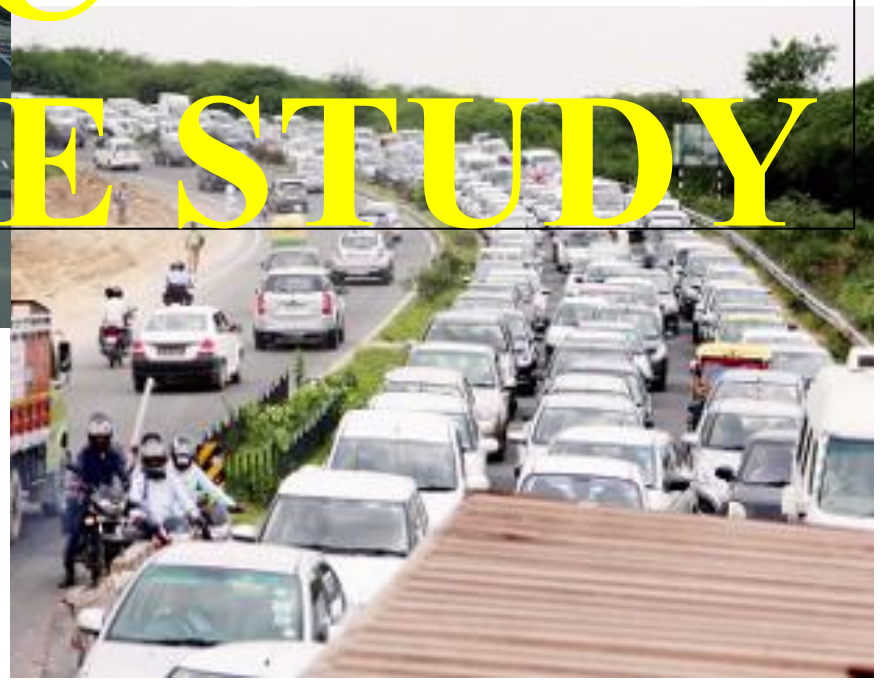


TRAFFIC VOLUME STUDY



Lecture Outline

1. Important Definition
2. Requirement of Traffic Volume Data
3. Scope
4. Objectives of Traffic Volume Study
5. Types of Flow/Volume Count
6. Methods of Volume Count
7. Traffic Stream Parameters
8. Factors Affecting Traffic Volume
9. Presentation of Traffic Data
10. Types of Traffic Count
11. Expansion Factors (Math)

REF

References

Institute of Traffic Engineers, "Transportation and Traffic Engineering Handbook", Second Edition.

O'Flaherty, C.A., "Highways and Traffic", Volume 1, Second Edition, 1983.

Transportation Research Board, "Highway Capacity Manual", Special Report 209, Third Edition, 1994.

Definitions

- **Volume/Flow:** The total number of vehicles that pass over a given point or section of a lane or roadway during a given time interval. Expressed in terms of annual, daily, hourly or sub-hourly periods; usually in **vph** or **vpd**. Volume is an actual number of vehicles observed or predicted to pass a point during a given interval.
- **Rate of Flow:** The equivalent hourly rate at which vehicles pass over a given point or section of a lane or roadway during a given time interval less than 1 hr. usually 15 min. It represents the number of vehicles passing during a time interval less than 1 hr. but expressed as an equivalent hourly rate.

VOLUME AND FLOW RATE

Volume and flow rate are two measures that quantify the amount of traffic passing a point on a lane or roadway during a given time interval. These terms are defined as follows:

- Volume—the total number of vehicles that pass over a given point or section of a lane or roadway during a given time interval; volumes can be expressed in terms of annual, daily, hourly, or subhourly periods.
- Flow rate—the equivalent hourly rate at which vehicles pass over a given point or section of a lane or roadway during a given time interval of less than 1 h, usually 15 min.

Volume and flow are variables that quantify demand, that is, the number of vehicle occupants or drivers (usually expressed as the number of vehicles) who desire to use a given facility during a specific time period. Congestion can influence demand, and observed volumes sometimes reflect capacity constraints rather than true demand.

The distinction between volume and flow rate is important. Volume is the number of vehicles observed or predicted to pass a point during a time interval. Flow rate represents the number of vehicles passing a point during a time interval less than 1 h, but expressed as an equivalent hourly rate. A flow rate is the number of vehicles observed in a subhourly period, divided by the time (in hours) of the observation. For example, a volume of 100 vehicles observed in a 15-min period implies a flow rate of 100 veh/0.25 h or 400 veh/h.

Volume and flow rate can be illustrated by the volumes observed for four consecutive 15-min periods. The four counts are 1,000, 1,200, 1,100, and 1,000. The total volume for the hour is the sum of these counts, or 4,300 veh. The flow rate, however, varies for each 15-min period. During the 15-min period of maximum flow, the flow rate is 1,200 veh/0.25 h, or 4,800 veh/h. Note that 4,800 vehicles do not pass the observation point during the study hour, but they do pass at that rate for 15 min.

Consideration of peak flow rates is important in capacity analysis. If the capacity of the segment of highway studied is 4,500 veh/h, capacity would be exceeded during the peak 15-min period of flow, when vehicles arrive at a rate of 4,800 veh/h, even though volume is less than capacity during the full hour. This is a serious problem, because dissipating a breakdown of capacity can extend congestion for up to several hours.

Peak flow rates and hourly volumes produce the peak-hour factor (PHF), the ratio of total hourly volume to the peak flow rate within the hour, computed by Equation 7-1:

$$PHF = \frac{Hourly\ volume}{Peak\ flow\ rate\ (within\ the\ hour)} \qquad (7\text{-}1)$$

If 15-min periods are used, the PHF may be computed by Equation 7-2:

$$PHF = \frac{V}{4 \times V_{15}} \qquad (7\text{-}2)$$

Highway Capacity

Capacity is the maximum hourly rate at which persons or vehicles can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing conditions.“ – HCM

Factors Affecting HW Capacity

Factor	Description
Roadway Geometry	Lane width, shoulder width, alignment, grades, intersections.
Traffic Composition	Presence of **heavy vehicles, buses**, motorcycles, NMV traffic.
Driver Behavior	Aggressiveness, lane discipline, headway preferences.
Environmental Conditions	Weather (rain, fog), lighting conditions.
Control Measures	Signals, stop signs, toll booth, ramps, merging/diverge operation
Access Points	Number of driveways or intersections causing interference.

II. CAPACITY

The capacity of a facility is the maximum hourly rate at which persons or vehicles reasonably can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions.

Vehicle capacity is the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic, and control conditions. This assumes that there is no influence from downstream traffic operation, such as the backing up of traffic into the analysis point.

Person capacity is the maximum number of persons that can pass a given point during a specified period under prevailing conditions. Person capacity is commonly used to evaluate public transit services, high-occupancy vehicle lanes, and pedestrian facilities.

