

Determinant of the Level of Service (LOS) of the Arterial Roads in Vigan City, Ilocos Sur, Philippines

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Abstract: This study focused on the determinant of the level of service of selected arterial roads in Vigan City, Ilocos Sur, Philippines. It aimed to characterize the area and level of service of intersection. It is recommended that the city government of Vigan should consider some engineering practices that would facilitate the movement of the people and the good within the central business district of Vigan City. It is suggested that the traffic enforcers will strictly implement traffic rules, laws found in the Land Transportation and Traffic Code of the Philippines (Republic act 4136) and the transportation code of the city of Vigan.. The City government should adopt some environmentally sustainable transport strategies in the pursuit of a sustainable development of the city of Vigan without sacrificing its legacy as world heritage site.

Keywords: Arterial Road, Traffic Management, Environmentally Sustainable Transport

1. INTRODUCTION

Vigan became a city and was declared as a UNESCO world heritage site on 2001 and there was a remarkable growth in population, transportation system and economic status of the city. Many areas of the city had developed new centers of business enterprises. The development of big shopping malls, banks, schools, and construction of hotels, preservation of ancestral houses and other establishment in the *poblacion* part of the city had generated traffic comprehension. All these developments of many new centers of activities defined where most people would want to go and invites higher demand for transportation.

Several arterial road connects main thoroughfare to the central business district (CBD) of the city of Vigan, a world heritage site. At present Quezon Avenue, Rizal St and Quirino Boulevard are considered as arterial /major road. The said major roads are considered as the main access to the different collector roads of the city of Vigan. Vehicles are parked on the streets and as a result capacity of the road is believed to be affected. Flow or vehicular volume is an indicator of road capacity. Information on the volume-to-capacity ratio (V/C) and level of service (LOS) provides the planner and the local official a basis in improving the traffic condition of the roads in Vigan City that would help the traffic enforcers and planners to provide mitigations to solve traffic problems.

2. OBJECTIVE OF THE STUDY

The study assessed the implementation of the one-way policy along Quezon Avenue, Vigan City, Ilocos Sur, Philippines.

The study has the following specific objectives:

1. To characterize the major road under study,
2. To gather parking data,
3. To determine the average speed of vehicles traveled along Quezon Avenue,
4. To determine the level of service of the intersections along the arterial/major roads.

3. SIGNIFICANCE OF THE STUDY

The result of the study positively helps the engineering department of the local government unit of Vigan City and their effort to address the traffic problems such as road accidents, congestion, pollution and energy problems which heavily confront and bother the authorities concerned on traffic rules and management.

The result will also provide important empirical data on the traffic conditions, issues, and concern of the city which are considered as prime movers of the LGUs as far as traffic management policy creation and implementation are concerned.

4. SCOPE AND LIMITATIONS

The study focused on determinant of the level of service (LOS) of selected arterial/major roads of Vigan City, Ilocos Sur, Philippines as shown in Figure 1. The information presented in this paper was limited to the data gathered during the conduct of road inventory, spot speed survey, traffic volume count.

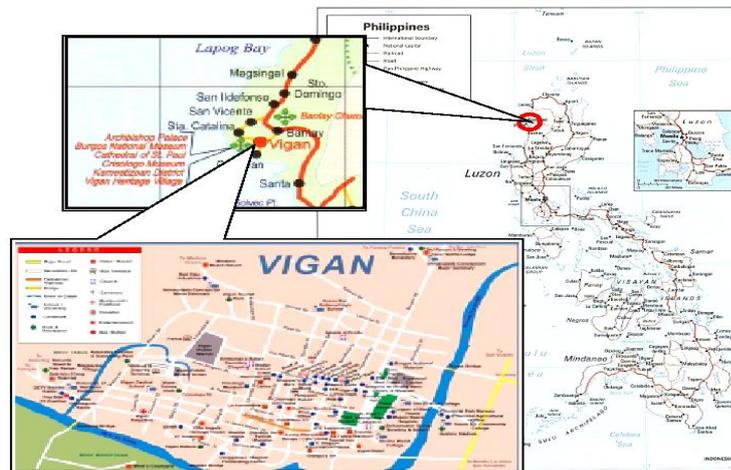


Figure 1. Location Map of Vigan City

5. METHODOLOGY

The researcher coordinated with the City Administration of Vigan. Information needed in this study was gathered by spot speed survey and volume survey. Traffic volume count was employed to establish information on the volume per capacity (V/Cap) ratio so that the researcher can derive the level of service of the arterial/major roads under study

