CE 486
Traffic Studies
Lec. 10

Traffic Engineering Studies

- **Traffic studies may be grouped into three main categories:**
  - **(1) Inventories,**
  - **(2) Administrative studies, and**
  - **(3) Dynamic studies.**

(1) Inventories:

provide a list or graphic display of existing information, such as:

- street widths,
- parking spaces,
- transit routes,
- traffic regulations.

(2) Administrative studies

- use existing engineering records, available in government agencies and departments.
- include the results of surveys, which may involve:
  - field measurements and/or
  - aerial photography.

(3) Dynamic traffic studies

- involve the collection of data under operational conditions and
- include studies of:
  - speed,
  - traffic volume,
  - travel time and delay,
  - parking, and
  - crashes.

Traffic Engineering Studies

- Volume studies
- Speed studies
- Travel time studies
- Delay studies
- Density studies
- Accident studies
- Parking studies
- Transit studies
- Pedestrian studies
- Calibration studies

1. SPOT SPEED STUDIES

- Spot speed studies are conducted to estimate the distribution of speeds of vehicles in a stream of traffic at a particular location on a highway.
- carried out by recording the speeds of a sample of vehicles at a specified location.

- **SPOT SPEED STUDIES**

  Used to:

  – Establish parameters for traffic operation and control, such as:
    - speed zones,
    - speed limits (85th-percentile speed)

1. Locations for Spot Speed Studies

- Represent different traffic conditions on a highway for *basic data collection*.
- Mid-blocks of urban highways and straight, level sections of rural highways for *speed trend analyses*.
- Any location may be used for solution of a *specific traffic engineering problem*.

2. Time of Day and Duration of Spot Speed Studies

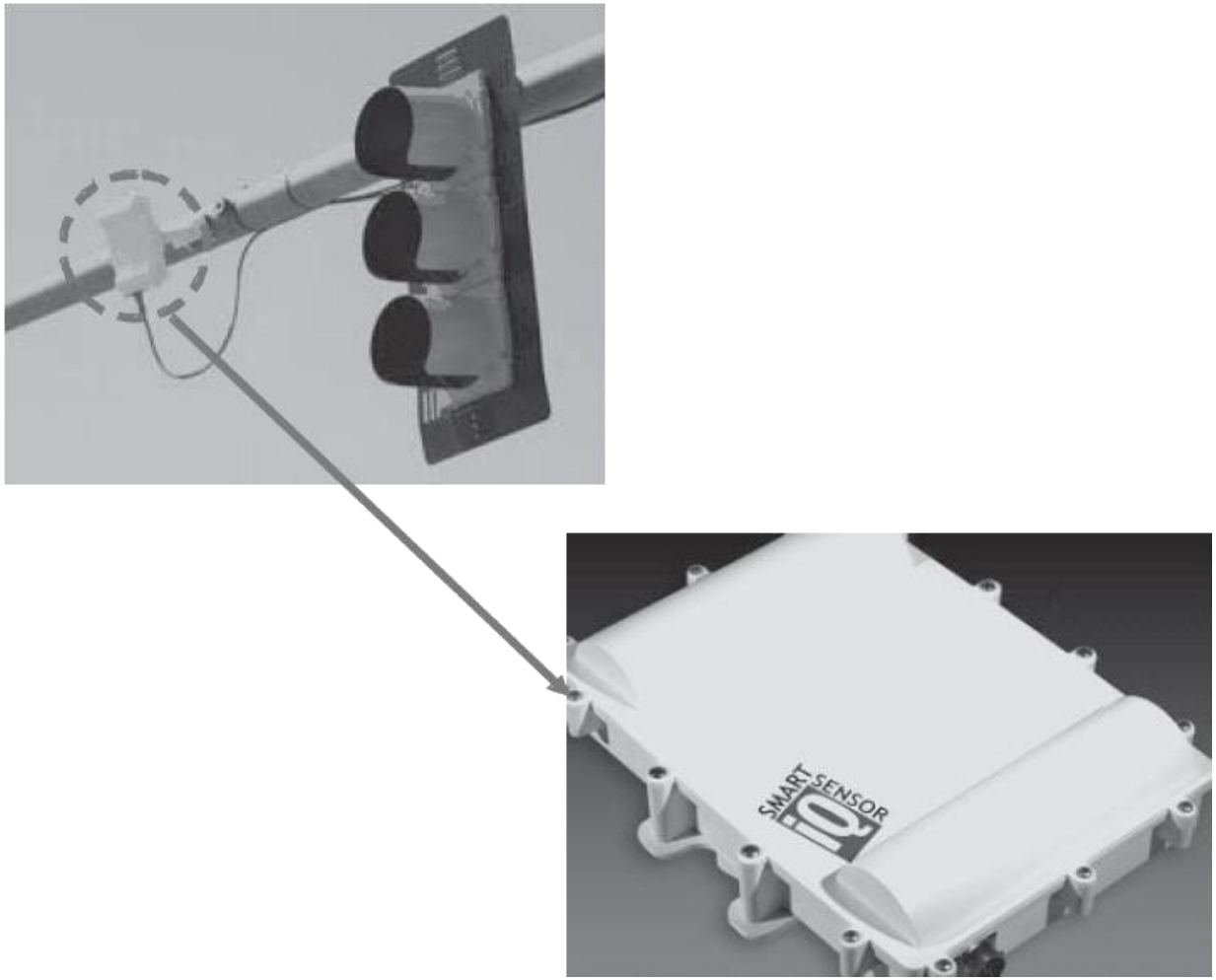
- depends on the purpose of the study.
  - recommended when traffic is free-flowing,
  - during off-peak hours.
  - typically:
    - the duration is at least 1 hour and
    - the sample size is at least 30 vehicles.