Prevailing roadway, traffic, and control conditions define capacity; these conditions should be reasonably uniform for any section of facility analyzed. Any change in the prevailing conditions changes the capacity of the facility.

Capacity analysis examines segments or points (such as signalized intersections) of a facility under uniform traffic, roadway, and control conditions. These conditions determine capacity; therefore, segments with different prevailing conditions will have different capacities.

Reasonable expectancy is the basis for defining capacity. That is, the stated capacity for a given facility is a flow rate that can be achieved repeatedly for peak periods of sufficient demand. Stated capacity values can be achieved on facilities with similar characteristics throughout North America. Capacity is not the absolute maximum flow rate observed on such a facility. Driver characteristics vary from region to region, and the absolute maximum flow rate can vary from day to day and from location to location.

Persons per hour, passenger cars per hour, and vehicles per hour are measures that can define capacity, depending on the type of facility and type of analysis. The concept of person flow is important in making strategic decisions about transportation modes in heavily traveled corridors and in defining the role of transit and high-occupancy vehicle priority treatments. Person capacity and person flow weigh each type of vehicle in the traffic stream by the number of occupants it carries.

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The capacity of an urban street is defined for a single direction of travel as the capacity of the through movement at its lowest point (usually at a signalized intersection). The capacity is determined by the number of lanes, the saturation flow rate per lane (influenced by geometric design and demand factors), and the green time per cycle for the through movement at the intersection.

LOS

There are 6 levels of service:

(A) Free Flow Traffic. Indl users practically unaffected by the presence of other veh on rd sec

(B) Steady Traffic. The presence of other vehicles on the section begins to affect the behaviour of individual drivers.

(C) Steady Traffic but Limited. The presence of other vehicles affects drivers. The choice of the speed is affected.

(D) Steady Traffic at High Density. The speed and the manoeuvrability are severely reduced. Low level of comfort for the driver

(E) Traffic at Saturation. Low but uniform speed. Manoeuvrability is possible only under constraint for another vehicle.

(F) Congestion. Unstable speed with the formation of waiting lines at several points. At this level the **volume to capacity ratio exceeds 1**, implying that the road segment is used above design capacity

LOS Urban street LOS is based on average through-vehicle travel speed for the segment or for the entire street under consideration. Travel speed is the basic service measure for urban streets.

EXHIBIT 15-2. URBAN STREET LOS BY CLASS

Urban Street Class	I	II	III	IV
Range of free-flow speeds (FFS)	90 to 70 km/h	70 to 55 km/h	55 to 50 km/h	55 to 40 km/h
Typical FFS	80 km/h	65 km/h	55 km/h	45 km/h
LOS	Average Travel Speed (km/h)			
A	> 72	> 59	> 50	> 41
B	> 56–72	> 46–59	> 39–50	> 32–41
C	> 40–56	> 33–46	> 28–39	> 23–32
D	> 32–40	> 26–33	> 22–28	> 18–23
E	> 26–32	> 21–26	> 17–22	> 14–18
F	≤ 26	≤ 21	≤ 17	≤ 14

Definitions

- **Average Daily Traffic (ADT):** The volume during a given time period (in the whole days greater than one day but less than one year) divided by the number of days in that time period and expressed in terms **veh/day** or **vpd.**

- **Average Annual Daily Traffic (AADT):** It is the total yearly volume divided by the number of days in a year and expressed in terms of **vpd.**

- **Design Hourly Volume:** It is the economic hourly flow of future year, which is used for designing geometric features of roadway. It is chosen in such a way that during the design period it should not be exceeded too often or too much.

Traffic Volume Studies

Volume data are needed:

- In research, planning, designing and regulation phases of traffic engineering.
- In establishing priorities and schedules of traffic improvements.
- The traffic engineer must acquire general knowledge of traffic volume characteristics in order to measure and understand the magnitude, composition and time and route distributions of volume for each area under his jurisdiction.

Scope of Traffic Volume Studies

The traffic **volume count study** is carried out to get **following useful information** –

- Magnitudes, classifications and the time & directional split of vehicular flows.
- Proportions of vehicle in the traffic stream.
- Hourly, daily, yearly and seasonal variations of vehicle flow.
- Flow fluctuation on different approaches at a junction or different parts of a road network system.

Objectives of Traffic Volume Studies

Design Purposes

- Structural & geometric design of pavements, bridge and other highway facilities.
- Intersection design including minimum turning path, channelization, flaring, traffic control devices (i.e. traffic signs, markings, signals) etc.
- Pedestrian volume study is useful for designing sidewalks, pedestrian crossing etc.

