
AUDITING OF TRAFFIC SIGNS AND ROAD MARKINGS IN DAR ES SALAAM CITY

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ABSTRACT

This study examines the efficacy of the traffic signs and road markings in Dar es Salaam City. The study focuses on the availability and conditions of traffic signs and road markings in some selected roads in the city. Auditing of traffic signs and road markings is carried out as one of the means of promoting road safety and improving road capacity in the city. The auditing procedure involved field studies through the use of traffic signs/markings checklists and ranking of road stretches according to the availability and conditions of traffic signs observed for improvement prioritization in case of financial constraints. In ranking the road sections in accordance to the overall conditions and availability of traffic signs, an index was developed. The index considered six factors of traffic signs availability and conditions that were observed in the field; (i) availability (ii) correctness of size (iii) visibility of signs (iv) physical condition (v) correct placement and (vi) the need of sign protection. It is recommended that the responsible agency and Municipal councils carry out auditing of traffic signs/markings independently and identify deficiencies in signage and road markings and plan for improvement accordingly. In case of financial constraints, the developed performance index may be used to rank roads/road sections for improvement priority.

Key words: *Traffic Signs, Road Markings, Road Safety Auditing.*

INTRODUCTION

In recent years, road authorities all over the world have shifted the emphasis from road accident reduction to road accident prevention. Road accident reduction implies the development of accident remedial measures for high accident frequency sites whilst road accident prevention aims at ensuring that the design of traffic schemes will provide high level of safety.

The purpose of traffic signs and road markings is to promote highway safety and efficiency by providing orderly movement of all road users on streets and highways. Traffic signs and road markings notify road users of regulations and provide warning and guidance needed for the safe, uniform and efficient operation of all elements of the traffic stream. Traffic signs or their supports are not required to bear any advertisement message or any other message that is not related to traffic control (FHWA, 2002).

Placement of traffic signs and road markings should be within the road users view so that maximum visual acuity is provided. To aid in conveying the proper meaning, the traffic control devices should be appropriately positioned with respect to location, object, or situation which it applies. The location and legibility of traffic signs/markings should be such that a road user has adequate time to make the proper response in both day and night conditions.

Unnecessary traffic control devices should be removed. The fact that a device is in good physical condition should not be a basis for deferring needed removal or change. Traffic signs and road markings should be reviewed periodically to determine if they meet current traffic conditions (FHWA, 2002).

Signs must only be used where there is a clear need for them. The incorrect or unnecessary use of a sign annoys drivers, and when this happens frequently

drivers lose respect for the sign, and it becomes ineffective in situations where it is really needed. For the same reason, it is important to avoid signs which impose a restriction which will be very unpopular and difficult to enforce. Using standard signs assists in their quick recognition, as does uniformity of shape, colour and lettering for each type. To obtain the full benefits of standardization, the signs must be used in a consistent manner (FHWA, 2002).

Road signs generally need to be located within close proximity of the roadway (i.e. within the clear zone) and therefore need to afford some protection to errant vehicles. This can be achieved through the use of a simple breakaway device or using a notched wooden support. Signs, particularly regulatory and warning signs, must be maintained in a sound order (i.e. reflectivity, cleanness, visibility) as they play a crucial role in terms of road safety in giving information on rules and hazards further ahead (e.g. sharp curves, pedestrian crossings, etc). Regular maintenance, trimming of grass verges and shrubs is particularly important at bends and around the signs. In case of financial constraints, first priority in the placement, replacement and maintenance of signage should be given to regulatory and warning signs (SATCC, 2003).

Road markings serve a very important function in conveying to road users information and requirements which might not be possible using upright signs. They have the advantage that they can often be seen when a verge-mounted sign is obscured, and, unlike such signs, they can provide a continuing message. Road markings have their limitations; their effective life is reduced if they are subjected to heavy trafficking and severe weather conditions. Nevertheless, road markings make a vital contribution to safety, for example, by clearly defining the path to be followed through hazards, by separating conflicting movements and by delineating the road edge on unlit roads at night. They can also help to improve junction capacity, and make best use of available road space. In particular, widespread use of lane markings is desirable. By encouraging lane discipline they improve the safety and efficiency of traffic flow. For road markings to be effective, they must be clearly visible both by day and night. Markings have two principal functions; the first is symbolic, for example, hatched markings,

the driver needs to have learned that these indicate an area which is not available to traffic. The second is guidance; centre lines, edge lines and lane lines help drivers to maintain their lateral positions on the road. Some markings, for example, hazard lines and double white line systems have both symbolic and guidance functions (FHWA, 2005).

Recognizing the importance of traffic signs and road markings in promoting road safety and improving road capacity, a study on the investigation of the adequacy and condition of traffic signs and road markings in Dar es Salaam city was carried out. Further, a procedure has also been developed to help road authorities to overall assess the adequacy and conditions of traffic signs and markings and to prioritize the placement, replacement and maintenance of signage and markings in case of financial constraints.

