

Program : **B.E** Subject Name: **Traffic Engineering** Subject Code: **CE-8003** Semester: **8th** 





## Unit -V

Accident Studies & Mass Transportation: (i) Accident Studies: Causes of accidents, accident studies and records, condition and collision diagram, preventive measures. (ii) Expressways and freeways, problems on mass transportation and remedial measures, brief study of mass transportation available in the country

### 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.

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## **Causes of 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, tyre burst, 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 makes driving unsafe.

6. Other causes -improper location of advertisement boards, gate of level crossing not closed when required etc..

Accident studies and records



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 Dr. Tom V. Mathew, IIT Bombay 42.3 February 19, 2014 Transportation Systems Engineering 42. Accident Studies Table 42:1: Number of Accidents and Number of Persons Involved: 2001 to 2009(Ref. Ministry of Road Transport and Highways Transport Research Wing)

No. of Accidents No. of persons affected Accident severity

Year Total Fatal Killed Injured (No. of persons killed per 100 accidents)

2005 4,39,255 83,491 94,968 4,65,282 22

2006 4,60,920 93,917 1,05,749 4,96,481 23

2007 4,79,216 1,01,161 1,14,444 5,13,340 24

2008 4,84,704 1,06,591 1,19,860 5,23,193 25

2009 4,86,384 1,10,993 1,25,660 5,15,458 25.8 RCPV NOTES IN

22.6 10.9 7.9 22.4 6.9 8.7 20.6

Auto Rickshaws Car, Jeeps, Taxis Trucks, Tempos, MAVs, Tractors Others Figure 42:2: Percent share in total road accident by type of motor vehicle involved (Primary responsible) in year 2009 (Ref. Ministry of Road Transport and Highways Transport Research Wing)

Fault of driver Fault of cyclist Fault of Pedestrian Defect in condition of Motor Vehicle

All Other Causes Weather Condition

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.

## Condition and collision diagram

Collision diagrams are used to display and identify similar accident patterns. They provide information on the type and number of accidents; including conditions such as time of day, day of week, climatic conditions, pavement conditions, and other information critical to determining the causes of safety problems. Accident reports should be organized by year of occurrence and accident type for the analysis period. Accidents that occurred after significant changes in highway or local land use should not be included.





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## **CONDITION DIAGRAMS**

A condition diagram is a scale drawing which provides an accurate picture of the physical conditions present at the location under study. From this diagram the required visibility distance for the 85th percentile speed) on the road, and the actual visibility triangle can be made. This will allow an evaluation of the effects obstructions have on the driver's view and road conditions.

A rough sketch of the location should be made at the scene and later transferred to an 8½ x 11-inch sheet of paper. A scale of 30 to 40 feet per inch should be used. Observations and measurements should include:

·Curbs Roadway limits Property lines ·Sidewalks Driveways View obstructions on corners ·Physical obstructions on roadway Ditches Bridges ·Traffic signals Signs Pavement marking Streetlights ·Grades ·Road surface •Type of adjacent property Irregularities (potholes, dips, etc.)

# Step 1: Measuring the Light Intensity

I will use the light meter to measure the number of foot-candles that there are hitting the subject. Once I have this number, I can then use it to convert it into Lumens or Watts depending on whichever method is preferred. For the case of this example, we will base our calculations on a measurement of 50 foot-candles.

# Step 2: Converting to Lumens

Please note that one foot-candle = 10.76 Lumens\*, which means that in order to convert foot-candles to lumens, I would need to take the amount of foot-candles that I measured, 50 foot-candles ,and multiply by 10.76 to get the number of lumens (50 x 10.76 = 538 lumens)

\* A lumen is the same as Lux and is what many modern light meters will calculate their measurement in.

## Step 3: Converting to Watts

The next step is to calculate the number of watts. One lumen is = 0.001496 watts. This is pretty simple, after you have your total number of lumens from step 2. You take the total number of lumens and multiply it by 0.001496 watts (538 x 0.001496 = 0.805 watts/square meter).







A STREET LIGHT, LIGHT POLE, LAMPPOST, STREET LAMP, LIGHT STANDARD, OR LAMP STANDARD is a raised source of light on the edge of a road or walkway. Modern lamps may also have light-sensitive photocells that activate automatically when light is or is not needed: dusk, dawn, or the onset of dark weather. This function in older lighting systems could have been performed with the aid of a solar dial. Many street light systems are being connected underground instead of wiring from one utility post to another.

