



JIMMA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
JIMMA INSTITUTE OF TECHNOLOGY
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
HIGHWAY ENGINEERING STREAM

Assessment of Traffic Signs and Its Remedial Measures: A Case Study of
Arada Sub-City

A Final Thesis Submitted to the School of Graduate Study of Jimma
University in Partial Fulfillment of the Requirements for the Degree of
Masters of Science in Highway Engineering Stream

By

Asqual Girma

October, 2017
Jimma, Ethiopia

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October, 2017
Jimma, Ethiopia

Declaration, Confirmation, Approval and Evaluation

Assessment of Traffic Signs and Its Remedial Measures: A Case Study of Arada Sub-City

Declaration

I, the undersigned, declare that this thesis is my original work, has not been presented for any degree in any other university, and that all sources of material used for it are duly acknowledged.

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Acknowledgement

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Abstract

Clear and effective traffic signs are essential for the efficient operation of the road network, for the enforcement of traffic regulations and for road safety. In our country due to poor trend, after an accomplishment of road construction, traffic sign management is not given proper assessment and management. This paper aimed at assessing the traffic signs in Arada Sub-city as traffic signs play a great role in minimizing traffic accidents and traffic congestions making the traffic flow smooth. This sub-city was chosen in a purposive sampling technique because the sub-city is at the center of the city whereby it is the busiest business center with a high traffic flow. Four research questions were forwarded to be answered at the end of the study. The first one was to identify what type of traffic signs were installed in the sub-city while the second one was to check the condition of the existing traffic signs, and the third question checked the causes of failure for problematic traffic signs followed by the last question which asked what kind of remedial measure could be taken for the problems observed.

The researcher used a descriptive survey study which was appropriate for this study. Observation, questionnaire and interview were used as data collection instruments. To make the assessment convenient, the sub-city was divided into nine sites and the traffic signs on the major roads of each site were observed; their type, height, age, legibility, visibility, condition were assessed. In addition, two sets of questionnaire were prepared for thirty traffic police officers and fifteen AATMA (Addis Ababa Traffic Management Agency) workers while two sets of interviews were prepared for the shift manager of Arada Sub-city Traffic Police Office and infrastructure asset management expert of AATMA. Then the data gathered through these instruments were analyzed.

The result reveals that only few redundantly used type of signs dominated the sub-city; other types of traffic signs that are important are not used. There are not sufficient traffic signs in the sub-city. The posted signs do not have any standard and quality. The condition of most of the signs shows that most of them have several problems and need solutions; so some remedial measures were given for the problems. Finally in light of the research findings which show that there are several problems in relation to the traffic signs in Arada Sub-city the recommendations are made in order maintain a safe and secure highway environment.

Key words: *Traffic signs, visibility, legibility, condition of sign, height, type, Arc GIS*

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Acronyms

AACRA	Addis Ababa City Road Authority
AASHTO	American Association of State Highway and Transportation Officials
AATMA	Addis Ababa Traffic Management Agency
AMS	Asset Management System
ASTPO	Arada Sub-city Traffic Police Office
ERA	Ethiopia Road Authority
ERF	European Union Road Federation
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Position system
JIT	Jimma Institute of Technology
TSR	Traffic Sign Recognition

CHAPTER ONE

INTRODUCTION

1.1 Background

Road Transport is one of the most frequently used modes of transportation systems in most countries of the world. It is relatively cheap (affordable) and safe as compared to other modes of transportation. When we take Ethiopia, and especially Addis Ababa, more than 80 % of travel (mobility) is based on this mode of transportation for motorized systems [1].

A road is one of the major financial community assets and provides large benefits to the society [2]. Because it serves as veins to accelerate developments in industry, trade, education, health and other services. However, in Ethiopian context there is no compatible road network access and effective management to meet the increasing trip frequency and mobility needs of the people and goods which resulted in the seriousness of the issue. Among the challenges of the road transport, poor road assets management is highly observed problems. Unless these challenges and other associated problems are addressed in time, they will have a negative impact on the day to day activity on roads. One of the biggest problems raised with the issue of road transport is the emphasis given to traffic signs. Though traffic signs play vital role in the traffic flow and road usage, it seems that they are not given the attention they needed. So this study tries to investigate traffic signs in a specified area to see the extent of the problem.

1.1.1. Traffic Sign

Traffic signs are essential components of the transportation system. During the day and night, traffic signs provide vital guidance to road users regarding traffic regulations, destinations, safe speeds, and unexpected road conditions [3]. Road signs perform a wide variety of tasks on the road network – from guidance on tourist destinations through to statutory control. Regulatory, warning and hazard signs in particular are crucial parts of the designed road safety system, working in conjunction with delineation (centerline and edge marking), road geometry, public lighting and traffic signals to form the overall system of control within which vehicle drivers, cyclists and pedestrians operate [4]. But in our country's context, road users have poor access and management of road traffic signs.. Arada is center for the remaining sub cities so it must have a good road access and

management, but the truth behind this is most traffic signs that exist in the sub city are not given the attention they needed and they are not properly managed. However, traffic signs give a vital guidance and information for road user and traffic signs are part of important assets of road.

1.1.2. Existing condition of Addis Ababa Transport

Addis Ababa, with an area of 540 km² is divided into 10 sub-cities and 116 Woredas. The city is the country's political and economic center, the seat of Head Offices of African Union and United Nations Economic commission for Africa. It also accommodates many international aid and development organizations and more than 100 embassies. The city's population is estimated to be 3.4 million. With the current population growth rate of 2.1% the city population is estimated to reach 5 million after 10 years. Addis Ababa is exhibiting high social, economic, structural change and is found to be a fast growing city. More than 70% of registered vehicles in the country are found in Addis Ababa. Taking into account Addis Ababa's fast growth and to enable the transport sector to play its required role, the government has invested a huge resource to construct roads so as to expand the road network. An effort has also been made to improve the transport service provisions [5].

1.1.3. Historical Background of Traffic Signs

Road regulations and traffic signs as we know them today are not older than a hundred years. The international conventions dealing with these issues had been preceded by an era of steam omnibuses at the beginning of the 19th century. That was the time when railway transport proved to be the cheapest, faster and more comfortable than the horse carts. At the same time the railway traffic signals developed which are therefore older than the signals and signs used in road transport.

The first international Convention on Road and Automobile Traffic was agreed upon in 1909 in Paris. Later, conventions in other cities followed, and the most important one was in Geneva in 1949, when the Protocol on Road Signaling was accepted, followed by its amendments in 1968 brought by the International Conference of the United Nations Organization on Road Traffic.

These conventions recommended that all states should stipulate equal traffic signs, that these traffic signs should not contain written instructions or information, since these could not be understood by the foreigners and the illiterate [6].

1.1.4. Historical Records about Arada Sub City

Arada Sub-city is one of the ancient parts of Addis Ababa where its establishment goes back to the years of the city's establishment. In 1886, when Emperor Minilik II and Empress Taitu Butil decided this place to be the seat of their government, most of their governmental structures, residences, social, economic, and political infrastructures were established mostly here in Arada. Arada was also the famous and big market place. And it was the meeting place for many Ethiopian people from different regions [7]. Most of the kings General lived around the palace and military of the generals are lived encircled around the generals house. The areas were named by the respective generals' name for example Ras Wube sefer and Talian sefer derived its name after the Italian captives were settled in the area. Arada sub city is also has 10 woredas. Comparing with the other sub cities, Arada is one of the oldest and most commercial centers of the city is found in this part of the sub city [8]. Museums The National Museum of Ethiopia, The Zoological Natural History Museum, The Ethiopian National Postal Museum, Saint George Cathedral Museum, The Trinity Cathedral Museum Monuments The Equestrian Statue of Emperor Minilik II , Freedom Monument, The Monument of Martyrs, Statue of His Holiness Abune Petros, Sebastopol Canon of Emperor Theodros Theatre Halls Hager Fikir Theatre ,Addis Ababa Theatre and Culture Hall Renown Hotels Itege Taitu Hotel, Sheraton Addis, Harambe Hotel, Hotel Soramba, Addis View Hotel Age old Churches and Mosques Mekane Sillasie Bealwold, Genete Tsige Kidus Giyorgis Church .Currently a lot of buildings are being built for different purposes such as workshop, administration, education, health and business centers [7].

1.2. Statement of the Problem

A "Traffic Sign" means any object, device, line or mark on the road whose object is to convey to road users, or any specified class of road user, restrictions, prohibitions, warnings or information, of any description. Clear and effective traffic signs are essential for the efficient operation of the road network, for the enforcement of traffic regulations and for road safety [9]. In our country due to poor trend, after an accomplishment of road construction, traffic sign management is not given proper assessment and management. Arada sub city, as the one of the busiest city centers of Addis Ababa, has high traffic flow and congestion. Though this sub-city, as a center for all the remaining sub cities, has high traffic flow a lot of problem is observed in its traffic sign assessment and management.

In addition to this, the responsibility of road asset management that involves traffic signs was transferred to Addis Ababa road traffic management agency from Addis Ababa City Road Authority only a year ago. Because of early age of responsibility and AACRA did not put any organized data and system, any strong and good management of traffic sign management is difficult to Addis Ababa road traffic management agency; as a result, the traffic signs in Arada sub-city are not well taken care of, so the aim of this research is to assess the problem and find remedial measure for this problem.

Even though the problem is big there are not many researches done in relation to traffic signs. The researcher has found some researchers conducted internationally and we will see their title and purpose as follows.

One of the studies conducted was by Boggs (2012) which describes Analysis of Traffic Sign Performance for the Establishment of a Maintenance Plan [10].

On another study Harris, Rasdorf et al. (2007) describe the minimum traffic sign reflectivity standards [11].

Harris (2007) conducted research on Sign Maintenance Strategies For Agencies To Comply With Proposed Federal Highway Administration Minimum Retroreflectivity Standards [3].

Hussain (2014) in his research points out the development of Traffic Sign AMS in Indian context [12].

Aydin (2009) has a research on Traffic Sign Recognition (TSR) which assesses the ability of detection and identification of traffic signs even with bad visual artifacts those originate from some weather conditions or other circumstances [13].

Howe (2006) describe Assessment of Road Signs for Retroreflectivity Road Authorities in Australia provide a range of road signs, the type, size, placement and manufacture of which is covered by a range of Australian Standards, Design Manuals, and Codes of Practice associated with legislation [4]

Zhang and Chan (2013) have done a study on Traffic Sign compression: a review of influential factors and future direction for research [14].

Brimley and Carlson (2013) present The Current State of Research on the Long-Term Deterioration of Traffic Signs [15].

Chan, Gonzalez, and Perez research on Designing Traffic Signs: A Case Study on Driver Reading Patterns and Behavior [16].

Jemil Awel (2007) describes GIS based road network analysis in the sub city of Arada. This study is intended to use GIS as a tool in analyzing, integrating and displaying information [1].

The above researches are some of the few studies conducted in relation to traffic signs. Though traffic signs play a great role for the traffic flow and safety of drivers and pedestrians, it is not given the attention it needed by all the stakeholders. This in turn is reflected in the shortage of researches conducted in the area. The researches conducted in the area internationally are not sufficient and locally as far as the researcher's knowledge is concerned there are no researches conducted in the area about traffic signs. This motivated the researcher to conduct the study in relation to traffic signs in our local context. This research is different from other studies in that most of the internationally conducted researches concentrate more on the retroreflectivity of the traffic signs because their asset management on their road assets and especially on their traffic signs are strong. Hence these signs are assessed every six month to check their condition. However when we come to Ethiopian context road asset inventory and management is not well known; in addition, traffic signs are not given much attention by the concerned bodies and stakeholders. Due to this, the condition the signs are in is critical and a lot of problems are observed in relation to the traffic signs especially in the capital city Addis Ababa. So the main purpose of this study is to assess the degree of the problem in Arada Sub-city as it is the center for all the other sub-cities and busiest from the rest of them.

1.3. Research Questions

The research questions that this study will attempt to clarify are as follows:

1. What type of traffic signs are installed in the study area?
2. What is the condition of the existing traffic signs?
3. What are the causes of failure for the existing sign?
4. What remedial measures can be taken for the problems observed?

1.4. Research Objective

1.4.1. General Objective

The general objective of this research was to assess the traffic signs in Addis Ababa specifically Arada sub city and give remedial measures to maintain a safe and secure highway environment.

1.4.2. Specific Objective

- To identify the traffic signs installed in study area.
- To check the condition of the existing traffic signs.
- To check the causes of failure for the existing signs
- To suggest remedial measures for the problems observed.

1.5. Scope of the study

The scope of this research concentrates on Addis Ababa and one may ask why Addis Ababa is chosen. Addis Ababa is chosen because it is the capital city where you find a lot of traffic signs as there is a lot of traffic flow and congestion compared to other towns and cities in Ethiopia. Addis Ababa is also very wide to study the whole traffic signs in it since the researcher has neither the time nor the money and the man power it needs for investigation. Therefore, this study is conducted in one of the 10 sub-cities in Addis Ababa. From the 10 sub-cities of Addis Ababa, Arada sub-city is chosen for this study due to three major reasons. Even though there are so many areas with traffic signs in Addis Ababa which need to be assessed, this research study concentrates on only at pre mentioned site because it is for one the busiest place where a lot of traffic flow and congestion is observed, secondly it is a center for the other remaining sub-cities which connects most of them and lastly it is the place where many traffic sign related problems are observed much more widely than the other sub-cities. For this reason, the researcher used purposive sampling to check the traffic signs that are posted in the major roads of Arada sub-city.

1.6. Significance of the Study

Clear and efficient signing is an essential part of the road system, and a road with poor signing or with badly maintained signs is an unsatisfactory road. Road users depend on signing for information and guidance, and highway authorities depend on signing for the efficient working of the highway network, the enforcement of traffic regulations, traffic control and as an aid to road safety. It also gives information and emphasis if those signs need maintenance or replacement, so this research assesses the condition of traffic signs in Arada sub city and give remedial measures. Hence, this study can help the following stakeholders. Addis Ababa Traffic Management Agency can use the information from this study as an input for their work; this means they can get the exact positions of the posted signs from the GPS records in this study and they can also get information about

the condition of the signs and recommended signs that have to be installed in the appropriate area. For Arada sub City Traffic police office, the data collected from the study can serve as an input to solve the problems usually observed so as to create conducive traffic flow. Finally this study can also be useful for all road users including both drivers and pedestrians that use Arada Sub City road in give a vital guidance and necessary information in addition to minimizing traffic accidents, time delays, traffic congestions and other traffic related problems and by trying to solve these problems this study contributes a lot in making road environment suitable, accessible, and secure for all road users.

1.7. Limitations of the Study

Every research has some limitations that it faces and this research is not any different as the researcher faced some challenges during the study. The first challenge was, not being able to get available information on time. To get single information from one office the researcher had to visit that office several times because the officers appointed for the task were not willing and they were afraid of being held responsible for the information they gave. So the researcher had to go to different offices to get the officers to cooperate with her.

Shortage of a time is another big problem. Because to get allocated money for the research took a long time and process, the researcher had to spend much time in Jimma to get the money as the research needed a lot of money and this has consumed the some valuable time of the researcher which could have been used in doing the research. This has put extra pressure on the researcher in addition to the unwillingness of the officers in Addis Ababa to give information on the research area.

The other one is shortage of information about the title that is being studied especially in Ethiopian context. For example, problem of getting standard specification and manual for traffic sign was impossible. Normally there is no any manual for only traffic sign in Ethiopian context so the researcher had to refer manuals of other countries.

In general, though these problems had created some obstacle during the research, the researcher had managed to handle them effectively to complete the study in the given time.

1.8. Structure of the thesis

This research contains five chapters and their outline is as follows:

The first chapter includes background of the study, statement of the problem, research questions, objective of the study, and the scope the research, followed by significance and limitation of the study. The second chapter covers review of related literature where upon review of traffic signs, introduction about geographic information system and works done in the area are discussed. The third chapter is about the research methodology used in the paper while the fourth chapter brings the data analysis and discussion; in this chapter using the data collected through observation, questionnaires, and interviews the type of traffic signs, their height, visibility, legibility, and condition is analyzed, their cause of failure and remedial measures are presented and the result of the data gathered is discussed. Then in the last chapter conclusions are drawn and recommendations are made.

CHAPTER TWO

LITERATURE REVIEW

In this chapter, review of related literature is discussed. The first part discusses the general review of traffic signs under which historical background of traffic signs; general principle of traffic signs; types of traffic signs; purpose and use of traffic signs; sizes, sitting, and positioning of traffic signs; sign legibility; foundations for the signs; maintenance of signs; record keeping and inspection; storage and transport of signs; and assessment of effectiveness of signs are enlightened. The second part explains some basic information about Geographic Information System followed by an investigation on works done in the area.

2.1. Review of Traffic Signs

2.1.1. Historical Background of Traffic Sign

Road regulations and traffic signs as we know them today are not older than a hundred years. The international conventions dealing with these issues had been preceded by an era of steam omnibuses at the beginning of the 19th century. That was the time when railway transport proved to be the cheapest, faster and more comfortable than the horse carts. At the same time the railway traffic signals developed which are therefore older than the signals and signs used in road transport.

At that time, in the most developed industrial country in the world, in England, the number of steam propelled vehicles travelling the roads, the so-called steam omnibuses, transporting even up to 20 passengers, was increasing. Their advantage compared to horse carts was the comfort and regularity of transport. However, the proprietors of horse cart transportation societies did not give up fighting to bring their passengers back. They could hardly wait for the traffic accidents of steam omnibuses. The first one, in 1831 in London, was not really a severe one, but people did get frightened. Soon, there was another accident in Glasgow in which a steam omnibus with 18 passengers hit a wagon and ran over a farmer. The issue of steam omnibuses was also raised in Parliament. After a lot of discussion the "Locomotive Acts" was passed in 1836, and supplemented in 1865. This Act can be considered as the first traffic regulation on road speed limitation. It limited the speed of every steam vehicle (it did not refer to the harnessed vehicles) to 3.2 km/h within residential areas and to 6.5 km/h on open roads. It also obliged every driver to have a rider 100 meters in front of the vehicle to wave a red flag and warn the

passersby of the approaching danger. The coachman only needed to raise his hand and the vehicle had to stop. The Act assumed that in case of any accident the responsibility was only on the driver of the steam vehicle. This Act, known also as "Red Flag Act", was revoked

as late as 1896 and caused England to lag behind other developed industrial countries in designing all kinds of power-driven vehicles. The rule of left driving was founded on the old customs inherited from the coachmen. They drove, namely, their wagons along the left side of the road, and the first regulations only enacted this custom, spread throughout the English colonies. All the other peoples followed the French customs and regulations, and abided by the rule of driving along the right side of the road.

When the first motor vehicles appeared on the roads, and started to cross the state borders with more ease and more frequency, and that was at the beginning of the 20th century, there arose a need to define international regulations in order to co-ordinate the conditions on all the roads.

The first international Convention on Road and Automobile Traffic was agreed upon in 1909 in Paris. Later, conventions in other cities followed, and the most important one was in Geneva in 1949, when the Protocol on Road Signaling was accepted, followed by its amendments in 1968 brought by the International Conference of the United Nations Organization on Road Traffic.

These conventions recommended that all states should stipulate equal traffic signs, that these traffic signs should not contain written instructions or information, since these could not be understood by the foreigners and the illiterate. At time when these regulations were made, there were quite many good but illiterate drivers, and symbolic signs were preferred. That was the reason why traffic signs and other notes, such as e.g. "Landslide", "Watch out -wild animals on the road", "Drinking water", "Fire risk" were abandoned and replaced by images [6].

2.1.2. General Principle of Traffic Sign

A "traffic sign" means any object, device, line or mark on the road whose objective is to convey to road users, or any specified class of road user, restrictions, prohibitions, warnings or information, of any description [17].

Traffic signs play a vital role in directing, informing and controlling road users' behavior in an effort to make the roads as safe as possible for everyone. This makes knowledge of

traffic signs essential. Not just for new drivers or riders needing to pass their theory test, but for all road users, including experienced professional drivers [18]

Signs must give road users their message clearly and at the correct time. The message must be unambiguous and speedily understood. Using standard signs assists in their quick recognition, as does uniformity of shape, color and lettering for each type. To obtain the fullest benefits of uniformity there must not only be uniformity of signs, but also uniformity in their use, siting and illumination.

Signs are provided to control and guide traffic and to promote road safety. They should only be used where they can usefully serve these functions. On the other hand, their omission where guidance, control or danger warrants the use of a sign is not in the road user's best interest. A balance must be achieved between too many and too few signs.

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, we should avoid using signs which impose a restriction which will be very unpopular and difficult to enforce. Drivers will stop taking signs seriously when they see others ignoring them without being caught [9].

So signs need to be posted in the sufficient and proper amount as they should not be too few or too many for the reasons explained above which leads us to the question of what are the requirements of signs. The following paragraphs will answer this question.

Requirements of Signs

Traffic signs are required in order to provide for the safe and orderly movement of motorized and non-motorized traffic and pedestrians. Signs provide information about highway routes, directions, destinations and points of interest. They also provide information on regulations which apply to specific locations or at specific times, and warn of hazards which may not be evident.

To be effective a sign must put the following four important points into consideration. First and foremost it must fulfill a need. Second it must command attention and respect. Third it must convey a clear and simple message and lastly it must allow adequate time for a proper response.

To meet these objectives, signs must have a carefully considered message, be of uniform design, and be applied and placed in a consistent manner. Contradictory or misleading information, incorrect placement or use of inappropriate standard signs can confuse the road user. It is also most important to recognize that improper or excessive use of signs

leads to disrespect and non-compliance of the sign [19].

It is important that the message be presented in a simple way. Signs make a great use of pictorial symbols, as these are much more effective than words, and can be understood by those who cannot read. Signs with words are used only where there is no alternative. Signs must have sufficient impact to be noticed by drivers. This has to be taken into account in the design of the signs, but the size and sitting of the sign are also relevant. For most signs there are several permitted sizes, and it is largely the speed of the traffic at the site that determines which size is appropriate.

The symbols and legends on signs must be easy to read. This has influenced the design of the symbols, lettering, letter spacing, colors, etc., but size is again of most importance, as drivers who are travelling fast need to be able to recognize a sign from a long distance away. This means that the symbols and lettering need to be large enough to enable drivers to recognize them at the required distance.

Traffic signs must be visible at night. They should preferably be reflectorised so that they show up clearly in vehicle headlights. Traffic signs should be constructed and erected so that they will last for many years without any attention apart from occasional cleaning [17].

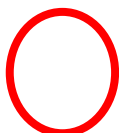
Communication Tools in Traffic Signs

A number of mechanisms are used by the traffic engineer to communicate with the road user. These mechanisms recognize certain human limitations, particularly eyesight. Messages are conveyed through the following elements.

1. Color: It is the first and most easily noticed characteristics of a device. Usage of different colors for different signs is important. The most commonly used colors are red, green, yellow, black, blue, and brown. These are used to code certain devices and to reinforce specific messages. Consistent use of colors helps the drivers to identify the presence of sign board ahead.



Blue circles generally give a mandatory instruction, such as "turn left", or indicate a route available only to particular classes of traffic, e.g. buses and cycles



Red rings or circles tell you what you must not do, e.g. you must not exceed 30 mph, no vehicles over the height shown may proceed

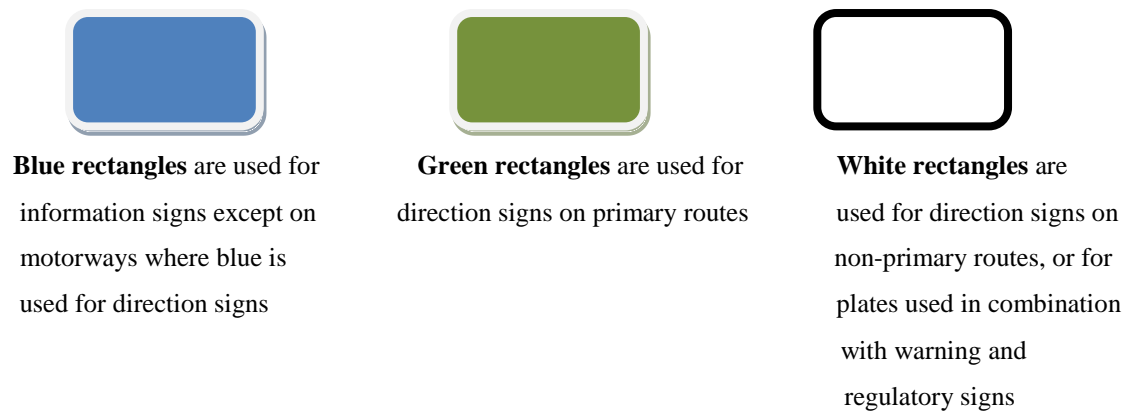
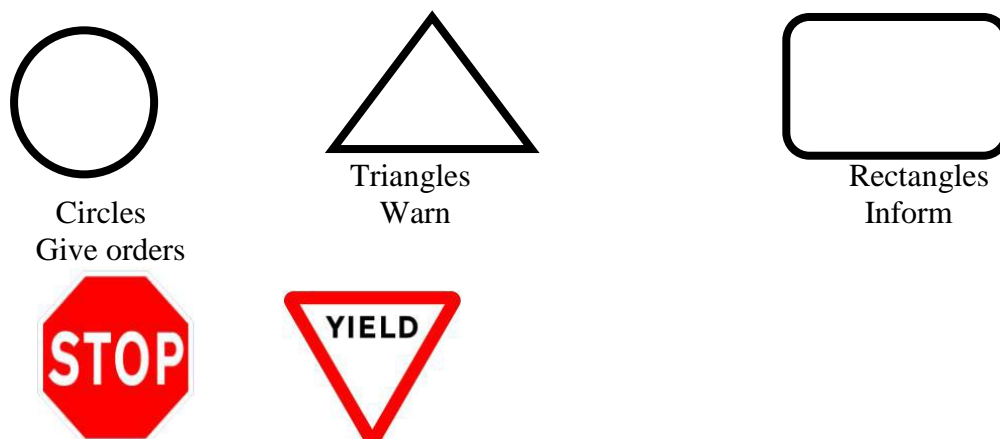


Figure 2.1 Color Requirement for Traffic Signs

2. Shape: It is the second element discerned by the driver next to the color of the device. The categories of shapes normally used are circular, triangular and rectangular shape. Two exceptional shapes used in traffic signs are octagonal shape for STOP sign and use of inverted triangle for GIVE WAY (YIELD) sign.



There are a few exceptions to the shape and color rules, to give certain signs greater prominence.

Examples are the "STOP" and "GIVE WAY" signs

Figure 2.2 Shape Requirement of Traffic Signs

3. Legend: This is an important aspect in the case of traffic signs. For the easy understanding by the driver, the legend should be short, simple and specific so that it does not divert the attention of the driver. Symbols are normally used as legends so that even a person unable to read the language will be able to understand that.

4. Pattern: It is normally used in the application of road markings, complementing traffic signs. Generally solid, double solid and dotted lines are used. Each pattern conveys different type of meaning. The frequent and consistent use of pattern to convey

information is recommended so that the drivers get accustomed to the different types of markings and can instantly recognize them [20].

2.1.3. Types of Traffic Signs

The three main functions of traffic signs are to regulate, warn, and inform. There is a different group of signs for each function, and the signs in each group have a uniform shape to help drivers recognize them quickly. The three groups are:

1) Regulatory Signs

These signs give orders. They tell drivers what they must not do (prohibitory), or what they must do (mandatory). Most of them take the form of a circular disc, although two signs, the Stop sign and the Give Way sign, have distinctive individual shapes [21].

These signs are also called mandatory signs because it is mandatory that the drivers must obey these signs. If the driver fails to obey them, the control agency has the right to take legal action against the driver. These signs are primarily meant for the safety of other road users. These signs have generally black legend on a white background. They are circular in shape with red borders. The regulatory signs can be further classified into:

1. Right of way series: These include two unique signs that assign the right of way to the selected approaches of an intersection. They are the STOP sign and GIVE WAY sign

For example, when one minor road and major road meets at an intersection, preference should be given to the vehicles passing through the major road. Hence the give way sign board will be placed on the minor road to inform the driver on the minor road that he should give way for the vehicles on the major road. In case two major roads are meeting, then the traffic engineer decides based on the traffic on which approach the sign board has to be placed. Stop sign is another example of regulatory signs that comes in right of way series which requires the driver to stop the vehicle at the stop line.

2. Speed series: Number of speed signs may be used to limit the speed of the vehicle on the road. They include typical speed limit signs, truck speed, minimum speed signs etc. Speed limit signs are placed to limit the speed of the vehicle to a particular speed for many reasons. Separate truck speed limits are applied on high speed roadways where heavy commercial vehicles must be limited to slower speeds than passenger cars for

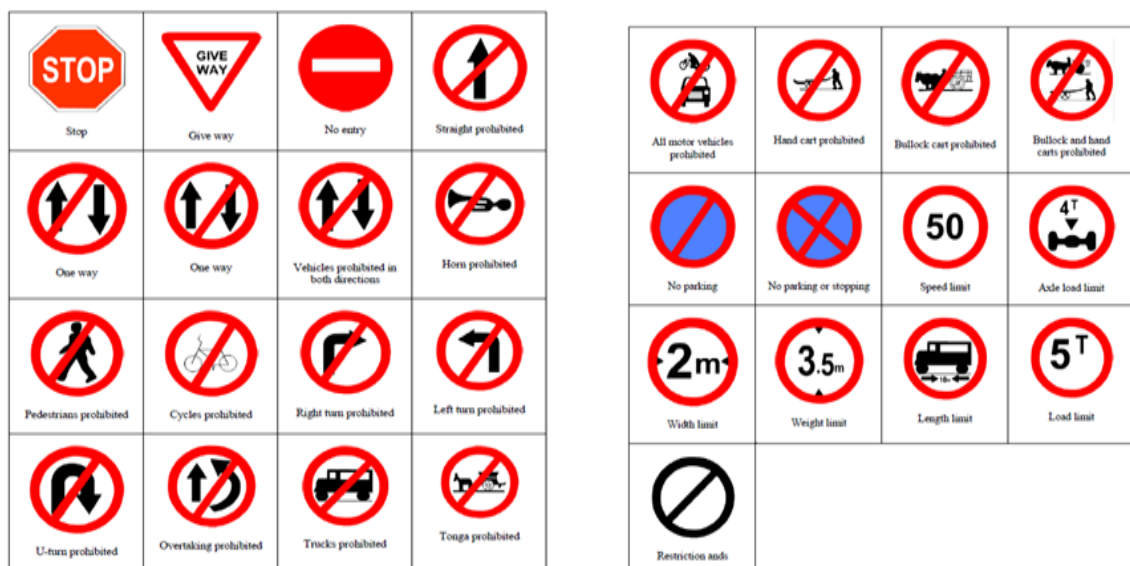
safety reasons. Minimum speed limits are applied on high speed roads like expressways, freeways etc. where safety is again a predominant reason. Very slow vehicles may present hazard to themselves and other vehicles also.

