

Sub-Saharan Africa Transport Policy Program

RMF Report No 10/06



Knowledge Sharing and Promotion of Appropriate Pavements and Surfacing Technologies for Low-volume Roads in Ghana, Sierra Leone and Burkina Faso

Workshop Report



Workshop Report

*Knowledge Sharing and Promotion of Appropriate Pavements
and Surfacing Technologies for Low-volume Roads in
Ghana, Burkina Faso and Sierra Leone*

Accra, Ghana
27th – 29th September, 2006

October 2006

Prepared for:

SSATP
Washington, USA

Prepared by:

Mike Pinard & Charles Overby
Consultants

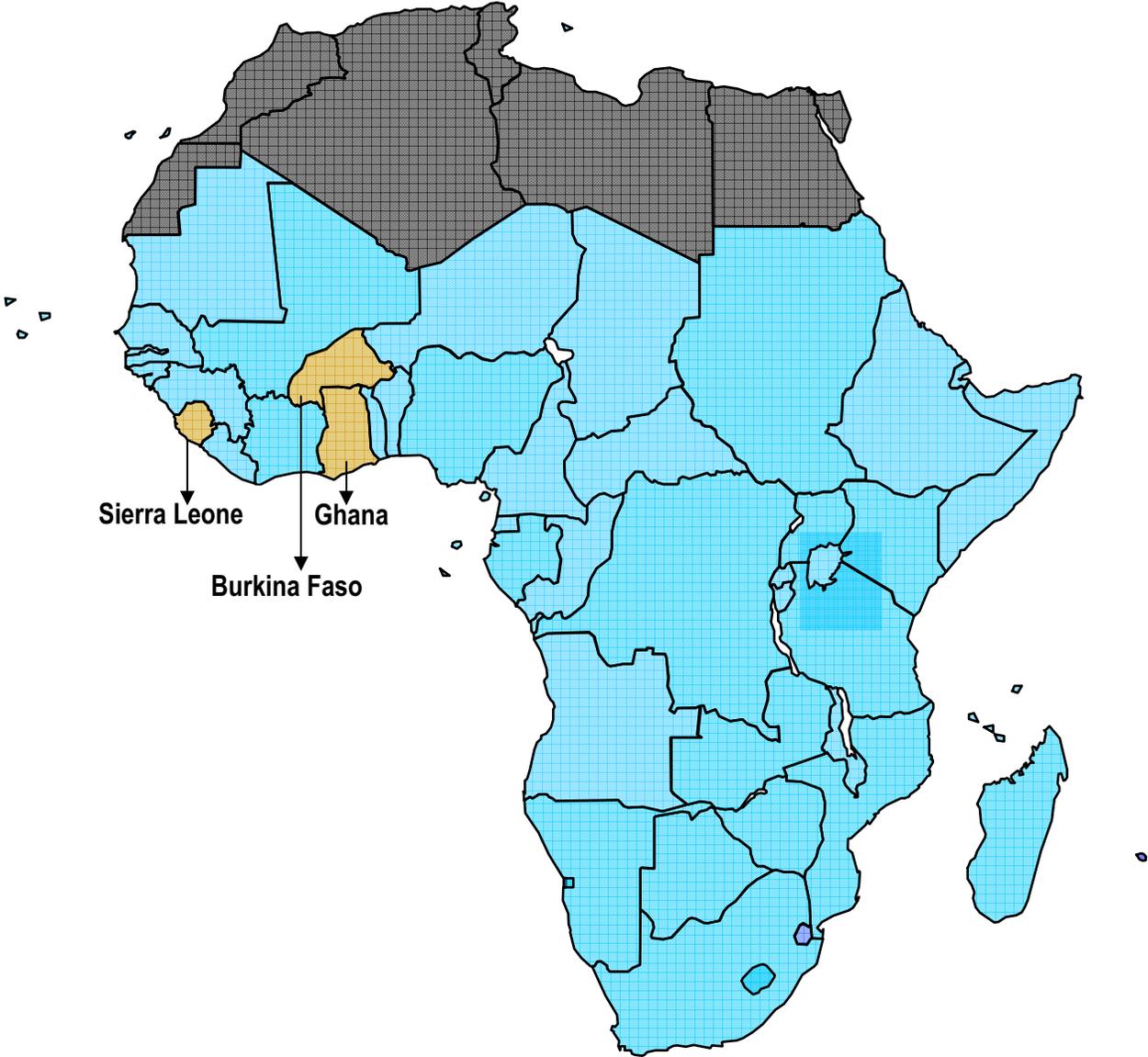
TABLE OF CONTENTS

LIST OF ABBREVIATIONS.....	ii
LOCATION MAP.....	iii
EXECUTIVE SUMMARY	E-1
1 INTRODUCTION.....	1
Background.....	1
Objectives	1
Scope of Work.....	2
Terms of Reference	2
Program	2
2 THE WORKSHOP.....	3
Objectives	3
Program	3
Attendance	3
Preliminaries	3
Presentations	5
3 THE FIELD TRIPS.....	7
Field Trip to University of Ghana	7
Field Trip to Twifo Hemang – Baakondzidzi Road Demonstration Project	8
4 WORKSHOP DELIBERATIONS	10
Objectives	10
Working Groups.....	10
5 WORKSHOP CLOSURE	12
6 ANNEXES.....	15
Annex A - Terms of Reference for Consultant’s Assignment.....	A.1
Annex B – Workshop Programme	B.1
Annex C – Workshop Attendance List.....	C.1
Annex D – Details of Demonstration Project.....	D.1
Annex E – Feedback from Working Group Deliberations.....	E.1
Annex F – Speech by Hon. Magnus Opare-Asamoah (MP), Deputy Minister.....	F.1

LIST OF ABBREVIATIONS

BP	Borrow Pit
CBR	California Bearing Ratio
DBST	Double Bituminous Surface Treatment
DSD	Double Surface Dressing
DFID	Department for International Development
ESA	Equivalent Standard Axles
Km	Kilometre
LTDP	Long Term Development Plan
LVSr	Low-volume Sealed Roads
MDGs	Millennium Development Goals
PI	Plasticity Index
RED	Roads Economic Decision Model
RMF	Road Management and Financing
SADC	Southern Africa Development Community
SSA	Sub-Saharan Africa
SSATP	Sub-Saharan Transport Policy Program
TRL	Transport Research Laboratory
UK	United Kingdom
USA	United States of America
VOC	Vehicle Operating Costs
WP	Work Program

**SSA Countries Participating in the Workshop on Knowledge Sharing
and Promotion of Appropriate Pavements and Surfacing Technologies
for Low-volume Roads**



EXECUTIVE SUMMARY

Background

1. As part of its support in the thematic area of Road Management and Financing, and on the basis of a specific recommendation arising from the last Annual meeting held in Bamako in November 2005, SSATP is promoting and disseminating aspects of the SADC Guideline on Low-volume Sealed Roads.
2. In support of the above, a workshop was held in Ghana by a World Bank/SSATP team from 27th -29th September, 2006 for participants from Ghana, Burkina Faso and Sierra Leone. The main objective of the workshop was to disseminate knowledge and promote the use of appropriate technologies in the construction of pavements and bituminous surfacings for low-volume roads.

The Workshop

3. Following Opening Remarks by Mr. Olav Ellevset, Senior Transport Specialist, SSATP/World Bank Program, the Welcome Address was presented by Mr. Martin hMensa, Deputy Chief Executive, Ghana Highway Authority. The 3-day workshop was attended by a total of 45 delegates from the host country as well as from the neighbouring countries of Burkina Faso and Sierra Leone.
4. The workshop was designed to be interactive in order to maximise the involvement of delegates in discussing burning issues related to pavement and surfacing technologies in their respective countries.
5. The workshop program included scene-setting presentations by the SSATP/World Bank consultants and break-away working group deliberations on the presentations to discuss the challenges of implementing these new technologies. The scene-setting presentations included:
 - New Approaches to Sustainable provision of Low-volume Sealed Roads
 - Alternative Surfacing Technologies for Low-volume Sealed Roads
 - Alternative Materials and Pavement Design Technologies for Low-volume Sealed Roads
 - History of the Otta seal
6. Issues considered in the workshop deliberations included the participants perceived barriers and constraints to implementation of the main aspects of low-volume road technology presented, measures for overcoming them and the way forward.

The Field Trip

7. A field trip was undertaken to a Demonstration Project in the Cape Coast region where, because of the relatively high cost of producing crushed aggregate for a traditional bituminous surface treatment, a graded aggregate (Otta) seal surfacing using locally available screened gravel had been constructed instead with the assistance of the World Bank consultants.

