Performance Assessment of Selected Intersections in Akure, Nigeria

Evaluarea performanței intersecțiilor selectate în Akure, Nigeria

Olufikayo Aderinlewo [1], Tolulope Ojekale [1]

[1] Civil Engineering Department,
Federal University of Technology Akure, Nigeria
E-mail: oluade2010@gmail.com

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Abstract. *This study assesses the performance of selected intersections in Akure, Nigeria. The identified intersections were Road block, Bye-pass and Cathedral intersections. Data for this study which included traffic volumes was collected through semi-automatic method, personal observations and questioning of individuals. The results of the data analysis revealed that the Level of Service (LOS) for Road block intersection was critically low (LOS = F) due to on-street parking and the absence of traffic signals to aid drivers. Likewise, the LOS for Cathedral intersection is low (LOS = E) while that of Bye-pass (LOS = C) appears to be adequate.*

Key words: Intersections, traffic volumes, semi-automatic, level of service

1. Introduction

Transportation can be defined as a process that involves the movement of commuters, goods and services from a given point of origin to a specific destination. However, transportation plays a major role in urban development and on city growth [1]. Transportation route is part of distinct development pattern or road network and mostly described by regular street patterns as an indispensable factor of human existence, development and civilization [2].

The major challenge of traffic on a roadway is traffic congestion; virtually every state capital city in Nigeria today faces the problem of traffic congestion [3]. In Akure city that was not previously associated with traffic congestion is now facing considerable traffic congestion on many of its urban roads, particularly when schools are in session. Although, a lot of research has been conducted on traffic congestion and delays in Nigeria, most of these studies concentrate on specific cities such as Lagos [4],[5] and Ilorin [6]; traffic problems surface when cities expand without control due to increase in population from rural to urban centres.

Traffic congestion occurs when a city's road network is unable to accommodate the volume of traffic that uses it. This situation is caused by rapid growth in motorization and with less than corresponding improvement in the road network, traffic management techniques and related transport facilities. Thus, traffic congestion is a phenomenon that is associated with urban environment all over the world. This is because we need transport to move from one place to another, especially when trekking becomes inefficient. While traffic congestion has been managed very well in some developed countries, it has continued to defy solutions in the developing world.

In this study, the selected intersections are assessed to determine their levels of performance by carrying out the following: traffic count at the intersections to determine the traffic volumes on each leg, determining the levels of service of the intersections as well as each leg that meets at the intersection and determine appropriate measures to improve on the performance of the intersections.

2. Background Literature

Traffic congestion occurs when a volume of traffic or modal split generates demand for space greater than the available road capacity; this point is commonly termed saturation. There are a number of specific circumstances which cause or aggravate congestion; most of them reduce the capacity of a road at a given point or over a certain length, or increase the number of vehicles required for a given volume of people or goods. About half of U.S. traffic congestion is recurring, and is attributed to sheer weight of traffic; most of the rest is attributed to traffic incidents, road work and weather events [7]. Traffic research still cannot fully predict under which conditions a "traffic jam" (as opposed to heavy, but smoothly flowing traffic) may suddenly occur. It has been found that individual incidents (such as accidents or even a single car braking heavily in a previously smooth flow) may cause ripple effects (a cascading failure) which then spread out and create a sustained traffic jam when, otherwise, normal flow might have continued for some time longer.

Congestion can be reduced by either increasing road capacity (supply), or by reducing traffic (demand). Capacity can be increased in a number of ways, but needs to take account of latent demand otherwise it may be used more strongly than anticipated. Critics of the approach of adding capacity have compared it to "fighting obesity by letting out your belt" (inducing demand that did not exist before). For example, when new lanes are created, households with a second car that used to be parked most of the time may begin to use this second car for commuting. Reducing road capacity has in turn been attacked as removing free choice as well as increasing travel costs and times, placing an especially high burden on the low income residents who must commute to work.

Incidentally, many urban centers in Nigeria suffer from inadequate facilities that could ensure smooth urban movement. This is because the rapid growth of cities anywhere in the world has impact not only for the land use but also for the spatial expansion. For example, the commuting distance of Lagos increased from 20km in 1970 to 35km in 1995 while that of Kaduna increased from 6km to 10km during the same period [8]. In Akure, the commuting distance increased from 5.2km in 1966 to 6.4km in 1976, 10.5km in 1986, 13km in 1996 and 19km in 2006 [9]. The increase in commuting distance has impact on trip attraction, fares paid by commuters and traffic build-up in some land use areas. It also shows the need for different modes of transportation. Thus, a number of factors have been found to influence trip generation, attraction and distribution in any urban environment.