Parking patrol survey was conducted to determine the duration of vehicle parked On-street along Quezon Avenue during the one hour period survey on October 7, 2017. Spots speed survey was implemented to determine the average speed of vehicles randomly selected. A trap of 20 meter was established along the road side of mid-block, General Luna Street and Salcedo Street on October 14, 2017. Traffic volume count was conducted for a period of ten hours (10) from 7:00 A.M. to 6:00 P.M. on September 23, 2017 and October 7, 2017. Manual counting was employed for every 15-minute interval considering the types of vehicle plying at selected intersections. A template for capacity analysis for Planning and Operational Method used by the Traffic Engineering Center (TEC), Metro Manila Development Authority (MMDA) and the Traffic Engineering and Management (TEAM), Department of Public Works and Highways (DPWH) was used by the researcher to derive the volume-to-capacity ratio (V/C) and identify the level of service of the intersections for the peak hour periods. The Level of Service and Volume-to-Capacity ratio for the traffic signal analysis, criteria for intersection used for the Philippine Highways and prescribed by the Department of Public Works and Highways is presented in Table 1.

Table 1. Traffic Signal Analysis Criteria for Intersection

Level of Service (LOS)	Volume/Capacity Ratio (V/Cap)	Description
A	Less than 0.20	Free flow traffic
B	0.21 to 0.50	Free flow traffic
C	0.51 to 0.70	Moderate traffic
D	0.71 to 0.85	Moderate heavy traffic
E	0.86 to 1.0	Heavy traffic
F	> 1.0	Force flow, Stop and go

6. RESULT AND DISCUSSION

6.1 Traffic Characteristics of the Major Road Under Study

The major roads under study are Quezon Avenue, Rizal Street and Quirino Boulevard are parallel to the minor road of P. Burgos, Florentino, Bonifacio, General Luna, Salcedo, Mabini, and Liberation Boulevard. The intersections along the arterial/major roads mentioned are unsignalized. The said major roads are the main thorough fares of the city located at the central business district (CBD) and believed to be the way to the different vital installations of the city (e.g. university, colleges, schools, churches, government offices, etc.). At present Quezon avenue is on one- way scheme during 7:00 A.M. to 7:00 P.M based on the Vigan Traffic Management Ordinance 1995 and on the Transportation Code of the City. The Rizal Street and Quirino Boulevard is two road. The unsignalized intersections regulate the drivers and pedestrians to consider awareness and take responsibility when crossing the road. Likewise, traffic enforcers are visible to control and man traffic the intersections on a regular basis because there are unregulated stoppage of vehicles and loading and unloading near the intersections especially on local tricycles that cause the unstable flow of traffic. It was observed that during the peak period, cars, tricycles, single motorcycles contributed much to the worsening of the traffic situation of the city. Likewise, some of the buses and trucks are contributing to the said traffic situation of the foresaid major road of the city. The non-motorized vehicle *calesa* (horse-drawn utility vehicle) also contributes to the unstable flow of

traffic within the area. Because of the present configuration, the three main thorough fares are the busiest road in the City.

6.2 Vehicle On-Street Parking

Table 2 shows the distribution of vehicles on-street parking along Quezon Avenue during the conduct of parking patrol survey on October 7, 2017. The table reflects that about 17% (81) vehicles are parked about 46 minutes to 1 hour in the morning. While more than 14 % (65) vehicles are parked for about 46 minutes to an hour during the afternoon of the same day of survey.

