AfCAP
Africa Community Access Partnership

UKaid
from the British people

Training-of-Trainers in the Use of the DCP-DN Pavement Design Method in Malawi

Training Report Course 1

J. Hongve & E. Mukandila

AFCAP Project Reference: MAL2007D

November 2017

Cover Photo: Author's photo

Quality assurance and review table			
Version	Author(s)	Reviewer(s)	Date
14.11.2017	J. Hongve & E. Mukandila	Henry Nkwanga	17.11.2017
		N Leta	28.11.17

ReCAP Project Management Unit
Cardno Emerging Market (UK) Ltd
Oxford House, Oxford Road
Thame
OX9 2AH
United Kingdom

RESEACH FOR COMMUNITY ACCESS PARTNERSHIP (ReCAP)

Safe and sustainable transport for rural communities

ReCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa and Asia. ReCAP comprises the Africa Community Access Partnership (AfCAP) and the Asia Community Access Partnership (AsCAP). These partnerships support 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 ReCAP programme is managed by Cardno Emerging Markets (UK) Ltd.

See www.afcap.org

Acronyms, Units and Currencies

AfCAP	Africa Community Access Partnership
CBR	California Bearing Ratio
DC	Design Consultant
DCP	Dynamic Cone Penetrometer
DN	DCP Number (mm/blow)
Km	Kilometre
LVSR	Low Volume Sealed Road(s)
LVR	Low Volume Road(s)
M	Metre
Mm	Millimetre
RA	Roads Authority
RDA	Roads Development Agency, Zambia
TARURA	Tanzania Rural and Urban Roads Agency
TT	Trainee Trainers
ToT	Training of Trainers
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

Table of Contents

1 Executive summary

The first of the three planned Training-of-Trainers (ToT) courses was conducted over two weeks from 30th October to 10th November 2017. Seven Trainee Trainers (TT) had been selected for participation including three from Roads Authority (RA), Malawi, one from Pamodzi Consulting Engineers, Malawi, two from Tanzania Rural and Urban Roads Agency (TARURA) and one from Roads Development Agency (RDA), Zambia. As it were, only three of the TT delegates participated for the duration of the course. The full benefit of the training was thus not attained.

As per the training approach, the TTs got to practice their skills in delivering a full course in the DCP-DN pavement design method to groups of up to 10 new trainees during the second week of each ToT Course. The second week of the first course was thus attended by eight new trainees including five from RA and three from local consulting firms. Their attendance was also somewhat erratic with only three out of the eight participating for the full five days.

Notwithstanding the above, the outcome of the training was deemed to be satisfactory for those who attended the full course. This assessment is corroborated by the course evaluation by both the TTs and the new trainees.

The problems with the apparent lack of commitment to participate in the training was, at least partly, caused by late selection of participants by RA, thus giving little time for the delegates to clear their schedules for the course period. The issue was raised with the CEO, RA who will make sure that invitations for the next course is sent out in good time and that all delegates commit themselves to participate for the full duration of the course.

Following the completion of the three training courses, it is expected that those who are deemed to qualify as Certified Trainers will be able to champion and conduct courses in the DCP-DN Environmentally Optimised Design of LVSRs within their respective countries and beyond.

Following the decision taken during the Project Inception, the extension of S126 Linthipe – Lobi shall be designed by the TTs as part of the training for construction in FY 2018/19. For this to be practically possible, the preparatory activities must be carried out by the Design Consultant (DC), Pamodzi Consulting Engineers, before the third course which has been scheduled for February 2018.

2 Introduction

2.1 Background

The background, context, phases and overall objectives of the project – Training of Trainers in the Use of the DCP-DN Pavement Design Method in Malawi - are presented in the Inception Report and will thus not be repeated here.

The design of three road sections, M24 Rumphi – Nyika, S126 Linthipe – Lobi and T397 Zaka – Neno was originally planned to be used in the Training-of-trainers project. However, due to the urgency of finalising the design to facilitate the construction of the sections within the current financial year, this is no longer possible. Instead, it was decided during the Inception visit in June, 2017, that the continuation of S126 Linthipe – Lobi in Dedza District, to be constructed in financial year 2018/19, will be used for the training.

