高等学校建筑类专业英语规划教材

Heating Ventilation and Air Conditioning

建筑环境与设备工程专业

（建筑环境与能源应用工程专业）

李安桂　主　编
闫秋会　南晓红　张孙孝　副主编

中国建筑工业出版社

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前　言

本书旨在培养建筑环境与设备工程（建筑环境与能源利用工程）专业学生的科技英语阅读、翻译和写作能力，提高学生以英语为工具获取专业所需信息的能力，为学生日后的工作、科学研究以及国际学术交流等打下良好的英语基础。

本书内容体系、课文选材考虑了学术性、实用性、可读性等方面。期望本书作为敲门之石，帮助大学生建立工程师素质、专业能力、未来进一步深造所关心的国外高校研究方向动态的成功之桥，学而有所思、有所得、有所悟。本书主要内容直接选自英、美等国家的高等教育年鉴、原版教科书和相关大学的课程体系设置，涉及工程热力学、传热学、流体力学、供热、空调、制冷、热泵、通风、锅炉、可再生能源等相关知识。结合作者多年的教学经验，在保持以往同类教材优点的基础上，本书在内容选取、体系设置等方面力争具有以下特色：

（1）内容选取上，既注重专业基础内容，又追踪暖通空调的发展历史，并关注目前的研究热点，力争实现“启发性”、“知识性”和“前瞻性”的有机结合；

（2）内容安排上，每个单元后均配有生词、短语、注释内容以及练习题，特别注重学生写作能力的培养；

（3）本书适当增加了图片信息，加强了直观效果，以期激发读者的阅读兴趣；

（4）本书附录包括了本专业涉及的国际期刊、学术组织、国际会议、专业术语、相关规范的翻译以及国际著名大学的课程设置等内容，对大学生日后的工作和进一步深造有一定的参考价值。

本书力图实现“启发性”、“可读性”、“前瞻性”以及“书目有留存价值”的有机融合，旨在使学生专业英语的阅读能力、翻译能力、写作能力及科学思维能力能够迈上新的台阶。

本书编写分工如下：李安桂（西安建筑科技大学）任主编，负责教材体系、选材衔接及内容科学设置等工作，并编写 Lesson 1 以及附录 A～附录 D。闫秋会（西安建筑科技大学）编写了 Lesson2～Lesson6 以及 Lesson17，南晓红（西安建筑科技大学）编写了 Lesson7～Lesson11 以及 Lesson16，张孙孝（长安大学）编写了 Lesson12～Lesson15。全书由李安桂教授统稿。

本书在编写过程中，研究生刘菊、王罡、王伟、甄亚曼、宋艳艳和刘永娟等作了资料性协助工作，在此一并表示感谢。

本书得到“西安建筑科技大学专业外语系列重点教材”教改项目的资助。本书可作为建筑环境与设备工程专业及相关专业本科生专业英语教材，同时也可以作为相关专业教师、工程技术人员和科研人员的参考书。由于编者水平有限，编写中难免有不妥之处，恳请广大读者对本教材的缺点错误予以斧正。

CONTENTS

Part 1 Reading Courses of Occupational English for HVAC (专业英语教程)

Lesson 1 Requirements for an Engineer and Brief Introduction to Engineering (工程师职业素养)

What is Engineering?

[1] Engineering is the art of applying scientific and mathematical principles, experience, judgment, and common sense to make things that benefit people. Engineers design bridges and important medical equipment as well as processes for cleaning up toxic spills and systems for mass transit. In other words, engineering is the process of producing a technical product or system to meet a specific need.

[2] Engineers have many different types of jobs to choose from, including research, design, analysis, development, testing, and sales positions. If you are interested in discovering new knowledge, you might consider a career as a research engineer. If you are imaginative and creative, design engineering may be for you. The work of analytical engineers most closely resembles what you do in your mathematics and science classes. If you like laboratory courses and conducting experiments, look into becoming a development engineer. Sales engineering could be a good choice if you are persuasive and like working with people.

[3] Engineering work is also organized by traditional academic fields of study. The five largest of these are chemical, civil, electrical, industrial, and mechanical engineering. There are also more specialized engineering fields, including aerospace, ocean, nuclear, biomedical, and environmental engineering.

