about fatigue fracture of a element, you will be interested in fracture and fatigue only. When you read a reference, you only need to first skim or glance quickly over the pages of the text to search for the words " fracture", " fatigue", and other related words, symbols, signs, or figures, ignoring everything else.

B. HOW TO GUESS A WORD OR WORD GROUP

1. Use the meaning of the stems and affixes to guess.

The interpretations in this area are refered to other books related.

2. Use the basic structure (subject–verb–object) of English sentences to guess the parts of speech, genders, numbers, and cases of the unknown words or word groups.

In this "sentence", for example, you may not know the three words (A, B, C):

A________ ________s __________s per week.
A B C

The basic structure of the English sentence tells you that A is a singular noun or noun phrase by the article A and the –s on the end of B. It also tells you that B is a verb, not a noun or noun phrase. Can you create a sentence in accordance with this pattern?

The same knowledge tells you that in this "sentence":

The________s ________ed.
A B

A is a plural noun or noun phrase, and B is the past tense of a verb.

3. Guess vocabulary items from the context.

The context is the language preceding or following the item you do not know.

Consider this sentence:

Most animals have some method of protecting themselves from predators. The porcupine, for example, can roll itself into a tight ball, its sharp spines discourage attack.

The reader may not know the words predators and porcupine. We can however, infer that predators and porcupines all belong to the class of animals. Moreover, the predators attack other animals, and the porcupine can roll itself into a ball to defend against an enemy. Only understand these you can continue the reading, often not needing to know the exact meanings of the two words and not obstructing understanding the subject of the section or the whole article.

Looking at another sentence:

Reading makes a full man; conference a ready man; writing an exactman.

Here the "writing" you may understand as a composition.

But the following is: "…and therefore, if a man writes little, he need have a great memory." Here the word "writes" means notes, that is to write a note as a record or reminder not a composition.

Example 3:

If an accent color is desired, use a high—chroma, deep—value color such as red, violet, or cocoa.

Here violet or cocoa may be an unknown word to you, but you must know red and color, consequently you must know that violet or cocoa is some kind of accent color.

You probably not know the word "chroma" either. However, from the context and punctuation you should know that chroma is a property of a color which is similar to value.

Summarizing the statement above, guessing and determining the tense of a word or word group from context is a useful method of increasing the reading comprehension.

4. Recognizing a word chain

Writers often need to refer to the same thing several times. They may use different words or expressions to do this.

Consider the above two sentences, the words "They" and "do this" in the second sentence refer to "writers" and "refer to the same thing several times", respectively in the first sentence. We should recognize such relationships among words and word groups, and learn to look for the common referents in word chain. For another example:

A lioness and her cubs could be seen under a small tree. The cats seemed unaware of our presence. We watched for several minutes, thinking how beautiful the animals were.

In this paragraph we may not know the words lioness and cubs, but we can recognize the lioness and her cubs are all a kind of cat and animals.

The lioness and her cubs are specific, the cats is general, and the animals is more general. These words constitute a word chain. Identifying a word chain is helpful to reading comprehension.

目 录

UNIT 1 STRUCTURES IN ARCHITECTURE

B. S. Benjamin

1.1 INTRODUCTION

Architecture has many definitions. One may define it as an attempt to control the physical environment while providing for the needs of people. As practical expressions of this attempt, architects design buildings of various types—houses, schools, hospitals, synagogues, churches, offices, shopping centers, factories, etc. These practical expressions of architecture stand out as semipermanent reminders of success or failure as an architect. The thought processes, the search for client needs, the logic employed, the complex interrelationships of spaces involved, the programming, the simulation, and the evaluation of various designs, all these—so vitally important to the final design—remain hidden in the architect's office.(1) What is evident for all to see is a physical structure, built from concrete or steel or timber, clad in brick or stone or glass, roofed as appropriate, that withstands such natural elements as snow and wind and rain and provides an enclosed—or unenclosed—space for the client. The architect, with the help of the structural engineer and the builder, has converted ideas of form and shape and space into a building. Whereas all the ideas are subtly expressed and half hidden, the structure and the materials of construction may be quite exposed and totally visible for all to see. The structure has become vital and perhaps the most exposed part of architect. The interface between architecture and structure is a fascinating field and one that needs to be explored more deeply. Structure should influence architecture by making it more rational and efficient, but it should not dictate architecture. With certain structural systems, however, such as a tension cable net, the structure so dominates the entire design that at least the visible expression of the architecture is basically all structure.

