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JOURNAL
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IJIRAS
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & ADVANCED STUDIES
(ISSN: 2394-4404)
International Journal Of Innovative Research & Advanced Studies

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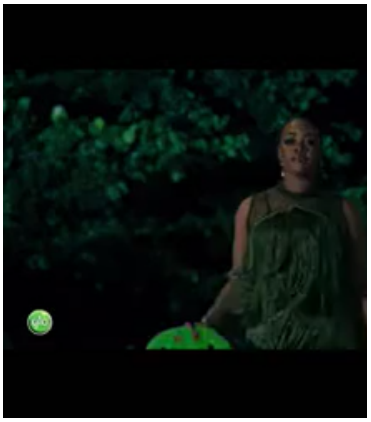

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International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 10 Issue 2, February 2023

ISSN: 2394-4404

Adequacy Of Road Furniture Within The Major Highways In Minna Metropolis, Niger State, Nigeria

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Abstract: ***The absence of sufficient safety laws, poor infrastructure, and inadequate enforcement in low- and middle-income countries account for 90% of the world's road traffic fatalities. Road furniture are used to improve safety and control traffic along the roads. The aim of the research was to determine the adequacy of road furniture that control traffic along the major roads in Minna, Niger State. The road furniture considered were traffic signals, road signs, speed humps and roundabouts. The research investigated their adequacy in terms of distribution, sufficiency, and conformity to standards. Both primary and secondary data were employed in the study. The coordinate's location points of all existing road furniture were collected using Global Position System and the points were determined on Google earth map covering the study area. The distribution, placements, composition and sizes of the existing furniture were determined using Geographical Information System techniques. The study revealed that the existing furniture are insufficient, although they are randomly distributed along the existing highways as 47% were conformed to conventional standards. The study recommended that efforts must be made in maintaining the existing road furniture and new one need be erected in places that possess dangers to pedestrians and other road users.***

Keywords: Roads, Metropolis, Infrastructure, Furniture and Transportation

I. INTRODUCTION

Providing and managing road transport system is a key issue facing regional and district councils as well as other providers of road transportation. Road furniture are fixtures along the road used to control the traffic, provide utility and sometimes aesthetics to the roads (Motorcycle council of NSW Inc., 2010). They are essential for the efficient and safe operation of the road network. Roads with poor signage or poorly maintained signs are unsatisfactory roads and cannot operate to their full traffic carrying capacity (Land Transport, 2013).

The placement and design of the furniture considers function, aesthetics, visual identity, safety, and pedestrian movement. The sizes, colours and layout in most developing countries have been standardized in accordance with international protocol and incorporated in departmental standards. Therefore, compliance with these standards is very important in order to ensure accurate and reliable communication as uniformity and standardization minimizes confusion and uncertainty about their meanings (Jose, 1968).

Situation reports conducted by the World Bank Transport Department on the state of roads in Sub Saharan Africa between 1998 and 2008 confirmed a gross inadequacy of road furniture for safety of road users. Specifically, in the West African region, previous credible studies showed that no country except for Ghana took broad steps to install appropriate and near adequate road furniture in 20% of the existing roads. Poor road infrastructure and inadequate road infrastructure have been an issue of concern in the past years given the threat it poses to the lives and safety of road users (Olawepo, 2010).

The objectives of this study include: analyze the distribution of road furniture along major routes in Minna Metropolis; determine the sufficiency of road furniture along major routes in Minna Metropolis: and assess the conformity

ISSN: 2394-4404

of the road furniture to the conventional standards. This study examined the adequacy of road furniture within the major highways in Minna metropolis. The roads investigated for this study are Tudun Fulani – Mobil – Chanchaga Road, Western Bypass and Kpakungu – Gidan Kwano Road which are the major highways within the metropolis.

II. LITERATURE REVIEW

Olawepo, 2010 revealed gross absence of road furniture on three major highways in Abuja, the Federal Capital City of Nigeria, Lagos, the commercial centre and Ilorin, a state capital. 50% of Federal Road Safety officials interviewed in this study suggested that the absence of road furniture in Nigeria is grossly contributing to the high incidence of road traffic crashes. Bus terminals are altogether lacking, except in Lagos where they are overcrowded, and in Abuja where they are few.

