

QUESTION BANK

CE 6006 TRAFFIC ENGINEERING AND MANAGEMENT

UNIT IV TRAFFIC SAFETY AND ENVIRONMENT

2 MARKS

**1. What are the statistical methods for analysis of accident data?**

The statistical methods for analysis of accident data are:

- a) Regression methods
- b) Poisson distribution
- c) Use of Chi-squared test for comparing accident data
- d) Quality control method

**2.write down the causes of accidents.**

- 1. Drivers
- 2. Pedestrians
- 3. Passengers
- 4. Vehicle defects
- 5. Road condition and design
- 6. Weather
- 7. Animals

**3.what are the objectives of accident studies ?**

- 1. To study the causes of accidents and to suggest corrective treatment at potential location
- 2. To evaluate existing design
- 3. To support proposed design
- 4. To carry out before and after studies and to demonstrate the improvement in the problem

**4.what are the datas are collected during accident studies**

- 1. General
- 2. Location
- 3. Details of vehicles involved
- 4. Nature of accident
- 5. Road and traffic conditions
- 6. Primary causes of accident
- 7. Accident costs

### **5. Define Spot Maps**

Accident location spot maps show accidents by spots, pins or symbols on the map. A map of suitable scale say 1 cm = 40 to 60 m, may be used for spotting urban accidents.

### **6. what is meant by condition diagram .**

A condition diagram is a drawing to scale showing all important physical conditions of an accident location to be studied. The important features generally to be shown in this diagram with suitable dimensions marked there in a roadway limits, curves, kerb lines, bridges and culverts and all details of roadway conditions, obstruction to vision, signs and signals etc.

### **7. Define Collision Diagram**

These are diagrams that show the approximate path of vehicles and pedestrians involved in the accident. Collision diagrams are most useful to compare the accident pattern before and after the remedial measures have been taken.

### **8. What are the safety measures of accident taken related to engineering ?**

The following safety measures are taken related to engineering

1. Road design
2. Preventive maintenance of vehicles
3. Before and after studies
4. Road lighting

### **9. What are the safety measures of accident taken related to enforcement ?**

The following safety measures are taken related to enforcement

1. Speed control
2. Traffic control devices
3. Training and supervision
4. Medical check
5. Special precautions for commercial vehicles
6. Observance of law and regulation

### **10. What are the safety measures of accident taken related to education ?**

The following safety measures are taken related to education

1. Education of road users
2. Safety drive

**16 MARKS****1. Write In Detail About Street Lighting****Purpose**

- It provides more visibility
- It helps the vehicles and pedestrians to move safely
- It reduces the accidents
- It increases the security in inter sections
- It provides attractive landscape during night hours.

**Factors Influence Night Visibility**

- Amount and distribution of light flux from lamps
- Size of object
- Brightness of object
- Brightness of background
- Reflecting characteristic of pavement surface
- Glare on the eyes of the driver
- Time availability to see an object

**Design Factor Of Highway Lighting**

- Lamps
- Luminaries distribution of light
- Spacing of lighting units
- Height and over hang of mounting
- Lateral placement
- Lighting layout

**Lamps**

- Filaments
- Florescent light

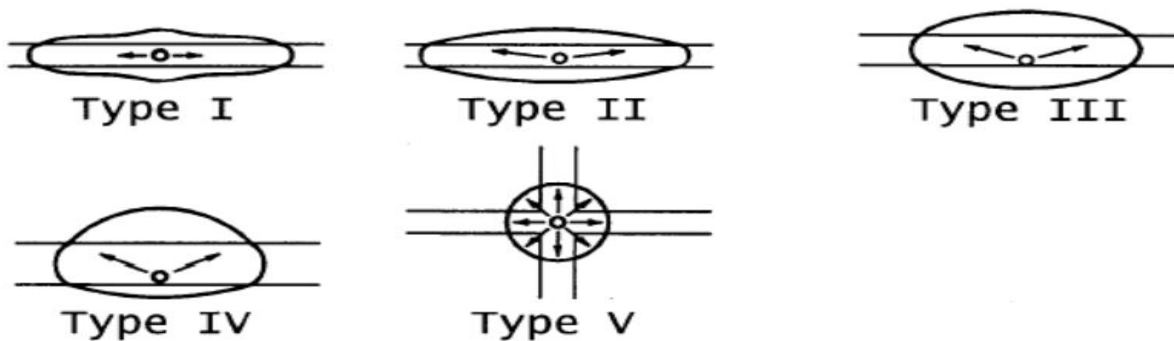
- Sodium vapour light
- mercury vapour light

