

CE 380

Highway and Traffic Engineering

Lec-11

Traffic Variables

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Types of Traffic variables

Main Traffic variables:

1. Traffic flow
2. Traffic Speed
3. Traffic Density

Secondary:

- Distance headway (S) or Time headway
- Clearance or gap

TYPES OF FLOW

Traffic flow is usually classified as either

- a. Uninterrupted Flow
- b. Interrupted Flow

A. UNINTERRUPTED FLOW



- flow occurring at long sections of road where vehicles are not required to stop by any cause external to the traffic stream

B. INTERRUPTED FLOW



-flow occurring at long sections of road where vehicles are required to stop by any cause outside the traffic stream such as traffic signs, traffic signal lights

1. FLOW RATE OR VOLUME

- number of vehicles passing a point during a specified period of time

- may be expressed as:

$$q = \frac{N}{T}$$

where q =flow rate in vehicles/min or vehicles/day

=volume in vehicles/hr

N =no. of vehicles

T =observation period

P.C.E's

- Passengers Car Equivalent units
- Car = 1
- Taxi = 1 or 1.25
- Micro bus or van = 1.5
- Bus = 2 or 2.5
- Truck = 3

EXAMPLE

Suppose a 15 minute count of vehicles bound for Manila was conducted at a particular location on Quezon Avenue. A summary is shown in the table below.

TYPE	15-MINUTE COUNT	EQUIVALENT P.C.E.'S
Car	420	
van	300	
Bus	16	
Truck	28	

The total number of vehicles counted in 15 minutes is Therefore, the flow rate is $q = \dots \times 4 = 3056$ P.C.E.'s per hour.

2. SPEED

-rate of motion in distance per unit time

Time Mean Speed

Space Mean Speed

Time Mean Speed

Also known as *spot speed*, time mean speed is the arithmetic mean of the speeds of vehicles passing a point within a given interval of time and is given by

$$u_i = \frac{3.6\Delta x}{t_i}$$

where
meters

u_i =speed of vehicle i , in kph
 Δx =trap length, in

t_i =time It takes to traverse trap length, in seconds

$$u_t = \frac{1}{n} \sum_{i=1}^n u_i$$

where

u_t =individual speed of vehicles observed within time, T

n =no. of measured vehicles

EXAMPLE

The speeds of 25 cars were observed. 10 cars were noted to travel at 35kph, 8 cars at 40 kph, 2 cars at 50kph, and 5 cars at 45kph. Assuming that each car was traveling at constant speed, determine the time mean speed.

Using $u_t = \frac{1}{n} \sum_{i=1}^n u_i$,

$$u_t = \frac{(10 \times 35) + (8 \times 40) + (2 \times 50) + (5 \times 45)}{25} = 39.8 \text{ kph}$$

Space Mean Speed

Space mean speed is defined as the harmonic mean of speeds passing a point during a period of time

$$u_s = \left(\frac{nL}{\sum t_i} \right)$$

or

$$u_s = \left(\frac{n}{\sum \frac{1}{u_i}} \right)$$

EXAMPLE

The speeds of 25 cars were observed. 10 cars were noted to travel at 35kph, 8 cars at 40 kph, 2 cars at 50kph, and 5 cars at 45kph. Assuming that each car was traveling at constant speed, determine the space mean speed.

Density

-number of vehicles in a given length of road at an instant point in time

$$k = \frac{n}{l}$$

where

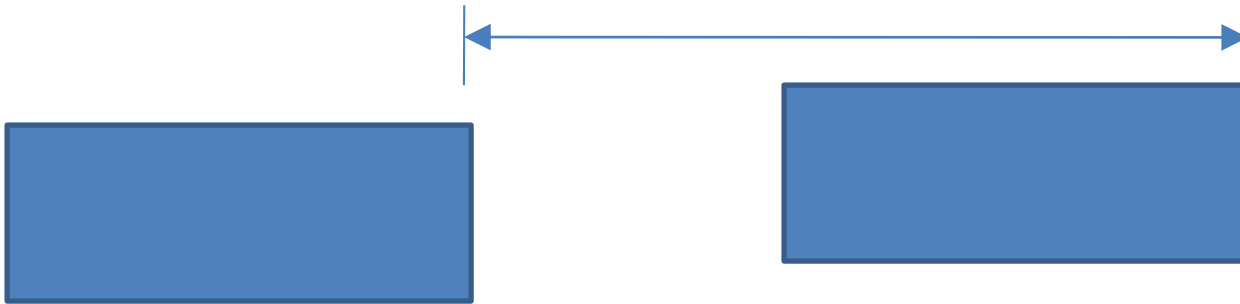
k = traffic density in vehicles per unit distance,

n = number of vehicles occupying some length of roadway at some specified time, and

l = length of roadway.