**Causes of collisions** 



Every day, drivers die in road collisions. Many die as a consequence of inexperience, speeding intoxication through drink or drugs or just plain recklessness.

The majority of road crashes are caused by human error. Research has shown that driver error accounts for over 80% of all fatal and injury crashes on Irish roads

The main causes of death and injury on Irish roads remain speeding, drink driving and non-wearing of seat-belts .

Because most traffic accidents are the product of several factors, the probability of accidents can be reduced in a number of different ways. There is no doubt that the following activities have prevented the increase in accidents that would normally result from increases in traffic density. There are three main approaches to preventing accidents:

Education and training of

(a) Children in school by road-traffic instructors and school teachers; and of

(b) Adolescents in the principles of safe driving and in good driving attitudes; by

(c) Refresher courses for older drivers to bring home safe-driving principles and to refresh their knowledge of traffic law; and by means of



(d) Newspaper, radio television, and other publicity, to draw the attention of all road users both to dangers and to safe practices on the road.

Enforcement by

(a) Adopting reasonable and enforceable traffic laws which, at the same time, are best designed to prevent accidents;

(b) Concentrating the time and energy of traffic officers on the offences, locations, and times that feature frequently in accidents; and

(c) Thoroughly testing new drivers to ensure they will not be liable to cause accidents.

Engineering of vehicles and roads: Vehicle engineering, comprising

(a) Regular inspection for a "warrant of fitness" to ensure that the main components of the vehicle are safe;

(b) Improving the design of the vehicle to give ease of vision and control to the driver and so reduce the likelihood of injury in an accident;

(c) Fitting safety equipment, such as seat belts.

Road or traffic engineering comprises



(b) Improving existing roads by realignment, improving vision, and resurfacing slippery surfaces;

(c) Regulating traffic movement by installing traffic signals, traffic islands, road markings, and regulatory signs such as "stop" and "give way" signs; and

(d) Assisting the driver with warning and destination signs to avoid danger and confusion.

Below you will find more information on one of the general causes of accidents on our roads.

Tyre Safety

The designer shall make arrangements with the electrical utility (where the existing street light network is incapable of supplying the proposed street lighting scheme) to provide a point of supply for 12 Street Lighting. Design Standards for Urban Infrastructure the street lighting sub-mains.

This will be undertaken at the preliminary design stage. Generally the power supply will be unmetered. The electricity utility will need to be advised with (as a minimum) the following preliminary design information:



- Number of lights per sub-main
- Wattage of each light
- Voltage drop to last light
- Proposed point of supply
- Proposed lighting layout

The designer shall obtain from the electricity utility details of the adjacent lights as needed for the design process. Once a preliminary design has been completed it is to be presented to the electricity utility for connection assessment. All costs associated with the establishment of preliminary design information and approval will be at the expense of the designer. Evidence of electricity utility supply approval (Request for Service form [RFS]) shall be presented with the completed design to Territory and Municipal Services Asset Acceptance for final design acceptance. This shall occur prior to any onsite street lighting works commencing.

The recommended remedial measures are grouped into the following categories:

• Measure A - remedial measures through planning process. These measures are based on the process of implementing planning measures to improve parking conditions;

• Measure B - remedial measures through management. This group of remedial measures is based on two principles: to manage the demand and supply of parking facilities and to optimize use of facilities;

• Measure C - remedial measures using advanced technology solutions. Advanced technologies have brought about opportunities and challenges in formulating innovative remedial measures for addressing parking problems in the long term.

**Measure A - Remedial Measures Through Planning Process** 

A1 Revision of HKPSG

1. Following the thorough review of HKPSG and wide consultation with interested parties, the Study recommends revisions to current parking standards and new guidelines to be incorporated into HKPSG. It also recommends a fundamental change to the criteria for establishing parking standards for residential housing. The details of revisions to HKPSG are given in section 3.5 of this report.

# A2 Provision of Park and Ride Facilities

2. The main objective of Park and Ride is to reduce private car trips to/from the busy urban areas and encourage the use of available public transport facilities. KCR/MTR stations, major public transport interchanges and bus termini are potential Park and Ride locations. The establishment of Park and Ride in these locations should continue to be encouraged.