The level of urbanization in the developing world indicates that more people now live in cities than before. Cities with one million people and above, according to the United Nations forecasts increased to over 300 by the year 2000 in the developing world [10]. This trend will continue because of the rapid growth in population, resulting from improvement in health services and the multifarious functions performed by cities, which have been another major attractive force. The situation as described above has its impact on traffic congestion in the cities of developing world. Thus, the activities, which take place in them, make them generators and attractors of traffic, which, of course, has implications on mobility. The automobiles have an inevitable appetite for space. It uses space at home, at work, shopping places, religious centers and recreational centers. Ironically, when some of these spaces are empty, they are still reserved for the automobiles. Thus, a large chunk of the urban land, which could have been used up for productive activities, is consumed by the transport sector.

The roadway carrying capacity, also, determines the maximum number of vehicles that would pass through a given section of a lane or road way in one direction or both for a two lane roadway, during a given time period. Thus, as traffic volume increases, the speed of each vehicle is influenced, to a large measure, by the speed of the slower vehicles. Thus, as traffic density increases, a point is reached where all vehicles would travel at the speed of the slower vehicle. This condition, when attained, indicates that the ultimate capacity has been reached and that would result in congestion on the road.

Most major Nigerian cities, which include Akure Township, have been developing without the conventional land use approach [11]. This has generated different urban problems in the form pollution of the environment, transportation problems, insanitary condition and epidemics. This is because the physical growth and development of cities have not been properly managed. It allows conversion of residential uses and other types of buildings to 3 commercial use, street trading, parking and infrastructural facilities, which increases the volume of traffic in such neighbourhood.

Illegal parking is also a major problem in urban environment. This is because parking on roadside, which is a common phenomenon, reduces the traffic corridors meant for the efficient movement of automobiles. Thus, it becomes a major problem in cities and especially in the Central Business District (CBD), where multi-storey buildings are common and the land use is devoted mostly to commercial purposes. The resultant effect of such illegal parking, therefore, is traffic congestion. This illegal parking leads to delay in traveling time and increases the cost of traveling because more fuel is used up in the process of accomplishing a delayed journey (go-slow / traffic jam). Most of these identified traffic congestion related problems still persist in our cities in the less developed countries due to lack of adequate geospatial information in usable format to tackle these spatially related problems.

Over the years, the transportation route of Oba Adesida road, Akure along the Oja-Oba (king's market) axis has allowed the commercial activities along that route to be very efficient serving larger percentage of the Akure populace. However, it is important to note that when the commercial activities of any area rises, the transportation route and facilities are likely to be neglected, which later deteriorate due to over use and lack of maintenance. Most often, coincidence arises from individual commuter's journey during peak hour periods. This type of coincidence, if not well managed, may lead to traffic crisis that makes traveling burdensome in addition to wasting person-hour productive time.

3. Methodology

In this study, the primary source of data collection involved direct collection of information on the field using traffic counts and observations. Such data included pictures of traffic-congested zones, information on traffic-congested junctions (points), the roads (lines) and the land use (areas). In the course of the study, traffic volume data was collected semi automatically through the use of a video camera and analyzed using a software known as SIDRA [12]. Three intersections within Akure were identified for the study namely Road block, Bye-pass and Cathedral intersections.

3.1 Description of the Study Area

Akure city is located within Ondo State in the South Western part of Nigeria. Ondo state is one of the 36 states of Nigeria which lies approximately on latitude 7° 15' North of the Equator and longitude 5° 12' East of the Greenwich Meridian. Akure is a medium- sized urban centre which became the capital city of Ondo State and a Local Government Headquarters in 1976. Figure 1 shows the map of Nigeria showing Ondo state and Akure.