1. 2 IMPORTANCE OF STRUCTURES TO ARCHITECTS

The importance of a knowledge of structures to architects now becomes quite clear. Architects need this knowledge to ensure that the practical expressions of their architecture are both rational and efficient. The structural system that enables buildings to withstand the loads imposed on them and the materials of construction, if properly chosen, help further the expression of architects' ideas rationally and economically. If improperly chosen, strucloads imposed on them and the materials of construction, if properly chosen, help further the expression of architects' ideas rationally and economically. If improperly chosen, structural systems and materials of construction may work against an architect. One may, for instance, wish to create an impression of airiness in his architecture, only to discover later that he has created an architecture that expresses monolithic massiveness—and all by an improper choice of structure or materials.

Some will argue that, because architects always work with consulting structural engineers, who make the final decisions on the structural system and the sizes to be used, a knowledge of structures is not really necessary for architects. There are two major objections to this argument. First, the architect who knows no structures hands over his beautiful piece of architecture to an engineer, possibly an unthinking, unfeeling one, who then inserts a structural system into it. [(2)] The engineer's decisions flow from his own philosophy and training, including such factor as pure economics and ease of calculation or construction, and they may express something quite different from the architect's overall philosophy. Because the structural system and the materials of construction may largely dictate the building's appearance, the architect has permitted the engineer to "rape" the architecture. The second and greater objection is that an architect ignorant of structures may propose a piece of architecture that cannot be built at the price the client is prepared to pay. In other words, this architecture is a pipedream, a futile intellectual exercise far from the realm of practicality.

Conversely, the architect who has an adequate background in structures will have relied on that background, even if only subconsciously, from the initial stages and will produce a feasible and practical design. Furthermore, in his consultations with the structural engineer, he will be able to discuss his objectives intelligently and to appreciate if necessary, to resist suggested changes. That architect operates from a position of knowledge and strength.

1.3 STRUCTURAL SYSTEMS AND THE ARCHITECTURAL DESIGN

It is now clear that an architectural design must incorporate a structural system or systems that will help the architect transform, conveniently, safely and economically, the design into a structure that resists the elements and encloses spaces according to his original ideas. [(3)] Thus it is the initial architectural design that provides the architect with the first data that will enable him to make rational choices. What are the spans involved? What are the shapes and sizes of the spaces? Is unobstructed space wanted or column supports that puncture the space at regular intervals? Structural systems suitable for spans of 30 ft(9. 14m) may be quite unsuitable for spans of 100 ft (30. 48m) and vice versa. Architects must realize that, although the architectural design has spans or spaces of its own, the spans they impose on the structural system influence the choice of that very system.

Consider, for instance, a large concourse, such as the lobby of a high-rise hotel, shown in plan in Fig. 1. 1a. The lobby is 60× 90 ft. (18. 29 × 27. 43m) and the architectural design shows this to be so. If the architect is not prepared to accept internal columns, as in Fig. 1. 1b, the shorter span for his structural system is 60 ft (18. 29m). If, however, he is prepared to accept internal columns in both directions at 30ft (9. 14m) centers, as in Fig. 1. 1c, then the spans for his structural system are only 30 ft (9. 14m). He can have quite different structural arrangements for the two cases, even though his architectural design has remained unchanged. Spans are not the only data that can be learned from the architectural design. Equally important is the realization that the architectural design, by its shape in plan and elevation and by the objective it tries to achieve, can suggest other structural systems better suited—or worse—to the design itself. A tennis club with indoor courts, which requires that the headroom in the middle be considerably more than the headroom at the ends, may suggest that an arch or a pitched–roof rigid frame, as shown in Fig. 1. 2, might be suitable structural systems, because they lend themselves more naturally a meeting headroom considerations. A cable structure, shown in Fig. 1. 3, where the maximum sag occurs in the middle may be quite unsuitable.