Observations, Conclusions and Recommendations

8. The main observation, conclusions and recommendations arising from the workshop deliberations and field trip were as follows:

- ❖ The Demonstration Project has shown the Otta seal technology which uses “non-standard” aggregates in the form of screened gravel, is a viable, practical and cost-effective alternative to the more conventional chip seal that requires the use of crushed aggregate. However, a comparison of the initial cost of construction alone does not tell the whole story; it is critical to undertake whole life costing in order to determine the overall benefits of adopting this option.
- ❖ There are various barriers and constraints to the introduction of the new technologies presented at the workshop. These included stakeholder (politicians, technocrats, donors, etc.) reluctance to accept non-traditional technology, lack of knowledge of the new technologies and limited implementation capacity.
- ❖ Measures for overcoming the various barriers and constraints to the introduction of the new technologies include more wide-spread dissemination of information and greater awareness raising and advocacy of the benefits of the new technologies.
- ❖ There are various benefits - technical, social, economic, environmental, etc. – to be derived in introducing the new technologies including making better use of available resources, achieving more sustainable roads for the available budget, reducing the depletion of finite gravel resources, providing more durable access in rural and other areas, reducing vehicle operating costs and reducing health hazards in built-up caused by dust generation.
- ❖ The way forward from the workshop includes the identification of “champions of change” to promote new technologies through well-documented case studies from both within and outside the country. The Ministry of Transport and other stakeholders (road agencies, consultants, contractor, bitumen suppliers, etc. should take the lead role in this initiative which would be facilitated by the development of customized guidelines for Ghana.

Outcome of Workshop

9. The participants expressed their appreciation of the initiative taken by the SSATP/World Bank in holding the workshop. They stated that they had benefited very much from the presentations of the consultants and were of the view that the workshop had achieved its objectives.



Participants to the World Bank/SSATP Workshop on *Knowledge Sharing and Promotion of Appropriate Pavements and Surfacing Technologies for Low-volume Roads in Ghana, Burkina Faso and Sierra Leone:*
Accra, Ghana, 27th – 29th September, 2006

1. INTRODUCTION

Background

1.1 The 2006 Work Program (WP) of the Sub-Saharan Africa Transport Policy Program (SSATP) is contained within a framework of priority thematic areas: (a) Road Management and Financing; (b) Appropriate Transport Services; and (c) Regional Integration and Transport. Overarching initiatives comprise transport strategy development based on the outcomes of ongoing poverty/transport analytical work (ensuring transport fully responsive to poverty reduction strategies) and the establishment of appropriate transport sector performance indicators linked to the Millennium Development Goals (MDGs). The work program is the second of four annual programs which will incrementally achieve the objectives of the SSATP Long Term Development Plan (LTDP) which runs to 2007.

1.2 The Road Management and Financing (RMF) Thematic area includes a number of initiatives namely: road network management (institutional and financial arrangements), road fund enhancement, road agency improvements, and capacity building and training. Many countries have embarked on reform agendas, but adherence to sound policy principles and emulation of established good practice is, in a number of cases, problematical. The SSATP is addressing demands for support in these areas in a number of ways, including the implementation of activities arising from specific recommendations made by the last SSATP Annual Meeting held in Bamako, Mali, in November 2005.

1.3 One such activity is the promotion and dissemination of the SADC Guideline on Low-volume Sealed Roads (LVSR), and support to the collection of corresponding experiences from SSA. Whilst the approach and the philosophy of the Guideline have been practiced in some countries over a number of years, the Guideline is now enabling a more comprehensive and coherent approach to be adopted in the utilization of technologies and methods that focus on the utilization of locally available materials. The major impact of adopting such approaches include a reduction of life-cycle costs. Another important factor is a reduction in the continuous exploitation of non-renewable gravel sources, more so when “good” gravel is used in an inappropriate manner.

Objectives

1.4 The main objectives of the workshop were to disseminate knowledge and to promote the use of appropriate technologies in the construction of pavements and bituminous surface treatments for low-volume roads in SSATP partner countries, in this case, Ghana, Burkina Faso and Sierra Leone. The SADC Guideline on Low-volume Sealed Roads served as the guiding background document for the workshop together with supporting case study information emanating from the recently constructed Twifo Hemang – Baakondzidzi road Demonstration Project.

Scope of Work

1.5 In order to achieve the above objectives, the following scope of work was undertaken by the SSATP/World Bank consultants, under the guidance of the RMF thematic leader.

- (1) Undertaking a field visit to the Coast Region of Ghana to brief participants on the details of the recently constructed Twifo Hemang – Baakondzidzi road Demonstration Project using the graded aggregate (Otta) seal approach in which one of the consultants was involved.
- (2) Facilitating an interactive workshop in Accra, Ghana to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and possible application in the mentioned countries.
- (3) Briefing the workshop participants on the way forward with regard to the potential for utilizing more appropriate technologies in the provision of Low-volume sealed road applications.

Terms of Reference

1.6 The Terms of Reference for the SSATP/World Bank consultants are attached as Annex A to this report.

Program

1.7 The overall program for fulfilling the full scope of the Terms of Reference is summarised below whilst the detailed workshop program is presented in Annex B:

Day 1 Friday 24 Feb.	- 08.30 -17.00: Day 1 of workshop - 17.00 – 18.00: Technical visit to 50 year old surfacings on roads at the University of Ghana
Day 2 Saturday 25 Feb.	- 08.00 – 19.00 hrs: Field trip to Twifo Hemang – Baakondzidzi road Demonstration Project.
Day 3 Sunday 26 Feb.	- 08.30 – 17.00 hrs: Day 2 of workshop

2. THE WORKSHOP

Objectives

2.1 The main objective of the workshop was to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and promotion of appropriate technologies in the construction of pavements and bituminous surface treatments for possible application in Ghana, Burkina Faso and Sierra Leone.

Program

2.2 The workshop took place in the conference room of the Golden Tulip Hotel in Accra. The programme for the workshop is attached as Annex B.

Attendance

2.3 The workshop was attended by some 45 delegates from Ghana (41 No.), Burkina Faso (1 No.), Sierra Leone (2 No.) and Tanzania (1 No.). The attendance list is attached as Annex C.

Preliminaries

2.4 **Opening Remarks:** The Opening Statement was made by Mr. Olav Ellevset, Senior Transport Specialist, SSATP/World Bank Program. He firstly expressed the gratitude of the SSATP Program and the World Bank to the Government of Ghana for hosting the workshop on Low-volume sealed roads in Accra. He also expressed his thanks to all participants to the workshop, including, those visiting from North and South Sudan and Uganda, for showing interest in the theme of the workshop.

2.5 Some of the key points made by Mr. Ellevset in his Opening Statement are as follows:

- The SSATP is a partnership of currently including 33 Sub-Saharan countries, with Sierra Leone being accepted as the 33rd country, as well as the European Union, several bilateral, regional associations and institutions, and the World Bank for promoting sustainable transport policies that will help in reducing poverty and supporting economic growth in the members countries.
- Good roads are important for the development of any country. However, the standard and condition of the roads are not able to provide people with basic access to education, to health services, to markets for selling their produce, etc. – unfortunately a common situation in many countries.

-
-
- Delegates might have seen in their countries gravel or earth roads that have been repaired and improved with a lot of effort and money, and which have served their purpose for some time. However, too often harsh weather conditions, sometimes combined with poor materials, have made these efforts and investments last for a short period only. In these circumstances, the investments involved in providing traditional bituminous surfacings may not be justifiable due to lack of good quality materials within reasonable haul distance and high costs in relation to the number of vehicles using the road.
 - The workshop will deal with optional technologies and customized designs that are appropriate for the local climate, the materials available and the prevailing traffic volumes and loads. Typically, construction cost savings could be 10-20% compared with traditional surface treatments, and 30-50% over 20 year life-cycle cost.
 - Overload control remains a serious threat to roads in many SSA countries, including Ghana, Burkina Faso and Sierra Leone and effective control of overloading is of paramount importance in order to avoid a reduction in their design lives as well as to preserve the investments made in providing such roads.
 - The workshop, the third of its kind arranged by SSATP, was meant to serve as a forum for sensitization and exchange of experiences based on practical applications such as the Demonstration Project in the Cape Coast region of Ghana as well as elsewhere in eastern and southern Africa.

2.6 Mr. Ellevset concluded his remarks by expressing the hope that the participants would find the outcome of the workshop interesting enough to engage in further steps for identifying the viability of customized applications within the framework of on-going and future projects in their respective countries.

2.7 **Welcome Remarks:** The Welcome Remarks were made by the Deputy Chief Executive of the Ghana Highways Authority, Mr. Martin hMensa, who thanked SSATP for organising the workshop in Accra for which the Ghana Highway Authority was pleased to be the host. He mentioned that the topic was very appropriate and relevant to Ghana and the countries bordering Ghana in that it focused on developments in both road pavements and surfacings. The remainder of his remarks may be summarised as follows:

- Ghana has a very large network of unpaved roads which comprise more than 80% of the total road network.
- For the past 10 years, the focus has been providing basic access. However, there is now a demand for provision of more sustainable access in terms of more paved roads in urban and rural areas.

-
-
- The main challenges faced by Ghana in providing more sustainable access included very high rainfall of up to 2500 mm per annum in the wet areas of the country; a predominance of very plastic, clayey soils; mountainous terrain and steep gradients in some areas and flat and poorly drained terrain in other areas;
 - The topics to be presented at the workshop should address the challenges faced in Ghana and the surrounding countries.

