
Assessment of Vehicle Speeds And Traffic Safety Along Commonwealth Avenue

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Abstract: This study evaluates vehicle speeds along an urban arterial, specifically the Commonwealth Avenue. The primary objectives of this study are to measure the speeds of vehicles passing along Commonwealth Avenue, to perform statistical analysis on the data collected, and to assess road traffic safety and policies along Commonwealth Avenue. These data were first analyzed and then compared to the data obtained by the International Road Assessment Programme (iRAP). Spot speeds of vehicles were gathered at specific points using video surveys. These data were analyzed for each type of vehicle moving northbound or southbound at different points along Commonwealth Avenue during different hours of the day. Findings include: (1) motorcycles have the highest speeds among the vehicle types; (2) the vehicles tend to have the highest speeds at the point near UP-Ayala Land TechnoHub; (3) the vehicles have relatively higher velocities along the south bound direction; (4) the afternoon period has the least velocity; and (5) motorcycles are more likely to exceed the 60-kph speed limit compared to other types of vehicle.

Key Words: vehicle speeds, arterial, traffic safety

1. INTRODUCTION

1.1. Background of the Study

The Commonwealth Avenue, previously called as Don Mariano Marcos Avenue, is one of the major highways in Metro Manila located in Quezon City, Philippines. It is a 12.4-km highway and runs in a southwest to northeast direction from the Quezon Memorial Circle at its southern end to the Quirino Highway at its northern end. Since its construction in the 1960's, the Commonwealth Avenue has undergone several road widening operations in order to increase its capacity and accommodate the rising demands of traffic growth and economic development. The road spans from 10 lanes to 18 lanes at its widest by the year 2000. At present, the Commonwealth Avenue carries an AADT of almost 200,000 vehicles per day.

The Commonwealth Avenue is dubbed the 'killer highway' because of the high occurrence of vehicular accidents along the arterial. MMDA statistics show that in 2010, at least 21 people were killed while 634 others were injured in more than 2,000 accidents that took place on the highway. Based on the iRAP study, the yearly cost of death and serious injury on Commonwealth Avenue is estimated to be PHP 527 million (USD 12 million) and despite the recent



Figure 1. Flow of Traffic along Commonwealth Avenue

efforts of both the DPWH and the MMDA in an attempt to lessen the death toll through different schemes, the number of people being killed and seriously injured on this major road is escalating.

1.2. Statement of the Problem

Due to the increasing occurrence of vehicular accidents, an assessment of vehicle speeds along Commonwealth Avenue should be conducted to determine the behavior of vehicles and use this to evaluate safety along the arterial.

1.3. Objectives

General Objectives:

The objectives of this study are to identify the speeds of vehicles passing along Commonwealth Avenue, to perform statistical data analyses and produce frequency histograms from the obtained vehicle speeds, and to use these data in assessing safety along Commonwealth Avenue.

Specific Objectives:

This study specifically aims to:

- To assess the speed behavior of vehicles depending on their type
- To identify the speed behavior of vehicles moving northbound and southbound
- To observe the speed behavior of vehicles during different hours of the day
- To evaluate the average speed of vehicles at different points along Commonwealth Avenue
- To determine the number of vehicles exceeding the currently implemented 60-kph speed limit along Commonwealth Avenue

1.4. Significance of the Study

This study evaluates the vehicle speeds along Commonwealth Avenue. This provides statistical analyses on the average speed for each type of vehicles moving northbound or southbound at different points along Commonwealth Avenue during different hours of the day. Frequency histograms of the obtained data are provided to present and illustrate the traffic flow characteristics. The result of this study can be of great help to the management

of the traffic flow, also in the evaluation of safety along the arterial. This also serves as a basis for future studies.

1.5. Scope and Limitations

The video surveys used for data gathering are conducted on weekdays during regular days, i.e. non-holidays and during fine weather conditions, i.e. not raining. This is to avoid the unnecessary build up of traffic which may cause erroneous results. U-turns and loading/unloading areas are not considered in this study.

1.6. Framework

Figure 2 shows the conceptual framework of the study. Of the three traffic characteristics, the speed of the vehicles is taken into account in assessing the vehicle behavior along Commonwealth Avenue. The speeds are obtained per type of vehicle moving northbound or southbound at different points along Commonwealth Avenue during different hours of the day.

