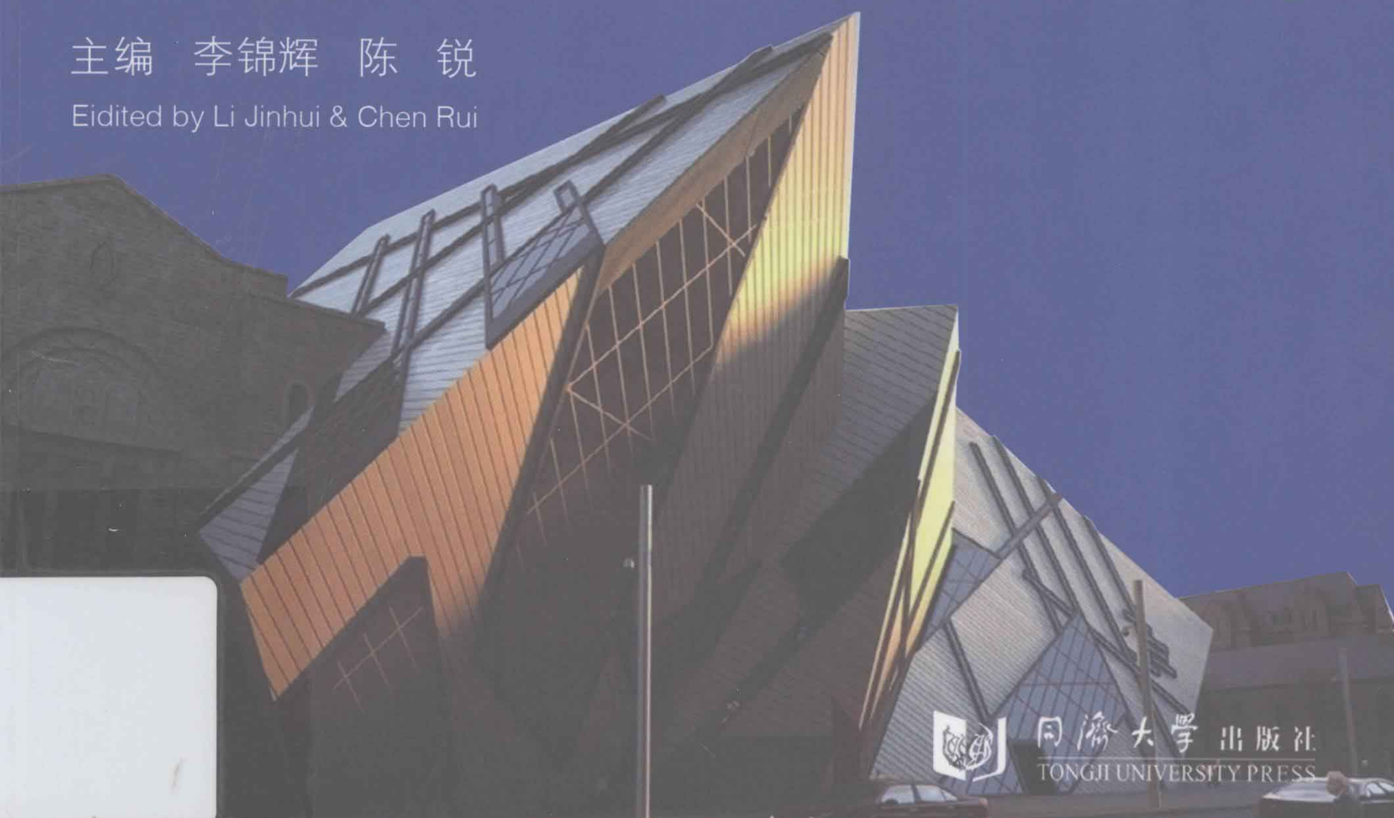
百校土木工程专业"十二五"规划教材

土木工程专业英语

English for Civil Engineering

主编 李锦辉 陈 锐

Eidited by Li Jinhui & Chen Rui



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内 容 提 要

本书第1章主要对土木工程领域的各个分支进行了总体介绍，第2章到第16章则依次介绍了高层建筑、空间结构、桥梁工程、道路工程、隧道工程、岩土工程、地震工程、建筑材料、测量、施工工程、项目管理、水资源工程、海岸工程、环境工程和市政工程。每章都介绍了一到两个工程案例，同时为便于读者查阅，每章末都附有文献索引。

