



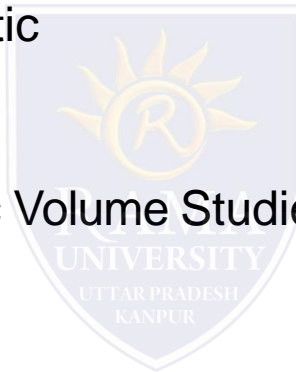
DEPARTMENT OF CIVIL ENGINEERING

FACULTY OF ENGINEERING & TECHNOLOGY

# TRANSPORTATION ENGINEERING – I (Highway Engineering)

## Topics to be covered:

- Traffic Engineering
- Traffic Characteristic
- Volume Studies
- Methods for Traffic Volume Studies



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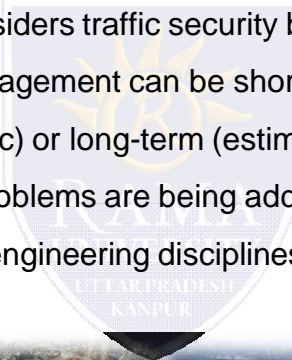
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# TRAFFIC ENGINEERING:

Traffic engineering is a part of structural designing that utilises designing methods to accomplish the protected and proficient development of individuals and products on streets. It centres fundamentally around research for sheltered and productive traffic stream, for example, street geometry, walkways and crosswalks, cycling foundation, traffic signs, street surface markings and traffic signals. Traffic designing arrangements with the useful piece of transportation framework, aside from the foundations gave. Typical traffic engineering ventures include structuring traffic light gadget establishments and alterations, including traffic lights, signs, and asphalt markings. Instances of Engineering Plans incorporate post designing examination and Storm Water Prevention Programs. However, traffic engineering additionally considers traffic security by exploring areas with high accident rates and creating countermeasures to decrease crashes. Traffic flow management can be short-term (preparing construction traffic control plans, including detour plans for pedestrian and vehicular traffic) or long-term (estimating the impacts of proposed commercial/residential developments on traffic patterns). Increasingly, traffic problems are being addressed by developing systems for intelligent transportation systems, often in conjunction with other engineering disciplines, such as computer engineering and electrical engineering.



# TRAFFIC CHARACTERISTICS :

## SCOPE OF TRAFFIC ENGINEERING :

1. Traffic characteristics
2. Traffic studies and analysis
3. Traffic operation – control and regulation
4. Planning and analysis
5. Geometric design
6. Administration and management

## TRAFFIC CHARACTERISTICS :

- a) The study of traffic characteristics is the most essential prerequisite for any improvement of traffic facilities. The traffic characteristics includes road users characteristics and vehicular characteristics.
- b) The physical, mental and emotional characteristics of human beings are to be given particular attention.
- c) The vehicular characteristics includes study of various parameters of vehicles like dimensions, weight, maximum turning radius, speed, braking system, lighting system, tyres, etc.
- d) The Traffic characteristics are further classified as:
  - (1) Road User Characteristics
  - (2) Vehicular Characteristics
  - (3) Road Characteristics
  - (4) Environmental Characteristics

# TRAFFIC CHARACTERISTICS CONTINUES.....:

## FUNCTIONS OF TRAFFIC ENGINEER :

### 1. COLLECTION, ANALYSIS AND INTERPRETATION OF TRAFFIC DATA

- a) Volume Study
- b) Origin and Destination Study
- c) Speed Study
- d) Parking Study etc.

### 2. TRAFFIC AND TRANSPORTATION PLANNING

Based on the study related to land use and transportation, mathematical models are formulated to predict how system will behave under given condition.

