Traffic Surveys

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Contents

1.
Introduction

What are Traffic Surveys?

Traffic surveys aim to capture data that accurately reflects the real-world traffic situation in the area. There are many types of data that traffic surveys collect. It may be counting the number of vehicles using a road, speed of vehicles or collecting journey time information.

Why Traffic Surveys?

- **Managing the physical system-** physical system elements such as traffic control devices, lighting fixtures, and roadways. These inventories help assess which items need to be replaced or repaired, and on what anticipated schedule

- **Investigating trends over time-** Traffic engineers need trend data to help forecast future transportation needs. Accident studies reveal locations with problems that must be addressed and mitigated

- **Understanding the needs and choices of the public and industry-** how and why people travel, how travelers make mode choices, time of trip decisions etc is critical to understanding the nature of travel demand. Studies of parking help plan facilities to effectively handle these demands

Why Traffic Surveys?

- **Calibrating basic relationships or parameters**. Fundamental measures, such as perception reaction time, discharge headways at a signalized intersection, headway and spacing relationships on freeways and other uninterrupted flow facilities, and other key parameters and relationships must be properly quantified and calibrated to existing conditions

- **Assessing the effectiveness of improvements**. When improvements of any kind are implemented, follow-up studies are needed to confirm their effectiveness, and to allow for adjustments if all objectives are not fully met.

Why Traffic Surveys?

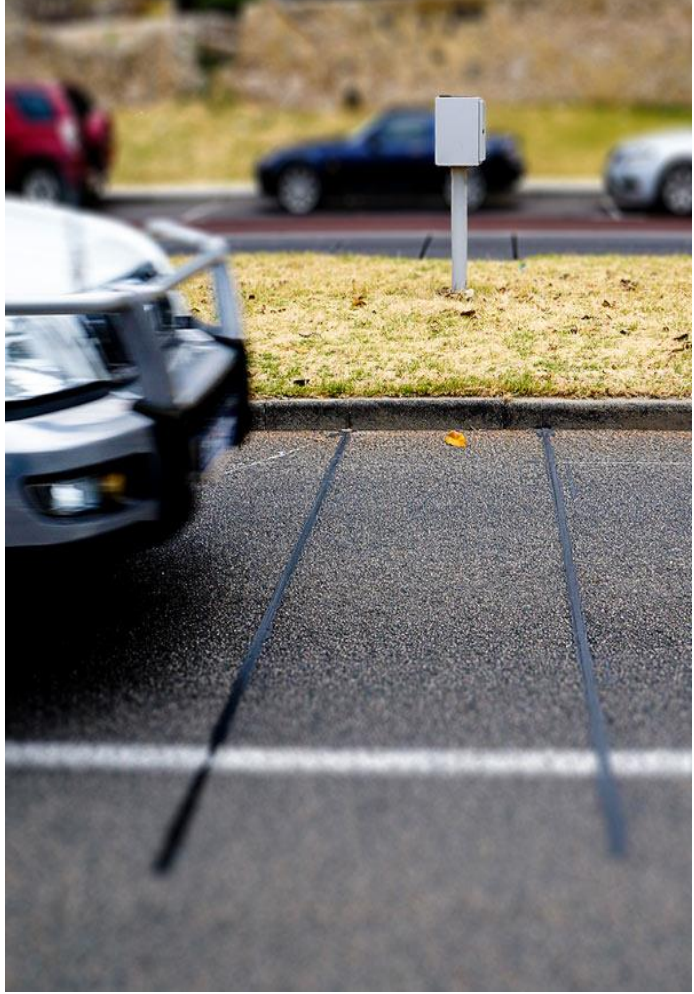
- **Assessing potential impacts**. An essential part of traffic engineering is the ability to predict and analyze projected traffic impacts of new developments and to provide traffic input to air pollution models.

- **Evaluating facility or system performance**. All traffic facilities and systems must be periodically studied to determine whether they are delivering the intended quantity and quality of access and/or mobility service to the public.

Objectives

The objectives of data collected in traffic studies are used as follows:

- For establishment of and updating design standards.
- To analyze traffic characteristics
- Deciding geometric design features
- Traffic control for safe and efficient movement