本书内容翔实，附有大量土木工程案例，图文并茂。

本书可供土木工程、水利工程、道桥工程和环境工程等领域的高等院校师生、科研人员和工程技术人员参考。

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前　　言

近年来，随着建筑技术与材料的不断革新，土木工程领域涌现出一大批优秀作品。以地道的英语和专业的视角来解读这些优秀案例，成为编写这本土木工程领域专业英语教材的初衷。本书以宽口径的土木工程为基础，分别介绍了建筑工程、桥梁工程、道路工程、隧道工程、岩土工程、地震工程、建筑材料、测量、施工工程、项目管理、水资源工程、海岸工程、环境工程和市政工程的概貌以及这些分支的典型案例。

全书分16章，第1章介绍土木工程的范畴，其余每章分别介绍一个分支，并附有典型工程实例及小组讨论环节，同时，书中对专业词汇和部分语句进行了注释，便于读者查阅和理解。作为土木工程专业的英语教材，本书旨在提高学生的英语阅读能力，丰富他们的专业词汇，拓宽他们的专业视野。本书的主要特点为：

- 每章都设有工程实例，除了经典的工程案例，如金门大桥、三峡大坝、Hinkly地下水污染（被拍成电影《永不妥协》）等，还介绍了近年建成的世界著名案例，如哈利法塔（原名迪拜塔）、国家体育场（俗称“鸟巢”）、青藏铁路、上海长江隧道、Katrina飓风下的新奥尔良堤防系统等。对这些作品的专业解读不但能开阔读者的眼界，还为他们带来了阅读的趣味性；
- 每章末都设有小组讨论环节，讨论主题紧密联系文章内容，引导读者进一步思考并参与其中，从而深刻理解文章内容、掌握知识要点；
- 本书配有大量图片和表格，以帮助读者理解文章内容，并使阅读更加直观生动；
- 文章多精选自国外原著，有部分文章参考了最新的网络资源，且每篇资料都提供出处，便于有兴趣的读者进一步查阅。

本书由哈尔滨工业大学深圳研究生院的李锦辉和陈锐主编，深圳大学的苏栋教授在本书编写过程中对结构安排和素材选取提出了很多宝贵建议，曹倩负责了第九章的编写和校正工作，刘剑和柳笛在语法和译文加工方面给予了大力支持，杨歌女士对译文进行了校阅修改，同济大学出版社的季慧老师始终密切配合，在此谨表示真挚的感谢。同时本书引用了许多书刊或网站的图、表、文字和公式等，有的已在参考文献中列出，在此向原作者致以谢意，对于没有列出的文献，我们表示深深的歉意，如有异议，请联系编者。

由于编者水平有限，书中难免有不足之处，恳请广大读者批评指正。请将您的宝贵意见发送至huithrough@yahoo.com.cn。

编　者

2012年5月

CONTENTS

Unit 1
Civil Engineering

1.1 Introduction

Engineering is the art of converting knowledge into useful practical applications. Civil engineering is that branch of engineering which aims to provide a comfortable and safe living for the people. Shelter, one of the primary needs of mankind, is provided by civil engineers. The efficient planning of water supply and irrigation systems increases the food production in a country. Shelters, apart from just being shelters, have been constructed by civil engineers to provide a peaceful and comfortable life. The engineering marvels of the world, starting from the pyramids to today's thin shell structures, are the results of the development in civil engineering. Communication lines like roads, railways, bridges, etc. without which development is impossible, are fruits of civil engineers' work. Various functions of a civil engineer are listed below.