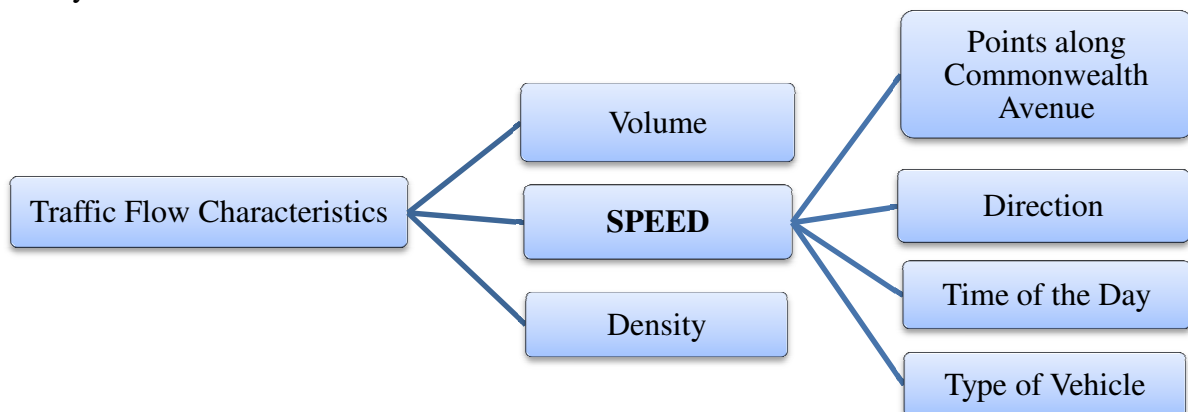


Figure 2. Conceptual Framework of the Study

2. REVIEW OF RELATED LITERATURE

2.1. Video Surveys

According to the book *Traffic Engineering Design Principles and Practice*, a relatively new and efficient tool for data collection of traffic flow is the use of video. A tactically positioned camera can be used to monitor the vehicles passing along an arterial. The camera is placed in such a way that it minimizes the obstruction and covers the desired study area. Depending on the kind of device used and its location, it is possible to observe up to 400 meters of road from a single vantage point. With a video, the following can be recorded at the same time: (1) Traffic flow, (2) Turning movements, (3) Speeds, (4) Congestion and delays, (5) Parking and loading, and (6) Pedestrian movements. Most importantly, a video provides the interaction of all these aspects.

One major advantage of using a video camera in observing traffic flow is that it records everything that actually happens. Other survey methods record partial data, gathering only

the characteristics of traffic needed for a certain study. Using a video survey, it is possible to view the traffic situation multiple times.

One advantage of doing video surveys is that only one person is needed to operate the video camera. A disadvantage, however, is that the repeated viewing of the video recordings may be time consuming, especially if there are no computer aided methods available.

2.2. iRAP

The International Road Assessment Programme (iRAP) is a registered aid organization dedicated to saving lives through safer roads. iRAP conducted a study of traffic flow along Commonwealth Avenue. Road Korea and DPWH observed in June 2011 the vehicle speeds in both directions with the use of a handheld laser during the following times of the day:

- 1:00 AM to 1:50 AM
- 1:50 AM to 2:40 AM
- 7:30 AM to 9:30 AM
- 11:00 AM to 11:50 AM
- 11:50 AM to 12:30 AM
- 9:00 PM to 10:00 PM

Shown in Figure 3 below are the obtained results of the speed surveys. It can be inferred that speeds during the early hours of the morning are the highest.

