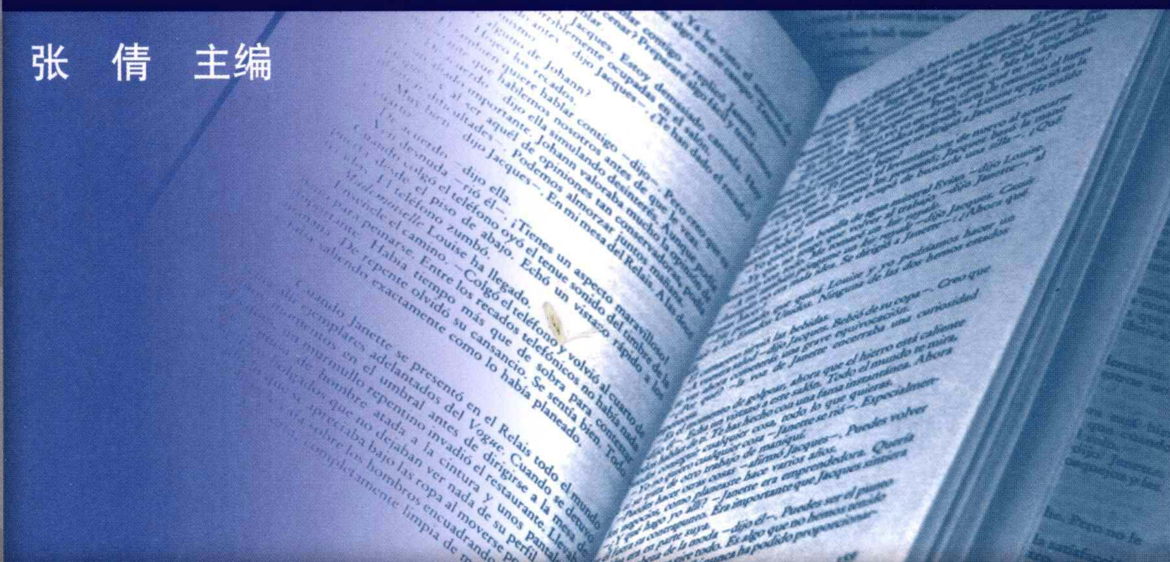
全国高等院校土木工程类系列教材

土木工程英语

张 倩 主编



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北　京

内 容 简 介

本书是根据2004年8月颁布的《大学英语课程教学要求(教学大纲)》(试行)的规定编写的。本书选材涉及工程力学、钢筋混凝土结构、钢结构、结构抗震、土质学和土力学、工程岩土学、桥梁工程、路面工程、路基工程、道路勘测设计、工程经济与管理等学科,共有22个单元,每个单元均由课文(Text)、注解(Notes)、生词(New Words)、词组(Phrases and Expressions)、练习(Exercises)和阅读材料(Reading Material)组成。

本书可作为高等学校土木工程类专业英语教材,也可作为土木工程专业技术人员提高专业英语水平的参考读物。

图书在版编目(CIP)数据

土木工程英语/张倩主编. —北京:科学出版社,2008
(全国高等院校土木工程类系列教材)
ISBN 978-7-03-022948-9

Ⅰ.土… Ⅱ.张… Ⅲ.土木工程-英语-高等学校-教材
Ⅳ.H31

中国版本图书馆CIP数据核字(2008)第138173号

责任编辑:童安齐 陈迅/责任校对:赵燕
责任印制:吕春珉/封面设计:耕者设计工作室

科学出版社出版
北京东黄城根北街16号
邮政编码:100717
http://www.sciencep.com

铭浩彩色印装有限公司印刷
科学出版社发行 各地新华书店经销

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2009年1月第一版 开本:787×1092 1/16
2009年1月第一次印刷 印张:13
印数:1—3 000 字数:293 000

定价:20.00元

(如有印装质量问题,我社负责调换〈环伟〉)
销售部电话 010-62136131 编辑部电话 010-62137026(BZ08)