Investigation The first function of a civil engineer is to collect the necessary data that is required before planning a project.

Surveying The objective of surveying is to prepare maps and plans to locate the various structures of a project on the surface of earth.

Planning Depending on the results obtained from investigation and surveying, a civil engineer should prepare the necessary drawing for the project with respect to capacity, size and location of its various components. On the basis of this drawing, a preliminary estimate should be worked out.

Design After planning, the safe dimension of the componets required is worked out. With this dimension a detailed drawing is prepared for various components and also for the whole structure and a detailed estimate is also calculated.

Execution This function deals with the preparation of schedules for construction activities, floating of tenders, finalisation of contracts, supervision of construction work, preparation of bills and maintenance.

Research and development In addition to the above works, a civil engineer has to engage himself in research and development to achieve economy and to improve the efficiency to meet the present and future needs.

Any discipline of engineering is a vast field with various specialisations. Civil engineering is traditionally broken into several sub-disciplines including structural engineering, transportation engineering, geotechnical engineering, construction materials, surveying, construction engineering, water resources engineering, coastal engineering, environmental engineering and municipal engineering.

Structural Engineering

Structural engineering is concerned with the structural design and structural analysis of buildings, bridges, towers, flyovers, tunnels, off-shore structures like oil and gas fields in the sea, and other structures. This involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, and then designing the structure to successfully support and resist those loads. The loads can be self weight of the structures, other dead load, live loads, moving (wheel) load, wind load, earthquake load, load from temperature change, etc. The structural engineer must design structures to be safe for their users and to successfully fulfill the function they are designed for (to be serviceable). Due to the nature of some loading conditions, sub-disciplines within structural engineering have emerged, including wind engineering and earthquake engineering. Figure 1-1 shows the Petronas Towers in Malaysia which were the tallest buildings in the world from 1998 to 2004.

Figure 1-1 The Petronas Towers in Malaysia

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, some aspects of urban engineering, queueing theory, pavement engineering, intelligent transportation system, and infrastructure management. Figure 1-

2 shows Sutong Bridge in China, which was the cable-stayed bridge with the longest main span in the world as of 2010.

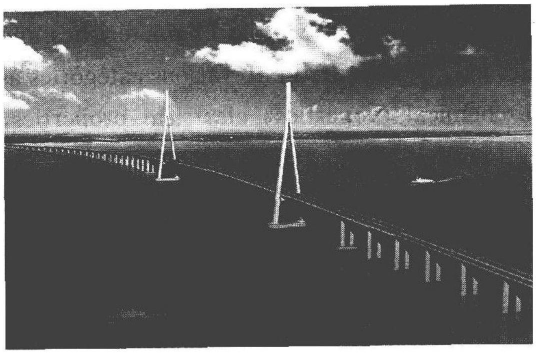

Figure 1-2 The Sutong Bridge in China

Figure 1-3 Deep excavation of Pingan IFC in Shenzhen

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. Figure 1-3 shows the deep excavation of Pingan International Finance Centre (IFC) in Shenzhen, China.

Earthquake Engineering

Earthquake engineering covers ability of various structures to withstand hazardous earthquake exposures at the sites of their particular location. Earthquake engineering is a sub-discipline of the broader category of structural engineering. The main objectives of earthquake engineering are: (i) understand interaction of structures with the shaky ground, (ii) foresee the consequences of possible earthquakes, (iii) design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes. Figure 1-4 shows shake table testing of two building models.

