MINOR FIELD STUDY ON TRAFFIC SAFETY IN GHANA
Pedestrian and cyclist facilities and access in central Accra

Bachelor Degree Project in Development Assistance Engineering.

30 ECTS, C-Level

2008-12-04
Tobias Davidsson
Göran Eriksson
Pauline Lundgren

Supervisor:
Per Hellström, M.Sc. Eng. University of Skövde
Anette Rehnberg, Swedish Road Administration
Chris Appiah, Ghana Ministry of Transport

Examinator:
Anders Biel, Ph.D, University of Skövde

University of Skövde
School of Technology and Society
**Abstract**
This study is an analysis of the traffic situation for pedestrians and bicyclist, unprotected road users, in Accra’s Central Business District. A Swedish method, Calm streets, is used to identify conflicts in the mixed traffic situation. The findings reveal a large amount of conflicts between unprotected road users and motor vehicles. These conflicts cause congestions which have negative implications on the environment, health and economy.

In addition an assessment of the quality of and access to pedestrian and bicycle facilities where conducted. This assessment indicates that the quality and access to the facilities are in general low, especially for the disabled, elderly and children.

A larger Traffic Network Analysis and a Cost Benefit Analysis are needed to address these problems for stakeholders and decision makers.

**Key words**
Traffic Safety, Gothenburg, Calm Street, Pedestrians, Bicyclists, Accra, Ghana, Unprotected Road Users, Traffic Network, Hawkers, Infrastructure, Encroachment, Calm Street, Lugna Gatan
Table of Contents

Part I Introduction ..................................................................................................................... 1

1. Guide to Reader .......................................................................................................................... 1
   Purpose of the study ................................................................................................................... 1
   Which questions does the study answer .................................................................................. 1

2. The Scope of the Traffic Safety Problem ................................................................................. 2
   In the World .............................................................................................................................. 2
   In Ghana ................................................................................................................................ 3
   In Sweden ............................................................................................................................... 5

3. The Scope of the Study ............................................................................................................. 7
   Problem Statement .................................................................................................................. 7
   Main Objective ........................................................................................................................ 7
   Specific Objectives .................................................................................................................. 7
   Scope and Limitation ............................................................................................................... 7

Part II Method ............................................................................................................................ 9

1. Research .................................................................................................................................... 10
   Systematic Literature search ................................................................................................... 10
       Calm Streets (7) .................................................................................................................... 10
       The Handbook of Road Safety Measures (9) ......................................................................... 10
       Selected Reports: ................................................................................................................. 11
       Statistical information by selected institutes and/or researchers: .................................... 11
       Conferences .......................................................................................................................... 11
       Interviews .............................................................................................................................. 12
       General Concepts ................................................................................................................ 12

2. Analyses ................................................................................................................................... 13
   Traffic Network Analysis ....................................................................................................... 13
   “Pedestrian and Bicyclist” infrastructure and design analysis ................................................ 14

Part III Result ............................................................................................................................... 15

1. Demands and Function Classification .................................................................................... 15
   Motor vehicle Network ............................................................................................................ 17
   Bus Network ............................................................................................................................. 20
   Emergency Service Network ................................................................................................ 22
   Bicycle Network ....................................................................................................................... 24
   Pedestrian and Bicycle crossings ........................................................................................... 25
Foreword
This study is the result of a Bachelor Degree Project that was undertaken by three development assistant engineer students from the University of Skövde.

The 30 ECTS project consist of a minor field study, conducted in the central business district of Accra, capital of Ghana, figure 1, between the 5th April and the 8th June, 2008.

During these 9 weeks comprehensive amounts of data were gathered and later analyzed. Unforeseen problems such as insufficient availability to maps and statistics limited the initial progress and had to be dealt with before the observations could be conducted, leading to an even more time pressed schedule.

The results of the study are compiled in this report and on a CD containing, for the study, a developed database and backup excel files.

The Minor Field Study, idea was initiated by Malin Ahrne, Program Officer Transport Issues, Department for Infrastructure and Economic Cooperation, INEC Sida. The study group came in contact with Christian Kwarteng Appiah, Assistant Planning Officer at the Ghana Ministry of Transportation, via Malin Ahrne, and the study took form.

To help assist and support the study contacts with the Swedish Road Administration was initiated. Initial contacts were also taken with the community of Skövde, Jönköping and Gothenburg to gather information about Swedish pedestrian/bicyclist facilities.

The supervisors in Sweden are M.Sc. Eng. Per Hellström, assistant programme director for the Development Assistance Engineering Program, School of Technology and Society, University of Skövde and Mrs. Anette Rehnberg, Swedish Road Administration.

The MFS supervisor in the field is Mr. Christian Kwarteng Appiah, Assistant Planning Officer at the Ghana Ministry of Transportation.
Acknowledgements
Our thanks to the persons mentioned above for all the help we received from you. We would also like to acknowledge and thank the Ministry of Transport, The Department of Urban Roads, Arthur at the project office for BRT, Magnus Quarshie at the Centre of Bicycle, Jonas Hermansson at SweRoad, Roger Johansson and Bo Lönegren at Swedish Road Administration, the traffic & Public Transport Authority in Gothenburg, Jönköping and Skövde.

Sara Hesse, at Swedish Local Authorities for sending us copies of Calm Streets, and last but not least MTTU.

A special thank to Mr. Christian Appiah and Mrs. Anette Rehnberg for all the help you gave us, the family of Mr. Christian Appiah for their hospitality.

Mr Antoine Lema, social scientist and Mrs Tawia Addo-Ashong, Senior Transport Specialist, at the World Bank and the rest of the World Bank team for the dinner, information and a most interesting week.

Finally our families for their vital economical and moral support which without we would not been able to performed this study.
Part I Introduction

1. Guide to Reader

Purpose of the study

The main purpose of the study is to evaluate the access and facilities available for pedestrians and bicyclist in the main core Accra Central Business District, (CBD) in Accra, (in this study referred to as Accra CBD).

The importance of this is to guide and show different stakeholders the benefits of improved pedestrian and bicycle facilities in combination with a clear vision.

This is especially notable in the Accra CBD where there is a lack of an Eco- and Socio-friendly environment for all modes of traffic. Furthermore there is a lack of a clear vision for the development of this particular area.

The method used in this study is based upon concepts from Swedish and Norwegian handbooks. Examples and comparisons are only drawn between Accra and Gothenburg.

The purpose of doing this was to evaluate how methods and measurements known and used in Sweden could be adapted or adjusted to a different traffic environment.

With the traffic analyze described in the Swedish handbook “Calm Streets”, Swedish Local Authorities, and additional observations compiled in a specially designed Microsoft Access 2007 database, BISP (Swedish acronym for Development Assistance Engineer Programme), proposals for general changes are presented in Chapter IV.

Information about a specific street section, maps, statistics and reports that concerns this study can be found in the BISP database. The meaning with this database is to provide an information-base for easier access the information wanted, easier than it would be in a hard copy. The database can also work as a “build-on” database for continued work in this field. A copy of BISP database is available through mail contacts with the authors of this report.

This study is not a technical design study, in terms of providing detailed technical solutions or blueprints. Neither is its purpose to idolize Swedish policies, methods and measurements as the only prescription to a solution. However, “faults” made by Sweden does not have to be made in Ghana, nor does all the steps in the process need to be reinvented when proven solutions may exist.

The intentions are that this study will guide and show different stakeholders the benefits of improved pedestrian and bicycle facilities in combination with a clear vision. The study and its components are meant to be used in further planning work both on policy and detailed levels.

Which questions does the study answer

-What pedestrian and bicycle facilities exist in Accra CBD?
-What are the quality of/ access to these facilities?
-What conflicts are there in Accra CBD and between which traffic modes do they occur?
2. **The Scope of the Traffic Safety Problem**

**In the World**

A week after World Health Day 2004, the United Nations General Assembly discussed and adopted a historic resolution known as A/RES/58/289 on “Improving Global Road Safety” urging countries around the world to take up the challenge of road safety, begin implementing the recommendations in the joint WHO/World Bank “World report on road traffic injury prevention” and also inviting WHO to coordinate road safety efforts across the United Nations system, in collaboration with the United Nations regional commissions.

The WHO/World Bank; “World report on road traffic injury prevention” predicts road traffic injuries to become the third largest contributor to the global burden of disease by 2020. Furthermore it is estimated that every year, road traffic crashes cost USD 518 billion globally. The cost in low and middle-income countries is estimated at USD 65 billion, exceeding the total amount received in development assistance.

According to the World Health Organization (WHO), developing countries account for a large percentage of the deaths and injuries from road crashes. 70% or more of those killed or seriously injured are typically poor people, either vulnerable road users or passengers in overcrowded buses. It has been established that, 90% of road deaths are in low and middle income countries that only have 35% of the world’s total amount of motor vehicles.

