

**A SURVEY INTO THE SAFETY CONSIDERATIONS FOR  
PEDESTRIANS.**

**(AWKA SEGMENT OF ENUGU-ONITSHA EXPRESSWAY)**

**BY**

**NWANKWU ELOCHUKWU ARINZE.**

**(NAU/ 2017224045)**

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## CERTIFICATION

This is to certify that the research project on “A survey into the safety considerations for pedestrians along Enugu-Onitsha expressway” was carried out by Nwankwu Elochukwu Arinze with registration number (NAU/2017224045) and submitted to the Department of Civil Engineering, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

\_\_\_\_\_  
Nwankwu, Elochukwu Arinze.

(Student)

\_\_\_\_\_  
Date

## **APPROVAL PAGE**

This research work titled “A survey into the safety considerations for pedestrians along Enugu-Onitsha expressway” was carried out by Nwankwu Elochukwu Arinze with registration number (NAU/2017224045) and submitted to the Department of Civil Engineering, Nnamdi Azikiwe University, Awka for approval in partial fulfillment for the award of Bachelor of Engineering (B. Eng.) Degree.

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Engr B.A Njotea  
(Project Supervisor)

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Date

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Engr.Dr. C. A. Ezeagu  
(Head of Department)

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Date

## **DEDICATION**

This research project is dedicated to the Almighty God, for his undeserved grace and love he showed me throughout my stay in this university and to my parents who saw me through my time here as a civil engineering undergraduate student.

## **ACKNOWLEDGEMENTS**

I express my profound gratitude to God the father, the son and the sweet Holy Spirit for their role in making my dream come through.

I wish to say a special thank you to my mum Mr. & Mrs. Ossie Nwankwu, my uncle Prof. Meshach Umenweke, my siblings and friends and family for their love and commitment towards my growth and journey. God bless you all.

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## **ABSTRACT**

This research is an attempt to dissect into the safety consideration for pedestrians along the Awka segment of the Enugu-Onitsha express way in Anambra Nigeria. The Awka segment of the highway was of interest, Awka is the capital of Anambra state with obvious commercial activities going on at both sides of the carriageway. Problems such as congestion, collisions and hostile vehicle to pedestrian relationship have been observed on this research location. Therefore, it is important to investigate and find possible remedies to this. There are three major intersections along this location, they are; Regina, Aroma and Unizik junction. The volume of pedestrians with respect to behaviors that affect their safety were gotten at these junctions by manual counting, direct and indirect interviews were also carried out on pedestrians. The Regina junction recorded the highest volume pedestrians crossing the carriageway, which is over 50% of the total pedestrian volume at that time. The Aroma junction had 745 people as the highest number of pedestrians walking along the junction during a one-hour period. This junctions lack crossing or walking facilities, hence obvious difficulties were observed for pedestrians using these intersections. The Unizik junction recorded the greatest number of pedestrians using their mobile phones on the road, which was over 35% of the pedestrians crossing at that time. From the interviews carried out, it was analyzed that motorists have a hostile attitude towards pedestrians which makes using these junctions without traffic and safety facilities difficult for pedestrians. It was recommended that there should be provision of facilities that would resolve pedestrian related issues, awareness campaign for road users on the right attitude to increase safety and maintenance of already existing facilities.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of study

Pedestrians are people that rather travelling with a vehicle, are walking as a means of transportation by the road side. Crossing roadblocks and walking is a minor part of pedestrian activity on the road, but this is known to be one of the activities with the highest probability of risks and accidents (collision with vehicles). The majority of these pedestrian collisions occur at crosswalks, which has been recorded numerous times as the location with the highest risk (Hamed,2010).

A pedestrian crosswalk is a segment of the road that is allocated to pedestrians. The crosswalks can be located at the end of an intersection or middle of the street block.

Hamed (2021) had observed that whilst there are several types of crosswalks, marked crosswalks which is one of the most convenient is not seen. The location of roads, crosswalks, and behavior of pedestrians are factors that have a significant effect on regularities and level of crashes. They also determine the impact of the crash outcome on the pedestrian.

Activities and behavior of pedestrians on the road is influenced by many factors, and demographic variables is one of the major factors. This covers the gender and age of pedestrians. Age is considered as one of the elements that could affect pedestrian behavior on the highway. Li et al. (2013) analyzed characteristics of three groups of pedestrians' pair while crossing the street in Albany, Oregon United States of America (USA); adults, adult-child pairs, and children alone. Coffin and Morrall (1995) found that the walking speed of elderly pedestrians above 60 years of age at the same street at midblock crossings and marked intersections overseen to be around 3.3 ft./s (1.01 m/s) to 3.9 ft./s (1.19 m/s). Gates et al. (2006) evaluated the performance of 1947 pedestrian using an 11 crossing Intersections in Eugene, Oregon USA, and found that elderly pedestrians

greater than 65 years of age were the slowest among all age groups. Groups of pedestrians crossed the freeway at 0.40 ft./s (0.12 m/s) to 0.60 ft./s (0.18 m/s) slower than pedestrians crossing alone. Thus, a recommended walking speed of 4.0 ft./s (1.22 m/s) was not sufficient time to cross the road for most vulnerable road users (elderly, children, persons with disability) or large groups of pedestrians. Hence, there is a need for special considerations for vulnerable road users (elderly, children, and disabled), and this also has an effect on the frequency of road accidents that involves pedestrians.

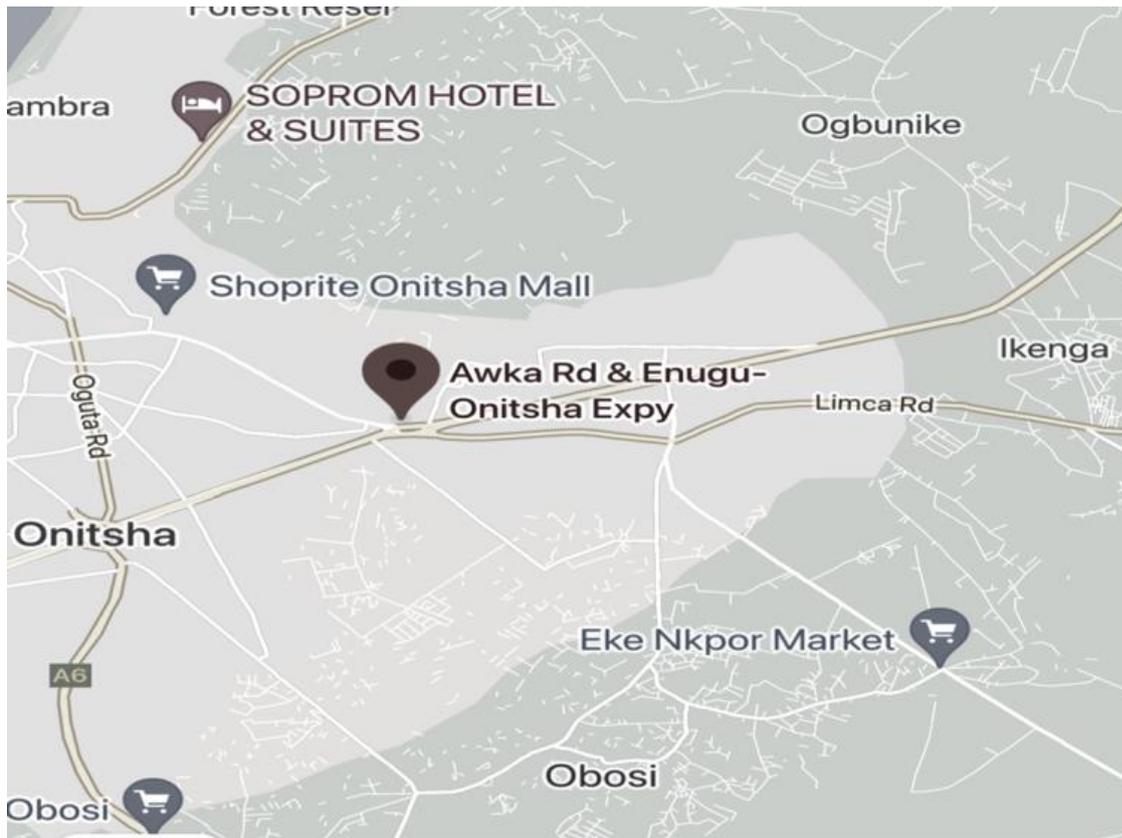
Considering the frequency of road accidents in Nigeria, it has been of utmost importance and critical concern. The death toll shows that every twelve hours, not fewer than eight lives are lost on Nigerian roads. The daily toll is 15 persons and a cumulative of 426 persons every month. Every year, about 20,000 of the 11.854 million vehicles in the country are involved in accidents, 20% of lives lost are due to pedestrian casualties, an analysis of data released by the National Bureau of Statistics (NBS) and the Federal Road Safety Commission (FRSC). In research shown by the FRSC (2016), there were 12,077 road accidents of which 5,400 lives were lost in the year 2015. There were 11,363 crashes with 5,053 deaths in 2016 as reported by NBS; and in 2017, a total of 10,026 crashes and 5,049 deaths.

According to Hamed (2012), distraction of pedestrians at roadway crossing increased the Hazard of pedestrian-vehicle crashes. Advanced Placement warnings, pavement markings, and traffic signals are being utilized as different traffic control equipment to increase pedestrian's safety at crosswalks. Some elements could be introduced at crosswalks to make the pedestrian more visible to the motorist and increase the awareness of the motorist to stop on the approach to the crosswalks. These countermeasures comprise slower vehicle speeds,

shorter crossing distances, enhanced visibility for both pedestrians and vehicles, and the adequate configuration of traffic control devices.

