FACULTY OF ENGINEERING AND ENVIRONMENTAL SCIENCES

OSUN STATE UNIVERSITY

OSOGBO, OSUN STATE, NIGERIA

PROCEEDINGS

OF THE

1ST INTERNATIONAL CONFERENCE ON ENGINEERING AND ENVIRONMENTAL SCIENCES

(NOVEMBER 5-7, 2019)

THEME

ADVANCING TECHNOLOGY AND ENVIRONMENTAL BURDENS: CHALLENGES AND SUSTAINABLE SOLUTIONS

EDITORS: **Abidoye**, L.K.; **Okedere**, O.B.; **Alawode**, K.O.; **Ibrahim**, R.B.;

Adebanjo, A.U.; **Thanni**, M.O.; **Adeyemo**, K.A.

Proceedings of the 1st International Conference on Engineering and Environmental Sciences

Published in January 2020

ISBN:

Published by: Faculty of Engineering and Environmental Sciences, Osun State University, Osogbo, Osun State, Nigeria.

Akinola, S. R., Olayode, O., Abiola, T. I., Adeosun, J. O. and Adejumo, A. O. 296

ASSESMENT OF RELIABILITY OF A CONCRETE COLUMN RESISTING AXIAL AND A COMBINATION OF AXIAL AND MOMENT LOADS **317**

Olawale, S.O.A., Adebanjo, A.U. and Tijani, A.O. 317

ACOUSTIC BEHAVIOUR OF CRUMB-RUBBER MASONRY HOLLOW CONCRETE BLOCK "WALLETTE" BASED ON ITS INSTALLED SELF-WEIGHT **335**

Sanni, M.Y., Ocholi, A., Abdulkarim, A.A., Ejeh, S.P. and. Amartey, Y.D. 335

EXPERIMENTAL STUDY ON THE PROPERTIES OF SORGHUM HUSK ASH PERVIOUS CONCRETE **351**

Tijani, M.A., Ajagbe, W.O., Olawale, S.O.A., Ganiyu, A.A. and Agbede, O.A. 351

TRAFFIC ANALYSIS AT A MULTILEGED INTERSECTION IN OSUN STATE, NIGERIA **359**

Olawuyi, O.A., Busari, A., Akintayo, F.O, and Ojagbule, T.E. 359

AN ASSESSMENT OF URBAN HOUSEHOLD OUTDOOR RECREATIONAL BEHAVIOURS IN OSOGBO, OSUN STATE, NIGERIA **370**

Adedotun, S.B., Yakubu, D.A., Ajayi, O.A., Adedotun, D.O. and Tewogbade, M. 370

REDEFINING THE SCALE OF ENVIRONMENTAL POLLUTION IN NIGERIA USING SUSTAINABLE DEVELOPMENT GOALS **384**

Gbadegesin, O.A. 384

APPRAISAL OF ENVIRONMENTAL SANITATION PRACTICES IN SELECTED MARKETS IN AKURE, NIGERIA **396**

Ibrahim, R. B., Adedotun, S. B., Waheed, F. I. and Akinbosoye, B.O. 396

IMPACT ASSESSMENT OF SMOKING DURATION ON POLYCYCLIC AROMATIC HYDROCARBONS (PAH'S) CONTAMINATIONS OF CATFISH (*Clarias gariepinus*) **407**

Abiona, O. O., Awojide, S. H., Adegunwa, A. O. and Tayo, A. S 407

TRAFFIC ANALYSIS AT A MULTILEGED INTERSECTION IN OSUN STATE, NIGERIA

Olawuyi, O.A. [1*], Busari, A.[2], Akintayo, F.O.[3] and Ojagbule, T.E.[1]

[1]Department of Civil Engineering, Faculty of Engineering and Environmental Science, Osun State University, Osogbo, Osun State, Nigeria.

[2]Department of Civil Engineering, Covenant University, Ota, Ogun State, Nigeria

[3]Department of Civil Engineering, University of Ibadan, Oyo State, Nigeria

*Email of Corresponding Author: oluwole.olawuyi@uniosun.edu.ng

ABSTRACT

The transportation system plays an important role in modern life throughout the universe; however, the undesirable myriad of traffic congestion has caused a number of problems in the society. This study aimed at evaluating the flow of traffic at Okefia intersection in Osun State. The present level of service was obtained to evaluate the road capacity. The traffic volume survey of the intersection was done using manual count procedure, volumes were taken at peak period of the day for 7 days at each approach, the peak hour factor was used to obtain the level of service. Approaches A and B were dual carriage with lane width of 7.3m each at both bound separated by a kerb, approaches C, D and E are single carriageways with road widths of 7.3m, 6.5m and 5.5 respectively. The average traffic volume counts for the 7 days at peak hour was 2632, 2517, 625, 3197 and 1694 veh/hr for approaches A,B,C,D, and E respectively. Therefore, the average peak hour factor at the intersection is 0.83 and this corresponds to an overall level of service (LOS) C. This LOS implied that there will be delay between 15.1 and 25.0 seconds per vehicle and thus witnessed longer cycle lengths and fair progression. In order to reduce congestion and to improve the road capacity there is need to build good parking facility and introduce traffic control system.