If current trends continue, deaths and disability caused by road traffic accidents will climb to the third position on WHO:s list of leading contributors to the global burden of disease and injury, even surpassing HIV/ AIDS by the year 2020. An extreme case is the African continent, with only 2% of the total global amount of motor vehicles, but 11% of all road traffic fatalities. (1)
In Ghana

The population of Ghana is about 22.1 million with more than 40 percent living in the urban areas. Every year more than 1600 are killed in the traffic and over 14,000 are injured. (2)

The most vulnerable road-users are the pedestrians. They stand for 42 percent of the fatalities. A large part of the roads in Ghana do not have the facilities need to enhance the safety of pedestrians. Within the group pedestrians, children between the ages of 6-15 are the most vulnerable.

23.5 percent of people that are killed on the roads of Ghana are between the ages of 26-35. This report however focuses on pedestrians and there the picture is different. Within the group pedestrians, children between the ages of 6-15 are the most vulnerable. (2)
The number of registered cars has been increasing with an estimated average of 10 percent annually the last couple of years. This has resulted in an increase of people getting killed in traffic accidents even though the rate of fatalities per 10,000 vehicles has gone down from 29 in 2001 to 23 in 2005.

Every year traffic accidents in Ghana cost the society over USD 130 million. This translates to 1.6 percent of the Nation’s Gross National Product (GNP). In addition it causes a lot of pain, suffering and grief that one cannot measure in USD.

National Road Safety Strategy:
In order to set focus on, and be able to work towards improvement regarding traffic safety issues in Ghana, the Ministry of Transport (MoT) and the National Road Safety Commission (NRSC) launched the 5 year National Road Safety Strategy (NRSS) in 2001.

Different stakeholders were identified and the first NRSS, NRSS I, created a broad framework for these agencies and organizations to be able to do coordinated interventions in road safety. The goal of the NRSS I was to reverse till upward trend in road traffic accidents and their consequences during the period 2001-2005.

In line with the African Ministerial Conference on Road Safety (held in Accra in September 2000), three main objectives where set.

- 5% reduction in fatalities by the year 2005, using 1998 as the base year.
- 20% reduction in fatalities by the year 2010.
- Develop the capacity to influence the quantity and quality of road safety interventions.

NRSS I came to an end in December 2005 and an evaluation carried out in February 2005 revealed that the strategy had proven a very useful tool. Ghana’s efforts were also recognized by the World Bank as a good example in Africa and in developing countries.

In spite of the achievements, a number of constraints hampered the full implementation of the interventions in NRSS I. These weaknesses, such as; “inadequate enforcement of road traffic laws and regulations”, need to be addressed, thus the NRSS II for the period 2006-2010. NRSS II outlines the national Vision for road safety in Ghana. (3)
In Sweden
The population of Sweden is about 9.2 million. (4)
Even though Sweden is a country that has put a lot of effort and recourses into the area of traffic safety, 400-600 people are killed and over 22,000 are injured each year.

As one can see in Sweden the most vulnerable group are the car occupants and in many cases the accident is of what is called a single accident, where the only victim is the driver.

Compared to Ghana, school-children in Sweden are quite safe in the traffic. The high risk group is people between 20-54 years of age.
**Vision Zero:**

People make mistakes. It is part of the human nature. Unfortunately when these mistakes are made in the road transport environment the consequences can be serious and fatal injuries.

Vision Zero was first introduced in Sweden in 1995 and the main objective of the Vision is that no one should be killed or seriously injured in traffic. In 1997 a Parliamentary resolution was adopted and Vision Zero became the foundation for work on road safety in Sweden.

The Vision stresses that the development and design of vehicles and road environments should be based on human limitations and that the road transport system should be adapted to the fact that humans make mistakes. Accidents have and will always happen, so the focus should be put on interventions that mitigate the consequences of these accidents.

In most countries and so also in Sweden, when a traffic accidents occur the responsibility is put on the individual. Vision Zero alters this view on responsibility and emphasizes that at major share of the safety responsibility should be put on those who design the road transport system. However the road users are responsible to comply with laws and regulations.

The introduction of Vision Zero has had some major effects on the road environment in Sweden. Central median barriers have become more common and so also roundabouts.

Focus on pedestrians and bicyclists have resulted in different types of speed calming measures in built up areas. In order for a pedestrian or a bicyclist to survive a collision the speed limit needs to be set at no higher than 30kph.
3. The Scope of the Study

Problem Statement

The problem with traffic accidents are that they don’t only cause pain and suffering, they also cost money. The Value of a statistical life was in 1995 estimated to 317000 USD (6). That means that Ghana lost 317 thousand USD/killed individual, (plus the additional material damage cost that follows an accident).

In Ghana pedestrians constitutes for the largest group involved in fatal accidents and there is a need to improve on safety for this group. While investigating and improving the safety for pedestrians, other unprotected road users can benefit from the result, hence the need for identifying bicycle facilities and access.

Main Objective

To analyze the quality of and access to pedestrians and bicyclists facilities in Accra CBD.

Specific Objectives

- Examine the quality of the infrastructure
- Investigate the current mixture of traffic and its impact on quality of life for pedestrian and bicyclists in the Accra CBD.
- Determine the usage of the existing infrastructure between different users with conflicting demands.
- Investigate the cause for conflicts between different road users.
- Develop suggestions to possible improvements

Scope and Limitation

The study geographically covers the Accra CBD and its immediate surroundings.

The site was specified and limited by the local supervisor Mr. Christian Appiah. He considers this to be the best area to study conflicts between different road users.

The area has been separated into three different sub areas. Rawlings Park as the yellow zone, Makola Shopping Mall and Makola Market 1 and 2 as the red zone and the Okaishie Market as the blue zone, see figure 8.

Furthermore the streets have been divided into sections so one can get more detailed information from each street.

The sections around the zones are indexed: R for red, Y for yellow and B for blue (Orientation map – Study site, Zones: Red (R1-R21), Yellow (Y1-Y4), Blue (B1-B30)).
A Streets and Sections list can be found in Appendix 1 - Streets and Sections (From Bisp Database).

The study will cover all five modes of traffic that Calm Street includes. The study will also give extra attention to the pedestrian and cyclist situation.

To highlight their problems and obstacles they are facing due to a society that gets more and more dominated by motor vehicles.
Part II Method

Even thou this study focus upon the pedestrian and bicyclist facilities and access, there is a need to investigate all modes of traffic in the Accra CBD. Finding conflicts in between the different traffic modes and increasing both traffic safety, environment and socio economical aspects of the society.

In many cases facilities for motor vehicles are prioritized at the expense of pedestrians and bicyclists. The method used in this study, to evaluate if this is the case in Accra and to assess the qualities of pedestrian and bicyclist facilities, is divided into three stages:

![Diagram showing three stages: Research, Analyses, Proposals and consequences]

The “research stage” consist of a literature search were Swedish and Norwegian traffic safety documents and handbooks where studied as well as other material used in this study such as documents and conference proceedings.

The “analyses stage” consists of two analyses, “Traffic Network Analysis and Pedestrian” and “Bicyclist infrastructure and design analysis”. The results from these analyses are summarized in the end of Part III, chapter 3.

Proposals for changes, based upon results in the “analyses stage”, are then discussed to reveal possible consequences. This can be found in Part IV.
1. Research

Systematic Literature search

The literature search uses the “ancestry” approach which consists of a “fixed” and a “variable” part. The variable part is based on the results of the fixed part of the search.

Five main sources of information were used in this study,

- Calm Streets
- The Handbook of road safety measures
- Reports issued by selected institutes
- Statistical information by selected institutes
- Conference proceedings

Calm Streets (7)

Calm Street describes a planning process which is conducted in the purpose to renew the mixed traffic streets by physical measures within the street environment.

In 1997 the existing Swedish guidelines had become partially outdated and did not satisfy the current need from local authorities. In April 1997 The Swedish Association of Local Authorities decided to produce a handbook that could provide support for traffic planning in urban areas until replacement for the more comprehensive official guidelines TRÅD and ARGUS were to be published. “Calm Streets” does not provide any instructions or advice on how the detailed design, construction or operation-/maintenance should be dealt with.