What is HVAC?

[4] You've probably heard of the term from different contractors, engineers, or perhaps colleagues and business partners; but you're still wondering what the initialism means. Well, HVAC ("H-V-A-C" or "H-VAC") stands for Heating, Ventilation, and Air-Conditioning—three closely related fundamental functions found in homes, offices, and other building structures.

[5] The beginning of HVAC is not clear, though as early as second century, a lot of Roman cities were using a central heating system known as hypocaust. This is further popularized during the Industrial Revolution as big factories used it. Now most modern buildings that you see have integrated HVAC.

[6] The HVAC system is also known as climate control. This is because these three functions are essential in maintaining comfort in every dwelling.

[7] The primary use of HVAC is to regulate room temperature, humidity, and air flow, ensuring that such elements remain within their acceptable ranges. Effective control of such factors minimizes health-related risks. A very humid atmosphere impairs the body's ability to regulate body temperature as it prevents the evaporation of sweat. High humidity also decreases physical strength, which usually leads to fatigue. An unhealthy surrounding

can also affect people's thinking abilities. Hypothermia, heat stroke, and hyperpyrexia, among others, are some of the illnesses that may also occur.

Three Functions of HVAC

[8] Heating is significant in maintaining adequate room temperature especially during colder weather conditions. There are two classifications of heating: local and central. The latter is more commonly used because it is more economical. Furnace or boiler, heat pump, and radiator make up the heating system.

[9] Ventilation, on the other hand, is associated with air movement. There are many types of ventilation, but they all function similarly. Ventilation is necessary to allow carbon dioxide to go out and oxygen to get in, making sure that people are inhaling fresh air. Stagnant air causes the spreading of sickness, usually airborne, and allergies. But it is also essential to maintain an efficient ventilation system, especially in the attics. Insufficient ventilation usually promotes the growth of bacteria and fungi such as molds because of high humidity. It will also decrease the effectiveness of rafter and roof sheathing insulation because of water vapor condensation.

[10] The air-conditioning system controls the heat as well as ventilation. They often come in different sizes. Most air conditioners have large air ducts, so it is better to check out the building first to see if they can be installed. Or else, you can use the split system or remote coils. It is necessary, though, that air ducts are properly cleaned. Pathogens thrive in dirty air ducts. Return-air grills are also vulnerable to chemical, microbiological, and radiological elements. Thus, HVAC return-air grill height should be that it is not accessible but visible for any observation.

The Future of HVAC

[11] How has technology changed in the HVAC field? Well, using PLCs (Programmable Logic Controllers) in HVAC is the trend nowadays. But a great deal of development of the HVAC system lies on the ever-changing technology and continuous innovation. Companies are adopting wireless technology after they found out that networking HVAC controllers, which often use sensors, can eventually cut installation and labor costs. A lot of engineers are also focused on further improving this technology through the use of mesh wireless setup, which will work for both the wireless sensor and wireless controller networks. The only downside of this could probably be the risk of being exposed to RF (Radio Frequency) radiation.

[12] The installation of an HVAC system is imperative if we want to achieve maximum comfort and be healthy in our homes, office spaces, or other building facilities. But you also need to consider the building size in installing an HVAC system. Optimum efficiency and comfort level are best achieved if the system is appropriate for the size. After all, any ineffective system usually means more incurred costs in the future. You should also see to it that HVAC is carefully integrated to the overall building design so other aspects needed for proper operations, such as cabling, are not sacrificed.

What is Civil Engineering and HVAC Engineering?

[13] Civil engineering is a remarkably broad field of study serving people by designing, constructing and maintaining the infrastructure of society including buildings, bridges, highways, airports, and harbors. Civil engineers impact the quality of the built environment and the quality of our land, water, and air resources. Students can elect to prepare for professional careers such as structural, environmental, transportation, construction, hydraulic, geotechnical, or surveying engineers. The curriculum accommodates this breadth by providing a fundamental set of required courses complemented by sufficient flexibility to allow students to concentrate portions of their studies on the special areas that are of particular interest to them.

