Chapter One
Introduction to Transport system



Objective

- After studying this lesson, you will be able to
  - Recognize the definition and importance of transport.
  - Identify the various modes of transport and describe the comparative advantages and limitations.
  - Understand transportation system components (Physical element) for each type of mode.

Introduction to Transport Systems

- Transport or transportation is the movement of peoples and goods from one location to another for some purpose.
- It is the translocation of object in a physical space and time.
- Modes of transport :- Land (Road and Rail) – Air – Water – Cable – Pipeline – Space
- A transportation system consists of three components:
  - Physical element-(Infrastructure, vehicles i.e. motorized or non-motorized, equipment, and control and communication)
  - Human resources-for operation of transportation system
  - Operations-(schedule, rules and regulations)

Introduction to Transport Systems

- Transportation Engineering is one of a specialty area of Civil Engineering concerned on:
  - Planning
  - Design
  - Construction
  - Traffic operations and managements, and
  - Maintenance of transport systems.

Introduction to Transport Systems

1. Planning

- Transportation planning deals with the selection of projects for design and construction.
- The transportation planner begins by defining the problem, gathering and analyzing data and evaluating various alternative solutions.
- Also involved in the process of forecasting future traffic, estimate of impact of the facility on land use, the environment, and the community and determination of the benefits and cost that will result if the project is built.

Introduction to Transport Systems

2. Design

- Transportation design involves the specification of all features of the transportation system so that it will function smoothly, efficiently and in according with physical laws.
- For a highway the design process involves:-
  - The selection of dimension for all geometric features, such as
    - Longitudinal profile
    - Vertical curve and elevation
  - Roadway cross-section like, pavement width, shoulders, drainage ditches, and fencing.
  - Design of railway track structures
  - Provision for traffic control device, road side area and land escapes.

Introduction to Transport Systems

3. Construction

- Transportation construction is closely related to design and involves all aspects of the building process:-
  - Beginning with clearing the native soil
  - Preparation of the surface
  - Placement of the track material, and
  - Preparation of the final railroad for use by traffic

Introduction to Transport Systems

4. Traffic Operation

- Involves the integration of vehicles, driver, pedestrian, and road characteristics to improve the safety and capacity of the streets and highways.
- Among the elements of concern are:-
  - Traffic accident analyses
  - Parking
  - Traffic Loading
  - Design of terminal and station facilities
  - Traffic signals
  - Speed regulation

Introduction to Transport Systems

5. Maintenance

- Involves all the work necessary to ensure the highway system is kept in proper working order.
- Such as:
  - pavement patching and overlay(highway)
  - Rail joint maintenance, rail deviation correction (Tamping)
  - Redesign of existing structure and etc.

Importance of Transport

- Makes available raw materials to manufacturers or producers
- Makes available goods to customers
- Enhances standard of living
- Helps during emergencies and natural disasters
- Helps in creation of employment (maintenance, operator, etc)
- Helps in labor mobility
- Helps in bringing nations together
- Balance b/n supply and demand.

Different Modes of Transport

- The transport of a person or cargo may be by one or more modes of transport(intermodal transport) e.g. foot---road --- rail --- air --- water
- Types of mode of transport:-
  - Human powered transport
  - Animal powered transport
  - Water transport
  - Railway transport
  - Road transport
  - Air transport
  - Cable transport
  - Space transport

Human-Powered Transport

- It is the transport of person(s) and/or goods using human muscle-power.
- The form are walking, running, cycling, swimming, ...
- Reasons may be no access of other mode, cost-saving, leisure (relaxation), physical exercise and environmentalism
- It is considered an ideal form of sustainable transportation





Animal-Powered Transport

- It is the use of working animals for the movement of people and goods.
- Forms of usage
  - Directly riding some of the animals
  - Use as pack animals for carrying goods
  - Harness them, alone or in teams to pull (drawing) wheeled vehicles.
- Advantages with respect to man-powered are in their speed, endurance and carrying capacity





Water Transport

- Water transport is the primary means of international shipping between countries separated by oceans for most products
- It is very low-cost form of shipping to heavy, bulk items of non-perishable goods such as raw materials, construction materials, minerals, ores, grains and fertilizer, chemicals, and petroleum products.
- Slow speed transportation mode.

Water Transport

- Advantages of water transport
  - It is a relatively economical mode of transport for bulky and heavy goods.
  - It is a safe mode of transport with respect to occurrence of accidents.
  - The cost of maintaining and constructing routes is very low as most of them are naturally made.
  - It promotes international trade.
- Limitations of water transport
  - The depth and navigability of rivers and canals vary and thus, affect operations of different transport vessels.
  - It is a slow moving mode of transport and not suitable for transport of perishable goods.
  - It is adversely affected by weather conditions.
  - Sea transport requires large investment on ships and their maintenance.

Road Transport

- A road is an identifiable route, way or path between two or more places.
- It is a flexible and versatile (flexible because it offers point to point service between any origin-destination; versatile because it can transport products of varying size and weight - container)
- It provides fast and reliable service.



Road Transport

- Advantages of Road transport
  - It is a relatively cheaper mode of transport as compared to other modes.
  - Perishable goods can be transported at a faster speed by road carriers over a short distance.
  - It is a flexible mode of transport as loading and unloading is possible at any destination. It provides door-to-door service.
  - It helps people to travel and carry goods from one place to another, in places which are not connected by other means of transport like hilly areas.

