A STUDY ON FACTORS THAT CONTRIBUTE TO PAVEMENT DETERIORATION ON THE MAMPONG ARTERIAL (SUAME ROUNDABOUT – PANKRONO ROAD)

BY

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A THESIS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF

MASTER OF SCIENCE

(ROAD AND TRANSPORTATION ENGINEERING)

MAY, 2016

CERTIFICATION

I hereby declare that this submission is my own handy work towards the Master of Science Programme and that to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where references have been duly cited in the text.

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ACKNOWLEDGEMENT

I am most grateful to my supervisor, Dr. Daniel Atuah Obeng for his time and valuable comments without which this research would not have been completed. I am also grateful to Prof. Y. A. Tuffour and all the lecturers of the Road and Transport Engineering Program (RTEP), for impacting knowledge which empowered me to carry out this research.

I extend many appreciation to my colleagues and for the fond memories we enjoyed together as students. Special thanks to Mr. Daniel Allotey Abossey and Mr. Micheal Owusu for their time and effort, especially, in the collection of field data.

In conclusion, I am very much thankful to my entire family most especially my beloved father and ever loving mother, Mr. & Mrs. Oppong for their generous support and encouragement to persevere in my educational sojourn. Thanks for not giving up on me. To my sister, Nana Akosua Oppong-Sem, thanks for being there every step of the way. Also to all the others not mentioned, I am delighted for your advice, criticism, love and prayers, it helped me realized that every process you begin in life no matter the odds has to be completed through hard work, determination and self-discipline.

ABSTRACT

Pavement deterioration is an outcome of structural fatigue and functional distresses. In Ghana, huge investments are made in the construction and maintenance of roads, as in 2008 alone, Government's expenditure on major rehabilitation and construction was US$ 229 million while US$ 317 million was spent on road maintenance. The interactions of traffic, climate, materials, and time and roadway geometric features account for this distressing phenomenon. Recognizing defects and understanding their causes is essential in providing not only long-term performance but also in the choice of cost-effective maintenance management systems. The goal of this research was to investigate the factors that causes pavement distresses on the Mampong arterial (from Suame Roundabout - Pankrono Estate Junction) by considering traffic and other road related features. Having visually assessed and measured the surface defects on delineated road sections, a Roughometer was also employed to objectively measure the International Roughness Indices for the same sections. Traffic surveys were undertaken to profile the flow pattern and to determine the Equivalent Standard Axle Load (ESAL). Following the correlation analysis, it was found that vehicular traffic and especially ESAL had strong relationships with pavement surface distresses such as depressions, cracks, potholes and rutting. This was demonstrated by high Pearson Correlation coefficients estimated for the various relationships. The overloading of the heavy vehicles and its deteriorating impact on pavements should trigger appropriate responses from policy makers and Road Authorities to ensure strict compliance of axle load limits on our road networks to ensure their sustainability.

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CHAPTER 1:

INTRODUCTION

1.1. Background

Universally, all built structures have a limited period of usefulness, meaning every infrastructure is functional only within a time frame after which it begins to collapse. Roads are important infrastructures which are critical to the socio-economic development of countries. Therefore, the road system demands constant maintenance through continuous assessment coupled with real-time repairs to keep them serviceable.

Pavement deterioration is very complex as it involves structural fatigue and functional distresses. The interactions among traffic, climate, material, time and the roadway geometric features account for this distressing phenomenon. It is widely known the huge effect extremely high traffic volumes have on the rapid deterioration of road pavements. In Ghana, huge investments are made in the construction and maintenance of road networks. In 2008 alone, the Government's expenditure on major rehabilitation and construction was US$ 229 million while US$ 317 million was spent on road maintenance(***MoT, 2009***).It is therefore essential to develop measures to curtail the high cost of road pavement maintenance as it is the case in Ghana.

The Department of Urban Roads of Ghana has been collecting road inventory and condition survey data for its road development program in all Metropolitan, Municipal and District Assemblies (MMDAs) under its jurisdiction to improve the riding quality of the road network. This also aided the choice of intervention measures required and the maintenance needs of the road network.

The study attempts to investigate the causes of road surface distresses by considering traffic and other road related features in determining the effects of these parameters on road pavement deterioration. Findings will help the Road Authorities to detect the different type of distresses on

road pavements earlier and to consequently determine the maintenance needs and activity requirements. This will likewise help the timing of repair or reconstruction, and evaluating the long term financing necessities needed to keep the road functional.

1.2. Problem Statement

An efficient urban transport system is the catalyst for socio-economic activities in most developing cities. Effective and efficient transportation provide economic benefits that result in multiplier effects such as better accessibility to markets, employment and additional investments. As a result citizens who are deprived of transportation infrastructure miss out on several economic opportunities. The road transport infrastructure constitutes a key component of the system but poorly maintained roads especially on the periphery has been a hindrance to most peri-urban commuters. Despite the significant roles transport plays in economic development, Ghana's total road network as 2009 stood at no more than 67,448 km with only 41% of the road network considered to be in good condition according to the National Development Planning Commission(NDPC). This is evident in long commuting times, journey delays and high accident rates among others in most parts of the country.

Keeping the road pavement in good condition is one of the most important aspects of not only keeping it at an acceptable level of service but also prolonging the life span of the road infrastructure and improving the safety of road users. A number of factors contribute to road pavement failure and the different pavement distresses. ***Kaare, Kuhi and Koppel (2012)*** emphasized that flexible pavements deteriorate under traffic loads and climate effects.***Abhijit (2011)*** investigated the effect of poor drainage on road condition and found that the increase in moisture content decreases the strength of the road pavement. ***Harischandra (2004)*** found that potholes, cracks, edge defects, depressions and corrugation are significant road pavement defects and emphasized that traffic, age, road geometry, weather, drainage, construction quality as well as construction materials and maintenance policies play major role as road deteriorating

agents. However, studies on determining these road deteriorating factors and pavement distresses have been rare in developing countries.

Kumasi is the second largest city in Ghana and the Mampong arterial one of the busiest and heavily congested road in the city. Using the Mampong road as a case study, the study examines the influences of roadway geometric features, drainage and traffic volumes on the occurrence and outcome of pavement distresses. Relationships on subjective and objective assessments were conducted to provide insights into pavement distresses prediction and consequent determination of maintenance needs.

1.3. Objectives of the Study

The aim of this study is to investigate the causes of road pavement deterioration by specifically considering the following:

- To identify pavement surface distresses on the study road;
- To establish relationships between road surface defects, traffic and road alignment features; and
- To inform policy direction on road pavement management systems.

1.4. Justification of the Research

A good road pavement is essential for the social and economic development of communities. It does not only improve the livelihood of communities by reducing commuting times and reducing traffic delays but it also ensures that their safety is not compromised. Vehicle operations cost is also minimized when a road network is good. Understanding how pavement defects occur will assist in developing appropriate methods in the planning and maintenance scheduling to minimize the risk of premature deterioration.

1.5. Scope of the Study

The study road covers the 4km stretch from Suame Roundabout to Tafo-Pankrono Estate

Junction. This road section forms part of the Mampong arterial (IR4) that connects Kumasi to Ejura and communities west of the Afram Basin. Data were collected from road feature inventory and condition surveys, traffic surveys and from other secondary sources. Time, financial and other logistical constraints prevented some additional assessments from being conducted. However the Roughometer was used to validate the visual assessment of road surface condition.

1.6. Organization of the Thesis Report

The thesis is organized in five chapters. Chapter one introduces the research topic, explains the research problem and outlines the objectives of the study. Chapter two reviews the related literature about pavement distresses, its causes and maintenance scheduling. Chapter three presents the study's methodology. It also describes the study area, discusses how the research was carried out and the methods used to collect, analyze and present data. Chapter four discusses the findings of the study. Chapter five presents the conclusions and recommendations of the study. The conclusions feature the major summaries that were established during the research in relation to the objectives. The recommendations are construed from the findings and provide important policy implications for major stakeholders.

CHAPTER 2:

LITERATURE REVIEW

2.0. Introduction

One of the essential features of the road transport infrastructure is the pavement. It is primarily built to provide for the safety of pedestrian. Thus, road pavements are to be sufficiently maintained in order to provide acceptable riding quality (***Feng and Dar, 2009***). Increased traffic loading, environmental conditions and drainage are some of the relevant factors that accelerate the deterioration of road pavements. The need to examine how these factors control the pavement performance cannot be over-emphasized. Generally, road pavements are divided mainly into flexible and rigid types.

2.1. Flexible Pavements

Flexible pavements are so named because the pavement structure deflects, or flexes, under loading .Flexible pavement is commonly made out of various layers of material, each of which gets the loads from the above layer, spreads them out and afterward passes them on to the layer underneath

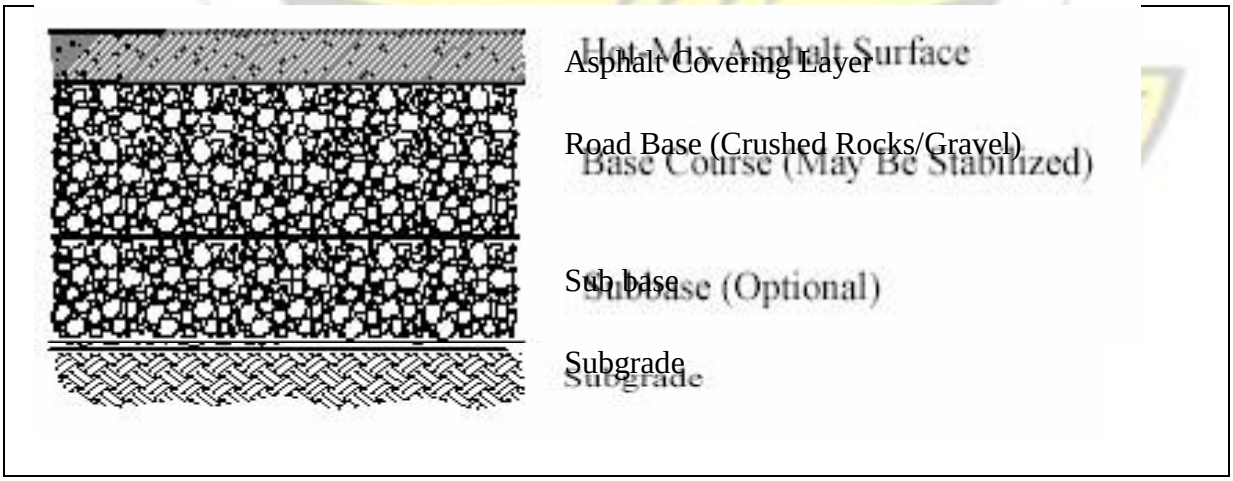

Figure 2 1. Typical Flexible Pavement Structure

The various layers comprising a flexible pavement are described below:

- **Asphalt Covering Layer:** This layer is made up of the quality materials which come in direct contact with traffic loads. It is usually comprised of a wearing and a binder course layers. They include a combination of various selected aggregates bounded together with asphalt cement or other bituminous binders. Its function is to prevent the penetration of surface water to the road base and provide smooth, well bond surface and enhance a skid surface that can tend to resist.
- **Road Base:** The base course is immediately underneath the asphalt covering layer. It may consist of either crush rock or gravel. It gives extra load distribution and contributes to drainage resistance. The materials making up the base course are selected hard and durable aggregates, which are either stabilized or un-stabilized.
- **Sub Base:** This layer is utilized in areas where the subgrade soil is enormously weak. In between the base course and the subgrade is the sub-base course. It is subjected to a lower load stresses and as a result of this the required materials are not strict as compared to the road base.
- **Subgrade:** The subgrade is the compacted soil layer that forms the foundation of the pavement structure. Subgrade soils are subjected to lower stresses. The sub-base, base and the surface must be thick enough to reduce the stresses which occurs in the subgrade thus preventing the distortion or deformation of the subgrade soil layer.

2.1.1. Causes of Pavement Failure

The key to a valuable assessment is to recognize the relationship between the different types of pavement distress and pavement failure. Establishing the cause will help choose the appropriate maintenance practice. Among the causes of pavement failure are categorized into environmental and structural factors. Environmentally induced distresses are those as an aftereffect of weathering, moisture and aging of the pavement. Loading causes

structuraloriented distress. In this way, pavement failure happens from both loading and weathering (***Lavin, 2003***).

Pavement deterioration is usually caused by combination of many factors, for example, traffic loads, environmental factors, poor road design methods and poor quality of construction. It may also come about as a result from traffic loads and a combination of any of the mentioned factors above. Inaccurate estimation of traffic volumes and loads could also contribute to the deterioration of the pavement earlier than the expected design life. That is when the road is designed based on an inaccurate evaluation of the traffic volume.

The rate at which pavement deteriorates depends on its environment, traffic loading conditions, original construction quality, and interim maintenance procedures. Poor quality materials or poor construction techniques can significantly reduce the life of a pavement. As a result, two pavements constructed at the same time may have considerably different lives, or certain portions of a pavement may deteriorate more rapidly than others. On the other hand, timely and effective maintenance can extend a pavement's life. Crack sealing and seal coating can reduce the effect of moisture in aging of asphalt pavement.

With every one of these variables, it is definitely not hard to see why pavements fail at various rates and why we find them in different phases of disrepair. Perceiving defects and comprehension their causes helps us rate the pavement condition and select the appropriate and cost-effective repairs. Intermittent assessment is important to give present and helpful assessment information in deciding on the right methods to correct the defective sections of the pavement (***Walker, 2002***).

Temperature is one of the key variables influencing the design and performance of both pavements. Varieties in temperature inside of the pavement structure contribute in a wide range of ways to the formation of the distresses and a likely failure of the structure.

Understanding temperature impacts is extremely significant for the maintenance needs necessary in places of very high temperatures. The issue of failures of flexible pavements in extremely hot localities can be considered as another sort of pavement problem. It has been given much attention of late in those parts of the world (***Abdulwahhab et al., 1998***).

Provision of a good drainage system is essential for the protection of a road pavement as the penetration of moisture will negatively affect pavement strength, and thereby its performance. As the moisture content of a layer increases, the strength decreases. Thus, subsurface drainage is necessary to improve the overall strength of the pavement. Some pavement sections have drainable layers built into the structure for additional drainage capacity. These drainage features should be strongly considered when grouping pavement sections (***OECO, 2008b***).

2.1.2. Collapse of the Flexible Pavement

Flexible pavements support loads through bearing rather than flexural action. They comprise several layers of carefully selected materials designed to gradually distribute loads from the pavement surface to the layers underneath. The design ensures the load transmitted to each successive layer does not exceed the layer's load-bearing capacity. When the load exceeds the layer's load-bearing capacity they pavement then begins to collapse.

Distresses can be divided into two groups: structural distress and functional distress.
Structural distress is associated with the ability of the pavement to carry the design load. Functional distress is mainly associated with ride quality and safety of pavement surface (**Luo, 2005**).

2.2. Deterioration in Flexible Pavement

The assessment of pavement condition by visual observation and recording of defect types on the pavement surface. Condition survey includes detection of surface distresses, such as, cracking,

rutting, and other surface defects. The defects elements surveyed by the visual assessment included the following:

a. Type of distress.

b. Severity of distress.

c. The intensity of the impact of defect layer pavement.

2.3. Pavement Distresses

Pavement distresses are generally described in terms of severity, extent and distress type. The distresses fall into one of the following categories: cracking, distortion, disintegration and loss of skid resistance(***U. S. Department of Transportation,1995***).

2.3.1. Cracking

The formation of cracks in flexible pavements is caused by deflection of the road surface over an unstable foundation, shrinkage, thermal expansion and contraction of the road surface. These are some examples of cracks that may occur in flexible pavements.

2.3.1.1. Longitudinal and Transverse Cracking

A longitudinal crack takes after a course roughly parallel to the centerline. Then again, a transverse crack runs generally opposite to the roadway centerline. Both are brought about by shrinkage or withdrawal of the black-top or bituminous surface. The progression of longitudinal cracks might be quickened because of inadequately developed path joints. Longitudinal and transverse cracks are measured in straight meter. The severity and length of every break are recorded after identification. In the event that the break does not have the same seriousness level along its whole length, every bit of the split having an alternate severity level are to be recorded independently. If a bump or sag occurs at a crack it is also recorded as a

distortion. Figure 2.2 illustrates longitudinal and transverse cracks developed on a road pavement.

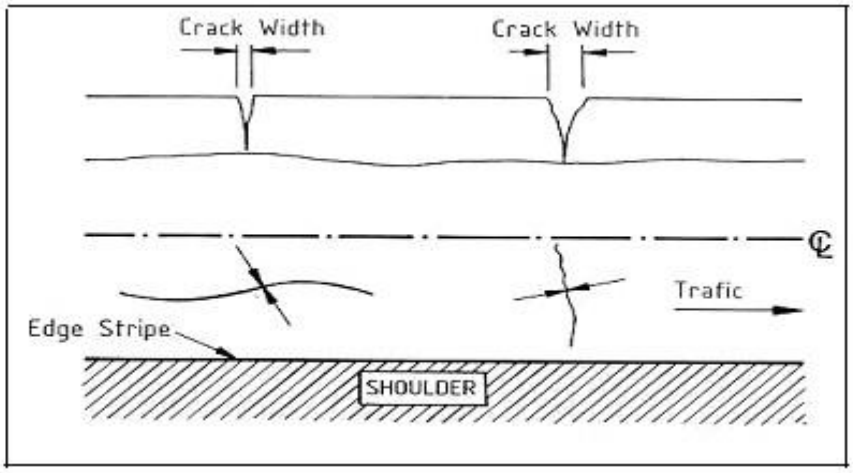

Figure 2.2. Longitudinal and Transverse Cracks (GTC, 1998)

2.3.1.2. Alligator Cracking

Alligator cracks are so called because the breaks resemble the skin of an alligator. They might be brought on by weakness of the pavement or bituminous surface under rehashed stacking or by unreasonable redirection of the surface over unsteady or frail foundations. Alligator cracking is measured in square meter of surface area. The real trouble in measuring this sort of depression is that a few levels of severity regularly exist inside of one distressed range. In the event that these segments can be effectively recognized from each other, they are then measured and recorded independently, in any case, if the different levels of severity can't be partitioned effortlessly, the whole region are evaluated as the highest severity level present. Alligator cracking is shown in Figure 2.3

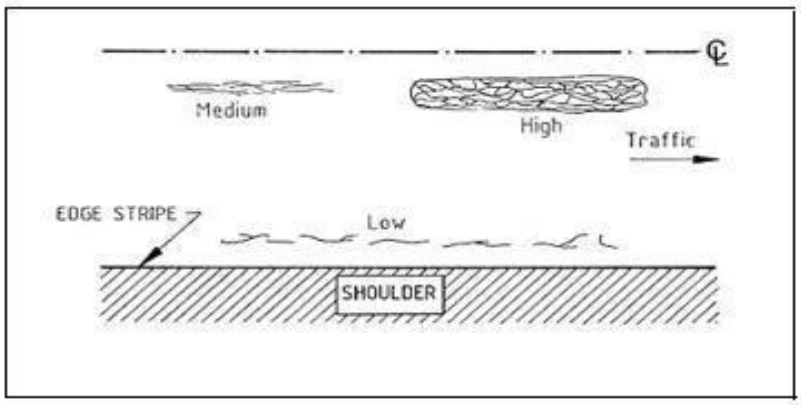

Figure 2.3. Alligator Cracking (GTC, 1998)

2.3.1.3. Block Cracking

The shrinkage of the pavement surfacing and daily temperature fluctuations causes block cracking. These breaks divide the asphalt into rectangular pieces. The appearance of this distress for the most part demonstrates that the pavement has solidified significantly. Block cracking for the most part happens over a huge segment of the asphalt territory and may in some cases happen just in non-traffic territories. Block cracking is measured in square meter of surface area. It normally happens at one severity level in a given pattern segment; notwithstanding, any ranges of the asphalt segment having particularly distinctive levels of damage are measured and recorded independently.

