



AfCAP
Africa Community Access Partnership



AFCAP Representation at the 11th TRB Low Volume Roads Conference 2015

Final Report



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Abstract

The report summarises the observations and comments of the AfCAP delegation to the 11th TRB International Conference on Low-Volume Roads, held on 12-15 July 2015 in Pittsburgh, United States of America. A delegation of eight researchers and two members of the ReCAP Project Management Unit participated in the conference, which featured six AFCAP papers. The objectives of the AfCAP participation were largely met. It was clear from the conference that commonalities and discrepancies exist in the views and approaches to provision of LVR, particularly between the US and developing countries. Recommendations following AFCAP participation in the conference focus on strengthening links with institutes and programmes in Latin America and other developing countries.

Key words

Low-volume roads; road research; research uptake; knowledge dissemination; sustainable maintenance; climate resilient infrastructure.

AFRICA COMMUNITY ACCESS PARTNERSHIP (AFCAP)

Safe and sustainable transport for rural communities

AFCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable rural access for all people in Africa and Asia. The AFCAP partnership supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. The AFCAP programme is managed by Cardno Emerging Markets (UK) Ltd.

See www.afcap.org

Acknowledgements

This report is based on the observations and comments of all AfCAP funded delegates to the 11th TRB Low Volume Roads conference.

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Acronyms

AfCAP	Africa Community Access Partnership
DCP	Dynamic Cone Penetrometer
GRS	Geo-synthetic Reinforced Soil
GVM	Gross Vehicle Mass
GWC	Gravel Wearing Course
IBR	Integrated Bridge System
LVR	Low -Volume Roads
TRB	Transportation Research Board
ReCAP	Research for Community Access Partnership
UKAid	United Kingdom Aid (Department for International Development, UK)

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1 Executive summary

The report summarises the observations and comments of the AfCAP delegation to the 11th TRB International Conference on Low-Volume Roads, held on 12-15 July 2015 in Pittsburgh, United States of America. The conference is organised every four years by the Low-Volume Roads Committee of the Transportation Research Board (TRB).

A delegation of eight researchers and two members of the ReCAP Project Management Unit participated in the conference. The conference comprised four pre-conference workshops, two plenary sessions, three parallel streams of technical sessions, six interactive round table discussions and two field trips, as well as two networking events. Six research papers on AfCAP funded rural roads research were featured in the conference programme. Furthermore AfCAP was participating in the accompanying exhibition.

The objectives of the AfCAP participation were largely met and included:

1. To support Africa-based researchers in developing their capacity to effectively disseminate their research, to prepare conference papers and present them to an international audience;
2. To expose Africa-based researchers to an international audience of research peers, have them interact to exchange knowledge and experience and enable them to build their personal professional networks;
3. To raise the profile of and awareness about the research undertaken in AFCAP Phase 1 and share lessons learned.
4. Draw lessons from LVR research carried out in other parts of the world with a view to learn appropriate lessons that enhance effectiveness of AFCAP research.

It was clear from the conference that commonalities and discrepancies exist in the views and approaches to provision of LVR, particularly between the US and developing countries. The key commonality concerned the objective of environmental sustainability; the discrepancies included the definition of low-volume roads, the volume of non-motorised transport on low-volume roads, the approach to pavement serviceability and the allocation of roles between road agencies and universities in LVR research.

Recommendations following the AFCAP participation in the conference include: 1) more proactive involvement of the ReCAP management unit to influence the conference programme; 2) setting up international study tours and exchange with Latin American countries with similar soil, climate and development levels as in Sub-Saharan Africa; 3) identifying and establishing partnerships with “twin” institutes in Latin America, and 4) the formulation of an effective strategy for the involvement of universities in applied research projects funded through the Partnership.

2 Background

2.1 About the TRB LVR Conference

Every four years, the Transportation Research Board (TRB) holds an International Conference on Low-Volume Roads (LVR). The LVR conference is convened by TRB's Committee on Low Volume Roads and features the latest information about low-volume road management, design, construction, safety, maintenance and other related topics.

The 11th edition of the conference took place from 12-15 July 2015 in Pittsburgh, Pennsylvania, United States of America. It was attended by some 260 delegates, of which approximately 75% were US delegates and 25% international delegates. The conference was accompanied by a 2-day exhibition of organisations active in the low volume roads domain.

The Africa Community Access Partnership (AfCAP) was present with the following delegation:

Name	Organisation	Country
Endale, Alemayehu	Ethiopian Roads Authority	Ethiopia
Geddes, Robert	Independent consultant	Zimbabwe
Juma, Salehe	Tanzania National Roads Agency (TANROADS)	Tanzania
Kelly, Kieran	MottMacdonald	United Kingdom
Leta, Nkululeko	ReCAP Project Management Unit	South Africa
Mukandila, Estime	Aurecon	South Africa
Otto, Andrew	Transport Research Laboratory (TRL)	United Kingdom
Paige Green, Phil	Independent consultant	South Africa
Pinard, Mike	Independent consultant	Botswana
Visser, Caroline	ReCAP Project Management Unit	Switzerland

AfCAP had a total of six papers presented at the conference and included in the official proceedings. Furthermore the Partnership was present with a table-top exhibition stand at the conference. Details about the AfCAP representation are provided in chapter 3.

2.2 Conference programme

The full conference programme included four pre-conference workshops, two plenary sessions, three parallel streams of technical sessions, six interactive round table discussions and two field trips, as well as two networking events. The full LVR conference programme is attached in Annex I.

2.2.1 Pre-conference workshops 12 July 2015

A pre-conference programme of four workshops was organised on Sunday 12th of July.

An important topic throughout the conference was environmental sustainability. A dedicated workshop addressed “Sustainability in Low Volume Road Infrastructure Projects: Climatic Issues, Resiliency, Carbon Footprint and Life-Cycle Cost Analysis”, focusing on material use to minimise environmental impacts. A highlight of the workshop was a presentation by Dr Dipanjan Basu of the University of Waterloo, Canada, entitled **Sustainability with Focus on Low-Volume Roads and Civil Engineering Applications**. Dr Basu gave an introductory presentation on the concept of sustainability, the technical concepts underlying sustainability and the application of sustainability in the civil engineering domain, among other topics. The author has been invited to write a blog for ReCAP on the topic of sustainability for low volume roads in developing countries.

Highlights of the workshop on Socioeconomic Issues Related to Low-Volume Roads were:

- A presentation by Gordon Keller of Genesee Geotechnical, United States, entitled **Diverse Benefits and Impacts of Low-Volume Roads in Developing Countries**. Based on his many experiences, the author illustrated the need for preserving the LVR asset values through good planning, investigations, design, construction and maintenance.
- A presentation by Mr Ken Skorseth of South Dakota State University, United States, entitled **Reversion of Paved Surfaces to Unpaved Surfaces**. For economic and technical sustainability purposes, a number of low-volume roads in the US are reverted from being paved to unpaved (aggregate surfacing). The presentation addressed the technical issues related to the reversion and pointed to the (political) sensitivity of the topic with local inhabitants who are impacted by it.

During the workshop on Environmentally Sensitive Maintenance of Low-Volume Roads, the presentation by Dave Creamer of Penn State University, United States, addressed environmentally sensitive maintenance practices that are summarised in a booklet available on the USDA Forest Service website: “[Environmentally Sensitive Road Maintenance Practices for Dirt and Gravel Roads](#)”. The presentation addressed unconventional approaches of dealing with drainage problems that affect low-volume roads. Most of the solutions addressed seem applicable under African conditions. The booklet can be found on the AFCAP website under Resources: <http://afcap.org/SitePages/Resources.aspx>.

2.2.2 Highlights from the main conference programme

Presentation highlights of particular interest for Sub-Saharan Africa during the conference programme included (in order of presentation):

- *Rethinking Rural Road Infrastructure Delivery: Case Study of a Green, Inclusive and Cost-Effective Road Program in Nicaragua*, S. Muzira, D. Hernandez de Diaz etc World Bank.
- *Design and Construction of Welded Wire Retaining Walls in the Siuslaw and Willamette National Forests*, Pete Bolander, USDA Forest Service.
- Interesting work is being undertaken related to quantifying the sediment quantities in runoff from gravel roads, like the paper on *Sediment Production from Unpaved Oil Well Access Roads in the Allegheny National Forest*, by Steve Bloser et al of PennState University, US. This has significant impacts on watercourses and on the health of these ecosystems.
- *Limitations of Using Conventional Unpaved Road Specifications for Understanding Unpaved Road Performance*, by D. Jones and P. Paige-Green

- Research on junction improvement in Idaho (*Safety Evaluations for Skewed Intersections on Low-Volume Roads: Case Study*) by CS Bhaskar, M Khanal and D Harelson of Idaho Department of Transport, showed that there is a very high cost-benefit ratio for investments in good signage.
- The presentation on *Evaluation of the Effect of Rural Road Condition on Agricultural Produce Transportation* (“Tomatoes in the Engineering Laboratory”), by Prof. Wynand Jacobus van de Merwe Steyn, University of Pretoria, South Africa, et al. clearly showed the relevance to the work that has been/can be carried out under AFCAP. The 'first mile' project was cited as particularly relevant and one that could be taken forward along similar lines.

2.2.3 Field trips

Two field trips were organised in the framework of the conference.

Field Trip: Environmentally Sensitive Maintenance for Low Volume Roads

Tuesday 13 July

Pennsylvania’s Dirt, Gravel, and Low-Volume Road Maintenance Program focuses on projects designed to create a more environmentally and economically sustainable low-volume road system. The field trip stops on paved and unpaved roads showed examples of the “Environmentally Sensitive Maintenance Practices” used, such as inlet/outlet protection; base improvements; French Mattresses; innovative drainage outlets; vegetation management; asphalt and/or unbound surface aggregate placement.



Rainfall simulator



Geo-synthetic Reinforced Soil (GRS) Integrated Bridge System (IBS)

The field trip comprised a visit to four technology demonstration sites including:

- **Geo-synthetic Reinforced Soil (GRS) Integrated Bridge System (IBS)**, showcasing the use of alternating layers of compacted granular fill material and fabric sheets of geotextile reinforcement. It was reported that the bridge cost just under \$300,000.00 to build and most delegates considered the cost to be excessive and not sustainable.
- **Bank stabilisation practices** to prevent slide, including GRS walls and two different generations of soil pinning;
- A **rainfall simulator**, used for measuring sediment loss from gravel roads during rain under controlled conditions;
- Dust quantification research through the use of an **aerosol monitoring device** to measure the effectiveness in reducing dust of three different commercially available dust control products.

Post-Conference Field Trip: Heavy Hauling Effects on Public Low-Volume Roads from Unconventional Gas Extraction

Thursday 16 July

Pennsylvania has 62 licensed operators who have drilled over 7,000 wells since the Marcellus and Utica shale gas plays began in 2008. This industry needs extensive heavy hauling of materials and water on public roads to get to remote well pads for hydro-fracturing. This field trip visited sites in Pittsburgh's neighbouring counties to see the negative road and environmental impacts as well as successfully remediated road sites on the State's public low-volume road system.