Three courses for a maximum of 15 Trainee Trainers have been planned. The first course, which is the subject of this report, was held in Lilongwe in the period 30th October to 10th November 2017.

2.2 Work Programme

Due to a conflict with a similar training course in Ghana, the second course in Malawi has been moved to 4th – 15th December 2017 instead of 8th – 19th January 2018. The updated Work Programme is shown in Annex 1.

2.3 Objectives of the ToT Training

The objective of the training programme is to enhance the Trainee Trainers' (TT) understanding of the key principles and concepts related to the design of LVSRs as well as to develop their skills in delivering the course to new trainees in a confident and effective manner. Thus, at the end of the training, it would be necessary for them to:

- Have a good understanding and appreciation of LVSR Design philosophy and principles.
- Be fully conversant with all aspects of the LVSR Design procedure based on the use of the AfCAP LVR-DCP software.
- Be able to prepare course materials (PowerPoint presentations) on LVSR design in a well-structured manner, present such materials to trainees in a confident manner, answer clearly any questions raised, or clarifications sought, by the trainees on any aspects of the subject matter.

Subject to the TTs having attained a satisfactory level in all the above aspects, they can then be certified as Trainers in DCP-DN Method of LVSR pavement design and other related aspects of LVSR provision.

It is also expected of them, after the training, to be able to champion and run courses in the DCP-DN Environmentally Optimised Design of LVSRs within their respective countries and beyond.

3 Training Programme

3.1 Approach

A carefully conceived approach has been adopted to instil in the TTs a sense of self-dependence in equipping themselves to become fully-fledged trainers. This approach entailed providing the TTs with source material on various aspects of LVSR provision from which they could extract appropriate information for preparing their own PowerPoint presentation on a particular topic. In the latter regard, guidance was also provided to the TTs on how to prepare well-structured PowerPoint slides and to deliver effective presentations. Thereafter, the TTs will be in a position to hone their newly acquired skills by making further presentations to new trainees.

3.2 Preparations

A comprehensive list of background material and presentation outlines was made available to the TTs in advance of the course, on the basis of which they were tasked with the preparation of Power Point presentations as shown in Table 1 below. The list of all background material and presentation outlines is shown in Annex 2.

Table 1: Planned presentations for the course

Topic	Who does what
Introduction	Presentation by J. Hongve
Module 1 LVR in perspective	Presentation to be prepared by S. Banda & J. Chilongo, RA
Module 2 Development of DCP method Pavement balance	Presentation by J. Hongve / E. Mukandila
Module 3 Site investigations	Presentation to be prepared by G. Tarimo, TARURA Tanzania
Module 4 Materials and testing	Presentation to be prepared by K. Fuko, TARURA Tanzania
Module 5 Pavement design	Presentation to be prepared by E. Sisya, RA
Module 6 Surfacing	Not assigned
Module 7 QA/QC	Presentation to be prepared by N. Kachali, Pamodzi Consulting Engineers
Module 8 AfCAP LVR DCP software	Presentation to be prepared by J. Chibwe, RDA Zambia

As it were, S. Banda, RA and N. Kachali, Pamodzi Consulting Engineers did not attend the course and K. Fuko, TARURA had to return to Tanzania after the first week for family reasons. The original plan was thus amended as shown in Table 2 below:

Table 2: Actual presentations prepared for the course

Topic	Who does what
Introduction	Presentation by J. Hongve
Module 1 LVR in perspective	Presentation prepared by J. Chilongo, RA
Module 2 Development of DCP method Pavement balance	Presentation by J. Hongve / E. Mukandila
Module 3 Site investigations	Presentation prepared by G. Tarimo, TARURA Tanzania
Module 4 Materials and testing	Presentation prepared by K. Fuko & G. Tarimo, TARURA Tanzania
Module 5 Pavement design	Presentation prepared by E. Sisya, RA
Module 6 Surfacing	Not covered
Module 7 QA/QC	Presentation prepared by J. Chibwe, RDA Zambia and G. Tarimo, TARURA Tanzania
Module 8 AfCAP LVR DCP software	Presentation prepared by J. Chibwe, RDA Zambia

3.3 Course Programme

The training course was conducted in two stages as shown below.