全国高等院校土木工程类系列教材
编委会

前　言

本书结合我国高等教育发展的新趋势，按照2004年6月教育部颁布的《大学英语课程教学要求（教学大纲）》（试行）的定位和要求编写。为了使学生毕业后能更快和更有效地应用英语这一语言工具获取国外与本专业有关的科技信息和进行专业技术交流，需通过专业英语课程的学习培养其专业英语基本技能，因此学生在完成基础阶段的英语学习任务后，须修读专业英语。专业英语属大学英语学习的应用提高阶段，其教学目的是让学生掌握一定量的专业或与专业有关的常用单词和词组，培养学生阅读和翻译专业英文文献的能力。

本书在选材上注意在有限的篇幅下尽可能多地涉及土木工程学科的相关课程，如工程力学、钢筋混凝土结构、钢结构、结构抗震、土质学和土力学、工程岩土学、桥梁工程、路面工程、路基工程、道路勘测设计、工程经济与管理等。本书共22个单元，每个单元均由课文（Text）、注解（Notes）、生词（New Words）、词组（Phrases and Expressions）、练习（Exercises）和阅读材料（Reading Material）组成。课文和阅读材料的题材均选自原版英文资料，选材时注意语言的规范性，并且配有与文章内容相关的插图和表格，以帮助学生加深对文章的理解。

本书由西安建筑科技大学和长安大学的部分教师编写。其中第1、3、4、6、7、21单元由长安大学雷自学编写，第8、9、10、11、20、22单元由西安建筑科技大学苏立君编写，第2、5、14、18、19单元由西安建筑科技大学王先铁编写，第12、13、15、16、17单元由西安建筑科技大学张倩编写。全书由张倩统稿。

由于编者水平所限，书中难免存在不妥之处，敬请读者批评指正。

Contents

Unit 1

Text

Civil Engineering

Civil engineering is a professional engineering discipline that deals with the design and construction of the physical and natural built environment, including works such as bridges, roads, canals, dams and buildings. Civil engineering is the oldest engineering discipline after military engineering, and it was defined to distinguish it from military engineering. It is traditionally broken into several sub-disciplines including environmental engineering, geotechnical engineering, structural engineering, transportation engineering, water resources engineering, materials engineering, coastal engineering, surveying, urban planning, and construction engineering.

- **Construction Engineering**

Construction engineering involves planning and execution of the designs from transportation, site development, hydraulic, environmental, structural and geotechnical engineers. As construction firms tend to have higher business risk than other types of civil engineering firms, many construction engineers tend to take on a role that is more business-like in nature: drafting and reviewing contracts, evaluating logistical operations, and closely-monitoring prices of necessary supplies.

- **Environmental Engineering**

Environmental engineering deals with the treatment of chemical, biological, and/or thermal waste, the purification of water and air, and the remediation of contaminated sites, due to prior waste disposal or accidental contamination. Among the topics covered by environmental engineering are pollutant transport, water purification, sewage treatment, and hazardous waste management(1). Environmental engineers can be involved with pollution reduction, green engineering, and industrial ecology. Environmental engineering also deals with the gathering of information on the environmental consequences of proposed actions and the assessment of effects of proposed actions for the purpose of assisting society and policy makers in the decision making process.

Environmental engineering is the contemporary term for sanitary engineering, though sanitary engineering traditionally had not included much of the hazardous waste management and environmental remediation work covered by the term environmental engineering. Some other terms in use are public health engineering and environmental health engineering.

- **Geotechnical Engineering**

Geotechnical engineering is an area of civil engineering concerned with the rock and soil that civil engineering systems are supported by. Knowledge from the fields of geology, material science and testing, mechanics, and hydraulics are applied by geotechnical engineers to safely and economically design foundations, retaining walls, and similar structures. Environmental concerns in relation to groundwater and waste disposal have spawned a new area of study called geoenvironmental engineering where biology and chemistry are important.

Some of the unique difficulties of geotechnical engineering are the result of the variability and properties of soil. Boundary conditions are often well defined in other branches of civil engineering, but with soil, clearly defining these conditions can be impossible. The material properties and behavior of soil are also difficult to predict due to the variability of soil and limited investigation. This contrasts with the relatively well-defined material properties of steel and concrete used in other areas of civil engineering. Soil mechanics, which defines the behavior of soil, is complex due to stress-dependent material properties such as volume change, stress-strain relationship, and strength(2).

