



# SJB Institute of Technology

## Department of Civil Engineering



# TRAFFIC SURVEYS

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# TRAFFIC STUDIES



Traffic studies are carried out to analyze the traffic characteristics. These studies help in deciding the geometric design features traffic control for safe and efficient traffic movement.

The various traffic survey studies generally carried out are:

- Traffic volume study
- Spot speed study
- Speed and delay study
- Origin and destination study
- Parking study
- Accident studies



# TRAFFIC VOLUME STUDIES



- It is the number of vehicles crossing a section of road per unit time
- Determination of the volume of each vehicle class separately and finding the total volume is called '**Classified volume studies**'.
- It is used as a quantity measure of flow- expressed as vehicles/day or vehicles/hour

## Methods:

1. Manual Counts
2. Automatic Counts



# TRAFFIC VOLUME STUDIES - Objectives



- To decide the priority for improvement and up-gradation of roads.
- For geometric design or re-design of road-way facilities.
- For analysis of traffic patterns trends and rate of growth of each vehicles class and projecting future traffic volume along identified roads.
- For computing roadway capacity.
- For planning one-way streets and other regulatory measures.
- To plan traffic-operation and control of existing facilities.
- To plan and design new facilities.
- To study turning movement studies at intersections
- For structural design / strengthening of pavements



# TRAFFIC VOLUME STUDIES - Methods



## Manual Counting Method

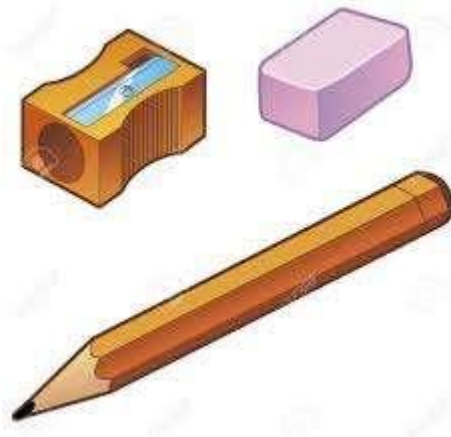
- Direct Method
- Indirect Method

## Automatic Counting Method

- Contact System
- Contact less system

# Manual Count Method

- 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 enumerators carry out classified count of the vehicle and record them on the prescribed record sheet/forms at desired time intervals (such as 10 to 15 minutes)



Name of Road : ..... Road No. : ..... Direction From : ..... To : .....

Station Name : ..... Station Number : ..... Date: ..... / ..... / .....  
 DD MM YY

Enumerator : ..... Supervisor : .....

HOURS COUNTED	MOTORISED										NON-MOTORISED		
	1 Heavy Truck	2 Medium Truck	3 Small Truck	4 Large Bus	5 Mini Bus	6 Microbus	7 Utility	8 Car	9 Auto Rickshaw	10 Motor Cycle	11 Bicycle	12 Cycle Rickshaw	13 Animal/Push Cart
: to :													
: to :													
: to :													
: to :													

Vehicle Type	Tally
Car	
CNG	
Bus	
Motorcycles	
NMT	





## ADVANTAGES:

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





## DISADVANTAGES:

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



# Automatic Count Method



- 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.
- 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.
- Two techniques of automatic counting include:
  1. Contact system: based on pneumatic, mechanical, magnetic
  2. Contactless system: based on electrical/optical/ultrasound/infrared radar, microwave, CCTV/video image processing etc

## Pneumatic road tube

Pneumatic road tube sensors send a burst of air pressure along a rubber tube when a vehicle's tires pass over the tube.