2.8 In concluding his remarks, Mr. Mensa expressed the hope that the workshop would provide guidance to practitioners in Ghana and the surrounding countries faced with the challenge of improving the livelihoods of its population through the provision of improved road infrastructure.

Presentations

2.9 **Presentation No. 1:** The first presentation was made by Mr. Mike Pinard, a SSATP/World Bank consultant, on *New Approaches to Sustainable Provision of Low-volume Sealed Roads*. Mr. Pinard's presentation, which is included as Annex F, dealt with the following main topics.

- Introduction
- Background to the SADC Guideline on Low-volume Sealed Roads
- Why Low-volume sealed roads
- New approaches and challenges
- Importance of technology transfer

2.10 **Presentation No. 2:** The second presentation was made by Mr. Charles Overby, a SSATP/World Bank Consultant, on *Bituminous Surfacing for Low-volume Sealed Roads*. Mr. Overby's presentation, which is included in Annex F, dealt with the following main topics:

- Introduction
- Types and Performance Characteristics
- Properties and functions of surfacings
- Selection of surfacing types
- Surfacing Design and Construction
- Brief of the Otta seal
- Case Histories

2.11 **Presentation No. 3:** The third presentation was made by Mr. Mike Pinard on *Materials and Pavement Design Technologies for Low-volume Sealed Roads*. Mr. Pinard's presentation, which is included as Annex F, dealt with the following main topics:

-
-
- Introduction
 - Materials issues
 - Pavement issues
 - Other issues
 - Examples

2.12 **Presentation No. 4:** A brief presentation on the History of the Otta Seal, which is included in Annex F, was made by Mr. Charles Overby and dealt with the following main topics:

- Introduction
- Background
- Development
- Approach to Design and Construction

2.13 **Presentation No. 5:** A technical orientation and briefing on the Twifo Hemang – Baakondzidzi road Demonstration Project involving the adoption of the Otta seal approach was presented by Messrs. hMensa and Charles Overby. The main topics covered in the presentation, which is included in Annex F, were as follows:

- Background to project
- Materials utilisation
- Equipment used
- General sealing operations
- After care of seal

3. FIELD TRIPS

Field Trip to University of Ghana

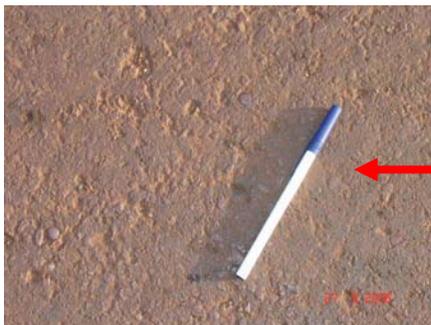
Objective of fieldtrip

3.1 The objective of the field trip was to show participants examples of surfacings on the internal roads of the University of Ghana that had been constructed from natural gravel. These surfacings, probably constructed as “gravel seals” using screened quartzitic gravel which was in evidence over the university site, were believed to have been in service for about 50 years. The traffic carried was mostly very light consisting mostly of cars and light delivery vehicles. Specific details of the surfacing design, in terms of type of binder and application rate, etc., and method of construction were not known.

Observations

3.2 As illustrated in the photographs below, the surfacings are still in good condition and have demonstrated very strikingly the viability of constructing durable seals using “non-standard” aggregates – in this case screened quartzitic gravel – that do not comply with traditional specifications in terms of aggregate strength, shape, texture, etc.

Close-up of natural gravel surfacing used on the internal roads of the University of Ghana



Martin hMensa, Deputy Chief Executive, Ghana Highways Authority, informing workshop participants about the details of the fifty year old surfacing used on the internal roads of the University of Ghana.

Field Trip to Twifo Hemang – Baakondzidzi road Demonstration Project

Background

3.3 As part of its support to the Department of Feeder Roads in Ghana, the UK Department for International Development (DFID) selected short sections of feeder roads to be sealed in order to reduce the high maintenance costs caused by a combination of high rainfall (>1000 mm/annum), steep gradients (> 10%), slippery road surfaces during the rainy season due to the relatively plastic (PI >10) wearing course gravels and dusty road conditions during the dry season.

The Demonstration Project

3.4 Due to the very long haulage, and related high cost, for obtaining traditional crushed aggregate for constructing a bituminous surface treatment (Chip seal) on the Twifo Hemang – Baakondzidzi road project, it was decided to use this project as a Demonstration Project for demonstrating the viability of constructing an economic and practical alternative – the graded aggregate (Otta) seal - to the more traditional Chip seal. Full details of the Demonstration Project are provided in Annex X.

Objective of fieldtrip

3.5 The main objective of the field trip was to inspect the outcome of the Demonstration Project during which a full briefing of the details of the design and construction of the Otta seal was given by the World Bank consultant, Charles Overby, who was involved in the training of the contractor and the consultant in the initial stages of construction of the Otta seal. The field trip also provided an excellent opportunity for participants to comment, raise issues and seek clarification on a variety on aspects of the project.



Participants being informed about the details of the Demonstration project.

Close up of the Otta Seal



Typical condition of gravel feeder road within one year of construction.

Typical section of feeder road after regravelling and surfacing with an Otta seal



Observations from field trip

3.6 The detailed observations and comments of the participants on the field trip are provided in Annex E and may be summarised as follows:

- Bearing in mind that this was the first time that the contractor had constructed an Otta seal, and that various teething problems were experienced initially such as a faulty bitumen distributor and insufficient rolling capacity, the outcome of the project was generally good and, after more than one year, the seal was performing very satisfactorily.
- The project has demonstrated that it was quite feasible to construct a durable bituminous surface treatment using screened gravel instead of the more traditional and costly crushed aggregate. In addition, many aspects of the construction operations utilised local labour which is a major advantage for employment creation and poverty alleviation.
- The previous problems encountered with the gravel road in terms of dust generation during the dry season and a slippery, dangerous surface in the wet season, particularly on steep grades, had been ameliorated. In this regard, a cross-section of road users interviewed during the field trip, including school children, a taxi driver and some local residents, all praised the government for providing them with “good” roads (see photos below).



The school children above expressed their delight in being able to walk to school on a “proper” road in contrast to the muddy conditions experienced during the rainy season.



Residents of the above village in the Cape Coast area were happy that they no longer suffered from dust generation in the dry season and muddy conditions in the wet season.

4. WORKSHOP DELIBERATIONS

Objective

4.1 The main objectives of the workshop deliberations were to seek the participants feedback on the following:

1. Their observations, comments and questions on the Demonstration Project.
2. Their perceived barriers and constraints to implementation in their country of the main aspects of LVSR technology presented
3. Their measures for overcoming constraints and barriers
4. Their proposals for the way forward

Working Groups

4.2 In pursuit of the above objectives, three working Groups were formed comprising a cross-section of participants from different countries and organisations with the objective of deliberating on the issues indicated above. A synthesis of the feedback from the Working Groups is presented below whilst the detailed feedback from each working Group is presented in Annex E.



One of the Working Groups in session



Feedback from one of the Working Groups

Feedback

4.3 *General observations from field trip*

- ❖ The Otta seal reduces depletion of gravel, a finite, diminishing resource, in many countries;
- ❖ Achievement of goal: all weather access, dust control, reduced VOC;
- ❖ A comparison of the initial cost of construction alone does not tell the whole story; it is critical to undertake whole life costing to be able to determine the most cost effective option;

-
-
- ❖ The Otta seal demonstration project has shown it to be a viable alternative to the conventional chip sealing.

4.4 *Barriers and constraints*

- ❖ Acceptance of new technology is often resisted
- ❖ There is often resistance to change at:
 - Political level
 - Technical level
- ❖ Contractor acceptance/capacity
- ❖ In house acceptance of new technology because of the perceived risks
- ❖ Consultants' knowledge is often initially lacking
- ❖ Social (road users) often perceive the Otta seal to be a “cheap” seal
- ❖ Donor reluctance to accept non-traditional technology

4.5 *Measures to overcome barriers and constraints*

- ❖ Political acceptance: more sustainable roads for the available budget
- ❖ Education:
 - Champions of change
 - Politicians/technocrats
 - Donor community
 - Engineers
 - Stakeholders (improved access)
- ❖ More wide-spread dissemination of information

4.6 *Benefits of new technologies*

- ❖ Social
- ❖ Economic
- ❖ Environmental
- ❖ Health

4.7 *Way forward*

- ❖ Identify champions of change to promote new technologies through well-documented case studies from both outside and within the country (who / when?)
 - MoT & road agencies / forthwith
- ❖ Tailor the technology to the Ghanaian environment (who / what / when?)
 - Road agencies, consultants, contractor, bitumen suppliers / production of Ghana guidelines & full implementation / within 2 years from now

5. WORKSHOP CLOSURE

Closing Remarks

General

5.1 The closing session of the workshop was attended by the Deputy Minister of Transportation, Hon. Magnus Opare-Asamoah. For this purpose, a synthesis of the main outputs of the workshop was presented by the Deputy Chief Executive of the Ghana Highways Authority. This was followed by the closing remarks of the Deputy Minister (see Annex F) and the SSATP / World Bank Senior Transport Specialist as summarized below.