Experiences from Gothenburg shows that “calm streets” is proved to successfully increase traffic safety in a city. This study uses the traffic analysis parts of the “the Calm Street method” in addition to some basic design, consequence descriptions and other selected references. (8)

The Handbook of Road Safety Measures (9)

“The Handbook of Road Safety Measures” is the result of a research effort that has been going on during 25 years at the Institute of Transport Economics, Oslo, Norway. Similar to “Calm Streets” it does not provide any instructions or advice on how to best design or implement road safety measures but summarizes over 100 measures and what is currently known about their effect. The Handbook also contains a comprehensive amount of road safety statistics and examples. Especially the “introduction” part provided useful information for this study.
Selected Reports:

The reports used in this study are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Author/Institute</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Status Report Greater Accra Metropolitan Area, Ghana</td>
<td>Centre for Cycling Expertise</td>
<td>2007</td>
</tr>
<tr>
<td>The Impact of Accra Metropolitan Assembly’s (AMA) Decongestion Exercise: Pedestrians Perspective</td>
<td>Centre for Cycling Expertise</td>
<td>2007</td>
</tr>
<tr>
<td>National Road Safety Commission Act 567</td>
<td>National Road Safety Commission NRSC</td>
<td>1999</td>
</tr>
<tr>
<td>Traffic safety development in the city of Gothenburg (Swedish)</td>
<td>VTI</td>
<td>2004</td>
</tr>
<tr>
<td>Reproductive health implications of street hawking in Accra</td>
<td>Stephen O. Kwankye, Philomena E. Nyarko &amp; Cynthia A. Tagoe</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Selected reports

Statistical information by selected institutes and/or researchers:

The statistical information used in this study comes from:

<table>
<thead>
<tr>
<th>Name</th>
<th>Author/Institute</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Traffic Accidents In Ghana Statistics 2006</td>
<td>Building And Road Research Institute, BRRI</td>
<td>2007</td>
</tr>
<tr>
<td>Road Traffic Accidents In Ghana Statistics 2005</td>
<td>Building And Road Research Institute, BRRI</td>
<td>2006</td>
</tr>
<tr>
<td>Accident Records and Plots</td>
<td>Department of Urban Roads, DUR</td>
<td>2004</td>
</tr>
<tr>
<td>Traffic Data</td>
<td>Department of Urban Roads, DUR</td>
<td>2003</td>
</tr>
</tbody>
</table>

Table 2. Statistical information

Conferences

The Transport Sectors Development Partners Conference with the theme: “Transport a Catalyst for Growth and Development”, was a tree day, “transport sector evaluation conference”, between: April 21-23, 2008. The conference was held by the Ministries of Transport at GIMPA (The Ghana Institute of Management and Public Administration), in Accra. Its purpose was to evaluate the situation for each sector and to view the plans for the future. The study members got an understanding of the transport sectors different purposes and made key contacts, which were of importance for the study.

The Public Transport Planning and Reform Course was a two day introduction course between; April 24-25, 2008. It was held by the World Bank and the location was also at GIMPA in Accra. It focused around a Bus Rapid Transit concept which the World Bank is implementing around the world, and gave suggestions and examples of transport planning and the need of a reform in the transport sector. The study members received an invitation to participate during this multinational workshop. During these days a collection of lecture material was handed out and some of these where used during the study as guidelines and as a source of inspiration.
**Interviews**

To compare the different countries and to better understand the differences between them a series of interviews were put in place with different authorities.

**General Concepts**

According to “The Handbook of Road Safety Measures”, one major problem of road safety evaluation research is the lack of a strong theoretical basis. The authors focus one chapter on the question: “Can findings of road safety evaluation studies be accounted for in theoretical terms?” They state that “Although the findings of road safety evaluation studies do not conform closely to a set of law like statements, some quite general concepts could be imagined that could be used in trying to discern patterns in the finding of these studies that could lend some credibility to them.” (9)

These general concepts guide the design of this study and the interpretation of its findings. The following general concepts are used as guidelines: Complexity, Compatibility, Energy, Predictability, Visibility and individual rationality, see Table 9.

<table>
<thead>
<tr>
<th>Concept:</th>
<th>Hypothesis:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complexity</strong> refers to the amount of new information a road user has to process per unit of time.</td>
<td><strong>Hypothesis 1</strong>: Measures that reduce the complexity of traffic will normally improve road safety.</td>
</tr>
<tr>
<td><strong>Compatibility</strong> refers to the differences between categories of road users in terms of the kinetic energy produced by their movements.</td>
<td><strong>Hypothesis 2</strong>: Measures that separate incompatible road users from each other will normally improve road safety.</td>
</tr>
<tr>
<td><strong>Energy</strong> refers to kinetic energy that is converted to other forms, such as deformation, in case of an accident.</td>
<td><strong>Hypothesis 3</strong>: Measures that reduce or control the amount of energy released in accidents will normally reduce accident severity.</td>
</tr>
<tr>
<td><strong>Predictability</strong> denotes the reliability with which the behavior of a road user can be predicted in a given situation.</td>
<td><strong>Hypothesis 4</strong>: Measures that make road user behavior more predictable will normally improve road safety.</td>
</tr>
<tr>
<td><strong>Visibility</strong> is the possibility of seeing something at a distance.</td>
<td><strong>Hypothesis 5</strong>: Measures that enhance visibility will normally improve road safety.</td>
</tr>
<tr>
<td><strong>Individual Rationality</strong> is a choice of best means to realize given ends.</td>
<td><strong>Hypothesis 6</strong>: Measures that strengthen the incentives road users have to avoid accidents will normally improve road safety.</td>
</tr>
</tbody>
</table>

In all these hypothesis, the authors have inserted the qualifier normally, “because all these hypothesis refer to statistical regularities, and not to laws of nature…” The Handbook p.118-120

Table 3. General Concepts (9)
2. **Analyses**

**Traffic Network Analysis**

To find conflicts and to assess quality shortcomings between different modes of traffic, within Accra CBD, “calm streets” traffic network analysis is used. This analysis evaluates five modes of transport, operating in a mixed traffic network (to different degrees sharing the same space, see figure 10.

![Diagram of mixed traffic network](image)

**Figure 10. Mixed Traffic Network**

The analysis is performed on each stretch and compiled in different sets of maps. Each mode of traffic is analyzed individually in two steps. In the first step the theoretical demands are stated together with a function classification, e.g. “a main street should provide a minimum speed of 40kph”. The next step is to evaluate to which degree the theoretical demands and function classification compares to the reality, e.g. “is it possible to drive in higher speeds than 40kph on the stretch?” The results are here presented as quality levels (red, yellow and green) on maps.

The two sets of maps are used to compare theoretical demands upon the traffic network against actual quality of the traffic network. They are also used to analyze conflicting demands between different modes of traffic, e.g. “a stretch is used as a main street by motor vehicles, demanding speeds above 40kph, at the same time pedestrians have an interest of crossing at any point of the stretch and poses a demand on motor vehicles to hold speeds lower than 30kph”.

“Pedestrian and Bicyclist” infrastructure and design analysis

The traffic network analysis don’t analyze the actual quality of existing facilities infrastructure and design hence “calm streets” are a method initially for renewing or remodelling an entire stretch. To examine this and to find possible differences between Swedish and Ghanaian facilities and design, further analysis was needed. Several walkthroughs on the streets of Accra CBD was performed and the infrastructure and design, was on each stretch evaluated by the following variables:

<table>
<thead>
<tr>
<th>Quality of sewer coverage:</th>
<th>Green for total coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yellow for walkable coverage (minor defects)</td>
</tr>
<tr>
<td></td>
<td>Red for non walkable coverage (open sewers or major defects)</td>
</tr>
<tr>
<td>Obstructing signs:</td>
<td>Signs or other fastened objects that are placed in a way that obstruct and/or force pedestrians and/or bicyclist out of the facilities.</td>
</tr>
<tr>
<td>Lights:</td>
<td>Are street lights installed and working</td>
</tr>
<tr>
<td>Potholes:</td>
<td>Green for non or very small potholes</td>
</tr>
<tr>
<td></td>
<td>Yellow for walkable larger potholes</td>
</tr>
<tr>
<td></td>
<td>Red for obstructing larger potholes</td>
</tr>
<tr>
<td>Level difference:</td>
<td>Measured in green or red. To be granted green a facilities level differences, without ramps, at entering/exiting a facility should not be greater than 0.02-0.04 m. Neither should it at any point along consist of level differences greater than 0.02 -0.04 m. A cornerstone with a height of 0.02 makes it very hard for a wheelchair or a Zimmer frame to cross. A cornerstone with a height &gt; 0.04 makes it impossible for some people to cross.</td>
</tr>
<tr>
<td>Width over 2m:</td>
<td>According to the Swedish VGU one person takes about 0.70 m “street space” and need &gt; 0.2 m to obstacles or edges (v) and &gt; 0.2 m between each other to meet unhindered. In the database yes means that the width of a sidewalk is above 2 m, see figure 11.</td>
</tr>
</tbody>
</table>

Intersections and crossing points were evaluated separately. Here an additional factor was investigated, if there were signal systems and to which extent these worked.
Part III Result

1. Demands and Function Classification

To analyze the quality of the traffic network, there is a need to prepare a proper comparable foundation. The “Calm Street” way of doing this is to classify the roads within the area by the different road user theoretical demand and function on these roads.