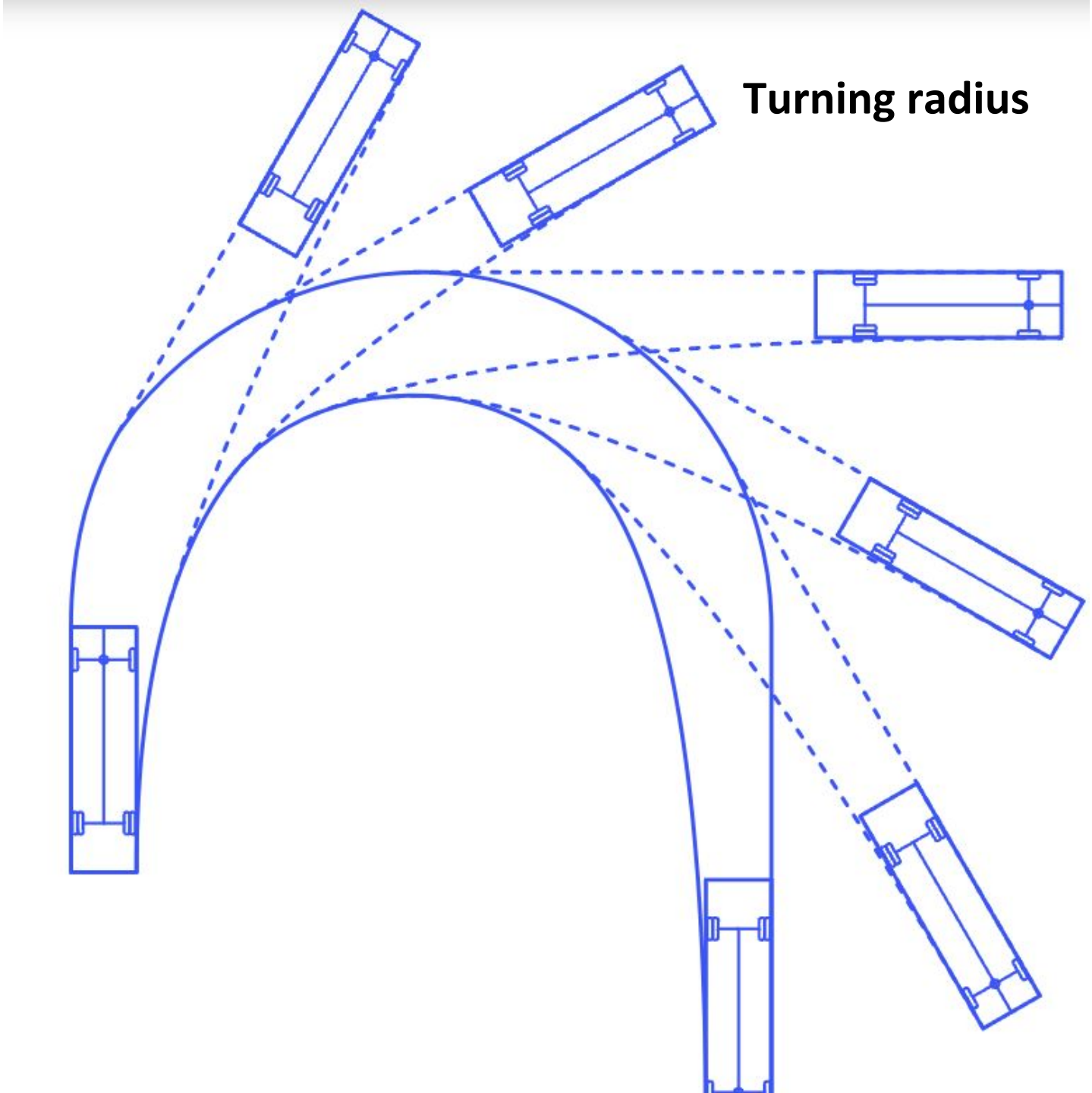
Objectives of volume study







Turning radius



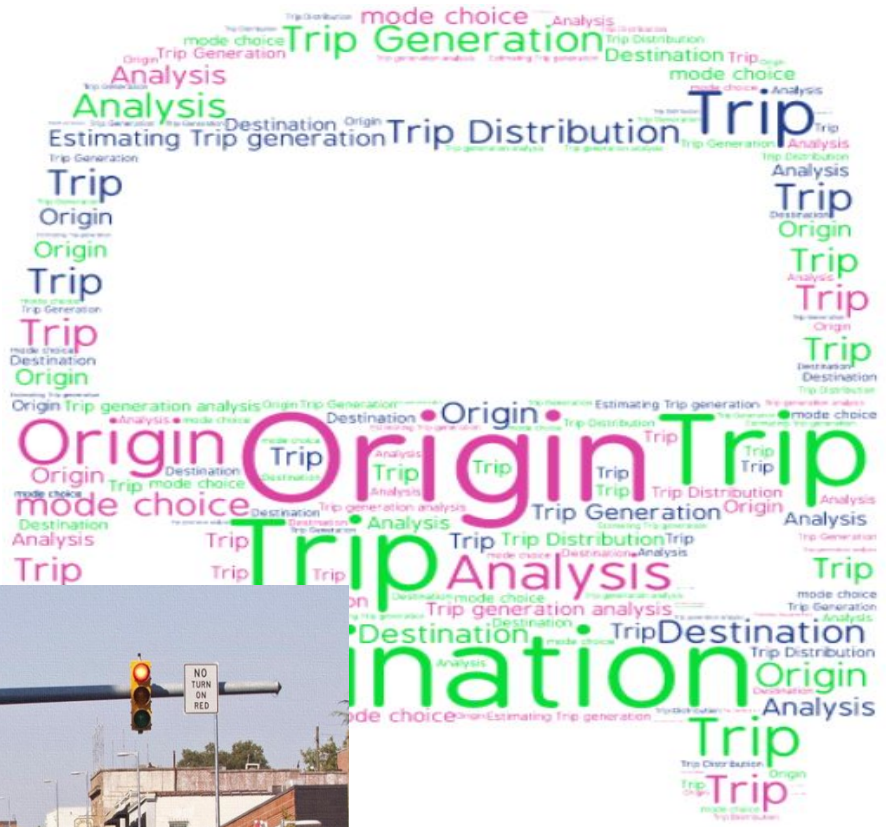
Objectives of Traffic Volume Studies

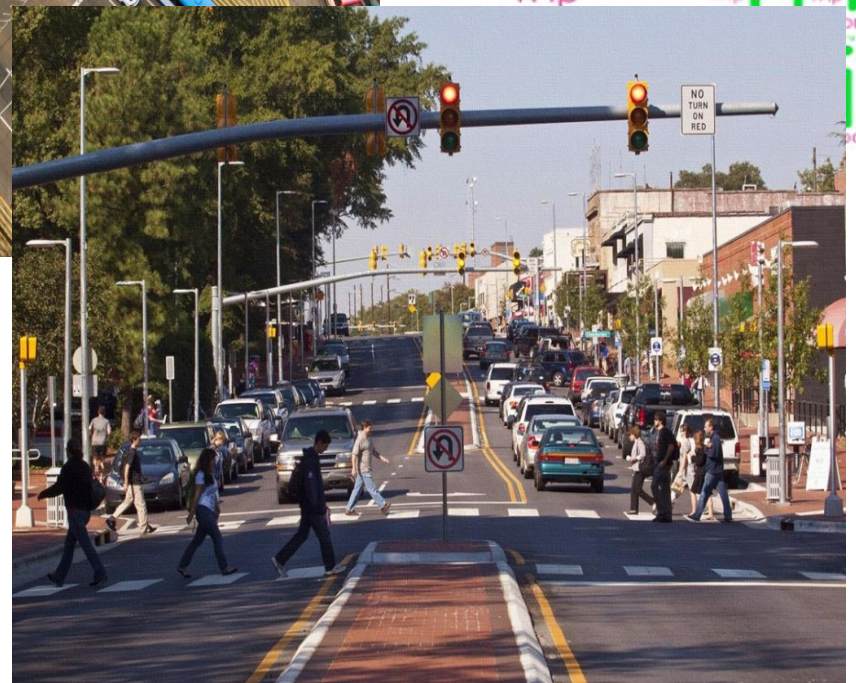
Improvement Purposes

- To allocate limited maintenance budget rationally, it is important to know traffic volume carried by a particular roadway section in order to decide the importance of the road and fixing its relative priority.
- In order to improve the **roadway operating condition** it is important to know the traffic volume –
  - To examine the existing operating/service condition of a roadway section
  - To check the need for traffic control devices
  - To determine the type of improvement measure need to be taken
  - To measure the effectiveness of a traffic control measure.