The visit centred on highlighting the manner of dealing with heavy hauling trucks servicing the gas fracking operations that have provided a much needed boost to the economy of Pittsburgh and the surrounding counties. Any truck with a Gross Vehicle Mass (GVM) >10 tonnes is required to post a bond, the amount of which is related to their actual GVM. The bond is then used by the Pennsylvania Department of Transport for the upgrading and maintenance of the roads used by these vehicles. This may provide some insights into how the issue of overloaded timber trucks on some of our roads in the African context can be dealt with.



Shale gas well access road



Heavy trucks involved in gas extraction operation

2.2.4 Exhibition

The exhibition included the following organisations active in the domain of low-volume roads (in alphabetical order):

- AFCAP
- Big R Bridge
- Center for Dirt and Gravel Road Studies, Penn State University
- Dynatest Consulting Inc.
- Federal Highway Administration
- GeoStabilization International
- Gregory Industries, Inc.
- Harman Products, LP
- IronWolf Manufacturing, LLC
- JAMAR Technologies, Inc.
- MetroCount Inc.
- Midwest Industrial Supply, Inc.
- Road Dust Institute
- Softree Technical Systems, Inc.
- TenCate Geosynthetics Americas
- USDA Forest Service

The larger share of the exhibitors consisted of technology and solution providers.

3 AFCAP Representation

3.1 Objectives of AFCAP representation at the 11th TRB LVR conference

In line with its capacity building and knowledge management strategies, ReCAP supports Africa- and Asia based researchers to present their research at international events of high standing.

Objectives of AFCAP representation at the 11th TRB Low Volume Roads conference were:

1. To support Africa-based researchers in developing their capacity to effectively disseminate their research, to prepare conference papers and present them to an international audience;
2. To expose Africa-based researchers to an international audience of research peers, have them interact to exchange knowledge and experience and enable them to build their personal professional networks;
3. To raise the profile of and awareness about the research undertaken in AFCAP Phase 1 and share lessons learned.
4. Draw lessons from LVR research carried out in other parts of the world with a view to learn appropriate lessons that enhance effectiveness of AFCAP research.

3.2 Paper presentations

The AFCAP-supported delegates were carefully selected to ensure an equitable mix of experienced practitioners and researchers (3no) and younger researchers (6no). The young researchers were co-authors to the various papers, prepared the PowerPoint presentations and presented during the conference sessions. At the end of the conference, the young researchers had to prepare reports, which were then reviewed by the senior researchers. This is in line with AFCAP objectives of mentoring and building capacity of the young researchers to ensure sustainability in the long term.

The following AfCAP presentations were scheduled in the conference programme:

Session	Presentation
Design	Environmentally Optimized Design for Low Volume District Roads in Tanzania <i>Authors: Salehe Juma, Kieran Kelly</i>
Geotechnical Engineering 1	New Approach for Upgrading Gravel Roads to a Low-Volume Sealed Standard Based on the Dynamic Cone Penetrometer. <i>Authors: Michael Pinard, Philip Paige-Green, Estime Mukandila, Jon Hongve</i>
Pavements 1	Method for Increasing the Use of Locally Available Materials for Road Construction in Ethiopia <i>Authors: Andrew Otto, P.A.K. Greening, Alemayehu Endale</i>
Pavements	Local Resource Solutions to Problematic Rural Road Access in Laos <i>Authors: Kieran Kelly, Simon Gillett, James Mitchell</i>

Materials and Pavements 1	Low Volume Roads with Neat Sand Bases <i>Authors: Philip Page-Green, Michael Pinard</i>
Materials and Pavements 2	A Route from Research into Practice: Outcomes of the Africa Community Access Programme Phase 1 <i>Authors: Nkululeko Leta, Rob Geddes</i>

There was a lot of interest shown in the AFCAP presentations by delegates from other developing countries such as Chile, Guyana and Nicaragua but the feedback from the US participants was rather lacklustre. The presence of the AFCAP stand at the exhibitions, however, did allow the speakers to direct interested parties to the exhibit for discussions and to gain access to the useful information and reports being made available.

AFCAP delegates also felt that in terms of appropriate and cost-effective pavement design and use of materials, AFCAP approaches were way ahead of those applied in the US context.

3.3 Exhibition stand

The table-top exhibition included the following materials:

- General AFCAP/ASCAP poster;
- Poster showing headline contents of the Tanzania Low Volume Road Manual;
- Screen displaying the AfCAP presentations scheduled in the conference including some introductory slides about the Partnership;
- Materials for delegates to take away:
 - o General AFCAP leaflet
 - o SloCat Factsheet on Rural Transport and the Sustainable Development Goals
 - o AFCAP/ASCAP USB-key with key outputs of the programme (standards, guidelines, reports)
 - o Printout with an overview of the AfCAP presentations scheduled in the conference including session and timing.

Delegates had the opportunity to leave their business cards/contact details in order to be included in the Community of Practice.

4 Knowledge acquired

4.1 Assessment of AFCAP knowledge in comparison with international expertise in LVR

The TRB conference offered a good opportunity to gain insights on the position of AFCAP knowledge and research on low-volume roads in the international context. A number of commonalities and discrepancies in views and approaches were noted by the delegation.

4.1.1 Commonalities

In general there is a common worldwide focus on the need for **environmental sustainability** in the construction and maintenance of low-volume roads. A number of sessions in the conference were dedicated to this topic, addressing sustainability principles in civil engineering, but also looking into more practical issues such as the use of local resources for road pavement.

4.1.2 Differences

What was clear over the conference is that **different views and definitions of low-volume roads** are in use internationally; no universally accepted definition of LVR exists. From the various US presentations, it appeared that definitions were used referring to traffic levels ranging from 50 to 5000 vehicles per day, without reference to traffic loading. The latter is a key reference for the definition and design of low-volume roads in Sub-Saharan Africa. AFCAP has gone further to define additional characteristics of LVR in the African context.

Low volume roads in the US tend to have very little **non-motorised transport** on them, which is an essential difference with the Sub-Saharan Africa context and other developing countries.

Furthermore the US approach to **pavement serviceability** is different to those in Sub-Saharan Africa in the sense that many low-volume roads in the US are asphalt paved whereas thin bituminous surfacing is the norm in Africa. An interesting trend observed in the US is the **reversion of asphalted roads to aggregate surfacing** for economic (maintenance costs) and environmental sustainability reasons. Using environmentally optimised design, as researched under AFCAP, might actually offer more benefits. However the concept seemed not to be commonly known and used in the US.

Use of **dust palliatives and chemical stabilisation** in gravel roads. Unlike in Africa where a proliferation of relatively unknown and untested soil stabilisers, the US has a systematic approach to assessing all the stabilisers through exhaustive testing in the field and laboratory before approving for wider application. This includes fit-for-purpose certification, product performance guarantees, performance or warranty specifications and maintenance contracts in which the risk is taken by the manufacturer or distributor.

The Associate Dean of Engineering and Academics & Extension at South Dakota State University expressed keen interest after the **Dynamic Cone Penetrometer (DCP)** presentation and mentioned that his students were looking at the DCP for design purposes and were keen to learn what developments had taken place under AFCAP.

In the US, **research on LVR is led by universities** on behalf of road agencies, whilst in Africa the road agencies lead with universities taking a low-key role. AFCAP intends to increase the involvement of universities on applied research projects.

4.1.3 Innovative character of AFCAP funded research

It was felt by the AFCAP delegation that AFCAP funded research on low volume roads, and particularly the research addressing pavement design and materials use, is advanced and cutting-edge internationally. Examples are the AFCAP research papers on *Method for Increasing the Use of Locally Available Materials for Road Construction in Ethiopia* (A. Otto, A. Endale, P. Greening) and *Low Volume Roads with Neat Sand Bases* (P. Paige-Green, M. Pinard).

4.2 Lessons learnt and research suggestions

Intercontinental study tours:

- ReCAP to support study tours by practitioners to Latin America (Brazil, Chile) to explore areas of common interest and share research outputs. It is interesting to note that the specifications for use of laterites in road pavements in Brazil were developed based on experiences in Angola and Mozambique and yet laterites have not been used to their fullest extent in the upper pavement layers in Africa largely due to lack of awareness of these more appropriate specifications!

Strong linkage between Infrastructure Research and Transport Services:

- The study conducted by Prof Wynand on tomatoes has the potential to be used as part of an influencing strategy for increasing funding to road maintenance because it clearly shows the link between road condition, economic development and rural livelihoods. It is also the type of research that could very usefully be supported by AFCAP because it bridges the two AFCAP components of road engineering and transport services. There are opportunities to explore further the '1st mile' study conducted with AFCAP-support in Kenya and also to extend the research to African countries and to involve local universities.

Knowledge management:

- Establishment of a ReCAP international roster of experts on low-volume roads, to expand the base of suppliers.
- Use of research outcomes to develop impact stories, advocacy and lobbying material for maintenance funding (e.g. tomatoes presentation)

Other important lessons learnt include:

- Good practice measures for achieving environmentally-sensitive maintenance of LVRs;
- Good practice measures for adapting to climate change;
- The importance of using appropriate criteria for selecting gravel wearing course (GWC) materials;
- Importance of measurement and control of sediment loss from gravel and earth roads during rain. Effect of sediment on water quality downstream.

4.3 Useful contacts

Contacts were established with the TRB Secretariat on the topic of access to TRB publications for the ReCAP Community of Practice (discussions ongoing). Various US- and Canada-based universities were represented at the conference, as well as research institutes and universities from Latin America and other developing countries. A number of private industry representatives were presenting papers and/or exhibiting, some showcasing interesting solutions that could well work in the African context.

4.4 Recommendations

- More pro-active involvement of ReCAP management to influence TRB conference programme in the same manner, as done in African events such T2, CAPSA 2015 and others. The scattered manner in which AFCAP presentations were programmed meant that the impact was not as strong as it could have been with a more focussed AFCAP LVR speciality session or workshop. For example, the general AFCAP presentation should have been made in plenary at the beginning of the conference to set the scene for the other presentations. Instead it was only made towards the end of the conference when attendance was starting to thin out.
- ReCAP to arrange Intercontinental study tours to countries such as Brazil and Chile where there are similarities in soils, climate and level of development in LVR technology.
- ReCAP to identify and establish partnerships with 'twin' research institutions/organisations in Latin America. Support to attendance in appropriate conferences in both continents by practitioners and young researchers to be explored by ReCAP.
- ReCAP to formulate an effective strategy for the involvement of universities in applied research projects funded through the Partnership. The road agencies will continue to lead the process as 'owners' of the infrastructure in the foreseeable future.

4.5 Conclusions

The authors of the report believe the objectives of the participation of the AFCAP-supported delegates have largely been met. This is mainly based on the observations during the conference and reports from the delegates themselves. The key is now to learn the right lessons and implement the recommendations and research suggestions that enhance attainment of the broader AFCAP objectives.

AFCAP support will continue to target young African researchers to carry out research in a scientifically vigorous manner; prepare research papers and present them at international fora. The ratio of young researchers to seniors will progressively increase with time to ensure that transfer of skills and capacity building efforts continue to yield positive results on an incremental basis.

One of the disappointing features of the conference was the lack of discussion and questions following the majority of presentations. Although time was usually sufficient, little in the way of constructive criticism or additional information was contributed. This is not unusual, however, for such conferences.