Stage 1 - Week 1:

- Discussion of the LVSR design principles to ensure that the fundamental aspects of Environmentally Optimised Design were properly understood by the TTs.
- Refinement of, and rehearsal in, delivery of the presentation material and in teaching the use of the design software by the TTs.

Stage 2 - Week 2:

- Delivery of the full course by the TTs to groups of new trainees under the guidance of the AfCAP Trainers.

The details of the Course Programme are shown in Annex 3.

Figure 1: Classroom training session

Figure 2: DCP test on S126 Linthipe- Lobi

3.4 Attendance

As shown in Table 3 the actual attendance during the course was less than planned for and somewhat erratic, with the consequence that the full benefit of the training was not attained.

Table 3: Course 1 Participants

ToT Malawi 1st Training 30 Oct - 10 Nov 2017				Week 1					Week 2				
No	**Name**	**Organisation**	**Category**	**M**	**T**	**W**	**T**	**F**	**M**	**T**	**W**	**T**	**F**
1	Elias Sisya	Roads Authority	Trainer	x	x	x	x	x	x	x	x	x	x
2	Jarrison Chilongo	Roads Authority	Trainer	x	x	x	x	x	x				
3	Sharmey Banda	Roads Authority	Trainer	Did not report for the course									
4	Nelson Kachali	Pamodzi Consulting	Trainer	Did not report for the course									
5	George Tarimo	TARURA, Tanzania	Trainer	x	x	x	x	x	x	x	x	x	x
6	Kuyoya Fuko	TARURA, Tanzania	Trainer	x	x	x	x	x					
7	Joseph Chibwe	RDA, Zambia	Trainer	x	x	x	x	x	x	x	x	x	x
1	Innocencia Mbisa	Roads Authority	Trainee						x	x	x	x	x
2	Fletcher Mkandawire	Roads Authority	Trainee						x	x	x	x	x
3	Dominic Mwafulirwa	Roads Authority	Trainee						x	x	x	x	x
4	Crispin Gondwe	Roads Authority	Trainee							x	x	x	0.5
5	Emmanuel Maluwa	Roads Authority	Trainee							x	x	x	x
6	George Kajanga	GK Works Consulting	Trainee						0.5		x	x	
7	Joseph Mphande	GK Works Consulting	Trainee						x	x	x	x	0.5
8	Chisomo Dan Kauma	David Consulting	Trainee							x	x	x	x
	Henry Nkwanga	AfCAP	Observer	x	x	x	x	x					
	Jon Honve	AfCAP	Facilitator	x	x	x	x	x	x	x	x	x	x
	Estime Mukandila	AfCAP	Facilitator	x	x	x	x	x	x	x	x	x	x

Key: X = full day attendance

The concern regarding the attendance, partly caused by late nomination of trainees by RA, was raised in a meeting with the CEO, RA on Friday 10th November. It was agreed that RA will nominate the trainees (both TTs and new trainees) in good time before the next course and insist that all trainees commit themselves to attend for the full duration of the course.

3.5 Training Outcome

3.5.1 Test after Week 1

To assess the understanding of key principles and concepts in LVSR design, the TTs were a given a short test at the end of Week 1. The results are summarised in Table 4.