### **1.2 Statement of problem**

Awka is the capital of Anambra state in Nigeria, a high rising and fast-developing city. This city is known as a core for hospitality, this matches with the number of high and beautiful structures, ranging from hotels, business plazas, learning institutions, hospitals, malls and event spaces. Along the area of study (Onitsha-Enugu expressway), particularly from the Unizik express gate to the Unizik junction, many important infrastructures that links to the highway exist, this is an area with high traffic volume of pedestrians during morning hours, especially in front of the university gate, Aroma junction and Unizik junction. Furthermore, the availability of shops, cafes, eateries, hotels, and infrastructure where people visit during different hours of the day, brings constant traffic of people during the night and day time, hence the road has a high recording of accidents in Anambra state. Map view of this research location is shown in Figure 1.1. The lack of adequate traffic system on this road is a major contributor to the accident and collision of pedestrians.



**Figure 1.1 View of Awka segment, Enugu Onitsha express way.**

This research area lacks enough crossing opportunities like signaled controlled crossings and pedestrian bridges that are supposed to be provided at regular convenient intervals to improve safety of crossing. The provision of these controlled crossings and implementation of a good and effective traffic system with the consideration of pedestrians will lessen the accident experienced on this road. Some sections of this research area already have signaled controlled traffics but they are not in use due to lack of maintenance, some of the traffic lights have not been working for a long period, and this has affected the traffic systems on this intersection.

In some sections of this research area, the road designs do not put into consideration pedestrians and vulnerable road users. A major provision lacking in this area is accessible paths for road users like sidewalks, transit stops, pedestrian bridges and refuge islands. Pedestrians are seen walking on the sides

of the roadway due to lack of a special path for them and this has had a high contribution to collisions.

### **1.3 Aim and Objectives**

The aim of this study is to investigate into the safety considerations for pedestrians along the Awka segment of Enugu Onitsha expressway. The objectives are;

- i. To identify pedestrian behaviors that cause and increases more crashing outcome on this research location, through pedestrian count and observation along the major intersection.
- ii. To offer countermeasures that reduce risk of pedestrian-vehicle crashes, by distributing questionnaires along this research location and making necessary evaluation of pedestrian problems.
- iii. To identify and analyze design facilities needed on this research location, by observation of already existing and non-existing facilities, major pedestrian activity and needs on different intersection in the research location.

### **1.4. Scope of work.**

This project research is concerned with general considerations that can be adopted for the pedestrians in the area, the need to adapt facilities like pedestrian bridges, pedestrian crossings, and road keens. Crossings controlled by authorized persons and other measures needed for a planned road network and how to effectively implement them is strongly canvassed throughout the text. It contains five chapters covering some aspect of pedestrian considerations from planning feasibility study and environmental impact assessment to traffic facilities and recommendations for management of these facilities.

This research brings pedestrians into limelight as it pertains to road design. The text also represents more background information that gives a clear overview of the pedestrian to motorists' relationship.

This study includes an analysis of distracted pedestrian crossing behavior, identifying the problems pedestrians face on the highway that affect their crossing speed and pedestrians experience with motorists. In brief, road network that gives equal consideration and attention to both pedestrians' safety and other traffic demands.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Pedestrians and their challenges

Contrary to popular beliefs that pedestrians are larger victims of road accidents, pedestrians are also a big factor of casualties on the road, they inflate the risk of road accidents and they are often flexible and unstable on the highway. In many analyses, some pedestrian activities like talking phone calls while crossing the street, disregarding road signals like traffic lights, crossing a red light, and crossing at unsuitable places (crossing dangerous lines) are referred to as pedestrians' unsafe behaviors. Furthermore, low perceived risk of unsafe behaviors, consumption of alcoholic beverages, poor vision on the roads, and minor distraction are also reported as other behavioral factors that contribute to pedestrian accidents. Lack of adequate traffic indications and environmental factors are also a cause of unsafe conditions for pedestrians. As an instance, there's a sense of insecurity experienced by older pedestrians as a result of inadequate crossing facilities on the crosswalk. prior to this literature, some factors like ignoring pedestrians needs on the road by drivers, avoiding the use of facilities that assist pedestrians to flow on the road, lacking a sense of safety in using the facilities during dark hours of the day, lack of pedestrian facilities like escalators and bridges, and the pile-up of traders along pedestrian bridges are also reported as hurdles to pedestrian safety (Hakeem, 2010).

There are vulnerable road users in pedestrians, but pedestrians as a whole are the most vulnerable on the highway. 25% of road accident deaths, injuries and casualties recorded in India are pedestrians. Pedestrian deaths and injuries are often preventable and yet pedestrian safety does not command the awareness it warrants (Salem, 2018).

According to the Haghghi et al. (2012) the challenges associated to pedestrian safety

were evaluated under six sectors including "Challenges related to pedestrians", "Challenges related to drivers", "Management system challenges", "Environmental infrastructure challenges", "Educational and media challenges" and "Challenges of legislation and enforcement". According to these outcomes, it was concluded that in developing countries, pedestrian safety was a formidable subject in urban transport systems with evident complexities, particularly in the supervision network system.

## **2.2 Age as a factor that affects pedestrians' safety**

The walking speed of pedestrians on the highway can be affected by gender, age, the level of urgency to the pedestrian, if he/she is carrying a heavy load, accompanied by a child, or has a disability. Statistics have then shown that younger people face more risk than older people, however, older people are prone to suffer more injuries. Older people are more at risk as a pedestrian because albeit the collision rate among older pedestrians been lower,(census data of Britain 2001 shows that 20% of the population are over 60 years old), injuries to older people over 65 years old tend to be more severe and fatal than that of other age groups (department for transport 2004, AA foundation 1994 and TRL unpublished research undertaken as part of the study by the wall, 2000).

In 2003, National statistics shows that 0.5% of collisions to child pedestrians under 16 years old resulted in severe casualties, while 21% of adults over 60years old involved in road collisions were recorded deceased.

In 2003, there were 36405 pedestrians' collisions reported on the Great Britain freeway.60% of those involved were male and the remaining 40% we're female pedestrians according to the government statistics. Research has also indicated that men, most especially young men are mostly involved in collision than women.

In research by Zhou and Sixian (2019), In four peak hours, 4196 pedestrians are

observed, among them, 328 pedestrians (7.82%) are using their mobile phones encompassing of 162 male pedestrians and 166 female pedestrians. The average phone use rate in different age groups is presented as follows: 4.49% are teenagers, 10.69% are youth, 6.87% are middle-aged, and 1.15% are old -aged. Age is a significant factor in terms of a pedestrian character on the crosswalk.

Statistically significant relationships were observed between age and the perceived crossing behaviors. Waiting time is at the lowest for individuals in their twenties, and then steadily increased as the age increases. Waiting time ranged from 19.0 s been the minimum for pedestrians in their twenties to a maximum of 59.1 s for pedestrians in their seventies (Ferenchak, 2015).

In research by Niebuhr (2016), using some assumptions, a model-based approach to injury risk, allowing for the specification of individual injury risk parameters for individuals is presented. The data set is divided into three age groups; children from 1-14 years, adults from 15-60 years of age, and older adults older than 60. Individual risk curves are computed for every group. The derived model addresses the influence of age on the outcome of pedestrians to car collisions. The results show that compared to younger people, older people have an increased injury risk at all collision speeds. The injury risk for children behaves is low compared to other age groups, their injury risk is lower at lower collision speeds but substantially increases once a threshold has been exceeded. At this stage in life, younger people are allowed and perceived to make decisions by themselves, which can affect their health and well-being in the long term and short term.

The research suggests that in spite of their supposition that they know what to do around roads and traffic, some factors combine to put young people at greater risk of injury than the middle and older age groups. Risks associated with being young include:

1. Oversee another pedestrian crossing the road.
2. New levels of independence.
3. Lack of experience with alcohol and experimentation with alcohol and drugs
4. Still cultivating maturity, hazard perception and decision-making skills
5. Peer pressure.
6. Risk-taking tendencies.
7. Catching public transport.

### **2.3 Effect of gender on the behavior of pedestrians**

The gender of a pedestrian is a very important characteristic considered in deducing the pedestrian behaviors such as waiting time and inclination towards risk. In particular, male pedestrians have been perceived to be keener to violate rules and make unsafe crossing decisions. They are also less likely to perceive risk when crossing a roadway in the presence of a motor. This harmony between males and higher rates of risky behavior has even been exhibited in young kids aged 5-8 years old. Female pedestrians also tend to wait for longer amounts of time than male pedestrians when crossing a roadway. Likewise, male pedestrians have reasonably faster-walking speeds than their female equivalents, probably linking to their lesser waiting times. As is predicted, males make up to 80% of pedestrian casualties. In extension to pedestrian behavior being strongly conditional on biological gender, it has also been seen to depend on the psychological masculinity of a person.

According to a research by Ferencliak (2015), the normal waiting time of female pedestrians is 34.4 s, which is 88.0% higher than the average waiting time of male pedestrians of 18.3 s. In terms of the available crossing treatments used in the

research, only 39.8% of males and 53.2% of females used functional crosswalks. This demonstrates that females are over one-third more likely to use crossing infrastructure than males. The most remarkable discovery related to gender is the difference between males and females in terms of conflict with motorists while crossing. While only 14.3% of females caused a conflict with a motor vehicle, 33.1% of males caused a conflict. This shows a 131.5% rise in the probability of causing a conflict, which is statistically critical at the 99% confidence level and a strong trend that demonstrates significant safety behavior differences between the two genders.

#### **2.4 Distraction from mobile phones.**

A combination of the attitude toward the behavior, biased norm, and awareness of behavioral control is known as Intention. These three variables will take out the most regular factor that influences the intention of the pedestrian to cross the road. Distractions while walking constitute to factors that influence the intention and behaviors of pedestrians. The average pedestrian is seen to use their mobile phone while walking rather than pay attention, even when crossing a road, using a phone is a risk to the drivers' and pedestrian safety, and also a major distraction to the pedestrians, especially for the new generation. Records has reflected that Pedestrians were less conscious of the traffic, took off in a less safe time between their crossing and the next arriving vehicle, experienced more collisions with vehicles, close calls with incoming traffic, and waited longer before starting to cross the street because they've been distracted by the phone usage (Hameed, 2021).

According to Zhou and Sixian (2019), talking on the phone is the main usage of mobile phones at the intersection located at commercial district, while text messaging or playing games is the most common use type at crossings located at the school and residential area.