3. Movement series: They contain a number of signs that affect specific vehicle maneuvers. These include turn signs, alignment signs, exclusion signs, one way signs etc. Turn signs include turn prohibitions and lane use control signs. Lane use signs make use of arrows to specify the movements which all vehicles in the lane must take. Turn signs are used to safely accommodate turns in unsignalized intersections.

4. Parking series: They include parking signs which indicate not only parking prohibitions or restrictions, but also indicate places where parking is permitted, the type of vehicle to be parked, duration for parking etc.

5. Pedestrian series: They include both legend and symbol signs. These signs are meant for the safety of pedestrians and include signs indicating pedestrian only roads, pedestrian crossing sites etc.

6. Miscellaneous: Wide variety of signs that are included in this category are: a “KEEP OF MEDIAN” sign, signs indicating road closures, signs restricting vehicles carrying hazardous cargo or substances, signs indicating vehicle weight limitations etc [20].



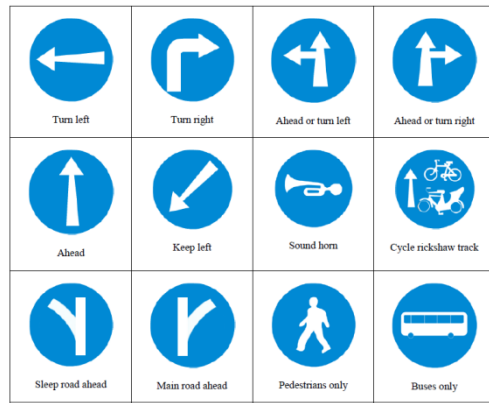


Figure 2.3 Regulatory Signs

2) Warning Signs

These warn drivers of some danger or difficulty on the road ahead. Most of them take the form of an equilateral triangle with its apex uppermost [21].

Warning signs or cautionary signs give information to the driver about the impending road condition. They advise the driver to obey the rules. These signs are meant for the own safety of drivers. They call for extra vigilance from the part of drivers. The color convention used for this type of signs is that the legend will be black in color with a white background. The shape used is upward triangular or diamond shape with red borders [20].



Figure 2.4 Warning Signs

3) Information Signs

Most of these signs give drivers information to enable them to find their way to their destination. It is a varied group of signs, but they are all either square or rectangular in shape [21].

Informative signs also called guide signs, are provided to assist the drivers to reach their desired destinations. These are predominantly meant for the drivers who are unfamiliar to the place. The guide signs are redundant for the users who are accustomed to the location. Some of the examples for these types of signs are route markers, destination signs, mile posts, service information, recreational and cultural interest area signing etc. Route markers are used to identify numbered highways. They have designs that are distinctive and unique. They are written black letters on yellow background. Destination signs are used to indicate the direction to the critical destination points, and to mark important intersections. Distance in kilometers is sometimes marked to the right side of the destination. They are, in general, rectangular with the long dimension in the horizontal direction. They are color coded as white letters with green background. Mile posts are provided to inform the driver about the progress along a route to reach his destination. Service guide signs give information to the driver regarding various services such as food, fuel, medical assistance etc. They are written with white letters on blue background. Information on historic, recreational and other cultural area is given on white letters with brown background [20].



Figure 2.5 Information Signs

2.1.4. Purpose and use of traffic signs

I. Regulatory sign

Most regulatory signs are the means of putting into practical effect the regulation or control of traffic. For example, they may impose restrictions on speed, on the turning of traffic at a junction, or on waiting.

Regulatory signs are either mandatory or prohibitory. The mandatory signs give instructions to drivers about what they must do - the Stop and Give Way signs being examples. Most other mandatory signs such as the Keep Left sign are circular with a white symbol and border on a blue background.

The prohibitory signs, of which there are many more types, give instructions to drivers about what they must not do - signs banning turns or entry being examples. Speed restriction signs and signs for parking restrictions are further examples. Most are circular and have a red border.

Regulatory signs must only be used where it is considered essential that traffic be controlled for safety reasons or for efficient use of the road system. Drivers will take more notice of them if they can see why they are needed. It is important to be realistic when setting speed restrictions. And a Stop sign should not be used where it would be safe to have a Give Way sign [17].

II. Warning sign

Warning signs are used to alert drivers to danger or potential danger ahead. They indicate a need for extra caution by road users and may require a reduction in speed or other manoeuvre. This section contains advice on when to use each sign.

Adequate warning signs can greatly assist road safety. To be most effective however, they should be used sparingly. Their frequent use to warn of conditions which are otherwise readily apparent tends to detract from their effectiveness.

Do not use warning signs in situations where the problem is obvious, or is so minor that no extra care is necessary. If they are over-used, drivers will lose respect for them. This is particularly true when specifying signs for urban roads. Side road junctions for example

are not usually a danger when traffic speeds are low. Warning signs are very important at road works.

Most warning signs are triangular in shape with a red border encompassing a black symbol on a white background. The black symbol represents the hazard. Sometimes additional information is put onto a supplementary plate below the main sign [21]

III. Information Sign

These information signs serve one of several purposes;

- (i) They may give advance information of prohibitions or restrictions ahead or they may indicate the end of a restriction or prohibition.
- (ii) They may give civic or geographical information such as the name of a town or village.
- (iii) They may give information about facilities ahead such as parking places, lay-bys, picnic areas, telephones etc.

These signs give drivers information to enable them to find their way to their destination. Good direction signing helps to reduce delay and frustration; to keep traffic flowing smoothly and safely through junctions; to promote commerce and tourism [9].

2.1.5. Sizes, Sitting and positioning of traffic sign

1. Regulatory Sign

The size of the regulatory signs has been standardized and will be dependent upon the designation of the road on which they were erected. In general the size of sign will be as shown on table 2.1 [9] .

Table 2.1 Size of regulatory sign

Road Designation	Diameter of Sign(mm)
National Highways, feeder roads and other rural roads	600
Locations on National Highways, feeder roads and other rural roads where additional impact is required	750
Town and urban roads	600
Town and urban roads where space is limited	450
Signs attached to traffic signal columns	300

Exceptions to the standard sizes are Stop signs, Go signs and Give Way signs which will be 750 mm except within urban areas where there may be a case for a 600 mm sign.

2. Warning signs

Table 2.2. Size of Warning Signs

Road Designation	Size of sign (Height of triangle in mm)	Distance of Signs from hazard (m)
National Highway.	750	180
Locations on National Highways where additional impact is required.	900	180
Feeder Roads.	750	100
Town and Urban Roads	600	50
Locations of signs in town and on urban roads where additional impact is required.	750	50

Sitting of Traffic Signs

Drivers have to be given the message at the right time neither too late for the driver to take action, nor too soon that he has forgotten it by the time he has to act on it.

Regulatory signs are normally sited at or near the point where the instruction applies. It is important to make sure that there is no confusion about which road they refer to. Drivers must be able to see the sign from at least 75 meters away so that they have time to read the message and act on it. Regulatory signs are placed at the left-hand side of the road, but a second sign on the right-hand side may be used where extra impact is needed. Each sign is designed to be read from a certain distance, which is determined by the road designation. The sign must be sited where it can actually be seen from this distance.

Signs should generally be sited on the left-hand side of the road. However, at sharp left-hand bends it may be better to put the sign on the right-hand side of the road where it will be more noticeable. Most warning signs, and some direction signs, have to be sited in advance of the hazard or junction to which they relate. The distance depends on the road designation. It is important to be consistent, so that drivers will become familiar with the rate at which they have to slow down. When signs have to be sat far away from their standard position, a supplementary plate may be used to give the distance to the junction or hazard. It is better to increase the distance between a sign and the junction or hazard to which it relates, rather than decrease it [9].

Positioning of Signs

There are three things to consider when positioning a traffic sign: its sitting in relation to the junction, hazard, etc., to which it refers; its position in relation to the edge of the carriageway; and the height of the sign plate and its angle to the road.

General advice on sign positioning is given below. Where there are special requirements for a specific sign, these are referred to on the relevant traffic sign diagram. The recommendations should be used as a guide, because the precise positioning can only be determined on site. There are often limitations on where signs can be placed, especially in urban areas. Always check that:

- ✓ the signs are clearly visible;
- ✓ there is no confusion about which road they refer to;
- ✓ the signs do not obstruct the view of drivers;
- ✓ the signs are not placed where they could be struck by vehicles

If necessary, alter the sitting or mounting to overcome the problem [17].

Position Relative to the Edge of the Carriageway

Signs should be placed so that no part of the sign, is closer than 600 mm from the outer edge of the shoulder, or carriageway in the case of roads without shoulders, - see Figure 2.6. This also applies to signs positioned on traffic islands. This is to reduce the risk of them being hit by passing vehicles. The siting of signs at places where vehicles stop or park on the shoulder should be avoided [21].

Height and Angle of the Sign Plate

Signs should normally be mounted so that the lower edge of the sign plate is 2,000 mm above the level of the carriageway - see Figure 2.6. This helps to discourage vandals and bill posters from defacing the sign plate.

Signs should never be mounted less than 1000 mm above ground level, however signs that are mounted at this height get dirty more quickly from rain splash and vehicle spray.

Where two warning signs are to be mounted on the same post, the sign that relates to the nearest hazard should be at the top. Temporary road signs should be mounted on a frame which keeps the sign above ground by at least 300mm.

Signs erected over footways and in urban areas must be high enough to enable pedestrians to walk beneath them. The lower edge of the sign place should be about 2.0 meters above the surface of the footway [9].

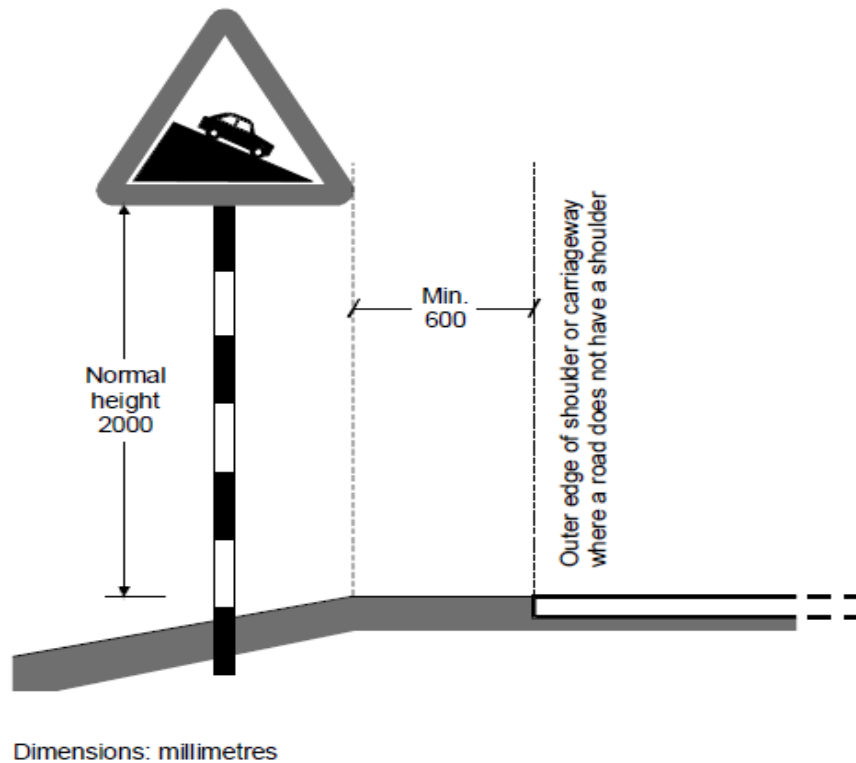


Figure 2.6 Height of Sign Plate

2.1.6. Sign Legibility

A sign must be capable of transmitting its message clearly and at the right time to road users travelling at the normal speed for the road during day and night. To achieve this, a sign must have correct legibility distance, appropriate target value, simple content and layout, and effective reflectorization. Signs must also be adequate in design and construction.

The legibility of signs is of prime importance; it is determined by the size of the symbol or lettering used. Contributory factors include the use of adequate color contrast between the symbols or lettering and the background and the type of any alphabet used. As size is the most important factor determining sign cost, signs should be designed to meet the required legibility without wasting space.

The factors which determine the distance over which a sign message is legible include: the size of symbol or text; the number of messages to be scanned; the lateral distance of the sign from the edge of carriageway; and the speed of the approaching vehicle[21].

2.1.7. Foundations for the signs

Excavations for the erection of road signs shall be made according to the dimensions shown on the drawings. Where the excavations are to be backfilled with soil, a 1:12

cement: soil mixture shall be made and backfilled at optimum moisture content in 100 mm thick layers and compacted to a minimum of 90% of modified American Association of State Highway and Transportation Officials (AASHTO) density.

Where posts or structures are to be fixed in concrete, or where concrete footings are to be cast, the concrete, formwork and reinforcement shall comply with the requirements of Division 8400. The holes shall be completely filled with concrete up to the level shown on the drawings or indicated by the Engineer. The upper surface of the concrete shall be neatly finished with sufficient fall to ensure proper drainage [22].

The type of foundations required, particularly for the larger route signs, will vary with the local soil conditions. Foundations may be in mass concrete or reinforced concrete. The buried section should be at least one-third the overall length of the post. Unless otherwise specified the foundation for a single post should be at least 0.1 cubic meters of class 15 concrete. After pouring, it should be properly compacted with a tamper. The top surface should be smooth with a slight slope outwards from the post to ensure proper drainage. The top surface of the finished concrete should not be proud of the surrounding ground surface as the provision of foundation blocks or plinths will enable vandals to reach the sign plate more easily.

The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil. Special precautions should be taken to ensure the adequacy of foundations in made up ground. Foundation for the large route signs should not be

‘covered up’ until they have been inspected and approved by the Engineer.

Temporary struts should be used to hold the post in position until the foundation is complete, making sure that the post is vertical and that the sign plate is level and at the correct angle to the road. It is recommended that the installation date is painted on the back of the sign [17].

2.1.8. Maintenance of Signs

An exclusive requirement of upkeep of movement signs, activity lights is fundamental on the off chance they are to satisfy their motivation. It should be a waste of cash to give the signs and afterward to permit them to lose viability and liability consequent weakening.

All traffic signs ought to be assessed at customary and regular interims step by step and for reflectance purpose inspected at night timings. Signs must be renewed as necessary. Signs

turn into a more modest sum powerful when characters of signs coloring devalue, as well as when overcast or ruined or relocated as an aftereffect of or decimation. Harmed or grimy signs diminish way clients. Continuous inspection of the signs should be made to ensure their early repair or replacement when necessary, and after-night inspections should be made of reflectorized signs. Regular cleaning of all the signs is essential [12].

Cleaning

Signs should be cleaned at least twice a year, and priority should be given to low-mounted signs. Cut back any long grass, bushes or tree branches which hide the sign face. Use water and a mild detergent to wash the sign and take care not to scratch the surface. Rinse the sign in clean water to remove all traces of detergent. Road tar can be cleaned off with petrol or white spirit, but be careful not to dissolve the paint, and rinse well afterwards [17].

Repairs

Minor repairs and repainting can be done on-site. Repainting should only be done in dry weather and after proper preparation of the surface. Do not apply paint to reflective sheeting, because this will make it non-reflective [9].

2.1.9. Record Keeping and Inspection

The key to good maintenance is proper record-keeping and regular inspection. An inventory of markings, signs, and other road furniture is helpful. In addition to a description of the item and its location, it can usefully include installation and inspection dates, and repair details. The inventory number should be painted on the back of the sign plate. Inspections should be made at least twice a year, preferably after routine cleaning has been done.

The things to look for are: signs that are missing or in the wrong location; signs that are pointing the wrong way or are tilting; signs that are hidden by trees or bushes; posts that are loose in their foundations; sign plates that are loose; corrosion of sign plates and posts; accident or other damage; flaking or faded sign faces and painted surfaces; poorly reflecting sign faces (best checked at night); worn or faded road markings.

Keep good records of the faults that are found and the action taken [17].

2.1.10. Storage and Transport of Signs

All road signs or portions of road signs shall be so handled and stored in a weather-proof storeroom to prevent any permanent deformation or damage to painted surfaces. All unpainted surfaces and steelwork shall be protected against corrosion [22].

Signs are expensive. Always store them where they cannot be damaged. Stack them vertically, if possible, and put sheets of cardboard or thick paper between them to prevent the sign faces from getting scratched. Take care when loading signs on and off trucks, and do not allow them to bounce around while being transported [17].

2.1.11. Assessment of Effectiveness of Signs

As a major aspect of the support program in the area and recurrence of accidents must to be rerecord. From this registers it might be built where mischances out and about system most regularly happen. Often the most cost effective ways of developing the safety on a section of road is to develop traffic signing. Accident sites should be looked at in more detail to find whether improved signing or road marking would develop safety and decrease accidents [12].

2.2. Introduction about Geographic Information System

Geographic Information System (GIS) is a system for mapping and analyzing any object on earth. This should be gathering, storing, and managing any type of data with spatial data components. GIS data is usually kept in above one layer. This is the fundamental aspect of GIS, and working with layers of geographic information system is generally known as data integration. GIS technology integrates powerful database capabilities with a unique visual perspective of a good old fashioned-map. This makes GIS unique among various information collection systems.

Basically, this system utilizes hardware, software, user, and effective management to collect, store, analyze and present the related information of a given area on the earth. Even more, it has the capability to overlap map and provide an information inquiry facility that can indirectly create a whole new set of information. Here, data output can be obtained in the form of tables, maps, graph or combination of these three. The other powerful aspect of GIS is its flexibility in modeling spatial objects to suit the particular needs of the user or application. GIS provides a set of tools or computer programs that allow user to perform specific operations on the map, assisted by a set of attribute data [23].

2.3. Works done in the area

There are some researches done in the area of traffic signs internationally though I would not say they are enough. Here in this part of chapter two we will see some of the few studies conducted in relation to traffic signs briefly.

Boggs (2012) describes Analysis of Traffic Sign Performance for the Establishment of a Maintenance Plan. This paper analyses to determine the contributing factors to rapid sheeting deterioration and increased damage rates. With the knowledge from the collection effort and the analysis on traffic sign performance, the feasibility of the different Federal Highway Administration (FHWA) methods is discussed [10].

Harris et al. (2007) in their study describe the minimum traffic sign reflectivity standards. This paper presents analysis of several traffic signs reflectivity maintenance methods in sign asset management using inspection and data collection process as a method. The simulation part was done taking 30 scenarios in the annual maintenance cost per sign and percentage of traffic signs which resulted in higher cost per higher sign maintenance that generally resulted in a lower percentage of signs for some signs using night time inspection method [11].

Harris (2007) in the dissertation in title Sign Maintenance Strategies for Agencies to Comply with Proposed FHWA Minimum Retroreflectivity Standards focus on improving traffic sign asset management. To meet this objective, the dissertation provides guidance on which traffic sign asset management strategies enable agencies to maintain a high level of safety on the road in a cost-effective manner. The research tasks that are necessary to provide this guidance include gathering data on sign deterioration, inspection, and replacement, designing a sign experimental facility, developing methods agencies can use to determine sign asset management parameters, surveying and documenting how agencies budget for signs and damage and developing a set of sign asset management scenarios, designing, testing, executing, and validating a sign asset management simulation, calculating and comparing the total costs of compliance with the proposed FHWA standards for each sign asset management scenario using the sign asset management simulation, determining what percentage compliance agencies can reasonably achieve, and developing recommended sign retroreflectivity asset management practices [3].

Hussain (2014) has a research that concentrates on The Development of Traffic Sign Asset Management System (AMS) in Indian Context. This project focuses on the development of traffic sign asset management system. For this the researcher applied a visual night time inspection method to find the Retro-reflectivity of a sign, and some of traffic signs failed the test and some signs needed maintenance [12].

Aydin (2009) Describe Traffic Sign Recognition (TSR). In TSR systems, the aim is to remind or warn drivers about the restrictions, dangers or other information imparted by traffic signs, beforehand. Since the existing signs are designed to draw drivers' attention by their colors and shapes, processing of these features is one of the crucial parts in these systems. In this thesis, a Traffic Sign Recognition System, having ability of detection and identification of traffic signs even with bad visual artifacts those originate from some weather conditions or other circumstances, is developed. The developed algorithm in this thesis, segments the required color influenced by the illumination of the environment, then reconstructs the shape of partially occluded traffic sign by its remaining segments and finally, identifies it. These three stages are called as "Segmentation", "Reconstruction" and "Identification" respectively, within this thesis. Due to the difficulty of analyzing partial segments to construct the main frame (a whole sign), the main complexity of the algorithm takes place in the "Reconstruction" stage [13].

In another related study Howe (2006) conducted Assessment of Road Signs for Retroreflectivity in Australia. Road Authorities in Australia provide a range of road signs, the type, size, placement and manufacture of which is covered by a range of Australian Standards, Design Manuals, and Codes of Practice associated with legislation. However the in-service performance is not currently mandated. Within their Road Asset Management plans, road authorities must describe their road-related services and intervention levels for service provision, as the basis for budgeting, community acceptance and defense of liability claims. Signs must remain visible and legible at distances assumed by design engineers when initially installed, by day and by night. The quantification of in-service night-time visibility and legibility standards applicable to individual signs or even classes of signs is particularly difficult, with multiple, varying factors to take into account in any given circumstance. However, research has determined rules of thumb that can be applied (albeit simplistically) as *de facto* performance standards, and in-service performance can be assessed against the resulting criteria. A key component of the assessment process is determining a sign's 'retroreflectivity' (or reflective luminance). The issues associated with measuring retroreflectivity against objective service standards is discussed in detail, as well as presentation of a regional municipal road authority's recently adopted approach [4].

Zhang and Chan (2013) in their study describe Traffic Sign comprehension: a review of influential factors and future direction for research. This paper reviews recent studies concerning traffic sign comprehension and finds that unsatisfactory comprehension is a common problem for drivers in many countries. The influence of user characteristics and sign cognitive features on understanding levels are summarized and discussed. While the positive relation between comprehension level and educational background is confirmed by various researchers, conclusions about effects of other factors are not unanimous. Finally, possible future traffic sign comprehension research topics and directions for future research are proposed to fill the present knowledge gap [14].

Brimley and Carlson (2013) study The Current State of Research on the Long-Term Deterioration of Traffic Signs. This paper serves as a compilation of studies related to the long-term deterioration of traffic signs to present what research has been completed in this area. The research compiled here shows that some signs may have an unrealistically long expected lifespan, a conclusion resulting from limitations in the study designs and their assumptions. A controlled long-term study of the deterioration of traffic signs with respect to retroreflectivity and color is encouraged to provide agencies the information necessary to select appropriate traffic sign products [15].

Chan, Gonzalez, Perez (2010) research on Designing Traffic Signs: A Case Study on Driver Reading Patterns and Behavior. In this study, the researchers analyze the behavior of motorists in reading traffic signs. Using eye-tracking data, determine at which parts of traffic signs drivers focus their attention, and if there are differences in viewing patterns when test subjects are shown multiple signs that convey similar meanings. Results suggest that behavioral patterns, which are common in newspaper design and advertising can also be applied in the analysis of reading traffic signs. The results also determined that participants read traffic signs in a standard fashion, and they tend to ignore these signs' other characteristics, such as shape and color. Finally test results, are able to provide empirical evidence on motorists' sign reading patterns or if they even read these signs at all which can further aid in standardizing traffic sign designs [16].

Lastly when we see a local study, Jemil Awel (2007) describes GIS Based Road Network Analysis in the Sub-city of Arada. This study is intended to use GIS as a tool in analyzing, integrating and displaying information. The overall activities of the work were concentrated around sub area selected as the study site in the Arada sub city (kifle

ketema) of the main capital, Addis Ababa. To demonstrate the use of road network analysis, this project focused on determining the best route between two destinations, the closest facility from a given incident, and a service area for a given facility. Generally for the purposes of this project, distance is taken as impedance in order to find the best route and the closest facility and that of travel time is taken as impedance in order to find the service area. A Geographical Information System (GIS) utility, which is network analyst, determined the best route, the closest facility and the service area. For this purpose database is created using SQL-SERVER. Data used by this project included public data and data generated using a Global Positioning System (GPS). Once analysis was completed, a route representing the (the best route) shortest travel distance, the route representing the closest facility and the polygons representing the service area were developed [1].

In general the studies conducted internationally are majorly on either retroreflectivity of traffic signs or traffic asset management while the only research conducted locally is not even related to traffic signs so the aim of this paper is to assess the condition of the traffic signs in Arada sub-city as there are no researches conducted in the area.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Description of the Study Area

The area under study is Arada Sub-city in Addis Ababa. Arada Sub-city is located between 8055' and 9005' North Latitude and between 38040' and 38050' East Longitude. Arada Sub-city is one of the 10 sub-cities in Addis Ababa City Administration. It covers an area of 900.7 hectares and a perimeter of 17970.97 meters. It is situated in the central part of Addis Ababa, bounded from south by Kirkos and Lideta, from west by Addis Ketema, from East by Yeka and from North by Gulele sub cities. This sub city is divided by 10 Weredas, 31 Sub weredas, 100 Sefers, and 316 blocks. The total population of the sub city for the year 1997 (Ethiopian calendar) or 2005 / 2006 GC is 321062 which becomes 330053 by the year 1998 Ethiopian calendar. The mean annual temperature in Arada is very mild at 15.9 degree Celsius. The hottest month is May, somewhat warm with an average temperature of 18 degree Celsius, and the coolest month is January with a mean temperature of 15 degree Celsius. Its average elevation is 2,500 meters above sea level, and hence has a fairly favorable climate and moderate weather conditions [7].

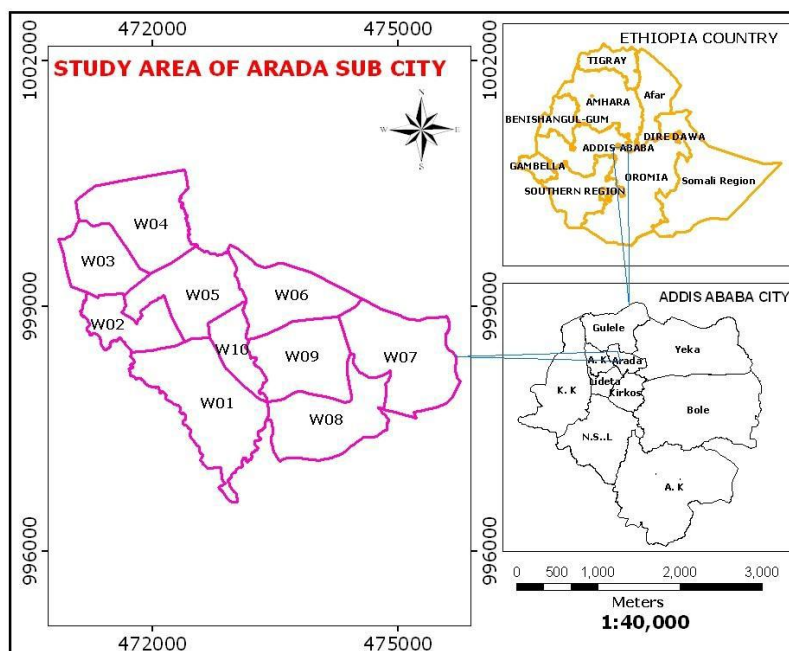


Figure 3.1 Map of Arada Sub-city

3.2. Research Design

This study was designed to be a descriptive survey study since its major aim was to assess the condition of the traffic signs found in the main roads of Arada Sub-city in Addis Ababa. The data collection instruments chosen for this study were questionnaire, interview, observation and which are mainly used in survey study to gather the necessary data. Observation was the major data collection instruments while questionnaire and interview were supportive data collection instruments. Qualitative and quantitative studies were employed in this study area. Qualitative study gives impression on the findings where a quantitative study was used to describe the numerical aspects of the research findings.

3.3. Research Population, Sample and Sampling Technique

This study was conducted in Arada Sub-city in Addis Ababa. First of all, Addis Ababa was selected intentionally as there is more traffic flow congestion and traffic accident in the capital city, Addis Ababa, than any other place in Ethiopia. In addition, it is in Addis Ababa that we find more traffic signs due to the above reasons. From all the ten sub-cities found in Addis Ababa, Arada Sub-city was chosen using purposive sampling technique as it has the busiest roads because it is the center for the other sub-cities where a lot of business interactions go on and a lot of traffic flows, congestions, and accidents are observed, so the effect of the traffic signs can be seen and observed more in this sub-city. Moreover, it is one of the smallest sub-cities compared to the other sub-cities in Addis Ababa though it has a lot of traffic flows, congestions, and accidents which makes it the most suitable place for the study as the researcher can assess the problem in a relatively smaller area without wasting too many resources which may not be affordable and effective for the other bigger sub-cities due to shortage of time and man power as well.

The traffic signs found in the major roads of Arada Sub-city were divided into nine sections and observed. Their visibility, legibility, and condition were analyzed. The concerned stake holders were given questionnaires and interviews. Thirty traffic police men are allocated in each day in the sub-city. In the questionnaire, generally 30 traffic police officers in Arada Sub-city, fifteen in each shift participated while fifteen Addis Ababa Traffic Management Agency (AATMA) workers who work in relation to traffic signs also participated in the study.

These participants were chosen using random sampling technique. Furthermore, two officials that are directly related to traffic signs were interviewed; one is a Shift Manager in Arada Sub-city Traffic Police Office, and another is Infrastructure Asset Management Expert in AATMA. In general, forty-seven individuals that are directly connected to the issue at hand participated in the study.

3.4. Data Collection Instruments

The data collection instruments used in this research were observation, questionnaire and interview. The next point shows why these instruments were chosen and how they were prepared.

3.4.1. Observation

The observation was used as a major data collection instrument, so two checklists were prepared for this purpose; the first checklist was prepared to check the height, age, legibility, visibility condition, and cause of failure of the traffic signs. The second checklist was prepared to collect the longitude, the latitude and elevation of the traffic sign posts. To collect this information different codes were used. The codes for the traffic signs were gathered from Addis Ababa Traffic Management Agency (AATMA) while the causes of failure were taken from different traffic sign manuals the codes for them were designed by the researcher. Eleven types of causes of failure were identified particular to this study and the traffic signs were categorized as ‘good’, ‘medium’ or ‘poor’ according to their condition.