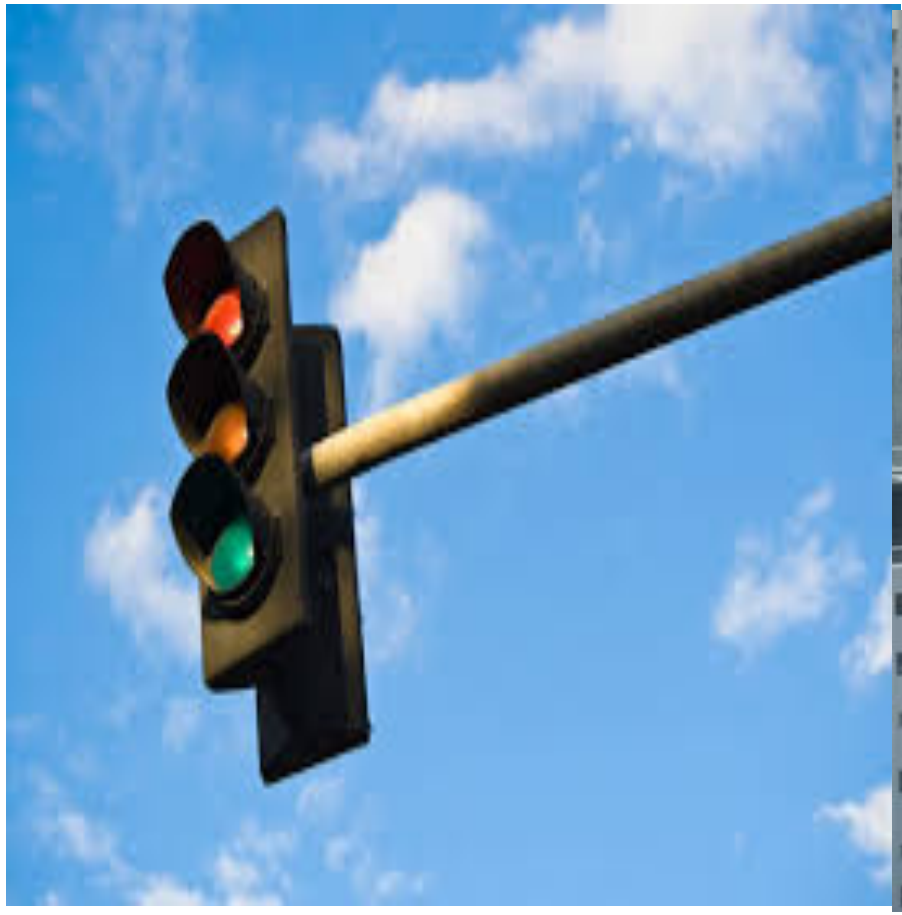
Objectives of volume study







Objectives of volume study





Objectives of Traffic Volume Studies

Planning Purpose

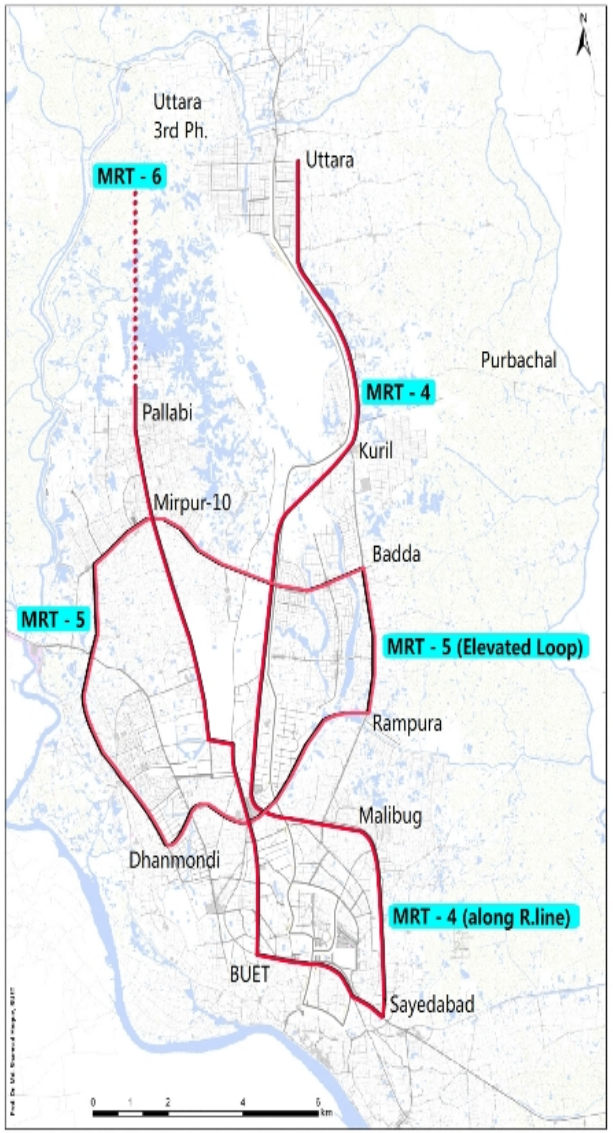
- Accurate information on the amount of traffic on the roads is vital for the planning of both road maintenance and improvement policies.

- Traffic volume network analysis helps in deciding/ planning if there is need for :
  - **Improvement** or
  - Expansion in terms of constructing missing links, by-pass, alternative road etc.

study


STOP
STOP
STOP




Uttara
3rd Ph.
Uttara
MRT - 6
Purbachal
MRT - 4
Pallabi
Kuril
Mirpur-10
Badda
MRT - 5
MRT - 5 (Elevated Loop)
Rampura
Malibug
Dhanmondi
MRT - 4 (along R.line)
BUET
Sayedabad

Objectives of Traffic Volume Studies

Dynamic Traffic Management Purposes

- Up to date and continuous flow/congestion information is essential for optimizing:
  - Traffic signal design and thereby improving junction performance
  - Network productivity by providing information to the road users.

Objectives of Traffic Volume Studies

- Other Purposes
  - Estimation of highway use
  - Measurement of current demand of a facility
  - Estimation of trend
  - Economic feasibility evaluation
  - Computation of accident rates – accidents/100m.

Types of Flow

- Interrupted Flow: Flow at stopped and go situation.
- Uninterrupted Flow: When the flow is smooth
- **Saturation Flow**: The maximum hourly rate of an approach at a signalized junction.
- **Service Flow Rate**: The maximum hourly rate of a roadway section during a given period under prevailing roadway condition.
- Free Flow: When drivers face no restriction in driving and can maintain their desired speed.

Types of Flow/Volume

- Forced Flow: When lane changing opportunity decreases with increasing traffic volume and drivers are forced to follow slow leaders.
- Stable/Steady Flow: When demand is well below the roadway capacity and the average rate of flow remains almost constant with time.
- Unstable Flow: When demand is at or near or exceed the roadway capacity and the average rate of flow fluctuates largely with time.
- Peak Flow: Flow at peak periods.
- Off-peak Flow: Flow at off-peak/lean periods.

Types of Flow/Volume

- **Contra Flow:**
  - For repair works: An arrangement on a large road by which traffic going on both directions uses only one side of the road.
  - For bus priority: An special arrangement on one-way street by which only bus is allowed to go in opposite directions.
- **Tidal Flow:** When traffic flows in both direction exhibit unbalanced characteristics at peak periods viz. morning rush at in-bound lanes due to commuter traffic and in the evening the same is true for the out-bound lanes.
- **Induced Flow:** Flow that is generated because of new or improved roadway facility.