In this research, some data research is performed to evaluate the relationship

between the use of mobile phones and pedestrians' observing behavior. Among all the pedestrians who do not use the phone, the percentage ratio of pedestrians who observe the traffic to those who do not observe be the traffic is 68% to 31%. Also for the pedestrians who use the phone, the ratio of those who observe the traffic is 39.02%, while 60.98% of them do not observe the traffic. The significance of the topic of using mobile phones and headphones by pedestrians is validated by the number of available papers and documents that denote the existence of this dilemma. The use of mobile phones and headphones is characterized as a major cause of pedestrian accidents. For example, in the document Pedestrian safety, a survey was conducted in New York in 2018 by the University of Northern Arizona, according to the results, 9% of pedestrians were on their mobile phones when crossing the road. Regardless, according to statistics for the entire United states of America (USA) for the duration 2010-2015, just 0.2% of pedestrians sustained severe accidents caused by the use of electronic gadgets, and a minimum of related cases was documented in the city. In addition, the New York City Transportation Department (NYCTD) is committed in different educational activities such as the Cross this Way campaign, which focuses on the threats of using mobile gadgets by road users, so they chose to centralize on speed, based on these facts, the law has ultimately not been adopted. The same problems have been recognized on the other side of the globe, in Australia. In 2018, the Pedestrian Council put forward a proposal to the government of Australia to fine pedestrians using electronic gadgets while crossing the road with charges of up to USD 200. This penalty also applies if a pedestrian crosses a road at a signalized crossing when the light is green. Certain charges for pedestrians have already been initiated, For instance, a sanction of up to USD 80 has been imposed for crossing the road outside the pedestrian crossing. Harold Scruby, chairman of the Pedestrian Council, insisted that the fine for pedestrians for using mobile devices and headphones at the crossings must be increased, it would be one of the major

ways to ensure pedestrians' safety. Speed management is much more than setting and enforcing appropriate speed limits. It employs a range of regulations in engineering, enforcement, and education, to balance safety and efficient vehicle speed on the road network. Younger people have a bigger percent of speed limit problems, but information on a likely law for this group of pedestrians ensued as early as 2020. (Mikusova, Wachnicka & Zukowska, 2020).

Granted that mobile phones are increasingly common among all age groups in daily life, and considering their dominant use in traffic scenarios (e.g., drivers, pedestrians), the problem may even worsen in the future. To reduce pedestrian fatality due to distraction-related to mobile gadget use, it is essential to observe such unsafe behavior among road users, along with their intention to cross under the condition of being diverted.

## **2.5 Vulnerable road users (VRU).**

According to the road statistics by World health organization (WHO), more than 3000 deaths are caused by traffic accidents worldwide per day, among which half are VRUs (pedestrians, children, cyclist, aged, etc.), showing a strong need for clues to protect VRUs.

Vulnerable road users typical walking speed is 1.4m/s (5 km/h). Pedestrians may walk unaccompanied or in groups of different sizes. Walking speed of VRU varies by age and physical proficiency or disability. Based on VRU's physical features, they may further be categorized into the following groups:

1. Aged—This group holds to the typical qualities of VRU, such as low speed and consistency.
2. Children/teenagers—This group may show characteristics such as unpredictable consistency, delay in walking or running.

3. physically disadvantaged persons—This group may demonstrate characteristics such as slow walking and may use some aid (e.g., cane, wheelchair, or a guide dog). Pedestrians embody a significant fraction of road users and are one of the most vulnerable groups. According to the most recent findings, vulnerable road-users account for 70% of road deaths in urban societies. Pedestrians represent 21% of total casualties. They account for a vast amount of road traffic fatalities and their vulnerability index is also on the highest level. (Mikusova, Wachnicka & Zukowska 2020)

According to WHO, each year about a million people die, and ten times that figure are severely injured on the world's roads. The World Health Organization has indicated that, for people above 3 years to 35 years of age, road traffic crashes are now the leading cause of their death and disability.

## **2.6 Safety enforcement measures for pedestrians.**

According to Salem (2018), In an article on measures to guarantee pedestrians, safety, some of the important measures are:

1. Minimizing pedestrian's exposure to traffic; There are a number of engineering regulations to ensure that pedestrians have minimal to no exposure to vehicular traffic. A great number of these measures involve operating vehicles from pedestrians, hence reducing traffic volume, building of usable sidewalks for pedestrians, building pedestrian overpasses and under passes, design of mass transport routes, putting up signaled and marked crossings. Marked crossings help to indicate pedestrian right-of-way and drivers need to yield to pedestrians at these points of intersection, the main aim of the marked crossings is to specify the most convenient location for pedestrians to cross, and signaled crossings help show the best time for pedestrians to cross, hence giving them a feeling of safety. Pedestrian safety is a key issue to consider in the design of any highway transport system, including paths and stops.

2. Reducing vehicle speeds: measures put in place to reduce vehicular speed is one of major ways to ensure pedestrians safety. Speed supervision is more than just setting and implementing a given speed limit, it entails a range of restriction on the highway, enforcement, and empowerment in engineering to harmonize safety, security and efficient vehicle speed on the highway system.

3. Improving pedestrian visibility: Low lightening condition on the highway has caused a high percentage of deaths and casualties on the highway for pedestrians. There are so many measures and details put in place to ensure an improved lightening on the highway, this helps make pedestrians visible to drivers especially and night, dusk or dawn.

4) Empowering pedestrian and motorist about safety awareness and behavior: altering the attitude and behavior of drivers and pedestrians is a huge long-term measure undertaken to bring a series of improvement on the highway. Interventions that can be put in place for these changes are; Education, outreach and empowerment programs, training and campaigns. This will result to better pedestrian behavior and a reduction in pedestrian to vehicle collision, but this also depends on the community support, exposure and risk perception, social models and norms, engineering enforcement laws and regulations. Strategic and planned media awareness, social media campaigns enlightening the public about the pedestrian risk factors and the necessary laws to abide by to enhance the driver and pedestrian relationship, and improve understanding of traffic problems such as ignoring traffic signs and marked crosswalks for all road users.

## **2.7 Significance of creating and maintaining a planned road network.**

Transport has become a significant subject issue for geographers for two major

motives. Firstly, transport is a very crucial human activity with a vital spatial element. Lastly, it is a significant component influencing the spatial distinction of several public and economic activities in the world. Transport is a means by which people and products are carried from one location to another by a number of ranging physical modes like water, roads, airlines, railways, and pipelines. So, transport in one form or the other is a fundamental and crucial aspect of the daily pulse of life throughout the world. Transport is considered an important part of life and a very essential feature of all modern economies. In social terms, as the economy of a country grows and develops, it develops more intent relationship with its transport sector, Development of the road transport network and highest sector plays a significant role in the economic development of a country and, therefore the kilometers-age of paved roads existing in a country is constantly used as an index to classify the degree of its development (Aldagheiri, 2007).

Roads make a sufficient amount of contribution to economic development and progress and bring significant social benefits. They are importance factors required in order to make nation maintain development and growth. Improving and giving access to employment, health, social, civic and education services makes a road network vital enough in revolting against poverty. Roads introduce more areas and community; it also promotes economic and social development. This makes highway infrastructure and development the most important of all national asset. Maintaining and improving road maintenance will attract so many benefits by preserving current assets whilst also lowering future costs of maintenance for citizens, pedestrians, motorists, tax payers and road owners. This can only be valuable and effective if the maintenance of this assets is done periodically and on time (Gülây, 2015).

Road transportation investment is frequently based on multiple purposes, such as

providing high tiers of mobility, protection, dependability, improving social equity, and guaranteeing elevated standards of environmental protection. Besides, highway infrastructure maintenance and building are recognized by the public opinion and by many citizens in high decision ranking as an important instrument to promote economic development (and regional growth). In fact, these objectives are, in general, considered by most decision makers as the ultimate goals for developing massive road infrastructure investments plans. However, regardless of the public consensus about the positive impact that road investment has on economic development, available empirical studies suggest that the impact is difficult to ascertain (Bruno, 2009).

## **2.8 Maintenance of road network.**

Road property management and supervision involve the application of engineering, physical, financial, and management practices to optimize the level of service result in exchange for the most cost-effective economic input. Certainly, the main purpose is to apply the right service at the right time to obtain the desired degree of contribution, reflecting that the highway infrastructure is a financial asset for the community and the economy. Concentrating on road maintenance will bring substantial benefits by conserving current assets, and also reducing future costs for citizens, pedestrians, motorists, taxpayers, and road owners. This would prevent these assets from depreciating in value, provided that timely services are carried out in time (Gülay,2015)

Road network planning comprises of the optimization of a road network by either improving the existing roads, adding new roads, or connecting existing road networks. In most of the works reported in the literature, the objective is to reduce travel costs for a given travel demand, while respecting a particular budget

limitation. There are several other objectives and intents contemplated in the road network planning literature e.g., the maximization of user benefits, the maximization of accessibility, and the maximization of equity in benefit distribution (Santos, 2009),

## **2.9 Design consideration for pedestrians.**

Drivers safety are neglected in designing for pedestrians, but they are more essential in designing for pedestrians' safety. Acceleration and deceleration time, characteristics of driver's reaction time and vehicular dimension, this are all vital in driver's safety, but function better as an element of pedestrians' safety.

Significant considerations in design for pedestrians are; their basic movement patterns, road facilities like roundabouts, junction configuration, crossing details, design details, signaled crossing and interaction with other pedestrians. New approaches been considered in deigning for pedestrians are; combined bicycle and pedestrians' route, new and rebranded street network system to reduce vehicle speed and encourage pedestrians moving with a feeling of security, measurement methods to determine the levels of benefit and auditing of new and existing systems.

After the pandemic in the year 2020, there has been a consultation draft aimed at reducing the dangers of pedestrians and cyclists; the launch of a gear change strategy by the government policy of England promising funds and measures for the walking and cycling infrastructure to aid the establishment of active travel England, an offset for road users to enforce elevated standards on the road. The department of transport has published strong traffic measures that includes: traffic level managements, low traffic neighborhood, where motor vehicles are filtered out of urban areas. Institution of civil engineers, (ICE) (2021).

