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TRAFFIC CHARACTERISTICS OF ABUBAKAR TAFAWA BALEWA UNIVERSITY (ATBU) BAUCHI YELWA CAMPUS GATE AND DESIGN OF EFFECTIVE MITIGATION MEASURES

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Abstract

Traffic Characteristics Research is vital for designing the required geometric features in the roadway. It includes volume of traffic, speed of traffic, and percentage of trucks or larger vehicles like bus to and fro. Traffic characteristics are broadly classified under two types viz: Road user characteristics and Vehicular characteristics. In this paper, we have studied and assess the traffic condition (volume) at Abubakar Tafawa Balewa University (A.T.B.U), Yelwa campus Gate Bauchi. The volume data was collected using manual volume count. The Traffic Volume assessment data shows that at daily basis between 7:30am to 5:30pm, the average daily traffic (cars, motorcycle, tricycle, bicycle, trucks and buses excluding pedestrians) was 5023 vehicles/day at the gate entrance and 4514 vehicles/day at the gate exit. The traffic flow map is developed and analyzed. From the results of this study it was found that there was no alarming issue from over speeding within the study area, however the higher traffic volume during the peak hour periods may require the implementation of traffic management strategies such as Tidal flow operations. After all the analysis carried out, the solutions chosen were design of a mini roundabout at the main gate to mitigate traffic congestion, eliminate

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traffic warden and also provide free traffic flow at the main gate intersection and design of a second gate at ATBU fence wall located 850m from Sabon kaura junction to provide easy access to parents bringing their children to international Nur/Pri and Secondary School within the campus and provide safe stopping sight distance and passing sight distance thereby providing free traffic flow.

Keywords: Traffic characteristics, Geometric features, Traffic volume assessment, Average daily traffic, Traffic flow map, Traffic management, Tidal flow operations, Stopping sight distance, Passing sight distance

INTRODUCTION

Transportation engineering, as practiced by civil engineers, primarily involves, planning, design, construction, maintenance, and operation of transportation facilities. The facilities support air, highway, railroad, pipeline, water, and even space transportation. The design aspect of transportation engineering includes the sizing of transportation facility (How many lanes or how much capacity the facility has), determining the materials and thicknesses used in pavement, designing the geometry (Vertical and horizontal alignment) of the roadway or (Track).

Traffic flow in mathematics and engineering is the analysis of interactions between vehicles, drivers and infrastructure with the aim of understanding and developing an optimal road network with efficient movement of traffic and minimal traffic congestion, pollution and accident rate [8]. [4], argues that rush hour traffic congestion is inevitable because of the benefits of having a relatively standard work day. In a capitalist economy, goods can be allocated either by pricing (ability to pay) or by queuing (first-come first-serve); congestion is an example of the latter. Instead of the traditional solution of making the "pipe" large enough to accommodate the total demand for peak-hour vehicle travel (a supply-side solution), either by widening roadways or increasing "flow pressure" via automated highway systems, Downs advocates greater use of road pricing to reduce congestion (a demand-side solution, effectively rationing demand), in turn plowing the revenues generated there from into public transportation projects.

Traffic engineering studies or survey is carried out to analyze the traffic characteristics, these studies help in deciding the geometric design feature and traffic control for safe and efficient

traffic movement. The traffic survey for collecting traffic data are also called traffic census. The various traffic studies generally carried out are: -

- Traffic volume studies
- Speed studies
- Origin and destination study
- Traffic flow characteristics

Most of us at some point in our lives have had the misfortune of experiencing the effect of a congested roadway; for majority of commuters, traffic congestion has become something that they endure on a regular basis during their morning and evening commutes. However, aside from the frustration and aggravation of creeping through slow moving traffic, congested roadways exert both private costs in wasted time and fuel, and social costs from increased travel time for all commuters as well as release of pollutants and greenhouse gas emissions into the air. In 21st century the biggest problem and challenge for the traffic engineer is often unbalanced between the amount of traffic and the capacity of route, leading to congestion. In some respect, congestion is a sign of success. Street and roads tend to be congested in places that are attractive to people and that enjoy economic prosperity. The movement of people and goods in a city, referred to as traffic flow, is the joint consequence of land activity. However, often congestion especially in developed countries is due to poor Planning [5].