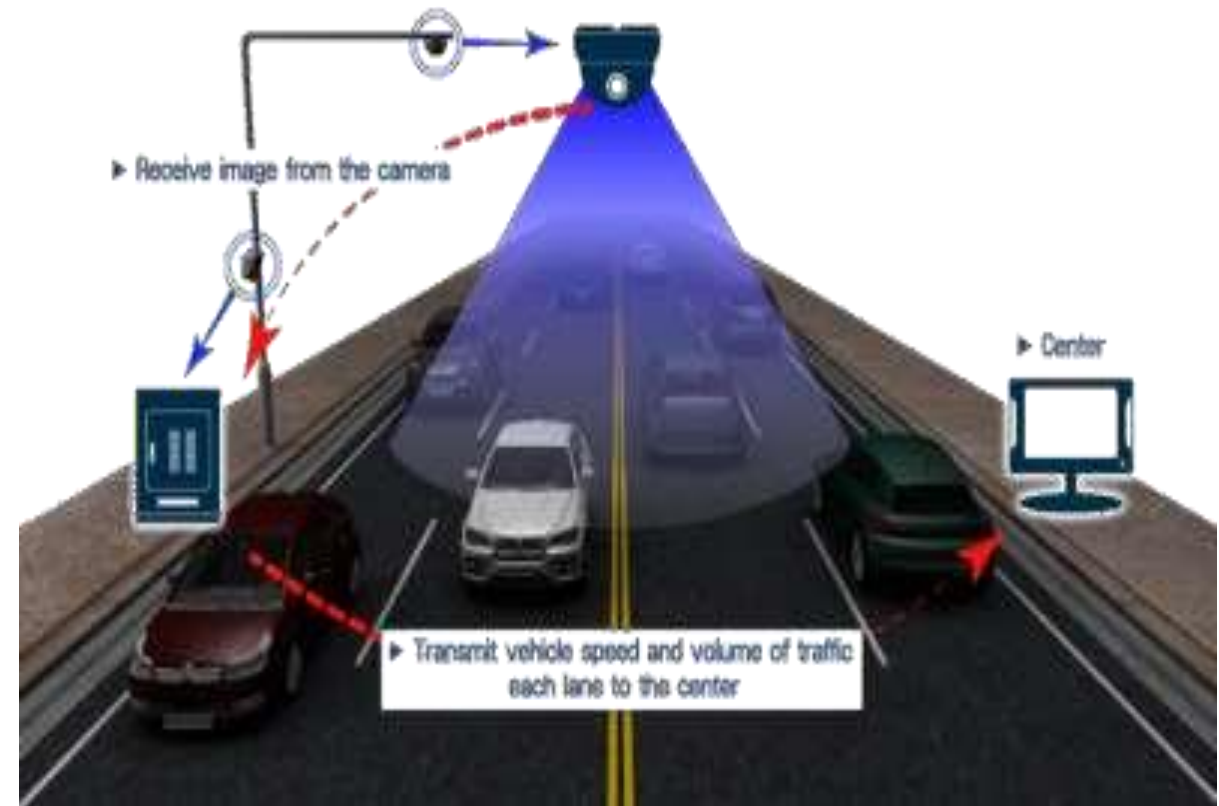


## Bending plate

A weight pad attached to a metal plate embedded in the road to measure axle weight and speed. It is an expensive device and requires alteration to the road bed.



### 3. Vehicles counting by video camera





## DATA COLLECTION

- Studies of different vehicle classes, time and financial constraints, it may not be practically flexible or to adopt long traffic counts.
- It may be possible for the same set of enumerators to carry out traffic volume count of several locations in a day by resorting to 'short counts'.
- The short counts may be for short periods of, or 15 minutes at each location every hour.  
Eg: Hourly flow at each station may be obtained by multiplying the minute count by 12.
- It is desirable that continuous traffic volume counts are made at selected 'control stations' so that the short volume counts made at sample locations are adjusted.

Representation: Average Daily Traffic(ADT) and Average Annual Daily Traffic (AADT)

- **Average daily traffic (AADT) at a given location is preferred to measure traffic volume.**



# TRAFFIC STUDIES



## Presentation of traffic volume data

Average annual, (vehicle/year)

Annual average daily traffic (AADT) vehicle/day

Hourly flow (vehicle/hour)

**Average Daily Traffic (ADT):** Traffic volume counts are carried out only for a few days (3 to 7 days), the average daily traffic volume obtained is called ADT.

**Annual average Daily traffic (AADT);** It is determined by average daily traffic volume recorded for all the 365 days. Of the year.

This data is useful in deciding the relative importance of route and in phasing the road development program



## Adjustment of volume count data

The traffic volume count at the coverage count stations are to be adjusted using the factors obtained from the permanent or control count stations. Daily and seasonal factors are to be estimated as follow:

$$\text{Daily Factor (DF)} = \frac{\text{Seven day average for 24 hour}}{\text{24 hour count on any particular day}}$$

$$\text{Weekly factor (WF)} = \frac{\text{Average 24 hour traffic volume count for 4 weeks}}{\text{24 hour count on any Specific weeks}}$$

$$\text{Seasonal Factor (SF)} = \frac{\text{Average 24 hour traffic volume count for 12 month}}{\text{24 hour count on any Specific month}}$$