The Requirement for Visibility and Legibility of the Sign

According to traffic sign manuals the drivers must be able to see the sign from at least 75 meters away so that they have time to read the message and act on it. The factors which determine the distance over which a sign message is legible include: the size of symbol or text; the number of messages to be scanned; the lateral distance of the sign from the edge of carriageway; and the speed of the approaching vehicle. So the data that was collected for visibility and legibility of the sign was according to this requirement.

Cause of Failure

01. Accident or other harm
02. Signs that are hidden by trees, bushes and other objects
03. Long age of sign

04. Flaking or faded sign faces and painted surfaces
05. Corrosion of the sign plates and posts
06. Signs that are in the wrong location
07. The area of installed sign surrounded by grass, water or other dusts
08. Dust and car smoke on a plate
09. Posts which are loose in their foundations
10. Signs which are too long or short
11. Sign plates that are loose

Condition of signs

The traffic signs are categorized into three different conditions namely good, medium, and poor depending on the severity of the problem they have from the aforementioned eleven causes of failures.

1. Good– The signs can continue giving service for road users.

2. Medium – The signs can continue after some maintenance.

3. Poor -The signs must be immediately replaced.

3.4.2. Questionnaire

Two types of questionnaires were prepared to gather information about traffic signs from different stake holders. Both questionnaires were prepared in Amharic to avoid any communication barrier that might be created. Then they were translated into English for analysis. The first type of questionnaire was designed for thirty traffic police officers, fifteen in the morning and fifteen in the afternoon shift while the second type was prepared for fifteen Addis Ababa Traffic Management Agency (AATMA) workers. The questionnaire for the traffic police officers contains seventeen questions where as the questionnaire for the AATMA includes sixteen questions. Both questionnaires are composed of open and close ended questions.

3.4.3. Interview

Two different interview questions were prepared for two officials as well. One was prepared for a Shift Manager in Arada Sub-city Traffic Police Office, and another was designed for an Infrastructure Asset Management Expert in Addis Ababa Traffic Management Agency (AATMA). Both interviews were structured types where the questions were given to the interviewees beforehand so that they can prepare themselves

well for the answers. The number of questions asked for Arada Sub-city Traffic Police Office representative was twelve and for the AATMA representative was thirteen.

3.4.4. Other Materials Used

In addition, the following materials and software were also used for this study. Meter tape for measuring the height of the sign, paper and pen for recording the data, digital camera for capturing the condition of each sign, GPS for recording the latitude, longitude and elevation of the sign, displayed all together in Arc GIS, MS word and Excel for analyzing and displaying collected research data were used in this study.

3.5. Procedure of Data Collection and Analysis

To conduct this study, the researcher followed the following procedures. The problems were observed and researches related to the topic were searched and read to assess their purpose and their findings; their similarity and difference was observed so as to find the gap to be filled. Then different articles, reference books, research papers, standard specifications and traffic manuals about traffic signs were read.

Before starting any data collection, formal letter was obtained from JIT and an official permission was obtained from Addis Ababa Traffic Management Agency and Arada Sub-city Traffic Police Office. For observation, the researcher classified the study area into nine sections based on the flow of the major roads and observed all the traffic signs in these areas. The data collection process was undertaken by the data collectors by observing and recording. Data collection of the signs on the road was carried out by using inspection methods and using cameras. In addition to this, the necessary measurement of the signs was taken, visibility and legibility of the signs, age of the signs, their height, condition of the signs, and causes of failure for those that have problems. In addition, the collected signs were plotted in a geographic information system. First, the researcher took the position of each sign, and then noted the longitude, latitude of the each sign and elevation of the sign was collected by using GPS. And this was plotted in the arc GIS. This makes it easier to find out the contributing factors that influence the safety performance of the road.

Moreover, questionnaire and interview were used for data collection. The questionnaire was designed and administered to forty-five concerned bodies while the interview was prepared and conducted for two stakeholders.

The data gained from data collection process were analyzed; the visibility, legibility and condition of the traffic signs were analyzed in tables and graphs using MS Excel. The causes of failure for problematic traffic signs were specified, and the remedial measures for them were also suggested.

In general, after all the data were collected through the instruments, they were analyzed and finally the conclusion was drawn followed by giving recommendations for the problems.

3.6. Study Variables

Dependent Variable

- ✓ Proper Assessment and Availability of Traffic Signs.

Independent Variable

- ✓ Maintenance
- ✓ Condition of signs
- ✓ Visibility
- ✓ Legibility
- ✓ Causes for failure of the signs.

3.7. Ethical consideration

The data was only collected after ethical permission was given from Ethiopian Roads Authority and Arada Sub-city traffic police office and civil engineering department of Jimma University. Consent letter from the university that dictates learning enough about the culture of informants was respected during the data collection process. The purpose of the study was clearly described to the organization and to the concerned local communities. The identity of the study participants was also kept confidential.

3.8. Data quality assurance

This research study data was collected very imperatively to get appropriate results and was prepared in order to avoid fallacious determination and conclusion. The training was given for the data collector to handle the data carefully. The reliability and accuracy of data was checked. To assure the quality of data obtained, the data was checked again and

again until the completeness and internal consistency reached. Missed data and incorrect data were treated by making correction work or by excluding.

CHAPTER FOUR

RESULTS AND DISCUSSION

In this chapter the data collected through observation, questionnaire, and interview are analyzed and discussed. The study area is divided into nine sites to easily address the objective of the study. In each site type, height, visibility, legibility, condition of the sign, and causes of failure with remedial measures are presented for the signs the types, the visibility, legibility, and condition of the signs are presented in number and percent while the causes of failure for those signs that are in bad conditions are explained. Moreover, the signs that have to be installed in each site are presented as one remedial measure while generally necessary traffic signs for the whole sub-city are recommended for the Arada Sub-city Traffic Police and AATMA at the end.

The signs are divided into four types according to the sign code that was obtained from AATMA. These are warning, regulatory, obligatory and informative signs.

4.1. Site One

The location of site one is from Sidest Kilo to Habte Giorggis Bridge. It starts from Sidest Kilo and goes through Afnchober, Semein Hotel, Daxsen village, St.Yohannes Church, Gojam Berenda, to Habte Giorggis Bridge.

4.1.1. General Description of the Signs

Table 4.1.1 Signs types for site one

Sign Type	Number	Percent
Warning	2	9
Regulatory	19	82
Obligatory	2	9
Informative	0	0
Total	23	100

Table 4.1.1 indicates, in this site totally there are twenty-three signs. From these signs nine percent of them are warning signs while eighty-two percent are regulatory, and another nine percent are obligatory signs, but there are no informative sign in the whole site.

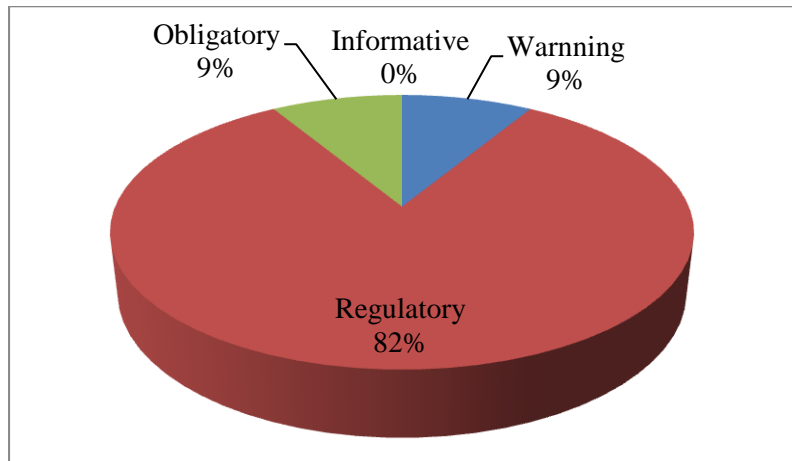


Figure 4.1.1 Sign types in percent for site one

Table 4.1.2 Height of the sign for site one

No.	Code	Height (m)
1	R29	2.6
2	O4	2.1
3	O4	2.1
4	W16	2.1
5	R30	2.75
6	R9	2.15
7	R29	2.56
8	R30	2.46
9	R29	2.3
10	R31	2.5
11	R29	2.29
12	W30	2.6
13	R29	2.3
14	R31	2.05
15	R29	1.89
16	R31	2.48
17	R29	2.7
18	R31	2.6
19	R29	2.6
20	R29	2.4
21	R29	2.4
22	R33	2.33
23	R29	2.3

The height of the signs as can be seen from the table varies greatly. The tallest traffic sign pole is 2.75 meters high while the shortest is 1.89 meters high.

4.1.2. Visibility of the Signs

Table 4.1.3 Visibility of the Signs for Site One

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	2	0
Regulatory	14	5
Obligatory	2	0
Informative	0	0
Total	18	5

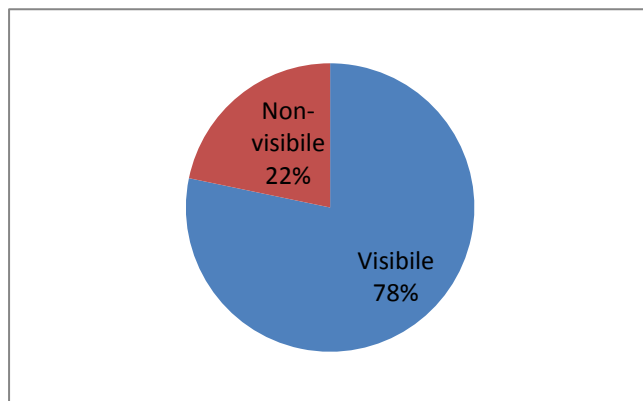


Figure 4.1.2 Visibility of the signs in percent for site one

When we assess the visibility of the signs, we must see the signs from the users' point of view. Accordingly, from the twenty-three available signs in the area, generally, eighteen of them are visible while 5 of them not visible for the users. From the eighteen visible signs two of them are warning, fourteen of them are regulatory, and other two are obligatory, but all the five non-visible signs are regulatory.

4.1.3. Legibility of the Signs

Table 4.1.4 Legibility of the sign for site one

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	2	0
Regulatory	18	1
Obligatory	2	0
Informative	0	0
Total	22	1

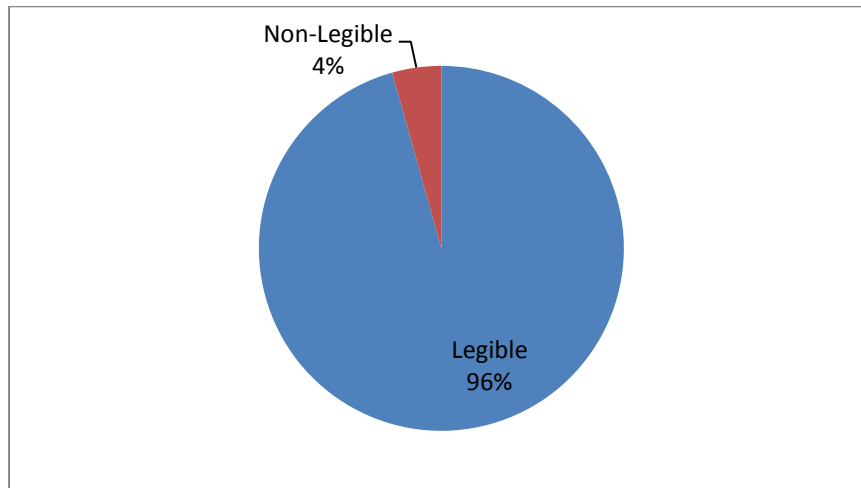


Figure 4.1.3 Legibility of the sign in percent for site one

When we see whether the signs are legible or not for the users, from the twenty-three signs installed in the area, twenty-two of them are legible, and only one of them is not legible. The only sign that is not legible for the users is a regulatory sign; all the other signs are legible for users.

4.1.4. Condition of the Signs

Table 4.1.5 Condition of the signs for site one

Condition of the signs	number	Percent
Good	3	13
Medium	14	61
Poor	6	26
total	23	100

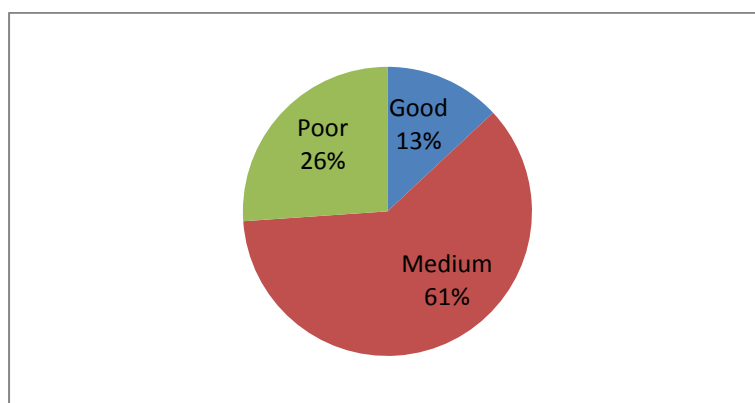


Figure 4.1.4 Condition of the sign in percent for site one

As indicated in table 4.1.5 and chart 4.1.4, three of the signs which compose thirteen percent of the whole signs in site one are in good condition which implies that they can continue giving service without any maintenance or change, but fourteen of them which include the majority sixty-one percent are in medium condition which means they can continue after some maintenance. However, six of them or twenty-six percent of them are in poor condition.

4.1.5. Causes of Failure for the Signs in Site One and Remedial Measures

Table 4.1.6 Causes of failure and its remedial measures for site one

Code for the Sign	Causes of Failure	Remedial Measure for the Sign
O4	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R30	<ul style="list-style-type: none"> ✓ Sign that is hidden by trees ✓ Long age of sign ✓ Corrosion of the sign plate and post 	<ul style="list-style-type: none"> ➤ Cut back tree branches and clear the area which hide the sign face ➤ Inspections should be made at least twice a year, so long aged signs can be replaced immediately ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material
R9	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Corrosion of the sign plate and post ✓ Sign that is in the wrong location 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material ➤ Immediately remove from the area and install it in an appropriate place
R29	✓ Corrosion of the sign plate and post	➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap










	<ul style="list-style-type: none"> ✓ Post which is loose in its foundations 	<p>50" or an equally approved material</p> <ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R30	<ul style="list-style-type: none"> ✓ Long age of sign ✓ Corrosion of the sign plate and post 	<ul style="list-style-type: none"> ➤ Inspections should be made at least twice a year, so long aged signs can be replaced immediately ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material
R29	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Flaking or faded sign face and painted surface 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ Painted steel post should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating. The viscosity of the paint shall be such that it can be applied without thinning.
R31	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Sign that is in the wrong location 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ Immediately remove from the area then install it in an appropriate place
R29	<ul style="list-style-type: none"> ✓ Accident or other harm 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area
W30	<ul style="list-style-type: none"> ✓ The area of installed sign surrounded by grass, water or other 	<ul style="list-style-type: none"> ➤ The surrounding of the sign must be clean from any grass and dusts. Sign should be cleaned at least twice a year

	dusts	
R29 5 Sign posts	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R31	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29	<ul style="list-style-type: none"> ✓ The sign is too short 	<ul style="list-style-type: none"> ➤ The height of the sign must be according to standard specification
R31	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R31	<ul style="list-style-type: none"> ✓ Corrosion of the sign plate and post ✓ Sign that is in the wrong location 	<ul style="list-style-type: none"> ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material ➤ Immediately remove from the area then install it in an appropriate place.
R33	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put it far away from accident area ➤ The foundation should be designed and

		placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29	✓ Flaking or faded sign face and painted surface	➤ Painted steel post should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating. The viscosity of the paint shall be such that it can be applied without thinning.

4.1.6. Recommended Signs for Site One

Table 4.1.7 Recommended signs for site one

Place	Recommended Signs
At Sidest Kilo roundabout	O4 
From Afincho ber to Sidest kilo for turn roads	R33 
At Addis Ababa Universtiy 5 th door	W30 
From Afincho ber turns to Amst Kilo and St Mariam	R33 
From Afincho ber to Semen Hotel turn roads	R33 
From Afincho ber to Semen Hotel before getting into the cross road	W9 
From Semen Hotel to St Yohannes turn road	R33 
From Gojam Berenda to Enkulal Fabrica before getting into the cross road	W9 
From Gojam Berenda to Enkulal Fabrica Agaziyan school	W30 

4.2. Site Two

4.2.1. General Description of the Signs

The location for site two is from Habte Giorgise Bridge to Afincho Ber. It starts at Habte Giorgise Bridge and goes through Atklt Tera, St. Giorgis Church, Dejach Wube Village and ends at Afincho Ber.

Table 4.2.1 Sign types for site two

Sign Type	Number	Percent
Warning	2	9
Regulatory	21	91
Obligatory	0	0
Informative	0	0
Total	23	100

In site two just like site one there are twenty-three traffic signs. Among the twenty-three signs the vast majority of the signs are regulatory signs which cover ninety-one percent while the rest nine percent of the traffic signs are warning signs. Here in this site there are no obligatory and informative signs at all.

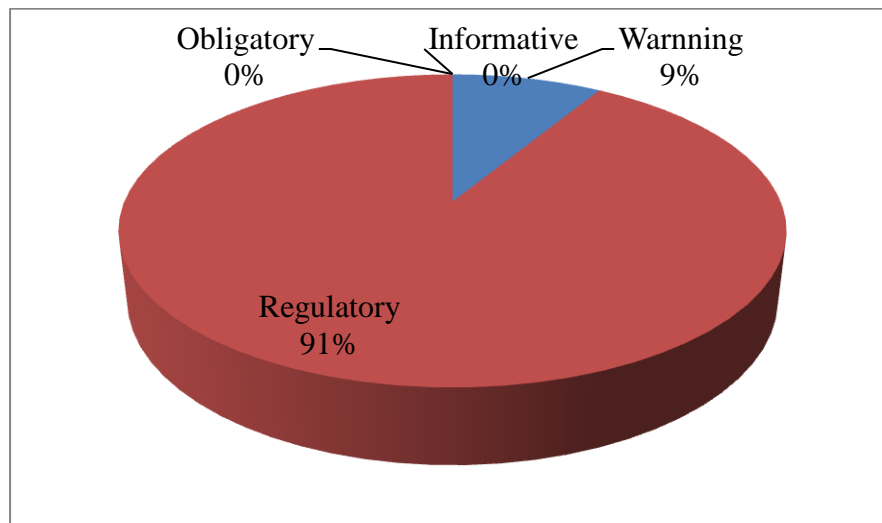


Figure 4.2.1 Sign types in percent for site two

Table 4.2.2 Height of the sign for site two

No.	Code	Height(m)
1	R29	2.63
2	R33	2.5
3	R29	2.5
4	R29	2.53
5	R29	2.61
6	R29	2.47
7	W28	2.28
8	R29	2.4
9	R28	2.61
10	R29	2.51
11	R29	2.65
12	R29	2.6
13	R29	2.41
14	R29	2.65
15	R33	2.37
16	R29	2.57
17	R29	2.63
18	R29	2.61
19	R29	2.48
20	R29	2.6
21	R31	2.56
22	R29	2.69
23	W30	2.98

The height of the traffic sign posts in site two, as mentioned in site one, also varies to a great extent. As can be seen from the table the highest traffic sign post is 2.98 meters (almost three meters) tall while the shortest one is 2.28 meters tall. However, most of the signs (Sixteen out of the twenty three) are between 2.5 and 2.6 meters range.

4.2.2. Visibility of the Signs

Table 4.2.3 Visibility of the sign for site two

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	1	1
Regulatory	20	1
Obligatory	0	0
Informative	0	0
Total	21	2

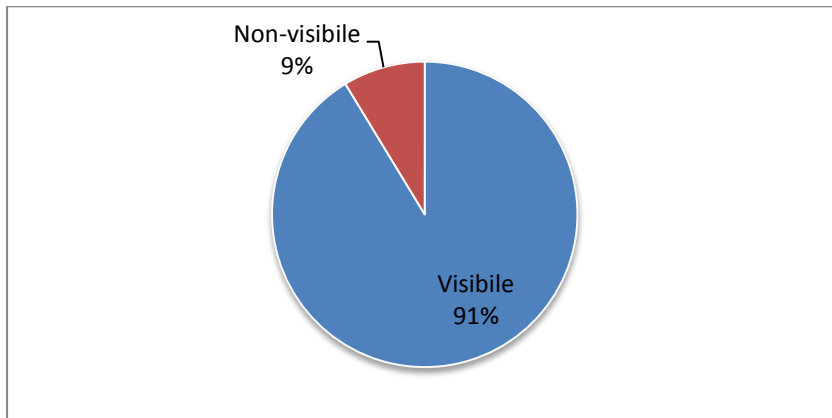


Figure 4.2.2 Visibility of the sign in percent for site two

In evaluating how many of the traffic signs found in this area are visible to the users, out of the twenty-three signs twenty-one of them, which account for ninety-one percent of the signs, are visible. From these twenty-one visible signs, twenty of them are regulatory signs while one of them is a warning sign. The rest two traffic signs which consist nine percent are found to be not visible for road users; one of these signs is a warning sign while the other one is a regulatory sign.

4.2.3. Legibility of the Signs

Table 4.2.4 Legibility of the signs for site two

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	1	1
Regulatory	19	2
Obligatory	0	0
Informative	0	0
Total	20	3

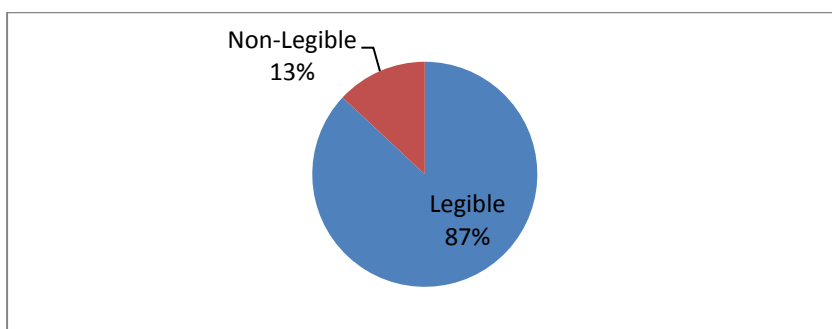


Figure 4.2.3 Legibility of the signs in percent for site two

Again in analyzing the legibility of the traffic signs in site two we find twenty signs which comprises eighty-seven percent of the total traffic signs in the area to be legible to the users. From these twenty legible signs nineteen of them are regulatory signs where as the rest one is a warning sign. Out of the three illegible traffic signs which include thirteen percent of the total traffic signs in the area two of them are regulatory signs while one of them is a warning sign.

4.2.4. Condition of the Signs

Table 4.2.5 Condition of the signs for site two

Condition of the Signs	Number	Percent
Good	5	22
Medium	16	69
Poor	2	9
total	23	100

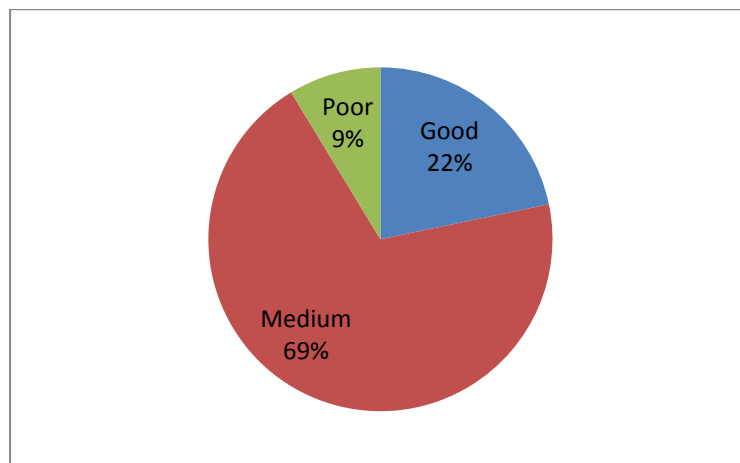


Figure 4.2.4 Condition of the signs in percent for site two

When we assess the condition of the traffic signs in site two, only five of the twenty-three signs which consist twenty-two percent of the total signs are in good condition while the majority of the signs (sixteen of them/sixty-nine percent) are in a medium condition and the rest two which cover nine percent are in poor condition. This suggests that most of the signs in this area need some maintenance before their condition turns into poor.

4.2.5. Causes of Failure for the Signs in Site Two and Remedial Measures



Table 4.2.6 Causes of failure and its remedial measures for site two









Code for the Sign	Causes of Failure	Remedial measure for the sign
R29	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil. ➤ The plate has to be welded or fastened properly by using appropriate bolt with the post
R29	<ul style="list-style-type: none"> ✓ Sign that is hidden by other objects 	<ul style="list-style-type: none"> ➤ Clear the area which hide the sign face
R29	<ul style="list-style-type: none"> ✓ The area of installed sign surrounded by grass, water or other dusts ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The surrounding of the sign must be clean from any grass and dusts. Signs should be cleaned at least twice a year ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29 10 Sign Posts	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R28	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.

R33	✓ Sign that is in the wrong location	➤ Immediately remove from the area and install it in an appropriate place
R29	✓ Sign that is hidden by trees, bushes and other objects	➤ Cut back any long grass, bushes or tree branches and clear the area which hide the sign face
R31	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W30	<ul style="list-style-type: none"> ✓ Long age of sign ✓ Flaking or faded sign face and painted surface ✓ Corrosion of the sign plate and post ✓ The sign is too long 	<ul style="list-style-type: none"> ➤ Inspections should be made at least twice a year ,so long aged signs can be replace immediately ➤ Painted steel posts should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating. The viscosity of the paint shall be such that it can be applied without thinning. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or equally approved material ➤ The height of the sign must be according to standard specification

4.2.6. Recommended Signs for Site Two

Table 4.2.7 Recommended signs for site two

Place	Recommended Sign
From Afnchober to St. Giorgis at Police Station	R29 
From Afnchober to St. Giorgis at opposite road of the Police Station	W48 

From Afnchober to St. Giorgis turn road	R33 
St. Giorgis to Afnchober at Mobile gas station	R29 
Atiklt Tera around Total gas station turn road	R33 
Around St. Giorgis to Shiromeda Taxi Station turn road	R33 
Dejach Wube to Ras Mekonenn turn road at the main road	W3 
Dejach Wube turn to Addis Ababa Restaurant	R33 
Dejach Wube around Bilichta School	W30 
Afncho ber Bridge turn from St. Giorgis road	R33 

4.3. Site Three

4.3.1. General Description of the Signs

The location for site three starts from Mnelik round about and goes straight up to Semein Mazegaja. It covers Sostegna Police Station, Semein Hotel, and Shola in its way. It is a relatively straight road with an increasing elevation.

Table 4.3.1 Sign types for site three

Sign Type	Number	Percent
Warning	3	10
Regulatory	27	90
Obligatory	0	0
Informative	0	0
Total	30	100

From all the nine sites, the highest number of signs is found in site three. In this site, there are a total of thirty signs. From these signs only three (ten percent) of them are warning sign while the rest twenty-seven (ninety percent) are regulatory signs. There are no obligatory and informative signs at all in the area.

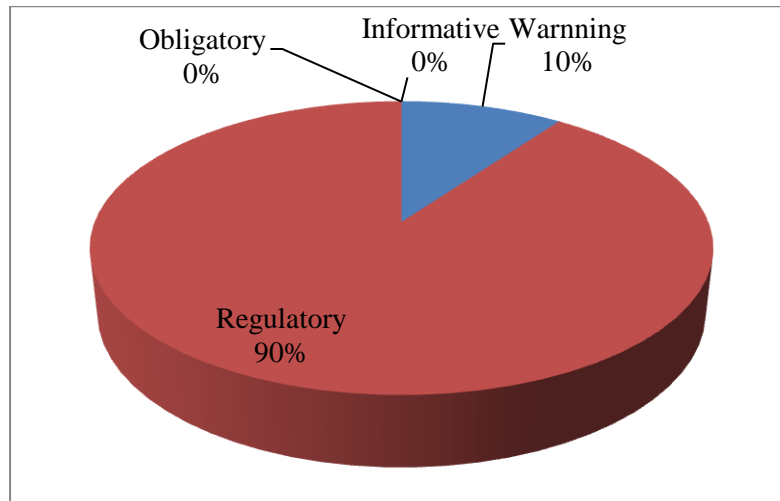


Figure 4.3.1 Sign types in percent for site three

Table 4.3.2 Height of the signs for site three

No.	Code	Height (m)
1	R4	2.51
2	R7	2.63
3	R29	2.57
4	R31	2.48
5	R29	2.66
6	R31	2.69
7	R29	2.53
8	R29	2.28
9	R29	2.62
10	W30	2.61
11	R33	2.53
12	R33	2.47
13	R29	2.5
14	R31	2.21
15	R31	2.63
16	R29	2.7
17	R29	2.61
18	R31	2.16
19	R9	2.29
20	R4	2.54
21	R29	2.53
22	R30	2.3
23	W30	2.62

24	R30	2.4
25	R31	2.3
26	W30	2.17
27	R31	2.55
28	R29	2.35
29	R29	2.4
30	R29	2.48

Here in this site the height of the traffic sign posts varies from 2.16 to 2.7 meters. As can be seen from the table, though all the sign posts are in the 2 meters range, they vary greatly within the 2 meter. While more than half (sixteen) of the sign posts are between 2.5 and 2.6 meters range, the others except one are below that.