There is a direct interaction between the type and intensity of land use and transportation facilities provided. Land use is one of the prime determinants of movement and activity i.e. trip generation which needs streets and transport systems for movement, and if this movement is not effectively managed, it could lead to traffic congestion.

Traffic congestion may be defined as the situation that arises when road networks are no longer capable of accommodating the volume of traffic on them [2]. The situation is usually caused by rapid growth in motorization with less than corresponding improvement in the road network and related facilities, the poor structural pattern of roads especially in the traditional area of cities and the unplanned growth mid haphazard land use distribution [3].

In urban areas of less developed countries, car ownership rate has been on the increase, Bauchi has continued to experience traffic congestion because many car owners find it more convenient to travel to work by car rather than public transport in congested conditions.

Traffic management can be described as the general process of adjusting the use of existing road system to improve traffic operations without resorting to major new construction; the term "traffic management" comprises a variety of techniques for dealing with highway and traffic related issues [7].

As a concept, it is a process for planning and operating a system of urban highway and street Network [1]. A lot of city/urban and even rural challenges have to do with coping with peak hour traffic periods when workers have to go to work and student/school children commute to school, and later return to their homes [6]. Generally, traffic congestion is experienced in most metropolises in the morning as a result of working time and in the opposite direction at closing hours. Traffic congestion in the evening occurs on almost all the roads as people rush back to their respective destinations.

Traffic congestion in Abubakar Tafawa Balewa University (ATBU) Bauchi Yelwa Campus Gate could be attributed to high growth in population of student and large volume of traffic due to increased vehicles and lack of additional alternative route for vehicles going in and out of the campus. Congestion put together have left most of our campuses in a very deplorable condition. The researcher's interest and aim toward tackling the problem of congestion on Yelwa campus of Abubakar Tafawa Balewa University will go a long way to avoid congestion at the early stage.

METHODS

The preliminary stage was organized into two aspects: the first involves a reconnaissance visit to the study area for on-the-spot evaluation of the selected traffic congestion area (ATBU Yelwa Campus Gate). The second involves the identification of the boundaries of the buildup study area. Two methods for collecting geometric and attribute data required for this study are the primary and secondary sources. The primary source of data collection involves direct collection of information on the field, using traffic counts, and observations. In this section, the researcher examined visible causes of congestion on the case road, studying traffic stream which involved traffic direction peak period and other factors that are physically affecting the easy flow of traffic along the study area. The data collected from primary sources includes, pictures of traffic-congested zones, information on traffic-congested junctions (points), the roads (lines) and the land use (area). The variable considered are; road condition, road infrastructure, car ownership rate, traffic management techniques

(e.g. parking restrictions, park and ride, preferential treatment for High occupancy vehicles, traffic sign such as pavement, markings, road sign, etc.). The secondary preliminary involves sourcing information from existing records; such data includes traffic counts for different road junctions in the study area, review of related literatures of past related studies from the internet, transport journals; traffic journals, textbooks, topographical and street guide maps.

The traffic study was carried out in the study area by the researchers alongside other experienced personnel conducted the studies. The method that was adopted was manual count method (traffic volume).