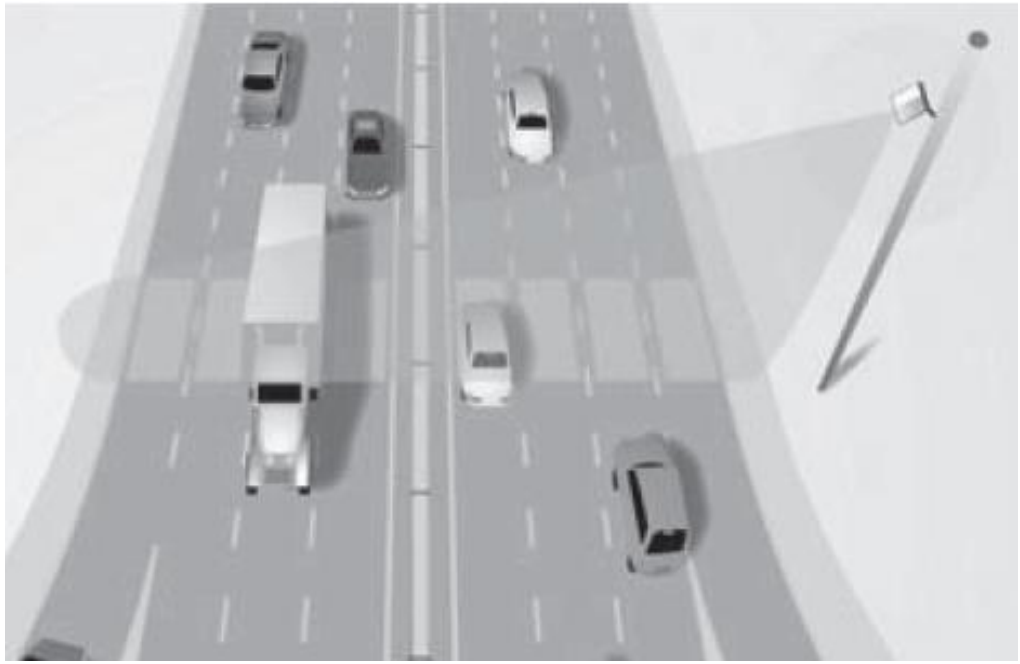
Methods for Conducting Spot Speed Studies

- manual and automatic
- manual method is seldom used
- automatic devices
  1. road detectors
  2. radar-based
  3. the principles of electronics.

- Road Detectors
  - pneumatic road tubes & induction loops collect data on speeds & volume at the same time
  - **Advantage:**
    - Human errors are considerably reduced
  - **Disadvantages:**
    - expensive
    - may, affect driver behavior,

- Radar-Based Traffic Sensors
- Electronic-Principle Detectors
  - traffic characteristics, such as speed, volume, queues, and headways are computed.
  - Using video image processing


SMART SENSOR
HD



Presentation and Analysis of Spot Speed Data

- frequency histogram
- cumulative frequency distribution curve

- **Example** Determining Speed Characteristics from a Set of Speed Data.