Single motorcycle have the most numbered vehicle parked of about 41% (192) are parked at the eastern portion of Quezon Avenue, while 21 % (98) of these type of vehicle are parked at the western portion of the said major road. For car there are about 14% (67) are parked on-street at the western portion and about 2% (7) were counted at the eastern lane. The non-motorize vehicle have the least numbered of vehicle parked on-street of less than 1% (4 and 3) for the eastern and western slot, respectively.

It was noticed during the conduct of the parking patrol survey that some drivers do not follow the traffic rules which prohibit drivers to park their vehicles within 6 meters from the section as stated in the Republic Act 4136 and the provision in the Traffic Code of Vigan City. Likewise some vehicles are parked near or within the “No Parking” traffic signs.

Table 2. Distribution of Vehicles Parked along Quezon Avenue, Vigan City on October 7, 2017

Duration	Eastern Slots at Quezon Avenue						Western Slots at Quezon Avenue						Grand Total	%
	Bi-cycle	Single Motor-cycle	Tri-cycle	Car	Truck /Bus	Total	Bi-cycle	Single Motor-cycle	Tri-cycle	Car	Truck/ Bus	Total		
AM														
<16 min.	0	6	2	1	1	10	0	28	15	20	0	63	73	15.27
16-30 min.	1	9	4	0	2	16	1	17	5	10	1	34	50	10.46
31-45 min.		11	5	2	3	21	0	4	5	5	0	14	35	7.33
46-60 min.	0	45	3	0	0	48	2	25	1	3	2	33	81	16.94
Sub-Total	1	71	14	3	6	95	3	74	26	38	3	144	239	50
PM														
<16 min.	0	7	1	2	0	10	0	13	20	17	3	53	63	13.18
16-30 min.	2	34	4	2	3	45	0	6	2	16	1	25	70	14.64
31-45 min.	1	23	7	0	2	33	0	1	5	2	0	8	41	8.58
46-60 min.	0	57	0	0	0	57	0	5	1	2	0	8	65	13.60
Sub-total	3	121	12	4	5	145	0	25	28	37	4	94	239	50
TOTAL	4	192	26	7	11	240	3	98	51	67	7	238	478	
%	0.84	40.17	5.44	1.4	2.30	50.20	0.63	20.50	10.67	14.02	1.45	49.80		100

6.3 Speed of Vehicle

The comparative mean speed of vehicles in kilometer per hour is presented in Table 3. Among the 193 different transport mode taken as samples during the spot survey conducted on October 7, 2017, bus has the lowest speed with a mean of 15.18 kilometers per hour while single motorcycle has the highest speed with a mean of 20.78. The over all mean speed of the vehicles during the survey is 18.84 kilometers per hour. The said speed of vehicles is below the maximum speed stated in the Republic Act 4136 which is 30 kilometers per hour for Municipalities and Cities in the Philippines.

Table 3. Comparative Mean Speed of Vehicles in Kilometers per hour (KPH), October 7, 2017

Type of Vehicle	Frequency	%	Mean Speed (Kilometer per hour)	Over All Mean Speed (Kilometer per hour)
Car	80	41.45	20.47	
Tricycle	54	27.98	18.29	
Single Motorcycle	40	20.72	20.78	18.49
Bus	10	5.18	15.18	
Truck	9	4.67	17.76	
Total	193	100		

6.4 Level of Service (LOS)

Table 4 presents the comparative data on the level of service (LOS) of the different intersections along Rizal Street, Vigan City during the conduct of traffic volume count on September 21, 2017. The table reflects that Rizal Street-Burgos Street intersection has a level of service of "F", force flow of there is stop and go for both morning and in the afternoon with a maximum volume per capacity ratio of 1.29 and 1.24, respectively. Rizal Street- Bonifacio Street and the intersection of Rizal Street-General Luna Street are also level of service of "F". Meanwhile the level of service for the average volume per capacity ratio are "C" to "D" which mean moderate to heavy traffic is experience except for Rizal Street- Burgos St. intersection described as forced flow and stoppages may occur which cause a delay of about 3 to 6 minutes or more and may result to a high density of vehicle queues. This suggests that there is a need to improve the intersection and rerouting of some vehicles is needed. Likewise the intersections are warranted for signalization.

