



# Traffic Engineering Surveys

# Objective

- ❑ **To conduct traffic surveys for the purpose of validation/evaluation of the existing traffic situation of critical intersections along the national road network**

# Outline

- **Topographic Survey**
- **Road Inventory Survey**
- **Volume Studies (vehicle and pedestrian)**
- **Spot Speed Survey**
- **Travel Time and Delay**

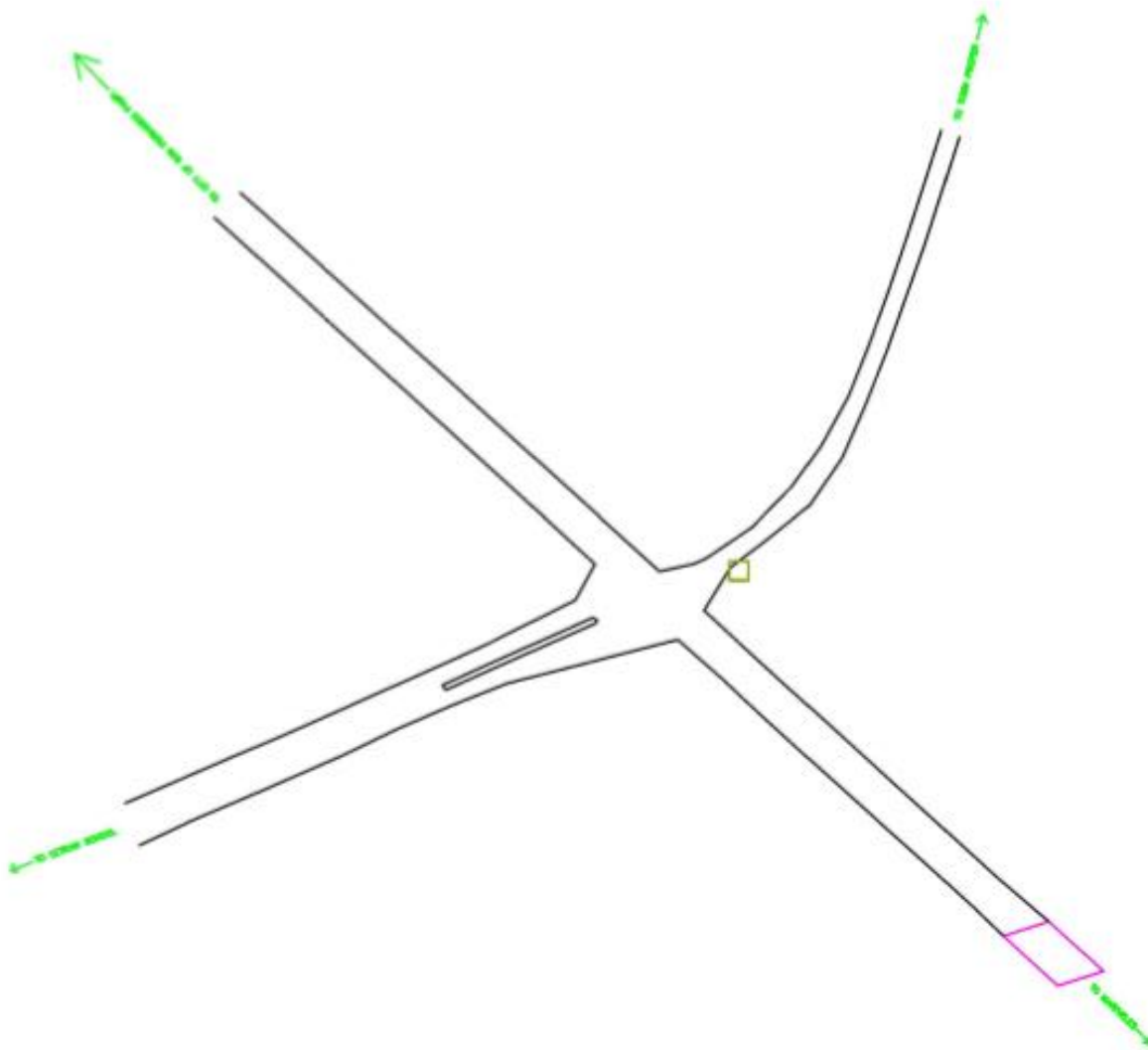
# Topographic Survey

- This survey involves the collection of data about the natural and manmade features of the land.

# Topographic Survey



# Topographic Survey



# Topographic Survey



- **For national roads**
  - 150-200 meters from the intersection
- **For minor/local roads**
  - 80-100 meters from the intersection

# Road Inventory and Condition Survey

- This survey involves the collection of data on on-street conditions. The information gathered is used as a data for other works and reduces the need for field trips.

# Comprehensive Transport System Inventory

## Highways

- Network description (details of links and junctions, usage restrictions)
- Fundamental structures (details of bridges, embankments, causeways etc.)
- Pavement (construction and surfacing)
- Drainage system
- Lighting (type, location of lights, control system)
- Pedestrian and cyclist crossing facilities (type and location)
- Traffic monitoring systems (location and type of sensors)
- Traffic control systems (location and type of signals etc.)
- Toll systems (location and type of toll systems, charging structure)
- Road signs and markings (location, type and wording)

# Comprehensive Transport System Inventory

## *On-street parking/loading facilities*

- Location and details of restrictions (e.g. start and end point of 'no waiting' area)
- Location and arrangement of designated spaces or bays
- Details of charging structure and enforcement method
- Infrastructure (location and type of any meter, ticket machines etc.)

# Comprehensive Transport System Inventory

## Off-street parking facilities

- Location and *capacity* of spaces and of access/egress points
- Type of structure (surface, underground, multi-storey)
- Usage restrictions (category of user, type of vehicle)
- Details of owner and operator
- Method of operation (attendant, entry-barrier, exit-barrier, ticket machine etc.)
- Details of charging structure

# Comprehensive Transport System Inventory

## Public transport infrastructure

- Fixed track systems (network details - number and gauge of tracks, segregated or
- shared right of way, points, power source, signals, detectors, crossing facilities, rolling
- stock, timetable of services)
- Bus systems (bus lanes, busways, guide ways, power sources, turning facilities,
- laybys, bus detectors, special signals, vehicle fleet, timetable of services)
- Passenger access and interchange facilities (location of bus stops, bus stations, rail or
- LRT stations, airports, ferry terminals etc., facilities available)

# Comprehensive Transport System Inventory

## *Facilities for cyclists and pedestrians*

- Network details (location of designated cycleways, paths, walkways etc.; details of
- width, surfacing, lighting, markings etc.)

