高等学校试用教材

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专业英语

（公路、桥梁工程专业用）

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前　　言

专业英语是公路、桥梁工程专业的一门必修课。本教材是根据交通部高等学校路桥本科《专业英语》教材编写大纲的要求编写的。专业英语作为基础英语的后续课程，重点是培养学生阅读和翻译英文专业书刊的能力，提高阅读翻译文献资料的质量和速度。

本教材分四大部分，第一部分为专业基础课方面的内容，共五课，涉及到建材、测量、工程合同等方面；第二部分为道路及交通工程方面的内容，共九单元；第三部分为桥梁工程方面内容，共九单元。第四部分为翻译方法与技巧，分八个单元阐述了科技英语翻译的基本原则、过程和实用的翻译技巧。第二、三部分的每个单元都配有课文及与课文相关的阅读材料各一篇，题材均选自近期原版书刊，内容基本覆盖了道路与桥梁设计、施工、管理各环节及新成就、新技术。既有丰富的专业词汇，又有一定的可读性，选材时注意英语的规范性。

为了便于英语学习者使用，每课之后附有生词、专业词汇和形式多样的练习，目的在于帮助读者更好地掌握课文中重要的语言材料，书后附有疑难语句注释和练习答案。这些注释和答案是供参考和检查用的，学生应当把主要精力放在课文的学习上。

本书的一个重要特点是书中印有一些与文章相关的插图和图表，对正确领会课文大有帮助。

本教材由湖南大学编写，其中第一部分、第三部分 15～18 课和附录Ⅱ、Ⅲ由土木系李嘉编写，第二部分由黄立葵编写，第三部分 19 课由周铁英编写，20、21、22、23 课由邵旭东编写，第四部分第 1、4 节由西语系陆魁秋编写，第 2、3、5、6、7、8 节由陈登编写。

全书承蒙同济大学俞同华教授仔细审阅，特此致谢。

本书若有差错和不当之处，敬请读者指正。

编　　者

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Part I General Knowledge

Lesson 1

Careers in Civil Engineering

Engineering is a profession, which means that an engineer must have a specialized university education①. Many government jurisdictions also have licensing procedures which require engineering graduates to pass an examination, similar to the bar examinations for a lawyer, before they can actively start on their careers.

In the university, mathematics, physics, and chemistry are heavily emphasized throughout the engineering curriculum, but particularly in the first two or three years. Mathematics is very important in all branches of engineering, so it is greatly stressed. Today, mathematics includes courses in statistics, which deals with gathering, classifying, and using numerical data, or pieces of information. An important aspect of statistical mathematics is probability, which deals with what may happen when there are different factors, or variables, that can change the results of a problem②. Before the construction of a bridge is undertaken, for example, a statistical study is made of the amount of traffic the bridge will be expected to handle③. In the design of the bridge, variables such as water pressure on the foundations, impact, the effects of different wind forces, and many other factors must be considered.

Because a great deal of calculation is involved in solving these problems, computer programming is now included in almost all engineering curricula. Computers, of course, can solve many problems involving calculations with greater speed and accuracy than a human being can. But computers are useless unless they are given clear and accurate instructions and information——in other words, a good program.

In spite of the heavy emphasis on technical subjects in the engineering curriculum, a current trend is to require students to take courses in the social sciences and the language arts. the relationship between engineering and society is getting closer; it is sufficient, therefore, to say again that the work performed by an engineer affects society in many different and important ways that he or she should be aware of④. An engineer also needs a sufficient comm and of language to be able to prepare reports that are clear and, in many cases, persuasive. An engineer engaged in research will need to be able to write up his or her findings for scientific publications.

The last two years of an engineering program include subjects within the student's field of specialization . For the student who is preparing to become a civil engineer , these specialized courses may deal with such subjects as geodetic surveying, soil mechanics, or hydraulics.

Active recruiting for engineers often begins before the student's last year in the university. Many different corporations and government agencies have competed for the services of engineers in recent years. In the science-oriented society of today, people who have technical training are, of course, in demand. Young engineers may choose to go into environmental or sanitary engineering, for example, where environmental concerns have created many openings⑤; or they may choose construction firms that specialize in highway work; or they may prefer to work with one of the government agencies that deals with water resources. Indeed, the choice is large and varied.