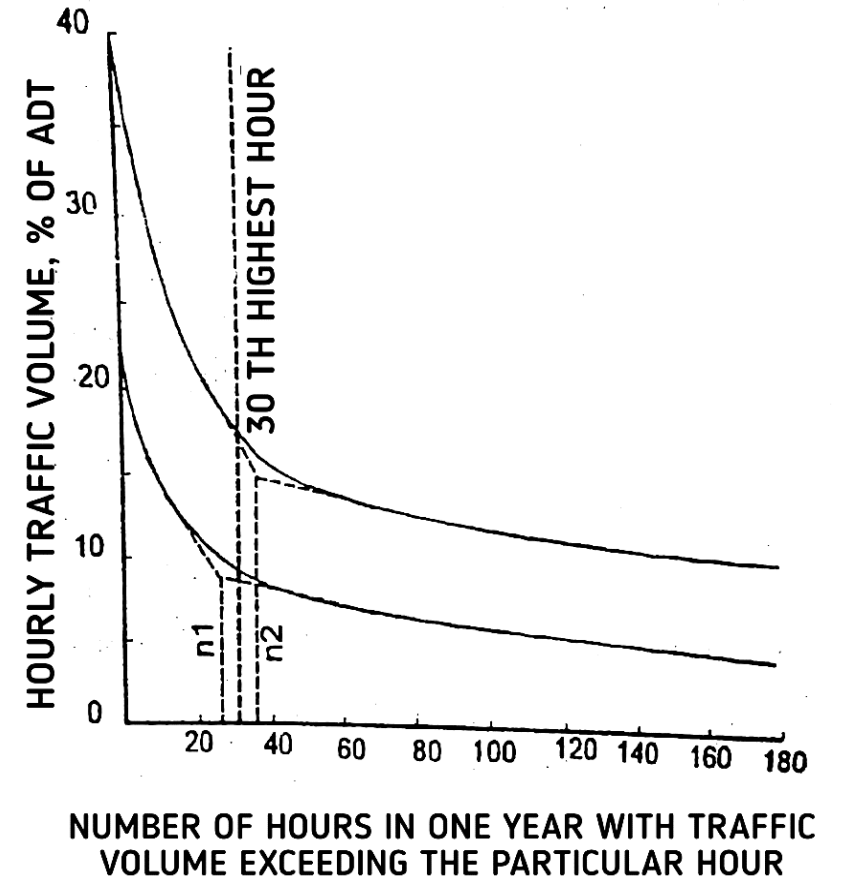
$$\text{ADT} = \text{Traffic volume count} \times \text{DF} \times \text{SF}$$

$$\text{AADT} = \text{ADT} \times \text{DF} \times \text{WF} \times \text{SF}$$



## Design hourly traffic volume

- It is determined from the plot between hourly volume and the number of hours in a year that the traffic volume is exceeded.
- The highest or peak hourly volume of the year will be too high that it will not be economical to design the facilities according to this volume
- 30th highest hourly volume is generally taken as the design hourly volume for the purpose of design of the roadway facility





## 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”
- Total traffic volume under mixed traffic condition generally expressed in terms of PCU per hour or **PCU/lane/hour** & the traffic density as **PCU per kilometer length of lane**

### IRC Recommendation

Sl. No	Vehicle type	Equivalency factor (PCU)
1.	Motor cycles and scooter	0.5
2.	Passenger car, pick up van and auto-Rickshaw	1.0
3.	Agricultural tractor and light commercial vehicle (LCV)	1.5
4.	Single Unit truck and Bus	3.0
5.	Truck trailer and Agricultural tractor- trailer	4.5



# SPEED STUDIES



## Spot Speed:

Instantaneous speed of a vehicle at a specified location

## Average Speed

Average of the spot speeds of all vehicles passing a given point on the highway.

## Running Speed

Average speed maintained by a vehicle over a given course while the vehicle is in motion.

$$\text{Running speed} = \frac{\text{Length of course}}{\text{Running time}} = \frac{\text{Length of course}}{\text{Journey time} - \text{Delays}}$$



## Journey speed

- Also known as overall travel speed
- It is the effective speed between two points. It is the distance between two points divided by the total time taken by the vehicle to complete the journey, including all delays.

$$\text{Journey speed} = \frac{\text{Distance}}{\text{Total journey Time (including delays)}}$$

## TYPES OF SPEED STUDIES

1. Spot speed studies
2. Speed and delay studies



1. For geometric design of roads
2. For regulation and control of traffic operations spot speed studies are needed.
3. For analyzing the causes of accidents and identifying any relation between speed and accidents
4. For before and after studies of road improvement scheme.
5. For determining the problem of congestion on roads and relating capacity



# SPOT SPEED STUDIES- Methods



The methods available for measuring spot speed can be grouped as:

1. Those that requires observation of the time taken by a vehicle to cover a known distance.
  - a) Direct timing procedure
  - b) Eno scope
  - c) Pressure Contact tubes
  - d) Short-base method.
2. Radar speed meter which automatically records the instantaneous speed.
3. Photographic method.



# DIRECT TIMING METHOD



- Simplest method
- Two reference points are marked on the pavement at a suitable distance apart and an observer starts and stops stopwatch as a vehicle crosses these two marks.
- From known distance and time, speed can be calculated.