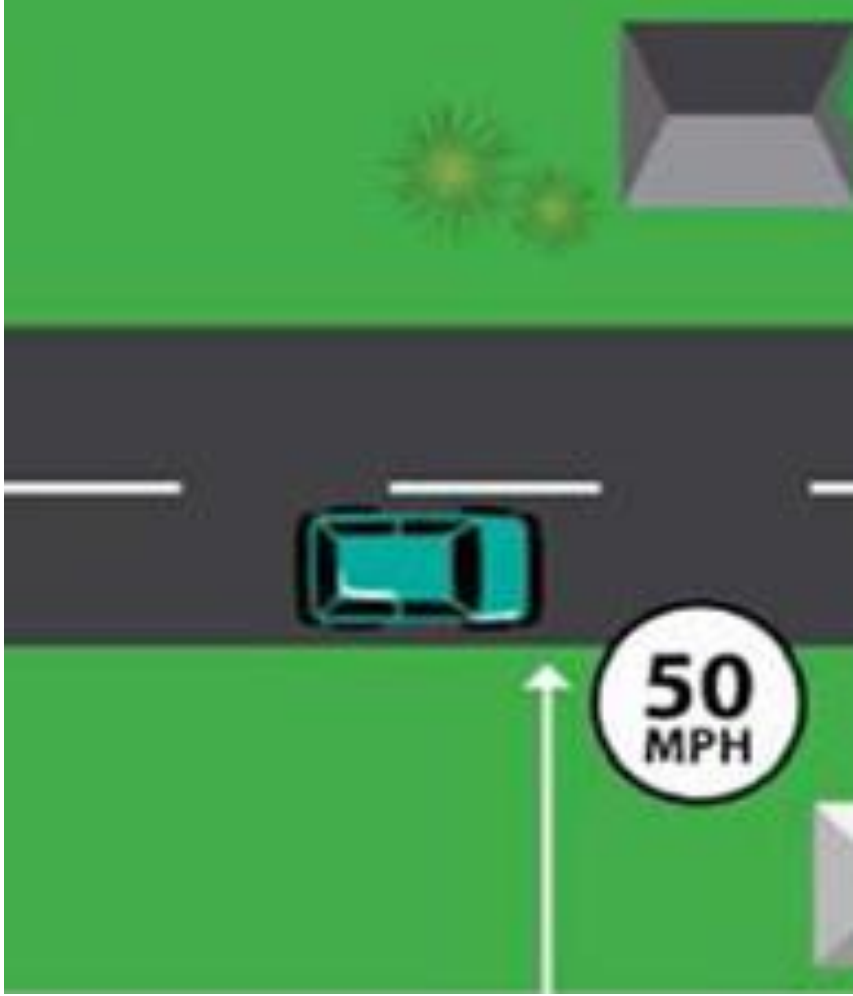


Source: https://www.strongtowns.org/journal/2016/5/9/ask-r-moses-how-do-traffic-counts-work

Types of Traffic Studies

- Based on characteristics of traffic in transit:
  - Traffic volume studies
  - Speed studies
  - Origin and Destination studies

- Based on land use movement:
  - Parking studies
  - Accident studies



Source: https://safety.fhwa.dot.gov/speedmgt/ref_mats/ePrimer_modules/module3.cfm

2.
Traffic Volume Study

Volume, demand and capacity..

"volume is what ***is***, demand is what motorists would like ***to be***, and capacity is the physical limit of ***what is possible***. "

- If traffic distributed itself uniformly amongst the 365 X 24 = 8,760 hours of the year, there is not a location in the nation that would experience congestion or significant delay.
- The problem for traffic engineers is that there are **strong peaks during a typical day**, fueled primarily by commuters going to and from work.
- Depending upon the specific region and location, the peak hour of the day typically contains from 10 to 15% of the 24-hour volume.

Volume, demand and capacity..

if vehicles were counted at any defined location for one hour:

- **Volume** would be the **number of vehicles counted passing the study location in the hour.**

- Demand would be the **volume plus the vehicles of motorists wishing to pass the site during the study hour** who were prevented from doing so by congestion.

- Capacity would be the **maximum volume that could be accommodated** by the highway at the study location.

Volume parameters

1. ***Volume*** is the number of vehicles (or persons) passing a point during a specified time period, which is usually one hour.

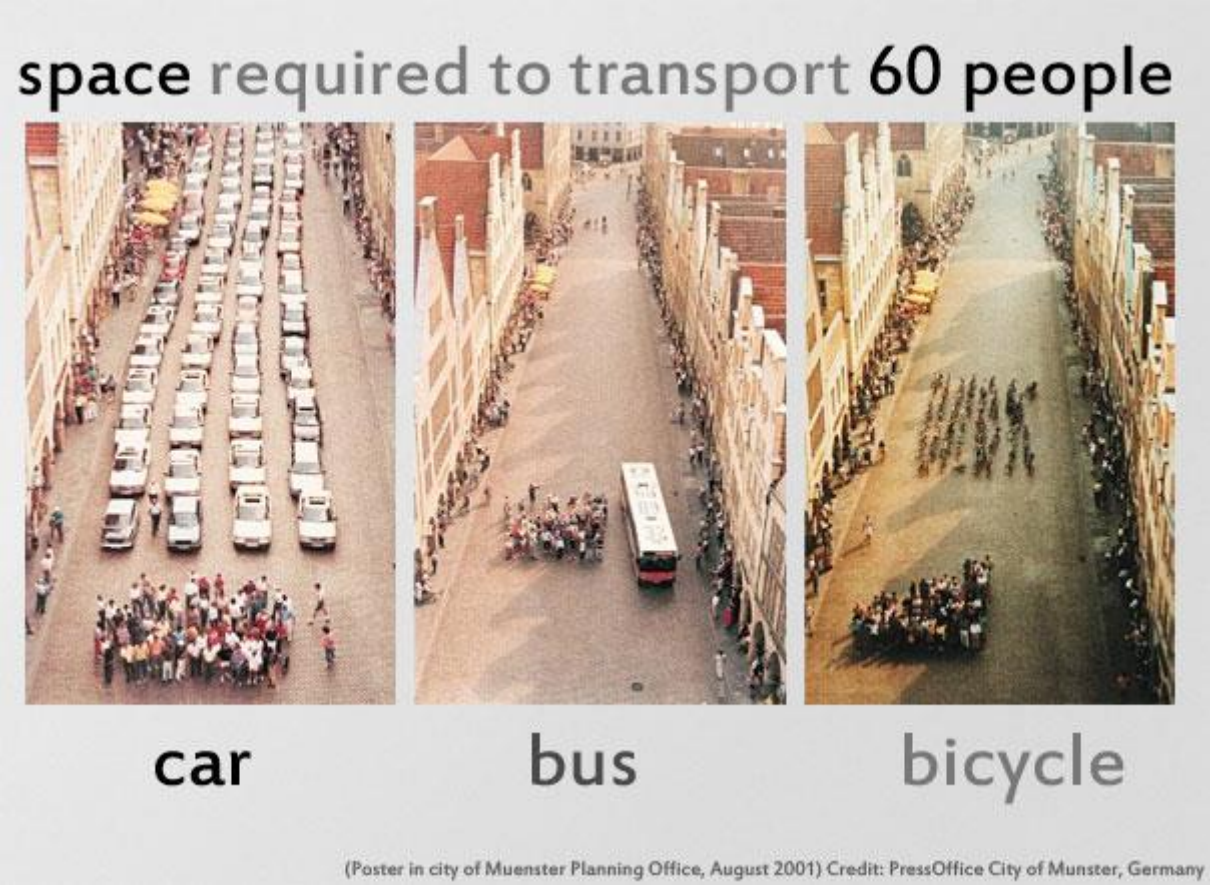
2. ***Rate of flow*** is the rate at which vehicles (or persons) pass a point during a specified time period less than one hour, expressed as an equivalent hourly rate.