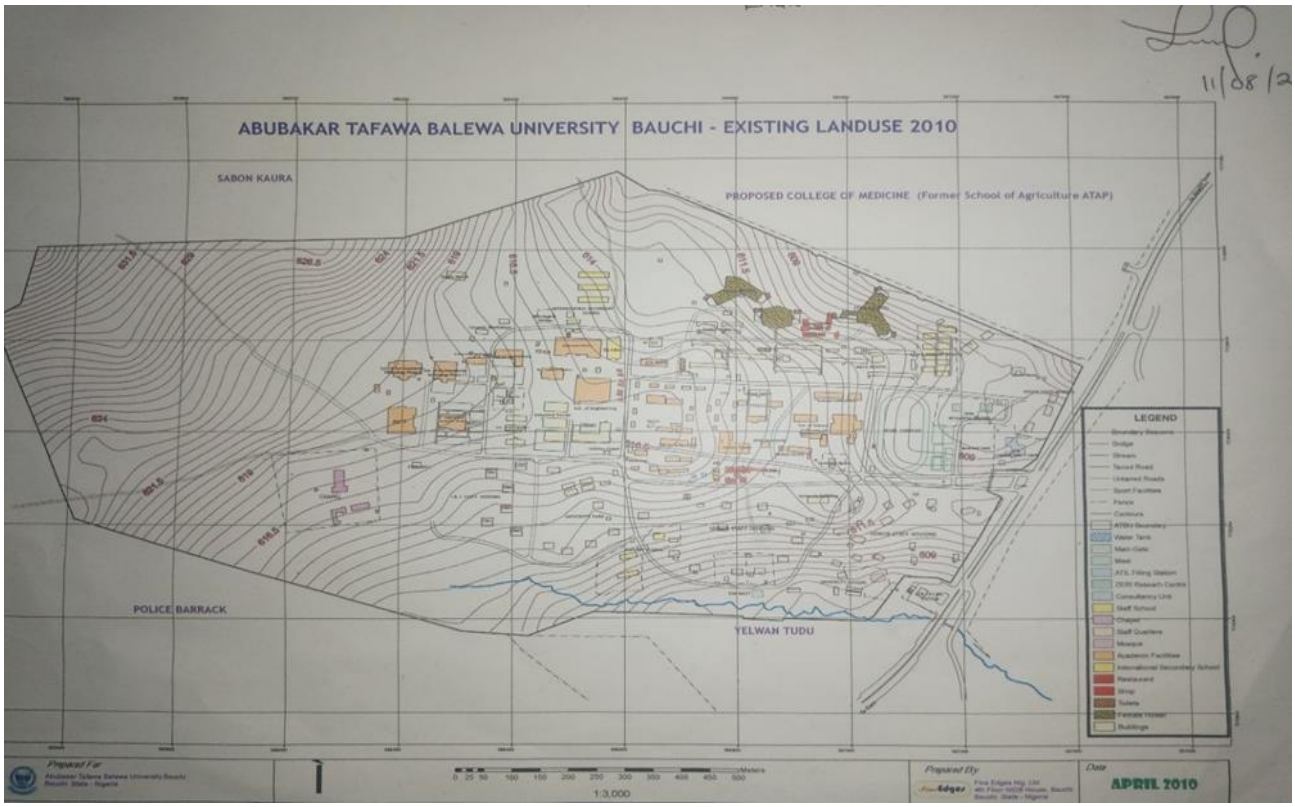


Fig 1: Layout of Abubakar Tafawa Balewa University, Showing Location of study area (ATBU Yelwa Campus Gate, Bauchi, Bauchi State.)

Traffic volume

Traffic volume is defined as the number of vehicles (or persons) that pass a point on a transportation facility during a specified time period, which is usually one hour.

In traffic engineering studies there are many volumes such as daily volume, hourly volume, peak hour volume. In addition, volumes of a day or an hour can vary greatly, depending on the different day of the week or different time period of a day.

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. The traffic volume data can identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The length of the sampling period depends on the type of count being taken and the intended use of the data recorded.

An intersection count may be conducted during the peak flow period. If so, manual count with 15-minutes intervals could be used to obtain the traffic volume data.

Manual Count Method

Applications of manual counts require small samples of data at any given location, Manual counts are sometimes used when the effort and expense of automated equipment are not justified, manual counts are necessary when automated equipment is not available. Manual counts are typically used for periods of less than a day; normal intervals for a manual count are 5, 10, or 15 minutes.

Traffic counts during a Monday morning rush hour and a Friday evening rush hour may show high volumes and are not normally used in analysis; therefore, counts are usually conducted on a Tuesday, Wednesday, or Thursday. The Procedure for this method is itemized below

a. The necessary office preparation was done
b. Day, time and location was selected
c. The observation was recorded on the data sheet

RESULTS

The data here shows the results obtained on different practical test carried out in the field (road). This include traffic volume count and analysis

Traffic Volume:

The tables below show the total volume count at the Entrance and at the Exit of the Gate.