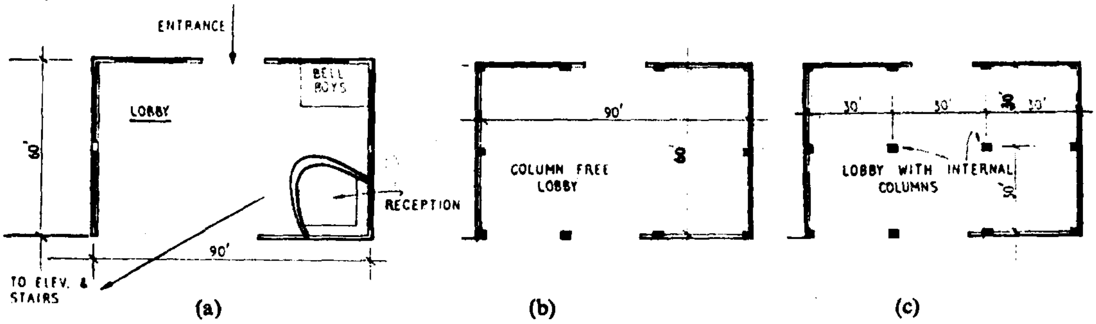

Fig . 1. 1

1.4 STRUCTURE AND LOADS

The structural system, now an aesthetic part of the architectural design and economically suitable for the spans involved, forms and supports enclosed spaces that are to meet the architect's objectives and fulfill the needs of the client. The structure will be subjected to loads, from both inside and outside the building. Loads from inside the building are imposed by the occupancy or the use to which the building is put and may consist of *live loads,* such as people, furniture, library bookstacks, auto mobiles, hospital beds, etc. , or any combination of these as appropriate. Other loads inside the building arise from the *dead load* of the total construction itself. The structural system must be capable of taking its own load and also the loads imposed on it by flooring, permanent internal partitions, external cladding walls, ceiling, roofing, such mechanical systems as ducts, etc. [4]

Loads from outside stem from the effects of the natural environment on the building. These may consist of *snow load* on the roof, *wind load* on the roof and sides, and perhaps *earthquake loads.* These loads depend largely on the location of the building. The snow load for which the building has to be designed in Arizona is vastly different from the snow load in Colorado. The wind load in Florida is considerably more than the wind load in Kansas. If the building is not in an earthquake zone, earthquake loads need not be considered at all.

All these loads, whether from inside or outside the building, whether arising from the building itself, the user, or the natural elements, have to be taken by the structural system from all points and manners of application and transferred safely and economically to the foundations, where they are then dissipated into the soil on which the building rests. (5) This is the function of structure in architecture, and its importance can hardly be underestimated. A badly designed structural system may not perform its function safely and may collapse with catastrophic and disastrous consequences under normal overload conditions.

Even if such an extreme situation does not result, a badly designed structural system may prove to be much more expensive than a comparatively efficient one.