- **Hydraulic Engineering**

Hydraulic engineering is concerned with the flow and conveyance of fluids, principally water. This area of civil engineering is intimately related to the design of pipelines, water distribution systems, drainage facilities (including bridges, dams, channels, culverts, levees, storm sewers), and canals. Hydraulic engineers design these facilities using the concepts of fluid pressure, fluid statics, fluid dynamics, and hydraulics, among others. Water resources engineering is concerned with the collection and management of water (as a natural resource). As a discipline it therefore combines hydrology, environmental science, meteorology, geology, conservation, and resource management. This area of civil engineering relates to the prediction and management of both the quality and the quantity of water in both underground (aquifers) and above ground (lakes, rivers, and streams) resources. Water resource engineers analyze and model very small to very large areas of the earth to predict the amount and content of water as it flows into, through, or out of a facility although the actual design of the facility may be left to other engineers.

- **Materials Science**

Civil engineering also includes elements of materials science. Construction materials with broad applications in civil engineering include ceramics such as Portland cement concrete (PCC) and hot mix asphalt concrete, metals such as aluminum and steel, and polymers such as polymethylmethacrylate (PMMA) and carbon fibers. Current research in these areas focus around increased strength, durability, workability, and reduced cost.

- **Structural Engineering**

Structural engineering is concerned with the structural design and structural analysis of buildings, bridges, and other structures. This involves calculating the stresses and forces that act upon or arise within a structure, and designing the structure to successfully resist those forces and stresses. Resistance to wind and seismic loadings, especially performance near resonant frequencies, which affect the overall stability of a structure, are major design concerns. Other factors such as durability and cost are also considered. In addition to design of new buildings, structural engineers may design a seismic retrofit for an existing structure to mitigate undesirable performance during earthquakes.

- **Surveying**

Surveying is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth. Modern surveying equipment, such as EDM, total stations, GPS surveying and laser scanning, allow for remarkably accurate measurement of angular deviation, horizontal, vertical and slope distances. This information is crucial to convert the data into a graphical representation of the Earth's surface, in the form of a map. This information is then used by civil engineers, contractors and even realtors. Elements of a building or structure must be correctly sized and positioned in relation to each other and to site boundaries and adjacent structures. Civil engineers are trained in the methods of surveying and may seek professional land surveyor status.

- **Transportation Engineering**

Transportation engineering is concerned with moving people and goods efficiently, safely, and in a manner conducive to a vibrant community. This involves specifying, designing, constructing, and maintaining transportation infrastructure which includes streets, canals, highways, rail systems, airports, ports, and mass transit. It includes areas such as transportation design, transportation planning, traffic engineering, urban engineering, queuing theory, pavement engineering, Intelligent Transportation System (ITS), and infrastructure management.

Notes

(1) Among the topics covered by environmental engineering are pollutant transport, water purification, sewage treatment, and hazardous waste management. 此句将 Among 置于句首，因而采用倒装句式，全句可译为：环境工程所包含的问题有污染物的运输、水的净化、污水

处理以及危险废物的处理。

(2) Soil mechanics, which defines the behavior of soil, is complex due to stress-dependent material properties such as volume change, stress-strain relationship, and strength. 句中 which …of soil, 为非限定性定语从句,修饰 soil mechanics。全句可译为:土力学确定土的特性,是一门复杂的学科,这是由于它涉及到依赖应力的材料性能,如体积变化、应力- 应变关系和强度。