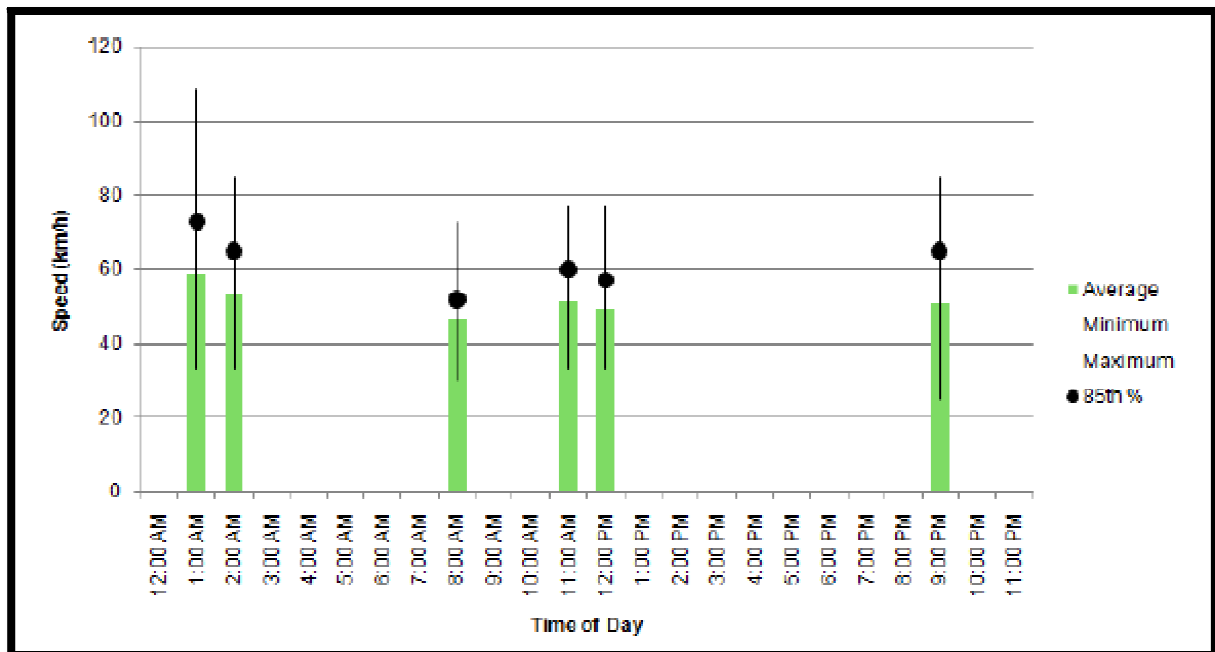


Figure 3. iRAP Data on Average, Maximum, Minimum, and 85th Percentile Speeds along Commonwealth Avenue

Based on the sampling considered, the average 85th percentile throughout the day is 58 km/h and the night-time 85th percentile speed is 73 km/h. These speeds can be used as basis of the analyses in assessing safety along Commonwealth Avenue.

2.3. Number of Deaths and Serious Injuries

To evaluate the safety measures, the occurrence of road accidents along Commonwealth Avenue is required. Shown in Table 1 is the reported number of accidents, both deaths and serious injuries provided by MMDA.

Table 1. MMDA Report on Road Crashes along Commonwealth Avenue

Year	Injuries	Deaths	Property Damage	TOTAL
2009	660	23	2356	3039
2010	634	21	2204	2859

A comprehensive breakdown of deaths per road user type is also used by iRAP in its study to determine which vehicle type contributed more accident occurrences along the arterial. This is provided by *ADB-ASEAN Regional Road Safety Program Country Report: C7, Road Safety in the Philippines*.

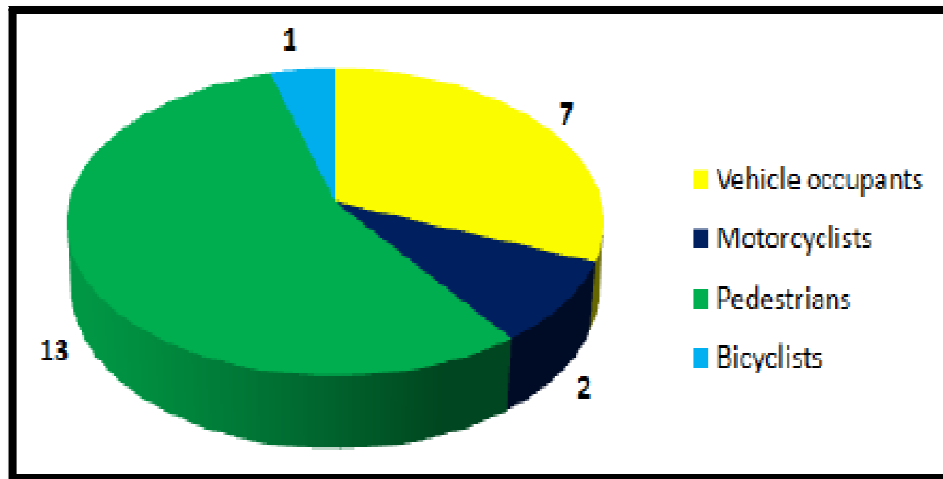


Figure 4. iRAP Data on Estimated Number of Deaths According to Vehicle Type

The number of serious injuries on the road was estimated using the standard iRAP assumption that for every death, 10 serious injuries take place. This is based on research by McMahon and Dahdah (2008). This means that, based on the figures in Table 1, there are 230 serious injuries in 2009 and 210 serious injuries in 2010. To get the approximation of yearly occurrences of deaths and serious injuries, the data available for 2009 and 2010 are averaged. It is assumed then that the yearly number of deaths is 22 and it follows that the yearly number of serious injuries is 220.

2.4. Imposed 60-kph Speed Limit

MMDA reevaluated its road traffic schemes and came up with an immediate solution of implementing the 60-kph speed limit along Commonwealth Avenue. This was implemented starting last January 2011, hoping that motorists slow down and be more cautious in driving along the killer highway. MMDA thought of this as a good scheme in doing away the fatal accidents happening along Commonwealth Avenue. It was reported by Ellson Quismorio in his online article at Manila Bulletin Publishing Corporation that close to 800 vehicles were caught violating the 60-kph speed limit between May 16-20, 2011. The number of violators decreased as days and months passed.