In this part the five different types of transport is presented by their theoretical demands on traffic safety and level of service, unrestricted by street space for each type of traffic. To clarify the interrelation and the overall network, all links are mapped out and each network is divided into function categories. The categories are listed in tables and the networks are shown on individual maps, independent of each other.

The order has been chosen by technical reasons and do not reflect any prioritizing between the different modes of traffic. The tables have been gathered from Calm Streets and in some cases changed to better fit in with this study.

An orientation map, figure 12, can be found on next page.

(Metro Mass, TUDU and STC are stations, bus and Tro-Tro, located within Accra CBD).
Figure 12 Orientation map – Study site, Zones: Red (R1-R21), Yellow (Y1-Y4), Blue (B1-B30)
**Motor vehicle Network**

The motor vehicle network has been classified into two different function categories. These can be read in the table 4 below and be seen in figure 13.

The demand is divided into two parts; the sole drivers speed demand and the collective capacity demand. The capacity demands for motor vehicles have not been investigated because lack of necessary statistics. To gather such statistics requires a constant survey over at least one year.

However, estimations can be made from data gathered by Department of Urban Roads (DUR) (10). Their statistics are gathered over one day of some of the streets that are in the Accra CBD. The result of the estimation can be seen in figure 14.

<table>
<thead>
<tr>
<th>Function classification</th>
<th>Type of link</th>
<th>Chief traffic function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main network</strong></td>
<td>Feeder network</td>
<td>Motor-vehicle traffic to an urban area</td>
</tr>
<tr>
<td></td>
<td>Other links in main network</td>
<td>Motor-vehicle traffic between districts in urban area</td>
</tr>
<tr>
<td><strong>Local network</strong></td>
<td>Link in local network</td>
<td>Motor traffic within a neighbourhood unit</td>
</tr>
</tbody>
</table>

In Sweden the longest distance between a start/destination point inside a neighbourhood unit and the nearest connection to the main network should not exceed 400m.

<table>
<thead>
<tr>
<th>Speed demands</th>
<th>Journey speed (kph)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of link</strong></td>
<td></td>
</tr>
<tr>
<td>Feeder network</td>
<td>&gt;60</td>
</tr>
<tr>
<td>Other links in main network</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Link in local network</td>
<td>&gt;20 or walking pace</td>
</tr>
</tbody>
</table>

During the first (or last) 100 meters of the motor vehicle’s journey within a neighbourhood area, the speed demand can be limited to walking pace.

<table>
<thead>
<tr>
<th>Capacity demands</th>
<th></th>
</tr>
</thead>
</table>

Capacity is analysed for current traffic flow plus the additional estimated flow generated when presently known development programmes have been implemented. Capacity restraints must be reduced to a level that permits the journey speed demands to be met. Particular attention should be paid to the capacity at pedestrian crossings with high motor-vehicle and pedestrian traffic volumes.

Table 4. Functions and demands, Motor vehicle Network (7)
Figure 13 Motor-vehicle network: function classification
Figure 14 Motor-traffic network: Capacity demands
Bus Network

In Accra some of the function classifications for the bus network are so unorganized or so significant small that these classifications has been removed in this report. The classification categories that have been removed are: Off-peak, night traffic and service route network. However, these should be taken into account when planning, for example, Bus Rapid Transit (BRT), networks.

In Ghana an additional “bus” type called Tro-tro exist. Tro-tros are mini busses that run within and between cities. They are equipped with 9-18 seats and are in general unscheduled, meaning they depart when they are filled. The basic bus, Tro-tro and taxi network are presented in table 6 and on figure 15.

<table>
<thead>
<tr>
<th>Function classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of network</td>
</tr>
<tr>
<td>Basic network</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of link</td>
</tr>
<tr>
<td>Link in basic network in outer area</td>
</tr>
<tr>
<td>Link in basic network in inner city</td>
</tr>
<tr>
<td>Link in off peak or night traffic network</td>
</tr>
<tr>
<td>Link in service route network</td>
</tr>
</tbody>
</table>

Capacity needs to be analysed for all streets where bus network and motor-vehicle network use the same link. Special attention must be paid to approaches to terminals and on links where several routes converge. Capacity restraints must be reduced to a level that permits the journey speed demands to be met.

Table 5. Functions and demands, Bus Network (7)
Figure 15 Basic Bus, Tro-tro and Taxi network
Emergency Service Network

One fire and one police station are located within Accra CBD. They use emergency service networks (ESN) to get to emergency destinations. These ESN shall be prioritized in design and speed classifications. The ESN is presented in table 6 and figure 16.

<table>
<thead>
<tr>
<th>Function classification</th>
<th>Scope and main traffic task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary emergency services network (PESN)</td>
<td>Covers most of the main motor-traffic network as well as approach streets to hospitals and care facilities, fire stations and other destinations frequently used by ambulances and fire-fighting vehicles. Provides access and good level of service to the most important destinations.</td>
</tr>
<tr>
<td>Secondary emergency vehicle routes (SEVR)</td>
<td>Cover the remaining stretches of the mixed-traffic network apart from walking-pace streets. Provide access and reasonable level of service to other important destinations.</td>
</tr>
<tr>
<td>Other emergency vehicle routes (OEVR)</td>
<td>Cover pedestrian precincts as well as certain local street and parts of the pedestrian and cycle network that may need to be used by ambulances etc., in order to reach individual buildings. Facilitate close-range access to all emergency vehicle destinations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of link</td>
</tr>
<tr>
<td>Primary emergency services network</td>
</tr>
<tr>
<td>Secondary emergency services network</td>
</tr>
<tr>
<td>Other streets and vehicle-accessible areas</td>
</tr>
</tbody>
</table>

Capacity demands

Capacity restraints must be reduced to a level that permits the journey speed demands to be met. Special attention should be paid to approach streets to hospitals, police- and fire-stations and other frequently used destinations.

Table 6. Functions and demands, Emergency Services Network (7)
Figure 16 Emergency service network
**Bicycle Network**

There are very few facilities for bicyclists in Accra and none in the Accra CBD.

It does exist bicycle networks and some projects are developing new bicycle networks. Within the study area, bicyclists are forced to walk their bikes or travel among the motorized vehicles.

With no facilities within the study area, the study group decided to leave out this part of the traffic analysis which would show a very low quality. However, suggestions are made in Part V, Discussions and Conclusion.
Pedestrian and Bicycle crossings

The most vulnerable road-user groups are the unprotected pedestrians and bicyclers. A safe way for pedestrians to cross motor-traffic without the risk of getting killed or severely injured is of great importance. The demands by pedestrians and bicyclists to cross motor traffic are presented in table 7 and in figure 17. Demands on motor traffic speed at pedestrian crossings are also displayed in the table 7.

<table>
<thead>
<tr>
<th>Demands for crossing motor-traffic network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination points in vicinity of link</td>
</tr>
<tr>
<td>Shops, office and residents entrances, service facilities, bus stops or similar destinations are both sides of the link</td>
</tr>
<tr>
<td>Destination points for pedestrian are concentrated in certain positions along the link so that pedestrians naturally choose to cross at well-defined points.</td>
</tr>
<tr>
<td>No activities/destination points are concentrated along the link or all activities/destination points are concentrated on one side of the link.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demands on motor-traffic speed at pedestrian crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian traffic demands for crossing</td>
</tr>
<tr>
<td>Cross motor-traffic link anywhere along the link</td>
</tr>
<tr>
<td>Cross motor-traffic link at specific pedestrian crossings</td>
</tr>
<tr>
<td>At pedestrian crossing used by many disabled (or children)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacity demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity for pedestrians should be clarified and guaranteed at pedestrian crossings connecting to terminuses, sport facilities, churches and other destination points with periodically large volumes of pedestrian traffic</td>
</tr>
</tbody>
</table>

Table 7. Demands, Pedestrian and Bicyclist Crossings (7)
Figure 17 Pedestrian and bicyclist network: Demands for crossing the motor-traffic network
2. **Assessment of Qualities of Current Traffic Network**

In chapter 6 and 7 in Calm Street one can read about quality levels for the different traffic networks. Calm Street means that in order to make good reform suggestions one must have a neutral base to stand on. Calm Street means that if an analysis, of the traffic network quality based out of how the demands from part II in this reports are met then the reform suggestions has a good neutral base to point back to. In this part an assessment of quality of the current traffic networks has been done in the same order as in previous part. The quality assessment comprise of traffic safety and how congested a street is. The streets should be designed so that no congestions for any traffic type occurs and special interest should be taken for the demands that elderly, children and disabled persons needs to be safe and to move freely within the city. As a result, if conflicting demands between different road users appear, the proposal of this study will try to prioritize pedestrian, bicyclists and especially the elderly, children and the disabled. Sweden has put focus on speed limits. This because some studies show that with increased speed the risk for fatalities increases rapidly.