Choice depends on type , size, colour, distribution of light brightness

Luminaries distribution of light

- Proper distribution of light
- Distribution should be downwards so that high percentage of light is used to illuminate the pavement.
- Uniformity of pavement distribution.

### Types Of Luminaire Distribution



Indian standard recommends an average level of illumination of 30 lux on important roads carrying fast traffic and 15 lux on main roads The ratio of minimum to average illumination is 0.4

### Height And Overhang Mounting

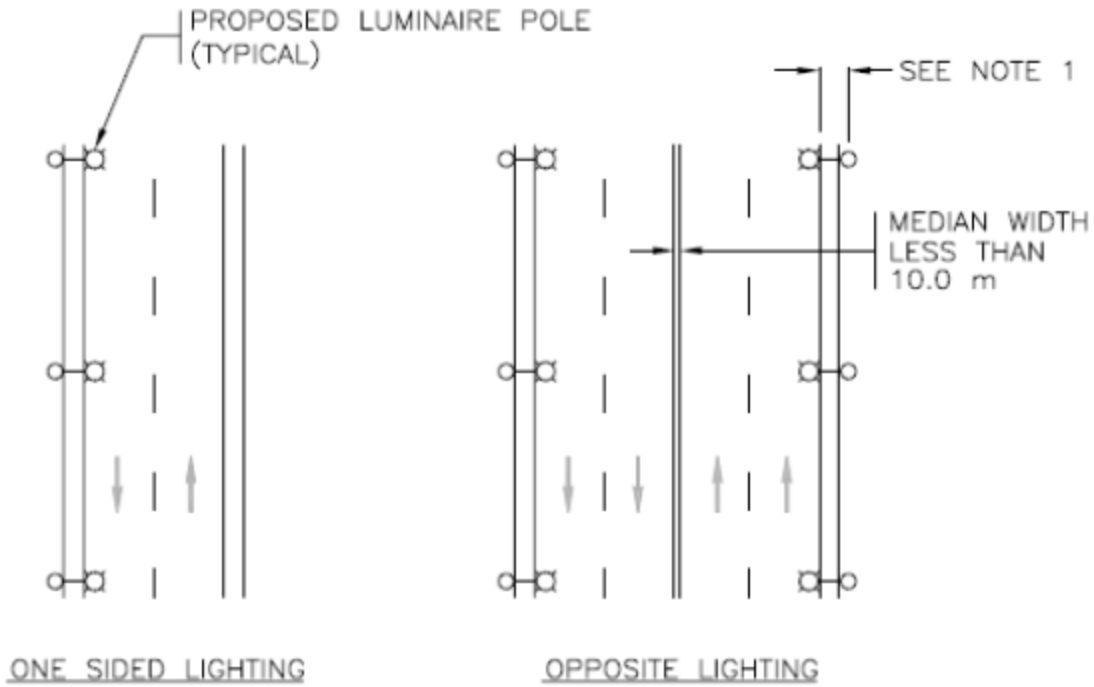
- Mounting height ranging from 6 m to 10m
- Minimum vertical clearance required for Electric power limit upto 650 volts has been specified as 6m