Annex I: Programme of the 11th TRB International LVR Conference, 12-16 July 2015

SUNDAY 12 JULY 2015

Time	Session(s)	
9.00AM	Manage Safety and Risk on Energy-Impacted Local Roads Now or Testify in Court Later	Sustainability in Low-Volume Road Infrastructure Projects: Climatic Issues, Resiliency, Carbon Footprint and Life-Cycle Cost Analysis
1200AM	Lunch	
1.30PM	Socioeconomic Issues Related to Low-Volume Roads	Environmentally Sensitive Maintenance of Low-Volume Roads
5.30PM	Exhibits and Welcome Reception	

MONDAY 13 JULY 2015

Time	Session(s)		
8.00AM	Opening Session		
9.45AM	Break and Exhibits		
10.15AM	Construction	Geotechnical Engineering 1	Design
12.00AM	Lunch		
1.30PM	Pavement Maintenance 1	Geosynthetics	Pavements 1
3.15PM	Break		
3.45PM	Environment	Stabilization 1	Safety 1

TUESDAY 14 JULY 2015

Time	Session(s)
8.00AM	Current Issues Facing Low-Volume Road Managers
	<p>Part 1: Adaptations to Climate Change and Local Issues Related to Low-Volume Roads:</p> <ul style="list-style-type: none"> • Table 1: Climatic Change, Reduction of Vulnerability of Roads and Climate Resilient Roads • Table 2: Impact of Freeze-Thaw Cycles, Differential Frost Heave, and Permafrost Thawing on Pave and Unpaved Roads • Table 3: Dust Control Material Selection, Impacts and Funding Sources

	<p>Part 2: Adaptations to Climate Change and Tribal Issues Related to Low-Volume Roads:</p> <ul style="list-style-type: none"> • Table 4: Flooding and the Impacts of Rising Sea Level on Low-Volume Roads Infrastructure • Table 5: Changes in Maintenance, Winter Maintenance Practices, and Avalanches Related to Extreme Weather Events • Table 6: Local and Tribal Road Design Models, Funding Sources
10.00AM	Break
10.15AM	Managing Low-Volume Roads in the States
12.00AM	Lunch
1.00PM	Field Trip: Environmentally Sensitive Maintenance for Low-Volume Roads

WEDNESDAY 15 JULY 2015

Time	Session(s)		
8.00AM	Pavement Maintenance 2	Safety 2	Stabilization 2
9.45AM	Break		
10.15AM	Geotechnical Engineering 2	Pavements 2	Traffic Engineering
12.00AM	Lunch		
1.30PM	Heavy Load	Materials and Pavements 1	Safety 3
3.15PM	Break		
3.45PM	Freeze-Thaw	Materials and Pavements 2	Safety 4
6.00PM	Reception and Dinner		

THURSDAY 16 JULY 2015

Post-conference Field Trip: Heavy Hauling Effects on Public Low-Volume Roads from Unconventional Gas Extraction

Annex II: AfCAP Delegates' Reports

Report Alemayehu Endale:

Report on 11th TRB Conference on Low Volume Roads

The conference was carried out in Pittsburgh, Pennsylvania, USA from 12 to 17th of July 2015. I have attended the conference from start to end and participated in the field trip also. It was an excellent conference and I have gained knowledge and experience from those who have presented papers and from participants through discussions during social activity sessions and field visits. Though the level of low volume roads research is different from my experience in Ethiopia from view point of priority and strategy, it is observed that we have to work very hard to improve the delivery of low volume roads as well as making them sustainable through research and technology transfer.

On this conference I and my colleague Mr. Andrew Otto have presented the paper on "A METHODOLOGY FOR INCREASING THE USE OF LOCALLY AVAILABLE MATERIALS FOR ROAD CONSTRUCTION IN ETHIOPIA BY ALLOWING FOR CLIMATIC VARIATIONS". From feedbacks we obtained after the presentation, the paper was well taken and has contributed to the existing knowledge. I have also noted that this study can further be replicated on more material types and a better conclusion can be made.

I have participated in more relevant topics of presentations in the breakaways sessions. All of those presentations I have attended are high quality and educational. It was an opportunity in which many ideas for future study are obtained from each of the discussion sessions. The exhibition stands and field visits have showed what is available to support research in low volume roads including equipment and systems. In general the conference was excellent and educational.

I believe AFCAP was well represented in the conference through paper presentation and number of attendees. This very important in dissemination of information on what is happening in Africa in terms of road research and the effort AFCAP is making in promoting the same.

Finally, I would like to thank AFCAP for giving me this opportunity to travel and participate in the conference. The support obtained to present the paper on this conference is highly appreciated. I would also like to thank my employer, Ethiopian Roads Authority for allowing me to participate in this conference. Arrangements for travel, accommodation and other logistics were fantastic as always and my regards goes to all AFCAP management members who have organized this trip for us. It is very important that AFCAP supporting researchers to present their papers in such highly regarded conferences and this will motivates other to take part in the effort to research and development works to improve the way things are done currently.

Best Regards,

Alemayehu Ayele,
Research and Development Director
Ethiopian Roads Authority

Report Rob Geddes:

**Report on Attendance at 11th International Conference on Low-Volume Roads
12th to 15th July 2015
Pittsburgh, Pennsylvania**

1. Conference Paper - Route from Research into Practice: Outcomes of the Africa Community Access Programme Phase 1

Rob Geddes attended the conference as a member of the AFCAP delegation and as co-author with Nkululeko Leta of the paper titled "Route from Research into Practice: Outcomes of the Africa Community Access Programme Phase 1". This paper was accepted by the conference organisers for inclusion in the conference proceedings. The paper was presented by N Leta. R Geddes assisted with the writing of the paper and preparation of the PowerPoint presentation.

The programme slot for the paper presentation was in the final session on the last day of the conference. As a result attendance at the session was disappointing, and although an opportunity was provided to publicise AFCAP and its achievements, there would have been far greater impact if the presentation had been included in an earlier technical session or (preferably) the plenary session on the first day. A few questions and comments were made by members of the audience following the presentation.

2. Other Technical Sessions

The following is a summary of highlights from other technical presentations and site visits, which may be relevant to AFCAP and the provision of low volume roads in Africa.

Rainfall simulator

The rainfall simulator was demonstrated during one of the site visits. It was also discussed in one of the technical presentations (SM Blosser and T Ziegler). The device (see photograph below) enables a controlled amount of water to be applied to a road in order to simulate rainfall. In the research example given in the paper and demonstrated on site it was being used to measure the sediment loss from gravel roads during rain. Controlling sediment is important because it affects water quality downstream and may therefore affect aquatic animals in forest areas.

An interesting finding of the research is that the amount of sediment lost increases significantly if there is traffic on the road when the road is wet. Other research presented at the conference (M Aust, M Bolding and SM Barrett) found that sediment erosion from earth roads was up to seven times worse than on gravel roads.

In the African context the loss of fines from earth and gravel roads is insignificant compared with the loss of soil from farm land use to poor land use practices. However the rainfall simulator may have an application under AFCAP in the development of the DCP design method, particularly for gravel roads. It is possible to simulate, at relatively low cost and at any time of the year, the worst case scenario of soaked conditions.



Figure 1: Demonstration of Rainfall Simulator

Soil Stabilisers and Dust Suppressants

There were several papers presented on soil stabilisers and dust suppressants. Of particular note was research carried out on three commercially available dust control products (B Kunz and E Little). Measurements were taken on road sections treated with the three products using a DustTrak DRX aerosol monitor. This device uses a laser photometer to measure particulate matter in several size ranges simultaneously. It was demonstrated during the field visit. The research found that all three products were effective in reducing dust for a period of year after application, and the leachate did not affect fish life in downstream water bodies.

In the Africa context it is probably too expensive to apply dust control products on gravel and earth roads as a routine maintenance activity. However, it is important to seek ways of reducing dust by careful selection of gravel wearing course materials and good construction practices. The emerging road research centres and/or local universities should consider procuring the aerosol monitoring device and conducting tests on different gravel materials in order to verify or modify existing wearing course material specifications. The effect of poor construction practice, in particular inadequate compaction, could also be quantified. AFCAP should support this type of research.

Climate Resilience of Roads

A workshop was held during the conference on climate resilience for low volume roads. The discussion was concerned mainly about flooding due to more intense rainfall. The impact of higher temperatures on binder embrittlement was mentioned but not discussed in detail.

It was agreed that it is not feasible to design waterway structures on LVRs to withstand extreme flood events. Therefore structures are required that are designed for overtopping. The New Zealand delegate mentioned an example of a waterway structure on a river in a remote part of NZ which is designed in this way. The river is prone to flash floods Concrete culvert pipes are placed in the river bed and covered with gravel (the rest of the road is paved). During floods the structure is overtopped and washed out but can be quickly re-constructed and access restored. This may include a need to recover some of the pipes from downstream in the river bed. The road carries low traffic volumes. This type of structure might be useful in, for example, Mozambique, where washouts on rural roads are experienced nearly every year in some locations.

An example was also given of a net structure that can be placed across a waterway to trap debris that might otherwise clog a culvert and cause overtopping and a washout. See www.geobrugg.com. However it is unlikely that this type of arrangement would work in rural areas in most of Africa due to vandalism and theft.

Inexpensive Retroreflective Field Inspection

Research on junction improvement in Idaho (CS Bhaskar, M Khanal and D Harelson) showed that there is a very high cost-benefit ratio for investments in good signage. However traffic signs become dull over time due to weathering and need to be replaced, but the equipment to measure the retro-reflection from signs is expensive. Signs are expensive and should not be replaced unless necessary. Research has been carried out at Cornell University (DP Orr and GR Scott) on an inexpensive method of measuring retro-reflection. Small panels of the reflective material (15 cm x 7.5 cm) are prepared for each colour used on the road signs. The panels are then dulled by covering them with layers of plastic film until they reach the minimum required standard of retro-reflection. This is measured with a retroreflectometer. The panels are taken into the field at night and fixed to each sign on the road in turn. A torch is shone on the sign from a few metres away and the inspector makes a decision on whether the sign is at least as reflective as the panels. Signs that are less reflective than the panels are replaced.

In Africa very few roads agencies routinely check the retroreflection from traffic signs. Indeed it is difficult for most road agencies to cope with even the replacement of signs that are lost due to theft and vandalism. Most road agencies also do not have adopted minimum standards for retroreflection. However, with increased focus on safety for road users in Africa there is likely to be increased attention to the adequacy of signs. The Cornell method of checking retroreflection is highly appropriate to African conditions. The method could, for example, be adopted for research on the contribution of (inadequate) signage to traffic crashes as part of a community awareness campaign on reducing vandalism. However it is noted that a retroreflectometer is required for the preparation of the comparison panels and the road agency needs to specify the minimum required standard for retroreflection.

Effect of Road Condition on Agricultural Produce Transportation

Research at Pretoria University in collaboration with the California Department of Transport, CSIR and the University of California (WJ Steyn, W Noakes, N Burmas, R Agacer, L du Plessis and L Popescu) has measured the effect of road roughness on the deterioration of agriculture produce transported along the road in trucks. Laboratory methods were developed in California to replicate the dominant vibrations from trucks on roads and to measure the resulting stresses exerted on tomatoes. The damage to the tomatoes as a result of the stresses was calculated and an assessment made of the typical costs to farmers as a result of different road conditions.