New Words

1. discipline [ˈdisiplin] n.纪律,学科
2. geotechnical [ˈdʒiːəʊteknikəl] a.岩土的,土工技术的
3. remediation [ˌriˌmidiˈeiʃən] n.补习,补救
4. sewage [ˈsju(ː)idʒ] n.下水道,污水
5. hazardous [ˈhæzədəs] a.危险的,冒险的
6. contemporary[kənˈtempərəri] a.当代的,同时代的
7. sanitary [ˈsænitəri] a.(有关)卫生的,(保持)清洁的,清洁卫生的
8. spawn [spɔːn] v.生产,产卵　n.(鱼等的)卵,(植物)菌丝,产物
9. geoenvironmental [ˈdʒiːəuinˌvaiərənˈmentl] a.地质环境的
10. culvert [ˈkʌlvət] n.管路,涵洞
11. levee [ˈlevi] n.防洪堤,码头,大堤
12. sewer [ˈsjuə] n.下水道,缝纫者
13. statics [ˈstætiks] n.[物]静力学
14. meteorology [ˌmiːtjəˈrɔlədʒi] n.气象学
15. aquifer [ˈækwifə] n.含水土层,蓄水层
16. polymethylmethacrylate [ˌpɔlimeθilmeˈθækrəleit] n.聚甲基丙烯酸甲酯,有机玻璃
17. durability [ˌdjuərəˈbiliti] n.经久性, 耐久性
18. workability[ˌwəːkəˈbiliti] n.和易性,易加工性,可加工性
19. seismic [ˈsaizmik] a.[地]地震的
20. retrofit [ˈretrəˌfit] n.改造,改进,花样翻新
21. mitigate [ˈmitigeit] v.减轻
22. realtor [ˈriːəltə] n.房地产经纪人
23. conducive [kənˈdjuːsiv] n.益处　a.有益的
24. infrastructure [ˈinfrəˈstrʌktʃə] n.基础设施,下部构造
25. conveyance [kənˈveiəns] n.运输,财产让与,运输工具
26. ceramics [siˈræmiks] n.制陶术,制陶业,陶瓷(器)
27. vibrant [ˈvaibrənt] a.振动的
28. polymer [ˈpɔlimə] n.聚合体

Phrases and Expressions

1. retaining wall 挡土墙
2. geotechnical engineering 岩土工程
3. geoenvironmental engineering 地质环境工程
4. fluid dynamics 流体动力学
5. EDM (Electronic Distance Measurement) 电子测距
6. logistical operation 后勤工作
7. thermal waste 热废料
8. sewage treatment 污水处理
9. sanitary engineering 卫生工程
10. resonant frequency 共振频率
11. queuing theory 排队理论

Exercises

1. Translate the following paragraph into Chinese.

Engineering has been an aspect of life since the beginnings of human existence. Civil engineering might be considered properly commencing between 4000 and 2000 BC in Ancient Egypt and Mesopotamia when humans started to abandon a nomadic existence, thus causing a need for the construction of shelter. During this time, transportation became increasingly important leading to the development of the wheel and sailing. The construction of Pyramids in Egypt (circa 2700-2500 BC) might be considered the first instances of large structure constructions. Other ancient historic civil engineering constructions include the Parthenon by Iktinos in Ancient Greece (447-438 BC), the Appian Way by Roman engineers (c. 312 BC), and the Great Wall of China by General Meng T'ien under orders from Ch'in Emperor Shi Huang Ti (c. 220 BC).

2. Translate the following sentences into English.

(1) 土木工程可分为许多分支，如结构工程、交通工程、环境工程和岩土工程等。

(2) 与其他土木工程分支不同，在岩土工程中，很难明确定义边界条件。

(3) 结构工程涉及计算结构中的应力和内力等作用效应，以及确定结构构件的材料、尺寸和外形等。

(4) 采用 GPS 和激光扫描技术可精确测量角度、水平和垂直距离等。

(5) 过去卫生工程基本不涉及当今环境工程所包括的危险废物处理。

Reading Material

Skyscraper

A skyscraper is a very tall, continuously habitable building. There is no official definition or a precise cutoff height above which a building may clearly be classified as a skyscraper. However, as per usual practice in most cities, the definition is used empirically, depending on the relative impact of the shape of a building to a city's overall skyline. Thus, depending on the average height of the rest of the buildings and/or structures in a city, even a building of 80 meters height (approximately 262 ft) may be considered a skyscraper provided that it clearly stands out above its surrounding built environment and significantly changes the overall skyline of that particular city.

The word skyscraper originally referred to a nautical term tall mast or its main sail on a sailing ship. The term was first applied to buildings in the late 19th century as a result of public amazement at the tall buildings being built in Chicago, Detroit and New York City.

The structural definition of the word skyscraper was refined later by architectural historians, based on engineering developments of the 1880s that had enabled construction of tall multi-story buildings. This definition was based on the steel skeleton—as opposed to constructions of load-bearing masonry, which passed their practical limit in 1891 with Chicago's Monadnock Building. Philadelphia's City Hall, completed in 1901, still holds claim as the world's tallest load-bearing masonry structure at 167 m (548 ft). The steel frame developed in stages of increasing self-sufficiency, with several buildings in Chicago and New York advancing the technology that allowed the steel frame to carry a building on its own. Today, however, many of the tallest skyscrapers are built almost entirely with reinforced concrete. Pumps and storage tanks maintain water pressure at the top of skyscrapers.

