American Journal of Engineering Research (AJER) 2015
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-4, Issue-9, pp-176-180
www.ajer.org
Research Paper Open Access

Determination of Traffic Delay at Selected Intersection within Ilorin Metropolis

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ABSTRACT :*Vehicle delay is one of the serious impacts of highway work zones on existing traffic operations. It is used to determine the overall level of service as well as the capacity of intersections. This work evaluated the overall delays at three various intersections in Ilorin metropolis which are tipper garage intersection, Oja Oba intersection and Judiciary-Offa road intersection. The three intersections were considered because of the commercial activities they serve such as linking up routes to important regions like the University, the post office, Government house and so on. Delay studies at each leg of intersection were carried out, the average delay was found out for each intersection and the corresponding level of service. Based on the results, the relocation of taxi/ bus terminals are proposed, on-street parking is discouraged, street hawking is discouraged at the intersections, potholes at the intersection approach should be mended, unpaved road should be overlayed with asphalt and the use of traffic signals should be encouraged so as to increase the present level of service and reduce traffic delay.*

Keywords: *traffic,intersection, delay, level of service*

I. INTRODUCTION

The increase in the number of road users always leads to increasing demand on the facilities. The proper way of determining the traffic should be adopted at intersected section and most especially the area where stopped-delay are more pronounced.According to highway engineering, intersection can be described as a highly complex component of many types of roadways. All the types of road involve numerous intersections with exception of freeways. In a simpler way, intersection is a place where two or more highways meet and provides an area for the cross movement of vehicular traffic.At intersections, a vehicle transfer from the route on which it is travelling to another route; crossing any other traffic streams, which flow between it and its destination. The performance of this maneuver involves a vehicle diverging from, merging with or crossing the paths of other vehicles.Intersections that do not carry a lot of traffic and where visibility is good from all approaches, control may not be needed. The driver uses simply the standing "rules of the road" to determine who gets right-of-way when two vehicles arrive at the same time.Level of service (LOS) of the intersection is measured with regards to stopped delay at intersection. For instance, on priority intersection, traffic volume on the major street may be so heavy that the traffic volume on the minor intersection street experiences excessive delays in entering or crossing the major street.Traffic volume is defined as the number of vehicles that pass a point along a roadway or traffic lane per unit of time. A measure of the quantity of traffic flow, volume is commonly given in units of vehicles per day, vehicles per minute and so forth.Daily on a road, the volume of traffic fluctuates widely with time. The nature of the pattern of variation depends on the type of highway facility. (Wright and Norman, 1978).Delay is the time lost by a vehicle due to causes beyond the control of the driver. It could also be described as the time consumed while traffic or a specific component of traffic is impeded in its free movement. (Garber &Hoel, 2014).Operational delay is that part of a delay cause by the impedance of other **traffic**. The impedance can occur either as side friction, where stream flow is interfered with other traffic (e.g parking or non-parking vehicles), or as internal friction where the interference is within the traffic stream (e.g reduction in capacity of the highway). Stopped time delay is that part of the delay for which the vehicle is at rest. (Garber &Hoel). Fixed delay is that of the delay caused by control devices such as traffic signals. This delay occurs regardless of traffic volume or the impudence that may exist.

Travel-time delay is the difference the actual travel and the 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. (Garber &Hoel).

II. METHODOLOGY

The intersection delay study was performed by the manual method due to the unavailability of delay meters. This involved the counting of 'vehicles stopped' and 'non-stopping' vehicles in the intersection approach at successive intervals. The duration for this interval was 15 seconds. Before the start of the field work, the identifying information is entered on the appropriate places on the field sheet and the first column is completed to indicate succession of sampling time intervals. When starting, the observer counts and records the number of vehicles stopped on the approach of each observation indicated. The stop watch is started at the beginning of the study and to advise the observers of the proper intervals for counting. A vehicle is counted more than once in the delay determination if it is stopped during more than one sampling time. This means that a particular vehicle will continue to be counted in all sample time periods during which it remains stopped on the intersection approach. A separate tabulation of the approach volume was obtained for each time period by classifying the vehicles as either stopping or non-stopping. The number of stopping vehicles is always equal or less than the total number of vehicles stopped on the approach for a specific time interval because vehicles can be delayed for more than one sampling period.