According to a report by the guardian, (2018). On the 27 March 2016, the UK

government published a draft on the cycling and walking investment strategy to be implemented in the other to reverse a recent decline in pedestrians interaction on the street, to make cycling or walking a shorter paths and a better choice for a journey that have longer paths, this strategy has an objective of ; doubling the rate of cycling activity by 2025, reducing the rate of pedestrians killed or seriously injured on the road, increase the percentage of vulnerable road users especially school children that use the road on a normal day and reverse the decline of walking activity, the strategies put in place are; creating a different route for cyclists, traffic systems and cards, putting campaigns and programs in place to get information and recommendation from the pedestrians and cyclists themselves .

In designing to improve pedestrian safety, it is important to observe and appreciate some behavioral characteristics of pedestrians on the highway, the body area, walking rates, pedestrian's ability and disability and the capacity for pedestrian-related facilities. Sight distance is a critical design element if considering pedestrians and it takes forms of stopping sight distance, decision sight distance and passing sight distance. Cross section elements like lane width, shoulders, curbs, traffic barriers, walk away, and medians should be taken into consideration. The intersection on a road network system is a vital instrument in easing the insecurity of pedestrians on the road, moreover, adding other systems to this intersection such as refuge and channelization islands, curb ramps, flared curbs, turning radii, traffic control devices, drainage, bus stops, street furniture and parking way.

Transportation engineers should consider vulnerable road users in order to design well efficient facilities for pedestrians. The good and efficient pedestrian design promotes the smooth cooperation of pedestrians into the flow of traffic among larger vehicles. Most facilities needed to aid the use of the road by pedestrians with disability are in operation with design consideration for well-to-do pedestrians but at this state efficiently designed with their disabilities in mind.

The basis of a pedestrian friendly environment is the community structure, the community transportation system provides for all the modes of transport action in a balanced manner whilst creating a pedestrian safe environment and this is possible through appropriate land use and development. The recommended regulations needed to arrive at a pedestrian-oriented growth in a community, such as; sub regions, regions, whole cities, or sub region of cities should be surveyed in order to produce a pedestrian-oriented community. Community structure considers use of land, physical details, and the circulation structure. It is also made up of construction blocks generated at a pedestrian scale: regions, hallways, centers, neighborhoods, horizons, seams, and layers (Owens, 1998).

Designing, enforcing, maintaining and operating on efficient road networks and pedestrian's facility is a critical element in the highway system. The solutions required to aid a better design for the pedestrian facility are organized into the following; roadway and building design, ITS technology, Trail design, Traffic measures and management, on-street parking improvement, designing for pedestrians with special needs, and street crossing. Among the many factors that are put as the basis for pedestrians' design, if engineers do not consider disabled pedestrians, the elements of the design is not complete. A high percent of pedestrians with full life expectancy will at some point experience some sort of disability. Design elements specially considered for pedestrians with disabilities include; clear side walk width, wheel chair ramp, side walk cross slope, temporary work zones, tightening curb, adequate median, pedestrian signal timing, construction zones, placement and designs.

On the design considerations necessary for pedestrian environment in Nigerian roads, a manual and demographic traffic count was carried out along the research location to know the policies needed for relating the efficiency of pedestrian activity and to formulate recommendable elements on the road. The result showed that

pedestrians engaged in more walking than crossing activity notwithstanding the lack of pedestrians' facilities in the study area. The difficulties on this road includes; lack of sidewalks, lack of walk ways, inadequate traffic signals and road markings, poor lightening, hostile relationships between pedestrians and motorist, poor road aesthetics and lack of sit-outs and shades.

According to this research, the remedies for these difficulties in the study location requires help from both government and non-governmental organizations, and this could be carried out if a great reputation is given to the pedestrian safety. Some of these remedies include; improved design and road materials, increased illumination and lighting during dark hours, public information and highway campaigns or programs, and enforcement of traffic laws.

A report on the design of a 2-way road to accommodate pedestrians used manual counting to determine the traffic volume of pedestrians and vehicles on the road.

This measurement was done to obtain the sidewalk and crosswalk volume demand used in the design, the facilities provided after the design were recommended to be less than the yearly count in other to save cost and enhance the economical factor of the design. The other pedestrian facilities recommended for this road network are; zebra and wombat crossings, children crossings, finalized intersections, design of islands, and design of bus shelters (Braithwaite & Gana 2018)

In a research by Muhammad (2020), the crossing facilities, usage and contributions to pedestrian's safety in Damaturu, a local town in Nasarawa state, Nigeria, were evaluated. In this research, the method of the research was divided into two segments, the manual pedestrian count and crossing count survey done in 4 sectors of the study location. The result of this survey shows that there were over 3000 pedestrians in this location, and 80% were walking with traffic while 20% were walking against the traffic signals, 20 of pedestrians used the designated crossing facility while 800 use the undesignated facility. Also, amongst 1000 respondents

only 10% could identify at least 4 different types of pedestrian crossing signs, while 30, 40 and 20% could identify only 1, 2, and 3 different types respectively. Zebra crossing happened to be the most recognized crossing sign, as 60% of the respondents understand what a zebra crossing is for. Fifty percent (50%) of the respondents do not understand what children crossing meant for.

## **2.10 Difficulties for pedestrians.**

Pedestrian to car collision has a high result in fatal injury, this is a major problem in the Nigerian traffic system. Pedestrians death have a higher percentage in urban areas than in rural areas. Regardless, the ratio of death to injury is higher in rural area due to the impact of high speed on rural roads compared to urban roads. A demographic of pedestrian accident shows that elderly pedestrians are more likely to die after a minor accident compared to younger pedestrians, even though younger pedestrians are more involved in pedestrian to vehicle collisions.

Accidents occur largely at intersections than any other location, but accidents that affect pedestrians occur in almost every part of the road. And a major attribute of this can be related to some of the following reasons;

1. **Over speeding:** speeding not only means driving too fast, or above the posted limit, it also means driving too fast for a particular road condition or weather like ice or rain, it can also mean driving too fast for a road without traffic facility or under construction. over speeding is one of the major causes of accidents on the highway. Over speeding is relative to the law and speed limit of that particular path. The most dangers caused by this reckless act of speeding includes; increased accident, high severity of accident injuries or sometimes death, increasing the stopping distance of a vehicle, and a reduced reaction time. There is an 85% of death chance when a pedestrian is involved in a motor collision at a speed of 45mph, a 45% chance at a speed of 32mph, and a 5% chance at a

speed of 20mph. This goes to show how much over-speeding affects pedestrians' experience on the highway. There are so many reasons why motorists speed, sometimes not related to aggressive behavior, most times it's due to the road condition or traffic situation at that particular period. Some reasons why motorists speed includes running late due to traffic congestion, trying to avoid a specifically timed congestion ahead of them, lack of awareness of the consequence of speeding, or simple disregard for the highway rules and regulations. It has been observed that drivers often mismanaged the provision of smooth roads and in turn, use this as an avenue for speeding. Very good and smooth roads have been seen to be a major factor that wills drivers to Over speed.

2. Careless driving: Careless driving falls below the standard expected of drivers and driving without consideration for other road users. careless driving is as a result of negligence by the driver, attentiveness to the road ahead, intoxicated drivers and aggressive driving. This occurs when drivers do not consider pedestrians on the highway, they often forget that there are vulnerable road users that their actions may affect. Careless driving includes overtaking at the wrong time and path, running a red light, forgetting to use traffic signals, using intersections for the wrong purpose, tailgating, sudden braking, diving on the pedestrian path, failing to check mirrors before overtaking, staying in an unsafe distance with other vehicle and generally disregarding traffic laws. According to the Highway traffic acts (HTA) Ontario, careless driving includes the driver not driving carefully enough, the driver not paying enough attention to their driving, driving without due care and consideration for other persons using the roadway, or not considering the road conditions. (Santos, 2001)
3. Crossing and waiting time of pedestrians; pedestrians crossing speed and waiting time plays a major role in their safety and the design of traffic facility. It has been observed that the waiting time of pedestrians varies with the intersection,

gender, age, place, waiting for location, and vehicle flow. Elderly pedestrians have a slower crossing speed and waiting time which makes them more susceptible on the road when crossing. Findings show that younger pedestrians do not wait more than 20-30seconds to cross the road, unlike elderly pedestrians. Traffic signals are designed to regulate the movement of pedestrians and improve their safety, enough time should be provided for their waiting time and crossing time to make them comfortable to the necessary extent when crossing the road. Waiting time for pedestrians should be considered differently for their specific nature (disabled, aged and children), because these different pedestrians are vulnerable in different ways. The crossing vulnerability of pedestrians during waiting time should be considered. Furthermore, the vulnerability of pedestrians increases with their increase in waiting time, and over increased waiting time make impatient pedestrians violate traffic rule which puts them at risk. For crossing speed, this is a major factor of unsafe pedestrian relationships on the highway, but it is mostly by the pedestrians themselves (Owen,2007)

4. Poor highway and road facilities: lack of highway facilities or poor effectiveness of the facilities has proven to be a major cause of casualties on the highway. Lack of street lights, pedestrian bridges, crosswalks, low lighting and lack of signs and road aesthetics. These facilities do not only give a safe and secure movement of the pedestrians, it also helps motorists understand and use the road in favor of them and pedestrians. Road and highway facilities include garage parking lots, telephone boots and services stations. Transportation is a major part of our lives as humans, we spend a high percentage of the day on the road, this demands a safe and standardized road facilities.
5. Poor pedestrian behavior: According to Hameed (2001), pedestrians have a role to play in their safety also, but most of them do not place importance to this. Bad road behaviors like using mobile phones, head phones, talking, and careless

crossing affect the rate of accident and cavities on the highway,

6. Pedestrian volume at intersections; crash prediction models developed (Eenink et al., 2008). The study shows that the number of crashes increases with an increasing traffic volume. This increase is not a proportional one, however. This means that the crash rate, which is here defined as ‘the number of crashes per motor vehicle kilometer, decreases with increasing traffic volume. However, this traffic volume to crash rate depends a lot on the road design and intersections.