This research has the potential to be used as part of an influencing strategy for increasing funding to road maintenance because it clearly shows the link between road condition, economic development and rural livelihoods. It is also the type of research that could very usefully be supported by AFCAP because it bridges the two AFCAP components of road engineering and transport services. There may be opportunities to extend the research to African countries and to involve local universities.

3. General Observations and Recommendations

The TRB LVR Conference 2015 provided an opportunity to exposure African practitioners to road management practices in the USA and elsewhere. It also enabled individuals to extend their experience with presenting papers at international fora and to broaden general awareness of AFCAP. On the downside it was evident that conditions in Africa are so different from conditions in the USA that many of the important lessons learned through AFCAP research are of little interest to practitioners in the US. This is partly because there are considerable differences between the road networks in the States and in African countries. In the US the long distance roads are built to interstate highway standard with separated carriageways and interchanges. In rural areas of the US the roads that provide access to/from the highways are known as “low volume roads”, even though

they may carry more than 1000 vehicles per day. In all cases the rural roads in the US are used predominantly by motorised vehicles and there is very little non-motorised transport. A further difference between road provision in Africa and in the USA is that in the US asphalt concrete is used for surfacing even very low traffic roads. Sprayed seals are seldom used. This is because most of the US paved road network was built at a time when oil prices were very low and AC was therefore affordable. This created an expectation amongst road users that AC surfacing will be provided. AC is easily available to contractors from commercial manufacturers.

Regarding the presentations made to the conference by the US delegates, it was noticeable that a large proportion was made by young people based in universities. In most cases they were presenting the outcome of research carried out for and in association with different road agencies. Very few presentations were made by representatives of government or local authority bodies. Furthermore, the local host agency for the conference was the Centre for Dirt and Gravel Road Studies at Penn State University. There is no doubt that such a conference held in Africa would have been co-hosted by the roads authority.

To date most of the AFCAP initiatives to build research capacity for the transport sector in Africa have focussed on establishing research units in road agencies. This model encourages the research centres to outsource research studies to local universities, but the challenge faced is that there is very little capacity in local universities to conduct this type of research.

Furthermore, the greatest challenge to establishing the local research centres in Africa is the employment and retention of technical experts who can conduct research. Perhaps it is time to admit that this is more than a challenge, but is an impossibility within a reasonable time frame. An alternative strategy, which may be far more feasible, is to outsource all research studies to universities and/or consultants, leaving the research centre with only a management function and responsibility for knowledge dissemination and uptake. Evidently this is the system used elsewhere in the world. AFCAP would then direct its focus more towards the universities and providing support to individuals in universities who want to carry out research.

Finally, whilst participation by AFCAP in events such as the TRB LVR Conference should continue to be encouraged, a more strategic approach should be adopted which tailors the AFCAP presentations more to the needs and areas of interest of the audience. In general there could be an overall improvement to the quality of the presentations to ensure that the key messages are clearly conveyed. More time and resources need to be invested in the preparations. AFCAP management should be more proactive in influencing the conference programme, for example to include a slot for an AFCAP overview in the introductory plenaries. Time should be set aside for meetings with representatives from other developing countries to discuss matters of mutual interest (in this case there were delegates from several countries in South America, the Caribbean and South Asia).

Report Kieran Kelly

TRB 11th International Low- Volume Road Conference, 12th – 15th July, 2015 - Attendance Report

Kelly, Kieran
7/23/2015

Introduction

This report is provided to Cardno ITT as stipulated under the Terms of Reference (ToR) for presenters participating in the 11th Transportation Research Board (TRB) Low-Volume Road Conference, held in Pittsburgh USA between 12th and 15th July 2015.

The purpose of the report is to outline the presenters findings on aspects such as conference feedback, recommendations for future actions relating to the presentation subject and lessons learnt.

Conference Feedback

Some feedback was received from participants, however, it was somewhat limited. Feedback came predominantly from participants with interests outside of the U.S.

In particular, brief discussions were held with a geotechnical engineer named Gordon Keller who was discussing low-volume road design in the Amazon rainforest. Two engineers from Chile also discussed their interest in what AFCAP is undertaking as it related to similar concepts being undertaken in their country.

After the first presentation about the AFCAP trial sections in Tanzania, I was approached by a gentleman about a product/concept he was promoting called “Mechanical Concrete”. This was essentially a geocell concept, similar to what we constructed in Tanzania, where the geocells structure is manufactured from used car tyres with the side walls removed.

I felt in theory the idea had some merit but there would also be some practical issues to overcome, such as connecting the tyres, filling with concrete rather than aggregate and simply procuring and removing side walls from the tyres. However, I pointed him towards the AFCAP stand to discuss the concept with the team as it may be something that could be utilised or trialled somewhere in the future.

Recommendations for Further Actions

I believe the trial sections in Tanzania and Lao PDR merit further investment in monitoring so we can get a better picture of long-term performance. I believe this may be undertaken in Tanzania and funding may already be available, however, in Lao PDR the case is different.

The road in Lao PDR has been trafficked since 2007 and has not been monitored to the extent originally envisaged. More useful information could be gained from additional monitoring and testing under AFCAP/ASCAP particularly as the sections come up to 10 years in service. There is nowhere else I am aware of that we have trial sections in service for this length of time.

It would also be interesting to take this work to West Africa. When I was with Roughton I did a lot of work speaking to the Sierra Leone Roads Authority and trying to get them onto the ToR for AFCAP 2.

They were very keen to be involved and there are great opportunities to assist the country in developing their LVR network and the tools to enable them do it themselves.

Also, there was some interesting work being undertaken by other U.S. presenters which related to quantifying the sediment quantities in runoff from gravel roads. This has significant impacts on watercourses and on the health of these ecosystems.

I believe it would be interesting for AFCAP to take on an environmental project such as this in Africa. It would be interesting to assess sediment quantities in runoff on typical African LVR and try determine the impact this is having on surrounding water bodies.

This would potentially add further weight behind the argument of reducing gravel use in areas where it is not suited (e.g. steep grades) and add a stronger environmental argument for sealing them with cost-effective surfaces.

Lessons Learnt and New Understandings

Overall, the conference was very useful and I learnt a lot from the experience. It was interesting to see what is being undertaken in the U.S. and how that compares to what we are undertaking in Africa.

I believe there are a number of items AFCAP could take forward, particularly relating to gravel losses and the effects of dust pollution.

However, it was interesting to note that there was a strong feeling in many cases what we are doing under AFCAP is much further ahead of what is being done in the U.S., particularly in terms of pavement design and materials. There is a lot the U.S. practitioners could learn from what is being undertaken by AFCAP and could save them a significant amount of money.

In the U.S. there appears to be significant use of thin asphalt surfaces on their LVR, which are perhaps required for reasons more political than technical. However, one presenter delivered a talk about converting some of these roads back to gravel because maintenance costs are lowered. This is unlikely to be an ideal solution either, but applying cost-effective pavements/surfaces or targeted solutions like under an environmentally optimised design, could offer them more benefits.

Talks by Andrew Otto about materials in Ethiopia and the effects of moisture and compaction, in addition to work by Phil Paige-Green on sand specifications and gravel surfacing specifications showed how we are pushing the boundaries further than our colleagues in the U.S.

Conclusions

The presentations were well received and the audiences found them interesting, but feedback from American attendees was somewhat limited.

Having seen what is being undertaken in the U.S. I believe there are elements we can take back to Africa and implement under AFCAP, particularly in relation to dust control and sediment in runoff, looking at more of the environmental aspects of low-volume roads.

However, the conference showed that the work AFCAP is funding is more innovative and ahead of the U.S. in many cases. Research on the use of local materials and pushing the boundaries on LVR pavement design appears far ahead of what is being undertaken in the U.S. This showed that AFCAP is providing a genuine and significant contribution to the knowledge base on this topic and in dissipating this knowledge.

Report Estimé Mukandila

REPORT ON THE 11th LOW VOLUME ROAD Conference held in Pittsburgh (USA) FROM the 12th to 15th July 2015

Prepared by Estimé Mukandila

Introduction

Since 2013, Estimé Mukandila (a practitioner from Aurecon) has been participating in various AFCAP capacity building initiatives related to the use of the DCP design method which was used on a pilot scale project in the Democratic Republic of the Congo. AFCAP is a DFID (UK) funded research initiative for the rural transport sector in Africa. The principal focus of AFCAP activities is on research, demonstration and capacity development (uptake). In line with this AFCAP objective, a conference paper entitled “A New Approach for Upgrading Gravel Roads to a Low Volume Sealed Standard Based on the Use of the Dynamic Cone Penetrometer”, was prepared by M.I. Pinard, P. Paige-Green, J. Hongve and E. Mukandila. This paper was presented by Mr Mukandila at the 11th Low Volume Road Conference held in Pittsburgh-USA from the 12th to the 15th July 2015. The aim of this

international conference was to examine new technologies and new techniques in the planning, design, construction, operation, maintenance and administration of low-volume roads.

This report briefly discusses the feedback received from other conference participants related to our presentation, as well as some recommendations related to the presentation for further actions that could be supported by AFCAP in the future.



Figure 1: 11th International conference on Low volume roads

Presentation feedback received

The aims of our paper is to present and promote the DCP design method for Low Volume Roads as developed in Southern Africa. Emphasis was placed on its ability to allow the upgrading of unpaved roads to a sealed standard, by optimised use of the residual strength of existing road pavement materials and the use of a “fit for purpose” specification. Although the DCP device is widely used internationally for characterising the in situ strength of existing roads, its use for pavement design purpose appears to be a new and interesting concept. This paper raised some interest among the participants, for example:

- Professor Richard A. Reid (South Dakota State University) said that his research team was looking for a way of adjusting the DCP DN values as a function of the moisture conditions prevailing at the time of the DCP measurements. He was very interested with the principle of adjustment of the DN value for the design moisture as discussed in the paper. He requested further details in this regards;
- Mr. Peter Bolander (USDA – Forest Service) mentioned that they are using DCP testing to determine the subgrade strength of the forest roads and that the idea of pavement design with DCP is very interesting.
- Many others participants mentioned to us their interest in the DCP design method for low volume roads.



Figure 2: Presentation of the paper by Estimé

Some recommendations that could be supported by AFCAP

- The DCP design method for Low Volume sealed roads should be disseminated especially in Africa where these roads are regarded as key elements for development. In this regard, we would suggest that AFCAP supports research to promote the dissemination of the method in the different regions of Africa. This research could comprise: the monitoring of the moisture variation during the construction and the life time of Low Volume Roads, the determination of appropriate vehicle equivalence factors for different regions.
- One of the regions requiring this type of research is central Africa, especially the Democratic Republic of Congo.



Figure 3 : AFCAP's booth at the 11th TRB Low Volume Road Conference

Lessons learnt

- African Low Volume Road technology has a lot to contribute to the international Road industry;
- Understanding of sustainability: while in Africa we strive to seal low volume roads for sustainability, in USA there is a new tendency of reversing sealed roads to gravel roads for sustainability purpose;
- Further research should be conducted to popularise the DCP design method for low Volume Sealed Roads;
- This was a very grateful and essential initiative from AFCAP as it allowed not only knowledge transfer but exposed AFCAP research activities internationally. This initiative permitted also a social interaction between different peoples working on AFCAP projects; and
- More engagement of AFCAP in such activities will only bring more international recognition and more knowledge in AFCAP projects.



