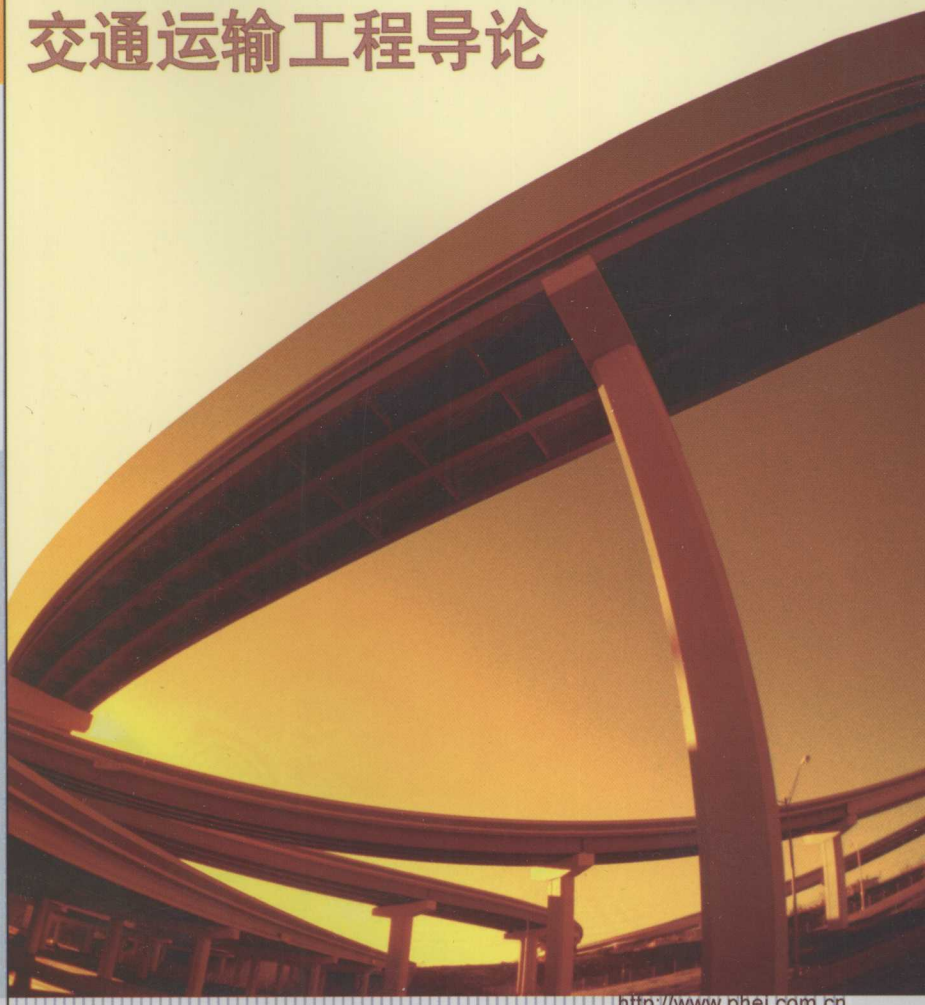
INTRODUCTION TO TRANSPORTATION ENGINEERING

双语教材

交通运输工程导论



高等学校教材

张庆英 主编

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Introduction to Transportation Engineering

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（双语教材）

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内容简介

本书以整个交通运输系统（包括铁路、道路、水运、航空、管道和城市交通运输系统）为对象，讨论现代社会运输的性质和作用、交通运输系统的组成以及各种交通运输系统的现状，各类载运工具的特点，以及各种交通运输系统的运行特性；分析交通流特性，探讨交通运输工程规划的基本原则与思路、交通运输基础设施、运输价格与合同管理、货运包装与标记、多式联运、智能交通系统，以及交通系统的分析与评价等方面的问题。全书共分为9章。

本书为物流工程、物流管理等专业的学科基础必修课教材，定位于交通运输工程、交通运输系统方面基础知识的介绍。本书不要求学生具备交通设施设计的专业能力，而是要在了解交通系统的基础上，学会分析交通系统的通行能力、性能特征、安全保证、规划调度等，为物流系统、社会系统的设计与集成打下基础。

本书可作为物流工程、物流管理、工业工程、交通工程等专业教材，同时还可供从事物流、交通等相关专业工程技术人员学习参考。

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Preface

Transportation engineering is a broad, multidisciplinary field aimed at the functional design of physical and/or organizational projects relating to transportation supply systems. transportation involves the movement of people and goods by land, air, and sea, using human locomotion, automobiles, buses, bicycles, trucks, trains, aircraft, ships, and pipelines. It also involves the design of streets and highways, intersections, traffic control devices, mass transit systems, railroad tracks, rail yards, airport runways, etc.

