Eugene J. Hall English For Careers

The Language of Civil Engineering in English

Eugene J. Hall English For Careers

The Language of Civil Engineering in English

Regents Publishing Company, Inc.

Illustrations by Oscar Fernandez

Published by
Regents Publishing Company, Inc.
2 Park Avenue
New York, N.Y. 10016

Printed in the United States of America

ISBN 0-88345-282-0

OTHER TITLES IN THE ENGLISH FOR CAREERS SERIES

The Language of Air Travel in English: Ground Services	# 18500
The Language of Air Travel in English: In-Flight Services	# 18501
The Language of the Petroleum Industry in English	# 18502
The Language of Computer Programming in English	# 18503
The Language of International Finance in English: Money and Banking	# 18504
The Language of the Air Force in English	# 18505
The Language of the Army in English	# 18506
The Language of the Navy in English	# 18507
The Language of Tourism in English	# 18508
The Language of Hotels in English	# 18509
The Language of Restaurants and Catering in English	# 18510
The Language of Hospital Services in English	# 18511
The Language of Accounting in English	# 18512
The Language of National Defense in English	# 18513
The Language of Atomic Energy in English	# 18514
The Language of Chemical Engineering in English	# 18515
The Language of Electrical and Electronic Engineering in English	# 18517
The Language of Mechanical Engineering in English	# 18518
The Language of the Merchant Marine in English	# 18519
The Language of Advertising and Merchandising in English	# 18520
The Language of Mining and Metallurgy in English	# 18521
The Language of International Trade in English	# 18522
The Language of Aviation in English: Flying and Traffic Control	# 18523
The Language of Agriculture in English	# 18524

FOREWORD

This book is one of a series of texts called *English for Careers*. The series is intended to introduce students of English as a foreign language to a number of different professional and vocational fields. The career areas that are covered are those in which English is widely used throughout the world—air travel, computer programming, international trade, or in the case of this particular book, engineering and specifically civil engineering.

Each book in the series serves several purposes. The first, of course, is to introduce the student to the particular vocational area in which he or she is involved. The duties of different kinds of jobs are discussed, as well as the problems that might be encountered at work. In this book, different phases of the civil engineering field are discussed, together with some of the methods involved in designing structures for a number of different purposes. The aptitudes and education that an engineer must have are also discussed, as well as some of the specific job areas in which he or she may work. The book is not intended as a detailed training manual, but rather as a broad introduction to the different kinds of work in the field of civil engineering.

From the point of view of teaching English as a foreign language, these books are intended for a student at the high intermediate or advanced level. In other words, the student who uses these books should be acquainted with most of the structural patterns of English. His or her principal goals as a learner should be mastering vocabulary, using the various patterns in a normal mixture, and improving his or her ability to communicate in English.

These books address themselves to all of these needs. Each unit begins with a glossary of special terms in which pertinent words and expressions are defined. The special terms are followed by a vocabulary practice section in which the student is asked questions whose answers will help him or her to use the special terms. In the reading which follows, these terms are used again within a contextual frame of reference. Each reading in turn is followed by questions for discussion which give the student the opportunity to use in a communicative situation both the vocabulary items and the structural patterns that have occurred in the reading.

Each unit ends with an exercise or exercises, some of which pose problems that might occur if the student were actually working in the field. In this book, for instance, he or she is asked to identify different kinds of bridges and their structural characteristics, or to identify defects in design and explain why the designs are defective. In doing such exercises, he or she will also practice the specialized vocabulary, as well as other vocabulary items and structural patterns.

A great deal of successful language learning comes from experiences in which the learning is largely unconscious. In offering these books, it is hoped that the student's interest in the career information presented will increase his or her ability to communicate more easily in English.

EUGENE J. HALL
Washington, D.C.

TABLE OF CONTENTS

UNIT ONE
THE ENGINEERING PROFESSION

Special Terms

Engineering: The practical application of the findings of theoretical science so that they can be put to work for the benefit of mankind. An *engineer* is a member of the engineering profession, although this term is also used to refer to someone who operates or maintains certain kinds of equipment—a *railroad locomotive engineer*, for example. In the latter context, the person referred to is a technician rather than a professional engineer.