**Disadvantage:** Errors due to parallax effect.

## Observation by two observers one at each reference points

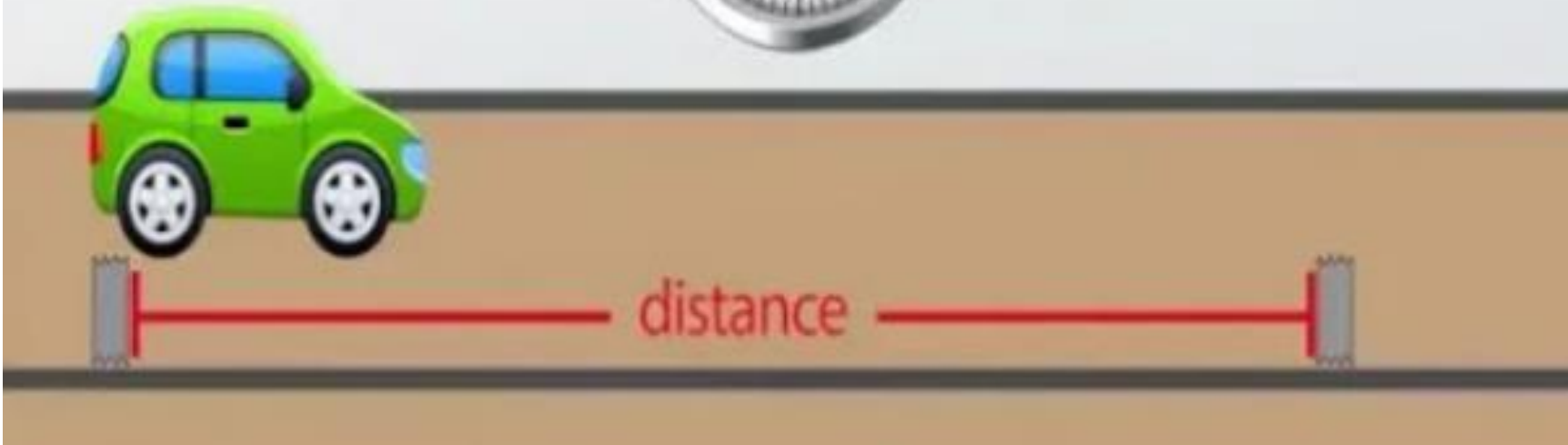
- First observer standing at the point in which the vehicle pass first, signals and seconds observer starts the stop watch. The second observer stops the stop watch when he observes the same vehicle passing the reference point.

**Disadvantage:** Reaction time of two observers.

calculate the speed  
of the car



Speed =  $\frac{\text{distance}}{\text{time}}$

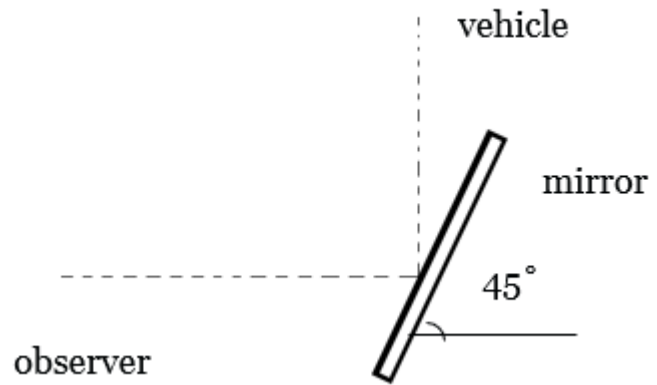


distance



# ENOSCOPE

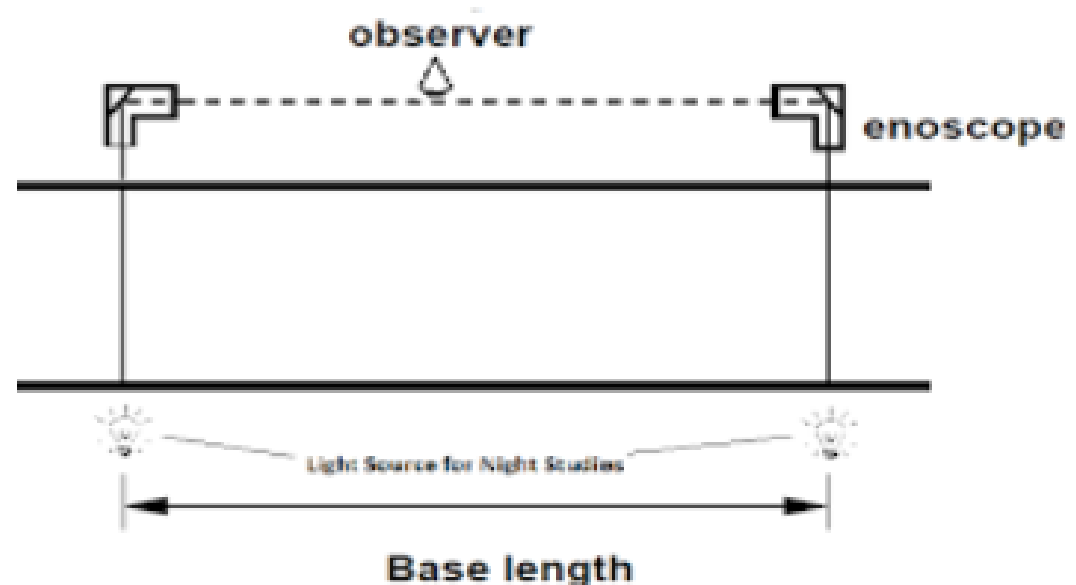
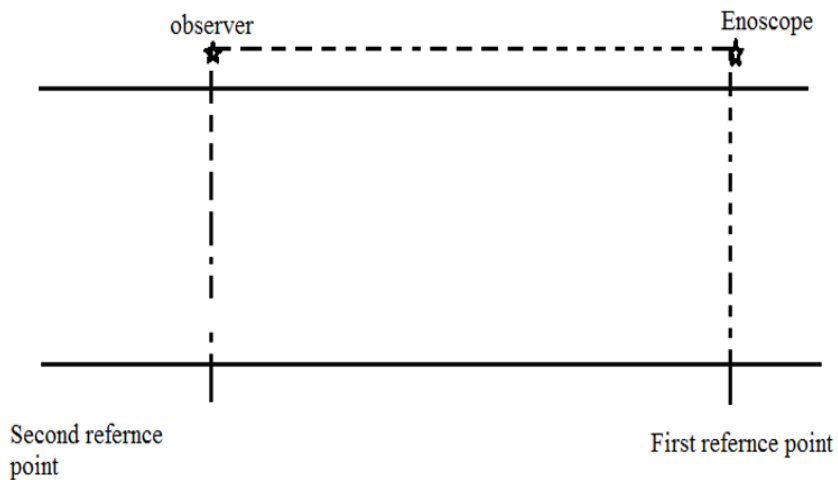
- Also known as mirror box
- L-shaped box, open at both ends ,with a mirror set at  $45^\circ$  to the arms of the instrument.