This book, titled as introduction to transportation engineering, includes 9 chapters.

Chapter 1 defines transportation, transportation engineering and a transportation system, discusses the relationship between transportation and people's life, the application of technologies in a transportation system, the structure, classification and functions of a transportation system.

Chapter 2 is about various transportation facilities. It introduces the basic demands and different modes of transportation facilities, such as automobiles, trains, ships, planes, and pipelines, discusses a reusable transportation tool- container, including its objects, its carrying capacity, and handing over of the container transit. Urban transportation system is the last content of this part.

Chapter 3 describes infrastructures of transportation, involving highways, railroads, airports, harbors and ports, as well as traffic control devices. The definitions, classification, and structures of different infrastructures are discussed. Three elementary types of traffic control devices, i.e. traffic markings, traffic signs, and traffic signals are set out.

Chapter 4 particularizes theory of traffic flow. Both two sorts of traffic flow, the smooth, or the uninterrupted one and the stiff, or interrupted one are expounded. Description and quantification of traffic flow, basic parameters of traffic stream such as volume, speed and density as well ad the relationships between them are spread out. As for the stiff flow, the cause of formation, the measures, and the relation between traffic and average speed are elucidated.

Chapter 5 is around transportation planning. Signification, new trend, and basic elements of transportation planning, perspectives on the planning process, planning regulations are set forth in this chapter. The political planning process, operational planning process, and the transportation planning hierarchy are diagrammatized. At the end of this chapter, dilemmas encountered in planning a transportation network is ticked off.

Chapter 6 defines intermodal, which refers to interconnections among modes of transportation, use of multiple modes for a single trip, and coordinated transportation policy-and decision making. Transportation network, intermodal transport chain, freight forwarder are expatiated. Two different conceptual perspectives, and an intermodal transport chain are illustrated. Existing problems, and liabilities cognizance in intermodal are discussed. Some international transportation organizations are briefly introduced, such as ICS, BIMCO, CMI, IMO, ICAO and IATA.

Chapter 7 talks over price, contract, and packing of transportation. Traffic price is the charge for the activities of transportation, which indicates the amount of money, asked for the transport service, while a contract, an agreement that is enforceable by law, is the only document between the parties to which they may refer for clarification of mutual responsibilities. Packing, including out packing and inner packing, marking and shipment are also expatiated, and some pictorial examples of labeling and marking are listed.

Chapter 8 describes ITS - intelligent transportation systems, which refers to the use of information technology including computers, electronics, and communications to improve traffic operations. Impetus, definitions, purposes, basic requirements and benefits of ITS are enucleated, the characteristics and components of ITS, and its applications, development are presented. A kind of typical ITS architecture is diagrammatized, while the what/how cycle explains pictorially the needs and solutions models referred separately the ITS user services and ITS market services.

Chapter 9, the last one of the book, attempts to address transportation system analysis and evaluation. Starting with system definition, transportation systems management, purpose of system analysis and steps in it, demand, supply, and equilibrium, are enumerated. Basic issues of evaluation, process, main work, and principles of evaluation are revealed. Figured illustration of system engineering method, system analysis process, value net in transportation, and evaluation chain are helpful to understand those questions.

This book is written for undergraduate and graduate students in logistics, transportation and relative fields as a text, and as a reference book for engineers, academicians, and other people.

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Chapter 1

TRANSPORTATION ENGINEERING INTRODUCTION

CHAPTER OUTLINE

1.1 Transportation and Transportation Engineering
1.2 Transportation Engineering
1.3 Transportation System

KEY TERMS

- transportation engineering [交通工程]: the application of scientific principles to the planning, design, operation, and management of transportation systems.
- transportation planning [交通计划]: an act of laying out a transportation system aiming to predict the needs/demands for a particular service.
- ITS: intelligent transportation systems [智能交通系统]: a system providing the opportunity to integrate travelers, vehicles and infrastructure into a comprehensive system through a range of technologies.
- IMS-Incident Management Systems [事故管理系统]: to reduce the effects of incident-related congestion by decreasing the time to detect incidents, the time for responding vehicles to arrive, and the time required for traffic to return to normal conditions, which makes use of a variety of surveillance technologies, often shared with freeway and arterial management systems, as well as enhanced communications and other technologies that facilitate coordinated response to incidents.

