



**FEDERAL UNIVERSITY OF TECHNOLOGY  
MINNA, NIGER STATE, NIGERIA**

**SCHOOL OF ENVIRONMENTAL TECHNOLOGY  
INTERNATIONAL CONFERENCE (SETIC) 2018**

# **CONFERENCE** *Proceedings*

**CONTEMPORARY ISSUES  
AND SUSTAINABLE PRACTICES  
IN THE BUILT ENVIRONMENT**

**EDITORS:**

**Asimiyu M. JUNAID  
Olatunde F. ADEDAYO  
Richard A. JIMOH  
Luqman O. OYEWABI**



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# Conference Proceedings of the School of Environmental Technology International Conference (SETIC) 2018

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## FOREWORD

The organising committee of the 2<sup>nd</sup> School of Environmental Technology International Conference is pleased to welcome you to Federal University of Technology Minna, Niger State Nigeria.

The conference provides an international forum for researchers and professionals in the built and allied professions to address fundamental problems, challenges and prospects that affect the Built Environment as it relates to Contemporary Issues and Sustainable Practices in the Built Environment. The conference is a platform where recognised best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. The scope and papers are quite broad but have been organised around the sub-themes listed below:

- Architectural Education and ICT
- Building Information Modeling
- Construction Ethics
- Energy efficiency and Conservation
- Environmental Conservation
- Facility Management
- Green Construction and Efficiency
- Health and Safety Issues
- Information Technology and Building Maintenance
- Information Technology and Construction
- Information Technology and Design
- Innovative Infrastructure Development
- Resilient Housing Development
- Smart Cities Development
- Social Integration in Cities
- Sustainable Building Materials Development
- Sustainable City Growth
- Sustainable Cost Management
- Sustainable Property Taxation
- Sustainable Architectural Design
- Sustainable Urban Transportation Systems
- Theory and Practices for Cost Effectiveness in Construction Industry
- Urban Ecology Management
- Urban Land Access
- Disasters, Resilient Cities and Business Continuity

We hope you enjoy your time at our conference, and that you have the opportunities to exchange ideas and share knowledge, as well as participate in productive discussions with the like-minded researchers and practitioners in the built environment and academia.

**Local Organising Committee  
School of Environmental Technology International Conference (SETIC) 2018  
APRIL 2018**

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# ASSESSMENT OF THE EXTENT OF TRAFFIC CONGESTION IN SELECTED TRAFFIC APPIAN IN MINNA, NIGERIA

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Traffic congestion has become a major challenge in major urban roads in Nigeria and Minna is not an exception to these challenges, which ranges from socio-economic to safety concerns on the lives of urban residents. This research therefore pursued the objectives of evaluating the nature of traffic congestion; assess the extent of congestion encountered in the selected traffic corridors; and analyse the impact of the congestion on urban accessibility in Minna, Nigeria. This research selected two major traffic corridors in Minna, which includes the primary apian that runs through the centre of the city which is the Suleja-Minna-Zungeru Road and the Western Bye pass. The research employs a comprehensive field survey and traffic count to analyse the nature of traffic, the extent of the congestion challenge and the various impact it poses to urban life in the selected corridors. The research findings show that, various peak and off-peak periods were identified at different times of the day, the traffic components identified in the selected corridors include cars, motorcycles, tricycles, and trucks. The research findings showed that the menace of congestion ranges from one osten point to the other on the selected traffic corridors. It is therefore recommended that, effective legislation and enforcement of traffic laws is required to deter some of the urban road users to comply with traffic rules must be put in Place and also raise the revenue base of the state government through surcharges and fines for traffic violations. Conclusively, it is quite pertinent to note that urgent attention should be focused on regulation the traffic situation in these selected corridors in order to attain sustainable urban transportation in the City.

**Keywords:** Cordon points, Traffic congestion, Traffic corridors, Traffic components, Sustainable urban transportation

## INTRODUCTION

Transportation is inherently central to the development of nations, as it is not only a necessity of life but have a resultant effect on all aspects of human existence ( Oyesiku, 2002). Oni (2004) described transport as the life wire of any urban environment. Without transport, life, as it is today, would be inconceivable; as it is central to the flow of knowledge, information and commercial goods ( Oluwasegun, 2015). Transport is particularly crucial in the existence of a city and cities over the world remain the focal point in an economy where people come together primarily to exchange goods and interacts (Oluwasegun, 2015). Indeed, the transportation sector all over the world is generally recognized as being in a state of crisis, particularly, Nigerian cities have continued to expand in recent time and transport supply falls below the demand (Oluwasegun, 2015). The continued alarming growth of urban population is one of the major factors partly contributing to the rate of physical development in Nigerian cities (World Bank, 2006).Despite the opportunities, however, Nigeria is experiencing increasing rate of urban mobility problems (Oyesiku, 2002). Ogunsanya (1983) noted that urban transportation problem started with increasing urbanization leading to urban transport problems such as traffic congestion.