Ten great reasons why you will love it!

What is an engineer?

[14] Engineers use their imagination and analytical skills to invent, design, and build things that matter. They are team players with independent minds who ask, "How can we develop a better recycling system to protect the environment, design a school that can withstand an earthquake, or create cutting-edge special effects for the movies?" By dreaming up creative and practical solutions, engineers are changing the world all the time.

Nature of the Engineer Work

[15] Engineers apply the principles of science and mathematics to develop economical solutions to technical problems. Their work is the link between scientific discoveries and the commercial applications that meet societal and consumer needs.

[16] Many engineers develop new products. During this process, they consider several factors. For example, in developing an industrial robot, engineers precisely specify the functional requirements; design and test the robot's components; integrate the components to produce the final design; and evaluate the design's overall effectiveness, cost, reliability, and safety. This process applies to the development of many different products, such as chemicals, computers, power plants, helicopters, and toys.

[17] In addition to design and development, many engineers work in testing, production, or maintenance. These engineers supervise production in factories, determine the causes of component failure, and test manufactured products to maintain quality. They also estimate the time and cost to complete projects. Supervisory engineers are responsible for major components or entire projects.

[18] Engineers use computers extensively to produce and analyze designs; to simulate and test how a machine, structure, or system operates; to generate specifications for parts; and to monitor product quality and control process efficiency. Nanotechnology, which involves the creation of high-performance materials and components by integrating atoms and molecules, also is introducing entirely new principles to the design process.

[19] Most engineers specialize. Following are details on the 17 engineering specialties covered in the Federal Government's Standard Occupational Classification (SOC) system.

Numerous other specialties are recognized by professional societies, and each of the major branches of engineering has numerous subdivisions. Civil engineering, for example, includes structural and transportation engineering, and materials engineering includes ceramic, metallurgical, and polymer engineering. Engineers also may specialize in one industry, such as motor vehicles, or in one type of technology, such as turbines or semiconductor materials.

Work Environment.

[20] Most engineers work in office buildings, laboratories, or industrial plants. Others may spend time outdoors at construction sites and oil and gas exploration and production sites, where they monitor or direct operations or solve onsite problems. Some engineers travel extensively to plants or worksites here and abroad.

[21] Many engineers work a standard 40-hour week. At times, deadlines or design standards may bring extra pressure to a job, requiring engineers to work longer hours.

- **Love your work, and live your life too!**

[22] Engineer is an exciting, rewarding career choice for young men and women. Engineering is an exciting profession, but one of its greatest advantages is that it will leave you time for all the other things in your life that you love!

- **Be creative**

[23] Engineering is a great outlet for the imagination—the perfect field for independent thinkers.

- **Work with great people**

[24] Engineering takes teamwork, and you'll work with all kinds of people inside and outside the field. Whether they're designers or architects, doctors or entrepreneurs, you'll be surrounded by smart, inspiring people.

- **Solve problems, design things that matter**

[25] Come up with solutions no one else has thought of. Make your mark on the world.

- **Never be bored**

[26] Creative problem solving will take you into uncharted territory, and the ideas of your colleagues will expose you to different ways of thinking. Be prepared to be fascinated and to have your talents stretched in ways you never expected.

- **Make a big salary**

[27] Engineers not only earn lots of respect, but they're highly paid. Even the starting salary for an entry-level job is impressive!

- **Enjoy job flexibility**

[28] An engineering degree offers you lots of freedom in finding your dream job. It can be a launching pad for jobs in business, design, medicine, law, and government. To employers or graduate schools, an engineering degree reflects a well-educated individual who has been taught ways of analyzing and solving problems that can lead to success in all

kinds of fields.

• **Travel**

[29] Field work is a big part of engineering. You may end up designing a skyscraper in London or developing safe drinking-water systems in Asia. Or you may stay closer to home, working with a nearby high-tech company or a hospital.

• **Make a difference**

[30] Everywhere you look you'll see examples of engineering having a positive effect on everyday life. Cars are safer, sound systems deliver better acoustics, medical tests are more accurate, and computers and cell phones are a lot more fun! You'll be giving back to your community.