The incessant surge in road traffic crashes on major intersections within the Nigeria's Federal Capital Territory, Abuja, provoked investigations into the causes and possible countermeasures. Traffic engineering measures such as the installation of speed humps, warning signs and markings were considered most suitable for the nature of problems detected. Observational studies of the traffic conditions on these sites, and the analysis of the "before" and "after" road crashes was piloted to assess the effectiveness of these countermeasures. The remarkable reduction in the road traffic crashes on these intersections made the consideration for the adoption of these measures on areas with similar problems(Omidiji, 2010)

However, a quick survey of the available road furniture on some roads within the city revealed a tolerant situation. the survey also showed that some of the furniture are defaced, or wrongly posted, to the extent that they make less meaning; the presence of traffic lights on most junctions are not buttressed by the required power supply to keep them operative all through; the road markings obviously makes less meaning to drivers; pedestrians on the pedestrian crossing are not given any priority by drivers and are even not often used; and traffic calming devices such as rumble stripes which are still being run-over on high speed.

Francesca et al., 2018 developed an analytical method for calculating urban road safety which utilized data such as geometric characteristics, road signs, and urban furniture collected during road safety inspections and presents a quantitative risk analysis of deaths and serious injuries caused by urban road accidents. The results from surveying 50 km of roads in an Italian municipality established the good performance of the proposed tool in recognizing, planning, and scheduling all the work required for enlightening urban road safety, because it is sensitive to improvements of infrastructure. The strategy proposed by the authors could have a significant influence on the risk management of urban roads, and could be used in decision-making processes to design safer roads and improve the safety of existing roads.

The Annual National Conference of the Nigerian Society of Engineers (NSE) (2011) have reported that traffic congestion has become a common sight in most urban cities of Nigeria. 300 questionnaires were circulated among participants comprising specialists in transportation planning and design as well as engineers of other disciplines, students, wives of engineers and other invited guests who constitute commuters, car owners/drivers, to conduct a study. 196 returns were made, and these were examined to ascertain the broad perspectives concerning the causes of traffic congestion in most urban cities in Nigeria. Lagos, Port Harcourt and Abuja were recognized as cities most affected by traffic congestion and lack of furniture causes 30% of the congestion and will reduce it by 13% if provided.

Christian et al, 2019 also argues that provision and maintenance of traffic signs present opportunity to improving safety on the highways and achieving the viable development goals.

III. METHODOLOGY

To examine the distribution of road furniture along major routes in Minna Metropolis, Coordinate locations of the existing road furniture were generated with the use of GPS and then plotted on ArcGIS. The nearest neighbourhood analysis was conducted on the points to determine the pattern of distribution of the infrastructure.

The sufficiency was determined by considering the number of existing furniture in relation to the total number of furniture that are required along the road. The sufficiency is given as:

$$S = \frac{N_E}{N_E + N_P} \times 100$$

Where S = Sufficiency

N_E= Number of existing furniture

N_p= Number of proposed Furniture

The sufficiency was rated on a five-point Likert scale. The scale rates 0 – 20% as very poor, 20 – 40% as poor, 40 – 60% as fair, 60 - 80% as good and 80 – 100% as Excellent. In assessing the conformity of the road furniture to the conventional standards, the lateral and longitudinal placements, shapes, colors composition, size and visibility of furniture obtained from the field were compared with conventional standards obtained from the Highway Manual. Descriptive analyses were carried out on the result.

IV. RESULTS DISCUSSIONS

A. DISTRIBUTION OF EXISTING ROAD FURNITURE

A total of 126 different types of furniture were identified along the roads selected for this study. 92(73%) furniture were identified along 20km Chanchaga – Mobil – Tudun Fulani Road signifying an average of 4.6 road furniture per km. 52 (41%) furniture were identified along 13.5km western bypass implying an average of 3.9 road furniture per km while 7 (5.6%) furniture were observed along 14km Kpakungu – Gidan Kwano road suggesting an average of 2.4 road furniture along the road. The analysis shows that road furniture is most concentrated along Chanchaga – Mobil – Tudun Fulani Road followed by the western by-pass and making Kpakungu – Gidan Kwano road the least concentrated road.

ISSN: 2394-4404

B. DISTRIBUTION OF TRAFFIC SIGNAL

The analysis carried out identified a total number 6 traffic signals, all of which were observed to be functional (Table 1). The locations and conditions of the traffic signals are included therein. The analysis carried out gathered that the traffic signals along the roads are dispersed. The nearest neighbor ratio was gotten as 1.5, the z score as 2.89 and the p value as 0.0038, hereby making the significance level of the dispersion to be 0.01 (low). This implies that there is a less than 1% likelihood that this dispersed pattern could be the result of random chance. The observed mean distance was gotten as 906m and the expected mean distance as 602m. The distribution of traffic signals is shown on Figure 1.