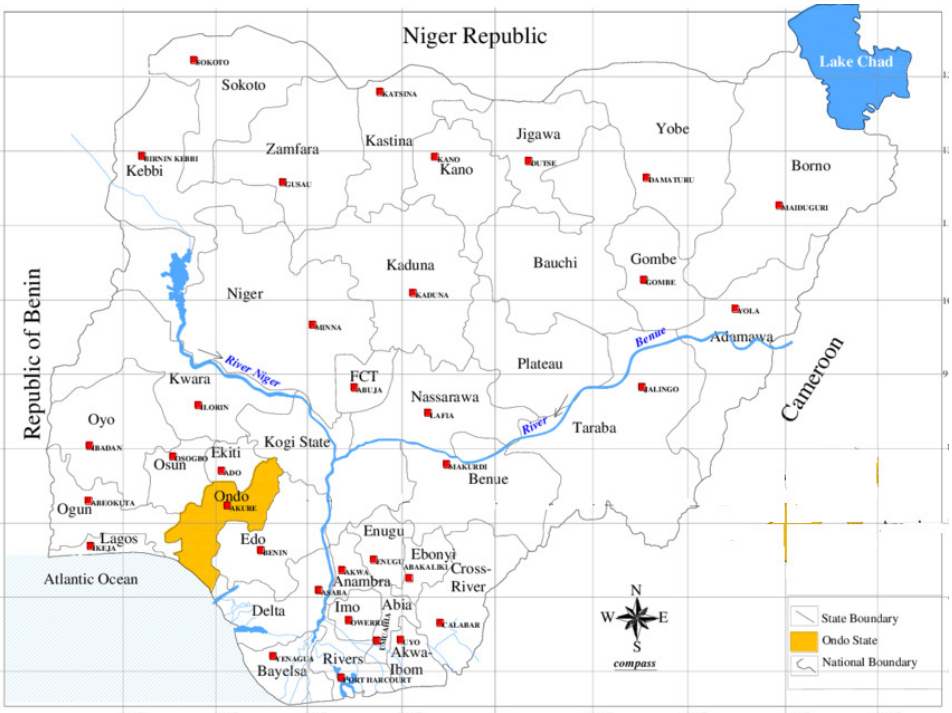

Fig. 1. Map of Nigeria showing Ondo State and Akure Source: Ministry of Works and Housing, Akure (2012)

In 1991, the provisional population for Akure was put at 316,925 (1991 census). The increased relative political influence of Akure as a State capital since 1976, when Ondo State was created has been partly responsible for its rapid development. This is because, the decentralization exercise, which accompanied the policy that led to the creation of the State led to the creation of jobs, which attracted many people. Improvements in transport facilities were given prominence in Akure shortly after 1976 when the city became the seat of Government. Figure shows the base map of the study intersections within Akure city. The intersections considered for this study and their locations are as shown in Figure 3.

3.2 Level of Service, Delay and Degree of saturation

Level of Service (LOS) is a qualitative measure that describes traffic conditions in terms of speed, travel time, freedom to maneuver, comfort, convenience, traffic interruptions, and safety. Six classifications are used to define LOS, designated by letters A through F [13]. Level A represents the best quality of traffic where the driver has the freedom to drive with free flow speed and level F represents the worst quality of traffic.

Delay to a vehicle is the difference between interrupted and uninterrupted travel times through the intersection while the degree of saturation is a ratio of demand to capacity on each approach to the intersection, with a value of 100% indicating that

demand and capacity are equal and no further traffic is able to travel through the junction. The degree of saturation is usually expressed as the ratio of the volume to capacity (v/c) of traffic at any point in the highway segment.

The LOS can then be expressed in terms of the delay and degree of saturation as follows:

- Level of Service "A": Free flow, with low volume and high speed. Traffic density is low, with speed controlled by drivers' desired speed limits and physical roadway conditions. Individual users are virtually unaffected by others in the traffic stream; v/c = 0.00 to 0.60.
- Level of Service "B": represents the range of stable flow but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A; v/c = 0.61 to 0.70.
- Level of Service "C": represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user, v/c =0.71 to 0.80. This is the target LOS for some urban and most rural highways.
- Level of Service "D": Approaches unstable flow, with tolerable operation speed being maintained through considerably affected changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operation speeds. Drivers have little freedom to maneuver; comfort and convenience are low, but conditions can be tolerated for short periods of time. Minor incidents are expected to create delays, v/c=0.81 to 0.90.
- Level of Service "E": unstable flow, operating at capacity, Cannot be describe by speed alone but represent operations at even lower operating speeds than in level D with volumes are or near the capacity of highway. At capacity speed are typical but not always in the neighborhood of 50 km/h. Flow is unstable, and there may be stoppage of momentary duration. Drivers' level of comfort becomes poor. Freedom to maneuver within the traffic stream is extremely difficult, v/c=0.91 to 1.00.
- Level of Service "F": Forced flow operations at low speeds, where volumes are below capacity. Conditions result from queues of vehicles backing up from a restriction downstream. Speeds are reduced substantially and stoppage may occur for long or short period of time, because of downstream congestion. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00.