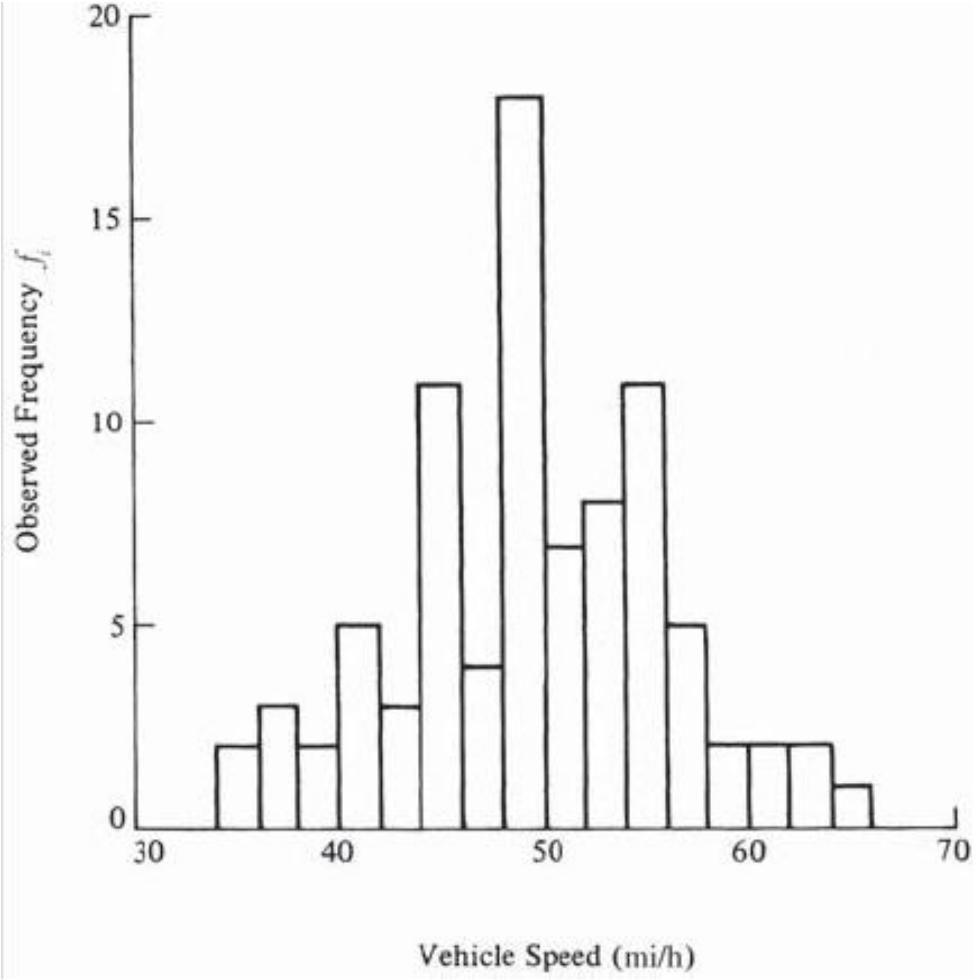
  Table shows the data collected on a rural highway in Virginia during a speed study. Develop the frequency histogram and the frequency distribution of the data and determine:

1. The arithmetic mean speed
2. The standard deviation
3. The median speed
4. The pace
5. The mode or modal speed
6. The 85^{th}-percentile speed

Car No.	Speed (mi/h)	Car No.	Speed (mi/h)	Car No.	Speed (mi/h)	Car No.	Speed (mi/h)
1	35.1	23	46.1	45	47.8	67	56.0
2	44.0	24	54.2	46	47.1	68	49.1
3	45.8	25	52.3	47	34.8	69	49.2
4	44.3	26	57.3	48	52.4	70	56.4
5	36.3	27	46.8	49	49.1	71	48.5
6	54.0	28	57.8	50	37.1	72	45.4
7	42.1	29	36.8	51	65.0	73	48.6
8	50.1	30	55.8	52	49.5	74	52.0
9	51.8	31	43.3	53	52.2	75	49.8
10	50.8	32	55.3	54	48.4	76	63.4
11	38.3	33	39.0	55	42.8	77	60.1
12	44.6	34	53.7	56	49.5	78	48.8
13	45.2	35	40.8	57	48.6	79	52.1
14	41.1	36	54.5	58	41.2	80	48.7
15	55.1	37	51.6	59	48.0	81	61.8
16	50.2	38	51.7	60	58.0	82	56.6
17	54.3	39	50.3	61	49.0	83	48.2
18	45.4	40	59.8	62	41.8	84	62.1
19	55.2	41	40.3	63	48.3	85	53.3
20	45.7	42	55.1	64	45.9	86	53.4
21	54.1	43	45.0	65	44.7		
22	54.0	44	48.3	66	49.5		