3. METHODOLOGY

3.1. General Research Flow

1. Video survey was conducted at four (4) different points along Commonwealth Avenue: (1) UP-Ayala Land TechnoHub Overpass, (2) Central Overpass near the UP entrance gate, (3) Zuzuarregui Overpass, (4) Overpass near the Diliman Preparatory School. Data gathering was performed during different times of the day: peak hours (7-9 AM and 4-6 PM) and off-peak hours (11 AM - 2 PM). Random sampling was used to produce an unbiased sample of vehicles. There were one hundred (100) randomly chosen samples per type of vehicle.
2. The speeds of vehicles were determined by viewing the videos and determining the elapsed time needed to cover the distance between lamp posts.
3. The speeds for each type of vehicles moving northbound or southbound at different points along Commonwealth Avenue during different hours of the day were analyzed.
4. The analyzed data was compared to the iRAP data.
5. The number and percentage of vehicles exceeding the imposed 60 kph speed limit along Commonwealth Avenue was determined.

3.2. Data Gathering

Video survey was the tool used for data collection. A camera was placed high to minimize the obstruction and provide a good view for the study area. The camera was mounted above the overpass and it was angled in such a way that it could cover the desired distance of the section of the road. This camera documented the traffic flow along Commonwealth Avenue.

Table 2. Number of Traffic Video Hours Needed for the Study

POINTS	Time of the Day	No. of Video Hours per Direction	
		North Bound	South Bound
UP-Ayala Land TechnoHub	7 AM – 9 PM	1	1
	12 PM – 2 PM	1	1
	4 PM – 6 PM	1	1
Central Overpass (near the UP gate)	7 AM – 9 PM	1	1
	12 PM – 2 PM	1	1
	4 PM – 6 PM	1	1
Zuzuarregui Overpass	7 AM – 9 PM	1	1
	12 PM – 2 PM	1	1
	4 PM – 6 PM	1	1
Diliman Preparatory School	7 AM – 9 PM	1	1
	12 PM – 2 PM	1	1
	4 PM – 6 PM	1	1

A one-hour video was recorded for the north bound direction and another one-hour video for the south bound route. These were taken at different points along Commonwealth Avenue during different times of the day (peak/off-peak hours). Shown in Table 2 are the video hours required in this study.

Distance between lamp posts was measured with the help of the DPWH lane marking workers and later on, was verified by the project engineer of the Brostan Construction Company. According to their measurement, the distance between lamp posts at the inner

island along Commonwealth Avenue is 35 meters. Shown in Figure 5 are photos during the actual measurement.



Figure 5. Actual Distance Measurement with the DPWH Lane Marking Workers

The velocity formula was used to obtain the vehicle speeds along the arterial. The time needed to cover the distance was determined from the recorded traffic video using a stopwatch.

$$v = d/t \quad (1)$$

where v : speed, km/h

d : distance between lamp posts, m

t : time elapsed to cover the distance, s

Data were gathered per type of vehicle: motorcycles, private vehicles (cars, SUVs), public transportation (jeepneys, buses), and large trucks. Shown in Figure 6 is a sample distance covered in determining the vehicle speeds.



Figure 6. Study Area near Diliman Preparatory School

The mean, median, mode and standard deviation, as well as the 15th and 85th percentile of the observed speeds were determined. Histograms, graphs and charts were shown for a more visual analysis.