This can be seen in figure 19 where the different curves represent three different accidents. If one car hit a pedestrian in 30 kph the risk for fatality is 10%, in 50 kph the risk for fatality is increased to 70%. The other curves illustrate the risk of fatality in side collision and frontal collision.

The Calm Street method analyses how well the quality meets the demands on a specific street and/or intersection. The method grades them in three levels, **Green-Yellow-Red**, see table 8. Green stands for good quality, where all demands are met. Yellow and Red differ from area to area and will therefore be more described in each specific area.

<table>
<thead>
<tr>
<th>Colour Code</th>
<th>Quality Level</th>
<th>How well it meets the demands</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>Completely</td>
<td>Always accepted</td>
</tr>
<tr>
<td>Yellow</td>
<td>Not very good</td>
<td>Partially</td>
<td>Can be accepted during a limited time or if other important qualities or financial gains can be achieved</td>
</tr>
<tr>
<td>Red</td>
<td>Low</td>
<td>Not at all</td>
<td>Not accepted or accepted during a limited time</td>
</tr>
</tbody>
</table>

Table 8. Color coded quality grades (7)
Quality Motor vehicle Network

The quality for the motor vehicle network is been based upon observations made during the field studies.

Rawlings Park as the yellow zone, Makola Shopping Mall and Makola Market 1 and 2 as the red zone and the Okaishie Market as the blue zone (figure 8, page 7).

The streets around the yellow and the red zone are on weekdays in general congested from 10 am-19pm. Most taxi and private drivers that were asked during the study tries to avoid going into those zones because of the dense congestion. However, many of those working within the area see no other way of getting themselves and their goods in and out to Accra CBD then taking a taxi or Tro-tro.

The quality definition for motor vehicle can be seen in table 9 and in figure 19

<table>
<thead>
<tr>
<th>Type of link</th>
<th>Quality level at given journey speed (kph at design hourly traffic)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Thoroughfare/approach</td>
<td>-</td>
</tr>
<tr>
<td>Main link</td>
<td>Red</td>
</tr>
<tr>
<td>Local link</td>
<td>Green</td>
</tr>
</tbody>
</table>

Table 9. Quality, Motor Vehicle Network (7)

Observe that:

Lower speed at a few points on a link in the main network does not result in a reduction in quality.

Yellow means lower level of accessibility for motor traffic, but can be accepted if it results in a better degree of safety for pedestrians.

Red means poor level of accessibility for motor traffic, but can be accepted for a limited period if it results in a better degree of safety for pedestrians.

The traffic safety aspect for motor vehicle is good due to the speed in the area. Most of the accidents that are between two vehicles results in minor injuries or car damaged only. Traffic safety can always be improved and a continued work to reduce the numbers should be paramount.
Figure 19 Motor vehicle traffic network quality map
Quality Bus Network
According to Department of Urban Roads (DUR), the bus network in Accra CBD is not well organized. As can be seen in figure 20 there are some bus stops in the CBD area but they are most often used as market area. The busses go where it is easiest each time they drive off. Therefore the quality of the network could not be observed. When the planned BRT is in order a new survey could be made over the network.

<table>
<thead>
<tr>
<th>Type of link</th>
<th>Quality level at given journey speed (kph at design hourly traffic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links in basic network</td>
<td>Red</td>
</tr>
<tr>
<td>Links in public transport service network</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

Table 10. Quality, Bus Network (7)

Observe that:
Lower speed at a few points on a link in the main network does not result in a reduction in quality.
Yellow means not very good level of service for bus traffic but can be accepted if it results in a better degree of safety for pedestrians
Red means poor level of bus service, which cannot be accepted.
Quality Emergency Services Network

There is one fire station in the Accra CBD located close to the intersection Kinbu Road and Thomson Road and one police station located on Kinbu Road, between Thomson Road and Kwame Nkrumah Ave, see figure 21 and table 11.

Today the biggest problem within the emergency network is for the emergency vehicles to get out from the stations and up to speed without getting stuck in traffic.

<table>
<thead>
<tr>
<th>Type of link</th>
<th>Quality level at given journey speed (kph at design hourly traffic)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;20</td>
</tr>
<tr>
<td>Links in primary emergency vehicle network</td>
<td>Red</td>
</tr>
<tr>
<td>Links in secondary emergency vehicle network</td>
<td>Yellow</td>
</tr>
<tr>
<td>Other streets and vehicle accessible areas</td>
<td>Green</td>
</tr>
</tbody>
</table>

Table 11. Quality, Emergency Services Network (7)

Observe that:

Lower speed at a few points on a link in the main network does not result in a reduction in quality.

Yellow means not very good accessibility for emergency services traffic but can be accepted if it results in a better degree of safety for pedestrians and cyclists or a reduction in traffic noise.

Red means poor quality, which cannot be accepted
Figure 21  Emergency traffic network quality map
Quality Pedestrian and Bicycle Crossings

The reason for pedestrians and cyclist to cross can be many. In the Accra CBD the main reason are stores, offices and other access points on both sides along a section.

Another problem is the traffic lights. Very often they are not working and/or destroyed.

Figure 22 shows how the current situation is at pedestrians and cyclist crossings.

| Quality level at given spot speed (kph at design hourly traffic) |
|------------------------|------------------|------------------|
| <30                    | 30-40            | >40              |
| Green                  | Yellow           | Red              |

Table 12. Quality Pedestrian and Bicycle Crossings (7)

Observe that:

Yellow means not very good quality and can be accepted for a limited period

Red means poor quality that cannot be accepted
Figure 22 Pedestrians and bicyclist crossing traffic network quality map
3. Quality shortcomings and quality conflicts in current traffic network

By comparing and analyzing the “demand and function” maps to the “assessment of qualities” maps, shortcomings and conflicting demands can be offset against each other. This report studies the Accra CBD and to modify the traffic network in only this area may create more conflicts and shortcomings. Therefore there is a need to overlook a greater area to test changes in the structure and in the function classification, finding an optimal traffic network and ease the amount of traffic in the Accra CBD.

In this report the streets or links within the Accra CBD are not dealt with separately, instead the focus are on different problems found on several streets within the area. For more information about a specific road or link, please see the database and/or appendix.

Modifying the traffic network

Transferring motor traffic from the Accra CBD to new or existing main roads, restricting streets from “unnecessary” traffic and moving parking areas to outer parts of the centre would provide a more attractive environment for pedestrians and bicyclist and also ease the congestions seen in figure 23. The bus and emergency networks would also improve their qualities making the overall access and service greater. By transferring motor traffic out on more speed-tolerant main street networks the Accra CBD can be transformed into a local network where traffic safety and level of service for pedestrians and cyclists can be prioritized.

Clearing Accra CBD from unnecessary motor traffic will allow the remaining road users to increase their speed. To prevent high speeds, at low traffic volumes, speed classifications of the streets should be made. To promote a pedestrian and bicycle friendly environment speeds should not exceed 30kph inside the area and 30kph at crossing points from/to the area. The streets are physically designed to allow higher speeds and by implementing physical traffic calming measures, such as speed bumps, the speed limits can be enforced and controlled.
Quality and access summary

The rest of this section deals with an overviewed presentation of the Accra CBD pedestrian and bicycle facility quality and access. The result on each street can be gathered from the database. Figure 27 shows the quality on each street section within the Accra CBD.

Green indicates that the overall quality of this street section was good. Figure 24 shows an example of a green section.

Yellow indicates that the section has some hinder-hinders but that these can be accepted because of the level of protection the facility gives in general. Figure 25 shows an example of a yellow section.

Red means that the street section has too many and/or too severe quality shortcoming/s which makes it unsuitable for its purposes. Figure 26 shows an example of a red section.
Figure 27 Pedestrian infrastructure quality map
Sidewalks

Many of the sidewalks are spacious, in relative good shape and with a total width over 2 m. Next to “main road networks” there is often protection in form of railings and/or pillars. But there is a lack of continuum in all of these over one street section or along combining street sections, see figure 28.

An over 2 m wide sidewalk can suddenly be transformed into a 0.5 m wide one, forcing pedestrians out on the street.

A railing ends for a few meters or ends completely in the middle of a street section leaving no separation between motor vehicles and pedestrians.

Obstacles in form of miss placed signs, open sewers (cracked or missing covers), booths, potholes and hawkers made some street sections sidewalks impossible to use, temporarily or totally forcing pedestrians out into the motor vehicle traffic.

The sidewalk has in general steep edges, see figure 29. Exit and entering points usually lack any form of ramp, making it hard, not only, for wheelchairs and Zimmer frames but also for pedestrians in general to climb and descend.

Guiding for visually handicapped persons were at all missing and the quality of the greater part of the street sections are most certainly unsuitable, see figure 30.

Many intersections are signal controlled. However, many of them are broken or “not respected” by motor vehicles and pedestrians/ bicyclists, see figure 31.