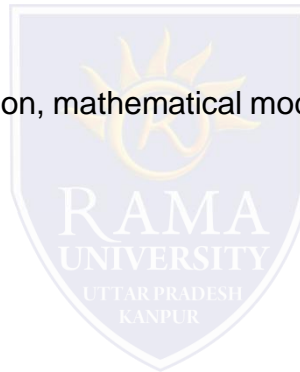
### 3. TRAFFIC DESIGN :

- a) Geometric design of highway
- b) Intersection design
- c) Grade separated interchange
- d) Design of on street and off street parking

### 4. MEASURES FOR OPERATION OF TRAFFIC :

- a) Legislation and enforcement measures
- b) Measures for regulation of parking of vehicle
- c) Management measures
- d) Traffic control devices

**5. ADMINISTRATION :** Various programs intended to secure safe and efficient traffic in cities is also an important function of traffic engineer.



# TRAFFIC CHARACTERISTICS CONTINUES.....

The behavior of traffic is highly dependent on the interaction amongst these four elements.

**ROAD USERS :** Response to various stimuli varies over a wide range. The drivers have varying degree of fatigue, attention, experience, training etc.

**VEHICLE :** They differ in dimension, weight and performance characteristics.

**HIGHWAY :** It have varying grades, alignment, carriage way width and surface.

**ENVIRONMENT CONDITION :** weather, adjacent land use etc.

## ROAD USER CHARACTERISTICS :

- Road user behavior is affected by both external and internal factors.
- The internal factors can be classified as following.
  - (a) Physical factors
  - (b) Temporary factors
  - (c) Permanent factors
  - (d) Psychological factors
- The environment factors are consider as external factors.
- The Physical Factors are further classified as : Permanent and Temporary Factors
- Permanent factors include : Vision , Hearing, Strength, Judgment Power, Reaction power
- Temporary factors include : Fatigue, Alcohol, drug, Illness, disability, Anger, Climate, season, time.
- **Permanent physical factor includes Visual activities of road users:** Vision is one of the important factors that affects almost all aspects of highway design & safety. The human eye is the sensory organ that enables one to see and evaluate the size, shape & color of objects & estimate distances and speed of bodies.



# TRAFFIC CHARACTERISTICS CONTINUES.....

The various aspects of human vision which affects the road user are:

**VISION :** The vision refers to the sight of human being. It depends on various factors such as:

1. **VISUAL ACUITY (EYE SIGHT)**

2. **PERIPHERAL VISION :** It deals with total visual field for the two eye. Angle of peripheral vision , horizontal direction =  $160^{\circ}$  , vertical direction =  $115^{\circ}$

3. **EYE MOVEMENT**

4. **COLOR VISION :** Under a good light many colors may differentiate but as light decreases, some colors are less visible. Color blindness is a condition where one cannot distinguish between different colors.

5. **GLARE VISION AND RECOVERY :** Adaptability to light is an important factor of vision. Eye takes more time to adapt when we go from light to dark. Glare recovery time is the time required to recover from the effect of glare after the light source is passed.

6. **PERCEPTION OF TIME AND SPACE :** Perception of space refer to ability of eyes to judge the space depth and time.

**HEARING:** Hearing is an aid to the road-user which can at times be very vital. The sound of a horn or the sound of the nearing vehicle itself can alert a pedestrian to safety.

**STRENGTH:** Though strength is not an important factor in general, lack of strength may make parking maneuvers difficult, particularly for heavy vehicles.

**REACTION TIME:** The time required to perceive & understand the traffic situation & to take the appropriate action is known as reaction time.

**JUDGMENT POWER:** Ability to judge the coming situation depends upon experience & one's own judgment power. before the actual response it is the right judgment of the steps to be taken to avoid the mishaps.



# TRAFFIC CHARACTERISTICS CONTINUES.....:

## PSYCHOLOGICAL FACTORS

- a) Motivation
- b) Intelligence
- c) Learning
- d) Emotion
- e) Individual difference
- f) PIEV time

**MOTIVATION:** People enter the traffic stream for business, social, recreation, marketing purposes. they may be intent on going to a regular place of employment, to market, to rail, water, air or other terminals.