# Comprehensive Transport System Inventory

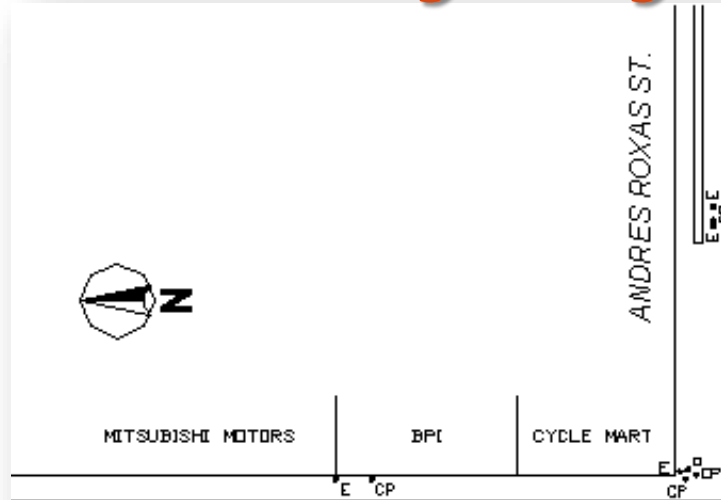
## *Canals and navigable rivers*

- Network details (location, width and depth of channels, locks, tidal restrictions, speed
- restrictions, fleet information, timetable of services)
- Docking facilities for vessels carrying passengers, vehicles and freight

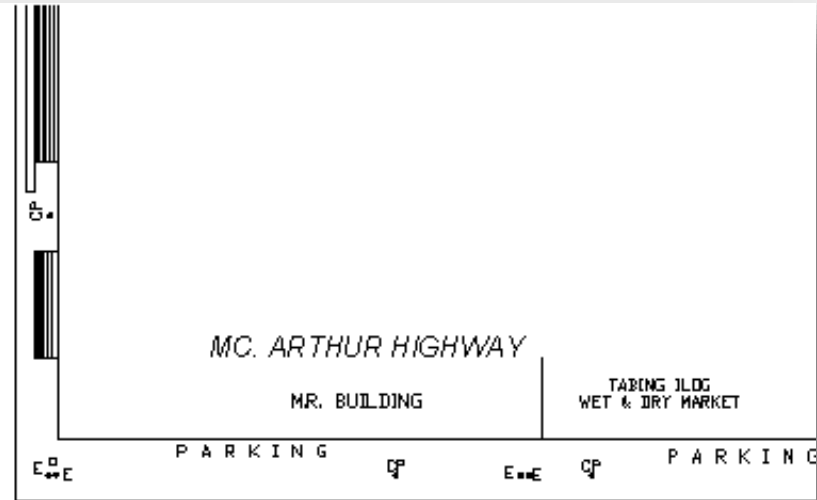
# Road Inventory Survey



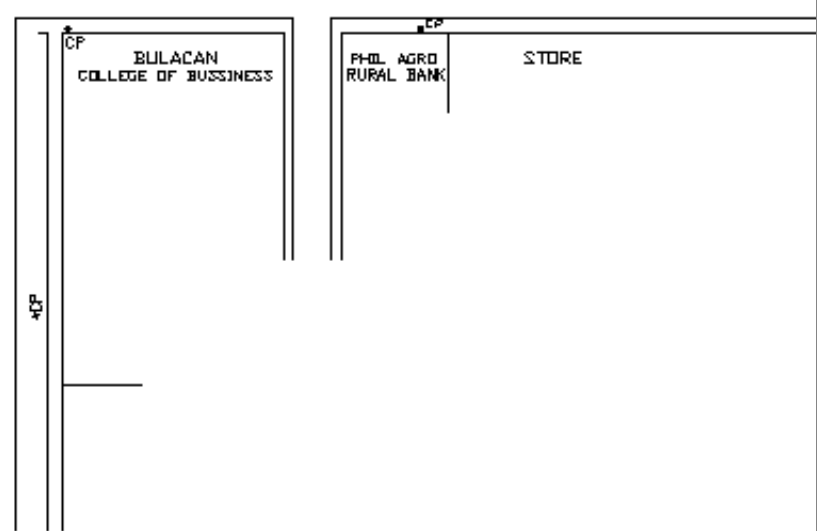
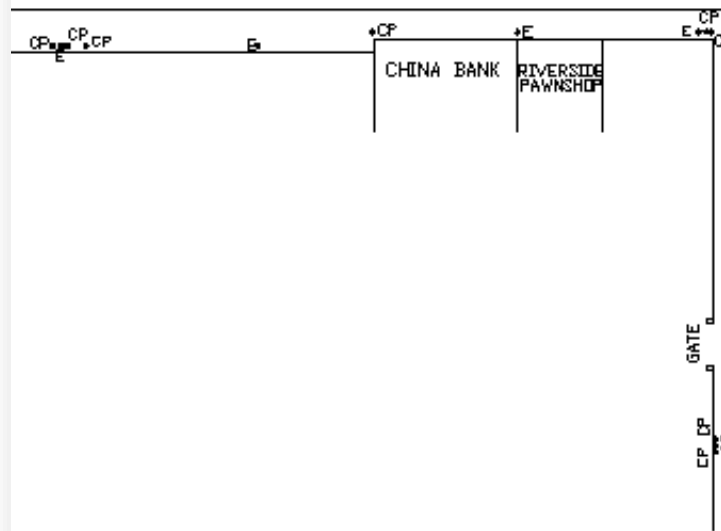
# Inventory Layout



ASPHALT



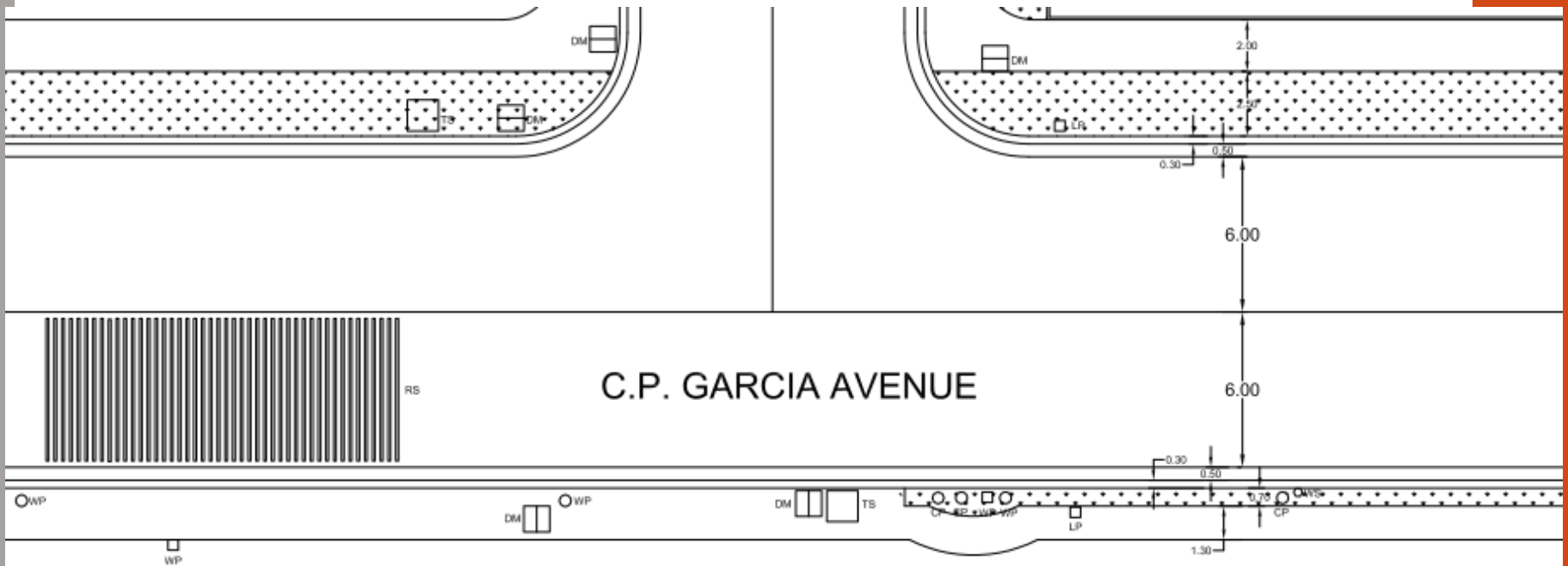
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# Output: C.P. Garcia Avenue