4. DATA AND RESULTS

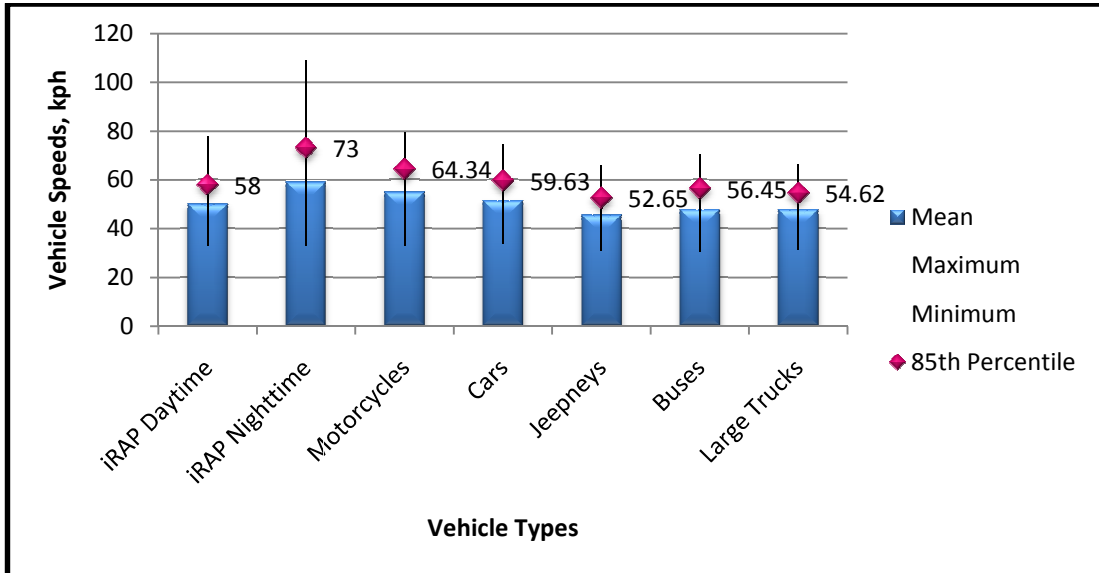


Figure 7. Vehicle Speeds According to Vehicle Type

Shown in Figure 7 is the comparison of speeds according to vehicle type. Notice that the motorcycles have the highest speed among the different types of vehicles. Its 85th percentile speed, 64.34 kph, exceeded the iRAP 85th percentile speed of 58 kph.

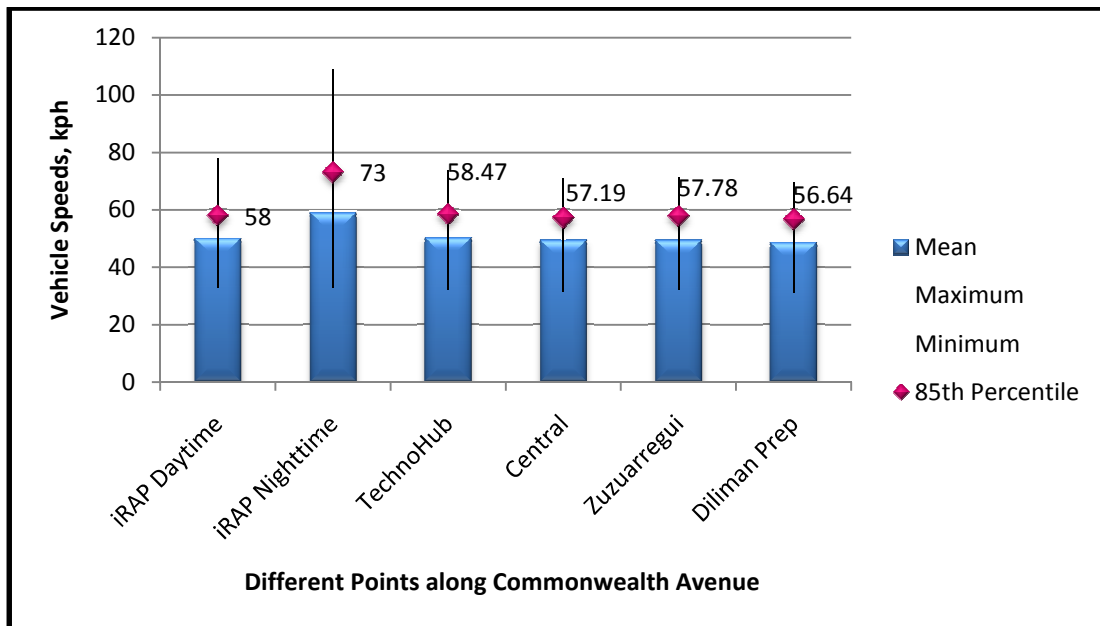


Figure 8. Vehicle Speeds at Different Points along Commonwealth Avenue

Based on Figure 8, it is clearly presented that vehicles tend to have the highest speed at the point near the UP-Ayala Land Techno Hub, with 85th percentile speed equal to 58.47 kph.