3.3 SIDRA intersection software

This is the software that was used for analyzing the traffic volume data obtained in this study. It is capable of:

- analyzing a large number of intersection types including signalized intersections (fixed-time / pre-timed and actuated), signalized pedestrian crossings, single point interchanges (signalized), roundabouts, roundabout metering, two-way stop sign control, all-way stop sign control, and give-way / yield sign-control;
- obtaining estimates of capacity and performance characteristics such as delay, queue length, stop rate as well as operating cost, fuel consumption and pollutant emissions for all intersection types; analyzing many design alternatives to optimize the intersection geometry, signal phasing and timings specifying different strategies for optimization;
- handling intersections with up to 8 legs, each with one-way or two-way traffic, one-lane or multi- lane approaches, and short lanes, slip lanes, continuous lanes and turn bans as relevant;
- determining signal timings (fixed-time / pretimed and actuated) for any intersection geometry allowing for simple as well as complex phasing arrangements and carrying out a design life analysis to assess impact of traffic growth;
- carrying out a parameter sensitivity analysis for calibration, optimisation, evaluation and geometric design purposes;
- designing intersection geometry including lane use arrangements taking advantage of the unique lane-by-lane analysis method of Sidra intersection;
- designing short lane lengths (turn bays, lanes with parking upstream, and loss of a lane at the exit side);

4. Discussion of Results

The three intersections considered are hereby analyzed and discussed.

4.1 Road Block Intersection

Road Block intersection is a T- junction in which the major road links Akure-Ilesha road to Benin road and the minor road links the intersection to Oba Adesida road. It experiences slightly heavy traffic as it leads to one of the major commercial centers in Akure. Figure 2 shows a pictorial representation of Road Block intersection.

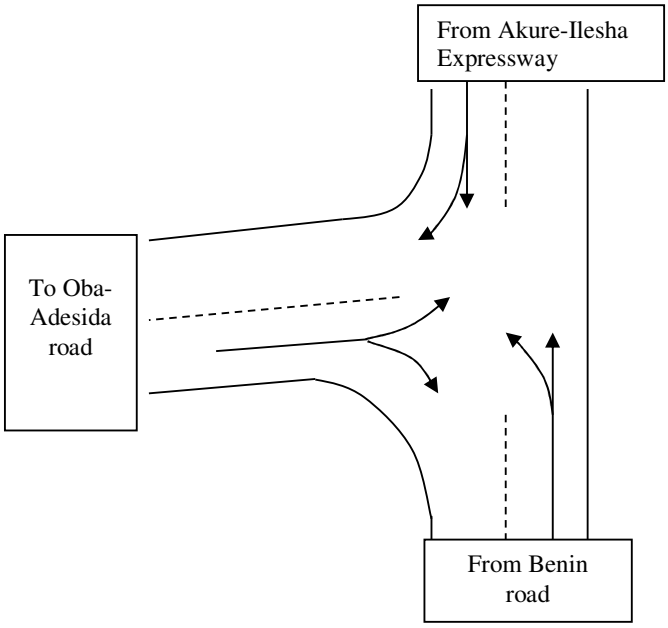

Fig. 2. Pictorial representation of Road Block intersection

Tables 1 and 2 show the number of vehicles going in (from Akure-Ilesha road and Benin road) and out (from Oba Adesida road) of the intersection between the hours of 7am and 5pm for 14 days. It also indicates the peak period observed from 7am to 9am due to the early morning rush caused by civil servants rushing to work, traders hawking and students heading to school, and 1pm to 3pm for Fridays due to Muslims going to mosque which incidentally is also the closing hours for secondary school students thereby contributing to the traffic on the road and 3pm to 5pm on Mondays to Thursdays. Traffic volumes on weekends (Saturdays and Sundays) were generally low and had their peak periods between 9am to 11am and 3pm to 5pm.