The results of the intersection delay study were summarized by calculating the following

1. Total stopped time delay in vehicles
2. Average delay per approach vehicle
3. Average delay per stopped vehicle
4. Percentage of vehicles stopped.

Other data collected were: number of vehicle waiting at intersection of each approach leg, the volume of traffic discharge at each leg of intersection per time period, physical features at intersection approach that may hinder free flow of traffic, the determination of total delay at intersection and evaluation of alternative intersection control measures.

III. RESULTS AND DISCUSSION

Data collection was carried out at the three different intersections. This involves physical characteristics and delay studies.

Table 3.1: PhysicalCharacteristics of Judiciary/Offa Road Intersection

Approach LEG	Number of lanes	Approach width(m)	Shoulder width(m)	Road surface
Nitel	1	6.90	0	G.C
Sabo-Oke	1	4.75	0	P.R
Post office	1	6.85	0	G.C
Judiciary	1	6.85	0	G.C

3.2: Physical Characteristics of Tipper Garage Intersection

Approach LEG	Number of lanes	Approach width (m)	Shoulder width (m)	Road surface
Tanke Junction	2	6.80	0	G.C
Pipeline	1	6.78	0	P.R
Unilorin	2	6.80	0	G.C
Opp.Pipeline	1	5.60	0	UPR

3.3: Physical Characteristics of Oja-Oba Intersection

Approach LEG	Number of lanes	Approach width (m)	Shoulder width (m)	Road surface condition
Surulere	2	7.20	0	P &G.C
Ita-Amodu	1	6.35	0	G.C
Emir's Road	2	6.83	0	G.C
Opp. Ita-Amodu	1	6.75	0	G.C

P…paved
P.R…paved road
G.C…good condition
UPR…unpaved Road

3.4:Total Average at Judiciary/Offa Road Intersection

Approach	**Average delay per approach Vehicle (Sec)**	**Percent of stopped vehicle**	**Average delay per stopped vehicle (Sec)**	**Level of service**
Nitel	10.56	36.85	26.46	B
Sabo-Oke	15.68	56.37	23.12	C
Post office	11.55	42.25	26.04	C
Judiciary	12.66	51.41	23.04	C
Total Av.average	50.61 12.61	188.53 47.13	98.66 24.67	

3.5: Total Average at Tipper Garage Intersection

Approach	Average delay per approach Vehicle (Sec)	Percent of stopped vehicle %	Average delay per stopped vehicle (Sec)	Level of service
TankeJunc	6.31	34.83	17.49	B
Pipeline	12.95	52.30	21.39	C
P.S	6.74	39.71	18.01	C
Opp pipeline	11.03	51.35	20.85	B
Total Av.average	37.03 9.26	178.19 44.55	77.74 19.44	

3.6: Total Average at Oja-Oba Roundabout

Approach	**Average delay per approach Vehicle (Sec)**	**Percent of stopped vehicle %**	**Average delay per stopped vehicle (Sec)**	**Level of service**
General	9.68	52.88	17.36	B
Ita- Amodu	9.91	54.14	17.05	B
Emir's Road	8.78	53.17	16.56	B
OppItaAmodu	8.45	53.78	15.76	B
Total Av. average	36.82 9.21	213.97 53.49	66.72 16.68	

3.7: Summary of the Delay Parameters for the three Intersections

Intersection location	**Average delay per approach Vehicle (Sec)**	**Average delay per stopped vehicle (Sec)**	**Average Percent of stopped vehicle %**	**Level of service**
Judiciary/Offa	12.61	24.69	47.13	C
Tipper Garage	9.26	19.44	44.55	B
Oja-Oba	9.21	16.68	53.49	B

3.8:Average Traffic Volume Tables at Judiciary-Offa Intersection

Approach	Lane of no	Traffic volume for 15 Mins duration	Rate of vehicle per hour (VPH)	Rate of flow of vehicles per lane (VPHL)
Nitel	1	123	492	492
Sabo-Oke	1	86	344	344
Post office	1	98	392	392
Judiciary	1	81	324	324
Total	4	388	1552	

3.9: Tipper Garage Intersection

Approach	Lane of no	Traffic volume for 15 Mins duration	Rate of vehicle per hour (VPH)	Rate of flow of vehicles per lane (VPHL)
Tanke junction	2	155	620	310
pipeline	1	89	356	356
P.S	2	158	632	316
Opp pipeline	1	70	280	280
Total	6	472	1888	