The highway as a national facility was created and developed for all citizens, both pedestrians and motorists, but the crash data in a way contradicts this. Pedestrians have a high percentage on the crash data released annually, more pedestrians lose their lives than the number of vehicle damages. This data brought the burden of this research topic along this major road in Awka city.

However, there are no available data that shows the time and volume relationship pedestrians have on the highway to fully understand the causes and triggers to this road casualty affecting pedestrians. The average time pedestrians spend on the highway, the volume of pedestrians, their crossing speed, their waiting time, the behavior that put them more at risk, the facilities needed to ensure pedestrian safety, and the necessary measures that can be imposed to reduce this casualty.

### **2.11 Considerations for pedestrians.**

The term considerations according to the Cambridge University dictionary refer to the act of carefully thinking about a particular act or subject before making a decision. It might be thinking about the feelings of people and the consequences an action might have on them. In the term of this research, considerations refer to the thoughts and actions that should be put into place during design to help pedestrians have a more secure and safe movement on the pathway of Enugu-Onitsha express road.

Design considerations are areas that may affect the outcome, requirement, policies, effectiveness and operational concept of a design system and should be part of the engineering process all through the preconstruction stage.

Some considerations are concepts that assist the system and accommodate every action taken, while others are limitations, constraints, and boundaries that affect the system and need to be negotiated on to have an effective design.

Design considerations are required to bring to the attention of the designer the accessibility and design systems to building and facilities. They are guidelines and tools needed by the designer, sometimes they are gotten from relevant design manuals while some other times they're inspired by the needs of the facility users.

In addition to engineering principles and manuals, these considerations have to also incorporate practical findings, analysis from surveys in the case studies, interviews from the users and professionals. Architectural service departments. (2018)

This research area is a major road passing through the city of awka, connecting the Anambra state to a neighboring state. The critical locations on this major road are; the Unizik express school gate, Unizik junction, Aroma junction, and Regina. There are various groups of pedestrians using this road due to the infrastructure inside this critical location, they include; University students, primary and secondary school kids, workers, the aged, and disabled. These pedestrians have and need special considerations to ensure they use

## **2.12 Summary of literature review.**

This literature review covers the effect of pedestrian behavior on their relationship with other road users, their safety on the road, challenges and considerations necessary for a well-planned road network. The significance of vulnerable road user's safety, their challenges and difficulties are discussed in details. From analysis of research recorded in this chapter, it can be concluded that pedestrians are often

neglected in road planning and design.

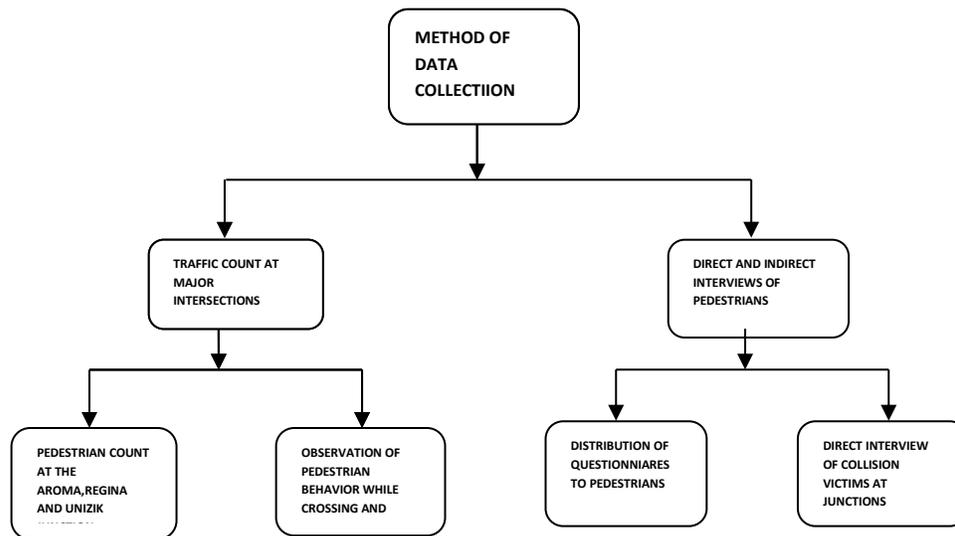
Considerations necessary for a safe and well-planned road network and pedestrian's safety needs were also recommended.

# CHAPTER THREE

## METHODOLOGY

### 3.1 Method of collecting data.

As a way to explain the traffic problems in a research location and provide solutions that'll aid better consideration and systems, engineers are required to collect data and information. The focus is aimed at collecting data related to the traffic volume, pedestrian behavior and traffic facilities available. Pedestrian traffic volume of pedestrians is important and can be applicable in different ways. For instance, it could be used to forecast future trends in society, decide safety analysis study, determine position of traffic infrastructure and help in modification of this infrastructure. Traffic surveys are important in planning, designing, and making major organized decisions on the highway. Location for pedestrian survey are important. They include intersections, sidewalks, and midblock crossing (Alutman ,2009).



**Figure 3.1 Flow chart of methodology for data collection.**

Data collection was done through manual observation first. A pedestrian count survey was conducted along the Awka segment of the Enugu Onitsha express way.

The survey was on four days; Tuesday to Thursday representing weekdays and Sunday representing weekends. The traffic count of people was carried out over a one-hour period for every of this location on the four days; 4-5pm, 5-6pm and 6;7pm. Three of these locations have different pedestrian facility features. The Aroma junction is with faulty traffic lights, the Regina junction has no pedestrian facility, while the Unizik junction has a pedestrian overhead bridge. The pedestrian count data gotten from this count is used to access the volume of pedestrians along the intersection that the questionnaires and pedestrian observation was conducted, pedestrian to vehicle relationship, congestion, and also compare the pedestrian count on the intersection with pedestrian facility to the intersection without any. Furthermore, direct interviews were conducted on pedestrians that have experienced collision on the intersection without pedestrian facilities.

The pedestrian count conducted on this road was done with respect to pedestrian behaviors; their use of phones, if the pedestrian was with a child, if the pedestrian is just walking along the junction or crossing the intersection. This count was done this way to help observe the major behavior of pedestrians on this research location that makes pedestrians more vulnerable to accidents of any form. The count of pedestrians using their mobile phones and carrying loads were only done for pedestrians walking along the junction of Regina and Aroma only, since it was noticed that pedestrians are often focused while crossing the carriage way without any crossing facility. For the Unizik traffic count and observation, the observation for pedestrian using their mobile phones and carrying loads were recorded for those crossing the pedestrian bridge and those walking along. Children were excluded from this count, because the observation during this count were done for pedestrians conscious of their actions.

On the traffic count done on Sunday, that of Regina and Unizik were done at the same time, this was done this way to help compare data at these two intersections

since they're 1km apart and have a difference of the availability of pedestrian facility.

Direct and indirect interview were also carried out in the data collection of this research study. A hardcopy interview guide in form of a questionnaire was shared, received and analyzed.

The questionnaire (appendix 1.0) was shared among 100 pedestrians walking along the Regina and Aroma junction intersection; this questionnaire had covered a few questions regarding pedestrian problems, thoughts, their preferences, and exposure on pedestrian safety and facilities. 92 of these questionnaires were collected back from the pedestrians. This survey question covered pedestrian's preference on traffic facilities, their view on motorist attitude and safety issues along the Regina and Aroma junction. This interview guide was shared with only participants along the Regina and Aroma junction, and this is because they have no pedestrian facility and are closer to the Unizik junction with a pedestrian bridge. This was considered to help give the questionnaire to pedestrians with better knowledge and experience of this questions asked. To increase data validity, two criteria including dependability and credibility were considered. These participants were pedestrians seen present on the two different days of the traffic count survey; hence they are considered to be regular road users of this location.

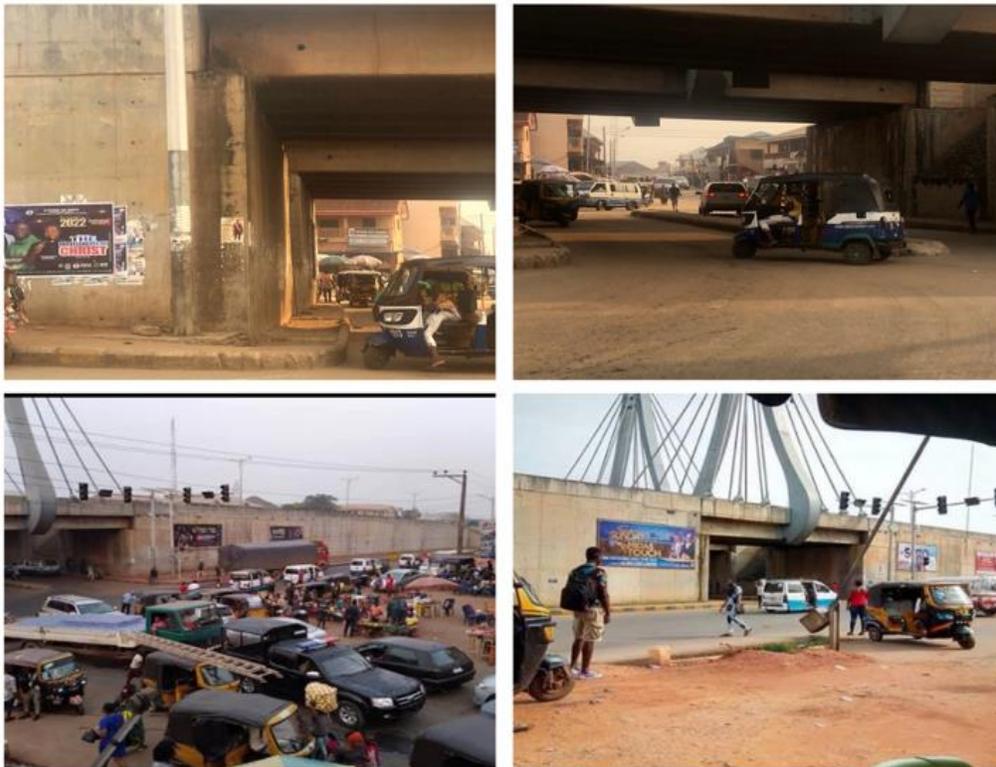
After the collection of the questionnaire from the pedestrians given, a direct interview on 4 pedestrians that were once victim of accidents on these intersections was carried out. 10 minutes personal interview was conducted with them, were they shared their collision experience and the assumed causes.