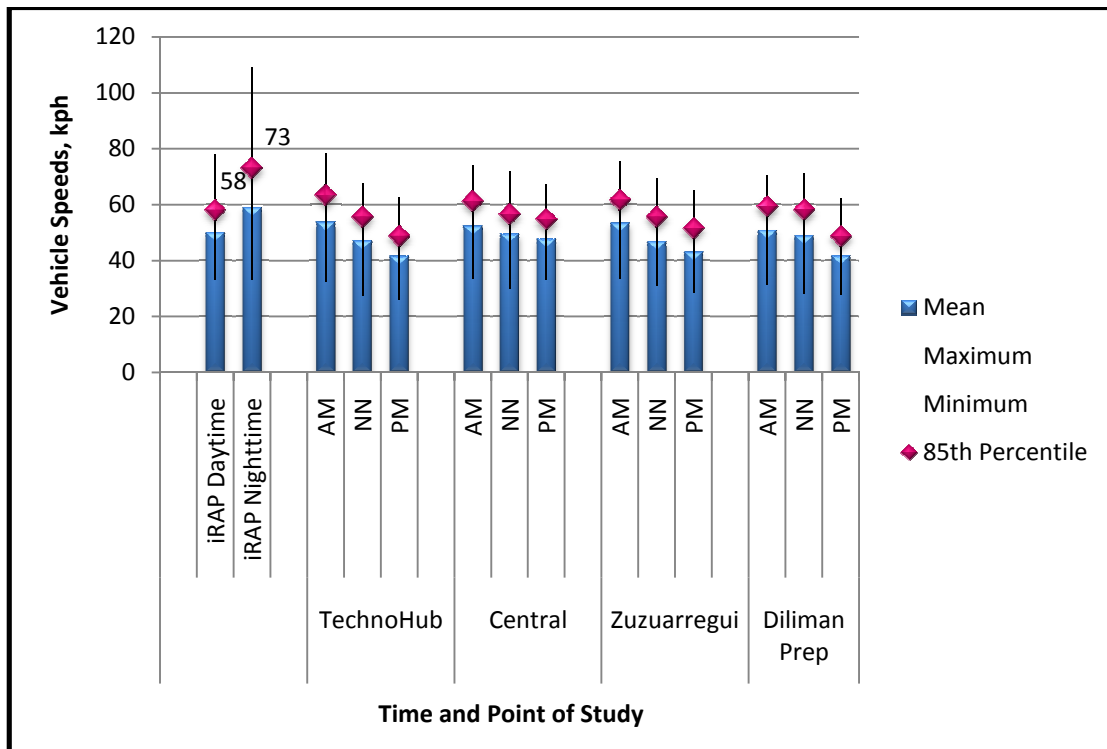


Figure 9. Vehicle Speeds along the North Bound Direction

Shown in Figure 9 are the speeds of all vehicle types passing the Commonwealth Avenue along the north bound direction. The speeds are lowest during the afternoon peak hour. This can be attributed to the traffic congestion during this specific period.

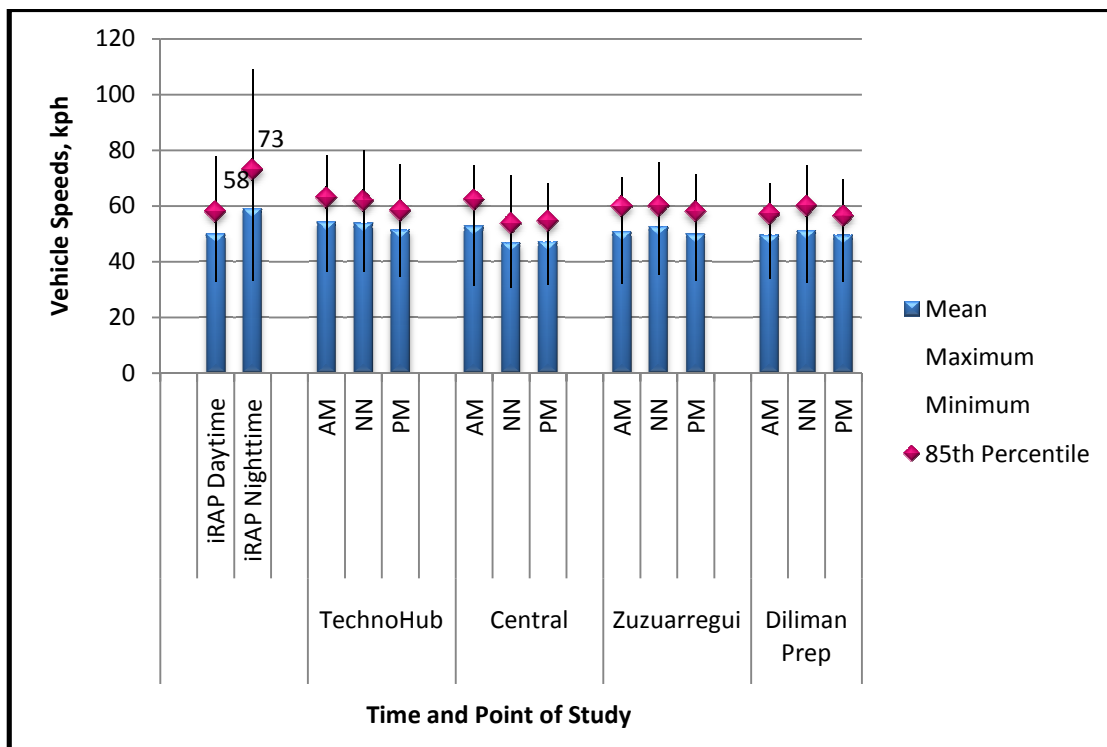


Figure 10. Vehicle Speeds along the South Bound Direction

Shown in Figure 10 are the speeds of all vehicle types passing the Commonwealth Avenue along the south bound direction. The 85th percentile speeds of the vehicles have almost comparable values during the different hours of the day. Small variation may be due to the traffic jam at certain times.