Table 1

Traffic volume data for Road Block Intersection - week 1

DAY		TIME									
		7AM-8AM	8AM-9AM	9AM-10AM	10AM-11PM	11AM-12PM	12PM-1PM	1PM-2PM	2PM-3PM	3PM-4PM	4PM-5PM
MONDAY	IN	1890	1801	1500	1299	1086	1103	1335	1510	1466	1310
	OUT	1520	1733	1503	1190	1114	1202	1280	1420	1317	1390
TUESDAY	IN	1662	1700	1517	1320	1434	1100	1390	1500	1680	1435
	OUT	1234	1341	1418	1100	1200	1231	1345	1535	1695	1515
WEDNESDAY	IN	1901	1712	1320	1010	1210	1222	1507	1509	1615	1616
	OUT	1727	1434	1111	931	1009	1176	1531	1707	1803	1605
THURSDAY	IN	1776	1780	1894	1200	1320	1210	1401	1568	1600	1531
	OUT	1530	1483	1322	1016	1200	1294	1134	1443	1514	1532
FRIDAY	IN	1300	1451	1500	1105	1288	1498	1300	1392	1000	1031
	OUT	1392	1399	1380	1008	1192	1302	1451	1400	1214	1215
SATURDAY	IN	1171	1210	1298	1015	994	952	1140	1271	1031	900
	OUT	1098	1082	1115	1129	1009	1100	1093	1051	993	1071
SUNDAY	IN	900	1310	1294	1300	1101	1074	1228	1400	1204	1396
	OUT	891	1398	1211	1109	984	950	1189	1399	1306	1400

Table 2

Traffic volume data for Road Block Intersection - week 2

DAY		TIME									
		7AM-8AM	8AM-9AM	9AM-10AM	10AM-11PM	11AM-12PM	12PM-1PM	1PM-2PM	2PM-3PM	3PM-4PM	4PM-5PM
MONDAY	IN	1795	1800	1740	1430	1261	1202	1438	1677	1630	1641
	OUT	1610	1552	1538	1214	1272	1281	1357	1600	1727	1681
TUESDAY	IN	1588	1570	1589	1320	1118	1078	1300	1570	1599	1600
	OUT	1268	1489	1590	1210	1203	1009	1219	1495	1584	1620
WEDNESDAY	IN	1601	1555	1521	1077	1009	1205	1302	1534	1591	1502
	OUT	1539	1571	1560	1210	1178	1220	1300	1560	1570	1555
THURSDAY	IN	1498	1504	1410	1011	1190	1200	1491	1600	1504	1510
	OUT	1561	1491	1333	1121	1191	1240	1481	1542	1561	1557
FRIDAY	IN	1391	1400	1351	1201	1200	1224	1408	1431	1110	1002
	OUT	1302	1430	1390	1006	1100	1231	1393	1450	1228	1131
SATURDAY	IN	1008	1109	1189	1001	956	993	1215	1300	1107	1103
	OUT	923	980	1009	1138	991	1115	1091	1003	986	1180
SUNDAY	IN	827	1238	1299	1376	901	932	1157	1399	1332	1222
	OUT	794	1193	1238	1006	810	823	1173	1340	1392	1345

Figure 3 shows the LOS for each leg at the intersection.

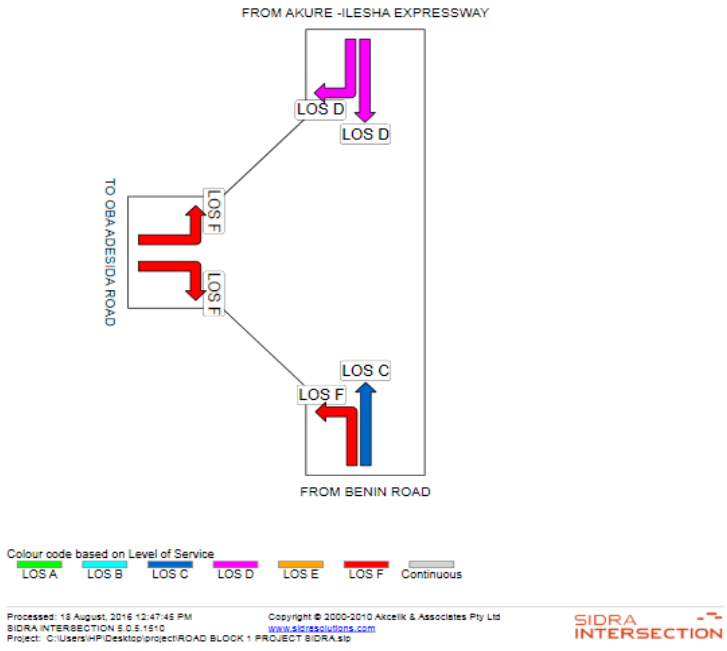

Fig. 3. LOS on each leg at Road block intersection

Table 3 shows the inferences drawn from the values of the LOS obtained for each leg of road meeting at the intersection.