### **3.2 Selected survey location**

Awka is a fast-developing city in Anambra state, with different roads and road intersections. The research area connects 3 busy junctions in Aroma, Regina and

Unizik to many other intersections leading to towns in Anambra state. This expressway is a two-way, three lane highway. Hence it is characterized by a heavy traffic volume daily. The research survey was done on the tempsite junction with a pedestrian overhead bridge, Regina and aroma junction; this are the two major junctions with intersections and no or poor pedestrian facility. The Aroma and Regina junction are shown in plate 3.1 and 3.2 respectively.

This selected survey locations are the major locations with observed high traffic volume. The aroma junction has a traffic light at the intersections as shown in Plate 3.2, but these facilities are not been used as supposed, because they are faulty.



**Plate 3.1 picture of Aroma junction intersection.**



**Plate 3.2 Picture of the Regina junction intersection**



**Plate3.3. Picture of the Unizik junction pedestrian bridge.**

## **CHAPTER FOUR**

### **RESULT AND ANALYSIS**

#### **4.1. General data analysis**

As explained in the methodology, three approaches were taken in an attempt to give sustainable considerations for pedestrians in this research location.

The first approach is the traffic count, the second is the direct and indirect interview and the third is the direct observations of pedestrian behavior during pedestrian count, and all these approaches were taken along the major intersection of the research location.

#### **4.2 Descriptive analysis**

The highest pedestrian volume recorded in this survey during the one hour viewing time is 1295. This was observed at the Regina junction on the Sunday evening (Table 4.1). The vehicular volume observed was high, and there was congestion at the major intersection. 275 of the pedestrians were holding kids or load, 108 were on their mobile phones, 233 pedestrians were walking along the intersection, and the rest of the pedestrians were crossing the junction without distractions from their phones or extra weights.

The lowest traffic volume was recorded at the Unizik junction with an overhead bridge, during the one hour viewing period on a Thursday evening. A total pedestrian count of 872 was recorded ,104 pedestrians were using their mobile

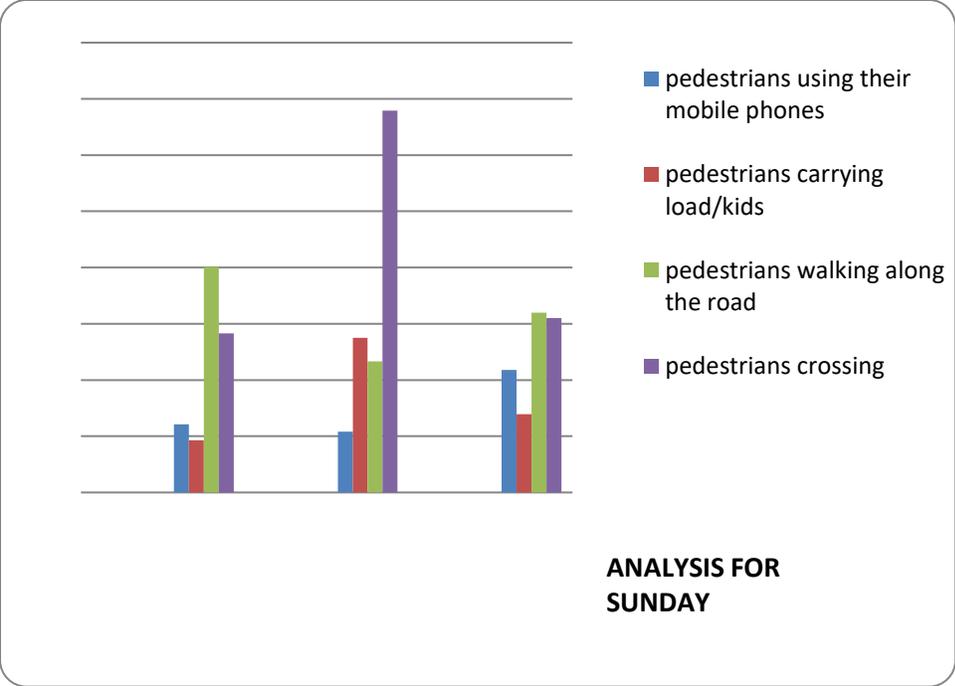
phones, 376 were walking, 106 were carrying loads or kids that delayed their movement and the rest of this pedestrians were observed using this pedestrian bridge without distraction. The result of the pedestrian count at the 3 intersections on the different days are shown in Table 4.1

**Table 4.1: Descriptive statistics of pedestrian count**

<b>Pedestrian statistics (Volume).</b>	<b>Sunday</b>	<b>Tuesday</b>	<b>Wednesda</b>	<b>Thursday</b>
<b>Total pedestrians at Aroma</b>	<b>898</b>	<b>1002</b>	<b>907</b>	<b>872</b>
Pedestrians using their mobile device	121	103	123	104
Pedestrians with loads or kid(s)	93	141	92	106
Pedestrians walking along the junction	401	501	358	376
Pedestrians crossing	283	257	334	296
<b>Total pedestrians at Regina</b>	<b>1295</b>	<b>1261</b>	<b>985</b>	<b>1080</b>
Pedestrians using their mobile device	108	131	103	147
Pedestrians with loads or kid(s)	275	274	271	316
Pedestrians walking along the junction	233	451	244	391
Pedestrians crossing	679	465	570	574

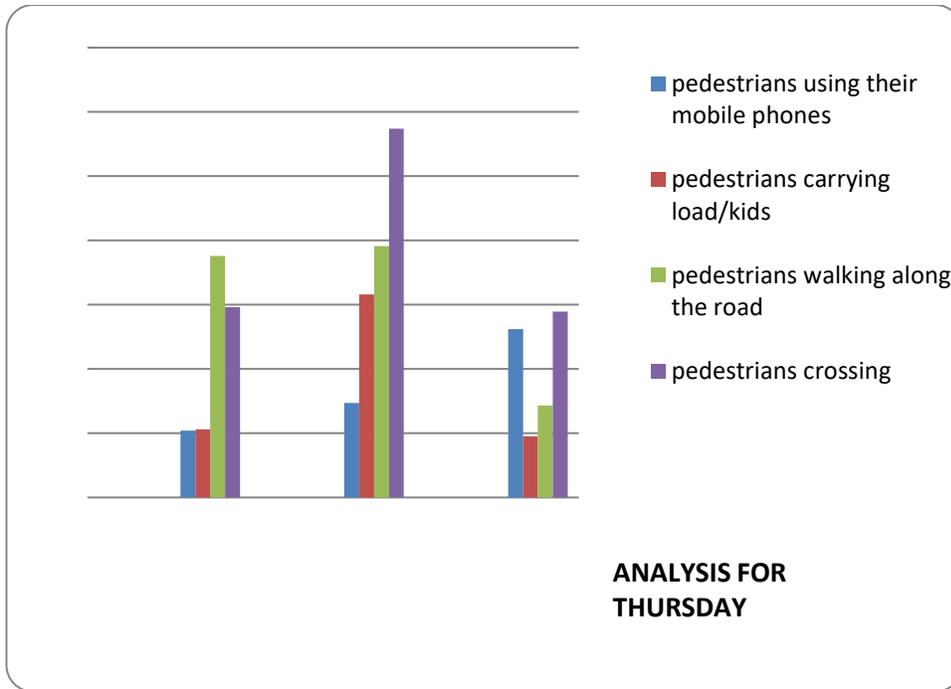
<b>Total pedestrians at Unizik junction</b>	<b>996</b>	<b>1064</b>	<b>902</b>	<b>789</b>
Pedestrians using their mobile device	218	304	321	262
Pedestrians with loads or kid(s)	139	278	122	95
Pedestrians walking along the junction	320	198	171	143
Pedestrians crossing the intersection	310	284	288	289

The analysis of data from the traffic count shows that the intersections without pedestrian facilities have an even higher pedestrian volume than the intersection with pedestrian facility. From the table analysis, the volume of pedestrians at the regina and aroma junction without pedestrian facility and the Unizik junction with a pedestrian bridge has the highest difference of 397 people. The first descriptive analysis done comparing locations, is with respect to the feeling of safety pedestrians experience on the intersections with facilities to that without facilities, and this is analyzed based on the number of pedestrians using their mobile phones on this different intersection. The Unizik junction with a pedestrian bridge records the highest number of pedestrians using their mobile phones while crossing and walking along this intersection on every day of this count. This result can be analyzed to say that pedestrians felt safe enough to use their phone on the facility created for them, using this pedestrian bridge, the fear of collision is less since there are no vehicles. The highest number of pedestrians using their mobile device was recorded on Sunday as shown in Figure 4.1.