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According to the Joint Transport Research Centre of the Organisation for Economic Cooperation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) in 2007, Cities and traffic have developed hand-in-hand since the earliest large human settlements (Fadairo, 2013). The same forces that draw inhabitants to congregate in large urban areas also lead to intolerable levels of traffic congestion on urban streets and thoroughfares (OECD, ECMT 2007). This captures the relationship between cities and traffic congestion as well as the world-wide dimension of the problem of traffic congestion in cities (Fadairo, 2013).

Traffic congestion is a major transportation problem of Nigerian cities. It occurs when urban road network is no longer able to accommodate the volume of traffic that uses them; it increases travel cost and causes physical and psychological discomfort (Jaco, 2008). The chaotic situation is observable in virtually all the road corridors in Minna Metropolis (Badamasi, 2014). Consequently, all over the major roads in Minna Metropolis, a large number of people and vehicles are seen crawling along the roads (Badamasi, 2014).

Minna the capital city of Niger State is largely populated because of the commercial activities going on within the town. Considering the fact that Minna is the capital, one should expect the influx of civil servants into the city. State and Federal Government workers within the state will most likely reside in the city for easy access to their different places of work. The 2017 projected population figure of Minna is 505,999 with growth rate of 3.4%.

The rapid increase in urbanization has a tremendous impact on the traffic system of cities in developing countries (Ogunbodede, 2003). According to the United Nation in 2012, the world population will reach 7.3 billion in July 2015 and that 83 million people will be added to the world's population at the end of 2016. 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 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 (Ogunbodede, 2003).

Urban areas have been noted to be very busy with automobiles, especially during the peak periods. During such peak periods, traffic noise comes from vehicle engines, exhaust systems and horns. Busy urban roads generate between 70-85 decibels of noise, depending on the characteristics of the traffic, speed and type of road surface (Ameyan, 1996). The tolerance level of noise is put at 66-68 decibels; meaning that with 70-85 decibels, a significant number of people are irritated and the negative effect of noise on health could be better imagined.

Illegal parking is also a contributing factor to this ugly trend. This is because of 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 (Ayotunde, 2013). The resultant effect of such illegal parking, therefore, is traffic congestion. This illegal parking leads to increase in travel 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) (Ayotunde, 2013).

Traffic congestion is a major transportation problem of many Nigerian cities. If this is true then efforts will be geared towards cost-effective management of the problem (Ogunsanya, 2002). The findings from this study can provide independent information to guide the Federal and State governments, including concerned private companies and international agencies in responding to the challenges of traffic congestion in Nigeria. Besides, it will also trigger further studies in attempt to find solutions to the issues raised by this study.

Most of these identified traffic congestion related problems still persist in our cities of which Minna is no exception. This research therefore, addresses the problems of traffic congestion amongst selected road corridors in Minna metropolis.

#### Aim and Objectives

The aim of this study is to compare road traffic congestion along some selected major traffic corridors within Minna metropolis, Nigeria. The specific objectives are:

1. Identify the existing road corridors in Minna metropolis;
2. Classify the identified road according to hierarchy;



3. Carry out spatio-temporal analysis to ascertain the rate of congestion along selected road corridors; and
4. Evaluate the extent of congestion along selected road corridors;

### Study Area

The study area is Minna which is the administrative capital of Niger State. Minna is in the middle belt of Nigeria, situated in the wet tropical or guinea climate in the guinea savanna zone. It extends on latitude 9°36'22"N and longitude 6°33'15"E. Minna lies on a valley bed (i.e. lowland) bordered to the east by Paidia hill stretching eastwards toward Maitumbi and northwards to Maikunkele village, to the west and the southward is highland, with an area essentially savannah and quite conducive for farming. Minna falls under the tropical continental wet and dry climate based on the Koppen classification scheme. Hence it has a distinct wet season as well dry season. Minna is invaded by two distinct air masses, one from the north; dry and continental in origin, the Sahara air mass. The other is from the Atlantic in the south; moist cool and equatorial in nature. The weather depends to a large extent on the air mass which covers its area and depth. Annual rainfall distribution pattern shows a maximum of 130mm rainfall and minimum of 900-1000mm. the rainy season is between April and October covering a period of six months of September has the maximum rainfall. A monthly rainfall value in excess of 400mm occurs in Minna and its environs (Garber, 2002).