A loose convention in the United States now draws the lower limit of a skyscraper at 150 meters (500 ft). A skyscraper taller than 300 meters (984 ft) may be referred to as supertall. In the United States, the supertall convention is 100 stories, which is equal to 1000 feet. Shorter buildings are still sometimes referred to as skyscrapers if they appear to dominate their surroundings.

The somewhat arbitrary term skyscraper should not be confused with the slightly less arbitrary term highrise, defined by the Emporis Standards Committee as "A high-rise building is a multi-story structure with at least 12 floors or 35 meters (115 feet) in height." All skyscrapers are highrises, but only the tallest highrises are skyscrapers. Habitability separates skyscrapers from towers and masts. Some structural engineers define a highrise as any vertical construction for which wind is a more significant load factor than weight is. Note that this criterion fits not only highrises but also some other tall structures, such as towers.

The word skyscraper often carries a connotation of pride and achievement. The skyscraper, in name and social function, is a modern expression of the age-old symbol of the world center or axis mundi: a pillar that connects earth to heaven and the four compass directions to one another.

Modern skyscrapers are built with materials such as steel, glass, reinforced concrete and granite, and routinely utilize mechanical equipment such as water pumps and elevators. Until the 19th century, buildings of over six stories were rare, as having great numbers of stairs to climb was impractical for inhabitants, and water pressure was usually insufficient to supply running water above 50m (164 ft). However, despite the lack of sanitation, the first highrise housing dates back to the 1600s in some places. In Edinburgh, Scotland, for example, a defensive city wall defined the boundaries of the city. Due to the restricted land area for development, the houses increased in height instead. Buildings of 11 stories were common, and there are records of buildings as high as 14 stories. Many of the stone-built structures can still be seen today in the old town of Edinburgh.

The oldest iron framed building in the world is the Flaxmill (also locally known as the " Maltings"), in Shrewsbury, England. Built in 1797, it is seen as the "grandfather of skyscrapers" due to its fireproof combination of cast iron columns and cast iron beams developed into the modern steel frame that made modern skyscrapers possible. Unfortunately, it lies derelict and needs much investment to keep it standing. On 31 March 2005, it was announced that English Heritage would buy the Flaxmill so that it could be redeveloped.

The first skyscraper was the ten-story Home Insurance Building in Chicago, built in 1884-1885. While its height is not considered unusual or very impressive today, the architect, Major William Le Baron Jenney, created the first load-bearing structural frame. In this building, a steel frame supported the entire weight of the walls, instead of load-bearing walls carrying the weight of the building, which was the usual method. This development led to the "Chicago skeleton" form of construction. After Jenney's accomplishment the sky was truly the limit as far as building was concerned.

Most early skyscrapers emerged in the land-strapped areas of Chicago, London, and New York toward the end of the 19th century. London builders soon found building heights limited due to a complaint from Queen Victoria, rules that continued to exist with few exceptions until the 1950s. concerns about aesthetics and fire safety had likewise hampered the development of skyscrapers across continental Europe for the first half of the twentieth century (with the notable exceptions of the 26-storey Boerentoren in Antwerp, Belgium, built in 1932, and the 31-storey Torre Piacentini in Genoa, Italy, built in 1940). After an early competition between New York City and Chicago for the world's tallest building, New York took a firm lead by 1895 with the completion of the American Surety Building. Developers in Chicago also found themselves hampered by laws limiting height to about 40 storeys, leaving New York to hold the title of tallest building for many years. New York City developers then competed among themselves, with successively taller buildings claiming the title of "world's tallest" in the 1920s and early 1930s, culminating with the completion of the Chrysler Building in 1930 and the Empire State Building in 1931, the world's tallest building for forty years. From the 1930s onwards, skyscrapers also began to appear in Latin America (São Paulo, Caracas, Mexico City) and in Asia (Tokyo, Shanghai, Hong Kong, Singapore).

Today, skyscrapers are an increasingly common sight where land is scarce, as in the centres of big cities, because of the high ratio of rentable floor space per area of land. Skyscrapers, like temples and palaces in the past, are considered the symbols of a city's economic power.