Table 3

Levels of Service for the legs meeting at Road Block intersection

LEGS OF THE INTERSECTION	LEVEL OF SERVICE (LOS)	Implications of the Level of Service (HCM)	CAUSES
From Akure-Ibadan expressway to Benin road	D	Approaches unstable flow, high density, reduced speed, significant operational difficulties on the highway, delay. There are severe restrictions on a driver's ability to manoeuvre, with poor levels of comfort and convenience.	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.
From Akure-Ibadan expressway to Oja road	D	Approaches unstable flow, high density, reduced speed, significant operational difficulties on the highway, delay. There are severe restrictions on a driver's ability to manoeuvre, with poor levels of comfort and convenience.	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.
From Benin road to Akure-Ibadan express	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Increase volume of traffic which is predominated by passenger car/taxi, increased socio-economic activities poor parking system, ribbon development, width of intersection legs is small.
From Benin road to Oba Adesida road	F	Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00	Geometric and/or operational constraints external to the intersection i.e illegal parking system, increased economic activities.
From Oba Adesida road to Benin road	F	Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00	Geometric and/or operational constraints external to the intersection i.e illegal parking system, increased economic activities.
From Oba Adesida road to Akure- Ilesha road	F	Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00	Absence of traffic personnel i.e. traffic warden or traffic signals to control traffic

The overall LOS for the intersection was obtained as F based on the fact that the degree of saturation is greater than 1.

4.2 Bye-pass intersection

Bye-pass intersection is also a T-junction whose major road links road block intersection to Cathedral junction and the minor road links the intersection to Bishops court road. Figure 4 shows a pictorial representation of Bye-pass intersection.

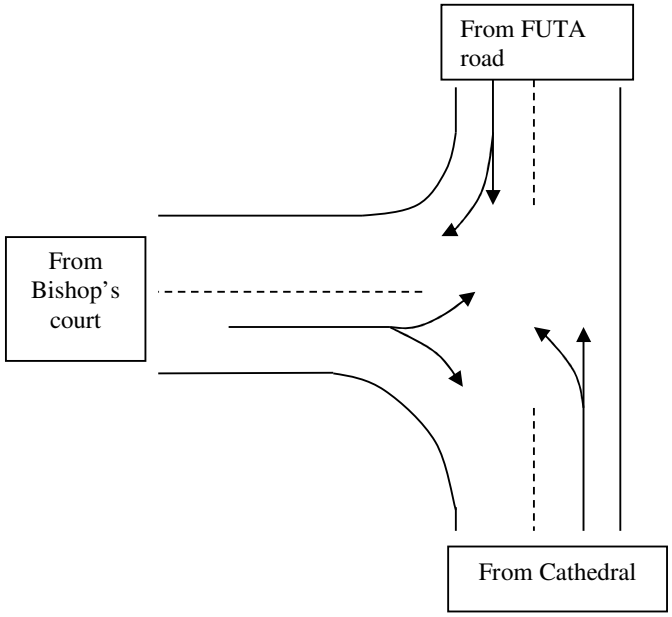

Fig. 4. Pictorial representation of Bye-pass intersection

Traffic volume data was also obtained for this intersection and inputed into SIDRA to get the LOS for each leg meeting at the junction as well as the overall LOS at the intersection. Figure 5 shows the LOS for each leg at the intersection.