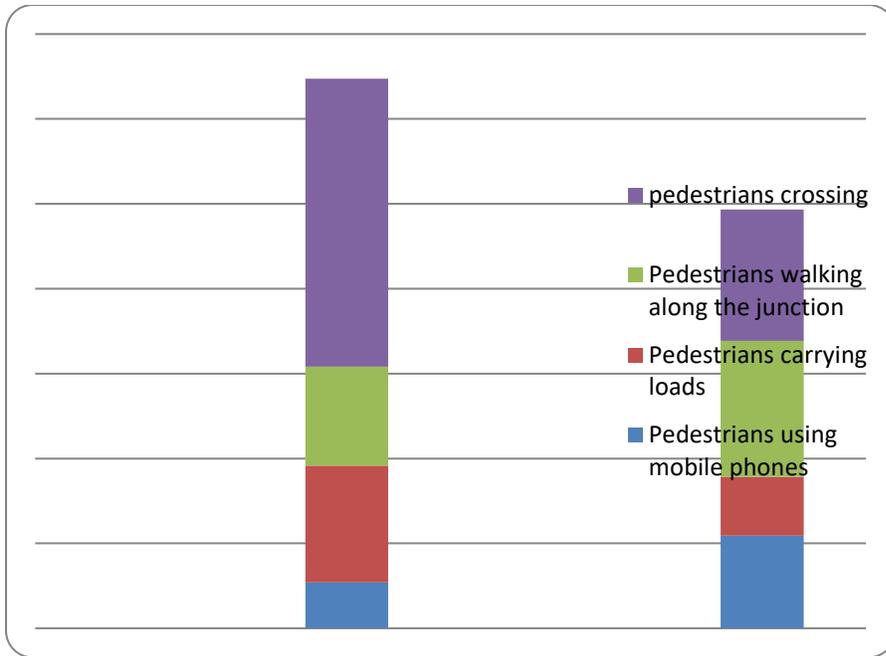
**Figure 4.1 Chart analysis of pedestrians on Sunday**

These intersections are leading inside and along places and communities, so pedestrians are seen either walking along these junctions or crossing to the other side of the carriage way. From the chart analysis, the volume of pedestrians crossing this survey intersections take more than 50% of the total volume of pedestrian count at the survey period in every location. This shows that the main pedestrian activity on this intersection is crossing, the highest crossing activity was recorded on Thursday at Regina junction as seen in Figure 4.2. This can be linked with the Eke awka market day (the community market of the awka city) been Thursday. The highest number of pedestrians carrying loads was also recorded on the same day as seen in this chart (Figure 4.2).



**Figure 4.2 Chart analysis of pedestrians on Thursday**

From Figure 4.3, the statistics shows that on the day and time with Regina junction having the highest pedestrian volume, the Unizik junction that is 1km after the Regina junction and with a pedestrian safety facility (pedestrian bridge) had one third of the volume of pedestrians crossing and walking recorded in Regina junction. This predicts that distance can be a factor pedestrians consider when faced with a decision of using the pedestrian facility or crossing the carriage way without any pedestrian, and also creates an assumption that pedestrians will choose to save their time if need be, instead of walking down to use safety facilities that are far from them. Pedestrians will choose time management over the level of safety experienced while crossing the road.



**Figure 4.3 chart analysis comparing pedestrian walking along and crossing Regina and Unizik junction.**

From Figure 4.2, the Regina junction has the highest volume of pedestrians, which can be linked to a major observation during this survey. During this survey, it was observed that the Regina at both sides of the junction is the major road entrance to eateries, hotels, eats out spots, churches and hotels. Analysis from all the locations shows that Regina junction also has the highest number of pedestrians crossing. Polished without any traffic facility at the Regina junction, the volume of pedestrians crossing was high, and this has obvious difficulties. A good number of pedestrians in each of this survey locations were seen with kids and loads, most of this weighed them down, affected their crossing speed, waiting time, and their relationship with other pedestrians. One of the reason for this pedestrian count in this research is to ascertain the volume of pedestrians using this intersection even with no availability of the pedestrian facility, and from the result, it is obvious that

there is a high number of vehicular movement on these intersections, it is safe to say that pedestrians experience difficulties using this location. A picture of pedestrian with heavy loads observed during this survey is shown in plate 4.1.



**Plate 4.1 Pedestrian carrying a heavy load, walking along the junction.**

During this survey, many abusive relationships between motorists and pedestrians were experienced. Motorists were seen parking in front of pedestrians and disrupting their waiting and crossing time, as shown in Plate 4.2.



**Plate 4.2 Motorists parking in front of pedestrians waiting to cross the road.**

It is unfair that this location lacks pedestrian facility, this location only has facilities aimed at making the road movement efficient for just vehicles, no sidewalks, pathways, Island, signaling or separate walkways. As of last year, an attempt was made to give pedestrians an easy movement by the presence of road safety officers that helped students and vulnerable pedestrians cross the road, but this didn't last

enough seeing that none were present throughout this survey,

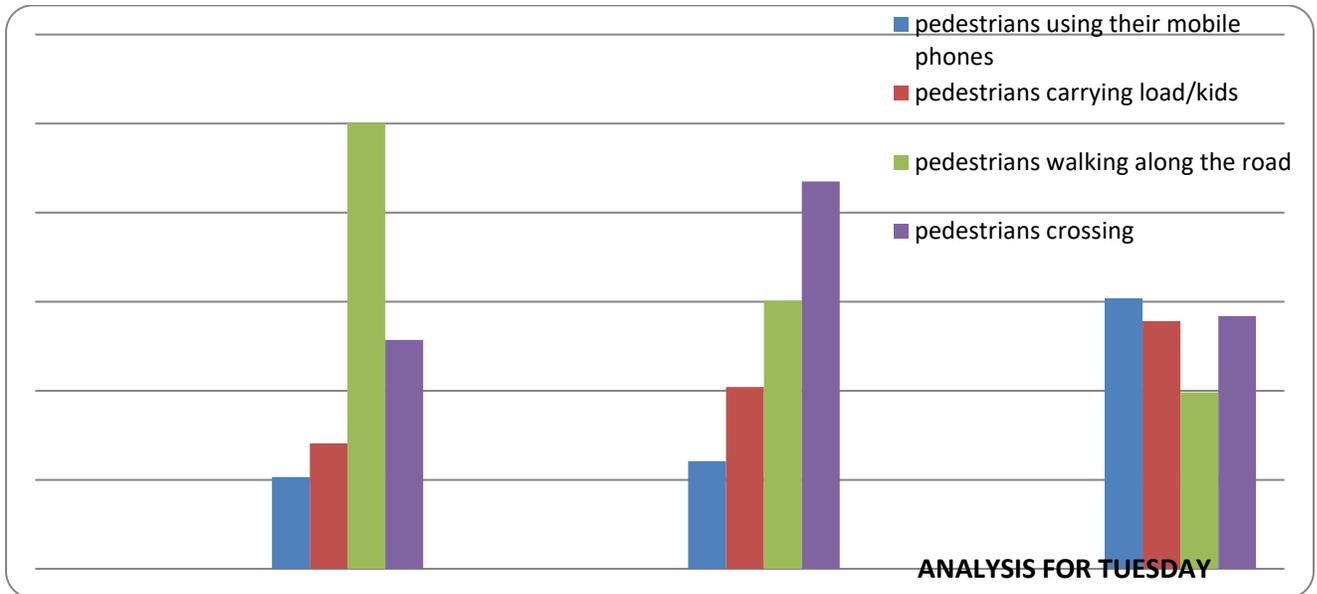


**Plate 4.3 pictures of pedestrians crossing the Regina junction carriage way.**

Pedestrians are left with no other but to cross the road with an average carriageway of 33m and a central drainage ditch of 2.7m opening. During the waiting time at this location, pedestrians are seen hiding close to try cycles to avoid vehicles over speeding into the intersection at this very location. Plate 4.3 shows a view of pedestrians crossing the road during an observation. On this road, pedestrians with disabilities, the elderly, and kids were seen struggling to cross the road too. Pedestrian safety is often neglected on the highway, and this survey proved that this research location is amongst them.

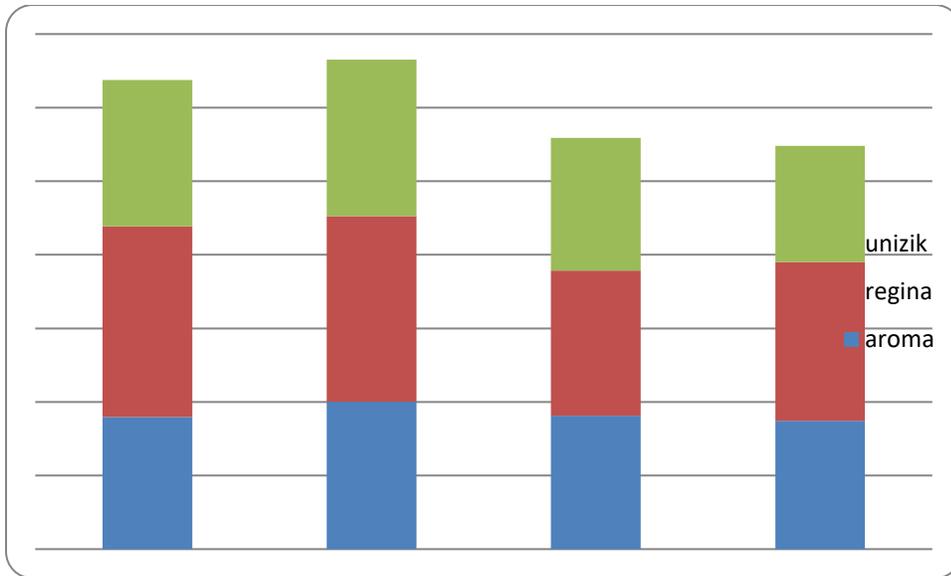
Furthermore, from this survey, it was analyzed from figure 4.4 that the highest number of pedestrians walking along the road was observed at the Aroma junction

on Tuesday. This is predictable because along the Aroma junctions are many firms and organizations.



**Figure 4.4 chart analysis of pedestrian volume with respect to character observation on Tuesday.**

Since the “sit at home” order in the eastern part of Nigeria, Tuesdays are now observed as the first work day of the week with highest traffic volume from workers coming to or going home from work. This can also explain the chart analysis from Figure 4.5 showing Tuesday as the day with the highest total pedestrian volume during.



**Figure 4.5 Chart analysis of total pedestrian volume on different days.**

### **4.3. Result analysis from the questionnaire**

From the answers given by these pedestrians in the questionnaire survey, it was observed that;

1. From the answers and analysis, with most of the answers to the first question on table 1 as “poor”, this shows that there is really a lack in pedestrian facility and the pedestrians are very aware of this.
2. The second question on table 1. was included to help ascertain if pedestrian will choose their safety over time management and the stress of walking 1km in order to use the overhead bridge. From these results, it's quite obvious that these participants representing the pedestrians on this road will choose a shorter time.
3. The third question on this survey was included to help determine how safe pedestrians feel using marked signals, and the ratio of those that prefer to use these marked crossings to those that do not wasn't quite high. This shows that the

least marked crossings will be well appreciated and used on this road by pedestrians. A number of this participant couldn't give a definite answer to this question because they had no knowledge of what a marked signal stands for.