Workshop summary

5.2 The following is an overview of the workshop summary presented by the Deputy Chief Executive of the Ghana Highways Authority, Mr. Martin hMensa.

- Workshop participants had been exposed to a number of innovative approaches to the provision of low-volume sealed roads based on research emanating from the Southern African region over the past 20 years which merited serious consideration for application in Ghana.
- The field visit to the Demonstration Project in the Cape Coast region had provided compelling evidence of the merits of embarking on alternative surfacing technologies in Ghana. The project had achieved its objectives of providing a cost-effective, durable surfacing using locally available, screened gravel and, in so doing, providing a range of technical social and environmental benefits.
- As with the introduction of any new technology, there are a number of barriers and constraints to be overcome such as an inherent resistance to change by many stakeholders and reluctance to adopt to non-traditional approaches to the provision of rural roads. However, such barriers and constraints can be overcome by wider dissemination of information, and greater awareness raising and advocacy of the benefits of the new technologies.
- The workshop had achieved its objective of sharing experiences with all participants on new developments in road technology including alternative pavement and surfacing technologies that are likely to be beneficial for application in Ghana, Burkina Faso and Sierra Leone. Indeed, Ghana would build on the experiences of the Demonstration Project and would embark on more wide-spread use of this technology in future.

Closing remarks Deputy Minister of Transport

5.3 The Deputy Minister of Transport, Hon. Magnus Opare-Asamoah, expressed his gratitude to the SSATP/World Bank for organising the workshop in Ghana which he was confident would be of tremendous benefit to the country. He also thanked all the workshop participants for their valuable contributions to the workshop, including the workshop recommendations on the way forward. See Annex F for the full text of the speech.

5.4 During the course of his closing remarks he mentioned that:

- He was fortunate to have visited Botswana where he was very impressed with the progress made in that country with the use of the Otta seal. Accordingly, he was a firm supporter of this surfacing technology which he was keen to see replicated in Ghana.
- He would give his full support to the promotion of innovative pavement and surfacing technologies in pursuit of achieving more cost effective and sustainable ways of providing road infrastructure in support of Ghana's drive towards economic growth and poverty alleviation.

Closing remarks by the SSATP/World Bank Senior Transport Specialist

5.5 On behalf of the SSATP/World Bank, Mr. Olav Ellevset firstly thanked the host country, Ghana, for kindly agreeing to hold the workshop in Accra. He also thanked the delegates from all the participating countries for their lively and enriching contributions to the workshop.

5.6 The remainder of Mr. Ellevset's closing remarks are summarized below:

- The field visit to the University of Ghana was an eye-opener in terms of Ghana's previous utilisation of the type of surfacing technology presented at the workshop; moreover, it was gratifying to learn that Ghana had embarked on the application of similar technology on its Demonstration Project at the Cape Coast region.
- The various thought provoking discussions raised during the inspection of the Demonstration Project highlighted the importance of customising surfacing solutions to local situations with the objective of protecting investments in roads through permanent applications utilising local materials in the vicinity of the actual roads themselves.
- With the excellent presentations and very knowledgeable and interested participants from Ghana, Burkina Faso and Sierra Leone, the objective of the workshop, which was to share and disseminate knowledge related to appropriate technologies in the construction of pavements and bituminous surface treatments for Low-volume roads, had been achieved.

-
-
- Ghana's commitment and dedication towards exploring new technologies for roads, including innovative bituminous surface treatments was very commendable.

5.7 Finally, Mr. Ellevset reiterated his thanks to the Ghanaian Government, and particularly the authorities of the Ministry of Transport and the Ghana Highways Authority, for their hospitality and gracious hosting of the workshop. He assured the Deputy Minister that the SSATP would always be there to support Ghana's efforts of exploring innovative and creative ways of providing roads on a cost-effective and sustainable basis in support of economic growth and poverty alleviation.

Annexes

SUB-SAHARAN TRANSPORT POLICY PROGRAM

Short Term Consultancy Services for Facilitating Workshops on Knowledge Sharing and Promotion of Appropriate Pavements and Bituminous Surface Treatment Technologies for Low-volume Sealed Roads in Ghana, Nigeria and The Gambia

TERMS OF REFERENCE

Background

The 2006 Work Program (WP) of the Sub-Saharan Africa Transport Policy Program (SSATP) is contained within a framework of priority thematic areas: (a) Road Management and Financing; (b) Appropriate Transport Services; and (c) Regional Integration and Transport. Overarching initiatives comprise transport strategy development based on the outcomes of ongoing poverty/transport analytical work (ensuring transport fully responsive to poverty reduction strategies) and the establishment of appropriate transport sector performance indicators linked to the Millennium Development Goals (MDGs). The work program is the second of four annual programs which will incrementally achieve the objectives of the SSATP Long Term Development Plan (LTDP) which runs to 2007.

The Road Management and Financing (RMF) Thematic area includes a number of initiatives namely: road network management (institutional and financial arrangements), road fund enhancement, road agency improvements, and capacity building and training. Many countries have embarked on reform agendas, but adherence to sound policy principles and emulation of established good practice is, in a number of cases, problematical. The SSATP is addressing demands for support in these areas in a number of ways, including the implementation of activities arising from specific recommendations made by the last SSATP Annual Meeting held in Bamako, Mali, in November 2005.

One such activity for which the current terms of reference are written is the promotion and dissemination of the SADC Guideline on Low-volume Sealed Roads (LVSR), and support to the collection of corresponding experiences from SSA. Whilst the approach and the philosophy of the Guideline have been practiced in some countries over a number of years, the Guideline is now enabling a more comprehensive and coherent approach to be adopted in the utilization of technologies and methods that focus on the utilization of locally available materials. The major impacts of adopting such approaches include a reduction of life-cycle costs and less consumption of scarce good construction materials. Another important factor is a reduction in the continuous exploitation of non-renewable gravel sources, more so when “good” gravel is used in an inappropriate manner.

Objectives

The objective of the consultancy services is to disseminate knowledge and promote the use of appropriate technologies in the construction of pavements and bituminous surface treatments for low-volume roads technologies for low cost seals in SSATP partner countries, this time particularly for Ghana, Nigeria and The Gambia.

Scope of Work

Under the guidance of the RMF theme, the consultants will carry out the following:

1. To participate in the field visit to the Cape region and brief participants on materials, traffic loads and the application experiences derived thereof.
2. To undertake an interactive workshop in Accra on September 27 to 29, 2006 to outline the concept and philosophy behind the SADC LVSR Guideline, including case studies, as a basis for knowledge sharing and possible application in the mentioned countries.
3. To participate in the RED course for consultants taking place in Accra September 25-26 and provide feedback about how the model can appreciate or incorporate the particulars for optional pavements.
4. Prepare a Workshop and field trip report

Presentations and materials can be provided in English, and handouts are to be provided to the participants.

Resources

The consultants, Mr. Mike I. Pinard and Mr. Charles Overby, are the two of the core team of authors of the SADC Guideline for Low Volume Sealed Roads presently available. Due to the in-depth knowledge behind the Guideline, they have been selected sole source to undertake the consultancy.

Total time input for each consultant will be:

(a) Preparation of workshop program	0.5 days
(b) Preparation of PP presentation	1.5 days
(c) Participation in workshop/Field trip	3 days
(d) Preparation of workshop/field trip report	3 days
(e) Participation in RED course	2 days
(f) Travel	<u>2 days</u>

Total each contract 12 days

Total both consultants 24 days

Timeframe and Reporting

The Consultants will arrive in Ghana on or about Sunday September 24, and will depart on or about Saturday September 30, 2006.

The deliverables are:

- (a) Review and revise as necessary the Draft Workshop Program
- (b) Preparation of PP Presentations for workshop
- (c) Preparation of a report summarizing the outcome of the workshop and the field visit
- (d) Come up with some recommendations as to how the RED Model can incorporate/appreciate optional pavements.