Methods of Counting

- **Manual Counting Method –** Following are the most forms of manual counting methods:
  - **Direct method –** data is collected by using hand tally and manual counters **Indirect method –** data is collected using video camera
- **Automatic Counting Method –** Following are the most common forms of auto counting techniques:
  - **Contact system –** mechanical/magnetic.
  - **Contact-less system –** optical/radar/video imaging

Comparison of Adv & Disadv

Manual Observation- Tally Sheets

-
-

Name: _____ Subject: Year 1 Geography

Date: _____ Unit: 2 Making your area safer

Traffic Going Passed a School Part 1

The children in class 1 watched the traffic going past the school between 10:00 a.m. and 11:00 a.m. Look at their tally chart.

	𝍸 𝍸 𝍸 |
	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||||
	𝍸 |||
	||
	𝍸 |

Answer the following questions:

1) How many people walked passed the school? _____

2) How many cars drove passed the school? _____

3) How many vans drove passed the school? _____

4) How many motorbikes drove passed the school? _____

5) How many lorries drove passed the school? _____

6) How many vehicles drove passed the school? _____

Manual Observation -Tally Sheets

Traffic Survey **KS3 Geography**

Traffic Survey Sheet

Location: Say where you are. Give street names, nearby shops etc.		Map point
Conditions: Describe road and weather conditions, eg dark raining, roadworks, narrow footpaths, muddy road, foggy, other		
Describe nearby road signs and traffic control. Traffic lights, one-way street, double yellow lines, no entry, other. Sketch the area overleaf		

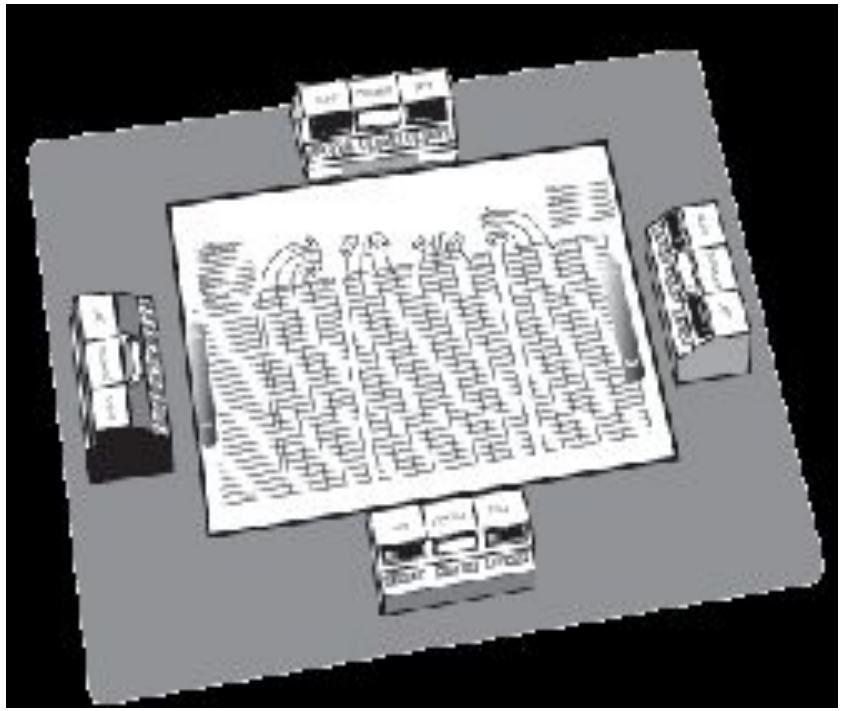
Tally Chart

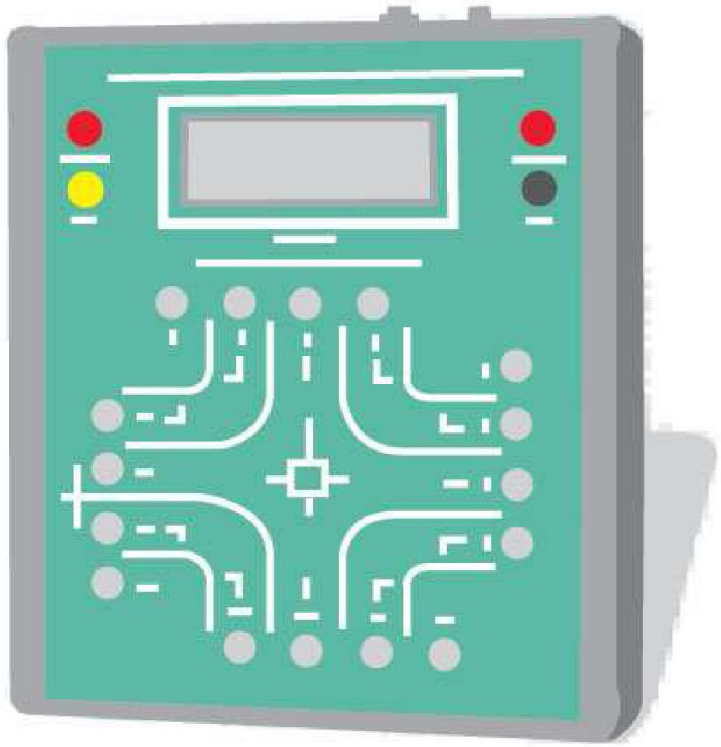
Record time and direction of traffic flow (e.g. either in or out of the town centre)

	No.1 Time..... in ☐ out ☐		No. 2 Time..... in ☐ out ☐		No. 3 Time..... in ☐ out ☐	
Bicycles						
Buses						
Cars						
Lorries						
Motor-cycles						
Taxis						
Vans						

TRAFFIC VOLUME STUDIES

Manual Observation:
Mechanical Count Boards





TRAFFIC VOLUME STUDIES

Automatic Recording

_ The automatic counting method involves the laying of surface detectors (such as pneumatic road tubes) or subsurface detectors (such as magnetic or electronic contact devices) on the road.

_These detect the passing vehicle and transmit the information to a recorder, which is connected to the detector at the side of the road.