Table Speed Data Obtained on a Rural Highway

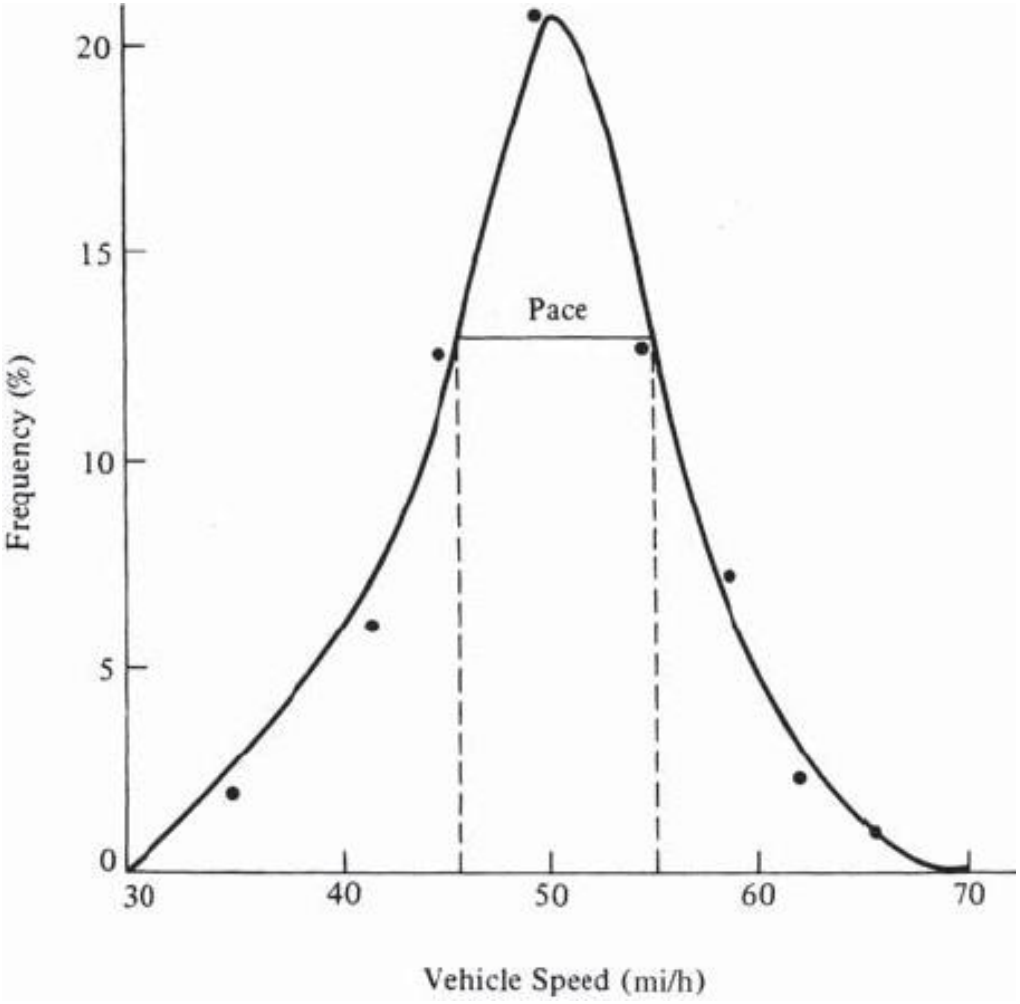
- **Solution:**
- The speeds range from 34.8 to 65.0 km/h, giving a speed range of 30.2.
- For eight classes, the range per class is 3.75 km/h;
- for 20 classes, the range per class is 1.51 km/h.
- It is convenient to choose a range of 2 km/h per class which will give 16 classes.
- A frequency distribution table can then be prepared,.



Histogram of Observed Vehicles' Speeds

1	2	3	4	5	6	7
Speed Class (mi/hr)	*Class Midvalue, u_i*	*Class Frequency (Number of Observations in Class), f_i*	*$f_i u_i$*	*Percentage of Observations in Class*	*Cumulative Percentage of All Observations*	*$f(u_i - \bar{u})^2$*
34–35.9	35.0	2	70	2.3	2.30	420.5
36–37.9	37.0	3	111	3.5	5.80	468.75
38–39.9	39.0	2	78	2.3	8.10	220.50
40–41.9	41.0	5	205	5.8	13.90	361.25
42–43.9	43.0	3	129	3.5	17.40	126.75
44–45.9	45.0	11	495	12.8	30.20	222.75
46–47.9	47.0	4	188	4.7	34.90	25.00
48–49.9	49.0	18	882	21.0	55.90	9.0
50–51.9	51.0	7	357	8.1	64.0	15.75
52–53.9	53.0	8	424	9.3	73.3	98.00
54–55.9	55.0	11	605	12.8	86.1	332.75
56–57.9	57.0	5	285	5.8	91.9	281.25
58–59.9	59.0	2	118	2.3	94.2	180.50
60–61.9	61.0	2	122	2.3	96.5	264.50
62–63.9	63.0	2	126	2.3	98.8	364.50
64–65.9	65.0	1	65	1.2	100.0	240.25
Totals		86	4260			3632.00