**INTELLIGENCE:** The capacity of the road user to be aware of external factors pertinent to his behavior in traffic and to adapt and adjust himself in accord with his intents and motives required a fair degree of intelligence.

**LEARNING:** The learning process, while dependent on motivation, intelligence, and other modifying factors, develops the skills, habits and abilities of road users to respond properly to the total environment of traffic operations.

**EMOTION:** Usually emotion strongly motivates the road user to inefficient, random adjustment. fear anger, worry, and other similar emotional states tend to create disorganized reaction and behavior.

**INDIVIDUAL DIFFERENCE:** Because of the modifying factors of motivation, intelligence, learning and emotion there is a great variation among users of the highway.



# TRAFFIC CHARACTERISTICS CONTINUES.....:

## ENVIRONMENT FACTORS

- a) Traffic Stream Characteristics
- b) Facilities to the Traffic
- c) Atmospheric Conditions
- d) Locality, Land Use & Activities

**PIEV THEORY :** According to theory, the total reaction time of the driver is split into 4 parts as ::

**PERCEPTION TIME:** Perception time is the time required for the sensations received by the eyes or ears to be transmitted to the brain through the nervous system and spinal chord.

**INTELLECTION TIME:** It is the time required for understanding the situation. it is also the time required for comparing the different thoughts, regrouping and registering new sensations.

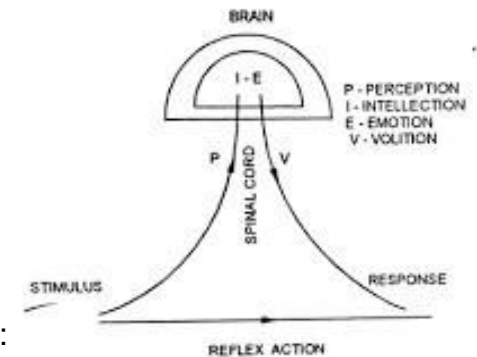
**EMOTION TIME:** It is the time elapsed during emotional sensations and disturbance such as fear, anger, etc. with reference to the situation.

**VOLITION TIME:** Volition time is the time taken for the final action. the “will” to take some act or produce some action is volition.

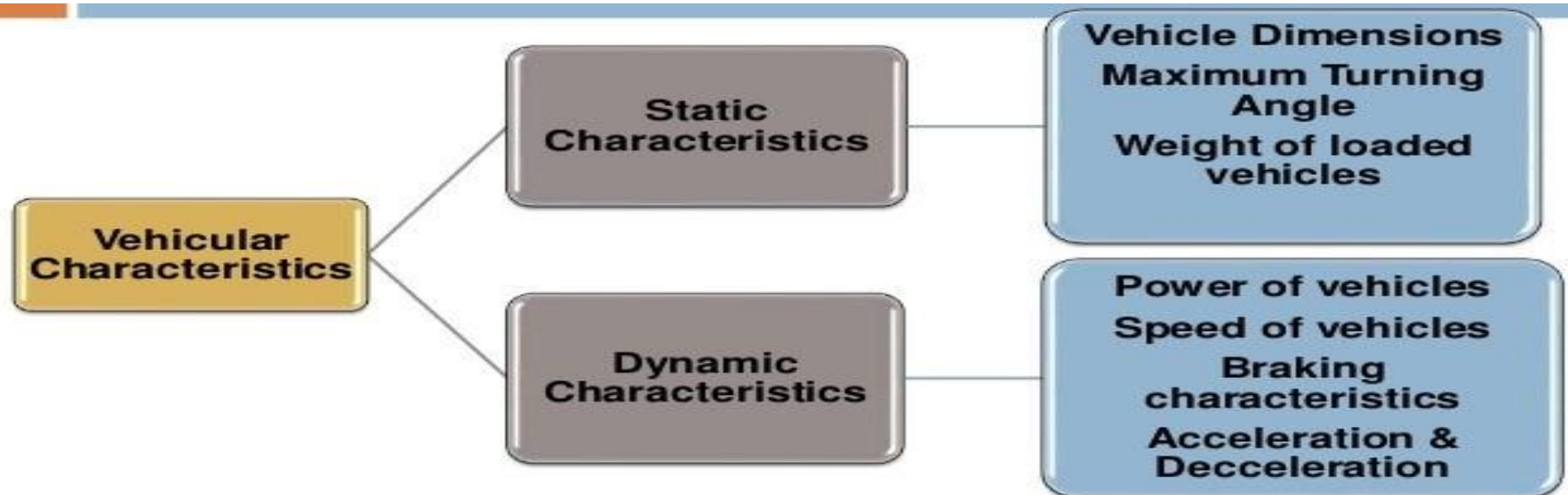
The PIEV time of a driver depends on several factors such as:

