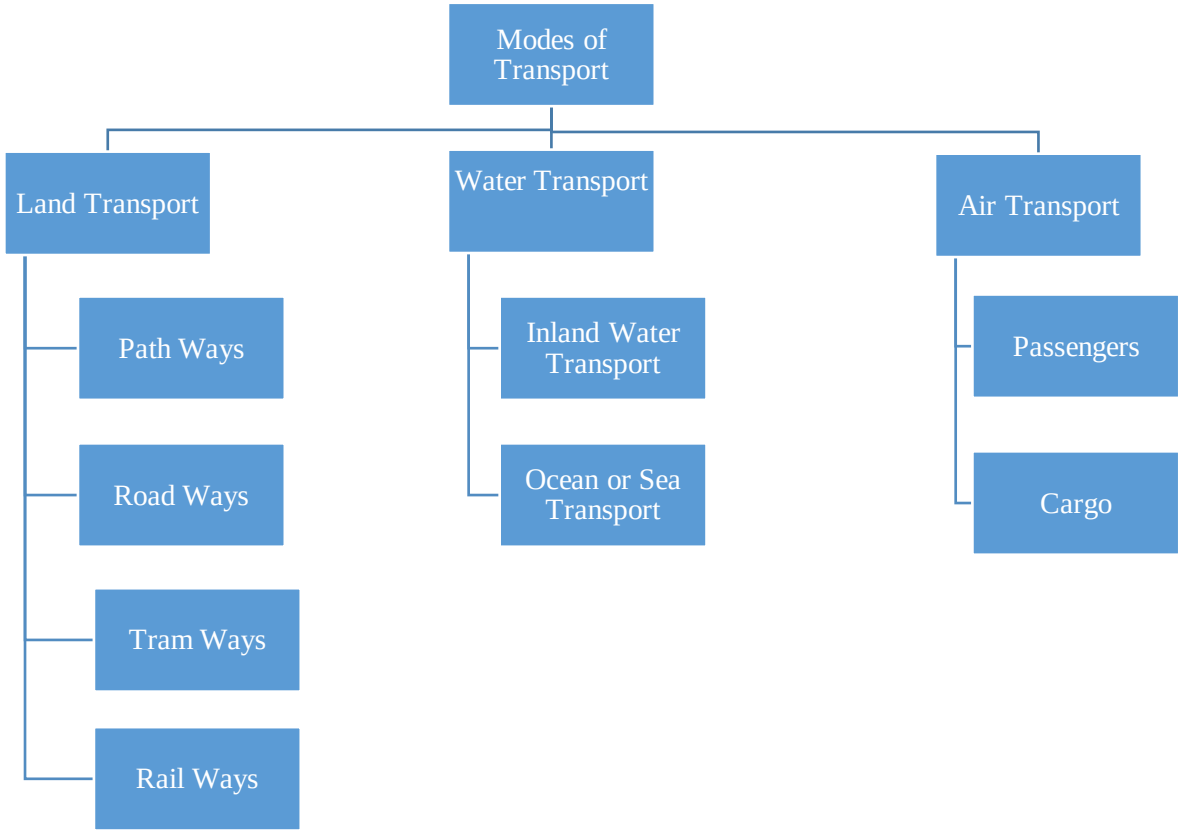
MODULE - IV

Transportation Engineering

From the beginning of history, human sensitivity has revealed an urge for mobility leading to a measure of Society's progress. The history of this mobility or transport is the history of civilization. For any country to develop with right momentum modem and efficient Transport as a basic infrastructure is a must. Transport (British English) or transportation (American English) is the movement of people and goods from one place to another.

Modes of Transport



Planning and Design Aspects of Transportation Engineering:

The planning aspects of transportation engineering relate to elements of urban planning, and involve technical forecasting decisions and political factors. Technical forecasting of passenger travel usually involves an urban transportation planning model, requiring the estimation of trip generation (how many trips for what purpose), trip distribution (destination choice, where is the traveler going), mode choice (what mode is being taken), and route assignment (which streets or mutes are being used). More sophisticated forecasting can include other aspects of traveler decisions, including auto ownership, trip chaining (the decision to link individual trips together in a tour) and the choice of residential or business location (known as land use forecasting). Passenger trips are the focus of transportation engineering because they often represent the peak of demand on any transportation system.