Keywords: Traffic Analysis, Level of Service, Intersection, Traffic flow, Traffic Volume.

INTRODUCTION

Presently, our dependence on roads had resulted in rapid deterioration of the road network, affecting the economy, with goods and services being delayed. This in turn has resulted in high transportation costs translating to high cost of goods and services, thus leading to a surge in not just the number of vehicles, but even motorcycles and other road transportation means. According to, Odeleye, 2008, the rate of vehicle ownership and use is growing faster than the population in many places, with the vehicle ownership growth rates increasing by 15 to 20 percent per year, which has made traffic management quite poor in many developing countries. This has led to increasing congestion on major highways, trunk B and trunk C roads.

The operation of an intersection is influenced by its capacity, queue length and delay, accident potential, vehicle operating characteristics and traffic control. (Garber and Hoel, 2009). It had long been recognized that intersections are the elements of the roadway system that experiences the greatest number and severity of crashes, at least one third and as much as one-half of all crashes occur at intersection. This is expected because different traffic streams meets and conflicts with each other. Various crashes also occur in intersections involving high-speed multilane divided highway and minor streets with two-way stop control. (Singh and Khubani, 2018).

Intersections may be classified by the number of road segments, traffic controls, and/or lane design. These intersections are being controlled by either signs or signals. (Garber and Hoel, 2009). An intersection that is non functional affects the flow of traffic which could in turn lead to congestion. (Ajibade and Mohammed, 2016). Congestion is an increase in traffic demand which exceeds the supply, it can also be said to be deficiency in traffic management at junctions, leading to queuing and increase in travel time.(Ogunbodede 2015). Road traffic congestion according to Godwin, (1997) can be defined as the impedance vehicles imposed on each other due to the speed flow relationship, in conditions where the use of transport system approaches its capacity.

Ogunsanya, (2002), conceptualized road traffic congestion as a situation where urban road network could no longer accommodate the volume of traffic on it. Traffic congestion is a growing problem in all forms of traffic facilities all over the globe (NAS, 2002). Repeated surveys in many countries of the world have revealed that the number of vehicles on highways keeps on increasing in volume; hence, the problem continues to persist (Hook, 2002)

It has equally created an artificial barrier to a cost-effective flow of goods and persons along our roads linking major town's together (Popoola *et al.* 2013). As various means of transportation demand approaches the capacity of a road (or of the intersections along the road), extreme traffic congestion occurs, and can lead to drivers becoming frustrated.

Choice of geometric parameters that control and regulate the vehicle path through the intersection could ensure reduced congestion (Roger, 2003; Mohammed *et.al*, 2019)
Capacity analysis therefore involves the quantitative evaluation of the capability of a road section to carry traffic, and it uses a set of procedures to determine the maximum flow of traffic that a given section of highway will carry under prevailing roadway traffic and control conditions.

The capacity at a signalized intersection is given for each lane and is defined as the maximum rate of flow for the subject lane group that can go through the intersection under prevailing traffic, roadway, and signalized conditions. Capacity is given in vehicles per hour (veh/h) but is based on the flow during a peak 15-minute period. (Garber and Hoel, 2009)

Capacity therefore is applied meaningfully only to major movements or approaches of the intersection. As the interaction among vehicles increases, motorists are increasingly influenced by the actions of others. Individual drivers find it more difficult to achieve their desired speeds and perceive deterioration in the quality of flow as the density increases. (Garber and Hoel, 2009).

The level of operating performance changes with traffic density. The measure of quality of **flow is the "level of service" (LOS), a qualitative measure, ranging from A to F, which** characterizes both operational conditions within a traffic stream **and highway users'** perception.The Highway Capacity Manual (HCM 2010). (LOS) expresses the performance of a highway at traffic volumes less than capacity.