The crossings at intersections are in general poorly marked and many lack “zebra”-markings to guide pedestrians at the right crossing points. As mentioned above, there is a lack of ramps to get from or onto the sidewalks at crossings. At intersections there were at a greater extent, ramps or less steep areas for pedestrians to use, however not at the quality needed for disabled and the elderly.
The Accra CBD is a glowing commercial centre with a number of commercial streets and markets. It attracts a high number of illegal salesmen known as hawkers. The hawkers often buy their product in larger volumes at stores located in the area and then sell them on the sidewalks, outside the stores or by the roads, see figure 32.

Everyone competes of the street space, making it overcrowded. Accra Metropolitan Assembly (A.M.A.), have assigned special markets for hawkers but these easily expand beyond their limits and out to surrounding streets where the goods can be sold to customers who doesn’t need to leave their vehicles.

By-laws are said to forbid illegal sales from hawkers but there seems to be little or none enforcement. However, a report, made by Magnus Quarhire, shows that once in a while the laws are enforced and the hawkers are removed. Furthermore the report shows that a large number of pedestrians found it easier to move around the city centre without the hawkers and felt that it was a more pleasant pedestrian environment (11).

Another report state that:

“Occasionally, the city authorities do embark on exercises to free the streets and pavements of hawkers, suggesting that street hawking is an illegal activity. This view was largely supported by the hawkers: four in five agreed that street hawking is not right as explained by a female participant of the Focus Group Discussion (FDG), when asked whether street hawking should be encouraged or not: - No, it is not good for us. We lose our lives in the process. If the government encourages it, they (government) do not have the nation at heart.”
When asked about the problems street vendors create for the society, however, only six (7.7%) of the hawkers did not see any problem resulting from their activities, which suggests that they are well aware of the problems they cause. They listed the problems to include littering the environment i.e., sanitation problems (37.2%), occurrence of accidents (24.4%), traffic jams (16.7%) and causing nuisance to motorists and other pedestrians.

Moreover the hawkers listed “being knocked down by vehicles” as their greatest problem as they move along the streets (12).

The environment in Accra CBD is with crowded streets, queuing cars and shouting hawkers a noisy place. By using a simple db meter (Nokia 5140i), each street section where measured during three different occasions, and the average result where a noise level of 84 db. In Calm Streets, the noise level is determined by measurements and theoretical calculation depending on traffic speed and flow of motor traffic. Noise levels above 65 on a pathway are considered to be of very poor quality. Because of the overcrowded sidewalks the study group also made a quality map over the accessibility on, and to, the sidewalks in the Accra CBD.

The study group made observations at three different occasions, first one at 10 am, the second one at 1 pm and the third and final at 5 pm. This was done to see if the level of accessibility changes during the day.

The compiled result can be studied in the data base and in figure 33.
Figure 33: Encroachment quality map
Part IV Discussion and Conclusion

The results given in chapter III shows that the quality of and access to pedestrian and bicycle facilities in Accra CBD are in general low. This chapter discuss what the study group believes being the cause.

Studying a larger map over Accra it appears that “all feeder roads lead to Accra CBD”. The Ring road surrounds Accra CBD to the north, but a large volume of traffic seems to pass through Accra CBD rather than going around. Accra CBD inhabits to larger bus hubs, several large commercial facilities, police-/fire stations, banks and offices making it somewhat understandable why traffic are converging there. The traffic network is in general one-way directed in Accra CBD and the large converging roads cross each other, or a street may cross itself (loop), causing large congestions, figure 34.

![Figure 34 Traffic flow and congested streets](image)

The complexity of the Accra CBD traffic network causes congestions that reduce the motor vehicle speed, in that sense improving the traffic safety for pedestrian. On the other hand it makes road users behavior less predictable, both pedestrians eager to cross and motor vehicles eager to make progress.

There are also negative environmental, health and economical aspects of congestions, further promoting a change in the current traffic network.

A larger traffic network analysis could give stakeholders and decision makers an insight on how the traffic congestions inside central Accra could be eased from some of its congestions. Suggesting citywide rerouting of urban feeder roads, which today converge at Accra CBD. Moving some of the traffic attractive features, such as markets, outside the city centre to locations with volume and speed tolerate roads.

To promote such a change requires a clear vision of the Accra CBDs development.
This study promotes a more pedestrian and bicycle friendly vision of Accra CBD, by leading motor traffic around the centre, on more speed and volume tolerant roads, to remote parking areas, Tro-Tro hubs and BRT stations. Creating new pedestrian and bicycle networks in and out of the CBD. Furthermore promoting “bus only streets” allowing; BRT, emergency and goods transports to “enter” the Accra CBD.

During the study there existed plans for a bicycle traffic network. A group of people, lead by Magnus Quarshie and his Cycle centre, promotes bicycle activities, projects and safety. They are encouraging stakeholders to introduce bicycle networks and facilities while planning for new or remodeling old streets and networks.

The study group strongly believes that an attractive pedestrian and bicycle environment will attract more citizens and tourists to Accra CBD allowing them to socialize and consume.

Lowering congestions allows motor vehicles to increase their speed and speed reducing measurements should therefore be implemented. Such measures could be to narrow the streets, speed bumps etc.

The theoretical consequences for implementing and enforcing different speed reducing measurements according to Calm Street are very hard to predict until they are in place. Estimations on the effects on pedestrians and unprotected road users could be at least a 50% reduction of serious injuries. A reduction of speed would also reduce motor vehicle accidents with 30%. These numbers could change depending on the traffic environment and could therefore vary from Sweden to Ghana.

The infrastructural problems, that the study group found, are often related to maintenance. Missing or broken coverage on sewers and broken pathways are serious problems for pedestrian and bicyclist if they are injured by them or forced out into the motor traffic.

Non functioning traffic signals and missing /faded zebra crossings puts crossing pedestrians and bicyclist at risk and makes all road users behavior harder to predict. If this maintenance problem is due to local or national authorities seems to be debated but nevertheless a serious problem.

Another debated problem is hawkers. Bylaws state that it is illegal to sell goods on the streets (hawkering), and A.M.A. restricts most of the legal commerce in Accra CBD. While performing the street analysis hawkers were viewed as obstructing object in the same category as misplaced signs. If they obstructed the sidewalks, forcing pedestrians and bicyclists out of the facility, the sidewalk was graded a lower level of quality. Most of the hawkers the study group spoke to acknowledge the problem but didn't see any alternatives. Many come from non urban areas to seek fortune in Accra and the solution to this problem seems to be political, and will not be commented on. However, the study group contacted Sigurd Hasselbom (electronic mail correspondence 2008), at the traffic office in Gothenburg who stated that this problem would in Sweden be a matter of enforcement and therefore an issue for the police authorities.

The economical aspects for renewing or remodeling Accra CBD to a more pedestrian and bicycle friendly area could be measured by a Cost Benefit Analysis, CBA. A great amount of statistical information is needed to perform such an analysis and a CBA is not made in this study. The calculation values in a CBA correlates to the infrastructural problems found in this study and a CBA study would show the socio economical aspects.
The Swedish method for CBA used in evaluation and planning within the traffic sector is presented below.

**Cost Benefit Analysis**

Cost benefit analysis measures a project's socioeconomic effect and can be used in evaluation and planning within the transport sector. A CBA gives decision makers and stakeholders a profitability analysis which can guide them in deciding upon one or between several projects.

No CBA was made for this study for several reasons mostly because of lack in time and statistics. However, we want to highlight the importance of statistical information and the benefits of using this information in analysis such as CBA.

The calculation values needed to compile a CBA for this study should include, in addition to the initial investment cost, seven calculation values. These seven values are used in Sweden and are developed by the Swedish Institute for Transport and Communications Analysis, SIKA, the Swedish traffic agencies and with the support from several scientists.

**Travel Time**

If the travel time is decreased this gained time can be used for other things, therefore time values can be set for private and business trips. The Contingent Valuation Method (CVM) is used for setting these time values. Time value can also be accounted for in terms of delayed goods, commuter traffic etc.

**Traffic Safety**

To calculate the traffic safety values the CVM method is used. By asking people how much they are willing to pay for a lowered risk of getting injured or killed in traffic. In payment it is not considered how much money a person is willing to pay but how much other consumption he/she is willing to prioritize away to lower a risk. The values that are used are however very debated and by many considered very uncertain.

**Noise**

Noise can create both irritation and medical inconveniences such as enhanced blood pressure and lowered quality of sleep. In Sweden, today calculations values are based upon a method called “the property value method”. The more people that stay near the source of the noise, the higher the cost for the noise are valued.

**Atmospheric/(traffic) pollution**

Traffic pollution causes damage on health and environment, both on a local and a regional scale. These effects are calculated by a method called ExtremeE, which treats the relations in a chain: Discharge of a certain substance leads to certain concentrations in the air that leads to certain damage, which in their term are valued.