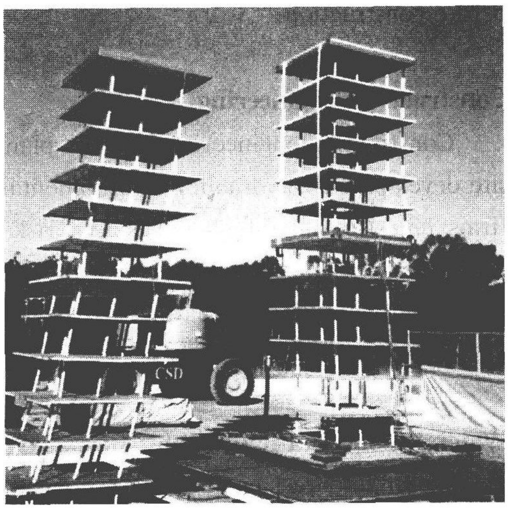

Figure 1-4 Shake table testing of two building models

Construction Materials

Construction materials deal with bricks, stones, cement, concrete and steel etc. Construction materials are found to be the basic elements for all engineering structures. So the behaviour of the structure depends on the behaviour of the basic elements, i. e. on the various characteristics and properties of the construction materials. Such properties may be classified into various categories as follows: physical properties, mechanical properties, chemical properties, electrical properties, magnetic properties, optical properties and thermal properties. From constructional aspects, the physical and mechanical properties are predominant. Hence, it is essential for a civil engineer to have knowledge on the various physical and mechanical properties of construction materials.

Surveying

Surveying is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, vertical and slope distances. With computerisation, electronic distance measurement (EDM), total stations, GPS surveying and laser scanning have supplemented (and to a large extent supplanted) the traditional optical instruments. 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 to design from, build on, and trade, respectively. Elements of a building or structure must be correctly sized and positioned in relation to each other and to site boundaries and adjacent structures. Although surveying is a distinct profession with separate qualifications and licensing arrangements, civil engineers are trained in the basics of surveying and mapping, as well as geographic information systems. Surveyors may also lay out the routes of railways, tramway tracks, highways, roads, pipelines and streets as well as position other infrastructures, such as harbors, before construction.

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.

Water Resources Engineering

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 resources 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. The actual design of the facility may be left to other engineers. 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 supply network, 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. Figure 1-5 shows Hoover dam in US, which is a concrete arch-gravity dam in the Black Canyon of the Colorado River, on the border between the US states of Arizona and Nevada.

