MODULE-III

Foundation

Function of a foundation is to transfer the structural loads from a building safely into the ground. A larger and heavier building of masonry, steel, or concrete would require its foundations to go deeper into earth such that the soil or the rock on which it is founded is competent to carry its massive loads.

Because of the variety of soil, rock, and water conditions that are encountered below the surface of the ground and the unique demands that many buildings make upon the foundations.

Types of Foundation

SHALLOW FOUNDATIONS ($D \leq B$)

DEEP FOUNDATION ($D \geq B$)

SHALLOW FOUNDATIONS

WALL Foundation

ISOLATED COLUMN Foundation

COMBINED Foundation

DEEP FOUNDATIONS

PILE Foundation

UNDER-REAMED PILE

WELL Foundation

MAT or RAFT Foundation

A **shallow** foundation is a type of foundation which transfers building loads to the earth very near the surface, rather than to a subsurface layer or a range of depths as does a deep foundation.

A **deep** foundation is a type of foundation which transfers building loads to the earth farther down from the surface than a shallow foundation does, to a subsurface layer or a range of depths.

Types of foundation

Foundations may be broadly classified as

(a) shallow Foundation

(b) Deep foundation

(a) Shallow Foundation: According to Terzaghi, a foundation is shallow if its depth is equal to or less than its width.

Types of shallow foundation:

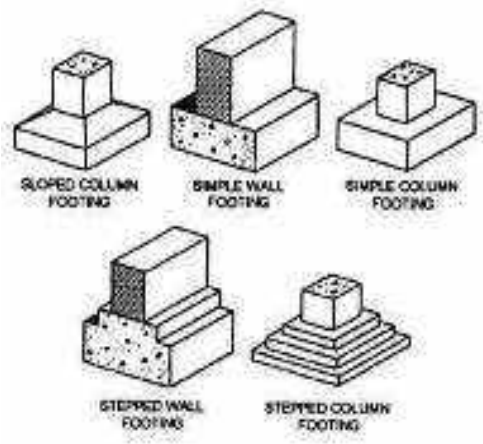
Spread footing

Combined footing

Strap Footing

Mat Foundation or Raft Foundation

Shallow Foundations



Spread Footing:-Spread footings are those which spread the super-imposed load of wall or column over larger area. Spread footing support either column or wall.

It may be following kinds

Single footing for column: In which the loaded area of column has been spread to the large size through single spread. The base is generally made of concrete.

Stepped footing for column: This type of footing provided for heavily loaded column which required greater spread with steps. The base is generally made of concrete.

Sloped footing for column: In this type of footing concrete base does not have uniform thickness but is made sloped.

Wall footing without step: It consist of concrete base without any steps including masonry wall.

Stepped footing for wall: It consist of masonry wall have stepped footing with concrete base .

Combined Footing:

A spread footing which supports two or more columns is termed as combined footing.

The combined footing may be of following kinds.

Rectangular combined footing: The combined footings will be provide in rectangular in shape if columns carry equal loads. The design of rectangular combined footing should be done in such way that centre of gravity of column coincide with centroid of footing area.

Trapezoidal combined footing: If columns carry unequal loads the footing is of trapezoidal shape are provided.

Combined column-wall footing: It may be required to provide a combined footing for column and wall. Such combined footing are shown in fig.

Combination of Spread and Strip Foundations

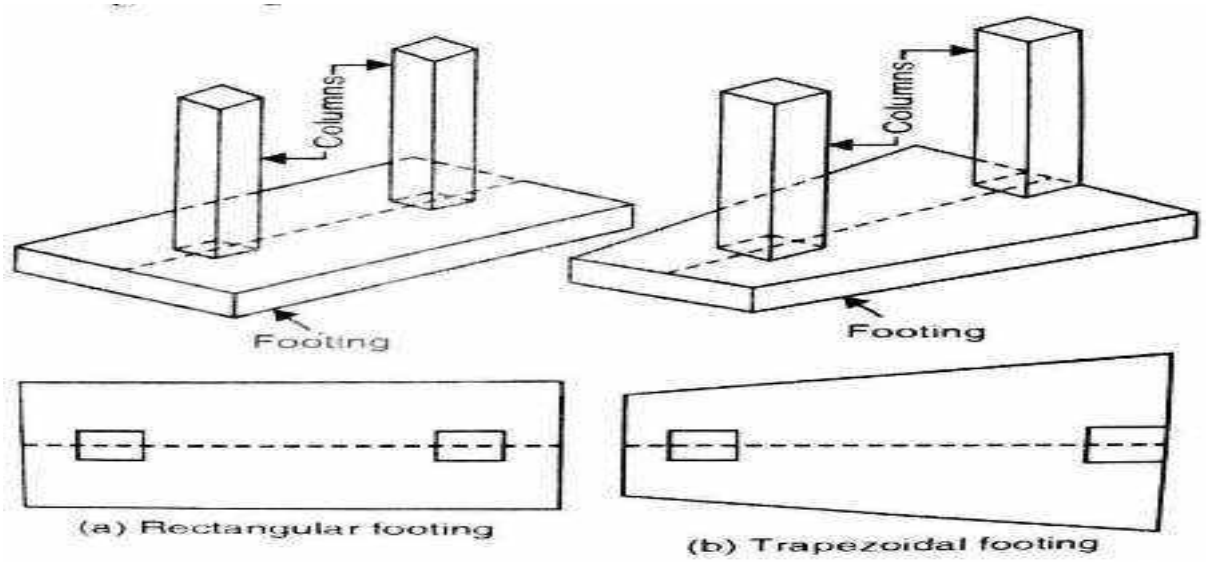
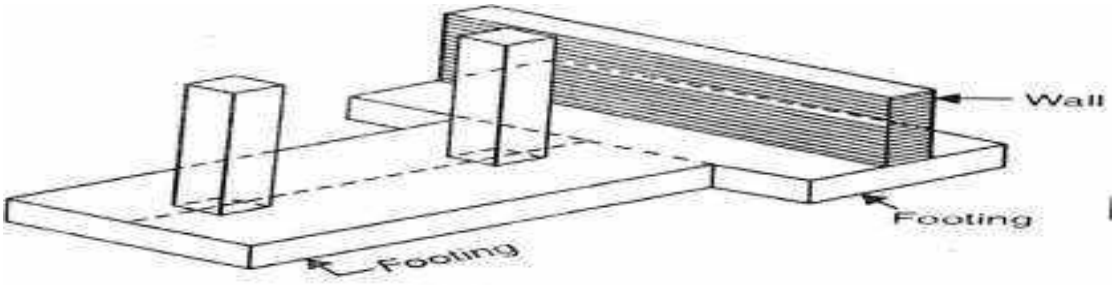


FIG. 2.5. COMBINED FOOTINGS FOR COLUMNS.

Strap footing



- If a Independent footing of two columns are connected by a beam, it is called a strap footing.

- Astrap footing may be used where the distance between the column is so great that trapezoidal footing becomes quite narrow.
- The strap does not remain in contact with soil and does not transfer any pressure to the soil.

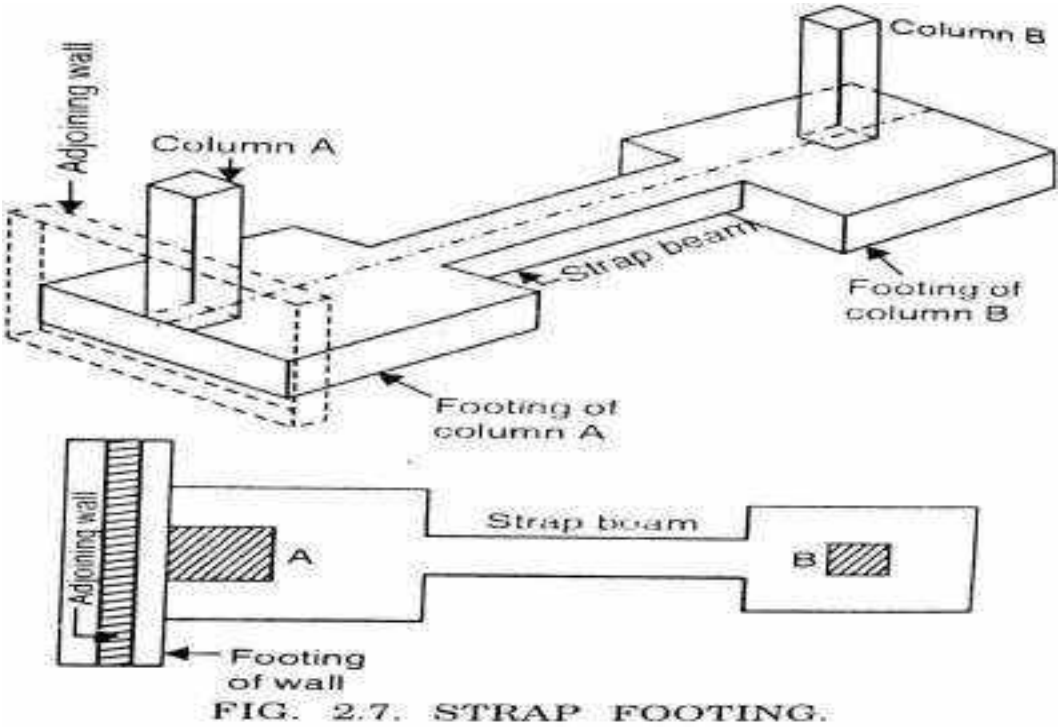
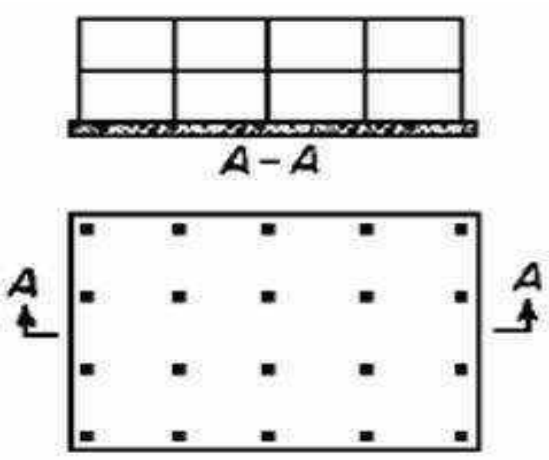


FIG. 2.7. STRAP FOOTING.