METHODOLOGY

Elements of Traffic Signs/Markings Auditing

Chand (2004) carried a study on auditing of traffic signs/markings in India. In this study, seven factors were considered in evaluation of condition of traffic signs and markings. The factors were: necessity, availability, accuracy in shapes, correctness of size, good physical condition and correct placement. These factors were used to prepare field sheets for data collection. In ranking the sections, scoring procedure for traffic signs and markings was developed for computing the index of each stretch. Chand, however, did not consider the aspects poor visibility and protection of signs.

The data collected by Chand (2004) from the field were based on the following components of traffic signs/markings auditing which have been used to develop the checklist.

- (i) Requirement : Whether a particular type of traffic signs or markings is needed or not
- (ii) Availability: Whether a particular type of traffic sign/markings is provided or not. If a particular sign/markings is needed but not provided or if a particular sign/markings is not needed but provided, both conditions should be taken as unsafe and undesirable.

- (iii) Condition: Traffic signs/markings need to be checked for their physical conditions.
- (iv) Placement: Traffic signs/markings need to be checked for their proper placement on the road.

On the other hand, according to Ministry of Infrastructure Development's Guide to Road Safety Auditing, a road can be subjected up to six stages of auditing; feasibility studies, preliminary design, detailed design, road works, pre-opening, and post-opening and existing roads. For existing roads, safety audits help identify unsafe, inconsistent, outworn and outdated elements in road environment. Under this stage, the guidelines provide various checklists for road safety audit. For traffic signs/markings auditing the following checklists are given (MOID, 2009):

- Are all necessary signs in place?
- Are they readable? (consider in all conditions)
- Are they located in a safe place?
- Do they give the correct message?
- Is there any confusion in the message they give?
- Do posts need protection?
- Is edge delineation adequate?
- Are road markings correct and in good condition?
- Does vegetation obstruct the traffic signs?

Keeping the above elements in view, the following checklists have been used by this study for traffic signs/markings auditing.

- are all necessary signs available?
- are all provided signs/markings necessary?
- are the signs located in appropriate and safe place?
- are they legible?
- do they convey the right messages?
- is there any confusion in the message they give?
- Are all signs in good physical conditions?

- do the posts require protection?
- is the prescribed colour correct?
- are the markings as prescribed and in good condition?
- Does vegetation obstruct the traffic signs?

In order to facilitate the collection of field data, special field sheets were prepared for data collection and classification of traffic signs (see Appendix 1).

Module for Prioritizing Road Sections for Improvement of Signage

This module was designed for a quick reference to help the road authorities to prioritize and schedule the placement, replacement and maintenance of signage in case of financial constraints. In ranking the sections the concept of weighted index was applied to derive a performance index. A matrix was developed to determine the score of each sign category depending on its availability and condition in the field. The matrix formed is the category of signs against the condition of the signs observed in the field. In assigning the weights to each sign category (Regulatory, Warning, and Guidance), a weight of 1 to 3 can be used.

According to Chand (2004) and MoID (2008) guidelines for traffic signs, regulatory signs are given high weight followed by warning signs. Therefore, since regulatory signs are the highest priority signs, they are given the highest weight of 3. The numbers decrease with the importance of category with 1 being the lowest for a guidance sign. The weights for the conditions of signs have been estimated based on the conditions observed in the field as shown in Table 1. For this case a weight of 0 to 5 has been used, 0 being the best condition of the signs (e.g. signs which complies with MoID specifications) and 5 the worst condition (missing signs). The other conditions of signs and their corresponding estimated weight between the worst and best conditions weights are given in Table 1.

The estimated matrix used in each type of sign assessed is given in Table 1. Using the weights assigned in each sign category and its corresponding condition, the scores of each case are computed and presented in Table 1 as well.

Table 1: Scoring procedure for traffic signs

Condition of the Signs Type of signs		Missing signs	Knocked Signs	Hidden signs	Signs need protection	Signs not correctly placed	Undersize signs	Good signs
		Weight	5	4	3.5	3	2.5	2
Regulatory	3	15	12	10.5	9	7.5	6	0
Warning	2.5	12.5	10	8.75	7.5	6.25	5	0
Guidance	1	5	4	3.5	3	2.5	2	0

After scoring procedure the following equations were formed and combined to determine the combined index.

$$PI_R = a_1 r_1 + a_2 r_2 + a_3 r_3 + \dots + a_n r_n \dots (1)$$

$$PI_w = b_1 w_1 + b_2 w_2 + b_3 w_3 + \dots + b_n w_n \dots (2)$$

$$PI_G = c_1 g_1 + c_2 g_2 + c_3 g_3 + \dots + c_n g_n \dots (3)$$

The combined index is determined by taking the average of the three equations

$$PI = \frac{PI_R + PI_w + PI_G}{3} \dots (4)$$

where:

$PI =$ = Combined Performance Index

$PI_R =$ = Performance Index for regulatory signs

$PI_w =$ = Performance Index for warning signs

$PI_G =$ = Performance Index for guidance signs

a_1, a_2, \dots, a_n are the score variables for regulatory signs

b_1, b_2, \dots, b_n are the score variables for warning signs

c_1, c_2, \dots, c_n are the score variables for guidance signs

r_1, r_2, \dots, r_n are the number of regulatory signs in each category

w_1, w_2, \dots, w_n are the number of warning signs in each category

g_1, g_2, \dots, g_n are the number of guidance signs in each category

By using the scoring procedure as shown in Table 1, a combined index was developed. The value of this index varied between zero and thirty nine for traffic signs. The lower value of index indicated the better condition of traffic signs while the highest shown the deficiency and poor quality of traffic signs. The lower the PI value, the better is the section traffic signs condition and so improvement priority for the signs is low. This method can be used as a good indicator to help the road authorities prioritize improvement of signing in the road sections.

RESULTS AND DISCUSSION

Data Collection along Morogoro Road: From Ubungo to Kimara (Chainage 0+000 to 5+400)

To demonstrate the methodologies developed by this study, a section of Morogoro road from Sokoine drive junction where the road starts to Kimara was therefore selected for the purpose. Detailed analysis of the section starting from Ubungo traffic lights, where the chainage was set as 0+000, to the end of dual carriageway in Kimara, where the chainage is 5+400, was carried out for the purpose of demonstrating the applicability of improvement prioritization methodology. This section was divided into 27 sections of 200 m each.

Traffic signs/markings were audited under five groups; regulatory signs, warning signs, guidance

signs, informatory signs and road markings. As there were no informatory signs along the road, these signs were not considered in the auditing process. The data collected along this road are summarized in Appendix 2.

Availability and Condition of Signs

Table 2 summarizes the availability and overall condition of signs observed along the Morogoro road section under study.

Table 2: Overall Status of Traffic Signs along Morogoro Road (Sokoine drive junction to Kimara)

Type of signs	Regulatory	Warning	Guidance	Total
Number of present signs	53	61	3	117
Number signs in perfect condition	30	9	3	42
Number of signs missing	25	34	7	66
Number of knocked signs	17	9	0	26
Number of signs need protection	16	10	0	26
Number of signs not correctly placed	16	25	0	41
Number of signs hidden	8	3	0	11
Number of undersize signs	19	16	0	34
Number of unnecessary signs	4	0	2	6

Missing signs

The total number of missing traffic signs include signs that were missing off their post as well as those that had apparently never been installed. The survey shows that 66 signs (i.e. 34 warning signs, 25 regulatory signs and 7 guidance signs) were missing which is 36% of all signs that were required to be installed. All these signs need to be placed to

enhance safety and proper traffic flow. A special case which is very disheartening was observed at the end of dual carriageway at Kimara where there is no any warning sign or marking installed for warning road users about the end of dual carriageway and start of single two way carriageway. The absence of these signs may lead to serious accidents and reduction of road capacity. Figure 1 shows missing signs at the end of dual carriageway at Kimara.



Figure 1: Missing Warning signs at the end of dual carriageway (End of dual carriageway – Kimara).

Items obscuring traffic signs

Some signs were observed to be obscured by vegetation and advertisements. Out of 117 signs, 11 signs (9.4%) were found to be completely or partially hidden from the approaching motorists by

an obstruction of some sort. The most common types of the obstructions were planted trees or vegetations and advertisements on the median of the road. Some of the typical examples of signs which are hidden by vegetations and advertisements are shown in Figures 2 and 3 below.



Figure 2: “No U Turn” Regulatory sign hidden by vegetations (Ubungo area, 255 m from Ubungo Traffic lights)



Figure 3: “No U Turn” Regulatory sign obscured by advertisements (Manzese area, 250 m from Manzese pedestrian bridge)

Knocked signs

It was found that 26 signs out of 117 (22.2%) signs were either completely or partially damaged by vehicular traffic. Out of this number, 17 signs are regulatory signs and 9 are warning signs. Further, it was found that 26 traffic signs out of 117 (22.2%) need protection. Examples of knocked signs are shown in Figure 4 and 5

Placement of traffic signs

In order to allow the drivers to comply safely with the message of the signs, signs should be sited at a correct distance before the site to which it relates. This distance depends on the message of the sign and the driving speed on the road. Also, traffic signs should not be placed too near to the edge of the carriageway and not too far away.