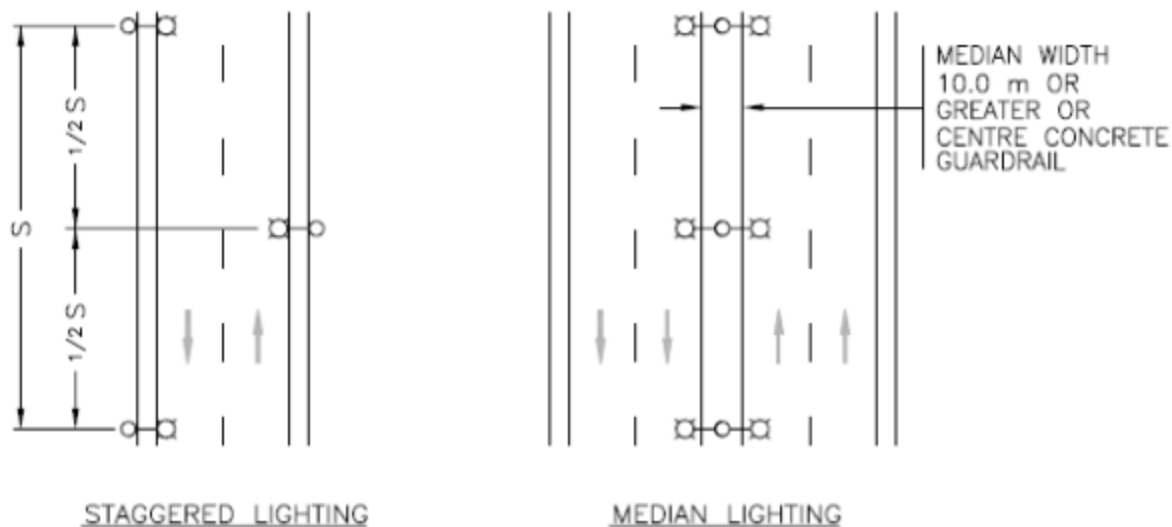
### Spacing Calculation

Spacing= (lamp lumen x coefficient of utilisation x maintence factor)/averagr lux x width of

Road

# LIGHTING LAYOUTS





**Spacing =30 to 60 m**

## 2. Explain In Detail About Causes Of Accidents And Accident Studies .

The problem of accident is a very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians. Traffic accident leads to loss of life and property. Thus the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety. Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can be reduced to a certain extent. For this reason systematic study of traffic accidents are required to be carried out. Proper investigation of the cause of accident will help to propose preventive measures in terms of design and control.

### Objectives of accident studies

Some objectives of accident studies are listed below:

- 1.To study the causes of accidents and suggest corrective measures at potential location
- 2.To evaluate existing design
- 3.To compute the financial losses incurred
- 4.To support the proposed design and provide economic justification to the improvement suggested by the traffic engineer
- 5.To carry out before and after studies and to demonstrate the improvement in the problem.

### Causes of road accidents

The various causes of road accidents are:

- 1.Road Users - Excessive speed and rash driving, violation of traffic rules, failure to perceive traffic situation or sign or signal in adequate time, carelessness, fatigue, alcohol,sleep etc.
- 2.Vehicle - Defects such as failure of brakes, steering system, tyreburst,lighting system .
- 3.Road Condition - Skidding road surface, pot holes, ruts.
- 4.Road design - Defective geometric design like inadequate sight distance, inadequate width of shoulders, improper curve design, improper traffic control devices and improper lighting,.
- 5.Environmental factors -unfavorable weather conditions like mist, snow, smoke and heavy rainfall which restrict normal visibility and and makes driving unsafe.
- 6.Other causes -improper location of advertisement boards, gate of level crossing not closed when required etc.

### **Accident data collection**

The accident data collection is the first step in the accident study. The data collection of the accidents is primarily done by the police. Motorist accident reports are secondary data which are filed by motorists themselves. The data to be collected should comprise all of these parameters:

- 1.General - Date, time, person involved in accident, classification of accident like fatal, serious, minor
- 2.Location - Description and detail of location of accident
- 3.Details of vehicle involved - Registration number, description of vehicle, loading detail, vehicular defects
- 4.Nature of accident - Details of collision, damages, injury and casualty
- 5.Road and traffic condition - Details of road geometry, surface characteristics,type of traffic, traffic density etc..
- 6.Primary causes of accident - Details of various possible cases (already mentioned) which are the main causes of accident.
- 7.Accident cost - Financial losses incurred due to property damage, personal injury and casualty

These data collected need proper storing and retrieving for the following purpose. The purposes are as follows:

- 1.Identification of location of points at which unusually high number of accident occur.
- 2.Detailed functional evaluation of critical accident location to identify the causes of accidents.
- 3.Development of procedure that allows identification of hazards before large number of accidents occurs.