Landscape area of Minna is characterized by an undulating topography. The geological structure depicts steep sloping rock outcrop on the north and eastern flank. These rock outcrops (on the eastern flank); forms a physical constriction on the eastern flank. There are also large but isolated rock outcrops in this landscape and also some areas of scattered rocks. In other words, land beyond the presently developed strip is suitable for development but needs careful planning to keep engineering cost of converting, bridges, embankments and drainage works low to the north over the hills there are some developable lands but intersperse with poor land to the south the land offers reasonable development possibilities but is curtailed by the Chanchaga river. There is a major drainage channel fed by many minor drainage flows from the Centre of the town south-west wards at some other locations, these drainage flood large areas of lying terrain especially after heavy downpour (Garber, 2002). Figure 1.1 and 1.2 shows Niger state in the national context and Minna in the state context respectively. Figure 1.3 shows Minna metropolis the study area.

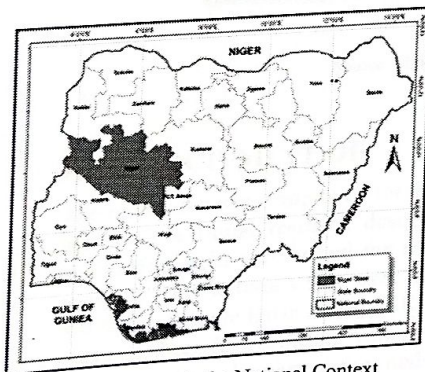


Figure 1.1: Niger State in the National Context  
Source: Researcher's Modification, 2017.

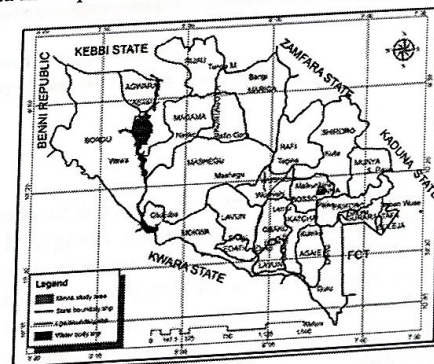


Figure 1.2: Minna in the State context.  
Source: Researcher's Modification, 2017.





All responses to the research data collection instrument and materials were checked and edited. Descriptive analysis of the volumetric count conducted was performed by means of frequency distribution and percentages, the result of which was presented using graphs, charts and tables. Microsoft Office (Excel and Word) was used to aid analysis. As part of the research process, inputs from volumetric count were organized comprehensively and analysed geo-spatially using ArcMap. The advancement in GIS enhances analysis and allows swift interpretation for better policy making. In Geographic Information System (GIS), there is a wide variety of data source, though all fall into two categories; primary and secondary data sources. For the sake of this research, data used in the Geographic information system are primary in nature. They include the high resolution satellite image captured from Google Earth viewer, the Street Map Guide from Niger State Ministry of Land and Housing which was geo-referenced and digitized, and volumetric count data collected during the field survey. These entire data sources aided the generation of attribute data. The attribute data are been stored in a relational structured format often characterized by a collection of tables relating object to their properties.

Analysis of the road traffic network of Minna Metropolis was developed showing the position of the Arterial roads and Distributor/Collector roads within the study area, road related attribute data will also be generated through analysis of the road network which will also help check the possibility of an alternative route. Attribute data generated via analysis will also show road networks with different congestion levels and hot/cordon points by congestion in the study area. The extent of congestion was measured via the aid of a buffer analysis in the GIS environment. A buffer analysis was established using the volumetric count of each peak periods of the day along the corridor studied. The lengths of each of the corridors were ascertained through a road network statistical analysis on ArcGIS. Thus aided measuring the extent of congestion especially during the peak hours of the day, the overlapping technique in ArcGIS was used to compare the trend of extent for different days of the week studied.