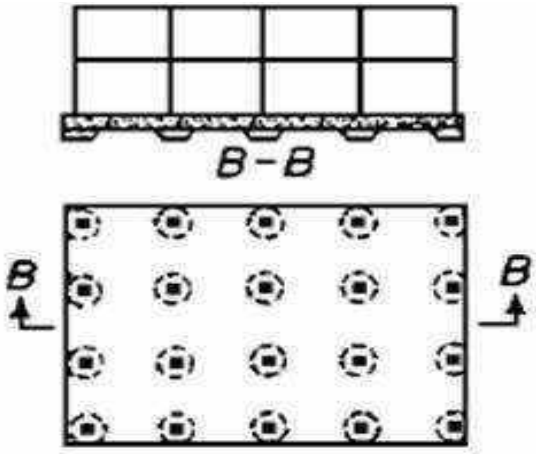
Raft foundation:

- A raft Foundation is a combined footing that covers the entire area beneath a structure and support all the wall and column.
- They are used in areas where the soil masses contains compressible lenses or the soil is sufficiently erratic so that differential settlement would be difficult to control.
- Raft foundation may be divided in to three types based on their design and construction.

- Solid slab system
- Beam slab system
- Cellular system
- All the three types are basically the same, consisting of a large, generally unbroken area of slab covering the whole or large part of structure.



Flat plate

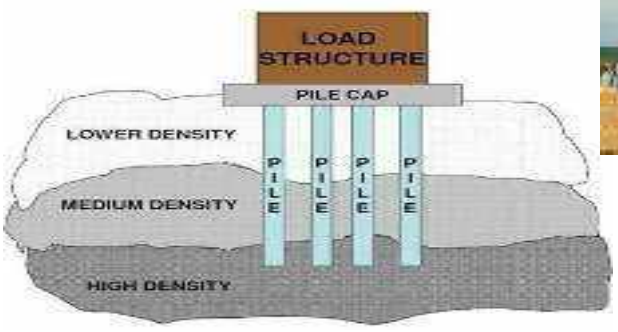


Flat plate thickened Under columns

Deep foundation

- Deep foundation are those in which the depth of foundation is very large in comparison to its width.
- Deep foundation may be of following types
- Pile foundation
- Pier foundation
- Caissons or Well foundation
- Pile Foundation
- Pile Foundation is that type of foundation in which the loads are taken to a low level by means of vertical members which may be timber, concrete or steel.
- Pile foundation may be adopted when no firm bearing strata is available and the loading is uneven.
- Piles may be of following types
- End bearing piles
- Friction Pile
- Compaction pile

Deep Foundations

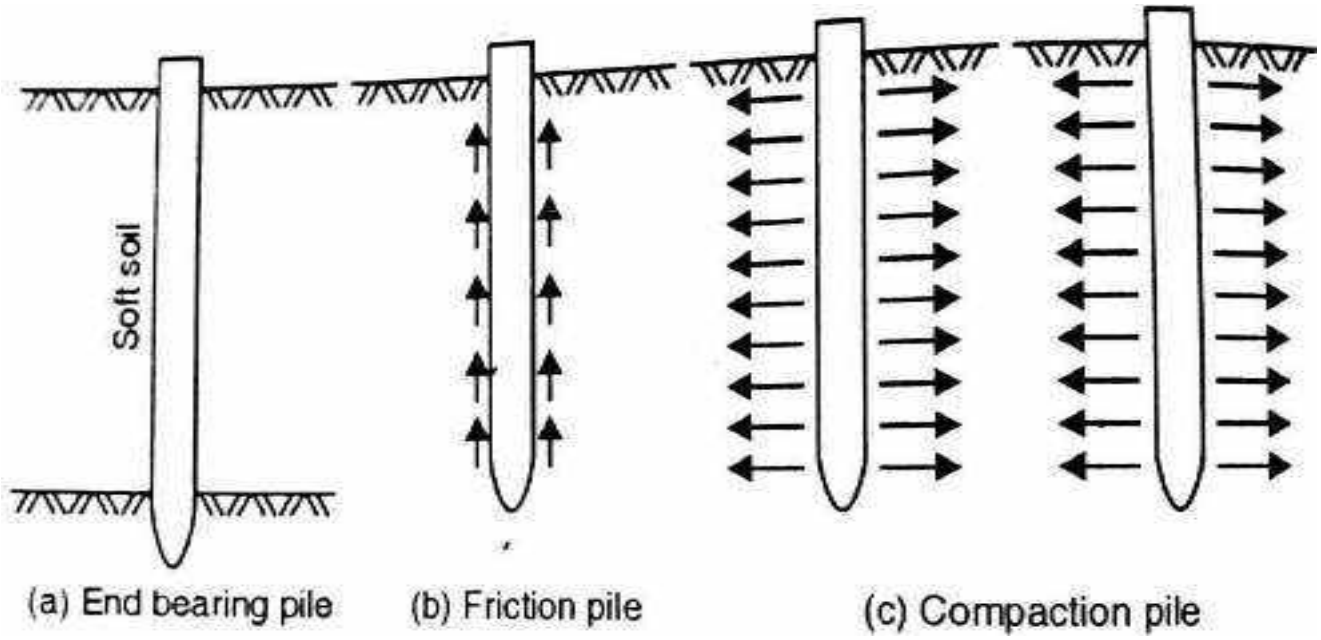


Pile Foundation

Pile foundations are used in the following situations, where:

- The load of the super structure is heavy and its distribution is uneven
- The top soil has poor bearing capacity
- The subsoil water level is high
- There is large fluctuations in subsoil water level
- Canal or deep drainage lines exist near the foundation
- The structure is situated on the sea shore or river bed

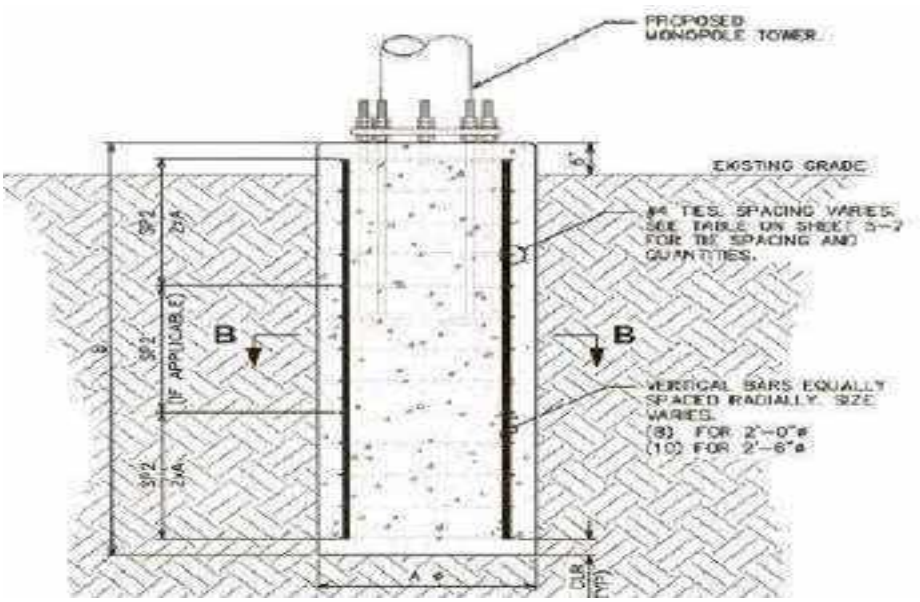
- End bearing piles: This types of piles are used to transfer load through water or soft soil to a suitable bearing stratum.
- Friction Pile: Friction piles are used to transfer loads to a depth of friction load carrying material by means of skin friction along the length of piles.
- Compaction pile: Compaction piles are used to compact loose granular soils, thus increasing their bearing capacity.

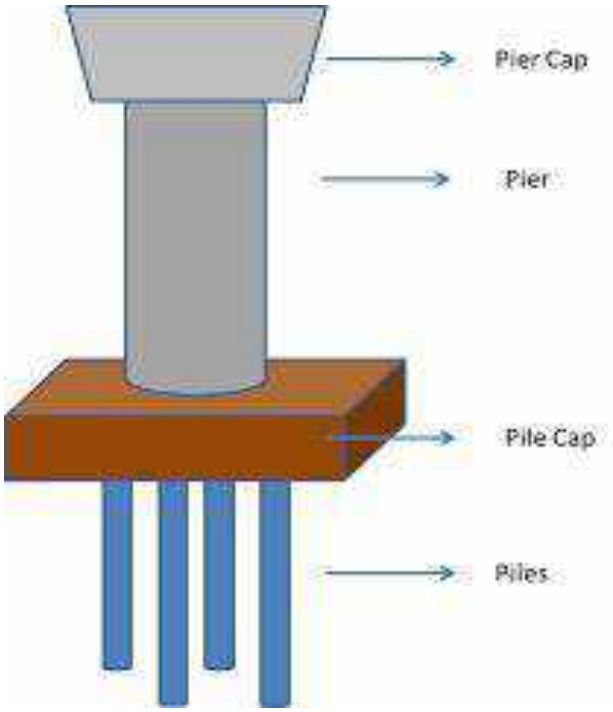


- Pier foundation:

A Pier foundation consist of cylindrical column of large diameter to support and transfer large superimposed load to the firm strata below.

Generally, pier foundation is shallow in depth than the pile foundation.




Pier Cap
Pier
Pile Cap
Piles

Well Foundation:

Well Foundation or Caisson are box like structures which are sunk from the surface of either land or water to the desired depth.