4. Development of different statistical measures of various accident related factors to give insight into general trends, common casual factors, driver profiles, etc.

### **Accident investigation**

The accident data collection involves extensive investigation which involves the following procedure:

1. Reporting: It involves basic data collection in form of two methods:

1. Motorist accident report - It is filed by the involved motorist involved in all accidents fatal or injurious.

2. Police accident report - It is filed by the attendant police officer for all accidents at which an officer is present. This generally includes fatal accidents or mostly accidents involving serious injury required emergency or hospital treatment or which have incurred heavy property damage.

2. At Scene-Investigation: It involves obtaining information at scene such as measurement of skid marks, examination of damage of vehicles, photograph of final position of vehicles, examination of condition and functioning of traffic control devices and other road equipments.

3. Technical Preparation: This data collection step is needed for organization and interpretation of the study made. In this step measurement of grades, sight distance, preparing drawing of after accident situation, determination of critical and design speed for curves is done.

4. Professional Reconstruction: In this step effort is made to determine from whatever data is available how the accident occurs from the available data. This involves accident reconstruction which has been discussed under Section No.7 in details. It is professionally referred as determining “behavioral” or “mediate” causes of accident.

5. Cause Analysis: It is the effort made to determine why the accident occurred from the data available and the analysis of accident reconstruction studies..

### **Safety measures**

The ultimate goal is to develop certain improvement measures to mitigate the circumstances leading to the accidents. The measures to decrease the accident rates are generally divided into three groups engineering, enforcement and education. Some safety measures are described below:

**3. Write short notes on Safety measures of accidents .**

### **Safety measures related to engineering**

The various measures of engineering that may be useful to prevent accidents are enumerated below

### **Visual guidance to driver**

There is consecutive change of picture in driver’s mind while he is in motion. The number of factors that the driver can distinguish and clearly fix in his mind is limited. On an average the perception time for vision is , for hearing is and for muscular reaction is . The number of factors that can be taken into account by organs of sense of a driver in one second is given by the formula below. where, = No. of



factors that can be taken into account by the organ of sense of driver for  $m$  long,  $v$  = speed of vehicle in m/sec. Factors affecting drivers' attention when he is on road can be divided into three groups:

1. Factors relating to the road – elements of road that directly affect the driving of a vehicle are traffic signs, changes in direction of road, three legged intersection and various other things.
2. Factors connected with traffic – Other vehicles, cycles, pedestrians.
3. Factors related indirectly to the vehicle motion – Building and structures that strike the eye, vegetation, landscape, etc.

So using the laws of visual perception certain measures have been suggested:

1. Contrast in visibility of the road should be achieved by provision of elements that differ from its surrounding by colors, pattern such as shoulder strips, shoulder covered with grass, edge markings.
2. Providing road side vegetation is an effective means.
3. The visibility of crown of trees from a distant location is also very useful in visual guiding.
4. The provision of guard rails of different contrasting colors also takes drivers attention and prevent from monotonous driving.

when the direction of road has a hazardous at-grade intersection trees are planted in such a way that it seems that there is dense forest ahead and driver automatically tends to stop or reduce the speed of the vehicle so that no conflicts occur at that point.

Driver tends to extrapolate the further direction of the road. So it is the responsibility of the traffic engineer to make the driver psychologically confident while driving that reduces the probability of error and prevent mental strain.

### **Road reconstruction**

The number of vehicles on the road increases from year to year, which introduces complications into organization of traffic, sharply reduces the operation and transportation characteristic of roads and lead to the growth of accident rate. This leads to the need of re constructing road. The places of accidents need to be properly marked so that the reconstruction can be planned accordingly. that there were too many conflict points before which reduced to a few number after construction of islands at proper places. Reconstruction process may also include construction of a new road next to the existing road, renewal of pavement without changing the horizontal alignment or profile of the road, reconstruction a particular section of road. Few more examples of reconstruction of selected road section to improve traffic safety