3. ***Demand*** is the number of vehicles (or persons) that desire to travel past a point during a specified period (also usually one hour). Demand is frequently higher than actual volumes where congestion exists.

Volume parameters

4. ***Capacity*** is the maximum rate at which vehicles can traverse a point or short segment during a specified time period. It is a characteristic of the roadway. Actual volume can never be observed at levels higher than the true capacity of the section.

Traffic volume

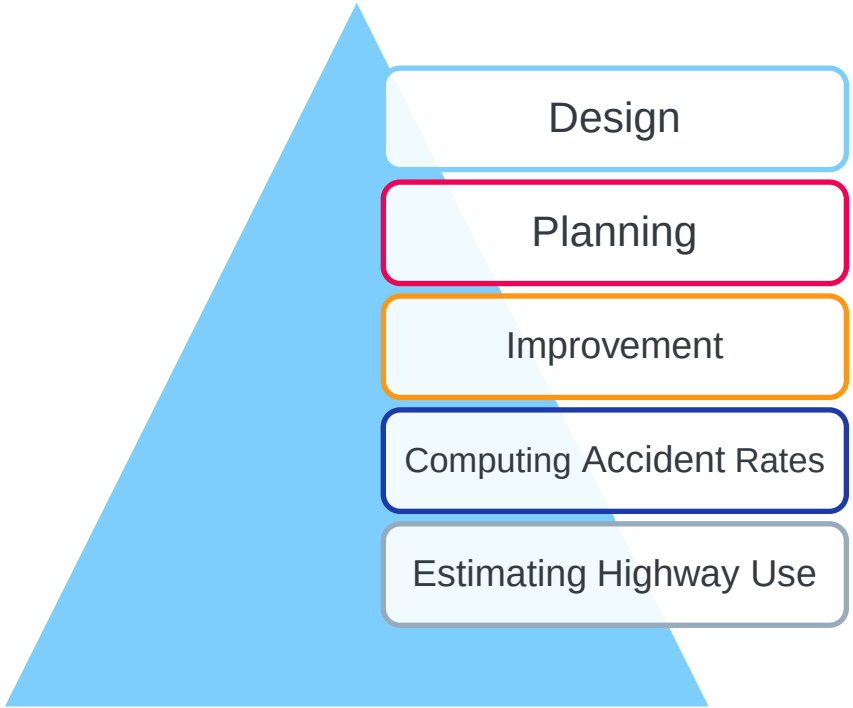


Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period.

Useful to establish:

- Importance of any route
- Fluctuations in flow
- Distribution of traffic in road system
- Capacity requirements and geometric design of roads and terminals
- Structural Design

Scope of traffic volume studies



Passenger Car Unit- PCU

- To describe the entire traffic flow on a highway per unit time, the flow of various vehicle classes must be converted into a single standard vehicle type

- Passenger Car Unit is a vehicle unit or car unit used to measure the rate of traffic flow on highway.

- PCU is a measure of number of vehicles moving on a highway at a given point of time.

- In some instances, PCU is referred to as Passenger Car Equivalent (PCE).

Passenger Car Unit- PCU

Sl. No.	Vehicle Class	Equivalency Factor	
		Percentage composition of vehicle type in traffic stream	
Fast Vehicles		**5%**	**10% & Above**
1	Two wheelers - motor cycle, scooter, etc.	0.5	0.8
2	Passenger car, Pick-up van	1.0	1.0
3	Auto-rickshaw	1.2	2.0
4	Light Commercial vehicle	1.4	2.0
5	Truck or Bus	2.2	3.7
6	Agricultural Tractor - trailor	4.0	5.0
Slow Vehicles			
7	Pedal cycle	0.4	0.5
8	Cycle rickshaw	1.5	2.0
9	Tonga (Horse drawn vehicle)	1.5	2.0
10	Hand cart	2.0	3.0

PCU Values recommended by the IRC 106: 1990 for different types of vehicles on roads in urban areas

Passenger Car Unit (PCU)

Type of Vehicle	PCU
Car, taxi, pick up	1
Cycle, motor cycle	0.5
Bus, truck	3
Horse drawn cart	4
Bullock cart	6
Bullock cart (large)	8

Method of traffic volume studies

- Manual count-
- Mechanical count-

Pressure sensitive detectors (Pneumatic tube)
Electronic detectors,

Method of traffic volume studies

ROADS AND HIGHWAYS DEPARTMENT **TRAFFIC COUNT TALLY SHEET** Sheet : ..... of .....