## RESULTS AND DISCUSSION

### Mapping of Selected Road Corridor

This research is primarily confined to selected road corridors characterised by the disturbing menace of congestion. Road hierarchy was used as a basis for the selection of these corridors. For the sake of effective and reliable analysis, road corridors of the same hierarchy were selected and compared. On a hierarchy based classification, Minna road corridor is classified into three broad types namely; the Arterial road, the Distributor/Collector road and the Access road. Statistics from the Federal Road Safety Commission (FRSC) in 2016 revealed that the two apian that runs through the centre of metropolis suffers major crisis resulting from the menace of congestion. This served as a basis for selecting the corridors for study.

**Volumetric traffic count along corridor A** (Western By-Pass carrying streams of traffic from Bosso, Dutsen Kura Hausa and Dutsen Kura Gwari to Kpakungu) Figure 4.2 summarizes the traffic distribution for the observed days of the week along the corridor under study. The most noticeable congestion problem along the study corridor was during the peak hour (between 8:01 am and 10:00 am) while coming from Bosso, Dutsen Kura Hausa and Dutsen Kura Gwari. This is because of the concentration of individual workers that leave for work during the morning and staffs and students of the Federal University of Technology Minna who have activities to engage in at Gidan Kwano campus. The type of congestion experienced during this period is the synchronized-flow congestion characterized with significant drop in the speed of vehicles with no noticeable change in the flow rate.

It could be deduced from figure 4.2 that the two peaks periods were constant for all the days of the week observed. The hours of the day associated with the peak periods are from 8:01 am – 10:00 am (morning Peak) and 2:01 pm – 4:00 pm (evening peak). This however is in line with the reality of two peak periods of congestion. Figure 4.3 reveals that traffic is at its highest on Monday. The implication of this is that it leads to the clogging of the corridor which often leads to terrible traffic on Monday. This is justified by the fact that Monday is the first day of the week.



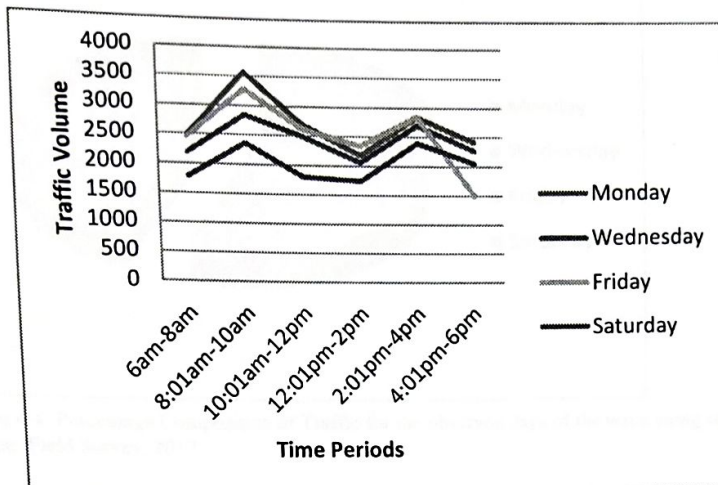


Figure 4.3: Percentage Composition of Traffic for the observed days of the week along corridor A.  
Source: Field Survey, 2017

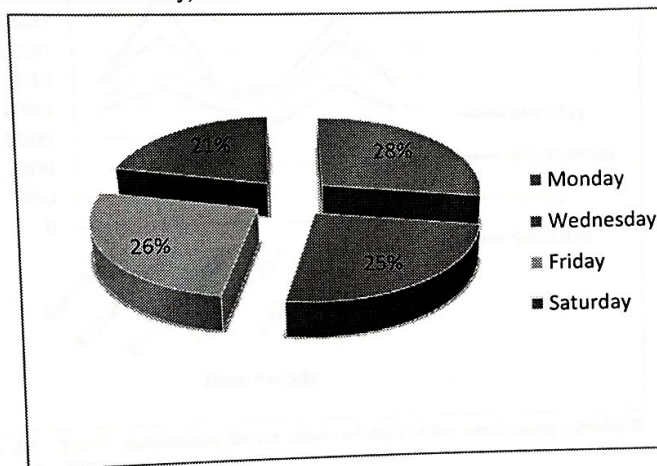


Figure 4.2: -Traffic distribution for the observed days of the week along corridor A.  
Source: - Field Survey, 2017

**Volumetric traffic count for Monday along corridor B (Western By-Pass carrying streams of traffic from Tunga, Sauka Kahuta and Barkin Sale to Kpakungu)**

Figure 4.4 summarizes the traffic distribution for the observed days of the week along the corridor under study. It could be deduced from figure 4.4 that the two peaks periods were constant for all the days of the week observed. The hours of the day associated with the peak periods are from 8:01 am – 10:00 am (morning Peak) and 2:01 pm – 4:00 pm (evening peak). This, however, is in line with the reality of two peak periods of congestion. During the peak periods when traffic was intense, traffic congestion was noticed in numerous cases. Contributing factors to the congestion situation along the corridor were grocery stores and shops that are juxtaposed to each other without provision for parking resorting to roadside parking by vehicle drivers alongside petty traders who lay their commodities for sale along the shoulders of the corridors resorting to customers parking on the roadside which obstructs traffic.