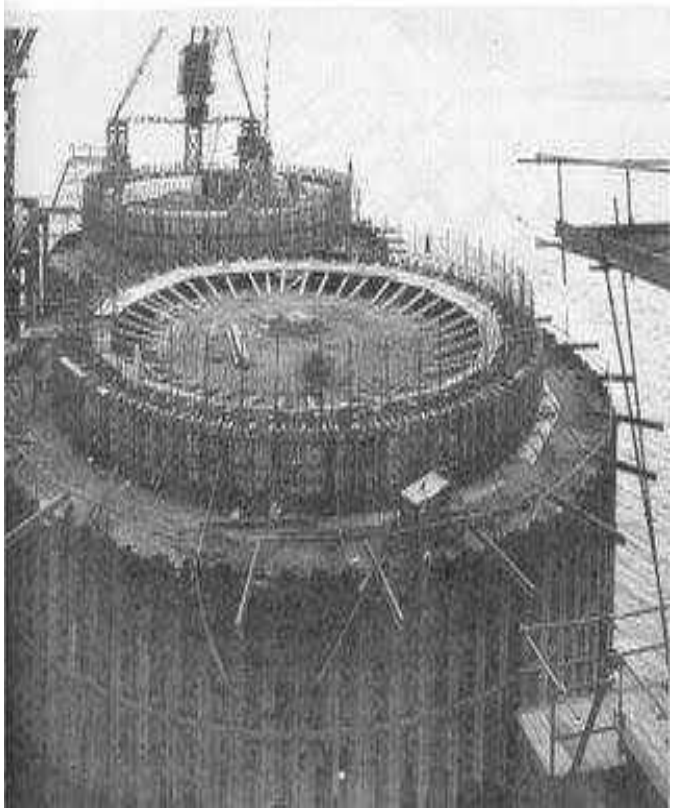
They are much larger than the pier foundation or drilled caissons.

Caisson foundations are used for major foundation works like

Bridge piers

Docks

Large water front structure such as pump house.



SHUTTERING WORK IN PROGRESS WELL FOUNDATION OF SIMBLE Br AT KM 18.0
ON SIMBLE Br JAMMU-AKHNOOR ROAD

TRAFFIC ENGINEERING

WHAT IS TRAFFIC ENGINEERING..?

The basic object of traffic engineering is to achieve efficient, free and rapid flow of traffic with least no of accidents.

STUDY OF TRAFFIC ENGINEERING

The study of traffic engineering may be divided into following sections

- Traffic Characteristics
- Traffic Studies and Analysis
- Traffic operation-control and regulation
- Planning and analysis
- Geometric Design
- Administration and Management

TRAFFIC CHARACTERISTICS

Road user characteristics- Broadly Classified under four heads

Physical Characteristics-Vision, hearing, strength and reaction to traffic situation
Mental Characteristics-Knowledge. skill, intelligence, experience, literacy
Psychological Characteristics-Emotional factors such as fear, anger, anxiety
Environmental Factors-traffic stream conditions, atmospheric conditions, facilities to the traffic locality etc

Vehicular Characteristics:-

Static Characteristics
Dynamic Characteristics
Breaking Characteristics

VEHICULAR CHABACTERISTICS

It is quite important to study the important vehicular characteristics which affect the design and traffic performance. For economic feasibility the standards of vehicles should be kept uniform. The vehicular characteristics are classified as

Static Characteristics-It involves dimensions of vehicles(length, width and height, wheel base, departure and ramp angles, the front, rear and centre clearances) , weight, maximum turning angle

Dynamic characteristics-Are speed, acceleration, power and breaking characteristics.

TRAFFIC STUDIES

Also called as Traffic census or surveys.

It involves analysing the traffic characteristics for road designs, safe and efficient movement for traffic and traffic control.

The various traffic studies generally carry out are:

- Traffic Volume Study.
- Speed Study.
- Origin and Destination study.
- Traffic Flow Characteristics.
- Traffic capacity study.
- Parking study.
- Accident Studies.

Traffic Volume Study.

Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period.

The unit for traffic count is generally taken as vehicles per day or vehicles per hour.

Traffic volume study are used for various purposes.

- They are used for roads improvement and expansion, traffic operation and control, structural design of pavements, in geometric design, planning and designing new facilities etc.

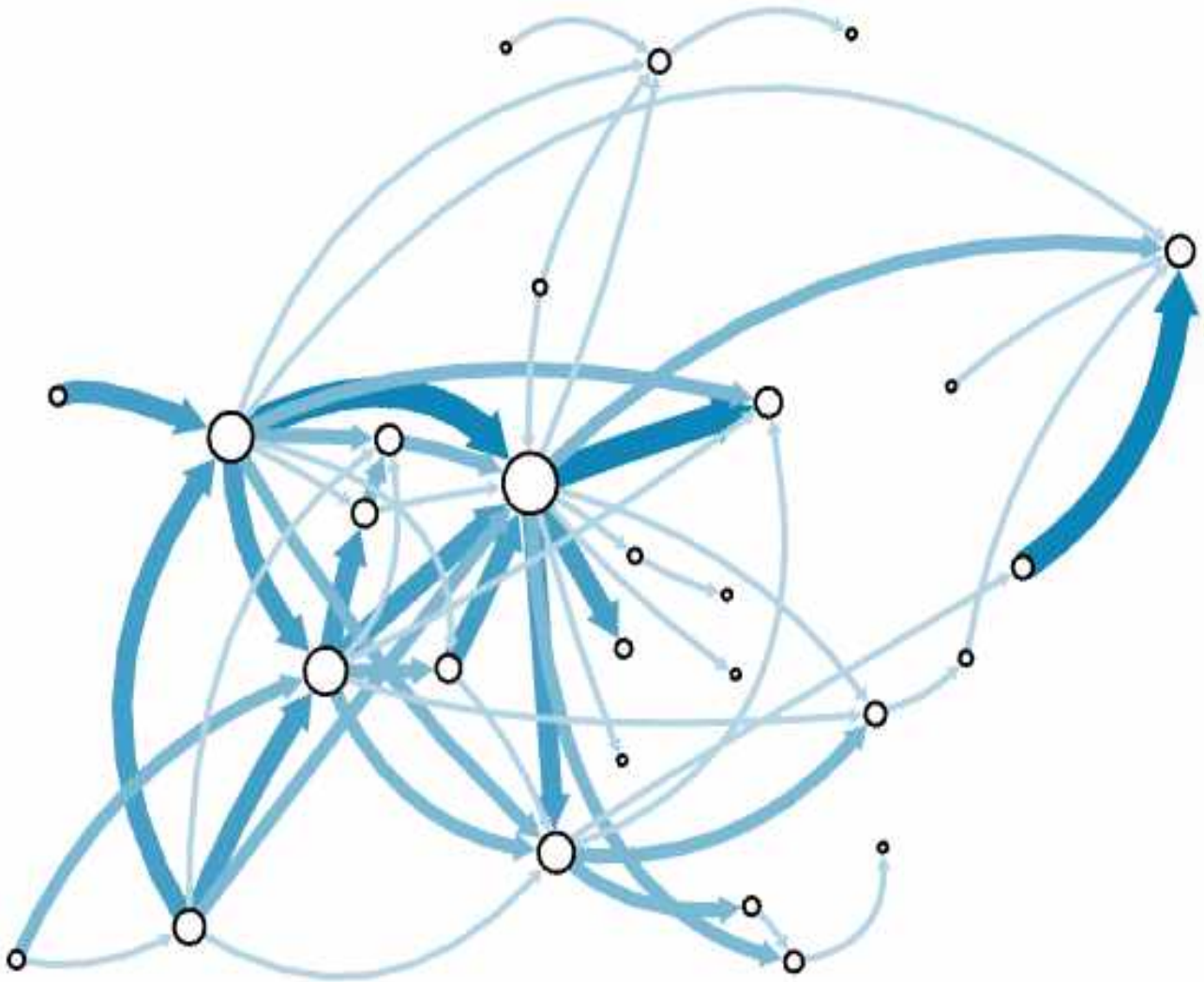
Counting of traffic volume can be done in two ways.

- Mechanical Counters
- Manual Counts

Speed Study

Speed studies are necessary because the actual speed of vehicles over a particular may vary depending on various factors such as geometric features, traffic conditions, time, place, environment and driver. Speed studies un be studied under following heads-

Origin and Destination study.

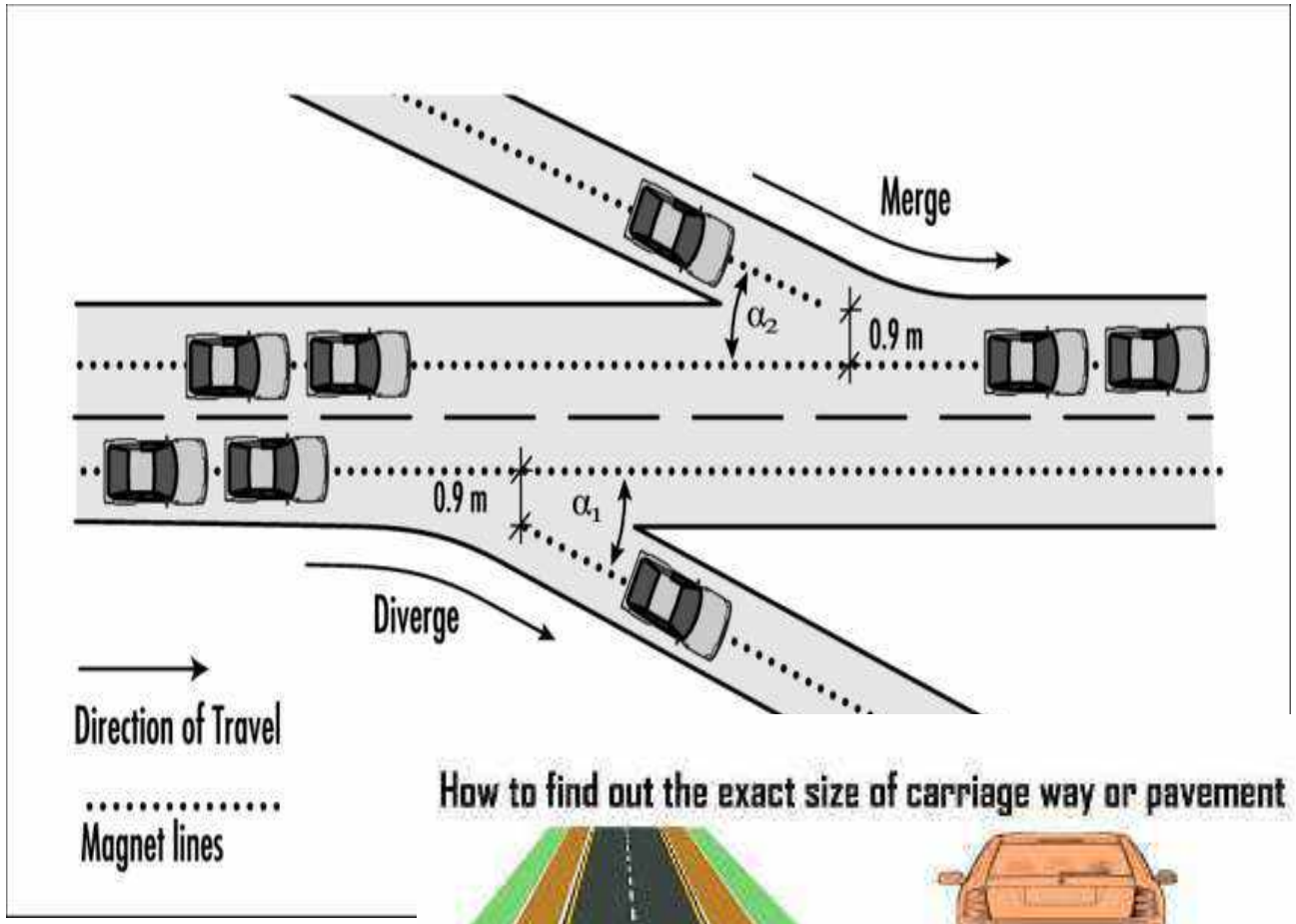


The origin and destination (OD) study is carry out mainly to
Plan the road network and other facilities for vehicular traffic
Plan the schedule of different modes of transportation for the trip demands of commuters.