3.10: Oja-Oba Intersection

Approach	Lane of no	Traffic volume for 15 Mins duration	Rate of vehicle per hour (VPH)	Rate of flow of vehicles per lane (VPHL)
General	1	70	280	280
Ita- Amodu	1	163	652	652
Emir's Road	2	140	560	280
OppIta-Amodu	1	111	444	444
Total	5	484	1936	

From the field observation of traffic delay, it may be concluded that under saturated flow conditions, the inter-relation of intersection traffic delay, in addition to intersection geometry and average vehicular delay is an important factor influencing the economic value of the people (i.e both commercial and private vehicle owner). This is evident from the fact that the delays observed are different when intersection delay are compared, even though the average vehicle delay is almost the same and there is only a marginal difference in the width of lanes available.

The amount of traffic, which can enter at a traffic signal controlled intersection, depends on the rate of flow of vehicles past the stop line during the green period and on the length of green time available.

From the summary of the delay parameters for the three intersections Table 3.3, it was observed that the average delay at approach varies from one another. It was also observed that the average value for each leg for each intersection varies. For instance the average value on leg of Judiciary/Offa road intersection (Sabo Oke) is more than post office (leg 3) due to more traffic delay at this intersection.

At tipper garage leg 2 (pipe line) has the highest delay due to part of the road section being used as parking space and as taxi terminus. Passengers from Gaa-Akanbi and Offa Grage alight and board taxi or private cab at this leg of the intersection. Passengers from Tanke junction also alight at this intersection thereby narrowing the road width for free flow of traffic.

From table 3.5, it was deduced that there is less delay on legs (P.S.) intersection and leg, (Tanke junction). The reason is because few cars make turning movement about the roundabout, which might cause little or no delay. The only periods delayswere recorded was when motorist do not park appropriately or when a vehicle breaks down due to mechanical failure.

Table 3.6 shows a very close range in delay per approach vehicle but the percentage of vehicles stopped at the in intersection is more compared to Tipper Garage and Judiciary/Offa road intersection. It shows that more vehicles stop at the intersection but do not get delayed for a long time.

For the average traffic volume, table 3.8, 3.9 and 3.10 shows the result obtained.

It was observed that the Oja intersection has more traffic volume for 15mins duration of 484 vehicles, followed by Tipper Garage 472 vehicles and 388 vehicles for Judiciary/Offa road intersection.

Level of service A describes that level of operation at which the average delay per vehicle is 5seconds or less. Level of service B describes that level of operation at which delay per vehicle is greater than 5 seconds but not greater than 10seconds which shows a decline in freedom to maneuver within the traffic stream relative to level of serve A. The vehicles stopped at the intersection is greater than A but progression is still good.
Level of service C describes the level of operation at which delay per vehicle is greater than 10 seconds, and up to 20 seconds. This shows a significant vehicle stop and general decline in level of comfort of motorist although many vehicles go through the intersection without stopping. At Level of Service D, delay per vehicle is greater than 20seconds and not greater than 30 seconds, unfavorable progression occurs and drivers experience reduction in physical and psychological comfort.
Level of service E is between 30 and 45 seconds. Level of Service F describes the level of operation at which delay is greater than 45 secs. At LOS-F, over saturation occurs that is, arrival flow rates are greater than the capacity of the intersection.

IV CONCLUSION

At any intersection in an urban area with so much traffic, there is likely to be delays and congestion. It is then important to improve on the traffic performance at such intersection. Generally it was observed that the level of service was satisfactory but it could be enhanced. For this improvement,it is recommended that relocation of Cab/Bus-stops to at least 30 meters away from the intersection, on-street parking should be discourage near intersection or at intersection approach, potholes right at the stop line of Sabo-Oke approach of judiciary/ Offa road intersection should be mended, road shoulders should be constructed to cater for emergencies, Ita-amodu approach of Oja intersection should be widened for easy maneuvering of vehicles, street hawking and partial placement of kiosk on the road pavement should be discouraged because it reduces the width of vehicle lane and proper planning and design of signalized intersectionshould be encouraged to maintain the level of service and for future traffic reduction.

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