The number and percentage of vehicles exceeding the imposed 60-kph speed limit along Commonwealth Avenue were also determined. The results are shown below:

Table 3. Number and Percentage of Vehicles Exceeding the Imposed 60-kph Speed Limit According to Vehicle Type

Vehicle Type	Number of Vehicles	Percentage of Vehicles, %
Motorcycles	588	24.50
Cars	329	13.71
Jeepneys	82	3.42
Buses	201	8.38
Large Trucks	105	4.38

Table 3 shows that out of the 2400 random samples for each vehicle type, motorcycles are more likely to exceed the 60-kph speed limit compared to other types of vehicles, with 588 number of motorcycles exceeding the speed limit, equivalent to 24.5% of the total number of motorcycle samples.

Table 4. Number and Percentage of Vehicles Exceeding the Imposed 60-kph Speed Limit at Different Points Along Commonwealth Avenue

Points along Commonwealth Avenue	Number of Vehicles	Percentage of Vehicles, %
TechnoHub	380	12.67
Central	320	10.67
Zuzuarregui	349	11.63
Diliman Preparatory School	256	8.53

Table 4 shows that out of the 3000 vehicle samples passing in every point along Commonwealth Avenue, the vehicles tend to speed up and violate the 60-kph speed limit along the UP-AyalaLand TechnoHub area, with 380 number of vehicles exceeding the speed limit, equivalent to 12.67% of the total number of vehicles passing along the area.

Table 5. Number and Percentage of Vehicles Exceeding the Imposed 60-kph Speed Limit According to Direction

Direction	Number of Vehicles	Percentage of Vehicles, %
North Bound	595	9.92
South Bound	710	11.83

Table 5 shows that out of the 6000 vehicle samples passing along each direction, the vehicles moving towards the south bound direction are more likely to exceed the 60-kph speed limit compared to those vehicles moving along the north bound route, with 710 number of vehicles, equivalent to 11.83% of the total number of vehicle samples passing along the south bound direction.

Table 6. Number and Percentage of Vehicles Exceeding the Imposed 60-kph Speed Limit During Different Hours of the Day

Time of the Day	Number of Vehicles	Percentage of Vehicles, %
Morning	677	16.93
Noon	402	10.05
Afternoon	226	5.65

Table 6 shows that out of the 4000 vehicle samples passing during the different hours of the day, more vehicles are over speeding during the morning hours compared to noon and afternoon hours, with 677 number of vehicles violating the imposed 60-kph speed limit, equivalent to 16.93% of the vehicle samples in the morning study period.

Based on the data presented, the motorcycles are more likely to speed up compared to other vehicle types. The motorcycle lane could be a contributing factor to their high speed, since the motorcycles did not have to swerve from one lane to another. Other vehicle types such as cars, and large trucks did not have specific lanes assigned to them, allowing them to change from one lane to another which may cause further delay in their travel time.

In assessing safety along the arterial, the data obtained using video surveys was used to determine the number and percentage of vehicles exceeding the currently implemented 60-kph speed limit along Commonwealth Avenue. As shown in Table 3, the motorcycles have the most number of over speeding incidents which reaches up to 588 motorcycles. This can be related to the fact that the motorcycles are more likely to speed up compared to other vehicle types as explained in the previous paragraph.

The data obtained using video surveys was also being compared to the iRAP data. Based on the iRAP study conducted in June 2011, the Commonwealth Avenue has general 85th percentile speeds of 58 kph during daytime and 73 kph during nighttime. As shown in Figure 8, there is no significant difference between the 85th percentile speeds of vehicles at different points along Commonwealth Avenue with the iRAP daytime 85th percentile speed. The vehicles passing along the TechnoHub section have an 85th percentile speed equal to 58.47 kph. For those passing along the Central area, the vehicles have an 85th percentile speed equal to 57.19 kph. While those vehicles passing along the Zuzuarregui and Diliman Preparatory School have 85th percentile speeds equal to 57.78 kph and 56.64 kph, respectively. The trivial differences between the video survey data and the iRAP data can be attributed to the different methods of data collection used. While the iRAP study used a handheld laser, the video survey used a camera to cover the traffic flow along Commonwealth Avenue.

5. CONCLUSIONS

After completion of this study, the general objectives have been met. The speeds of vehicles passing along Commonwealth Avenue were determined. Statistical data analyses were performed. Histograms and charts were produced. Also, safety assessment along the arterial was also performed. Based on the data presented in the previous section, the specific objectives have also been met. It can be concluded that:

- The motorcycle has the highest speed among the vehicle types, with 85th percentile speed equal to 64.34 km/h.