### **Channelization**

The Channelization of traffic at intersection separates the traffic stream travelling in different direction, providing them a separate lane that corresponds to their convenient path and spreading as far as possible the points of conflict between crossing traffic streams. The traffic lanes are separated by marking relevant lines or by constructing slightly elevated islands as shown in Figure 15. Proper Channelization reduces

confusion. The number of decision required to be made by the driver at any time is reduced allowing the driver time to make next decision. The principles of proper channelized intersection are:-

- 1.The layout of intersection should be visibly clear, simple and understandable by driver.
- 2.Should ensure superiority to the vehicles using road of higher class.
- 3.Layout of intersection makes it necessary for a driver running through it to choose at each moment of time one of not more than two possible direction of travel. This is achieved by visual guidance, islands and markings.
- 4.The island provided should separate high speed, through and turning traffic flows.
- 5.The width of traffic lane should ensure unhampered turning to the big vehicles. Width of straight section without kerb should be 3.5 m and that of traffic lane near island is 4.5-5 m at entry and 6 m at exit.
- 6.Pedestrian crossing should be provided

### **Road signs**

Road signs are integral part of safety as they ensure safety of the driver himself (warning signs) and safety of the other vehicles and pedestrians on road (regulatory signs). Driver should be able to read the sign from a distance so that he has enough time to understand and respond. It is essential that they are installed and have correct shape, colour, size and location. It is required to maintain them as well, without maintenance in sound condition just their installment would not be beneficial.

### **Other methods**

Various other methods of traffic accident mitigation are described below:

#### **1.Street lighting**

Street lightning of appropriate standard contributes to safety in urban area during night time due to poor visibility. Installation of good lighting results in 21% reduction in all accidents, 29% reduction in "all casualty" accidents, 21% reduction in "non pedestrian casualty" accidents, and 57% reduction in "pedestrian casualty" accidents.

#### **2.Improvement in skid resistance**

If road is very smooth then skidding of the vehicles may occur or if the pavement is wet then wet weather crashes occur which account about 20-30%. Thus it is important to improve the skid resistance of the road. Various ways of increasing the skid resistance of road are by constructing high-friction overlay or cutting of grooves into the pavement.

#### **3.Road markings**

Road markings ensure proper guidance and control to the traffic on a highway. They serve as supplementary function of road sign. They serve as psychological barrier and delineation of traffic path

and its lateral clearance from traffic hazards for the safe movement of traffic. Thus their purpose is to provide smooth and safe traffic flow.

#### **4. Guide posts with or without reflector**

They are provided at the edge of the roadway to prevent the vehicles from being off tracked from the roadway. Their provision is very essential in hilly road to prevent the vehicle from sliding from top. Guide posts with reflector guide the movement of vehicle during night.

#### **5. Guard rail**

Guard rail have similar function as of guide post. On high embankments, hilly roads, road running parallel to the bank of river, shores of lake, near rock protrusion, trees, bridge, abutments a collision with which is a great hazard for a vehicle. It is required to retain the vehicle on the roadway which has accidentally left the road because of fault or improper operation on the part of the driver. Driver who has lost control create a major problem which can be curbed by this measure.

#### **6. Driver reviver stop**

Driver reviver stop are generally in use in countries like U.S.A where driver can stop and refresh himself with food, recreation and rest. They play a very important part in traffic safety as they relieve the driver from the mental tension of constant driving. These stops are required to be provided after every 2 hour travel time.

#### **7. Constructing flyovers and bypass**

In areas where local traffic is high bypasses are required to separate through traffic from local traffic to decrease the accident rate. To minimize conflicts at major intersections flyovers are required for better safety and less accident rate

#### **8. Regular accident studies**

Based on the previous records of accidents the preventive measures are taken and after that the data related to accidents are again collected to check the efficiency of the measures and for future implementation of further preventive measures.

#### **Safety measures related to enforcement**

The various measures of enforcement that may be useful to prevent accidents at spots prone to accidents are enumerated below. These rules are revised from time to time to make them more comprehensive.

#### **Speed control**

Checks on spot speed of all vehicles should be done at different locations and timings and legal actions on those who violate the speed limit should be taken

#### **Training and supervision**

The transport authorities should be strict while issuing licence to drivers of public service vehicles and taxis. Driving licence of the driver may be renewed after specified period, only after conducting some tests to check whether the driver is fit

### **Medical check**

The drivers should be tested for vision and reaction time at prescribed intervals of time Safety measures related to education The various measures of education that may be useful to prevent accidents are enumerated below.