Figure 4: Conference dinner held at Omni William Penn Hotel

Conclusion

It can thus be said that this paper on the DCP was an important knowledge sharing experience of Southern Africa technology development on Low Volume Roads with the world.

Report Andrew Otto

TRB 11th International Conference on Low-Volume Roads: Pittsburgh Pennsylvania, USA 12th-15th July 2015.

Conference Report: Andrew Otto

Introduction

I was sponsored by AFCAP to attend the conference and present a paper. I arrived in Pittsburgh on Saturday 11th July 2015 and departed on Friday 17th July.

Together with two co-authors Alemayehu Ayele Endale and P.A.K. Greening we wrote a paper titled “a method for increasing the use of locally available materials for road construction in Ethiopia by allowing for climatic variation”.

Alemayehu and I presented our paper on Monday 13th July 2015. The presentation was well attended and successful.

The conference attracted more than 260 participants from 80 different countries around the world. Over the duration of the conference, there were 4 plenary sessions and many other parallel sessions. I attended various sessions that in my opinion would benefit AFCAP. The highlights of which are discussed below.

Low-Volume Roads

It was evident that various regions of the world defined low-volume roads in different ways. Though no formal definitions were discussed or presented, it was evident from the presentations that the perceptions were different although the objective of sustainability was common to all.

Low-volume Roads in USA, lessons for Africa

In USA, haul roads used to ferry natural materials are not usually surfaced with bituminous surfacings. In other cases where the low-volume roads are mainly for provision of access to residents, they are surfaced with asphalt concrete. These roads often carry little traffic for local residents but on some occasions carry very heavy triaxle trucks. The influx in heavy vehicles only occurs for a short period of time, usually due to exploitation of shale gas wells or other natural materials deposits. Whenever the influx occurs, the roads receive significant surfacing and pavement damage. This was evident in the field visit of Thursday 16th July 2015. In USA, the exploiter of the natural resource is responsible for major repairs and strengthening of the road that they damage. Africa should learn that in the exploitation of natural resources, significant damage will occur to the low-volume road infrastructure. Unless comprehensive plans are in place, the primary purpose of the road will be jeopardised. Despite the obvious difference in the construction of the low-volume roads in USA and Africa, the main similarity between the two is the need for sustainable use of resources and reduction on cost of construction and maintenance.

Sustainability and Resilience

This was a major theme in the conference with a major focus on how to use materials in a minimal way and in such a way that environmental degradation is minimised.

A notable lesson to learn from this comes from the presentation on the afternoon of Sunday 12th July 2015 entitled “Environmentally Sensitive Maintenance of Low-Volume Roads”. In this presentation, unconventional approaches of dealing with drainage problems that affect low-volume roads were discussed. Most of these solutions are applicable to African conditions. A booklet that discusses some of these approaches is available from the United States Department of Agriculture website. The booklet is entitled “Environmentally Sensitive Road Maintenance Practices for Dirt and Gravel Roads”.

Chip Seals in Virginia

It was interesting to learn from one of the presenters from “The Commonwealth of Virginia” Mr. Sean Nelson that whenever the state surfaced a road using chip seals, the local residents were not happy. This negative perception about chip seals (as compared to asphalt concrete) seems to go beyond Africa. It is a perception that needs to be addressed if low volume roads sealing technology is to advance and to save over-exploitation of gravels.

Retaining Walls and Slope Protection

In many parts of Africa, landslides and slope failures are a major problem. A number of presentations at the conference addressed this issue. One of them, on the morning of Monday 13th July 2015 discussed the use of welded wire retaining walls for the protection of slopes. It is simple, quick and cheap method that should be adopted in Africa.

Field visit on Tuesday 14th July 2015

The field visit comprised four sites, one on protection of slopes using wire nails and drainage pipes, the second the use of geo-fabric and gravel to construct bridge abutment walls, the third on the simulation of rain in studying gravel and sediment loss and the fourth on instruments for quantifying dust on and around gravel roads.

The simulation of rain and sediment loss study is very important for Africa and AFCAP should look into ways by which we can do similar studies in Africa. This is important so that we can better understand the quantity of gravel loss that is due to or accelerated by rain. The results of such a study would make it easier to secure funds for maintenance dependent on the climate of a region. In upcoming AFCAP studies on socio-economic and health impact studies of road projects, the ability to quantify dust generated by gravel roads is important. What is even more useful is that the dust meters are able to separately quantify the amount of dust particles that can be inhaled and lead to lung disease. A system costs only about US\$ 12,000.

Tomatoes in the Engineering Laboratory

The presentation on the morning of Wednesday 15th July 2015 by Wynand Jacobus van de Merwe Steyn on the effect of road condition on agriculture produce transportation raises a major question on provision of access in Africa. If we as AFCAP practitioners work towards the provision of access, we must remember that the main purpose is to provide access to markets and social services. What good is it, if the roads provided lead to damage of certain market goods? This means a certain level of road condition must be maintained to guarantee a fast and safe way to deliver produce to markets.

Absence of the Brazilians

It was disappointing that the Brazilians who were originally supposed to attend the conference did not turn up. Africa and Brazil share similar climates around the tropical belt. Because of that, our materials and road building practices are similar. It would have been great to share experiences and new research findings with the Brazilians. This would have been particularly useful in the area of the use of lateritic soils and laterite gravels. For the purpose of laterite and other materials use, it is my recommendation that AFCAP should organise a study visit to Brazil for at least 12 practitioners (me included).

Final Remarks

The conference was a major learning experience and AFCAP should continue to sponsor young researchers to ensure that the most up-to-date knowledge on provision and management of low-volume roads is gained from conferences and also that the knowledge so far gained is sustainable through a constant chain of growing researchers.

Report Phil Page Green

Report on 11th Low Volume Road Conference, Pittsburgh, Pennsylvania, USA Submitted to AFCAP by P Paige-Green (Presenter)

AFCAP agreed to subsidise the visit of Prof P Paige-Green to the 11th International Low Volume Roads (LVR) Conference held in Pittsburgh, Pennsylvania between the 12th and 16th July 2015. Three papers co-authored by the writer were presented during the conference, one of these by the writer. These were:

- Paige-Green, P, Pinard, MI and Netterberg. Low Volume Sealed Roads with Neat Sand Bases. Transportation Research Record 2473, Vol 3, pp 56-64, July, 2015. (Presented by P Paige-Green)
- Pinard, MI, Paige-Green, P, Hongve, J and Mukandila, E. A New Approach to the Upgrading of Gravel Roads to Low Volume Sealed Roads Based on Dynamic Cone Penetrometer testing. Transportation Research Record 2473, Vol 2, pp 136-146, July 2015. (Presented by E Mukandila)
- Jones, DJ and Paige-Green, P. Limitations of Using Conventional Unpaved Road Specifications for Understanding Unpaved Road Performance. Transportation Research Record 2473, Vol 2, pp 30-38, July 2015. (Presented by D Jones)

The first two papers were based entirely on AFCAP research carried out over the past few years, with the first one being a follow up to a paper presented at the previous LVR conference in 2011. Although there was little discussion following the presentation of the papers, significant follow up discussions were held with various delegates, as a result of the wide-spread presence of sands with little alternative materials in many countries. It is clear, however, that there is still some scepticism regarding their use by generally conservative engineers in the developing countries.

A similar scenario was encountered with the use of the DCP for design purposes. Despite the apparatus measuring the in situ strength of materials directly and relatively wide use of the equipment, most people who discussed this work at the conference seem to be rather wary of implementing such designs. It is thought that only by implementing the principles proposed and conveying the results at such for a, will wider acceptance be forthcoming. The current AFCAP experiments and projects in Kenya, Malawi and other areas in East Africa should definitely be fully monitored and the findings widely publicised.

The Conference was attended by about 280 delegates from more than 20 countries. 80 technical papers were included in the Proceedings, most of which were presented by the authors. 44 of the papers were by US authors and the remaining 36 from 16 other countries, of which 6 were under the AFCAP umbrella.

Papers covered all avenues of LVRs from the administration and management to construction, materials, sustainability and safety. The majority of papers from the USA described research and implementation projects carried out at universities, with governmental organisations (US Forestry Service, US Geological Survey) also having a significant input. One of the main points of concern is the traffic limits pertaining to low volume roads. Many examples were cited of roads carrying between 1000 and 5000 vpd, traffic normally carried on major interurban arterial roads in Africa.

It was notable among the presentations for the USA that the cost of road provision and construction is almost universally subordinate to the environmental requirements imposed on road engineers. Although it is acknowledged that environmental issues and concerns are important and need consideration, it is important that they do not dominate the provision of access in developing areas as they do in the USA.

One of the disappointing features of the conference was the lack of discussion and questions following the majority of presentations. Although time was usually sufficient, little in the way of constructive criticism or additional information was contributed. This is not unusual, however, for such conferences.

During the Conference, many old contacts were renewed and many new contacts made. The role of AFCAP in developing the low volume road field was acknowledged by a number of the delegates during personal discussions.

The major area of concern arising from the conference was the reluctance of many of the delegates from developed countries to really deviate from existing technologies in terms of low volume roads. Instead of making significant paradigm shifts in their thinking, they tend to try and incrementally extrapolate traditional theories and principles developed for conventional roads downwards into the realm of low volume roads. Southern African experience has shown that this does not result in substantial savings nor cost-benefits and in order to ensure significant benefits a totally different approach is necessary.

A good example of conservatism was exemplified in discussion with delegates from the USA, Canada and New Zealand. Despite the innovations and developments in unpaved road technologies from Brazil and Africa, these developed countries insist on pursuing the use of materials with low plasticities. This results in excessive maintenance requirements, relatively poor performance and high consumption of non-renewable materials. Although there are a few experienced practitioners in the USA advocating the use of higher plasticity natural gravels, they meet strong resistance from most of their fellow engineers.

Only by documenting success stories is this problem likely to be overcome. AFCAP can take a lead in this area by ensuring that trials and experiments involving new developments are clearly written up and widely publicised at relevant conferences, in order to show the benefits of the technologies and provide evidence of their successful implementation.

CONCLUSIONS

The opportunity for the author to represent AFCAP at the conference is gratefully acknowledged. Although AFCAP is more interested in roads carrying much less traffic and being far less costly than most of those discussed in the USA, the opportunity to meet and discuss mutual problems with those working in the field was most useful. However, the impact of AFCAP was probably not as great as it could have been as a result of the presentations being dispersed through the sessions at the conference. On the other hand, a full session of AFCAP papers may not have drawn a sufficiently wide “audience” of interested practitioners, when “competing” against papers from the USA.

The presence of the AFCAP stand at the exhibitions, however, did allow the speakers to direct interested parties to the exhibit for discussions and to gain access to the useful information and reports being made available.

Report Mike Pinard

Report on Attendance at 11th International Conference on Low-Volume Roads
12th to 15th July 2015, Pittsburgh, Pennsylvania, USA
A Personal Perspective
By Mike Pinard

1. Introduction

1.1 Background

The writer, with AFCAP support, attended the 11th International Conference on Low-Volume Roads that was held in Pittsburgh, Pennsylvania, USA from 12th -15th July, 2015, in the capacity of Senior Researcher. Although not required by his Terms of Reference, the writer, nonetheless, presents below a report on his impressions of the conference and any lessons learnt that might be of benefit

to the AFCAP 2 project in general, and AFCAP practitioners, in particular.