Table 4. Comparative Data on the Level of Service of the Intersections along Rizal Street, September 23, 2017

Intersection	Time	Max V/ CAp	LOS	Remarks	Ave. V/Cap	LOS	Remarks
Rizal St.- Burgos St.	8:00- 9:00AM	1.29	F	Force Flow	1.04	F	Force Flow
	4:00- 5:00PM	1.24	F	Force Flow	1.01	F	Force Flow
Rizal St. Florentino	8:00- 9:00AM	1.36	F	Force Flow	0.83	D	Moderate Heavy Traffic
	5:00- 6:00PM	0.89	E	Heavy Traffic	0.53	C	Moderate Traffic
Rizal St.- Bonifacio St.	8:00- 9:00 AM	1.18	F	Force Flow	0.52	C	Moderate Traffic
	1:00- 2:00PM	1.22	F	Force Flow	0.63	C	Moderate Traffic
Rizal St.- Gen. Luna St.	8:00- 9:00AM	1.48	F	Force Flow	0.77	D	Moderate Heavy Traffic
	5:00- 6:00PM	1.35	F	Force Flow	0.53	C	Moderate Traffic

Table 5 reflects a comparative data on the level of service (LOS) of the different intersections along Quezon Avenue, Vigan City during the conduct of traffic volume count on October 7, 2017. The table present that Quezon Avenue-Burgos Street intersection has a level of service of “E”, heavy traffic for morning while in the afternoon the LOS is “F” for the maximum volume per capacity ration. Others streets under study have similar LOS as that of the Quezon Avenue- Burgos Street’s. On the other hand for the average v/cap ratio the LOS varies from “c” to “D”, moderate traffic to moderate heavy traffic. Period, respectively, thus the drivers can maneuver the vehicles with control. With this description there is a need to re-route some motored vehicles to reduce the volume of the vehicles along Quezon Avenue.

When the same intersections are analyzed for average volume per capacity ratio the level of service (LOS) of the intersections is “C” describe as moderate traffic. This description is justified by the value of the volume-to-capacity ratio that ranges from 0.53 to 0.69. This description is said to be suitable for urban places like Vigan City.

Table 5. Comparative Data on the Level of Service of the Intersections along Quezon Avenue, October 7, 2017

Intersection	Time	Max V/Cap	LOS	Remarks	Ave. V/Cap	LOS	Remarks
Quezon Avenue- Burgos St.	8:00-9:00AM	0.95	E	Heavy Traffic	0.69	C	Moderate Traffic
	4:00-5:00PM	1.02	F	Force Flow	0.77	D	Moderate Heavy Traffic
Quezon Avenue- Florentino Street	8:00-9:00AM	1.13	F	Force Flow	0.81	D	Moderate Heavy Traffic
	4:00-5:00PM	1.23	F	Force Flow	0.73	D	Moderate Heavy Traffic
Quezon Avenue- Bonifacio St.	8:00-9:00AM	1.03	F	Force Flow	0.78	D	Moderate Heavy traffic
	4:00-5:00PM	1.13	F	Force Flow	0.82	D	Moderate Heavy Traffic
Quezon Avenue- Gen. Luna Street	8:00-9:00AM	1.0	F	Force Flow	0.68	C	Moderate Traffic
	4:00-5:00PM	1.35	F	Heavy Traffic	0.81	D	Moderate Heavy Traffic
	5:00-6:00PM	1.35	F	Force Flow	0.53	C	Moderate Traffic

Table 6 present a comparative data on the level of service (LOS) of the different intersections along Quirino Boulevard, Vigan City during the conduct of traffic volume count on October 3, 2017. The table revealed that Quirino Boulevard- Florentino Street intersection has a level of service of “E”, heavy traffic for morning while in the afternoon the LOS is “F” for the maximum volume per capacity ratio of 1.12. meanwhile, the LOS when the average volume per capacity ratio ranges from 0.53 to 0.80 is describe as “C” and “D”, respectively.