# **VOLUME STUDIES (VEHICLE AND PEDESTRIAN)**

# Vehicle Flow Surveys

- Information on the flow of vehicles past a given point in a specified time period provides a key input to decisions on the planning, design and operation of transport systems.
- Depending on the purpose of the survey, the count may relate to traffic passing along a specified link or may relate to traffic making a particular turning movement at an intersection.

# VOLUME AND FLOW

- Volume is simply the number of vehicles that pass a given point on the roadway or a given lane or direction of a highway in a specified period of time. The unit of volume is simply vehicles, although it is often expressed as annual, daily, hourly peak and off-peak.

# 1. DAILY VOLUMES

- Daily volumes are frequently used as the basis for highway planning, for general trend observations, as well as for traffic volume projections. Four daily volume parameters are widely used: average annual daily traffic (AADT), average annual weekday traffic (AAWT), average daily traffic (ADT), and average weekday traffic (AWT).

# AADT

- AADT is the average 24-hour traffic volume at a given location over a full year, that is, the total number of vehicles passing the site in a year divided by 365.

# ADT

- ADT is the average 24-hour traffic volume at a given location for a period of time less than a year (e.g., summer, six months, a season, a month, a week). ADT is valid only for the period of time over which it was measured.

# AAWT

- AAWT is the average 24-hour traffic volume occurring on weekdays over a full year.
- AAWT is normally obtained by dividing the total weekday traffic for the year by the annual weekdays (usually 260 days).
- This volume is of particular importance since weekend traffic is usually low; thus, the average higher weekday volume over 365 days would hide the impact of the weekday traffic.

# AWT

- AWT is the average 24-hour traffic volume occurring on weekdays at a given location for a period of time less than a year, such as a month or a season.

## 2. HOURLY VOLUMES

- Hourly volumes are designed to reflect the variation of traffic over the different time period of a day. They are also used to identify single hour or period of highest volume in a day occurring during the morning and evening commute, that is, rush hours.
- The single hour of the day corresponding to the highest hourly volume is referred to as **peak hour**.
- The peak hour traffic volume is a critical input in the design and operational analysis of transportation facilities.

# PEAK HOUR VOLUMES

Peak hour volumes can sometimes be estimated from AADT, as follows:

$$DDHV = AADT \times K \times D$$

where DDHV = directional design hourly volume (veh/hr)

AADT = average annual daily traffic (24 hours) (veh/day)

$K$  = factor for proportion of daily traffic occurring at peak hour

$D$  = factor for proportion of traffic in peak direction

# 3. SUBHOURLY VOLUMES

- Subhourly volumes represent traffic variation within the peak hour, i.e., short-term fluctuations in traffic demand. In fact, a facility design may be adequate for design hour, but breakdown may occur due to short-term fluctuations.
- Typical designs and operational analyses are based on 15-minute peak traffic within the peak hour

# PEAK HOUR FACTOR (PHF)

The peak-hour factor (PHF) is calculated to relate the peak flow rate to hourly volumes. This relationship is estimated as follows:

$$\text{PHF} = \frac{V}{4 \times V_{15}}$$

where PHF = peak hour factor

$V$  = peak hour volume (veh/hr)

$V_{15}$  = volume for peak 15-min period (veh)

The PHF describes trip-generation characteristics. When PHF is known, it can be used to convert a peak-hour volume to an estimated peak rate of flow within an hour:

$$v = \frac{V}{\text{PHF}}$$

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

$V$  = peak hourly volume (veh/hr)

PHF = peak hour factor

# Volume Studies

- Traffic volume studies are conducted to collect data on the **number of vehicles and/or pedestrians** that pass a point on a highway facility during a specified time period.
- This time period varies from as little as 15 minutes to as much as a year depending on the anticipated use of the data.
- The data collected also may be put into **subclasses** which may include directional movement, occupancy rates, vehicle classification, and pedestrian age.

# Uses of Volume Studies (1)

## Average Annual Daily Traffic (AADT)

- Estimation of highway user revenues
- Computation of crash rates in terms of number of crashes per 100 million vehicle miles
- Establishment of traffic volume trends
- Evaluation of the economic feasibility of highway projects
- Development of freeway and major arterial street systems
- Development of improvement and maintenance programs

# Uses of Volume Studies (2)

## Peak Hourly Volume

- Functional classification of highways
- Capacity analysis
- Design of the geometric characteristics of a highway, for example, number of lanes, intersection signalization, or channelization
- Development of programs related to traffic operations, for example, one-way street systems or traffic routing
- Development of parking regulations

# Uses of Volume Studies (3)

## Vehicle Classification

- Design of geometric characteristics, with particular reference to turning-radii requirements, maximum grades, lane widths, and so forth
- Capacity analyses, with respect to passenger-car equivalents of trucks
- Adjustment of traffic counts obtained by machines
- Structural design of highway pavements, bridges, and so forth