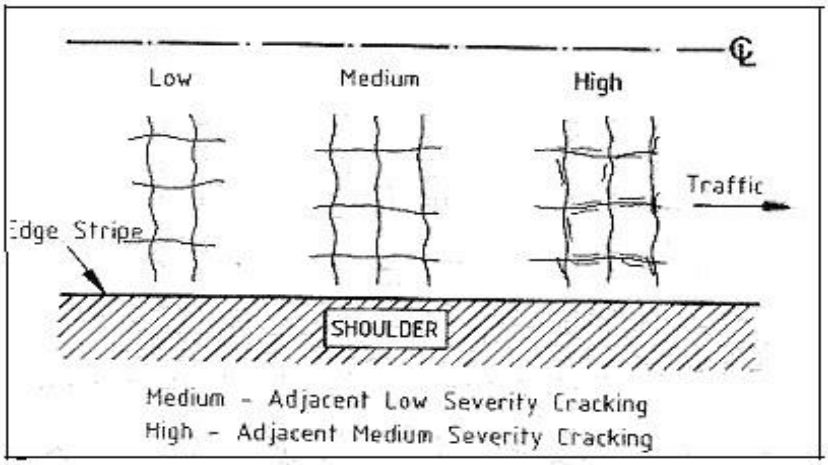

Figure 2.4. Block Cracking (GTC, 1998)

2.3.2. Distortion

Distortion in flexible pavements is caused by foundation settlement, insufficient compaction of the pavement layers, lack of stability in the bituminous mix, poor bond between the surface and the underlying layer of the pavement structure, and swelling soils in the subgrade.

The following are examples of distortions that may occur in flexible pavements.

2.3.2.1. Rutting

A rut is characterized as a surface depression in the wheel path(see Figure 2.5). In many instances, ruts are noticeable only after a rainfall when paths are filled with water. This type of distress is caused by permanent deformation in any of the pavement layers or subgrade and is caused by consolidation or displacement of materials due to traffic loads. Rutting is measured in square meter of surface area. The rut depth is determined by laying a (3m) straight edge across the rut and measuring its depth.

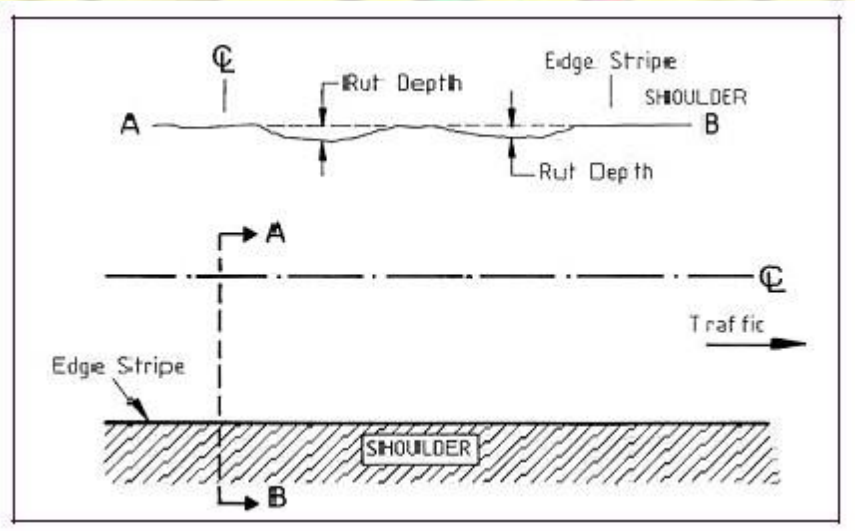

Figure 2.5. Rutting (GTC, 1998)

2.3.2.2. Corrugation and Shoving

Corrugation emerges from a type of plastic surface development encapsulated by swells over the surface (see Figure 2.6). Shoving is a type of plastic movement bringing about limited protruding

of the asphalt surface. Corrugation and shoving can be created by absence of solidness in the mix and poor bond between materials layers. Corrugation is measured in square meters of surface area. The mean rise difference between the edges and valleys of the corrugation demonstrates the level of seriousness. To decide the mean height contrast, a 3meter straight edge is put opposite to the creases so that the depth of the valleys can be measured in millimeters.

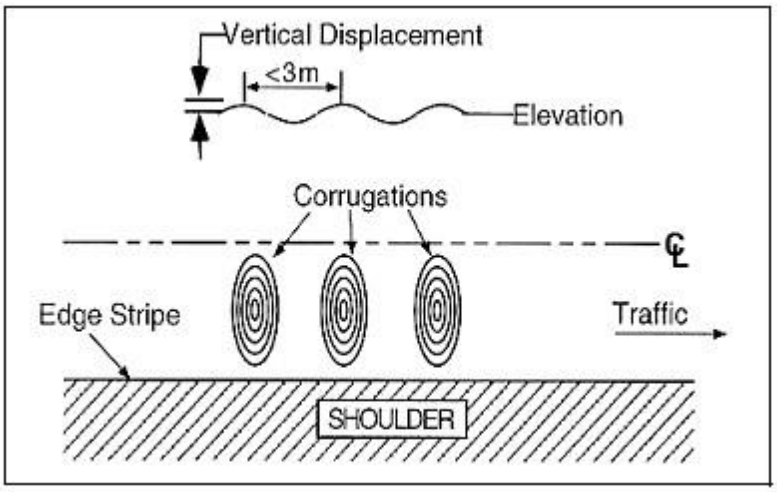

Figure 2.6. Corrugations (GTC, 1998)

2.3.2.3. Depression

Depressions are restricted low ranges of constrained size(see Figure 2.7). In numerous cases, light depressions are not perceptible until after a downpour. Depressions can be brought on by heavier activity than that for which the asphalt was planned, by limited settlement or by poor construction techniques. Depressions are measured in square meters of surface areas. The greatest depth of the depression decides the level of damage. This depth is measured by putting a (3-meters) straight edge over the depressed territory and record the most extreme depth in millimeters.

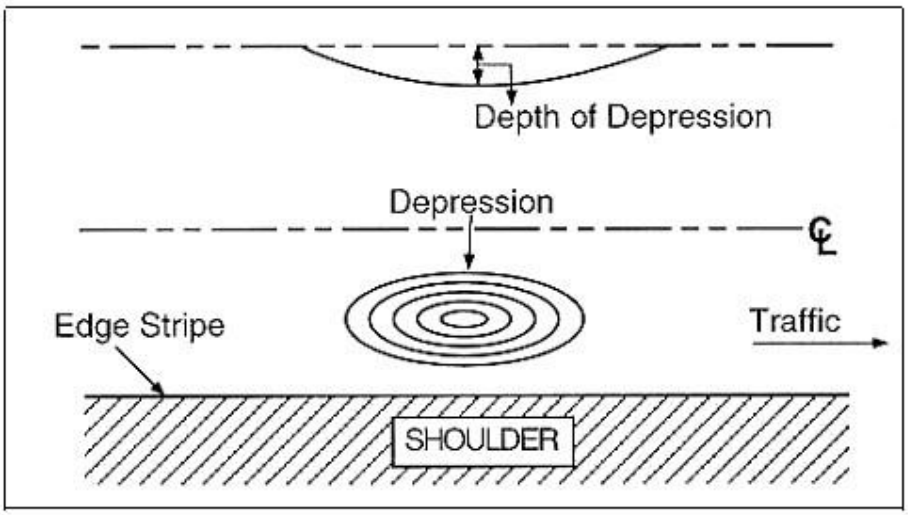

Figure 2.7.. Depression (GTC, 1998)

2.3.3. Disintegration

Disintegration in flexible pavements is caused by insufficient compaction of the surface, insufficient asphalt in the mix, loss of adhesion between the asphalt coating and aggregate particles or overheating of the mix. Below are examples of pavement disintegrations.

2.3.3.1. Weathering and Raveling

Weathering and Raveling is the wearing off the asphalt surface brought on by dislodging of total particles and loss of asphalt binder. As the raveling proceeds, bigger pieces are broken free and the asphalt takes a rugged appearance. Weathering and raveling are measured in square meter of surface area.

2.3.3.2. Potholes

At the point when potholes are not joined by distortion of the contiguous surface, they usually result from a cracked pavement surface which has permitted dampness to enter and mollify the asphalt or infiltrate on a level plane under the pavement layer. Once water has entered, the cracked surfacing is prone to disintegrate and lift out under the action of traffic, particularly after rain, thereby initiating the formation of a pothole. As a general rule, repairs to potholes

are carried out before the onset of inclement weather. Any pothole which is likely to be a potential hazard to traffic should be repaired immediately after detection.

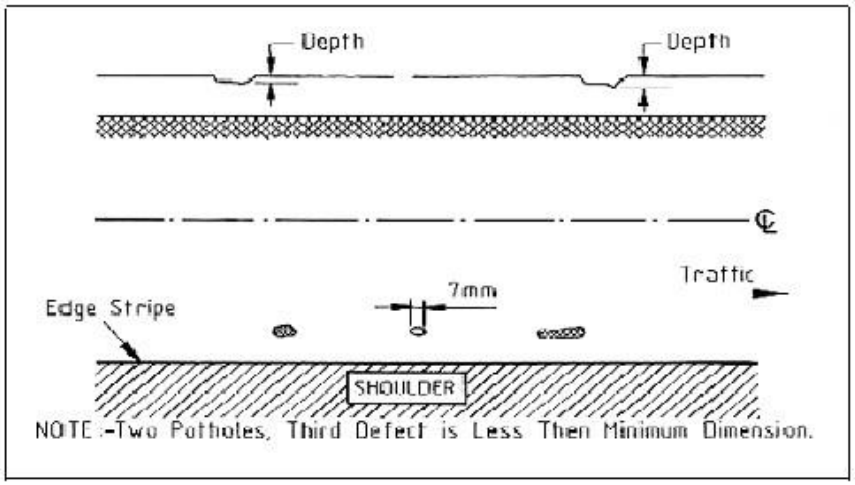

Figure 2.8. Potholes (GTC, 1998)

2.3.4. Surface Patches

2.3.4.1. Patching

A patch is a region of asphalt which has been displaced with new material to repair the current asphalt (see Figure 2.9). A patch is viewed as a deformity regardless of how well it is functioning.

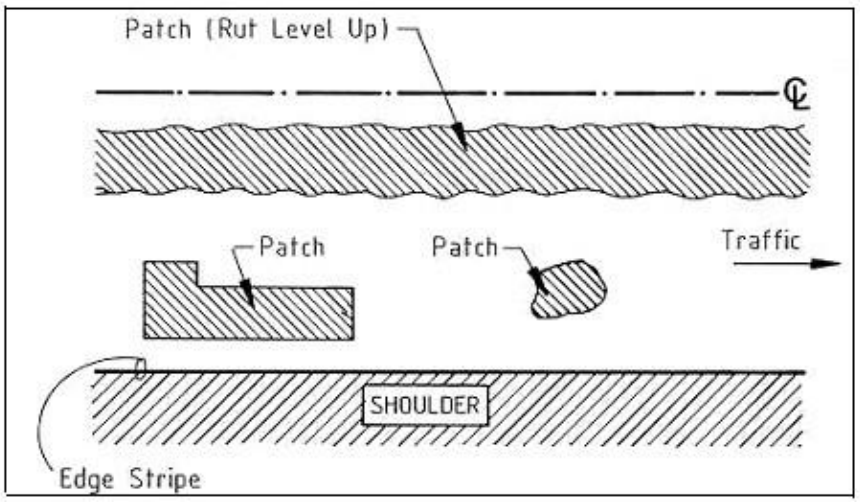

Figure 2.9. Patching (GTC, 1998)

2.3.5. Loss of Skid Resistance

Loss of skid resistance is caused by too much asphalt in the bituminous mix, poor aggregate subject to wear and builds up of contaminants. Examples of this class are discussed below.

2.3.5.1. Bleeding

Bleeding is free asphalt on the surface of the pavement caused by excessive amount of asphalt in the mix, low few voids and hot weather. This type of distress often shows a shiny, glass-like reflective surface. External bleeding may cause a severe reduction in skid resistance. Bleeding is measured in square meters of surface area. If bleeding is counted, polished aggregate is not counted in the same area.

2.3.5.2. Fuel Spillage

Continuous fuel spillage on a bituminous surface will soften the asphalt. Areas subject to only minor fuel spillage will usually heal without repair and only minor damage will result.

2.4. Assessment of Surface Condition

With a comprehension of surface strains, one can assess and rate asphalt surfaces. The rating scale ranges from 10–excellent condition to 1–failed. Most asphalt will decay through the stages recorded in the rating scale. The time it takes to go from magnificent condition (10) to total failure (1) depends generally on the nature of the first construction and the measure of substantial activity stacking. Once noteworthy decay starts, it is normal to see asphalt decrease quickly. This is generally because of a blend of stacking and the impacts of extra dampness. As an asphalt ages and extra breaking grows, more dampness can enter the asphalt and quicken the rate of disintegration.

2.5. Pavement Condition Survey

Asphalt maintenance is a key part of any state's transportation framework. One ofthe obligations of the asphalt administration division in every state is to assess thepavement execution for the

state's asphalt system. As characterized by the Highway Research Board (1962), asphalt execution is an element of the asphalts relative ability to serve activity over a timeframe. The capacity of asphalt to serve activity is dependent on different components, one of which is the measure of disintegration the pavement has experienced, or the asphalt condition.

The degree of disintegration of street asphalt is controlled by leading an asphalt condition overview. In condition reviews, germane physical and infrastructural components of existing street and connecting offices are recorded and measured. Information gathered incorporate asphalt shoulder sort, surface sort auxiliary conditions, riding quality, channels, courses, spans, sign posts, person on foot walkway sort, intersection controls among others. The review gives the most profitable data to asphalt execution examination, and is essential in estimating asphalt execution, suspecting support and restoration needs, setting up upkeep and recovery needs, and apportioning subsidizing for repair works. The condition overviews alongside records of movement history and time give a background marked by disintegration of the ride quality, or serviceability (***Haas, 1994***). It is this history of serviceability that characterizes asphalt execution as appeared in Figure 2.10.

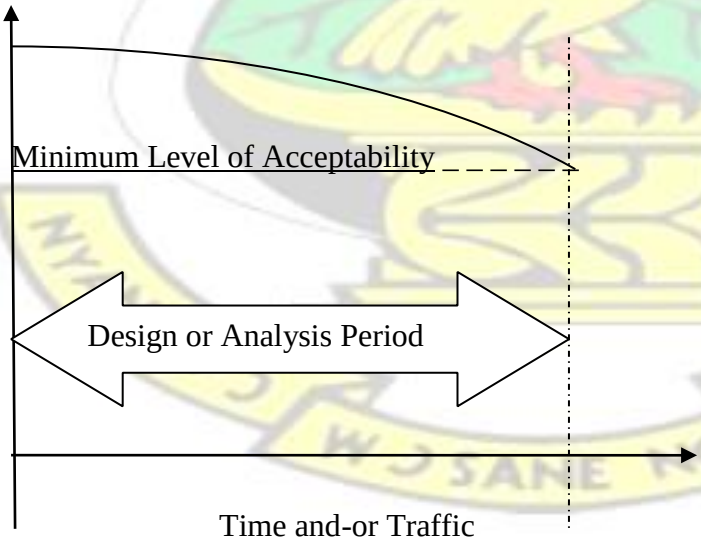

Figure 2.10. Deterioration of serviceability over time

2.6. Pavement Distress Measurement

Pavement distresses can be measured either manually or automatically.

2.6.1. Manual Pavement Condition Surveys

While the utilization of mechanized asphalt condition surveys are turning out to be increasingly common, numerous departments still depend on manual asphalt condition survey to gather their asphalt condition information. There are two essential strategies for directing manual asphalt condition studies, strolling and windshield reviews. Strolling and windshield studies are ordinarily consolidated to give a more thorough asphalt system study. Strolling reviews are finished by a rater who is prepared to rate bothers as per the organization's trouble recognizable proof details. The rater strolls down the side of the asphalt and rounds out an asphalt condition shape that depicts the sum, degree, and seriousness of every pain present on the roadway. Walking overviews provide the most exact information about the state of the evaluated asphalt (***Haas, 1994***), gave the raters are very much prepared an accomplished. Nonetheless, just an example of the asphalt system can be overviewed on account of the measure of time a mobile study expends. A windshield study is finished by driving along the street or on the shoulder of the street. The asphalt is evaluated by a rater through the windshield of the vehicle. This strategy takes into consideration a more prominent measure of scope in less time; be that as it may, the nature of the asphalt trouble information is traded off. The whole system could be studied utilizing this technique or tests may even now utilize.

2.6.2 Automated Pavement Condition Surveys

A critical phase of automated asphalt condition review is the data gathering process. This procedure is finished by high technology complex vehicles traversing down the road gathering and disseminating information. There are various sorts of robotized asphalt condition survey vehicles accessible and some use various types of information data collection tools, in any case, for the most part they are comparative in the way that they are all attempting to accomplish the same result, precise asphalt condition information.

2.7. Pavement Evaluation

A major objective of pavement evaluation system is to assist Highway Engineers in making timely cost-effective decision making related to the maintenance and rehabilitation ofpavements (***Marathe, 1995***). In evaluating the condition of road pavements, the PCI survey system uses data from the survey to develop and build database **(*Cline et al, 2002***).

2.7.1. Pavement Condition Index (PCI*)*

The PCI evaluation process is determined in accordance with procedures contained in ASTMD 5340.This procedure is used worldwide to provide a measurement of the condition of pavements taking into account the functional performance with implications also on structural performance. Periodic PCI determinations on the same pavement will show the change in performance level with time since the procedure is designed to be objective and repeatable, it can also be used to predict condition(***ERESS,1998***).

2.7.2. Pavement Condition Rating

The asphalt condition rating is a presentation of asphalt condition as a component of the PCI index that fluctuates from neglected to phenomenal as presented in Table value that varies from failed to excellent as shown in Table 2.1(***Seiler, 2009.Weil, 2009.U.S DOT, 2009***).

Table 2.1. - Ratings and Index Ranges of Pavement Condition

Pavement Condition Rating	Pavement Condition Index
Excellent	86-100
Very Good	71-85
Good	56-70
Fair	41-55
Poor	26-40
Very Poor	11-25
Failed	0-10

The PCI is a rapid technique for contrasting the general state of asphalt and extent of reconstruction needs. Figure 2.11 shows how asphalt condition ordinarily decays after some time. The new asphalt holds its great condition for a long time, however, its condition drops quickly once it starts to decay (***Weil, 2009***).