When the young engineer has finally started actual practice, the theoretical knowledge acquired in the university must be applied. He or she will probably be assigned at the beginning to work with a team of engineers. Thus, on-the-job training can be acquired that will demonstrate his or her ability to translate theory into practice to the supervisors⑥.

The civil engineer may work in research, design, construction supervision, maintenance, or even in sales or management. Each of these areas involves different duties, different emphases, and different uses of the engineer's knowledge and experience.

Research is one of the most important aspects of scientific and engineering practice. A researcher usually works as a member of a team with other scientists and engineers. He or she is often employed in a laboratory that is financed by government or industry. Areas of research connected with civil engineering include soil mechanics and soil stabilization techniques, and also the development and testing of new structural materials.

Civil engineering projects are almost always unique; that is, each has its own problems and design features. Therefore, careful study is given to each project even before design work begins. The study includes a survey both of topography and subsoil features of the proposed site. It also includes a consideration of possible alternatives, such as a concrete gravity dam or an earth-fill embankment dam. The economic factors involved in each of the possible alternatives must also be weighed. Today, a study usually includes a consideration of the environmental impact of the project. Many engineers, usually working as a team that includes surveyors, specialists in soil mechanics, and experts in design and construction, are involved in making these feasibility studies.

Many civil engineers, among them the top people in the field, work in design. As we have seen, civil engineers work on many different kinds of structures, so it is normal practice for an engineer to specialize in just one kind. In designing buildings, engineers often work as consultants to architectural or construction firms. Dams, bridges, water supply systems, and other large projects ordinarily employ several engineers whose work is coordinated by a systems engineer who is in charge of the entire project. In many cases, engineers from other disciplines are involved. In a dam project, for example, electrical and mechanical engineers work on the design of the powerhouse and its equipment. In other cases, civil engineers are assigned to work on a project in another field; in the space program, for instance, civil engineers were necessary in the design and construction of such structures as launching pads and rocket storage facilities.

Construction is a complicated process on almost all engineering projects. It involves scheduling the work and utilizing the equipment and the materials so that costs are kept as low as possible. Safety factors must also be taken into account, since construction can be very dangerous. Many civil engineers therefore specialize in the construction phase.

Much of the work of civil engineers is carried on outdoors, often in rugged and difficult terrain or under dangerous conditions. Surveying is an outdoor occupation, for example, and dams are often built in wild river valleys or gorges. Bridges, tunnels, and skyscrapers under construction can also be dangerous places to work. In addition, the work must also progress under all kinds of weather conditions. The prospective civil engineer should be aware of the physical demands that will be made on him or her⑦.

From: E. J Hall "The Language of Civil Engineering in English". 1984.

New Words and Expressions

1. jurisdiction[ˌdʒuəris'dikʃən] n. 管辖权，权限
   government jurisdiction 政府行政区
2. bar[bɑː] n. 法庭，律师的职业
3. curriculum[kə'rikjuləm] ([pl.] curricula)
   n. 课程，学习计划
4. probability[prɔbə'biliti] n. 概率论，可能性
5. impact['impækt] n. 冲击(力)，影响
6. geodetic[dʒiːou'detik] n. 大地测量学
7. hydraulics[hai'drɔːliks] n. 水力学
8. recruit[ri'kruːt] v. 招聘
9. orient['ɔːriənt] v. 定向，定位
   science-orient 注重科学的
10. supervision[sjuːpə'viʒən] n. 管理，监控
11. maintenance['meintinəns] n. 维修，保养
12. construction[kən'strʌkʃən] n. 施工，建设
13. topographic(al)[ˌtɔpə'græfik] a. 地形学(的)
14. subsoil['sʌbsɔil] n. 下(亚)层土，地基下层土
15. alternative[ɔːl'təːnətiv] n. 可供选择的方法
16. consultant[kən'sʌltənt] n. 顾问
17. architectural[ˌɑːki'tektʃərəl] a. 建筑(学)的
18. rugged[rʌgid] a. 崎岖的，艰难的
19. terrain['terein] n. 地域，地带，领域
20. gorge[gɔːdʒ] n. 峡谷
21. engineering graduate 工科毕业生

22. geodetic surveying 大地测量
23. soil mechanics 土力学
24. on-the-job 在现场的,在职的
25. soil stabilization 土壤稳定
26. earth-fill embankment dam 填土坝
27. feasibility study 可行性研究
28. systems engineer 系统工程师
29. construction phase 施工阶段