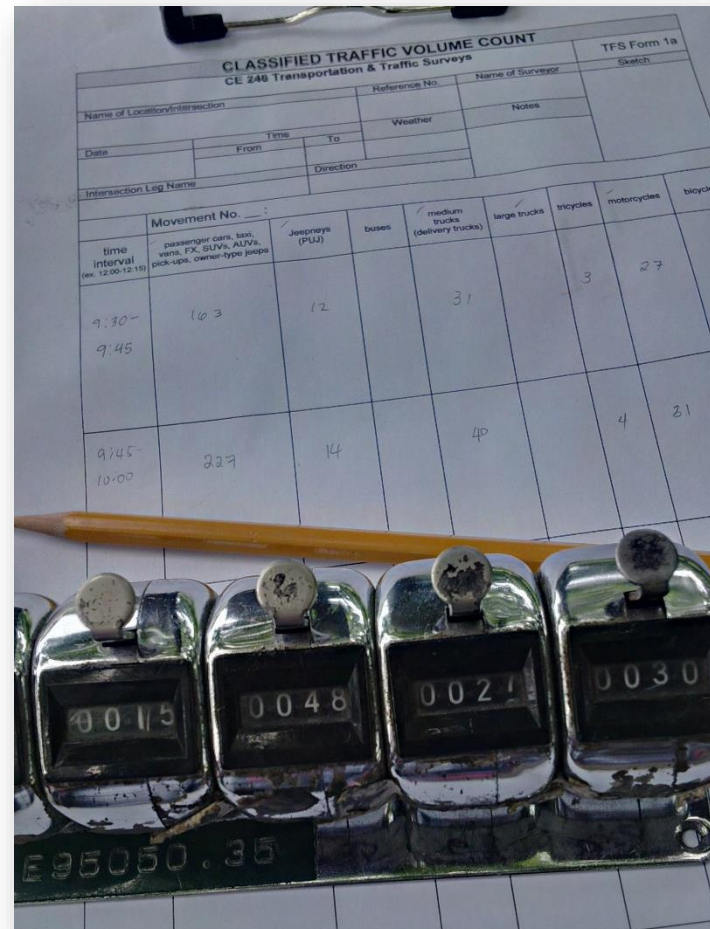
# Vehicle Classification

- Car/AUV/SUV/Jeep
- Public Utility Jeep (PUJ)
- Pick-up/Utility Van
- Small (Mini) Bus
- Large Bus
- 2-Axle Truck
- 3-Axle Truck
- Articulated/Cargo Truck
- Motorcycle
- Motor Tricycle

# Methods of Conducting Volume Counts (1)

- **Manual Method**

- Manual counting involves one or more persons recording observed vehicles using a counter.
- With this type of counter, both the turning movements at the intersection and the types of vehicles can be recorded.
- The main disadvantages of the manual count method are that
  - (1) it is labor-intensive and therefore can be expensive,
  - (2) it is subject to the limitations of human factors, and
  - (3) it cannot be used for long periods of counting.



# Methods of Conducting Volume Counts (2)

- **Automatic Method**

- Automatic counters can be classified into two general categories: those that require the laying of detectors (surface or subsurface), and those that do not require the laying of detectors.
- Automatic counters that require the laying of **surface detectors** (such as pneumatic road tubes) or **subsurface detectors** (non invasive, such as magnetic or electric contact devices) on the road, detect the passing vehicle and transmit the information to a recorder, which is connected to the detector at the side of the road.
- Automatic counters that do not require the laying of detectors use one of many technologies including electronics: Doppler principles, laser scanning, and infrared.

# Methods of Conducting Volume Counts (3)



# Methods of Conducting Volume Counts (4)

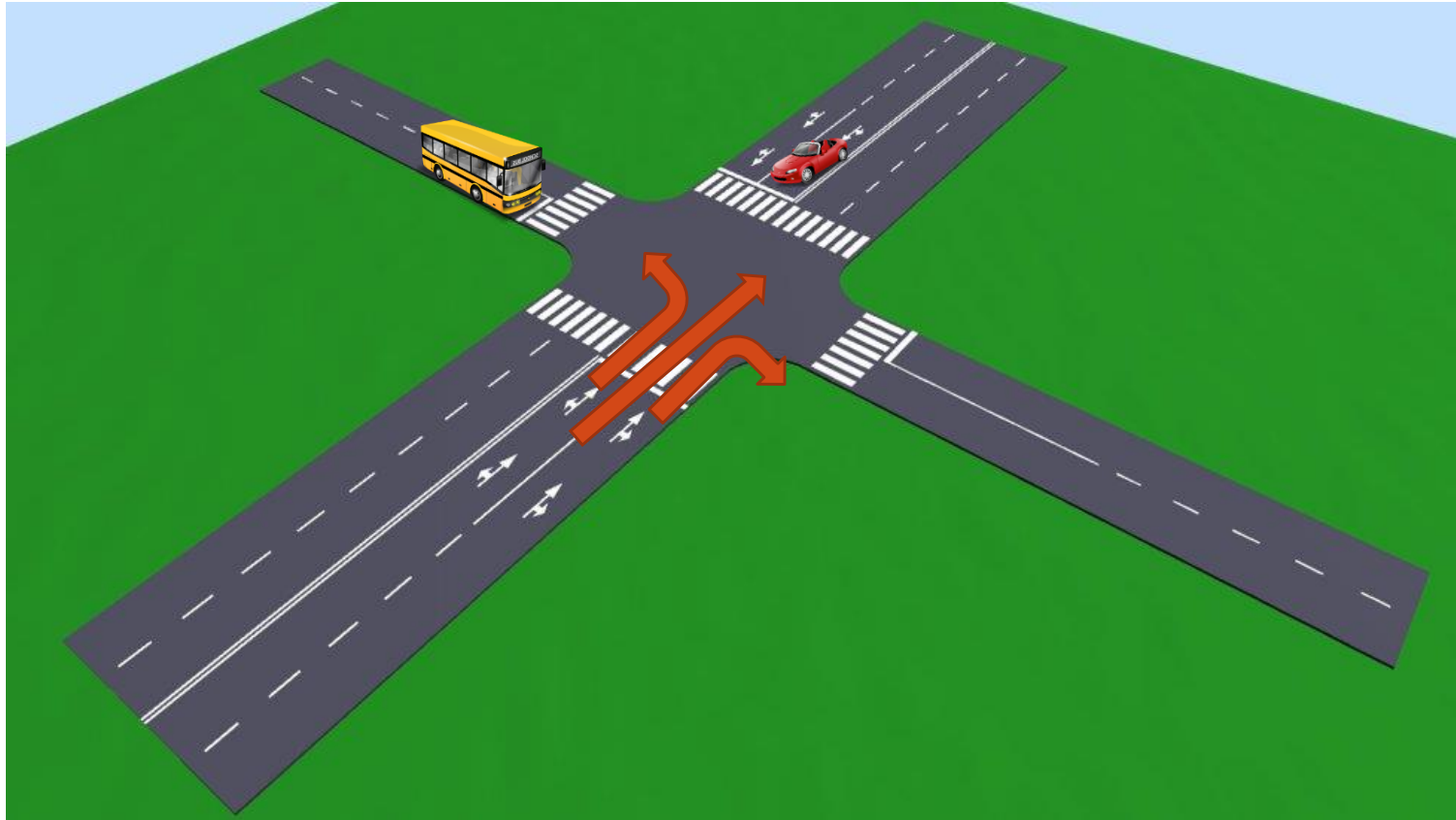


# Intersection Count

- **Intersection counts** are taken to determine vehicle classifications, through movements, and turning movements at intersections.
- These data are used mainly in determining phase lengths and cycle times for signalized intersections, in the design of channelization at intersections, and in the general design of improvements to intersections.
- Standard duration of intersection count is **at least 12 hours**.