S/N	Road	Coordinates		Location	Condition
		X	Y		
1	Chanchaga - Bosso - Tudun Fulani	9.597167	6.561317	Top Medical Junc.	Functional
2		9.617017	6.546783	Ogbomosho Junc.	Functional
3		9.621667	6.545733	Stadium Junc.	Functional
4		9.632417	6.544133	Gvt House Junc.	Functional
6	Western Bypass	9.58835	6.541467	Mandela Rd Junc.	Functional

Table 1: Inventory of Traffic Signals along the Major Roads in Minna

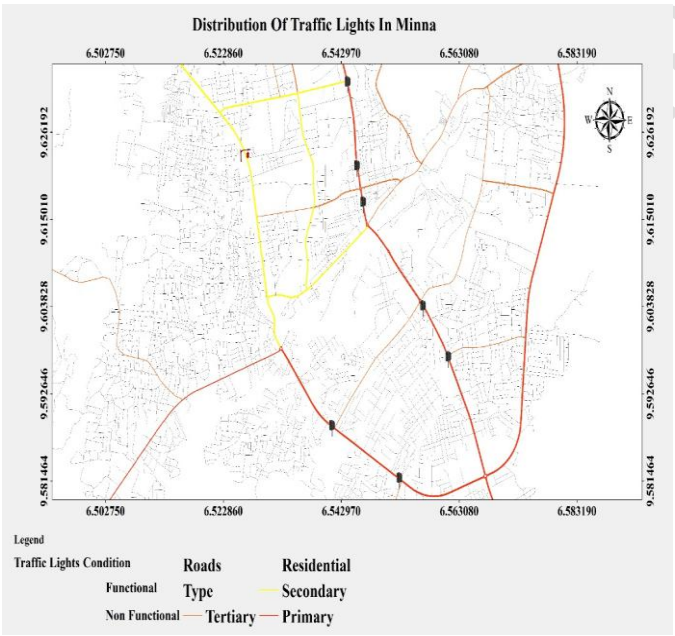


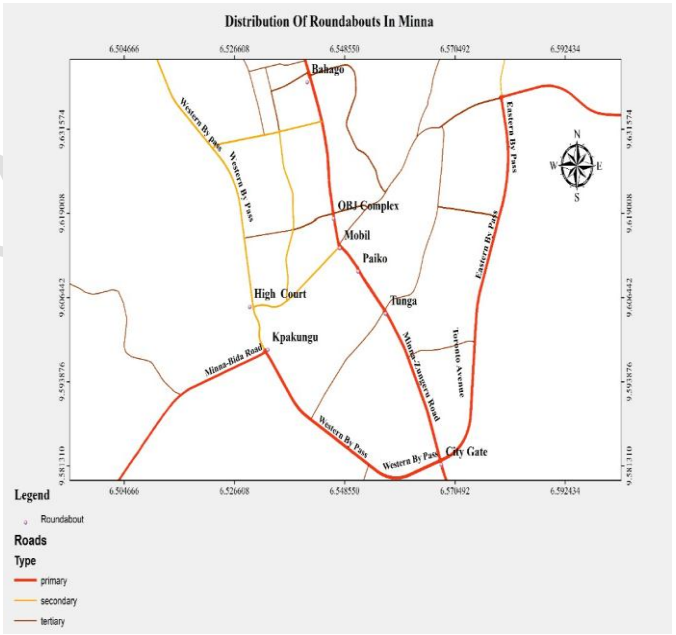
Figure 1: Distribution of Traffic Signals along Major Roads in Minna

C. DISTRIBUTION OF ROUNDABOUTS

As shown in Table 2, the total numbers of Roundabouts identified along the major roads were nine. 7 were observed to be adequate, 1 is inadequate and 1 is under construction. The roundabouts were discovered to be dispersed as the nearest neighbor ratio was attained as 1.5, the z score as 2.72 and the p value as 0.0065, hereby making the significance level of the dispersion to be low (0.01). This signifies that there is a less than 1% likelihood that this dispersed pattern could be the result of random chance. The observed mean distance was gotten as 1152m and the expected mean distance as 766m. Figure 2 shows the dissemination of roundabouts.