Accra, Ghana
SSATP/World Bank Workshop

Knowledge Sharing and Promotion of Appropriate Pavements and Bituminous Surface Treatment Technologies for Low-volume Roads

Day 1-Wednesday 27th September, 2006

08.00 – 08.30	REGISTRATION OF DELEGATES
08.30 – 12.30	MORNING SESSION
08.30 – 08.40	Opening Remarks <i>Olav Ellevset, SSATP/World Bank</i>
08.40 – 08.50	Welcome Address <i>Deputy Chief Executive Martin hMensa, Ghana Highway Authority</i>
08.50 – 10.15	New Approaches to Sustainable Provision of Low-volume Sealed Roads <i>Mike Pinard</i>
10.15 – 10.45	Coffee/Tea Break
10.45 – 12.00	Alternative Surfacing Technologies for Low-volume Sealed Roads + Case Studies <i>Charles Overby</i>
12.00 – 12.30	Discussion <i>All Participants</i>
12.30 – 14.00	Lunch
14.00 – 18.00	AFTERNOON SESSION
14.00 – 15.30	Alternative Materials and Pavement Design Technologies for Low-volume Sealed Roads + Case Studies <i>Mike Pinard</i>
1530 – 16.00	Tea/Coffee Break with A technical orientation and briefing about the project roads in Cape region by <i>Deputy Chief Executive Martin hMensa, GHA, and Charles Overby</i>
16.00 – 18.00	Technical visit to 50-years old seals and applications on roads at the University Area
18.00	Closure - Day 1

Day 2-Thursday 28th September, 2006

07.30 – 18.00	FIELD TRIP
07:30	Bus leaving from Golden Tulip Hotel for field trip to Twifo Hemang - Baakondzidzi Road Project in the Cape region.
12:00-13:00	Lunch at Hans' Cottage
18.00	<i>Back to Hotel in Accra</i>

Day 3-Friday 29th September, 2006

08.30 – 12.30	MORNING SESSION
08.30 – 09.00	Observations, questions and feed-back from field trip
09.00 – 09.15	Instructions to Working Group sessions
09.15 – 10.15	Working Group deliberations
10.15 – 10.45	Tea/Coffee Break
10.45 – 11.45	Working Group deliberations (continued)
11.45 – 12.30	Working Groups 1 & 2 – Feedback
12.30 – 14.00	Lunch
14.00 – 16.30	AFTERNOON SESSION
14.00 – 15.00	Discussion and Way forward <i>All participants</i>
15.00 – 15.45	Workshop resolution
15.45 – 16.15	Tea/Coffee Break
16.15 – 16.50	Workshop summary <i>Consultants</i>
16.50 – 17.00	Closing remarks <i>Minister of Transportation</i>
17.00	Closure Workshop

Program update September 20, 2006

REGISTRATION FORM

**WORKSHOP AND FIELD VISIT ON APPROPRIATE PAVEMENT AND BITUMINOUS
TREATMENT TECHNOLOGIES FOR LOW VOLUME ROADS (LVSR)
SEPTEMBER 27 – 29, 2006**

VENUE: GOLDEN TULIP HOTEL

NAME	RANK	ADDRESS	PHONE NO./E-MAIL
1. ESSONE NKOGE JEANPIERRE	Engineer	Eier-Etsher Group, Ouagadougou, B.Faso	Jp_essone@yahoo.com Cel:00.226.76.406191
2. CHARLES MENSAH	Assistant Engineer	Dept. of Urban Roads- Ghana	204-4753144 carlmens2000@yahoo.com
3. ABRAHAM DANQUAH	Assistant Engineer	Dept. of UrbanRoads- Ghana	0244270769 abrahamdanquah79@ yahoo.com
4. WILLIAM AGYEMANG	Research Officer	Building and Road Research Institute	0244-614727 waggingo@yahoo.com
5. IAN LUNT-BELL	Engineer	c/o DFR	771903
6. CUDJOE DARTEY	Principal Engineer	DFR, Ministries Accra	0244374053 cwardartey@yahoo.co.uk
7. DAVID AFOSAH-ANIM JNR	Assistant Engineer	DUR, Ministries Accra	024-4994836 david_aj48@yahoo.com
8. FRANCIS LAMBRAH	Asst. Engineer	DUR, Ministries Accra	0244219408 frangam2002@yahoo.com
9. MUNDU E. ROGSS	Director	Sierra Leone Roads Authority	0023276679741
10. DAVID K. FONNIE	Director	Sierra Leone Roads Authority	00232-76-603083 dkfonnie@yahoo.com
11. COLLINS DONKOR	Prin. Engineer	c/o GHA Accra	0242 686666 cdonkor@ufl.edu
12. ELIAMIN L. TENGA	Engineer	TANROADSDAR- ES-SALAAM	Tuga-eliamin@ yahoo.Co.uk
13. P. K. BLABOE	Road Area Manager	GHA – Cape Coast	0208197223
14. K. KORANKYI-ADJEI	Prin. Engineer	GHA	Korankye-adjei@ Highways.mrt.gov.gh
15. KWASI A. DARKO	Asst. Area. Eng.	DUR	Siisi00@yahoo.com
16. CHRISTIAN NTI	Project Manager	MMU II -GHA	cxnnti@yahoo.com

Annex C – Workshop Attendance List

17. JAMES ANAFI	Civil Engineer	M.D.C.	0244632646 delta040@yahoo.com
18. EMMANUEL YAW OSEI	Project Manager	MMU 1GHA	0243267983
19. SAMUEL MENSAH	Asst. Area. Eng.	DUR	0244261656 samtesano@yahoo.com
20. ALEXANDER AMEYAW	Civil Engineer	TB&P	0244372808 aaamoyaw@yahoo.com
21. FRANCIS HAMMOND	Regional Highway Director	GHA	0209041404 fk_hammond@yahoo.com
22. A.B.K NUHU	Regional Highway Director	GHA	02448381118 abknuhu@yahoo.co.uk
23. D.K. SINTIM-ABOAGYE	Dir. Of Materials	GHA	0208180597 dolittle@uk.com
24. DAVID O. ADONTENG	Dy. Director	NRSC	0242 2009265 doadonteng@yahoo.co.uk
25. MARTIN HMENSA	Deputy Chief Executive (Adm)	GHA	mhmensa@ highways.mrt.gov.gh
26. OLIVER BIGA	Area Engineer	Accra Metro RoadsDept.	0244127000
27. ROBERT K. QUAYE	Asst. Roads Engr.	Road Fund, MOT	papayequaye@yahoo.com
28. EMMANUEL PIREKU	RHD/NR	GHA	0208137237
29. ERNEST ARTHUR	RHD/UWR	GHA	0209080913 joojoarthur@yahoo.co.uk
30. BERNARD BADU	Principal Engineer	DFR	0208160530 bbadudfr@yahoo.com
31. S. SWANZY-BAFFOE	Dy. Chief Executive (DEV)	GHA	ssbaffoe@ highways.mrt.gov.gh
32. SAMUEL K. AHIAMADI	Lecturer	Civil Eng. Dept.	0244368787 skahiamadi@yahoo.com
33. FRANCIS K. AFUKAAR	Researcher	BRR	0244-434413 fkafukaar@yahoo.com
34. E.A.K. BOATENG	RHD/GAR	GHA	0243044285
35. PATRICK A. BEKOE	Asst. Engr.	DFR	0244531631 patrick-evrela@yahoo.com
36. BENEDICT B. BOATENG	Asst. Eng.	DFR	0244461003 boateng@yahoo.co.uk
37. SAMUEL Y. BANINI	Engineer	DFR	0244-118565
38. OLAV ELLEVSET	Senior Transport Specialist	SSATP / The World Bank	oellevset@worldbank.org

Annex C – Workshop Attendance List

39. CHARLES OVERBY	Consultant		Charles_overby@hotmail.com
40. E. DUNCAN-WILLIAMS	PE	DFR	0244 955725
41. FRANCIS O.M DIGBER	DY. DIRECTOR MTCE	DFR	020 8113062 digber3@yahoo.com
42. OLIVER BIGA	Area Engineer	Accra Metro Roads Dept.	0244 127000
43. DR. S.S.K. AMPADU	Senior Lecturer	KNUST	0208165506
44. MIKE PINARD	Consultant		mipnard@global.bw
45. S.M. TETTEH	Director of Training	Ghana HighwayAuthority	020 820 7577 smtetteh@yahoo.co.uk
46. JOYCE AGBEKA	Principal Training Officer	Ghana HighwayAuthority	0277 582242 joyagbeka@yahoo.com
47. LILA DAISY ASHONG	Training Officer(N.S.P)	Ghana Highway Authority	0244213491 lildainsy@hotmail.com
48. J. K. DANSO	Deputy Chief Exe.(Mtce)	Ghana Highway Authority	0244 376166 dansoalbino@yahoo.com

Alternative Bituminous Surface Treatments for Rural Feeder Roads in Ghana

THE OTTA SEAL

A short description of the pilot project Twifo Hemang – Baakondzidzi road

1 BACKGROUND

As part of the DFID support to Feeder Roads in Ghana selected short sections are intended to be sealed with a bituminous surface treatment. These road sections are highly stressed roads and a bituminous treatment will reduce the burden of maintenance owing to high traffic volumes and steep gradients and mitigate dust nuisance to the roadside settlements and the road users.



A feeder road only a year after being constructed as a gravel road, is this sustainable? Certainly NOT.

For the Twifo Hemang – Baakondzidzi road the contractors sources for chipping proved to be unacceptable owing to the costs of haulage and the total length to be sealed. An other type of surfacing that allow the use of lower quality aggregate, both crushed and uncrushed aggregate including dust is the Otta Seal. Natural occurring gravel can therefore be screened and used in the Otta Seal. Owing to the wider availability of natural gravel, the Otta Seal offer considerable potential savings in respect of the cost of extraction, mechanical processing and haulage of the aggregate.

It was on this background this demonstration project following the Otta Seal approach surfaced, and may in the future pioneering a more widespread introduction of the Otta Seal for sealing roads throughout Ghana.