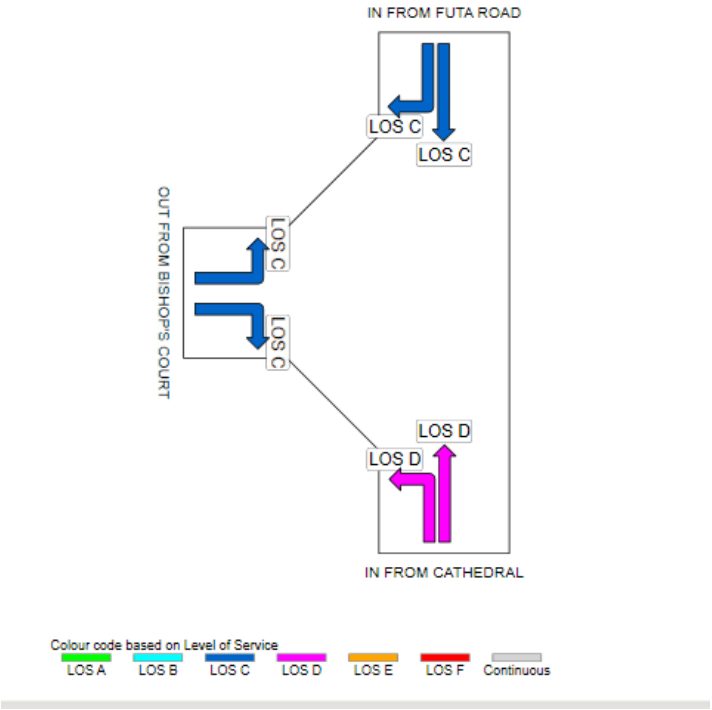

Fig. 5. LOS on each leg at Bye-pass intersection

Table 4 shows the inferences drawn from the values of the LOS obtained for each leg of road meeting at Bye-pass intersection.

Table 4

Levels of Service for the legs meeting at Bye-pass intersection

LEGS OF THE INTERSECTION	LEVEL OF SERVICE (LOS)	Implications of the Level of Service (HCM)	CAUSES
In from FUTA road to Cathedral	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user.	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.
In Cathedral road to FUTA road	D	Approaches unstable flow, high density, reduced speed, significant operational difficulties on the highway, delay. There are severe restrictions on a driver's ability to manoeuvre, with poor levels of comfort and convenience.	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.

LEGS OF THE INTERSECTION	LEVEL OF SERVICE (LOS)	Implications of the Level of Service (HCM)	CAUSES
From FUTA road to Bishop's court	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Increase volume of traffic which is predominated by passenger car/taxi, increased socio-economic activities poor parking system, ribbon development, width of intersection legs is small.
From Cathedral to Bishop's court	D	Approaches unstable flow, high density, reduced speed, significant operational difficulties on the highway, delay. There are severe restrictions on a driver's ability to manoeuvre, with poor levels of comfort and convenience.	Geometric and/or operational constraints external to the intersection i.e faulty fixed time signal, illegal parking system, increased economic activities.
From Bishop's court to Cathedral	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Geometric and/or operational constraints external to the intersection i.e faulty fixed time signal, illegal parking system, increased economic activities.
From Bishop's court to FUTA road	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Narrow width of circulating carriageway width of the roundabout, street trading/ribbon development.

The overall LOS for Bye-pass intersection was obtained as C which indicates stable flow of traffic and easy maneuvering by drivers is possible, also it signifies stable operating conditions with average traffic delays at the intersection.

4.3 Cathedral Intersection

Cathedral intersection is a T-junction whose major road links Oyemekun road to Oja Oba road and the minor road links the intersection to Ondo road. Figure 6 shows a pictorial representation of Cathedral Intersection.

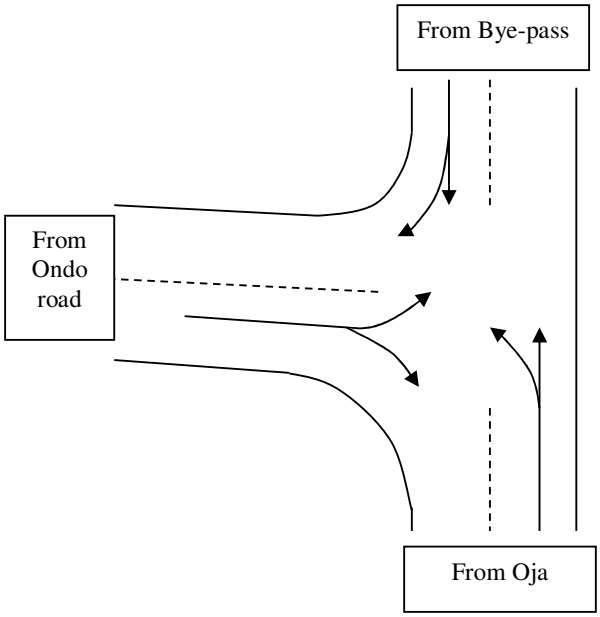

Fig. 6. Pictorial representation of Cathedral Intersection

Analyses of the traffic volume data collected for 14 days at this intersection in SIDRA gave the LOS for each leg of road meeting at the junction as well as the average LOS for the entire intersection. Figure 7 shows the LOS for each leg at the intersection.