Table 4.3 Frequency Distribution Table for Set of Speed Data



Frequency Distribution

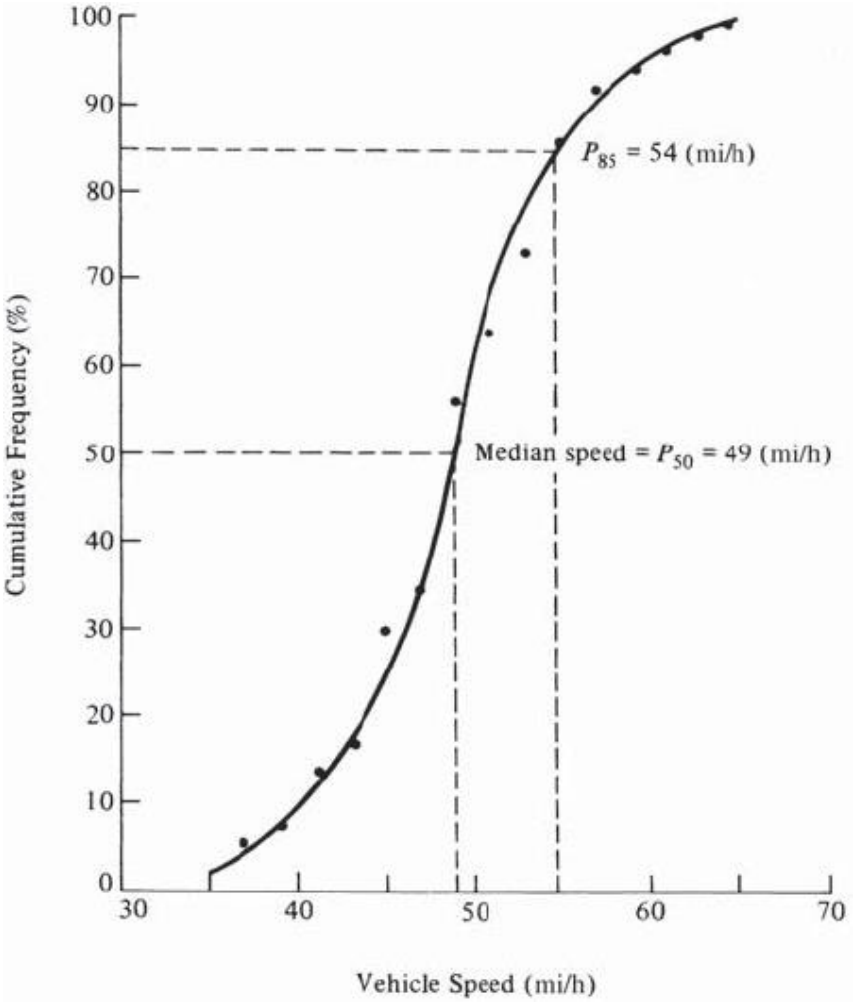


Figure 4.6 Cumulative Distribution

- The median speed 49 km/h,

  the 50^{th}-percentile speed.
- 85^{th}-percentile speed is 54 km/h

VOLUME STUDIES

Definitions & Useful Parameters

- ***Volume:***

  Volume on a road is the number of vehicles passing the measurement point during a specified time interval.

- ***Demand:***