Road Transport

- Limitations of Road transport
  - Due to limited carrying capacity road transport is not economical for long distance transportation of goods.
  - Transportation of heavy goods or goods in bulk by road involves high cost.
  - It is affected by adverse weather conditions. Floods, rain, landslide, etc., sometimes create obstructions to road transport.

Railway Transport

- Rail transport is where train runs along a two parallel steel rails, known as a railway or railroad.
- Railroads are cost-effective for transporting low-value, high-density, bulk products such as raw materials, coal, minerals, and ores over long distances.
- May be LRT [urban] or conventional railway [rural]
- The locomotive can be powered by steam, diesel or by electricity
- Very high investment cost
- Advantages are low service cost, environmental friendly, high capacity

Railway Transport

- Advantages of Rail transport
  - It is a convenient mode of transport for travelling long distances.
  - It is relatively faster than road transport [now a day can be competent to air transport?]
  - It is suitable for carrying heavy goods in large quantities over long distances.
  - Its operation is less affected by adverse weather conditions like rain, floods, fog, etc.

Railway Transport

- Limitations of Railway transport
  - It is relatively expensive for carrying goods and passengers over short distances.
  - It is not available in remote parts of the country.
  - It provides service according to fixed time schedule and is not flexible for loading or unloading of goods at any place.
  - It involves heavy losses of life as well as goods in case of accident.

Air Transport

- It is the quickest and expensive mode of transporting people and limited amounts of cargo over longer distances.
- Usually handle high value products (pharmaceuticals, high technology, consumer electronics and perishable goods)
- It provides frequent and reliable service and rapid time-in-transit



Air Transport

- Advantages of Air transport
  - It is the fastest mode of transport.
  - It is very useful in transporting goods (e.g. perishable goods, ...) and passengers to the area, which are not accessible by any other means.
  - It is the most convenient mode of transport during natural calamities.
  - It provides vital support to the national security and defense.

Air Transport

- Limitations of air transport
  - It is relatively more expensive mode of transport.
  - It is not suitable for transporting heavy and bulky goods.
  - It is affected by adverse weather conditions (e.g. volcanic explosion…..).
  - It is not suitable for short distance travel.
  - In case of accidents, it results in heavy losses of goods, property and life.

Pipeline Transport

- Pipeline transport sends goods through a pipe, most commonly liquid and gases are sent, but pneumatic tubes can send solid capsules using compressed air.
- Common products transported by pipeline are:
  - Natural gas, crude oil, petroleum products,
  - Water, chemicals, sewage, and
  - Slurry products

Pipeline Transport

- Pipelines deliver products on time (controlled by computer, minimum effect of climate change, not labor intensive-little effect if absence, extremely rare leaks and breaks of pipeline)
- Once in place, pipelines have a long life and are low cost in terms of operation, maintenance, and labor.





Cable Transport

- Cable transport is a broad mode where vehicles are pulled by cables instead of an internal power source.
- It is most commonly used at steep gradient.
- Typical solutions include aerial tramway, elevators, escalator and ski lifts; some of these are also categorized as conveyor transport.

Spaceflight

- Spaceflight is transport out of Earth's atmosphere into outer space by means of a spacecraft.
- While large amounts of research have gone into technology, it is rarely used except to put satellites into orbit, and conduct scientific experiments.
- However, man has landed on the moon, and probes have been sent to all the planets of the Solar System.

Comparison of Different Modes Economic Characteristics

Economic characteristics	Modes of transport				
	Road	Rail	Air	water	Pipeline
Cost	Moderate	Low	High	Low	Low
Market coverage	Point to point	Terminal to terminal	Terminal to terminal	Terminal to terminal	Terminal to terminal
Degree of competition	Many	Few	Moderate	Few	Few
Predominant traffic	All type	Low- moderate value, moderate- high density	High value, low-moderate density	Low value, high density	Low value, high density

Comparison of Different Modes Service Characteristics

Service characteristics	Modes of transport				
	Road	Rail	Air	water	Pipeline
Speed (time in transit)	Moderate	Moderate-Fast	Fast	Slow	Slow
Availability	High	Moderate	Moderate	Low	Low
Consistency (delivery time variability)	High	Moderate to high	High	Low to moderate	High
Loss and damage	Low	Moderate	Low	Low to moderate	Low
Flexibility (adjustment to customers)	High	Moderate	Moderate to high	Low to moderate	Low

Physical Elements of Transport System

- Infrastructure refers to the fixed parts of a transportation system (i.e., parts that are static and do not move). These include:
  - Travel ways must be built for rail, pipeline and road but no need for air and water transport.
  - Terminals are required as fixed infrastructure for all modes
  - Stations serve only a subset of the functions served by terminals. They are primarily points of system exit or entry. Examples include bus, subway, and railway stations. A parking garage or a regional airport also serves as a station.

Physical Elements of Transport System

- Vehicles are the elements of a transportation system that move along the travel-way. They include automobiles, buses, locomotives, railroad cars, ships, and airplanes.
- Most vehicles are self-propelled (e.g., automobiles, locomotives, ships, and aircraft) and some are without propulsion (e.g., railroad cars and truck trailers).

Physical Elements of Transport System

- Equipment refers to physical components whose main function is to facilitate the transportation process. Examples include:
  - Snowplows,
  - Railroad track maintenance vehicles, and
  - Baggage-handling conveyor belts at airports.
  - Control involves the elements required to allocate right-of-way. Allocating right-of-way requires air traffic control centers, traffic signals, and travel-way signs.
  - Communications systems link traffic control centers to travel-way equipment such as variable message signs, traffic signals, transit vehicles, air traffic controllers, and pilots.