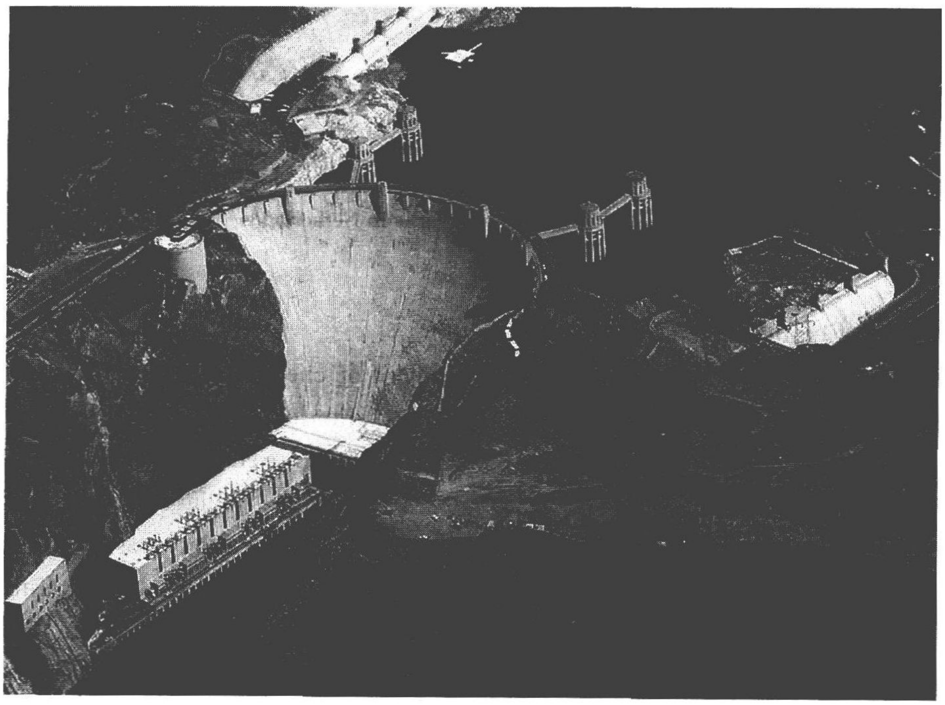

Figure 1-5 Hoover dam in US

Coastal Engineering

Coastal engineering is concerned with managing coastal areas. In some jurisdictions the terms sea defense and coastal protection are used to mean, respectively, defence against flooding and erosion. The term coastal defence is the more traditional term, but coastal management has become more popular as the field has expanded to include techniques that allow erosion to claim land. Figure 1-6 shows Zuiderzee Works in Netherlands which is a manmade system of dams, land reclamation and water drainage works.

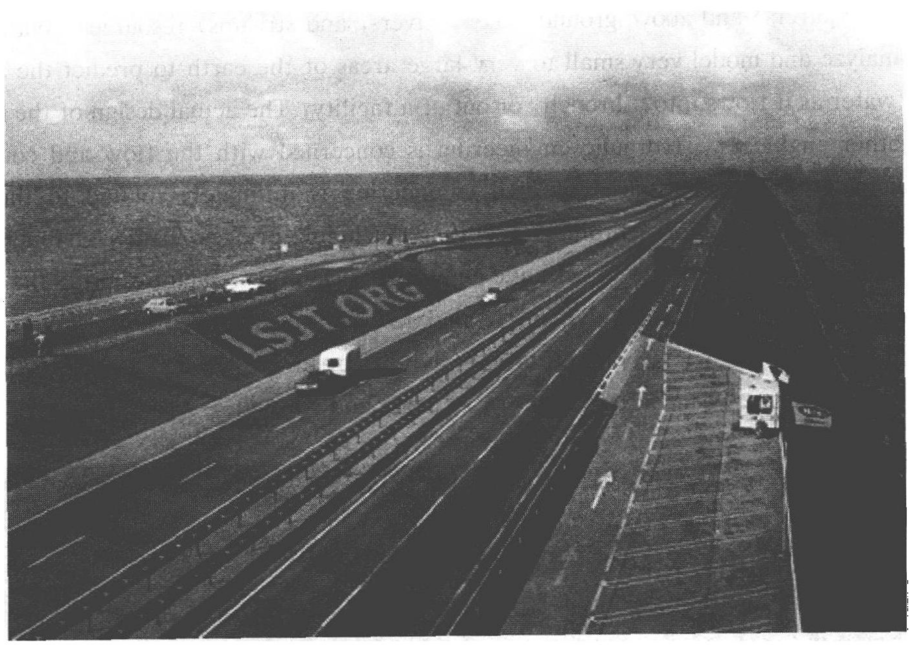

Figure 1-6 Zuiderzee Works in Netherlands

Envirionmental 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, waste water treatment, air pollution, solid waste treatment and hazardous waste management. 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. Figure 1-7 shows a filter bed which is a part of sewage treatment.

Figure 1-7 A filter bed

Municipal Engineering

Municipal engineering is concerned with municipal infrastructure. This involves specifying, designing, constructing, and maintaining streets, sidewalks, water supply networks, sewers, street lighting, municipal solid waste management and disposal, storage depots for various bulk materials used for maintenance and public works (salt, sand, etc.), public parks and bicycle paths. In the case of underground utility networks, it may also include the civil portion (conduits and access chambers) of the local distribution networks of electrical and telecommunications services. It can also include the optimizing of waste collection and bus service networks. Some of these disciplines overlap with other civil engineering specialties. However, municipal engineering focuses on the coordination of these infrastructure networks and services, as they are often built simultaneously, and managed by the same municipal authority.