SPECIAL WORDS

- mph: miles per hour [速度单位：英里 / 小时]
- MOEs: measures of effectiveness [效力度量]
- MOCs: measures of costs [成本度量]
- pipeline [管道]
- highway [公路]
- freeway [高速公路]
- beltway [环形公路]
- sea-lane [航路]
- ubiquity [普遍性、通达性]

- railroad System Engineering [铁路系统工程]
- civil Engineering [土木工程]
- structural engineering [结构工程]
- traffic signal [交通信号]
- mobility [机动性]
- geometric design [几何设计]
- traffic congestion [交通拥堵]
- transportation facility [交通设施]
- transportation demand [交通需求]

1.1 TRANSPORTATION AND TRANSPORTATION ENGINEERING

Transportation is ordinarily defined as a means of conveyance or travel from one place to another, or, it is a public conveyance of passengers or goods especially as a commercial enterprise. The importance of transportation in world development is multidimensional. For example, one of the basic functions of transportation is to link residence with employment and producers of goods with their users. From a wider viewpoint, transportation facilities provide the options for work, shopping, and recreation, and give access to health, education, and other amenities. Nearly every day, items in the news remind us of transportation's vital role in our economy and its significant relationship to our quality of life. Mobility is important to the whole community. An exploration of the realm of transportation, with emphasis on key aspects of its engineering and its close relationship to our social and economic lives is focused in this course, which is likely to be helpful to lead to transportation engineering solutions in the real world.

1.1.1 Definitions of Transportation

What is transportation? How do you define your relationship to transportation? Is it only the trips that you make? Or is it the car that you drive? Whether we are considering people or goods, each trip begins at an origin and ends at a destination. Transportation is everything involved in moving either the person or goods from the origin to the destination. Consider the businessman's trip depicted in Figure 1.1. The trip is from the businessman's home (origin) to a hotel in a distant city (destination). If he takes train rather than airplane for a distant trip, the departure and arrival airports are replaced by the railway stations.

The trip could begin in his personal automobile, on a public transit vehicle, or in a taxi. This first link of his trip takes him from home to the airport parking garage or to the door of the airport terminal. This first segment is one of several line-haul portions of the trip. If he drives his car, he parks it at the airport parking garage, changing from the highway mode to the walking mode for a short distance, and then taking the shuttle bus to the airport. If he left home by public transit or taxi, he gets dropped off directly at the door to the airport terminal. The places where there is a change of mode are referred to as intermodal transfer points. Figure 1.1 indicates that this trip has several points where the businessman

changes mode. Although the main portion of his trip is by airplane, there are numerous other uses of the transportation system involved.

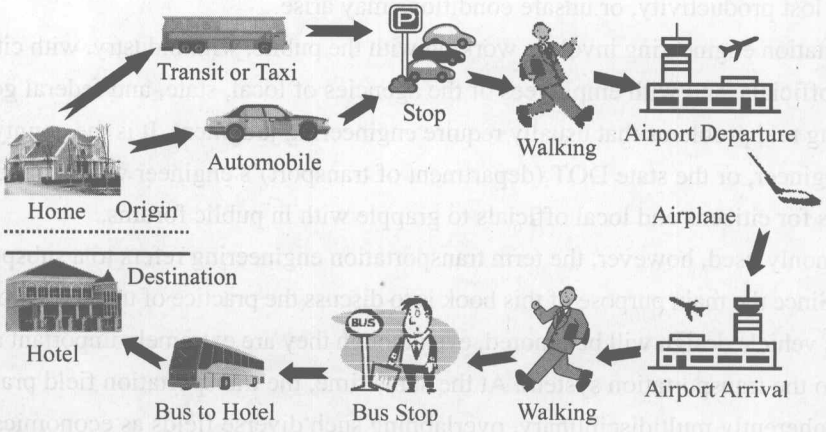

Figure 1.1 A businessman's trip

1.1.2 What Is Transportation Engineering?

Transportation engineering is the application of the principles of engineering, planning, analysis, and design to the disciplines comprising transportation: its vehicles, its physical infrastructure, safety in travel, environmental impacts, and energy usage. Transportation engineering involves the "hard" physical sciences, as the engineer evaluates pavements, geometric design, vehicle design, environmental effects, and the like. It involves thorough analyses of the impact on transportation design and operations from a variety of "soft" or social sciences, such as human behavior, welfare economics, urban planning, and political science. The competent transportation engineer must be capable of integrating the factors found in both the "hard" and the "soft" sciences when searching for the best solution to a given transportation problem.

Take a businessman's trip as an example, it is clear that each segment of his trip depends on at least one constructed facility, such as a roadway or a runway. At the intermodal transfer points, constructed facilities such as parking lots or airport terminals are necessary. Transportation engineers play an important role in planning and designing such facilities. They also need to be aware of the operational capabilities and limitations of the various transportation modes and services that need to be integrated.

