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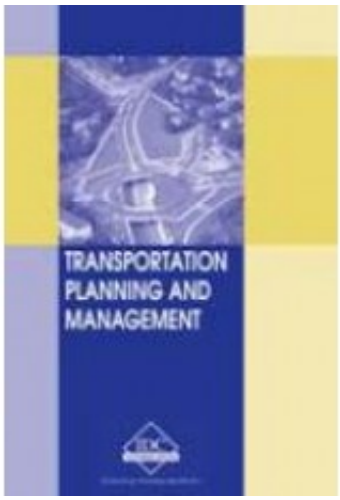
TN-E - Transportation Planning and Management



Price: $139.94

Ex Tax: $127.22

Short Description

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First Chapter

1. **Transportation Engineering – An Introduction**
2. Transportation Engineering – An Introduction

This chapter describes the basic objectives of the course and provides an insight into the various aspects of transportation engineering, including its scope and the fields of application.

Objectives

After completing this chapter, you will be able to:

- Understand the use and limitations of various modes of transportation.
- Learn techniques to design an efficient transportation system by a combination of the various modes.
- Appreciate the overall objective of the course.

1.1 Introduction

Transportation is defined as the movement of people and/or goods from one place to another. Transportation is one of the basic needs of mankind from ancient times. Various modes of transportation are combined together form a transportation system that serves the overall needs of transport.

Transportation occupies a high space in modern life. Advancement in all spheres of life has been influenced by transportation to a great extent. Transportation is also a function of land-use; the need and type of transportation changes with the change in land-use. Sometimes transportation or lack of it, and insufficient or unsafe transportation can be a regional or national level problem that can affect the overall development of that region.

1.2 Modes of Transportation

Transport modes are the vehicles supporting the mobility of passengers, freight and information and the infrastructures supporting their movements.

- **Road transportation**– This is the most common and easiest mode of transportation. Road infrastructures have the lowest level of physical

constraints among all the transportation modes. They are mainly linked to places where rapid movements of people and freight in small batches are the norm. All other modes have to be accompanied with roads to provide complete transportation. This is the only mode of transportation which is complete in its entirety and need not be accompanied by other modes to provide door to door transportation.

Road transportation has an average operational flexibility as vehicles can serve several purposes. Road transport systems have high maintenance costs, both for the vehicles and infrastructures, and there are significant environmental constrains in road construction.

- **Rail transportation** - Railways are composed of traced paths on which the locomotive runs. Unlike road transportation, the operator has less control on the movement of the locomotive. They have an average level of physical constrains linked to the types of locomotives and affected by the gradient. However, unlike road transportation there are no uncontrolled delays due to congestion on the travel path. When separate traced paths (rails) are designed for movement in opposite directions, rail transportation can be a very efficient mode of transportation.

It is a common mode of transportation for mass movements as well as heavy goods and long distances. Heavy industries are traditionally linked with rail transport systems, although rail stations have to be connected by a road network to satisfy the complete needs of transportation. Sometimes they are also connected to a harbor to establish a link with maritime transportation.

- **Maritime transportation**- Main maritime routes are composed of oceans, coasts, seas, lakes, rivers and channels. However, maritime circulation takes place on specific parts of the maritime space. High inventory costs characterize maritime transportation. It involves very high initial investment as docks, harbors etc are very expensive to construct. The locomotive (ships) cost as well as the maintenance, improvement and operating costs are high.

More than any other mode, maritime transportation is linked to heavy industries, such as steel and petrochemical facilities adjacent to port sites. Despite all this it can be a cheaper mode for intra-continent transportation, as other modes (i.e. air

transport) is even more expensive.

- **Air transportation -**This is the most modern and expensive mode of transportation. It is the fastest and most suitable when cost is not the constraint. Air routes are practically unlimited, but they are denser over North America, Europe and the North Pacific. Air transport constraints are multidimensional and include the site (a commercial plane needs about 3,300 meters of track for landing and take off), the climate, fog and aerial currents. The capital investment for airports as well as aircraft is so high, that it can not be compared with other modes of transportation.

Air activities are linked to the tertiary and quaternary sectors, notably finance and tourism that require movements of people. More recently, air transportation has been accommodating growing quantities of high value freight. Airports have to be connected to other areas by road transportation to increase the effectiveness of air transportation.

- **Non-mechanical Transportation –** Even with the tremendous development in transportation networks all over the world, there are still some places where non-mechanical is the only mode of transportation, e.g. in the deep of Antarctica, vehicles pulled by snow-dogs is the only mode.

In modern transportation networks also, there are sidewalks, crosswalks, tunnels, and bike paths that are used by pedestrians and cyclists. Such systems of paths and right-of-way laws require compromise on the part of both the users and the vehicles, and the engineer of such projects is responsible to find the happy balance between the two groups.

Both of these require a certain amount of engineering to insure the safety of the users. These are the least expensive modes and very effective as far as short distances are concerned.

- **Pipelines -**This mode is useful for transportation of liquid and gas cargo. Pipeline routes and its uses are practically unlimited. The use of a water supply pipe line is self explanatory in its proof of effectiveness. Pipeline

construction costs vary according to the diameter and increase proportionally with the distance and with the viscosity of fluids (from gas to oil). The longest oil pipeline is the Tran Siberian, extending over 9,344 km to Western Europe from the Russian arctic oilfields in eastern Siberia. Pipeline terminals are very important since they correspond to refineries and harbors.