4. The fourth question helps us understand how pedestrians feel about motorists' attitude towards them, from this interview, from this answers and analysis, it is observed that most pedestrians experience hostility from motorists.

**Table 4.2 Questionnaire data analysis.**

Question	Answers
<p>What do you think about the availability of pedestrian facility in awka?</p> <p>a. Satisfactory b. Good c. Poor d. Very poor</p>	<p><b>20 participants choose “satisfactory”, 32 choose “poor” and 40 choose “very poor”</b></p>
<p>So you prefer walking down to the overhead bridge using the pedestrian bridge or crossing the carriageway at regina?</p> <p>a. Yes, I'll rather use the bridge</p> <p>b. I prefer crossing the carriageway at regina.</p>	<p><b>65 pedestrians choose “b” while the rest went for “b”</b></p>

<p>Can you confidently use a zebra crossing mark on the highway when you see one?</p> <p>a. Yes, I can</p> <p>b. No, I'll rather use a bridge</p>	<p><b>49 pedestrians said they'll use the zebra crossing mark confidently, while 34 said they'll not. The remaining 9 pedestrians did not know what a zebra marking indicated; hence they couldn't make any decision.</b></p>
<p>How will you rate the motorists' attitude towards you during crossing?</p> <p>a. Hostile</p> <p>b. Satisfactory</p> <p>c. Normal</p>	<p><b>42 pedestrians choose the option a, 30 choose the option b 20 choose the option c</b></p>

**4.4 Analysis on direct interview**

To understand the perception of pedestrians on the facilities and their relationship with other road users, it was necessary to delve into their experience on these major intersections. The 4 pedestrians that indicated to been a victim of accident at the Regina junction was interviewed. In this analysis, they'll be referred to as respondent A, B, C, and D respectively. Before the interview started, they were asked if the accidents were major or just caused minor injuries. They all said it wasn't severe, but respondent C and B said they spent some nights at the hospital to heal properly. Respondents were first asked what time of the day these

accidents happened. 3 out of 4 of them said these accidents occurred at night. When asked if they were crossing or walking along the side of the road, 4 of them said they were in the process of crossing the road when this happened. Then lastly, they were asked to express their opinion on who contributed majorly to this accident between them and the motorist involved. In response, respondent A stated that it wasn't the fault of either her or the motorist. In her words *"I checked my left and right hand side before crossing, but this Aroma junction has plenty turns, so I didn't see the car coming, and I'm sure he didn't see me coming, it felt like we both rushed into the lane of this accident at the same time, Hence the collision"*

Respondent B stated;

*"I was crossing the carriageway and even though I saw the car coming, It was still far to me and I felt I could finish crossing before it gets too close. But it didn't go as I planned, the car came with speed and stopped abruptly because of the break. There was no physical collision nut I was I shock and I fainted. I'll say it's the fault of the driver, he was impatient. And most drivers on these roads are"*

This in a way shows how much pedestrians expect from the motorists as their fellow road users. Regina junction is a location with an intersection on both sides; this means that vehicles use the intersection where pedestrians often wait before crossing the road. The only hint they have as to if a vehicle is turning or moving straight is the vehicle indicator light, which not all road users can detect.

Respondent C shared her experience after;

*“it was wholly my fault, I was waiting with my load for drivers to reduce their speed so I can cross, I waited and It didn’t look like they wanted to stop, so I walked into the road thinking the vehicles will stop, I’ve seen people do it, and vehicles stopped for them”*

She went further to explain how frustrating it can get when the road feels like it is meant for motorists alone.

The last respondent shared her experience “the road was very congested and looked easy to cross between vehicles, when I started crossing, the congesting started reducing and the driver ignorantly started driving without looking carefully. It’s all the drivers’ fault”

After her narration of the story, she went ahead to tell us that the driver involved in this accident put on his light for her to see that his engine has started, but in her words *“I’ve never drove a car, so I don’t know of signs and marks for pedestrians”*.

#### **4.5 Other analysis on this research location.**

The road was solely built with only vehicles in mind.

Summary of some other observed difficulties faced by pedestrians on this road are;

1. No road markings: road markings are form of traffic signs that are on the road surface to help regulate traffic flows and movement time for both motorists. This aesthetically pleasing item could be in form of white lines on the road surface used to indicate curbside parking, intersections, pedestrian or bicycle lane and other features. An example of a marking important when

considering pedestrians as the zebra mark. Zebra markings are used to determine the pedestrian right of way, this mark helps pedestrians move with a sense of security. On this Research location, this mark was not found.

2. Poor road pavement; this is an issue that affects all road users, but during the observation of pedestrian behavior, the state of the pavement was observed to have a slowing down effect on the pedestrians, there are potholes on the refuge island pedestrians stand at some of this intersection.



**Plate 4.4 Potholes on the refuge island**

3. Uneven sidewalks and always: sidewalks are paths on the side available for pedestrians to walk on the road, while walkways are made specifically for pedestrians' traffic. This aids better movement and gives a sense of security to pedestrians when walking on the road. In these research locations, the availability of sidewalks was seen to be very low, and the paths with

sidewalks were uneven, the sidewalks were available on just one path of the road. This will cause difficulties among pedestrians, and also reduce the feeling of security the pedestrian should experience. The pedestrian friendly path of the road in these research locations has been used to create ditches and wide trapezoidal drainage channels. Pedestrians on this road are forced to walk on the side of the carriageway. Most walkways found in this road are unpaved, unkempt and filled with grass.

4. Absence of pedestrians' bridges; during this survey, it was found that in the whole city of awka, there is only one pedestrian bridge, which is at one of the survey locations, Unizik junction. This pedestrian bridge is highly utilized by the pedestrians and according to the survey, pedestrians prefer using the bridge to crossing the carriageway.
5. Hostile attitude of drivers towards pedestrians: according to the survey in this location, the motorists have a very poor attitude towards the pedestrians, they treat the pedestrians as though the road is not meant for their use also, and this can be understandable from the design consideration on this highway that excludes the pedestrians.
6. Poor night lightning: the road lightning at night on this highway is either very poor or absent. This is a major issue because pedestrians and motorists use the road every hour of the day, and some pedestrians have little or no knowledge of wearing bright clothing at night to help motorists notice them.
7. No traffic signals and signs: Throughout this survey, it was either that there was no traffic lights or signals on this research location. Traffic signs help minimize traffic congestion and improves the vehicle to pedestrian relationship. The lack of this traffic facility made it very difficult for

pedestrians to use some of the road intersection. The traffic wardens who operated on some locations were found absent on all their usual locations.

8. Lack of sit out and pedestrian shades: on these locations, there were not enough sit out or pedestrian shades, these shades and sit out are one of the most important facility that improves vehicle to pedestrian relationships, pedestrians use this when waiting for vehicles. The few sit-outs on the road were occupied by hawkers and traders.
9. Careless and reckless driving: motorists exhibited careless driving on this research location. During the survey here, I experienced so much careless and unsafe driving. Driving carelessly shows great negligence of other road users.



## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATION

#### 5.1 Conclusion

The research work done to investigate into pedestrian problems and safety needs along the Enugu Onitsha express way. To identify pedestrian behavior that causes collision on this research location, a pedestrian traffic count on three of the major junctions in this research location was carried out. This count entailed recording of pedestrian volume with respect to the behaviors likely to cause collision. It was observed that pedestrians engaged in operating their mobile device while either crossing or walking along this junction at the expense of their safety. Pedestrians were also seen carrying heavy loads that might affect their focus and further distract them from paying attention at these junctions with traffic volume.

In order to analyze and offer countermeasures that should reduce risk of pedestrians-vehicle crashes, questionnaires were distributed to pedestrians and direct interviews were carried out on some pedestrians that have been victims of collision. This was done to get a better and direct view of pedestrian's experience and problems from them the major challenges analyzed from these interviews stated that drivers show very hostile attitudes towards pedestrians on these junctions without pedestrian facility. It was also observed that some pedestrians have little or no knowledge of attitudes and characters to exhibit on the road that increases their safety.

Furthermore, to better recommend measures and facilities needed in this research location, observation of the use of pedestrian facilities in these major junctions

along the research location was done. It was analyzed that pedestrians felt safer using the pedestrian bridge which is the only pedestrian facility along this location. The traffic light along the aroma intersection that should be serving the road users by regulating traffic flow from all sides is not properly maintained and currently faulty.

## **5.2 Recommendation**

From the analysis and result gotten from this investigation, it can be said that pedestrian safety is neglected in this study location. This has an effect on the awareness of motorists that the road is for both pedestrians and them, and the feeling of safety pedestrians experience while using this road. The following recommendations can be used to give a better relationship between the road, pedestrians and motorists;

1. Pedestrian awareness program and campaign: due to the lack of awareness and knowledge on pedestrian safety on this intersection, campaigns and programs focused on educating pedestrians on necessary information they should know as road users. These campaigns should also be focused on enlightening pedestrians on the fact that they are major road users too, and they should always put their safety as priority. In these programs, Pedestrians should be more exposed to Road signs and facilities that increases safety.

2. Designs should be made with pedestrians in mind, every road construction plan should have the facilities for safety of pedestrians as a major factor for a complete design. Facilities like road signs, traffic lights, crossings marks, pedestrian islands / refuge, hallway and crosswalks. Junctions with more than two intersections should have traffic lights to help control pedestrian and vehicle movement.

3. There should be a maintenance of already existing facilities, facilities at the aroma intersection should be repaired and maintained. The faulty traffic light and pedestrian refuge island should be maintained, and signs added to it.

4. Motorists should be more enlightened about their relationship with pedestrians and how it affects vehicular flow. They should be better exposed to the fact that pedestrians are also road users like them.

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