Profession: An occupation, such as law, medicine, or engineering, that requires specialized education at the university level.

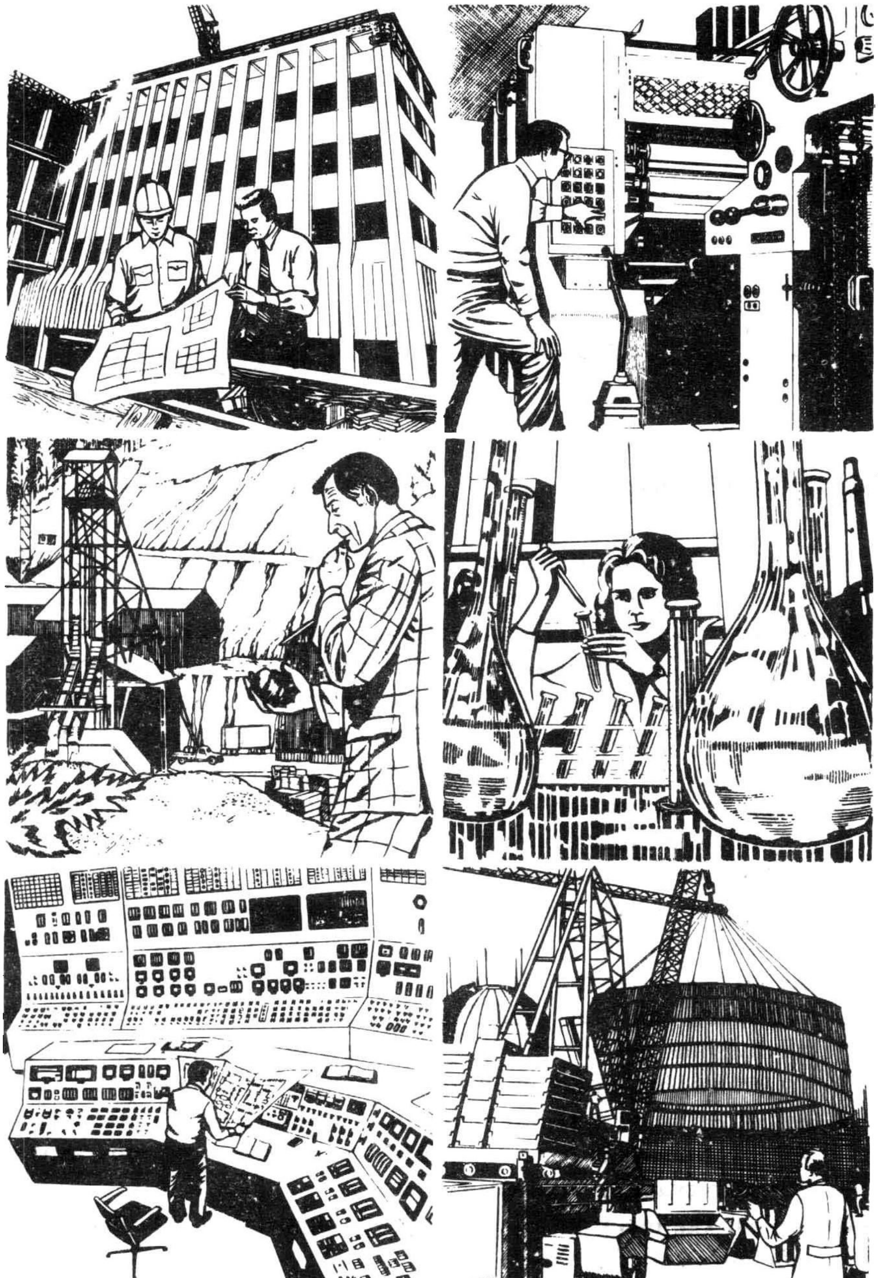
Empirical Information: Information that is based on observation and experience rather than theoretical knowledge.