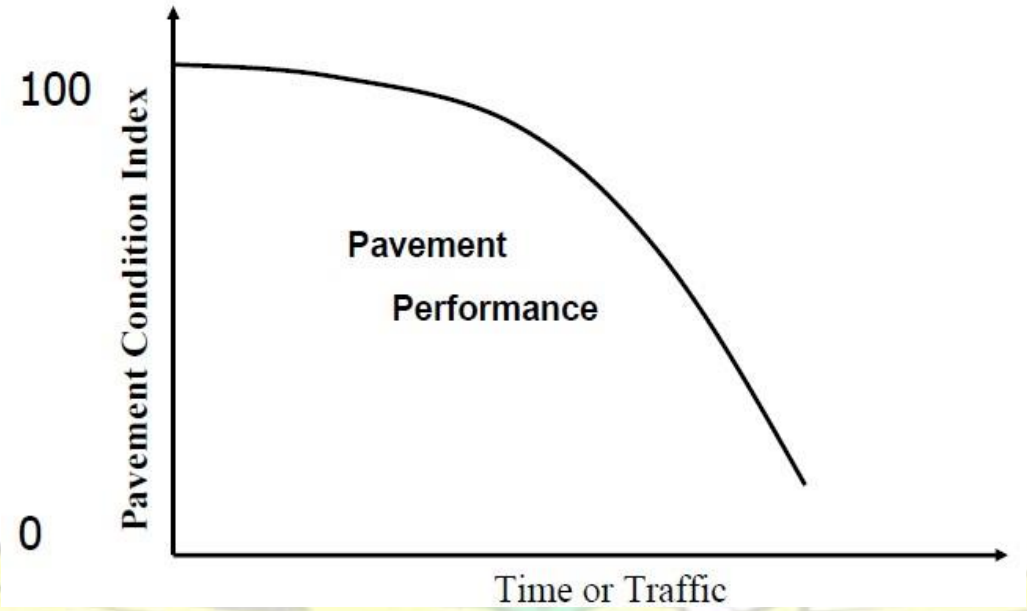

Figure 2.11. Relationships between Pavement Condition and Time (*U.S DOT, 2009*)

2.8. Pavement Maintenance

As indicated by the Foundation for Pavement Preservation, asphalt repairs includes doing the right treatment, at the spot, at the correct time. To accomplish this, great administration and a comprehension of the options are required (***David, 2006***).Terminology concerned with highway maintenance varies considerably from country to country. It also varies from urban area to urban area and from Highway Authority to Highway Authority(***O'Flaherty, 1988***).Maintenance programs can be classified according to the time of carrying out the maintenance operations as follows:

1. ***Routine Maintenance***: those activities that are carried out as frequently as required during each year. It could be carried out several times per year to ensure serviceability at all times and in all weathers. It also includes normal maintenance works beginning

from road sweeping, crack sealing and repair of minor damage to carriageway surfaces. In addition, urgent maintenance works, as emergency repairs to roads, may be contained in routine maintenance.

2. ***Periodic Maintenance***: it covers all longer-term programmable operations required within the service life of the road. These activities which may be required only at intervals of several years may include renewal or renovation of the wearing surfaces of carriageways that become worn or deformed by use, resealing of paved roads and restoring of road markings.

3. ***Extraordinary Maintenance***: it includes activities that aim to return roads to their original condition when they have severely deteriorated. Typically, they involve road strengthening, by the application of one or more structural layers (overlays) to an existing pavement, and/or reconstruction of pavement structure that has deteriorated.

Pavement maintenance activities can also be grouped and classified according to the purpose of treatment (***Lavin, 2003***):

1. *Preventive Maintenance*: it is used to describe actions taken to prevent premature deterioration and/or to retard the progression of deficiencies so as to reduce the rate of deterioration and effectively increase the useful life of pavement.

2. *Corrective (Remedial) Maintenance*: it is used to refer to maintenance actions taken to correct deficiencies which are potentially hazardous, e.g. to repair defects which seriously affects a pavement operation so as to keep the highway within a tolerable level of serviceability.

In general, preventive maintenance programmes automatically include routine maintenance activities, whilst corrective maintenance actions tend to encompass many of the activities carried out in the course of routine, periodic and extraordinary programmes.

2.8.1. Maintenance Activities and Strategies

Engineering studies have determined that there are preferred strategies for the different levels of pavement deterioration. As a pavement ages and the amount of deterioration increases, the strategy changes. When the pavement is in a good condition, relatively inexpensive preventive maintenance treatments are cost-effective. When the pavement reaches the end of its design life, expensive reconstruction will be necessary.

In general, there are four maintenance/repair strategies that should be considered for road surfaces (***Washington State Transportation Department,2002***).These are:

1. *Routine Patching:* Isolated responses to minor pavement failure caused by subgrade problems or poor pavement construction. This includes filling potholes, covering trenches dug for and other miscellaneous repair.
2. *Crack Sealing:* Placement of an asphalt sealing material in major cracks to prevent moisture from entering the pavement and causing potholes or street failure.
3. *Slurry Seal:* Spreading a very thin layer of asphalt/sand/small aggregate mixture over the pavement to reduce moisture penetration, improve skid resistance and slows the rate of deterioration. It extends the pavement life by 3 – 5 years.
4. *Cape Seal:* Liquid asphalt sprayed on pavement followed with a layer of small stone chips followed 1week later with a slurry seal to reduce moisture penetration. This method can also be utilized with a rubberized asphalt mixture which improves its long term performance. It extends the pavement life by 5 – 7 years. Slurry seals are generally applied to roads surfaces that are basically in a good condition but cape seals are applied to roads that have at least a fair condition rating.

Rehabilitation strategies may include:

1. *Pavement Overlay:* Adding a new layer of hot-mix asphalt to the existing pavement reduces moisture content, improves skid resistance and restores pavement surface condition. It extends the pavement life by 10 years.

2. *In-Place Cold Recycling:* It is a process with specialized equipment that grinds and removes several inches of the existing pavement surface, mixes it with a rejuvenating agent and new asphalt binder and places it back on the road. This is followed later with a thin overlay surface, improves skid resistance and restores pavement surface condition.

3. *Reconstruction:* It occurs by removing the existing pavement and base and installing an entire new road section. This strategy is a last resort because of the high cost and disruption to traffic. Reconstructed pavements are designed to a 20 –year design period.

Summary

This chapter discussed relevant literatures on the subject matter. It described a flexible road pavement and its structure, reviewed causes of pavement failure and appropriate condition survey to determine pavement distresses. Pavement maintenance and strategies required for the treatment of specific defects were also assessed. The research methodology, which is the next chapter, adopted some of the appropriate methods and approaches used in the reviewed literature.

CHAPTER 3:

RESEARCH METHODOLOGY

3.0. Introduction

This chapter describes the methodology employed in the study. Data for this study were mainly primary sourced. Fieldwork was limited to traffic surveys, road feature inventory and the pavement condition survey. The chapter presents the methods and procedures used in data collection and the analysis of the data collected.

3.1 Approach and Methods

Figure 3.1 presents the flow of the research, including the selection of study road, the survey types including pavement condition and traffic surveys, data analysis and reporting. The choice of study road has been explained and the description of traffic and pavement condition surveys provided later in this chapter. For purposes of this study, four pavement distress types, namely; depression, pothole, rutting and cracks were considered.

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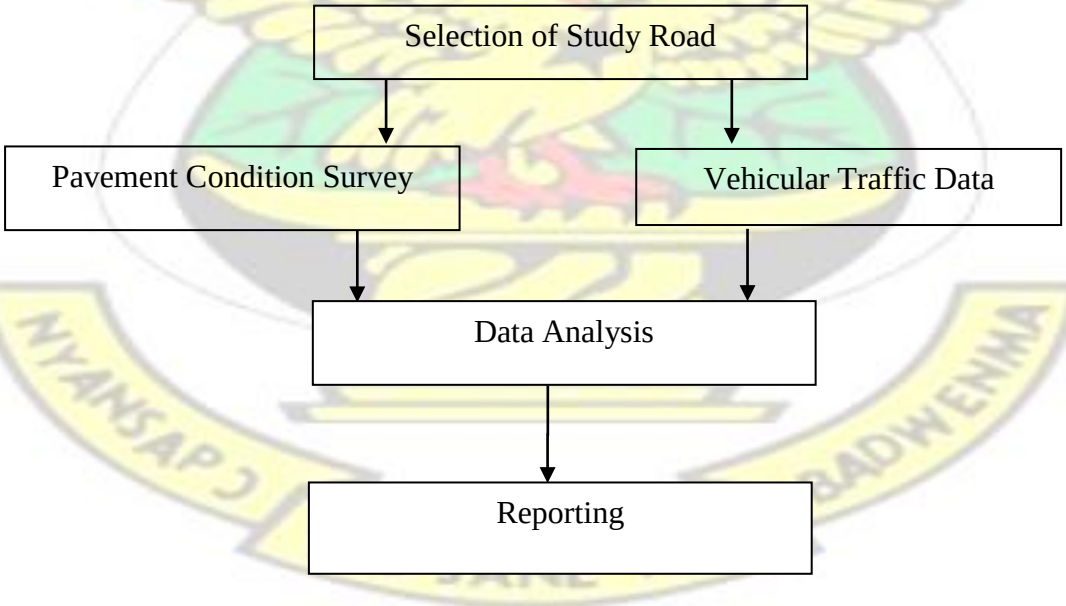

Figure 3.1. Flow Chart of the Research

3.2. Study Road

The Mampong road, a north-south principal inter-regional road (IR4)was selected for this study. It is entirely paved and comprises a single carriageway section (about 90%), and a dual carriageway section (about 10%). The dual carriageway starts from Suame Roundabout and ends at 250 m from the roundabout whilst the single carriageway begins at 250m and runs through the entire study road. The Mampong road is one of the busiest arterials in the Kumasi Metropolis with very high vehicular traffic especially during the day. This can be attributed to the many commercial and social facilities abutting the road, which attracts considerable traffic. There is also the Tafo cemetery, which is the largest public cemetery in Kumasi, and also features the Tafo market and a number of Junior and Senior High Schools. The study area is densely populated and it is common to see vehicular queues during most times of the day (***BCEOM and ACON Report, 2004***).Road pavement distresses are also clearly evident on this road due to the impact of high volumes of heavy vehicular traffic and other environmental factors. The study was conducted on an approximately 4km stretch of road starting from the Suame Roundabout and ending at Tafo (PankronoEstate junction). The map of the study road (Mampong Road) is shown in figure 3.2.

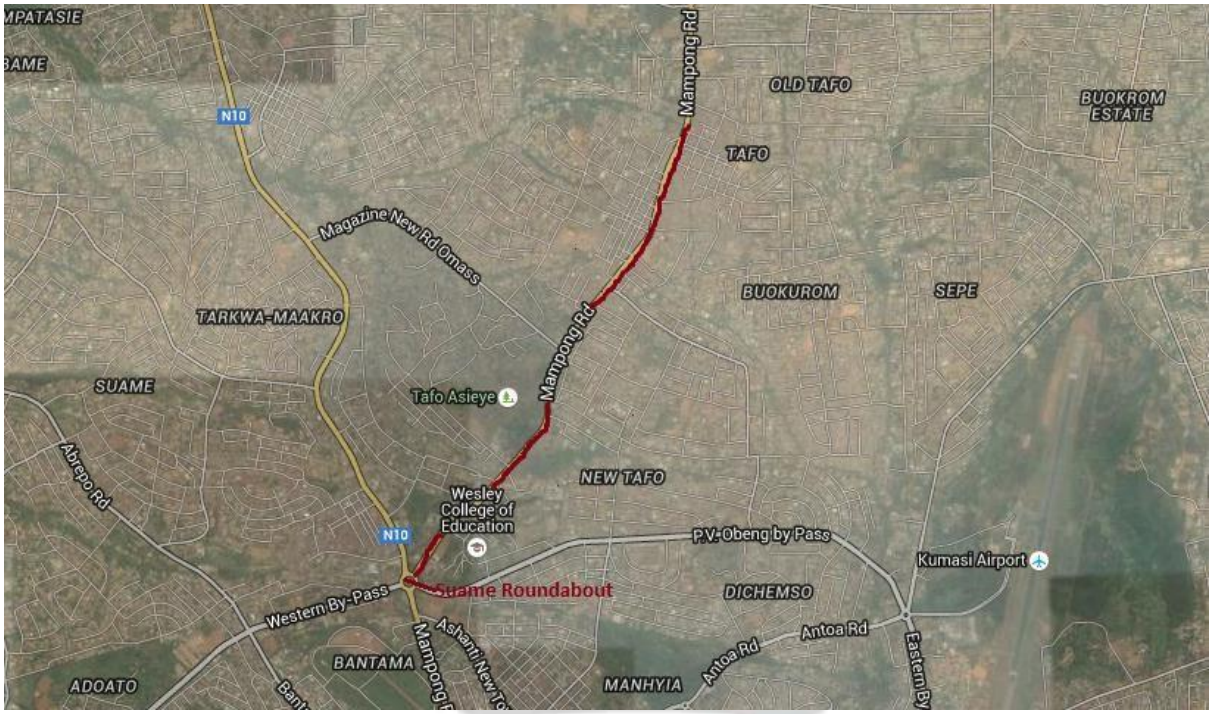

Figure 3.2. - Location of Study Area (Source: Google Earth)

3.3. Data Collection

The data collection was primarily from the field.

3.3.1. Delineation of Study Roads

The study road was delineated into sections of five (5) before the commencement of data collection. In order to obtain some homogeneity in terms of data for the selected study sections, major intersections were used to divide the study road length of 4km. The sections were thus delineated as follows: Suame Roundabout –Tafo Nhyiaso Junction (1.5km), Tafo Nhyiaso Junction – Magazine New Road Junction(0.3km), Magazine New Road Junction – Tafo Hospital Junction (0.3km), Tafo Hospital Junction – Ahenbronumu Junction (0.9km), Ahenbronumu Junction – Pankrono Estate Junction(1km).

3.3.2. Road Feature Inventory and Pavement Condition Survey

Road condition survey was carried out to determine the present state and condition of the selected study road sections. Data were collected using the Pedestrian Observer Survey (POS) method. A

team of three (3) enumerators conducted the survey with one enumerator assigned the operation of the distance measuring wheel and the two enumerators observed and recorded the features and condition of the study road sections which were done in inspection units. The inspection unit is defined as a small section of a pavement, usually at intervals of 100m, which is inventoried and physically assessed in detail. Each of the five (5) sections was divided into these inspection units at intervals of 100m.Condition survey was carried out on each section on these units to determine the distresses present on the pavement. Information collected included type of distress, their area and volume. Additional information collected included the road width, shoulders and the drains.

3.3.3. Roughness Measurement

The roughness measurements were carried out on the pavement surface at each study section. The International Roughness Index (IRI) was measured using the ARRB Roughometer II device fixed on the wheel of the survey vehicle. The device is designed to provide an objective and repeatable indication of road roughness. Roughness for a road section was recorded in 10-meter intervals maintaining a speed between 40km/h and 60km/h. The Roughometer II software was used in processing the survey data at 10-meter intervals. The processing software generates the IRI value in MS Word Sheet and the average IRI value for the whole section of a road is then computed and reported. The output of the field data is in units of IRI, which is metric and was reported in m/km. In assessing the ride quality of a road pavement surface, the IRI value was adopted as the assessment criterion. The smaller the IRI value of the road, the better the riding quality on that road and vice versa. For purposes of this study, the assessment criteria adopted for urban road network based on surface type and road class is presented in Table3.1 (*Source: Ministry of Roads and Highways, Annual Review Report, 2004*).

Table 3.1. Assessment Criteria for Urban Road Network

Surface Type	Road Class	Road Condition (IRI)

Asphaltic Concrete	Arterial	1 – 5 Good
		5 – 9 Fair
		> 9 Poor

Source: Ministry of Roads and Highways, Annual Review Report, 2004

3.3.4. Classified Traffic Volume Count

Manual classified count was carried out at identified stations on all five sections for two (2) days at Wesley College, Beige Capital, EcoBank, Hospital Junction and Barclays Bank respectively. Vehicles were classified as follows:

- Light vehicles - cars, taxis, pick-ups, vans, small buses.
- Medium Vehicles - medium bus, large bus, light truck and medium truck.
- Heavy Vehicles - heavy truck, semi-light trailer, semi-heavy trailer, truck trailers, others.

Volume and classified traffic counts were taken at one (1) hour intervals for 24 hrs (6:00am6:00am) and the surveys were conducted on the 10th and 11th of March 2015. The total number of vehicles (motorized and non-motorized) by type moving in each direction were recorded.

3.3.5..Axle Load Data

Secondary axle load data were obtained from the Ghana Highway Authority Axle Weighbridge Station located at Boankra. Table 3.2 presents the permissible axle load limits for various trucks.

1. Average Daily Container Traffic = 120 TEUs

Table 3.2. Permissible Axle Load Limits for Various Trucks

Vehicle Type	Average Weight of Truck Load (Tonnes)
Light trucks	14
Medium trucks	14
Heavy trucks	19.5

S/Trailer (Light)	19.5
S/Trailer (Heavy)	29.3
Truck trailer	35.5
Extra-large truck and others	41.5

Source: GHA Axle Load Station, Boankra, 2015

3.4. Data Presentation and Analysis

The analysis of data was conducted using the Microsoft Excel and SPSS analytical tools. With the road feature and condition surveys, averages were computed for road width, length, area and volume of distresses. Regarding the International Roughness Indices(IRI), the Roughometer internal software generated the values as the road sections were measured. The Average Daily Traffic(ADT) flows were computed from the field surveys and presented for the different road sections.

The next chapter presents the results of the study and discusses the findings accordingly.

CHAPTER 4:

PRESENTATION OF DATA, RESULTS AND DISCUSSION

4.0. Introduction

This chapter presents the detailed analysis of the field data and other secondary data gathered for the study. Apart from the presentation of the results obtained, correlation analyses were undertaken to examine and assess the relationships and influences of traffic and road related factors(independent variables) and pavement defects, such as, rutting, cracking, potholes, depressions and IRI (dependent variables).

4.1. Road Alignment Features

An average width of 9.6m was recorded for the entire study route.Section 1, which starts from the Suame Roundabout begins as a dual carriageway with an average width of 10.8 m converges to a single carriageway at a point 850m away from the roundabout. An average width of 9.2 then cuts across the rest of the study road. Each section had both drains and shoulders on its sides. Table 4.1shows the average width of each section and other road features.

Table 4.1. - Average width per section and other road features

Section No	Section Name	Width (m)	Drains	Shoulders
1	Suame Roundabout –TafoNhyiaso Junction	10.8	Yes	Yes
2	Tafo Nhyiaso Junction – Magazine New Road Junction	9.2	Yes	Yes
3	Magazine New Road Junction – Tafo Hospital Junction	9.5	Yes	Yes
4	Tafo Hospital Junction – Tafo Market	9.2	Yes	Yes
5	Tafo Market – Pankrono Estate Junction	9.2	Yes	Yes

4.2. Pavement Condition

The road pavement was assessed both visually and by the use of the Roughometer on each of the sections. Road pavement condition survey carried out by visual inspection is shown in Table 4.2 and the IRI values obtained from the Roughometer is also shown in Table 4.3.

Table 4.2. - Summary of distresses on road study sections

Section No	Section Name	Vol. Depression (m^3)	Pot hole Volume (m^3)	Rutting Volume (m^3)	Area of Cracks (m^2)
1	Suame Roundabout –Tafo Nhyiaso Junction	440	13	4	3,756
2	Tafo Nhyiaso Junction – Magazine New Road Junction	20	7	5	187
3	Magazine New Road Junction – Tafo Hospital Junction	26	8	5	2,997
4	Tafo Hospital Junction – TafoMarket	7	2	0	1,469
5	Tafo Market – Pankrono Estate Junction	6	0	0	2,038

From Table 4.2, the highest volume of depression and pot hole were recorded on Section 1 with values 440m^3 and 13m^3respectively.Section 1 also featured the highest area of cracks of3,756m^2.There was however no evidence of pot holes and rutting on Section 5 and Section 4 also recorded no rutting.

Table 4.3. Recorded IRI Values on Road Study Sections

Section No	Section Name	Total distance (km)	Average IRI value	Average Speed (km/hr)
1	Suame Roundabout –Tafo Nhyiaso Junction	1.46	5.5	50
2	Tafo Nhyiaso Junction – Magazine New Road Junction	0.33	4.9	50

3	Magazine New Road Junction – Tafo Hospital Junction	0.54	5.3	50
4	Tafo Hospital Junction – Tafo Market	0.43	3.8	50
5	Tafo Market – Pankrono Estate Junction	1.3	2.7	50

From Table 4.3,the smaller IRI value is an indication of good riding quality and the converse is true for a poor riding surface condition. Using the assessment criteria adopted for the Urban Road Network based on surface type and road class, the sections were grouped under good, fair or poor conditions in Table 4.4.