2 DEMONSTRATION PROJECT

It was envisaged that a demonstration project using the Otta Seal approach was necessary to construct prior to consider a possible change in the common practice using primer seal as the first seal followed by a chip seal. The Twifo Hemang -

Baakondzidzi in the Coast Region road was selected as the demonstration site with the approach uses what is available if within economical hauling distance. In this case natural occurring gravel was available (decomposed granite and quartzite) although containing a fairly high fraction of fines (passing the 0,075mm about 10 - 15%) and with a PI of about 10.

The selected material was stockpiled by the use of a dozer and the oversize and to some extent some fines were screened out by using labours. Later a power screen arrived and a combination of labours and mechanical screening took place.

From the mid of August 2005 to mid 2006 10 km of Otta Seal were constructed at a width of 6,6m, including the shoulders. Because of rather frequent rainfall, the materials were difficult to screen due to the fairly high fines content and the clayey fractions and consequently clog the screens.

3 MATERIALS

Bitumen

Bitumen was brought to site by a supply truck with a volume of 16000 kg. The 150/200 penetration bitumen supplied was fluxed back by engine oil and other flux oil from a 80/100 pen. grade bitumen at the refinery. Test results provided by the bitumen supplier confirmed that the supplied bitumen was within the requirements for a 150/200 pen. grade. i.e. a penetration at 25⁰C of 172.

Power paraffin (kerosene)

Paraffin was first brought to site in 200 l drums and was used to cut back the 150/200 pen. grade to the required viscosity.

Aggregate

The aggregate stockpiled at the end of the road had been screened to remove oversize of the aggregate (>16mm) by labours. All this activity took place at the BP location, close to the turn off from the main road, and was later brought to site. The screened aggregate stockpiled at the end of the road was fairly clean, but did not follow the required grading envelope smoothly. The aggregate did in fact touch all the three grading envelopes “dense”, “medium” and “open” becoming to some extent instable. The fines content passing the 0.075mm sieve was between 2 - 12%. Although, not confirming fully to the grading requirement it was decided to use the aggregate due to the low traffic volume prevailing on this road – of the order of 50 – 60 vehicles per day.



Oversize aggregate was removed by labour based methods with a good results. At a later stage a vibrating screen took over this work as seen below.



Aggregate screening operations by removing the oversize aggregate were carried out at the BP area and a considerable quantity was stockpiled. However, the fines content passing the 0.075mm sieve was very high (about 17% before screening) and with a fairly high clay fraction causing a of clayey and dusty film covering the stone, and followed the “dense” grading envelope which is more appropriate for traffic levels above 1000 v.p.d. Some of this aggregate (high fines content) was used extensively as Otta seal aggregate.

Anti stripping Agent

The intention was from the beginning to use bitumen anti stripping agent due to the high fines content and partly moist aggregate. However, as the bitumen supplier was not able to supply the anti stripping agent the sealing work still progressed with a slightly higher proportion of power paraffin than planned in order to ensure adequate bond between the aggregate and bitumen during the maturation of the Otta seal.

4 EQUIPMENT

Bitumen Supply truck

The bitumen supply truck was not equipped with a gauge that measured the volume in the tank. The heating facilities seemed not to be sufficient as the bitumen distributor truck was not able to suck bitumen from the sucking hose in the bottom of the tank as the bitumen in the supply truck was too cold, although the temperature gauge showed a temperature of 120°C sufficient for pumping. Consequently, the bitumen had to be such from the top through the manhole. This process was rather time consuming and could have been hazardous from a safety point of view if not being attended to.

Bitumen Distributor truck

The bitumen distributor was leaking at several hose joints. The gauge showing the quantity in the tank was not working making the cutting back procedures inaccurate. However, the tank was filled up to the 7500 l mark after adding the required quantity of paraffin and then circulated the mixture for 1 hour before sealing operation started. The distributor was not equipped with a dip-stick to measure the volume in the tank which did not allow accurate design binder application.



The cutting back with power paraffin to the required viscosity range was done at site.

The bitumen application rate from the bitumen distributor was obtained by increasing or reducing the speed of the truck. A linear relationship where 1.4l/m² gave a speed of 3.5 as given by a formula. 1.6l/m² at a speed of 3.0, 1.8l/m² at a speed of 2.5, 2.0l/m² at a speed of 2.0 and 2.2l/m² at a speed of 1.8, respectively.

When spraying bitumen, the distributor operator normally follows the set out bitumen spray lines by using a rod with a chain fixed at the front of the truck. This rod is adjusted according to the first nozzle at the spray bar allowing for a straight and clean application of bitumen. This spray rod device was missing on the bitumen distributor truck which resulted in an untidy edge of the surfacing and an unsatisfactory overlaps for the longitudinal joints. Sometimes no overlap at all, some time too wide overlaps.

Chip spreaders

Two tipper trucks were provided and of which both were equipped with tail gate chip spreaders. They were in a satisfactory condition and the drivers operated the trucks satisfactory when reversing the truck during aggregate application. However, the aggregate spray width was maximum 2.4 m (controlled by the tailgate width), resulting in a maximum bitumen spray width of 2.2 m ensuring that the full width of sprayed bitumen was covered by aggregate and preventing the truck tires to run on uncovered bitumen. The maximum sealed road width obtained was therefore only 6.6 m combined with 3 longitudinal joints. This was 40 cm less than planned.

Brooming

There was no mechanical broom on site, however with the use of labours using hand brooms this was not a problem. However, this will depend largely on the number of people being employed.



Brooming of the base prior to sealing operations was done by the use of labours.

Watering

A water bowser truck was used to water the base prior to the sealing operations. The water sprays was satisfactory. At some occasions it was necessary to do the watering by labours using wheel barrows and buckets. However, this did not give a satisfactory and homogeneous watering of the base, and is not recommended.

Rollers

One steel roller and two pneumatic rollers were available. Because of the strong aggregate the steel roller was used extensively.

5 GENERAL SEALING OPERATIONS

The sealing width of about 6.60m was achieved spraying bitumen and aggregate in three runs each of about 2.2m in width. In general, the 150/200 pen. bitumen was cut back with 5 – 8% power paraffin) and applied at a hot spray rate of 1.90l/m². This is was close to the design spray rate of 1.80l/m². However, by eye one could see at a few locations that the spray rate was much higher and lower than the target spray rate of 1,90l/m². The weather conditions was in general good apart from some few light showers that could occur in the afternoon.

Preparing the Base for Sealing operations

The prepared base was in general in a satisfactory condition, apart from a few depressions and areas with some lamination. These areas were attended to improve the situation. The base was broomed by labours and this work was carried out satisfactory. However, a better management of the operation could easily been achieved by giving each labour a task, instead to allowing them to work in large groups.

The base was NOT primed prior to spraying bitumen for the Otta seal.

Setting out the Spray line

The setting out of the spray line was carried out by a designated team which placed larger stones at 5m intervals. As the width of the prepared base varied considerably, it was important to place the sealed road width in the middle of the road, avoiding large differences in unsealed shoulder width on either side of the road.

When setting out the overlap spray line for the next bitumen spray run, the loose aggregate was broomed back with about 40-50cm, this to avoid bitumen to be spread on the loose aggregate and causing large problems as by lamination. The rather wide brooming back was caused by the fact that the bitumen distributor truck did not have a spray road attached, making it difficult for the operator to follow a set line. The brooming back was carried out by the labours and worked quite well.

Spraying bitumen

Prior to spraying bitumen the spray nozzles and temperature of bitumen were checked. The spraying temperature of the bitumen was between 150 - 160°C. The spray nozzles were checked one by one and all together in special made trays prior to each “pull”. Paper was put in place where leakage were discovered to avoid bitumen to flow onto the base.



Spraying of bitumen with the use labours brooming back aggregate for the longitudinal joint immediately spraying the bitumen.

Papers were placed transversely for the full spraying width at each start and stopping point. As said earlier three ‘pulls’ were required to cover a surfaced width of 6.6m and a spray distance of 100m for each ‘pull’ was adhered to as this was close to the maximum average coverage for one tipper truck loaded full with aggregate. The start point for each ‘pulls’ were staggered with a few meters to avoid a full width of transverse joints at equal intervals.

Spreading aggregate and Back chipping

The spreading of the aggregate was carried out by reversing the tipper trucks that were guided by a tail gate operator. In general the spreading of the aggregate was satisfactory. However, an excess of aggregate had to be applied as the tail gate had to be open in full forcing the tipper trucks to reverse at a higher speed. By closing the tail gates more forced the tipper truck to travel at a lower speed and at this speed the tipper truck engines were not able to keep a constant revolution causing a non uniform speed of the trucks which resulted in uneven spreading of the aggregate. In places too little and in other places too much as humps, created a sort of a ‘wave’ pattern occurred



Spreading of the aggregate immediately after spraying the bitumen by the use of tail mounted chip spreaders. Notice the large amount of fines.

A back chipping team consisting of three wheel barrows and a loaded ‘backie’ together with people with shovels and brooms applied the aggregate where needed after the tipper trucks had past. This work did take too long and it also hampered the rolling process. Where back brooming had taken place for an overlap of 15cm the labours broomed back the aggregate immediately after spraying the bitumen and before the tipper trucks applied the aggregate. This worked very well and was carried out in less than a minute for a full ‘pull length’.