# Traffic Volume Count

(Classified Turning Movement Count)

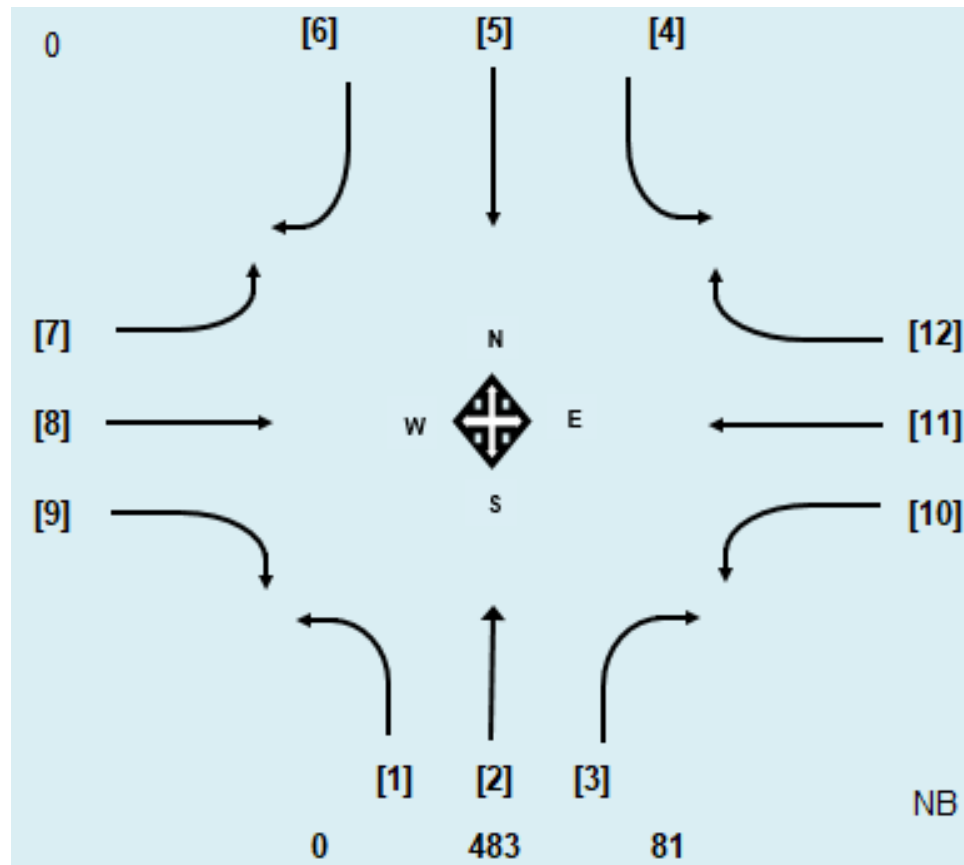


# Duration of Survey

## Traffic Volume and Pedestrian Count Surveys

- 14-Hour Count Survey (6:00 AM to 8:00 PM)
  - 1<sup>st</sup> Shift – 6:00 AM to 1:00 PM
  - 2<sup>nd</sup> Shift – 1:00 PM to 8:00 PM

# Traffic Flow Designation



# Vehicle Classification

- Car/AUV/SUV/Jeep
- Public Utility Jeep (PUJ)
- Pick-up/Utility Van
- Small (Mini) Bus
- Large Bus
- 2-Axle Truck
- 3-Axle Truck
- Articulated/Cargo Truck
- Motor Cycle
- Motor Tricycle