Table 4.4. Pavement Surface Condition of Road Study Sections

Surface Type	Road Class	Section No.	IRI	Road Condition
Asphaltic Concrete	Arterial	1	5.5	Fair
		2	4.9	Good
		3	5.3	Fair
		4	3.8	Good
		5	2.7	Good

4.3. Traffic Volume and Flow Characteristics

Summaries of traffic volumes and vehicle composition for the study sections are presented in Tables 4.5 and 4.6 respectively.

Table 4.5. Summary of Traffic Volumes on the Study Road

Section No	Section Name	Length (km)	Traffic Volume (ADT)
1	Suame Roundabout –Tafo Nhyiaso Junction	1.46	22,936
2	Tafo Nhyiaso Junction – Magazine New Road Junction	0.33	22,628
3	Magazine New Road Junction – Tafo Hospital Junction	0.54	22,787

4	Tafo Hospital Junction – TafoMarket	0.43	20,639
5	Tafo Market – Pankrono Estate Junction	1.3	19,914

Table 4.6. Summary of Traffic Composition on Study Road

Section No	Section Name	Light Vehicle	Medium Vehicle	Heavy Vehicle	Traffic Volume (ADT)
1	Suame Roundabout –Tafo Nhyiaso Junction	22,126	578	232	22,936
2	Tafo Nhyiaso Junction – Magazine New Road Junction	21,491	597	540	22,628
3	Magazine New Road Junction – Tafo Hospital Junction	21,091	901	795	22,787
4	Tafo Hospital Junction – Tafo Market	19,826	579	234	20,639
5	Tafo Market – Pankrono Estate Junction	19,227	420	267	19,914

From Tables 4.5 and 4.6, the highest average daily traffic volume was recorded on Section 1with an ADT of 22,936veh/day. Light vehicles made up the highest category of vehicles on Section 1 recording 22,126 veh/day. Section 3 recorded the highest medium vehicles with 901 veh/day. Section 3 again recorded the highest heavy vehicles with a flow of 795 veh/day.

4.4. Computation of Pavement Loads

The axle load for each vehicle type were computed from Liddle's equation. The result is presented in Table 4.7 below

Table 4.7. Summary of Computed First Year ESAL on Study Road

Section No	Section Name	ESAL(First Year)

1	Suame Roundabout –Tafo Nhyiaso Junction	11,648.07
2	Tafo Nhyiaso Junction – Magazine New Road Junction	10,138.69
3	Magazine New Road Junction – Tafo Hospital Junction	11,038.58
4	Tafo Hospital Junction – Tafo Market	10,008.22
5	Tafo Market – Pankrono Estate Junction	9,048.28

4.5. Correlation Analysis

Correlation analysis was used to measure the relationship between the surface defects (dependent variables) and the deteriorating factors (independent variables).Positive correlation means a direct proportionality relationship and a negative correlation implies an inverse relationship. The SPSS software was used in the data analysis. Data obtained were categorized mainly into two types of variables, the dependent and independent variables. The dependent variables were distresses measured on the pavement and included depression, pothole, rutting and cracks. The independent variables consisted of traffic volumes and their distribution as well as the road alignment features. Table 4.8 presents the results of the correlation analysis. Additionally, the relationship between the IRI values recorded for the road study sections were determined with the same independent variables. The Pearson

Correlation coefficient(r) value was employed to interpret the results of the analysis.

- Exactly 1 is a perfect linear relationship
- ($0.70 > x \geq 0.99$)-a very strong relationship
- ($0.50 > x \geq 0.69$)-a strong relationship
- ($0.30 > x \geq 4.99$)- a moderate relationship

- (0.0 > x ≥ 0.29)- a weak relationship

For the purposes of this study, a coefficient value ≥ 0.50 was considered to indicate a strong relationship between the variables.

Table 4.8. Surface Defects and IRI Correlation with Traffic And Roadway Features Results

		SECTION LENGTH (M)	AREA OF SECTION (M^2)	TRAFFIC VOLUME (ADT)	ESAL
VOL. DEPRESSION (M^3)	Pearson Correlation	**.670**	**.764**	**.499**	**.737**
	Sig. (2tailed)	.216	.132	.392	.156
	N	5	5	5	5
POT HOLE VOLUME (M^3)	Pearson Correlation	**.179**	**.295**	**.929***	**.955***
	Sig. (2tailed)	.773	.630	.023	.012
	N	5	5	5	5
RUTTING VOLUME (M^3)	Pearson Correlation	**-.269**	**-.198**	**.940***	**.659**
	Sig. (2tailed)	.662	.750	.018	.226
	N	5	5	5	5
AREA OF CRACKS (M^2)	Pearson Correlation	**.675**	**.716**	**.263**	**.628**
	Sig. (2tailed)	.211	.174	.669	.257
	N	5	5	5	5
IRI	Pearson Correlation	**-.151**	**-.035**	**.982****	**.926***
	Sig. (2tailed)	.808	.956	.003	.024
	N	5	5	5	5

4.6. Correlation Analysis Results

4.6.1. Depression

Table 4.9 shows the correlation analysis summary for depression and the independent variables.

Table 4.9. Correlation between Depression and Independent Variables

Very Strong	Strong	Moderate	Weak
First Year ESAL (0.737)		Traffic volume (0.499)	.

Depressions are said to be caused by heavier traffic volumes or by poor constructing methods. Table 4.9 appears to partly affirm this assertion as traffic volume show a moderate relationship with depression but First Year EASL was also found to have a strong relationship with depression. The positive coefficient values demonstrate a direct proportionality relationships which confirms existing literature.

4.6.2. Pot Holes

Table 4.10 shows the correlation analysis summary for potholes and the independent variables.

Table 4.10. Correlation Analysis between Potholes and Independent Variables

Very Strong	Strong	Moderate	Weak
Traffic volume (0.929)			
First Year ESAL (0.955)			

Table 4.10, shows very strong relationships between potholes formation and traffic volume as well as First Year ESAL. The positive correlation coefficients indicate a direct proportionality between the parameters of interest.

4.6.3. Cracks

Table 4.11 shows the correlation analysis summary for cracks and the independent variables.

Table 4.11. Correlation Analysis of Cracks and Independent Variables

Very Strong	Strong	Moderate	Weak
	First Year ESAL (0.628)		Traffic volume (0.263)

Cracks occur on pavements when the surface is deflected over an unstable foundation, shrinkage, heat expansion and constriction on the surface. There exist various types of pavement cracks as learnt from literature. Alligator, traverse and longitudinal cracks were the predominant forms of cracks observed on the study road. The results from the correlation analysis established a strong relationship between cracks and First Year ESAL

4.6.4. Rutting

Table 4.12 shows the correlation analysis summary for rutting and the independent variables.

Table 4.12. Correlation Analysis of Rutting and Independent Variables

Very Strong	Strong	Moderate	Weak
Traffic volume (0.940)	First Year ESAL (0.628)		

A rut is identified as a surface constriction in the wheel way. This kind of strain is created by deformation in any of the asphalt layers or subgrade and is brought on by displacement of materials as a result of traffic burden. From Table 4.12, rutting had a very strong correlation with traffic volume and with First Year EASL. The relationships were positive indicating direct proportionality and thus affirm existing knowledge on the causes of rut formation.

4.6.5. International Roughness Index (IRI)

Table 4.13 shows the correlation analysis summary between IRI and the independent variables

Table 4.13. Correlation Analysis of IRI and Independent Variables

Very Strong	Strong	Moderate	Weak
Traffic volume (0.982)			
First Year ESAL (0.926)			

The IRI values had very strong positive relationship with the traffic volume and the First Year ESAL. This is a more objective assessment and also affirm the damage that traffic and its loadings do to the road pavement. Apart from the high values of the correlation coefficients, the relationships were positive indicating a direct proportionality between IRI, a

proxy for road surface defects, and traffic volume and its loadings.

CHAPTER 5:

CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction

This chapter covers the summary of all the findings of this research, the various conclusions drawn. It also makes appropriate recommendations in order to address the risk of premature deterioration in preserving investments in the road transport sector.

5.1. Conclusions

This research was aimed at identifying the pavement surface condition distresses on the Mampong arterial (thus from Suame Roundabout - Pankrono Estate Junction) and established relationships between the surface defects and traffic flow and related road alignment features.

The results obtained from the visual inspection and the Roughometer show severe pavement surface distresses on sections of the road, namely; depressions, cracks, potholes and rutting. The extent of road deterioration measured for each road section and the IRI values obtained from the Roughometer readings indicated that the general road surface condition is between fair and good.

Following the correlation analysis, results obtained affirmed that the damage done by vehicular traffic and especially pavement loading was significant. This was demonstrated by the high values of Pearson Correlation Coefficient values that were estimated for the various relationships.

5.2. Recommendation

Following the relationships established between the road surface defects and traffic flow and related road alignment features, it is recommended that:

1. The study be expanded to include all classes and types of roads in order to build on this knowledge and to proffer a more sustainable and scientific approach to addressing the subject of maintenance by Road Authorities and relevant stakeholders.

2. There will be the need to also include as part of the study some additional data such as rainfall data among others to widen the scope of road and environmental factors that contribute to road pavement deterioration.

3. There will also be the need for policy makers and Road Authorities to ensure strict compliance of axle load limits on our road networks is adhered to, be they feeder, urban and highways.

REFERENCES

1. Feng Hand Dar.H,(2009) Effects of surface preparation, thickness, and material on asphalt pavement overlay transverse crack propagation, NRC Research Press, Can. J. Civ. Eng. Vol. 36. P 1411.

2. Lavin.P.G, (2003) Asphalt Pavement, Taylor & Francis e-Library, London and New York,

3. Walker D, (2002) Pavement Surface Evaluation and Rating, University of Wisconsin–Madison.

4. OECO (Omran Engineering Consultants Office),(2008) Book of general technical specifications for the establishment and paving roads,Roads and land Transportation Authority,Tripoli,Libya

5. Abdulwahhab H I,.Ramadhan R H and Ibrahim M., Temperature Impact on Pavement Structures in Hot Arid Environment, Civil Engineering Department, Research Institute King Fahd University of Petroleum and Minerals, Saudi Arabia.

6. Luo Z, (2005) Flexible Pavement Condition Model Using Clusterwise Regression and Mechanistic-Empirical Procedure for Fatigue Cracking Modeling, Ph.D Dissertation, The University of Toledo, December

7. GTC (Geotechnical Testing Center),(1998), guide of pavement defects and proposals for maintenance, Riyadh – KSA. www.momra.gov.sa/GeneralServ/Specs/spec0101-4.asp. accessed on Nov 2015

8. ERES Consultants, Inc., "Eye on ERES", Volume 5, Number 1, Champaign, Illinois, 1998.

9. Marathe P. D., “Flexible Pavement Evaluation System”, in Proceedings International

Conference on New Horizons in Roads and Road Transport, Vol. 1, ICORT-95, December 11-14, 1995.

10. Weil R, (2009) State of the Streets in San Carlos, Report to Council, California.

11. U.S. Department of Transportation,(2009) Airport Pavement Design and Evaluation, Federal Aviation Administration,.

12. Seiler W J, (2009) Airport Pavement Management Concepts, FAA Great Lakes Region Conference, Schaumburg.

13. David P. Orr (2006) Pavement Maintenance Engineer Cornell Local Roads Program. Cornell Local Roads Program.pp-17-40.

14. O'Flaherty C. A., "Highway Engineering", 3rd ed., Volume 2, Edward Arnold, Great Britain, 1988.

15. AASHTO Guide for the Design of Pavement Structures 1993" Published by the American Association of State Highway and Transportation Officials Washington DC.

16. Washington State Transportation Department, "Maintenance Manual", Olympia, March 2002.

17. http://www.modernghana.com/news/561267/50/the-role-of-road-transport-ineconomic-development.html. Accessed 25/10/2015.

APPENDIX A

TRAFFIC VOLUME DATA ON EACH SECTION (10/3/2015)

Traffic Count for Section 1

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:10/3/2015 Tuesday	GPS:	
Road Direction: TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT :	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County:ASHANTI	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck trail	Extra Large Truck	Total
8-9	179	223	61	117	330	0	0	5	1	5	0	1	1	0	**923**
9-10	170	208	57	130	308	1	1	9	7	1	0	0	3	2	**897**
10-11	189	222	67	146	371	1	0	13	4	5	0	0	0	4	**1022**
11-12	172	275	58	103	388	1	1	17	4	6	0	0	2	1	**1028**
12-1	145	219	50	72	301	4	0	13	5	1	0	0	1	2	**813**
1-2	132	207	55	63	364	3	1	16	3	8	0	0	0	1	**853**
2-3	166	206	44	62	367	1	0	8	6	5	0	0	1	0	**866**
3-4	174	141	62	85	223	9	0	16	3	4	0	0	2	0	**719**
4-5	99	150	28	60	178	9	1	13	3	3	0	0	2	0	**546**
5-6	186	87	50	64	183	6	2	12	3	4	0	0	3	0	**600**
6-7	47	99	36	78	187	0	0	4	4	2	0	1	1	0	**459**
7-8	85	160	47	28	201	2	0	13	3	2	0	0	3	1	**545**
8-9	42	161	39	24	162	1	0	4	1	2	1	0	3	0	**440**
9-10	2	142	2	8	153	0	1	3	0	2	0	0	3	0	**316**
10-11	14	62	4	5	48	0	0	3	2	2	0	0	1	0	**141**
11-12	10	36	4	5	28	0	0	3	2	3	0	0	2	0	**93**
12-1	5	25	3	0	10	0	0	1	1	1	0	0	0	0	**46**
1-2	0	12	3	0	11	0	0	1	2	1	0	0	0	0	**30**
2-3	1	8	1	0	12	0	0	0	1	2	0	0	1	0	**26**
3-4	1	16	1	1	45	0	0	3	0	3	0	0	1	0	**71**
4-5	11	57	3	6	180	2	0	2	3	2	0	0	0	0	**266**
5-6	44	72	27	27	203	3	3	10	3	3	0	0	0	0	**395**
6-7	64	103	26	94	223	1	0	5	3	4	0	0	0	0	**523**
7-8	42	150	50	151	278	3	2	7	1	2	0	0	3	0	**689**
T0TAL	**1980**	**3041**	**778**	**1329**	**4754**	**47**	**12**	**181**	**65**	**73**	**1**	**2**	**33**	**11**	**12307**

Enumerator: TRAFFIC CONTRACTORS	Signature:		Supervisor: TONY	

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction: TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County:Bong	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
8-9	175	223	38	54	317	0	0	7	0	2	0	0	1	0	**817**
9-10	153	269	51	78	331	6	1	8	1	0	0	0	1	1	**900**
10-11	176	263	52	61	325	8	0	9	1	3	1	0	0	1	**900**
11-12	169	271	52	75	362	5	0	13	7	2	1	0	0	0	**957**
12-1	193	237	61	88	345	6	1	19	5	2	0	1	1	0	**959**
1-2	178	252	61	70	313	10	0	8	6	2	0	1	3	0	**904**
2-3	178	179	45	66	284	7	1	6	4	4	3	1	0	4	**782**
3-4	146	185	61	90	298	11	3	8	2	6	1	0	1	0	**812**
4-5	180	174	49	82	286	3	1	10	7	6	0	0	1	1	**800**
5-6	178	197	38	88	287	6	1	9	5	7	0	0	2	2	**820**
6-7	126	131	98	68	206	0	0	9	16	2	1	0	2	0	**659**
7-8	103	91	68	51	289	13	2	6	3	1	0	3	0	1	**631**
8-9	145	124	74	62	198	0	1	8	3	4	0	0	1	2	**622**
9-10	127	95	33	9	179	4	3	6	1	2	0	0	0	1	**460**
10-11	68	58	6	9	57	1	0	3	0	3	0	0	1	2	**208**
11-12	6	51	11	36	9	0	0	3	1	0	0	0	1	2	**120**
12-1	10	39	4	0	8	0	0	2	2	1	0	0	0	0	**66**
1-2	4	27	2	0	11	0	0	0	1	0	0	0	1	1	**47**
2-3	4	15	2	0	17	1	0	0	0	0	0	0	0	1	**40**
3-4	6	22	4	0	27	0	1	1	0	1	0	0	0	1	**63**
4-5	8	22	6	0	67	0	1	2	0	1	1	0	1	0	**109**
5-6	7	62	13	6	198	0	3	3	3	2	0	0	0	1	**298**
6-7	39	86	24	19	195	2	3	2	3	0	0	0	2	0	**375**
7-8	53	123	45	10	258	4	3	7	2	1	0	0	1	1	**508**
TOTAL	**2432**	**3196**	**898**	**1022**	**4867**	**87**	**25**	**149**	**73**	**52**	**8**	**6**	**20**	**22**	**12857**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	

Survey location	District:	Special Feature: Day: Tuesday
Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck raile	Extra Large Truck	Total
	4412	6237	1676	2351	9621	134	37	330	138	125	9	8	53	33	25164

Traffic Count for Section 2

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:10/3/2015 Tuesday	GPS:	
Road Direction:TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County: ASHANTI	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Trail	Extra Large Truck	Total
8-9	135	265	69	80	359	3	0	15	13	7	0	0	1	0	**947**
9-10	153	253	56	68	347	2	3	10	10	5	2	4	0	1	**914**
10-11	196	241	76	62	381	1	0	13	10	8	0	1	0	1	**990**
11-12	108	237	88	67	332	1	1	15	9	7	2	6	0	0	**873**
12-1	191	257	67	48	326	0	2	19	16	9	1	3	0	0	**939**
1-2	112	226	101	42	285	3	1	13	10	8	4	2	0	0	**807**
2-3	187	250	74	54	288	5	3	13	8	9	1	6	0	0	**898**
3-4	110	138	84	47	278	3	1	15	7	7	0	7	1	0	**698**
4-5	95	160	65	44	265	10	2	11	12	6	0	5	0	0	**675**

5-6	83	130	83	42	275	10	5	8	7	16	0	9	0	0	**668**
6-7	106	119	67	47	327	7	3	9	9	16	0	8	0	0	**718**
7-8	57	80	44	29	182	2	1	5	10	5	0	2	0	0	**417**
8-9	48	159	3	13	112	1	0	5	5	3	0	3	0	0	**352**
9-10	51	109	22	14	68	2	1	2	6	4	0	2	0	0	**281**
10-11	16	28	8	1	27	0	3	2	3	0	0	3	0	0	**91**
11-12	3	33	7	1	10	0	0	1	6	3	0	3	0	0	**67**
12-1	4	24	3	0	5	0	0	0	3	2	0	1	0	0	**42**
1-2	1	19	8	0	6	0	0	0	3	1	0	0	0	0	**38**
2-3	1	3	0	2	0	0	0	1	0	0	0	0	0	0	**7**
3-4	4	13	3	1	41	0	0	0	0	1	0	0	0	0	**63**
4-5	16	51	5	7	169	1	2	3	4	3	0	0	0	0	**261**
5-6	43	68	23	16	346	2	1	2	5	6	0	0	0	0	**512**
6-7	62	113	35	50	384	3	3	5	4	4	0	0	0	0	**663**
7-8	91	85	44	49	244	2	1	5	2	2	0	0	0	0	**525**
T0TAL	**1873**	**3061**	**1035**	**784**	**5057**	**58**	**33**	**172**	**162**	**132**	**10**	**65**	**2**	**2**	**12446**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date: 10/3/2015 Tuesday	GPS:	
Road Direction:TO MAMPONG	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location	District:	Special Feature: Day: Tuesday		
Nearest Town	County:	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
8-9	96	158	90	65	348	0	1	13	11	4	2	5	0	0	**793**
9-10	105	200	91	62	367	3	3	5	12	9	1	2	2	0	**862**
10-11	187	175	95	65	334	2	2	4	16	7	1	2	0	0	**890**
11-12	189	182	76	63	321	12	2	3	16	12	2	0	3	0	**881**
12-1	163	150	52	70	267	7	1	1	19	8	1	4	1	0	**744**
1-2	166	139	75	57	295	5	4	4	6	7	1	3	0	0	**762**
2-3	170	175	91	45	304	2	1	0	11	9	1	2	1	0	**812**
3-4	156	195	105	63	332	2	2	3	19	12	0	3	1	0	**893**
4-5	106	191	81	68	261	6	1	0	11	4	3	3	1	0	**736**
5-6	98	151	71	76	310	3	1	2	13	12	2	3	0	0	**742**