4.3.2. Visibility of the Signs

Table 4.3.3 Visibility of the signs for site three

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	3	0
Regulatory	20	7
Obligatory	0	0
Informative	0	0
Total	23	7

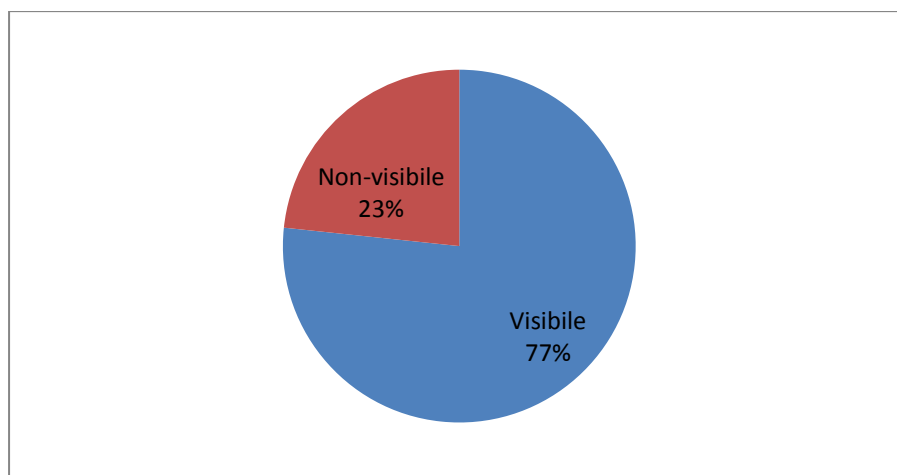


Figure 4.3.2 Visibility of the signs in percent for site three

When we see the visibility of the traffic signs in this site, generally twenty-three of the total thirty signs, which comprise for seventy-seven percent, are visible while the rest

seven traffic signs (twenty-three percent) are not visible. Specifically, from the total twenty-seven regulatory signs twenty of them are visible but the rest seven are not visible. On the other hand, all the three warning signs are visible to users.

4.3.3. Legibility of the Signs

Table 4.3.4 Legibility of the signs for site three

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	2	1
Regulatory	26	1
Obligatory	0	0
Informative	0	0
Total	28	2

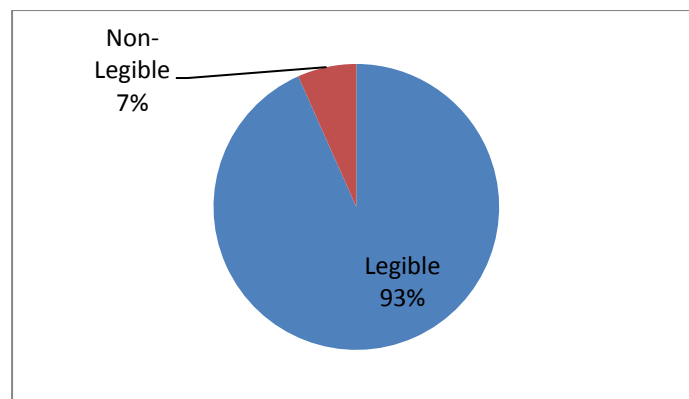


Figure 4.3.3 Legibility of the signs in percent for site three

In checking the legibility of the traffic signs in site three, from the thirty signs installed in the area twenty- six regulatory and two warning signs (twenty-eight signs in total) are legible while one warning and one regulatory (two signs in total) are not legible for road users.

4.3.4. Condition of the Signs

Table 4.3.5 Condition of the signs for site three

Condition of the signs	Number	Percent
Good	6	20
Medium	15	50
Poor	9	30
total	30	100

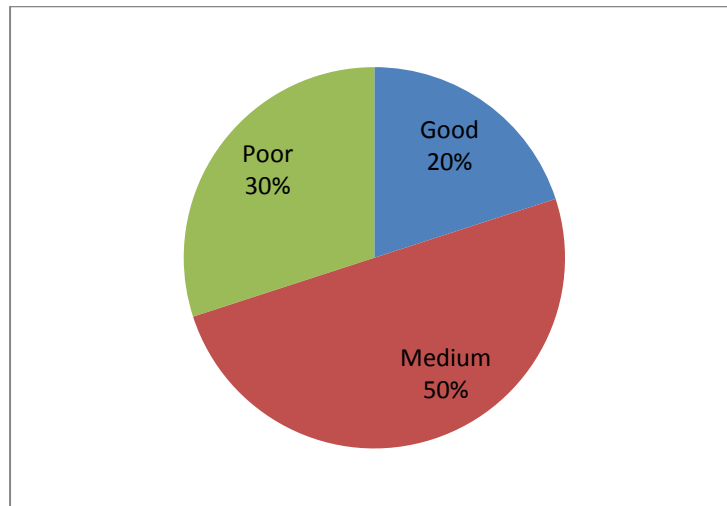


Figure 4.3.4 Conditions of the signs in percent for site three

When we see the condition of the traffic signs in the three parameters, six (twenty percent) of the traffic signs in this site are in good condition. These signs can continue giving service for sometime without asking for some maintenance. On the other hand, fifteen (fifty percent) of the traffic signs in this area are in medium condition; these signs need some maintenance to give the appropriate service. However, nine (thirty percent) of the traffic signs in this site are in a really poor condition which means they must be immediately replaced.

4.3.5. Causes of Failure for the Signs in Site Three and Remedial Measures

Table 4.3.6 Causes of failure and its remedial measures for site three

Code for the Sign	Causes of Failure	Remedial measure for the sign
R31	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29 2 Sign Posts	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post
R31	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely

	✓ Sign plate that is loose	<p>support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post</p>
R29 4 Sign Posts	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W30	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R33	<p>✓ Post which is loose in its foundation</p> <p>✓ Sign plate that is loose</p>	<p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R29	<p>✓ Corrosion of the sign plate and post</p> <p>✓ Post which is loose in its foundation</p>	<p>➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material.</p> <p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p>
R31	✓ Post which is loose in its	➤ The foundation should be designed and











	<p>foundation</p> <p>✓ Sign plate that is loose</p>	<p>placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R31	<p>✓ Post which is loose in its foundation</p>	<p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p>
R31	<p>✓ Sign plate that is loose</p>	<p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R9	<p>✓ Post which is loose in its foundation</p> <p>✓ Sign plate that is loose</p>	<p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R4	<p>✓ Sign that is hidden by other objects</p> <p>✓ Sign that is in the wrong location</p> <p>✓ Post which is loose in its foundation</p>	<p>➤ Clear the area which hide the sign face.</p> <p>➤ Immediately remove from the area and installed it in appropriate place.</p> <p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p>
R29	<p>✓ Sign that is hidden by trees</p>	<p>➤ Cut back tree branches and clear the area which hide the sign face.</p>

R30	<ul style="list-style-type: none"> ✓ Sign that is hidden by trees ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Cut back and clear the area which hide the sign face. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W30	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R30	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R31	<ul style="list-style-type: none"> ✓ Sign that is hidden by trees 	<ul style="list-style-type: none"> ➤ Cut back tree branches and clear the area which hide the sign face.
W30	<ul style="list-style-type: none"> ✓ Long age of sign ✓ Corrosion of the sign plate and post 	<ul style="list-style-type: none"> ➤ Inspections should be made at least twice a year, so long aged signs can be replace immediately. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material
R31	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions

		<p>without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
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4.3.6. Recommended Signs for Site Three

Table 4.3.7 Recommended signs for site three

Place	Recommended Sign
At Semein Mazegaja before getting into cross road	W9 
Around Abysiniya Bank turn road	R33 
At Eagle Bar turn road	R33 
Around Future Hopes School	W30 
Around Kelemework School	W30 
At Shola round about	O4 
Around Atsaie Fasil School	W30 
At Addis Ababa Police Commission	R29 
Around Bethelhem School	W30 
Around New Era School	W30 

4.4. Site Four

4.4.1. General Description of the Signs

The locations for site four starts from Abune Petros roundabout and ends at Enkulal Fabrica. This site includes the road that passes through Sebara Babur, St. Yohannes Church, Ras Desta Hospital, and Mekonnenoch Lounge, and ends at Enkulal Fabrica.

Table 4.4.1 sign types for site four

Sign Type	Number	Percent
Warning	1	7
Regulatory	14	93
Obligatory	0	0
Informative	0	0
Total	15	100

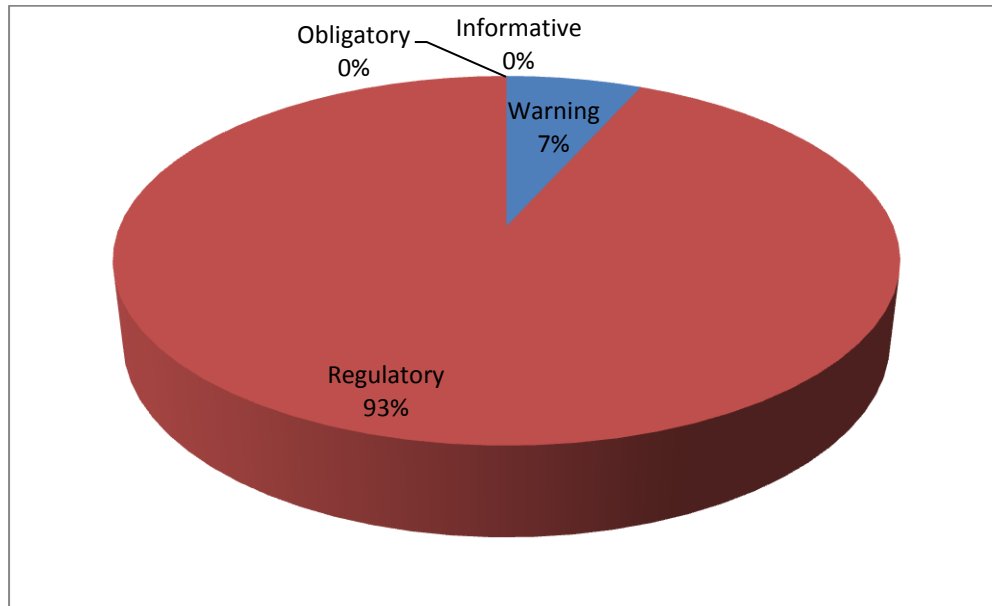


Figure 4.4.1 Sign types in percent for site four

As the table shows, there are a total of fifteen signs in this area which is the third least compared to the whole nine sites. From these fifteen signs only one of them (seven percent) is a warning sign while the rest fourteen (ninety-three percent) is a regulatory sign. No obligatory and informative sign is found in this area.

Table 4.4.2 Height of the signs for site four

No.	Code	Height (m)
1	R31	2.6
2	R4	2.52
3	R4	2.48
4	R4	2.62
5	W18	2.55
6	R31	2.54

7	R9	2.53
8	R9	2.63
9	R30	2.48
10	R29	2.58
11	R9	2.57
12	R30	2.54
13	R30	2.67
14	R31	2.58
15	R4	2.45

The height of the traffic sign posts in this particular site is somehow relatively similar the tallest being 2.67 meters and the shortest being 2.45 meters. Most of the sign posts are between 2.5 and 2.6 meters range (thirteen out of fifteen) while only two of the sign posts are in the high 2.4 meters range.

4.4.2. Visibility of the Signs

Table 4.4.3 Visibility of the signs for site four

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	1	0
Regulatory	11	3
Obligatory	0	0
Informative	0	0
Total	12	3

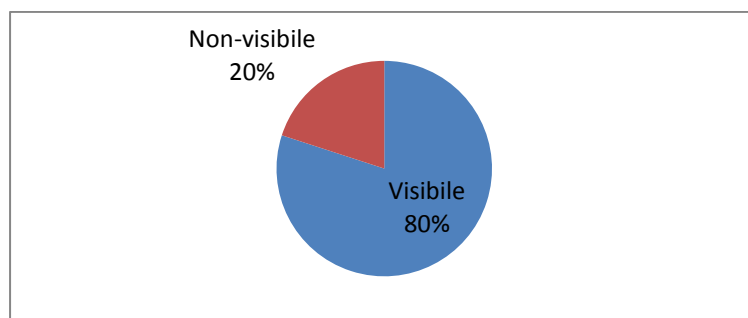


Figure 4.4.2 Visibility of the signs in percent for site four

In assessing the visibility of the traffic signs in this area as indicated in the table and the pie chart above, out of the total fifteen signs eleven regulatory and one warning signs which encompass eighty percent are visible to road users while three regulatory signs which comprise twenty percent of the total traffic signs in the site are not visible.

4.4.3. Legibility of the Signs

Table 4.4.4 Legibility of the signs for site four

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	1	0
Regulatory	12	2
Obligatory	0	0
Informative	0	0
Total	13	2

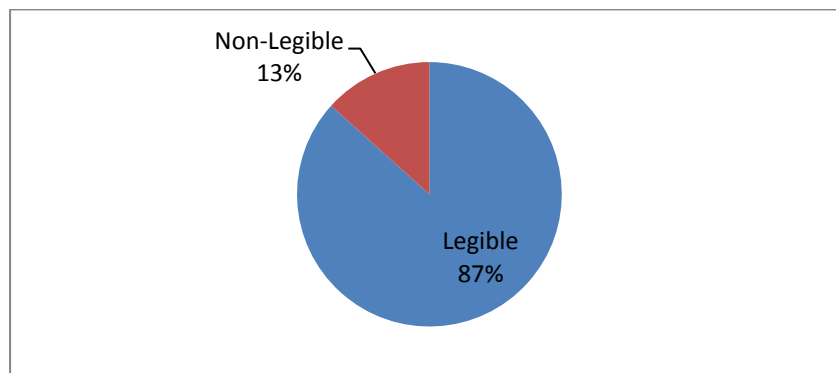


Figure 4.4.3 Legibility of the signs in percent for site four

When we see the legibility of the traffic signs in this site, twelve regulatory and one warning signs which cover eighty seven percent of the total signs are legible to road users while two regulatory signs or thirteen percent are not legible.

4.4.4. Condition of the Signs

Table 4.4.5 Condition of the signs for site four

Condition of the Signs	Number	Percent
Good	7	47
Medium	5	33
Poor	3	20
total	15	100

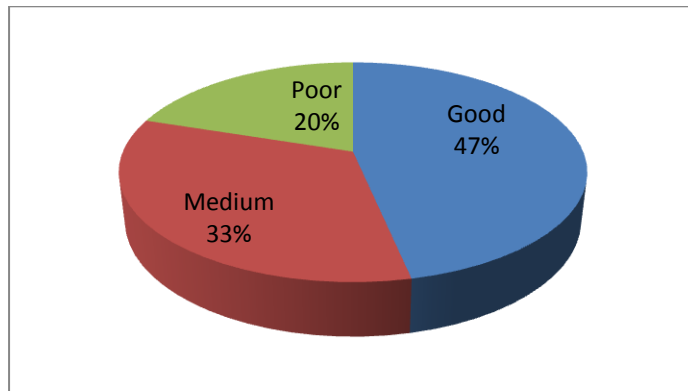


Figure 4.4.4 Condition of the signs in percent for site four

In checking as to whether the traffic signs in this area are in good, medium or poor condition, seven of the traffic signs (forty-seven percent) are in good condition while five of them (thirty-three percent) are in medium condition; these signs that are in medium condition need some maintenance. However, three signs (twenty percent) are in poor condition and need to be immediately replaced or changed.

4.4.5. Causes of Failure for the Signs in Site Four and Remedial Measures


Table 4.4.6 Causes of failure and its remedial measures for site four







Code for the Sign	Causes of Failure	Remedial measure for the sign
R31	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W18	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R31 2 Sign Posts	✓ Post which is loose in its foundation ✓ Sign plate that is loose	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil. ➤ The plate has to be welded or fastened

		properly by using appropriate bolt with the post.
R9	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R29	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R9	✓ Accident or other harm ✓ Post which is loose in its foundation	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R4	✓ Accident or other harm ✓ Long age of sign ✓ Corrosion of the sign plate and post	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ Inspections should be made at least twice a year so that long aged signs and posts can be replaced immediately. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material.

4.4.6. Recommended Signs for Site Four

Table 4.4.7 Recommended signs for site four

Place	Recommended Signs
At Enkulal Fabrica roundabout	O4 

Arbegoch School	W30 
At Ras Desta Police Station	R29 
Lutran School	W30 
St. Yohannes Church before getting into cross road	W9 
Arada First Instance Court	R29 
At Total Gas Station	R29 

4.5. Site Five

4.5.1. General Description of the Signs

The location of site five is from Sidest Kilo to Sheraton Addis Hotel. It starts from Sidest Kilo and goes through Amist Kilo, St. Mary Church, Arat Kilo, St. Trinity Church, the Palace and turn right to Sheraton Addis Hotel.

Table 4.5 1 Sign types for site five

Sign Type	Number	Percent
Warning	0	0
Regulatory	21	95
Obligatory	0	0
Informative	1	5
Total	22	100

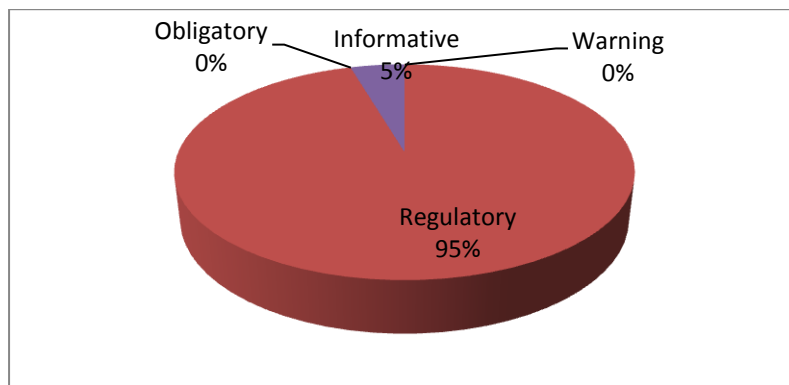


Figure 4.5.1 Sign types in percent for site five

As table 4.5.1 and the pie chart 4.5.1 indicate, in this site totally there are twenty-two signs. From these signs twenty-one (ninety-five percent) of them are regulatory signs while only one (five percent) of them is an informative sign, but there are no warning and obligatory traffic signs in the whole site.

Table 4.5.2 Height of the signs for site five

No.	Code	Height (m)
1	R7	2.46
2	R29	2.68
3	R29	2.47
4	R30	2.7
5	R30	2.7
6	R29	2.6
7	R10	2.46
8	R29	2.3
9	I3	2.15
10	R29	2.6
11	R29	2.64
12	R9	2.12
13	R9	2.64
14	R29	2.65
15	R9	*NA
16	R29	*NA
17	R29	*NA
18	R31	2.62
19	R30	2.6
20	R30	2.53
21	R30	2.5
22	R33	2.3

*NA- Not Assigned because taking measure is not allowed as it is next to the palace.

The height of the traffic sign posts in site five, as mentioned in the above sites, also varies to a great extent. As can be seen from the table the highest traffic sign post is 2.7 meters tall while the shortest one is 2.12 meters tall. However, most of the signs (ten out of the nineteen measured signs) are between 2.5 and 2.6 meters range.

4.5.2. Visibility of the Signs

Table 4.5.3 Visibility of the signs for site five

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	0	0
Regulatory	17	4
Obligatory	0	0
Informative	1	0
Total	18	4

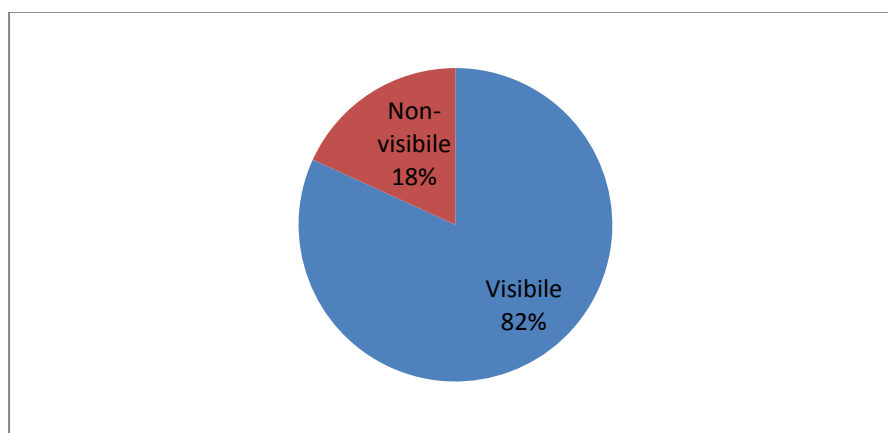


Figure 4.5.2 Visibility of the signs in percent for site five

When we assess the visibility of the signs, we must see the signs from the users' point of view. Accordingly, from the twenty-two available traffic signs in the area, generally, eighteen of them which contain eighty-two percent are visible. From these eighteen visible signs seventeen of them are regulatory while the rest one is informative. There are four signs which cover eighteen percent of the total signs that are not visible for the users, and all of them are regulatory signs.

4.5.3. Legibility of the Signs

Table 4.5.4 Legibility of the signs for site five

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	0	0
Regulatory	21	0
Obligatory	0	0
Informative	1	0
Total	22	0

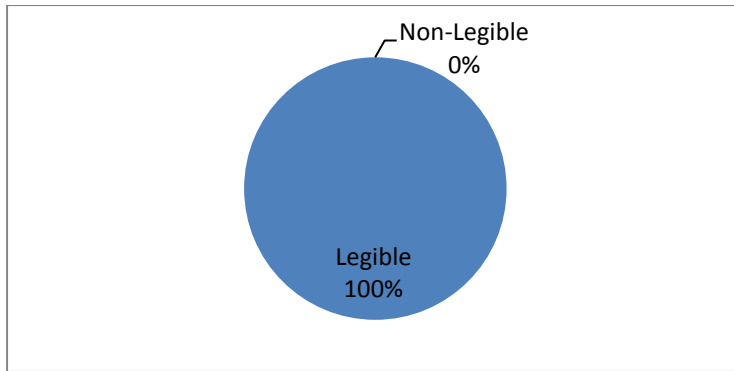


Figure 4.5.3 Legibility of the signs in percent for site five

When we see whether the signs are legible or not for the users, from the twenty-two total signs installed in the area, all the twenty-two of them, twenty-one regulatory and one informative signs, (hundred percent) are legible; there are no signs that are not legible for the road users in this site which makes it the only site without any legibility problem.

4.5.4 Condition of the Signs

Table 4.5.5 Condition of the signs for site five

Condition of the signs	Number	Percent
Good	13	59
Medium	7	32
Poor	2	9
total	22	100

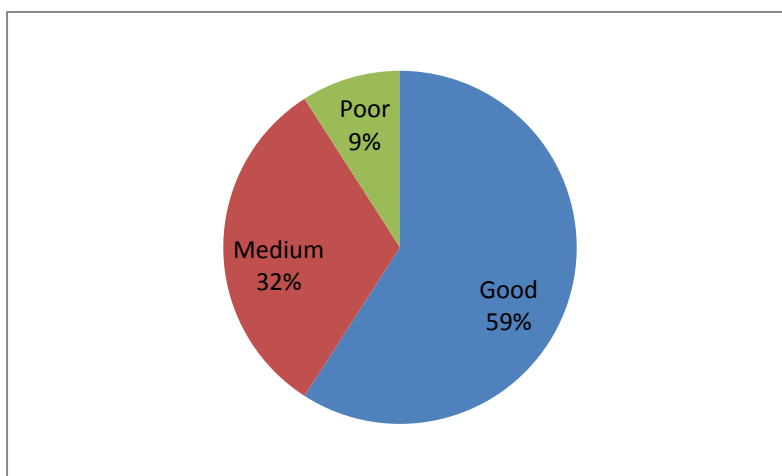


Figure 4.5.4 Condition of the signs in percent for site five

As indicated in table 4.5.5 and chart 4.5.4, thirteen of the signs which compose fifty-nine percent of the whole signs in site five are in good condition which implies that they can continue giving service without any maintenance or change, but seven of them which include thirty-two percent are in medium condition which means they can continue after some maintenance. However, two of them or nine percent of them are in poor condition which should be immediately replaced or changed.

4.5.5 Causes of Failure for the Signs in Site Five and Remedial Measures

Table 4.5.6 Causes of failure and its remedial measures for site five








Code for the Sign	Causes of Failure	Remedial measure for the sign
R7	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R29	✓ Accident or other harm ✓ Post which is loose in its foundation	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29 2 Sign Posts	✓ Post which is loose in its foundation	➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R30	✓ Accident or other harm ✓ Post which is loose in its foundation ✓ Sign plate that is loose	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely

		<p>support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R30	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation ✓ Sign plate that is loose 	<p>➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area.</p> <p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R29	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation ✓ Sign plate that is loose 	<p>➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area.</p> <p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p> <p>➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.</p>
R10	<ul style="list-style-type: none"> ➤ Post which is loose in its foundation 	<p>➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.</p>

I3	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Long age of sign ✓ Corrosion of the sign plate and post 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ Inspections should be made at least twice a year so that long aged signs and posts can be replaced immediately. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material.
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4.5.6 Recommended Signs for Site Five

Table 4.5.7 Recommended signs for site five

Place	Recommended sign
At Amist Kilo Radical School, Addis Ababa university Technology Campus	W30 
St. Mary cross road	W9 
St. Mary joint from minor road	R33 
At National Examination center	R29 
Minilik School	W30 
Road joint from St. Trinity Church	R33 
Before getting into Arat Kilo roundabout from Sheraton road	R31 

4.6 Site Six

4.6.1 General Description of the Signs

The location for site six includes the main road that goes from Minilk roundabout to Tikur Anbessa School. It starts at Minilk roundabout and goes through Addis Ababa Municipality, Arada Building, Churchel, Tewodros roundabout and ends at Tikur Anbessa School.

Table 4.6.1 Sign types for site six

Sign Type	Number	Percent
Warning	1	5
Regulatory	13	69
Obligatory	5	26
Informative	0	0
Total	19	100

In site six there are nineteen traffic signs. Among the nineteen signs there is one warning sign that comprises five percent of the total signs in the area. The vast majority of the signs are regulatory signs which are thirteen in number and cover sixty-nine percent while the rest five traffic signs (twenty-six percent) are obligatory signs. Here in this site there is no obligatory sign.

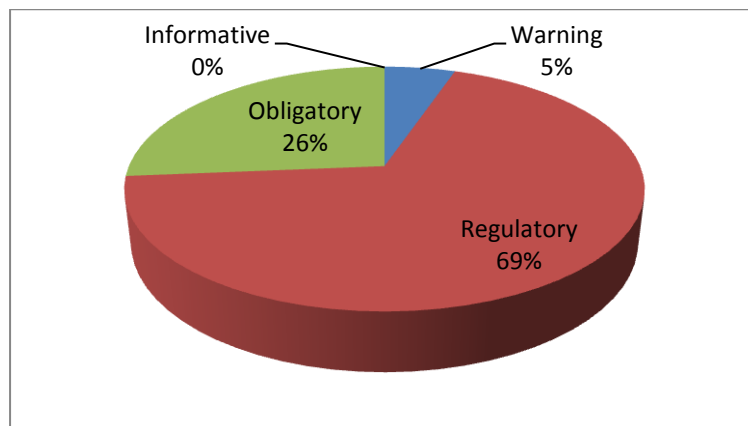


Figure 4.6.1 Sign types in percent for site six

Table 4.6.2 Height of the signs for site six

No.	Code	Height (m)
1	O4	2.4
2	O4	2.27
3	O4	2.36
4	O4	2.37
5	O4	2.32
6	R29	3.27
7	R7	3.27
8	R9	2.24
9	R28	2.32
10	R9	2.25

11	R29	2.05
12	R9	2.56
13	R30	2.6
14	R29	2.45
15	R30	2.63
16	R31	2.3
17	R29	2.67
18	W30	2.48
19	R29	2.26

The height of the traffic sign posts in site six, as mentioned in most of the other sites, also varies to a great extent. As can be seen from the table the highest traffic sign post is 3.27 meters tall; Site Six is the only site that is in three meters range. The shortest traffic sign post is 2.05 meters tall. However, most of the signs (eleven out of the nineteen) are within 2.2 and 2.3 meters range.

4.6.2 Visibility of the Signs

Table 4.6.3 Visibility of the signs for site six

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	1	0
Regulatory	10	3
Obligatory	5	0
Informative	0	0
Total	16	3

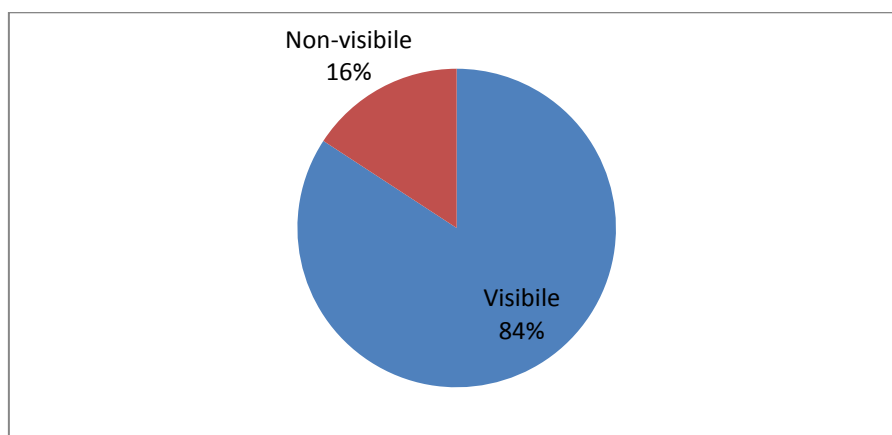


Figure 4.6.2 Visibility of the signs in percent for site five

In evaluating how many of the traffic signs found in this area are visible to the users, out of the nineteen signs sixteen of them, which account for eighty-four percent of the signs,

are visible. From these sixteen visible signs, ten of them are regulatory signs while five of them are obligatory signs and one of them is a warning sign. The rest three traffic signs which consist sixteen percent are found to be not visible for road users; all three of these non-visible signs are regulatory signs.

4.6.3 Legibility of the Signs

Table 4.6.4 Legibility of the signs for site six

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	1	0
Regulatory	11	2
Obligatory	5	0
Informative	0	0
Total	17	2

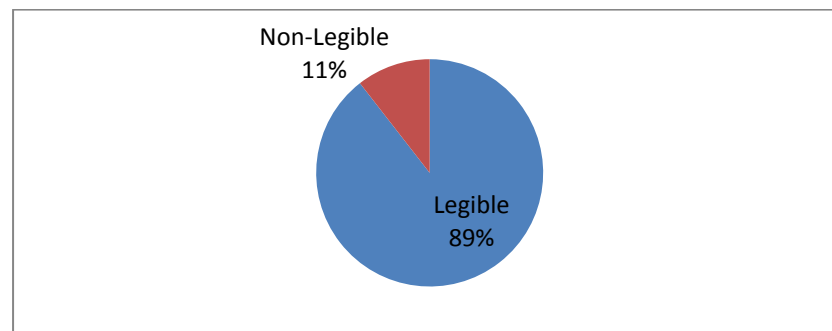


Figure 4.6.3 Legibility of the signs in percent for site six

Again in analyzing the legibility of the traffic signs in site six, we find seventeen signs (eighty-nine percent) of the total nineteen traffic signs in the area to be legible to the users. From these seventeen legible signs eleven of them are regulatory signs where as five of them are obligatory signs, and one sign is a warning sign. The rest two signs, which cover eleven percent of the total traffic signs in the area, are non-legible, and both of these traffic signs are regulatory signs.