S/N	Road	Coordinates		Location	Diameter	Condition
		X	Y			
1	Chanchaga - Mobil – Tudun Fulani	9.639137	6.541068	Bahago	90 x 23.84 (Oval Shape)	Adequate
2		9.61875	6.5463	OBJ Complex	22.76	Inadequate
3		9.614333333	6.547566667	Mobil	34.46	Adequate
4		9.61085	6.5512	Paiko	30.9	Adequate
5		9.604566667	6.556666667	Tunga	68.36	Adequate
6	Western By Pass	9.582016667	6.56775	City Gate	40.2	Adequate
7		9.605587	6.529647	High Court	30.58	Adequate
8		9.599162	6.533216	Kpakungu	63.2	Adequate
9		9.6231	6.52665	Shiroro Junc.	Under construction	

Table 2: Inventory of Roundabouts along the Major Roads in Minna



Source: Author's field survey , 2021

Figure 2: Distribution of Roundabouts along the Major Roads in Minna

D. DISTRIBUTION OF SPEED HUMPS

25 Speed humps were observed along the major roads. 11 were observed to be in poor condition while the remaining 14 were good. Table 3 shows the locations and conditions of the speed humps and figure 3 shows their distribution. The Speed Humps along the roads were indicated to be randomly distributed. The nearest neighbor ratio was obtained as 0.91, the z score as 0.90 and the p value as 0.37. Therefore, the pattern appears to be significantly random. The observed mean distance was obtained as 2588m and the expected mean distance as 2857m.

ISSN: 2394-4404

S/N	Road	Coordinates		Location	Condition
		X	Y		
1	Chvcanchaga - Mobil – Bosso	9.075267	6.500967	Rafin Yashi	Good
2		9.675183	6.500833	Rafin Yashi	Good
3		9.67465	6.502283	Rafin Yashi	Bad
4		9.6576	6.527317	FUT Bosso	Bad
5		9.655	6.528433	FUT Bosso	Bad
6		9.64025	6.5412	Bahago	Bad
7		9.639233	6.541683	Bahago	Good
8		9.565133	6.575	COE	Bad
9		9.5678	6.574817	COE	Bad
10		9.5637	6.57675	Barrack	Good
11		9.5633	6.577183	Barrack	Good
12		9.565133	6.5762	COE	Bad
13	Western By Pass	9.6617	6.509367	New Bosso Market	Good
14		9.662083	6.509567	New Bosso Market	Good
15		9.662433	6.509617	New Bosso Market	Bad
16		9.6625	6.509767	New Bosso Market	Good
17		9.662733	6.509867	New Bosso Market	Good
18		9.662783	6.509783	New Bosso Market	Good
19		9.663083	6.509933	New Bosso Market	Bad
20		9.663383	6.5101	New Bosso Market	Good
21	Kpakungu - Gidan Kwano	9.6617	6.509367	Kowa School	Bad
22		9.6625	6.509767	Flaik	Bad
23		9.662733	6.509867	Flaik	Bad
24		9.662783	6.509783	Beganu	Bad
25		9.50275	6.453055	Gidan Kwano	Good