Figure 4: Knocked “Speed Hump” warning sign (Morogoro road – 565 m from Ubungo traffic light)



Figure 5: Vehicle moving very close to the “Speed limit” regulatory sign which is already damaged (Morogoro road 595 m from Ubungo traffic light)

Overall, 41 signs out of 117 (35%) were found not to be correctly placed. A sample of seven pedestrian crossing warning signs were investigated in detail along Morogoro road from Ubungo to Kimara (Chainage 0+000 to 5+400) and found that all signs were not correctly placed. Basing on

the road design speed, the results show that the provided free distance to the sign is not correct. For edge distance some of signs are placed within the recommended distances. Table 3 shows the status of placement of pedestrian crossing signs.

Table 3: Placement of Pedestrian Crossing Warning Signs along Morogoro Road-Ubungo to Kimara Section

Chainage	Speed limit	Edge distance	Recommended edge distance	Visibility distance	Recommended visibility distance
0+455	50km/h	1.0m	1.05m	31.0m	60m
1+640	50km/h	1.0m	1.05m	45.0m	60m
2+023	50km/h	0.5m	1.05m	22.0m	60m
2+712	60km/h	2.0m	1.05m	18.5m	60m
3+200	50km/h	0.9m	1.05m	45.0m	60m
3+920	80km/h	1.7m	1.05m	41.5m	80m
4+265	80km/h	1.9m	1.05m	49.5m	80m

Size of traffic signs

Signs were checked against the sizes recommended by the MoID (2008) traffic signing guide. The guide requires the signs to be large enough to be read clearly by drivers. In all road sections it was observed that some available signs are not complying with the recommended sizes. It was observed that 34 out of 117 (29%) signs particularly in the case where the speed limit is 80 km/hr the signs were found to be smaller than the recommended sizes by the Ministry of Infrastructure Development (MoID, 2008).

Other observations

A total of six redundant signs were observed along Morogoro Road, these signs should be removed in the road environment because

currently they don't contribute anything positive to road users but instead they may bring confusion to road users. The signs are regulatory and guidance signs located at Morogoro road - urafiki area Ch. 7+650 from the city centre where Morogoro road starts and Korogwe area Ch. 3+200 from Ubungo traffic lights. An example of unnecessary guidance sign is shown in Figure 6. It was also observed in Magomeni Kagera area Ch. 4+700 from the city centre where the Morogoro road starts that an advertisement, as shown in Figure 7, was placed on top of the sign. This advertisement may bring confusion to the road users. In order for the road users to observe the signs clearly advertisement should not be placed on top of the signs.



Figure 6: Advertisement placed on top of the sign and worn out pedestrian zebra crossing (Morogoro road – Kagera Area)



Figure 7: Unnecessary guidance sign on the road environment (Morogoro road - Urafiki area)

Road Markings

The survey shows that only 37% of all markings are in good condition and 20.6% are missing in the stretch from Sokoine drive junction to Ubungo while in the stretch from Ubungo to Kimara only 29.3% are in good condition and 47% are missing.

Roads within the Central Business District (CBD)

Within the CBD, the present study was limited to Maktaba Street, Sokoine Drive Street, Bibi Titi Mohamed Street and Msimbazi Street. Table 4

shows that in the selected roads within the CBD, only 3 (10%) of traffic signs and road markings are in good condition in all provided signs and markings and 49 are missing which is 62% of all signs/markings that were required to be provided. Also, it was observed that some signs were unnecessarily placed (Figure 8) and poorly placed (Figure 9). Three cases of unnecessary signs were observed along Sokoine drive Street. Further, the missing traffic signs were noted to be 27 which is 64.3% of all signs that were required to be installed and only one is in good condition out of 15 signs observed along the selected roads.

Table 4: Summary of availability and conditions of Traffic signs/markings in selected CBD roads

Type of Traffic signs/markings	Redundant	Present	In Good Condition	Missing
Regulatory	3	14	0	24
Warning	0	0	0	1
Guidance	0	1	1	2
markings	0	15	2	22
Total	3	30	3	49

Ranking of Road Sections for Signing Improvement Priority

By using the scoring procedure and combined index as shown in Table 1; Appendix 3 presents a list of stretches from Ubungo to Kimara along with values of index and their rank. The stretches having the index value of 35 to 40 have been given ranking one (priority one) for improvement. Similarly stretches having an index value between 25 and 30, have been given rank 2 and so on. Thus, stretches with an index of zero are those in perfect condition, most of them are those stretches which do not require signs. In ranking the index values, an interval of index values between 30 and 35 is not considered because there is no stretch with index value which falls between these two numbers. For the improvement purposes in case of financial constraints, the sections with ranking of one are given first priority for improvement followed by two and so on.

CONCLUSION

Traffic signs/markings play a vital role in controlling and regulating movements of traffic, apart from promoting road safety. In this context, this study has demonstrated how a systematic auditing of traffic signs and marking can be carried out in line with the Ministry of Infrastructure and Development's Guide to Road Safety Auditing. The study has thus investigated the availability and conditions of traffic signs and markings in Dar es Salaam city by using checklists of traffic signs/markings auditing.