The type of congestion experienced during this period is the synchronized-flow congestion characterized with significant drop in the speed of vehicles with no noticeable change in the flow rate. It was observed during the study that elementary school students plied through the corridor frequently on bicycle as a mode of transportation to their schools. This is responsible for the significant up-rise in the bicycle traffic along corridor B as compared to corridor A. This is justified by the current location of the Limawa Government Secondary School along the western by-pass.



Figure 4.5 reveals that traffic is at its highest on Monday with 29% of the entire traffic for the days observed. This, however, leads to the clogging of the corridor which often leads to terrible traffic on Monday. It could also be ascertained from the figure that traffic gradually falls progressively from the start of working days (Monday) to weekend (Saturday).

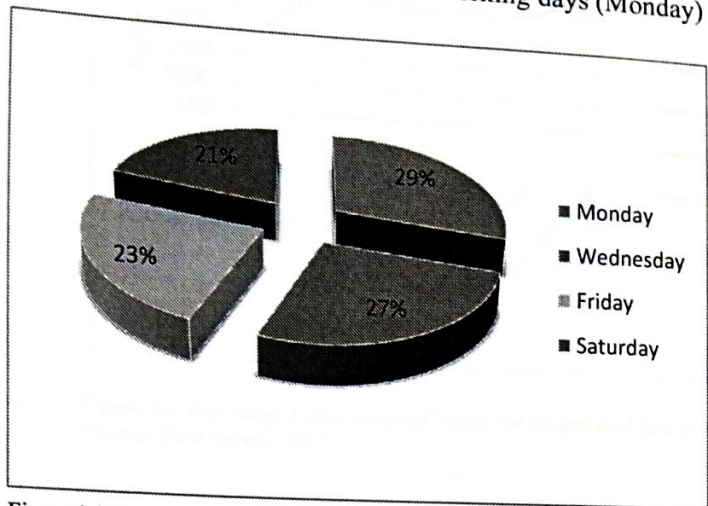


Figure 4.4: Percentage Composition of Traffic for the observed days of the week along corridor B. Source: Field Survey, 2017.

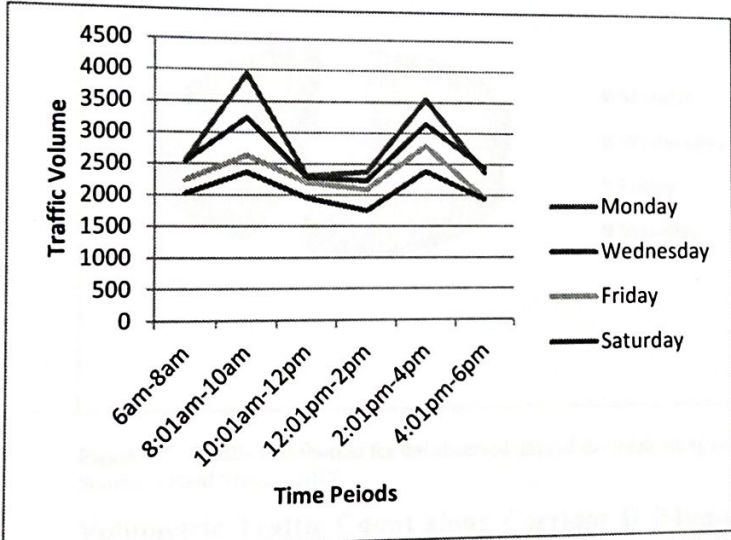


Figure 4.5: -Traffic distribution for the observed days of the week along corridor B. Source: - Field Survey, 2017

**Volumetric traffic count along corridor C (Minna-Zungeru road carrying streams of traffic from Chanchaga, Tunga and Shango to Mobil)**