OD gives information like the actual direction of travel, selection of routes and length of the trips. The various applications of OD surveys are

- To judge the adequacy of the existing routes and to use it planning new network of roads, transportation system and mass transit facilities in cities.
- To locate expressway terminals new bypass and bridges as per traffic demands
- To establish design standards for the road, bridge and culverts along the route

Traffic Flow Characteristics.



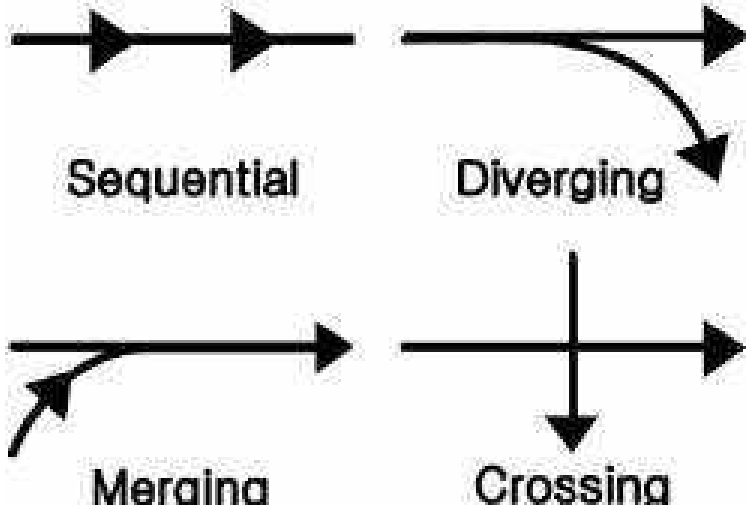
Traffic stream generally has flow and counter flow along a common route, unless the stream is separated by one wav flow by proper design and regulation.

The basic traffic manoeuvres are diverging, merging and crossing.

Study of traffic flow characteristics includes both transverse and longitudinal distribution of vehicles in the traffic stream and is useful in geometric design features such as traffic capacity, volume, number of lanes and width of carriageways

How to find out the exact size of carriage way or pavement

Carriage way Type	Carriage way Width
Single Lane	3.75
Two Lane, No kerbs	7.0
Two Lane, Raised kerbs	7.5
Intermediate Carriage	5.5
Multi-Lane	3.5



V. TRAFFIC CAPACITY STUDIES

- Traffic capacity is the ability of a roadway to accommodate traffic volume.
- It is expressed as the maximum no of vehicles in a lane or a road that can pass at a unit time.
- Capacity and volume are measures of traffic flow and have same units

- Traffic volume is the no of vehicles moving in a specified direction on a given lane and roadway that pass a given point or cross section during specified unit of time.

Parking study.

Parking studies are useful to evaluate the facilities available. Various aspects to be investigated during parking studies are

Parking Demand- This can be evaluated by different methods. One of the methods is by making counts of the selected area and recording accumulation of vehicles during the peak hours by subtracting the outgoing traffic from the traffic volume entering the cordoned area.

Other method is by counting the number of vehicles in the parked area under study during different periods of the day.

Parking Characteristics-

Parking Space Inventory-The area under study is fully surveyed and a map is prepared showing all places where kerb parking and offset parking can be provided to meet the general problems in parking.

Accident Studies.

Road accident cannot be totally prevented, but by suitable traffic engineering and management measures, the accident rate can be decreased considerably. The various objectives of the accident studies may be listed as

To study the causes of accident and to suggest corrective treatment at potential location

To evaluate the existing

To support proposed design

To carry out studies before and after for improvement

To make financial computations and to give economic justifications for the improvements suggested by the traffic engineer

CAUSES F ACCIDENTS

The road users

The vehicles

The road and its conditions

Environmental Factors

Other causes-Incorrect signs and signals, gate of level crossing, badly located advertized boards etc.

Urban Engineering

Urban engineers provide physical definition of the urban habitat, by planning, designing, building/constructing, operating and maintaining the infrastructure including buildings and roads.

This involves specifying, designing, constructing, and maintaining streets, sidewalks, water supply networks, sewers, street lighting, municipal solid waste management and disposal, storage depots for various bulk materials used for maintenance and public works (salt, sand, etc.), public parks and cycling infrastructure.

In the case of underground utility networks, it may also include the civil portion (conduits and access chambers) of the local distribution networks of electrical and telecommunications services.

It can also include the optimizing of garbage collection and bus service networks.

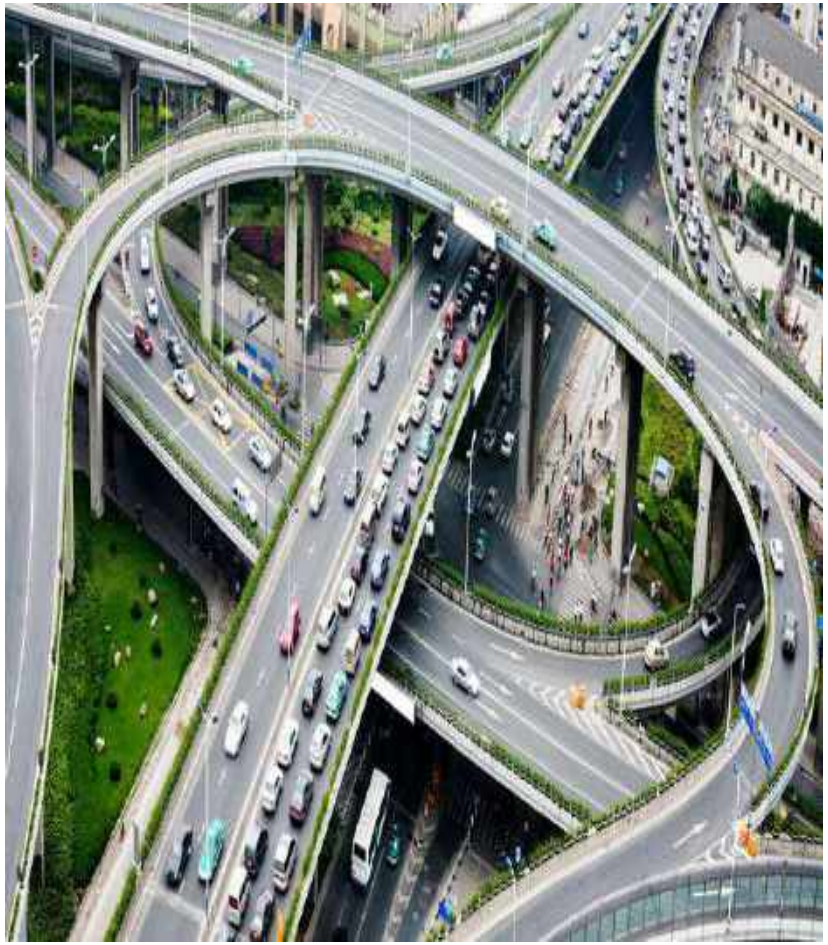
a channel for conveying water or other fluid.

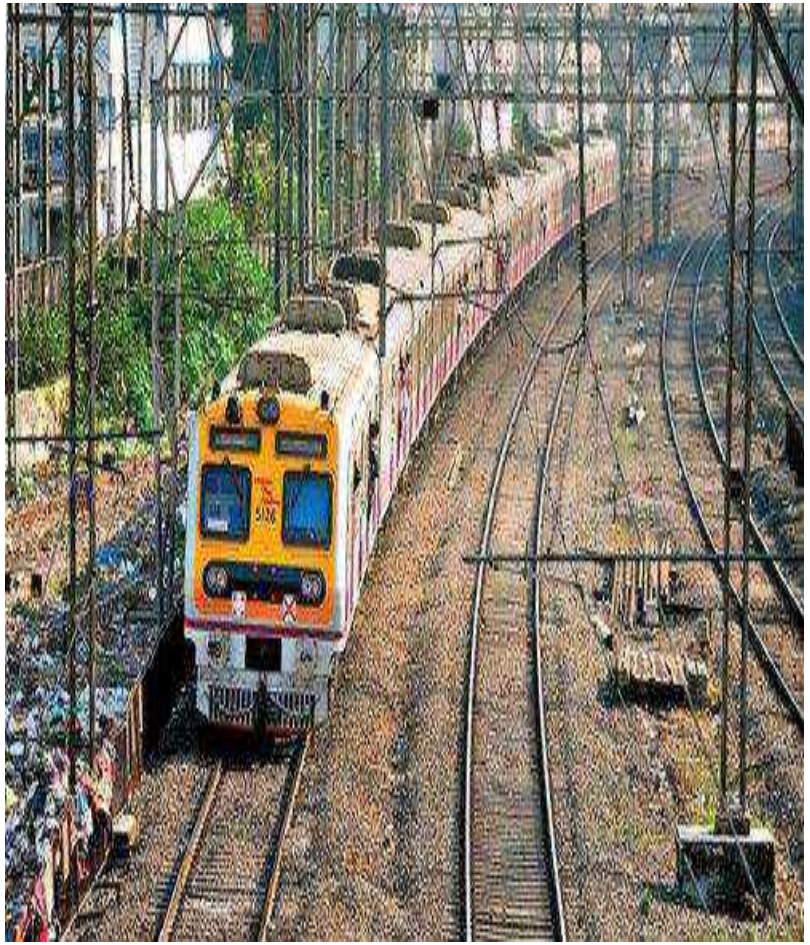
An access chamber (or manhole) is **a structure designed to allow access to an underground service, such as a stormwater pipe or a sewer**.