1.2 Conference Details

The conference was attended by about 260 delegates with about 60% coming from the USA and the remainder from a wide range of countries including Sub-Saharan Africa, Australia, Canada, India, China, Japan, South America (Chile, Argentina, Brazil), Europe (Finland, Norway), and the Caribbean (Guyana).

By far the largest contingent of delegates was from the USDA Forest Service, an organization that is responsible for the management of many thousands of kilometres of mostly unpaved roads which carry volumes of traffic more akin to the Sub-Saharan African definition of low volume roads (LVRs), i.e. typically < 300 vpd with a design traffic loading of ≤ 1.0 MESA.

Apart from the opening and closing sessions, the various presentations were made simultaneously in three venues. Because a number of potentially interesting presentations clashed, this required delegates to make a careful choice of presentation to attend. Unfortunately, there were a number of no-show presenters which tended to confuse the programme as the presentations were then not made at the times listed in the programme.

The 17-storey hotel where the conference was held, the Omni Penn, was well appointed with grand rooms and an excellent restaurant – at a price! However, the acoustics in the main conference hall were very poor and detracted from the presentations made in that room.

2. Conference Coverage

As would be apparent from the table below, a wide range of topics was covered at the conference.

Design	Safety	Environment
Construction	Pavements	Stabilisation
Geotechnical engineering	Materials and pavements	Freeze-Thaw
Geo-synthetics	Pavement maintenance	
Traffic engineering	Heavy Loads	

There were also other related events during the conference, as follows:

- Sunday 12th July, 2015: Pre-conference workshops
- Tuesday 14th July, 2015: Working Group discussions on Issues Facing LVR Managers
- Tuesday 14th July, 2015: Field trip: Environmentally Optimized Maintenance for LVRs
- Thursday 16th July: Post-conference field trip

3. Inputs to Conference

The writer was responsible for authoring and co-authoring respectively the following papers:

- a) *New Approach for Upgrading Gravel Roads to a Low-Volume Sealed Standard based on the Use of the Dynamic Cone Penetrometer*, by M I Pinard, P. Paige-Green, J. Hongve and E. Mukandila. The presentation of this paper was made by E. Mukandila of Aurecon International, South Africa.
- b) *Low-Volume Roads with Neat Sand Bases*, by P. Paige-Green and M.I.Pinard. The presentation was made by P. Paige-Green of Tshwane University of Technology.

The writer was also involved in a number of pre-conference preparations including reviewing, commenting upon and suggesting means of improving the PowerPoint presentations originally prepared by Messrs. E. Mukandila and A. Otto.

In addition to the above, the following AFCAP presentations were also made:

- *Environmentally Optimized Design for Low Volume District Roads in Tanzania* , by S. Juma and K. Kelly
- *Method for Increasing the Use of Locally Available Materials for Road Construction in Ethiopia by Allowing Climatic variations*, by K. Kelly
- *Route from Research into Practice: Outcomes of the African Community Access Programme Phase 1* by N. Leta

There was also an AFCAP stand at which a number of AFCAP leaflets were displayed as well as a continuous scrolling of all the PowerPoint presentations made at the conference. The stand seemed to have attracted quite a number of delegates and it will be interesting to learn of the extent of enquiries made and any follow-up on AFCAP from the conference delegates.

4. Conference Workshops and Presentations

(a) Pre-conference Workshops

On the day before the conference started (Sunday 12th July), four half-day workshops were held on various aspects of LVRs which were quite well attended and offered sufficient discussion time to explore various aspects related to LVRs. The two presentations of particular interest to the writer were:

i. Diverse Benefits and Impacts of Low-Volume Roads in Developing Countries by Gordon Kellar – author of the well-known *Low-Volume Roads Engineering: Best Management Practices Field Guide (2003)* which should be mandatory reading for all budding roads practitioners in the E and S Africa region – just like the *SADC Guideline on Low Volume Roads (2003)*!

This interesting presentation was all about “the good, the bad and the ugly” aspects of LVRs from experiences gained by the presenter from many developing countries of the world. A lot of what was said was very pertinent to the E and S Africa region and reflected many of the challenges currently being faced in not only providing rural roads but, more importantly, preserving the investments made in their provision through good planning, investigations, design, construction and maintenance.

Some of the key points made were:

(a) Positive impacts

- Improving quality of life/ social well-being
- Providing better access to schools and clinics
- Promoting resource management and development
- Providing rapid movement of goods and services
- Lowering the cost of food/products/operations
- Improving food security
- Reducing disaster vulnerability

The above impacts would apply equally to the E and S Africa region as the *raison d'être* for investing in rural roads.

(b) Negative impacts

- Degradation of water quality
- Pollution - Dust and trash
- Traffic accidents

- Land use changes –forests to crops
- Growth--Loss of terrain
- Deforestation and illegal logging/hunting
- Pressure on reserves and sensitive areas
- High cost of maintenance and repairs
- Promotion of landslides and stream channel changes
- Damage to coastal areas, mangroves, and swamps
- Wildlife mortality and habitat fragmentation
- Barriers to fish and AOP movement
- Promoting movement of invasive species

What is most interesting with the above set of impacts is that so many of them are related to environmental protection of flora and fauna and natural habitats of one type or another – to an extent that is far greater than in the E and S Africa region where environmental degradation is sometimes misguidingly viewed as the price to be paid for development. Examples of the extent to which provision is made for preserving wildlife habitats are illustrated below.

One of the interesting issues raised in the presentation which must be of much relevance to many, especially water deficient, countries is that of water-wise road initiatives as illustrated below. The above water harvesting initiatives in the E and S African context, although potentially very beneficial, would require careful planning and management in order to avoid producing mosquito breeding grounds, especially in built-up areas, and posing a danger to children, many of whom can't swim and end up drowning – a not infrequent occurrence in the region.

ii. Reversion of Paved Surfaces to Unpaved Surfaces by Ken Skorseth who also participated in the 6th T2 Conference that was held in Gaborone, Botswana in 2013.

The motivation given for reversion of paved to unpaved surfaces is that the current paved portion of the local road/street system in many American states is not sustainable in many places. Why?

- Money! Dramatic increase in cost of paving and maintenance costs while budgets have remained essentially the same.
- Too many existing pavements can't handle change in traffic type and volume since original construction.
- It is often more economical to convert to an aggregate surface than rehabilitate pavement or reconstruct pavement although this may not always be true in life cycle costs terms. Then why do it? The reason is – Affordability. Many states do not have sufficient funding to undertake optimum strategies, including paved surfaces. Obviously, this is an expedient, un-cost-effective option which can generate disproportionately high user costs.

Ironically, for a number of good reasons (technical, economic, social, environmental), there is a strong move in E and S Africa under the AFCAP project to promote the construction of sealed roads using environmentally optimised design approaches - a term that was very strange to most of the delegates outside of E and S Africa!

So what is the strategy being adopted to managing an increasing kilometrage of unpaved roads in America? Answer: The use of dust palliatives and various forms of stabilized gravel – topics that featured in a number of papers at the conference including one by D. Jones (ex CSIR) and P. Paige-Green on *Limitations of Using Conventional Unpaved Road Specifications for Understanding Unpaved Road Performance* – a message that should be seriously heeded in all E and S Africa countries as there will always be a substantial proportion of unpaved roads that, for good performance, need to

be properly designed, using appropriate criteria for selecting wearing course gravels and, where warranted, treating them with appropriate palliatives or stabilisers – a big subject!

Lessons learnt:

- A great need in E and S Africa for better understanding of what good wearing course gravel is all about and how it can most appropriately be treated, where warranted, and constructed to provide vfm (see comments below on presentation by D. Jones and P. Paige-Green.

(b) AFCAP Presentations

A total of six presentations was made by the AFCAP team. The writer was able to attend all the presentations, except the one made by S. Juma on *Environmentally Optimized Design of Low Volume District Roads in Tanzania* which, unfortunately, clashed with the AFCAP presentation on the use of the DCP for upgrading gravel road to a sealed standard.

The audience feedback on the AFCAP papers was generally very disappointing with no questions in some cases! This poor feedback was by no means unique to the AFCAP papers, as there were many other presentations where this was also the case. However, there were also a number of presentations where there was prolonged discussion, but this tended to be on more general topics, rather than the somewhat more technical presentations made by AFCAP.

Some interest was shown after the DCP presentation by the Associate Dean of Engineering for Academics and Extension, South Dakota State University (Dr. Richard Reid) who mentioned that his graduate students were looking at the DCP for design purposes and was very keen to learn what developments had taken place under the AFCAP project. The writer will provide the information requested.

(b) Other Presentations

Of the various presentations attended by the writer, the following merit brief mention.

i. Can Traffic Signs Be Too Bright on Low Volume Roads

By P.J. Carson

The paper on which this presentation was based won the “Best paper award”. The objective of the study was to determine if traffic signs along rural roads can be so bright that they cause reduced legibility, glare, or both to the point of their being a safety concern. Ironically, the low-volume rural roads that were investigated were carrying an AADT of 5000 vpd!!! Hardly a LVR in the E and S Africa context. Nonetheless, assuming that the investigation was of interest to trunk roads in the region, the finding was that there is evidence that shoulder-mounted signs with low or no visual complexity can be too bright in rural areas in the USA, resulting in a reduction in the overall ability to detect potentially hazardous objects near the roadway. Various recommendations were made to mitigate this “problem” by specifying particular types of sign coating materials with the right level of reflectivity.

Much as the above paper might have been technically excellent, the subject matter is hardly a priority in the E and S Africa region where the problems with signs are of a much more fundamental nature – they are either completely absent, in the wrong place, have not been maintained, are completely misleading or when placed on many roads, tend to be quickly vandalized.

ii. Rethinking Rural Road Infrastructure Delivery: case Study of a Green, Inclusive, and Cost-effective Road Program in Nicaragua.

By S. Muzira, D. Hernandez de Diaz and B. Mota, World Bank

The paper presents a development case study on alternative thinking in rural road infrastructure delivery including: the use of pre-cast concrete-like paving blocks, the empowerment of local citizens using labour-based methods in the form of specially formed community development modules. The objectives of this approach, which certainly apply to a typical rural road environment in all E and S Africa countries, is to: provide short-term employment opportunities, the building of technical and entrepreneurial skills, and the engendering of a sense of ownership in and responsibility for the roads.