Table 3: Inventory of Speed Humps along the Major Roads in Minna

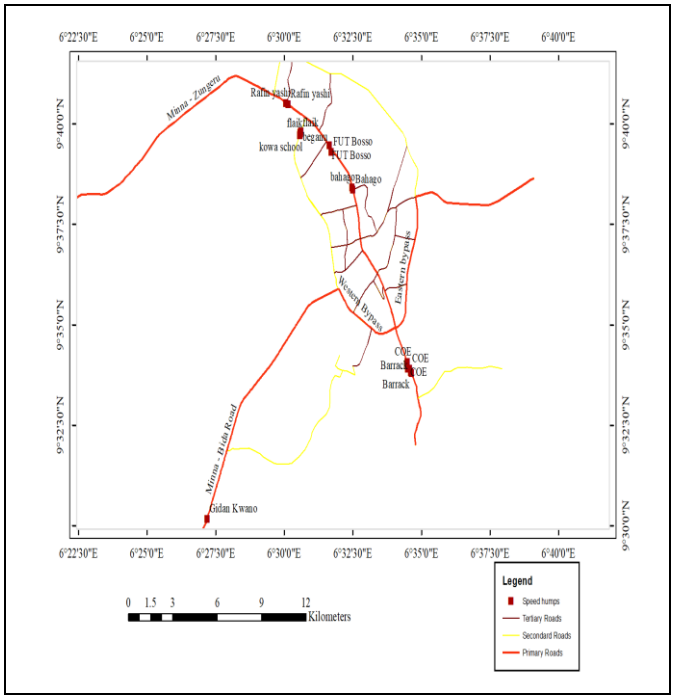


Figure 3: Distribution of Speed Humps along the Major Roads in Minna

E. DISTRIBUTION OF ROAD SIGNS

The field investigation carried out discovered 85 road signs along the major roads in Minna metropolis. Table 4 shows an inventory which encompasses the locations and conditions of the road signs. Figure 4 shows the distribution for each sign

. The road signs along the major roads in Minna were discovered to be clustered. The nearest neighbor ratio was gotten as 0.5, the z score as -4.87 and the p value as 0.00001, hereby making the significance level of the dispersion to be 0.01(low). This implies that there is a less than 1 percent likelihood that the dispersed pattern could be the result of random chance. The observed mean distance was gotten as 334.6m and the expected mean distance as 616.28m. 49 randomly distributed informative signs, 17 randomly distributed warning signs and 19 randomly distributed regulatory signs were observed.

S/N	Coordinates		Category	Type of Furniture	Condition
	X	Y			
1	9.542883	9.542883	Information Sign	Sign (unidentified)	Damaged
2	9.545817	9.545817	Information Sign	Bus Stop Sign	Functional
3	9.55225	9.55225	Information Sign	Pharmacy Sign	Functional
4	9.55835	9.55835	Information Sign	Bus Stop Sign	Functional
5	9.563983	9.563983	Information Sign	Command Sign	Functional
6	9.5653	9.5653	Information Sign	Bus Stop Sign	Functional
7	9.565817	9.565817	Information Sign	Bus Stop Sign	Functional
8	9.5679	9.5679	Information Sign	Bus Stop Sign	Functional
9	9.572467	9.572467	Information Sign	Bus Stop Sign	Functional