Rolling

The two pneumatic rollers and a steel roller were running continuously during the sealing operations and they continued the rolling process up to 6 pm, after the daily sealing operations had terminated. It can not be over emphasised that rolling is the most important operation in the Otta seal construction. To lower the traffic volume are, to more rolling is required, and vice versa. Also important is the checking of the aggregate application during the rolling process by ensuring that areas that have been exposed to bitumen coming up are covered by more aggregate.

The rolling should continue with the pneumatic rollers a week after completion of the work.



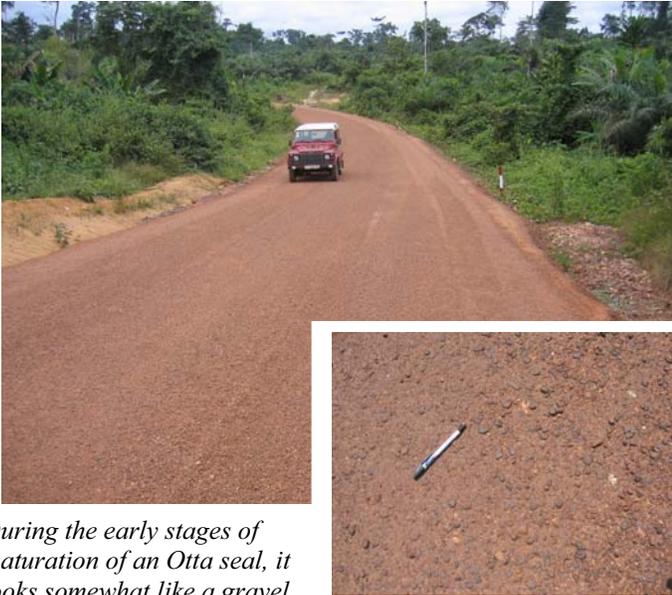
Rolling with pneumatic rollers is an essential part of the constructing the Otta seal. It is worth to notice that an Otta seal can never be rolled too much.

6 AFTER CARE

For the next following 8 weeks after sealing operations, the dislodged aggregate by traffic was broomed back and more rolling took place if deemed necessary. Areas that showed fatty up or bleeding additional aggregate was brought in and rolled. The broomed off aggregate (excessive aggregate) collected and reused for later sealing operations and did not to waste.



Excess aggregate is collected for later use in the sealing operations.



During the early stages of maturation of an Otta seal, it looks somewhat like a gravel Road. However, after 6 – 8 months the surface takes on the appearance of asphaltic concrete

7 PROBLEMS ENCOUNTERED

Beyond the control of the Contractor

a) Limited window for screening lateritic gravel. As dug material needs to be fairly dry to screen out excessive fines. Only 2 months per year (December and January) where monthly rainfall is less than 50mm. For 9 months of the year monthly rainfall is in the range 100 - 250mm. The severity of the problem increases with plasticity and a higher proportion of fines. Screened material needs to be covered with tarpaulins to keep it dry.

b) Considerable amounts of oversize material also needed to be screened out. Some oversize material was large enough to choke the aperture to the conveyor belt that feeds the vibratory screen. As a result, pre-screening by hand to remove oversize was necessary. The use of a ‘grizzly’ to screen out large particles of oversize material while loading the hopper by wheeled loader is therefore recommended.

The tanking up of the bitumen distributor (capacity 7500 liters) and heating on site took a considerable time as the supply truck where not able to heat the bitumen to much higher temperature than the minimum pumping temperature. Therefore considerable time was lost when the bitumen distributor heated the bitumen to spraying temperature, albeit the cutting back procedure took place at the same time. This limited the maximum amount possible to be sprayed to 1 bitumen distributor load per day. Owing to the relatively high spray rates for Otta seal the daily output (in terms of area sealed) was relatively low in comparison with conventional chip seals.

However, the main constraint to the sealing output was the availability of serviceable PTRs. Eventually 2№ 5t PTRs were obtained (less than the recommended rolling capacity) which were able to cope only as the bitumen distributor had to return periodically to the depot for replenishment.

Within the control of the Contractor

Impossible to calculate and calibrate spray rates as all measuring devices missing or broken (on both distributors). This prevented the accurate measurement of the actual amount of bitumen sprayed for payment purposes. Although at variance with the specifications, this problem is common when spraying conventional chip seals. Variations in spray rates and aggregate application rates do not appear to be as critical with Otta seals as in comparison to other surface treatments

Finishing of the base course layers by making the final pass of the grader entirely in cut seems to be beyond the scope of many contractors. There is a tendency to create scabs or laminations through spreading trimmed material in thin layers or in depressions and then finishing them off with a water bowser and roller. This (mal) practice is common when finishing the base course for conventional chip sealing. Consultants do not seem to be able to put a stop to it.

As the completed base course was left without sealing for a period of several months, rectification of surface defects in the base course before sealing certain sections was required. The preferred alternatives were to accept and seal in minor surface defects or, in the case of major defects (e.g., gullyng, corrugations, soft uncompacted spots, etc.) reprocess the whole layer by scarifying (adding base course material as necessary), watering, shaping and compacting over the full length of the affected section. As with finishing the base course site operatives tended to avoid full reprocessing of the affected layer in favour of the cosmetic treatment of the affected surface of the defect leading to the formation of scabs and laminations. Such practice is prevalent in repairing surface defects in the base course layer prior to conventional chip sealing.

Insufficient rolling of certain sections immediately following Otta seal construction were immediately apparent and pointed out to contractor who promised better future compliance.

Rectification of defects in the Otta seal after curing period were identified in certain locations, sections with no overlapping joint between adjacent strips, low spots, incorporation of occasional large oversize material. The preferred solution was to treat them as potholes and repair them by cutting out the defects to leave a square excavation with vertical sides, prime the exposed base and sides and fill with Otta seal aggregate mixed with hot bitumen in a drum mixer.

Feedback from Working Group Deliberations

Working Group I

Observations from Field visit

- 1 Road generally good, Otta seal performing satisfactory
- 2 Achievements goal
 - Dust control
 - All weather road
- 3 Conservation of maintenance
- 4 Road safety considerations
 - Road signs and road marking not in place
- 5 Non uniformity of the surfacing
 - excess of bitumen at transverse/longitudinal joints
- 6 The screened oversized aggregate should have been crushed and added to the screened aggregate
- 7 Where the other BP used apart from the surfacing BP?
- 8 Rejected material because of excessive fines?

Design and construction of the Otta seal

The design and construction of an Otta seal is both an art and science, however at present more an art (60/40).

With the construction of more trials one would accumulate experience.

Barriers and constraints

- 1 Funding of more trials may be a constraint
- 2 Acceptance by the technocrats, they must be taken on board
- 3 Lack of documentation and the need for a guideline
- 4 Education of both technocrats and communities
- 5 Relatively higher initial cost pavement of pavement compared to gravel option
- 6 Comparative cost for different seals (DSD/Otta seal)

The way forward

- 1 There should be more trial sections throughout the country
- 2 The sections should be monitored by the research unit
- 3 Allocation of funds for the Otta seal construction in the budget
- 4 Emphasis must be focused on education with regard to the Otta seal. Possible a film to be made.

Various items

- the use of 10 – 14 – 10 aggregate for primer seal and DSD versa 14 – 10 – 10 aggregate.
- Otta seal and other ST need adequate structural support from the pavement layers
- The pavement structure should be constructed to specifications
- The drainage should be adequate
- The sealed feeder roads should have sealed shoulders
- All sealed roads should have sealed shoulders
- What is the definition of a Low volume road?

Working Group II

Observations, comments and questions from Field visit

- In spite of the relatively high spray rate of bitumen, there were no signs of bleeding
- The construction joints as observed at some sections of the road was untidy, meaning that the workmanship should be improved
- The spread rate of the aggregate was not stated
- The road geometry need to be improved
- Some sections of the road was too narrow
- A cost comparison between the DSD and the Otta seal need to be carried out
- Skid resistance, should there be a speed limit for the Otta seal

2 The Otta seal is a combination of art and science

3 **Overcoming conventions**

- Convincing politicians and the public
- Enforcement of specifications
- Capacity of contractors in terms of equipment holding
- Acquisition of land
- Weather conditions
- Education and training

4 **Solutions to barriers**

Education:

- Transfer of knowledge. People with Otta seal knowledge should champion its course
- Research institutions should be involved
- There should be full scale trials on the roads
- The use of appropriate guidelines are available

Equipment:

- get local ITTV to develop a power screen in conjunction with KNUST

Specifications:

- Enforcement of workmanship, quality and specifications
- Application of appropriate technology outside the specifications
- Weather may be a constraint. Plan screening operations outside the wet season. Screened aggregate must be covered.