### **Education of road users**

The passengers and pedestrians should be taught the rules of the road, correct manner of crossing etc. by introducing necessary instruction in the schools for the children and by the help of posters exhibiting the serious results due to carelessness of road users.

### **Safety drive**

Imposing traffic safety week when the road users are properly directed by the help of traffic police as a means of training the public. Training courses and workshops should be organized for drivers in different parts of the country.

## **4. Write In Detail About Non-Motorized Transport**

Cities in developing countries are increasing in population and motor vehicles. Hence they are facing problems such as congestion, traffic jams, environmental pollution, high cost of travel, longer travel distances, increasing cost of fuel imports, ill-health, etc.

Planners are looking for different policy options and one such solution is to promote and integrate non motorized modes in transportation systems, planned and developed for habituated areas.

The promotion of walking and cycling also has a positive influence on accident reduction. As reported by the 'Urban Transport Strategy' of the World Bank, road accidents could be reduced largely by improved non-motorized transport (NMT) infrastructure, enhanced road design and better management.

### **Why Non-Motorized Transport?**

- Low Cost Infrastructure
- Higher User Safety
- Environment friendly
- Low Cost for users
- Healthy for users

- Low-Cost Vehicles
- Reduces greenhouse gases emissions & provides important health benefits such as
  - Better quality sleep , health-related quality of life & fitness
  - Less high blood pressure, cancer possibilities & depression
  - Less risk of falls in older adults

**Advantages of expanding the role of NMT:**

Priority and promotion for non motorized transport will generate:

- Greater access to all population
- Greater traffic safety
- Greater liveability

**Comparison studies on NMT**

The importance of use of non-motorized (NM) modes can be ascertained based on the comparison of these modes with other motorized modes.

1. Traffic handling capacity
2. Space requirement:
3. Cost of infrastructure
4. Energy consumption
5. Environment emission
6. Operational and congestion cost

**Traffic Handling Capacity:**

<b>Passenger capacity (per hour per metre)</b>	<b>Capacity</b>
rail and road based public transport	4000 and 8000
Walking	3500
Cycling	1500
motorized vehicles under urban traffic condi	100 & 400

**Space Requirement:**

Considering this, the road space required per person by different modes is as given below:

Car	120 sq. m	Bicycle	9 sq. m
Bus	12 sq. m	Pedestrian	2 sq. m
Rail	7 sq. m	Air travel	1.5 sq. m

This clearly indicates that under congested traffic conditions, the use of walk or bicycle would result in more efficient movement.

### **Cost Of Infrastructure:**

- The investment required for providing infrastructure depends upon the area required for the movement and storage of the vehicle. The monthly cost of bicycle parking stall is less than 1/10th compared to an automobile parking stall construction.
- The comparative costs of facilities (for 1 km) constructed for different types of modes are observed to be as follows.
- Freeway: highway: bus lane: high Quality: cycle route:: 20 : 10 : 5 : 1.

### **Energy Consumption**

- Compared to bicycle, the energy consumption per passenger per mile for public transport is 2–2.5 times higher, and 3–6 times higher for motorized modes.
- When compared with walking, the energy consumption is 3–4 times higher for public transport and 5–10 times higher for motorized vehicles
- Over all Non-motorized vehicle (NMV) consumes around 1/9th of the power consumed by motor vehicles.

### **Environment Emission**

- The National Personal Transportation Study (1990) from the USA states that passenger vehicles are responsible for 20% of the total CO<sub>2</sub> emissions, 45% of CO, 16% of NO<sub>x</sub> and 25% of volatile organic compounds emission.
- It is estimated that cycling and walking can displace 4–15% of the projected passenger vehicle emissions of carbon monoxide, nitrogen oxides and VOCs.
- According to a study, 70% of air pollution in Bangkok is from motorized vehicles.

### **Operational And Congestion Cost**

- Automobile operating expenses, as compared to bicycle, are around 2 : 1 to 10 : 1.
- In heterogeneous traffic conditions, the operating efficiency of walk and bicycle is much more when compared to that of motorized.
- The annual motor vehicle congestion cost for the US ranges between \$100 billion and \$300 billion. The health and productive cost varies in a wide range of \$10 billion to \$200 billion per year.