Exercises

I. Complete each sentence. Write a T before the right ending.

1. Statistics is a branch of mathematics that deals with ______.

____ a. what may happen when different factors can change the results of a problem.

____ b. gathering, classifying, and using numerical data.

____ c. highway engineering, structural engineering and environmental engineering.

2. Computers can't solve complicated problems unless they are given ______

____ a. a good air-condition. ____ b. a good program.

____ c. a young civil engineer.

3. Besides technical subjects in the engineering curriculum, an engineer needs to take courses in ______.

____ a. social sciences and surgery. ____ b. law and polities.

____ c. language arts and social sciences.

4. A civil engineer may specialize in some of the kinds of work. for example ______.

____ a. research, design, construction management and maintenance.

____ b. electrical and mechanical equipment.

____ c. mathematics, physics and chemistry.

5. Civil engineering projects are almost always ______.

____ a. distinctive. ____ b. the similar. ____ c. alike.

6. The study, which must consider not only structural features, but also economic factors and possible alternatives or other choices, is called ______.

____ a. system engineering. ____ b. feasibility study.

____ c. structural design.

II. Find the words or phrases that fit the meaning in *italics*.

1. To design a new bridge, a statistical study is made of the amount of traffic the bridge will expect to *carry* (par. 2)

______

2. On-the-job training will demonstrate the young engineer's ability to *apply* theory *to* practice. (par. 7)

______

3. In each of the possible alternatives, the economic factors must be *balanced*. (par. 10)

______

4. Many civil engineers specialize in the construction phase because construction is a *complex* process. (par. 12)

______

5. In civil engineering, the *outstanding* people sometimes work in design. (par. 11)

______

III. Discussion

1. Why is computer programming included in engineering courses? Only in what circumstances can a computer do an accurate job?
2. What are some of the areas of research connected with civil engineering? What are some others that are not mentioned in the text?
3. Why don't all civil engineers specialize in the design of all kinds of different structures?
4. What kind of physical demands may be made on a civil engineer?

Lesson 2

Modern Buildings and Structural Materials

Many great buildings built in earlier ages are still in existence and in use. Among them are the Pantheon① and the Colosseum② in Rome, Hagia Sophia③ in Istanbul; the Gothic churches of France and England, and the Renaissance cathedrals, with their great domes, like the Duomo④ in Florence and St. Peter's⑤ in Rome. They are massive structures with thick stone walls that counteract the thrust of their great weight. Thrust is the pressure exerted by each part of a structure on its other parts.

These great buildings were not the product of knowledge of mathematics and physics. They were constructed instead on the basis of experience and observation, often as the result of trial and error. One of the reasons they have survived is because of the great strength that was built into them-strength greater than necessary⑥ in most cases. But the engineers of earlier times also had their failure. In Rome, for example, most of the people lived in insulae, great tenement blocks that were often ten stories high. Many of them were poorly constructed and sometimes collapsed with considerable loss of life.

Today, however, the engineer has the advantage not only of empirical information, but also of scientific data that permit him to make careful calculations in advance. When a modern engineer plans a structure, he takes into account the total weight of all its component materials. This is known as the dead load, which is the weight of the structure itself. He must also consider the live load, the weight of all the people, cars, furniture, machines, and so on that the structure will support when it is in use. In structures such as bridges that will handle fast automobile traffic, he must consider the impact, the force at which the live load will be exerted on the structure. He must also determine the safety factor, that is, an additional capability to make the structure stronger than the combination of the three other factors.

The modern engineer must also understand the different stresses to which the materials in a structure are subject. These include the opposite forces of compression and tension. In compression the material is pressed or pushed together; in tension the material is pulled a-

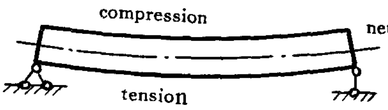

Fig. 2.1

part or stretched, like a rubber band. In the Fig. 2.1, the top surface is concave, or bent inward, and the material in it is in compression. The bottom surface is convex, or bent outward, and the material in it is in tension. When a saw cuts easily through a piece of wood, the wood is in tension, but when the saw begins to bind, the wood is in compression because the fibers in it are being pushed together⑦.

In addition to tension and compression, another force is at work, namely shear, which we defined as the tendency of a material to fracture along the lines of stress. The shear might occur in a vertical plane, but it also might run along the horizontal axis of the beam, the neutral plane, where there is neither tension nor compression.