An example of the Inductance loop installed in the road for cars and bikes





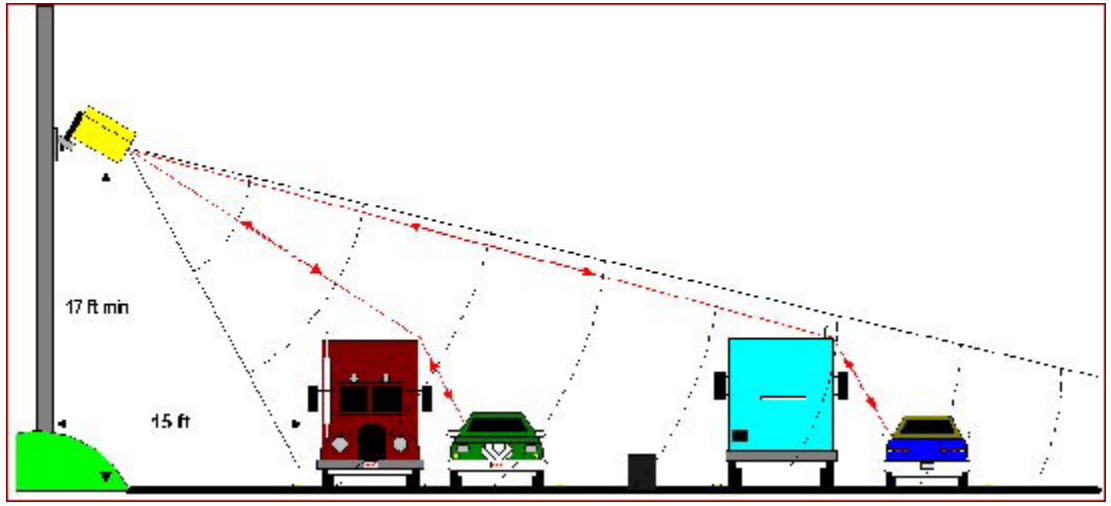
Inductive loops

Video Image Processors (VIPs)





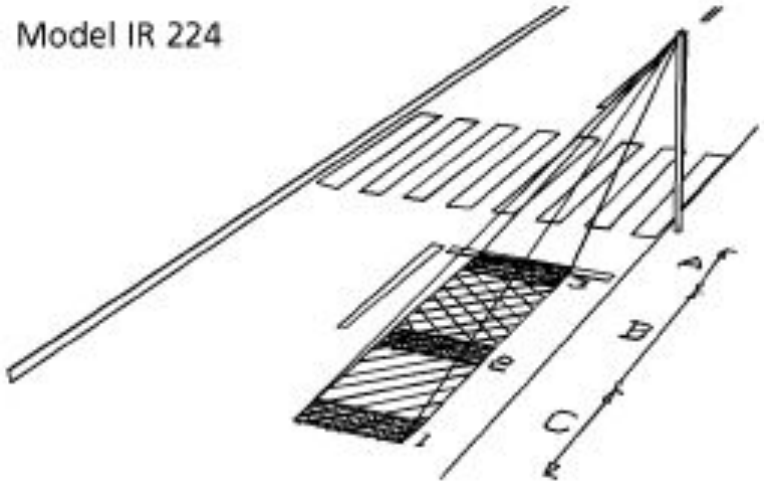




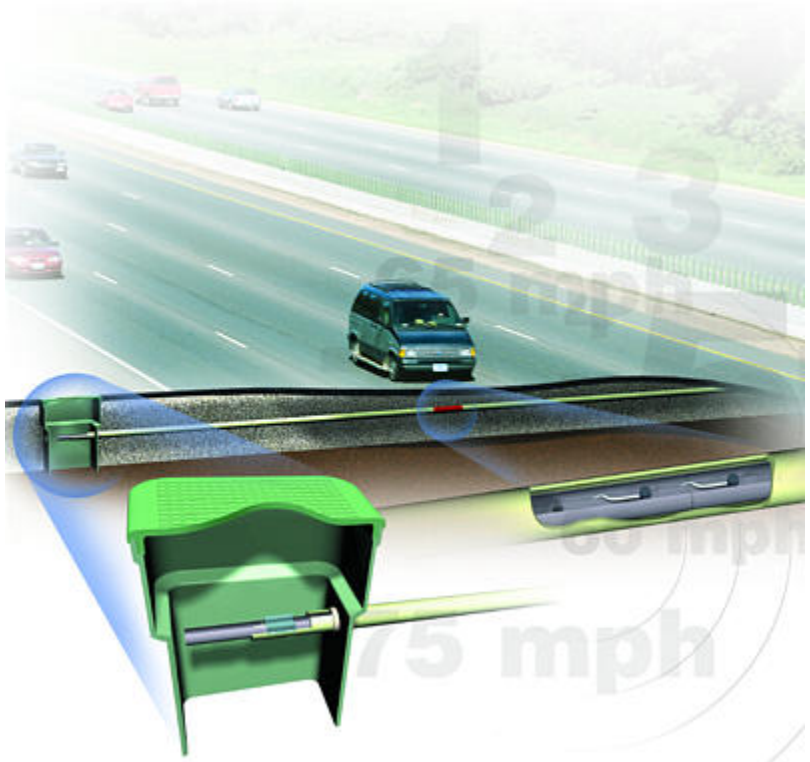
Remote Traffic Microwave Sensor (RTMS)