Before any planning occurs the Engineer must take what is known as an inventory of the area or if it is appropriate, the previous system in place. This inventory or database must include information on (1) population, (2) land use, (3) economic activity. (4) transportation facilities and services, (5) travel patterns and volumes. (6) laws and ordinances, (7) regional financial resources (8) community values and expectations. These inventories help the engineer create business models to complete accurate forecasts of the future conditions of the system review.

Transport design

Transport engineers face multi-faceted design decisions when they are designing optimized transport infrastructure networks. These might relate to:

- The physical expansion of transport facilities, such as lane width or the number of lanes, for a roadway.
- The materials and thickness used in pavements.
- The geometry of a facility, such as a roadway, rail line or airport.
- Road pricing schemes.
- Deploying information-based technology.

In all design decisions, multiple performance measures, cost metrics and safety criteria must be considered and weighed.

Transport Operations

Transport operations, whether for road, rail, port or air traffic, are designed to minimize travel delays, improve safety, reduce emissions and enhance reliability, as well as taking other considerations into account. Transport operation decisions involve:

- Optimizing traffic signals
- Setting specific tolls
- Designing traffic signs and markings

With the development of new Intelligent Transportation Systems (ITS), transport engineers use tools including advanced traveller information systems (such as variable message signs). Advanced traffic control systems (such as ramp meters) and vehicle to-vehicle (V2V) communications to optimize the performance of the transport system.

Highway Engineering

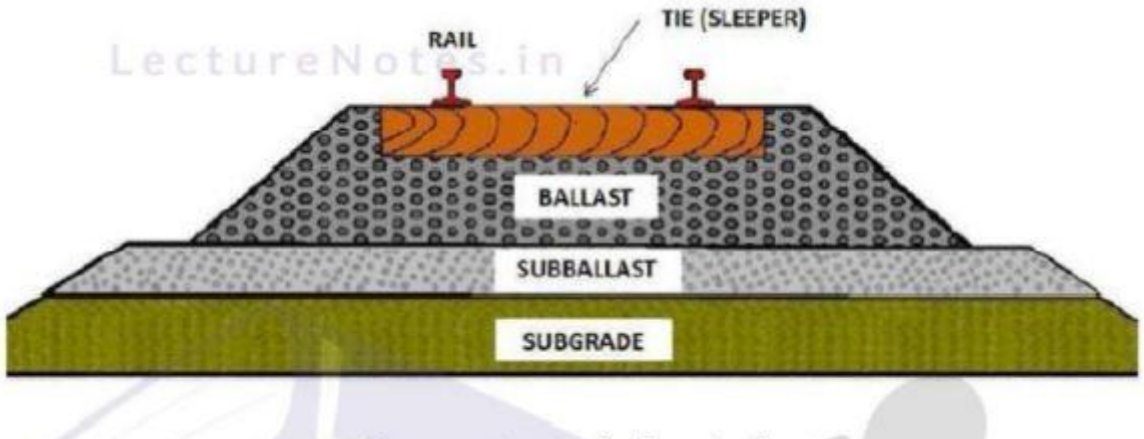
Highway engineering is an engineering discipline branching from civil engineering that involves the planning, design, construction, operation, and maintenance of roads, bridges, and tunnels to ensure safe and effective transportation of people and goods. Highway engineers must take into account future traffic flows, design of highway intersections/interchanges, geometric alignment and design, highway pavement materials and design, structural design of pavement thickness, and pavement maintenance. The most appropriate location, alignment, and shape of a highway are selected during the design stage. Highway design involves the consideration of three major factors (human, vehicular, and roadway) and how these factors interact to provide a safe highway.

Human factors include reaction time for braking and steering, visual acuity for traffic signs and signals, and car-following behaviour. Vehicle considerations include vehicle size and dynamics that are essential for determining lane width and maximum slopes, and for the selection of design vehicles.

Highway engineers design road geometry to ensure stability of vehicles when negotiating curves and grades and to provide adequate sight distances for undertaking passing maneuvers along curves on two-lane, two-way roads.