Figure 4.6 summarizes the traffic distribution for the observed days of the week along corridor c. The most noticeable congestion problem along the study corridor was during the peak hour (between 8:01 am and 10:00 am) while coming from Chanchaga, Tunga and Shango. During the peak periods when traffic was intense, traffic congestion was experienced in numerous cases. Congestion during this period could be attributed to absence of lay-bays at the shoulders of the corridor to allow for on-street parking. Thus vehicle owners resort to parking along the road just before the cordon point which obstructs traffic. The type of congestion experienced during this period is the synchronized-flow congestion as experienced on previous corridors examined characterized with significant drop in the speed of vehicles with no noticeable change in the flow rate. It could be said from the figure that peak periods did not follow the same trend as seen in the previous corridors examined. Peak periods during the week occurred between the hours of 8:01am-10: 00 am for the morning peak, 2:01pm-4: 00 pm and 4:01pm-6: 00 pm for the evening peak.

Figure 4.7 reveals that traffic is at its highest on Monday with 29% of the entire traffic for the days observed. This, however, leads to the clogging of the corridor which often leads to terrible traffic on Monday.

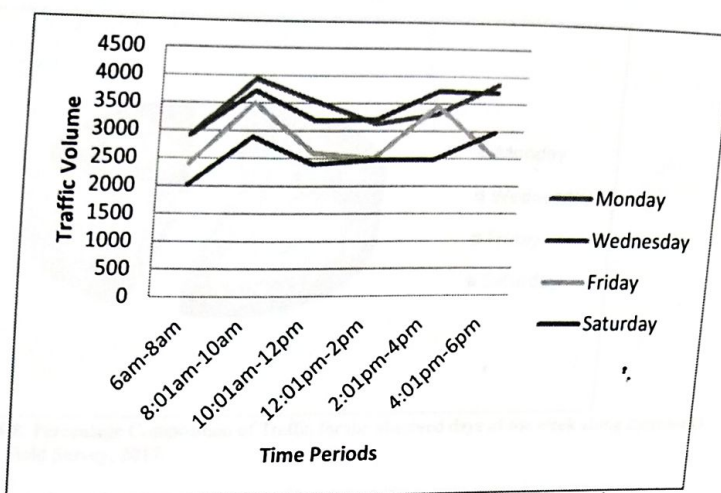


Figure 4.6: Percentage Composition of Traffic for the observed days of the week along corridor C. Source: Field Survey, 2017

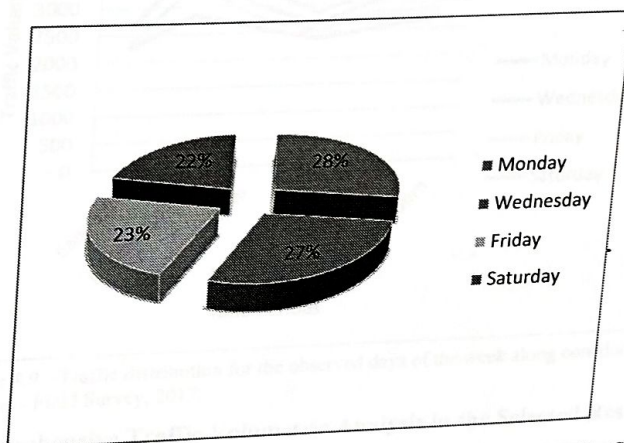


Figure 4.7: -Traffic distribution for the observed days of the week along corridor C. Source: - Field Survey, 2017

**Volumetric Traffic Count along Corridor D (Minna-Zungeru road carrying streams of traffic from Bosso, Tayi village and F-Layout to Mobil);** Figure 4.8 gives a summary of the traffic distribution along corridor D during the observed days of the week. It also presents the trend in peak periods and off-peak periods. Just like in previous corridors examined, the most noticed congestion period was during the morning and evening peak hour (between 8:01 am – 10 am and 4:01 pm – 6 pm) while coming from Bosso, Tayi village and F-Layout. During the peak periods when traffic was intense, traffic congestion was experienced in numerous cases. Contributing factor to the congestion along the corridor were petty traders who lay their commodities for sale along the shoulders of the road resorting to vehicles (commercial taxis and tricycles in particular) parking on the road side which obstructs traffic. The corridor runs through the central business district of the metropolis and as such traffic is intense because of the various land uses that generates and attracts traffic within the central business district. The available right of way for traffic is very small considering the nature of traffic in the CBD and as such various transport vessels compete for the available space especially during intense traffic period.