The way forward

- Compile data for possible sources of aggregate for Otta seal, grading, PI and quantity on regional basis
- The Otta seal technology should be applied in full scale. Enough trials has been done
- Politicians and leaders need to be encouraged to champion the change

Working Group III

Observations, comments and questions from Field visit

- 1 Preserving life of pavement by stopping water ingress. Stop deletion of gravel material.
- 2 Total life costs savings in road construction of LVSR
- 3 Environmental issues
 - reduction in dust nuisance
 - stop or reduce erosion of gravel roads
- 4 Traffic safety issues
 - geometric design, in particular the horizontal design is not appropriate
 - Introduction of road traffic signs is needed
- 5 Routine road Maintenance
 - the need for maintenance, i.e. grass cutting outside road pavement structure
- 6 Drainage
 - both cross and longitudinal drainage are adequately provided
- 7 local materials
 - optimum usage of local material, reducing the need for chipping
 - Fit for purpose approach as on this road has been achieved
- 8 Questions to Consultants
 - Relative cost (initial) difference between Otta seal and chip seal
- 9 Contractors performance
 - overlap of joints
 - Poor workmanship

Science or art

Combination of the two. Application of science based knowledge in material selection using the grading envelope and bitumen type and spray rate.

Art, based on experience from visual observations and experience.

Barriers and Constraints

- 1 Acceptance of the new technology by the citizen and consultants
- 2 Contractor capacity. Problem with local contractors with equipment, personnel and finances
- 3 Communication. The need for the Road Agency to inform, explain and obtain feedback from constituents on new technologies or projects in general
- 4 Education. All stakeholders need to be educated, although at various scenarios
- 5 Cost of projects. Initial cost of feeder road projects. Otta seal project may cost more initially and may therefore create competition for budget-allocation
- 6 Knowledge/documentation. Technology not readily available in standard engineering text books

Overcoming the barriers

- 1 Training and supervisory personnel and contractors
- 2 Education of stakeholders
- 3 Improve contractor capacity by equipment loans
- 4 Further research necessary for local setting

The way forward

- 1 The technology is feasible and should be applied to LVSR
- 2 Education of all stakeholders, politicians, engineering personnel and other beneficiaries
- 3 Pilot projects to be undertaken at many locations using appropriate technology, i.e. combination of machine based and LBM approaches
- 4 Enforcement of axle load restrictions
- 5 Road safety considerations
- 6 Improve contractor capacity
- 7 Donor acceptance of the new technology
- 8 Knowledge sharing

SPEECH DELIVERED BY HON. MAGNUS OPARE-ASAMOAH (MP), DEPUTY MINISTER OF TRANSPORTATION AT THE CLOSING SESSION OF WORKSHOP ON APPROPRIATE PAVEMENT & BITUMINOUS SURFACING FOR LOW-VOLUME ROADS ON FRIDAY 29TH SEPTEMBER 2006 AT GOLDEN TULIP HOTEL

Mr. Chairman,
Workshop Coordinators,
Acting Chief Executive of the Ghana Highway Authority,
Distinguished Participants,
Ladies and Gentlemen,

It is my pleasant duty to deliver the closing address to formally draw down the curtain on this three-day workshop that has been deliberating on the technologies and methods for utilization of local gravel materials for the sealing of low volume roads.

Mr. Chairman, I believe that the workshop has achieved its set aims of brainstorming on a more comprehensive and coherent approach to be adopted in the utilization of technologies and methods for sealing low volume roads with a focus on using locally available gravel.

Mr. Chairman, I believe that in view of the above aim, deliberations during the workshop might have been very practical and comprehensive. I am making this observation based on my study of the programme content of the workshop.

From the programme one could see that the workshop had discussed new approaches to sustainable provision of low-volume sealed roads, alternative technologies for surfacing materials, as well as pavement Designs. The workshop has also looked at the way Forward regarding the promotion of using locally available gravels for sealing low-volume roads. Participants have also undertaken a field trip to the Twifo Hemang - Baakondzidzi Road project in the Central Region.

Mr. Chairman,
It is noteworthy that this workshop has taken place in Ghana because the objectives as well as the innovations in road sealing technologies that the workshop sought to promote, are in line with those of my Ministry and for that matter, the Government of Ghana.

Mr. Chairman,
The Ministry of Transportation is quite supportive of the technologies for Low-volume roads owing to a number of reasons.

Mr. Chairman,
Ghana has a substantial length of unsurfaced, particularly gravel, roads and it is becoming increasingly difficult to sustain the service delivery of such roads. This is because unsurfaced roads impose a logistical, technical and financial burden on the national budget. Furthermore, it

requires the continuous use of a non-renewable resource (gravel) which is being seriously depleted in many countries and, in the process, is causing serious environmental problems.

Secondly, results of regional research initiated by the World Bank for example, indicated that the increased use of natural gravels to seal gravel roads is economically justified for roads that have less than 100 vehicles per day. This figure is in contrast to the previously recommended threshold values above 200 vehicles per day for Sub-Saharan Africa.

Furthermore, it is seen that failure to observe the optimal timing for sealing gravel roads can be very costly in terms of high transport costs, excessive maintenance burden and adverse socio-environmental effects. These provide a strong impetus for policy change and the adoption of alternative, cost-effective, surfacing strategies for gravel roads.

Mr. Chairman

The whole-life benefits of sealed roads include lower transport costs in terms of construction, maintenance and vehicle operating costs; increased social benefits more reliable access to schools, clinics, etc. reduced adverse environmental impacts and health and safety problems

The above benefits hinge critically on the ability of the responsible authority to maintain the sealed roads to the level of service for which they were designed. This requires provision of adequate, sustainable and timely funding for the sub-sector.

Mr. Chairman, Ladies and Gentlemen,

I believe that the spirit or rationale for this workshop calls for rethinking by policy-makers. This is because low-volume roads are important in that they impact significantly on the livelihoods of the majority of the population of many Sub-Saharan countries who live and work in rural areas where poverty levels are generally high. Low volume roads are also central to sustained socio-economic growth and development of rural areas, and as such a key component of poverty reduction strategies. It is therefore evident that new, and more appropriate approaches are now required for the provision of low-volume sealed roads if we are to improve road transport efficiency and attain its broader goals of socio-economic growth, development and poverty alleviation in rural areas.

Mr. Chairman,

This view is buttressed by the fact that traditional approaches to the provision of low-volume sealed roads have stemmed from technology and research carried out in Europe and the USA over 40 years ago in very different environments.

Our locally circumstances are usually very different in terms of climate, traffic, materials and road users. It is therefore not surprising that many of the imported approaches, designs and technologies are inappropriate for application in the Sub-Saharan region.

Mr. Chairman,

I am informed that the technology, research and knowledge about LVSRs have advanced significantly in Southern African countries and this supports the wisdom of adopting LVSR technologies in Ghana and the need to revise conventional approaches.

Unfortunately, however there has been little effective dissemination and adoption of the results of research carried out in the region. I am therefore pleased to note that this has triggered the need for an SADC Guideline on Low-volume Sealed Roads.

Mr. Chairman,

I understand that the Guideline is not a prescriptive document but, rather, provides guidance to users so as to ensure that well-considered decisions are made.

The Guideline also presents a major departure from traditional practice in all aspects of LVSR provision by examining procedures, practices and methods used in:

- (a) planning, appraisal and environment;
- (b) geometric design and road safety;
- (c) pavement design, materials and surfacing;
- (d) construction and drainage; and
- (e) maintenance.

There are a number of benefits to be derived from adopting the approaches for LVSRs advocated in the Guideline. Low Volume Sealed Roads are less expensive in economic terms to build and to maintain through the adoption of more appropriate, locally-derived technology and design/construction techniques that are better suited to local conditions. LVSRs also minimize adverse environmental impacts, particularly as regards the use of non-renewable resources (gravel).

Mr. Chairman,

Such roads also increase employment opportunities through the use of more appropriate technology, including the use of labour-based methods, where feasible; they improve road safety in all aspects of road provision; they take better account of the needs of all stakeholders, particularly the local communities served by these roads; and foster local road building and maintenance capacity through the greater use of small-scale, local contractors. Ultimately, LVSRs facilitate the longer-term goal of socio-economic growth, development and poverty alleviation in rural areas.

Mr. Chairman,

It is my hope that this workshop will generate the awareness and stimulate the dissemination of the knowledge required to make the benefits reach all stakeholders involved in the provision of sustainable roads in rural areas.

I also assure participants that the Ministry of Transportation will take a more critical look at the SADC Guidelines on LVSRs with a view of adopting and implementing it in Ghana.

The Ministry will also give its support to efforts to provide and publicize the technologies and methods for provision of LVSRs in Ghana as part of the strategies of facilitating government efforts at poverty alleviation and socio-economic development of our rural areas.

Mr. Chairman,

As I indicated at the beginning of my address, this approach falls in line with our objective of providing cost effective and sustainable road surfacing technology for roads in rural areas.

Mr. Chairman, Ladies and Gentlemen,

You have definitely had a fruitful workshop and I could sense the eagerness with which you want to promote and implement this technology for LVSRs in Ghana and in your home countries. We in Ghana will do our best to make your dreams and expectations become realities.

Mr. Chairman,

I wish safe journey to those of you who will be traveling back to other participating countries such as Nigeria, The Gambia, Sierra Leone and Liberia.

On that note I hereby formally declare this workshop closed.

Thank you very much for your attention.