Table 1: Total volume count for three days at Gate Entrance

Time Interval GMT + 1	Volume (Day one)		Volume (Day two)		Volume (Day three)		Total Volume	
	Vehicle	pedestrian	vehicle	pedestrian	vehicle	pedestrian	vehicle	Pedestrian
7:30-8:30	835	423	808	453	767	365	2410	1241
8:30-9:30	715	399	716	368	696	343	2127	1110
9:30-10:30	619	323	636	283	683	299	1938	905
10:30-11:30	467	314	493	235	507	232	1467	781
11:30-12:30	370	271	443	200	465	213	1278	684
12:30-13:30	347	154	403	131	313	150	1063	435
13:30-14:30	524	200	591	199	564	245	1679	644
14:30-15:30	508	213	538	280	581	287	1627	780
15:30-16:30	301	276	290	324	264	268	855	868
16:30-17:30	220	312	215	351	191	282	626	945
Total	**4906**	**2885**	**5133**	**2824**	**5031**	**2684**	**15070**	**8393**

Table 2: Total volume count for three days at Gate Exit

Interval GMT + 1	Volume (Day one)		Volume (Day two)		Volume (Day three)		Total Volume	
	Vehicle	Pedestrian	vehicle	pedestrian	vehicle	pedestrian	vehicle	pedestrian
7:30-8:30	330	75	301	94	272	97	903	266
8:30-9:30	262	87	265	100	240	104	767	291
9:30-10:30	294	181	270	145	282	139	846	465
10:30-11:30	331	222	352	169	333	154	1016	545
11:30-12:30	357	267	413	204	379	209	1149	680
12:30-13:30	369	289	424	254	385	221	1178	764
13:30-14:30	546	381	583	325	558	289	1687	995
14:30-15:30	625	397	610	424	627	485	1862	1306
15:30-16:30	672	401	677	476	657	414	2006	1291
16:30-17:30	729	425	699	489	701	499	2129	1413
Total	**4515**	**2725**	**4694**	**2680**	**4434**	**2611**	**13543**	**8016**