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

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

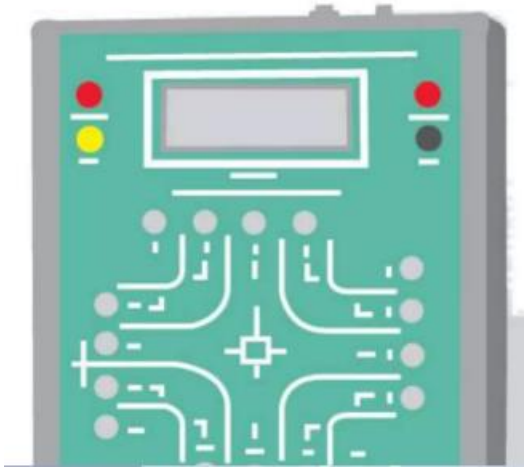
Enumerator : ..... Supervisor : .....

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

Pneumatic Tubes

Method of traffic volume studies

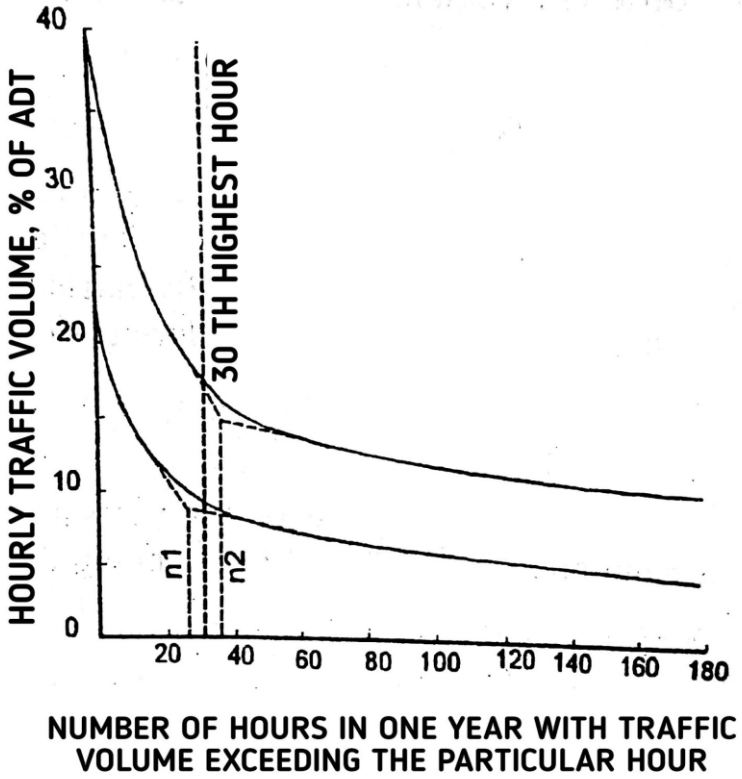
- Portable recorders-
- Moving car observer method-



Presentation of Traffic Volume data

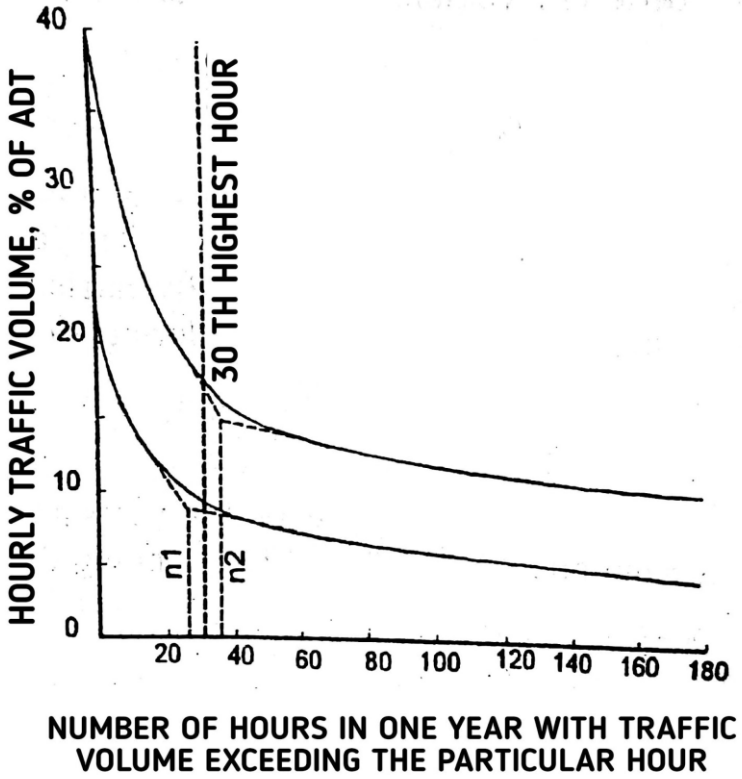
- **Annual Average Daily Traffic (AADT):** The average 24-hour traffic volume at a given location over a full 365-day year.

- **Average Daily Traffic (ADT):** An average 24-hour traffic volume at a given location for some period of time less than a year. It may be measured for six months, a season, a month, a week, or as little as two days. An ADT is a valid number only for the period over which it was measured



Thirtieth (30^{th}) highest hourly volume or the design hourly volume is found from the plot between hourly volume and the number of hours in a year that the traffic volume is exceeded.

The 30^{th} highest hourly volume is the hourly volume that is exceeded only 29 times in a year and all other hourly volumes will be less than this value.