Railway Engineering

It is a branch of civil engineering concerned with the design, construction, maintenance, and operation of railways. Railway engineering includes elements of civil, mechanical, industrial, and electrical engineering, Railway engineers handle the design, construction, and operation of railroads and mass transit systems that use a fixed guideway (such as light rail or even monorails). Typical tasks would include determining horizontal and vertical alignment design, station location and design, construction cost estimating, and establishment of signaling & controlling system. Railroad engineers can also move into the specialized field of train dispatching which focuses on train movement control. Railway engineers also work to build a cleaner and safer transportation network by reinvesting and revitalizing the rail system to meet future demands.



Component parts of railway track

Airport Engineering

Airport engineers design and construct airports. Airport engineers must account for the impacts and demands of aircraft in their design of airport facilities. These engineers must use the analysis of predominant wind direction to determine runway orientation, determine the size of runway border and safety areas, different wing tip to wing tip clearances for all gates and must designate the clear zones in the entire port.

An airport system plan is a representation of the aviation facilities required to meet the immediate and future needs of a metropolitan area, region, state, or country. The system plan presents the recommendations for the general location and characteristics of new airports and heliports and

the nature of expansion for existing ones to meet forecasts of aggregate demand. It identifies the aviation role of existing and recommended new airports and facilities. It includes the timing and estimated costs of development and relates airport system planning to the policy and objectives of the relevant jurisdiction. Its overall purpose is to determine the extent type, nature, location, and timing of airport development needed to establish a viable, balanced, and integrated system of airports. It also provides the basis for detailed airport planning such as that contained in the airport master plan. The airport system plan provides both broad and specific policies, plans, and programs required to establish a viable and integrated system of airports to meet the needs of the region.

❖ The objectives of the system plan include:

1. The orderly and timely development of a system of airports adequate to meet present and future aviation needs and to promote the desired pattern of regional growth relative to industrial employment, social, environmental and recreational goals development aviat meet role in a balanced and multimodal transportation

2. The system to foster the overall goals of the area as reflected in the transportation system plan and comprehensive development plan.

3. The protection and enhancement of the environment through the location and expansion of aviation facilities in a manner which avoids ecological and environmental impairment.

4. The provision of the framework within which specific airport programs may be developed consistent with the short-and long-range airport system requirements.

5. The implementation of land-use and airspace plans which optimize these resources in an often constrained environment.

6. The development of long-range fiscal plans and the establishment of priorities for airport financing within the government budgeting process.

❖ The elements in a typical airport system planning process include the following:

1. Exploration of issues that impact aviation in the study area

2. Inventory of the current system

3. Identification of air transportation needs Notes.in

4. Forecast of system demand

5. Consideration of alternative airport systems

6. Definition of airport roles and policy strategies

7. Recommendation of system changes, funding strategies, and airport development

8. Preparation of an implementation plan

Traffic Engineering

Traffic engineering is a branch of civil engineering that uses engineering techniques to achieve the safe and efficient movement of people and goods on roadways. It focuses mainly on research for safe and efficient traffic flow, such as road geometry, sidewalks and crosswalks, cycling infrastructure, traffic signs, road surface markings and traffic lights. Traffic engineering deals with the functional part of transportation system, except the infrastructures provided.

Typical traffic engineering projects involve designing traffic control device installations and modifications, including traffic signals, signs, and pavement markings. However, traffic engineers also consider traffic safety by investigating locations with high crash rates and developing countermeasures to reduce crashes. Traffic flow management can be short-term (preparing construction traffic control plans, including detour plans for pedestrian and vehicular traffic) or long-term (estimating the impacts of proposed commercial developments on traffic patterns). Increasingly, traffic problems are being addressed by developing systems for intelligent transportation systems, often in conjunction with other engineering disciplines, such as computer engineering and electrical engineering.

Traffic engineering is closely associated with other disciplines:

- Transport engineering
- Pavement engineering
- Bicycle transportation engineering
- Highway engineering
- Transportation planning
- Urban planning
- Human factors engineering.

Urban Planning

Transportation Engineering and Urban Planning are closely related fields. Transportation engineering deals with the planning, design, construction, and operation of transportation systems, while urban planning is concerned with broader issues that are related with transportation. These issues include land use, environment, economic development, community housing and development, urban design, and other social, economic and political issues at the local, region, state and national level.