# LECTURE 5

# TRAFFIC CHARACTERISTICS

## Traffic Stream Parameters:

Traffic stream parameters represent the engineer's quantitative measure for understanding and describing traffic flow. Three essential macroscopic parameters describe the traffic stream: Speed, volume or rate of flow, and density.

### 1. Speed

The speed of vehicle is defined as the distance it travels per unit of time. It is in the inverse of the time taken by a vehicle to traverse a given distance.

$$Speed\ (\frac{km}{hr}) = \frac{Distance\ (km)}{Time\ (hr)}$$

**Spot speed** is the instantaneous speed of vehicle as it passes a specified point along a street or highway.

**Average travel speed** is a traffic stream measure based on travel time observed on a known length of highway. It is the length of the segment divided by the average travel time of vehicles traversing the segment, including all stopped delay times. It is also a **space mean speed**.

**Space mean speed** is a statistical term denoting an average speed based on the average travel time of vehicles to traverse a segment of roadway.

$$SMS = \frac{nd}{\sum t_i}$$

*n= no. of observed vehicles*

*d= distance traversed*

*ti= time for the ith vehicle to traverse the section.*

**Time mean speed** is the arithmetic average of speeds of vehicles observed passing a point on a highway; also referred to as the average spot speed. The individual speeds of vehicles passing a point are recorded and averaged arithmetically.

$$TMS = \sum \frac{\left(\frac{d}{t_i}\right)}{n}$$

*d= distance traversed*

*ti= time for the ith vehicle to traverse the section.*

*n= no. of observed vehicles*

**Example**: Find TMS and SMS from table below.

| Time (sec) | d (ft) | d/t (ft/sec) |
|---|---|---|
| 5.0 | 500 | 100.0 |
| 5.6 | 500 | 89.3 |
| 5.6 | 500 | 89.3 |
| 4.8 | 500 | 104.2 |
| 6.1 | 500 | 82.0 |
| 5.3 | 500 | 94.3 |
| 5.9 | 500 | 84.7 |
| 5.2 | 500 | 96.2 |
| 4.5 | 500 | 111.1 |
| 5.0 | 500 | 100.0 |
| | | Total =951.1 |
| | | n= 10 |

**Solution:**

TMS=951.1/10=95.1 (ft/sec)

SMS= (10x500) / (5.0+5.6+5.6+4.8+6.1+5.3+5.9+5.2+4.5+5.0) = 94.3 ft/sec

Space mean speed is always less than time mean speed. Based on the statistical analysis of observed data, this relationship is useful because time mean speeds often are easier to measure in the field than space mean speeds.

## Types of Speed:

**Travel (Journey) speed**: it is the length of highway section divided by the overall travel time (including stopping time).

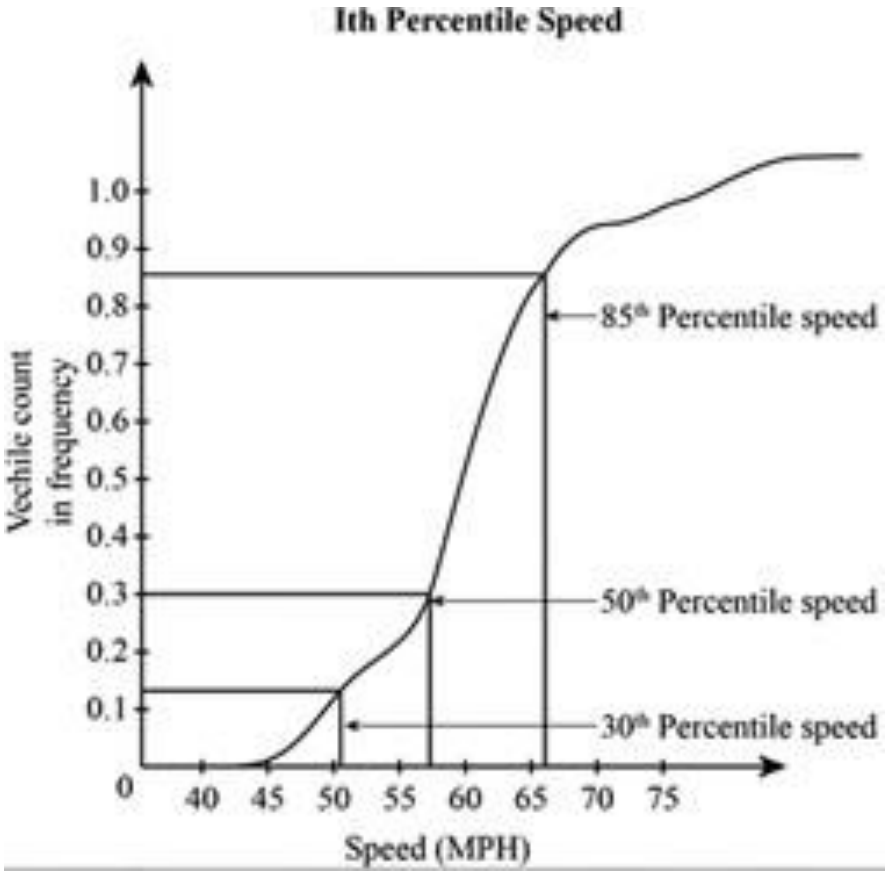
$$Travel\ (journey) speed = \frac{Distance}{Overall\ travel\ time}$$

**Running speed:** it is the length of the highway section divided by running time required for the vehicle to travel through the section.