10	9.574217	9.574217	Information Sign	Bus Stop Sign	Functional	47	9.579517	9.579517	Direction Sign	Direction Sign	Functional
11	9.580733	9.580733	Information Sign	Round About Sign	Functional	48	9.579883	9.579883	Direction Sign	Direction Sign	Functional
12	9.582717	9.582717	Information Sign	Sign (unidentified)	Damaged	49	9.581583	9.581583	Direction Sign	Overhead Sign	Functional
13	9.586833	9.586833	Information Sign	Pharmacy Sign	Functional	50	9.568367	9.568367	Warning Sign	Walking Sign	Functional
14	9.58775	9.58775	Information Sign	Abd. Garage Sign	Functional	51	9.57075	9.57075	Warning Sign	Sign For Bump Ahead	Functional
15	9.60505	9.60505	Information Sign	Round About Sign	Functional	52	9.593267	9.593267	Warning Sign	Zebra Crossing Sign	Functional
16	9.60755	9.60755	Information Sign	Nysc Secretariat Sign	Functional	53	9.654317	9.654317	Warning Sign	Bump Ahead Sign	Damaged
17	9.610167	9.610167	Information Sign	Overhead Sign	Damaged	54	9.64985	9.64985	Warning Sign	Children Crossing	Functional
18	9.610167	9.610167	Information Sign	Round About Sign	Functional	55	9.648933	9.648933	Warning Sign	Crossing Sign	Functional
19	9.610483	9.610483	Information Sign	Union Bank Sign	Functional	56	9.648267	9.648267	Warning Sign	Sharp Bend Ahead Sign	Functional
20	9.611383	9.611383	Information Sign	Overhead Sign	Functional	57	9.646583	9.646583	Warning Sign	Person Crossing Sign	Functional
21	9.6184	9.6184	Information Sign	Round About Sign	Functional	58	9.638933	9.638933	Warning Sign	Sharp Bend Ahead Sign	Functional
22	9.6356	9.6356	Information Sign	Bus Stop Sign	Functional	59	9.636167	9.636167	Warning Sign	Crossing Sign	Functional
23	9.63905	9.63905	Information Sign	Round About Sign	Functional	60	9.631667	9.631667	Warning Sign	Crossing Sign	Functional
24	9.640217	9.640217	Information Sign	Round About Sign	Functional	61	9.599383	9.599383	Warning Sign	Crossing Sign	Functional
25	9.668183	9.668183	Information Sign	Overhead Sign	Functional	62	9.597317	9.597317	Warning Sign	Crossing Sign	Functional
26	9.669167	9.669167	Information Sign	T Junction Sign	Functional	63	9.591767	9.591767	Warning Sign	Bump Ahead	Functional
27	9.6708	9.6708	Information Sign	Bus Stop Sign	Functional	64	9.6472	9.6472	Warning Sign	Sign Stand With No Sign	Damaged
28	9.668083	9.668083	Information Sign	T Junction Sign	Functional	65	9.597	9.597	Warning Sign	Crossing Sign	Functional
29	9.648367	9.648367	Information Sign	T Junction Sign	Functional	66	9.596683	9.596683	Warning Sign	Crossing Sign	Functional
30	9.6452	9.6452	Information Sign	T Junction Sign	Functional	67	9.570733	9.570733	Prohibitory Sign	Speed Limit Sign 40km/hr	Functional
31	9.59765	9.59765	Information Sign	Round About Sign	Functional	68	9.57075	9.57075	Prohibitory Sign	Speed Limit Sign 50km/Hr	Functional
32	9.5305	9.5305	Direction Sign	Direction Sign	Functional	69	9.597233	9.597233	Prohibitory Sign	No U Turn Sign	Functional
33	9.581517	9.581517	Direction Sign	Direction Sign (Zungeru)	Functional	70	9.607017	9.607017	Prohibitory Sign	No Parking Sign	Functional
34	9.581567	9.581567	Direction Sign	Welcome To Minna Sign	Functional	71	9.617017	9.617017	Prohibitory Sign	No U Turn Sign	Functional
35	9.583283	9.583283	Direction Sign	Direction Sign	Functional	72	9.617567	9.617567	Prohibitory Sign	No U Turn Sign	Functional
36	9.603933	9.603933	Direction Sign	Direction Sign	Functional	73	9.61805	9.61805	Prohibitory Sign	No Parking Sign	Functional
37	9.605183	9.605183	Direction Sign	Direction Sign	Functional	74	9.620617	9.620617	Prohibitory Sign	No Parking Sign	Functional
38	9.612033	9.612033	Direction Sign	Zungeru Sign	Functional	75	9.621667	9.621667	Prohibitory Sign	No U Turn Sign	Functional
39	9.632817	9.632817	Direction Sign	Direction Sign	Functional	76	9.621333	9.621333	Prohibitory Sign	No U Turn Sign	Functional
40	9.67065	9.67065	Direction Sign	Direction Sign	Functional	77	9.632417	9.632417	Prohibitory Sign	No U Turn Sign	Functional
41	9.668583	9.668583	Direction Sign	Direction Sign	Functional	78	9.632817	9.632817	Prohibitory Sign	No Parking Sign	Functional
42	9.668083	9.668083	Direction Sign	Direction Sign	Functional	79	9.654317	9.654317	Prohibitory Sign	No Parking Sign	Functional
43	9.651433	9.651433	Direction Sign	Direction Sign	Functional	80	9.639267	9.639267	Prohibitory Sign	Speed Limit 80	Functional
44	9.6286	9.6286	Direction Sign	Direction Sign	Functional	81	10.63588	10.63588	Prohibitory Sign	No Parking Sign	Functional
45	9.609833	9.609833	Direction Sign	Direction Sign	Functional	82	9.60685	9.60685	Prohibitory Sign	Speed Limit Sign	Functional
46	9.597717	9.597717	Direction Sign	Direction Sign	Damaged	83	9.58835	9.58835	Prohibitory Sign	No U Turn Sign	Functional
						84	9.58815	9.58815	Prohibitory	No U Turn	Functional