6-7	122	186	90	77	310	10	0	1	13	3	0	3	0	0	**815**
7-8	81	163	91	39	200	8	1	2	11	6	2	3	1	0	**608**
8-9	70	89	40	20	145	0	4	0	7	7	1	1	0	0	**384**
9-10	58	76	18	15	60	0	1	2	9	2	0	1	0	0	**242**
10-11	15	29	7	1	26	0	0	1	2	0	0	3	0	0	**84**
11-12	12	22	5	4	16	0	0	1	1	1	0	1	0	0	**63**
12-1	12	29	2	2	8	0	0	1	5	1	0	0	0	0	**60**
1-2	3	15	2	0	3	0	0	0	1	4	1	1	0	0	**30**
2-3	2	8	0	0	2	0	1	0	2	1	0	1	0	0	**17**
3-4	0	13	3	1	13	0	0	0	1	0	0	1	0	0	**32**
4-5	4	30	6	1	71	0	1	1	0	3	0	3	0	0	**120**
5-6	19	55	13	7	189	2	1	1	4	2	0	8	0	0	**301**
6-7	55	82	49	26	390	6	1	1	5	3	3	2	0	0	**623**
7-8	52	97	38	27	278	1	2	0	6	3	2	3	0	0	**509**
T0TAL	**1941**	**2610**	**1191**	**854**	**4850**	**69**	**30**	**46**	**201**	**120**	**23**	**58**	**10**	**0**	**12003**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

TRAFFIC COMPOSITION (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County: ASHANTI	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
	3814	**5671**	**2226**	**1638**	**9907**	**127**	**63**	**218**	**363**	**252**	**33**	**123**	**12**	**2**	**24449**

Traffic Count for Section 3

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:10/3/2015 Tuesday	GPS:	
Road Direction: TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County:ASHANTI	Any other Remarks:24 hour Counts		
Time	Motorized Traffic				

	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landroves, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Trail	Extra Large Truck	Total
8-9	177	156	35	150	320	1	0	26	4	6	0	1	0	0	**876**
9-10	137	139	40	108	381	0	2	18	7	2	0	0	4	0	**838**
10-11	153	185	34	82	392	0	0	17	5	6	0	2	1	0	**877**
11-12	156	135	36	91	299	1	0	25	7	6	0	2	4	0	**762**
12-1	101	102	21	70	297	0	1	30	4	4	0	2	7	0	**639**
1-2	167	136	33	62	307	2	1	29	4	3	0	4	1	0	**749**
2-3	121	112	19	64	321	0	3	28	9	3	0	0	0	0	**680**
3-4	111	105	30	64	308	2	3	22	6	6	0	1	6	0	**664**
4-5	118	135	16	79	303	5	3	25	6	6	0	2	3	0	**701**
5-6	105	98	26	70	219	0	2	23	5	5	0	3	5	0	**561**
6-7	115	114	21	72	307	4	0	16	6	7	0	3	7	0	**672**
7-8	47	120	43	61	150	7	3	16	7	6	1	0	0	0	**461**
8-9	76	125	60	60	105	1	0	12	5	5	0	0	0	0	**449**
9-10	33	30	10	0	5	50	0	0	4	1	1	0	0	0	**134**
10-11	13	35	3	1	26	0	1	3	0	0	1	0	0	0	**83**
11-12	10	35	5	4	18	0	1	3	0	0	0	0	0	0	**76**
12-1	4	17	2	0	0	0	0	0	1	0	0	0	0	0	**24**
1-2	10	8	1	1	3	0	0	0	0	1	0	0	0	0	**24**
2-3	3	17	3	1	13	0	1	0	0	0	0	0	0	0	**38**
3-4	14	33	13	6	42	0	0	3	1	1	0	0	0	0	**113**
4-5	23	53	13	12	53	2	1	2	0	2	0	0	0	0	**161**
5-6	22	100	25	0	235	4	1	4	2	2	0	0	2	0	**397**
6-7	93	249	54	15	330	4	3	20	8	2	0	0	0	0	**778**
7-8	93	300	93	20	350	8	1	27	4	6	1	0	0	0	**903**
T0TAL	**1902**	**2539**	**636**	**1093**	**4784**	**91**	**27**	**349**	**95**	**80**	**4**	**20**	**40**	**0**	**11660**
Enumerator: TRAFFIC CONTRACTORS					Signature:			Supervisor: TONY							

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date: 10/3/2015 Tuesday	GPS:	

Road Direction: TO MAMPONG	Road Section: SUAME-MAMPONG	Weather: DRY SHIFT:
Survey location	District:	Special Feature: Day: Tuesday
Nearest Town	County:Bong	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
8-9	175	142	58	56	264	10	10	19	20	60	0	0	3	0	**817**
9-10	178	142	68	68	222	1	23	22	12	20	0	0	3	0	**759**
10-11	181	100	68	82	309	2	15	13	12	20	0	0	1	0	**803**
11-12	144	129	72	178	302	0	21	24	11	10	5	0	1	0	**897**
12-1	97	124	61	66	268	0	11	23	10	30	1	0	3	0	**694**
1-2	180	161	71	49	370	0	8	22	13	11	0	2	0	0	**887**
2-3	103	139	63	37	340	1	11	20	10	47	2	0	7	0	**780**
3-4	140	238	65	70	222	0	10	22	9	40	0	1	4	0	**821**
4-5	126	199	72	114	290	1	13	23	10	49	8	0	3	0	**908**
5-6	102	95	66	87	369	1	5	12	4	69	2	0	4	0	**816**
6-7	87	119	63	106	351	4	9	8	15	71	0	1	2	0	**836**
7-8	87	68	13	21	387	1	1	10	3	30	0	1	1	0	**623**
8-9	79	77	17	9	287	1	2	12	0	12	0	1	1	1	**499**
9-10	26	33	8	2	137	1	0	6	0	10	0	0	1	0	**224**
10-11	22	34	3	3	49	0	4	2	1	2	0	0	4	0	**124**
11-12	9	34	4	0	12	0	0	11	1	2	0	0	1	0	**74**
12-1	6	17	3	3	14	0	0	8	3	1	0	0	2	0	**57**
1-2	2	12	2	0	13	2	7	4	1	2	0	1	1	0	**47**
2-3	3	10	6	1	18	0	13	11	0	0	0	1	7	0	**70**
3-4	3	22	4	2	58	2	13	5	2	3	2	0	0	0	**116**
4-5	12	19	6	0	53	2	3	8	1	1	0	1	1	0	**107**
5-6	49	78	11	12	310	0	3	9	3	3	0	0	0	0	**478**
6-7	66	190	10	67	477	2	0	13	1	4	0	0	0	0	**830**
7-8	61	72	23	107	308	3	1	13	3	1	0	0	0	0	**592**
TOTAL	**1938**	**2254**	**837**	**1140**	**5430**	**34**	**183**	**320**	**145**	**498**	**20**	**9**	**50**	**1**	**12859**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY

TRAFFIC COMPOSITION (CTV) FORMAT

		Date: 10/3/2015 Tuesday	GPS:	

Road Direction:ALL	Road Section: SUAME-MAMPONG	Weather: DRY SHIFT:
Survey location	District:	Special Feature: Day: Tuesday

Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
	3840	4793	1473	2233	10214	125	210	669	240	578	24	29	90	1	24519

Traffic Count for Section 4

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:10/3/2015 Tuesday	GPS:	
Road Direction: TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Tuesday	Day:	
Nearest Town		County:ASHANTI	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrove rs, landcruis ers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer (Light)	Semi-Trailer (Heavy)	Truck Trail e	Extra Large Truck	Total
8-9	167	112	57	146	302	2	1	7	2	0	0	0	1	0	**797**
9-10	145	145	75	161	356	1	0	17	3	2	0	2	4	0	**911**
10-11	103	227	70	130	241	2	0	13	6	4	0	0	1	1	**798**
11-12	192	210	64	104	316	1	1	17	7	5	0	0	4	0	**921**
12-1	98	233	43	95	296	3	0	9	3	1	0	1	2	0	**784**
1-2	128	263	63	54	313	13	3	7	1	1	0	0	1	0	**847**
2-3	57	122	57	64	278	2	0	4	1	3	0	2	0	0	**590**
3-4	79	205	43	62	348	4	0	10	4	2	0	1	1	0	**759**

4-5	45	126	45	64	253	8	1	10	2	2	1	1	2	0	**560**
5-6	99	81	22	52	308	7	0	8	3	3	0	1	5	0	**589**
6-7	150	101	33	59	293	3	0	5	3	4	0	3	2	0	**656**
7-8	123	97	44	59	234	1	0	0	0	1	1	0	1	0	**561**
8-9	89	110	37	19	134	0	2	8	0	1	0	0	1	0	**401**
9-10	36	46	19	4	97	0	0	1	1	11	0	0	0	0	**215**
10-11	42	62	11	8	24	0	1	4	1	0	0	0	0	0	**153**
11-12	13	53	3	0	12	0	0	0	1	0	0	1	0	0	**83**
12-1	7	47	0	0	8	0	0	2	0	0	0	0	1	0	**65**
1-2	0	19	1	0	4	0	0	0	1	0	0	0	1	0	**26**
2-3	1	21	0	0	8	0	1	0	0	0	0	0	1	0	**32**
3-4	4	36	3	1	52	0	1	3	0	1	0	0	1	0	**102**
4-5	12	57	4	6	163	0	2	3	0	3	0	0	0	0	**250**
5-6	27	81	12	11	227	6	0	3	0	4	0	0	0	0	**371**
6-7	18	77	13	9	312	4	1	9	0	0	0	0	0	0	**443**
7-8	89	128	61	153	296	2	3	17	2	1	0	0	0	0	**752**
T0TAL	**1724**	**2659**	**780**	**1261**	**4875**	**59**	**17**	**157**	**41**	**49**	**2**	**12**	**29**	**1**	**11666**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction: TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County:Bong	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
8-9	132	185	57	83	340	3	6	11	7	0	0	0	1	0	**825**
9-10	145	107	33	36	280	0	1	12	2	1	1	0	2	0	**620**
10-11	121	242	38	46	383	0	0	13	3	3	2	0	0	0	**851**
11-12	153	235	39	71	380	0	1	17	4	3	2	0	1	0	**906**
12-1	170	245	44	61	301	0	0	13	3	2	2	0	1	0	**842**
1-2	136	185	30	44	250	1	2	11	9	0	0	0	2	0	**670**

2-3	135	207	43	44	261	3	1	12	3	1	1	0	5	0	**716**
3-4	100	85	50	37	306	0	2	7	7	2	4	0	0	0	**600**
4-5	139	103	41	37	315	2	0	3	3	3	3	4	1	0	**654**
5-6	167	79	61	42	342	1	2	6	3	1	2	0	4	1	**711**
6-7	105	126	77	105	316	1	1	8	5	3	0	0	6	0	**753**
7-8	88	87	70	54	298	2	1	7	2	0	3	1	5	0	**618**
8-9	78	61	27	15	134	0	1	1	2	0	1	0	0	0	**320**
9-10	68	46	18	9	89	0	0	3	1	0	1	0	0	0	**235**
10-11	41	69	12	6	80	1	0	1	0	0	0	0	2	0	**212**
11-12	16	28	6	2	33	0	0	2	0	1	0	0	0	0	**88**
12-1	5	14	0	0	4	0	0	2	2	1	0	0	0	0	**28**
1-2	7	17	2	0	3	0	0	0	0	1	2	0	1	0	**33**
2-3	6	13	0	0	6	0	1	0	0	0	0	1	1	0	**28**
3-4	6	37	4	0	52	0	1	1	0	1	0	0	0	0	**102**
4-5	11	47	3	7	117	2	0	0	2	0	0	0	0	0	**189**
5-6	19	35	13	11	168	1	2	4	0	1	0	0	0	0	**254**
6-7	30	61	17	10	247	6	1	2	1	5	0	0	0	0	**380**
7-8	34	67	21	20	202	5	0	2	3	3	0	0	0	0	**357**
T0TAL	**1912**	**2381**	**706**	**740**	**4907**	**28**	**23**	**138**	**62**	**32**	**24**	**6**	**32**	**1**	**10992**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

TRAFFIC COMPOSITION (CTV) FORMAT

									Date: 10/3/2015 Tuesday					GPS:	
Road Direction:ALL					Road Section: SUAME-MAMPONG				Weather: DRY					SHIFT:	
Survey location					District:				Special Feature: Day: Tuesday						
Nearest Town					County: ASHANTI				Any other Remarks:24 hour Counts						
Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
	3636	**5040**	**1486**	**2001**	**9782**	**87**	**40**	**295**	**103**	**81**	**26**	**18**	**61**	**2**	**22658**

Traffic Count for Section 5

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:10/3/2015 Tuesday	GPS:
Road Direction: TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:
Survey location		District:	Special Feature: Day: Tuesday	
Nearest Town		County:ASHANTI	Any other Remarks:24 hour Counts	

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landroves, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Trailer	Extra Large Truck	Total
8-9	187	112	57	146	302	2	2	7	2	0	0	0	1	0	**818**
9-10	199	245	75	161	250	1	0	16	3	2	0	2	4	0	**958**
10-11	145	227	70	130	344	2	0	10	6	4	0	0	1	1	**940**
11-12	192	203	64	114	316	1	1	15	7	5	0	0	4	0	**922**
12-1	121	233	43	95	380	3	0	9	3	1	0	1	2	0	**891**
1-2	128	261	60	54	384	13	3	8	1	1	0	0	1	0	**914**
2-3	157	256	47	68	358	2	0	4	1	3	0	2	0	0	**898**
3-4	179	205	39	52	349	4	0	11	4	2	0	1	1	0	**847**
4-5	145	199	45	60	345	5	1	9	2	2	1	1	2	0	**817**
5-6	139	181	25	55	228	6	0	5	3	3	0	1	5	0	**651**
6-7	150	101	33	58	299	3	0	4	3	4	0	3	2	0	**660**
7-8	156	97	40	59	240	1	0	1	0	1	1	0	1	0	**597**
8-9	111	86	37	20	145	0	2	7	0	1	0	0	1	0	**410**
9-10	99	46	19	6	103	0	0	2	1	11	0	0	0	0	**287**
10-11	101	62	10	11	34	0	1	4	1	0	0	0	0	0	**224**
11-12	13	53	3	3	22	0	0	1	1	0	0	1	0	0	**97**
12-1	7	47	0	2	18	0	0	2	0	0	0	0	1	0	**77**
1-2	0	19	2	8	9	0	0	0	1	0	0	0	1	0	**40**
2-3	1	21	0	4	15	0	1	2	0	0	0	0	1	0	**45**
3-4	4	36	3	1	48	0	1	3	0	1	0	0	1	0	**98**
4-5	12	57	8	6	160	0	1	4	0	3	0	0	0	0	**251**
5-6	23	81	12	11	222	5	1	3	0	4	0	0	0	0	**362**
6-7	18	77	13	9	298	4	1	8	0	0	0	0	0	0	**428**
7-8	89	100	61	153	300	2	3	16	2	1	0	0	0	0	**727**
T0TAL	**2376**	**3005**	**766**	**1286**	**5169**	**54**	**18**	**151**	**41**	**49**	**2**	**12**	**29**	**1**	**12959**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction: TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: Tuesday		
Nearest Town		County:Bong	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
8-9	199	83	54	79	340	3	6	11	7	0	0	0	1	0	**783**
9-10	132	100	33	36	280	0	1	12	2	1	1	0	2	0	**600**
10-11	178	120	38	46	283	0	0	11	3	3	2	0	0	0	**684**
11-12	101	129	39	66	290	0	1	15	4	4	2	0	1	0	**652**
12-1	123	82	40	62	303	0	0	13	3	2	2	0	1	0	**631**
1-2	155	80	30	44	249	1	1	10	9	0	0	0	2	0	**581**
2-3	158	100	44	34	259	2	1	10	3	1	1	0	5	0	**618**
3-4	147	167	48	37	208	0	1	8	4	2	4	0	0	0	**626**
4-5	142	96	41	37	188	2	0	2	2	2	3	4	1	0	**520**
5-6	150	89	61	42	172	1	2	5	3	1	2	0	4	1	**533**
6-7	111	116	68	98	145	1	1	6	4	1	0	0	6	0	**557**
7-8	129	91	70	51	188	2	1	7	2	0	3	1	5	0	**550**
8-9	117	71	26	18	130	0	1	1	2	0	1	0	0	0	**367**
9-10	73	56	17	10	68	0	0	3	1	0	1	0	0	0	**229**
10-11	41	72	12	7	75	1	0	1	0	0	0	0	2	0	**211**
11-12	20	31	6	3	30	0	0	2	0	1	0	0	0	0	**93**
12-1	5	24	0	1	3	0	0	2	3	1	0	0	0	0	**39**
1-2	1	23	2	0	4	0	0	0	0	1	2	0	1	0	**34**
2-3	0	19	0	0	9	0	1	0	0	0	0	1	1	0	**31**
3-4	6	33	4	0	52	0	1	1	0	1	0	0	0	0	**98**
4-5	11	45	3	7	121	2	0	0	1	0	0	0	0	0	**190**
5-6	24	35	13	11	170	1	1	4	0	1	0	0	0	0	**260**
6-7	31	55	15	10	245	3	1	2	1	5	0	0	0	0	**368**
7-8	30	62	21	18	206	5	0	2	3	3	0	0	0	0	**350**
T0TAL	**2084**	**1779**	**685**	**717**	**4018**	**24**	**20**	**128**	**57**	**30**	**24**	**6**	**32**	**1**	**9605**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	

Survey location	District:	Special Feature: Day: Tuesday
Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
	4460	4784	1451	2003	9187	78	38	279	98	79	26	18	61	2	22564

TRAFFIC VOLUME DATA ON EACH SECTION (11/3/2015)

Traffic Count for Section 1

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date:11/3/2015 WEDNESDAY	GPS:	
Road Direction: TO SUAME		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location:		District:	Special Feature: Day: WEDNESDAY		
Nearest Town		County:Ashanti	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Trail	Extra Large Truck	Total
7-8	114	225	29	61	362	0	2	16	4	0	0	1	0	0	**814**
8-9	98	287	54	71	380	0	1	0	1	1	0	1	0	1	**895**
9-10	101	256	84	61	372	5	1	8	0	5	1	1	2	0	**897**
10-11	175	254	67	63	291	15	0	9	3	5	0	0	1	0	**883**
11-12	189	249	83	77	274	8		8	4	3	1	0	3	2	**901**
12-1	132	156	63	76	243	7	2	6	2	1	0	0	2	4	**694**