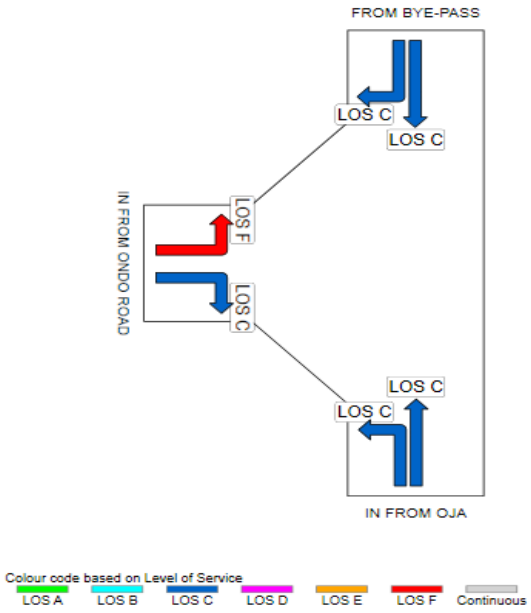

Fig. 7. LOS on each leg at Bye-pass intersection

Table 5 shows the inferences drawn from the values of the LOS obtained for each leg of road meeting at Cathedral intersection.

Table 5

Levels of Service for the legs meeting at Cathedral intersection

LEGS OF THE INTERSECTION	LEVEL OF SERVICE (LOS)	Implications of the Level of Service (HCM)	CAUSES
From bye-pass to Oja	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user.	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.
From Ondo Road to Bye-pass junction	F	Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS. In extreme, both speed and volume can drop to zero, v/c greater than 1.00	Poor parking system, abandon vehicles on road, increased volume of traffic which is predominated by passenger car/taxi.
From Oja to bye-pass junction	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Increase volume of traffic which is predominated by passenger car/taxi, increased socio-economic activities poor parking system, ribbon development, width of intersection legs is small.
From Oja To Ondo road	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Geometric and/or operational constraints external to the intersection i.e faulty fixed time signal, illegal parking system, increased economic activities.
From Ondo road to Bye-pass junction	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Geometric and/or operational constraints external to the intersection i.e faulty fixed time signal, illegal parking system, increased economic activities.
From bye pass to Ondo road	C	Represents the range of stable flow but the selection of speed is affected by the presence of others. Maneuvering within the traffic stream requires substantial vigilance on the part of the user	Narrow width of circulating carriageway width of the roundabout, street trading/ribbon development.

The overall LOS for Cathedral intersection was obtained as E which indicates that there is delay at the intersection and also flow of traffic is greatly impeded.

5. Conclusion and recommendations

An appraisal of the three intersections studied indicated road block intersection is not efficient enough for the volume of traffic plying the roadway and in the same vein Cathedral intersection also is not effective enough for the volume of traffic traversing the roadway but By-pass intersection proved efficient. The maximum volume of veh/hr was an average of over 1700vehicles per hour for all intersection.

An appraisal of Road block intersection reveals that the presence of two close intersections at that junction is sometimes abused as some drivers take the wrong intersection turn to maneuver their way around traffic, this is more possible since there is absence of any traffic personnel to put them in order. Also from the west approach i.e. approach from the minor road, there is high level of delay indicating a Level of Service of F on that leg and signifying poor operating conditions resulting in lower travel speeds. However, at the Northern and Southern approaches (Akure - Ibadan Expressway) and (Benin expressway) the average delays are quite minimal but still not efficient enough as it indicated a Level of Service D and C respectively which translates to impeded traffic flow.

Bye-Pass intersection has been adjudged to be efficient and it has a delay of 24.5s indication an average Level of Service C i.e. reasonably unimpeded traffic operations with only short traffic delays at intersections. Cathedral intersection's challenges can also be attributed to be similar with that of Road blocks' as it also has a low efficiency rate.

Based on the results obtained in this study, the following should be carried out:

- Widening of Road block to Oba Adesida road as well as the road joining Ondo Road to Bye Pass in order to allow the road meet up with future traffic demands
- Maintenance and repair of the traffic signal system at Cathedral intersection.
- Provision of traffic personnel or traffic signals at road block intersection so as to put drivers in order.
- Provision of proper off -street parking facilities at Road block intersection

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