Altogether, three forces can act on a structure: vertical-those that act up or down; horizontal-those that act sideways; and those that act upon it with a rotating or turning motion. Forces that act at an angle are a combination of horizontal and vertical forces. Since the structures designed by civil engineers are intended to be stationary or stable, these forces must be kept in balance. The vertical forces, for example, must be equal to each other. If a beam supports a load above, the beam itself must have sufficient strength to counterbalance that weight. The horizontal forces must also equal each other so that there is not too much thrust either to the right or to the left. And forces that might pull the structure around must be countered with forces that pull in the opposite direction.

One of the most spectacular engineering failures of modern times, the collapse of the Tacoma Narrows Bridge in 1940, was the result of not considering the last of these factors carefully enough. When strong gusts of wind, up to sixty-five kilometers an hour, struck the bridge during a storm, they set up waves along the roadway of the bridge and also a lateral motion that caused the roadway to fall. Fortunately, engineers learn from mistakes, so it is now common practice to test scale models of bridges in wind tunnels for aerodynamic resistance⑧.

The principal construction materials of earlier times were wood and masonry brick, stone, or tile, and similar materials. The courses or layers were bound together with mortar or bitumen, a tarlike substance, or some other binding agent. The Greeks and Romans sometimes used iron rods or clamps to strengthen their buildings. The columns of the Parthenon

⑨ in Athens, for example, have holes drilled in them for iron bars that have now rusted away. The Romans also used a natural cement called pozzolana, made from volcanic ash, that became as hard as stone under water.

Both steel and cement, the two most important construction materials of modern times, were introduced in the nineteenth century. Steel, basically an alloy of iron and a small amount of carbon, had been made up to that time by a laborious process that restricted it to such special uses as sword blades. After the invention of the Bessemer process in 1856, steel was available in large quantities at low prices. The enormous advantage of steel is its tensile strengh; 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 materials⑩. New alloys have further increased the strength of steel and eliminated some of its problems, such as fatigue, which is a tendency for it to weaken as a result of continual changes in stress.

Modern cement, called Portland cement, was invented in 1824. It is a mixture of limestone and clay, which is heated and then ground into a powder. It is mixed at or near the construction site with sand, aggregate (small stones, crushed rock, or gravel), and water to make concrete. Different proportions of the ingredients produce concrete with different strength and weight. Concrete is very versatile; it can be poured, pumped, or even sprayed into all kinds of shapes. And whereas steel has great tensile strength, concrete has great strength under compression. Thus, the two substances complement each other.

They also complement each other in another way: they have almost the same rate of contraction and expansion. They therefore can work together in situations where both compression and tension are factors. Steel rods are embedded in concrete to make reinforced concrete in concrete beams or structures where tension will develop. Concrete and steel also form such a strong bond-the force that unites them-that the steel cannot slip within the concrete. Still another advantage is that steel does not rust in concrete. Acid corrodes steel, whereas concrete has an alkaline chemical reaction, the opposite of acid.

Prestressed concrete is an improved form of reinforcement. Steel rods are bent into the shapes to give them the necessary degree of tensile strength. They are then used to prestress concrete, usually by pretensioning or posttensioning method. Prestressed concrete has made it possible to develop buildings with unusual shapes, like some of the modern sports arenas, with large spaces unbroken by any obstructing supports⑪. The uses for this relatively new structural method are constantly being developed.

The current tendency is to develop lighter materials. Aluminum, for example, weighs much less than steel but has many of the same properties. Aluminum beams have already been used for bridge construction and for the framework of a few buildings.

Attempts are also being made to produce concrete with more strength and durability, and with a lighter weight. One system that helps cut concrete weight to some extent uses polymers, which are long chainlike compounds used in plastics, as part of the mixture.

From: E. J Hall "The Language of Civil Engineering in English". 1984.