In this study it was found that for Morogoro road (from Sokoine Drive Junction to Kimara) 35.9% of all signs are in good condition and 36 % of all signs required to be installed are missing. It was also found that 9.4% of all signs are either completely or partially hidden from the approaching motorists by an obstruction of some sort and 22.2% of all signs are either completely or partially knocked by vehicular traffic. Within the CBD it was found that all provided signs are in poor condition, these signs are either completely or partially worn out on their surfaces and posts.

In the case of financial constraints, the study has illustrated how a performance index can be developed for ranking the road stretches in accordance to the conditions and availability of traffic signs. The index has been used for priority ranking of road sections for improvement.

RECOMMENDATIONS

From observations of traffic signs/markings auditing in the selected roads, the following are recommended for improved safety and efficient movement of traffic in our cities and towns:

- Progressively checking of all traffic signs/markings to conform to MoID standards, to identify especially, proper locations, size, shape, visibility and physical conditions.
- Carrying out systematic road signs/markings audits as an independent review of installations, checking particularly for correctness, and consistency of sign installations and the conditions of these signs/markings. The field sheets used for this study may be used for this purpose.
- Carrying out replacement and maintenance of traffic signs and road markings regularly. In case of financial constraints, sections with critical problems may be given priority. The approach used in this study of ranking and prioritization of the road sections may be used for this purpose.
- Identification and removal of all redundant signs and posts.
- Protection of all signs which are likely to be damaged by vehicular traffic.

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APPENDIX 1: FIELD SHEETS USED TO COLLECT THE DATA FROM SITE

Auditing of traffic signs and markings													
Form No.1. Auditing of Traffic Signs - Warning signs													
1. Name of Road:.....						2. Name of stretch:							
3. Type of Road:.....						4. From(Km) TO(Km).....							
S/N	Type of sign	Chainage	Necessity		Provided		Poor visibility	Does it meet design and Condition				Placement	Recommendations
			Yes	No/NA	Yes	No		Protection	S	Z	C		
1	Sharp curve signs												
2	Right /left hairpin bend												
3	Traffic control 'Give												
4	Side road junction												
5	Narrow bridge												
6	Narrow road on priority												
7	Pedestrian crossing												
8	School												
9	Cross roads												
10	T junction												
11	Y junction												
12	Staggered junction												
13	Major road												
14	Round about												
15	Barrier												
16	Traffic signals ahead												
17	End of dual carriageway												
18	Start of dual carriageway												
19	Reduced carriageway												
20	Rough road												
21	Lane closures												
22	Road humps												
23	Two way traffic												
24	Skew T junction												
25	Staggered junction												
26	Children												
27	General warning												
28	drift												
29	Height restricted												
Note: S - Shape, Z - Size, C - colour, P - Physical condition													

Auditing of traffic signs and markings													
Form No.1. Auditing of Traffic Signs - Regulatory signs													
1. Name of Road:.....						2. Name of stretch:.....							
3.Type of Road:.....						4. From(Km) TO(Km).....							
S/N	Type of sign	Chainage	Necessity		Provided		Visibilty limited by	Does it need Protection	design and Condition			Placement	Recommendations
			Yes	No/NA	Yes	No			S	Z	R&CP		
1	Pedestrian (zebra)												
2	No U-Turn												
3	Give way sign												
4	Stop sign												
5	Prohibitory sign												
6	No entry												
7	One way												
8	No right/left turn ahead												
9	No overtaking												
10	Horn prohibited												
11	No standing/stopping												
12	Speed limit												
13	Width limit												
14	Height limit												
15	Load limit												
16	Axle load limit												
17	Restriction ends												
18	Compulsory keep												
19	Parking												
20	No good vehicles												
21	No parking												
22	Round about												
23	No excessive noise												
24	Pedestrian (zebra)												
25	Area reserved for bus												
Note: S - Shape, Z - Size, R - colour, P - Physical condition													

Auditing of traffic signs and markings													
Form No.1. Auditing of Traffic Signs - Guidance sign													
1. Name of Road:.....						2. Name of stretch:.....							
3. Type of Road:.....						4. From(Km) TO(Km).....							
S/N	Type of sign	Chainage	Necessity		Provided		Visibility limited by	Does it need Protection	design and Condition			Placement	Recommendations
			Yes	No/NA	Yes	No			S	Z	R & C P		
1	Directional sign												
2	Destination signs												
3	Confirmation sign												
4	Place/city identification												
5	Petrol pump												
6	Hospital												
7	Eating place												
8	No through side road												
9	Pedestrian subway												
10	Airport												
11	Police station												
12	Railway station												
13	Taxi stand												
14	Parking signs												
15	Street Name												
16	River name												
17	Hospital												
18	Lane added on left hand												
19	Left-hand lane ends												
20	Lane pre-selection sign												
21	First Aid												
Note: S - Shape, Z - Size, C - colour, P - Physical condition													