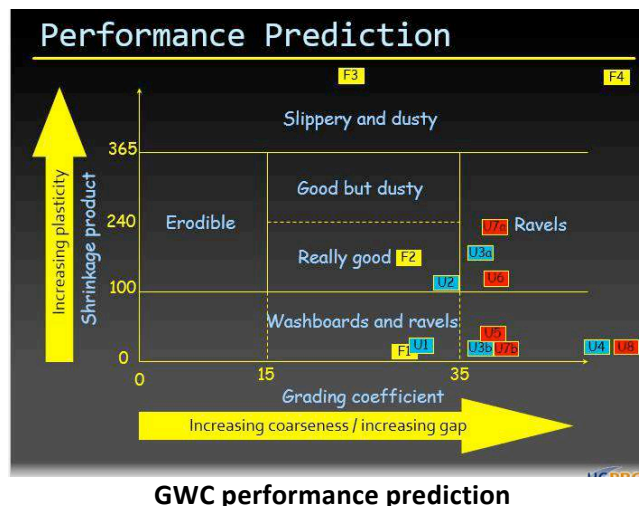
The paper concluded that the surfacing option and construction method adopted provided a cost-effective solution, in life-cycle terms, when compared with the more traditional options which involved the use of AC! This conclusion does beg the question, however, as to whether the most appropriate alternative options were being compared? It seems likely that an equally competitive, if not more cost-effective option would be that pursued in the E and S Africa region – a DCP designed 8

LVR with an appropriate bituminous or non-bituminous surfacing as demonstrated in a number of countries in the region.

iii. Limitations of Using Conventional Unpaved Road Specifications for Understanding Unpaved Road Performance

By D. Jones and P. Paige-Green

The main objective of this paper was to highlight the many factors that affect the performance of gravel roads and the widely differing specifications that exist for selecting the GWC materials, some of which have no PI requirement! What is most interesting, as illustrated in the figure below, is that, based on the extensively investigated gravel wearing course performance model developed by P. Paige-Green for the S. Africa region, the application of many of the US specs (shown in red, blue and yellow boxes) could result in the selection of unsuitable materials! Is it any wonder, therefore, that the performance of gravel roads in the USA is so variable, despite that application of their national specification!



The main conclusion to be drawn from this instructive presentation is that the cost of selecting gravels that are likely to be suitable for use as GWC is not high and is likely to save much money in the long run. However, it is fair to say that there are many examples in the E and S Africa region where such testing is not carried out and, more often than not, unsuitable gravel is hauled at great cost, and to poor performance.

iv. Dust Palliatives/Suppressants and Soil Stabilisers

With the serious attention paid to environmental issues in the USA, especially dust generation on unpaved roads, there were not surprisingly quite a number of papers on dust palliatives/suppressants and soil stabilisers. To varying extents, these products all apparently show cost-effective application when applied in the appropriate manner. However, it was also pointed out that there are a number of “rogue” products that are flogged by glib sales people who were often successful in selling these products to the uninitiated. The lesson was – be very careful with the type of product being considered as it is often a specific case of “horses for courses” and what works in some situations will be quite useless in others. The materials properties are a key factor in choosing the right kind of additive or stabiliser.

In order to reduce the risk in the use of proprietary products for which there is limited information, the following options, and the risks incurred by the parties, are highlighted for using the products.

- Fit-for-purpose certification in which the risk is taken by the road agency based on an informed decision
- Product performance guarantees in which the risk is shared between the road agency and the manufacturer
- Performance or warranty specifications in which the risk is taken by the manufacturer or distributor
- Maintenance contract in which the risk is taken by the manufacturer or distributor.

v. Climate Resilience

In relation to current issues facing low-volume roads managers, a workshop was presented on *Adaptations to Climate Change and Local issues Related to LVRs*. It was highlighted that global climate change appears to be very real with the consequence that we can expect more erratic weather, more intense storms, more drought and associated wildfires, etc., all of which impact on LVR infrastructure and transport.

A number of useful suggestions were made for dealing with the issue of climate resilience that would certainly have application in the E and S African context. They include:

- Employing “self-maintaining” concepts in the selection and implementation of impacts such as additional cross-drains, larger drainage structures, etc.
- Adhering to scheduled maintenance activities by, for example, ensuring that culverts are regularly cleaned to avoid reducing their capacity; keeping roadway surface shaped to disperse water rapidly; and avoiding areas of water concentration.
- Recognizing that it may not be possible to design waterway structures on LVRs to withstand extreme flood events for which overtopping would have to be tolerated and mitigation measures for erosion installed.
- Using simple fords or vented low-water crossings for small or low-flow stream crossings, instead of pipe culverts, that are more susceptible to plugging and failure.
- Using deep-rooted vegetation to “anchor” soils.
- Designing high risk bridges and culverts with armoured overflows to minimize erosion.
- Using scour protection measures for structures on questionable foundation materials.
- Being aware of channel morphology and stream channel changes near a bridge, culvert or road along a river.

Other issues of relevance emanating from the discussions include the issue of bitumen durability that becomes all the more important due to the onset of higher diurnal temperature variations and the inability of pen grade bitumens to accommodate such variations without bleeding or cracking.

In view of the heightened awareness of the impact of climate change on road infrastructure design and maintenance in the E and S Africa region, the above, and other measures, should be incorporated in the LVR manual being produced in the region.

Field Trips

(a) Environmentally Sensitive Maintenance for Low Volume Roads

The objective of this trip was to demonstrate examples of so-called environmentally sensitive maintenance of LVRs. The field trip was a follow-up to the excellent workshop that was presented on the Sunday afternoon by Penn State DoT at which an excellent manual was handed out to participants. This handbook illustrates numerous examples of good practice maintenance of unpaved and paved road maintenance which, if it could be made available to roads agencies in the E and S Africa region, would be a very useful aid to improved practice.

The field trip illustrated many examples of good maintenance practice regarding drainage, slope stability, culvert alignment, use of geo-textiles, etc. – all practices that come at a cost and are seldom adopted in the E and S Africa region.

A gravel road dust monitor and rainfall simulator were also demonstrated on the field trip – testimony to the attention paid in the USA to measuring the dust, gravel loss and sediment run-off aspects of gravel roads as a basis for adopting mitigating maintenance measures in terms of the use of appropriate dust palliatives/gravel stabilisers and selection criteria for gravel wearing courses. In summary, the field trip was of much general interest, at least with regard to arising an awareness of the many ways in which LVRs may be vulnerable to lack of, or improper approaches to, maintenance and the mitigating measures that can be adopted to overcome such vulnerability.

(b) Heavy Hauling Effects on Public Low-Volume Roads from Unconventional Gas Extraction.

This field trip was more in the nature of a recreational outing rather than a technically educative one. The highlight of the trip was probably a stop at the Meadowcroft tourist facility where a 16,000 year old native American camping site had been painstakingly excavated to reveal artefacts such as hard stone arrowheads and the likes.

The technical aspect of the trip centred on the manner of dealing with heavy hauling trucks servicing the gas fracking operations that have provided an economic boost to the Pittsburgh economy. Any trucks with a GVM > 10 tonnes are required to post a bond, the amount of which is related to their actual GVM. This bond is then used by Penn DoT for the upgrading and maintenance of the roads used by these vehicles. The typical pavement design used on the service roads to the gas platforms was apparently a 200 mm gravel layer stabilized with 8 – 10% cement (!!!) which hardly seems to be an appropriate or cost-effective solution.

In summary, the field trip provided more of an opportunity to see something of the Pittsburgh countryside, good in itself, rather than to observe any technically innovative practices used by Penn DoT that might be emulated in the E and S Africa region.

5 General Observations and Recommendations

5.1 General

The conference provided the junior researchers with an excellent opportunity to present their research work to an international audience and, by so doing, to broaden their presentation skills which are an important aspect of their professional career development. Such presentations also provided an opportunity to showcase the AFCAP project in a positive light and to expose other practitioners to aspects of LVR technology with which they may not be familiar. Also, the conference

provided an opportunity for the AFCAP team to interact with other practitioners from many parts of the world and to cultivate contacts in particular areas of interest that can be pursued in future.

5.2 Definition of LVRs

What was most apparent from the conference, however, was that LVRs in the USA are viewed in a very different light to that in the E and S Africa region. For example:

- The definition of a LVR for which presenters from the USA quoted traffic levels that ranged from 50 – 5000 vpd! Moreover, such figures are not linked to traffic loading which is a key defining factor for design of LVRs in the E and S Africa region.
- The very high levels of serviceability provided in terms of pavement surfacing – invariably asphaltic concrete, and very little thin bituminous surfacing, even for LVRs, which is the norm for E. and S. Africa.
- The near absence of NMT, especially motor bikes (boda bodas), which often dominate the traffic stream on LV rural roads.

5.3 Impact of AFCAP presentations

The impact of the AFCAP presentations was rather limited. This was probably because the various presentations were dispersed throughout the conference programme and centred on topics with which the mostly USA delegates were not familiar. A much stronger impact might have been achieved if the general presentation on AFCAP was made in a plenary session early on in the conference proceedings and, possibly, if there was a specific AFCAP session that was well sold both before and during the early stages of the conference. In contrast, the general AFCAP presentation was made on the last afternoon of the conference when attendances had already tapered off.

5.4 Lessons Learnt

In terms of the beneficial lessons learnt from the conference, there were a few, including:

- Good practice measures for achieving environmentally sensitive maintenance of LVRs.
- Good practice measures for adapting to climate change
- The importance of using appropriate criteria for selecting GWC materials.
- Most importantly, the fact that the AFCAP project is demonstrating the many options for attaining environmentally optimised provision of LVRs in a cost-effective manner, whether it be through the manner of making more judicious use of local materials, designing economic road pavements or showcasing a wide array of both bituminous and non-bituminous surfacings. This is in contrast to the “pie crust” pavements that were used in the good old days in the USA which entailed the use of relatively thick, expensive AC surfacings over relatively weak subgrades/sub-bases comprised resulting in very unbalanced pavements that are prone to cracking under heavy axle loads.
- Finally, much as we have been using the term “environmentally optimised design”, should we not rightly be using the broader, and probably more appropriate, term “environmentally optimised provision” of LVRs as we are certainly responding to the road environment at not only the design stage, but also the construction and maintenance stages as well.

5.5 LVR – Quo Vadis?

Much as the 11th TRB conference has offered a number of positives, they have come at a relatively high cost. Thus, should the focus in future not be more on regional conferences, such as CAPSA, SARF, T2 and international conferences, such as ARRB, where the topics presented and the delegates are much more attuned to LVR philosophy of the AFCAP project?

Report Salehe Juma

REPORT ON CONFERENCE ATTENDED:

TRB 11th International Conference on Low-Volume Roads

WHEN: July 12-15, 2015, in Pittsburgh, PA

WHO: Eng. Salehe Juma, B.Sc. Civil and Transportation Engineering, Maintenance Engineer, Tanzania National Roads Agency.

First of all, I would like to thank Transportation and Research Board (TRB) for giving me the opportunity to attend the TRB 11th International Conference on Low-Volume Roads. This conference was very interesting and gave the opportunity to learn many issues in regards to Design, Materials, Construction issues, Environment, Safety, Maintenance and Traffic Engineering issues in low Volume road.



I want to thank the UKAID through African Community Access Partnership (AFCAP) for sponsoring me to attend this Conference. As a team member of the African Community Access Partnership (AFCAP) and given the nature of my daily duties which is mainly consisting of managing low volume roads in Ulanga and Kilombero District in Tanzania it was a very enriching experience for me to attend this conference.