Table 6. Comparative Data on the Level of Service of the Intersections along Quezon Avenue, October 7, 2017

Intersection	Time	Max V/Cap	LOS	Remarks	Ave. V/Cap	LOS	Remarks
Quirino Blvd. – Florentino St.	7:00-8:00AM	0.85	E	Heavy Traffic	0.69	C	Moderate Traffic
	4:00-5:00PM	1.12	F	Force Flow	0.80	D	Moderate Heavy Traffic
Quirino Blvd.- Liberation Blvd.	7:00-8:00AM	1.10	F	Force Flow	0.59	D	Moderate Heavy Traffic
	4:00-5:00PM	0.97	E	Heavy Traffic	0.53	C	Moderate Traffic

7. SUMMARY

The arterial/major road under study are Rizal Street, Quezon Avenue and Quirino Boulevard, Vigan City parallel to the minor road of Burgos, Florentino, Bonifacio, General Luna, Salcedo, Mabini and Liberation Boulevard.

In the morning, there are 95 vehicles parked at the Eastern slots at Quezon Avenue, while 145 vehicles are parked at the Western slots at Quezon Avenue. In the afternoon, 144 vehicles are parked at the Eastern slots at Quezon Avenue, while 94 vehicles are parked at the Western slots at Quezon Avenue.

The average speed of vehicles traveled along Quezon Avenue are the following: Car (20.47 KPH), Tricycle (18.29 KPH), Single motor (20.78 KPH) , Bus (15.18 KPH), Truck (17.76 KPH) and as a whole the mean speed traveled by vehicles along Quezon Avenue is 18.49 KPH.

It was found out that when the maximum volume per capacity ratio was considered the Level of Service (LOS) of the majority of the intersections along Rizal Street, Quezon Avenue, and Quirino Boulevard are “F” described as force flow or stop and go. When the average volume per capacity ration was analyze the LOS of the intersections are “F” , “E” , “D” and “C” described as force flow or stop and go, heavy traffic, and moderate heavy traffic, and moderate traffic, respectively.

8. CONCLUSIONS

Based on the findings of this study the following conclusions were drawn:

1. The arterial/major roads under study Rizal Street, Quezon Avenue, and Quirino Boulevard, Vigan City. The unsignalized intersections along Rizal Street and Quirino Boulevard have twelve (12) movements, Quezon Avenue have four (4) movements except Quezon Avenue-Burgos Street with six (6) movements. There are traffic control devices along the three arterial/major road.
2. Majority of the vehicles parked along Quezon Avenue are parked at the western slots of Quezon Avenue.
3. The highest mean speed traveled along Quezon Avenue is that of single motor cycle followed by car, tricycle, truck and the lowest is by bus.