- Physical & psychological characteristics of the driver.
- Type of the problem involved.
- Environmental conditions.
- Temporary factors.

The total reaction time (PIEV time) of an average driver may vary from 0.5 sec for simple situation to as much as 3 to 4 sec for a more complex problem, such as the decision to overtake and pass on a two-lane road.

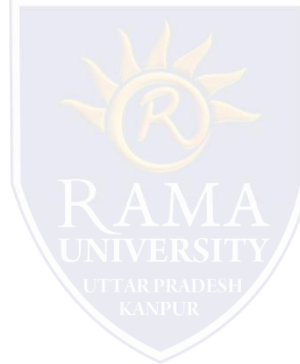


## TRAFFIC CHARACTERISTICS CONTINUES.....:



# TRAFFIC STUDIES :

**TRAFFIC STUDIES:** Traffic examines give smart data during the arranging and configuration periods of activities. These examinations can help decide the effect of staged turns of events, decide whether traffic lights are required, and decide whether administration and crisis vehicles can appropriately get to the site. Architects can appraise future traffic dependent on the proposed land use. We would then be able to course this traffic to and from the site to comprehend the effect on the encompassing system and site. Reproducing the dissemination ways of vehicles on location helps settle clashes before development with the goal that you have certainty your arrangements will work for the two vehicles and individuals. The Traffic studies include study of various aspects related to the Traffic such as the study of :



- a) Traffic volume
- b) Speed Studies
- c) Spot speed
- d) Speed & Delay
- e) Origin & Destination
- f) Traffic Capacity
- g) Parking
- h) Accident

**CAPABILITIES :** The capabilities of Traffic Studies are to carry out :

- a) Traffic Impact Studies
  - b) Corridor and Feasibility Studies
  - c) Access Management
  - d) Safety
-

# TRAFFIC VOLUME STUDIES :

## TRAFFIC VOLUME STUDIES :

- It is carried out to measure to quantify traffic flow.
- No. of vehicles passing across a given traverse line of the road during unit time.
- It is expressed as no. of vehicles/hour or per day.
- It classifies traffic volume as Volume of each vehicle class separately. The

Level of measurements of traffic volume is represented as :

- 1) Hourly flow ( Vehicle/Hour),
- 2) Annual Average Daily Traffic ( AADT)(Vehicle/day)
- 3) Average Annual Flow ( Vehicle/year)

➤ Traffic Volume is the number of vehicles crossing a section of road per unit time at any selected period. It is used as a quantity measure of flow.

## OBJECT AND USES OF TRAFFIC VOLUME STUDY:

- ✓ It is generally accepted as a true measure of the relative importance of roads and in deciding the priority for improvement and expansion.
- ✓ It is used in planning, traffic operation and control of existing facilities and also for planning the new facilities.
- ✓ It is used in the analysis of traffic patterns and trends.
- ✓ Useful in structural design of pavement
- ✓ Pedestrian traffic volume study is used for planning side walk, cross walks, subway and pedestrian signals.