4.6.4 Condition of the Signs

Table 4.6.5 Condition of the signs for site six

Condition of the signs	number	Percent
Good	10	53
Medium	6	31
Poor	3	16
Total	19	100

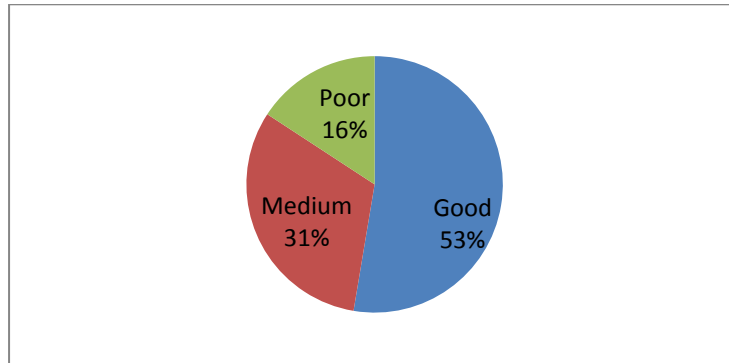


Figure 4.6.4 Condition of the signs in percent for site six

When we assess the condition of the traffic signs in site six, ten of the nineteen signs which consist fifty-three percent of the total signs are in good condition while six of the signs (thirty-one percent) are in a medium condition and the rest three which cover sixteen percent are in poor condition. This suggests that a good half of the signs in this area can continue their service without any maintenance or change.

4.6.5 Causes of Failure for the Signs in Site Six and Remedial Measures

Table 4.6.6 Causes of failure and its remedial measures for site six

Code for the Sign	Causes of Failure	Remedial measure for the sign
R7	<ul style="list-style-type: none"> ✓ Flaking or faded sign faces and painted surfaces ✓ Corrosion of the sign plate and post ✓ The signs too long 	<ul style="list-style-type: none"> ➤ Painted steel posts should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating . The viscosity of the paint shall be such that it can be applied without thinning ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material. <p>The height of the sign must have to be according to standard specification.</p>
R9	<ul style="list-style-type: none"> ✓ Long age of sign ✓ Corrosion of the sign 	<ul style="list-style-type: none"> ➤ Inspections should be made at least twice a year so that long aged signs can be replaced

	plate and post	immediately. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material.
R28	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R9	✓ Sign that is hidden by trees, bushes and other objects	➤ Cut back any long grass, bushes or tree branches and clear the area which hide the sign face
R9	✓ Accident or other harm ✓ Corrosion of the sign plate and post	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material.
R30	✓ Accident or other harm ✓ Post which is loose in its foundations	➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R31	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
W30	✓ Long age of sign	➤ Inspections should be made at least twice a year so that long aged signs can be replaced immediately.
R29	✓ Sign plate that is loose	➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.

4.6.6 Recommended Signs for Site Six

Table 4.6.7 recommended signs for site six

Place	Recommended Signs
For the road at Taxi Station for Mexico to Menilk round about road	R33 
At Addis Ababa City Municipality	R29 
Turn road Ethiopia cinema, Taitu Hotel	W3 
Turn road Ethiopia cinema, Taitu Hotel	R4 
Before getting into cross road at Mohamud Music Shop	W9 
At Tewodos round about	O4 
Tikur Anbessa School	W30 

4.7 Site Seven

4.7.1 General Description of the Signs

The location for site seven is the main road that goes from Minelik Roundabout to Kebena. It is the main road that covers Minilk roundabout, Piyasa Degole Roundabout, Rasmekonen Bridge, Arat Kilo, and kebena.

Table 4.7.1 Sign types for site seven

Sign Type	Number	Percent
Warning	5	21
Regulatory	15	62
Obligatory	3	13
Informative	1	4
Total	24	100

In site seven there are a total of twenty-four traffic signs. From these signs fifteen (sixty-two percent) of them are regulatory signs while five (twenty-one percent) are warning

signs. There are three obligatory signs (thirteen percent) and one informative sign (four percent) in the area.

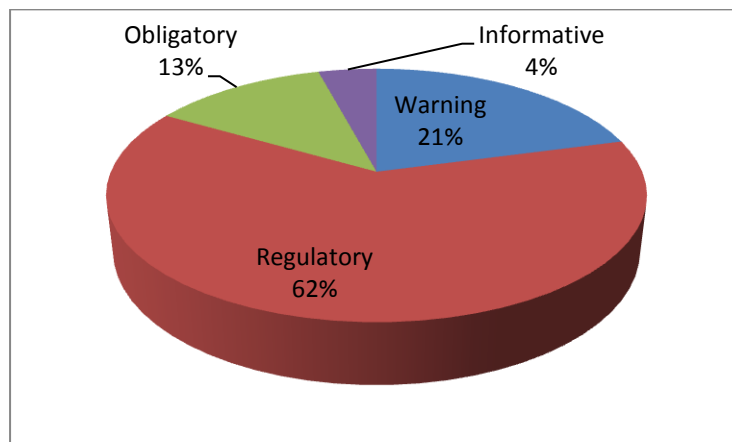


Figure 4.7.1 Sign types in percent for site seven

Table 4.7.2 Height of the signs for site seven

No.	Code	Height (m)
1	R29	2.73
2	R9	2.14
3	R9	2.1
4	R9	2.48
5	I3	2.6
6	R4	2.53
7	R29	2.52
8	R4	2.52
9	R29	2.61
10	R29	2.67
11	R29	2.57
12	R31	2.13
13	R29	2.4
14	R29	2.26
15	W20	2.6
16	R31	2.26
17	R29	2.6
18	O9	2.52
19	W2	2.62
20	W20	2.46
21	W16	1.24
22	O4	2.39
23	W16	1.26
24	O4	2.47

Here in this site the height of the traffic sign posts varies from 1.24 to 2.73 meters. As can be seen from the table, all the sign posts vary greatly within the aforementioned rang. In comparison, the variation and distribution of the sign posts in height in this site is much more than the other eight sites as it is hard pin-point the range most of the sign posts can be included in.

4.7.2 Visibility of the Signs

Table 4.7.3 Visibility of the signs for site seven

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	5	0
Regulatory	11	4
Obligatory	3	0
Informative	0	1
Total	19	5

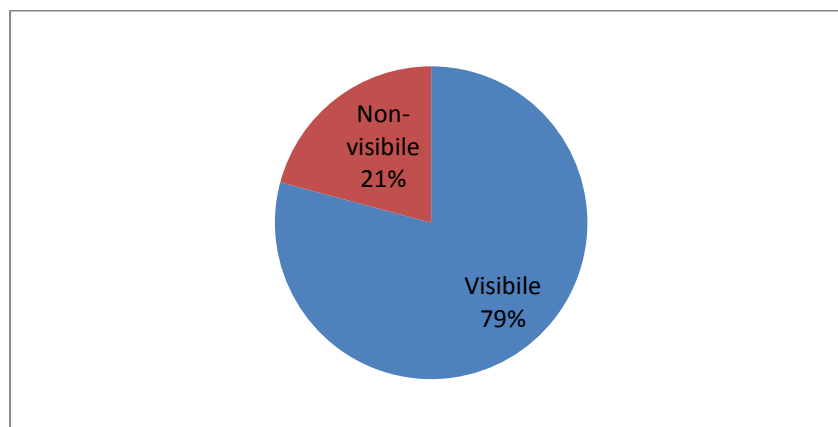


Figure 4.7.2 Visibility of the signs in percent for site seven

When we see the visibility of the traffic signs in this site, generally nineteen of the total twenty-four signs, which comprise for seventy-nine percent, are visible while the rest five traffic signs (twenty-one percent) are not visible. Specifically, from the total fifteen regulatory signs eleven of them are visible but the rest four are non-visible. On the other hand, the only one informative traffic sign found in the area is non-visible while all the five warning and the three obligatory signs are visible to users.

4.7.3 Legibility of the Signs

Table 4.7.4 Legibility of the signs for site seven

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	5	0
Regulatory	13	2
Obligatory	3	0
Informative	1	0
Total	22	2

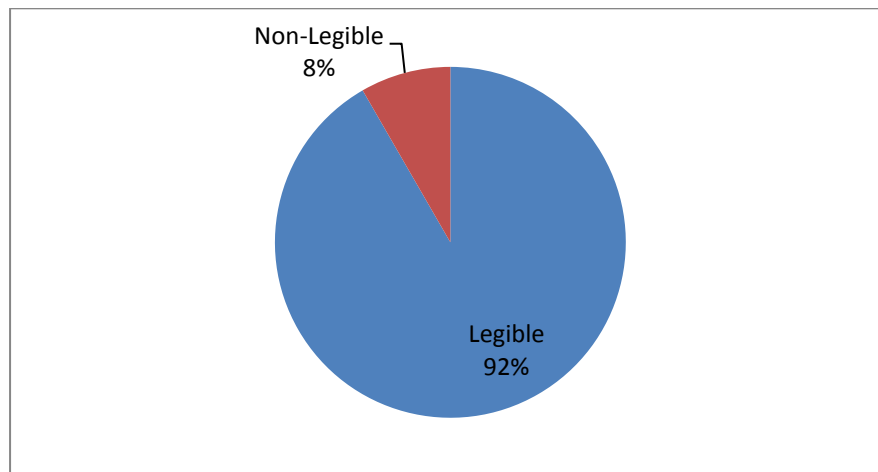


Figure 4.7.3 Legibility of the signs in percent for site seven

When we assess the legibility of the traffic signs in site seven, from the total twenty-four signs installed in the area thirteen regulatory, five warning signs, three obligatory signs, and one informative sign (twenty-two signs in total) are legible while two regulatory traffic signs are non-legible for road users. When this is put in percent, generally ninety-two percent of the total traffic signs are legible while the rest eight percent are non-legible for users.

4.7.4 Condition of the Signs

Table 4.7.5 Condition of the signs for site seven

Condition of the signs	number	Percent
Good	16	67
Medium	6	25
Poor	2	8
total	24	100

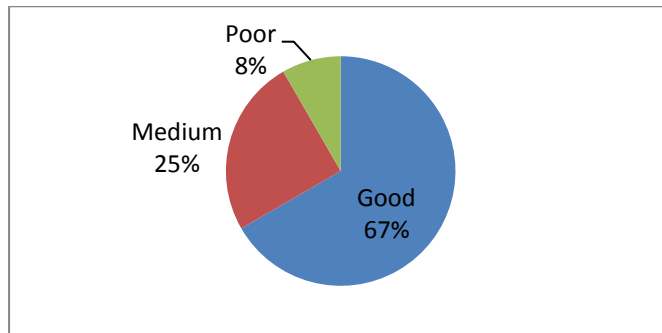


Figure 4.7.4 Condition of the signs in percent for site seven

In judging the condition of the traffic signs in the three parameters, sixteen of the traffic signs which comprise sixty-seven percent) in this site are in good condition. These signs can continue giving service for sometime without asking for some maintenance. On the other hand, six (twenty-five percent) of the traffic signs in site seven are in medium condition; these signs need some maintenance to continue giving the appropriate service. However, two traffic signs that cover eight percent of the total traffic signs in this site are in a really poor condition which means they must be immediately replaced.

4.7.5 Causes of Failure for the Signs in Site Seven and Remedial Measures

Table 4.7.6 Cause of failure and its remedial measures for site seven







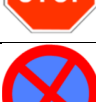
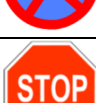


Code for the Sign	Causes of Failure	Remedial measure for the sign
R29	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Posts which are loose in their foundations 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R9	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The plate has to be welded or fastened properly by using appropriate bolt with the

		post.
R9	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Long age of sign ✓ Corrosion of the sign plate and posts ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ Inspections should be made at least twice a year so that long aged signs can be replaced immediately. ➤ Corrosion protection tape used between aluminum and steel shall be "Scotch rap 50" or an equally approved material. ➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
I3	<ul style="list-style-type: none"> ✓ Sign that is in the wrong location 	<ul style="list-style-type: none"> ➤ Immediately remove it from the area and install it in appropriate place.
R29 2 Sign Posts	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R29	<ul style="list-style-type: none"> ✓ Sign that is hidden by other objects 	<ul style="list-style-type: none"> ➤ Clear the area which hide the sign face.
R31	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The plate has to be welded or fastened properly by using appropriate bolt with the post

4.7.6 Recommended Signs for Site Seven

Table 4.7.7 Recommended signs for site seven

place	Recommended sign
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Mnelik Roundabout to Piassa at Olibiya Gas Station	R29 
At Degole Roundabout	O4 
Road from Eri Bekentu to Electric corporation turn road	R33 
From St. Giorggis Church to Ras Mekonnen	R33 
Seba Dereja at Gas station	R29 
TVET college, Kindergarten	W30 
Arada Land Agency	R33 
Infront of Birhane ena Selam Total Gas Station	R29 
Anglican Church Turn road	R33 
Green valley Hotel turn road	R33 

4.8 Site Eight

4.8.1 General Description of the Signs

The location for Site Eight starts from Sidest Kilo and ends at Kebena. This main road passes through Sidest Kilo, Janmeda, Emperor Minelik II Hospital and finally reaches Kebena.

Table 4.8.1 Sign types for site seven

Sign Type	Number	Percent
Warning	5	42
Regulatory	7	58
Obligatory	0	0
Informative	0	0
Total	12	100

As table 4.8.1 shows, there are a total of twelve signs in this site which makes it the second least in total number of traffic signs compared to the whole nine sites. From these twelve signs five of them which cover forty-two percent of the total traffic signs are warning signs while the rest seven which comprise fifty-eight percent are regulatory signs. No obligatory and informative sign is found in this area.

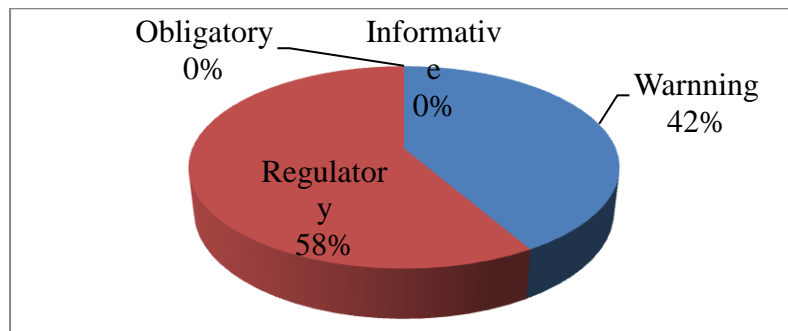


Figure 4.8.1 Sign types in percent for site eight

Table 4.8.2 Height of the signs for site eight

No.	Code	Height (m)
1	R29	2.53
2	R29	2.56
3	R31	2.57
4	R31	2.47
5	R29	2.49
6	R4	2.74
7	Slow	2.63
8	W2	2.6
9	W20	2.56
10	W30	2.56
11	W28	2.51
12	W30	2.6

The height of the traffic sign posts in this particular site is somehow relatively similar the tallest being 2.74 meters and the shortest being 2.47 meters. Most of the sign posts are between 2.5 and 2.6 meters range (nine out of twelve) while only two of the sign posts are in the high 2.4 meters range and one is in the low 2.7 meters range.

4.8.2 Visibility of the Signs

Table 4.8.3 Visibility of the signs for site eight

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	5	0
Regulatory	6	1
Obligatory	0	0
Informative	0	0
Total	11	1

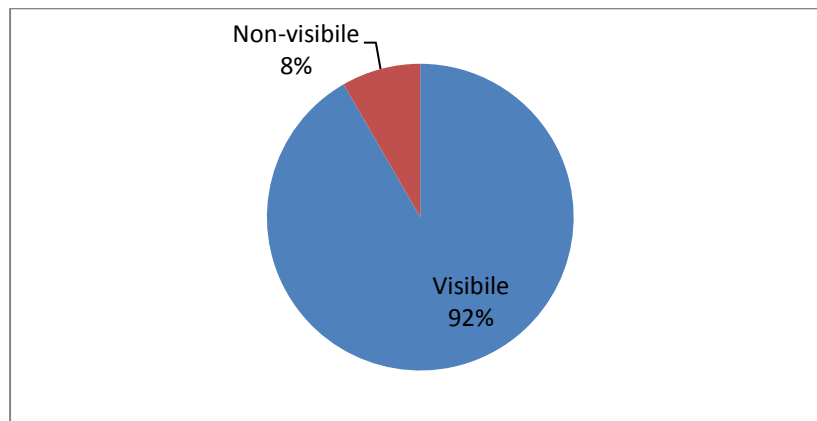


Figure 4.8.2 Visibility of the signs in percent for site eight

In checking the visibility of the traffic signs in this area, out of the total twelve signs, all the five warning signs and six of the regulatory signs are visible to road users; these eleven visible signs in total encompass ninety-two percent. On the other hand, only one regulatory sign which comprises eight percent of the total traffic signs in the site is non-visible.

4.8.3 Legibility of the Signs

Table 4.8.4 Legibility of the signs for site eight

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	5	0
Regulatory	6	1
Obligatory	0	0
Informative	0	0
Total	11	1

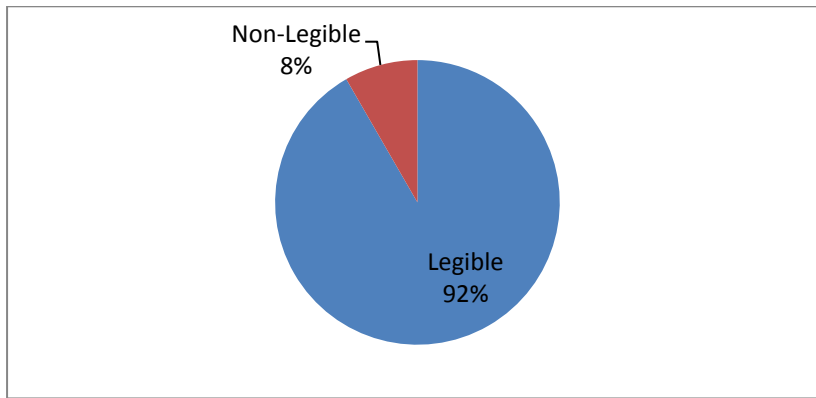


Figure 4.8.3 Legibility of the signs in percent for site eight

When we see the legibility of the traffic signs in this site, it has the same result as the visibility of the traffic signs in this area. Five warning and six regulatory signs which cover ninety-two percent of the total signs are legible to road users while only one regulatory sign which contains eight percent is not legible.

4.8.4 Condition of the Signs

Table 4.8.5 Condition of the signs for site eight

Condition of the signs	number	Percent
Good	7	59
Medium	4	33
Poor	1	8
total	12	100

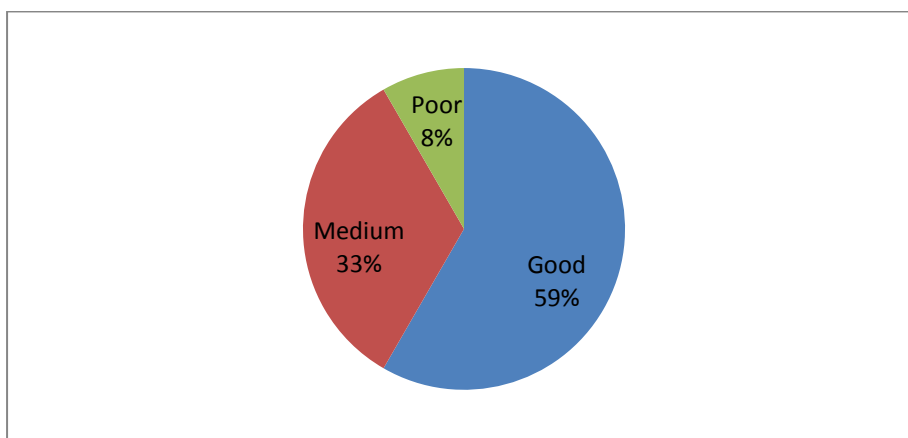


Figure 4.8.4 Condition of the signs in percent for site seven

In checking as to whether the traffic signs in this area are in good, medium or poor condition, seven of the traffic signs (fifty-nine percent) are in good condition while four

of them (thirty-three percent) are in medium condition. However, one sign (eight percent) is in poor condition and needs to be immediately replaced or changed.

4.8.5 Causes of Failure for the Signs in Site Eight and Remedial Measures




Table 4.8.6 Causes of failure and its remedial measures for site eight

Code for the Sign	Causes of Failure	Remedial measure for the sign
R29 2 Sign Posts	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R31	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Flaking or faded sign face and painted surface ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area ➤ Painted steel post should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating. The viscosity of the paint shall be such that it can be applied without thinning ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W30	<ul style="list-style-type: none"> ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The foundation should be designed and placed at such a depth that it will safely

		support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
W28	✓ Flaking or faded sign face and painted surface	➤ Painted steel post should be repainted in accordance with an agreed schedule, or when inspection proves it necessary. All paint should be compatible with the existing protective coating .The viscosity of the paint shall be such that it can be applied without thinning

4.8.6 Recommended Signs for Site Eight

Table 4.8.7 Recommended signs for site seven

Place	Recommended Sign
Sidest Kilo to Janmeda road turn to Amist Kilo	R33 
Around Andnet kinderga	W30 
At the soldiers camp in front of Janmeda	R29 

4.9 Site Nine

4.9.1 General Description of the Signs

The locations for site nine was starting from Degole Roundabout to Atkilt Tera. It goes from Degole Roundabout through Arada building, Shoa Bakery, Abune Petros roundabout, and Atiklt Tera.

Table 4.9.1 Sign types for site nine

Sign Type	Number	Percent
Warning	0	0
Regulatory	7	100
Obligatory	0	0
Informative	0	0
Total	7	100

Site Nine is the area in which the number of the traffic signs is observed to be the least compared to all the nine sites. In this site, there are a total of seven traffic signs and all these seven signs (hundred percent) are regulatory signs; this area does not have any warning, obligatory or informative sign.

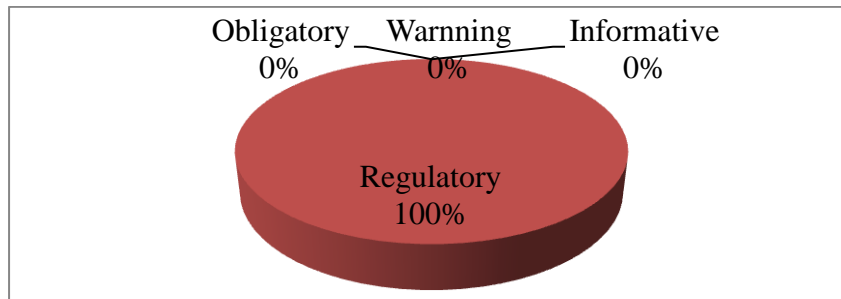


Figure 4.9.1 Sign types in percent for site nine

Table 4.9.2 Height of signs for site nine

No.	Code	Height (m)
1	R29	2.47
2	R4	2.48
3	R30	2.6
4	R29	2.4
5	R4	2.05
6	R30	2.58
7	R28	2.65

The height of all the seven traffic sign posts in this site is in a two meters range. The tallest one is 2.65 meters tall while the shortest is 2.05 meters tall. Much variation is not observed in their height may be because the numbers of the traffic signs is less.

4.9.2 Visibility of the Signs

Table 4.9.3 Visibility of the signs for site nine

Sign Type	Visibility of the Signs	
	Visible	Non-Visible
Warning	0	0
Regulatory	5	2
Obligatory	0	0
Informative	0	0
Total	5	2

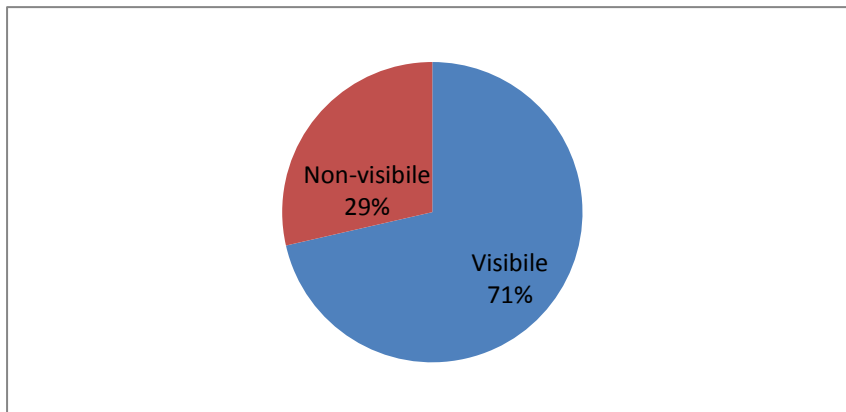


Figure 4.9.2 Visibility of the signs in percent for site nine

When we assess as to whether the traffic signs are visible or not, from the seven available traffic signs in the area, generally, five of them which contain seventy-one percent are visible. All these five visible signs are regulatory. On the other hand, there are two non-visible signs which cover twenty-nine percent of the total traffic signs, and all of them are regulatory signs as there are no other types of signs in the area.

4.9.3 Legibility of the Signs

Table 4.9.4 Legibility of the signs for site nine

Sign Type	Legibility of the Signs	
	Legible	Non-Legible
Warning	0	0
Regulatory	5	2
Obligatory	0	0
Informative	0	0
Total	5	2

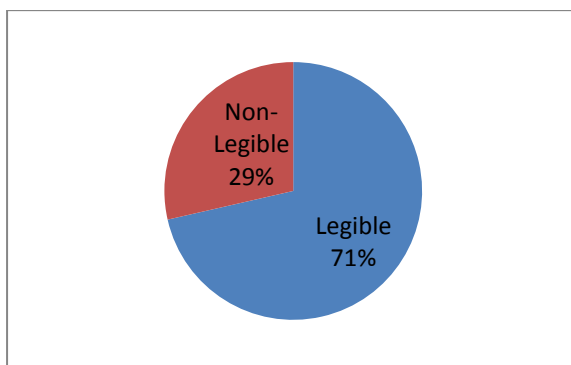


Figure 4.9.3 Legibility of the signs in percent for site nine

As indicated in table 4.9.4 and pie chart 4.9.3, the legibility of the traffic signs in this area is also similar to the visibility. From all the seven regulatory signs installed in the site, five of them (seventy-one percent) are legible while two (twenty-nine percent) are non-legible for users. There are no other signs in this site.

4.9.4 Condition of the Signs

Table 4.9.5 Condition of the signs for site nine

Condition of the Signs	Number	Percent
Good	2	29
Medium	4	57
Poor	1	14
total	7	100

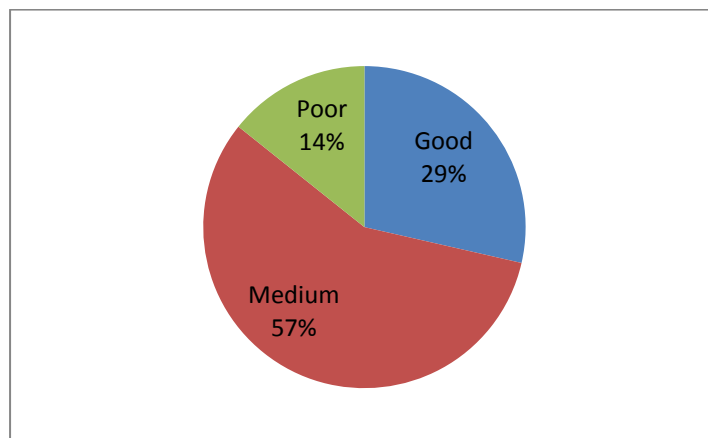


Figure 4.9.4 Condition of the signs in percent for site nine

As indicated in table 4.9.5 and chart 4.9.4, two of the signs which compose twenty-nine percent of the whole signs in Site Nine are in good condition which implies that they can continue giving service without any maintenance or change, but four of them which cover fifty-seven percent are in medium condition which means they can continue giving service after some maintenance. However, one of the traffic signs (fourteen percent) is in poor condition which should be immediately replaced or changed.



4.9.5 Causes of Failure for the Signs in Site Nine and Remedial Measures

Table 4.9.6 Causes of failure and its remedial measures for site nine

Code for the Sign	Causes of Failure	Remedial measure for the sign
R30	<ul style="list-style-type: none"> ✓ The area of installed sign is surrounded by grass, water or other dusts ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ The surrounding of the sign must be clean from any grass and dusts. Signs should be cleaned at least twice a year. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R29	<ul style="list-style-type: none"> ✓ Accident or other harm 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area.
R4	<ul style="list-style-type: none"> ✓ Sign plate that is loose 	<ul style="list-style-type: none"> ➤ The plate has to be welded or fastened properly by using appropriate bolt with the post.
R30	<ul style="list-style-type: none"> ✓ Accident or other harm ✓ Post which is loose in its foundation 	<ul style="list-style-type: none"> ➤ Put a guard rail for the sign to protect it from accident or put the sign far away from accident area. ➤ The foundation should be designed and placed at such a depth that it will safely support the sign under its loading conditions without causing failure due to shear or heave in the surrounding soil.
R28	<ul style="list-style-type: none"> ✓ Long age of sign 	<ul style="list-style-type: none"> ➤ Inspections should be made at least twice a year so that long aged signs can be replaced immediately.

4.9.6 Recommended Signs for Site Nine

Table 4.9.7 Recommended signs for site nine

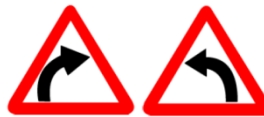
Around Atklt tera Africa Andnet School	W30 
Kelifa Building –Piasa Arada building cross road	W9 

General Recommendation of sign that have to be installed for all roads in Arada Sub-city

According to Federal Negarit Gazeta No 89 August 26th 2011 page 6144 it is prohibited to use road sign other than those prescribed in the annex to this regulation and similar signs to be implemented in accordance with appropriate law [24].

1.warning Sign

- For roads that bend to right and left from the main road as a rule there must be a warning sign for the main road users to show that the road bends since this might cause accidents if the drivers do not know this.



- Before every cross road, to aware and warn road users there must be signs like this



- To cede priority to traffic on the cross road but there are no signs just like this except on place as I trie to see



- There must be a sign to aware a road user before they to get into roundabout but there are no signs like this except at 3 places.