Unit 2

Text

Analysis of Plane Structures

- **Equations of Equilibrium**

A system of forces is said to be in equilibrium when the resultant of all the forces and the resultant of all the moments at one point are equal to zero. For a three-dimensional system with a set of mutually perpendicular axes, x, y and z, six conditions must be satisfied. These six conditions can be stated in mathematical terms as follows:

$$\sum P_x = \sum P_y = \sum P_z = 0$$
$$\sum M_x = \sum M_y = \sum M_z = 0$$

Where P_x is the component of any force in the x direction and M_x is the moment of a force P about the x axis.

In fact it is not necessary for the axes to be orthogonal—any three axes can be chosen for the summation of the forces, and any three axes for the summation of the moments. The case of parallel axes would of course be excepted.

If the system is coplanar, that is say $P_z = 0$ and $\sum M_x = \sum M_y = 0$, then there will be only three conditions of equilibrium

$$\sum P_x = \sum P_y = 0$$
$$\sum M_z = 0$$

Several special cases arise for a coplanar system.

1. If there are only two forces acting on a body that is in equilibrium, then the forces must be equal and opposite.

2. If there are only three forces acting on a body that is in equilibrium, then the three forces must be concurrent.

3. A set of coplanar forces not in equilibrium can be reduced to a single resultant force or resultant moment.

· Stability and Determinacy of Reactions

If we consider a two-dimensional system with known applied loads, the free-body diagram can be drawn showing all the unknown reactions. With the system in static equilibrium the three conditions of equilibrium can be applied, and will result in three equations in terms of the unknown reactions. The equations can then be solved simultaneously. For a complete solution there will in general be a limitation of three unknowns.

If there are less than three unknown independent reactions, there will not be sufficient unknowns to satisfy the three equations and the system will not be in equilibrium. It is then termed statically unstable so far as the external supports are concerned.

If there are more than three unknowns, the equations cannot be completely solved and the system will be statically indeterminate or redundant. For example if there were five unknowns, two of them could be assigned any value, the remaining three could then be found from the equations of equilibrium and would be entirely dependent on the values chosen for the first two reactions[1]. This does not mean that a statically indeterminate system is insoluble, the name implies that the system cannot be solved by the use of statics alone. Additional information will be required about the manner in which the system deforms under the applied loading. This type of structure is generally described as redundant and methods of solution will be discussed later.

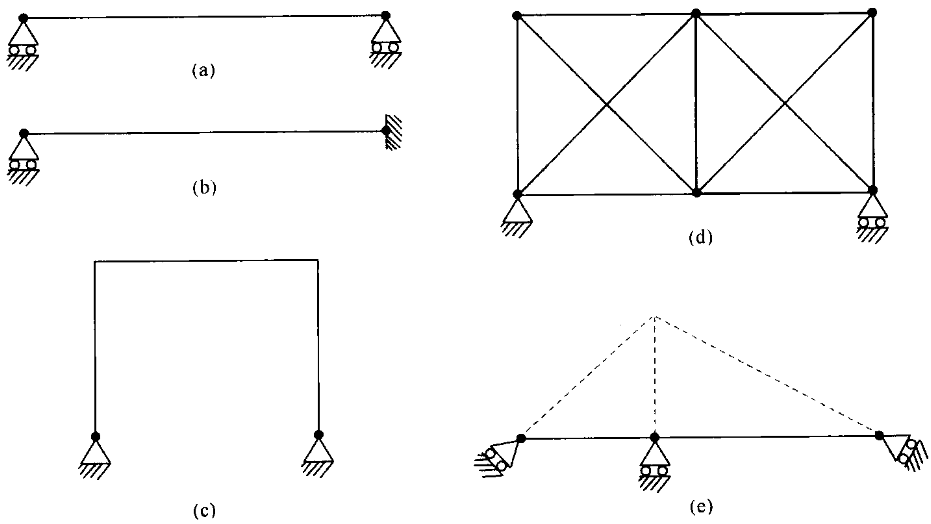

Fig.2.1 Two-dimensional structural system

In Fig.2.1 several examples of different structures are shown. The beam, in Fig.2.1(a), has only two unknown vertical reactions and will therefore be an unstable system. The beam, in Fig. 2.1(b), has four unknown reactions, one at the left-hand end and three at the right-hand end, the beam is therefore statically indeterminate to the first degree, that is there is one more reaction