## A3 Provision of Kiss and Ride Facilities

3. Like Park and Ride, this measure would encourage the transfer from private car to public transport mode. By providing proper pick up/set down areas at KCR/MTR stations and major public transport interchanges,



commuters could be encouraged to use public transport to complete the trip. It is recommended that adequate facilities be provided for vehicles to wait at the pickup end.

#### **Expressways and freeways**

Freeways and expressways are different kinds of Limited-access roads, meaning that access to the roadway is controlled in ways designed to reduce the impact on through traffic from traffic that enters and exits.

Around where I live, freeways are roads that have on and off-ramps only, no driveways, no stop lights. If other roads go across a freeway, they go above or below it. Bikes and pedestrians are not allowed on freeways.

An expressway, on the other hand, has stop lights. They tend to be fewer and farther between than other main surface streets, and they're generally timed to favor the expressway traffic over that of side streets. Many smaller side streets do not cross or connect with the expressways, or they go over or under the expressway. Some entrances and exits are ramps. The speed limits are somewhere between those of freeways and those of larger surface streets. And, at least where I live, bikes are permitted on the expressways.

## Brief study of mass transportation available in the country

### MASS TRANSPORTATION

Public transportation is a crucial part of the solution to the nation's economic, energy, and environmental challenges - helping to bring a better quality of life. In increasing numbers, people are using public transportation and local communities are expanding public transit services. Every segment of American society - individuals, families, communities, and businesses - benefits from public transportation.

## PUBLIC TRANSPORTATION CONSISTS OF A VARIETY OF MODES

- Buses
- Trolleys and light rail
- Subways
- Commuter trains
- Streetcars
- Cable cars
- Van pool services
- Para transit services for Senior citizens and people with disabilities
- Ferries and water taxis
- Monorails and tramways

At the beginning when the number of vehicle was very low on the roads of our country there were no serious needs for traffic rules and regulations. But as and when mass production of vehicles begun and the roads flooded with different kind and class of vehicles the Government felt the need for a system to control the vehicular traffic. In the year 1914 the first legislation as "Indian Motor Vehicle Act 1914" was passed in our country to regulate the motor vehicles and as well as other road users. Since then the traffic pressure on the roads of our country multiply several times and at the same time to control the unprecedented growth in the number of motor



vehicles, the first Motor Vehicle Act 1914 which was in later years known as "The motor Vehicle Act 1988" was amended and revised several times by the Government of India. Traffic rules and regulations are devised to assure the smooth flowing of motor vehicles in the road. Moreover, traffic rules and regulation are not only for the driver of the vehicles but at the same times these rules are meant for the pedestrians, cyclist, motor-cyclist and other road users. The thorough knowledge of traffic rules/regulations, traffic signs and markings are very essential for the drivers and road users. The proper knowledge of these rules can reduce the number of accident and thus can establish a healthy and organized traffic system in our country.

Public transport is crucial to the livability of any city. More than 1.8 million journeys are made on Melbourne's trains, trams and buses every weekday. However the social, economic and environmental benefits extend beyond those who use it regularly. Here's a snapshot of the advantages of public transport:

#### Social

Public transport: Helps foster a sense of community. For example, people travelling together are more likely to feel a community connection than those travelling in cars in isolation. Encourages people to have a more active healthy lifestyle, particularly if they are walking or cycling to their station or stop. Helps reduce injuries and fatalities caused by car accidents. Provides accessible transport for people regardless of demographics such as income or age. Is less stressful. Rather than driving in traffic or wasting time looking for an elusive car park, public transport passengers can relax and listen to music, play computer games or read a book.

Economic Public transport: Travel is cheaper than owning and operating a car. Reduces the need for building vast car parks on valuable land that could have otherwise been used as highly prized office or retail space. Reduces reliance on rapidly decreasing oil supplies.