# Passenger Car [1]



# Taxi [4]



# HOV/UV Express/FX [3]



# SUV [1]



# Pick-up [1]



# Van [1]



# UV Express [3]



# Owner Type Jeep [1]



# Public Utility Jeepney (PUJ) [2]



# Utility/Pick-up Van [5]



# Large Bus [7]



# Mini Bus [6]



# Multi-Axle Trucks [3]



# Multi-Axle Trucks [10]



# Motorcycles/Scooters [12]

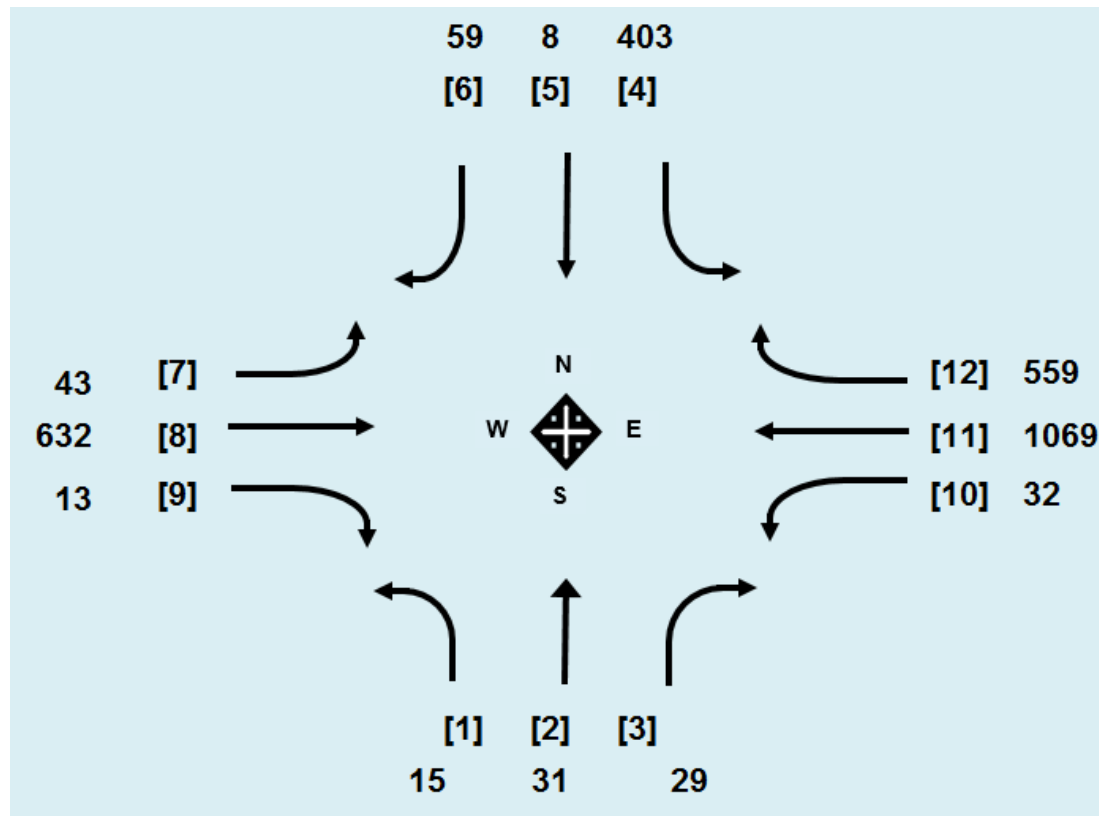


# Tricycles [11]



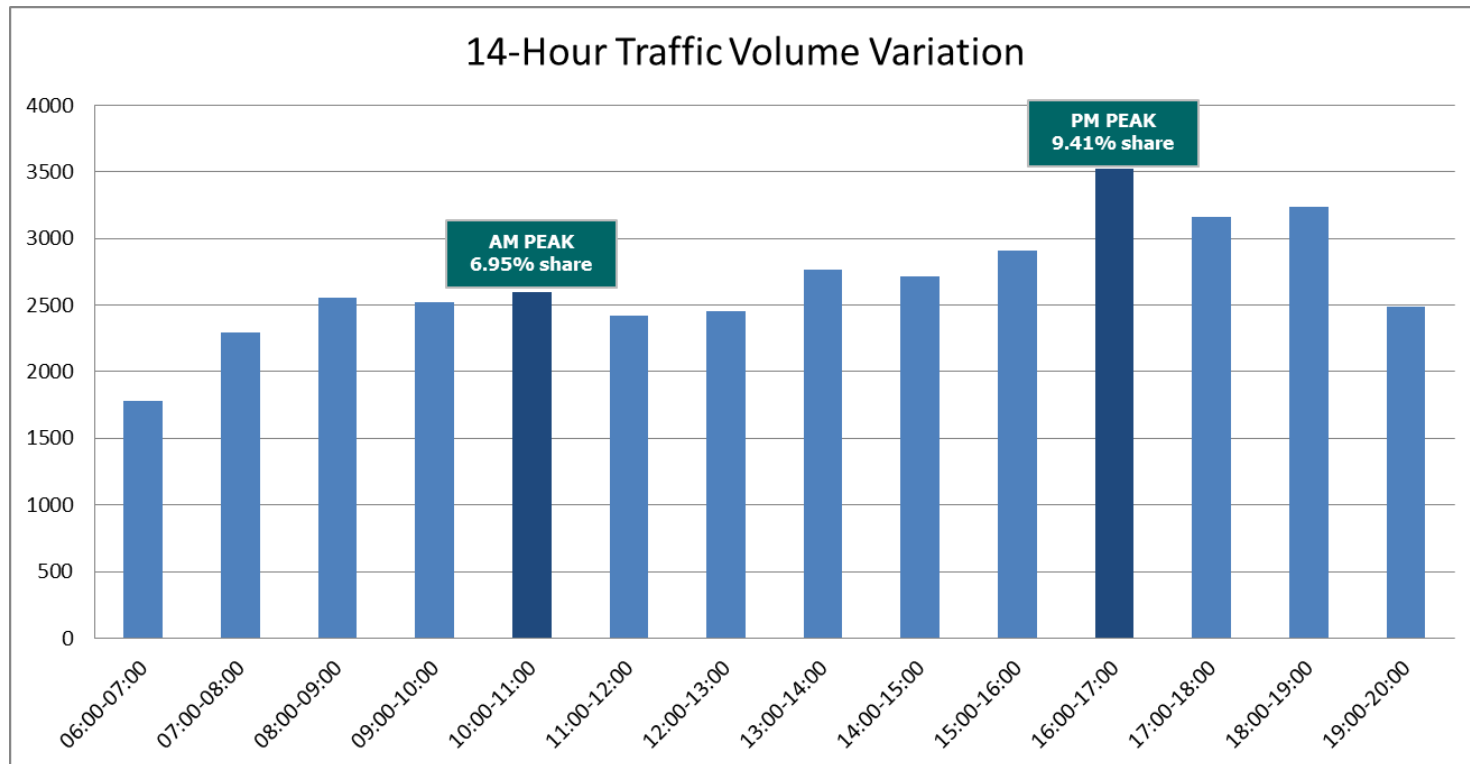
# Traffic Volume Data Presentation

- Turning Movement Count at Sumulong Highway-Olalia Road intersection



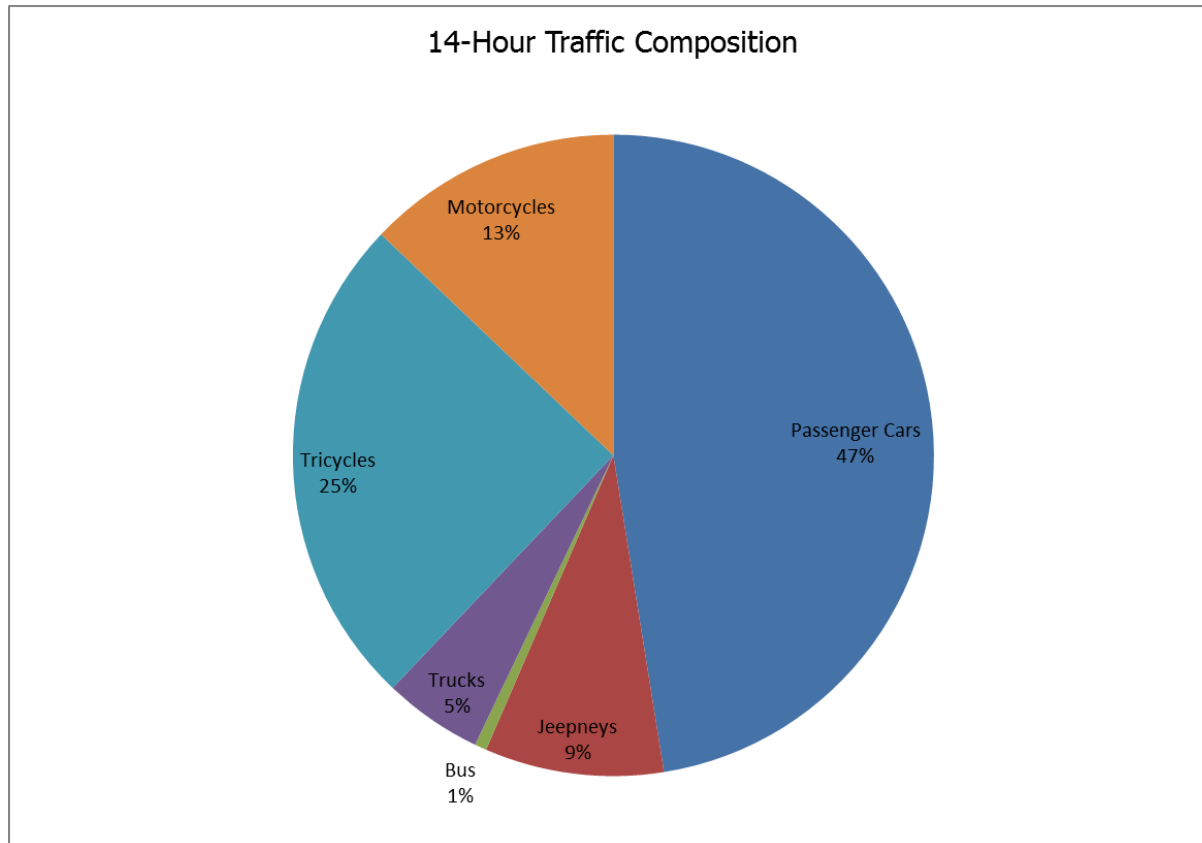
# Traffic Volume Data Presentation

- 14-Hour Traffic Variation of Sumulong Highway-Olalia Road intersection



# Traffic Volume Data Presentation

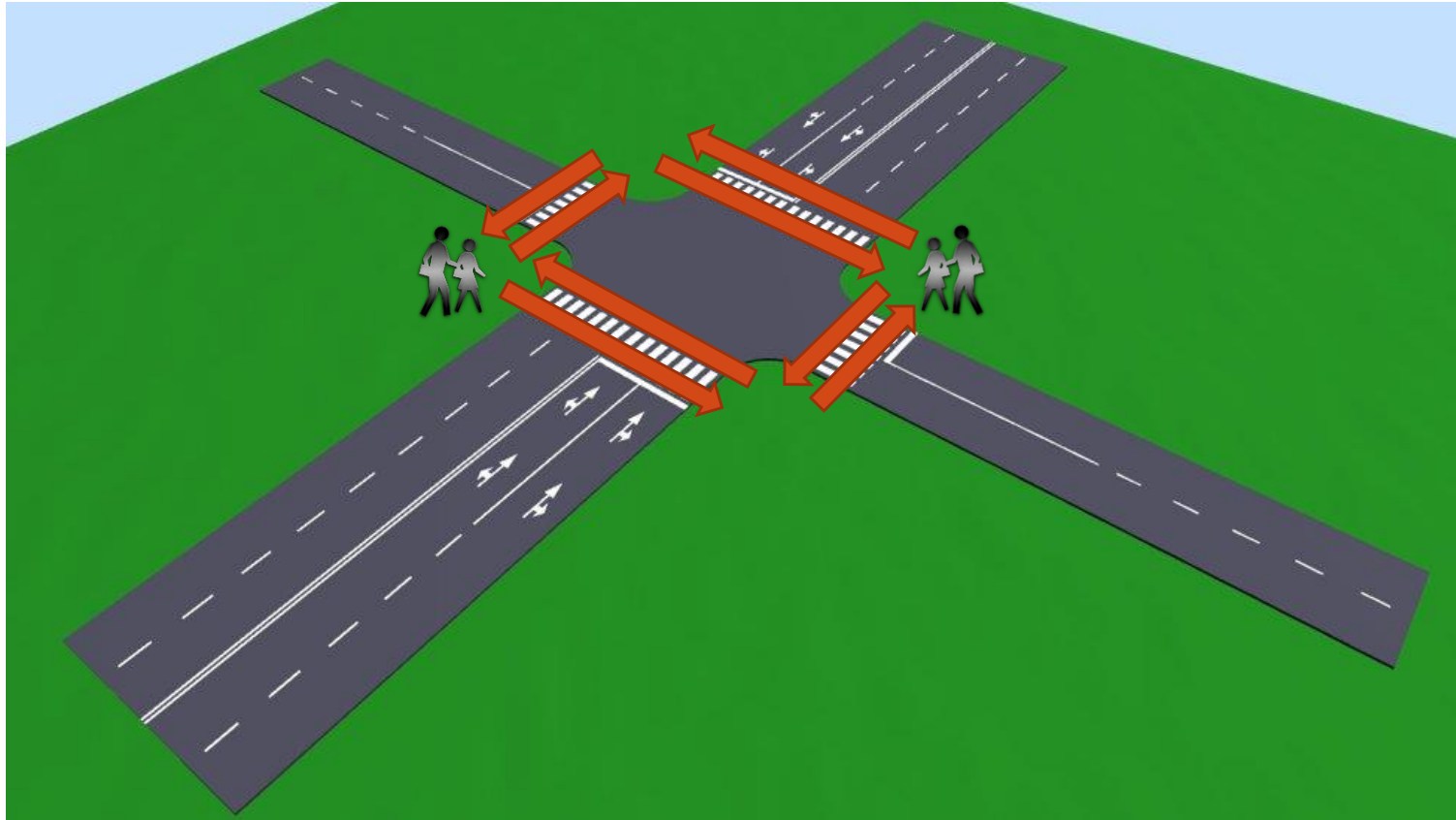
- 14-Hour Traffic Composition of Sumulong Highway-Olalia Road intersection



# Pedestrian Count (1)

- Volume counts of pedestrians are made at locations such as subway stations, mid-blocks, and crosswalks. The counts are usually taken at these locations when the evaluation of existing or proposed pedestrian facilities is to be undertaken. Such facilities may include pedestrian overpasses or underpasses.
- The locations at which pedestrian counts are taken also include intersections, along sidewalks, and mid-block crossings. These counts can be used for crash analysis, capacity analysis, and determining minimum signal timings at signalized intersections.

# Pedestrian Count (2)



# SPOT SPEED SURVEY

# Spot speed surveys

- Spot speeds are the instantaneous speeds of vehicles at the observation site.
- They are commonly required in accident analyses, and used to assess the need for, and impact of, traffic management and control measures/devices, e.g. speed limits, signal settings, road markings, speed-change lanes, no passing zones, traffic signs, and pedestrian crossings.
- Spot speed surveys are carded out as inconspicuously as possible to minimise the influence of the observer(s) and equipment upon the vehicles surveyed.

# SPEED

- The speed of a vehicle is defined as the distance it travels per unit of time. It is the inverse of the time taken by a vehicle to traverse a given distance.
- Most of the time, each vehicle on the roadway will have a speed that is somewhat different from the speed of the vehicles around it.