- There must be a sign for pedestrian crossing at appropriate places



2. Regulatory Sign

- There must be a sign warning users that the road is prohibited to bicycles to minimize accident



- Around hospitals, churches, and mosques there must be a sign that prohibits sound



- For roads such as Arat Kilo there are pedestrian crossing bypasses so there must be a sign prohibiting pedestrians from crossing the roads; and in addition to this for ring roads that prohibit pedestrians from crossing the road there must be a sign like this.



- There must be a sign for speed limit restriction



- There must be a sign that ends the restriction for no stopping or parking signs. As observed in this study there are a lot of signs that restrict parking and stopping, but the problem is most of these restriction signs do not have signs that shows the end of the restriction and it is a difficult for road users to know where the end of the restriction is.











3. Information signs

Totally in this study there are no information signs found in the whole sub-city except two; only two parking information signs are found in the sub-city. this sign means

parking area allowed. as mentioned above there are no any information signs, but these signs minimize accident and give awarness about the condition of activity that is going beside and on the road.

Table 4.9.8 General Recommended Information signs

	Break down service
	Refreshments or cafeteria
	Restaurant
	Pedestrian crossing ahead
	Telephone
	Filling Station
	First aid station
	Hotel or Motel

4.10 Data Analysis of the Questionnaires

4.10.1 Data Analysis of the Questionnaire for the Traffic Policemen

Two sets of questionnaires were prepared to support the data found in the observation and to find out extra information about the perception of the concerned bodies. The first set of questionnaire was prepared for the traffic policemen who work under Arada Sub-city Traffic Police Office. It contained seventeen questions in total and there were thirty

respondents. The questions and the responses of the traffic police men are analyzed as follows.

In an attempt to know the awareness of the traffic policemen about traffic signs, the researcher asked how much they know about the traffic signs and twenty-nine out of the thirty respondents answered that they know about traffic signs very well while only one respondent said that he knows about them partially.

In another attempt to know how important traffic signs are again twenty-nine respondents agreed that they are very important while only one respondent said they are important which in general implies that all the traffic policemen believe that traffic signs are important.

The respondent traffic policemen were also asked how much traffic signs contribute in decreasing traffic accidents; thirteen respondents believe that traffic signs can decrease traffic accidents seventy-five to hundred percent while fourteen respondents believe that traffic signs can decrease the accidents fifty to seventy-four percent. However, two traffic policemen believe the amount to be twenty-five to forty-nine while one respondent believe it to be less than twenty-five percent. Generally, twenty-seven out of the total thirty respondents believe that traffic signs can contribute in decreasing traffic accidents more than fifty percent.

The respondents were also asked if they believe there are sufficient traffic signs in Arada Sub-city. Ten of the respondents believe that the traffic signs are sufficient in amount while twenty of the respondents think that the number of traffic signs present in the sub-city is not sufficient.

The respondents were inquired if they get information about the location and condition of the traffic signs in Arad Sub-city. While nine traffic policemen said that they get enough information, the majority seventeen policemen they get the information partially. From the rest four respondents two of them said that they do not get any information, and the other two did not respond to this question at all. The traffic police men believe that there is a shortage of information concerning the traffic signs because there is no organized and readily available data and controlling system. This is also observed by the researcher; when she tries to get the information about the signs the concerned bodies (both AATMA and ASTPO) did not have any organized and available information to give.

The purpose of the next question in the questionnaire was to check if the traffic police officers have the awareness as to whose responsibility it is to install and control traffic signs. Seventeen of the respondents gave the correct answer which is the responsibility of AATMA, but the rest eleven gave a wrong answer, two respondents gave invalid answer. This shows that though many traffic police officers have the knowledge as to who is responsible for installation and control of traffic signs, some of the traffic policemen do not have the information.

Another question raise for the traffic policemen was to check if they believe that traffic sign management is effective. Five of the participants answered that it is effective while the majority twenty-three believe that it is only partially effective as there are many problems, and two respondents believe that it is not effective at all.

The participant traffic police officers were asked if there were traffic accidents due to absence of traffic signs in their working area. Seven respondents said that they have witnessed many accidents due to absence of traffic signs while twelve traffic police officers said there were some accidents and ten respondents said they have seen few accidents, but one respondent answered that he has never witnessed any accident due to absence of traffic signs.

The next question asked the traffic police officers how much drivers and pedestrians comply with the rules and regulation of traffic signs. Only three respondents said that seventy-five to hundred percent of the drivers and pedestrians comply with the rules and regulations of traffic signs while seven respondents believe this number to be from fifty to seventy-four percent. However, nine participant police officers said that the number of drivers and pedestrians that comply with the traffic signs from twenty-five to forty-nine percent while eleven respondents believe this number to be less than twenty-five percent. Here in this case the majority of the participants' responses (twenty out of thirty police officers) suggest that the more than half of the pedestrians and drivers do not comply with the rules and regulations of traffic signs.

The other point raised was in relation to the road users as to what kind of measure should be taken against those that do not comply with the traffic signs. Five respondents believe that educating the society is the solution while most of the participants (twenty-five of them) believe that educating the society and getting driving license teaching institutions

and authorities to teach about traffic signs are the best solutions. Generally all the respondents believe that punishing the offenders does not bring any change rather teaching the road users is the one that can bring change.

The traffic police officers were asked if they have ever reported when they see fallen or damaged traffic signs. Twenty-eight of the thirty respondents answered that they have reported while only two of the participants said that they have not.

The last two questions the traffic police officers were open-ended questions. The first one asks what kind of management method or system should be used to control the location and condition traffic signs since they are road assets. The traffic police officers gave different answers for this question; the main points are generalized as follows. Some traffic police men suggested that the stake holders should work hand-in-hand to protect the traffic signs from accidents, intentional destructions, and repair or fix those signs that are damaged. Yet others suggested that educating and giving awareness to the drivers and the society at large to look after the traffic signs; in addition, giving workshop for the concerned bodies, following up the condition of the traffic signs regularly, installing signs in a better and safer ground and regularly controlling their condition, reporting to the concerned bodies when damaged signs are found are some of the answers given in general.

The last question asks what kind of measure should be taken to decrease traffic accidents in relation to traffic signs. Generally the traffic police officers suggested that everyone should play their role well, educating the drivers and the society should also be considered; moreover, installing visible and legible signs in appropriate places and controlling their conditions regularly, putting a heavy fine for those who do not comply with the rules of the traffic signs are suggested answers by the traffic police officers.

4.10.2 Data Analysis of the Questionnaire for the AATMA Workers

The second type of questionnaire was prepared for the AATMA (Addis Ababa Traffic Management Agency) workers as this agency is directly responsible for the installation and management of traffic signs all over the city. The first eight set of questions in this questionnaire are similar with the questions prepared for the traffic police officers; however, the rest questions are specifically designed to gather information about the work in relation to the agency. Fifteen randomly selected employees of the AATMA

participated in the study. Here under the questions are analyzed in relation to the responses the participants gave.

The first question asks the participants how much they know about traffic signs, and thirteen of the respondents answered that they know about traffic signs very well; two of them said that they know partially while one respondent admittedly does not about traffic signs.

The respondents were also asked how important they think traffic signs are. In their answers all the fifteen participants pointed out that traffic signs are very important. Their answer shows that they have the awareness about the value of traffic signs.

In relation to this question the participants were inquired how much traffic signs contribute in decreasing traffic accidents; six of the total fifteen respondents believe that traffic signs can decrease traffic accidents seventy-five to hundred percent; four respondents believe this number to be fifty to seventy-four percent. Another two participants take this number to be twenty-five to forty-nine percent, but three participants did not give any response for this question. As can be from the answers, most respondents (ten out of fifteen) think that traffic signs can decrease more than half of (fifty percent) of the traffic accidents.

The next question raised for the respondents was if they believe that there are sufficient traffic signs on the roads of Arada Sub-city. While one of the participants said that there are sufficient traffic signs in the sub-city, nine participants agreed that the number of traffic signs in the sub-city is not sufficient; two respondents admitted that they do not have the information, and the rest three respondents did not give any answer. According to the answer of most participants (nine out of fifteen), the number of traffic signs in the sub-city is not adequate.

In relation to this, the participants were also asked if they get information about the location and condition of the traffic signs in the sub-city. Two respondents said that they get enough information while seven participants said that they get the information partially and the rest six participants admitted that they do not get any information at all.

The workers were asked what kind of means or system they use to control the number and condition of the traffic signs in Addis Ababa. Most respondents (eleven out of the total fifteen) reported that they collect the information about the traffic signs by going to the

location of the traffic signs and surveying them physically. One respondent said that the agency is still thinking about the kind of system it should use where as one gave extra information and there are two invalid answers.

The next question was asked to see if the participants think that traffic signs management strategy is effective. While two respondents believe that it is effective, five of them think it is partially effective, but four of them believe it is not effective, and another four did not reply to this question.

The respondents were asked whether their organization (AATMA) follows up road assets and in particular traffic signs properly. Two of the respondents said that it does and ten of the respondents said it follow up is partial and incomplete. One participant said it is under considered to be done in the future, and two respondents did not give any answer. In relation to this, they were also asked how long it has been since the responsibility of following up controlling road assets was passed on to their organization (AATMA). One respondent said it has been six months while the majority eight participants state it has been a year. Two participants said it was a year and half, and another two respondents said it to be two years while the rest two said that they do not know. Generally the answer of the respondents shows that the responsibility has been passed on to this organization recently which makes the task of following up and controlling road assets and traffic signs in particular difficult as the organization is a newly established one.

The respondents were inquired if standard quality of traffic signs (height, installation, retroreflectivey etc.) is maintained and whether the traffic signs are standardized. Six of the fifteen participants agreed that the traffic signs are standardized, and the quality is maintained while another six of them believe the standard kept to be partial, and one believes the standard is not kept at all; other two respondents did not give answer to this question.

In relation to the above question those respondents who said 'yes' and 'partially' if the standard and quality of the traffic signs is applied were asked to explain how. Those six respondents who said 'yes' gave the reason that the traffic signs are produced in line with the standard and quality of traffic sings while the other six respondents who said 'partially' stated that some of the standards and qualities such as the height and diameter of the traffic signs are not taken into consideration.

The next question asks the AATMA workers if they have ever reported when they see fallen or damaged traffic signs. Eleven of the fifteen participants said that they have reported while four of the participants said that they have not, and one respondent admitted that he/she has never come across fallen or damaged traffic signs.

Similar to the traffic police officers, AATMA workers were also asked to suggest measures that should be taken to decrease traffic accidents in relation to traffic signs. Some suggested that the traffic signs should be regularly inspected, while others pointed out that concerned bodies should work together, and yet others proposed that educating the society about traffic signs is important. Some also mentioned that the task of managing, controlling, and inspecting the traffic signs should be computerized and modern.

4.11 Data Analysis of the Interviews

The interview was prepared for two concerned government officials. The first one was prepared for Ato Solomon Degefa who works in AATMA as an infrastructure management expert. The second one was prepared for Sergeant Abiy Fikadu who is a shift manager in Arada Sub-city Traffic Police office. Structured type of interview was used for this study. The interviews and their answers to the questions are presented as follows.

4.11.1 Data Analysis of the Interview for AATMA

Thirteen questions were prepared for Ato Solomon Degefa who is an infrastructure management expert in AATMA.

In the first question, he was asked if he could explain the importance of traffic signs in detail. He responded that traffic signs are international, and if there are no traffic signs, rule will be broken; for example, if no-parking signs are not posted, people will park in places where they should not; if there is no speed limit sign, an accident may occur; if there is no traffic sign in steep roads, it might cause a problem in the traffic flow and cause traffic congestion.

In an attempt to know when the responsibility of traffic signs was transferred from AACRA to their organization, AATMA, and what kind of system they are planning to use in their work Ato Solomon explained that AATMA was established in the year 2008 under proclamation number 72. He also explained that though its establishment was in 2008, it started work in the mid of 2009 because they had to take the data form AACRA

and get to know the work, they had to share experience from AACRA and they had to make preparation; therefore, they started work in Tir 2009. He stated that since they started work in Tir till Sene 2009, they have installed around 600 traffic signs in Addis Ababa after gathering information from the society and institutions, a long study by the organization, and from the traffic police offices about the traffic signs. He also pointed out that when they get information and requests from these bodies they install the traffic signs as necessary after checking the situation and the area.

The other point raised for him to explain was about their management and control system of signs; he was asked that since traffic signs are part of road assets what kind of system or method they are using or they are planning on using to manage and control these signs. In his response he pointed out that they are in the process of counting the traffic signs in different routes using a GPS system which is still going on; it is not completed yet. Since the agency (AATMA) is newly established, it needs a workshop and trained manpower to fix damaged traffic signs that need repair; it also needs a place to store those signs that are uprooted or damaged beyond repair. Hence, they are conducting a new research on the problem; a paper in title ‘An Input for Permanent Asset Management’ is also prepared. The research includes how to give solutions for those signs that might be uprooted or damaged due to accidents; however, he stated, need assessment analysis should be conducted to determine how many and what type of signs are needed in the city.

In the fourth question Ato Solomon was asked to give information about the condition of the traffic signs in the city and specifically in Arada Sub-city. He said that they are in the process of collecting the data using GPS so he does not have sufficient information. Nevertheless, around forty traffic signs were being installed from Piassa to Arat Kilo; however, the installation was being carried out after the researcher had collected the data.

In an attempt to collect data the researcher found that there are very few signs in Arada Sub-city and most of these signs are no-parking signs which are not even abided.

Ato Solomon was requested to give explanation about this problem and what they are planning to do about it. In his reply, he admitted that the traffic signs are not sufficient; unnecessary traffic signs should be dug up and removed; a lot of necessary signs should be installed and there is a lot to be done as they are in the beginning stage. Moreover, he suggested that as a crowded area, they are planning to work on the problem in Arada Sub-city in the future.

Pointing out that the researcher could not find any information sign except two throughout the whole Arada Sub-city, she asked the official (Ato Solomon) to give a comment as to why this is so. He answered that since the agency is giving response for urgent and critical problems and questions, they have not worked on information signs; though information signs are important, their installation needs time, making assessment, and collecting information, and the agency will work on them in the future.

In his response to the question how much could the unavailability of traffic signs or their improper installation cause traffic accidents or expose people to traffic accidents, he answered that the unavailability of traffic signs or their improper installation can definitely and unquestionably cause traffic accidents. He further explained that if there are no traffic signs, the traffic flow will be impaired; and if the traffic flow is impaired, the chance of getting into traffic accidents becomes higher and worse; therefore, traffic signs should be available and properly installed; moreover they must also be obeyed, so in general if the traffic signs are available in appropriate places and if they are obeyed, they can decrease traffic accidents to a great extent.

In relation to the above problem, Ato Solomon was asked to explain what they are planning to do in the future in terms of decreasing traffic accidents. he replied that roads which could potentially cause traffic accidents are being changed and when the roads are changed, traffic signs related and necessary to the road should be installed, so the designing section of their agency is conducting a study on the issue.

Ato Solomon was asked if they have the standard and quality for the traffic signs such as their height, their retroreflectivity, their visibility and legibility, and their installation place and condition; he was also asked what they are planning to do in this area in the future. In his reply, Ato Solomon stressed that traffic signs should have the required standard and quality; while having the required standard and quality makes traffic signs effective, the reverse is also true. He reported that their agency (AATMA) asked AACRA if they had a standard and quality specification for the traffic signs for which AACRA told them that they had no specification. Though Traffic Police Management Office had the specification of standard and quality of traffic signs, it was not legalized, so AATMA is working to legalize the standard and quality specification of the traffic signs. He also mentioned that they need adequate manpower to measure and work on each traffic sign according to the standard, but they do not have enough manpower to do so.

The next question was raised to check if the agency has planned to use any software to apply asset management system; he replied that they do not have any software for asset management system. However, analyzing the resources, the scarcity, asset management system, they are planning to utilize their scarce resources effectively and efficiently.

Lastly Ato Solomon was asked what their agency intended to do about traffic signs in Arada Sub-city since the sub-city is the center for high business flow and many other sub-cities, and whether it would be helpful if they get a study conducted in the area. He answered that as Arada is a densely populated area with a high business transaction and hence traffic flow they would be glad to accept and use any research conducted on traffic signs in the sub-city.

4.11.2 Data Analysis of the Interview for Arada Sub-city Traffic Police Office

This interview was prepared for Sergeant Abiy Fikadu who is a shift manager in Arada Sub-city Traffic Police office. The twelve questions asked and his responses are presented as follows.

The first question Sergeant Abiy asked was to compare the traffic accidents that occur in Arada Sub-city with the other sub-cities. In his response he reported that the traffic accidents that occur in Arada Sub-city are much more compared to the accidents in other sub-cities mainly because it has much more complicated traffic flow a lot of congestions as it is in the center of the city and the other sub-cities; moreover, it previously had incomplete traffic signs. These contributed for the traffic accidents in Arada to be much higher than the traffic accidents in other sub-cities.

In an attempt to know how much the unavailability of appropriate traffic signs expose people to traffic accidents, Sergeant Abiy replied that the unavailability of appropriate traffic signs such as no-parking signs in the appropriate place could cause drivers to park their cars carelessly which would cause traffic congestion and hence lead to traffic accidents; in addition, other than no-parking signs other types of traffic signs are not sufficiently available which increase the exposure to traffic accidents much higher.

Sergeant Abiy was also asked if he thinks there are sufficient traffic signs in Arad Sub-city for which he answered he does not think so; he believes that the traffic signs posted in Arada Sub-city are not adequate, not nearly as much as the sub-city needs. In relation

to this problem he was asked as to what the reason is behind. He said that there are different reasons for the problem. The first reason is that Arada Sub-city Traffic Police Office and AATMA got into work without studying the problem and making earlier preparation. Even those few signs posted are either uprooted or damaged by business centers and Ethiopian Electric Power Corporation workers irresponsibly. So it would be better if the concerned bodies work together.

The next question presented was what their office is planning on working regarding traffic signs and their management system. He replied that their office is getting into work communicating with AATMA concerning the traffic signs; individual traffic police men are informing the office about uprooted or damaged traffic signs on which the office is working in collaboration with AATMA for their reposting or replacement.

The next question in the interview raises if Arada Sub-city Traffic Police Office has any plan to alleviate wastage of valuable time caused by overcrowded traffic flow as the sub-city is in the center of the city for which Sergeant Abiy replied that traffic signs create conducive traffic flow which means they can minimize time wasted on traffic congestion, so making arrangements to get traffic signs posted in necessary places is one of their office's plans.

Sergeant Abiy was asked to explain the general benefits of traffic signs and how much they can minimize work load or burden for traffic police officers on duty. In his answer he pointed out that traffic signs mainly have the benefit in make the traffic flow smooth; they decrease traffic jamming; it aids traffic police officers on duty because if there is traffic sign in a place, seeing the signs road users will know what they have to do without the traffic police officers telling them. Furthermore, it minimizes the long hour workload and burden of traffic police men on squares.

In an attempt to know how much the traffic signs are obeyed by the drivers and pedestrians and what kind of measurement is taken on those who do not obey them, Sergeant Abiy replied that pedestrian do not follow the rules of the traffic signs; though proclamation number 97 states that pedestrians who do not follow traffic rules should be fined and punished, the traffic police office did not put it into effect; instead the traffic police officers usually advise and educated the pedestrians. When it comes to drivers,

says Sergeant Abiy, some of them do not even know what the traffic signs stand for and their meaning and we will directly punish drivers if they do not obey the traffic signs.

While moving around the sub-city to collect data, the researcher has observed that there are almost no signs other than signs that allow or prohibit parking, and even these signs are not obeyed which makes the chance of getting into traffic accident much higher. Mentioning these facts, Sergeant Abiy was asked who should take the responsibility for this problem and if there is anything planned to solve it. In his response he explained that not only the traffic flow but also the condition is complicated and due to this the manpower they have cannot cover every road except the major and most important ones. He further explained that Arada Sub-city is different from the other sub-cities in that it is the seat for the mayor of Addis Ababa, it is also the seat for the prime minister of the country; therefore, the traffic police officers spend most of their time with the tasks related to these. He believes that they should work on all the problems, and they will improve it in the future; besides, teaching the society can solve the problem to a great extent.

Sergeant Abiy was asked how many of traffic accidents (from the total traffic accidents which occur in the sub-city) are caused by disobeying traffic signs or due to absence of traffic signs in the area or they do not give service properly. In his response, he pointed out that several traffic accidents occur because of disobeying traffic signs or due to absence of traffic signs in the area or the traffic signs do not give service properly. As an example, he mentioned that around St. Petros roundabout a lot of traffic accidents occur due to the fact that there is no warning sign informing drivers that they are about to enter a roundabout before they do. Hence they get into the roundabout and without decreasing their speed and not giving priority which results in a sever traffic accident. Just like this many accidents in the sub-city occur because of unavailability of traffic signs or disobedience of the traffic signs.

The last question presented to Sergeant Abiy asks how much it would help them if a research is carried out about traffic signs in the sub-city. He replied that an orientation would be given based on the research; furthermore, communicating with the concerned bodies the research will be put into effect.

4.12 Discussion

In this part of the chapter the data gathered and analyzed through observation, questionnaire, and interview are discussed. Their connection and triangulation is checked.

Table 4.12.1 Sign types of all nine sites

Sign Type	No. of Signs	Percent
Warning	19	11
Regulatory	143	82
Obligatory	11	6
Informative	2	1
Total	175	100

As can be seen from the table there are a total of one hundred seventy-five traffic signs in Arada Sub-city. From the four sign types the most commonly used sign is a regulatory sign which consists one hundred forty-three (eighty-two percent) of the total one hundred seventy-five signs. Even from the above mentioned regulatory signs, R29 or no-parking sign takes the vast majority number; there are sixty-eight R29 signs in the sub-city. On the other hand, there are only nineteen warning signs (eleven percent), eleven obligatory signs (six percent), and only two information signs (one percent) throughout the whole sub-city. What can be observed from the distribution of the traffic signs in the sub-city is that they are not evenly distributed and only one type of sign is given attention which implies that the signs were not installed in consideration with the need and condition of the roads in the area. Finding only one type of sign in most of the sub-city is a proof of this. In addition, the majority of the respondents in both questionnaires and the interviewees from both AATMA and Arada Sub-city Traffic Police Office admitted that the traffic signs in the sub-city are not sufficient. The result found in the observation, questionnaires, and the interviews shows that there are not enough traffic signs installed in the sub-city, and the researcher has tried to show some of the signs that should be posted in each nine site individually and in the whole sub-city generally.

In relation to the height of the traffic sign posts, the difference observed in their height is extreme in the sub-city. The tallest traffic sign post measures 3.27 meters while the shortest is 1.24 meters. International traffic standard manuals suggest that traffic signs must have standardized heights which is not applied in our situation. The height difference of these traffic posts is one indicator that the concerned bodies do not have standard for the traffic signs posted; this is also proven through the interview with Ato

Solomon as he said that they do not have any standard for the traffic signs, and they are still planning on developing one in the future.

The other problem observed in the sub-city is in relation to the age of the traffic signs. Again international standard of traffic signs suggest that the year the traffic signs produced must be written at the back of the traffic signs; however, none of the one hundred seventy five traffic signs have the year they were produced at their back which is another indicator that the traffic signs are not produced according to the standard. It is hard to know the age of the traffic signs and how many years they have been serving as there is no description of their production and installation date at the back of the traffic signs or on the post.

Table 4.12.2 Visibility of the signs in all nine sites

Visibility	No. of Signs	Percent
Visible	143	82
Non-Visible	32	18
Total	175	100

When we see the visibility of the signs, from the total one hundred seventy-five signs, one hundred forty-three (eighty-two) of them are visible while thirty-two signs (eighteen percent) are not visible to road users due to different technical and environmental problems.

Table 4.12.3 Legibility of the signs in all the nine sites

Legibility	No. of Signs	Percent
Legible	160	91
Non-legible	15	9
Total	175	100

Similarly in assessing the legibility of the signs, one hundred sixty (ninety-one percent) of the traffic signs in the sub-city are legible while only fifteen (nine percent) of the signs are non-legible to road users. When we see the visibility and the legibility of the traffic signs in the area though most of the traffic signs are visible and legible to users, there are few signs which have visibility and legibility problems. This has its own influence on road users and may cause accidents and other traffic related problems. Not most but all the signs in the sub-city must be visible and legible to road users.

Table 4.12.4 Condition of the signs in all the nine sites

Condition of sign	No. of signs	Percent
Good	70	40
Medium	76	43
Poor	29	17
Total	175	100

In analyzing the condition of the traffic signs found in Arada Sub-city, three parameters were used which are ‘good’, ‘medium’, and ‘poor’ to determine the condition the signs are in. Signs that are considered ‘good’ are those that can continue giving service for road users without any maintenance or replacement, and seventy (forty percent) of the signs in Arada Sub-city are in good state. On the other hand, Signs that are deemed to be ‘medium’ are those that can continue giving service after some maintenance; these signs need some form of repair. Accordingly seventy-six (forty-three percent) of the traffic signs in the sub-city are medium. However, signs that are considered ‘poor’ must immediately be changed or replaced. Based on this, twenty-nine (seventeen percent) of the traffic signs in Arada Sub-city are in poor condition. Therefore, when we see the condition of the traffic signs in general, in the sub-city only seventy (forty percent) of the installed signs can continue giving service without a problem while one hundred five (sixty percent) of them either need maintenance or should be immediately replaced. This shows that more than half of the installed signs in the sub-city have several problems and the problem should be attended soon.

The number of the signs in Arada Sub-city as observed and agreed by most stakeholders is not enough and even from these insufficient number of signs found in the sub-city more than half (sixty percent) are not in good condition. They were observed to have different problems and eleven major causes of problems were identified. From these causes of problems, the problem of posts which are loose in their foundation takes the highest place as it is observed in sixty one signs followed by accident or other harm – a second most commonly observed cause of problem as it is observed in thirty of the signs. the third major problem recorded on twenty-seven signs was sign plates that are loose. Moreover, Corrosion of the sign plates and posts was observed in nineteen traffic signs while a problem of long age of service is seen in ten of the signs. the problem of signs that are hidden by trees, bushes and other objects is observed in nine of the traffic signs in the

sub-city while the problem of flaking or faded sign faces and painted surfaces, and the problem of signs that are in the wrong location are observed in six signs each. The least causes of problems recorded are the area of installed signs being surrounded by grass, water or other dusts, and the signs being too long or short with three traffic signs in each.

There were one hundred seventy four causes of failures in total that were observed on the problematic traffic signs; in some extreme cases single traffic signs were observed to have two or three and even four problems at once. This shows how severe the problem is and regular inspection is not being carried out by the responsible bodies. This is also proven through the interview with the AATMA representative as he said they are still new for the work they do not have sufficient information about the traffic signs; they are in the beginning stage of gathering information about the traffic signs. The researcher has put remedial measure for each cause of problem observed in each sign post in each site.

Generally all traffic signs are necessary that is why they are incorporated with the rules and regulations. As a developing country, it may be difficult to install all traffic signs but we have to install traffic signs that are highly important. Normally traffic signs can minimize accidents, traffic congestion, and time delay. When we come to Addis Ababa, it is the capital city of the country with a high traffic flow; in Addis Ababa there are 10 sub-cities, and from other sub-cities, the problem of traffic sign is observed in Arada in a higher degree. In this sub-city there are almost no signs other than regulatory signs and specifically R29 or no-parking sign; from one hundred seventy five signs that existed sixty-eight of them are R29. This shows that the number of other traffic signs is extremely less.

The general condition of the posted traffic signs is not also good. The major problem observed in this area is foundation problem of existing signs; this means the strength of the foundation is less so the posts get uprooted and fall within a short period of time. All the observed problems on each sign are listed above in the assessment of each site with causes of failure and its remedial measures. Traffic signs minimize the work of traffic police men if they are installed properly, but as we tried to see in this study the observation, the responses of the questionnaires and also the interviews show that they are not given proper assessment with in time and they are not managed well.

4.13 Traffic signs data mapping in a geographic information system (GIS):

The collected signs were plotted in a geographic information system. First, the position of each sign was taken and then the longitude and latitude of the each sign was noted using GPS, after which their longitude and latitude were displayed in the Arc GIS. Then the category of the traffic signs was identified. After that Arada Sub-city road map and its boundary was added followed by leveling by category on arc GIS map and creating attribute table field with code of each of the sign. Finally arrangement of the lay out paper was done. Figure 1 below shows the installed signs in Arada sub-city. Latitude and longitude points are shown in the appendix H.

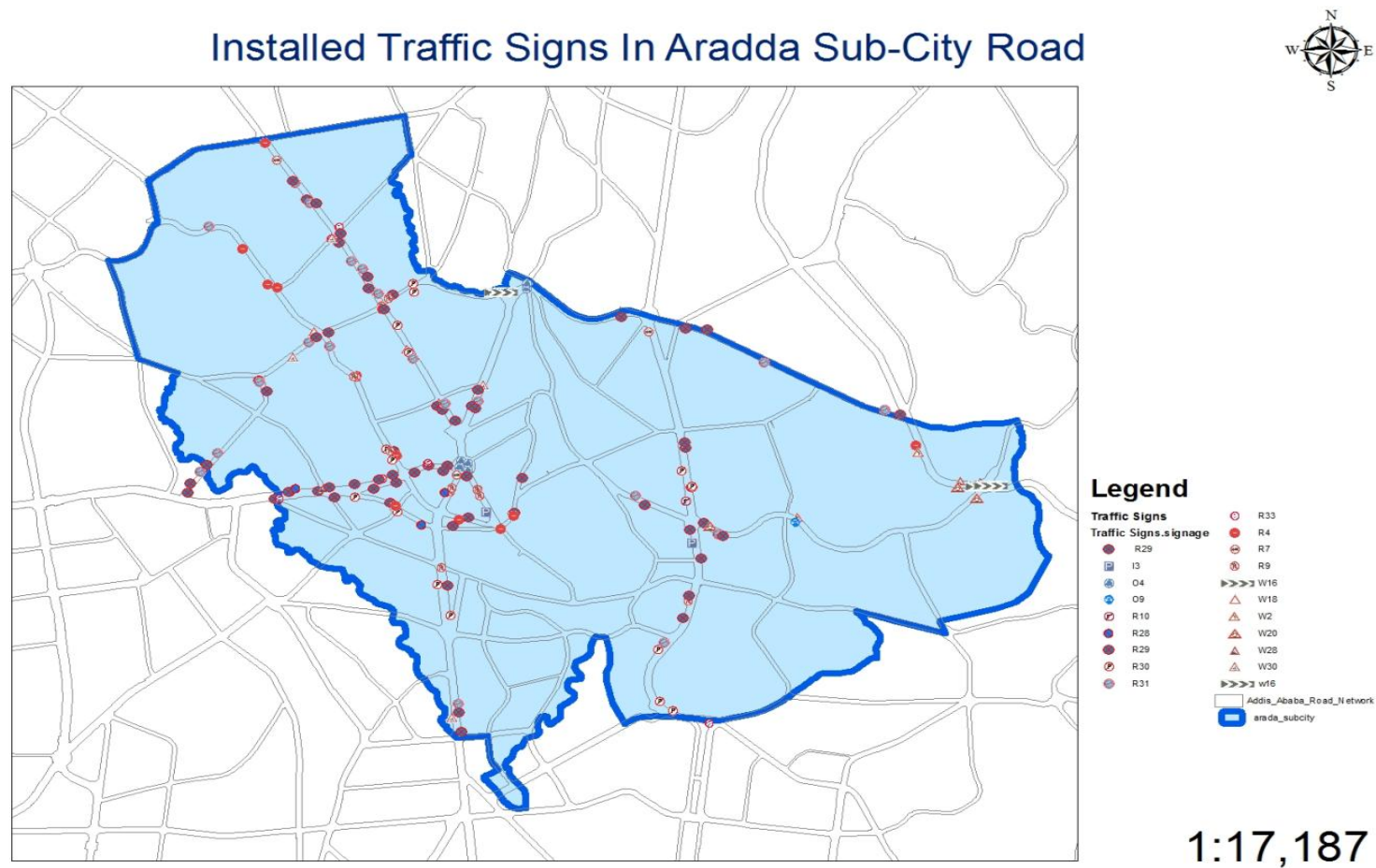


Figure 4.13 Installed Sign in Arada Sub-city Using Arc GIS

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

In this chapter the summary, conclusion, and recommendation parts are included. In the summary part all the points that have been discussed in this paper are briefly mentioned while the conclusion reveals the findings of this study followed by the recommendation that puts forward some solutions for the problems.