Figure 4.9 reveals that traffic is at its highest on Monday and least on Saturday. This is justified by the fact that Monday is the first day of the week and economic activities are vibrant a case of which is different during weekends. This, however, leads to the clogging of the corridor leading to terrible traffic on Monday the case of which is different on Saturday characterized by very smooth traffic flow.



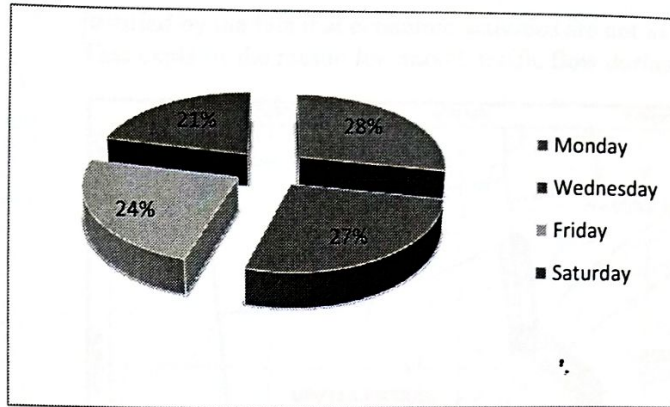


Figure 4.8: Percentage Composition of Traffic for the observed days of the week along corridor D. Source: Field Survey, 2017.

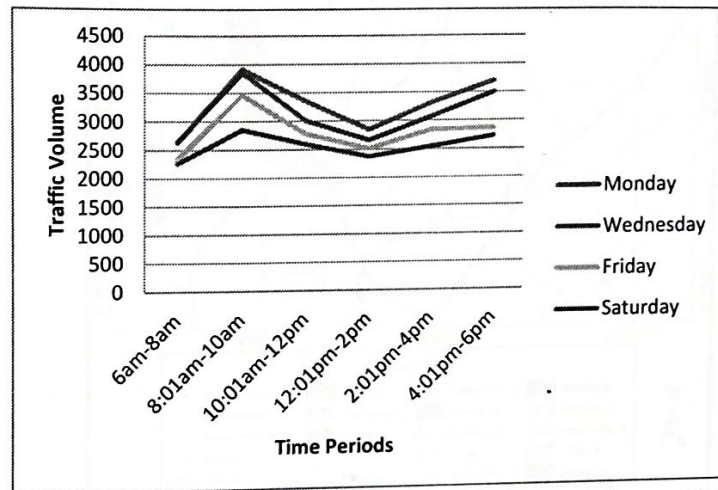


Figure 4.9: -Traffic distribution for the observed days of the week along corridor D. Source: - Field Survey, 2017.

### Comprehensive Traffic Volumetric Analysis in the Selected Research Road Corridors

Days of the Week	Corridor A					Corridor B					Corridor C					Corridor D								
	C	T	B	TT	M	B	C	T	B	TT	M	B	C	T	B	TT	M	B	C	T	B	TT	M	B
Monday	6286	3263	66	56	6535	9	6374	4236	48	26	6392	10	7404	5603	90	97	7442	47	6627	5432	89	88	7494	44
Wednesday	5748	2976	35	25	5764	4	5748	4212	49	47	3806	12	7396	5668	66	67	7036	50	6394	5430	96	81	6696	37
Friday	5501	3611	46	39	5852	12	4971	4040	56	44	4772	17	6001	4608	93	60	6256	24	6042	5150	67	71	5420	43
Saturday	4227	3138	24	41	4699	3	4365	3357	35	37	4621	18	5248	4195	65	50	5679	9	5094	4802	68	61	5294	28

Legend .	
C	Cars
T	Tricycles
B	Buses
TT	Trucks/Trailers
M	Motorcycles
B	Bicycles

Source: Author's Research, 2017

### Congestion Extent Experienced along Corridors Studied.

The extent of congestion was extreme during certain peak periods of the day. A composite map that shows all the extent of congestion experienced during the days of the week along the corridors studied is seen in figure 4.10. The extent of congestion for each day of the week studied along the corridor is represented by different colour tones. The direct correlation between the colour tones and the extent of congestion tells that the denser the tone, the more extreme the extent of congestion experienced. The overlapping technique in ArcGIS was used to arrive at the map composite. The congestion extent of each day of the week studied was overlapped accordingly to reveal the trend.

Figure 4.10 reveals that the extent of congestion along each of the corridors examined is extreme on Mondays. The implication of this is that there will be clogging of road corridors on Monday which will often lead to terrible traffic on Mondays. The trend falls concurrently all through the week along the corridors leaving Saturday (a weekend) with the least extent of congestion. The extent of congestion is least on Saturdays all through the corridors

This explains the reason for smooth traffic flow during weekends.