- In quantifying the traffic stream, the average speed of the traffic is the significant variable. The **average speed**, called the **space mean speed**, can be found by averaging the individual speeds of all of the vehicles in the study area.

# Measurement Method of Speed

1. Electronically measuring the time taken by a vehicle to cross two parallel detectors located closely together, on or in or over the carriageway, e.g. two pneumatic tubes, cables, inductive loops, or infra-red beams;
2. using video or closed circuit television (CCTV) to measure the distances travelled by vehicles during a fixed time-interval or the times taken to cover a fixed distance;
3. Manual measurement using a radar speedmeter.

# TRAVEL TIMES AND DELAY SURVEYS

# Travel Time And Delay Studies

- A **travel time study** determines the amount of time required to travel from one point to another on a given route.
- In conducting such a study, information may also be collected on the locations, durations, and causes of delays. When this is done, the study is known as a **travel time and delay study**.
- Data obtained from travel time and delay studies give a good indication of the level of service on the study section. These data also aid the traffic engineer in identifying problem locations, which may require special attention in order to improve the overall flow of traffic on the route.

# Definition of Terms

- **Travel time**
  - the time taken by a vehicle to traverse a given section of a highway
- **Running time**
  - the time a vehicle is actually in motion while traversing a given section of a highway
- **Delay**
  - the time lost by a vehicle due to causes beyond the control of the driver

# Definition of Terms

- **Operational delay**

- that part of the delay caused by the impedance of other traffic.
- This impedance can occur either as side friction, where the stream flow is interfered with by other traffic (for example, parking or unparking vehicles), or as internal friction, where the interference is within the traffic stream (for example, reduction in capacity of the highway)

- **Stopped-time delay**

- that part of the delay during which the vehicle is at rest

- **Travel-time delay**

- the difference between the actual travel time and the travel time that will be obtained by assuming that a vehicle traverses the study section at an average speed equal to that for an uncongested traffic flow on the section being studied.