Environmental Public transport: Reduces pollution and road congestion - the more people who travel by train, tram or bus, the fewer cars on the road. Requires less land use than road infrastructure. Problems on mass transportation and remedial measures

#### 8 Helpful Steps for Solving the Problems of Urban Transport

There is no readymade universally acceptable solution to the urban transport problem. Planners, engineers, economists and transport technologists each have their own views, which when combined, invariably produced a workable strategy. Whatever policy evolved should be considered firstly, in the light of time it takes to implement them and secondly, all policies need to be appraised in terms of their cost. The following common steps may be helpful in solving the problems of urban transport:

1. Development of Additional Road Capacity: One of the most commonly adopted methods of combatting road congestion in medium and small towns or in districts of larger centers is the construction of bypasses to divert through-traffic. This practice has been followed throughout the world including India. Mid-twentieth century planners saw the construction of additional road capacity in the form of new or improved highways as the acceptable solution to congestion within major towns and cities. Since the pioneer transportation studies of the 1950s and 1960s were carried out in the US metropolitan areas, where the needs of an auto-dominated society were seen to be paramount, the provision of additional road capacity was accepted for several decades as the most effective solution to congestion, and urban freeways were built in large cities such as Chicago, San Francisco



and Los Angeles. Western European transport planners incorporated many of their American counterparts' concepts into their own programmers and the urban motorway featured in many of the larger schemes (Muller, 1995). However, it soon became evident that the generated traffic on these new roads rapidly reduced the initial advantages. The construction of an urban motorway network with its access junctions requires large areas of land and the inevitable demolition of tracts of housing and commercial properties. By the 1970s planners and policy-makers came to accept that investment in new highways dedicated to the rapid movement of motor traffic was not necessarily the most effective solution to urban transport problems.

2. Traffic Management Measures: Temporary and partial relief from road traffic congestion may be gained from the introduction of traffic management schemes, involving he reorganization of traffic flows and direc-tions without any major structural alterations to the existing street pattern. Among the most widely used devices are the extension of one-way systems, the phasing of traffic-light controls to take account of traffic variation, and restrictions on parking and vehicle loading on major roads. On multi-lane highways that carry heavy volumes of commuter traffic, certain lanes can be allocated to incoming vehicles in the morning and to outgoing traffic in the afternoon, producing a tidal-flow effect. Recent experiments using information technology have been based upon intelligent vehicle highway systems (IVHS), with the computerized control of traffic lights and entrances to freeways, advice to drivers of alternative routes to avoid congestion, and information on weather and general road conditions. The IVHS can be linked up with advanced vehicle control systems, making use of in-car computer to eliminate driver error and control automatic braking and steering when accidents are imminent. Traffic management has been extensively applied within urban residential areas, where excessive numbers of vehicles produce noise, vibration, pollution and, above all, accident risks, especially to the young. 'Traffic calming' has been intro-duced to many European cities and aims at the creation of an environment in which cars are permitted but where the pedes-trian has priority of movement. Carefully planned street-width variations, parking restrictions and speed-control devices such as ramps are combined to secure a safe and acceptable balance between car and pedestrian.

3. Effective Use of Bus Service: Many transportation planning proposals are aimed specifically at increasing the speed and schedule reliability of bus services, and many European cities have introduced bus priority plans in an attempt to increase the attractions of public transport. Bus-only lanes, with or against the direction of traffic flow, are designated in heavily congested roads to achieve time savings, although such savings may later be dissipated when buses enter inner-city areas where priority lanes at intersections and certain streets may be restricted to buses only, particularly in pedestrianized shopping zones. Where entirely new towns are planned, there is an oppor-tunity to incorporate separate bus networks within the urban road system, enabling buses to operate free from congestion. In the UK, Run corn New Town, built as an overspill center for the Merseyside conurbation, was provided with a double- looped bus way linking shopping center, industrial estates and housing areas. About 90 per cent of the town's population was within five minutes' walk of the busway and operating costs were 33 per cent less than those of buses on the conventional roads. Although the system is not used to the extent originally envisaged, it successfully illustrates how public transport can be integrated with urban development. Bus-only roads can also be adapted to vehicle guidance systems, whereby the bus is not steered but controlled by lateral wheels, with the resumption of conventional control when the public road network is re-entered.



4. Parking Restrictions: As we have seen, it is not possible to provide sufficient space for all who might like to drive and park in the central areas of large towns. Parking thus must be restricted and this is usually done by banning all-day parking by commuters or making it prohibi-tively expensive. Restrictions are less severe – off-peak, so that shoppers and other short-term visitors who benefit the economy of the center are not deterred. Separate arrangements must be made for local residents, perhaps through permits or reserved parking. City authorities can thus control public car-parking places, but many other spaces are privately owned by businesses and reserved for particular employees. The effect of this is to perpetuate commuting to work by car. The future provision of such space can be limited through planning permission for new developments, as is done in London, but controlling the use of existing private spaces raises problematical issues of rights and freedoms that many countries are reluctant to confront.