Introduction to Transportation Engineering

Movement of people and goods
Society's progress
Development

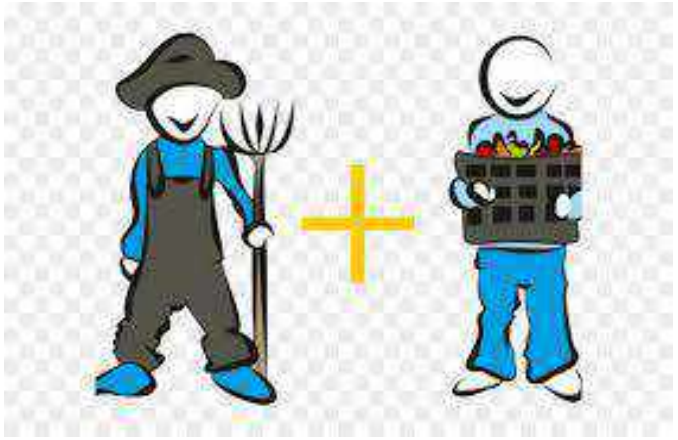
- **Transportation engineering** is the planning, construction, and operation of systems for moving goods and people by highway, rail, air, water, and pipelines, as well as urban and intermodal transportation.





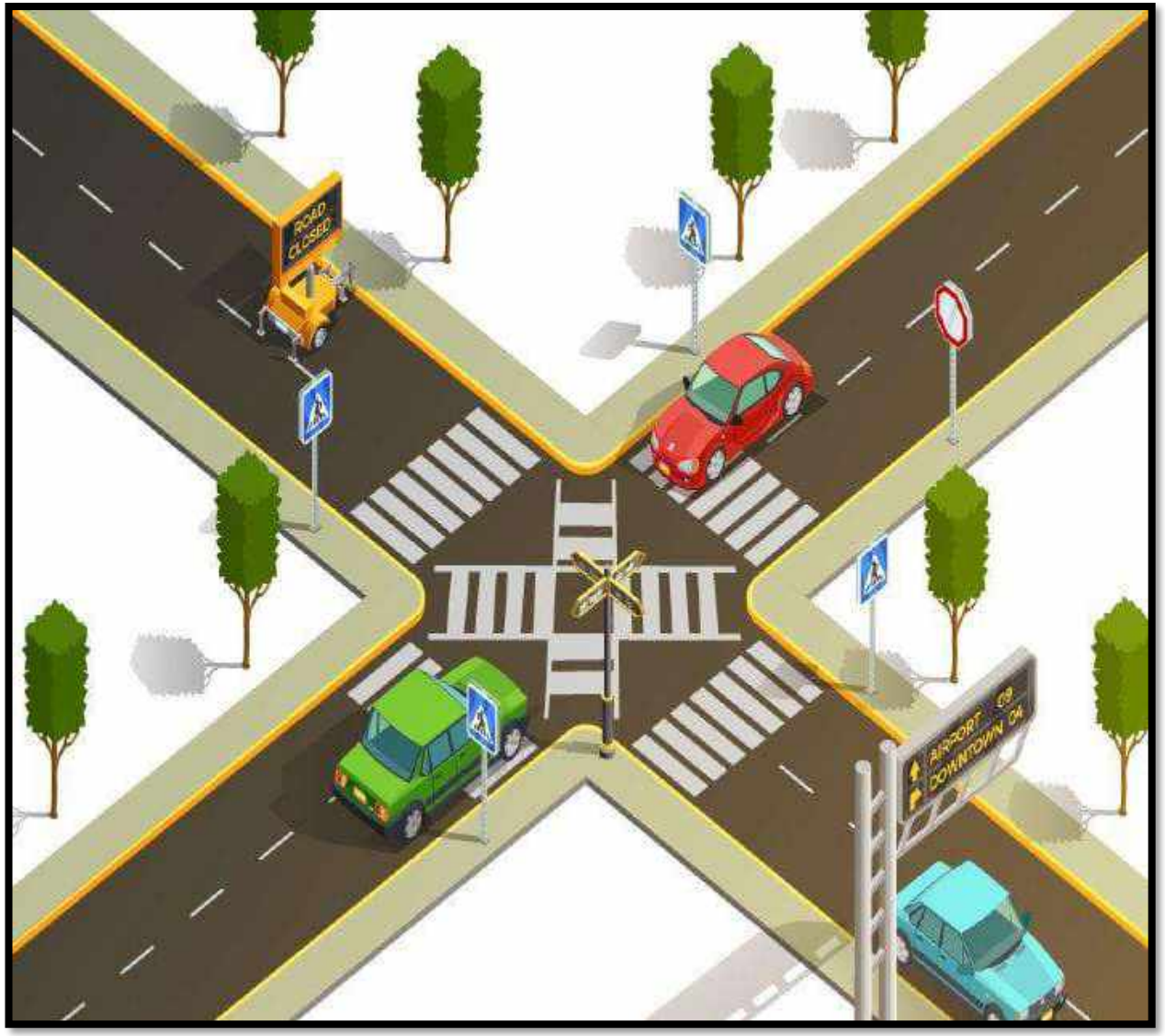
Role of Transportation

- **Transport and economic growth**
- **Place utility of goods**
- **Time utility of goods**
- **Producer and consumer**
- **Preservation of quality of goods**



Mass production
Exploitation of natural resources
Transport and urbanization
Transport and industrial development
Transport and agricultural development
Costs of goods
Administration
Defense and strategic needs
Tourism
Transport facilities and social activities

Traffic engineering is a branch of civil engineering that uses engineering techniques to achieve the safe and efficient movement of people and goods on different mode of transportation .




T6
m
T8
m
T10
m


Heathrow
Airside Safety

Urban engineering can more properly be described as the branch of engineering that covers all the **civil and environmental engineering services** related to the range of complex problems associated with infrastructure, services, buildings, environmental and land-use issues generally encountered in urban areas.

Urban Planning

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 traveller 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 traveller 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

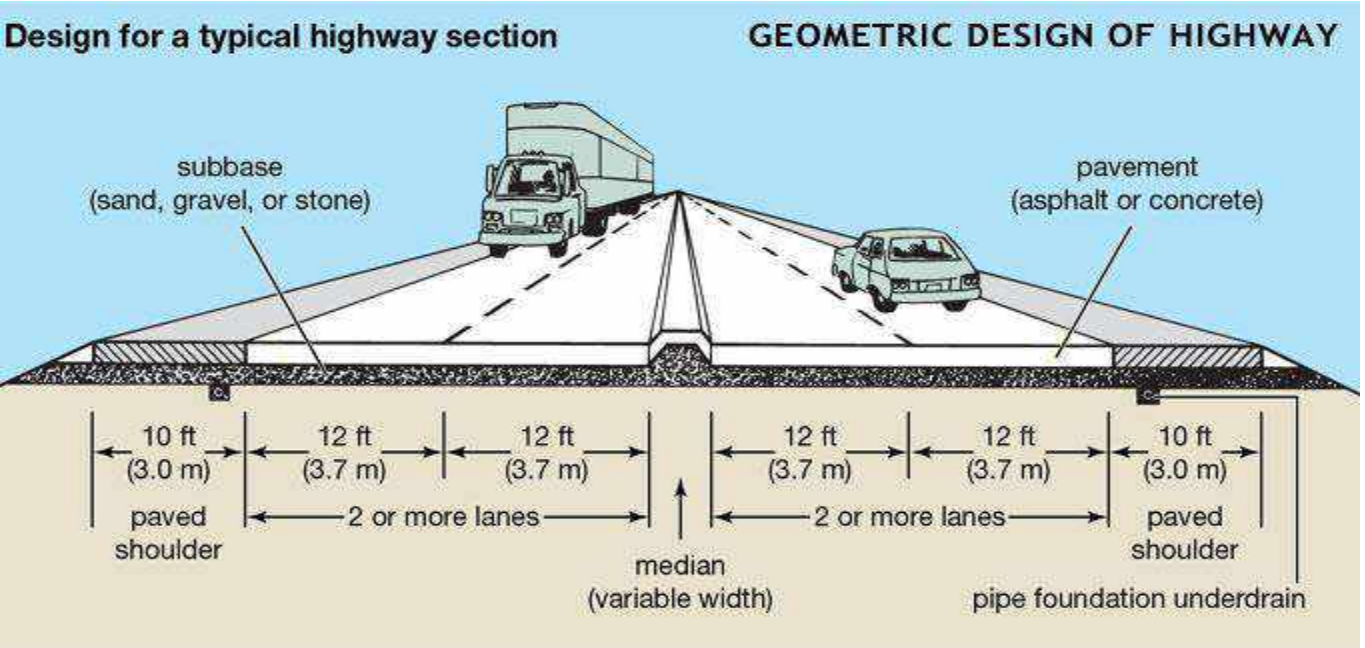
(1) Population,
(2) Land use,
(3) Economic Activity.
(4) Transportation Facilities and Services,
(5) Travel Patterns and Volumes.
(6) Laws and Ordinances.
(7) Regional Financial Resources
(8) Community Values and Expectations.