Civil Engineering: The branch of engineering that deals with the design and construction of structures that are intended to be stationary, such as buildings, dams, and bridges. Among its subdivisions are *structural engineering*, dealing with permanent structures; *hydraulic engineering*, dealing with the flow of water and other fluids; and *environmental/sanitary engineering*, dealing with water supply, water purification, and sewer systems, as well as urban planning and design.

Mechanical Engineering: The branch of engineering that deals with machines and their uses.

Mining and Metallurgy: The branch of engineering that deals with extracting metal ores from the earth and refining them.

Chemical Engineering: The branch of engineering that deals with processes involving reactions among the *elements*, the basic



Different kinds of engineers at work. Clockwise from the upper left: civil engineer, mechanical engineer, chemical engineer, nuclear engineer, electrical and electronics engineer, and mining engineer.

natural substances. *Petroleum engineering* is a subdivision which deals specifically with processes involving petroleum.

Electrical and Electronic Engineering: The branch of engineering that deals with the effects and processes that result from the behavior of tiny particles of matter called electrons.

Nuclear Engineering: A modern branch of engineering that deals with the processes that result from breaking up some particles of matter.

Aqueduct: A structure that is used for transporting water over long distances.

Stress: Physical pressure or other forces exerted on an object. The force of gravity, the natural pull of the earth, for example, is one of the stresses that acts on an object.

Silt: Sand or earth transported from one location by water and deposited as sediment at a second location.

Environmental Impact Study: A study that shows the effect a proposed structure will have on its surroundings: the air, water, human, animal, and plant life, for example. Such studies are now required for most major construction projects in the United States.

Quantification: Putting data (pieces of information) into exact mathematical terms.

Vocabulary Practice

1. What does *engineering* mean?

2. What is a *profession*? Give some examples.

3. How does a railroad locomotive engineer differ from a professional engineer?

4. What is *empirical information*?

5. What does a *civil engineer* deal with?

6. What are some of the subdivisions of civil engineering? With what is each of them concerned?

7. What does a *mechanical engineer* deal with?

8. What does a *mining and metallurgical engineer* deal with?

9. What does a *chemical engineer* deal with? Name a subdivision of chemical engineering.

10. What do *electrical and electronic engineers* deal with?

11. What do *nuclear engineers* deal with?

12. What is an *aqueduct*?

13. What is *stress*?

14. Define *silt*.

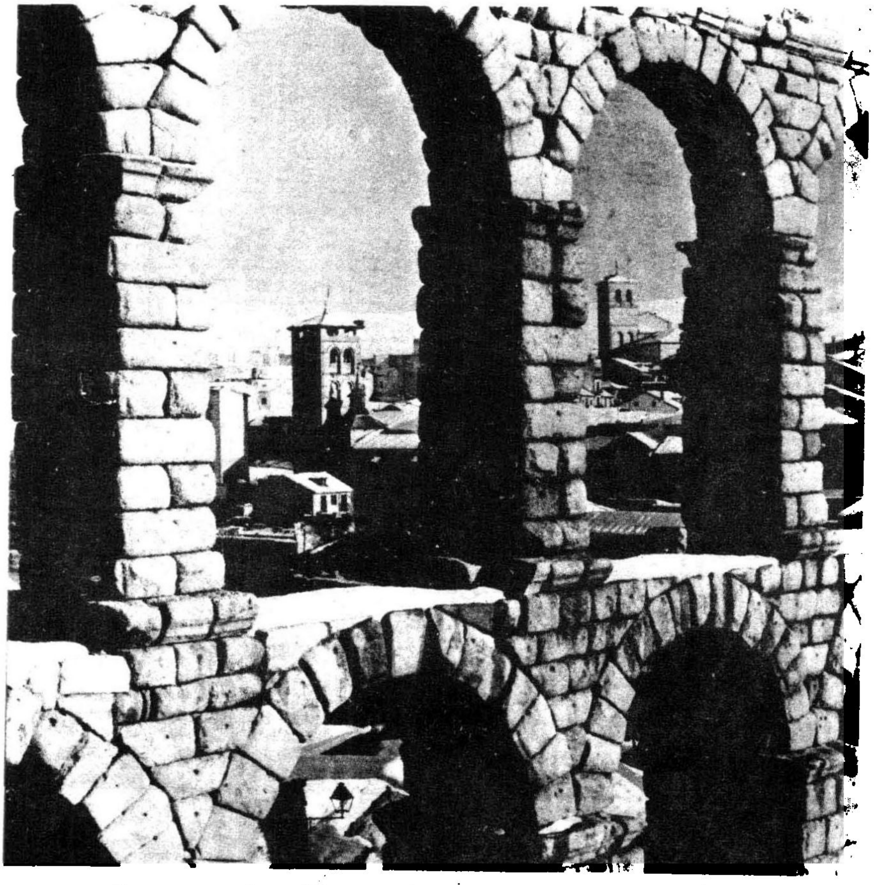
15. What is an *environmental impact study* concerned with?