5.1. Summary

The aim of this study was to assess the traffic signs in Arada Sub-city. The researcher put forward four research questions to be answered at the end of the study. The first one was to identify what type of traffic signs are installed in the sub-city while the second one was to check the condition of the existing traffic signs, and the third question checks the causes of failure for problematic traffic signs followed by the last question which asks what kind of remedial measure can be taken for the problems observed.

The researcher used a descriptive survey study which was appropriate for this study. Three data collection instruments (observation, questionnaire, and interview) were used to gather the data. In the observation the traffic signs found on the major roads of Arada Sub-city were investigated; their type, height, visibility, legibility, and condition were checked. Two sets of questionnaires were prepared for thirty Arada Sub-city traffic policemen and fifteen AATMA workers. Again two sets of interviews were prepared, one to AATMA infrastructure asset management expert and another to Arada Traffic Police Office shift manager.

Then the data gathered was analyzed using descriptive statistics (maximum, minimum, and percentile) and other analytical methods. The result shows that the traffic signs are not sufficient in amount and they have several problems.

5.2. Conclusion

The aim of this research was to answer four basic questions in relation to the traffic signs in the major roads of Arada Sub-city. The first one was to identify what type of traffic signs are installed in the sub-city while the second one was to check the condition of the existing traffic signs, and the third question checks the causes of failure for problematic traffic signs followed by the last question which asks what kind of remedial measure can be taken for the problems observed. Based on the findings of the study, the following conclusions have been drawn:

- ❖ The number of signs posted in Arada Sub-city is not sufficient; from the four type of traffic signs (warning, regulatory, obligatory, and informative signs) that are posted in the sub-city, the vast majority of the signs are regulatory signs and even from these regulatory signs most of them are R29 signs while the number of other types of signs in the sub-city is significantly low. In general, traffic signs that can minimize traffic accidents and congestions are not posted in the sub-city in a sufficient amount. In addition, the height of the traffic signs is not standardized and varies to a great extent. The age of the traffic signs is not known because it is not written in the back of the traffic sign plates or posts according to the rule and regulation of traffic signs.
- ❖ Though the visibility and legibility of the traffic signs is not in a critical condition as most of the signs are visible and legible to road users, their condition is in a critical stage. This is because more than half of the traffic signs posted are either in medium or poor condition which shows that they have different problems. In some cases more than one problem was observed in individual traffic signs.
- ❖ Eleven types of causes of failure were identified among the traffic signs that are in medium and poor condition. From these problems posts which are loose in their foundation take the leading place while signs which are damaged due to accident or other harm take the second place followed by sign plates that are loose.
- ❖ Two major remedial measures were suggested for the problems observed. The first one specifies the type of traffic signs that should be posted in each of the nine sites specifically and the type of signs that should be posted throughout the whole sub-city in general. The second remedial measure forwards the solution for the causes of failures that are observed in each sign in each of the nine sites.

5.3. Recommendation

In light of the research findings which show that there are several problems in relation to the traffic signs in Arada Sub-city, the following recommendations are made:

- Traffic signs are not intended to show only parking or non-parking areas, they have much more use other than that. Therefore, different types of traffic signs which can minimize traffic accidents and decrease traffic congestions to a great length should be posted throughout the sub-city. Moreover, equal attention should be given to all the four signs as each of them has their own specific purpose and they can play a great role in the traffic flow.
- Traffic signs should be produced and installed according to international standards and quality as this helps the traffic signs to be more effective and give service for a longer time. Their height, legibility, visibility, their position and distance from the carriageway should be considered well when they are produced and posted. The sign posts should also be installed in a good foundation so that they will not be easily uprooted; the signs should be bolted to the post according to the standard so that they will not be loose and fall from the post.
- Traffic signs must be inspected at least twice a year to see if there are problems and immediate solution should be give to the problems observed. Traffic signs should be regularly cleaned and taken care of. Other obstacles that hide them or hinder their work such as trees and bushes or grasses should be regularly cleared from their areas.
- Regular assessment should be made to see what types of signs are important for the specific roads, what type of signs should be posted and what type should be uprooted as the city is undergoing through a massive change
- Continuous and rigorous education must be given to the society in general and the drivers in particular to obey the traffic signs and to take care of them so that they can give longer service.
- All the traffic signs should be available in a modern and computerized system as this helps to get anyone full information about the signs and to make the work of the concerned bodies easier in conducting sign inventory.

Reference

- [1] Jemil Awel. GIS Based Road Network Analysis in the Sub-city of Arada. Department of Earth Sciences GIS and Remote Sensing. A Master's Thesis. Addis Ababa University. 2007.
- [2] European Union Road Federation (ERF). Road Asset Management. 2014.
- [3] Harris, E.A. Sign Maintenance Strategies for Agencies to Comply With Proposed FHWA Minimum Retroreflectivity Standards. Department of Civil, Construction, and Environmental Engineering. Proposal for Degree of Doctor of Philosophy. North Carolina State University. 2007.
- [4] Stephen, J.H. Assessment of Road Signs for Retroreflectivity. Paper 209. Australia. 2006.
- [5] The Federal Democratic Republic of Ethiopia Ministry of Transport. Transport Policy of Addis Ababa. Addis Ababa. 2011.
- [6] S. Pasagic, A. Scukanac. Historical Development of Traffic Signs.
- [7] Arada Sub City Integrated Land Information Office. 2014. pg 22
- [8] Arada News (2007) Monthly edition of Arada Magazines, Hedar edition 2007.
- [9] Traffic Engineering and Safety Unit Design Branch, Department of Roads Ministry of Works and Transport His Majesty's Government of Nepal. Traffic Signs Manual. 1997.
- [10] Boggs, W.B. An Analysis of Traffic Sign Performance for the Establishment of a Maintenance Plan. A Master's Thesis. Utah State University. 2012.
- [11] Harris E, Rasdorf W, Hummer J and Yeom C. Analysis of Traffic Sign Asset Management Scenarios. 2007.
- [12] Hussain, T.K. Development of Traffic Sign Asset Management System in Indian Context. Department of civil Engineering. A Master's Thesis. Rourkela National Institute of Technology. 2014.
- [13] Aydin, U.K. Traffic Sign Recognition. Department of Electrical and Electronics Engineering. A Master's Thesis. Middle East Technical University. 2009.
- [14] Zhang T and Chan A. Traffic Sign Compression: a Review of Influential Factors and Future Direction for Research. Hong Kong. 2013.
- [15] Brimley B and Carlson P. The Current State of Research on the Long-Term Deterioration of Traffic Signs. Submitted for Presentation at the Transportation Research Board 92nd Annual Meeting and publication in the Transportation Research Record. Washington, DC. 2013.

- [16] Chan J, Gonzalez P and Perez E. Designing Traffic Signs: A Case Study on Driver Reading Patterns and Behavior.
- [17] Bangladesh Road Transport Authority. Bangladesh Road Sign Manual. Volume 1 of 2. 2000
- [18] Department for Transport London. Know Your Traffic Sign. fifth edition .2007.
- [19] British Columbia Ministry of Transportation and Highway. Manual of Standard Signs and Pavement Markings. 2000.
- [20] L. R Kadiyali. Traffic Engineering and Transportation Planning. Khanna Publishers, New Delhi, 1987.
- [21] Department of Transport an Roinn Iompair .Traffic Signs Manual. 2010.
- [22] Ethiopia Road Authority Standard Technical Specification .Series 9000: Ancillary Works. 2002.
- [23] Zulkifli M et .al .Journal of Geographic Information System. Paper no 2, 215-219. 2010.
- [24] Federal Negarit Gazeta .No 89, page 6144. August 26th 2011.

Appendices

Appendix A: Interview for Arada Sub-city Traffic Police office

ለአራዳ ከ/ከተማ ትራፊክ ፖሊስ ጽ/ቤት የተዘጋጀ ቃለመጠየቅ

1. አራዳ ክፍለ ከተማ ላይ የሚደርሱ አደጋዎች ከሌላው ክፍለ ከተማ አንጻር ሲታዩ ምን ያህል ናቸው?
2. የመንገድ ላይ ምልክቶች በአግባቡ አለመኖር ምን ያህል ለአደጋ ተጋላጭ ያደርጋል?
3. አራዳ ክፍለ ከተማ ላይ በቂ የሆኑ የመንገድ ላይ ምልክቶች አሉ ብለው ያስባሉ?
4. የለም ከተባለ ምክንያቱ ምንድነው?
5. የእናንተ ጽ/ቤት ስለ መንገድ ላይ ምልክቶች ያሰበው ወይም ሊሰራ ያቀደው አዲስ ነገርና እነሱን ለመቆጣጠር የሚመችበት እስትራቴጂ ካለ ሰፊ ያለ ማብራሪያ ቢሰጡኝ ?
6. አራዳ ለሌሎቹ ከ/ከተማዎች መሀል እንደመሆኑ መጠን እና በዚህ ምክንያት በጣም የተጨናነቀ የትራፊክ ፍሰት እንደመኖሩ ከመንገድ ላይ ምልክቶች ጋር በተያያዘ ይህንን ጭንቅንቅ ለመቀነስ እና በዛ ምክንያት የሚጠፉ ሰዎችን ለመቀነስ የታቀደ ነገር ካለ?
7. የመንገድ ላይ ምልክቶች ያላቸው ጠቀሜታ እና ለትራፊክ ፖሊስ ምን ያህል ስራን መቀነስ እንደሚችሉ ሰፊ ያለ ማብራሪያ ቢሰጡኝ?
8. የመንገድ ላይ ምልክቶችን በአግባቡ በማስቀመጥ የትራፊክ አደጋን ምን ያህል ለመቀነስ ታቅዷል?
9. እዚህ ክፍለ ከተማ ላይ አሽከርካሪም ሆነ እግረኛ እነዚህን ምልክቶች ምን ያህል ያከብራሉ? ያለከበሩትስ ምን አይነት እርምጃ ትወስዳላችሁ?
10. እዚህ ክፍለ ከተማ ላይ መረጃ ለመሰብሰብ ባደረኩት ጥረት ላይ እንደተመለከትኩት መቆም ከሚከለክሉ እና ከሚፈቅዱ ውጭ ሌላ ምልክቶች የሉም ማለት ይቻላል። ያሉትም እየተከበሩ አይደለም ይህንን እንዴት ለመቅረፍ ታስቧል ይህ ደግሞ ላደጋ ተጋላጭነትን በጣም የሰፋ ያደርገዋል እና ይህንን ኃላፊነት ማን ነው መውሰድ ያለበት ከእንተስ ምን ይጠበቃል ይላሉ ሰፊ ያለ ማብራሪያ ቢሰጡኝ?
11. ከማድረሱ አደጋዎች ምን ያህሉ ይሆናሉ ምልክቶችን ካለማክበር ወይም ተገቢው ምልክቶች በቦታው ባለመኖራቸው አለዚያ ደግሞ በተገቢው አገልግሎት በለመስራታቸው ምክንያት የሚከሰቱት ይህን ሰፊ አድርገው ቢያብራሩኝ?
12. ከመንገድ ላይ ምልክቶች ጋር በተያያዘ ጥናታዊ ጽሁፍ በስራ ምን ያህል ይጠቅማችኋል ሰፊ ያለ ማብራሪያ ቢሰጡኝ?

Translation of Interview Questions for Arada Sub-city Traffic Police Office

1. How much traffic accidents occur in Arada Sub-city compared to other sub-cities?
2. How much risk of traffic accidents is created by the absence of traffic signs?
3. Do you believe there are sufficient traffic signs in Arada Sub-city?
4. If there aren't enough, what is the reason?
5. Can you tell me if your office has any plans regarding traffic signs for the future and what kind of strategies you have for monitoring and managing them?
6. Arada Sub-city is located at the center of other sub-cities, and I understand that you have a lot of traffic congestion as a result. Considering this, do you have any planned strategies to ease this problem and reduce the time wasted in traffic jams?
7. Can you elaborate the importance of traffic signs and their value in reducing the work burden of traffic police officers?
8. What has been done so far with regard to the proper installation of traffic signs so as to reduce traffic accidents.
9. How well are traffic laws (as denoted by traffic signs) complied with by both drivers and pedestrians in your sub-city? And what kinds of penalties are imposed on transgressors?
10. While researching this issue in this sub-city, I have encountered traffic signs that deal mostly with parking and no parking areas and not much else. Even the ones that exist are not obeyed. Since this increases the risk of traffic accidents, what is being done to relieve this problem? Who is responsible for these issues, and what is expected of your office in all of this?
11. How many of the traffic accidents that occur in your sub-city do you think result from disregard to traffic signs or the absence and/or damage of these traffic signs?
12. Can you explain how useful studies on traffic signs can be to your work?

Appendix B: Interview for Addis Ababa Traffic Management Agency

ለአዲስ አበባ ትራፊክ ማኔጅመንት ኤጀንሲ የተዘጋጀ ቃለ መጠየቅ

1. የመንገድ ላይ ምልክቶች አስፈላጊነት ምን ያህል እንደሆነ ሰፊ ያለ ማብራሪያ ቢሰጡኝ
2. የመንገድ ላይ ምልክቶችን በተመለከተ ኃላፊነት ወስዶ የሚሰራ በፊት መንገዶች ባልሰጠግን ነበር አሁን ግን ሙሉ ለሙሉ ኃላፊነቱ እናንተ ወስዳችኋል እና ይህን ኃላፊነት ከመቼ ጀምሮ ነው ወደ እናንተ የመጣው በተጨማሪም ምን አይነት የአሰራር ዘዴ ዘርግታች ለመሰራት እያሰባችሁ ነው?
3. የመንገድ ላይ ምልክት አንዱ የመንገድ ላይ ንብረት ወይም ሀብት ነው ይህንን ማስተዳደርና ንብረትን በአግባቡ ተቆጣጥረው ውጤታማ ከመሆን አንጻር ምን አይነት ዘዴ እየተጠቀማችሁ ነው ወይስ ለወደፊት ገና እየታሰበበት ነው ሰፊ ያለ ማብራሪያ ቢሰጡኝ ?
4. በአሁኑ ሰአት ያሉ የመንገድ ላይ ምልክቶች ምን አይነት ሁኔታ ላይ እንዳሉ በተለይ ደግሞ አራዳ ክፍለ ከተማ ላይ መረጃ ቢሰጡኝ ?
5. መረጃ ለመስብሰብ በተዘጋገቡበት ጊዜ እንዳየሁት አራዳ ክ/ከተማ ላይ ምልክቶች አሉ ብሎ መናገር ይከብዳል ያሉትም ምልክቶች መቆም የሚከለክሉ ናቸው እነሱም አንዳንድ ቦታዎች ላይ እየተከበረ አይደለም በዚህ ዙሪያ ምን ልትሰሩ ታስባላችሁ እና ስለዚህ ጉዳይ የሚሉኝ ነገር ካለ ?
6. እንዳየሁት ከሆነ በተጨማሪ መረጃ የሚሰጡ ምልክቶች ምንም የለም እነዚህ ደግሞ አስፈላጊ ናቸው በዚህ ላይ የሚሰጡኝ አስተያየት ካለ
7. የመንገድ ላይ ምልክቶች አለመኖራቸው ወይም ደግሞ በአግባቡ አለመተካላቸው ለአደጋ ምን ያህል አጋላጭ ነው ይላሉ ሰፊ ያለ ማብራሪያ ቢሰጡኝ ?
8. ከዚህ ጋር በተያያዘ ወደፊት እዚህ ላይ ምን ሊሰራ ታቀደ አደጋን ከመቀነስ አንጻር ?
9. የመንገድ ላይ ምልክቶች ጥራትና እስታንዳርድ በተመለከተ ለምሳሌ :- ቁመታቸው አንጻራቸው ማለት ይቻላል እና በዚህ ዙሪያ ወደፊትም ምን ታስባላችሁ ::
10. Asset management system ለመተግበር ልትጠቀሙበት ያሰባችሁት ሰፍት ዌር አለ ?
11. Asset management system በተለይ ደግሞ የመንገድ ላይ ምልክቶች ላይ በምን አይነት ሁኔታ ላይ ነው እየተተገበረ ያለው ?
12. አራዳ ክ/ከተማ ከሌሎቹ መሀል እንደመሆኑ መጠን እና ቢዝነስ የሚካሄድበት ቦታ እንደመሆኑ የመንገድ ምልክቶች ላይ ምን ሊሰራ ታስቧል?
13. ከመንገድ ላይ ምልክቶች ጋር በተያያዘ ጥናታዊ ጽሑፍ ቢሰራ ምን ያህል ይጠቅማችኋል ሰፊ ያለ ማብራሪያ ቢሰጡኝ ?

Translation of the Interview Questions for Addis Ababa Traffic Management Agency

1. Can you explain the importance of traffic signs in detail?
2. When was the responsibility of traffic signs transferred from AACRA to your organization, AATMA? In addition, what kind of system are you planning to use in your work?
3. Since traffic signs are part of road assets what kind of system or method are you using or planning on using to manage and control these signs so that you can be effective?
4. Can you give me information about the condition of the traffic signs in the city and specifically in Arada Sub-city?
5. In an attempt to collect data I found that there are very few signs in Arada Sub-city and most of these signs are no-parking signs which are not even abided. Can you give me explanation about this problem and what you are planning to do about it?
6. In addition I could not find any information sign except two throughout the whole Arada Sub-city, can you give me a comment as to why this is so?
7. How much could the unavailability of traffic signs or their improper installation cause traffic accidents or expose people to traffic accidents?
8. In relation to this, what are you planning to do in the future in terms of decreasing traffic accidents?
9. Do you have the standard and quality for the traffic signs such as their height, their retroreflectivey, their visibility and legibility, and their installation place and condition? What are you planning to do in this area in the future?
10. Do you have a plan to use any software to apply asset management system?
11. What kind of asset management system are you using for traffic signs?
12. What do you intend to do about traffic signs in Arada Sub-city since the sub-city is the center for high business flow and many other sub-cities?
13. Would it be helpful if you get a study conducted in the area of traffic signs?

Appendix C: Questionnaire for Arada Sub-city Traffic Police officers

በጅማ ዩኒቨርሲቲ highway engineering MSC program . Assessment of Traffic Signs and its Remedial Measure በሚለው ርዕስ በተማሪ አስኳል ግርማ ለሚዘጋጀው ጥናታዊ ጽሑፍ ለአራዳ ከፍለ ከተማ ትራፊክ ፖሊስ ጽ/ቤት ላሉ ትራፊክ ፖሊሶች የተዘጋጀ መጠይቅ።

ቀን _____

የሚሰሩበት የስራ መደብ _____

የሚሰሩበት አካባቢ _____

እባክዎትን ከዚህ በታች ላሉት ጥያቄዎች አግባብ ያለው መልስ ከእውነታው ጋር እንዲስጡኝ ስል በትህትና እጠይቃለሁ ስለትብብርዎ አመሰግናለሁ።

ጥያቄ

1. ስለ መንገድ ላይ ምልክቶች ምን ያህል ያውቃሉ?
 - ሀ. አዎ በደንብ
 - ለ. በከፊል
 - ሐ. ምንም አላቅም
2. የገኛው መልስ ምንም አላቅም ከሆነ ምክንያቶች ምንድነው?
 - ሀ. በመንገድ ላይ ምልክቶች በቂ ስልጠና አለማግኘት
 - ለ. የመንገድ ላይ ምልክቶች አስፈላጊነት እምብዛም አይደለም ብሎ ማሰብ
 - ሐ. ሌላ መልስ ካለ ይግለጹት

3. የመንገድ ላይ ምልክቶች ምን ያህል አስፈላጊ ናቸው?
 - ሀ. እጅግ በጣም
 - ለ. በጣም
 - ሐ. አያስፈልጉም
4. የገኛው ጥያቄ መልስ አያስፈልግም ከሆነ ምክንያቱም ይገለጹ? _____

5. የመንገድ ላይ ምልክቶች ምን ያህል ፐርሰንት አደጋን ይቀንሳል ብለው ያስባሉ ?
 - ሀ 75-100%
 - ለ. 50-74%
 - ሐ. 25-49%
 - መ. ከ25% በታች
6. በአራዳ ከፍለ ከተማ መንገዶች ላይ የመንገድ ላይ ምልክቶች የሚያስፈልገውን ያህል አሉ ብለው ያስባሉ?
 - ሀ. አዎ
 - ለ. በከፊል
 - ሐ. ምንም የለም

7. ምልክቶች አሉ ብለው ካሉ በምን አይነት ሁኔታ እና ቦታ እንደሚገኙ የሚያሳውቅ መረጃ ያገኛሉ?
 - ሀ. አዎ በደንብ
 - ለ. በከፊል
 - ሐ. ምንም አይነት መረጃ አናገኝም
8. ምንም አይነት መረጃ አናገኝም ካሉ ምክንያቱ ምን እንደሆነ ቢገልጹት?

9. የመንገድ ላይ ምልክቶች ሚተክለው አካል እና መቆጣጠረው የማን ኃላፊነት ነው ብለው ያስባሉ?
 - ሀ. አዲስ አበባ ትራፊክ ማኔጅመንት ኤጀንሲ
 - ለ. አዲስ አበባ ትራፊክ ፖሊስ ጽ/ቤት
 - ሐ. የአዲስ አበባ መንገዶች ባለስልጣን
 - መ. የየክፍለ ከተማው ትራፊክ ፖሊስ ጽ/ቤት
10. የመንገድ ላይ ምልክቶች አስተዳራጭ ስትራቴጂ ጠንካራ ነው ብለው ያስባሉ?
 - ሀ. አዎ በደንብ
 - ለ. በከፊል
 - ሐ. አይደለም
11. እርስዎ በሚሰሩበት አካባቢ በቂ የሆነ የመንገድ ላይ ምልክቶች አሉ
 - ሀ. አዎ
 - ለ. በከፊል
 - ሐ. የለም
12. እርስዎ በሚሰሩበት አካባቢ የመንገድ ላይ ምልክቶች ባለመኖራቸው ወይም ደግሞ በአግባቡ አገልግሎት ባለመስጠታቸው ምን ያህል አደጋ ይደርሳል?
 - ሀ. እጅግ ብዙ
 - ለ. በጣም ብዙ
 - ሐ. ትንሽ
 - መ. ምንም
13. የመንገድ ላይ ምልክቶች በአሽከርካዎች እና በአግረኞች ምን ያህል ይከበራሉ?
 - ሀ. 75--100%
 - ለ. 50-74%
 - ሐ. 25--49%
 - መ. ከ25% በታች
14. ምልክቶችን ለሚያከብሩ ምን አይነት እርምጃ ቢወስድ ጥሩ ነው ይላሉ?
 - ሀ. ህብረተሰቡን አሽከርካዎችን ጨምሮ ማስተማር
 - ለ. ህጉን ለጣሱ ቅጣት መቅጣት
 - ሐ. መንጃ ፍቃድ ለሚያስተምሩ እና ለሚሰጡ አካላት ስለምልክቶች ትምህርት እንዲሰጡ ማድረግ
 - መ. ሀ እና ሐ

15. የመንገድ ላይ ምልክቶች ወድቀው፣ ተሰብረው እና አደጋ ደርሶባቸው ሲያዩ ለሚመለከተው አካል አሳውቀው ያውቃሉ

ሀ. አዎ

ለ. ይህ የኔ ስራ አይደለም

ሐ. አሳውቄ አላቅም

16. የመንገድ ላይ ምልክቶች አንዱ የመንገድ ሀብት እንደመሆኑ መጠን አተካክል ፣ ቁጥጥር ፣ ያሉበት ሁኔታ እና ቦታ በምን አይነት መንገድ ብናስተዳራቸው እና ብንከበከባቸው ብለው ያስባሉ አጠር ያለ ማብራሪያ ይስጡን?

17. ከመንገድ ላይ ምልክቶች ጋር በተያያዘ አደጋን ለመቀነስ ምን አይነት እርምጃ ቢወስድ ጥሩ ነው ብለው ያስባሉ?

ጊዜዎን ስለሰጡኝ አመሰግናለሁ!

“ማንም ሰው በመኪና አደጋ እንዳይሞት ሁላችንም የበኩላችንን አስተዋጽኦ እንወጣ!”

Translation for the Questionnaire for Arada Sub-city Traffic Police Officers

Questionnaire prepared by Asqual Girma in partial fulfillment of MSc. program in Highway Engineering at Jimma University in title Assessment of Traffic Signs and Its Remedial Measures: A Case of Arada Sub-city for Traffic Police Officers at the Arada Subcity Traffic Police office

Date _____

Job Title _____

Work area _____

You are requested to give your honest responses for the following questions. Thank you in advance for your kind cooperation.

Questions

1. How much do you know about traffic signs?
 - a. Yes, very well
 - b. Yes, partially
 - c. I don't know
 2. If your response for question number 1 is "I don't know", what is the reason?
 - a. I didn't get enough training in traffic signs
 - b. I don't think knowing traffic signs is necessary
 - c. Please disclose any other reasons
-
3. How important are traffic signs?
 - a. Very much important
 - b. Important
 - c. Not important
 4. If your response is "Not important" for question number 3, what is your reason for it?
-
5. How effective do you think traffic signs are in preventing traffic accidents?
 - a. 75 – 100%

- b. 50 – 74%
 - c. 25 – 49%
 - d. Below 25%
6. Do you believe there are enough traffic signs in Arada Subcity?
- a. Yes
 - b. Partially
 - c. No
7. If your answer is “yes” or “Partially”, do you have information regarding their locations and conditions?
- a. Yes
 - b. Partially
 - c. No
8. If your answer is “No”, what is the reason?
-
9. Whose responsibility is installing and administering traffic signs?
- a. Addis Ababa Traffic Management Agency
 - b. Addis Ababa Traffic Police Administration
 - c. Addis Ababa Roads Authority
 - d. Traffic Police Administrations of each Subcity
10. Do you think the strategic management of traffic signs in our city is effective?
- a. Yes
 - b. Partially
 - c. No
11. Are there sufficient traffic signs in your local area?
- a. Yes
 - b. Partially
 - c. No
12. Are you aware of traffic accidents that came about as a result of faulty or missing traffic signs in your working area?
- a. Yes, many
 - b. Yes, some
 - c. Yes, few
 - d. No
13. Do drivers and pedestrians comply with traffic signs?

- a. 75 -100%
 - b. 50 – 74%
 - c. 25 – 49%
 - d. Below 25%
14. What measures do you think should be taken on those who do not comply with traffic signs?
- a. Educating the society including drivers
 - b. Fining transgressors
 - c. Training institutions and licensing offices should give education on traffic signs
 - d. All
15. Have you ever reported damaged traffic signs to designated bodies?
- a. Yes
 - b. It is not my responsibility
 - c. I have never done so
16. Since traffic signs are part of our traffic assets, what kind of management do you think should be implemented to supervise them?

17. With regard to traffic signs, what should be done to reduce traffic accidents?

Thank you for your time and cooperation.

“Let us do our part to prevent traffic deaths!”

Appendix D: Questionnaire for Addis Ababa Traffic Management Agency

Agency

በጅማ ዩኒቨርሲቲ highway engineering MSC program . Assessment of Traffic Signs and its Remedial Measure በሚለው ርዕስ በተማሪ አስኳል ግርማ ለሚዘጋጀው ጥናታዊ ጽሑፍ ለአዲስ አበባ ትራፊክ ማኔጅመንት ኤጀንሲ ላሉ በምልክቶችና ተያያዥ ጉዳይ ለመሰሩ ስራተኞች የተዘጋጀ መጠይቅ ::

ቀን _____

የሚሰሩበት የስራ መደብ _____

ምን ያህል ጊዜ እዚህ የስራ መደብ ላይ ቆይተዋል _____

እባክዎትን ከዚህ በታች ላሉት ጥያቄዎች አግባብ ያለው መልስ ከእውነታው ጋር እንዲሰጡኝ ስል በትህትና እጠይቃለሁ ስለትብብርዎ አመሰግናለሁ::

ጥያቄ

1. ስለ መንገድ ላይ ምልክቶች ምን ያህል ያውቃሉ?
 - ሀ. አዎ በደንብ
 - ለ. በከፊል
 - ሐ. ምንም አላቅም
2. የነኛው መልስ ምንም አላቅም ከሆነ ምክንያቱ ምንድነው?
 - ሀ. በመንገድ ላይ ምልክቶች በቂ ስልጠና አለማግኘት
 - ለ. የመንገድ ላይ ምልክቶች አስፈላጊነት እምብዛም አይደለም ብሎ ማሰብ
 - ሐ. ሌላ መልስ ካለ ይግለጹት

3. የመንገድ ላይ ምልክቶች ምን ያህል አስፈላጊ ናቸው?
 - ሀ. በጣም አስፈላጊ
 - ለ. አስፈላጊ
 - ሐ. አያስፈልጉም
4. የነኛው ጥያቄ መልስ አያስፈልግም ከሆነ ምክንያቱን ይግለጹ? _____

5. የመንገድ ላይ ምልክቶች ምን ያህል ፐርሰንት አደጋን ይቀንሳሉ ብለው ያስባሉ ?
 - ሀ 75-100%
 - ለ. 50-74%
 - ሐ. 25-49%
 - መ. ከ25% በታች
6. በአራዳ ክፍለ ከተማ መንገዶች ላይ የመንገድ ላይ ምልክቶች የሚያስፈልገውን ያህል አሉ ብለው ያስባሉ?
 - ሀ. አዎ
 - ለ. በከፊል
 - ሐ. ምንም የለም
7. ምልክቶች አሉ ብለው ካሉ በምን አይነት ሁኔታ እና በታ እንደሚገኙ የሚያሳውቅ መረጃ ያገኛሉ?