Okefia intersection is a typical circular intersection that provides a circular traffic pattern at the central area of Osogbo, Osun state, Western Nigeria. This intersection exhibit a typical characteristic associated with various intersections such as congestion especially at peak hours. Moreover, it is noticeable that the demand for the road intersection usually exceeds the capacity of the intersection at that period, although roads are continually being created for the road transport system, they have far less capacity to contain the number of vehicles being used daily leading to road traffic congestion. These concerns often lead to the creation of more road networks to address such concerns. However, the continuous increase in the number of vehicles renders this effort ineffective. The aim of this study is to assess the road capacity level at the intersection.

MATERIALS AND METHODS

The studied area is a five leg intersection comprising of two dual carriageways, and 3 two lane single carriageway with roundabout as the conflict control at the intersection. The road map showing the study location is given in Figure 1.

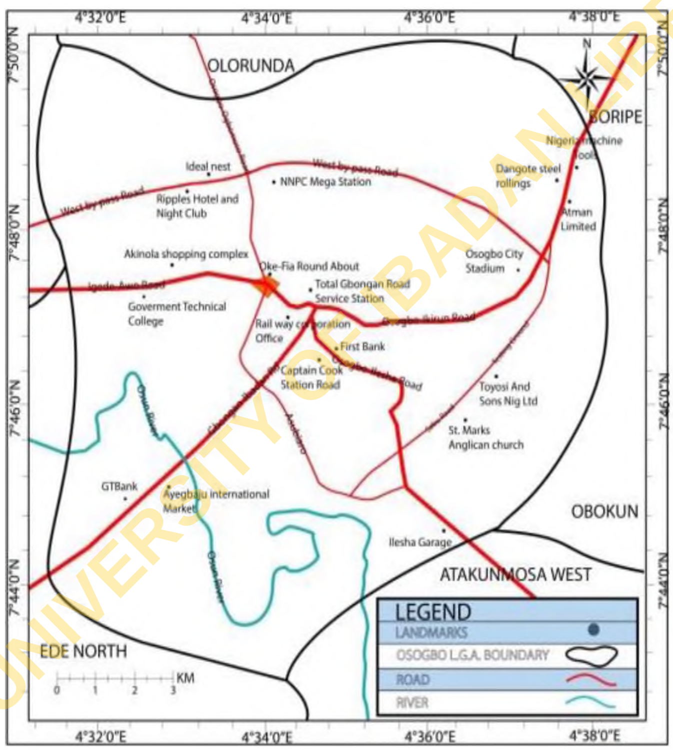

Fig 1.Road map showing Okefia Intersection

Traffic Volume Studies

Manual counts was typically used to gather data for determination of vehicle classification, turning movements, direction of travel, pedestrian movements, or vehicle occupancy.

Traffic volume studies were conducted to collect data on the number of vehicles that passed the intersection at a specified period of 12 hours daily for seven (7) days. Vehicles were recorded at 15 minutes interval. The data collected were classified into subclasses of various vehicle types. Traffic volume study conducted was used to estimate the volume characteristics needed.

Percentage Car Unit

Percentage of car unit was calculated so as to present vehicles in terms of standard type of vehicle using certain conversion factors given in Table 1

Table 1: PCU Values For Urban Roads

S/N	Types of Vehicle	Equivalency factor
1	Passenger car, tempo, auto rickshaw and agricultural tractor.	1.00
2	Bus, truck andagricultural tractor-trailer unit.	3.00
3	Motor cycle, scooter, and peddle cycle.	0.50
4	Cycle rickshaw.	1.50
5	Horse drawn vehicles.	4.00

Source: IRC.(Ref. 2)

Volume and Delay Study

The delay study was done using the stopped vehicles count survey following Overseas road note 11 (TRL, 1993). The number of stopped vehicles queuing on approaches to the road intersections was counted at an interval of fifteen seconds (15secs).

Level of Service

The level of service (LOS) of the intersection was calculated based on Peak hour factor method

Peak Hour factor (PHF) method.

Peak-hour traffic volume was used to evaluate the capacity and other parameters of the road because it represented most critical time. This analysis of level of service was based on peak rates of flow of vehicle occurring within the peak hour because substantial short-term fluctuations typically occur during an hour. Common practice was to use a peak 15-minute rate of flow. But in this study the rate of flow was taken at 30 minutes interval. The relationship between the peak 15-minute flow rate and the full hourly volume was given by the peak-hour factor (PHF) as shown in the following equation (Authority, 2003, Abdulla *et.al*. 2018). Peak-hour factors in urban areas generally range between 0.80 and 0.98. Peak-hour factors over 0.95 are often indicative of high traffic volumes.