1-2	105	176	66	53	265	7	3	6	2	2	0	0	2	0	**687**
2-3	75	132	48	64	301	0	0	7	3	1	0	1	0	0	**632**
3-4	198	257	60	59	307	9	0	5	2	2	0	0	2	0	**901**
4-5	117	183	76	77	245	17	2	6	2	2	0	0	1	0	**728**
5-6	145	220	56	38	204	13	0	6	1	1	0	0	3	0	**687**
6-7	111	143	57	65	218	27	2	9	3	1	0	0	1	0	**637**
7-8	88	169	67	37	239	15	1	8	0	1	0	1	3	0	**629**
8-9	66	126	71	35	189	0	0	10	2	0	0	0	0	0	**499**
9-10	81	146	46	15	177	1	2	11	1	2	0	0	2	0	**484**
10-11	69	74	17	5	145	1	1	6	2	0	0	0	0	0	**320**
11-12	23	87	7	3	51	0	2	7	1	2	0	0	0	0	**183**
12-1	13	51	7	3	22	0	0	2	1	3	0	0	1	0	**103**
1-2	11	16	10	0	20	0	1	0	0	0	0	0	3	0	**61**
2-3	7	17	5	0	7	0	2	0	0	0	0	0	2	0	**40**
3-4	4	34	4	1	39	0	0	0	3	2	0	0	0	0	**87**
4-5	22	60	8	8	75	2	3	6	1	0	0	0	0	0	**185**
5-6	49	12	23	34	163	2	1	13	7	2	0	0	0	0	**306**
6-7	88	75	35	95	201	2	0	8	2	1	0	0	0	0	**507**
T0TAL	**2081**	**3405**	**1043**	**1001**	**4790**	**131**	**26**	**157**	**47**	**37**	**2**	**5**	**28**	**7**	**12760**
Enumerator: TRAFFIC CONTRACTORS					Signature:				Supervisor: TONY						

			Date: 11/3/2015 WEDNESDAY	GPS:	
Road Direction: TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY		SHIFT:
Survey location		District:	Special Feature: Day: WEDNESDAY		
Nearest Town		County:Bong	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
7-8	89	121	51	29	307	1	0	5	0	0	2	0	0	0	**605**
8-9	132	186	62	45	217	2	0	11	3	2	0	0	0	0	**660**
9-10	112	205	68	43	209	4	1	14	4	1	1	0	1	2	**665**
10-11	125	183	63	42	248	2	0	8	1	2	0	0	0	1	**675**
11-12	127	181	66	58	236	0	1	6	1	2	0	0	0	0	**678**
12-1	99	201	88	49	248	0	0	5	2	3	1	2	1	2	**701**
1-2	82	230	98	38	320	2	6	3	0	0	1	0	1	1	**782**
2-3	103	171	67	71	306	1	1	6	2	3	2	1	0	0	**734**
3-4	145	210	95	58	248	1	3	7	1	0	0	0	0	0	**768**
4-5	123	188	93	61	293	0	1	8	0	0	4	0	0	2	**773**
5-6	187	133	72	34	301	0	0	9	0	3	0	1	2	0	**742**
6-7	169	162	47	59	248	0	0	12	2	0	0	2	3	2	**706**
7-8	124	155	62	44	216	3	1	7	0	1	0	0	0	0	**613**
8-9	163	126	54	29	252	0	1	9	1	1	0	0	0	0	**636**
9-10	98	142	60	17	180	0	3	12	0	0	0	1	1	0	**514**
10-11	69	101	35	22	90	0	1	9	1	1	0	0	1	0	**330**
11-12	63	96	17	13	42	0	0	3	4	0	0	0	0	0	**238**
12-1	32	50	8	9	14	0	0	4	0	2	1	0	1	0	**121**
1-2	11	8	4	4	11	0	2	2	0	0	0	0	0	1	**43**
2-3	6	9	3	2	11	1	0	0	2	0	0	0	0	0	**34**
3-4	7	14	6	0	15	1	0	3	3	1	0	0	0	0	**50**
4-5	18	29	12	4	71	0	0	4	1	3	0	0	0	0	**142**
5-6	32	36	7	4	195	3	0	4	3	0	0	0	0	0	**284**
6-7	79	44	22	22	372	2	2	11	2	1	0	0	0	3	**560**
T0TAL	**2195**	**2981**	**1160**	**757**	**4650**	**23**	**23**	**162**	**33**	**26**	**12**	**7**	**11**	**14**	**12054**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY

TRAFFIC COMPOSITION (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL		Road Section: SUAME-MAMPONG	Weather: DRY		SHIFT:

Survey location	District:	Special Feature: Day: Tuesday
Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	truck traile	Extra Large Truck	Total
	4276	6386	2203	1758	9440	154	49	319	80	63	14	12	39	21	24814

Traffic Count for Section 2

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date:11/3/2015 Tuesday	GPS:	
: TO SUAME	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
n	District:	Special Feature: Day: Tuesday		
	County:ASHANTI	Any other Remarks:24 hour Counts		

Motorized Traffic												
Passenger Vehicle					Goods Vehicle							
Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
112	57	146	302	2	1	7	2	0	0	0	1	0	**753**
145	75	161	344	1	0	17	3	2	0	2	4	0	**923**
179	70	130	341	2	0	13	6	4	0	0	1	1	**903**
156	64	104	316	1	1	17	7	5	0	0	4	0	**861**
199	43	95	296	3	0	9	3	1	0	1	2	0	**775**
203	63	54	313	13	3	7	1	1	0	0	1	0	**787**
253	57	64	378	2	0	4	1	3	0	2	0	0	**881**
256	43	62	348	4	0	10	4	2	0	1	1	0	**927**

226	45	64	353	8	1	10	2	2	1	1	2	0	**902**
281	22	52	314	7	0	8	3	3	0	1	5	0	**799**
165	33	59	393	3	0	5	3	4	0	3	2	0	**820**
97	44	59	299	1	0	0	0	1	1	0	1	0	**602**
110	37	19	134	0	2	8	0	1	0	0	1	0	**435**
96	19	4	97	0	0	1	1	11	0	0	0	0	**307**
62	11	8	24	0	1	4	1	0	0	0	0	0	**153**
53	3	0	12	0	0	0	1	0	0	1	0	0	**83**
47	0	0	8	0	0	2	0	0	0	0	1	0	**65**
9	1	0	4	0	0	0	1	0	0	0	1	0	**16**
12	0	0	8	0	1	0	0	0	0	0	1	0	**23**
22	3	1	52	0	1	3	0	1	0	0	1	0	**88**
19	4	6	163	0	2	3	0	3	0	0	0	0	**212**
81	12	11	327	6	0	3	0	4	0	0	0	0	**471**
77	13	9	312	4	1	9	0	0	0	0	0	0	**443**
128	61	153	296	2	3	17	2	1	0	0	0	0	**752**
2988	**780**	**1261**	**5434**	**59**	**17**	**157**	**41**	**49**	**2**	**12**	**29**	**1**	**12981**

TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	
		Date: 11/3/2015 Tuesday	GPS:
MAMPONG	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:
	District:	Special Feature: Day: Tuesday	
	County:Bong	Any other Remarks:24 hour Counts	

Motorized Traffic													
Passenger Vehicle						Goods Vehicle							
Taxi	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
178	57	80	340	3	26	11	7	12	0	0	1	0	**857**
201	33	36	380	0	16	12	2	49	1	0	2	0	**895**
254	38	46	383	0	22	13	3	30	2	0	0	0	**931**
200	31	71	387	0	10	17	4	33	2	4	1	0	**916**
208	48	61	321	0	7	13	3	30	2	0	1	0	**773**
254	30	44	350	1	13	11	9	22	3	0	2	0	**873**
214	43	44	261	3	11	12	3	10	1	0	5	0	**707**

185	55	37	315	0	2	7	7	22	4	0	0	0	**732**
184	41	37	206	2	7	3	3	33	3	4	1	0	**584**
114	61	42	30	1	2	6	3	10	2	0	4	1	**441**
136	48	88	230	1	1	8	5	24	0	0	6	0	**660**
145	70	54	198	2	1	7	2	3	3	1	5	0	**593**
135	27	15	134	0	1	1	2	0	1	0	0	0	**398**
89	18	9	66	0	0	3	1	0	1	0	0	0	**234**
52	12	6	80	1	0	1	0	0	0	0	2	0	**205**
78	6	2	33	0	0	2	0	1	0	0	0	0	**170**
58	7	0	4	0	0	2	2	1	0	0	0	0	**124**
29	2	0	3	0	0	0	0	1	2	0	1	0	**50**
27	3	0	6	0	1	0	0	0	0	1	1	0	**56**
6	4	0	52	0	1	1	0	1	0	0	0	0	**71**
45	3	7	117	2	0	0	2	0	0	0	0	0	**177**
66	11	11	168	1	2	4	0	1	0	0	0	0	**267**
89	10	10	247	6	1	2	1	5	0	0	0	0	**373**
67	21	20	202	5	0	2	3	3	0	0	0	0	**357**
3014	**679**	**720**	**4513**	**28**	**124**	**138**	**62**	**291**	**27**	**10**	**32**	**1**	**11444**

: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV) FORMAT

		Date: 10/3/2015 Tuesday	GPS:	
	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
	District:	Special Feature: Day: Tuesday		
	County: ASHANTI	Any other Remarks:24 hour Counts		

Motorized Traffic													
Passenger Vehicle						Goods Vehicle							
Taxi	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
6002	**1459**	**1981**	**9947**	**87**	**141**	**295**	**103**	**340**	**29**	**22**	**61**	**2**	**24425**

Traffic Count for Section 3

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date:11/3/2015 WEDNESDAY	GPS:
: TO SUAME	Road Section: SUAME-MAPONG	Weather: DRY	SHIFT:

n :	District:	Special Feature: Day: WEDNESDAY
	County:Ashanti	Any other Remarks:24 hour Counts

Motorized Traffic													
Passenger Vehicle						Goods Vehicle							
Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
145	46	43	327	4	13	14	50	40	0	1	0	0	**871**
136	45	53	288	5	10	17	23	35	0	3	2	0	**810**
242	51	59	255	4	9	10	23	33	0	0	2	0	**820**
209	58	55	284	2	10	6	32	30	0	1	2	0	**804**
189	63	66	299	3	8	15	41	40	0	2	3	0	**815**
199	76	69	233	1	11	9	27	10	0	1	5	0	**759**
156	82	44	236	1	21	8	14	17	0	1	2	0	**680**
138	88	45	215	2	9	11	30	42	0	0	1	0	**658**
95	61	36	222	3	12	6	29	33	0	0	1	0	**525**
104	74	56	248	3	4	14	20	29	0	0	2	0	**650**
116	69	23	232	1	9	7	11	25	0	1	3	0	**598**
102	60	37	245	4	3	6	33	18	0	0	0	0	**621**
85	62	15	277	3	2	7	14	12	0	1	4	0	**653**
110	61	10	203	2	1	7	10	7	0	0	0	0	**600**
91	51	11	174	2	2	7	2	9	0	0	1	0	**473**
62	10	2	127	1	1	3	3	3	0	0	0	0	**310**
51	3	1	58	0	2	3	2	0	0	0	0	0	**207**
40	3	1	12	0	0	5	1	3	1	0	0	0	**105**
21	0	1	12	0	0	2	0	1	0	0	0	0	**52**
12	0	0	3	0	1	0	0	0	1	0	0	0	**23**
35	3	0	46	0	0	1	1	3	0	0	1	0	**97**
57	8	4	156	1	3	5	0	0	0	0	0	0	**257**
87	47	16	287	3	1	12	4	2	0	1	0	0	**501**
78	51	29	263	2	3	13	2	2	0	0	0	0	**512**
2560	**1072**	**676**	**4702**	**47**	**135**	**188**	**372**	**394**	**2**	**12**	**29**	**0**	**12401**

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

TRAFFIC CONTRACTORS	Signature:		Supervisor: TONY	
		Date: 11/3/2015 WEDNESDAY	GPS:	
AMPONG	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
	District:	Special Feature: Day: WEDNESDAY		
	County:	Any other Remarks:24 hour Counts		

Motorized Traffic													
Passenger Vehicle							Goods Vehicle						
Taxi	**Pickups, Landrove rs, landcruis ers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**Truck Traile**	**Extra Large Truck**	**Total**
191	61	14	325	1	1	3	1	1	0	1	0	0	**755**
186	52	28	276	0	1	7	0	1	1	1	2	0	**752**
132	61	34	339	0	1	15	0	2	0	0	1	0	**722**
207	74	34	317	0	1	11	1	3	1	1	2	0	**842**
202	49	31	303	1	3	6	1	2	1	0	0	0	**752**
202	61	22	280	1	1	9	2	2	1	0	2	0	**765**
172	84	71	249	3	3	9	4	1	0	3	0	0	**791**
189	93	36	256	0	1	9	3	2	1	1	1	0	**751**
205	66	12	268	2	0	1	1	3	0	0	0	0	**742**
206	72	22	257	0	1	4	4	1	1	0	1	0	**757**
188	27	39	281	0	1	2	1	2	1	0	0	0	**712**
191	48	46	189	0	0	10	6	0	0	3	1	0	**668**
153	43	13	213	0	1	4	1	0	0	0	0	0	**560**
177	31	4	194	0	2	4	0	0	1	0	0	0	**578**
143	7	8	123	0	0	3	1	0	1	0	0	0	**374**
65	21	5	87	0	1	3	2	2	0	0	0	0	**221**
25	4	4	19	0	0	2	0	0	0	0	0	0	**88**
29	3	1	7	0	0	3	0	0	0	0	1	0	**60**
22	1	0	5	0	0	1	0	0	0	0	1	0	**41**
19	1	0	8	0	0	1	0	0	2	0	0	0	**43**
41	8	1	56	0	1	3	1	0	3	0	0	0	**133**
50	5	3	157	0	2	1	0	0	0	0	0	0	**238**
54	8	8	217	0	2	4	1	0	1	0	0	0	**330**
38	14	11	233	1	2	5	2	1	0	0	0	1	**335**
3087	**894**	**447**	**4659**	**9**	**25**	**120**	**32**	**23**	**15**	**10**	**12**	**1**	**12010**

r: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV) FORMAT

		Date: 10/3/2015 Tuesday	GPS:	
	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
	District:	Special Feature: Day: Tuesday		

	County: ASHANTI	Any other Remarks:24 hour Counts

Motorized Traffic													
Passenger Vehicle						Goods Vehicle							
Taxi	Pickups, Landrove rs, landcruis ers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
5647	1966	1123	9361	56	160	308	404	417	17	22	41	1	24411

Traffic Count for Section 4

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date:11/3/2015 WEDNESDAY	GPS:
n: TO SUAME	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:
n :	District:	Special Feature: Day: WEDNESDAY	
	County:Ashanti	Any other Remarks:24 hour Counts	

Motorized Traffic													
Passenger Vehicle						Goods Vehicle							
Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
116	24	45	277	28	3	8	4	0	0	0	1	0	**652**
136	20	61	263	26	0	18	3	2	2	0	0	0	**701**
140	51	60	216	26	2	7	4	5	0	1	0	0	**668**
132	62	61	246	35	0	6	4	3	0	1	1	0	**691**
103	44	52	232	19	2	8	5	2	0	22	5	0	**620**
99	40	60	234	10	3	18	1	1	0	1	0	2	**634**
93	62	48	213	0	3	8	4	5	0	2	1	5	**644**
131	30	66	238	1	0	12	0	5	0	0	0	2	**684**
115	24	47	229	0	0	13	2	5	0	1	3	0	**633**

120	23	52	231	1	1	18	0	1	0	2	3	0	**635**
119	22	39	238	0	0	13	0	5	0	0	3	0	**602**
100	27	40	200	0	1	7	5	0	0	0	1	0	**517**
95	12	20	184	1	1	11	2	0	0	0	5	0	**471**
89	26	23	238	2	0	10	0	3	0	0	0	1	**544**
59	13	9	64	1	1	13	1	1	0	0	1	0	**242**
54	9	3	34	0	1	5	4	3	0	0	0	0	**148**
57	4	1	27	0	2	5	1	2	0	0	1	0	**116**
37	1	3	18	0	0	5	2	1	1	0	2	0	**76**
2	0	1	3	0	0	0	1	0	0	0	0	0	**7**
14	0	0	14	0	1	0	0	1	0	0	0	0	**33**
22	0	0	35	0	0	2	2	0	0	0	1	0	**71**
31	0	4	120	2	3	4	0	0	0	0	0	0	**178**
72	12	21	279	0	1	9	1	2	0	0	0	0	**422**
139	12	83	463	1	0	11	3	1	0	0	1	0	**817**
2075	**518**	**799**	**4296**	**153**	**25**	**211**	**49**	**48**	**3**	**30**	**29**	**10**	**10806**
TRAFFIC CONTRACTORS			Signature:				Supervisor: TONY						

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date: 11/3/2015 WEDNESDAY	GPS:	
Road Direction: TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: WEDNESDAY		
Nearest Town		County:	Any other Remarks:24 hour Counts		

Time	Motorized Traffic													
	Passenger Vehicle							Goods Vehicle						
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
7-8	93	110	45	21	279	1	2	8	2	0	0	0	1	0	**562**
8-9	115	151	72	38	324	0	0	11	4	5	0	0	0	0	**720**
9-10	125	121	60	46	312	6	4	16	1	5	1	0	1	0	**698**
10-11	125	153	75	65	346	0	3	14	3	5	0	0	2	0	**791**
11-12	74	122	60	58	301	5	1	7	5	1	0	0	3	0	**637**
12-1	723	175	86	39	289	2	0	12	1	4	1	0	3	0	**1335**
1-2	174	201	79	41	270	5	1	14	1	7	1	0	1	0	**795**
2-3	128	210	85	55	198	1	1	13	2	3	0	0	3	1	**700**
3-4	222	132	145	41	185	0	0	6	6	0	0	0	0	0	**737**
4-5	126	139	104	50	202	0	1	13	5	1	0	0	0	1	**642**
5-6	183	119	65	38	203	1	1	13	2	2	0	3	3	0	**633**
6-7	145	118	64	47	181	0	0	10	4	1	0	0	2	0	**572**
7-8	150	78	40	17	222	1	0	7	1	1	0	0	0	0	**517**
8-9	130	73	45	26	137	4	0	7	2	1	0	0	1	0	**426**
9-10	51	54	28	6	71	0	0	3	0	0	1	0	0	1	**215**
10-11	40	64	33	6	43	0	1	4	2	2	0	0	0	0	**195**
11-12	12	32	7	4	24	0	0	6	0	0	0	0	1	0	**86**
12-1	5	30	2	0	6	0	0	4	1	0	0	0	1	0	**49**
1-2	0	8	2	0	1	0	0	0	0	0	0	0	0	0	**11**
2-3	2	6	0	0	8	0	0	0	1	0	0	0	0	0	**17**
3-4	3	17	2	0	12	1	0	0	0	1	0	0	0	0	**36**
4-5	11	27	6	1	40	0	0	2	1	1	0	0	1	0	**90**
5-6	12	37	8	2	145	0	1	0	2	0	0	0	0	1	**208**
6-7	53	73	24	14	370	4	1	9	3	1	0	0	1	1	**554**
T0TAL	**2702**	**2250**	**1137**	**615**	**4169**	**31**	**17**	**179**	**49**	**41**	**4**	**3**	**24**	**5**	**11226**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV) FORMAT

			Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	

Survey location	District:	Special Feature: Day: Tuesday
Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck traile	Extra Large Truck	Total
	5262	4325	1655	1414	8465	184	42	390	98	89	7	33	53	15	22032

Traffic Count for Section 5

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

		Date:11/3/2015 WEDNESDAY	GPS:	
UAME	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT :	
	District:	Special Feature: Day: WEDNESDAY		
	County:ASHANTI	Any other Remarks:24 hour Counts		