ሀ. አዎ በደንብ

ለ. በከፊል

ሐ. ምንም አይነት መረጃ አናገኝም

8. ምንም አይነት መረጃ አናገኝም ካሉ ምክንያቱ ምን እንደሆነ ቢገልጹ?

9. በአጠቃላይ አዲስ አበባ ላይ ያሉትን የመንገድ ላይ ምልክቶች የምትቆጣጠሩት እና በምን ሁኔታ ላይ እንዳሉ የምታውቁት እንዲሁም ብዛታቸውን ምን ያህል እንደሆኑ የምትለዩበት መንገድ በምን አይነት ሁኔታ ነው ?

ሀ. ኮምፒተራይዝ በሆነ መንገድ

ለ. በየቦታ ያሉ ምልክቶች እዛው ድረስ ሄዶ መረጃ በመሰብሰብ

ሐ. አይ እስካሁን ምንም አይነት መንገድ አልተጠቀምንም

መ. ለወደፊት እያሰብኩት ነው

ሠ. ሌላ ተጨማሪ መልስ ካለ ይገለጹልን

10. የመንገድ ላይ ምልክቶች አስተዳደራዊ ስትራቴጂ ጠንካራ ነው ብለው ያስባሉ?

ሀ. አዎ በደንብ

ለ. በከፊል

ሐ. አይደለም

11. የመንገድ ላይ ሀብቶችን በተለይ ደግሞ የመንገድ ላይ ምልክቶች በእናንተ መ/ቤት በአግባቡ ክትትል ይደረግላቸዋል?

ሀ. አዎ በደንብ

ለ. በከፊል

ሐ. ለወደፊት እየታሰበበት ነው

መ. ሌላ መልስ ካለ _____

12. ይህ ኃላፊነት ወደ እዚህ መ/ቤት ከተላለፈ ምን ያህል ጊዜ ሆኖታል? _____

13. የመንገድ ላይ ምልክቶች የጥራት መለኪያዎች (ቁመት፣አንጻባራቂነት፣ አተካከል በታ እና ወዘተ) ተግባራዊ ይደረጋሉ? ይህ ማለት እስታንዳርዳቸውን የጠበቁ ናቸው?

ሀ. አዎ

ለ. በከፊል

ሐ. ምንም

14. የ13ኛው መልስ አዎ ወይም በከፊል ከሆነ ስለሁኔታው በዝርዝር ይግለጹልን? _____

15. የመንገድ ላይ ምልክቶች ወድቀው፣ ተሰብረው እና አደጋ ደርሶባቸው ሲያዩ ለሚመለከተው አካል አሳውቀው ያውቃሉ?

ሀ. አዎ

ለ. ይህ የኔ ስራ አይደለም

ሐ. አሳውቄ አላቅም

16. የመንገድ ላይ ምልክቶች የመንገድ ሀብት እንደመሆናቸው መጠን አተካክል ፣ ቁጥጥር ፣ ያሉበት ሁኔታ እና ቦታ በምን አይነት መንገድ ብንከታተል እና ብንከበከባቸው ብለው ያስባሉ አጠር ያለ ማብራሪያ ይሰጡን?

ጊዜዎን ስለሰጡኝ አመሰግናለሁ!

“ማንም ሰው በመኪና አደጋ እንዳይሞት ሁላችንም የበኩላችንን አስተዋጽኦ እንወጣ!”

Translation for the Questionnaire for Addis Ababa Traffic Management Agency Workers

Questionnaire prepared by Asqual Girma in partial fulfillment of MSc. Program in **Highway Engineering** at **Jimma University** under the title Assessment of Traffic Signs and Its Remedial Measures for officers of the Addis Ababa Traffic Management Agency dealing with traffic signs and related issues.

Date: _____

Job title (Position) _____

How long have you worked in this capacity/position? _____

Please respond to the following questions with candid and relevant answers.

Questions

1. How much do you know about traffic signs?
 - a. Very well
 - b. Partially
 - c. None at all

2. If your answers for question 1 is C, what are the reasons for it?
 - a. I did not get sufficient training about traffic signs.
 - b. I don't believe traffic signs are very useful.
 - c. If any other reasons, please specify.

3. How important are traffic signs?
 - a. Very important
 - b. Important

- c. Not important
4. If your response for question 3 is C, what is the reason?
-
5. How successful (in percent) do you think traffic signs are in reducing traffic accidents?
- a. 75 – 100%
 - b. 50 – 74%
 - c. 25 – 49%
 - d. Below 25%
6. Do you think there are enough traffic signs on the roads of the Arada Subcity?
- a. Yes
 - b. Some
 - c. None
7. If you think there are enough traffic signs, do you have information regarding their locations and conditions?
- a. Yes, I have enough information.
 - b. I have some information.
 - c. I don't have any information.
8. If you don't have any information, what do you think is the reason?
-
9. How do you and your colleagues monitor and identify the total number of traffic signs on the streets of Addis Ababa and manage their conditions?
- a. Using a computerized system
 - b. By manually collecting data from location

- c. We have not used any methods so far
 - d. We are planning that for the future
 - e. If any other methods, please specify.
-

10. Do you believe the traffic signs management strategy in place is robust?

- a. Yes
- b. Maybe
- c. No

11. Is there a proper follow-up and management of traffic assets, especially traffic signs?

Are traffic assets, especially traffic signs properly managed?

- a. Yes, very well.
 - b. Partially.
 - c. It is planned for the future.
 - d. If any other response, please specify.
-

12. How long has your agency been responsible for these issues?

13. Are the standards regarding the height, reflectivity, installing, etc. of traffic signs maintained?

- a. Yes
- b. Partially
- c. No

14. If your response to question 13 is B, please explain the situation further.

15. Have you ever reported damaged traffic signs to designated bodies?

- a. Yes
- b. It is not my responsibility
- c. I have never done so

16. Considering traffic signs are essential traffic assets, what are your beliefs about their installation, management, monitoring of their conditions? Please explain.

Thank you for your time and cooperation.

“Let us do our part to prevent traffic deaths!”

Appendix E: Codes for the Traffic Signs in Their Type

ADDIS ABABA ROAD TRAFFIC MANAGEMENT AGENCY ROAD SIGNS INDEX MAP									
WARNING SIGNS			REGULATORY SIGNS			OBLIGATORY SIGNS		INFORMATIVE SIGNS	
W1	W31	W61	R1	R31		O1		I1	
W2	W32		R2	R32		O2		I2	
W3	W33		R3	R33		O3		I3	
W4	W34		R4			O4		I4	
W5	W35		R5			O5		I5	
W6	W36		R6			O6		I6	
W7	W37		R7			O7		I7	
W8	W38		R8			O8		I8	
W9	W39		R9			O9		I9	
W10	W40		R10			O10		I10	
W11	W41		R11			O11		I11	
W12	W42		R12			O12		I12	
W13	W43		R13			O13		I13	
W14	W44		R14			O14		I14	
W15	W45		R15			O15		I15	
W16	W46		R16					I16	
W17	W47		R17					I17	
W18	W48		R18						
W19	W49		R19						
W20	W50		R20						
W21	W51		R21						
W22	W52		R22						
W23	W53		R23						
W24	W54		R24						
W25	W55		R25	R34					
W26	W56		R26						
W27	W57		R27						
W28	W58		R28						
W29	W59		R29						
W30	W60		R30						●

Appendix F: Codes for Causes of Failure

01. Accident or other harm
02. Signs that are hidden by trees, bushes and other objects
03. Long age of sign
04. Flaking or faded sign faces and painted surfaces
05. Corrosion of the sign plates and posts
06. Signs that are in the wrong location
07. The area of installed sign surrounded by grass, water or other dusts
08. Dust and car smoke on a plate
09. Posts which are loose in their foundations
10. The signs too long or short
11. Sign plates that are loose

Appendix G: Observation Data for All the Nine Sites**Table for collecting the data**Site Number 1 Location Sidist Kilo-Habte Giorgis Date 20/10/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R29	2.60	-	Yes	yes	-	Good
2	O4	2.10	-	Yes	Yes	-	Good
3	O4	2.10	-	Yes	Yes	9	Medium
4	W16	2.10	-	Yes	Yes	-	Good
5	R30	2.75	-	No	No	02,03,05	Poor
6	R9	2.15	-	No	No	01,05,06	Poor
7	R29	2.56	-	Yes	Yes	05,09	Medium
8	R30	2.46	-	Yes	Yes	05,03	Medium
9	R29	2.30	-	Yes	Yes	01,04	Medium
10	R31	2.50	-	No	No	01,06	Poor
11	R29	2.29	-	Yes	Yes	1	Medium
12	W30	2.60	-	Yes	Yes	7	Good
13	R29	2.30	-	No	No	01,09	Poor
14	R31	2.05	-	Yes	Yes	01,09	Medium
15	R29	1.89	-	Yes	Yes	10	Medium
16	R31	2.48	-	Yes	Yes	9	Medium
17	R29	2.70	-	Yes	Yes	01,09	Poor
18	R31	2.60	-	No	No	05,06	poor
19	R29	2.60	-	Yes	Yes	01,09	Medium
20	R29	2.40	-	Yes	Yes	01,09	Medium
21	R29	2.40	-	Yes	Yes	01,09	Medium
22	R33	2.33	-	Yes	Yes	-	Good
23	R29	2.30	-	Yes	Yes	4	Medium
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Table for collecting the dataSite Number 2 Location Habte Giorgis-Afincho Ber Date 22/10/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R29	2.63	-	Yes	Yes	09,11	Medium
2	R33	2.50	-	Yes	Yes	-	Good
3	R29	2.50	-	Yes	Yes	2	Medium
4	R29	2.53	-	Yes	Yes	07,09	Medium
5	R29	2.61	-	Yes	Yes	9	Medium
6	R29	2.47	-	Yes	Yes	-	Good
7	W28	2.28	-	Yes	Yes	-	Good
8	R29	2.40	-	Yes	Yes	-	Good
9	R28	2.61	-	Yes	Yes	9	Medium
10	R29	2.51	-	Yes	Yes	9	Medium
11	R29	2.65	-	Yes	Yes	9	Medium
12	R29	2.60	-	Yes	Yes	9	Medium
13	R29	2.41	-	Yes	Yes	9	Medium
14	R29	2.65	-	Yes	Yes	9	Medium
15	R33	2.37	-	No	No	6	Poor
16	R29	2.57	-	Yes	Yes	-	Good
17	R29	2.63	-	Yes	Yes	2	Medium
18	R29	2.61	-	Yes	Yes	9	Medium
19	R29	2.48	-	Yes	Yes	9	Medium
20	R29	2.60	-	Yes	Yes	9	Medium
21	R31	2.56	-	Yes	Yes	9	Medium
22	R29	2.69	-	Yes	Yes	9	Medium
23	W30	2.98	-	No	No	03,04,05,10	Poor
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Table for collecting the dataSite Number 3 Location Mnilik Roundabout-Semen Mazegaja Date 24/10/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R4	2.51	-	Yes	Yes	-	Good
2	R7	2.63	-	Yes	Yes	-	Good
3	R29	2.57	-	Yes	Yes	-	Good
4	R31	2.48	-	Yes	Yes	9	Medium
5	R29	2.66	-	No	No	11	Poor
6	R31	2.69	-	Yes	Yes	9	Medium
7	R29	2.53	-	Yes	Yes	9	Medium
8	R29	2.28	-	No	No	9	Poor
9	R29	2.62	-	Yes	Yes	9	Medium
10	W30	2.61	-	Yes	Yes	9	Medium
11	R33	2.53	-	No	No	09,11	Poor
12	R33	2.47	-	Yes	Yes	-	Good
13	R29	2.50	-	Yes	Yes	05,09	Medium
14	R31	2.21	-	No	No	09,11	Medium
15	R31	2.63	-	Yes	Yes	9	Medium
16	R29	2.70	-	Yes	Yes	11	Medium
17	R29	2.61	-	Yes	Yes	-	Good
18	R31	2.16	-	Yes	Yes	11	Medium
19	R9	2.29	-	Yes	Yes	09,11	Poor
20	R4	2.54	-	Yes	Yes	02,06,09	Poor
21	R29	2.53	-	No	No	2	Poor
22	R30	2.30	-	No	No	02,09	Poor
23	W30	2.62	-	Yes	Yes	9	Medium
24	R30	2.40	-	Yes	Yes	9	Medium
25	R31	2.30	-	No	No	2	Poor
26	W30	2.17	-	Yes	Yes	03,05	Poor
27	R31	2.55	-	Yes	Yes	9	Medium
28	R29	2.35	-	Yes	Yes	9	Medium
29	R29	2.40	-	Yes	Yes	09,11	Medium
30	R29	2.48	-	Yes	Yes	-	Good
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Table for collecting the dataSite Number 4 Location Abune Petros-Enkulal Fabrica Date 27/10/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R31	2.60	-	Yes	Yes	9	Medium
2	R4	2.52	-	Yes	Yes	-	Good
3	R4	2.48	-	Yes	Yes	-	Good
4	R4	2.62	-	Yes	Yes	-	Good
5	W18	2.55	-	Yes	Yes	11	Medium
6	R31	2.54	-	Yes	Yes	09,11	Medium
7	R9	2.53	-	Yes	Yes	-	Good
8	R9	2.63	-	Yes	Yes	11	Medium
9	R30	2.48	-	Yes	Yes	-	Good
10	R29	2.58	-	Yes	Yes	9	Medium
11	R9	2.57	-	No	No	01,09	Poor
12	R30	2.54	-	Yes	Yes	-	Good
13	R30	2.67	-	Yes	Yes	-	Good
14	R31	2.58	-	No	No	09,11	Poor
15	R4	2.45	-	No	No	01,03,05	Poor
16							
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Table for collecting the dataSite Number 5 Location Sidest Kilo-Sheraten Date 29/10/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R7	2.46	-	Yes	Yes	11	Medium
2	R29	2.68	-	No	No	01,09	Poor
3	R29	2.47	-	Yes	Yes	9	Medium
4	R30	2.70	-	No	No	01,09,11	Medium
5	R30	2.70	-	No	No	01,09,11	Medium
6	R29	2.60	-	No	No	01,09,11	Poor
7	R10	2.46	-	Yes	Yes	9	Medium
8	R29	2.30	-	Yes	Yes	9	Medium
9	I3	2.15	-	Yes	Yes	01,03,05	Medium
10	R29	2.60	-	Yes	Yes	-	Good
11	R29	2.64	-	Yes	Yes	-	Good
12	R9	2.12	-	Yes	Yes	-	Good
13	R9	2.64	-	Yes	Yes	-	Good
14	R29	2.65	-	Yes	Yes	-	Good
15	R9	NA	-	Yes	Yes	-	Good
16	R29	NA	-	Yes	Yes	-	Good
17	R29	NA	-	Yes	Yes	-	Good
18	R31	2.62	-	Yes	Yes	-	Good
19	R30	2.60	-	Yes	Yes	-	Good
20	R30	2.53	-	Yes	Yes	-	Good
21	R30	2.50	-	Yes	Yes	-	Good
22	R33	2.30	-	Yes	Yes	-	Good
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Table for collecting the data**Site Number 6 _____ Location Mnilik Roundabout-Tkuranbesa Date 30/10/09**

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	O4	2.40	-	Yes	Yes	-	Good
2	O4	2.27	-	Yes	Yes	-	Good
3	O4	2.36	-	Yes	Yes	-	Good
4	O4	2.37	-	Yes	Yes	-	Good
5	O4	2.32	-	Yes	Yes	-	Good
6	R29	3.27	-	Yes	Yes	-	Good
7	R7	3.27	-	Yes	Yes	04,05,10	Medium
8	R9	2.24	-	Yes	Yes	03,05	Medium
9	R28	2.32	-	Yes	Yes	11	Medium
10	R9	2.25	-	No	No	2	Poor
11	R29	2.05	-	Yes	Yes	-	Good
12	R9	2.56	-	Yes	Yes	01,05	Poor
13	R30	2.60	-	No	No	01,09	Poor
14	R29	2.45	-	Yes	Yes	-	Good
15	R30	2.63	-	Yes	Yes	-	Good
16	R31	2.30	-	Yes	Yes	11	Medium
17	R29	2.67	-	Yes	Yes	-	Good
18	W30	2.48	-	Yes	Yes	3	Medium
19	R29	2.26	-	No	No	11	Medium
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Table for collecting the dataSite Number 7 Location Mnilik Roundabout-Kebena Date 3/11/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R29	2.73	-	No	No	01,09	Medium
2	R9	2.14	-	No	No	01,11	poor
3	R9	2.10	-	No	No	01,03,05,11	Poor
4	R9	2.48	-	Yes	Yes	-	Good
5	I3	2.60	-	No	No	6	Medium
6	R4	2.53	-	Yes	Yes	-	Good
7	R29	2.52	-	Yes	Yes	-	Good
8	R4	2.52	-	Yes	Yes	-	Good
9	R29	2.61	-	Yes	Yes	01,11	Medium
10	R29	2.67	-	Yes	Yes	01,11	Medium
11	R29	2.57	-	No	No	2	Medium
12	R31	2.13	-	Yes	Yes	01,11	Medium
13	R29	2.40	-	Yes	Yes	-	Good
14	R29	2.26	-	Yes	Yes	-	Good
15	W20	2.60	-	Yes	Yes	-	Good
16	R31	2.26	-	Yes	Yes	-	Good
17	R29	2.60	-	Yes	Yes	-	Good
18	O9	2.52	-	Yes	Yes	-	Good
19	W2	2.62	-	Yes	Yes	-	Good
20	W20	2.46	-	Yes	Yes	-	Good
21	W16	1.24	-	Yes	Yes	-	Good
22	04	2.39	-	Yes	Yes	-	Good
23	W16	1.26	-	Yes	Yes	-	Good
24	04	2.47	-	Yes	Yes	-	Good
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Table for collecting the dataSite Number 8 Location Sidst kilo-Kebena Date 6/11/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R29	2.53	-	Yes	Yes	01,09	Medium
2	R29	2.56	-	Yes	Yes	-	Good
3	R31	2.57	-	Yes	Yes	-	Good
4	R31	2.47	-	No	No	01,04,09	poor
5	R29	2.49	-	Yes	Yes	01,09	Medium
6	R4	2.74	-	Yes	Yes		Good
7	Slow	2.63	-	Yes	Yes	-	Good
8	W2	2.60	-	Yes	Yes	-	Good
9	W20	2.56	-	Yes	Yes	-	Good
10	W30	2.56	-	Yes	Yes	10	Medium
11	W28	2.51	-	Yes	Yes	4	Medium
12	W30	2.60	-	Yes	Yes	-	Good
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Table for collecting the dataSite Number 9 Location Degole Roundabout - Atklittera Date 9/11/09

No.	Code	Height (m)	Age (Manuf. date)	Visibility Yes/No	Legibility Yes/No	Cause of Failure	Condition
1	R29	2.47	-	Yes	Yes	-	Good
2	R4	2.48	-	Yes	Yes	-	Good
3	R30	2.60	-	Yes	Yes	07,09	Medium
4	R29	2.40	-	No	No	1	poor
5	R4	2.05	-	Yes	Yes	11	Medium
6	R30	2.58	-	No	No	01,11	Medium
7	R28	2.65	-	Yes	Yes	3	Medium
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Appendix H: Coordinates and Elevation of the Signs**Table for Coordinates and Elevation of the Signs**Site Number 1 Location Sidst Kilo-Habte Giorgis Date 20/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R29	38.7591	9.0428	2498	3
2	O4	38.75456	9.0443	2491	1
3	O4	38.7546	9.0445	2488	2
4	W16	38.75339	9.04401	2472	2
5	R30	38.7492	9.04403	2516	2
6	R9	38.74805	9.043665	2507	2
7	R29	38.74826	9.04389	2509	2
8	R30	38.7492	9.04449	2506	2
9	R29	38.74510	9.04196	2492	2
10	R31	38.74423	9.04136	2489	2
11	R29	38.74458	9.04166	2489	2
12	W30	38.74342	9.04065	2486	2
13	R29	38.74191	9.03937	2478	2
14	R31	38.74198	9.03929	2478	2
15	R29	38.74229	9.03877	2478	2
16	R31	38.73993	9.03543	2459	2
17	R29	38.73944	9.03478	2465	2
18	R31	38.73908	9.03446	2465	2
19	R29	38.73866	9.03383	2463	2
20	R29	38.73844	9.0334	2463	2
21	R29	38.742600	9.033044	2442	2
22	R33	38.74282	9.032901	2440	2
23	R29	38.743271	9.033403	2442	2
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Table for Coordinates and Elevation of the SignsSite Number 2 Location Habte Giorgis-Afincho Ber Date 22/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R29	38.7481925	9.0343552	2493	2
2	R33	38.7477576	9.0340881	2469	2
3	R29	38.7476432	9.0340204	2467	2
4	R29	38.7464606	9.0337638	2467	2
5	R29	38.7455375	9.0336036	2463	2
6	R29	38.7452056	9.0336122	2464	2
7	W28	38.7449	9.03362	2456	2
8	R29	38.7432907	9.0334081	2451	2
9	R28	38.7435806	9.0335998	2448	2
10	R29	38.7454192	9.0333156	2452	2
11	R29	38.74465331	9.0334682	2453	2
12	R29	38.7472960	9.0336503	2455	2
13	R29	38.7483832	9.0339155	2452	2
14	R29	38.7492529	9.0344639	2474	2
15	R33	38.7499014	9.0349618	2486	2
16	R29	38.7499434	9.0348187	2483	2
17	R29	38.7506147	9.0345574	2482	2
18	R29	38.7508360	9.034812	2482	2
19	R29	38.7521520	9.037886	2485	2
20	R29	38.7519994	9.0380043	2482	2
21	R31	38.75226	9.0382536	2482	2
22	R29	38.7522817	9.0388474	2481	2
23	W30	38.7525373	9.0391077	2485	2
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Table for Coordinates and Elevation of the Signs

Site Number 3 Location Mnilik Roundabout-Semen Mazegaja Date 24/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R4	38.74214	9.0519863	2578	2
2	R7	38.742623	9.051055	2548	3
3	R29	38.7434432	9.049952	2549	2
4	R31	38.7435462	9.0498432	2549	2
5	R29	38.7441942	9.0490316	2542	2
6	R31	38.7443282	9.0488513	2536	2
7	R29	38.7446258	9.0487779	2526	2
8	R29	38.7457	9.0471794	2520	3
9	R29	38.7453429	9.0469295	2521	2
10	W30	38.7453429	9.0469295	2521	2
11	R33	38.7452933	9.0468847	2523	2
12	R33	38.7456595	9.0473978	2527	2
13	R29	38.7456862	9.046713	2524	2
14	R31	38.7463423	9.0457182	2525	2
15	R31	38.7467810	9.0452461	2519	2
16	R29	38.7469489	9.0448131	2510	2
17	R29	38.7470671	9.044238	2506	2
18	R31	38.7475287	9.0439462	2510	2
19	R9	38.7477080	9.0432976	2504	2
20	R4	38.7477118	9.0431564	2503	2
21	R29	38.7478224	9.0431498	2502	2
22	R30	38.7484251	9.0422742	2503	2
23	W30	38.7489248	9.0410458	2501	2
24	R30	38.7490011	9.0408875	2499	2
25	R31	38.7492262	9.0404878	2497	2
26	W30	38.7504774	9.0381473	2489	2
27	R31	38.7507406	9.0381454	2492	2
28	R29	38.7503207	9.0379775	2492	2
29	R29	38.7506185	9.0378001	2491	2
30	R29	38.7511946	9.0372136	2491	2
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Table for Coordinates and Elevation of the SignsSite Number 4 Location Abunepetros-Enkulal Fabrica Date 27/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R31	38.7394799	9.0474817	2523	2
2	R4	38.7410133	9.0462933	2556	2
3	R4	38.7422340	9.0444278	2526	2
4	R4	38.7427490	9.0442466	2512	2
5	W18	38.7445037	9.0419871	2510	2
6	R31	38.7452056	9.0411621	2500	2
7	R9	38.7463614	9.0395703	2489	2
8	R9	38.7465064	9.039514	2488	2
9	R30	38.7465255	9.039617	2486	2
10	R29	38.7482192	9.0355903	2483	2
11	R9	38.7480895	9.0355903	2477	2
12	R30	38.7479102	9.0357066	2473	2
13	R30	38.7482840	9.0351601	2467	2
14	R31	38.7484175	9.035348	2467	2
15	R4	38.7484213	9.0354033	2466	2
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Table for Coordinates and Elevation of the Signs

Site Number 5 Location Sidest Kilo-Sheraten Date 29/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R7	38.7605068	9.0419862	2443	2
2	R29	38.7620891	9.0360624	2471	2
3	R29	38.7621158	9.0357553	2467	2
4	R30	38.7620929	9.0345383	2469	2
5	R30	38.7622760	9.0336885	2468	2
6	R29	38.7623218	9.0336752	2465	2
7	R10	38.7623712	9.0329684	2466	2
8	R29	38.7624362	9.0314148	2459	2
9	I3	38.7625011	9.0307004	2454	2
10	R29	38.7628825	9.0298916	2432	2
11	R29	38.7624172	9.0279164	2437	2
12	R9	38.7624057	9.0276226	2433	2
13	R9	38.7623676	9.027895	2427	2
14	R29	38.7621463	9.026645	2426	2
15	R31	38.7612995	9.0252258	2426	2
16	R30	38.7610210	9.0249263	2428	2
17	R30	38.7608379	9.0221576	2422	2
18	R30	38.7614483	9.0216511	2436	2
19	R33	38.763444	9.0211504	2433	2
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Table for Coordinates and Elevation of the Signs

Site Number 6 Location Mnilik Roundabout-Tkuranbesa Date 30/10/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	O4	38.7517744	9.0349618	2485	2
2	O4	38.7514654	9.035059	2477	2
3	O4	38.7513929	9.0347538	2477	2
4	O4	38.7517798	9.0345907	2477	2
5	O4	38.7517553	9.0346556	2479	2
6	R29	38.7512556	9.034317	2479	2
7	R7	38.7512556	9.034317	2479	2
8	R9	38.7510382	9.0336198	2466	2
9	R28	38.7507215	9.0333699	2470	2
10	R9	38.7509581	9.0334071	2472	2
11	R29	38.7510878	9.031637	2488	2
12	R9	38.7505537	9.0293813	2481	2
13	R30	38.7504126	9.0284962	2437	2
14	R29	38.7506758	9.0284352	2440	2
15	R30	38.7508741	9.0268415	2434	2
16	R31	38.7513662	9.0221375	2390	2
17	R29	38.7512938	9.0216959	2378	2
18	W30	38.7511526	9.0214213	2379	2
19	R29	38.7513701	9.0206754	2379	2
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Table for Coordinates and Elevation of the Signs

Site Number 7 Location Mnilik Roundabout-Kebena Date 3/11/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R29	38.7517477	9.0342464	2476	2
2	R9	38.7522665	9.0335388	2476	2
3	R9	38.7522932	9.0335435	2476	2
4	R9	38.7523656	9.0332068	2674	2
5	I3	38.7526746	9.0323685	2475	2
6	R4	38.7533880	9.0314348	2458	2
7	R29	38.7540471	9.0321434	2448	2
8	R4	38.7540471	9.0321434	2448	2
9	R29	38.7540136	9.0323246	2449	2
10	R29	38.7539754	9.03226871	2454	2
11	R29	38.7543531	9.0341902	2452	2
12	R31	38.7597813	9.0331954	2451	2
13	R29	38.7602695	9.0327939	2446	2
14	R29	38.7630084	9.0317016	2447	2
15	W20	38.7633212	9.0315483	2444	2
16	R31	38.7637294	9.0312164	2448	2
17	R29	38.7639659	9.0311448	2446	2
18	O9	38.7674143	9.0318621	2445	2
19	W2	38.7675059	9.0320872	2443	2
20	W20	38.7759743	9.0331535	2422	2
21	W16	38.7763023	9.0337191	2432	2
22	04	38.7763214	9.0337753	2428	2
23	W16	38.7766991	9.0337582	2437	2
24	04	38.7766838	9.0337734	2436	2
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Table for Coordinates and Elevation of the SignsSite Number 8 Location Sidst kilo-Kebena Date 6/11/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R29	38.7621921	9.0421092	2495	2
2	R29	38.7632335	9.041991	2489	2
3	R31	38.7659952	9.0403744	2484	2
4	R31	38.7716142	9.0377239	2484	2
5	R29	38.7724872	9.0374187	2485	2
6	R4	38.7731629	9.0359318	2475	2
7	Slow	38.7732269	9.0357735	2474	2
8	W2	38.7733308	9.0355837	2470	2
9	W20	38.7751351	9.033742	2441	2
10	W30	38.7751351	9.033742	2441	2
11	W28	38.7752686	9.03401	2438	2
12	W30	38.7762070	9.0339251	2436	2
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Table for Coordinates and Elevation of the Signs

Site Number 9 Location Degole Roundabout - Atkltera Date 9/11/09

No.	Code	X(°C)	Y(°C)	Elevation (m)	Accuracy(m)
1	R29	38.7518507	9.0320185	2456	2
2	R4	38.7513739	9.0319736	2460	2
3	R30	38.7464263	9.0332431	2439	3
4	R29	38.7481085	9.0327738	2476	2
5	R4	38.7483450	9.0326804	2456	2
6	R30	38.7484862	9.03242	2460	2
7	R28	38.7496458	9.0317552	2460	2
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