The highway facilities designed with capacity for 30 highest hourly traffic value is assumed year is found to be *satisfactory from the consideration of facility as well as the cost.*

This is because the cost will be much leaser when compared to the peak hourly volume and there will be *congestion only during 29 hours in the year* and this is considered *reasonable*

Peak Hour Factor

Peak Hour

The Peak Hour Factor (PHF) **compares the traffic volume during the busiest 15-minutes of the peak hour with the total volume during the peak hour**.

It indicates how consistent traffic volume is during the peak hour.

Problem 1

- The table shows the volumetric data observed at an intersection. Calculate the

1. peak hour volume
2. peak hour factor (PHF), and the
3. actual (design) flow rate for this approach

Time interval	Cars
4:00 - 4:15	30
4:15 - 4:30	26
4:30 - 4:45	35
4:45 - 5:00	40
5:00 - 5:15	49
5:15 - 5:30	55
5:30 - 5:45	65
5:45 - 6:00	50
6:00 - 6:15	39
6:15 - 6:30	30

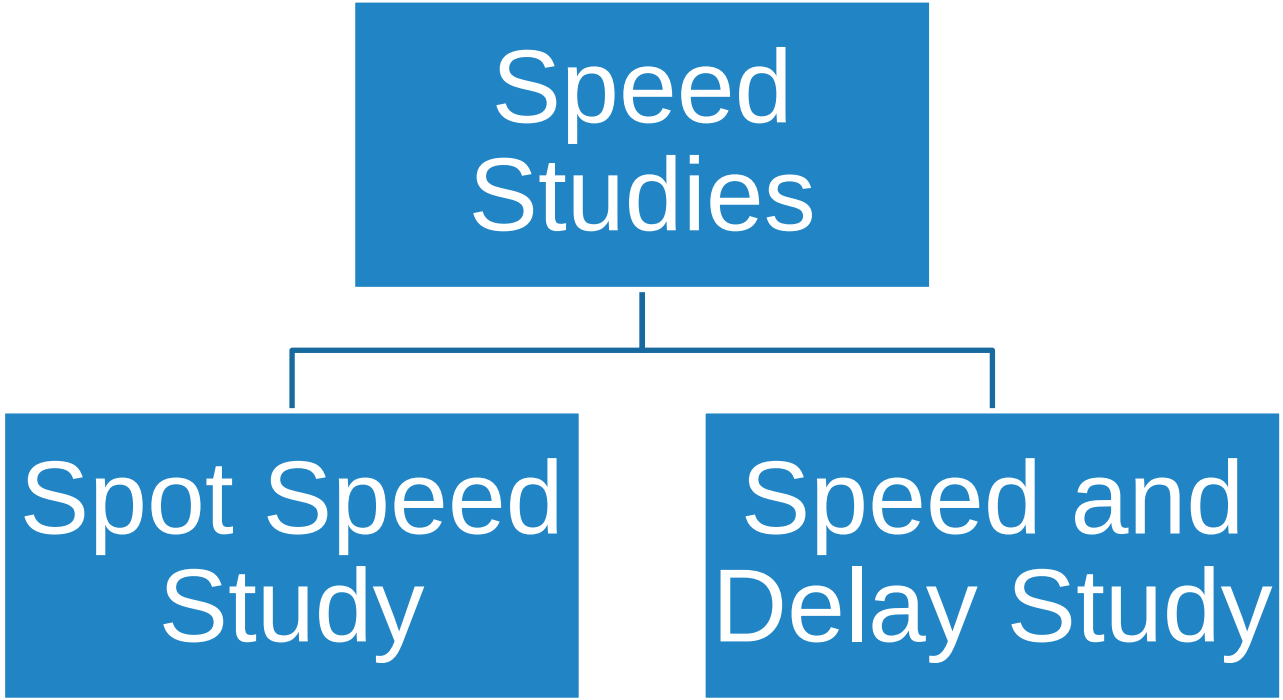
Solution

- We can locate the hour with the highest volume and the 15 minute interval with the highest volume. The peak hour is shown in red with the peak 15 minute period shown in bold font.
- The peak hour volume is just the sum of the volumes of the four 15 minute intervals within the peak hour (219). The peak 15 minute volume is 65 in this case.
- The peak hour factor (PHF) is found by dividing the peak hour volume by four times the peak 15 minute volume. PHF = 219/(4×65) = 0.84.
- The actual (design) flow rate can be calculated by dividing the peak hour volume by the PHF, 219/0.84 = 260 vehicles/hr, or by multiplying the peak 15 minute volume by four, 4 × 65 = 260 vehicles per hour.

3.
Speed Studies

As speed defines the distance travelled by user in a given time. In other words speed of movement is the *ratio of distance travelled to time of travel*. The actual speed of traffic flow over a given route may fluctuated widely, as because at each time the volume of traffic varies. Accordingly, speeds are generally classified into three main categories:

1. **Spot speed** Instantaneous speed of a vehicle at any specific location.
2. **Running speed** Average speed maintained over a particular course.
3. **Journey speed** This is the effective speed of the vehicle on a journey between two points. The distance between two points divided by the total time taken for the vehicle to complete the journey, it includes all delay.