# METHODS FOR TRAFFIC VOLUME STUDIES :

## MANUAL METHOD FOR TRAFFIC VOLUME STUDIES :

counts are typically used to gather data for determination of vehicle classification, turning movements, direction of travel, pedestrian movements, or vehicle occupancy. Most applications of manual counts require small samples of data at any given location. Manual counts are sometimes used when the effort and expense of automated equipment are not justified. Manual counts are necessary when automatic equipment is not available. Manual counts are typically used for periods of less than a day. Normal intervals for a manual count are 5, 10, or 15 minutes. Traffic counts during a Monday morning rush hour and a Friday evening rush hour may show exceptionally high volumes and are not normally used in analysis; therefore, counts are usually conducted on a Tuesday, Wednesday, or Thursday. A manual classified count (MCC) involves counting all the vehicles passing a selected location on a road for a pre-determined period of time. The count is conducted by persons standing at the roadside and recording passing vehicles on a form, hence the term “manual traffic count”. This distinguishes it from counts by machines that can record passing vehicles automatically, which are known as “automatic traffic counts”. The count records individual vehicles by categories (i.e. a truck or car) and the direction they are travelling in. This is the reason it is called a ‘classified count’. For the counting purpose the head of the study employs a field team to count and classify traffic volume.

## PROCEDURE

- a) No. of observers required depends upon no. of Lanes and type of information required.
- b) More desirable to record traffic in each direction of travel by posting separate observers for each direction.
- c) For all-day counts, work in three shifts can be arranged.
- d) Data is recorded by Five- dash system. (||||)

## EQUIPMENTS FOR MANUAL COUNTS

- |                             |              |
|-----------------------------|--------------|
| • Watch                     | • clip board |
| • Pencil, Rubber, Sharpener | • Data sheet |
-



# MANUAL METHOD FOR TRAFFIC VOLUME COUNT :

## ADVANTAGES :

- a) Details such as vehicle classification and no. of occupants can be obtained.
- b) Records Turning movement data of vehicles at intersections.
- c) Analyzing traffic characteristics in unusual conditions such as adverse weather conditions, traffic breakdowns, temporary closure of any lane of highway etc.
- d) Comparatively cheaper method of counting.
- e) Data accumulated by manual methods are easy to analyze.

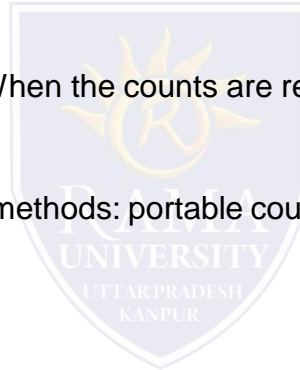
## DISADVANTAGES :

- a) Not practicable to have manual count for 24 hrs of the day and throughout the year.
- b) Counts of remote areas is possible by automatic devices.



# AUTOMATIC COUNTING METHOD FOR TRAFIC VOLUME STUDIES:

- An automatic survey involves placing a tube or loop across a road which is connected to a box containing the means for storing the information.
  - In this method, vehicles are counted automatically without any human involvement.
- There are two techniques of automatic counting: **Contact system based on pneumatic, mechanical, magnetic or Contactless system based on electrical/optical, ultrasound/infrared radar, micro wave, CCTV/video image processing method etc.**
- The automatic count method provides a means for gathering large amounts of traffic data. Automatic counts are usually taken in 1-hour intervals for each 24-hour period.
  - The counts may extend for a week, month, or year. When the counts are recorded for each 24-hour time period, the peak flow period can be identified.
  - Automatic counts are recorded using one of three methods: portable counters, permanent counters, and videotape.



## PORTABLE COUNTERS :

Portable counting is a form of manual observation. Portable counters serve the same purpose as manual counts but with automatic counting equipment. The period of data collection using this method is usually longer than when using manual counts. The portable counter method is mainly used for 24-hour counts. Pneumatic road tubes are used to conduct this method of automatic counts. Specific information pertaining to pneumatic road tubes can be found in the users 'manual.