- It bends the line of sight of the observer perpendicular to the path of vehicle

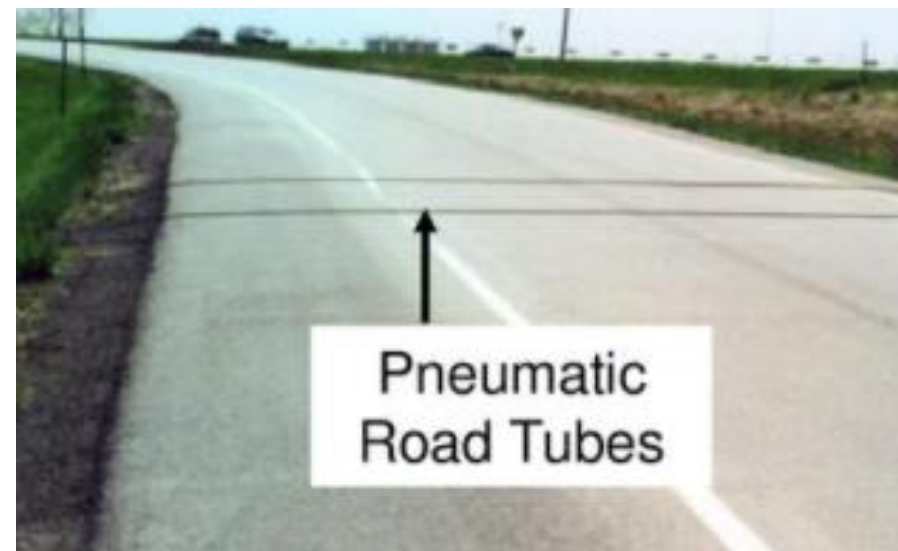
# ENOSCOPE - Procedure

- The instrument is placed directly opposite to the first reference point and the observer stations himself at the second reference point.
- Stop watch is started as soon as the vehicle passes the first point and is stopped as soon as it passes the observer.
- If two enoscope is used, the observer stations himself midway between two reference points.



# Pressure Contact Tube

- When the vehicle passes over first reference point air impulse is sent, which activities as electromagnetically controlled stopwatch in the hands of observer.
- When the vehicle passes over second tube the stopwatch automatically stops.
- Reading is noted by observer alternatively the reading can be recorded by automatic data recorder.
- Disadvantage: Pressure contact tubes are easily seen by drivers, and this may affect their behavior.



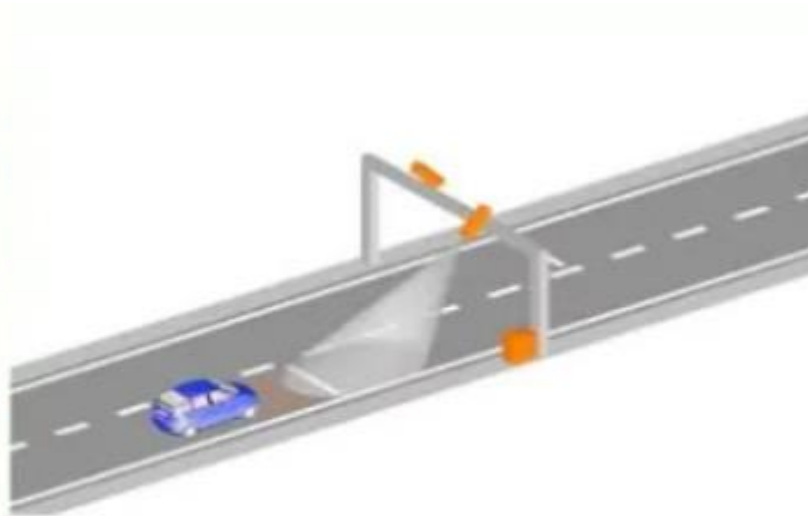
# Radar Speedo Meter

- Works on the Doppler principle.
- Speed of a moving body is proportional to change in frequency between the Radio wave transmitted to the moving body and the radio wave received back.
- Instrument directly measures speed.
- Instrument is setup near the edge of carriageway at a height of 1m.
- The speed meter is so kept that the angle between direction of travel of vehicle and axis of transmission of radio wave is as low as possible, say within  $20^\circ$ .
- Speed of vehicles in both directions can be observed