Table 4: Summary of Week 1 Test Results

Questions	Max score	J. Chilongo	J. Chibwe	E. Sisya	K. Fuko	G. Tarimo
1: Name three key characteristics of low volume roads that differ from high volume roads	3	3	2	3	1	2
2: Which are the three key questions you have to ask yourself regarding seasonal moisture fluctuations in the pavement before deciding which percentile value to apply for your pavement design?	3	3	3	3	3	1
3: Which percentile of the DN values would you apply if your DCP survey was carried out in the wet season and you expect the long-term in-service moisture regime in the pavement to be the same after upgrading and improvement of drainage and surfacing of the road?	1	1	0	1	0	0
4: What are four important risk factors that affect the long-term performance of LVSR pavements?	4	4	4	4	4	3
5: List three factors that affect the accuracy of a DCP measurement	3	2.5	3	3	2	2
6: How does pavement strength change with depth for: - Deep, well-balanced pavement - Shallow pavement - Inverted pavement	3	3	3	2	0	0
7: What factors collectively affect the DN value of a material?	4	3	2	2	0	3
8: What is the significance of the fmc/omc ratio in a road pavement.	1	1	1	1	0	0
9: What is meant by "compaction to refusal" and applying it in practice can derive what benefits?	2	2	1	1.5	1.5	1
10: List three benefits of using the DCP test for pavement design purposes.	3	2	2	1	2	3
Score	27	24.5	21	21.5	13.5	15
Score %	100	91	78	80	50	56

The test results clearly identified the issues that the TTs were still struggling with, and which were subsequently discussed and explained in depth.

3.5.2 Course Evaluation and Assessment of TTs

The TTs were asked to evaluate the outcome of the first course from their own perspective as shown in Table 5. The post-course assessments and recommendations by the AfCAP Trainers are shown in Table 6 below.

Table 5: Course evaluation by TTs

Items for evaluation	**Score (tick in the appropriate cell)**				
	5	**4**	**3**	**2**	**1**
1. Training					
The background material and presentation outlines provided was helpful for the preparations for the course	**3**				
The training approach was effective for acquiring skills in training delivery	**1**	**2**			
I had enough time to study the background material and prepare for the course	**1**	**1**	**1**		
I have got a good understanding of the design principles for Low Volume Roads	**1**	**2**			
I have got a good understanding of the strengths and limitations of the DCP-DN design method	**1**	**1**	**1**		
I have got a good understanding of the design process for Low Volume Roads using the AfCAP LVR-DCP software	**1**	**2**			
I have got a good understanding of the Laboratory DN testing procedure and how to interpret the results	**2**	**1**			
There was enough time for practical exercises using the software and discussions / clarifications	**2**	**1**			
The practical instructions were well delivered and understood	**3**				
2. Organisation					
I was informed about the course in time for me to organize my arrangements for participation in the training	**2**		**1**		
Arrangements for accommodation during the course was satisfactory	**2**	**1**			
I was given satisfactory support from my employer/organization for participation in the course	**2**	**1**			
The course was well organized	**2**	**1**			
3. Venue					
The classroom facilities were satisfactory	**1**	**2**			
The practical training was well organized	**1**	**2**			
The meals and refreshments were satisfactory	**2**	**1**			

Key: 5 – strongly agree, 1 – strongly disagree

Figure 3: Course 1 participants (including 8 new trainees during Week 2)

As shown in Table 6, there are significant variations in the levels achieved at the end of the first course, some of which can be attributed to the different backgrounds and experiences of the TTs.

The assessment of the TTs by the AfCAP Trainers and recommendations for additional training is shown in Table 6

Table 6: Post course assessments and recommendations

Name / Country	Assessment	Recommendation
J. Chilongo, RA Malawi	Has a good grasp of the key principles of LVSR design, but need more training and practice in delivery of presentations and teaching of new trainees	Should attend the third course to gain more experience in delivery of presentations and teaching of new trainees.
E. Sisya, RA Malawi	Have a good grasp of the key principles of LVSR design, but need more training and practice in delivery of presentations and teaching of new trainees	Should attend the third course to gain more experience in delivery of presentations and teaching of new trainees.
G. Tarimo, TARURA, Tanzania	Has a reasonable grasp of the key principles of LVSR design, but need more training and practice in delivery of presentations and teaching of new trainees	Should attend the third course to gain more experience in delivery of presentations and teaching of new trainees.
K. Fuko, TARURA, Tanzania	Did not have sufficient training background in the DCP-DN method and principles of design. More training and exposure therefore required.	Should attend the second course. Further training needs to be assessed after Course 2
J. Chibwe, RDA Zambia	Has a good grasp of the key principles of LVSR design and in delivery of presentations and teaching of new trainees	Does not need more training per se, but practice in course delivery and DCP-DN design. Can possibly be achieved by upcoming training and design of LVSR project in Zambia

3.5.3 Course Evaluation by new trainees

The course evaluation by the new trainees is a reflection of the proficiency level of the TTs in the various aspects of LVSR design, the delivery of the course and in the teaching of the use of the software. The summary of the evaluations shown below thus corroborates the assessment by the AfCAP Trainers in Table 6 above.