1.2.1 Transportation System

A transportation system can be defined as a system consisting of fixed facilities, flow entities, and the control system that permits people and goods to move from Point 1 to Point 2 efficiently, and in a timely manner safely.

- *Fixed facilities* are the physical components of the system that are fixed in space and constitute a network of links (e.g., roadway segments, railway tracks, tunnels) and nodes (e.g., intersections, interchanges, transit terminals, harbors, airports) of the transportation system. The development of fixed facilities needs capital investment.
- *Flow entities*are the units that traverse the fixed facilities. They include vehicles, container units, railroad cars, etc. In highway design, fixed facilities are expected to accommodate a variety of vehicle types, ranging from bicycles to large tractor-trailer combinations. The operating cost of the transportation mode depends on the flow entities.
- The *control system*consists of vehicular control and flow control*.* Vehicular control refers to the technology in which individual vehicles are guided on the fixed facilities. Such control can be manual or automated. The control system determines the efficiency of the system.

The flow control system consists of the means that permit the efficient and smooth operation of streams of vehicles and reduction of conflicts between vehicles. This system includes signing, marking, and signal systems.

Usually a transportation system is formed with the combination of two or more modes. An efficiency of a transportation system of a region is judged on the basis of following criteria:

- Speed
- Safety
- Adequacy
- Comfort

- Per head Cost
- Fuel Efficiency
- Environmental Effects (Pollution etc)

1.2.2 Transportation Demand:

Transportation systems are built to serve people in undertaking their economic, social, and cultural activities. For example, going to work, school, shopping or visiting friends.

1.3 Transportation planning

Planning can be used as an effective tool for achieving certain goals and objectives identified by the analysis of existing problem. Planning and the use of management tools has proved to be an economic way of solving traffic problems.

An approach to transport planning can be explained using following chart:

Figure 1.1

Transportation Planning Process

The transport planning process can be broken in five important stages:

1. Survey and analysis of existing conditions
2. Forecast and analysis of future conditions
3. Evaluation and anticipation of future problems
4. Program adoption and implementation
5. Continuing studies

In an urban system, there are a number of alternative transport plans that are feasible for a given set of goals and policies. In order to select the best from

these, it is necessary to evaluate each of the alternatives as to how it fulfils the desired objectives.

As transport planning is a dynamic and complex process, considerable uncertainty is always associated with selecting the best option and way to implement it. In addition, transport planning is usually done after anticipating some future growth of traffic and a sudden change in land use or control system or any other factor can affect the anticipated results. Periodic reviews and surveys of travel patterns and journey times should be carried out and the plan should be readjusted if needed.

1.3.1 Citizen participation

Since transportation plans are essentially intended to serve the community and fulfill their aspirations, it is necessary to consult the affected people in the community and give them a voice in the formulation of decisions. The policies and goals may need to be redefined as a result of such consultations.

1.3.2 Traffic Problems in Cities

With industrialization and urbanization there is tremendous growth of traffic in urban areas which results in severe congestion on streets. Congestion leads to delays, time loss, fuel and energy loss, reduction in safety and increased pollution. Parking, loading-unloading goods also contribute to additional damage in a congested traffic situation.

Providing extra capacity in the form of additional lanes or turn-pockets cannot always be a solution. The construction of an extra road is a very expensive and time consuming solution. Even though it is necessary to increase the capacity of any route with increases in demand, using the correct regulations and traffic

management measures can lead to an simpler, faster and longer lasting solution.

Typical transportation problems in cities

- Congestions (severe during peak hours)
- Delays (increased travel times)
- Safety (increased number of accidents)
- Air pollution
- Noise pollution
- Additional consumption of fuel
- Increased traffic in residential neighborhoods as people search for alternate routes
- Wear and tear of road surface increased due to heavy traffic
- Inadequate public transportation (serious problems for non-drivers)
- Insufficient parking
- Lack of safe place for the loading and unloading of goods
- Emergency vehicles like ambulances or fire engines get stuck in traffic
- Traffic system collapse during road construction or repairs

1.3.3 Traffic Problems in non-urban areas

On the other hand, lack of transportation is a problem in many non-urban areas around the world. In some cases public transportation is available but with inadequate frequency, capacity and safety. Transportation management measures are not very effective in finding solutions in such situations. Transportation planning for a region can lead to permanent and effective solutions for such problems. Improvement in transport network can sometimes lead to overall development of the region in relation to industry and tourism, thus bringing potential economic growth.

1.4 Course objectives

The objective of this course is to explain the concepts of structural engineering and to provide skills anticipating existing and future traffic problems and to develop a capacity to find a fast, economical and effective solution of the frequent or occasional traffic problems.

1.5 Course outcomes

- Acquiring a basic knowledge of different transportation modes; their use and limitations.
- The ability to anticipate traffic problems
- Acquiring the ability to analyze the nature of traffic problem and its mitigation.
- Understanding concepts used for transportation planning.
- Basic transportation planning for a region
- Geometric design of roadways and highways
- Basic traffic management for big events or construction sites. I.e. occasional traffic issues
- Understanding the value of time lost in traffic delays as well as transportation economics
- Transportation safety