# Photographic method

- Time-lapse camera photography can be used.
- Photographs are taken at fixed intervals of time(say one second per frame) on a special camera.
- By projecting the film on a screen, the passage of any vehicle can be traced with reference to time.
- Images by video cameras can be also used.



Spot Speed Study  
Data Collection Form

Location: \_\_\_\_\_ Observer/s (group #) \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Direction of Travel: \_\_\_\_\_ Posted Speed: \_\_\_\_\_

Weather Conditions: \_\_\_\_\_

Safety officer \_\_\_\_\_

Vehicle number	Speed, mph	Vehicle number	Speed, mph	Vehicle number	Speed, mph	Vehicle number	Speed, mph

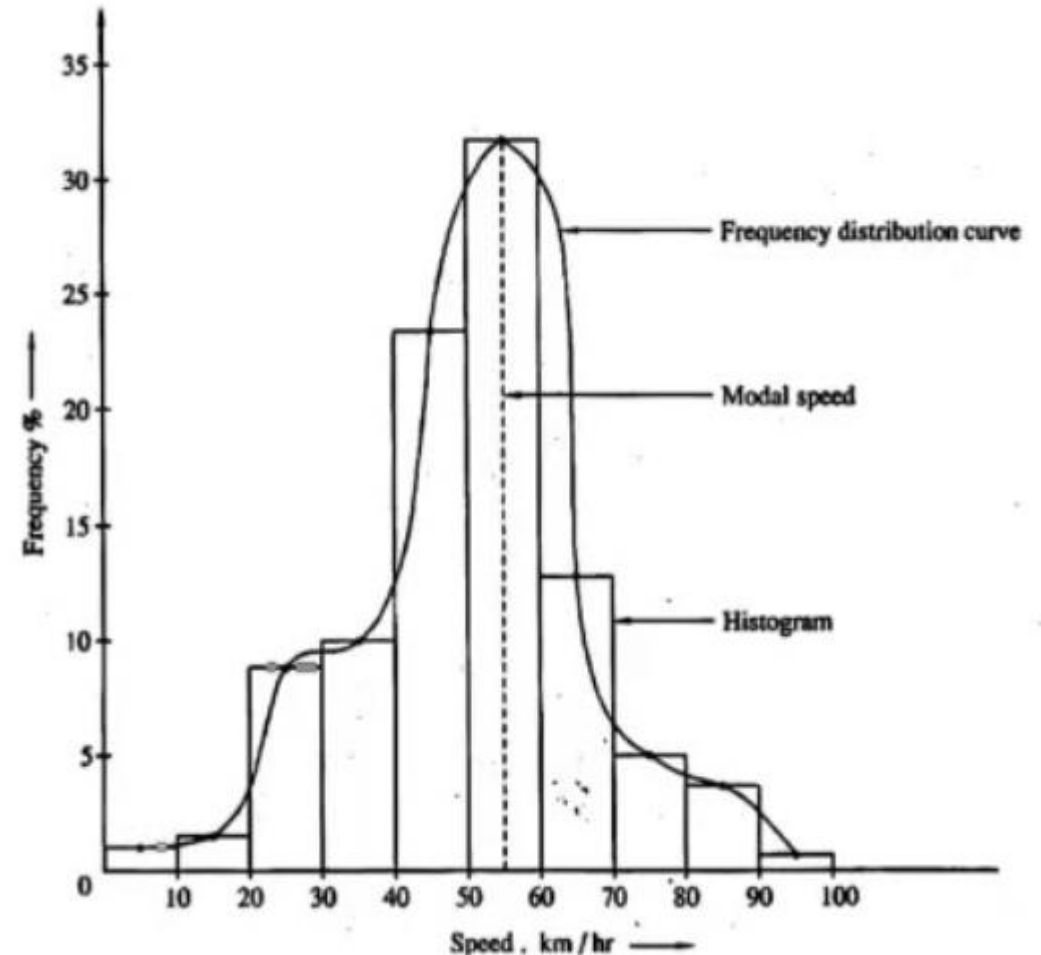
**Data collection form**

From the spot speed data of the selected samples frequency distribution table of spot speed data is prepared by arranging the speed groups covering desired speed ranges (such as 10-20 kmph, 20-30kmph, 30-40kmph, etc) and the number of vehicles in each speed.

## Average speed of vehicles

From spot speed data, distribution tables are prepared by arranging the data in groups covering various speed ranges and number of vehicles in each range.

Arithmetic mean is the average speed.