Table 7: Summary of Course Evaluations by New Trainees

Items for evaluation	Score (tick in the appropriate cell)				
	5	4	3	2	1
1. Training					
The objectives of the course were generally achieved	5	2			
The classroom presentations were well presented and understood	5	2			
I have obtained a good understanding of the characteristics of Low Volume Roads	4	2	1		
I have obtained a good understanding of the design principles for Low Volume Roads	4	2	1		
I have obtained a good understanding of the design process for Low Volume Roads using the AfCAP LVR-DCP software	4	1	2		
I have obtained a good understanding of the Laboratory DN testing procedure and how to interpret the results	4	2	1		
I have obtained a good understanding of the various factors that affect the performance of LVSRs.	5	2			
There was enough time for practical exercises using the software and discussions / clarifications	3	3	1		
The practical instructions were well delivered and understood	6	1			
2. Organisation					
I was informed about the course in time for me to organize my personal arrangements for participation in the training	3	1	1	1	1
Arrangements for accommodation during the course was satisfactory	4				1
I was given satisfactory support from my employer/organization for participation in the course	6			1	
The course was well organized	6	1			
3. Venue					
The classroom facilities were satisfactory	4	3			
The practical training was well organized	4	2			
The meals and refreshments were satisfactory	5	2			

4 Discussion and Recommendations for the Way Forward

4.1 Additional Courses

Based on the assessment of the TTs as summarised in Table 6, the following schedule of courses is envisaged.

Table 8: Envisaged schedule of remaining courses

Course No	Duration	Location	Participants
Course 2	2 weeks 4-15 Dec 2017	Lilongwe	TBA
Course 3	1 or 2 weeks depending on assessment after Course 2. Dates TBA	Lilongwe	TBA

4.1.1 Duration of Courses 2 and 3

Assessment of the TTs at the end of Course 2 will be carried out in a similar fashion as for the first course. The duration and modality of Course 3 will depend on the outcome of Course 2 and the overall assessment of further training needs.

4.1.2 Design of the extension of S126 Linthipe - Lobi

Pamodzi Consulting Engineers were appointed as Design Consultants (DC) for the extension to be constructed during FY 2018/19. As per the ToR for the project, the design should be carried out by the Trainee Trainers and be reviewed by AfCAP Trainers.

For this to work in practice, preparatory activities listed in Table 9 below must be carried out by the DC prior to Course 3. While a preliminary DCP survey at 200 m intervals has already been carried out on the section in October 2017, which was at the end of the dry season, it is recommended that a detailed DCP survey at 50-100 m intervals be carried out in February 2018 during the wet season.

Table 9: Preparatory activities by DC for design of S126 Linthipe - Lobi

Preparatory activities by DC	Comments
Topographic survey	Longitudinal profile and cross sections at 25 m intervals over the full width of the road reserve
Traffic counts	Wet season counts to confirm/adjust previous traffic counts
Axle load survey	If possible, to confirm/adjust previous Traffic Load estimates
DCP survey	50-100 m intervals depending on ground conditions. Wet season DCP data to be used for design.
Drainage assessment/plan	To ensure adequate drainage on the whole section
Identification of borrow pit(s)	Prospecting/testing of material sources to assess suitability. If necessary, modification (mechanical stabilisation) to increase strength as required.
Road safety assessment	Propose measures to attain satisfactory road safety

5 Summary

The first of the three planned courses for the Trainee Trainers (TT) was conducted over two weeks from 30th October to 10th November, 2017. Seven TTs were nominated to participate in the course, but for various reasons only three attended the full two week course.