New Words and Expressions

1. counteract[ˌkauntə'rækt]	v. 抵抗，平衡
2. thrust[θrʌst]	v. ;n. 推；推力
3. insula['insjulɑː]	([pl.] insulse)n. 群屋，公寓
4. tenement['tenimənt]	n. 出租的房子，经济公寓
5. concave['kɔn'keiv]	a. ;n. 凹的，凹面
6. convex['kɔn'veks]	a. ;n. 凸的，凸面
7. shear[ʃiə]	v. ;n. 剪切，剪力
8. rotate[rou'teit]	v. (使)旋转，转动
9. gust[gʌst]	n. 阵风(雨)，骤风(雨)
10. roadway['roudwei]	n. 车行道，路面
11. masonry['meisnri]	n. 圬工，砌筑
12. mortar['mɔːtə]	n. 砂(灰)浆
13. bitumen['bitjumin]	n. 沥青
14. tarlike['taːlaik]	a. 焦油般的
15. clamp[klæmp]	n. ;v. 夹子，夹钳；卡紧
16. blade[bleid]	n. 刀刃，刃片
17. cement[si'ment]	n. ;v. 水泥；粘结
18. aggregate['ægrigit]	n. ;v. ;a. 骨料；聚集
19. ingredient[in'griːdiənt]	n. (混合物)成分，配料
20. versatile['vəːsətai]	a. 多用途的，多方面适应的
21. alkaline['ælkəlain]	a. ;n. 碱性(的)
22. arena['ə'riːnə]	n. 表演场，斗技场
23. polymer['pɔlimə]	n. 聚合物(体)
24. dead load	恒载
25. live load	活载
26. safety factor	安全系数
27. neutral plane	中性面
28. wind tunnel (test)	风洞(试验)
29. volcanic ash	火山灰
30. tensile strength	抗拉强度
31. Portland cement	波特兰水泥，硅酸盐水泥
32. reinforced concrete	钢筋混凝土
33. prestressed concrete	预应力混凝土
34. pretensioning (posttensioning) method	先(后)张法

Exercises

I. Five of the following words or phrases are true about concrete. Underline each of them.

a widely used building material   high tensile strength
a mixture   can be poured into kinds of shape   high compressive strength   will not deform under loads   an natural aggregate   can't be pumped   a corrosive material to steel   in a wide range of strength properties

II. Complete the following sentences:

1. When planning a structure, an engineer must take into account four factors: ______, ______, ______, ______.
2. As a structural material, the enormous advantage of steel is ___________ .
3. Modern cement is made from ___________________________.
4. The three forces that can act on a structure are ___________________ .
5. Both steel and concrete can work together in structures because __________ .

III. Match each special terms on the left with the statement on the right.

1. Masonry	a. the force at which the live load will be exerted on a structure.
2. Portland cement	b. a bind material made of limestone and clay, heated and ground to a powder.
3. Fatigue	c. the tendency of a material to break along lines of stress.
4. Neutral plane	d. the weight of all the materials in a structure.
5. Shear	e. the pressure or force exerted by each part of a structure on the other parts.
6. Thrust	f. the tendency of a material to weaken because of continual changes in stress.
7. Dead load	g. the weight that will be added to a structure as a result of its use.
8. Live load	h. material such as stone, brick, or concrete used for construction.
9. Impact	i. the ability of a material to retain its strength under tension.
10. Tensile strength	j. the place in a material where there is neither tension nor compression.

Answer: 1- (h); 2- ( ); 3- ( ); 4- ( ); 5- ( );
6- ( ); 7- ( ); 8- ( ); 9- ( ); 10- ( ).

Lesson 3
Prestressed Concrete

Concrete is strong in compression, but weak in tension: its tensile strength varies from 8 to 14 percent of its compressive strength. Due to such a low tensile capacity, flexural cracks develop at early stages of loading. In order to reduce or prevent such cracks from developing, a concentric or eccentric force is imposed in the longitudinal direction of the structural element. This force prevents the cracks from developing by eliminating or considerably reducing the tensile stresses at the critical midspan and support sections at service load, thereby raising the bending, shear, and torsional capacities of the sections①. The sections are then able to behave elastically, and almost the full capacity of the concrete in compression can be efficiently utilized across the entire depth of the concrete sections when all loads act on the structure.

Such an imposed longitudinal force is called a prestressing force, i. e. , a compressive force that prestresses the sections along the span of the structural element prior to the application of the transverse gravity dead and live loads or transient horizontal live loads. The type of prestressing force involved, together with its magnitude, are determined mainly on the basis of the type of system to be constructed and the span length and slenderness desired. Since the prestressing force is applied longitudinally along or parallel to the axis of the member, the prestressing principle involved is commonly known as linear prestressing.

Circular prestressing, used in liquid containment tanks, pipes, and pressure reactor vessels, essentially follows the same basic principles as does linear prestressing. The circumferential hoop, or "hugging" stress on the cylindrical or spherical structure, neutralizes the tensile stresses at the outer fibers of the curvilinear surface caused by the internal contained pressure.