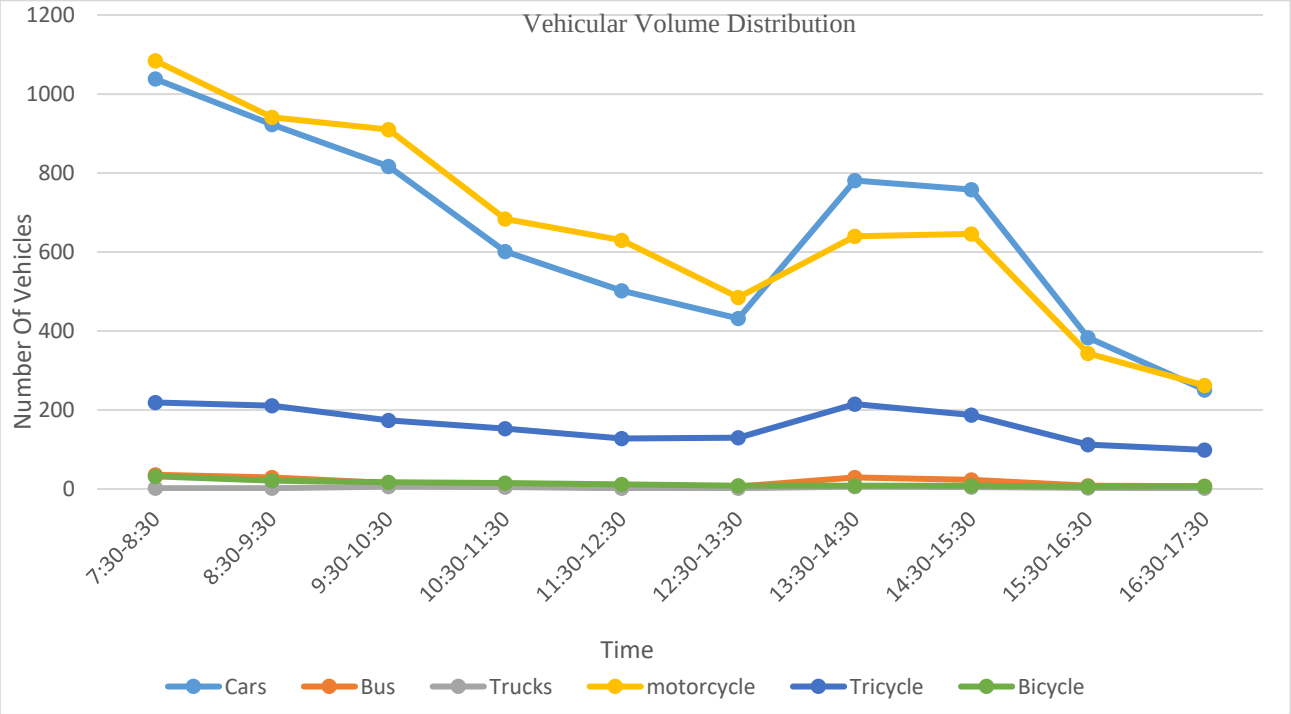


Fig 2: Vehicular Volume Distribution at Gate Entrance Using Line Chart

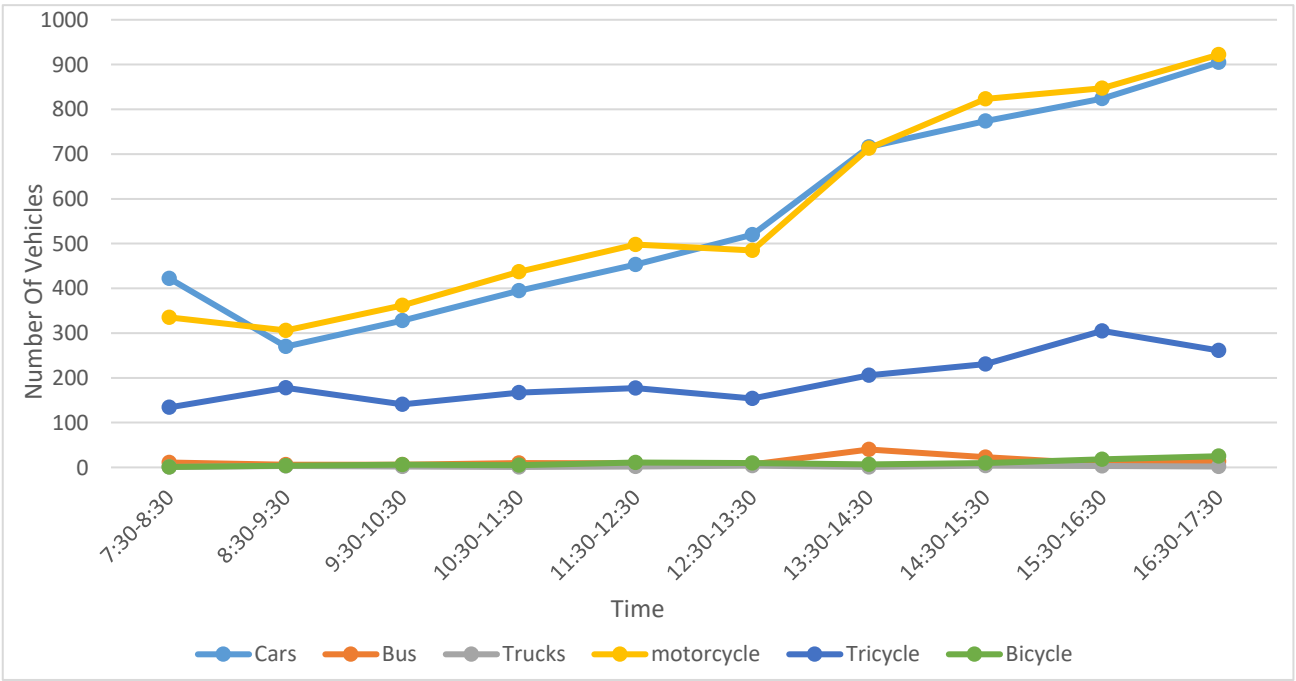


Fig 3: Vehicular Volume Distribution at Gate Exit Using Line Chart

DISCUSSION

The survey reveals that congestion occurs mostly along the study area during the morning peak hour from 7:30am-10:30am while coming into the campus and at the afternoon peak hour from 1:30pm-3:30pm. This indicates the morning peak period and afternoon peak period of the area. The morning peak period is attributed to the fact that, these hours are usually for students and staffs who are going to lectures and offices, parents taking their children to ATBU primary school and international primary/secondary school within the campus, and business workers going to business places while the afternoon peak period is mostly as a result of parents with vehicles going to pick up their children from ATBU primary school and international primary/secondary school within the campus during their closing hours and security checks being conducted at the Gate also contribute to delay of free traffic flow.