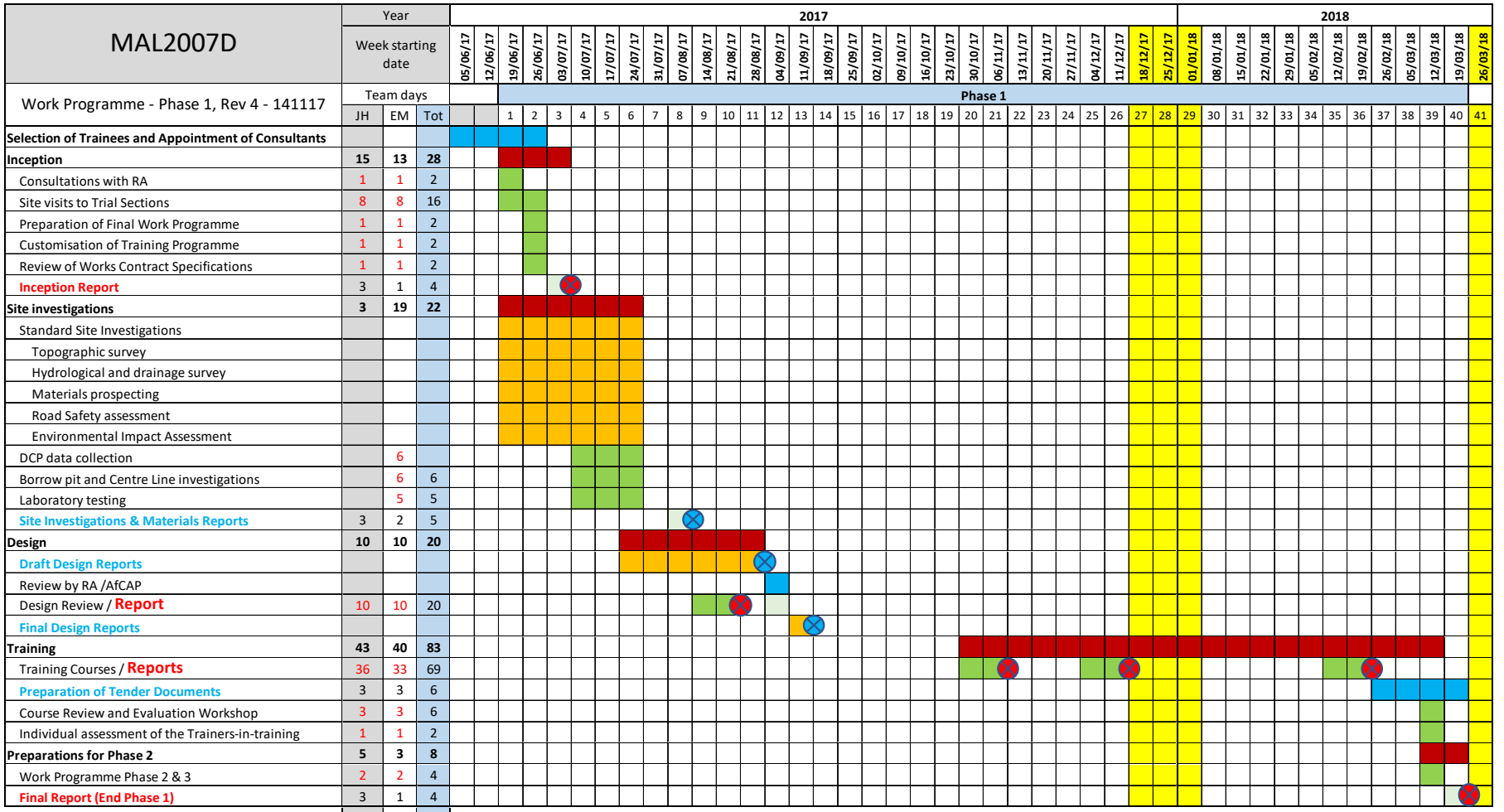
Eight new Trainees attended the second week of the course during which the TTs practiced their skills in delivery of the training course.