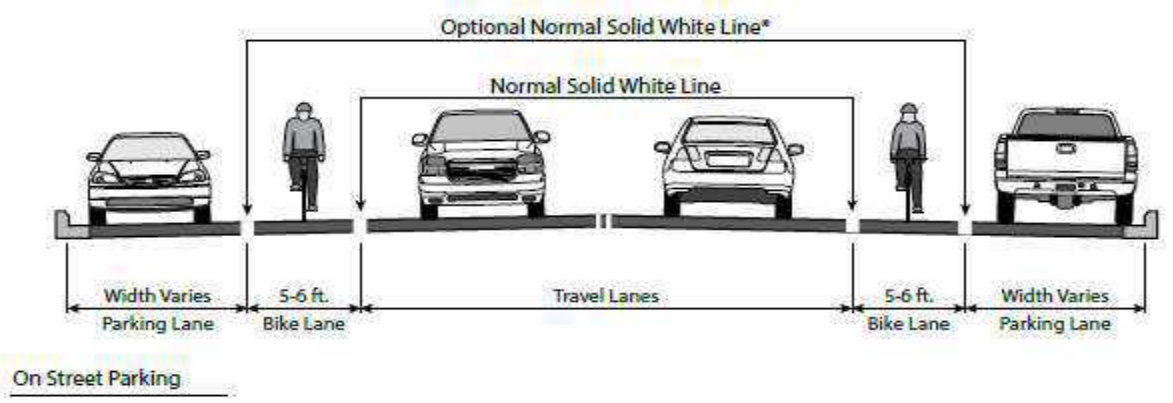
These inventories help the engineer create business models to complete accurate forecasts of the future conditions of the system review.

Transport design

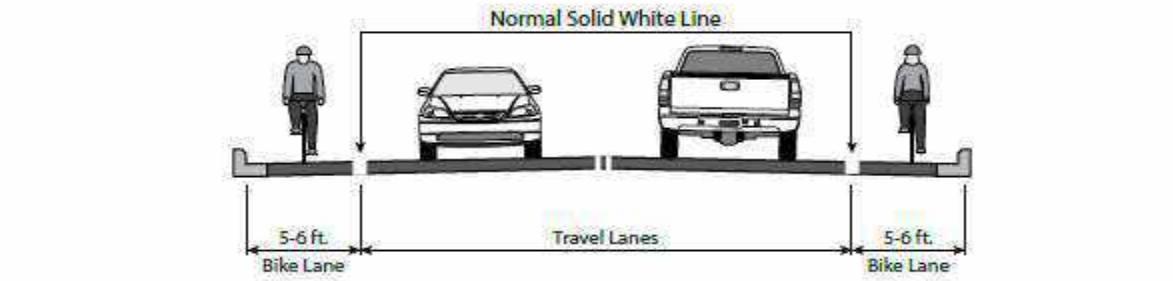
Transport engineers face multi-faceted design decisions when they are designing optimized transport infrastructure networks. These might relate to:

- 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.

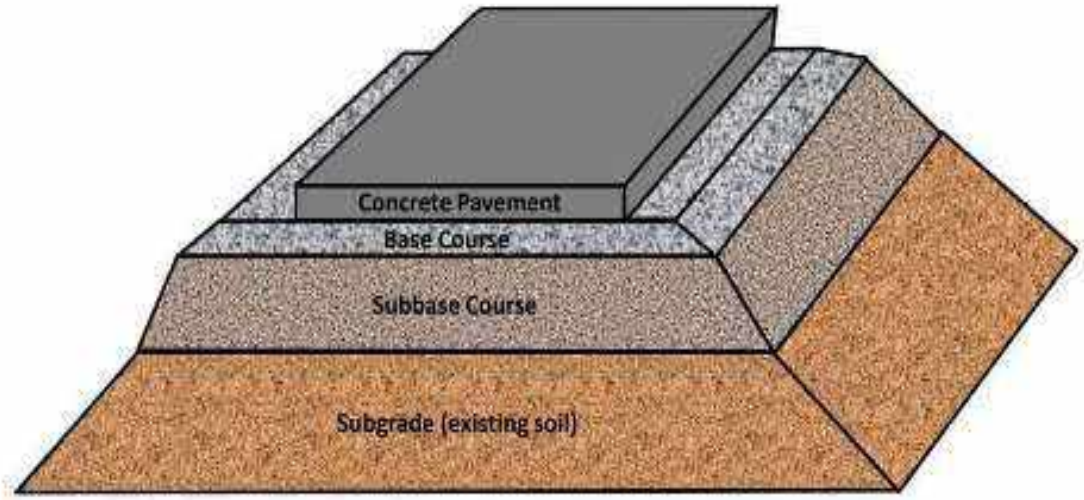




On Street Parking

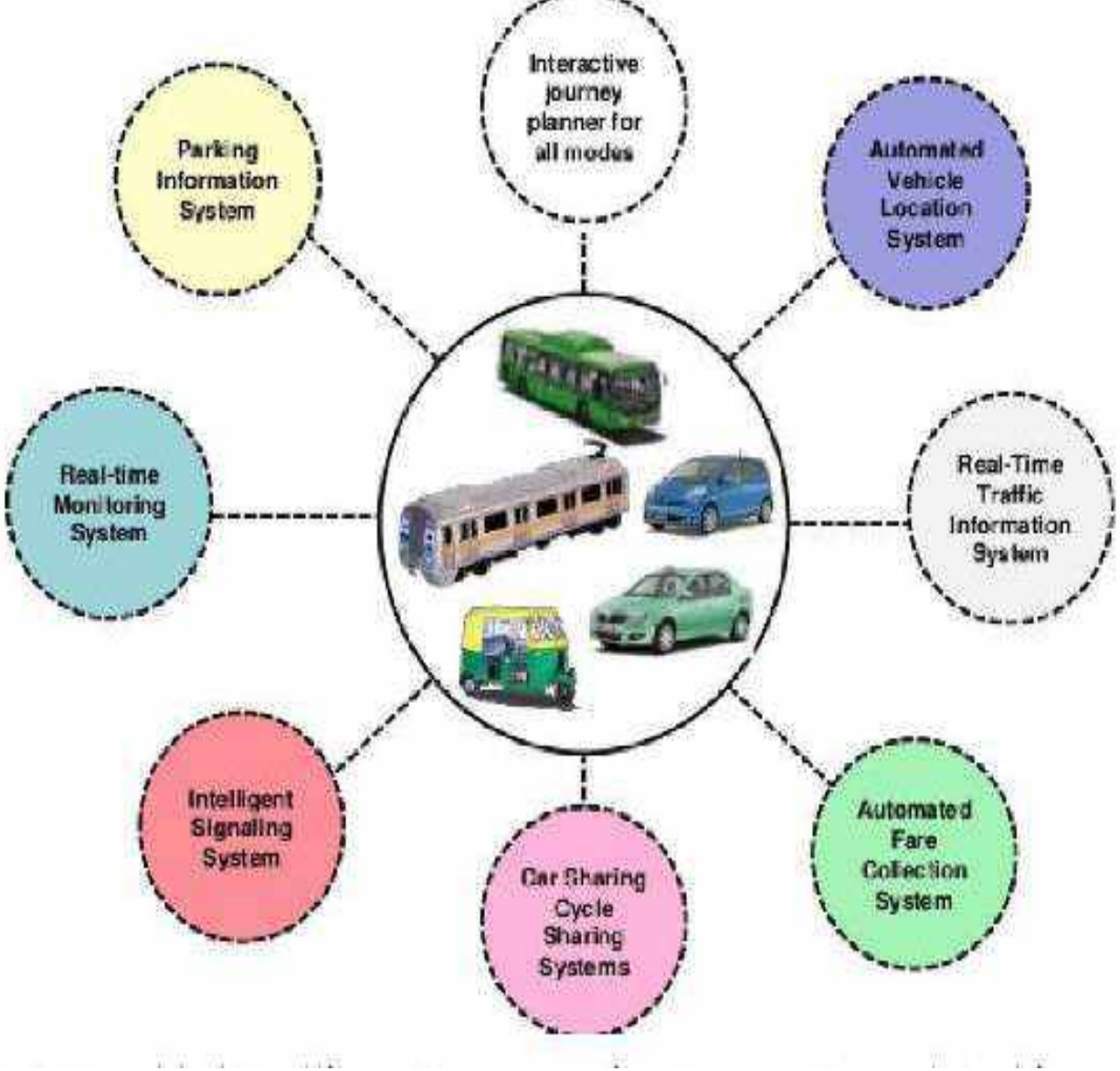


Parking Prohibited



- Road pricing schemes.
- Deploying information-based technology.