PHF was evaluated by the following formula

$$PHF = \frac{\text{Hourly volume}}{\text{Peak rate of flow within the hour}} \quad \text{Eqn 1}$$

$$PHF = V/[4 \times V_{15}] \quad \text{Eqn 2}$$

Therefore for 30 minute interval the

PHF= V/ {2 x V/30}

Table 2: LOS with respect to its PHF.

Peak Hour Factor Value	LOS
0.7 or less	A
0.8 or less	B
0.85 or less	C
0.90 or less	D
0.95 or less	E
>1 or less	F

Source: Authority 2003

RESULTS AND DISCUSSION

Okefia intersection consists of five legs which include~~s~~: Approach A (Old garage road), Approach B (Ilobu road), Approach C (G.R.A road), Approach D (Alekuwodo road) and Approach E (Estate road) as presented in Figures 2 and 3. The road is a flexible pavement with no major pavement defect except for the some potholes at the roundabout area. Approaches D and E are dual carriages with lane width of 7.3m at each bound separated by a kerb, approaches A, B and C are single carriage ways with ~~a~~ road width of 7.3m, 6.5m and 5.5 respectively

Fig 2. Okefia intersection view

Fig 3. Okefia intersection

The volume count obtained from the traffic volume study showed that the intersection is a busy area with various vehicular flow. The vehicles plying the road are passenger cars, motorcycles, **mini buses, coaster buses and two axle's trunk. The vehicular flow percentage is presented in**

Figures 4, this shows that the mini-bus had the highest percentage of flow throughout the week while the two axles had the lowest.

The averages peak hour traffic volume counts for the 7 days was 2632, 2517, 625, 3197 and 1694 veh/hr for approach A, B, C, D, and E respectively.

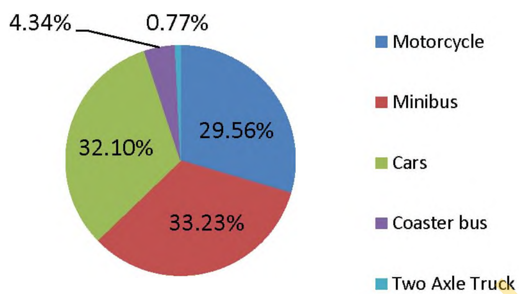

Fig.4. Percentage Vehicular flow from Monday – Sunday

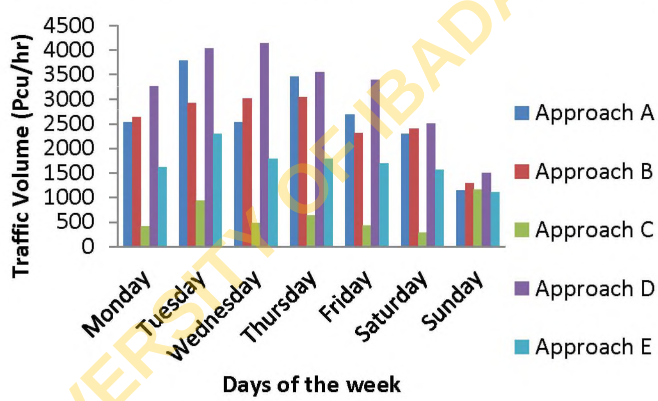

Table 5: Traffic volume showing flow for different classes of vehicle against the days of the week

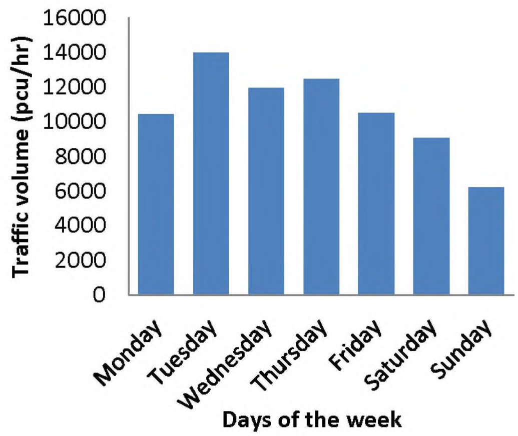

Fig.6. Total traffic volume count from Monday – Sunday

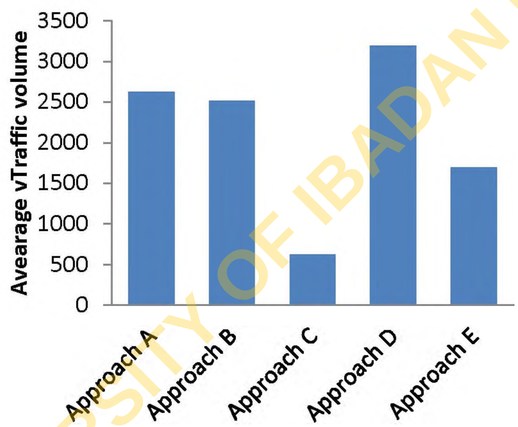

Fig.7. Average daily No. of vehicles per approach

Figure 7 shows that traffic distribution at each approach. Approach D apparently **had** the highest traffic volume which was due to the fact that it is a major approach for people returning home from their places of work to their various residences.