  is a measure of the number of vehicles (or passengers, or persons) waiting for service in the given time period.

- ***Capacity:***

  is the maximum number that can reasonable be expected to be served in the given time period.

2. VOLUME STUDIES

1. **Average Annual Daily Traffic** (AADT)

   the average of 24-hour counts collected every day of the year.

2. **Average Daily Traffic** (ADT)

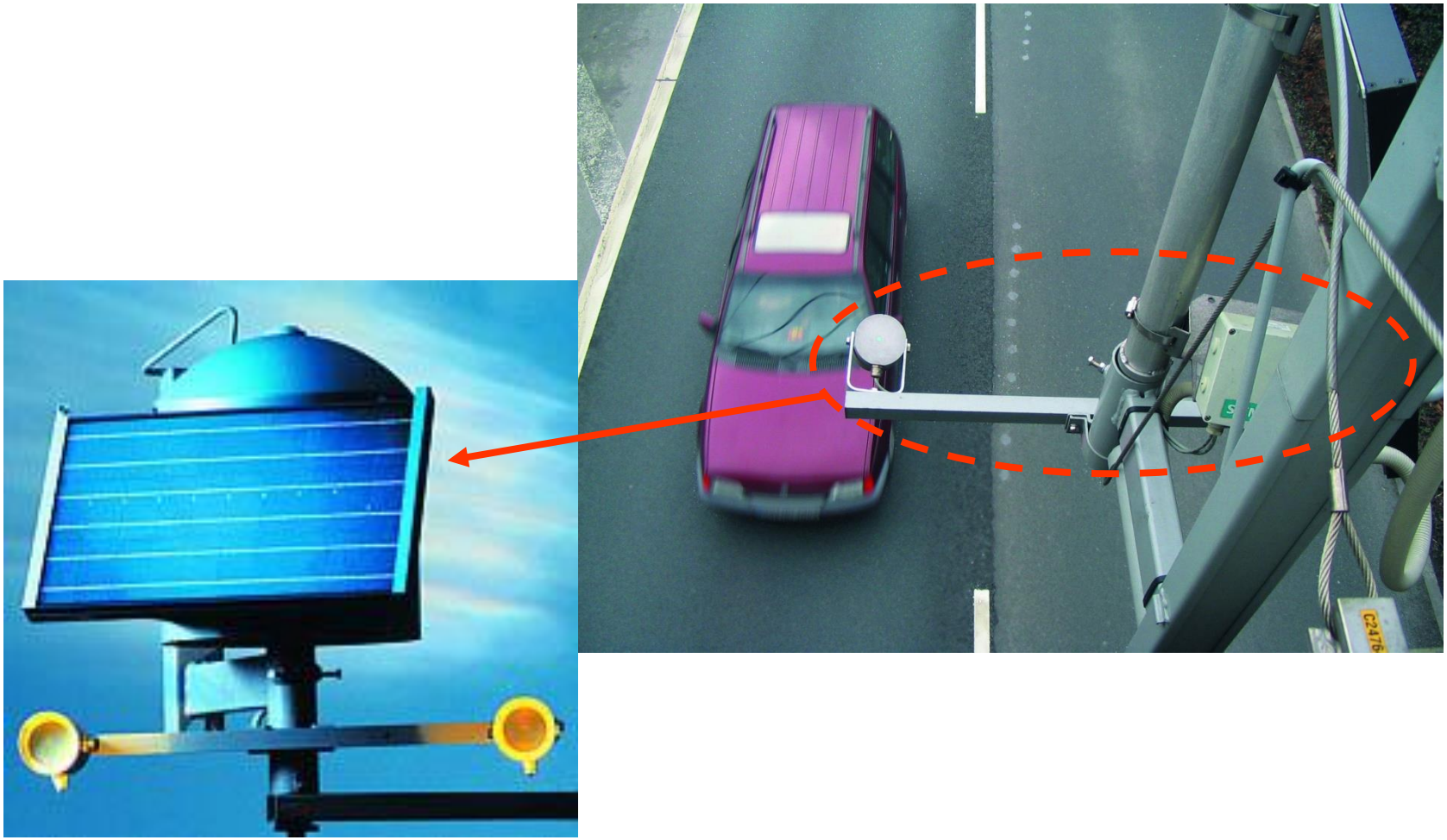
   the average of 24-hour counts collected over a number of days greater than one but less than a year.