Auditing of traffic signs and markings														
Form No.1. Auditing of Traffic Signs - Informatory signs														
1. Name of Road:.....						2. Name of stretch:.....								
3. Type of Road:.....						4. From(Km) TO(Km).....								
S/N	Type of sign	Chainage	Necessity		Provided		Poor Visibility	Does it need Protection	design and Condition				Placement	Recommendations
			Yes	No/NA	Yes	No			S	Z	C	P		
1	No through road													
2	Bus stop ahead													
3	Supplementary message sign													
4	Information centre													
5	On coming vehicles are required to give way													
6	Message on main sign applied to direction													

Auditing of traffic signs and markings												
Form No.1. Auditing of Traffic Signs - Road markings												
1. Name of Road:.....						2. Name of stretch:						
3.Type of Road:.....						4. From(Km) TO(Km).....						
S/N	Type of sign	Chainage	Necessity		Provided		design and Condition				Placement	Recommendations
			Yes	No/NA	Yes	No	S	Z	C	P		
1	Centre line											
2	Traffic lane lines											
3	No- overtaking zone marking											
4	Stop lines											
5	Pedestrian (zebra) crossing											
6	Lane direction arrow											
7	Marking at approach to											
8	Parking space limits											
9	Bus stop											
10	Kerb marking											
11	Obstruction approach marking											
12	Edge line											
13	Give way control ahead											
14	Roadstuds											
15	Speed hump											
16	Give way control ahead											
17	Channelising line											
18	No overtaking line ahead											
19	Lane reduction arrow											
20	Channelling island - do not cross											
21	No overtaking and dividing line											
22	No crossing lines											
23	Railway crossing ahead											
24	Give way line											
25	Zig- zag zone line											
26	Round about marking											
27	Pedestrian guide line											
28	Word marking											
29	Speed limit marking											
Note: S - Shape, Z - Size, C - colour, P - Physical condition												

APPENDIX 2: SUMMARY OF THE DATA COLLECTED FROM THE SITE

LIST OF ROAD SECTIONS STATUS FROM UBUNGO TO KIMARA (CH. 0+00 TO 5+400)																																																						
S/N	Kilometers	Number of present signs/markings					Number of signs in good condition					Number of signs /markings missing					Number of knocked signs					Number of signs need protection					Number of signs not correctly placed					Number of signs Hidden					undersize signs																	
		W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T													
1	0.0 to 0.2	1	5	3	7	16	0	4	3	1	8	1	0	0	2	3	0	0	0	0	0	0	1	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
2	0.2 to 0.4	0	3	0	4	7	0	2	0	1	3	1	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0						
3	0.4 to 0.6	3	4	0	4	11	0	1	0	1	2	1	0	0	2	3	2	2	0	0	0	4	2	3	0	5	3	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
4	0.6 to 0.8	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	0.8 to 1.0	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
6	1.0 to 1.2	0	0	0	2	2	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
7	1.2 to 1.4	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
8	1.4 to 1.6	3	3	0	3	9	1	1	0	0	2	0	0	0	1	1	0	2	0	0	2	0	2	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
9	1.6 to 1.8	2	2	0	4	8	0	1	0	0	1	1	0	0	1	2	2	1	0	0	3	2	1	0	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
10	1.8 to 2.0	0	0	0	3	3	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
11	2.0 to 2.2	0	0	0	3	3	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
12	2.2 to 2.4	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
13	2.4 to 2.6	0	0	0	4	4	0	0	0	2	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
14	2.6 to 2.8	2	3	0	4	9	0	1	0	2	3	1	0	0	1	2	1	0	0	1	1	0	0	1	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
15	2.8 to 3.0	3	2	0	3	8	1	2	0	1	4	0	1	0	1	2	1	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
16	3.0 to 3.2	1	0	0	3	4	0	0	0	1	1	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
17	3.2 to 3.4	2	3	0	4	9	1	2	0	2	5	1	0	0	1	2	1	1	0	2	1	2	0	3	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
18	3.4 to 3.6	0	2	0	3	5	0	1	0	1	2	0	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19	3.6 to 3.8	0	0	0	4	4	0	0	0	2	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
20	3.8 to 4.0	4	3	0	3	10	0	0	0	1	1	2	1	0	1	4	1	0	0	1	1	0	0	1	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	7	0	0			
21	4.0 to 4.2	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
22	4.2 to 4.4	4	2	0	2	8	0	0	0	1	1	0	2	0	1	3	0	1	0	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	2	0	0	6	0	
23	4.4 to 4.6	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
24	4.6 to 4.8	0	1	0	3	4	0	0	0	1	1	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	
25	4.8 to 5.0	4	3	0	4	11	0	2	0	1	3	2	1	0	1	4	1	0	0	1	0	0	0	0	0	0	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26	5.0 to 5.2	0	0	0	4	4	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	5.2 to 5.4	0	0	0	4	4	0	0	0	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		29	36	3	96	164	3	17	3	29	52	14	6	0	30	47	9	9	0	0	18	8	10	0	0	19	17	5	0	0	22	0	3	0	0	0	0	0	0	3	8	7	0	15	0	0	0	0						
KEY:		W - Warning signs					R - Regulatory signs					G - Guidance Signs					M - Markings					T - Total																																