Unfortunately, the attendance both by the TTs and the new Trainees was somewhat erratic, with the consequence that the full benefit of the course was not attained.

Notwithstanding the above, the outcome of the training, for those who attended the full course, was deemed to be satisfactory.

As per the ToR for the project, the extension of S126 Linthipe – Lobi, which will be constructed in FY 2018/19, is supposed to be designed by the TTs. For this to be possible, preparatory activities to be carried out by the DC, Pamodzi Consulting Engineers, prior to Course 3, have been identified.

Annex 1: Work Programme



Annex 2: Background Material and Presentation Outlines

A Paradigm Shift in Geometric Design of Low Volume Rural Roads - Final 29-02-16.pdf
An Alternative Philosophy on the Deterioration and Design of LVRs.pdf
Are we doing Unnecessary or Incorrect Material Testing for LVRs.pdf
Developments in LVR Technology - Challenging Conventional Paradigms.pdf
DN as alternative to CBR.docx
Guideline for Compaction Quality Control using the DCP - Revision Oct 16.pdf
Guideline for Mozambique LTPP Monitoring 24.03.17.pdf
Guideline for Soil and Rock Logging in South Africa.pdf
Lab Test Methods Pinard & Netterberg AFCAP paper Final.pdf
Lab training workshop PPG.pdf
Lab training workshop PPG 2.pdf
Lab training workshop PPG 3.pdf
LVR Pavement Design Based on the DCP-DN Method.pdf
LVR-DCP Structural Design Manual_v1.00.docx
Materials for Sealed LVRs.pdf
Otta-Seal-Guide-by-C Overby-M Pinard.pdf
Performance Review of Design Standards and Technical Specifications for Low Volume Sealed Roads in Malawi.pdf
Sabita Manual_10 Bituminous Surfacings for LVRs and Temporary Deviations.pdf
SADC Guideline on LVSRs.pdf
SAICE Site Investigation Code of Practice.pdf
Soil testing variability.pdf
Tanzania LVR Manual 2016.pdf
Towards a Classification System for the Strength-Balance of Thin Surfaced Flexible Pavements.pdf

Annex 3: Course Programme

Week 1 – Train-the-trainers					
Training sessions	Mon	Tue	Wed	Thu	Fri
1. session 08.30 – 10.00		**Presentation of Module 2**	**Presentation of Module 8**	**Design exercises**	**Demo of Lab Module**
Break 10.00-10.30					
2. session 10.30-12.00		**Presentation of Module 3**	**Field visit Linthipe – Lobi**	**Design exercises**	**Design exercises**
Lunch 12.00-13.00					
3.session 13.00 – 14.30		**Presentations of Modules 4 & 5**	**Field visit Linthipe – Lobi**	**Design exercises**	**Design exercises**
Break 14.30 – 15.00					
4. session 15.00 – 16.30	**Registration** **Introduction** **Presentation of Module 1**	**Presentations of Modules 6 & 7**	**Field visit Linthipe – Lobi**	**Design exercises**	**Q&A** **Wrap up incl. assessment of TT performance**
Week 2 – Training of new trainees					
Training sessions	Mon	Tue	Wed	Thu	Fri
1. session 08.30 – 10.00	**Registration** **Introduction** **Module 1** - LVR in perspective	**Field work** - Site reconnaissance - DCP data collection	**Module 5** - Pavement design **Module 8** - AfCAP LVR DCP software	**Design exercises**	**Module 6** - Surfacing **Module 7** - QA/QC
Break 10.00-10.30					
2. session 10.30-12.00	**Module 2** - Development of DCP method	**Field work**	- Practical exercise with DCP Data entry and analysis	**Design exercises**	**Q&A** **Wrap up incl. assessment of TT performance and course evaluation**
Lunch 12.00-13.00					
3.session 13.00 – 14.30	**Module 3** Site Investigations	**Field work**	- **Demo of LAB DN test**	**Design exercises**	
Break 14.30 – 15.00					
4. session 15.00 – 16.30	**Module 4** Materials and testing	**Field work**	- **Demo of Lab Module**	**Design exercises**	