TIME HEADWAY

Time interval between passage of consecutive vehicles at a specified point on the road



The average time headway and flow rate are related as follows

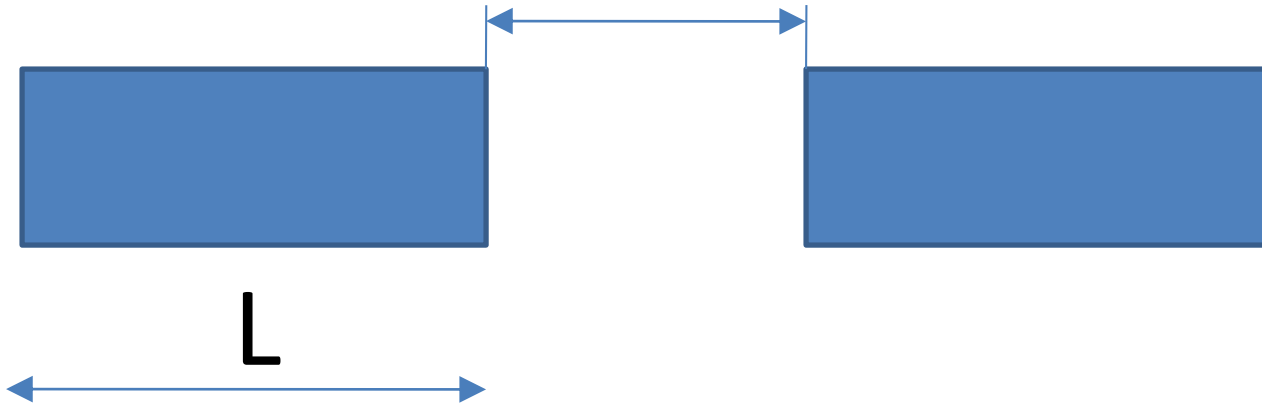
$$h_t = \frac{1}{q}$$

DISTANCE HEADWAY SPACING

Distance between two vehicles measured from the front bumper of the vehicle to that of another and is computed as the inverse of density

$$s = \frac{1}{k}$$

GAP OR CLEARANCE



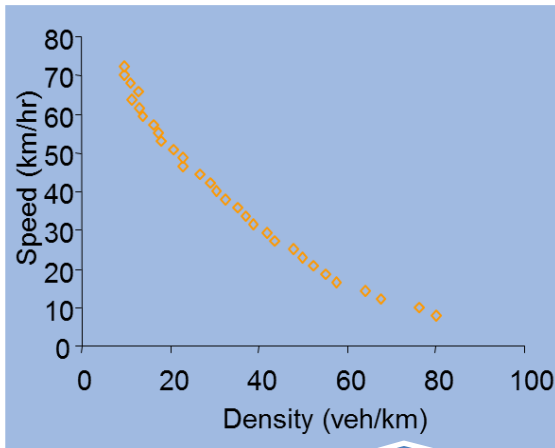
Traffic Variables Relationships

RELATIONSHIP OF FLOW, SPEED AND DENSITY

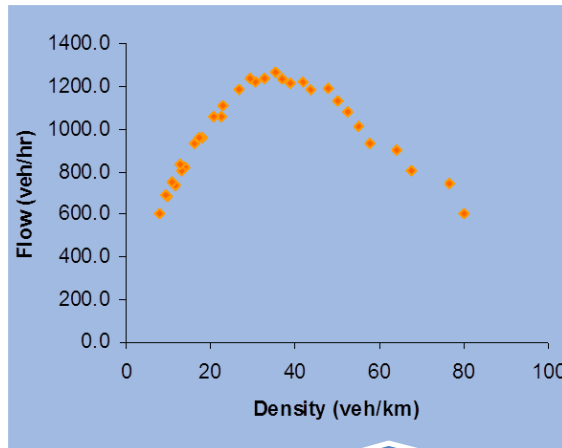
A relationship exists among the three most important traffic variables: flow rate, space mean speed and density.

- a. Observed Relations
- b. Empirical Relations

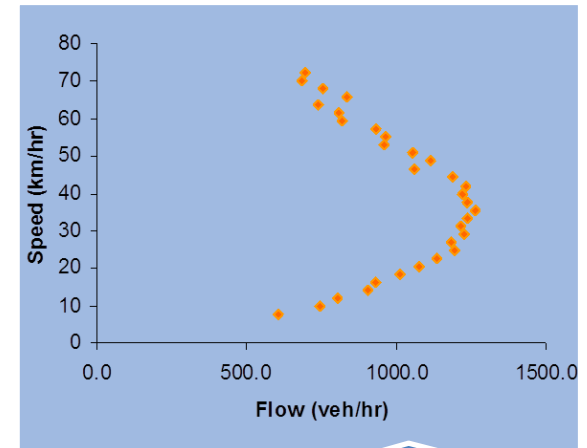
A. OBSERVED RELATIONS



Speed-Density
Relation



Volume-Density
Relation



Speed-Volume
Relation

Master Relationship

$$q = u_s k$$

B. EMPIRICAL RELATIONS

Speed-density relation

Volume-density relation

Volume-speed relation