Motorized Traffic											
Passenger Vehicle				Goods Vehicle							
Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	Truck Traile	Extra Large Truck	Total
54	116	260	6	2	5	0	1	0	0	2	0	**645**
58	46	273	0	2	19	1	2	1	2	0	0	**619**
84	40	240	4	2	9	3	2	3	0	2	0	**626**
74	46	277	1	0	7	0	2	0	1	2	0	**644**
66	36	241	2	1	10	2	2	1	3	3	0	**559**
64	49	249	2	3	8	3	2	0	0	2	0	**573**
90	41	207	3	3	11	1	3	1	3	3	0	**593**

104	70	52	228	17	3	11	3	2	0	5	1	0	**616**
91	71	30	194	1	1	3	4	2	0	3	1	0	**517**
90	71	40	233	0	1	8	6	0	0	5	0	0	**553**
103	76	25	221	2	1	3	2	5	1	2	3	0	**534**
92	55	30	198	3	2	4	1	2	0	0	0	0	**494**
77	66	23	183	2	3	7	3	2	0	5	0	0	**478**
80	69	12	140	1	1	10	1	3	0	3	0	0	**405**
58	47	9	74	0	1	6	1	0	0	2	0	0	**262**
55	15	4	45	1	1	3	3	2	0	1	0	0	**168**
48	8	0	22	1	2	0	4	1	0	0	0	0	**102**
37	5	0	17	0	0	2	1	4	0	0	0	0	**71**
14	3	2	12	0	0	4	1	0	2	0	0	0	**42**
16	0	1	16	0	1	2	0	1	0	2	0	0	**40**
22	4	1	56	1	1	0	2	0	0	0	0	0	**95**
16	0	3	52	0	3	2	1	0	0	0	0	0	**88**
88	24	22	385	2	1	9	5	3	0	0	0	0	**586**
125	46	53	441	2	3	5	3	3	0	3	1	0	**776**
185 7	**1120**	**681**	**4264**	**51**	**38**	**148**	**51**	**44**	**9**	**40**	**20**	**0**	**1008 6**
: TRAFFIC CONTRACTORS			Signature:				Supervisor: TONY						

MANUAL CLASSIFIED TRAFFIC COUNTS (CTV) FORMAT

			Date: 11/3/2015 WEDNESDAY	GPS:	
Road Name:TO MAMPONG		Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location		District:	Special Feature: Day: WEDNESDAY		
Nearest Town		County:Bong	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	Taxi	Pickups, Landrovers, landcruisers etc	Two Wheelers (Motor Cycles)	Small Bus	Medium Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer(Light)	Semi-Trailer(Heavy)	ruck raile	Extra Large Truck	Total
7-8	98	130	66	26	288	5	3	2	0	0	0	0	0	0	**618**
8-9	89	128	71	21	280	1	1	3	0	5	0	1	0	0	**600**
9-10	124	123	67	42	240	1	1	5	0	2	1	0	1	0	**607**
10-11	130	139	69	46	240	3	1	11	0	1	1	0	2	0	**643**
11-12	81	118	68	55	265	0	3	6	1	3	2	1	1	0	**604**

12-1	111	115	92	24	223	2	4	8	0	1	3	0	2	0	**585**
1-2	116	114	84	31	276	0	2	7	1	1	2	3	3	0	**640**
2-3	195	130	73	35	206	0	3	3	0	3	3	6	1	0	**658**
3-4	197	131	72	35	291	0	1	3	0	2	4	1	0	0	**737**
4-5	171	153	109	42	204	0	1	5	1	1	4	5	0	0	**696**
5-6	121	121	59	41	245	0	1	1	0	3	2	3	1	0	**598**
6-7	113	109	82	47	210	0	2	11	0	2	0	1	1	0	**578**
7-8	137	98	51	24	161	1	1	4	0	0	2	1	0	0	**480**
8-9	137	105	48	57	170	0	3	9	2	0	3	2	0	0	**536**
9-10	57	81	35	14	94	0	0	4	1	1	0	1	0	0	**288**
10-11	46	82	26	6	39	0	1	6	0	0	1	2	0	0	**209**
11-12	14	52	13	3	19	0	0	5	0	0	0	2	0	0	**108**
12-1	6	38	4	1	7	0	0	4	1	1	1	0	0	0	**63**
1-2	5	25	7	4	0	0	1	0	0	0	0	0	0	0	**42**
2-3	2	15	2	2	10	0	0	2	1	0	0	0	0	0	**34**
3-4	3	6	3	0	9	0	1	0	0	0	0	0	0	0	**22**
4-5	8	29	16	0	63	0	1	1	0	1	0	1	0	0	**120**
5-6	21	37	7	1	224	0	3	2	3	3	1	1	0	0	**303**
6-7	55	86	35	10	442	0	5	8	1	5	3	4	2	2	**658**
TOTAL	**2037**	**2165**	**1159**	**567**	**4206**	**13**	**39**	**110**	**12**	**35**	**33**	**35**	**14**	**2**	**10427**

Enumerator: TRAFFIC CONTRACTORS	Signature:	Supervisor: TONY	

TRAFFIC COMPOSITION (CTV)
FORMAT

		Date: 10/3/2015 Tuesday	GPS:	
Road Direction:ALL	Road Section: SUAME-MAMPONG	Weather: DRY	SHIFT:	
Survey location	District:	Special Feature: Day: Tuesday		
Nearest Town	County: ASHANTI	Any other Remarks:24 hour Counts		

Time	Motorized Traffic														
	Passenger Vehicle							Goods Vehicle							
	saloon car	**Taxi**	**Pickups, Landrovers, landcruisers etc**	**Two Wheelers (Motor Cycles)**	**Small Bus**	**Medium Bus**	**Large Bus**	**Light Truck**	**Medium Truck**	**Heavy Truck**	**Semi Trailer(Light)**	**Semi-Trailer(Heavy)**	**ruck raile**	**Extra Large Truck**	**Total**
	3800	**4022**	**2279**	**1248**	**8470**	**64**	**77**	**258**	**63**	**79**	**42**	**75**	**34**	**2**	**20513**

APPENDIX B

MANUAL ROAD CONDITION SURVEY RESULTS FOR SURFACE DEFECTS ON EACH SECTION

Table B.1 Pavement Condition Survey for Section 1 (Suame Roundabout - TafoNhyiaeso Junction)

SECTION 1 (1460M)	DEPRESSION				POTHOLE				RUTTING			
	LENGTH	**WIDTH**	**DEPTH**	**VOLUME**	**LENGTH**	**WIDTH**	**DEPTH**	**VOLUME**	**LENGTH**	**WIDTH**	**DEPTH**	**VOLUME**
	74.8	9	0.2	134.64	5	3	0.4	**6.00**	76.5	0.3	0.15	**3.44**

	100	8.5	0.2	170.00	4.7	0.8	0.15	**0.56**				
	78.3	4.5	0.15	52.85	6.1	4.2	0.25	**6.41**				
	66.2	2.5	0.1	16.55								
	6.8	2.5	0.1	1.70								
	28.9	2.5	0.15	10.84								
	84.6	2.5	0.2	42.30								
	20.9	2	0.1	4.18								
	7.3	1.5	0.1	1.10								
	15.2	1.5	0.1	2.28								
	20.8	1.8	0.1	3.74								
TOTAL				**440.18**				**12.97**				**3.44**

CRACKS		
LENGTH	**WIDTH**	**AREA**
45.3	7	317.10
0.003	7	0.02
14.1	1.5	21.15
21.7	4.2	91.14
100	10	1000.00

76.5	7.2	550.80
8.2	5.6	45.92
39.3	3	117.90
8	3	24.00
47.2	3	141.60
0.003	2	0.01
0.003	2	0.01
17.6	1.5	26.40
18.4		0.00
100	3.5	350.00
69.7	6.4	446.08
21.6	1.8	38.88
38.9	2.2	85.58
76.2	4.3	327.66
31.2	5.5	171.60
		3755.84

Table B.2 Pavement Condition Survey for Section 2 (TafoNhyiaeso Junction - Magazine New Road Junction)

	DEPRESSION				POTHOLE				RUTTING			
	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME
SECTION 2(329.2M)	5.9	0.8	0.1	0.47	4.2	0.8	0.15	0.50	18.7	0.5	0.08	0.75
	23.6	2.3	0.2	10.86	6.1	4.2	0.25	6.41	99.2	0.5	0.08	3.97
	78.9	0.7	0.15	8.28								
TOTAL				**19.61**				**6.91**				**4.72**

CRACKS		
LENGTH	WIDTH	AREA
10.4	2	20.8
12.9	1.8	23.22
71.4	2	142.8
		186.82

Table B.3 Pavement Condition Survey for Section 3 (Magazine New Road Junction - Tafo Hospital Junction)

	DEPRESSION				POTHOLE				RUTTING			
	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME
	15.1	3	0.1	4.53	6.2	2.7	0.31	5.19	100	0.6	0.08	4.8
	63.1	3	0.08	15.14	8.5	2.5	0.15	3.19				
	33.2	2	0.1	6.64								
SECTION 3(540 M)												
TOTAL				**26.31**				**8.38**				**4.8**

CRACKS		
LENGTH	WIDTH	AREA
75.9	1.5	113.85
14.1	1.5	21.15
100	5.8	580.00
8.1	2.2	17.82
13.1	3.6	47.16
100	7	700.00
100	4.5	450.00
56.2	4.5	252.90
14.8	5	74.00
44.7	5.3	236.91
26.1	3.2	83.52
100	4.2	420.00
		2997.31

Table B.4 Pavement Condition Survey for Section 4 (Tafo Hospital Junction - Ahenbronum Junction)

	DEPRESSION				POTHOLE				RUTTING			
	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME
SECTION 4(430 M)	63	3	0.02	3.78	5.2	2	0.22	2.29				
	13.5	3	0.07	2.84								
TOTAL				**6.62**				**2.29**			0	

CRACKS		
LENGTH	WIDTH	AREA
22.3	3.1	69.13
48.3	2.3	111.09
12.6	3	37.8
42.1	3	126.3
9.3	2	18.6
66.7	3	200.1
85	6.3	535.5
74	5	370
		1468.52

Table B.5 Pavement Condition Survey for Section 4 (Ahenbronum Junction - Pankrono Estate Junction)

	DEPRESSION				POTHOLE				RUTTING			
	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME	LENGTH	WIDTH	DEPTH	VOLUME
SECTION 5(1300M)	74	2.5	0.01	1.85								
	16.9	3	0.08	4.06								
TOTAL				5.91			0				0	

CRACKS		
LENGTH	WIDTH	AREA

32.1	3.5	112.35
50.8	2.5	127
10.8	2	21.6
52.1	2	104.2
7.1	2	14.2
86.3	3	258.9
100	7	700
100	7	700
		2038.25

APPENDIX C

IRI RESULTS FOR ON EACH SECTION

Table C.1 IRI for Section 1 (Suame Roundabout - TafoNhyiaeso Junction)

March 26, 2016, 03:51 PM
C:\Roughometer\Survey Results\2016-03-24 21h07m17s Survey 5 IRI.rtf ***Field***
Data Sheet

ROAD NAME: Mampong Road

SECTION: FROM: Suame Round About TO: TafoNhyiaeso Junction

SURVEY DATE: 2016-03-24 TIME: 21:07:17

TRAVEL DIRECTION: .....

REFERENCE: .....

VEHICLE: Nissan Pickup

OPERATOR: Michael Owusu

COMMENTS: .....

Roughness Value

SecID	SubDist	TotDist	IRI	Speed	Event
1	0.010	0.010	11.0	38.0	
1	0.020	0.020	3.8	37.1	
1	0.030	0.030	3.1	38.9	
1	0.040	0.040	3.6	41.5	
1	0.050	0.050	2.5	43.9	
1	0.060	0.060	2.2	46.1	
1	0.070	0.070	9.8	48.5	
1	0.080	0.080	9.0	50.5	
1	0.090	0.090	2.4	52.6	
1	0.100	0.100	14.0	54.6	
1	0.110	0.110	4.3	53.2	
1	0.120	0.120	3.1	51.6	
1	0.130	0.130	3.0	50.5	
1	0.140	0.140	4.7	50.2	
1	0.150	0.150	4.3	50.7	
1	0.160	0.160	1.8	51.7	
1	0.170	0.170	2.4	52.4	
1	0.180	0.180	4.1	52.5	
1	0.190	0.190	3.6	53.0	
1	0.200	0.200	3.7	53.7	
1	0.210	0.210	2.6	53.8	
1	0.220	0.220	2.8	53.1	
1	0.230	0.230	4.1	52.2	1
0.240	0.240	4.0	52.0	1	0.250
0.250	4.6	51.2			
1	0.260	0.260	5.0	50.4	
1	0.270	0.270	3.1	50.1	
1	0.280	0.280	4.4	50.2	
1	0.290	0.290	4.1	50.7	
1	0.300	0.300	4.3	51.1	
1	0.310	0.310	2.8	52.0	
1	0.320	0.320	3.7	52.8	
1	0.330	0.330	3.6	52.7	
1	0.340	0.340	4.8	52.1	
1	0.350	0.350	5.8	51.4	
1	0.360	0.360	7.0	50.7	
1	0.370	0.370	3.1	50.1	
1	0.380	0.380	5.3	49.6	
1	0.390	0.390	4.6	48.9	
1	0.400	0.400	2.7	48.9	
1	0.410	0.410	4.7	49.0	
1	0.420	0.420	4.7	49.2	
1	0.430	0.430	3.2	49.3	
1	0.440	0.440	3.7	49.2	
1	0.450	0.450	6.0	49.1	
1	0.460	0.460	4.5	48.7	
1	0.470	0.470	4.7	47.8	
1	0.480	0.480	3.9	46.6	
1	0.490	0.490	3.6	45.2	

1	0.500	0.500	4.7	43.6		
1	0.510	0.510	4.7	42.2		
1	0.520	0.520	4.9	42.0		
1	0.530	0.530	4.5	42.8		
1	0.540	0.540	5.3	44.2		
1	0.550	0.550	3.1	45.6		
1	0.560	0.560	2.5	47.1		
1	0.571	0.571	4.2	48.5		
1	0.581	0.581	2.9	49.9		
1	0.591	0.591	2.1	51.0		
1	0.601	0.601	2.4	52.0		
1	0.611	0.611	2.1	52.5		
1	0.621	0.621	3.2	52.6		
1	0.631	0.631	4.1	52.6		
1	0.641	0.641	2.7	52.7		
1	0.651	0.651	4.7	52.8		
1	0.661	0.661	2.7	52.9		
1	0.671	0.671	3.4	53.0		
1	0.681	0.681	5.1	52.8		
1	0.691	0.691	2.9	52.5		
1	0.701	0.701	2.3	52.2		
1	0.711	0.711	1.8	51.9		1
0.721	0.721	4.1	51.7			
1	0.731	0.731	4.5	51.5		
1	0.741	0.741	2.2	51.1		
1	0.751	0.751	5.9	50.8		
1	0.761	0.761	4.5	50.4		
1	0.771	0.771	5.8	49.9		
1	0.781	0.781	12.2	49.3		
1	0.791	0.791	7.8	48.6		
1	0.801	0.801	13.9	47.6		
1	0.811	0.811	15.5	46.6		
1	0.821	0.821	9.8	46.1		
1	0.831	0.831	5.5	46.3		
1	0.841	0.841	5.3	46.4		
1	0.851	0.851	8.1	46.4		
1	0.861	0.861	3.5	46.3		
1	0.871	0.871	2.3	46.3		
1	0.881	0.881	3.4	45.8		
1	0.891	0.891	12.4	45.3		
1	0.901	0.901	8.9	45.1		
1	0.911	0.911	12.9	45.0		
1	0.921	0.921	8.9	44.6		
1	0.931	0.931	7.3	44.7		
1	0.941	0.941	7.0	44.9		
1	0.951	0.951	11.4	44.9		
1	0.961	0.961	16.1	44.8		
1	0.971	0.971	14.7	44.8		
1	0.981	0.981	15.4	45.2		
1	0.991	0.991	10.9	45.7		
1	1.001	1.001	6.2	46.5		
1	1.011	1.011	10.5	47.4		

1	1.021	1.021	4.8	48.0						
1	1.031	1.031	3.4	48.3						
1	1.041	1.041	2.1	48.9						
1	1.051	1.051	1.7	49.8						
1	1.061	1.061	2.3	50.3						
1	1.071	1.071	2.0	50.6						
1	1.081	1.081	2.3	51.0						
1	1.091	1.091	1.5	51.4						
1	1.101	1.101	1.4	51.7						
1	1.111	1.111	2.0	51.9						
1	1.121	1.121	1.8	52.0						
1	1.131	1.131	2.3	52.2						
1	1.141	1.141	2.2	52.3						
1	1.151	1.151	2.5	52.3						
1	1.161	1.161	1.9	51.9						
1	1.171	1.171	1.7	51.4						
1	1.181	1.181	2.3	50.9						
1	1.191	1.191	3.9	50.5						
1	1.201	1.201	4.3	50.9						
1	1.211	1.211	4.8	51.3						
1	1.221	1.221	4.2	51.6						
1	1.231	1.231	2.2	51.4						
1	1.241	1.241	8.5	50.6						
1	1.251	1.251	4.9	49.9						
1	1.261	1.261	3.2	49.3					1	
1.271	1.271	5.2	48.8							
1	1.281	1.281	3.4	48.3					1	
1.291	1.291	4.9	47.7							
1	1.301	1.301	8.2	47.6						
1	1.311	1.311	7.8	48.0						
1	1.321	1.321	12.9	48.3					1	
1.331	1.331	9.3	48.6							
1	1.341	1.341	9.7	48.7						
1	1.351	1.351	10.1	48.7						
1	1.361	1.361	11.0	48.3						
1	1.371	1.371	5.4	47.2						
1	1.381	1.381	7.2	46.9						
1	1.391	1.391	14.5	47.2						
1	1.401	1.401	10.4	47.4						
1	1.411	1.411	8.7	47.0						
1	1.421	1.421	10.0	44.7						
1	1.431	1.431	9.1	40.2						
1	1.441	1.441	15.6	35.5						
1	1.451	1.451	9.7	30.5						
1	1.460	1.460	8.2	21.6						

Average Value **5.5**

Table C.2 IRI for Section 2 (TafoNhyiaeso Junction - Magazine New Road Junction)

March 26, 2016, 03:49 PM

C:\Roughometer\Survey Results\2016-03-24 21h02m20s Survey 4 IRI.rtf ***Field Data Sheet***

ROAD NAME: Mampong Road

SECTION: FROM: TafoNhyiaeso Junction TO: Magazine New Road Junction

SURVEY DATE: 2016-03-24 TIME: 21:02:20

TRAVEL DIRECTION: .....

REFERENCE: .....

VEHICLE: Nissan Pickup

OPERATOR: Michael Owusu

COMMENTS: .....