**Carbon dioxide discharge**

In Sweden the calculation values for carbon dioxide discharge has been calculated based on the goal the Swedish government has stated for the transport sector (concerning carbon dioxide). It is not based upon cost or avail caused by traffic but on which measures that needs to be taken to reach the goal. In Sweden the calculation value is set to 1.50 SEK/kg, independent of the context, (same increased greenhouse effect where ever the discharges appear).
**Operation costs**

Operators within the transport area have costs for vehicles, maintenance, fuel, salaries etc. These costs are calculated at market prices.

**Operation and maintenance**

Operation and maintenance of the infrastructure involves large costs for the responsible department. Market prices can be used if calculation values can’t be gathered from the responsible department.

**Effects outside the calculation**

Some effects are, by numerous reasons, particular hard to quantify or value and are there by not accounted for in CBA calculations for the traffic sector. If these effects are of such significance that they cause insecurity upon if the total profitability becomes positive or negative, then the analysis is an assessment rather than a calculation. Such assessments of effects can be; Infringement in nature and culture environments or effects on regional economics. (13)
Technology and Knowledge exchange

In the year 1997 Gothenburg started a big traffic safety reform to break the long trend of increasing numbers of people being killed or seriously injured in traffic. They introduced measures to reduce speed and to separate unprotected road users from motor vehicles. Gothenburg did this with the assist of the “Calm Streets” method. (14)

The book on “Calm Streets” gives guidance in planning a traffic project. It guides through setting of the goals, how a traffic analysis should be done and how basic design shall be mapped out.

Ghana’s capital Accra seems to have many similar problems that Gothenburg had in 1997 e.g. congestions, a prioritized motor traffic making it hard for pedestrians and cyclist to move freely and without being put in serious risk for life and health.

Accra could learn from Gothenburg’s work. Accra doesn’t have to come up with a new solution and can take advantage of methods, mistakes and measures used in Gothenburg and Sweden.

Accra have a good possibility to do a similar reform as Gothenburg by using Calm Street and in this process establish good relations with Sweden. This study has noticed that Calm Street doesn’t directly have a solution to the infrastructural- and hawker problems as these are less of a problem in Sweden. Another reason is that “Calm Streets” are to be used when renewing a street, and/or network of streets. This means creating a new infrastructural design with; traffic calming measures, pathways, crossings and a pedestrian/bicycle friendly environment.

Gothenburg’s commitment on traffic calming measure has in the past decade resulted in a 40% decrease in number of non-lethal accidents. Under the same period Stockholm, capital of Sweden, have had an increase by 60%. In Stockholm the authorities prioritize accessibility. (15)

Traffic calming is not a local but a global issue, the leading cause of fatal accidents on New York roads is excessive speed, which only contributes to 10% of all accidents but can be blamed for 29% of all fatalities. (16)

The implementation of physical traffic calming measures, in the form of concrete speed bumps, has been the main reason to success in Gothenburg.

The road pillow, figure 35, has been developed to inflict less speed reduction on busses. (17)
Other physical traffic calming measures such as narrowed streets, see figure 33, separation of incompatible road users and raised zebra crossings, see figure 37 and displacement, see figure 38, also provide a more predictable road user behavior, increasing the traffic safety.

Gothenburg’s persistent work has proven to be successful and the “Calm Streets” method a model to follow. We believe that Gothenburg have the knowledge to guide other Swedish and foreign cities to improve their traffic safety and that the “Calm Streets” method can be adjusted to foreign traffic, cultural and infrastructural environments.

Ghana’s ambition to be on the frontline of traffic safety is driven by officials with the knowledge to adopt and adjust these methods. With a clear vision the Accra CBD can be developed into a pedestrian and bicycle friendly environment, free of congestion and with a high level of traffic safety.
Part V References and Vocabulary

Reference


3. BRRI. *Statistics 2005*. Accra : BRRI.


Tables and Figures

Table 1 “Selected reports” ........................................................................................................................................ 11
Table 2 “Statistical information” .................................................................................................................................. 11
Table 3 “General Concepts (9)” ...................................................................................................................................... 12
Table 4 “Functions and demands, Motor vehicle Network” (7) .................................................................................. 17
Table 5 “Functions and demands, Bus Network” (7) ...................................................................................................... 20
Table 6 “Functions and demands, Emergency Services Network” (7) ........................................................................... 22
Table 7 “Demands, Pedestrian and Bicyclist Crossings” (7) ......................................................................................... 25
Table 8 “Color coded quality grades” (7) ...................................................................................................................... 27
Table 9 “Quality, Motor Vehicle Network” (7) .............................................................................................................. 28
Table 10 “Quality, Bus Network” (7) .......................................................................................................................... 30
Table 11 “Quality, Emergency Services Network” (7) .................................................................................................... 31
Table 12 “Quality Pedestrian and Bicycle Crossings” (7) .............................................................................................. 33
Figure 1. Accra CBD and its surroundings .................................................................................................................... a
Figure 2. Numbers of road traffic accidents, injuries and fatalities in Ghana 2001-2005 (3) ............................................. 3
Figure 3. Distribution of RTA Fatalities in Ghana by Age (2) .......................................................................................... 4
Figure 4. Percent of RTA Fatalities in Sweden by Road Use Class (2005) (5) ................................................................. 5
Figure 5. Numbers of road traffic accidents, injuries and fatalities in Sweden 2001-2005 (20) ................................. 5
Figure 6. Distribution of RTA Fatalities in Sweden by Age (2005) (19) ................................................................. 5
Figure 7. Sub Areas in the Accra CBD .......................................................................................................................... 7
Figure 8. RTA Fatalities in Ghana by Road User Class (2) ............................................................................................. 3
Figure 9. Three step method .......................................................................................................................................... 9
Figure 10. Mixed Traffic Network .................................................................................................................................. 13
Figure 11. Variables (21) .............................................................................................................................................. 14
Figure 12. Orientation map – Study site ....................................................................................................................... 16
Figure 13. Motor-vehicle network: function classification ............................................................................................. 18
Figure 14. Motor-traffic network: Capacity demands .................................................................................................. 19
Figure 15. Basic Bus, Tro-tro and Taxi network ......................................................................................................... 21
Figure 16. Emergency service network ....................................................................................................................... 23
Figure 17. Pedestrian and bicyclist network: Demands for crossing the motor-traffic network.. 26
Figure 18. Risk for fatality at increased speeds (7) ....................................................................................................... 27
Figure 19. Motor vehicle traffic network quality map .................................................................................................. 29
Figure 20. Bus-Stop-market in Accra CBD .................................................................................................................. 30
Figure 21. Emergency traffic network quality map ..................................................................................................... 32
Figure 22. Pedestrians and bicyclist crossing traffic network quality map ..................................................................... 34
Figure 23. View over Rawlings park, Accra CBD ......................................................................................................... 35
Figure 24. Green Section ............................................................................................................................................. 36
Figure 25. Yellow Section ............................................................................................................................................. 36
Figure 26. Red Section ................................................................................................................................................. 36
Figure 27. Pedestrian infrastructure quality map .......................................................................................................... 37
Figure 28. Inconsistent width of a sidewalk, Accra CBD ............................................................................................... 38
Figure 29. Steep edge of a sidewalk, Accra CBD ........................................................................................................... 38
Figure 30. Outside Makola Market, Accra CBD ............................................................................................................ 38
Figure 31. Crossing at a intersection, Accra CBD ........................................................................................................... 38
Figure 32. Crowded Street, Accra CBD ......................................................................................................................... 39
Figure 33 Encroachment quality map ......................................................... 41
Figure 34 Traffic flow and congested streets .......................................... 42
Figure 35 Two road pillows on Viktor Rydbergsgatan, Gothenburg (17) ........ 46
Figure 36 Standardized speed bump on Utmarkgatan, Gothenburg (17) ........ 47
Figure 37 City speed bump on Östra Hamngatan, Gothenburg (17) .............. 47
Figure 38 Displacement on Sankt Olofsgatan, Gothenburg (17) ................. 47
List of abbreviations, acronyms or terms