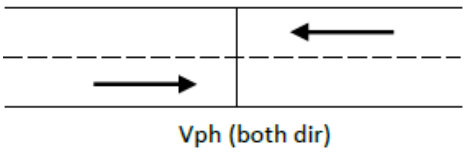
$$Running\ speed = \frac{Distance}{Overall\ travel\ time - Stopping\ time}$$

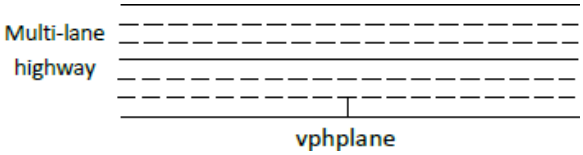
**Design speed:** It is a selected speed used to determine various geometric design features of the road (20 – 130) km/hr.

**Operating speed:** It is the speed at which drivers are observed operating their vehicles during free flow condition (the 85th percentile of the distribution of observed speeds can be used as a measure for operating speed) (56-88 km/hr) in Iraq.



**Volume (vpd, vph):** The total number of vehicles that pass over a given point or section of a lane or roadway during specified time interval (usually one day or one hour).




Traffic Volume can be expressed in several terms such as flow rate, ADT, AADT, AAWT, and DHV

## Flow rate:

Flow rate is the equivalent hourly volume based on time interval less than one hour (15 min).

The traffic variation within the peak hour is called Sub hourly volume

For example a volume of 200 vehicles observed over a 15-minute period may be expressed as a rate of 200*4=800 vehicle/hour.

Actually, the 800 vehicles may not be observed if the full hour were counted.

The 800 vehicle/ hour becomes a rate of flow that exists for a 15-minute interval.

**Example:** the table below shows the volume per 15-minute for two sections of road.

| Time | Flow1 at section1 | Flow2 at section 2 |
|---|---|---|
| 8.00-8.15 | 100 | 400 |
| 8.15-8.30 | 100 | 0 |
| 8.30-8.45 | 100 | 0 |
| 8.45-9.00 | 100 | 0 |
| Volume/hour | 400 | 400 |
| Flow rate (v/h) | (100*4)400 | (400*4)=1600 |

The peak hour factor (PHF)

The peak hour factor is calculated to relate the peak flow rate to hourly volumes as follow:

$PHF = Volume hourly\ flow\ rate\ (4 * V15)\ 0.25 \leq PHF \leq 1$

Where PHF =peak hour factor

V15=volume for peak 15-minute period

The peak hour factor is used to convert a peak hour volume to an estimated peak rate of flow within an hour as below:

v=Peak hourly volume/PHV

v=peak rate of flow within hour (veh/hour)

The maximum possible value of the PHF is 1.0 which occurs when the volume in each interval is constant. In the previous example, section1, the volume per each 15-minute was equal to 100. Then the PHF=400/4(100) = 1.0. This indicates a condition in which there is virtually no variation of flow within the hour.

The minimum values occur when the entire hourly volume occurs in one interval as the flow 2 in section 2 in the previous example. The PHF=400/4(400)=0.25. This indicates the most extreme case of volume variation.

In practical terms, the PHF generally varies between 0.7 in rural roads and 0.98 in dense urban areas.

**Example:** 1000 vehicles counted over 15-minute interval could be expressed as 1000 veh/0.25h=4000veh/h.

The rate of flow of 4000 veh/h is valid for the 15-minute period in which the volume of 1000 vehicles was observed.

The table below illustrates the difference between volumes and flow rate

| *Time interval* | *Volume per time interval (veh)* | *Flow rate for time interval (veh/h)* |
|---|---|---|
| *5:00-5:15 pm* | *1000* | *1000/0.25=4000* |
| *5:15-5:30 pm* | *1100* | *1100/0.25=4400* |
| *5:30-5:45 pm* | *1200* | *1200/0.25=4800* |
| *5:45;6:00 pm* | *900* | *900/0.25=3600* |
| *5:00-6:00 pm* | *4200* | |

**Solution:**

The full hourly volume is the sum of four 15-miumte volume observations = 4200veh/h

The flow rate for each 15-minute interval is the volume observed for the interval divided by the 0.25 hours over which it is observed.

In the worst period of time, 5:30-5:45 pm, the flow rate is 4800 veh/h.

The PHF= 4200/4*1200= 0.875

The peak rate of flow= 4200/0.875=4800 veh/h, which is equal to the flow rate in the worst interval.