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



DIFFERENT MAJOR MODES OF TRANSPORTATION

BASIC MODE OF TRANSPORT IS

- **Road WAY**
- **Railway**

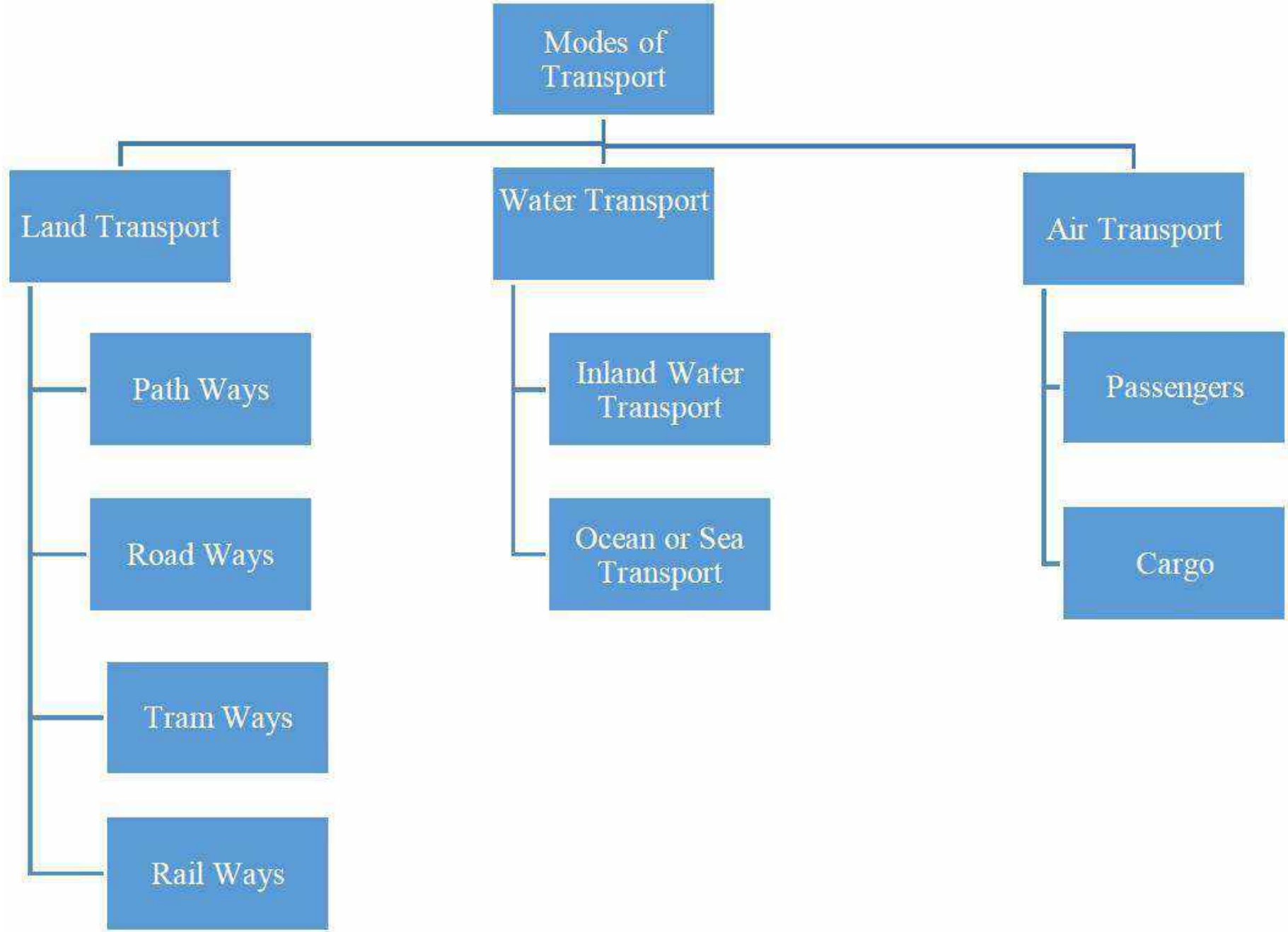
LAND

- **WATER WAY**

WATER

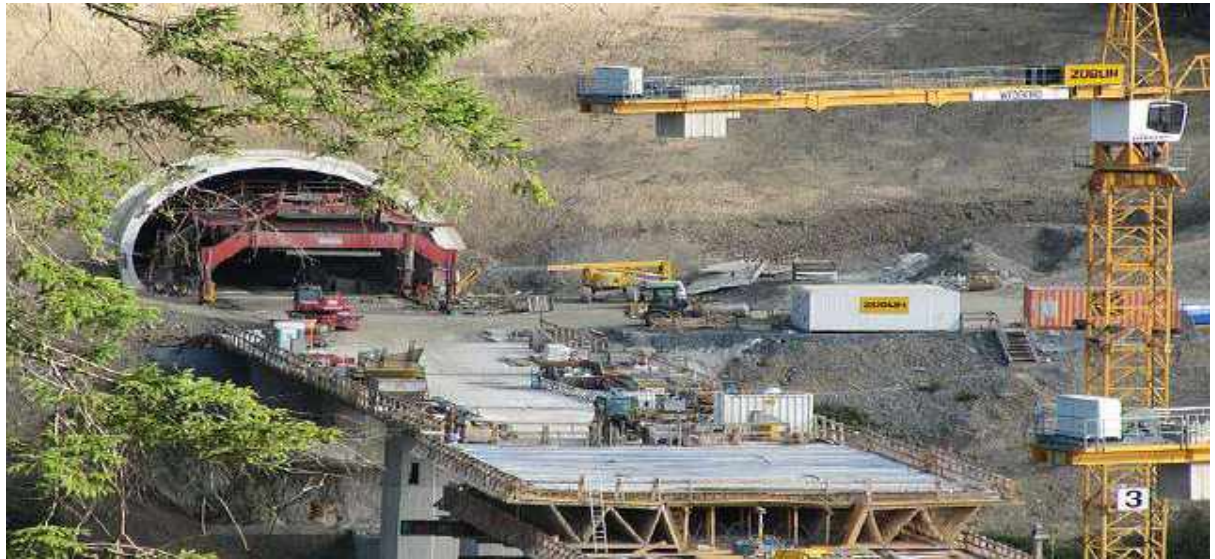
- Air WAY

AIR

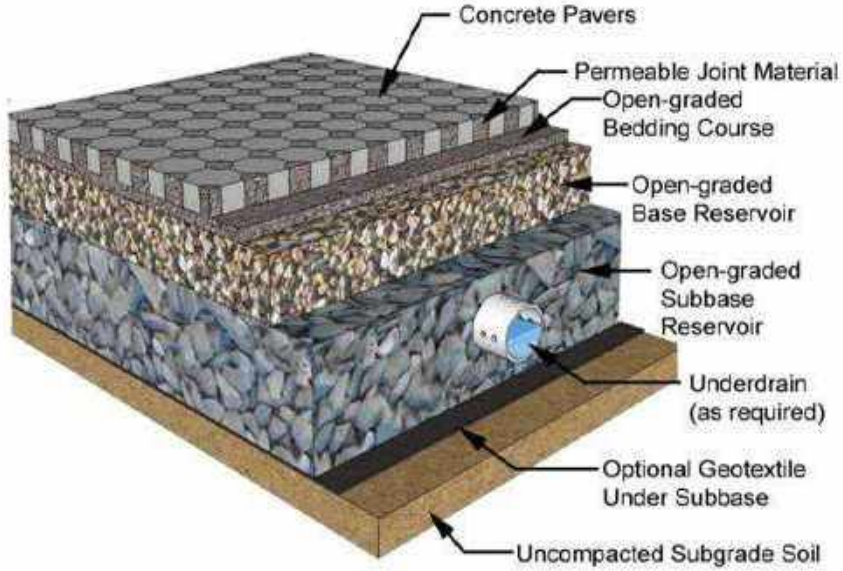

Modes of Transport
Land Transport
Water Transport
Air Transport
Path Ways
Road Ways
Tram Ways
Rail Ways
Inland Water Transport
Ocean or Sea Transport
Passengers
Cargo

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.

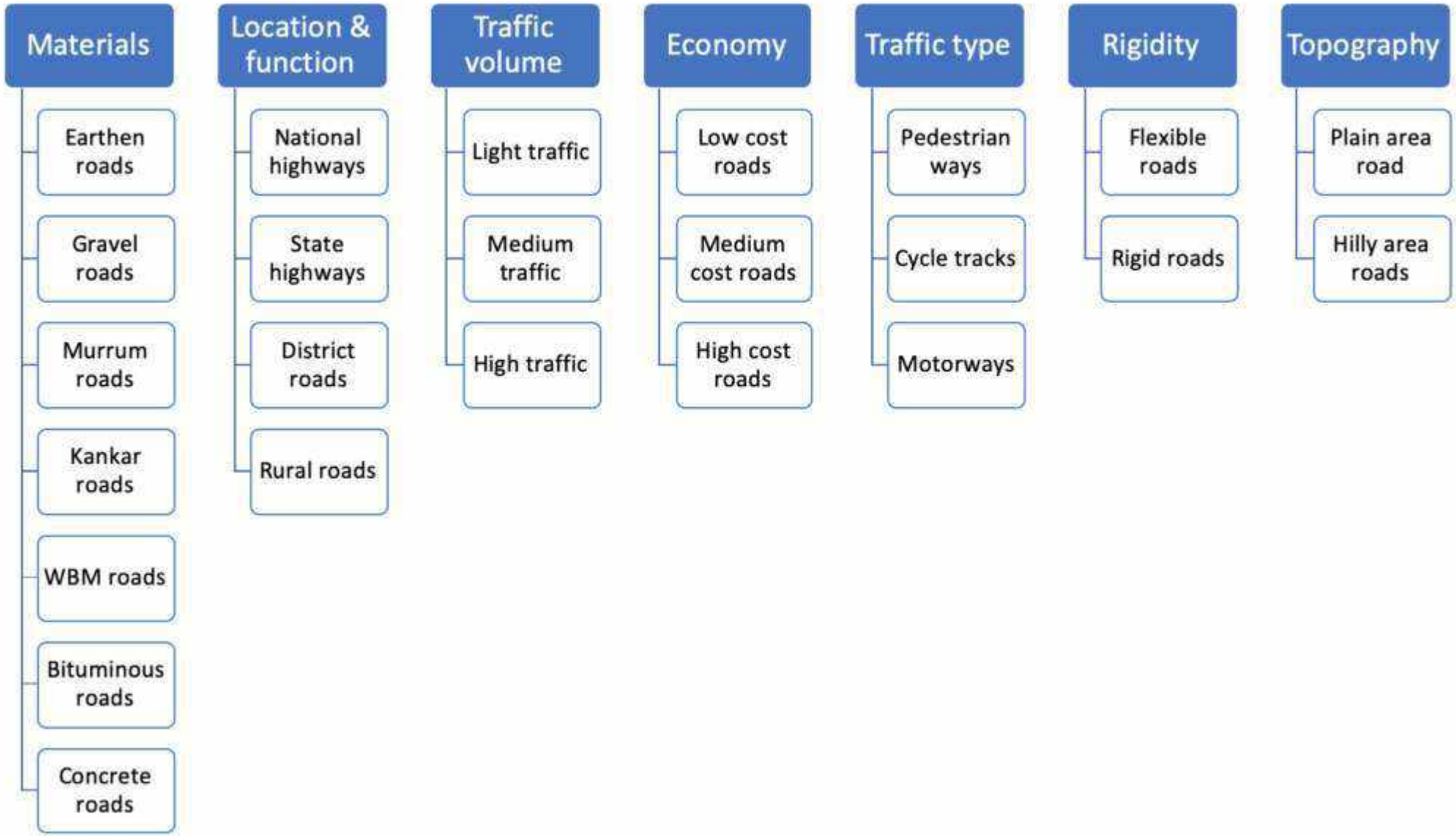




Human factors include reaction time for **braking** and **steering**, **visual acuity for traffic signs and signals**, and **car-following behaviour**. Vehicle considerations include vehicle size and dynamics that are essential for determining lane width and maximum slopes, and for the selection of design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