Proposals

Based on the traffic congestion we make the following proposals, given in figure 6-11.

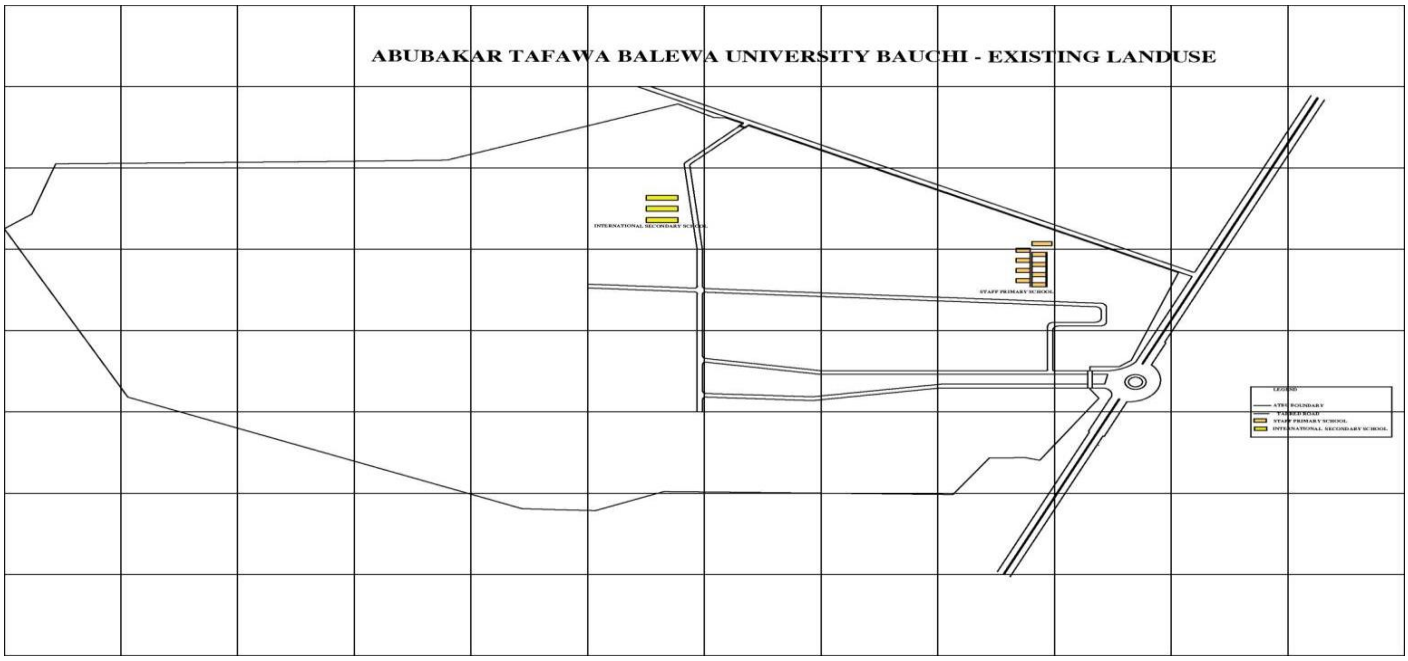


Fig 6. Proposed Layout of Second Gate Design and Roundabout at Main Gate

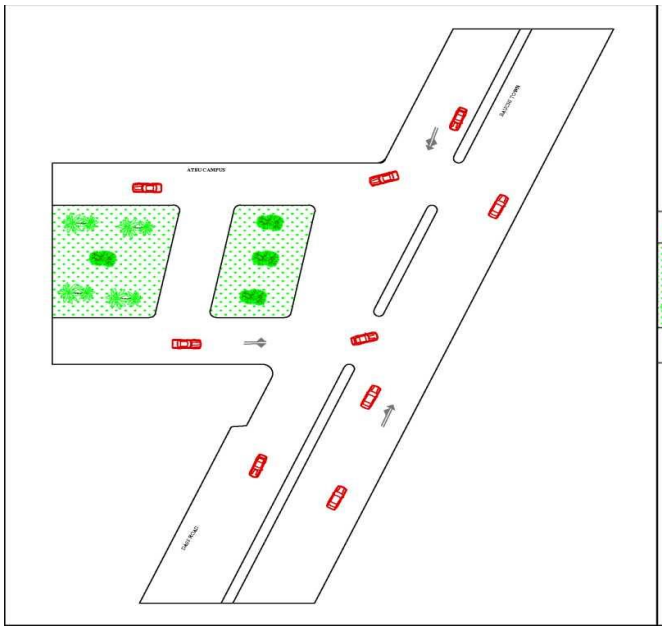


Fig 7. current layout of main gate intersection movements

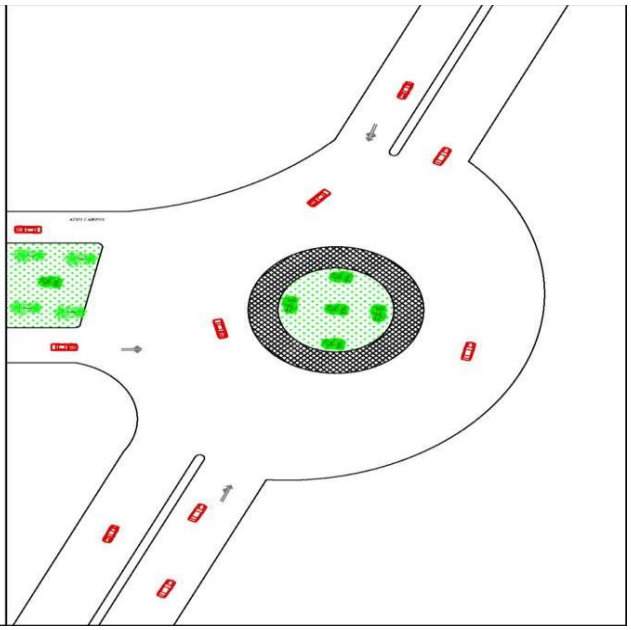


Fig 8. Proposed roundabout intersection movement

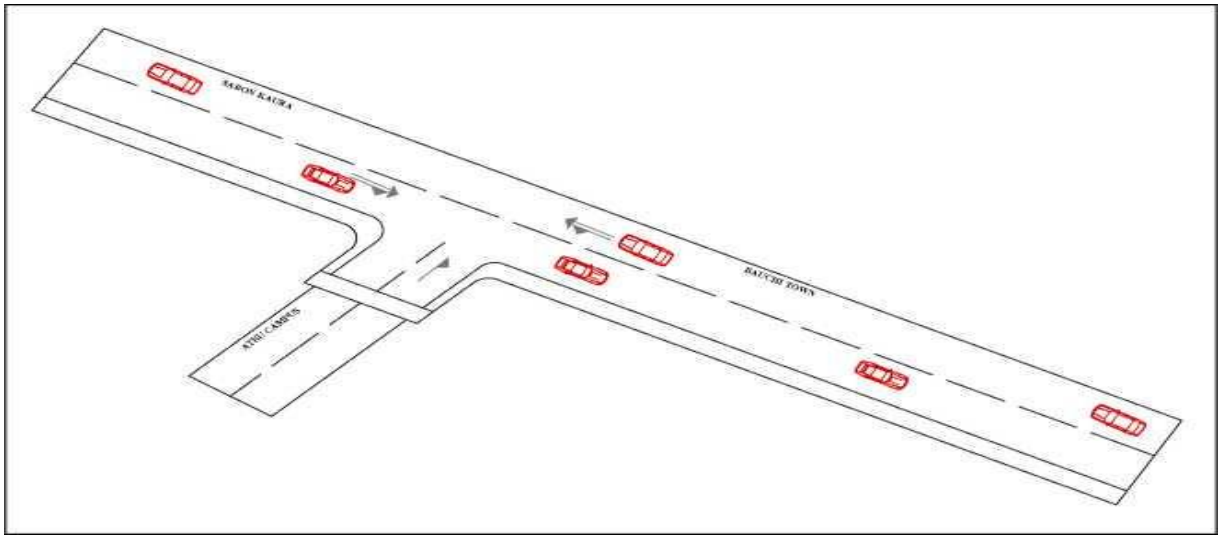


Fig 9. Proposed Second Gate Intersection Movements



Fig 10. Proposed Second Gate Front Elevation

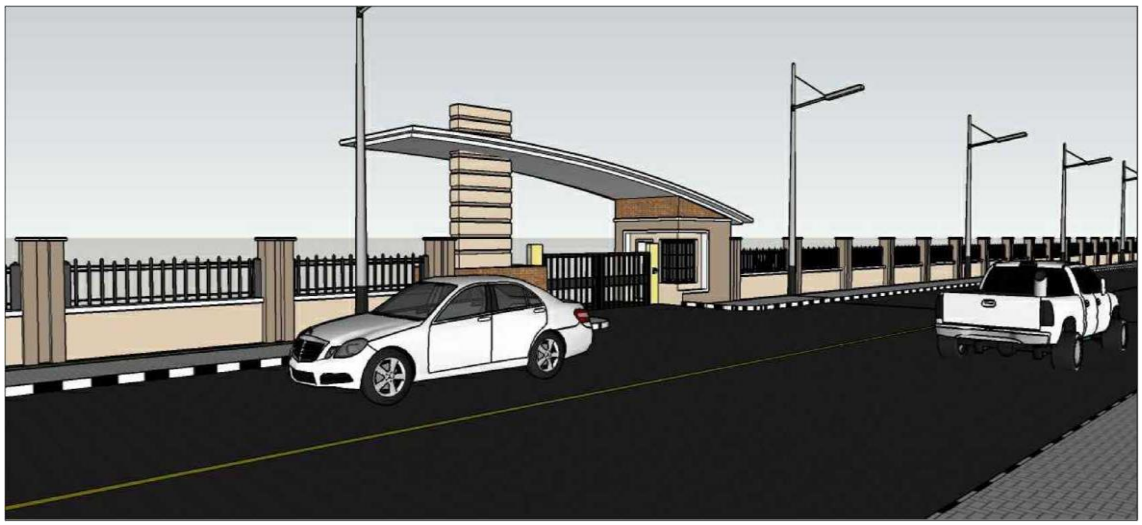


Fig 11. Proposed Second Gate Ariel View

CONCLUSION

The conclusion for this research work is based on the results obtained in the experiments as follows.

- Traffic Volume assessment data shown that at daily basis between 7:30am to 5:30pm, the amount of traffic (cars, motorcycle, tricycle, bicycle, trucks and buses excluding pedestrians) was 5023 vehicles/day at the gate entrance and 4514 vehicles/day at the gate exit And also the traffic flow map was developed.