Furthermore, the traffic flow at approaches B and C had an average peak hour factor of 0.71 and 0.74 respectively and therefore made the level of service to be B. Approaches D and E, both had peak hour factor of 0.89 which put the level of service to correspond to LOS D. Approach A traffic flow had a peak hour factor of 0.95 which made the road to be operating at LOS E, this approach was the busiest due to the fact that the road is a single carriageway with a road width of 7m and most cars parked along the road width. This roads also leads to various commercial centres such as banks, e.t.c.

Conclusion

In summary, traffic volume counts and analysis was done at Okefia intersection being one of the major intersections in Osogbo, Osun State. its multi-legged junction with 5 connecting roads and a roundabout at the intersection.

The road has two dual carriageways and 3 single carriageways. Approach A did not have parking space thereby the road capacity, thereby accounting for the level of service of the road. The averages the average peak hour factor at for intersection was 0.83 and this corresponds to level of service (LOS) at the intersection to be C (Authority, 2003)

This implies that will be delays between 15.1 and 25.0 seconds per vehicle. This LOS showed longer cycle lengths and fair progression. (HCM, 2000).

Properly built parking management and traffic control system should be introduced to increase the capacity of road and thus decrease road congestion at the intersection.

.

REFERENCES

Abdulla, A., Lamia F., Saleha , A.P., Mahmud, A., Sherazum, M.., Shazzu, R., Nashid, R., Farzana, A., Farhana, M., Tofael, A, Nahid A.K., Hossain, M. and Nazia, H.(2018). Estimating Traffic Volume to Identify the Level of Service in Major Intersections of Rajshahi, Bangladesh Volume 2 - Issue 4

Ajibade, M.and Mohammed, H. (2016). Operational Performance Evaluation of Post Office – Teaching Hospital road, Ile - Ife, Nigeria. Civil and Environmental Research, 8(7), 18–27.

Authority, SCCT (2003) Traffic Level of Service Analysis Guidelines.

Garber, N. J. and Hoel,L. A., (2010) **"Waste tyre rubber in asphalt pavement modification,"** Materials Research Innovations, vol. 18, no. S6, pp. S6-6, 2014

Highway Capacity Manual. TRB, (2010) National Research Council, Washington, D.C,5th Edition

Hook P. (2002), Go with the flow, Traffic technology International, Aug/Sept. Edition, pp. 72-73.

Mohammed, H, Oyebode I. A and OyefesoB.D. (2019) Operational evaluation of Obafemi Awolowo university Main gate–ede road intersection, Proceedings of the OAU Faculty of Technology Conference 2019 pp 261-165

National Academy of Science (NAS). (2002), Capacity of Interchange Ramp Terminals, Retired 3rd January 2004 form

http://www.nap.edu/openbook/ucho12html/1.html.

Nelson, L.J. (2002), aught Red Handed, Traffic Technology Internal Aug/Sept. Edition, pp. 46-48

Odeleye , J. A. (2008): A Study of Road Traffic Congestion in selected Corridors of Metropolitan Lagos, Nigeria. Unpublished Ph.D. Thesis, University of Lagos, Nigeria,

Ogunbodede, E.F (2015), Assessment of Traffic Congestion in Akure (Nigerian) Using GIS Approach: Lessons and Challenges for Urban Substances.

Ogunsanya A.A (2002) Maker and Breakers of Cities.59th Inaugural Lecture, University of Ilorin.

Popoola, M.O. Abiola, S.O. and Adeniji, W.A (2013), **"Traffic Congestion on Roads in Nigeria Causes, Effects and Remedies". Vol. 10, No 5, pp.** 25 – 37.

*Roger, M. (2003).*Highway Engineering (1st ed.).USA: Blackwell Publishing.

Singh, S.K and Khubani,P. (2018) "Traffic Analysis of Grade Intersections and Measures of Congestion Mitigation at Indore", Pyrex Journal of Engineering and Manufacturing Technology Vol 3 (2) pp.10-19

*Tom, V. Mathew, and K V Krisha Rao (2007),*Introductionto Transportation Engineering.

Transportation Research Laboratory, TRL, (1993), Urban Road Traffic Survey: Overseas Road, Note11, Transportation Research Laboratory, United Kingdom.