Infrared Sensors

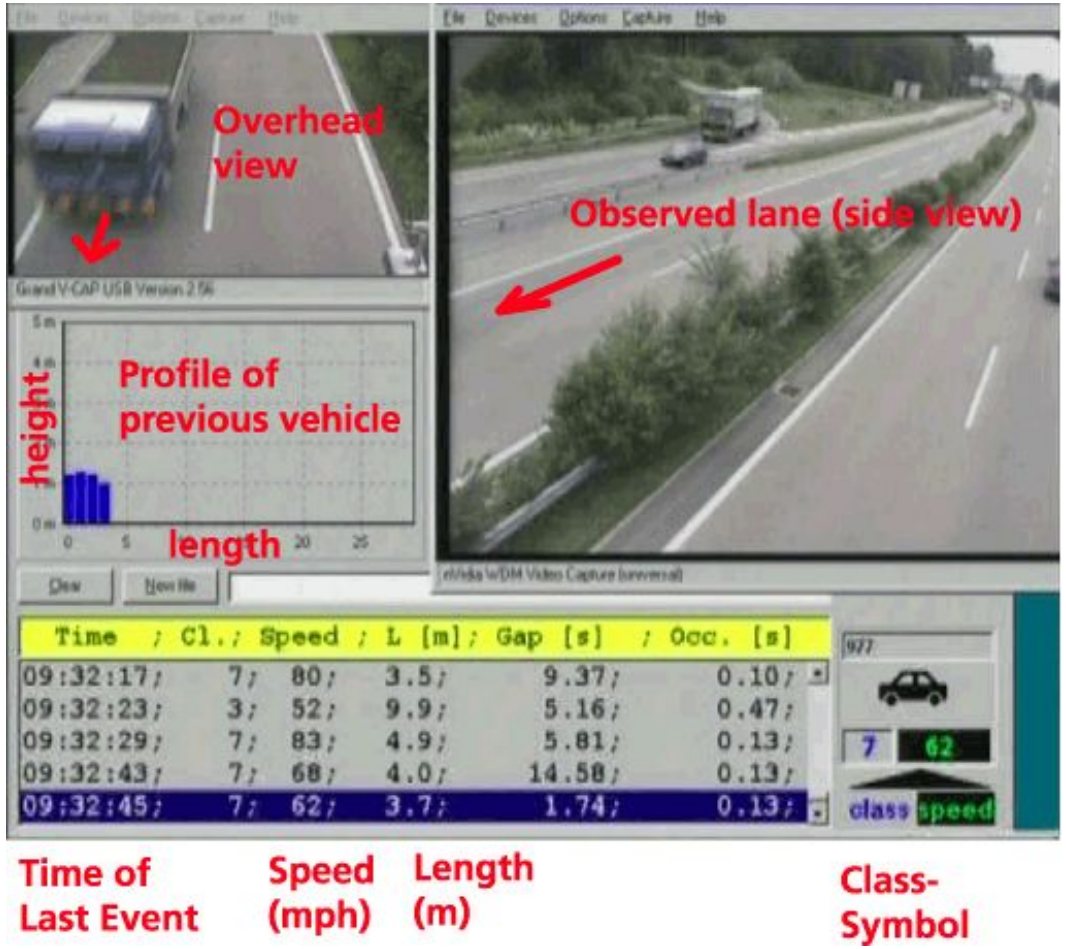


Magnetic Sensors

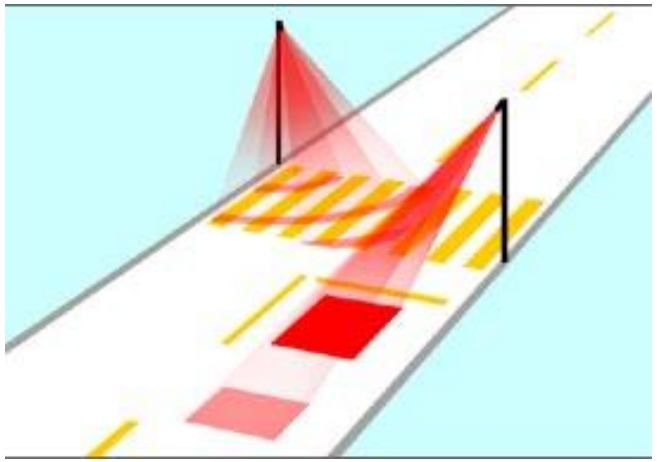




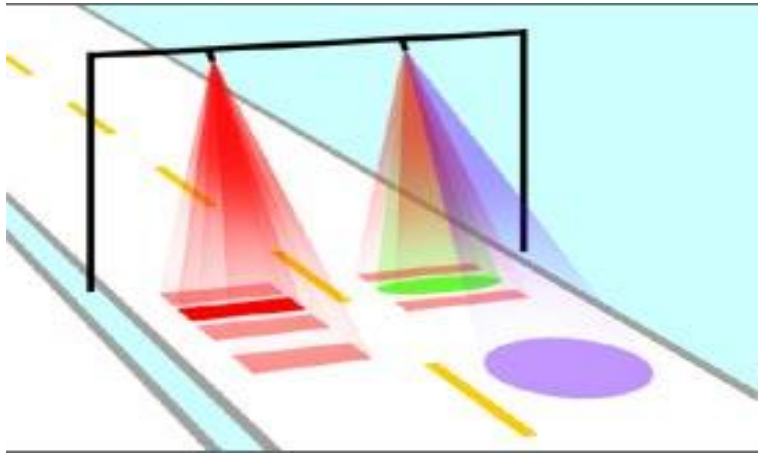
Doppler RADAR, ultrasonic, passive infrared.



Doppler RADAR, ultrasonic, passive infrared.



Intersection Control



Traffic Data Acquisition

= infrared (counting)

= ultrasonic (vehicle height)

= microwave doppler radar (speed)

TRAFFIC VOLUME STUDIES

Counting Periods: The count can be of any duration and depends on the objective of the study or the information needed

_ Short duration count at peak period is conducted for *operational studies including roadway improvement and maintenance*

_ Long duration count is conducted for transport planning and design

TRAFFIC VOLUME STUDIES

Daily Volumes and Their Use

_ A common time interval for volumes is a day.

_ Daily volumes are frequently used as the basis for highway planning and general observations of trends.

_ Traffic volume projections are often based on measured daily volumes.

Traffic Stream Parameters

Table 3-7 Illustration of Daily Volume Parameters

1 Month	2 No. of Weekdays in Month (days)	3 Total No. of Days in Month (days)	4 Total Monthly Volume (veh)	5 Total Weekday Volume (veh)	6 AWT 5/2 (vpd)	7 ADT 4/3 (vpd)
Jan.	22	31	425,000	208,000	9,455	13,710
Feb.	20	28	410,000	220,000	11,000	14,643
Mar.	22	31	385,000	185,000	8,409	12,419
Apr.	22	30	400,000	200,000	9,091	13,333
May	21	31	450,000	215,000	10,238	14,516
Jun.	22	30	500,000	230,000	10,455	16,667
Jul.	23	31	580,000	260,000	11,304	18,710
Aug.	21	31	570,000	260,000	12,381	18,387
Sep.	22	30	490,000	205,000	9,318	16,333
Oct.	22	31	420,000	190,000	8,636	13,548
Nov.	21	30	415,000	200,000	9,523	13,833
Dec.	22	31	400,000	210,000	9,545	12,903
Year	260	365	5,445,000	2,583,000	—	—

AAWT = 2,583,000/260 = 9,935 vpd
AADT = 5,445,000/365 = 14,918 vpd

Traffic Stream Parameters

Hourly Volumes and Their Use

_ While daily volumes are useful in highway planning, they cannot be used alone for **design or operational analysis** purposes.

_ Traffic volume varies considerably during the course of a 24-hr day, usually with periods of maximum volume occurring during the morning and evening commuter “rush” hours.

_ The single hour of the day that has the highest hourly volume is referred to as the “peak hour”.

_ Traffic volume within this hour is of greatest interest to traffic engineers in design or operational analysis.

Traffic Stream Parameters

Hourly Volumes and Their Use (contd…)

_ The peak hour volume (PHV) is generally a directional volume and may be viewed as a directional design hour volume (DDHV).