3. **Peak Hour Volume** (PHV)

   the maximum number of vehicles that pas a point on a highway during a period of 60 consecutive minutes.
4. **Vehicle Classification** (VC) with respect to the type of vehicles for cars, two-axle trucks, or three-axle trucks.
5. **Vehicle Miles of Travel** (VMT)

- **Methods of Conducting Volume Counts**
  - Manual Method
  - Automatic Method

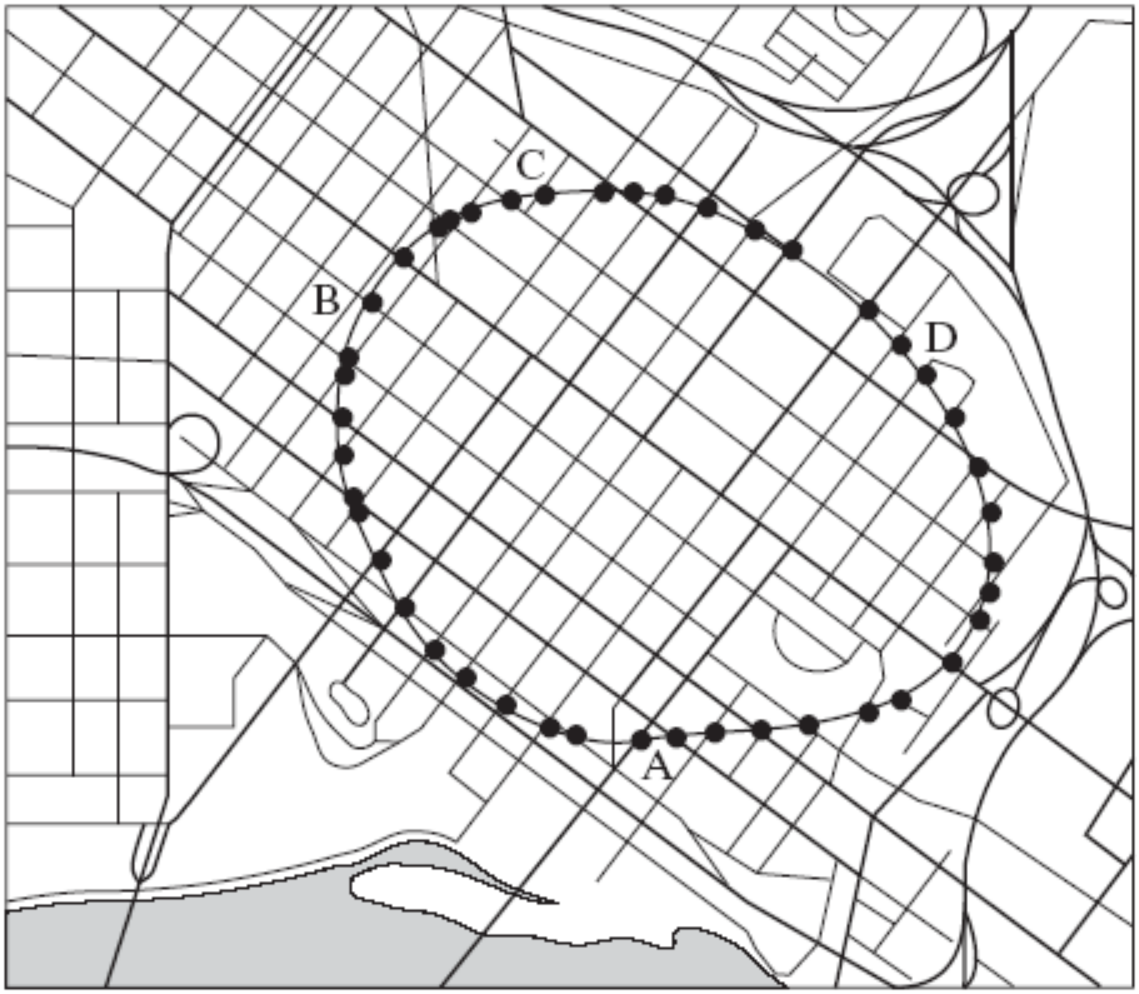
Traffic Counter/Classifier



Traffic Eye Universal System

Counting locations

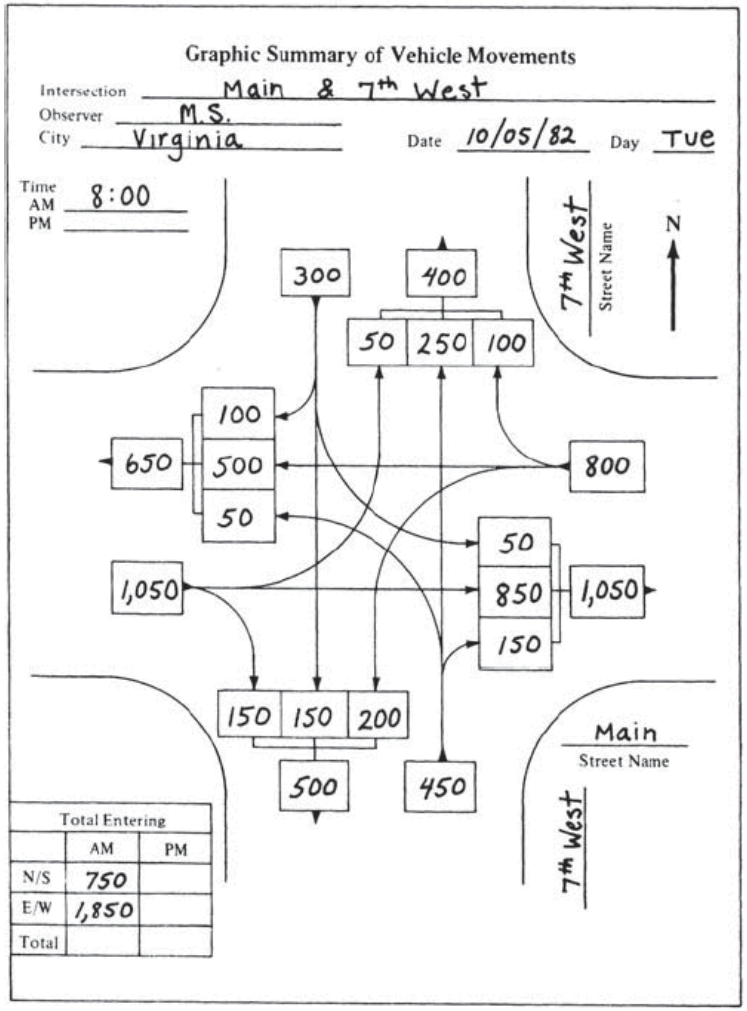
1. At mid of Road
2. At intersections



Example of Station Locations for a Cordon Count

Intersection Summary Sheets:

Figure shows a typical intersection summary sheet.



Intersection Summary Sheet

Summary Tables:

PHV, Vehicle Classification (VC), and ADT.

Summary of Traffic Volume Data for a Highway Section

PHV	430
ADT	5375
Vehicle Classification (VC)	
Passenger cars	70%
Two-axle trucks	20%
Three-axle trucks	8%
Other trucks	2%

3. TRAVEL TIME

- Travel time: time required to travel from one point to another on a given route.
- the locations, durations, and causes of delays.
- good indication of the level of service
- identifying problem locations,