4. Majority of the intersections' level of service during the morning and afternoon peak hour period are "F" and "D".

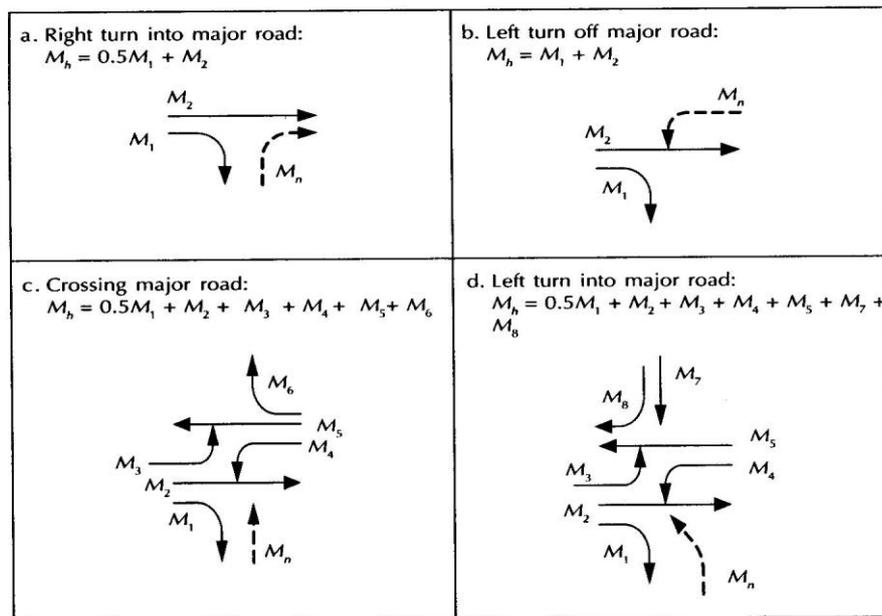
9. RECOMMENDATIONS

1. Planners should adopt the Manual on Uniform Traffic Control Devices (MUTCD) and the Highway Safety Standard-Part 2: Road Signs and Pavement Marking Manual of the Department of Public Works and Highways. Also recommended is that the Local Government Units (LGU) of Vigan City should assess the adequacy of traffic control devices available in the major roads and the collector roads in their respective service area to ensure safety on the road.
2. Traffic policies in Republic Act 4136 also known as the Land Transportation and Traffic Code of the Philippines concerning traffic laws, rules, and regulations and the Traffic Code of the City of Vigan should be strictly implemented.
3. It is recommended that the city should amend the speed set in the city of Vigan of 35 KPH to 30 KPH for uniform with other LGU as stated in the Republic Act 4136.
4. There is a need to re-route some motored vehicles to reduce the volume of vehicles along Rizal Street, Quezon Avenue, and Quirino Boulevard especially during peak hours.

The LGU should encourage the people to use non-motorized vehicles like bicycles, promote car pooling, and implement strategies on how to reduce conflict among street users such as pedestrians and drivers. The city government should adopt an Environmentally Sustainable Transport (EST) System and should consider improvement on urban planning of the city and implement mitigation measures to solve problems that are brought about by the inevitable growth of the different transport modes with the limited road space in the city of Vigan.

5. The Intersections requires improvement. Traffic signals and geometric improvement may be necessary to improve the LOS of the arterial roads. The implementing agency and other researchers may verify the derived LOS by using a more appropriate method in analyzing unsignalized intersection. It is recommended that Planners and Researchers should analyze the structure of the major road traffic considering the major road traffic streams (see figure 6)

LGU should consider the involvement of the public for the betterment of traffic management practices in the heritage city of Vigan.



Source: Organization for Economic Cooperation and Development 1978.

Figure 2. Major Road Traffic Streams

REFERENCES

- Amistad, F. T., (2010) Assessment of Pedestrianization Policy in Vigan City: UNESCO World Heritage Site, Journal of Urban Planning and Development, American Society of Civil Engineers, ISSN 0733-9488, Reston, VA.
- Amistad, F.T., Regidor, J.R., (2005) Traffic Management in a City with U.N. World Heritage Site, Journal on the Proceedings of the Eastern Asia Society for Transportation Studies.
- Babiano, I. M. (2003) The study on Effective Urban Downtown Pedestrian Streets in Metro Manila, Transportation research in the Philippines, A compendium of Graduate Theses in Transportation (1993-2003), National Center for Transportation Studies, University of the Philippines, Diliman, Quezon City, Philippines, ISSN 1656-023X, 161-165.
- Sigua, R. G., (2008) Fundamentals of Traffic Engineering, University of the Philippines, Diliman, Quezon City, ISBN 978-971-542-552-0, Intersection Design and Control, 105-132.
- Tsukaguchi, H., Vandebona U., Sugihara, S., Yeh, K. (2007) *Comparison of Attitude Toward Walking in Japanese Cities*. Journal of the Eastern Asia Society for Transportation Studies, 1794-1805.
- Vizcarra, F.D. (2003), Introduction to Educational Research, Great Books Trading, Philippines, ISBN 971-8581-55-3, Slovin's formula, Non-Parametric Test, 61-68, 191-202.
- Wiersma, W. (2000), Research Method in Education An Introduction, Needham Heights, MA, Pearson Education Co., Measurement and Data Collection, 305-307.

Status/Rules and Others

http://www.wikipedia.org/wiki/cities_of_philippines

Republic Act No.4136. (1964) *An Act to Compile the Laws Relative to Land Transportation and Traffic Rules to Create a Land Transportation Commission and Other Purposes*, Republic of the Philippines

<http://www.vigancity.gov.ph>