_ Directional Design Hour Volume may be estimated using the following relationship

DDHV = AADT x K x D

_ K = proportion of daily traffic occurring during the peak hour, expressed as a decimal, and

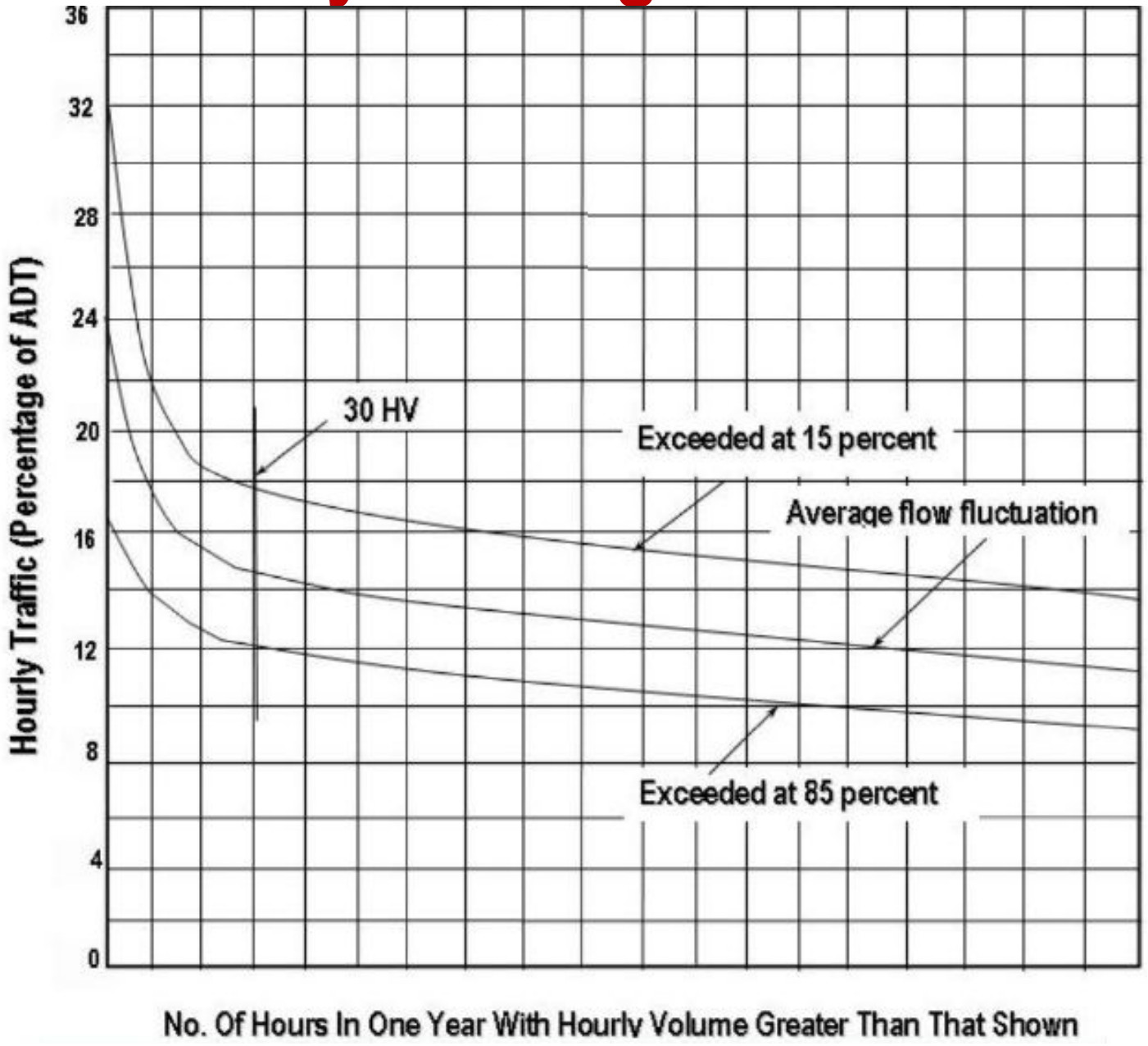
_ D = proportion of peak hour traffic traveling in the peak direction, expressed as a decimal.

_ “K” often represents the proportion of AADT occurring during **the thirtieth highest peak hour (30 HV**) of the year.

Why 30th Highest Hour

The 30th highest hour is used in design as above this level , the **economic costs of extra capacity** show diminishing returns. It represents an acceptable compromise between a road being congested for an acceptable amount of time, and the economic cost of the road.

Why 30th Highest Hour



Traffic Stream Parameters

Hourly Volumes and Their Use (contd…)

Table 3-8 General Ranges for *K* and *D* Factors

Facility Type	Normal Range of Factors	
	K Factor	*D* Factor
Rural	0.15–0.25	0.65–0.80
Suburban	0.12–0.15	0.55–0.65
Urban:		
Radial route	0.07–0.12	0.55–0.60
Circumferential route	0.07–0.12	0.50–0.55

AADT
Annual Average Daily Traffic

AADT Data Helps to:

- Estimate highway revenues
- Establish overall volume trends
- Establish annual accident rates
- Analyze benefits of road improvements

ADT
Average Daily Traffic

ADT Data Helps to:

- Planning of HW activities
- Measurement of current demand
- Evaluation of existing traffic flow

PHV

Maximum number of veh that pass a point during a period of 60 consecutive minutes.

PHV Data used for:

- Finding design hour volumes
- Capacity analysis
- Functional classification of HW
- Design of geometric characteristics of HW (lane, sig, channelization)
- Dev of program related to traffic op e.g one way op, traffic routing
- Dev of parking regulation

Composition of Traffic Volumes

- Different types of vehicle within the traffic stream makes it difficult to express flow in terms of vehicle. Flow value is calculated by converting all the vehicle to a common type usually the passenger ‘car’.
- **PCE- It** is the method of expressing various types of vehicles having different characteristics in a common equivalent unit. It is needed to remove the effects of traffic composition from flow calculation. One car is considered as one unit. In respect of its road occupancy and operational requirements each type of vehicle is equivalent to a number of passenger cars and this is called the **Passenger Car Equivalent/Unit (PCE/PCU)**. PCE is directly related to capacity value.

Vehicle Categories	PCU
Passenger Car	1.00
Light Good Vehicle	1.00
Truck	3.00
Bus	3.00
uto-rickshaw/Motorcycle	0.75
Rickshaw/Van	2.00
Bicycle	0.50

Calculating AADT using expansion factors

• A traffic engineer urgently needs to determine the AADT on a rural primary road that has the volume distribution characteristics shown in previous Tables 4.6, 4.7, and 4.8. He collected the data shown below on a Tuesday during the month of May. Determine the AADT of the road.

Time Period #	Vehicles
7:00 – 8:00 AM	400
8:00 – 9:00 AM	535
9:00 – 10:00 AM	650
10:00 – 11:00 AM	710
11:00 – 12:00 Noon	650

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Solution:

- Estimate the 24-hr volume for Tuesday using the factors given in Table 4.6:

$$\frac{(400 \times 29.0 + 535 \times 22.05 + 650 \times 18.80 + 710 \times 17.10 + 650 \times 18.52)}{5} \approx 11{,}959$$

- Adjust the 24-hr volume for Tuesday to an average volume for the week using the factors given in Table 4.7:

$$\text{Total 7-day volume} = 11{,}959 \times 7.727$$

$$\text{Average 24-hr volume} = \frac{11{,}959 \times 7.727}{7} = 13{,}201$$

- Since the data were collected in May, use the factor shown for May in Table 4.8 to obtain the AADT:

$$\text{AADT} = 13{,}201 \times 1.394 = 18{,}402$$

Discussion