Speed Studies
Spot Speed Study
Speed and Delay Study

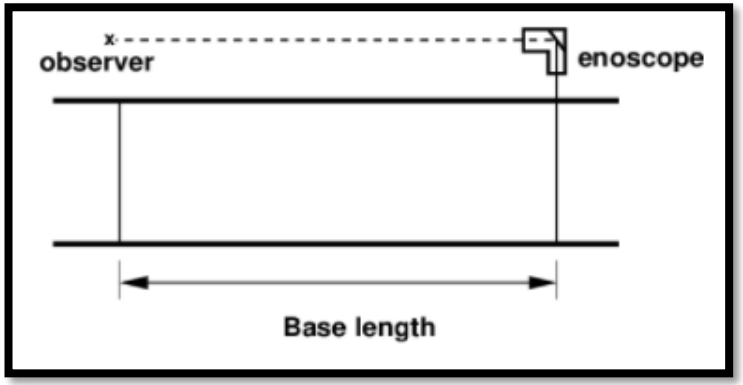
3.1
Spot Speed Study

Spot Speed Study:

- to use in planning traffic control
- to use in geometric design
- to use in accident studies
- to study the traffic capacity
- to decide the speed trends
- to compare the diverse types of drivers and vehicles under specified conditions.

Methods of measuring spot speed:

- Pavement markings
- Enoscope or mirror box
- Road detector (Pressure strips)
- Radar Speedometer
- Photography

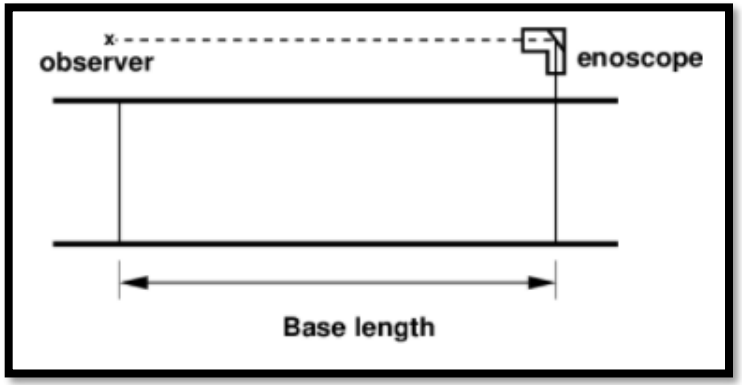


Source: https://www.gta5-mods.com/scripts/speed-radar

Methods of measuring spot speed:

➢ Enoscope or mirror box

- Enoscope consists of a simple open housing containing a mirror mounted on a tripod at the side of the road in such a way that an observer's line of sight turned through 90 degrees.
- The observer stands at one end of section and on the other end enoscope is placed and measure the time taken by the vehicle to cross the section



Source: https://www.gta5-mods.com/scripts/speed-radar

Methods of measuring spot speed:

- **Pressure Strips**

- Pressure contact strips, either pneumatic or electric, can be used to avoid error due to parallax and due to manually starting and stopping the chronometer or stopwatch.
- This is the best method over short distance it gives quite relevant data and if it is connected through graphical recorder then it gives continuous data automatically

Methods of measuring spot speed:

- **Doppler-Principle Meters (Radar)**

- automatically records speed, employs a radar transmitter-receiver unit. The apparatus transmits high frequency electromagnetic waves in a narrow beam towards the moving vehicle, and reflected waves changed their length depending up on the vehicles speed and returned to the receiving unit, through calibration gives directly spot speed of the vehicle.

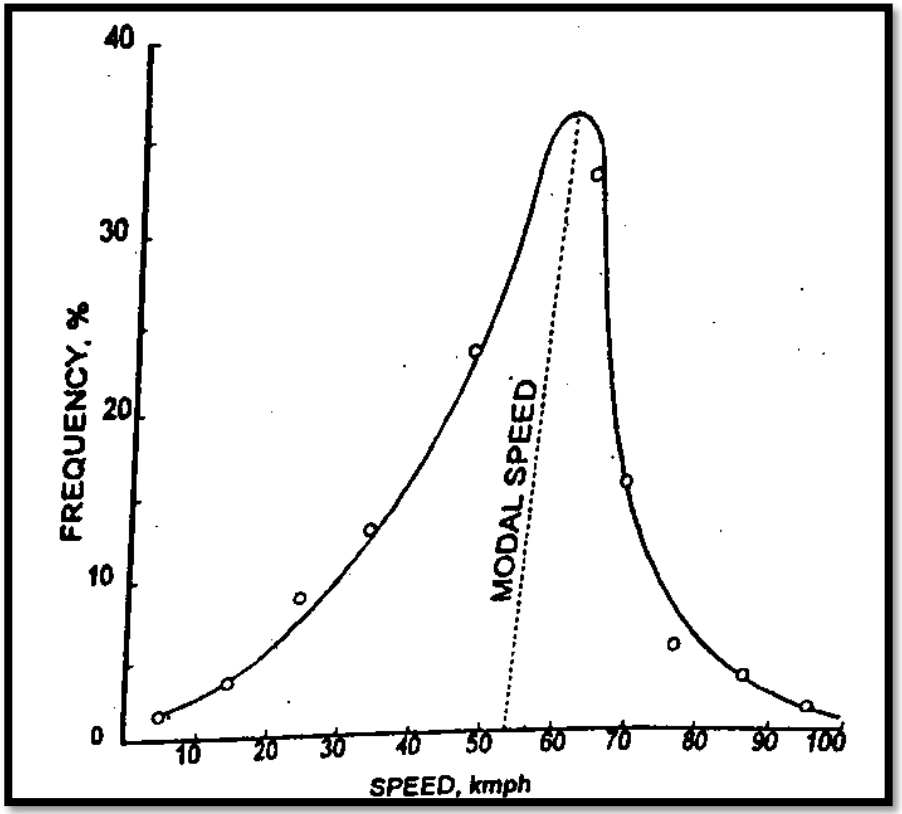
Presentation of spot speed data:

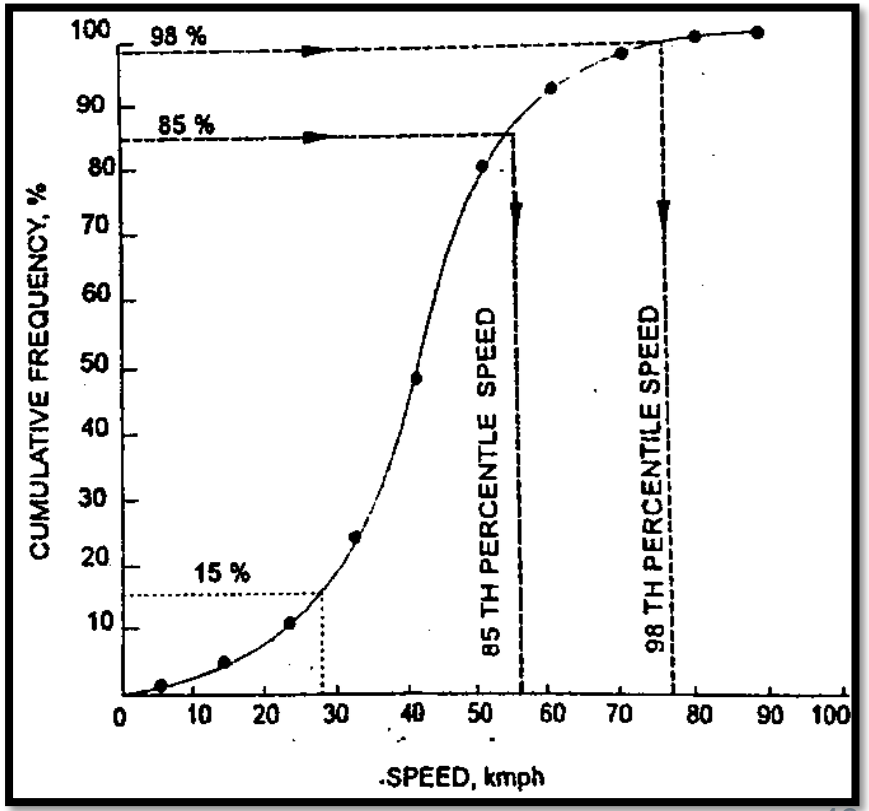
- **Average Spot Speed: -** From the spot speed data of selected samples, frequency distribution table is prepared by arranging speed groups (such as 10-20 kMph, 20-30, 30-40…etc.) and number of vehicles in each speed range. The arithmetic mean of the measured speeds is taken as the 'Average Spot Speed' of all the vehicles in the stream.

- **Frequency Distribution Diagram:** A graph is plotted with the average value of each speed group on X-axis and percentage of vehicles on Y-axis.

- The peak value of travel speed is denoted by **'Modal Speed'.**

Presentation of spot speed data:





Presentation of spot speed data:

Upper speed limit for regulation – 85th percentile speed

Lower speed limit for regulation – 15th percentile speed

Speed to check geometric design elements – 98th percentile speed

Presentation of spot speed data:

Determine the most preferred speed from the data below

Speed Range (kmph)	No of speed observations	Speed Range (kmph)	No of speed observations
0-10	0	50-60	216
10-20	11	60-70	68
20-30	30	70-80	24
30-40	105	80-90	0
40-50	233		

Speed Range (kmph)	Mean Speed (kmph)	Frequency, f	Percent Frequency
0-10	5	0	0.0
10-20	15	11	1.6
20-30	25	30	4.4
30-40	35	105	15.3
40-50	45	233	33.9
50-60	55	216	31.4
60-70	65	68	9.9
70-80	75	24	3.5
80-90	85	0	0.0
TOTAL		**687**	**100.0**

- Plot frequency distribution curve , using mean speed on X axis and percent frequency on Y axis.

- Most preferred speed at which maximum proportion of vehicles travel is the modal speed corresponding to peak value of frequency which is obtained from the plotted graph.

- Answer- 45 kmph

spot speed data: Example

Consolidated data of spot speed studies on a stretch are given below. Determine the upper and lower limits of speed for installing traffic signs. Also find the design speed for checking geometric design elements of the highway.

Speed Range (kmph)	No of speed observations	Speed Range (kmph)	No of speed observations
0-10	12	50-60	255
10-20	18	60-70	119
20-30	68	70-80	43
30-40	89	80-90	33
40-50	204	90-100	9

Speed Range (kmph)	Mean Speed (kmph)	Frequency, f	Percent Frequency	Cumulative frequency, %
0-10	5	12		
10-20	15	18		
20-30	25	68		
30-40	35	89		
40-50	45	204		
50-60	55	255		
60-70	65	119		
70-80	75	43		
80-90	85	33		
90-100	95	9		
TOTAL		**850**	**100.0**	

Speed Range (kmph)	Mean Speed (kmph)	Frequency, f	Percent Frequency	Cumulative frequency, %
0-10	5	12	1.41	1.41
10-20	15	18	2.12	3.53
20-30	25	68	8.00	11.53
30-40	35	89	10.47	22.00
40-50	45	204	24	46.00
50-60	55	255	30	76.00
60-70	65	119	14	90.00
70-80	75	43	5.06	95.06
80-90	85	33	3.88	98.94
90-100	95	9	1.06	100.00
TOTAL		**850**	**100.0**	

Desired speed values

1	upper limit for speed regulation	=85th percentile speed =60 kmph
2	lower limit for speed regulation	=15th percentile speed = 30 kmph
3	Speed to check geometric design elements	= 98th percentile speed = 84 kmph

3.2
Speed & Delay Study

What is speed & delay study?