• **Change the world**

[31] Imagine what life would be like without pollution controls to preserve the environment, life-saving medical equipment, or low-cost building materials for fighting global poverty. All this takes engineering. In very real and concrete ways, engineers save lives, prevent disease, reduce poverty, and protect our planet.

[32] Today, just 20 percent of undergraduate engineering students are women. Even more astounding is the number of women engineers in the professional workforce - less than ten percent! Engineer Your Life is an unprecedented awareness and outreach program designed to encourage young women to choose engineering as a career and to develop a new generation of role models for those already in the field.

What Engineers Do: A Look Behind the Scenes

[33] Typical Progression:

- Orientation and some reading
- Small assigned task with supervision
- Small assigned task with minimum supervision
- Larger assigned task with supervision
- Large assigned task with technician support
- Help choose your own task: Define your own support, schedule
- Define a task and work with others to get it done
- Define a significant task and lead a group of peers
- Become a local expert in your area of expertise
- Interact with other groups and secure their cooperation to accomplish a task
- Help define a major piece of work: Lay out the plan and execute it
- Publish/invent/document significant ideas
- Become the major engineer on a product or major part of a product
- Choose a management career: Manage a department, or Secure support for your own project
- Choose a technical career: Become a recognized expert at your site and beyond, or Consult widely in your area of expertise

- Lead major task forces
- Move up the corporate ladder

[34] Solve Design Problems:

Fuzzy definition of task ("Figure out what needs doing and do it!")

- Factor in time constraint ("If I wanted it tomorrow, I'd ask you tomorrow!")
- Factor in cost constraint (Cheaper than anyone ever did it before)
- Factor in constrained resources (few people, equipment not available)
- Balance priority with other duties ("Don't let your other work slip!")
- Learn where to seek help: Develop a support group.

[35] Schedules:

- State resource assumptions (people, equipment)
- Do two schedules: Working back from end date, Working forward from start date, Seek a reasonable balance
- State dependencies and exposures
- Draw up schedule with tasks, start/end dates
- Review schedule with peers for sanity
- Submit to manager for review
- Rework schedule (Don't commit to insanity!)
- Final review with manager
- Do it!: Track your schedule, Make notes of what you forgot for next time, Get good at scheduling (Your boss will love you!)

[36] Product Planning:

- Market requirements (Who wants it, what functions are important?)
- Competitive analysis (Who is competition, what performance and price?)
- When could the product be announced?
- What countries? Language translations.
- Development plan: Assign design team, Budget/resource estimate, Functional specifications, Major check points, Development schedule (components/prototypes), Test plans with schedule, Test model build/debug, Test schedule, Documentation schedule, Problem resolution and redesign time, Manufacturing plan, Marketing plan, Human factors, Costs/cost reduction plan
- Reliability/service cost estimate: Monthly usage estimate, Repair actions per month, Duration of repair action, Service aids
- Market plan: Who will sell it, Who will buy it, How many will be sold, Advertising, Sales incentives, Order/delivery method, Service/maintenance plan, Marketing/development commitment to plan, Check points, Marketing literature, Early demo hardware
- Manufacturing plan: Where to be manufactured, How many (by month), Manufacturing cost estimate, Packaging and ship group, Distribution, Commitment agreements, Budget (by quarter/year), Capital expenses/schedule (equipment), Head count buildup

(and skills)

- Test schedule and early model quantities/assignments
- Announce date and general availability dates
- Reviews by everyone involved (non-congruency and resolution)
- Continual negotiation
- Profit/revenue plan
- Safety/security/EO plans
- Budget/space/resource/schedule/equipment plans: Justify everything, Multiple iterations, Fight for your share
- Personnel appraisals/promotions/awards/reprimands/dismissals
- Presentations to upper management on every subject
- Keep employees appropriately informed
- Maintain troop morale throughout tough times
- Look calm and reassure the troops when the word is caving in
- Plan ahead constantly for contingencies (and insanity)
- Protect troops/turf against raiders and upper management gyrations
- Work within budget/manpower/schedule/space constraints (ever changing)
- Get others to do work for you, preferably out of their budget
- Write nice notes to managers of folks who help you: They will love to help you again, Your note help justify raises/promotions
- Calmly take the blame for everything that happens: By definition you are responsible, Excuses do not impress anyone
- Know everything about anything ("Ask your manager!")
- Great responsibility with surprisingly little authority: Succeed in spite of it all, Find ways around the system (its your job), Ask forgiveness (not permission), Be unbelievably creative, Don't whine
- Praise your good people to the sky! Get them incredible raises and promotions!