## Cumulative speed of vehicles

Graph is plotted with average values of each group on X- axis and cumulative percentage of vehicles travelling at different speeds.

85<sup>th</sup> percentile speed: Speed at or below 85 % of

vehicles are passing the point of highway.

Only 15 % of vehicles exceed the speed at that spot.

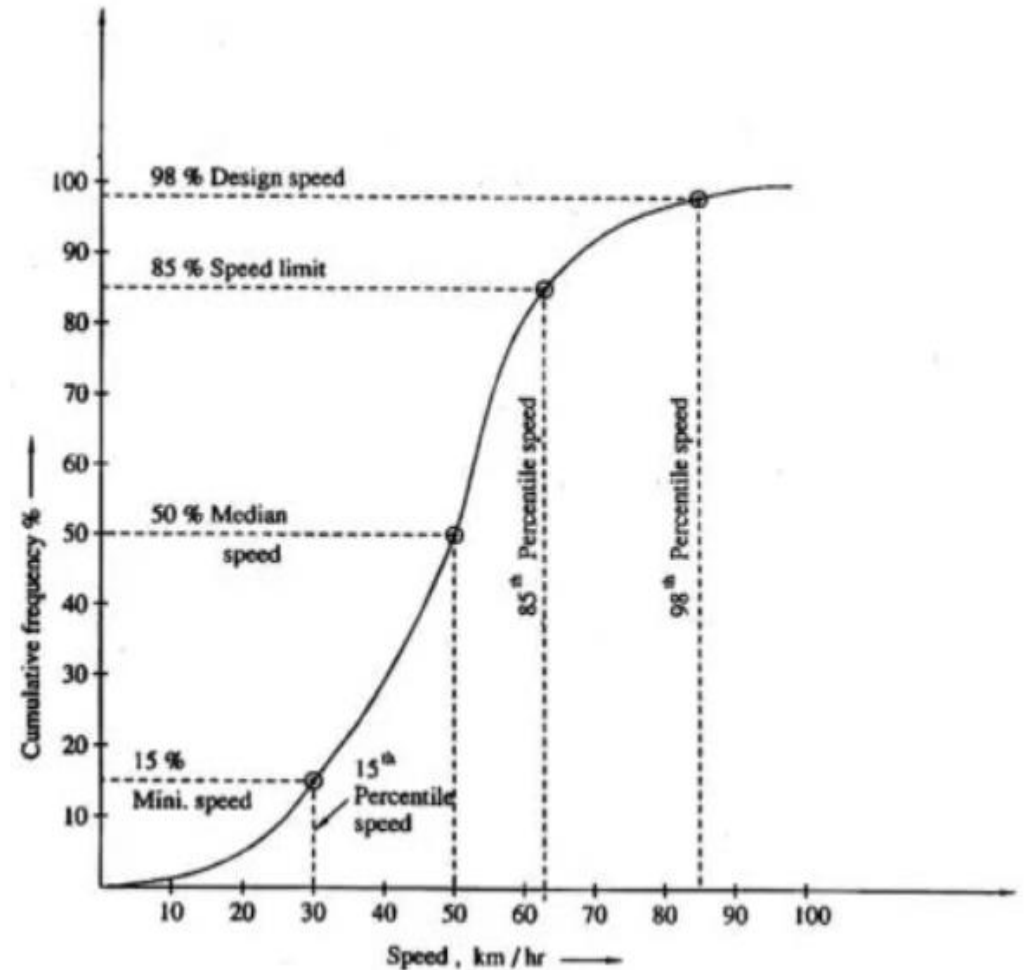
Drivers exceeding 85<sup>th</sup> percentile speed are considered to drive faster than the safe speed.

**98<sup>th</sup> percentile speed** – Speed for geometrics

**85<sup>th</sup> percentile speed** - Safe speed limit

**50<sup>th</sup> percentile speed** - Median speed.

**15<sup>th</sup> percentile speed** - Lower speed limit







# SPEED AND DELAY STUDIES



- Speed and delay studies give running speeds, overall speeds, fluctuations in speed and delay between two stations of a road spaced far apart.
- They also give the information such as amount, location, duration, frequency and causes of the delay in the traffic stream.

## **METHODS**

- Floating Car method
- License Plate record method
- Elevated observation



# Moving Car Observer Method



## Requirements:

- Test car is required usually two-each car carrying a driver and three observers.
- Observer 1: Counts the opposing traffic using hand tallies.
- Observer 2: Carries a recording boards carries a journey log - records times at predetermined points in-route together with the times of stopping and starting at intersections.
- Two stop watches - one for recording continuous time at different points in-route and another for measuring the individual delays.
- Observer 3: Records the number of overtaking and overtaken vehicles.
- If only two observers are available, the driver is instructed to overtake as many vehicles as do overtake him and no record need to be kept of those vehicles.
- It is desirable that twelve to sixteen runs in each direction along the route be made and the results arranged out to arrive at an accurate estimate of speed and flow.