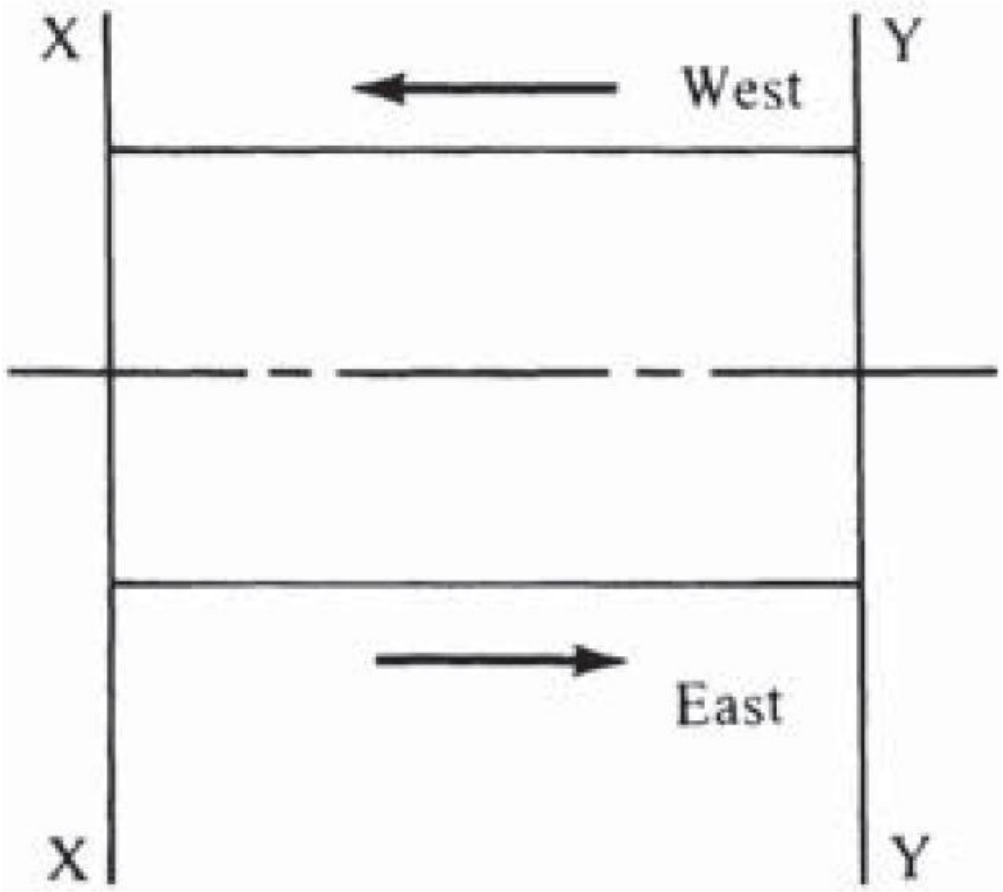
- **Applications of Travel Time and Delay Data**
  - efficiency of a route
  - locations with relatively high delays
  - causes for delays
  - before-and-after studies
  - relative efficiency of a route
  - travel times on specific links
  - economic studies

- **Methods for Conducting Travel Time and Delay Studies**
  - Methods Requiring a Test Vehicle: floating-car, average-speed, and moving-vehicle techniques.

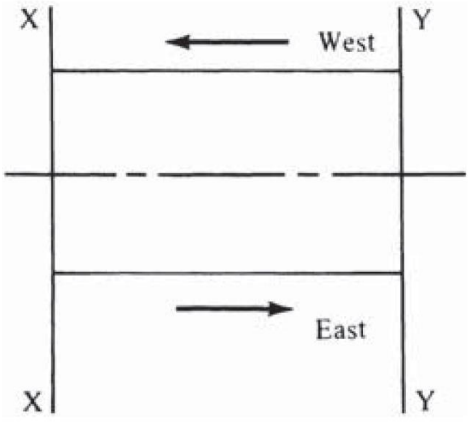
Moving-Vehicle Technique

(moving observer):

- the observer makes a round trip on a test
- The observer starts at section X-X, drives the car eastward to section Y-Y,
- turns the vehicle around
- drives westward to section X-X again

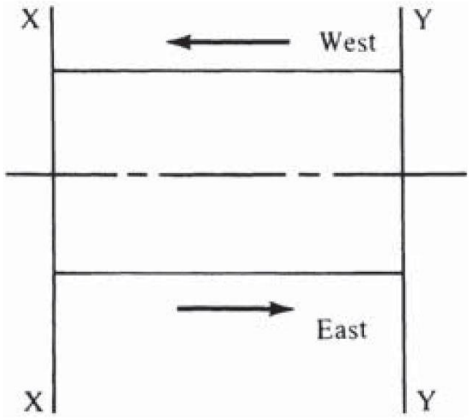


Test Site for Moving-Vehicle Method



Moving-Vehicle Technique.

- **following data are collected as**
  - The time it takes to travel east from X-X to Y-Y (*Te*), in minutes
  - The time it takes to travel west from Y-Y to X-X (*Tw*), in minutes
  - The number of vehicles traveling west in the opposite lane while the test car is traveling east (*Ne*)



Moving-Vehicle Technique.

- The number of vehicles that overtake the test car while it is traveling west from Y-Y to X-X, that is, traveling in the westbound direction (*Ow*)
- The number of vehicles that the test car passes while it is traveling west from Y-Y to X-X, that is, traveling in the westbound direction (*Pw*)

Moving-Vehicle Technique.

- The volume (V_w) in the westbound direction can then be obtained from the expression:

$$V_w = \frac{(N_e + O_w - P_w)60}{T_e + T_w}$$

- where (N_e O_w P_w) is the number of vehicles traveling westward that cross the line X-X during the time ($T_e T_w$).
- Similarly, the average travel time in the westbound direction is obtained from

$$\frac{\overline{T}_w}{60} = \frac{T_w}{60} - \frac{O_w - P_w}{V_w}$$

$$\overline{T}_w = T_w - \frac{60(O_w - P_w)}{V_w}$$