# AUTOMATIC COUNTING METHOD FOR TRAFIC VOLUME STUDIES:

**PERMANENT COUNTERS :** Permanent counters are used when long-term counts are to be conducted. The counts could be performed every day for a year or more. The data collected may be used to monitor and evaluate traffic volumes and trends over a long period of time.

**VIDEOTAPE OR VIDEOGRAPHY :** Observers can record count data by videotaping traffic. Traffic volumes can be counted by viewing videotapes recorded with a camera at a collection site. A digital clock in the video image can prove useful in noting time intervals.

## Factors affecting vehicle counting:

Weather conditions.

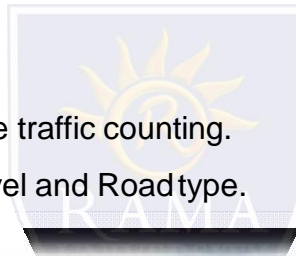
Location of the counting sites.

Purpose of the traffic counting.

Traffic flow level and Road type.

Method of traffic counting.

Traffic composition.



## PRESENTATION OF TRAFFIC VOLUME DATA :

**TRAFFIC FLOW MAPS:** IT shows volume along various routes by using bands proportional to traffic volume carried where thickness of lines represent traffic volume.

**INTERSECTION FLOW DIAGRAMS :** These diagrams give direction and volume of traffic through an intersection.

**TREND CHARTS :** The trends charts show the hourly , daily or monthly changes in volume through an area. Such charts are useful for planning future expansion, design and regulation.

### BASIC TERMS :

**ANNUAL AVERAGE DAILY TRAFFIC (AADT) :** The total yearly volume divided by number of days in the year.

**AVERAGE DAILY TRAFFIC (ADT) :** The total volume during a given time period, in whole days greater than one day and less than one year, divided by number of days in that time period.

**PASSENGER CAR UNIT :** The different vehicle classes have a wide range of static characteristics and dynamic characteristics, apart from these the driver behavior of the different vehicle classes is also found to vary considerable. Therefore mixed traffic flow characteristics are very much complex when compare to homogeneous traffic and it is difficult to estimate the traffic volume, capacity of roadway under the mixed traffic flow, unless the different vehicle classes are converted to one common standard vehicle unit. •Therefore it is a common practice to consider the passenger car as the standard vehicle unit to convert the other vehicle classes and this unit is called **PASSENGER CAR UNIT PCU**.

It is a common practice to consider the passenger car as the standard vehicle unit to convert the other vehicle classes and this unit is called Passenger car unit or PCU. Thus in mixed traffic flow, the traffic volume & capacity are generally expressed as PCU per hour or PCU/lane/hour & the traffic density as PCU per kilometer length of lane.

## PRESENTATION OF TRAFFIC VOLUME DATA :

**PRESENTATION OF TRAFFIC VOLUME DATA :** The values for PCU as per IRC : 86-1983 are given below in tables as :

Serial No.	VEHICLE CLASS	Equivalence Factor
1	Motor Cycle, Scooter and Pedal Cycle	0.5
2	Passenger Car, Tempo, Auto Rickshaw, Agricultural Tractor, Pick-Up Van	1.0
3	Cycle – Rickshaw	1.5
4	Truck, Bus, Agricultural Tractor- Trailer	3.0
5	Horse-Drawn Vehicle	4.0
6	Small Bullock-Cart and Hand-Cart	6.0
7	Large Bullock-Cart	8.0

## FACTOR AFFECTING PASSENGER CAR UNIT :

- a) Vehicle characteristics
- b) Speed distribution of the mixed traffic stream, volume to capacity ratio.
- c) Roadway characteristics.
- d) Regulation and control of traffic.
- e) Environmental and climatic conditions.

# “Thank you”



**Have Any Query ?**

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