MOROGORO ROAD (Sokoine Drive Junction to Ubungo)																																															
LIST OF ROAD SECTIONS STATUS FROM SOKOINE DRIVE JUNCTION TO UBUNGO (CH. 0.000 TO 9+100)																																															
S/N	Kilometers	Name of Stretch	Number of present signs/markings					Number of signs in good condition					Number of signs /markings missing					Number of knocked signs					Number of signs need protection					Number of signs not correctly placed					Number of signs hidden					Undersize signs									
			W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T	W	R	G	M	T					
1	0.0 to 0.90	Dar to Akiba	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.9 to 1.30	Akiba to Tanzania legion	0	0	0	5	5	0	0	0	0	0	2	0	1	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
3	1.30 to 1.60	Tanzania Legion to Fire station	2	2	0	6	10	2	1	0	0	3	1	2	1	6	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
4	1.60 to 3.40	Fire station to Magomeni mapipa	2	2	0	0	4	1	2	0	0	3	4	5	2	5	16	0	1	0	0	0	1	1	1	0	0	2	1	0	0	1	2	0	0	0	0	0	1	0	0	1					
5	3.40 to 4.10	Magomeni mapipa to Mwembechai	1	4	0	0	5	0	2	0	0	2	2	2	1	0	5	0	1	0	0	0	1	0	1	0	0	1	1	2	0	0	3	0	2	0	0	2	1	2	0	3					
6	4.10 to 4.70	Mwembechai to Magomeni Kagera	2	6	0	8	16	1	2	0	2	5	2	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	2	2	0	4					
7	4.70 to 7.00	Magomeni Kagera to Urafiki	8	10	0	12	30	2	3	0	2	7	3	5	0	16	24	0	2	0	0	0	2	0	1	0	0	1	4	0	0	0	4	3	2	0	0	5	4	6	0	10					
8	7.00 to 7.80	Urafiki to Shekilango	0	3	0	6	9	0	2	0	2	4	1	1	0	4	6	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	0	1					
9	7.80 to 8.80	Shekilango to bus terminal	1	3	0	3	7	0	1	0	1	2	2	1	2	4	9	0	2	0	0	0	2	0	1	0	0	1	1	2	0	0	3	0	0	0	0	0	0	0	0	0					
10	8.80 to 9.10	Bus terminal to Ubungo traffic lights	0	1	0	3	4	0	0	0	1	1	3	1	0	4	8	0	1	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0					
Total			17	32	0	43	92	6	13	0	8	27	20	19	7	43	89	0	8	0	0	0	8	2	6	0	0	8	8	11	0	1	20	3	5	0	0	8	8	11	0	19					
KEY:			W - Warning signs					R - Regulatory signs					G - Guidance Signs					M - Markings					T - Total																								