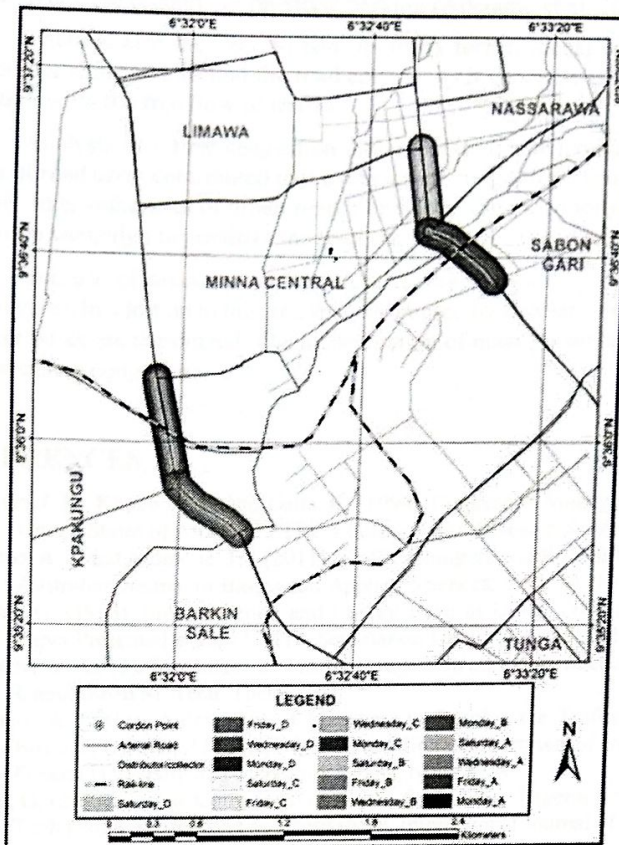


Figure 4.10: Composite Map of Extent of Congestion Experienced along Corridors Examined. Source: Field Survey, 2017.

## CONCLUSION

The conclusion for this research work is based on the research findings. Transportation is a basic tool, vital to the effectiveness and smooth running of every single human activity. Consequently, it is most appropriate that significant effort is adapted towards guaranteeing its greatest practicable usefulness (Badamasi, 2014). This study has been able to identify the nature, impact and extent of traffic congestion on urban accessibility in Minna metropolis and offered some useful suggestions on ways and means to solve these problems.

Although the congestion issues in Minna has not yet assumed the dimensions of that of larger cities like Abuja, Lagos, Ibadan and Port-Harcourt, signs of bottlenecks are already apparent. With increasing population growth and affluence, it is expected that the situation will deteriorate much sooner unless we evolve efficient traffic management for our cities, especially at traffic intersections.

Conclusively, it is quite pertinent to note that urgent attention should be focused on regulating the traffic situation in these selected corridors in order to attain sustainable urban transportation in the City.

## Recommendations

Traffic congestion problems are huge impediments to the free flow of traffic. These problems are caused by the growth in the number of vehicles on the roads, occasioned by population growth, as well as ineffective use of the road spaces (Aderamo et al., 2011). In lieu of the research findings, the following recommendations have been proposed in order to effectively deal with the problems of traffic congestion in the study area:

1. The narrowness of the corridors do not give ample space for side-kerb parking and due to the absence of a provision for off-street parking, drivers resort to parking on the streets, thereby, further constricting the already narrow carriageway. It is therefore



recommended that the expansion of the carriageway, the provision of off-street parking facilities as well as the installation of NO PARKING and NO WAITING signs strategically, will alleviate the problem of on-street parking (Aderamo et al, 2011).

2. There is also the need to ban, in all its forms, illegal commercial activities being carried out along and around the road corridor as it generally constitutes a nuisance and an impediment to the free flow of traffic.

3. Analysis of traffic congestion along the study corridors revealed that poor driving habits of road users contributed to the menace of congestion experienced along the corridor. On this note, authorities of urban road transport in the metropolis should embark on regular education campaign to sensitize the road users on effective utilization of roads.

4. The use of mass transit has an advantage in moving more people than cars and motorcycles. In addition to this, the space occupied by smaller vehicles will be well reduced, if larger buses are patronized. The incorporation of mass transit lanes on highways will also help in easing congestion.

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