Notes

1. 本文节选自本单元后参考文献[1—6]。
2. Communication lines like roads, railways, bridges, etc. without which development is impossible, are fruits of civil engineers' work. 如果没有公路、铁道、桥梁这些交通干道的存在,社会不可能得到发展。而这些交通干道的建成则归功于土木工程师们的努力。句中,"which"是指"communication lines"。
3. 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. 与地下水和废弃物处理相关的环境问题衍生出一个全新的研究领域——环境岩土工程。在这门学科中,生物学和化学知识所占的分量很重。
4. Design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes. 设计、建造和维修结构物使其在地震荷载作用下达到预期性能并同时满足建筑规范的要求。

Words and Expressions

shelter	*n.*	居所，庇护所
irrigation	*n.*	灌溉，冲洗
pyramid	*n.*	金字塔
thin shell structure		薄壳结构
geotechnical	*adj.*	土工技术的
municipal	*adj.*	市政的
coastal	*adj.*	沿海的，海岸的
biological	*adj.*	生物的
thermal	*adj.*	热的，热量的
purification	*n.*	净化，提纯
remediation	*n.*	补救，矫正
contaminated site		污染场地
geology	*n.*	地质学，地质情况
hydraulic		水力的
retaining wall		挡土墙
spawn	*v.*	造成，酿成
geoenvironmental engineering		环境岩土工程
flyover	*n.*	天桥，立交桥
off-shore structure		近海结构
conducive	*adj.*	有益的，有助于……的
vibrant	*adj.*	有活力的，振动的
canal	*n.*	运河，灌溉水渠
mass transit		公共交通，大众运输
queueing theory		排队论，大系统服务理论
pavement	*n.*	路面
infrastructure	*n.*	基础设施，公共建设
sidewalk	*n.*	人行道
sewer	*n.*	下水道
conduit	*n.*	沟渠，导水管
access chamber		通道井
meteorology	*n.*	气象学
conservation	*n.*	保存，保持
aquifer	*n.*	蓄水层
conveyance	*n.*	运输
culverts	*n.*	涵洞
levee	*n.*	堤坝
statics	*n.*	静力学
dynamics	*n.*	动力学
jurisdiction	*n.*	管辖区
erosion	*n.*	侵蚀，腐蚀
level	*n.*	水准仪
theodolite	*n.*	经纬仪
angular deviation		角度偏差
computerisation	*n.*	电子计算机化
total station		全站仪
GPS		全球定位系统
laser scanning		激光扫描
license	*n.*	执照，许可证
lay out		安排，展示
tramway	*n.*	电车，电车轨道
logistical		后勤的
shaky	*adj.*	摇晃的

1.2 Group Discussion

Task 1

Can you list and describe the impressive structures in civil engineering you've ever seen?

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Task 2

Which sub-discipline do you like in civil engineering? Why?

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Unit 2
Structural Engineering: Tall Buildings

2.1 Introduction

Tallness is a relative matter and tall buildings cannot be defined in specific terms related just to height or to the number of floors. The tallness of a building is a matter of a person's or community's circumstance and their consequent perception; therefore, a measurable definition of a tall building cannot be universally applied. From the structural engineer's point of view, however, a tall building may be defined as one that, because of its height, is affected by lateral forces due to wind or earthquake actions to an extent that they play an important role in the structural design. The influence of these actions must therefore be considered from the very beginning of the design process.

Tall buildings emerged in the late nineteenth century in the United States of America. They constituted a so-called "American Building Type", meaning that most important tall buildings were built in the U.S.A. Today, however, they are a worldwide architectural phenomenon. Many tall buildings are built worldwide, especially in Asian countries, such as China, Korea, Japan, and Malaysia.

Traditionally the function of tall buildings has been as commercial office buildings. Tall commercial buildings are primarily a response to the demand by business activities to be as close to each other, and to the city center, as possible, thereby putting intense pressure on the available space. Also, because they form distinctive landmarks, tall commercial buildings are frequently developed in city centers as prestige symbols for corporate organizations. Other usages, such as residential, mixed-use, and hotel tower developments have since rapidly increased. There has been some skepticism regarding construction of tall buildings since September 11, 2001, however, they will continue to be built due to their significant economic benefits in dense urban land use.

Tall building development involves various complex factors such as economics, aesthetics,