VIII

Transportation Engineering

Kumares C. Sinha
Purdue University

© 2003 by CRC Press LLC

Transportation has been one of the essential components of the civil engineering profession since its early days. The building of roads, bridges, tunnels, canals, railroads, ports, and harbors from time immemorial has shaped the profession and defined much of its public image. As the cities grew, civil engineers became involved in developing, building, and operating transit facilities, including street railways and elevated and underground systems. The role of civil engineers as the vanguard of growth and development through the provision of transportation infrastructure to accommodate a growing population and economy was never more prominent than in the U.S. around the late 19th century and the early part of the 20th century. Transcontinental railroads, national highways, canals, and major urban transit systems are testimonials to the achievement of civil engineers.

Rapid urbanization and motorization challenged the civil engineers not only to serve as developers and builders of transportation facilities, but also to plan and operate such facilities. This challenge gave rise to the art and science of transportation planning, traffic engineering, and facility management. At the beginning of the 21st century, transportation engineering has evolved into a mature subdiscipline within civil engineering with clear functions of planning, design, construction, operation, and maintenance of multimodal systems for the transportation of people and goods.

This subdiscipline has greatly expanded the civil engineering field to areas such as economics and financing, operations research, and management. With the rapid development of intelligent transportation systems in recent years, the transportation engineering profession has also started to make increasing use of information and communication technologies.

Transportation engineering, as practiced by civil engineers, primarily involves facilities to support air, highway, railroad, pipeline, and water transportation. A review of descriptions of the scope of various transportation-related technical committees in the America Society of Civil Engineers (ASCE) indicates that while facility planning and design continue to be the core of the transportation engineering field, such areas as facility operations, management, and environmental considerations are of much current interest to civil engineers. In addition, the research and deployment of intelligent transportation systems, as well as the implementation of high-speed ground transportation systems, have gained wide attention in recent years.

In keeping with current needs and emerging interests, this section of the handbook presents the updated versions of the basic principles and techniques of transportation engineering. Many of the chapters have been thoroughly rewritten to incorporate recent developments.

Chapter 58 provides a detailed discussion on concepts and models used for both strategic (long-term) and tactical (short-term) planning processes. The primary thrust is to present a quantitative background on demand estimation for effective planning of surface transportation facilities.

The details of airport planning and design are given in Chapter 59. This chapter covers various aspects of airport planning, including air traffic control requirements, passenger terminal design, airport location, layout and design, and environmental considerations.

Chapter 60, on high-speed ground transportation, presents the planning requirements, design guidelines, and financing and policy issues. The lessons from Europe and Japan are also discussed. The details on urban transit systems are covered in Chapter 61, where procedures are discussed for operational

© 2003 by CRC Press LLC

planning, scheduling, and routing; patronage prediction and pricing; operations cost modeling; and system performance monitoring.

Aspects of structural design of pavements for highways and airports are dealt with in Chapter 62. The concept and methods of thickness design of both rigid and flexible pavements are presented. Highway geometric design fundamentals are given in Chapter 63, including design applications. Principles of highway traffic operations are presented in Chapter 64, where the emphasis is on fundamental concepts and analytical techniques that can be applied to better understand traffic operating characteristics.

Potential applications of advanced technologies in the area of intelligent transportation systems (ITS) are examined in Chapter 65, where various components of ITS, along with the current status of operational tests and other field applications, are discussed. The concepts and principles of highway asset management are discussed in Chapter 66. Three specific systems are presented involving pavement, bridge, and highway maintenance management systems, along with recent requirements for infrastructure asset valuation. Chapter 67 presents a discussion on environmental considerations in transportation planning and development. An overview to the environmental process is given, with emphasis on the physical impacts, particularly air quality and noise pollution.

The challenges and opportunities faced by the transportation engineering profession in the new century are unique. These challenges cover a wide spectrum, including increasing traffic congestion on our highways and at our airports, continuing problems with transportation safety and environmental degradation of our communities, ever more acute budget constraints, and the specter of terrorism and the attendant need for security. However, there are also opportunities offered by the timely application of technical innovations through the use of emerging information and communication technologies, as well as new propulsion and engine technologies. Major advances in these areas have the potential of opening new horizons in transportation engineering by developing new techniques and procedures while making substantial improvements in cost, safety and security, and productivity. This section of the second edition of the handbook provides a brief overview of the fundamentals of planning, design, operation, and management aspects of transportation engineering that will be useful not only for learning about the state of the art of transportation engineering in the U.S., but also for preparing for the future.

© 2003 by CRC Press LLC