[37] Senior Technical Tasks:

- Budgeting: People, Money, Capital equipment, Space, Salaries, Support from other groups
- Set a professional tone for the department
- Encourage colleagues
- Mentor younger colleagues
- Publish papers, formal and informal
- Teach courses
- Patent applications
- Set technical direction for the department, site
- Lead Technical Presentations: Department, Management, Tech Society, Executives
- Lead design reviews

- Lead/partcipate in program audits
- Lead Task Forces (Serious technical problems): Listen and absorb info quickly, Recommend actions, Create and defend action plan, Get resources, Assign tasks, Monitor results daily, Daily/Weekly Status Reports, Management/Executive Presentations, Hold off the Doomsayers, Final recommendations (report)
- Consult widely (formal, phone calls, meetings)
- Participate in advanced technical planning
- Continue to study and grow in your field of expertise
- Broaden your areas of expertise-tackle new things

Engineering Specialty Employment in Key Industries

[38] About 37 percent of engineering jobs were found in manufacturing industries and another 28 percent were in the professional, scientific, and technical services sector, primarily in architectural, engineering, and related services. Many engineers also worked in the construction, telecommunications, and wholesale trade industries.

[39] Federal, State, and local governments employed about 12 percent of engineers in 2006. About half of these were in the Federal Government, mainly in the U. S. Departments of Defense, Transportation, Agriculture, Interior, and Energy, and in the National Aeronautics and Space Administration. Most engineers in State and local government agencies worked in highway and public works departments. In 2006, about 3 percent of engineers were self-employed, many as consultants.

[40] Engineers are employed in every State, in small and large cities and in rural areas. Some branches of engineering are concentrated in particular industries and geographic areas—for example, petroleum engineering jobs tend to be located in areas with sizable petroleum deposits, such as Texas, Louisiana, Oklahoma, Alaska, and California. Others, such as civil engineering, are widely dispersed, and engineers in these fields often move from place to place to work on different projects.

[41] Engineers are employed in every major industry. The industries employing the most engineers in each specialty are given in table 1, along with the percent of occupational employment in the industry.

Percent concentration of engineering specialty employment in key industries, 2006 Table 1

Specialty	Industry	Percent
Aerospace engineers	Aerospace product and parts manufacturing	49
Agricultural engineers	Food manufacturing	25
	Architectural, engineering, and related services	15
Biomedcal engineers	Medical equipment and supplies manufacturing	20
	Scientific research and development services	20
Chemical engineers	Chemical manufacturing	29

continued

Specialty	Industry	Percent
	Architectural, engineering, and related services	15
Civil engineers	Architectural, engineering, and related services	49
Computer hardware engineers	Computer and electronic product manufacturing	41
	Computer systems design and related services	19
Electrical engineers	Architectural, engineering, and related services	21
Electronics engineers, except computer	Computer and electronic product manufacturing	26
	Telecommunications	15
Environmental engineers	Architectural, engineering, and related services	29
	State and local government	21
Health and safety engineers, except mining safety engineers and inspectors	State and local government	10
Industrial engineers	Transportation equipment manufacturing	18
	Machinery manufacturing	8
Marine engineers and naval architects	Architectural, engineering, and related services	29
Materials engineers	Primary metal manufacturing	11
	Semiconductor and other electronic component manufacturing	9
Mechanical engineers	Architectural, engineering, and related services	22
	Transportation equipment manufacturing	14
Mining and geological engineers, including mining safely engineers	Mining	58
Nuclear engineers	Research and development in the physical, engineering, and life sciences	30
	Electric power generation, transmission and distribution	27
Petroleum engineers	Oil and gas extraction	43