16. What does *quantification* mean?

The Engineering Profession

Engineering is one of the oldest occupations in the history of mankind. Indeed, without the skills that are included in the field of engineering, our present-day civilization could never have evolved. The first toolmakers who chipped arrows and spears from rock were the forerunners of modern *mechanical engineers*. The craftsmen who discovered metals in the earth and found ways to process and refine them were the ancestors of *mining and metallurgical engineers*. And the skilled technicians who devised irrigation systems and erected the great buildings of the ancient world were the *civil engineers* of their time. One of the earliest names that has come down to us in history is that of Imhotep, the designer of the stepped pyramid at Sakkara in Egypt about 3,000 B.C.

Engineering is often defined as the practical application of theoretical sciences, such as physics or chemistry, for the benefit of mankind. Many of the early branches of engineering, however, were



Roman aqueduct. (Courtesy Spanish National Tourist Office)

based not on science but on *empirical information*, that is, information that depended on observation and experience rather than theoretical knowledge. Many of the structures that have survived from ancient times, such as the *aqueducts* of Rome, exist because they were built with greater strength than modern standards require. But at least the Roman engineers were sure that their buildings would last for a long time. Probably the oldest text in engineering is the work of a Roman architect and engineer named Vitruvius Pollio, who wrote a book in the first century B.C. about the engineering practices of his day. Many of the problems encountered by Vitruvius Pollio were similar to those that modern engineers still must confront.

The Hagia Sophia in Istanbul. (Courtesy Turkish Tourism and Information Office)

The term *civil engineering* originally came into use to distinguish it from military engineering. Civil engineering dealt with permanent structures for civilian use, whereas military engineering dealt with temporary structures for military use. An example of the latter is the bridge built across the Rhine in 55 B.C. that is described in Julius Caesar's *Commentaries on the Gallic War*. A more appropriate definition of civil engineering is that it deals with the design and construction of objects that are intended to be stationary. In practice, this definition includes buildings and houses, dams, tunnels, bridges, canals, sanitation systems, and the stationary parts of transportation systems—highways, airports, port facilities, and roadbeds for railroads.

Civil engineering offers a particular challenge because almost every structure or system that is designed and built by civil engineers is unique. One structure rarely duplicates another exactly. Even when structures seem to be identical, site requirements or other factors generally result in modifications. Large structures like dams, bridges, or tunnels may differ substantially from previous structures. The civil engineer must therefore always be ready and willing to meet new challenges.

Since the beginning of the modern age in the sixteenth and seventeenth centuries, there has been an explosion of knowledge in every scientific field: physics and chemistry, astronomy and physiology, as well as recently evolved disciplines like nuclear and solid-state physics. One reason for this rapid increase in scientific knowledge was the development of the experimental method to verify theories. At least of equal importance has been the use of *quantification*, that is, putting the data from the results of experimentation into precise mathematical terms. It cannot be emphasized too strongly that mathematics is the basic tool of modern engineering.