Roughness Value

Sec	ID	SubDist	TotDist	IRI	Speed	Event
1		0.010	0.010	25.1	47.5	
1		0.020	0.020	8.3	47.8	
1		0.030	0.030	9.3	49.2	
1		0.040	0.040	7.8	50.4	
1		0.050	0.050	7.0	52.0	
1		0.060	0.060	3.5	53.5	
1		0.070	0.070	2.9	54.9	
1		0.080	0.080	2.6	55.9	
1		0.090	0.090	4.0	56.8	
1		0.100	0.100	4.1	56.9	
1		0.110	0.110	2.7	56.9	
1		0.120	0.120	3.3	56.4	
1		0.130	0.130	4.1	55.5	
1		0.140	0.140	6.5	54.7	
1		0.150	0.150	10.8	53.8	
1		0.160	0.160	6.5	53.8	

1	0.170	0.170	3.4	53.8
1	0.180	0.180	2.2	53.7
1	0.190	0.190	2.5	53.6
1	0.200	0.200	1.9	53.1
1	0.210	0.210	1.6	52.1
1	0.220	0.220	3.1	50.2
1	0.230	0.230	3.1	48.8
1	0.240	0.240	2.3	46.8
1	0.250	0.250	2.3	42.1
1	0.260	0.260	2.6	38.4
1	0.270	0.270	5.0	32.4
1	0.280	0.280	11.3	21.4
1	0.290	0.290	4.9	8.0
1	0.300	0.300	1.9	14.4
1	0.310	0.310	1.7	18.4
1	0.320	0.320	1.2	20.0
1	0.327	0.327	1.1	10.0
Average Value			**4.9**	

Table C.3 IRI for Section 3 (Magazine New Road Junction - Hospital Junction)

March 26, 2016, 03:46 PM
C:\Roughometer\Survey Results\2016-03-24 21h00m31s Survey 3 IRI.rtf

Field Data Sheet

ROAD NAME: Mampong Road

SECTION: FROM: Magazine New Road Junction TO: Tafo Hospital Junction

SURVEY DATE: 2016-03-24 TIME: 21:00:31

TRAVEL DIRECTION: .....

REFERENCE: .....

VEHICLE: Nissan Pickup

OPERATOR: Michael Owusu

COMMENTS: .....

Roughness Value

SecID	SubDist	TotDist	IRI	Speed	Event
1	0.010	0.010	6.4	46.0	
1	0.020	0.020	3.2	45.8	
1	0.030	0.030	2.6	47.9	
1	0.040	0.040	3.6	50.4	
1	0.050	0.050	3.4	52.7	
1	0.060	0.060	2.6	54.7	
1	0.070	0.070	2.7	56.5	
1	0.080	0.080	3.0	58.3	
1	0.090	0.090	4.1	59.8	
1	0.100	0.100	1.4	61.1	
1	0.110	0.110	3.1	61.4	
1	0.120	0.120	2.1	60.7	
1	0.130	0.130	2.5	59.4	
1	0.140	0.140	1.9	58.2	
1	0.150	0.150	2.4	57.4	
1	0.160	0.160	3.8	56.5	
1	0.170	0.170	11.2	55.7	
1	0.180	0.180	3.7	54.9	
1	0.190	0.190	2.4	53.3	
1	0.200	0.200	4.6	51.7	

1	0.210	0.210	2.2	50.4
1	0.220	0.220	1.9	49.4
1	0.230	0.230	2.0	48.8
1	0.240	0.240	4.9	48.7
1	0.250	0.250	7.1	48.7
1	0.260	0.260	3.9	48.5
1	0.270	0.270	4.7	48.4
1	0.280	0.280	6.3	48.7
1	0.290	0.290	5.6	48.8
1	0.300	0.300	12.6	48.9
1	0.310	0.310	9.2	49.0
1	0.320	0.320	4.8	48.9
1	0.330	0.330	8.4	48.5
1	0.340	0.340	7.2	47.9
1	0.350	0.350	7.6	47.2
1	0.360	0.360	6.4	46.9
1	0.370	0.370	5.5	46.9
1	0.380	0.380	4.0	46.5
1	0.390	0.390	2.4	46.6
1	0.400	0.400	2.6	46.7
1	0.410	0.410	2.9	46.2
1	0.420	0.420	4.1	45.4
1	0.430	0.430	4.1	44.7
1	0.440	0.440	2.3	44.0
1	0.450	0.450	3.3	43.4
1	0.460	0.460	2.2	43.1
1	0.470	0.470	2.0	43.2
1	0.480	0.480	2.9	42.7
1	0.490	0.490	4.3	42.5
1	0.500	0.500	15.3	41.5
1	0.510	0.510	7.5	36.8
1	0.520	0.520	9.6	32.0
1	0.530	0.530	28.0	30.8
1	0.540	0.540	20.3	23.7
1	0.544	0.544	5.0	8.8

Average Value 5.3

Table C.4 IRI for Section 4 (TafoHospital Junction - Ahenbronum Junction)

March 26, 2016, 03:40 PM
C:\Roughometer\Survey Results\2016-03-24 20h59m03s Survey 2 IRI.rtf ***Field Data Sheet***

ROAD NAME: Mampong Road

SECTION: FROM: Tafo Hospital Junction TO: Ahenbronum Junction

SURVEY DATE: 2016-03-24 TIME: 20:59:03

TRAVEL DIRECTION: .....

REFERENCE: .....

VEHICLE: Nissan Pickup

OPERATOR: Michael Owusu

COMMENTS: .....

Roughness Value

SecID	SubDist	TotDist	IRI	Speed	Event
1	0.010	0.010	4.4	40.9	
1	0.020	0.020	8.1	45.1	
1	0.030	0.030	4.3	46.5	
1	0.040	0.040	4.5	47.8	
1	0.050	0.050	4.2	50.5	
1	0.060	0.060	3.8	52.8	
1	0.070	0.070	4.2	53.3	
1	0.080	0.080	2.8	53.4	
1	0.090	0.090	3.0	53.1	
1	0.100	0.100	3.8	53.3	
1	0.110	0.110	3.1	53.2	
1	0.120	0.120	3.4	51.9	
1	0.130	0.130	3.3	50.5	
1	0.140	0.140	2.5	50.1	
1	0.150	0.150	3.2	50.2	
1	0.160	0.160	2.7	50.4	
1	0.170	0.170	2.1	50.3	
1	0.180	0.180	2.4	50.1	
1	0.190	0.190	3.7	50.0	
1	0.200	0.200	2.0	49.8	
1	0.210	0.210	1.4	49.4	
1	0.220	0.220	2.4	48.5	1
0.230	0.230	4.8	47.6		
1	0.240	0.240	3.9	47.3	
1	0.250	0.250	3.7	47.3	1
0.260	0.260	3.3	47.3	1	0.270
0.270	2.9	48.1			
1	0.280	0.280	5.2	48.5	

1	0.290	0.290	2.9	47.9		1	
0.300	0.300	3.1	47.3		1	0.310	
0.310	6.9	47.1					
1	0.320	0.320	4.2	46.2			
1	0.330	0.330	4.9	45.4			
1	0.340	0.340	3.0	45.3			
1	0.350	0.350	2.8	44.9			
1	0.360	0.360	3.0	44.3			
1	0.370	0.370	2.0	44.2			
1	0.380	0.380	2.2	43.8			
1	0.390	0.390	1.6	43.0			
1	0.400	0.400	9.9	43.1			
1	0.410	0.410	4.6	41.8			
1	0.420	0.420	2.7	37.1			
1	0.430	0.430	9.5	27.2			
1	0.437	0.437	4.8	11.4			

Average Value **3.8**

Table C.5 IRI for Section 5 (Ahenbronum Junction - Pankrono Estate Junction)

March 26, 2016, 03:53 PM
C:\Roughometer\Survey Results\2016-03-24 20h56m33s Survey 1 IRI.rtf ***Field***

Data Sheet

ROAD NAME: Mampong Road

SECTION: FROM: Ahenbronum Junction TO: Pankrono Estate Junction

SURVEY DATE: 2016-03-24 TIME: 20:56:33

TRAVEL DIRECTION: .....

REFERENCE: .....

VEHICLE: Nissan Pickup

OPERATOR: Michael Owusu

COMMENTS: .....

Roughness Value

SecID	SubDist	TotDist	IRI	Speed	Event
1	0.010	0.010	2.8	50.1	
1	0.020	0.020	3.5	49.9	
1	0.030	0.030	3.2	51.8	
1	0.040	0.040	3.0	53.9	
1	0.050	0.050	3.5	55.2	
1	0.060	0.060	2.0	56.5	
1	0.070	0.070	4.3	57.7	
1	0.080	0.080	2.3	59.0	
1	0.090	0.090	3.4	60.0	
1	0.100	0.100	2.7	60.9	
1	0.110	0.110	2.0	61.5	
1	0.120	0.120	4.8	62.2	
1	0.130	0.130	5.0	62.7	
1	0.140	0.140	4.3	63.0	
1	0.150	0.150	1.7	62.4	
1	0.160	0.160	1.9	61.6	
1	0.170	0.170	1.6	60.9	
1	0.180	0.180	2.6	60.2	

1	0.190	0.190	2.0	59.5
1	0.200	0.200	2.6	59.2
1	0.210	0.210	1.2	59.4
1	0.220	0.220	2.4	59.1
1	0.230	0.230	3.6	58.6
1	0.240	0.240	1.9	57.9
1	0.250	0.250	4.1	57.4
1	0.260	0.260	3.9	56.5
1	0.270	0.270	7.3	56.0
1	0.280	0.280	4.7	55.2
1	0.290	0.290	1.7	54.7
1	0.300	0.300	0.8	54.2
1	0.310	0.310	1.6	53.9
1	0.320	0.320	2.4	53.7
1	0.330	0.330	1.5	53.4
1	0.340	0.340	1.9	53.1
1	0.350	0.350	1.2	53.0
1	0.360	0.360	1.6	52.8
1	0.370	0.370	1.8	52.6
1	0.380	0.380	1.0	52.6
1	0.390	0.390	2.1	52.6
1	0.400	0.400	2.6	52.5
1	0.410	0.410	1.9	52.1
1	0.420	0.420	2.8	51.6
1	0.430	0.430	2.0	50.8
1	0.440	0.440	2.8	50.5
1	0.450	0.450	4.0	50.3
1	0.460	0.460	2.3	50.1
1	0.470	0.470	3.7	49.9
1	0.480	0.480	2.5	49.9
1	0.490	0.490	3.0	50.1
1	0.500	0.500	4.3	50.3
1	0.510	0.510	2.6	50.5
1	0.520	0.520	2.1	50.7
1	0.530	0.530	2.1	50.9
1	0.540	0.540	3.5	51.1
1	0.550	0.550	1.9	51.3
1	0.560	0.560	1.9	51.3
1	0.571	0.571	1.7	51.4
1	0.581	0.581	2.6	51.3
1	0.591	0.591	3.2	51.1
1	0.601	0.601	3.4	50.8
1	0.611	0.611	3.5	50.8
1	0.621	0.621	1.9	51.0
1	0.631	0.631	1.7	51.2
1	0.641	0.641	1.6	51.4
1	0.651	0.651	1.9	51.6
1	0.661	0.661	2.7	51.8
1	0.671	0.671	3.5	51.7
1	0.681	0.681	3.9	51.7
1	0.691	0.691	2.6	51.7
1	0.701	0.701	2.7	51.8

1	0.711	0.711	3.3	51.9	
1	0.721	0.721	3.1	52.0	
1	0.731	0.731	2.6	52.1	
1	0.741	0.741	2.5	52.1	
1	0.751	0.751	4.3	52.1	
1	0.761	0.761	3.4	52.0	
1	0.771	0.771	3.1	51.8	
1	0.781	0.781	4.5	51.4	1
0.791	0.791	2.5	51.1		
1	0.801	0.801	2.4	50.7	
1	0.811	0.811	1.6	50.5	
1	0.821	0.821	1.4	50.3	
1	0.831	0.831	1.7	50.1	
1	0.841	0.841	2.1	50.1	
1	0.851	0.851	2.1	49.9	
1	0.861	0.861	2.4	50.3	
1	0.871	0.871	3.2	50.4	
1	0.881	0.881	2.7	50.4	
1	0.891	0.891	1.9	50.3	
1	0.901	0.901	2.5	50.4	
1	0.911	0.911	2.4	50.5	
1	0.921	0.921	2.2	50.6	
1	0.931	0.931	3.5	50.7	
1	0.941	0.941	3.0	50.8	
1	0.951	0.951	3.6	50.8	
1	0.961	0.961	2.1	50.8	
1	0.971	0.971	1.4	50.7	
1	0.981	0.981	1.9	50.5	
1	0.991	0.991	1.6	50.4	
1	1.001	1.001	2.1	50.3	
1	1.011	1.011	2.2	50.3	
1	1.021	1.021	2.2	50.3	
1	1.031	1.031	2.3	50.3	
1	1.041	1.041	2.0	50.0	
1	1.051	1.051	3.0	49.7	
1	1.061	1.061	2.6	49.5	
1	1.071	1.071	1.9	49.4	
1	1.081	1.081	2.6	49.0	
1	1.091	1.091	1.3	48.6	
1	1.101	1.101	1.2	48.5	
1	1.111	1.111	4.2	48.6	
1	1.121	1.121	2.0	48.8	
1	1.131	1.131	3.6	48.9	
1	1.141	1.141	2.9	48.9	
1	1.151	1.151	2.3	48.1	
1	1.161	1.161	2.3	46.8	
1	1.171	1.171	2.4	45.7	
1	1.181	1.181	2.4	44.8	
1	1.191	1.191	3.3	44.6	
1	1.201	1.201	1.5	44.5	
1	1.211	1.211	1.3	43.6	
1	1.221	1.221	1.5	42.5	

1	1.231	1.231	4.0	37.3
1	1.241	1.241	8.6	28.5
1	1.249	1.249	6.4	12.2

Average Value **2.7**

APPENDIX D

CORRELATION RESULTS

Table D.1 Defects And IRI Correlation with Traffic and Roadway Features Results

Correlations

		SECTION LENGTH (M)	AREA OF SECTION (M2)	TRAFFIC VOLUME (ADT)	EASL	VOL. DEPRESSION (M3)	POT HOLE VOLUME (M3)	RUTTING VOLUME (M3)	AREA OF CRACKS (M2)	IRI
SECTION LENGTH (M)	Pearson Correlation	1	.991**	-.138	.119	.670	.179	-.269	.675	-.151
	Sig. (2tailed)		.001	.824	.849	.216	.773	.662	.211	.808
	N	5	5	5	5	5	5	5	5	5
AREA OF SECTION (M2)	Pearson Correlation	.991**	1	-.034	.239	.764	.295	-.198	.716	-.035
	Sig. (2tailed)	.001		.957	.698	.132	.630	.750	.174	.956
	N	5	5	5	5	5	5	5	5	5
TRAFFIC VOLUME (ADT)	Pearson Correlation	-.138	-.034	1	.861	.499	.929*	.940*	.263	.982**
	Sig. (2tailed)	.824	.957		.061	.392	.023	.018	.669	.003
	N	5	5	5	5	5	5	5	5	5
EASL	Pearson Correlation	.119	.239	.861	1	.737	.955*	.659	.628	.926*
	Sig. (2tailed)	.849	.698	.061		.156	.012	.226	.257	.024
	N	5	5	5	5	5	5	5	5	5

ESSION	Pearson Correlation	.670	.764	.499	.737	1	.778	.233	.681	.541
	Sig. (2tailed)	.216	.132	.392	.156		.121	.707	.206	.347
	N	5	5	5	5	5	5	5	5	5
IOLE ME	Pearson Correlation	.179	.295	.929*	.955*	.778	1	.766	.521	.943*
	Sig. (2tailed)	.773	.630	.023	.012	.121		.131	.368	.016
	N	5	5	5	5	5	5	5	5	5
ING ME	Pearson Correlation	-.269	-.198	.940*	.659	.233	.766	1	.081	.871
	Sig. (2tailed)	.662	.750	.018	.226	.707	.131		.897	.055
	N	5	5	5	5	5	5	5	5	5
OF KS (M2)	Pearson Correlation	.675	.716	.263	.628	.681	.521	.081	1	.333
	Sig. (2tailed)	.211	.174	.669	.257	.206	.368	.897		.584
	N	5	5	5	5	5	5	5	5	5
	Pearson Correlation	-.151	-.035	.982**	.926*	.541	.943*	.871	.333	1
	Sig. (2tailed)	.808	.956	.003	.024	.347	.016	.055	.584	
	N	5	5	5	5	5	5	5	5	5

rrelation is significant at the 0.01 level (2-tailed).

elation is significant at the 0.05 level (2-tailed).

APPENDIX E

Axle loading per section

Table E.1 Axle loading per vehicle

Vehicle Type	Average Weight of Truck Load (Tonnes)	LEF/axle	No. of axles	Axle Load
Light trucks	14	0.00036	2	0.00072
Medium trucks	14	0.00036	2	0.00072
Heavy trucks	19.5	0.00160	3	0.00481
S/Trailer (Light)	19.5	0.00160	4	0.00641
S/Trailer (Heavy)	29.3	0.01002	5	0.05008
Truck trailer	35.5	0.02376	6	0.14255
Extra-large truck and others	41.5	0.04797	6	0.28784

Table E.2 Axle load computation for Section 1 (Suame Roundabout –Tafo Nhyiaso Junction)

Vehicle Type	Axle Load	Volumes/day	AADT	First Year ESAL
Light trucks	0.00072	22126	8075990	5814.71
Medium trucks	0.00072	578	210970	151.898
Heavy trucks	0.00481	137	50005	240.524
S/Trailer (Light)	0.00641	12	4380	28.0758
S/Trailer (Heavy)	0.05008	10	3650	182.792
Truck trailer	0.14255	46	16790	2393.41
Extra-large truck and others	0.28784	27	9855	2836.66
TOTAL		**22936**	**8326640**	**11648.0698**

Table E.3 Axle load computation for Section 2 (Tafo Nhyiaso Junction – Magazine New Road Junction)

Vehicle Type	Axle Load	Volumes/day	AADT	First Year ESAL
Light trucks	0.00072	21491	7844215	5647.83
Medium trucks	0.00072	597	217905	156.892
Heavy trucks	0.00481	451	164615	791.798
S/Trailer (Light)	0.00641	31	11315	72.5292

S/Trailer (Heavy)	0.05008	73	26645	1334.38
Truck trailer	0.14255	37	13505	1925.14
Extra-large truck and others	0.28784	2	730	210.123
TOTAL		**22682**	**8278930**	**10138.6922**

Table E.4 Axle load computation for Section 3 (Magazine New Road Junction - Tafo Hospital Junction)

Vehicle Type	Axle Load	Volumes/day	AADT	First Year ESAL
Light trucks	0.00072	21091	7698215	5542.71
Medium trucks	0.00072	901	328865	236.783
Heavy trucks	0.00481	681	248565	1195.6
S/Trailer (Light)	0.00641	21	7665	49.1327
S/Trailer (Heavy)	0.05008	26	9490	475.259
Truck trailer	0.14255	66	24090	3434.03
Extra-large truck and others	0.28784	1	365	105.062
TOTAL		**22787**	**8317255**	**11038.5767**

Table E.5 Axle load computation for Section 4 (Tafo Hospital Junction – Ahenbronumu Junction)

Vehicle Type	Axle Load	Volumes/day	AADT	First Year ESAL
Light trucks	0.00072	19826	7236490	5210.27
Medium trucks	0.00072	579	211335	152.161
Heavy trucks	0.00481	125	45625	219.456
S/Trailer (Light)	0.00641	17	6205	39.7741
S/Trailer (Heavy)	0.05008	26	9490	475.259
Truck trailer	0.14255	57	20805	2965.75
Extra-large truck and others	0.28784	9	3285	945.554
TOTAL		**20639**	**7533235**	**10008.2241**

Table E.6 Axle load computation for Section 5 (Ahenbronumu Junction - Pankrono Estate Junction)

Vehicle Type	Axle Load	Volumes/day	AADT	First Year ESAL
Light trucks	0.00072	19227	7017855	5052.86
Medium trucks	0.00072	420	153300	110.376
Heavy trucks	0.00481	136	49640	238.768
S/Trailer (Light)	0.00641	34	12410	79.5481

S/Trailer (Heavy)	0.05008	47	17155	859.122
Truck trailer	0.14255	48	17520	2497.48
Extra-large truck and others	0.28784	2	730	210.123
TOTAL		**19914**	**7268610**	**9048.2771**