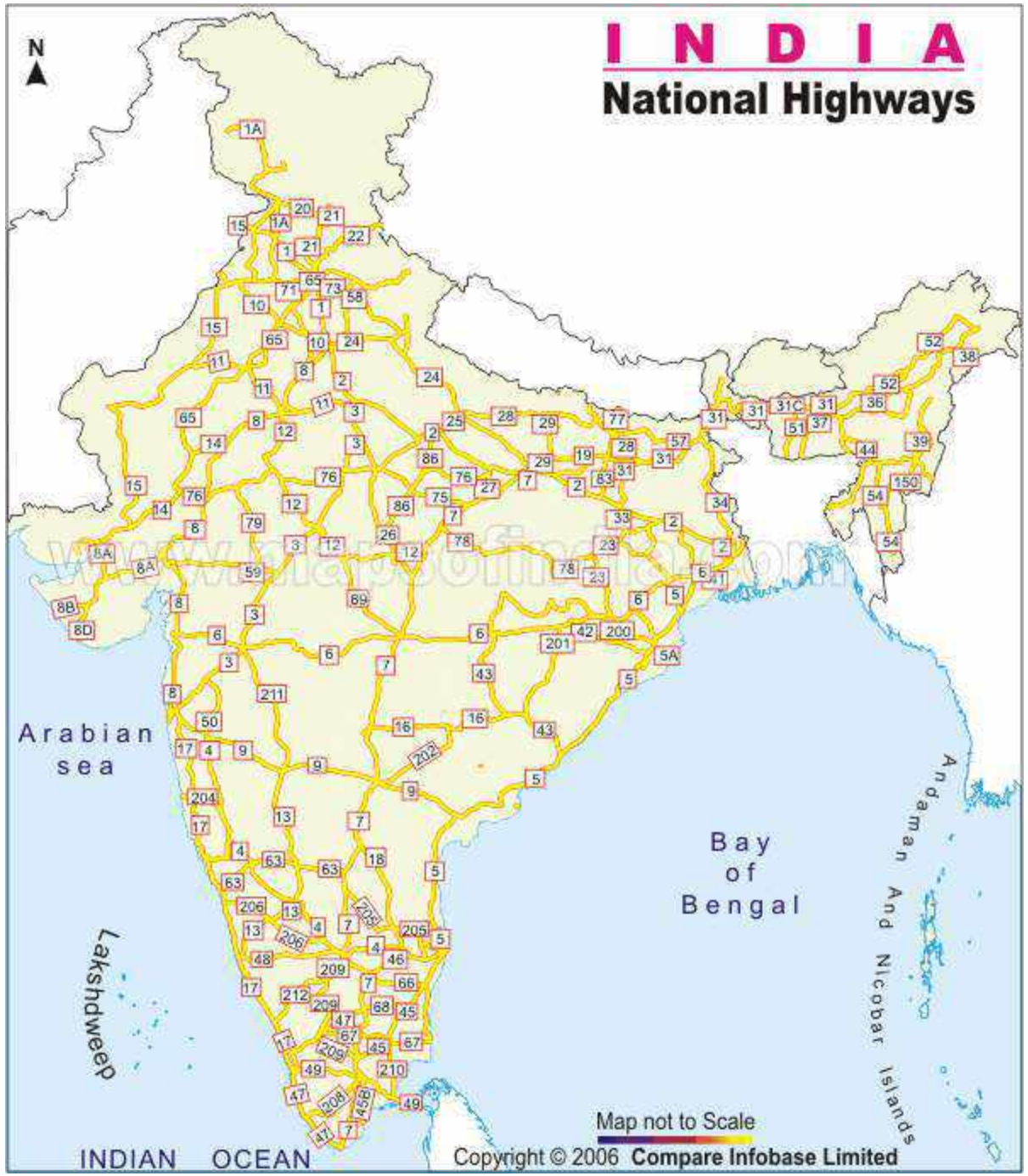
Highway engineers design road geometry to ensure stability of vehicles when **negotiating curves** and **grades** and to provide adequate sight distances for undertaking passing maneuvers along curves on two-lane, two-way roads.

Road Classification based on the following factors



How are roads classified in India?

•The **Nagpur Plan** divides roads into 4 main categories: **National Highways, State Highways, District Roads** and **Village roads**.



National Highways

•They connect all major ports, state capitals, large industrial and tourist centres, and foreign highways.

•Roads that are required for strategic movement, those that reduce the travel time substantially, and those that open up backward areas and help economic growth, are also classified as National Highways.

•Total 599 NH in India of total **151,000 km**

•Currently, the longest National Highway in India is National Highway 44 at **3,508 km**

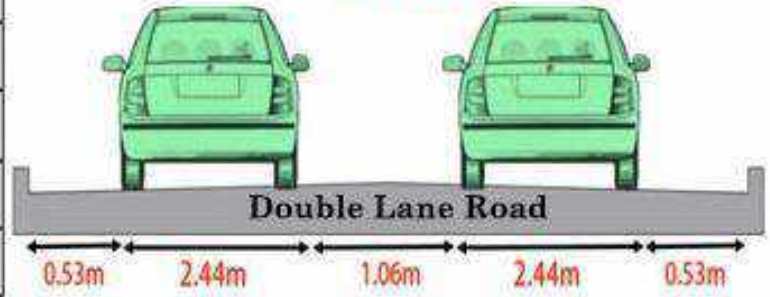
State Highways

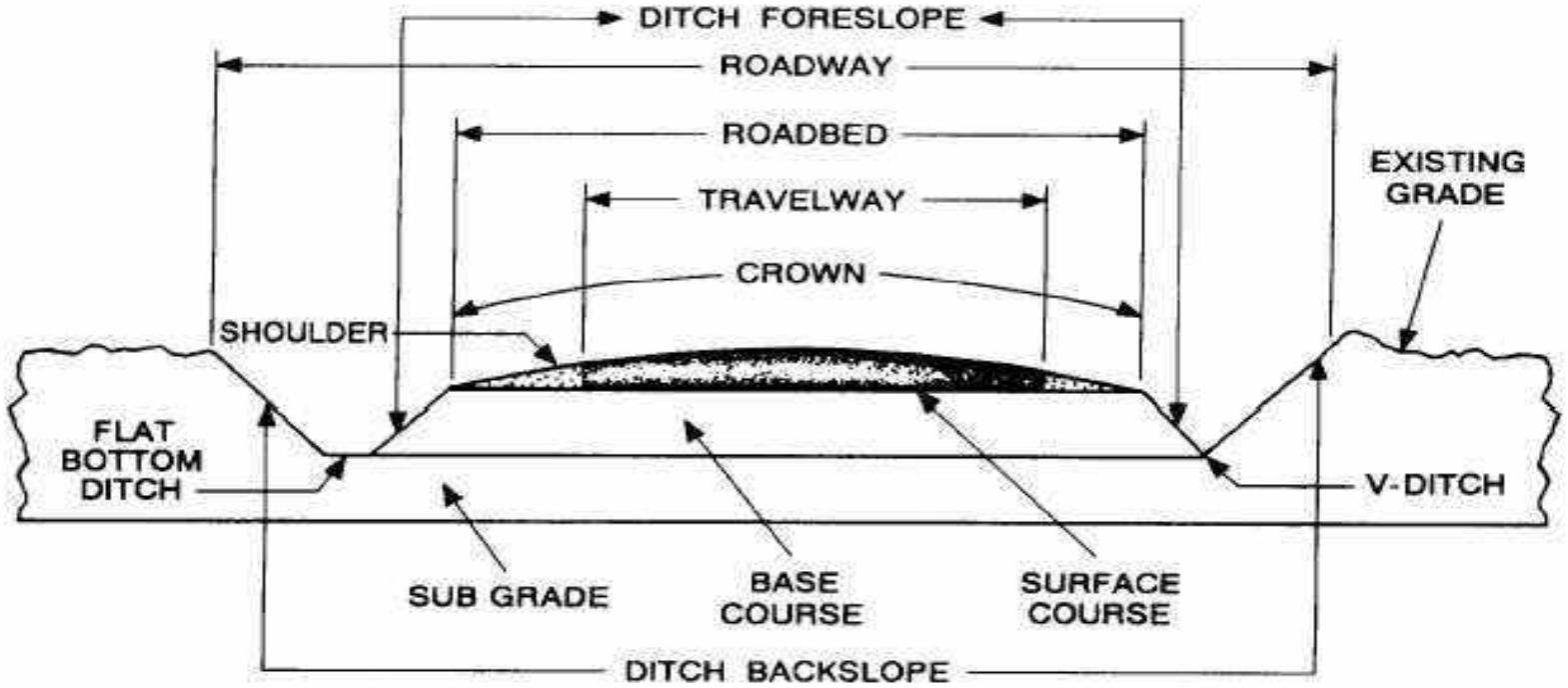
•They are the arterial roads of a state that connect to National Highways, district headquarters and important cities and are also linked to district roads.

•**Major District Roads** - They connect areas of production, main markets and the State and National Highways crossing the state.

•**Village Roads** connect villages to each other or to the nearest District Roads.

Carriage way Type	Carriage way Width
Single Lane	3.75
Two Lane, No kerbs	7.0
Two Lane, Raised kerbs	7.5
Intermediate Carriage	5.5
Multi-Lane	3.5





Advantage and Disadvantage Road Transport

ADVANTAGES

1. Less Capital Outlay
2. Door to Door Service
3. Service in Rural Areas
4. Flexible Service
5. Suitable for Short Distance
6. Lesser Risk of Damage in Transit
7. Saving in Packing Cost
8. Rapid Speed
9. Less Cost
10. Private Owned Vehicles
11. Feeder to other Modes of Transport

DISADVANTAGES

1. Seasonal Nature
2. Accidents and Breakdowns
3. Unsuitable for Long Distance and Bulky Traffic
4. Slow Speed
5. Lack of Organisation

Railway Engineering

The branch of Civil Engineering which deals with the design, construction and maintenance of the railway tracks for safe and efficient movements of trains is called Railway Engineering

Amongst the different modes of transport, Railways have their greatest utilization in the transport of large volumes of heavy and bulk commodities and passengers over long distances with safety, comfort and convenience.

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).






A monorail is **a railway system in which the track consists of a single elevated rail, beam or track with the trains either supported or suspended**.