As scientific knowledge increased, so did the practical applications. The eighteenth century witnessed the beginning of what is usually called the Industrial Revolution, in which machines began to do more and more of the work that previously had been done by human beings or animals. In the nineteenth century and in our own day, both scientific research and the practical applications of its results have progressed rapidly. They have given the civil engineer new and stronger materials; the mathematical formulas which he can use to calculate the *stresses* that will be encountered in a structure; and machines that make possible the construction of skyscrapers,

The twin towers of the World Trade Center in New York City.
(Courtesy The Port Authority of New York and New Jersey)

dams, tunnels, and bridges that could never have been built before.

Another result of the explosion of knowledge was an increase in the number of scientific and engineering specialties. By the end of the nineteenth century, not only were civil, mechanical, and mining and metallurgical engineering recognized, but courses were also being offered in the newer specialties of *electrical engineering* and *chemical engineering*. This expansion has continued to the present day. We now have, for example, *nuclear*, *petroleum*, *aerospace*, and *electronic engineering*. Of course, many of these disciplines are subdivisions of earlier specialties—electronic engineering from electrical engineering, for example, or petroleum engineering from chemical engineering.

Within the field of civil engineering itself, there are subdivisions: structural engineering, which deals with permanent structures; hydraulic engineering, which is concerned with systems involving the flow and control of water or other fluids; and sanitary or environmental engineering, which involves the study of water supply, purification, and sewer systems. Obviously, many of these specialties overlap. A water supply system, for example, may involve dams and other structures as well as the flow and storage of water.

Many different kinds of engineers often work on large projects, such as space exploration or nuclear-power development. In the space program, for example, the launching pads and the rocket assembly and storage building at Cape Canaveral, Florida—the largest such structure in the world—are primarily the work of civil engineers. In a nuclear power plant, civil engineers are responsible for the design and construction of the plant itself, as well as the protective shielding around the nuclear reactor. In both these cases, however, the civil engineers work with specialists in aerospace, nuclear, and electrical engineering. In projects of this kind, the engineer is a member of a team that is often headed by a systems engineer who coordinates the contributions of all members of the team. Because teamwork is necessary in so many engineering projects nowadays, an important qualification for engineers is the ability to work successfully with other people.

Still another result of the increase in scientific knowledge is that engineering has grown into a *profession*. A profession is an occupation like law, medicine, or engineering that requires specialized, advanced education; indeed, they are often called the "learned professions." Until the nineteenth century, engineers generally were craftsmen or project organizers who learned their skills through apprenticeship, on-the-job training, or trial and error. Nowadays, many engineers spend years studying at universities for advanced degrees. Yet even those engineers who do not study for advanced degrees must be aware of changes in their field and those related to it. A civil engineer who does not know about new materials that have become available cannot compete successfully with one who does.

The word *engineer* is used in two ways in English. One usage refers to the professional engineer who has a university degree and an education in mathematics, science, and one of the engineering specialties. *Engineer*, however, is also used to refer to a person who operates or maintains an engine or machine. An excellent example is the railroad locomotive engineer who operates a train. Engineers in this sense are essentially technicians rather than professional engineers.

Engineers must be willing to undergo a continual process of education and be able to work in other disciplines. They must also adapt themselves to two requirements of all engineering projects. First, the systems that engineers produce must be workable not only from a technical but also from an economic point of view. This means that engineers must cooperate with management and government officials who are very cost-conscious. Therefore, engineers must accommodate their ideas to the financial realities of a project.

Second, the public in general has become much more aware, especially in the last ten years or so, of the social and environmental consequences of engineering projects. For much of the nineteenth and twentieth centuries, the attitude of the public could be summed up by the phrase, "Science is good." The most visible part of science was the engineering work. No one can avoid seeing the great dams, the bridges, the skyscrapers, and the highways that have created an impressive, engineered environment around us.

Nowadays, however, the public is more conscious of the hidden or delayed hazards in new products, processes, and many other aspects of civil engineering systems. For instance, new highways in the United States are no longer approved routinely; instead, highways and other similar projects must now undergo *environmental impact studies* to assess the project's effect on air pollution and other environmental concerns.

A recent news story which reported that the Egyptian government now permits public criticism of the Aswan High Dam underlines this concern. The Aswan Dam is one of the engineering wonders of