5. Promoting the Bicycle: The benefits of cycling have long been recognized. The bicycle is cheap to buy and run and is in urban areas often the quickest door-to-door mode. It is a benign form of transport, being noiseless, non-polluting, energy-and space-efficient and non-threatening to most other road users. A pro-cycling city would promote fitness among cyclists and health among non-cyclists. Cycling is thus a way of providing mobility, which is cheap for the individual and for society. Advocates of Environmental Traffic Management (ETM) frequently cast envious glances at the Netherlands, where cycle planning is set in the context of national planning for sustainability. The Master Plan Bicycle, which aims to increase bicycle-kilometers by at least 30 per cent between 1986 and 2010, not only tackles the traditional concerns of cycle infra-structure and road safety, but also addresses issues of mobility and modal choice; how to encourage businesses to improve the role of the bicycle in commuting; reducing bicycle theft and increasing parking quantity and quality; improving the combi-nation of cycling and public transport; and promoting consideration of the bicycle amongst influential decision makers. These 'pull' measures are part of a national transport strategy of discouraging car use, which 'pushes' motorists towards use of the bicycle. Travel Time in Urban Areas from Door-to-Door

6. Encouraging Walking: Walking is the most important mode of transport in cities, yet frequently data on it are not collected and many planners do not think of it as a form of transport. As a result of this neglect, facilities provided specifically for walking are often either absent or badly maintained and pedestrians form the largest single category of road user deaths. There are social, medical, environmental and economic reasons for promoting walking, for it is an equitable, healthy, non-polluting and inexpensive form of transport. Moreover, 'foot cities' tend to be pleasurable places in which to live, with access to facilities within walking distance frequently cited as a key indicator of neighborhood quality of life.

7. Promoting Public Transport: It aims to shift trips away from cars, then attractive alter-natives are required. Cycling and walking may be appropriate for the shorter distances, but transferring longer trips requires that a good quality public transport system is in place to ensure that the city can function efficiently. This means that:

- 1. Fares need to be low enough for poor people to be able to afford them;
- 2. There must be sufficient vehicles for a frequent service to be run throughout the day;

3. Routes must reflect the dominant desire lines of the travelling public and there should be extensive spatial coverage of the city so that no one is very far from a public transport stop;

4. Speeds of buses need to be raised relative to cars by freeing them from congestion;



5. It is not enough to provide public transport: it also has to be coordinated. Multi-modal tickets may be one essential ingredient of a functional urban transport system, but the key item is the integration of services by the provision of connections between modes.

6. Other Measures:

Some of the other measures useful for urban transport planning are:

- 1. Restrictions on road capacity and traffic speeds,
- 2. Regulating traffic access to a link or area,
- 3. Charging for the use of roads on a link, or area basis,
- 4. Vehicle restraint schemes,
- 5. Rail rapid transit,
- 6. Transport coordination, and
- 7. Public transport improvement, etc.

Expressways -An expressway is normally a 4 lane divided highway that may have limited access, entrances and exits, which may include overpasses, over intersections. It may be toll or not. A highway especially planned for high-speed traffic, usually having few if any intersections, limited points of access or exit, and a divider between lanes for traffic moving in opposite directions. A highway especially planned for high-speed traffic, usually having few if any intersections and a divider between lanes for traffic moving in opposite directions. A highway especially planned for high-speed traffic, usually having few if any intersections. A highway especially planned for high-speed traffic, usually having few if any intersections, limited points of access or exit, and a divider between lanes for traffic moving in opposite directions. A highway.

Freeways - Freeways described the first 4 lane highways just like our Interstate system. They were not always free. Some charged a usage fee from the entrance to the exit by drivers. They did not have frequent toll booths, only at entrances, where a ticket was issued, and exits. The freeway is often to quickest way to get where you're going, unless there's traffic jam or an accident slowing things down. All freeways are highways, but not every highway is a freeway. A freeway is a "controlled-access" highway — also known as an express highway — that's designed exclusively for high-speed vehicular traffic. Traffic flow on a freeway is unhindered because there are no traffic signals, intersections, or at-grade crossings with other roads, railways, or pedestrian paths. People often use the terms freeway and highway interchangeably, and there's also parkway and expressway — or motorway, in the UK. The main difference between freeways and multilane highways is that in the case of freeways, these roads are separated from the rest of the traffic and can only be accessed by ramps.

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