- There was no alarming issue from over speeding within the study area

- The higher traffic volume during the peak hour periods which from the analysis shows that one of the major cause of congestion in the study area is as a result of pupils of the nur/pri and secondary schools being taking to schools in the morning and likewise in the afternoon period while picking them up from schools,
- The evening peak period is often due to staffs, students and people involve in business leaving the campus in the evening and therefore the higher traffic volume require the implementation of traffic management strategies such as Tidal flow operations.
- The provision of a second gate and a roundabout at the main gate will mitigate traffic congestion at the main gate and also provide easy access for students and staffs who have vehicles and are residing in sabon kaura.

Recommendation

From the observations and analysis drawn from the result of the traffic volume counts and speed analysis, we recommend the following;

i. Mini-roundabout should be provided at the front gate as earlier designed to mitigate traffic congestion and enable free traffic flow at the main gate intersection.

ii. A second gate should be provided at the university fence wall about 850m from sabon kaura road junction.

iii. Road signs (stop sign, yield sign etc.) should be provided in order to regulate traffic movement within and outside the campus.

iv. Tidal flow operation should be use at the main gate during in-bond and out-bond, due to the volume of the vehicles.

v. Road markings should be provided especially in single carriage way, in order to reduce rate of accident within the study area.

vi. It can be viewed that from all analysis carried out, the need for a pedestrian footbridge is handy at the university main gate in order to save pedestrian lives and prevent accidents while crossing the road.

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