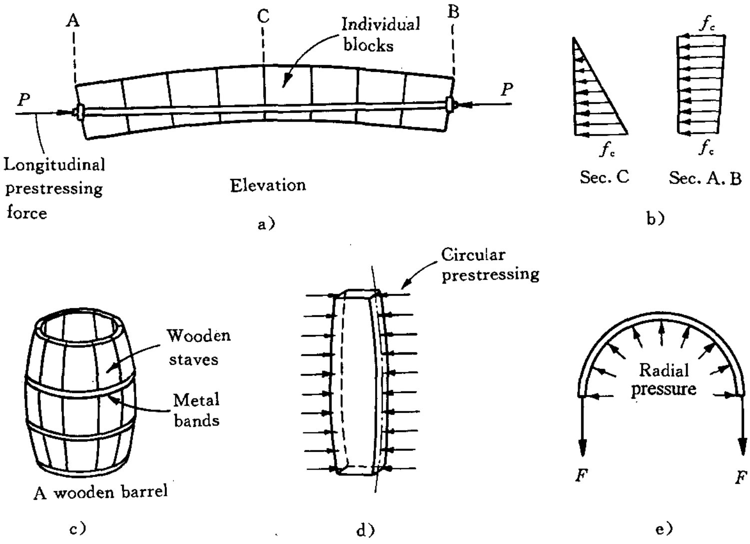

Fig. 3. 1 Prestressing principle in linear and circular prestressing

Figure 3. 1 illustrates, in a basic fashion, the prestressing action in both types of structural systems and the resulting stress response. In (a), the individual concrete blocks act together as a beam due to the large compressive prestressing force P. Although it might appear that the blocks will slip and vertically simulate shear slip failure, in fact they will not because of the longitudinal force P②. Similarly, the wooden staves in (c) might appear to be capable of separating as a result of the high internal radial pressure exerted on them. But a-

gain, because of the compressive prestress imposed by the metal bands as a form of circular prestressing, they will remain in place③.

From the preceding discussion, it is plain that permanent stresses in the prestressed structural member are created before the full dead and live loads are applied in order to eliminate or considerably reduce the net tensile stresses caused by these loads. With reinforced concrete, it is assumed that the tensile strength of the concrete is negligible and disregarded. This is because the tensile forces resulting from the bending moments are resisted by the bond created in the reinforcement process. Cracking and deflection are therefore essentially irrecoverable in reinforced concrete once the member has reached its limit state at service load.

The reinforcement in the reinforced concrete member does not exert any force of its own on the member, contrary to the action of prestressing steel. The steel required to produce the prestressing force in the prestressed member actively preloads the member, permitting a relatively high controlled recovery of cracking and deflection. Once the flexural tensile strength of the concrete is exceeded, the prestressed member starts to act like a reinforced concrete element.

Prestressed members are shallower in depth than their reinforced concrete counterparts for the same span and loading conditions. In general, the depth of a prestressed concrete member is usually about 65 to 80 percent of the depth of the equivalent reinforced concrete member. Hence, the prestressed member requires less concrete, and about 20 to 35 percent of the amount of reinforcement. Unfortunately, this saving in material weight is balanced by the higher cost of the higher quality materials needed in prestressing. Also, regardless of the system used, prestressing operations themselves result in an added cost: formwork is more complex, since the geometry of prestressed sections is usually composed of flanged sections with thin webs.

In spite of these additional costs, if a large enough number of precast units are manufactured, the difference between at least the initial costs of prestressed and reinforced concrete systems is usually not very large. And the indirect long-term savings are quite substantial, because less maintenance is needed, a longer working life is possible due to better quality control of the concrete, and lighter foundations are achieved due to the smaller cumulative weight of the superstructure.

Once the beam span of reinforced concrete exceeds 70 to 90 feet (21.3 to 27.4m), the dead weight of the beam becomes excessive, resulting in heavier members and, consequently, greater long-term deflection and cracking. Thus, for larger spans, prestressed concrete becomes mandatory since arches are expensive to construct and do not perform as well due to the severe long-term shrinkage and creep they undergo④. Very large spans such as segmental bridges or cable-stayed bridges can only be constructed through the use of prestressing.