# Method for Conducting Travel Time and Delay Studies

1. Floating Car Method
2. Number Plate Survey
3. Test Car Method

# Method for Conducting Travel Time and Delay Studies

## 1. Floating Car Method

- This method involves making a round trip along a route, both with and against the traffic flow. Observations are made of the travel time in each direction, the number of vehicles passed by the test vehicle and the number passing.

$$q = 60 \frac{(X+(Y-Z))}{ta+tw} \qquad t = tw - 60 \frac{(Y-Z)}{q}$$

**X**= number of vehicles passing the observer in the **opposite** direction

**Y**= number of vehicles which pass the driver in the **same** direction

**Z**= number of vehicles that the driver **overtakes** in the section

**ta**= journey time of the observer when travelling **against the stream**

**tw** = journey time of the observer when travelling **with the stream**

# Method for Conducting Travel Time and Delay Studies

## 2. Number Plate Survey

- This method involves the recording of number plate and times at the start and end of the surveyed route. Number plates are then matched to determine the travel time between the stations.

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# Method for Conducting Travel Time and Delay Studies

## 3. Test Car Method

- This method involves driving along a route starting at a precise time, and recording times at selected points along the route.

Driving Techniques:

a. Floating Car Technique

- drivers attempt to "float" with the moving traffic

b. Average Car Technique

- drive according to the driver's judgment of the average speed of other vehicles.

c. Maximum Car Technique

- test car is driven at the posted speed limit

# Method for Conducting Travel Time and Delay Studies

## 3. Test Car Method (Average Car Technique)

- This technique involves driving the test car along the length of the test section at a speed that, in the opinion of the driver, is the average speed of the traffic stream.
- The time required to traverse the test section is noted. The test run is repeated for a **minimum three (3) times per time period** (during peak hours and off peak hours), and the average time is recorded as the travel time.

AM Peak – 7:00 AM to 10:00 AM

Off Peak – 12:00 NN to 2:00 PM

PM Peak – 4:00 PM to 6:00 PM

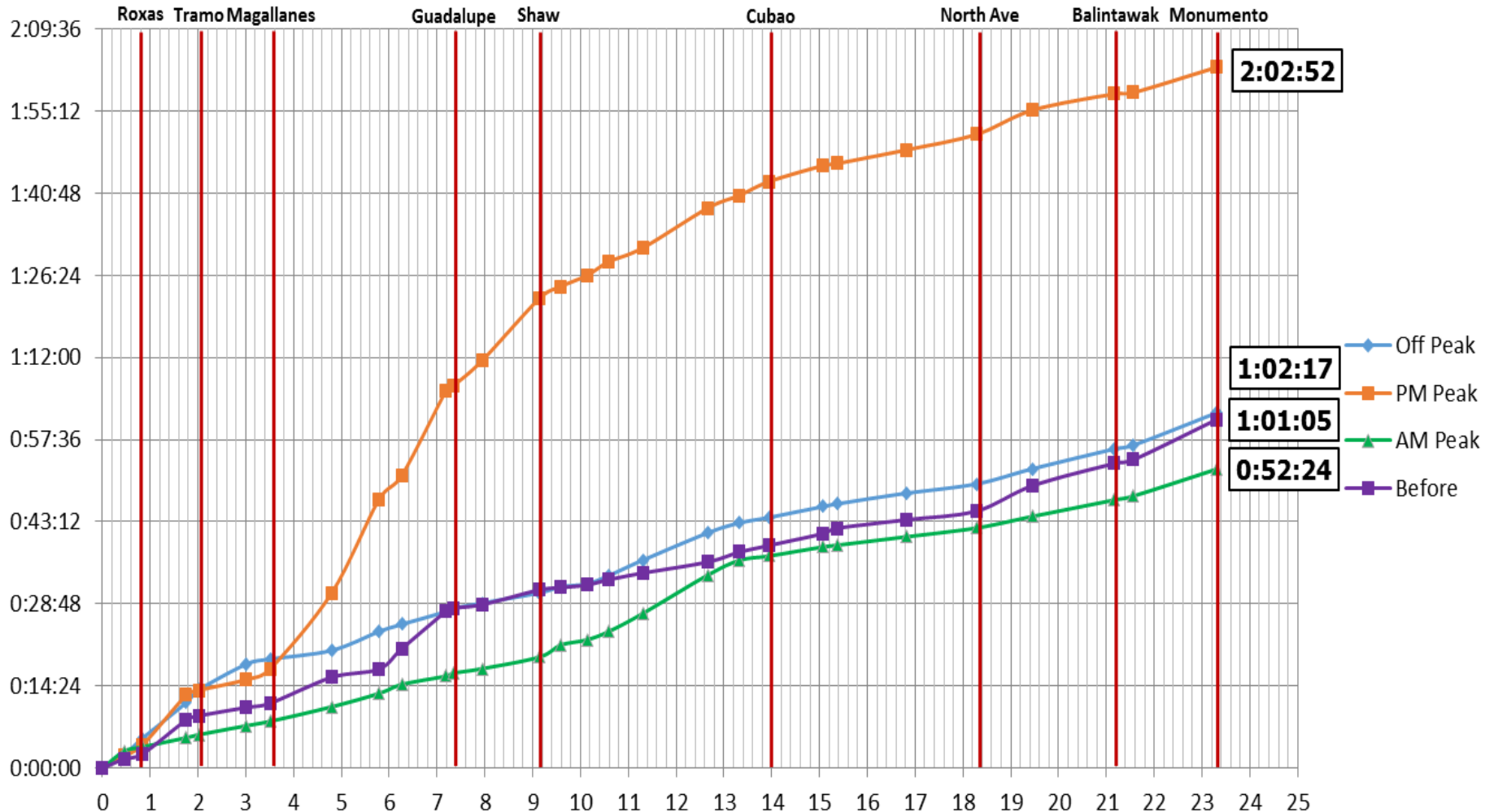
# Method for Conducting Travel Time and Delay Studies

- It is first necessary to clearly **identify the test section**.
- The way the travel time is usually obtained is that the observer starts a stopwatch at the beginning point of the test section and stops at the end.
- Additional data also may be obtained by recording the times at which the test vehicle arrives at **specific locations** which have been identified before the start of the test runs.
- A second stopwatch also may be used to determine the time that passes each time the vehicle is stopped. The recorder then records the reason for stoppage.
- The sum of these times for any test run will give the stopped-time delay for that run.

# Travel Time and Delay Data Presentation

■ Time-distance diagram for EDSA Northbound travel time study

## NB Travel Time using CAR



# Travel Time and Delay Data Presentation

■ Time-distance diagram for EDSA Southbound travel time study

## SB Travel Time using CAR