### **Travel Time And Trips**

- Non-motorized modes serve a small portion of travel distance but a larger share of travel time and trips.
- International data indicates that at the metropolitan level, a mile of additional walking and cycling is associated with 7 miles of reduced motor vehicle travel.

**5. Write Short Notes On Public Transport**

- On the national level, public transportation supports our nation's goals and policies, reduces our dependence on foreign oil, and providing critical response in emergencies.
- Public transportation saves money, and provides people with choices, freedom and opportunities.
- It is essential to the economic and social quality of life of our citizens.
- Public transportation helps everyone—commuters, families, students, senior citizens, persons with disabilities

Public transportation offers a variety of modes of travel, such as:

\_ **Road vehicles:** bus, trolleybus

\_ **Rail and other fixed guideways:** heavy rail, monorail, aerial tramway

\_ **Water:** water taxis

**Benefits of Public Transportation:**

- Energy conservation is a national priority. In USA President Bush stated that our country is “addicted to oil” and needs to do more to reduce our dependence on foreign oil.
- The best secret is that it can achieve significant energy savings.
- Reduce our country's dependence on foreign oil.
- Transportation is the backbone of a strong and prosperous economy

Public transportation is critical to this nation's future. A stronger economy, conservation of energy and resources, reduced congestion, less global warming and improved air quality and health, critical support during emergencies and disasters, increased real estate values and development, mobility for small urban and rural communities, increased access for groups of all ages and circumstances, lower health-care costs—all contribute to a better quality of life.

**❖ Enhances Business**

- Investing in public transportation is good for business. It is estimated that every \$10 million in capital investment in public transportation yields \$30 million in increased business sales

➤

**❖ Creates and Sustains Employment**

- Public transportation not only helps to maintain and create jobs, it also moves people to and from their jobs.
- It provide driver job to more than 10 lack peoples.

- Apart from that it also includes durable and non-durable manufacturing jobs, as well as jobs in non-manufacturing industries such as construction, finance, insurance, retail and wholesale trade, and service.
- Employees are happier because they are not driving in congestion delays

❖ **Money saving**

- Public transportation usage lowers Household expenses on transport and frees up more income for other needs
- Household transportation costs rise in areas with sprawl and few transportation services.

❖ **Protects the Environment, Improves Air Quality and Health**

- Increased investment in and use of public transportation can directly improve and protect the personal health of all people.
- Our car-centered transportation system has led to pollution and poor air quality. Emissions from road vehicles are the largest contributors to smog.
- Public transportation produces
  - ✚ 95 % lesser carbon monoxide (CO),
  - ✚ 90 % lesser volatile organic compounds (VOCs), and
  - ✚ About half as much carbon dioxide (CO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>), when compared with private vehicles.
- In addition to reduced pollution, direct health benefits of public transportation include:
  - ✚ Lower rates of respiratory and heart disease
  - ✚ Lower accident rates
  - ✚ Quality of life.

❖ **Emergencies and Disasters**

- During natural or man-made disasters, public transportation systems provide comfort, safety, security and rescue.
- During emergency, people who had never used transit before discover that public transportation can literally mean a matter of life or death.
- In major evacuations of urban areas during disaster periods, only public transportation has the capacity to move millions of people quickly and to delivering emergency equipment and transporting emergency response personnel.
- The 9/11 response illustrates public transit's vital role during times of emergency.

❖ **Increased Real Estate Values and Development**

**Boosts Real Estate Values**

- Real estate—residential, commercial or business places served by public transportation are valued more highly by the public than similar properties not as well served by transit.

❖ **Provides Access for All Ages**

- Very much Helpful to students
- More than four in five seniors believe public transportation is a better alternative to driving alone, especially at night.



**General :**

A report from US states that

- Without public transportation, travel delays would have increased by 27 percent.
- Public transportation services in America's most congested cities saved travellers 1.1 billion hours of added travel time.
- Few Riders uses public transport to save fuel while others uses public transportation to avoiding traffic jams and reading or relaxing while travelling.