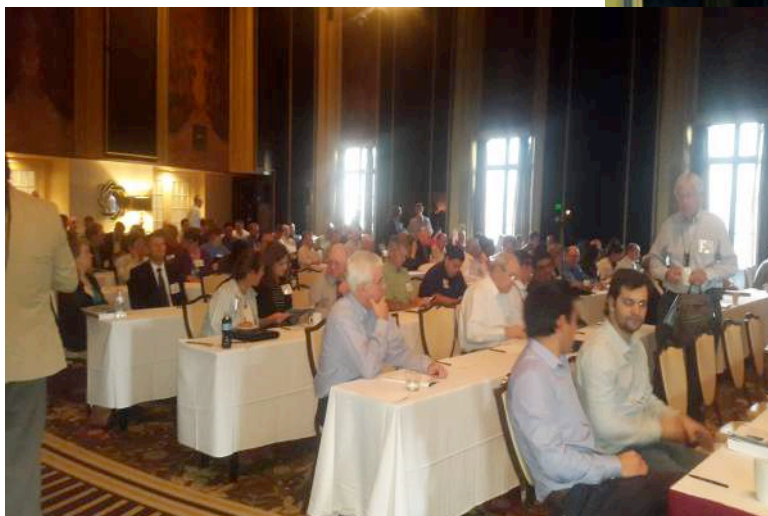
This Conference Continues the long tradition of low-volume roads conferences, held every four years since 1975 to provide a forum for the exchange of information and innovative ideas on all aspects of low-volume planning, financing, design, construction, maintenance, operations and safety.

The 11th International Conference on Low - Volume Roads highlights many of innovative approaches that have been used worldwide to maintain this important first link in the transportation network.

The Conference was well organized and the presentations were grouped into closely related themes like Design, Environment, Safety, Traffic Engineering, Maintenance & Pavement, Materials & Geotechnical Engineering, Stabilization, Geosynthetics, Freez-Thaw, Heavy Load and Construction. However there were parallel sessions thus make difficult to attend all interested paper but I was trying to make the most of it by attending as many as possible interested presentations, the presentations were organized in a way that the parallel sessions were on different themes, and also the posters were available to view from day one and throughout the length of the Conference so even if you could not be present for one of sessions, there was plenty of time for viewings, introductions and discussions after the presentations and during coffee breaks.

The main thing I learned from this 11th International Conference on Low - Volume Roads through each session I attend was about the importance of conducting research to face the real situation depend on challenge and available resource to provide access to community. Not only did I hear about wonderful strategies for Design, Construction and Management of Low Volume Roads, but I get chance to present to international audience and share experience of what I have been doing in my country to provide all weather accessibility.

I presented one of our six presentations from our group (AFCAP/ASCAP), which was well received. The presentation was on “Environmentally Optimized Design for Low Volume District Roads in Tanazania”. Design theme (from 10:15 a.m to Noon, on Urban



room) which consisted of 4 presentations, the time allocated

for each paper was 20 minutes (presentation).

I will describe briefly below some of the different interested aspects discussed in the Conference which catch my interest.

Performance of sand-treated Clay Subgrade Supporting a Low Volume Flexible Pavement

This presentation was discussing the mechanical stabilization of soft clay with graded sand that has been adopted as a base course for pavements. For this study, a local soft clayey soil from Dallas was mixed with various fractions of graded sand soil, and the stiffness behavior of the compounded material was studied. The soil mixtures were then studied for their basic soil characterization, including standard Proctor compaction studies. Statically compressed soil specimens were prepared and then evaluated for their unconfined compressive strength and resilient. Resilient moduli results were used in the design of low-volume roads, both with aggregate base and with no aggregate base. Results show that the variation of sand content in soft soil considerably affects the strength and stiffness properties of the Subgrade. The effects of improved Subgrade performance on the aggregate base and surface layers of the low –volume pavement are highlighted.

Amendment of soft Subgrade clayey soil with sandy soils yielded significant improvements in soil engineering properties, which constrict to the design of LVR pavements. The amendment methods are sustainable because expensive chemical treatments are not needed for subgrades.

Following are the main conclusions from the research:

Inclusion of sand particles in clay not only results in higher strength and a reduction in HMA thickness but also is a sustainable alternative because sand particles are reliable, environmentally friendly, and chemically neutral. Studies on more types of soils are recommended for gaining an understanding of the durability and reliability of these mixtures.

Optimized Maintenance Standard for Unpaved Road network based on Cost - Effectiveness

Unpaved roads play a crucial role in the economic and social development of societies, linking rural communities to education, health services, and markets. The asset value of unpaved roads is low compared with national and provincial road networks, because agencies responsible for rural roads management lack the resources to assess and maintain the network properly. Lack of resources is especially critical in developing countries (like here **Tanzania**,) where the majority of the population lives in rural areas and where few tools are available for sustainable management of the unpaved network.

The main objective for this study was to develop and validate cost-effective maintenance standards for unpaved rural roads. The study was directed at improving the management process of unpaved road networks that serve rural populations. The scope was to develop maintenance standards that can be used by agencies in charge of network management, given available resources and technical skills. The developed four-step methodology evaluates an

unpaved road network for 4 years; identifies the effects of maintenance treatments on the condition of roads from field data analysis, defines maintenance strategies, and develops optimal maintenance standards. The study was part of a 4-years project conducted at the University of Waterloo, in Ontario, Canada, that resulted in the development of a sustainable management system for rural road networks in developing countries. The proposed standards were applied and successfully validated and were demonstrated to be adoptable to varying climates, budgets, traffic, and road structures.

New approach for Upgrading Gravel Roads to a Low-Volume Sealed Standard based on the use of the Dynamic Cone Penetrometer

Over the years, and under traffic loading and wetting and drying cycles, unpaved roads achieve a significant degree of compaction. Sustainable upgrading of these roads to a paved standard is best accomplished by making use of in situ conditions to provide a sound foundation for the new road. This usually reduces the need to import large quantities of virgin material. The dynamic cone penetrometer (DCP) device can be used to quickly and cheaply assess the in situ condition, including material quality and moisture regimes at selected test positions, as well as to determine the suitability of imported materials for incorporation into the new road pavement. The information obtained from the in situ testing can then be used to identify uniform sections along the road alignment. By comparing the in situ layer strength profiles of each of these uniform sections with the required design strength profiles for a particular design loading, the required layer needs for the new pavement can be determined. The paper describes the use of the DCP for the environmentally optimized design of low-volume roads, including the manner of characterizing the in situ road conditions and the selection and specification of borrow pit materials. The use of the DCP for compaction quality control is outlined. Data from various road sections in several counties in southern Africa are used to support the approach.

Strengths and Limitations of The DCP Design Method

Strengths

The main strengths of the DCP method are as follows:

- It is a relatively low –cost, robust apparatus that is quick and simple to use and that allows comprehensive characterization of the in situ road condition, both in the longitudinal direction and with depth (to 800mm or refusal).
- It provides improved precision limits compared with the CBR test.
- Little damage is done to the pavement being tested (it is effectively nondestructive) and useful information is obtained
- The pavement is tested in the condition at which it performs and the test can be carried out identically in the field and in the laboratory.
- The simplicity of the test allows repeated testing to minimize errors and to account for temporal effects.

- The laboratory DN value is determined over a depth of 150mm not just the top 25 to 50 mm, as with the CBR test.
- The method is as good as or better than any other method for taking into account variations in moisture content, and it provides data quickly for analysis.

Limitations

- The main limitations that are likely to affect the results and their interpretation and that must be considered when the DCP design method is used include the following.
- Contraindication of the method in very coarse granular or lightly stabilized materials;
- Contraindication of the method in very hard cemented layers in the pavement structure.
- The possibility that very weak or thin layers are not recorded when depth measurement are taken every five blows;
- Poorly executed tests (hammer not falling the full distance non vertical DCP, excessive movement of the depth measuring rod etc)
- Changes to standard specifications and the associated bidding documents ; and
- As with all empirical methods, contraindication of the use of the method outside the type of environment (materials, climate, traffic, etc) in which it was developed.
- Many of these limitations are controllable if they are considered when the DCP is used. The onus is on the designer to understand the environment and implications of each test in relation to the in situ state of the material, including aspects such as material composition, presence of large stone or hard layers, moisture content, and density. Sound engineering judgment and understanding as well as knowledge of the specific site are necessary for maximizing the information that can be obtained from a DCP profile. Unless the field conditions are fully comprehended, the design engineer may draw erroneous conclusions or wrongly extrapolate data proved by site teams. Hence it is critical that a well-designed and effective drainage environment is maintained during the life of the road.

Summary

The design of light pavement structures with the DCP design method has been successfully carried out on several roads in South Africa. The procedure allows a simple and cost-effective design to be used, often resulting only in the need to rip and re-compact the existing upper layer of appropriate material that can be placed directly on the reshaping in situ material.

With this technique, it will be possible to economically upgrade a significantly greater length of road (often with in situ materials or at most important of a single layer of material) than would be possible with conventional pavement design techniques, without increasing the risk of premature failures. The fundamental principle used in this pavement design process has been used for many years in southern Africa for pavement rehabilitation, and hence the risk of premature failure is not increased over any other design method, provided that the initial

layer strength diagrams for the traffic categories are based on local experience and are appropriate.

The method allows the designer to make use of local knowledge and experience when developing the appropriate layer strength diagrams for various traffic classes and environmental conditions, optimizing the pavement layer thicknesses and material strength.



Field Trip

We got chance to visit site to observe some innovation in low volume roads,

Site A: GRS – IBS Bridge

Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) technology uses alternation layers of compacted granular fill material and fabric sheets of geotextile reinforcement in place of concrete abutments.

The technology offers unique advantages in the construction of small bridges, including reduced construction time and cost, with costs reduced 25 to 60 percent from conventional construction methods, easy to build with common equipment and materials, easy to maintain because of fewer parts, flexible design that's easily modified in the field for unforeseen site conditions, including unfavorable weather conditions. (-FHWA)



Penn DOT completed construction of a 18 foot span (12' opening) GRS-IBS bridge on Potato Garden Run Road in Findlay Town ship, Allegheny County, in 2014. This low volume road provided an ideal opportunity to showcase the GRS-IBS technology

The site visit will include:

- Info and discussion on GRS – IBS in general
- Information on the bridge visited.
- A chance to examine the bridge

- A “cutaway” tabletop model of a GRS Bridge
- Samples of the material used in the bridge abutments.

This Site give me exceptional knowledge and real useful to my Country.

Site B: Bank Stabilization Practices

We got chance to visit Camp meeting Road in Findlay Township, Allegheny County is a township –owned road with a long history of slide issues. Like many roads in Pennsylvania, Camp meeting road was built from old footpaths that tended to follow stream valleys. The road cuts across a steep,



saturated, and highly unstable alluvial slop and is very prone to sides on the down slope side of the road. The site provides an excellent opportunity to discuss slope stabilization as several different stabilization practices have

been used on the road to address numerous slides over the past 15 years. The site included two GRS walls and two different generations of “soil pinning” technology. Representatives from GeoStabilization International who performed the project work will on site to explain the projects and answer questions.

Exhibitions

During this Conference there was chance to visit different products in Exhibitions Centre, myself I got interest on the product from Hartman Products, LP. they have the stay-in-place forms for endwalls/headwalls at the end of the culvert pipe which is real good to the situation I face here in Tanzania.

Also I get to know other works conducted by my fellow AFCAP/ASCAP by visiting the Africa Community Access project Phase 2 and Asia Community Access Project and many others

Conclusion

The Conference was worthwhile and in this instance, I was able to achieve my objectives as I gained an overview of different aspects of Low Volume Roads, and also had useful discussion with key researchers in the area, making a few useful contacts along the way. Since this was my Second international conference I got more confidence and infatuation to conduct research on low Volume Roads. Finally I would like to take this opportunity to thank the AFCAP (AFRICA COMMUNITY ACCESS PROGRAM) under CROWN AGENT for their financial contribution, which made it possible for me to benefit from such experience