- A speed and delay study determines the average time required and amount of delay caused on a given route.
- **Delay is the extra time spent by drivers against their expectation**.
- Data obtained from speed and delay studies give a good indication of the *level of service* on the study section.
- These data aids the traffic engineer in identifying locations like presence of intersections, which may require special attention in order to improve the overall flow of traffic on the route.

Methods of speed & delay study:

- Floating Car or Riding Check Method
- Liscence Plate or Vehicle Number Method
- Interview Technique
- Elevated Observations
- Photographic Technique

Floating Car or Riding Check Method

1. Test vehicle is driven over a given route of travel at approximately the average speed of the stream.
2. A group of observers are seated in the test vehicle to record various observations during the test run.
3. One observer with two stop watches is seated, one stop watch is used to record the time of arrival of test car at various control points such as intersections, bridges etc.
4. The other stop watch is used to determine the duration of individual delays
5. Another observer notes the time, location and cause of delay.
6. No of vehicles overtaking and being overtaken are noted.
7. No of vehicles travelling in opposite direction are also noted.

Floating Car or Riding Check Method

$$t = t_w - n_y/q$$

$$q = (n_a + n_y)/(t_a + t_w)$$

t = average journey time (min)

q = flow of vehicles (volume per min) in one direction

t_w =Average journey time when test vehicle is travelling with the stream

n_y = Average no of vehicles overtaking the test vehicle minus the overtaken vehicles when test vehicle travels in the direction of stream

n_a = Average number of vehicles counted in the direction of stream when test vehicle travels in opposite direction of stream

t_a = Average journey time when test vehicle is travelling against the stream

Q. The consolidated data from speed and delay studies by floating car method on a stretch of urban road of length 3.5 km running North-South are given below. Determine the average values of

(i) Volume

(ii) Journey Speed

(iii) Running speed

Of the traffic along each direction.

Trip No	Direction of Trip	Journey Time Min-Sec	Total Stopped delay, Min- sec	No. of vehicles overtaking	No of vehicles overtaken	No of vehicles from opposite direction
1	N-S	6-32	1-40	4	7	286
2	S-N	7-14	1-50	5	3	186
3	N-S	6-50	1-30	5	3	280
4	S-N	7-40	2-00	2	1	200
5	N-S	6-10	1-10	3	5	250
6	S-N	8-00	2-22	2	2	170
7	N-S	6-28	1-40	2	5	290
8	S-N	7-30	1-40	3	2	160

Direction	Journey Time Min-Sec	Stopped delay, Min- sec	No. of vehicles overtaking	No of vehicles overtaken	No of vehicles from opposite direction
N-S	6-32	1-40	4	7	286
	6-50	1-30	5	3	280
	6-10	1-10	3	5	250
	6-28	1-40	2	5	290
Total	26-00	6-00	14	20	1106
Mean	**6-30**	**1-30**	**3.5**	**5.0**	**276.5**

Direction	Journey Time Min-Sec	Stopped delay, Min- sec	No.of vehicles overtaking	No of vehicles overtaken	No of vehicles from opposite direction
S-N	7-14	1-50	5	3	186
	7-40	2-00	2	1	200
	8-00	2-22	2	2	170
	7-30	1-40	3	2	160
Total	30-24	7-52	12	8	716
Mean	**7-36**	**1-58**	**3.0**	**2.0**	**179**

a. **For North South Direction**

Ny = average no of vehicles overtaking minus overtaken

= 3.5- 5.0 = -1.5

Na = Average no of vehicles during trips in opposite direction (for S-N direction)

= 179

Tw= average journey time with the stream

= 6 min 30 sec = 6.5 min

Ta = average journey time during trips against the stream

= 7 min 36 sec =7.6 min

a. For North South Direction

Average volume , **q= (na + ny)/(ta+tw)**

= 12.59 veh/min

Average Journey time, t = tw-(ny/q)

= 6.5 – [(-1.5)/12.59]

= 6.62 min

Average journey speed = 3.5/6.62 km/min = 31.7 kmph

Average stopped delay = 1.5 min

Average running time = average journey time – average stopped delay

= 6.62-1.50 = 5.12 min

Average running speed = (3.5 X 60)/ 5.12 = 41 kmph

a. For South North Direction

Ny = average no of vehicles overtaking minus overtaken

= 3-2= 1

Na = Average no of vehicles during trips in opposite direction (for N-S direction)

= 276

Tw= average journey time with the stream

= 7.6 min

Ta = average journey time during trips against the stream

= 6.5 min

a. For South North Direction

Average volume , q= (na + ny)/(ta+tw) = 19.36 veh/min

Average Journey time, t = tw-(ny/q)= 7.55 min

Average journey speed = 27.8 kmph

Average stopped delay = 1.8 min

Average running time = average journey time – average stopped delay

= 7.55-1.80 = 5.75 min

Average running speed = (3.5 X 60)/ 5.75 = 36.5 kmph

SUMMARY

- Traffic surveys are used to collect data which are further used in planning, designing and improvement of transportation infrastructure facilities.
- Traffic volume is the number of vehicles crossing a section of road per unit time. 30^{th} highest hourly volume is used in design purposes.
- Speed studies are categorized into spot speed study and speed & delay study.
- 85^{th} percentile speed is the safe speed limit and 98^{th} percentile speed is used as design speed in highways.

Thanks!

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