			Sign	Sign	
85			Prohibitory	No U Turn	
	9.581433	9.581433	Sign	Sign	Functional

Table 4: Road Signs along the Major Roads in Minna

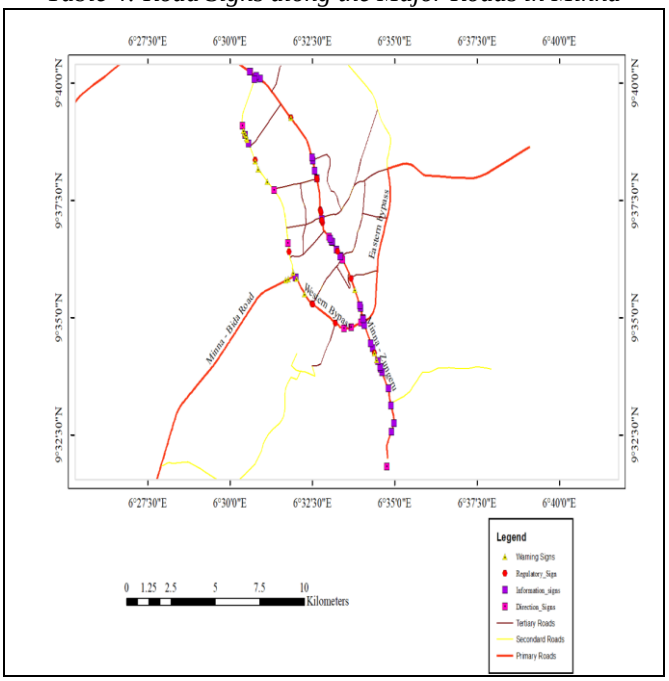


Figure 4: Distribution of Road Signs along the Major Roads in Minna

F. SUFFICIENCY OF EXISTING ROAD FURNITURE

From the analysis done to determine the sufficiency of road furniture, the number of existing furniture was considered with reference to the total number of furniture considered to be ideal along the roads. 204 points were identified to be deficient of relevant road furniture. Therefore, the sufficiency is given as;

$$S = \frac{N_E}{N_E + N_P} \times 100$$

Where S = Sufficiency

N_E= Number of existing furniture

N_p= Number of proposed Furniture

The number of existing furniture was identified as 126 while 204 number were proposed.

Therefore,

$$S = \frac{126}{106 + 204} \times 100$$

S = 38%

This value rates fair on a three point likert scale.

G. CONFORMITY OF THE ROAD FURNITURE TO CONVENTIONAL STANDARDS

The parameters of existing road furniture were determined from the field and compared with conventional standards to determine their conformity. From the analysis, it was discovered that 69 out of 126 (55%) of the furniture conform to conventional standards while the remaining 45% do not. Table 5 shows the details.

S/N	Type of Furniture	Road	Category	Conformity to Standards	Non Conformity to Standard	Total
1	Traffic Signal	Chanchaga - Bosso - Tudun Fulani	-	5	0	5
		Western by pass	-	1	1	2
		Kpakungu - Gidan Kwano	-	0	0	0
		Cumulative	-	6(86%)	1(14%)	7
2	Roundabouts	Chanchaga - Bosso - Tudun Fulani	-	4	1	5
		Western by pass	-	3	0	3
		Kpakungu - Gidan Kwano	-	0	0	0
		Cumulative	-	7(87.5%)	1(12.5%)	8
3	Speed Humps	Chanchaga - Bosso - Tudun Fulani	-	5	7	12
		Western by pass	-	6	2	8
		Kpakungu - Gidan Kwano	-	1	4	5
		Cumulative	-	12(48%)	13(52%)	25
4	Road Signs	Chanchaga - Tudun Fulani	Mobil - Warning Sign	11	11	22
			Regulatory Signs	4	24	28
			Informative Sign	10	10	20
		Western by pass	Warning Sign	11	2	13
			Regulatory Signs	2	7	9
			Informative Sign	6	6	12
		Kpakungu - Gidan Kwano	Warning Sign	0	2	2
			Regulatory Signs	0	0	0
			Informative Sign	0	0	0
		Cumulative		44(41.5%)	62(58.5%)	106
	TOTAL			69 (47%)	77(53%)	146

Table 5: Conformity of Road Furniture to Conventional Standards

V. CONCLUSION AND RECOMMENDATIONS

About 126 diverse furniture were identified to be dispersed along the roads selected for this study. 92 furniture were identified along 20km Chanchaga – Mobil – Tudun Fulani Road, 52 furniture along 13.5km western bypass and 7 along 14km Kpakungu – Gidan Kwano road making Chanchaga – Mobil – Tudun Fulani Road the most concentrated and Kpakungu – Gidan Kwano road the least concentrated road. These furniture were observed to be insufficient as analysis carried out determined their sufficiency to be fair. 204 points were identified to be deficient of relevant road furniture. The analysis also showed that the general quality of existing furniture is inadequate as only 41.5% of the furniture conform to conventional standards. Most of the existing furniture have deteriorated and/or do not conform to conventional standard.

ISSN: 2394-4404

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