- The vehicle speeds along the south bound direction have small discrepancies during the different hours of the day.
- Meanwhile, the vehicle speeds along the north bound direction have large differences, ranging from 63.32 km/h to 48.66 km/h.
- For the different hours of the day, the vehicles passing the arterial in the afternoon (4-6 PM) have the least speed. This can be accounted to the traffic congestion during the afternoon peak hour.
- The vehicles tend to have the highest speed at the point near UP-Ayala Land TechnoHub, with 85th percentile speed equal to 58.47 km/h.
- The motorcycle has the highest chance of over speeding and violating the 60-kph speed limit implemented along Commonwealth Avenue.

Shown in Figure 11 is the summary of results:

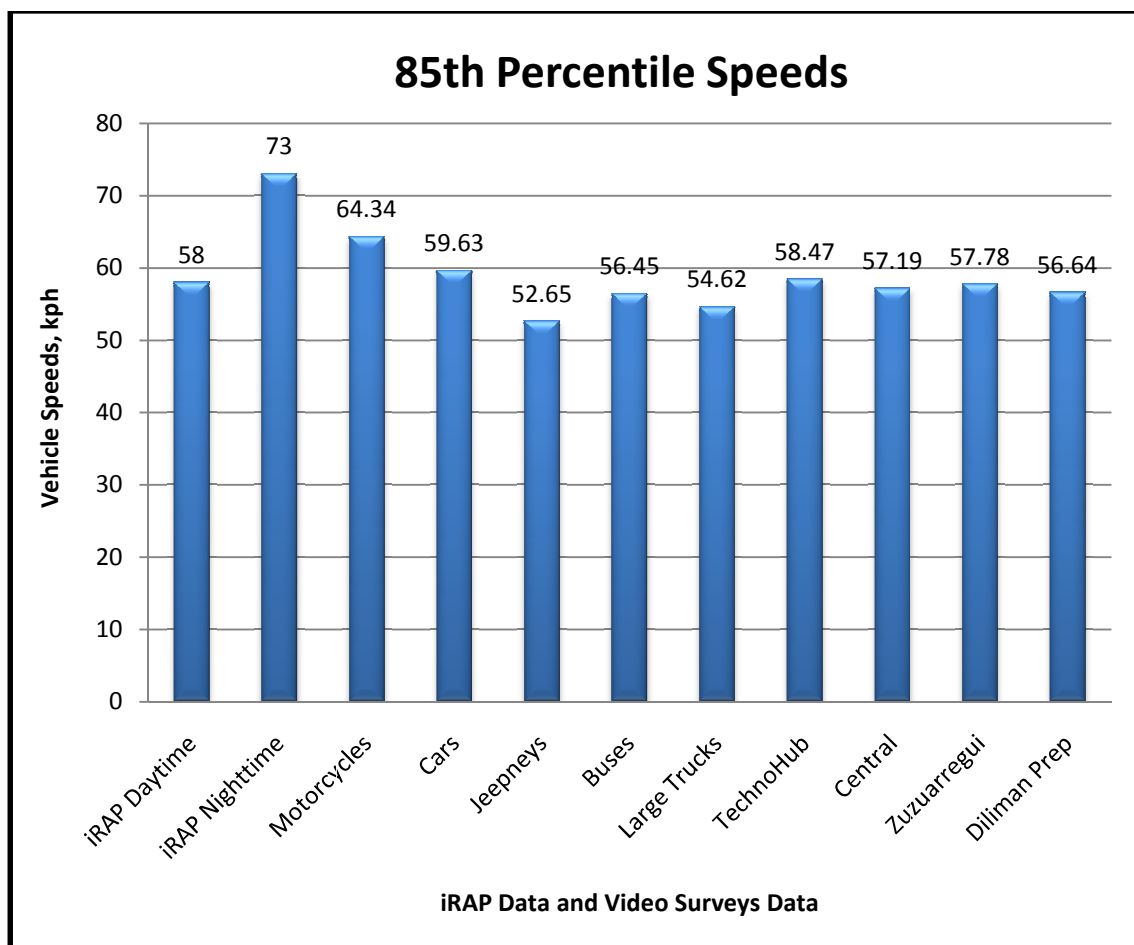


Figure 11. Comparison of the 85th Percentile Speeds Between the Video Surveys Data and the iRAP Data

6. RECOMMENDATIONS

For safety assessment, the MMDA and Quezon City Council should strictly observe the implementation of the 60-kph speed limit. The traffic enforcers should not discriminate in apprehending the motorists. This is to ensure the security of motorists along the arterial and thereby, reducing the accident occurrences.

For data gathering, consider additional sections along Commonwealth Avenue to be able to sketch vehicle speeds throughout the whole arterial. If possible, take into account the different lanes in obtaining the speeds. Weekdays and weekends data can also be obtained. It is also appreciated if the institute can provide manpower in helping the future researchers conduct the study, also for safety purposes. Other data collection tools can also be used. Hopefully, by the upcoming terms, the National Center for Transportation Studies (NCTS) can provide LED Speed Gun to have a faster, more advanced, and more accurate data gathering.

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