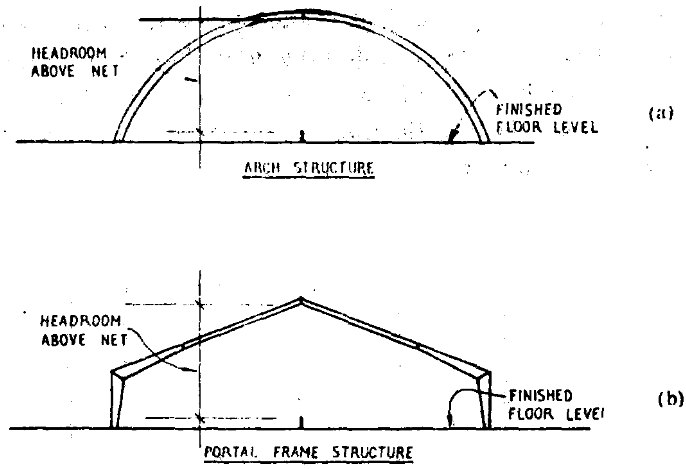

Fig.1.2

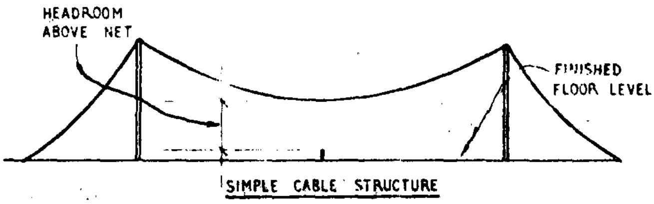

Fig.1.3

1.5 STRUCTURE AND MATERIALS OF CONSTRUCTION

Having considered the structural system, the architect then chooses the materials of construction. (6) Sometimes the choice is dictated by experience, which suggests that certain structural systems are compatible only with certain materials of construction. For instance, timber is totally unsuitable and incompatible as the main structural material in a high–rise building. Such a building requires a structural system in steel or concrete. The incompatibility of the material of construction with the structural system chosen may be governed in some cases by the consideration that final sizes would be either too large or too small to warrant an economical structure. (7) Incompatibility can be dictated by the nature of the construction material itself. All materials have certain characteristics in response to load that make them unique, and the good architect needs to exploit the strong characteristics of his building materials for proper design. For instance, steel is extremely strong in tension, but concrete is not. Steel is also, for the strength it affords, a comparatively light structural material, whereas concrete is heavy. The dead load of a steel structure is therefore quite small, though the dead load of a concrete structure is quite large. A light, largespan, cable–net roof structure, which uses tension as the primary means of load propagation to transfer the loads from the roof toward the supports, is therefore very suitable in steel, but unsuitable in concrete. The nature of the material, once again, is not the only reason for incompatibility between the structure system and the material of its construction. Various degrees of incompatibility can arise from a number of reason, such as architect aesthetic requirements; building code requirement, particularly the fire codes; ready or poor availability material; local methods and practices; and finally economics.

1.6 DESIGN OF THE STRUCTURE

Now, having weighed structural system and compatible building materials, the architect is in a position to design his structure. He has a structural system he wishes to use, he has estimated the loads that will be imposed on it and he has chosen his material of construction. He cannot be fully sure that his choices have been rational, however, until he is able to approximately size the members of his structural system to determine whether or not the entire system is going to be feasible and economical. (8) Consider, for in stance, the floor of a 30–story high–rise building. On designing the floors, the architect finds that the structural depth of the floor, for the spans he is considering and for the reinforced concrete material he had in mind, is 3 ft(0. 91m). Even a saving of 6 in. (152mm) in the structural depth would reduce the building height by 15 ft(4. 57m)! Should he try another structural material, such as steel? Should he try perhaps another structural arrangement in the same type of structural system to reduce his structural depth? Should he go to an entirely different structural system altogether? Should he alter his spans and perhaps compromise his architectural design? These are questions the architect cannot conceivably even begin to answer until he is able to approximately design his structural system. The emphasis here is on the word *approximate*. A structural engineer will later accurately size his members for construction purposes, perhaps using more sophisticated methods of analysis. The architect, however, needs an approximate size, not to duplicate the efforts of the structural engineer, but to better appreciate his structural system—thereby enabling him to improve his architectural design.

To design the structure, the architect needs to fully appreciate two separate stages of design.