A.M.A. – Accra Metropolitan Assembly
AIDS - Acquired Immune Deficiency Syndrome or Acquired Immunodeficiency Syndrome
ARGUS – Allmänna råd om gators utformning och standard. General advice for street design and standards in Sweden. Still in use, some parts are out of date.
BISP Database - A databased developed for this study, the name BISP are related to the Development Assistance Engineer Programme
BRT – Bus Rapid Transit
Calm Streets – It describes a planning process which is conducted in the purpose to renew the mixed traffic streets by physical measures within the street environment.
Casualty: Any person injured or killed in a traffic accident. Thus the accident is the event whilst the casualty is the individual.
CBA - Cost Benefit Analysis
CBD - Central Business District
CVM - Contingent Valuation Method
db - Decibel
Design Hourly Traffic – An estimation of the amount of traffic a street must handle per hour
DUR – Department of Urban Road
ECTS - European Credit Transfer and Accumulation System
ESN - Emergency Services Network
Fatal Accident: Accident in which, at least, one casualty dies of injuries sustained within 30 days of occurrence
FDG - Focus Group Discussion
GIMPA - The Ghana Institute of Management and Public Administration
GNP - Gross National Product
Hawkers – Street salesmen and women that sells on the sidewalk ore comes up to cars and sells there goods. This type of trade is illegal.
HIV - Human Immunodeficiency Virus
INEC - Department for Infrastructure and Economic Cooperation
kg - kilogram
Kph - Kilometres Per Hour
MFS - Minor Field Study
MTTU - The Motor Traffic and Transport Unit
NRSC - National Road Safety Commission
NRSS - National Road Safety Strategy
OEVIR - Other Emergency Vehicle Network
Off-peak traffic – Non rush hour traffic
PESN - Primary Emergency Services Network
RTA - Road Traffic Accidents
Rush Hour – The time when traffic moves the slowest
SEK - Swedish Krona
Serious Injury Accident: Accident in which, at least, one person is detained in hospital as an in-patient.
SEVR - Secondary Emergency Vehicle Network
Sida – Swedish International Development Cooperation Agency
SIKA - Swedish Institute for Transport and Communications Analysis
TroTtro – Mini busses that go to pre-agreed places when they are full
TRÅD - Trafikplaneringsråd för tätort - Traffic planning advice council in urban area in Sweden. No longer in use.
Urban: City or municipal area characterized by a concentration of residential, commercial and industrial buildings and activities.
USD - United States dollar
WHO - World Health Organization
Vision Zero – A Swedish vision that hopes that the amount of people killed and serious injured in traffic each year will be reduced to zero.
# Appendix 1 – Streets and Sections (From Bisp Database)

## Streets and Sections

<table>
<thead>
<tr>
<th>Street Name</th>
<th>Street ID</th>
<th>From</th>
<th>To</th>
<th>Main use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnes Road</td>
<td>R11-R12</td>
<td>Kimbu</td>
<td>Electricity</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R12-R18</td>
<td></td>
<td>Electricity</td>
<td>Pedestrian crossing</td>
</tr>
<tr>
<td>Derby Av.</td>
<td>B20-B21</td>
<td>Thompson Road</td>
<td>Clement Papafio</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B21-B1</td>
<td>Clement Papafio</td>
<td>Kweame Nkrumah Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>Y4-Y1</td>
<td>Makola Square</td>
<td>Kweame Nkrumah Av.</td>
<td>Sidewalk (Entrance/exit Rawlings park)</td>
</tr>
<tr>
<td>Electricity</td>
<td>R12:1-R13</td>
<td>Gas Station</td>
<td>Makola Square</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R18-R19</td>
<td>Barnes Road</td>
<td>School1</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R19-R20</td>
<td>School1</td>
<td>School Law</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R20-R21</td>
<td>School Law</td>
<td>Makola Square</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R12-R12:1</td>
<td>Barnes Road</td>
<td>Gas Station</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>Kimbu Road</td>
<td>R8-R9</td>
<td>Tudu</td>
<td>STC</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B8-B9</td>
<td>Kweame Nkrumah Av.</td>
<td>Clement Papafio</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R7-R8</td>
<td>Tudu</td>
<td>Tudu</td>
<td>Entrance/exit bus station</td>
</tr>
<tr>
<td></td>
<td>B9-B10</td>
<td>Clement Papafio</td>
<td>Clement Papafio</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B10-B11</td>
<td>Clement Papafio</td>
<td>Granville Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B23-B24</td>
<td>MTTU</td>
<td>MTTU</td>
<td>Entrance/exit police station</td>
</tr>
<tr>
<td></td>
<td>B24-B25</td>
<td>MTTU</td>
<td>Thompson Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B11-B12</td>
<td>Granville Av.</td>
<td>Granville Av.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B12-B13</td>
<td>Granville Av.</td>
<td>Thompson Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B22-B23</td>
<td>Kweame Nkrumah Av.</td>
<td>MTTU</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R15-R16</td>
<td>Tudu Road</td>
<td>Tudu Road</td>
<td>Pedestrian crossing</td>
</tr>
<tr>
<td></td>
<td>R9-R10</td>
<td>STC</td>
<td>STC</td>
<td>Entrance/exit bus station</td>
</tr>
<tr>
<td></td>
<td>R10-R11</td>
<td>STC</td>
<td>Barnes Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B25-R14</td>
<td>Thompson Road</td>
<td>Thompson Road</td>
<td>Pedestrian crossing</td>
</tr>
<tr>
<td></td>
<td>R14-R15</td>
<td>Thompson Road</td>
<td>Tudu Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R16-R17</td>
<td>Tudu Road</td>
<td>Barnes Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>R6-R7</td>
<td>Thompson Road</td>
<td>Tudu</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>Kweame Nkrumah Av.</td>
<td>B8-B22</td>
<td>Kimbu Road</td>
<td>Kimbu Road</td>
<td>Pedestrian crossing</td>
</tr>
<tr>
<td></td>
<td>B7-B8</td>
<td>Station Road</td>
<td>Kimbu Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B6-B7</td>
<td>Station Road</td>
<td>Station Road</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>Y1-Y2</td>
<td>Derby Av.</td>
<td>Selwyn Market Stree</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B27-B28</td>
<td>Commercial St.</td>
<td>Commercial St.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B29-B30</td>
<td>Kimberly Av.</td>
<td>Station Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B28-B29</td>
<td>Commercial St.</td>
<td>Kimberly Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B1-B2</td>
<td>Derby Av.</td>
<td>Commercial St.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B5-B6</td>
<td>Kimberly Av.</td>
<td>Station Road</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B4-B5</td>
<td>Kimberly Av.</td>
<td>Kimberly Av.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B3-B4</td>
<td>Commercial St.</td>
<td>Kimberly Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B2-B3</td>
<td>Commercial St.</td>
<td>Commercial St.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B26-B27</td>
<td>Derby Av.</td>
<td>Commercial St.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>Street Name</td>
<td>Street ID</td>
<td>From</td>
<td>To</td>
<td>Main use</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Makola Square</td>
<td>Y3-Y4</td>
<td>Selwyn Market St.</td>
<td>Derby Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>R13-R1</td>
<td></td>
<td>Electricity</td>
<td>Thompson Rd.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>Selwyn Market St.</td>
<td>Y2-Y3</td>
<td>Kwame Nkrumah Av.</td>
<td>Makola Square</td>
<td>Sidewalk (Entrance/exit Rawlings Park)</td>
</tr>
<tr>
<td>Thompson Rd.</td>
<td>B13-B14</td>
<td>Kimbu Rd.</td>
<td>Station Rd.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B14-B15</td>
<td>Station Rd.</td>
<td>Station Rd.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B15-B16</td>
<td>Station Rd.</td>
<td>Kimberly Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B16-B17</td>
<td>Kimberly Av.</td>
<td>Kimberly Av.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B17-B18</td>
<td>Kimberly Av.</td>
<td>Commercial St.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td></td>
<td>B18-B19</td>
<td>Commercial St.</td>
<td>Commercial St.</td>
<td>Walking pace street</td>
</tr>
<tr>
<td></td>
<td>B19-B20</td>
<td>Commercial St.</td>
<td>Derby Av.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>R2-R3</td>
<td></td>
<td>Parkin M. Mall</td>
<td>Parkin M. Mall</td>
<td>Entrance/exit Makola Market</td>
</tr>
<tr>
<td>R3-R4</td>
<td></td>
<td>Parkin M. Mall</td>
<td>Fire Station</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>R4-R5</td>
<td></td>
<td>Fire Station</td>
<td>Fire Station</td>
<td>Entrance/exit Fire Station</td>
</tr>
<tr>
<td>R5-R6</td>
<td></td>
<td>Fire Station</td>
<td>Kimbu Rd.</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>R1-R2</td>
<td></td>
<td>Makola Square</td>
<td>Parkin M. Mall</td>
<td>Sidewalk</td>
</tr>
</tbody>
</table>
Appendix 2 – Screen Captures of the Bisp Database

The Welcome Screen

Function, Demand and Quality Editor

Demand and Function Classification and Assessment of Qualities
To edit or add data choose the relevant Tab to reveal that form.
If you wish to see all results, choose view datasheet or go to Reports.
To view the street codes, Go To> Streets and press the Report Button.
If you want to know more about the different categories, or download excel files,
Go To> Study and download the Word File.
If you need help, press F1.
Appendix 2 – Screen Captures of the Bisp Database

Function, Demand and Quality Editor - Facilities

Streets Editor