APPENDIX 3:
RANKING OF MOROGORO ROAD SECTIONS FROM UBUNGO TO KIMARA (CH. 0+00 TO 5+400) BEFORE SORTING

S/N	Kilometers	Number of present signs			Number of signs in good condition			Number of signs missing			Number of signs knocked signs			Number of signs need protection			Number of signs not correctly placed			Number of signs Hidden			Number of undersize signs			Index	Ranking by priority					
		W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T							
1	0.0 to 0.2	1	5	3	9	0	4	3	7	1	0	0	1	0	0	0	1	1	0	2	0	0	0	0	0	0	7.2	6				
2	0.2 to 0.4	0	3	0	3	0	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	7.7	6				
3	0.4 to 0.6	3	4	0	7	0	1	0	1	1	0	0	1	2	2	0	4	3	1	0	4	0	0	0	0	0	39.0	1				
4	0.6 to 0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
5	0.8 to 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
6	1.0 to 1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
7	1.2 to 1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
8	1.4 to 1.6	3	3	0	6	1	1	0	2	0	0	0	0	2	0	2	0	2	0	0	2	0	0	0	0	0	18.2	4				
9	1.6 to 1.8	2	2	0	4	0	1	0	1	1	0	0	1	2	1	0	3	2	0	0	2	0	0	0	0	0	21.5	3				
10	1.8 to 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7					
11	2.0 to 2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7					
12	2.2 to 2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7					
13	2.4 to 2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7					
14	2.6 to 2.8	2	3	0	5	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	0	1	0	0	0	0	18.1	4				
15	2.8 to 3.0	3	2	0	5	1	2	0	3	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	12.9	5				
16	3.0 to 3.2	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	10.4	5				
17	3.2 to 3.4	2	3	0	5	1	2	0	3	1	0	0	1	1	1	0	2	1	0	0	1	0	0	1	0	0	25.6	2				
18	3.4 to 3.6	0	2	0	2	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	7.0	6				
19	3.6 to 3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
20	3.8 to 4.0	4	3	0	7	0	0	0	0	2	1	0	3	1	0	0	1	1	0	0	3	0	0	0	4	3	0	25.8	2			
21	4.0 to 4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
22	4.2 to 4.4	4	2	0	6	0	0	0	0	2	0	2	0	1	0	1	0	1	0	1	0	1	0	1	4	2	0	19.1	4			
23	4.4 to 4.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
24	4.6 to 4.8	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	4.0	7			
25	4.8 to 5.0	4	3	0	7	0	2	0	2	2	1	0	3	1	0	0	1	0	0	0	3	0	0	0	0	0	23.3	3				
26	5.0 to 5.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7				
27	5.2 to 5.4	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.3	5			
Total		29	36	3	68	3	17	3	23	14	6	0	17	9	9	0	18	8	10	0	19	6	0	22	0	4	0	4	8	6	0	14

KEY: W - Warning signs R - Regulatory signs G - Guidance Signs T - Total

APPENDIX 3: CONTINUED
RANKING OF MOROGORO ROAD SECTIONS FROM UBUNGO TO KIMARA (CH. 0+00 TO 5+400) - AFTER SORTING

S/N	Kilometer	Number of present signs			Number of signs in good condition			Number of signs missing			Number of knocked signs			Number of signs need protection			Number of signs not correctly placed			Number of signs Hidden			Number of undersize signs			Index	Ranking by priority								
		W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T	W	R	G	T										
1	0.4 to 0.6	3	4	0	7	0	1	0	1	1	0	0	1	2	2	0	4	2	3	0	5	3	1	0	4	0	0	0	0	0	0	0	39.0	1	
2	3.2 to 3.4	2	3	0	5	1	2	0	3	1	0	0	1	1	1	0	2	1	2	0	3	1	0	0	1	0	1	0	0	0	0	0	25.6	2	
3	3.8 to 4.0	4	3	0	7	0	0	0	0	2	1	0	3	1	0	0	1	1	0	0	1	2	1	0	3	0	0	0	4	3	0	7	25.8	2	
4	1.6 to 1.8	2	2	0	4	0	1	0	1	1	0	0	1	2	1	0	3	2	1	0	3	2	0	0	2	0	0	0	0	0	0	0	21.5	3	
5	4.8 to 5.0	4	3	0	7	0	2	0	2	2	1	0	3	1	0	0	1	0	0	0	0	2	1	0	3	0	0	0	0	0	0	0	23.3	3	
6	1.4 to 1.6	3	3	0	6	1	1	0	2	0	0	0	0	2	0	2	0	2	0	2	0	2	2	0	0	2	0	0	0	0	0	0	18.2	4	
7	2.6 to 2.8	2	3	0	5	0	1	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	1	0	2	0	1	0	0	0	0	0	18.1	4	
8	4.2 to 4.4	4	2	0	6	0	0	0	0	2	0	2	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	19.1	4	
9	2.8 to 3.0	3	2	0	5	1	2	0	3	0	1	0	1	1	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	12.9	5	
10	3.0 to 3.2	1	0	0	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	10.4	5	
11	5.2 to 5.4	0	0	0	0	0	0	0	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.3	5	
12	0.0 to 0.2	1	5	3	9	0	4	3	7	1	0	0	1	0	0	0	0	1	0	1	1	1	1	0	2	0	0	0	0	0	0	0	7.2	6	
13	0.2 to 0.4	0	3	0	3	0	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	7.7	6	
14	3.4 to 3.6	0	2	0	2	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.0	6	
15	0.6 to 0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
16	0.8 to 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
17	1.0 to 1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
18	1.2 to 1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
19	1.8 to 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
20	2.0 to 2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
21	2.2 to 2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
22	2.4 to 2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
23	3.6 to 3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
24	4.0 to 4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
25	4.4 to 4.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
26	4.6 to 4.8	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4.0	7
27	5.0 to 5.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	7	
Total		29	36	3	68	3	17	3	23	14	6	0	19	9	9	0	18	6	8	0	19	16	6	0	22	0	4	0	4	0	8	6	0	14	

KEY: W - Warning signs R - Regulatory signs G - Guidance Signs T - Total