Transportation is much more than people making trips. The movement of goods is a critical part of local, regional, and national economies. As goods move from origin to destination, transfer points can be rail yards, truck terminals, warehouses, or distribution centers. Line-haul goods movement will be by rail, truck, water, pipeline, or some combination of these modes. Again, properly designed and

operated facilities are essential to an efficient transportation system. If a transportation facility or service is overdesigned, the result may be a waste of resources. If it is underdesigned, bottlenecks that cause delays, lost productivity, or unsafe conditions may arise.

Transportation engineering involves working with the public, with industry, with citizens' groups, with elected officials, and with employees of the agencies of local, state, and federal governments. It involves facing real problems that usually require engineering judgment. It is the county engineer, the city traffic engineer, or the state DOT (department of transport)'s engineer who will be asked to propose solutions for citizens and local officials to grapple with in public forums.

As commonly used, however, the term transportation engineering refers to a subspecialty of civil engineering. Since the main purpose of this book is to discuss the practice of transportation engineering, such topics as vehicle design will be ignored, even though they are extremely important applications of engineering to the transportation system. At the same time, the transportation field practiced by civil engineers is inherently multidisciplinary, overlapping such diverse fields as economics, psychology, geography, city planning, public administration, political science, industrial engineering, and electrical engineering. In addition, major theoretical contributions to transportation engineering have been made by people with backgrounds in physics and mathematics.

This breadth of interaction with other disciplines stems from the fact that the scope of transportation engineering is determined more by society's need to provide an adequate transportation system than by the backgrounds of its practitioners. Thus it involves synthesis of several different intellectual perspectives and scientific knowledge bases to solve perceived technical, economic, social, and environmental problems. Among the civil engineering specialties, it is similar in this respect to environmental engineering, but differs from hydraulic engineering or structural engineering, which are more closely tied to particular bodies of scientific knowledge.

This range of material presents a challenge, especially in an introductory course.

Any such course needs to serve at least three purposes:

(1) To provide general information about the practice of transportation engineering for readers, mostly students, who will practice other civil engineering specialties,

(2) To prepare students who will practice in transportation related jobs immediately upon graduation, and

(3) To provide the necessary background for students who wish to pursue graduate studies in transportation engineering.

The material presented in this book is dealt with lots of matters. For instance, it is organized in terms of the different transportation modes such as land (highways), rail, water, air and pipe, etc., and some focus exclusively on one of these modes, usually highways. In contrast, the approach here is to

organize the material in terms of the different types of design and analysis that transportation engineers engage in, for instance, geometric design of facilities, traffic analysis, analysis and design of traffic control systems, transportation demand analysis, or transportation planning, and to discuss these in terms of basic concepts and techniques that often can be applied in a wide variety of situations to different transportation modes. The objective in presenting the material in this way is not only to emphasize the many similarities among the transportation modes but (more importantly) to help students experience the intellectual power and efficiency that can result from being able to apply abstract concepts and techniques to a range of concrete situations. At the same time, most of us learn abstract ideas best by first being exposed to concrete examples. Consequently, the approach that will be followed is to introduce basic concepts and techniques by means of examples. Students are expected to understand that these examples are applications of basic principles that can be used in many other situations; and students should strive to understand the principles and imagine their full range of application, rather than merely memorizing the solution to specific problems.

1.1.3 Transportation and People's Life

Considering your furniture, your clothes, the food you eat, and everything else you use as part of your life, there is very little among those things that did not at some point undergo movement by at least one freight carrier.

Good transportation provides for the safe, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods. The field of transportation can be compared to a mansion with several stories, many chambers, and scores of connections. We would like to take the reader on a short tour of this mansion just to acquaint him or her with some of its characteristics. One of the prerequisites for accompanying us on this trip is to have an open mind. Almost everyone will have had several years of personal experience as a user of the transportation system, such as a car driver, a bus passenger, an elevator user, a frequent flyer, or just a sidewalk user. Naturally, almost every person will tend to acquire his or her own personal viewpoint. No two persons can expect to come to the same conclusion about a problem confronting transportation even though they are each known to be highly objective and rational. Try as hard as you can to approach the field of transportation and its myriad problems with an open mind, free of presumptions and prejudice. Like food, shelter, clothing, and security, transportation is an integral part of human culture. Movement in a broad sense offers both inherent joy and pleasure as well as pain, suffering, and frustration. These factors will assume even greater importance in the years ahead.

Everybody is involved with transportation in so great a variety of ways that a mere listing of these ways would take us by surprise. Ultimately, all human beings are interacting over distance and time, and this interaction in itself creates involvement. Transportation has an increasingly close relationship

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