Prestressd concrete is not a new concept, dating back to 1872, when P. H. Jackson, an engineer from California, patented a prestressing system that used a tie rod to construct beams or arches from individual blocks [see Figure 3.1(a)]. After a long lapse of time during which little progress was made because of the unavailability of high-strength steel to overcome prestress losses, R. E. Dill of Alexandria, Nebraska, recognized the effect of the shrinkage and creep (transverse material flow) of concrete on the loss of prestress. He subsequently developed the idea that successive post-tensioning of unbonded rods would compensate for the time-dependent loss of stress in the rods due to the decrease in the length of the member because of creep and shrinkage. In the early 1920s, W. H. Hewett of Minneapolis developed the principles of circular prestressing. He hoop-stressed horizontal reinforcement around walls of concrete tanks through the use of turnbuckles to prevent cracking due to internal liquid pressure, thereby achieving watertightness. Thereafter, prestressing of tanks and pipes developed at an accelerated pace in the United States, with thousands of tanks for water, liquid, and gas storage built and much mileage of prestressed pressure pipe laid in the two to three decades that followed.

Linear prestressing continued to develop in Europe and in France, in particular through the ingenuity of Eugene Freyssinet, who proposed in 1926-28 methods to overcome prestress losses through the use of high-strength and high-ductility steels. In 1940, he introduced the now well-known and well-accepted Freyssinet system⑤.

P. W. Abeles of England introduced and developed the concept of partial prestressing between the 1930s and 1960s. F. Leonhardt of Germany, V. Mikhailov of Russia, and T. Y. Lin of the United States also contributed a great deal to the art and science of the design of prestressed concrete. Lin's load-balancing method deserves particular mention in this regard, as it considerably simplified the design process, particularly in continuous structures. These twentieth-century developments have led to the extensive use of prestressing throughout the world, and in the United States in particular.

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-encompassing application. The success in the development and construction of all these structures has been due in no small measures to the advances in the technology of materials, particularly prestressing steel, and the accumulated knowledge in estimating the short-and long-term losses in the prestressing forces⑥.

From: Edward G. Nawy "Prestressed Concrete" 1989.

New Words and Expressions

1. flexural['fleksjurəl] a. 弯(挠)曲
2. eccentric[ik'sentrik] a. ;n. 偏心(轮)
3. torsional['tɔːʃənl] a. 扭转的,扭力的
4. transverse['trænzvəːs] a. ;n. 横向,横断
5. transient[trænziənt] a. ;n. 瞬间,瞬态

6. hoop[huːp] n. ;v. 箍筋，箍住
7. spherical['sferikəl] a. 球(形)的，鼓形的
8. deflection[di'flekʃən] n. 变形，挠度
9. irrecoverable[iri'kʌvərəbl] a. 不能恢复的
10. formwork['fɔːmwəːk] n. 模(样)板，支模
11. flange[flændʒ] n. ;v. 翼(边)缘，镶边
12. superstructure[sjuːpəstrʌktʃə] n. 上部结构，上层建筑
13. mandatory['mændətəri] a. 必须遵循的，命令的
14. compensate['kɔmpenseit] v. 补偿，赔偿
15. ductility[dʌk'tiliti] n. (可延展)性，韧(塑)性
16. ingenuity[ˌindʒi'nju(ː)iti] n. 独创性，机灵
17. compressive strength 抗压强度
18. critical section 临界截面
19. service load 使用荷载
20. prestressing force 预应力
21. linear prestressing 线预应力
22. circular prestressing 环形预应力
23. stress response 应力响应，应力特性
24. net tensile stress 净拉应力
25. bending moment 弯矩
26. thin-web (beam) 薄腹(梁)
27. long-term shrinkage 长期收缩
28. long-term creep 长期徐变
29. partial prestressing 部分预应力

Exercises

I. Write a T in front of a statement if it is true and write an F if it is false according to the text.

______ 1. Prestressing force prevents the cracks from developing by eliminating or reducing the tensile stress in the structure.

______ 2. Prestressing principle in linear prestressing is different from that in circular prestressing.

______ 3. No stresses are created in the prestressed structural member before the dead and live loads are applied.

______ 4. Prestressed concrete will crack on the tension side at much larger load than reinforced concrete.

______ 5. Prestressing reduces the dead weight of concrete construction most dramatically.

______ 6. In 1872, prestressing had been successfully used in beams or arches because of the solution of prestress losses.