1. He needs to know how load propagates or flows through the various elements of his structure. This is *analysis*.

2. He needs to know how this propagation, or flow, of load affects the material of his structural element, so that he can provide an adequate amount of material for structural element to be safe. This is *sizing* and, more properly, *design*.

Let us consider each of these stages in greater detail.

1.6.1 Load Propagation Through the Structural System

We have already seen that the structural system collects the loads from the points of application—snow load on the roof, wind load on the roof and sides, live or user load on the floors, dead load everywhere, etc. — and transmits them to the foundations. The load in fact propagates, or flows from the point of application, with the help of structural mechanisms of load transfer, along and through the structural system to the foundations. (9) The particular mechanism or combination of mechanisms used is vitally important to a proper understanding of the behavior of the structural system and, hence to a proper design of the structure.

As an example, consider a chandelier hanging by a chain or cable from a roof beam that rests on columns, as shown in Fig.1.4. The load of the chandelier travels upward through the mechanism of *tension* in the chain or cable to the underside of beam. It then flows sideways, together with the dead load of the beam itself and the load from the slab, through the mechanisms of *bending moment* and *shear force* (the bending of the beam), to the columns, where it is converted into end reactions or compressive forces that the beam imposes on the columns.[10] Each column then, through the mechanism of *compression*, transfer its share of the load, together with the dead load of column itself, to the foundation as a compressive force on the soil, where together with the dead weight of the foundation itself, it is dissipated into the earth.[10] The chain or cable that supports the chandelier is in *tension*, the beam is in *bending* and *shear*, and the columns are in *compression*.

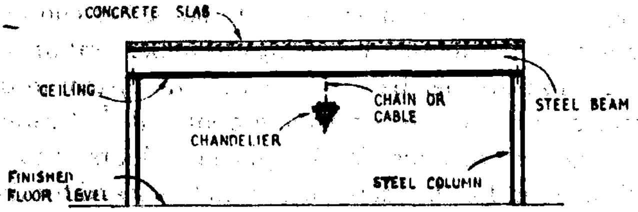

Fig.1.4

A correct appreciation of load propagation, that is, the determination of the correct path and manner in which the transfer and flow of load occur, is critical to an appreciation of the behavior of the structural system and, hence, to its analysis and design.

1.6.2 Effect of Load Propagation on the Material

The load, in its path through the structural system, stresses and strains the material in various ways. An understanding of how this occurs is essential to a proper understanding of the structure. The material of the cable in Fig. 1. 4 is under a tensile stress due to the tension in the cable. It needs to have a sufficiently large area of cross section, therefore, so that it does not snap. To phrase it differently, the tensile stress in the material of the cable must be below the *ultimate tensile strength* of the material of the cable—with a certain *factor of safety*. The load of the chandelier can never increase and can be estimated with a fair degree of accuracy. Nevertheless, a factor of safety of 1 . 4 or 1. 5 must be applied, to ensure that the cable is perfectly safe against defects in the material of the cable or the workmanship and our ignorance of any extra loading that may be applied during the erection of the chandelier or the exact connections to be used that could lead to overstressing, etc. The factor of safety is really our *factor of ignorance*, which we apply to ensure that the structure is safe at all times and under all conditions.

There are two ways of applying the factor of safety in structural design. In *working stress* design, this factor of safety is applied to the ultimate strength of the material to yield a permissible stress up to which the material can *safely* be stressed

$$\text{Permissible stress} = \frac{\text{ultimate strength}}{\text{factor of safety}}$$

The load on the structure is then the working load that the structure normally takes uner all conditions of operation.

In ultimate load or strength design, however, the factor of safety is applied to the working load to yield a much larger load, for purpose of design, called the ultimate load.

$$\text{Ultimate load} = \text{working load} \times \text{factor of safety}$$

This ultimate load is a fictitious value, because it is never expected to be reached. The structure is then designed in such a way that the ultimate strength of the material would in fact be reached under the ultimate load and collapse would occur.

Strength is not the only criterion of design. Deflections are equally important. The ca-