# Determination of Speed and Delay



Consider a stream of traffic moving along a section of road of length ' $l$ '

The stream can be consisting of flow  $q_1$  moving with speed  $V_1$ ,  $q_2$  moving with speed  $V_2$  etc.

Consider the observer travels with stream at speed  $V_w$  and against the stream at speed  $V_a$ . The flow of all vehicles in the stream is calculated as:

$$Q = \frac{(x+y)}{(t_a + t_w)}$$

Where,  $x$  = total number of vehicles met in the section while travelling against the stream.

$y$  = Number of vehicles overtaking the observer-number of vehicles he overtakes while travelling with the stream.

$t_a$  = Journey time,  $\left(\frac{l}{V_a}\right)$  corresponding to speed  $V_a$

$t_w$  = Journey time,  $\left(\frac{l}{V_w}\right)$  corresponding to speed  $V_w$



Mean journey time of vehicle,  $\bar{t} = t_w - \frac{y}{q}$

Mean journey speed =  $\frac{l}{\bar{t}}$

In the above formula, it is useful to affix subscripts 'n' and 's' signifying north bound and should bound traffic respectively thus

$$q_n = \frac{x_s + y_n}{(t_s + t_n)}$$

Where,  $q_n$  = flow in the north bound direction

$x_s$  = opposing traffic count of vehicles met when the test car was travelling south.

$y_n$  = (number of vehicles overtaking- no of overtaken vehicle) when test car is travelling north

$$\text{also, } \bar{t}_n = t_n - \frac{y_n}{q_n}$$

where,  $\bar{t}_n$  = mean journey time in north bound direction

$t_n$  = journey time when test car travelled in north bound direction.

## Registration number method

- Observers are stationed at the ends of a measuring section about 0.5-1.0 km long.
- The time and registration number of the vehicle entering and leaving the section are noted
- By matching the registration number later, the journey times and speed can be determined.
- Sampling can be adopted if traffic is too heavy
- The analysis of data is laborious and time consuming but can be rendered easier by the help of computers.
- Used on highway section heaving minor or no intersections, since vehicle may enter, leave or stop within the section having intersections.





### 3. Elevated observer method

- Observer stationed on top of an elevated building select vehicles at random and follow their course along the road noting the time of entering the test section, duration and nature of delays suffered and the time of leaving.
- The test section has to be short such as a street in the central area of a city.



# ORIGIN AND DESTINATION SURVEY (O&D SURVEY)



- To exact origin and destination of the trips

## **Purpose:**

1. To determine the amount of by passable traffic that enters a town to establish the need for a bypass.
2. To develop trip generation and trip distribution models in transport planning process.
3. To determine the extent to which present highway system is adequate and to plan the new facilities.
4. To assess the adequacy of parking facilities and to plan for future.

## **Methods:**

- a) Home interview survey
- b) Road side interview survey
- c) Post card questionnaire survey
- d) Tags on vehicles



# Home Interview Survey



- Reliable type of survey for collection of origin and destination data
- Information related to travel pattern of the residents of the household and the general characteristics of household can be obtained
- Information on travel pattern - number of trips made, their origin and destination, purpose of trip, travel mode, time of departure from origin and time of departure from origin and time of arrival at destination
- Information on household characteristics - type of dwelling unit, number of residents age, sex, race, vehicle ownership, number of drivers, family income
- **Method adopts random sample of 0.5 to 10% of the population is selected**





# Roadside Interview Survey



- Survey is done by directly interviewing drivers
- The vehicles are stopped at the interview stations by a group of persons and the answers to the questionnaire are collected on the spot.
- Information collected includes:
  1. Place and time of origin
  2. Place and time of destination
  3. Route
  4. Purpose of the trip
  5. Types of vehicles
  6. Number of passengers in each vehicle



## Advantages :

- Data can be collected quickly in short duration

## Disadvantages:

- The vehicles are stopped for interview and causes delay to the vehicular movement



# Post Card Questionnaire



- Reply paid questionnaires are handed over to each of the drivers or a sample of them at the survey points and requesting them to complete the information and return by post.

## Advantages :

- Avoids delay caused to the drivers by the direct roadside interview method

## Disadvantages:

- Poor response rate



# Registration number plate survey



- Survey consists of noting down the registration number of vehicles entering/leaving an area at survey points
- By matching the registration number of the vehicles at the point of entry and exit from the area, one can identify two points on the paths of the vehicles.

## Advantages:

- Work does not interfere with the traffic in any way.

## Disadvantages:

- Large number of observers are needed
- Analysis of the results is complicated.



# Tags on vehicles



- In this method at each point where the **road** crosses the cordon line, vehicles are stopped and a tag is affixed, usually under a wind screen wiper.
- The tags for different survey stations have different shape and colour to identify the survey stations.
- The vehicles are again stopped at exit points where tags were removed.

## Advantages:

- Method is simple and error are not very large.

## Disadvantages:

- It is not possible to handle all the vehicles, sampling may be restored to done.

# Presentation of Results

The most popular pictorial representation is by means of a desire line chart

